A STUDY ON (R,S)-PAIR CIRCULANT POLYNOMIAL MATRICES

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ABSTRACT

This paper is concerned with a new type of polynomial matrix. This class of polynomial matrix is a generalization of the k-circulant polynomial matrix, and we call it (r,s)-pair circulant polynomial matrix. Some properties such as sum, difference, product, inverse and adjoint of (r,s)-pair circulantpolynomial matrices are investigated. Moreover, we give some necessary and sufficient conditions for a matrix to be an (r,s)-pair circulant matrix.

Keywords: *Circulant polynomial matrices, (r,s)-pair circulant polynomial matrices.*

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Introduction

Let $(a_1(\lambda), a_2(\lambda), ..., a_n(\lambda))$ be an ordered n-tuple of polynomials with coefficients in the field of complex numbers,and let them generate the circulant polynomial matrix [1,3,4] of order n:

$$A(\lambda) = \begin{pmatrix} a_1(\lambda) & a_2(\lambda) & \dots & a_n(\lambda) \\ a_n(\lambda) & a_1(\lambda) & \dots & a_2(\lambda) \\ & & \mathrm{M} & \\ a_2(\lambda) & a_3(\lambda) & \dots & a_1(\lambda) \end{pmatrix} \quad (1)$$

We shall often denote this circulant polynomial matrix as

$$A(\lambda) = circ(a_1(\lambda), a_2(\lambda), ..., a_n(\lambda)) \quad (2)$$

In this paper, we define a new type of polynomial matrix called (r,s)-pair circulant polynomial matrix, which is a generalization of the k-circulant polynomial matrix. For this class of matrices, we investigate their basic properties such as their sum, difference, product, inverse and adjoint. In addition, several necessary and sufficient conditions for a matrix to be an (r,s)-pair circulant matrix are presented.

Before proceeding, we introduce some notation needed throughout the paper. Let $C_{n\times n}(\lambda)$ denote the set of all $n\times n$ polynomial matrices over the complex field C and $I_n(\lambda)$ denote the identity polynomial matrix of order n. For a matrix $A(\lambda)\in C_{n\times n}(\lambda)$, we denote the transpose, the adjoint and the determinant of $A(\lambda)$ by $A^T(\lambda)$, $A^*(\lambda)$ and $|A(\lambda)|$, respectively.

(r,s)- pair Circulant Polynomial Matrices

In this section we introduce the concept of (r,s)- pair circulant polynomial matrix. Also, we give several properties, discriminance for (r,s) - pair circulant polynomial matrices found in [2,5,6,7].

Definition 2.1

A polynomial matrix $A(\lambda)$ of order n is called (r,s)- pair circulant polynomial matrix if it is of the form

$$A(\lambda) = \begin{bmatrix} a_0(\lambda) & a_1(\lambda) & a_2(\lambda) & \mathrm{L} & a_{n-2}(\lambda) & a_{n-1}(\lambda) \\ ra_{n-1}(\lambda) & a_0(\lambda)-sa_{n-1}(\lambda) & a_1(\lambda) & \mathrm{L} & a_{n-3}(\lambda) & a_{n-2}(\lambda) \\ ra_{n-2}(\lambda) & ra_{n-1}(\lambda)-sa_{n-2}(\lambda) & a_0(\lambda)-sa_{n-1}(\lambda) & \mathrm{L} & a_{n-4}(\lambda) & a_{n-3}(\lambda) \\ ra_{n-3}(\lambda) & ra_{n-2}(\lambda)-sa_{n-3}(\lambda) & ra_{n-1}(\lambda)-sa_{n-2}(\lambda) & \mathrm{L} & a_{n-5}(\lambda) & a_{n-4}(\lambda) \\ \mathrm{M} & \mathrm{M} & \mathrm{M} & \mathrm{M} & \mathrm{M} & \mathrm{M} \\ ra_2(\lambda) & ra_3(\lambda)-sa_2(\lambda) & ra_4(\lambda)-sa_3(\lambda) & \mathrm{L} & a_0(\lambda)-sa_{n-1}(\lambda) & a_1(\lambda) \\ ra_1(\lambda) & ra_2(\lambda)-sa_1(\lambda) & ra_3(\lambda)-sa_2(\lambda) & \mathrm{L} & ra_{n-1}(\lambda)-sa_{n-2}(\lambda) & a_0(\lambda)-sa_{n-1}(\lambda) \end{bmatrix}$$

Which is denoted by

$$A(\lambda) = C_{(r,s)}(a_0(\lambda), a_1(\lambda), ..., a_{n-1}(\lambda)).$$

Remark 2.2

(i) If $s=0$, then $A(\lambda)$ is a r-circulant polynomial matrix.

(ii) The polynomial matrix $\mathcal{B}(\lambda)=C_{(r,s)}(0,1,0,...,0)$ is called basic (r,s)–pair circulant polynomial matrix.

Example 2.3

A 4×4 $(3,2)$-pair circulant polynomial matrix is given below.

$$A(\lambda)=\begin{pmatrix} \lambda+\lambda^2 & 1-\lambda & -3+\lambda-2\lambda^2 & 2+2\lambda+3\lambda^2 \\ 6+6\lambda+9\lambda^2 & -4-3\lambda-5\lambda^2 & 1-\lambda & -3+\lambda-2\lambda^2 \\ -9+3\lambda-6\lambda^2 & 12+4\lambda+13\lambda^2 & -4-3\lambda-5\lambda^2 & 1-\lambda \\ 3-3\lambda & -11+5\lambda-6\lambda^2 & 12+4\lambda+13\lambda^2 & -4-3\lambda-5\lambda^2 \end{pmatrix}$$

$=A_0+A_1\lambda+A_2\lambda^2$ where $A_0=C_{(3,2)}(0,1,-3,2)$, $A_1=C_{(3,2)}(1,-1,1,2)$, and $A_2=C_{(3,2)}(1,0,-2,3)$.

That is,

$$A_0=\begin{pmatrix} 0 & 1 & -3 & 2 \\ 6 & -4 & 1 & -3 \\ -9 & 12 & -4 & 1 \\ 3 & -11 & 12 & -4 \end{pmatrix}, A_1=\begin{pmatrix} 1 & -1 & 1 & 2 \\ 6 & -3 & -1 & 1 \\ 3 & 4 & -3 & -1 \\ -3 & 5 & 4 & -3 \end{pmatrix}, A_2=\begin{pmatrix} 1 & 0 & -2 & 3 \\ 9 & -5 & 0 & -2 \\ -6 & 13 & -5 & 0 \\ 0 & -6 & 13 & -5 \end{pmatrix}$$

Proposition 2.4

Suppose that $A(\lambda)$ and $B(\lambda)$ are (r,s)-pair circulant polynomial matrices. Then $A(\lambda)+B(\lambda)$, $A(\lambda)-B(\lambda)$ and $\alpha A(\lambda)$ are also (r,s)–pair circulant polynomial matrices.

Proposition 2.5

A polynomial matrix $A(\lambda)$ is an (r,s)–pair circulant polynomial matrix if and only if $A(\lambda)=f_{A(\lambda)}(\mathcal{B}(\lambda))=\sum_{i=0}^{n-1}a_i(\lambda)\mathcal{B}^i(\lambda)$ for some polynomial $f_{A(\lambda)}(x(\lambda))=\sum_{i=0}^{n-1}a_i(\lambda)x^i(\lambda)$.

Theorem 2.6

A polynomial matrix $A(\lambda)\in C^{n\times n}(\lambda)$ is an (r,s)-pair circulant polynomial matrix if and only if $A(\lambda)\,\mathcal{B}(\lambda)=\mathcal{B}(\lambda)\,A(\lambda)$.

Proof

Assume that $A(\lambda)$ is an (r,s)-pair circulant polynomial matrix.

We have to prove that $A(\lambda)\,\mathcal{B}(\lambda)=\mathcal{B}(\lambda)\,A(\lambda)$. Let $A(\lambda)=C_{(r,s)}(a_0(\lambda),a_1(\lambda),...,a_{n-1}(\lambda))$ be an (r,s)-pair circulant polynomial matrix. Then $A(\lambda)=\sum_{i=0}^{n-1}a_i(\lambda)\mathcal{B}^i(\lambda)$.

$\Rightarrow A(\lambda)\,\mathcal{B}(\lambda)=\mathcal{B}(\lambda)\,A(\lambda)$

Conversely, assume that $A(\lambda)\,\mathcal{B}(\lambda)=\mathcal{B}(\lambda)\,A(\lambda)$. We have to prove that $A(\lambda)$ is an (r,s)- pair circulant polynomial matrix.

Suppose that $A(\lambda)\,\mathcal{B}(\lambda)=\mathcal{B}(\lambda)\,A(\lambda)$.Then

$$\left[A(\lambda)\mathcal{B}(\lambda)\right]^T=\left[\mathcal{B}(\lambda)A(\lambda)\right]^T$$

$$\mathcal{B}^T(\lambda)A^T(\lambda)=A^T(\lambda)\mathcal{B}^T(\lambda)$$

$$\left(\mathcal{B}^T\right)^i(\lambda)A^T(\lambda)=A^T(\lambda)\left(\mathcal{B}^T\right)^i(\lambda),\ i=1,2,...$$

Let $e_i(\lambda)$ be the i^{th} column of $I_n(\lambda)$.

$\Rightarrow \mathcal{B}^T(\lambda)e_i(\lambda)=e_{i+1}(\lambda)$ *for* $i=1,2,...,n-1$.

Thus, we have $\left(\mathcal{B}^T\right)^i(\lambda)e_i(\lambda)=e_{i+1}(\lambda)$ for $i=1,2,...,n-1$.

Now $A^T(\lambda)=A^T(\lambda)I_n(\lambda)$

$$=A^T(\lambda)\left[e_1(\lambda),e_2(\lambda),...,e_n(\lambda)\right]$$

$$=A^T(\lambda)\left[e_1(\lambda),\mathcal{B}^T(\lambda)e_1(\lambda),...,\left(\mathcal{B}^T\right)^{n-1}(\lambda)e_1(\lambda)\right]$$

$$=\left(A^T(\lambda)e_1(\lambda),A^T(\lambda)\mathcal{B}^T(\lambda)e_1(\lambda),...,A^T(\lambda)\left(\mathcal{B}^T\right)^{n-1}(\lambda)e_1(\lambda)\right)$$

$$=\left(A^T(\lambda)e_1(\lambda),\mathcal{B}^T(\lambda)A^T(\lambda)e_1(\lambda),...,\left(\mathcal{B}^T\right)^{n-1}(\lambda)A^T(\lambda)e_1(\lambda)\right)$$

$$=\left(\alpha(\lambda),\mathcal{B}^T(\lambda)\alpha(\lambda),...,\left(\mathcal{B}^T\right)^{n-1}(\lambda)\alpha(\lambda)\right)$$

Where $\alpha^T(\lambda)$ is the first row of $A(\lambda)$.

Let $\alpha^T(\lambda)=(a_0(\lambda),a_1(\lambda),...,a_{n-1}(\lambda))$

Thus, $\alpha(\lambda)=\sum_{i=0}^{n-1} a_i(\lambda)e_{i+1}(\lambda)$

$$A^T(\lambda)=\left(\sum_{i=0}^{n-1} a_i(\lambda)e_{i+1}(\lambda),\sum_{i=0}^{n-1} a_i(\lambda)\mathfrak{B}^T(\lambda)e_{i+1}(\lambda),...,\sum_{i=0}^{n-1} a_i(\lambda)\left(\mathfrak{B}^T\right)^{n-1}(\lambda)e_{i+1}(\lambda)\right)$$

$$=\sum_{i=0}^{n-1} a_i\left(e_{i+1}(\lambda),\mathfrak{B}^T(\lambda)e_{i+1}(\lambda),...,\left(\mathfrak{B}^T\right)^{n-1}(\lambda)e_{i+1}(\lambda)\right)$$

$$=\sum_{i=0}^{n-1} a_i\left(\left(\mathfrak{B}^T\right)^i(\lambda)e_1(\lambda),\left(\mathfrak{B}^T\right)^{i+1}(\lambda)e_1(\lambda),...,\left(\mathfrak{B}^T\right)^{n+i-1}(\lambda)e_1(\lambda)\right)$$

$$=\sum_{i=0}^{n-1} a_i\left(\mathfrak{B}^T\right)^i(\lambda)\left(e_1(\lambda),e_2(\lambda),...,e_n(\lambda)\right)$$

$$=\sum_{i=0}^{n-1} a_i(\lambda)\left(\mathfrak{B}^T\right)^i(\lambda)$$

$$\Rightarrow A(\lambda)=\sum_{i=0}^{n-1} a_i(\lambda)\mathfrak{B}^i(\lambda)$$

Hence, $A(\lambda)$ is an (r,s) - pair circulant polynomial matrix.

Corollary 2.7

If $A(\lambda)$ is an non-singular polynomial matrix, then $A(\lambda)$ is an (r,s) - pair circulant polynomial matrix if and only if $A^{-1}(\lambda)$ isan (r,s)- pair circulant polynomial matrix.

Proof

Given that $A(\lambda)$ is a non-singular polynomial matrix.

$A(\lambda)$ is an (r,s) -pair circulant polynomial matrix

$$\Leftrightarrow A(\lambda)\mathfrak{B}(\lambda)=\mathfrak{B}(\lambda)A(\lambda)$$

$$\Leftrightarrow A^{-1}(\lambda)\mathfrak{B}(\lambda)=\mathfrak{B}(\lambda)A^{-1}(\lambda)$$

$\Leftrightarrow A^{-1}(\lambda)$ is an (r,s) - pair circulant polynomial matrix.

Theorem 2.8

If $A(\lambda)$ and $B(\lambda)$ are (r,s) - pair circulant polynomial matrices, then $A(\lambda)B(\lambda)$ and $B(\lambda)A(\lambda)$ are also (r,s) - pair circulant polynomial matrices and $A(\lambda)B(\lambda)=B(\lambda)A(\lambda)$.

Proof

Given that $A(\lambda)$ and $B(\lambda)$ are (r,s) - pair circulant polynomial matrices.

From theorem (2.6) ,we have $A(\lambda)\mathfrak{B}(\lambda)=\mathfrak{B}(\lambda)A(\lambda)$ and $B(\lambda)\mathfrak{B}(\lambda)=\mathfrak{B}(\lambda)B(\lambda)$.

Now $\left[A(\lambda)B(\lambda)\right]\mathfrak{B}(\lambda)=A(\lambda)\left[B(\lambda)\mathfrak{B}(\lambda)\right]$

$=A(\lambda)\left[\mathfrak{B}(\lambda)B(\lambda)\right]$

$=\left[A(\lambda)\mathfrak{B}(\lambda)\right]B(\lambda)$

$=\left[\mathfrak{B}(\lambda)A(\lambda)\right]B(\lambda)$

$=\mathfrak{B}(\lambda)\left[A(\lambda)B(\lambda)\right]$

Therefore, $A(\lambda)B(\lambda)$ is an (r,s) - pair circulant polynomial matrices.

Also, $\left[B(\lambda)A(\lambda)\right]\mathfrak{B}(\lambda)=B(\lambda)\left[A(\lambda)\mathfrak{B}(\lambda)\right]$

$=B(\lambda)\left[\mathfrak{B}(\lambda)A(\lambda)\right]$

$=\left[B(\lambda)\mathfrak{B}(\lambda)\right]A(\lambda)$

$=\left[\mathfrak{B}(\lambda)B(\lambda)\right]A(\lambda)$

$=\mathfrak{B}(\lambda)\left[B(\lambda)A(\lambda)\right]$

Hence, $B(\lambda)A(\lambda)$ is an (r,s) - pair circulant polynomial matrix.

From proposition (2.5) , we assume that $A(\lambda)=f\left(\mathfrak{B}(\lambda)\right)$ and $B(\lambda)=g\left(\mathfrak{B}(\lambda)\right)$.

$\Rightarrow A(\lambda)B(\lambda)=B(\lambda)A(\lambda)$.

Theorem 2.9

Let $A(\lambda)$ be a non-singular polynomial matrix and $r\neq 0$. Then $A(\lambda)$ is an (r,s) -pair circulant polynomial matrix if and only if $A^*(\lambda)$ is an (r,s) -pair circulant polynomial matrix.

Proof

Let $A(\lambda)$ be a non-singular polynomial matrix and $r\neq 0$. Assume that $A(\lambda)$ is an $(r,s)-$pair circulant polynomial matrix.

We have to prove that $A^*(\lambda)$ is an (r,s)-pair circulant polynomial matrix.

Let $A(\lambda)$ be an (r,s) -pair circulant polynomial matrix. Then

$$A(\lambda)\mathcal{B}(\lambda)=\mathcal{B}(\lambda)A(\lambda)$$

$$\left[A(\lambda)\mathcal{B}(\lambda)\right]^*=\left[\mathcal{B}(\lambda)A(\lambda)\right]^*$$

$$\mathcal{B}^*(\lambda)A^*(\lambda)=A^*(\lambda)\mathcal{B}^*(\lambda) \qquad (3)$$

Since $\mathcal{B}(\lambda)B^*(\lambda)=\left|\mathcal{B}(\lambda)\right|I_n(\lambda)$

$$=(-1)^{n+1}rI_n(\lambda)$$

$$\mathcal{B}^*(\lambda)=(-1)^{n+1}rI_n(\lambda)\mathcal{B}^{-1}(\lambda)$$

$$\mathcal{B}^*(\lambda)=(-1)^{n+1}r\mathcal{B}^{-1}(\lambda) \qquad (4)$$

sub (4) in (3), we get

$$(-1)^{n+1}r\mathcal{B}^{-1}(\lambda)A^*(\lambda)=A^*(\lambda)(-1)^{n+1}r\mathcal{B}^{-1}(\lambda)$$

$$\mathcal{B}^{-1}(\lambda)A^*(\lambda)=A^*(\lambda)\mathcal{B}^{-1}(\lambda)$$

$$A^*(\lambda)\mathcal{B}(\lambda)=\mathcal{B}(\lambda)A^*(\lambda)$$

Hence, $A^*(\lambda)$ is an (r,s) -pair circulant polynomial matrix.

Conversely, assume that $A^*(\lambda)$ is an (r,s) -pair circulant polynomial matrix.

We have to prove that $A(\lambda)$ is an (r,s)-pair circulant polynomial matrix.

Suppose that $A^*(\lambda)$ is an (r,s)-pair circulant polynomial matrix. Then

$$\left[A^*(\lambda)\mathcal{B}(\lambda)=\mathcal{B}(\lambda)A^*(\lambda)\right]^*$$

$$\mathcal{B}^*(\lambda)\left(A^*\right)^*(\lambda)=\left(A^*\right)^*\mathcal{B}^*(\lambda)$$

According to $\mathcal{B}^*(\lambda)=(-1)^{n+1}r\mathcal{B}^{-1}(\lambda)$ and we get $\left(A^*\right)^*(\lambda)=\left|A(\lambda)^{n-2}\right|A(\lambda)$ we get,

$$(-1)^{n+1}r\mathcal{B}^{-1}(\lambda)\left|A(\lambda)\right|^{n-2}A(\lambda)=\left|A(\lambda)\right|^{n-2}A(\lambda)(-1)^{n+1}r\mathcal{B}^{-1}(\lambda)$$

$$\mathcal{B}^{-1}(\lambda)A(\lambda)=A(\lambda)\mathcal{B}^{-1}(\lambda)$$

$$A(\lambda)\mathcal{B}(\lambda)=\mathcal{B}(\lambda)A(\lambda)$$

Hence, $A(\lambda)$ is an (r,s) -pair circulant polynomial matrix.

Conclusion

Some of the characterizations of (r,s)-pair circulant polynomial matrices are discussed here.All other properties can also be extended in a similar way.

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PROPERTIES OF POLYNOMIAL ORTHOGONAL OF TYPE I MATRICES

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ABSTRACT

The concept of polynomial orthogonal of type I matrices are introduced. We define the index of orthogonal of type I matrices and we extended some results of orthogonalof type I matrix to polynomial orthogonal of type I matrices

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Keywords: *Orthogonal matrix, orthogonal of type I matrix, determinant, inverse, transpose.*

Introduction

Matrices provide a very powerful tool for dealing with linear models.In multidimensional system theory, problems related to multivariable control system invertibility require the use of generalized inverse of matrices whose elements are polynomials in several variables with coefficients over a real field (or) a rational field (or) an integral domain of integers. Orthogonal matrices are important for a number of reasons, both theatrical and practical. A polynomial matrix of degree n, $A(\lambda)=\sum_{j=0}^{n}\lambda^{j}A_{j}$, $\det A_1 \neq 0$, is said to be polynomial matrix if all entries of $A(\lambda)$ are polynomials.Polynomials and polynomial matrices arise naturally as modelling tools in several areas of applied mathematics, sciences and engineering, especially in systems theory **[2, 3, 4, 5, 6, 7, 8]**. In this paper, we introduced the new type of matrices, we called it polynomial orthogonal of type I matrices and extended some results of polynomial orthogonal of type I matrices.

Preliminaries

Definition: 2.1[1]

A square matrix A is called an orthogonal of type I matrix if $A^{k}(A^{T})^{k}=I_{n}$ *and* $(A^{T})^{k}(A\ )^{k}=I_{n}$, for some $k\epsilon N$

Definition: 2.2[1]

Let Abe an orthogonal of type I matrix and There exists positive integer k with $A^{k}(A^{T})^{k}=I_{n}$ is called the index of A. We say that A is an orthogonal of typeI of period k .

Example: 2.3

$A=\begin{bmatrix}\sqrt{i} & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & \sqrt{i}\end{bmatrix}$ is an orthogonal of type I matrix.

Solution

$A=\begin{bmatrix}\sqrt{i} & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & \sqrt{i}\end{bmatrix}$ Then $A^{T}=\begin{bmatrix}\sqrt{i} & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & \sqrt{i}\end{bmatrix}$

Since A is an orthogonal of type I matrix.

So that, $A^{k}(A^{T})^{k}=I_{n}$

Put k = 1, $AA^{T}=\begin{bmatrix}i & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & i\end{bmatrix}$

Put k = 2, $A^{2}(A^{T})^{2}=\begin{bmatrix}-1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & -1\end{bmatrix}$

Put k = 3, $A^{3}(A^{T})^{3}=\begin{bmatrix}-i & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & -i\end{bmatrix}$

Put k = 4, $A^{4}(A^{T})^{4}=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}$

Put k = 5, $A^{5}(A^{T})^{5}=\begin{bmatrix}i & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & i\end{bmatrix}$

Put k = 6, $A^6(A^T)^6 = \begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

put k = 7, $A^7(A^T)^7 = \begin{bmatrix} -i & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -i \end{bmatrix}$

Put k = 8, $A^8(A^T)^8 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

The index of A is 4, then $A^k(A^T)^k = I_2$ *and* ,k=4,8,12,….. and$A$ is of period 4.

Polynomial Orthogonal Of Type I Matrices

Definition: 3.1

A polynomial orthogonal of type I matrix is a polynomial orthogonal of type I matrix whose coefficient matrices are orthogonal of type I matrices.

Let $A(\lambda) = A_0 + A_1\lambda + A_2\lambda^2 + \ldots\ldots\ldots + A_n\lambda^n$ be polynomial orthogonal of type I matrix. Here coefficient matrices $A_i's$ are orthogonal of type I matrices.

That is, $A_i^k(A_i^T)^k = I_n$ *and* $(A_i^T)^k(A_i)^k = I_n$, for some $k \epsilon N$

Example: 3.2

$$Let\ A(\lambda) = \begin{pmatrix} i - i\lambda & 0 \\ 0 & i - i\lambda \end{pmatrix} = A_0 + A_1\lambda$$

$$A(\lambda) = \begin{pmatrix} i & 0 \\ 0 & i \end{pmatrix} + \begin{pmatrix} -i & 0 \\ 0 & -i \end{pmatrix}\lambda$$

where $A_0 = \begin{pmatrix} i & 0 \\ 0 & i \end{pmatrix}$ and $A_1 = \begin{pmatrix} -i & 0 \\ 0 & -i \end{pmatrix}$

Put k = 1, $A_0A_0^T = \begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$

Put k = 2, $A_0^2(A_0^T)^2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Put k = 3, $A_0^3(A_0^T)^3 = \begin{bmatrix} -i & 0 \\ 0 & -i \end{bmatrix}$

Put k = 4, $A_0^4(A_0^T)^4 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Put k = 5, $A_0^5(A_0^T)^5 = \begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$

Put k = 6, $A_0^6(A_0^T)^6 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

The index of A_0 is 2, then $A_0^k(A_0^T)^k = I_2$ *and* k=2,4,6,….. and$A$ is of period 2.

Put k = 1, $A_1A_1^T = \begin{bmatrix} -i & 0 \\ 0 & -i \end{bmatrix}$

Put k = 2, $A_1^2(A_1^T)^2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Put k = 3, $A_1^3(A_1^T)^3 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

Put k = 4, $A_1^4(A_1^T)^4 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Put k = 5, $A_1^5(A_1^T)^5 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

Put k = 6, $A_1^6(A_1^T)^6 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

The index of A_1 is 2, then $A_1^k(A_1^T)^k = I_2$ *and* k=2,4,6,….. and$A$ is of period 2.

Theorem: 3.3

If $A(\lambda)$ is a polynomial orthogonal of type I matrix. Whose coefficient matrices of $A(\lambda)$ are orthogonal of type I matrices. That is $A_0, A_1, A_2, \ldots\ldots A_n$ are orthogonal of type I matrices. The matrix $A_i's$ are orthogonal of type I of index k if and only if A_i^m are orthogonal of type I matrices of index k for each $m \epsilon \mathbb{N}$

Proof

If $A(\lambda)$ is a polynomial orthogonal of type I matrix. Whose coefficient matrices of $A(\lambda)$ are orthogonal of type I matrices. That is $A_0, A_1, A_2, \ldots\ldots A_n$ are orthogonal of type I matrices.

Suppose that $A_i's$ are orthogonal of type I matrices.

To prove A_i^m are orthogonal of type I matrices.

So that , $A_i^k(A_i^T)^k = I_n$ for some $k \epsilon R$

Taking m on both side

$(A_i^k(A_i^T)^k)^m = (I_n)^m$ for m ∈ N

$(A_i^k)^m((A_i^T)^k)^m = I_n$

Hence A_i^m are orthogonal of type I matrices .

Conversely, suppose that A_i^m are orthogonal of type I matricesfor each $m \in N$

To prove $A_i's$ are orthogonal of type I matrices of index k.

Since $(A_i^m)^k((A_i^m)^T)^k = I_n$, for $m \in N$,

Each of A_i^2 and A_i^3 are orthogonal of type I matrices of index k.

So,

$I_n = (A^3)^k((A^3)^T)^k$

$I_n = A_i^k(A_i^2)^k((A_i^2)^T)^k(A_i^T)^k$ for A^2 is an orthogonal of type I matrix.

$I_n = A_i^k(A_i^T)^k$

Hence $A_i's$ are orthogonal of type I matrix of index k.

Theorem: 3.4

If $A(\lambda)$ is anpolynomial orthogonal of type I matrix is a polynomial orthogonal of type I matrix whose coefficient matrices are orthogonal of type I matrices. Then $\det A_i^k = \pm 1$.

Proof

Let $A(\lambda) = A_0 + A_1\lambda + A_2\lambda^2 + \ldots\ldots\ldots + A_n\lambda^n$ be polynomial orthogonal of type I matrix. Here coefficient matrices $A_i's$ are orthogonal of type I matrices.

Let Abe an orthogonal of type I matrix of index k.

Given that , $A_i^k(A_i^T)^k = I_n$

Taking det on both sides

$\det(A_i^k(Ai^T)^k) = \det(I_n)$

$\det A_i^k.\det(A_i^T)^k = \det(I_n)$

Since, $\det A^k = \det(A^T)^k$

ie) $\det A_i^k.\det A_i^k = 1$

$(\det A_i^k)^2 = 1$

$\det(A_i^k) = \pm 1$

Hence $\det(A_i^k) = \pm 1$

Example: 3.5

Let $A(\lambda) = \begin{pmatrix} i - i\lambda & 0 \\ 0 & i - i\lambda \end{pmatrix} = A_0 + A_1\lambda$

$(A_i^m)^k((A_i^m)^T)^k = I_n$

$A(\lambda) = \begin{pmatrix} -i & 0 \\ 0 & -i \end{pmatrix} + \begin{pmatrix} i & 0 \\ 0 & i \end{pmatrix}\lambda$

where $A_0 = \begin{pmatrix} -i & 0 \\ 0 & -i \end{pmatrix}$ and $A_1 = \begin{pmatrix} i & 0 \\ 0 & i \end{pmatrix}$

$\det A_0 = [i^2 - 0] = -1$

$\det A_1 = [i^2 - 0] = -1$

Hence $\det A_i = \pm 1$

Theorem: 3.6

If $A(\lambda) = A_0 + A_1\lambda + A_2\lambda^2 + \ldots\ldots\ldots + A_n\lambda^n$ be polynomial orthogonal of type I matrix. Here coefficient matrices $A_i's$ are orthogonal of type I matrices.

The following statements are equivalent.

(i) $A(\lambda)$ is an polynomial orthogonal of type I matrix.

(ii) $A(\lambda)^{-1}$ is an polynomial orthogonal of type I matrix.

(iii) $A(\lambda)^T$ is an polynomial orthogonal of type I matrix.

(iv) $\overline{A(\lambda)}$ is an polynomial orthogonal of type I matrix.

(v) $A(\lambda)^*$ is an polynomial orthogonal of type I matrix.

Proof

Let $A(\lambda) = A_0 + A_1\lambda + A_2\lambda^2 + \ldots\ldots\ldots + A_n\lambda^n$ be polynomial orthogonal of type I matrix. Here coefficient matrices $A_i's$ are orthogonal of type I matrices. Where i = 1, 2, 3,.....n.

To prove (i) ⇒ (ii).

Let us assume that $A(\lambda) = A_0 + A_1\lambda + A_2\lambda^2 + \ldots\ldots\ldots + A_n\lambda^n$ is a polynomial orthogonal of type I matrix. To prove $A(\lambda)^{-1}$ is a polynomial orthogonal of type I matrix. By the definition of polynomial orthogonal of type I matrix, all the coefficient matrices of $A(\lambda)$ are orthogonal of type I matrices. That is

$A_0, A_1, A_2, \ldots\ldots A_n$ are orthogonal of type I

Suppose that $A_i's$ are orthogonal of type I matrices.

That is, $A_i^{\,k}(A_i^{\,T})^k = I_n$.

Taking inverse on both sides,

$$\left[A_i^{\,k}(A_i^{\,T})^k\right]^{-1} = [I_n]^{-1}$$

$$\left[A_i^{\,k}\right]^{-1}\left[(A_i^{\,T})^k\right]^{-1} = I_n$$

$$\left[A_i^{-1}\right]^k\left[(A_i^{-1})^T\right]^k = I_n \text{ where } i = 1,2,3,\ldots\ldots n$$

Hence A_i^{-1} are orthogonal of type I matrices.

Therefore $A_i's$ are orthogonal of type I matrices. Hence all the coefficients of $A(\lambda)^{-1}$ are orthogonal of type I matrices. Therefore $A(\lambda)^{-1}$ is a polynomial orthogonal of type I matrix.

Example: 3.7

Let $A(\lambda) = \begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix} + \begin{pmatrix} 0 & -i \\ -i & 0 \end{pmatrix}\lambda = A_0 + A_1\lambda$

where and $A_0 = \begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix}$ *and* $A_1 = \begin{pmatrix} 0 & -i \\ -i & 0 \end{pmatrix}$

$$A_0^{\,T} = \begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix}$$

To find: $A_0^{\,-1}$

$$A_0^{\,-1} = \frac{1}{|A_0|} adj A_0$$

$$adj\, A_0 = \begin{pmatrix} -i & 0 \\ 0 & i \end{pmatrix}$$

$$|A_0| = \left|\begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix}\right| = 1$$

$$A_0^{\,-1} = \frac{1}{1}\left[\begin{pmatrix} -i & 0 \\ 0 & i \end{pmatrix}\right]$$

$$A_0^{\,-1} = \left[\begin{pmatrix} -i & 0 \\ 0 & i \end{pmatrix}\right]$$

$$\text{Put k=1, } A_0^{-1}\left[A_0^{-1}\right]^T = \begin{pmatrix} -i & 0 \\ 0 & i \end{pmatrix}\begin{pmatrix} -i & 0 \\ 0 & i \end{pmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

matrices.

$$\text{Put k = 2, } A_0^{-1^2}\left[\left(A_0^{-1}\right)^T\right]^2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\text{Put k = 3, } A_0^{-1^3}\left[\left(A_0^{-1}\right)^T\right]^3 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$\text{Put k = 4, } A_0^{-1^4}\left[\left(A_0^{-1}\right)^T\right]^4 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

The index of $A_0^{\,-1}$ is 2, then $A_0^{-1^k}(A_0^{-1^T})^k = I_2$ *and* k=2,4,…..and $A_0^{\,-1}$ is of period 2.

To find: $A_1^{\,-1}$

$$adj\, A_1 = \begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix}$$

$$|A_1| = 1$$

$$A_1^{\,-1} = \frac{1}{1}\left[\begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix}\right] = \begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix}$$

$$\text{Put k = 1, } A_1^{-1}\left[A_1^{-1}\right]^T = \begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix}\begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$\text{Put k = 2, } A_1^{-1^2}\left[\left(A_1^{-1}\right)^T\right]^2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\text{Put k = 3, } A_1^{-1^3}\left[\left(A_1^{-1}\right)^T\right]^3 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$\text{Put k = 4, } A_1^{-1^4}\left[\left(A_1^{-1}\right)^T\right]^4 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

The index of $A_1^{\,-1}$ is 2, then $A_1^{-1^k}(A_1^{-1^T})^k = I_2$ *and* k=2,4,….. and $A_1^{\,-1}$ is of period 2.

To prove (ii) ⇒ (iii).

Suppose $A(\lambda)^{-1}$ is a polynomial orthogonal of type I matrix to prove $A(\lambda)^T$ is a polynomial orthogonal of type I matrix. That is to prove all its coefficient matrices are orthogonal of type I matrices. Since $A(\lambda)^{-1}$ is a polynomial orthogonal of type I matrix.

This implies,

$\left(A_i^{-1}\right)^k\left[\left(A_i^{-1}\right)^T\right]^k = I_n, i = 0, 1, 2, \Lambda\ , n,$

Taking inverse on both sides,

$$\left[\left(A_i^{-1}\right)^k\left[\left(A_i^{-1}\right)^T\right]^k\right]^{-1} = [I_n]^{-1},$$

$$\left[\left[\left(A_i^{-1}\right)^T\right]^k\right]^{-1}\left[\left(A_i^{-1}\right)^k\right]^{-1} = I_n$$

$$\left[\left[\left(A_i^{-1}\right)^{-1}\right]^T\right]^k\left[\left(A_i^{-1}\right)^{-1}\right]^k = I_n$$

$$\left[\left(A_i\right)^T\right]^k\left(A_i\right)^k = I_n.$$

Taking transpose on both side

$$\left[\left[\left(A_i\right)^T\right]^k\left(A_i\right)^k\right]^T = (I_n)^T$$

$$\left[A_i^T\right]^k\left[\left(A_i^T\right)^T\right]^k = I_n$$

Hence $A(\lambda)^T$ is a polynomial orthogonal of type I matrix.

Example: 3.8

Let

$$A(\lambda) = \frac{1}{\sqrt{5}}\begin{pmatrix}1 & 2\\ 2 & -1\end{pmatrix} + \begin{pmatrix}-1 & 0\\ 0 & -1\end{pmatrix}\lambda = A_0 + A_1\lambda$$

where and

$$A_0 = \frac{1}{\sqrt{5}}\begin{pmatrix}1 & 2\\ 2 & -1\end{pmatrix} and\ A_1 = \begin{pmatrix}-1 & 0\\ 0 & -1\end{pmatrix}$$

$$A_0^T = \frac{1}{\sqrt{5}}\begin{pmatrix}1 & 2\\ 2 & -1\end{pmatrix}$$

Putk=1, $(A_0)^T A_0 = \left(\frac{1}{\sqrt{5}}\begin{pmatrix}1 & 2\\ 2 & -1\end{pmatrix}\right)\left(\frac{1}{\sqrt{5}}\begin{pmatrix}1 & 2\\ 2 & -1\end{pmatrix}\right) = \begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ $\overline{A_0} = \begin{pmatrix}\sqrt{i} & 0\\ 0 & -\sqrt{i}\end{pmatrix}$

Put k = 2, $\left(A_0^T\right)^2 A_0^2 = \begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$

Put k = 3, $\left(A_0^T\right)^3 A_0^3 = \begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$

Put k = 4, $\left(A_0^T\right)^4 A_0^4 = \begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$

The index of A is 1, then $\left(A_0^T\right)^k A_0^k = I_2$ k=1,2,3,….. and$A$ is of period 1.

Similarly we have to prove $\left(A_1^T\right)^k A_1^k = I_2$

To prove (iii) ⇒ (iv)

Suppose $A(\lambda)^T$ is a polynomial orthogonal of type I matrix to prove $\overline{A(\lambda)}$ is a polynomial orthogonal of type I matrix. That is to prove all its coefficient matrices are orthogonal of type I matrices.

Since $A(\lambda)^T$ is a polynomial orthogonal of type I matrix.

This implies, $A_i^k\left(A_i^T\right)^k = I_n, i = 0, 1, 2, \Lambda, n,$

Taking conjugate on both sides,

$$\Rightarrow \overline{\left[A_i^k\left(A_i^T\right)^k\right]} = \overline{I_n}$$

$$\Rightarrow \left(\overline{A_i}\right)^k\left(\overline{\left(A_i^T\right)}\right)^k = I_n, i = 0, 1, 2, \Lambda, n$$

Therefore all $\overline{A_i}'s$ are orthogonal of type I matrices. Hence $\overline{A(\lambda)}$ is a polynomial orthogonal of type I matrix.

Example: 3.9

Let $A(\lambda) = \begin{pmatrix}-\sqrt{i} & 0\\ 0 & \sqrt{i}\end{pmatrix}\lambda = A_0 + 0\ \lambda$

where and $A_0 = \begin{pmatrix}-\sqrt{i} & 0\\ 0 & \sqrt{i}\end{pmatrix}$

Put k = 1, $\overline{A_0}\left[\overline{A_0}\right]^T = \begin{pmatrix}\sqrt{i} & 0\\ 0 & -\sqrt{i}\end{pmatrix}\begin{pmatrix}\sqrt{i} & 0\\ 0 & -\sqrt{i}\end{pmatrix} = \begin{bmatrix}i & 0\\ 0 & i\end{bmatrix}$

Put k = 2, $\left(\overline{A_0}\right)^2\left[\left(\overline{A_0}\right)^T\right]^2 = \begin{pmatrix}\sqrt{i} & 0\\ 0 & -\sqrt{i}\end{pmatrix}\begin{pmatrix}\sqrt{i} & 0\\ 0 & -\sqrt{i}\end{pmatrix} = \begin{bmatrix}-1 & 0\\ 0$

Put k = 3, $\left(\overline{A_0}\right)^3\left[\left(\overline{A_0}\right)^T\right]^3 = = \begin{bmatrix}-i & 0\\ 0 & -i\end{bmatrix}$

Put k = 4, $\left(\overline{A_0}\right)^4\left[\left(\overline{A_0}\right)^T\right]^4 = = \begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$

Put k = 5, $\left(\overline{A_0}\right)^6\left[\left(\overline{A_0}\right)^T\right]^6 = \begin{bmatrix}i & 0\\ 0 & i\end{bmatrix}$

Put k = 6, $\left(\overline{A_0}\right)^6\left[\left(\overline{A_0}\right)^T\right]^6 = \begin{bmatrix}-1 & 0\\ 0 & -1\end{bmatrix}$

Put k = 7, $\left(\overline{A_0}\right)^7\left[\left(\overline{A_0}\right)^T\right]^7 = = \begin{bmatrix}-i & 0\\ 0 & -i\end{bmatrix}$

Put k = 8, $\left(\overline{A_0}\right)^8\left[\left(\overline{A_0}\right)^T\right]^8 = = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

The index of A is 4, then $\left(\overline{A_i}\right)^k\left(\left(\overline{A_i}^T\right)\right)^k = I_n$, k = 4,8,12,….. and A is of period 4.

To prove (iv) ⇒ (v)

Suppose $\overline{A(\lambda)}$ is a polynomial orthogonal of type I matrix to prove $\overline{A(\lambda)}^T = A(\lambda)^*$ is a polynomial orthogonal of type I matrix.That is to prove all its coefficient matrices are orthogonal of type I matrices. That is $\left(A_i^*\right)^k\left((A_i^*)^T\right)^k = I_n, i = 0, 1, 2, \Lambda\ , n$

Since $\overline{A(\lambda)}$ is a polynomial orthogonal of type I matrix.

This implies, $\left(\overline{A_i}\right)^k\left(\left(\overline{A_i}^T\right)^k\right) = I_n, i = 0, 1, 2, \Lambda\ , n$

Taking transpose on both sides,

$$\left[\left(\overline{A_i}\right)^k\left(\left(\overline{A_i}^T\right)^k\right)^T\right]^T = (I_n)^T$$

$$\left(\left(\left(\overline{A_i}\ \right)^T\right)^k\right)^T\left(\left(\overline{A_i}\right)^k\right)^T = I_n$$

Since $\left(\overline{A_i}\ \right)^T = A_i^*$

$$\left(\left(\left(\overline{A_i}\ \right)^T\right)^k\right)^k\left(\left(\overline{A_i}\right)^T\right)^k = I_n$$

$$\left((A_i^*)^T\right)^k\left(A_i^*\right)^k = I_n$$

Therefore all A_i^*'s are orthogonal of type I matrices. Hence $A(\lambda)^*$ is a polynomial orthogonal of type I matrix.

Example: 3.10

Let

$$A(\lambda) = \begin{pmatrix} 1 & 1 \\ -1-i & -1 \end{pmatrix} + \begin{pmatrix} i & 0 \\ 0 & i \end{pmatrix}\lambda = A_0 + A_1\lambda$$

$$where\ A_0 = \begin{pmatrix} 1 & 1 \\ -1-i & -1 \end{pmatrix}\ and\ A_1 = \begin{pmatrix} i & 0 \\ 0 & i \end{pmatrix}$$

$$\overline{A_0} = \begin{pmatrix} 1 & 1 \\ -1+i & -1 \end{pmatrix}$$

$$\left(\overline{A_0}\ \right)^T = A_0^{\ *} = \begin{pmatrix} 1 & -1+i \\ 1 & -1 \end{pmatrix}$$

Put k = 1, $A_0^*\ A_0^{*T} = \begin{bmatrix} 1-2i & 2-i \\ 2-1 & 2 \end{bmatrix}$

Put k = 2, $A_0^{*2}(A_0^{*T})^2 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

Put k = 3, $A_0^{*3}(A_0^{*T})^3 = \begin{bmatrix} -i+i & -2+i \\ -2+i & -2 \end{bmatrix}$

Put k = 4, $A_0^{*4}(A_0^{*T})^4 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Put k = 5, $A_0^{*5}(A_0^{*T})^5 = \begin{bmatrix} 1-2i & 2-i \\ 2-i & 2 \end{bmatrix}$

Put k = 6, $A_0^{*6}(A_0^{*T})^6 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

Put k = 7, $A_0^{*7}(A_0^{*T})^7 = \begin{bmatrix} -i+i & -2+i \\ -2+i & -2 \end{bmatrix}$

Put k = 8, $A_0^{*8}(A_0^{*T})^8 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

The index of A is 4, then $\left((A_i^*)^T\right)^k\left(A_i^*\right)^k = I_n$ k = 4,8,12,….. and A is of period 4.

To prove (v) ⇒ (i)

Suppose $A(\lambda)^*$ is a polynomial orthogonal of type I matrix to prove $A(\lambda)$ is a polynomial orthogonal of type I matrix. That is to prove all its coefficient matrices are orthogonal of type I matrices.

Since A^* is a polynomial orthogonal of type I matrix.

This implies, $\left((A_i^*)^T\right)^k\left(A_i^*\right)^k = I_n$.

Taking * on both sides

$$\left(\left((A_i^*)^T\right)^k\left(A_i^*\right)^k\right)^* = (I_n)^*$$

$$\left(\left(\left(A_i^*\right)^T\right)^k\right)^*\left(\left(A_i^*\right)^k\right)^* = I_n$$

$$\left(\left(\left(A_i^*\right)^*\right)^T\right)^k\left(\left(A_i^*\right)^*\right)^k = I_n$$

$$A_i^{\,k}(A_i^{\,T})^k = I_n$$

If $A(\lambda) = A_0 + A_1\lambda + A_2\lambda^2 + \ldots\ldots\ldots + A_n\lambda^n$ is a polynomial orthogonal of type I matrix. Whose coefficient matrices of $A(\lambda)$ are orthogonal of type I matrices. That is $A_0, A_1, A_2, \ldots\ldots\ldots A_n$ are orthogonal of type I matrices. Then $A_i^{-1} = A_i^{k-1}\left(A_i^T\right)^k$

Proof

Let $A(\lambda) = A_0 + A_1\lambda + A_2\lambda^2 + \ldots\ldots\ldots + A_n\lambda^n$ is a polynomial orthogonal of type I matrix. Whose coefficient matrices of $A(\lambda)$ are orthogonal of type I matrices.

By theorem (3.4) we have $\det(A_i) \neq 0$. Then $A_i's$ are invertible.

$A_i^{\,k}(A_i^{\,T})^k = I_n$ for some $k \in N$.

This equivalent to $\left(A_i^{\,k}\right)^{-1} = (A_i^{\,T})^k$

This implies, $\left(A_i^{\,-1}\right)^k = (A_i^{\,T})^k$

This implies, $\left(A_i^{\,-1}\right)^{k-1}\left(A_i^{\,-1}\right) = (A_i^{\,T})^k$

Hence $A_i^{-1} = A_i^{k-1}\left(A_i^T\right)^k$

Theorem: 3.12

If $A(\lambda)$ is a polynomial orthogonal of type I matrix. Whose coefficient matrices of $A(\lambda)$ are orthogonal of type I matrices. That is $A_0, A_1, A_2, \ldots\ldots\ldots A_n$ are orthogonal of type I matrices with index k if and only if A_i^m are orthogonal of type I matrices with index k for each $m \in N/\{1\}$.

Proof

Suppose that $A_i's$ are orthogonal of type I matrices,

So $A_i^{\,k}(A_i^{\,T})^k = I_n$ for some $k \in N$.

This implies, $\left(A_i^{\,k}(A_i^{\,T})^k\right)^m = (I_n)^m$

$$\left(A_i^{\,k}\right)^m\left((A_i^{\,T})^k\right)^m = I_n$$

$$\left(A_i^{\,m}\right)^k\left((A_i^{\,T})^m\right)^k = I_n$$

Therefore all $A_i's$ are orthogonal of type I matrices. Hence $A(\lambda)$ is a polynomial orthogonal type I matrix.

Theorem: 3.11

Hence $A_i^m's$ are orthogonal of type I matrices.

$$ind\left(A_i^m\right) = lcm\{\underbrace{ind(A_i), ind(A_i), ind(A_i)\ldots\ldots\ldots ind(A_i)}_{m\ times}\}$$

$$ind\left(A_i^m\right) = lcm\{\underbrace{k,k,k\ldots\ldots k}_{m\ times}\} = k$$

Now, A_i^m are orthogonal of type I matrices with index k for each $m \in N/\{1\}$.

Especially, each of A_i^2 *and* A_i^3 are orthogonal of type I matrices with index k.

So, $I_n = \left(A_i^3\right)^k\left(\left(A_i^3\right)^T\right)^k$

$$I_n = A_i^{\,k}\left(A_i^2\right)^k\left(\left(A_i^2\right)^T\left(A_i\right)^T\right)^k$$

$I_n = A_i^{\,k}(A_i^{\,T})^k$, A_i^2 are orthogonal of type I matrices with index k.

Hence $A_i's$ are orthogonal of type I matrices with index k.

Theorem 3.13

If $A(\lambda)$ is a polynomial orthogonal of type I matrix. Whose coefficient matrices of $A(\lambda)$ are orthogonal of type I matrices. That is $A_0, A_1, A_2, \ldots\ldots\ldots A_n$ are orthogonal of type I matrices, then it preserves the inner product in the eigenvectors subspace .

Proof

Let $A(\lambda) = A_0 + A_1\lambda + A_2\lambda^2 + \ldots\ldots\ldots + A_n\lambda^n$ is a polynomial orthogonal of type I matrix. Whose coefficient matrices of $A(\lambda)$ are orthogonal of type I matrices. If λ is an eigenvalue of $A_i's$ and x and y be eigenvectors corresponding to λ .

Then $A_i\,x = \lambda y$ and $A_i\,y = \lambda x$

So $\langle A_i x, A_i y\rangle = \langle \lambda x, \lambda y\rangle$

$$= \lambda\bar{\lambda}\langle x, y\rangle$$

$$= |\lambda|^2\langle x, y\rangle$$

$\langle A_i x, A_i y \rangle = \langle x, y \rangle$

Hence A_i's are preserves the inner product in the eigenvectors subspace.

Conclusion

Here we have extended some properties of orthogonal of type I matrices to polynomial orthogonal of type I matrices. All other properties can also be extended in a similar way.

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PAKEEZAH: A COURTESAN'S STRUGGLES FOR SOCIAL RECOGNITION

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ABSTRACT

Pakeezah, a perfect work of art of wonderful articulations on celluloid, arranged together by MeenaKumari and her better half Kamal Amrohi, in 1958 and released on 4 February 1972, accentuates the pride of a concubine in Indian culture. The film recounts the story set in Muslim Lucknow at the turn of the twentieth century. Its focal hero is a Lucknavinautch-young girl, for whom to become hopelessly enamored was prohibited, it was a wrongdoing she was told. A nautch-young girl is destined to amuse others. Such is her fate but her anxious soul couldn't smother her flooding want – To Love and Be Loved. It was apparently in light of Kamal Amrohi and MeenaKumari's own romantic tale. Pakeezah, an Indian film came in the early seventies, is the story of a beautiful courtesan named Sahibjaan (MeenaKumari) who is unable to break away from the cycle of Tawaif until a young forest ranger named Salim (Rajkumar) falls in love with her enthralling beauty and innocence. Unfortunately, his wealthy parents are not in favour of their union.While prostitutes had the option to mix in, they didn't generally stay undetected by its class. Here and there, even a fashionable lady, showing all the appropriate manners of the time could be uncovered for the twofold life that she drove and along these lines ignored.This paper is an attempt to highlight asserting FemaleSelf in Pakeezahfilm.

***Keywords**: Feminism, Women, Feminist movement, Kotha, Legitimate Marriage, prehistoric times, Sexual deception, Prostitute.*

In prehistoric times, the major job responsibilities of women were within the four walls of the house. Limited formal education made them dependent on their menfolk---Father and brother before marriage and husband after marriage. They were supposed to dedicate themselves to the stereotypical household chores, taking care of the needs and requirements of the members of the household and child development. This limited their roles and contribution to the building of family, community or society. But still it was the dream of the majority of women to have their own home, husband, children and a dignified secure life.

In the eponymous role, Nargis (MeenaKumari) also fantasies about wedding the man - Shahabuddin (Ashok Kumar) whom she loves ardently, but their union is dismissed by the patriarch of Shahabuddin's blue-blooded family, Hakim Saaab, who dismisses the union with a nautch young lady, as he thinks that it was unsuitable for the Royal family. Dejected, Nargis flees to a nearby cemetery and lives there, ultimately giving birth to a daughter before passing away.

On her deathbed, she writes a letter to Shahabuddin requesting him to come for his new-borndaughter. But Nargis' sister, Nawabjaan, an owner of a *Kotha*, discovers the infant girl first and takes her back to the *Kotha.*She trains Sahibjaan into a fine singer and dancer. At the point when Nargis' assets are sold quite a long whilelater, a book lover discovers her letter to Shahabuddinin her book and sends it to Shahabuddin, who comes to claim his now grown-up daughter, Sahibjaan. But Nawabjaan takes her niece away from him to another town. During this journey, an unknown admirer (Rajkumar) leaves a note praising her beautiful feet, in the train while she wasfast asleep. This note touches the chords of the young woman's heart to the extent that she starts dreaming of that unknown admirer, whom she yearns to meet to fulfil her unmet desire of having her on home.

She grows up singing and dancing like her mother. She works as a dancing girl and is courted by a prince, but can think only of the lover she has never met, who left her a message on the train. She dreams of him and cannot dance, becomes frightened and runs into the night.

During 20th century, India was brimming with sexual hypocrisy. The paradox appears to be odd that prostitution was not supposed to be an honorable profession by the society in general, but there were rich lords and aristocrats, who visited these *Kothas* unobserved and unnoticed and showered their wealth on the prostitutes.

They invested their energy with courtesans, but disapproved of prostitution in its numerous structures. While numerous men would openly revolted against prostitution and would guarantee that it was an evil transgression, they could typically be found with one of these women in the evening. Kragh U.T(2011) in his article emphasizes, "female was raised to an ideal of transcendence, she nevertheless was subject to an androcentric depiction represented as the male's other" (85-108).

Not only men but women were also additionally desirous to have the glamourous lifestyle of these prostitutes of the times, who drove truly agreeable lives as did lorettes. Ladies of the night and normal whores were not actually fortunate yet they were basically living autonomously, supporting themselves. It is not necessarily the case that the ladies of the time needed to be whores yet who wouldn't begrudge somebody who invested nearly as much energy with their spouses as they, when all is said and done.

It appears that despite the fact that it was extremely challenging for this profession to acquire social approval, everybody, even whores of various classes, attempted to accomplish it. For some, the fantasy was rarely acknowledged and for those that had the option to crawl into the general public life was not in every case simple. This is to a great extent because of the double standards of the social reality that India's populace contained a lot of sexual false reverence and disregarded whores while supporting them.

Nargis couldn't enter into this good society. However, her injured pride made her conceal herself in a graveyard. She would have rather not returned back to her old glamorous universe of mistresses, since she needed decency and social approval. She needed an agreeableness for her new born girl, Sahibjaan,by that so-called high society. She yearned to give that dignity and respect to her girl which she herself could not acquire during her life time.

Nargiscraved for this non-public fulfillment and did not go again to her *Kotha*. But Nargis's worldly-wise and practical sister Nawabjaan deliberatelyhid the truth of Sahibjaan, being the daughter of Shahabuddin, because she knew the harsh reality of this cruel social hierarchy, which could, in no way, accept her niece. Therefore, she kept her faraway from Shahabuddin and trained her into the requisite skills of a courtesan. The film does not give any account of Sahibjaan being sent to any formal educational institution, but she is taught all the sophisticated etiquettes to cater to the needs of the customers from the aristocracy.

The women of these times were not given similar social or legal rights as their male counterparts and were, basically treated as the "Second Sex" due to gender discrimination. A young woman was not expected to be trained intellectually. Instead, she was trained to cultivate her physical charms to allure men, who had all the resources socially as well as legally. Husband hunting and marriage was the ultimate vocation for the majority of the so-called fortunate girls who had the social security of a home or family, whereas, those, who were pushed circumstantially or by birth into the profession of prostitution, the only available resource was to allure the rich men for their survival, as the entire population of the *Kotha* would be dependent on their earnings.

The reflections and judgments of women were not approached in a serious way in case they were even paid attention to by men and regardless of whether they seemed well and good, the way that it came from a woman limited any substance it may have had.

Cole, Longman, & Walker (2011) in their research highlighted:

Self-regulation is the other critical factor which influences performance and emotional and affective growth. Self-regulation is defined as a mental effort to control internal status, processes and functions to achieve goals. (13-20)

Nawabjaan opted for this self-regulation and kept Sahibjaan away from Shahabuddin and shaped her into an extremely appealing and handy artist and vocalist. She chose this life full of social ignominy for her niece, Sahibjaan, whom she trained to perform mujras for the rich men, who cared less about her poetic or dancing and singing skills, as their lasciviousness brought them to the *Kotha*. ButSahibjaandid not like these sexual overturesand unknowingly got attracted

towards that unknown admirer who had touched her soul with his note for her beauty in the moving train.

With the progression of time Sahibjaan turned into an extremely successful courtesan. She was rich, adorned with gems, and her life was viewed as a luxurious life, yet she longed to meet that anonymous lover, who might give her a social acceptance and position.

One specific patron, the aggressive NawabZafar Ali Khan, wishes to establish a physical union withSahibjaan and takes her to his boat for the evening. The boat is assaulted by elephants and Sahibjaan is moved by the quick streaming waterway in a messed-up boat. As destiny would have it, she is taken to the riverside tent of a woodland officer, Salim Ahmed Khan. Alone in that tent, she happens to read his diary and comes to know that this was the man who hadleft her a note on her feet.Sahibjaanfinally meets this man of her dreams, but pretends of a fake amnesia to hide her identity, as she is scared of the social unacceptability. But shattering all her dreams, prior to nightfall, she is tracked byNawabjaan and is taken back to the *Kotha.*

Salim's rebellious outlook towards social norms, takes him to her *Kotha*and convinces her to elope with him. Sahibjaan dreams of Salim as her radiant and heartfelt darling, who might liberate her from the tag of a tawaif. She imagines that in the organization of the one who adores her—and whom she cherishes; she would have the option to dispose of those licentious looks of rich individuals who were keen on her body as it were. She is floated by the expectation that satisfaction is here.

This movie is about the pure hearted Sahibjaan whose innocence and beauty enthrall aristocratic Salim Ahmed Khan, who eventually convinces her to come with him to his *Haveli*, which she does. But Hakim Sahab, the traditional patriarch refuses to accept her as the *bahu*. Salim, unlike his uncle, takes Sahibjaanout of the ancestral *Haveli* to live calmly, but trials and tribulations await Sahibjaan, as she is perceived and recognized by other people, who are familiar with her past. She realizes that it would be difficult for her to get rid of her past identity.In any event, Salim is ready to confront that load of preliminaries, and needs to legitimately wed her, shows the courage to support her in all circumstances, re-names her "*Pakeezah*" (Pure of Heart) and takes her to a priest to be legally married, but she refuses, and returns to the brothel. Emotionally shattered Salim's hurt male pride makes him decide to marry someone else, and invite Sahibjaan to dance at his wedding.

According to Aghaeiet. al. (2003)

An assertive person can establish close relationships with others, avoid himself/herself from being abused and express a wide range of needs and positive and negative thoughts without guilt and anxiety or violating others' rights. (17-28)

The deprived childhood of Sahibjaan in absence of love and carrying by her mother made her stronger to assert herself. Quotation from an eminent psychologist indicates that how deprived childhood makes an individual a strong and self-willed person.

Sahibjaanasserts her identity of a courtesan by accepting her lover's invitation to dance in the very *Haveli*, which refused to provide her any dignity. She dances so stubbornly and vigorously venting out all her frustration and anger against the so-called contractors of the society that she faints and falls down on the floor. She is entirely oblivious to many secrets that are revealed by her aunt at this wedding. Nawabjaan perceives Shahabuddin and mocks him to observe the incongruity of the circumstance; his own daughter dancing in front of his family. Hakim Sahab attempts to shoot Nawabjaan to quiet her, yet rather winds up killing Shahabuddin. With his perishing breath, Shahabuddin requests his nephew Salim to marry Sahibjaan.

Finally, Sahibjaan gets that social approval and dignity for which she had been craving for so long. Her doli (cart) lifted by *Kahars*from her *Kotha,* consequently satisfy her desires and prompt a cheerful, feeling charged with consummation. But this leaves behind many unanswered questions as to why society has the double standards for men and women. Rich men going and supporting prostitutes do not lose their social ranks, while women sitting in these *Kothas* are labelled as bad women and looked down upon with a bias. In my opinion, the film has tried to establish the dignity of a woman irrespective of her caste, creed, social status or profession.

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AFRICAN UNION AND NEW PARTNERSHIP OF AFRICA'S DEVELOPMENT RELATIONSHIP AND FUTURE PROSPECTS

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ABSTRACT

Africa faces a dual challenge of governance and development, with institutional and implementation crises looming large. Whereas the continent has skilled an active period of diplomacy during the last decade 1998–2008, during which institutions and programmes just like the African Union (AU) and the New Partnership for Africa's Development (NEPAD) are established, we've also witnessed serious problems revealing themselves. One such problem has been institutional rivalries which served to undermine the continent's political and development agendas, and one such enmity was the strain and rancour between the AU and NEPAD. The newly elected Chair of the AU Commission in Addis Ababa will need to address such serious institutional tensions and rivalries within the continent.

Keywords- *NEPAD, African Union, ECOWAS, development, conflict prevention, resolution, conflict management, peace and security*

Introduction

"This New Partnership for Africa's Development" NEPAD might be a promise by African pioneers, upheld an overall vision and an enterprise and shared conviction, that they have an earnest obligation to wipe out poverty and to place their nations, each individually and all in all, on a course of suitable growth development and improvement, and at an equivalent chance to participate effectively inside the worldwide monetary framework and casing. The Programmed is anchored at the willpower of Africans to remove themselves and subsequently the landmass from the malaise of underdevelopment and rejection during a globalizing global.

2. The poverty and backwardness of Africa substitute obvious contrast to the accomplishment of the created world. The continued marginalization of Africa from the globalization interaction and in this way the social avoidance of the mind-boggling majority of its people committee involves a danger to worldwide stability.

3. By and large promotion to the establishments of the institutional local area, the credit and help binomial has underlined the rationale of African turn of events. Credit has incited the obligation stop, which, from portions to rescheduling, still exists and blocks the improvement of African countries. the limits of this part are reached. Concerning the contrary part of the binomial – help – we will similarly observe the decrease of individual guide and hence the most extreme constraint of public guide, which is under the objective set inside the 1970s.

4. In Africa, 340 million people, or a large portion of the populace, survive but US $1 every day. The deathrate of adolescents under 5 years matured is 140 for every 1000, and expectation upon entering the world is simply 54 years. Just 58% of the general population have safe water. The speed of absence of education for people more than 15 is 41 percent. There are only 18 mainline telephones for each 1000 people in Africa, differentiated and 146 for the planet in whole.

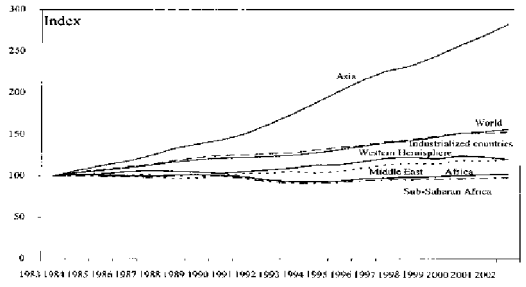
Hypothesis

The operational hypothesis of the study is premised on the rationale that Africa's developmental success ushered by NEPAD depends on the continent sticking to the prescribed conditions of the rich north countries. during this regard, the rich north countries entered into an asymmetric partnership with African leaders with the aim of developing the continent. the event of Africa depends entirely on adherence to good governance and trade liberalization. However, the rich north countries are hypocrites on trade liberalization due to their continued tariff barriers for exports also as subsidies for his or her agriculture.

Methodology

	1980s[1/]	1990s	2000-2002[2/]	1980[1/]	1990s	2000-2002[2/]
Africa	2.6	2.2	3.3	0.1	-0.2	0.6
Sub-Saharan Africa	2.5	2.1	3.2	0.1	-0.5	0.4
Sub-Sahara excl. Nigeria and south Africa	2.7	2.3	4.2	0.0	-0.4	1.3
Asia	6.7	7.4	5.8	5.5	5.8	4.8
Middle East	2.2	3.8	2.6	-0.4	1.6	0.3
Western Hemisphere	2.1	3.0	0.0	0.7	1.4	-1.5
World	3.4	3.1	2.5	3.0	2.1	1.6

Figure 1. Real GDP Per Capita Across Regions (1983=100)



"Real GDP Growth Growth of Real GDP per capita"
(In Percent) (In Percent)
Source: IMF, World Economic Outlook
1/1983-89.
2/2002 Projected growth

A. Macroeconomic Performance

Although there are "positive signs of recent progress, Africa's overall economic performance has been disappointing". Since the first 1980s, "GDP growth has averaged only 2.5 percent a year," and real per capita GDP has remained virtually unchanged (Figure 1 and Table 1). Thus, extreme poverty remains widespread, particularly in Sub-Saharan Africa. supported the planet "Bank Atlas method, which uses three-year averages of exchange rates," in 2000 GNP per capita amounted to only $470 in Sub-Saharan Africa , compared

This study mainly employs a qualitative, analytical and theory-testing approach supported the relevant diplomacy theories and methodology. a crucial theoretical -analytical tool was derived from well-developed concepts and notions of NEPAD, particularly partnership, good governance, socio economic development and trade liberalization. Throughout the study, appropriate documents concerning the subject were examined. These included books, articles, journals, and official websites of NEPAD, AU and South African Department of diplomacy and Cooperation. This study is original and every one references are included.

Study Work

with a mean of just about $27,700 in high-income countries (World Bank, 2002a).

Weak domestic policies have contributed to the present lackluster performance, though factors that are beyond the control of African countries, like negative terms of trade shocks, have also affected performance (see also Easterly and Levine, 1998).

During the 1980s and therefore the half of the 1990s, macroeconomic policies in Africa were often unsatisfactory, institutions deteriorated, and governance was weak. additionally, variety of nations faced periods of adverse external conditions or had to deal with internal conflicts. Improved macroeconomic management, market liberalization, and progress privately sector development improved growth appreciably within the mid-1990s. However, this short period of upper growth rates was soon followed by a moderating in economic performance.

The average performance hides important differences across countries. This becomes evident when the experience of the best-performing African countries is compared thereupon of weak performing countries. For illustrative purposes, we ask the highest five growth performers between 1990 and 2001 as "high-growth countries."

This group comprises Botswana, Mauritius, Mozambique, Uganda, and Tunisia. rock bottom five growth performers, mentioned as "low growth countries," comprise the Democratic Republic of Congo, Djibouti, Sierra Leone, Zambia, and Zimbabwe.

Table 2. The NEPAD: A Simple Framework for Analysis

Area	Policy Questions
Overall plan	• What is the NEPAD from an economic perspective-a Marshall Plan, a framework, an institution, or a blueprint? • What are its basic objectives? Are they coherent? • How ambitious are the reform objectives in terms of quantity and quality? • Are reforms priorities well specified? • In what way does the NEPAD differ from previous initiatives?
Analysis of selected initiatives	• What are the economic benefits of the initiative? • What should reform priorities be in light of recent developments in Africa? • Are there any specific lessons fromrecent reform experiences?
Risks	• What are the opportunities and risks associated with the NEPAD? • What needs to be done to minimize risks?
What must African Countries do to achieve results?	• How can public support be obtained and sustained? • How can authorities increase the credibility of the NEPAD? • How can reform progress be measured? • What are the contingency provisions needed to address reform slippages or unforeseen shocks?
How can the international community support the NEPAD?	• What should be the relation between the NEPAD and otherongoing international initiatives? • How can cooperation between donors be improved? • Under which conditions will internationally support likely increase?

Findings and Conclusions

The elaboration and alertness of the NEPAD has supplied African countries with their first possibility to put into effect sweeping and complete programmers for ability development – together with the equipment of the African referee Mechanism, which can be a completely unique device for peer evaluation and reform encompassing ability issues – and with widespread assist from the donor community. The EU, through its Commission of the ecu Communities (2005:6–7), has captured the scene as follows:

In latest years, a forward-searching Africa has re-emerged at the worldwide scene with greater confidence, dynamism and optimism than ever before. Governance has advanced drastically in latest years, sustained financial procedure is being recorded for the number one time in decades, and consequently the AU/NEPAD and local agencies have supplied Africa with political and financial roadmaps and a vision for the longer term. Africa's improvement is now at the best of the worldwide political schedule and there is a vast worldwide consensus at the vital motion that needs to be taken.There's now a novel window of possibility to provide Africa a decisive push towards sustainable improvement.

This study has proven the significance of growing ability in Africa and consequently the want for African governments to capture the opportunities being supplied in assist of the NEPAD to marshal the resources for ability improvement. It is cautioned that ability-improvement projects be preferably carried out via sector-huge approaches. A further concept

is that each African country need to set up a focal-factor facility for coordinating and tracking all plans, programmers, and external help destined for ability improvement. Developing ability in Africa will circulate the continent ahead to enhance properly governance, the effectiveness of each state, and motive sustainable improvement.

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ANALYSING THE IMPACT OF PERFORMANCE MANAGEMENT AND INTERNET OF THINGS ON PROJECT SUCCESS IN LARGE ENTERPRISE

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ABSTRACT

The industrial world is flourishing day by day where each organization is trying to reach to the best potential success managing the extreme competitiveness in this contemporary world. Organization success is inevitably determined by efficient performance, and those performances must be organized through a systematic way. Performance manager (PM) and Internet of Things (IoT) are the two crucial things within the organizational structure which ultimately determines the success of the organization. This study is developed illustrating the key features of PM and IoT and their role in organizational success. Major purpose of this study demonstrates the functions of these to reach success and how it works connecting the available resources and strategies of the business. Performance management is considered as the key driver of the business which organizes the entire management; similarly the IoT enables the management gathering multiple data of management over the internet. Furthermore, this article focuses on the current situation of IoT implementation and performance management within organizational boundaries in the entire globe as well as under the domestic boundary of India. In some ways, these appraises and evaluates the entire management depicting the future vision of success and loss, as both of them raises the assumption about the outcomes acquiring propensity to break and make the entire organization. Additionally, this study describes those features why it is necessary to acquire a suitable performance management and IoT implementation in business and how it works in achieving the best potential success of the business in the long-term.

Keywords: *Internet of Things (IoT), Project Management (PM), Key features of IoT and PM, organizational success*

Introduction

Organizations undertake projects assuming it will create more opportunities in the business and will be beneficial for the success of the business. The performance management organizes the entire stages of the business, on the other side the Internet of Things creates the connectivity in the business and boosts the strategic procedure of the business. Here, in this article the concept of PM, and IoT are described briefly along with the key features in acquiring organizational success. The study has focused on the typical characteristics of these ingredients of business in order to describe how it works to find the potential outcome. Furthermore, it concentrates on the current situation of PM implementation, and use of IoT in achievement of business success in India.

Literature review

Concept of performance management and internet of things (IoT)

Project management (PM) is the strategic procedure of planning, creation, managing, and implementing the business strategy to contribute to organizational success. In business strategy, rather than concentrating on the execution of business operations, the project management illustrates the broader picture [9]. It concentrates on three major areas to ensure the best potential profit for the business. The PM is linking the project with the strategy of the business which takes time to recognize specific projects before the foundation of the business.

Internet of Things (IoT) depicts the network of external objects- 'objects' which are constituted with software, sensors, and other technologies in order to connect and exchange

various data with other devices through the internet [10].. It is the systematic approach of business procedures which acts through the internet. Low-cost computing, analytics, mobile technologies everything is adjusted and interacted through IoT. Hyper Connected organizational activities are determined by the specific features of IoT where major industries are managing the extreme competitiveness through this connection over the internet.

In order to get the best potential success for the organization, it needs to be started from the right place. The HRM of any organization must need to understand the key features of PM along with the functions of IoT in getting the organizational success. First necessity of performance management is to establish the PM is easy-to understand which determines the ultimate success of the business. Key features of PM and IoT are described in the following table-

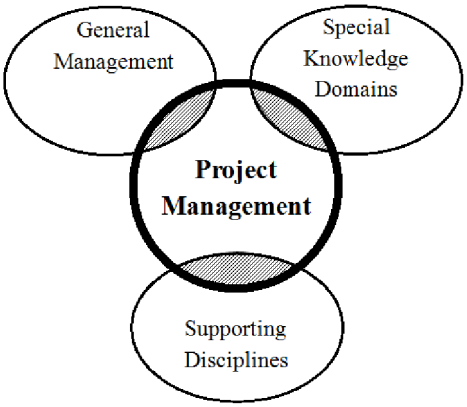


Figure 1: Key features of PM and IoT

Performance Management (PM)	Internet of Things (IoT)
Intuitive and automated process	Connectivity tool
Evaluation tool	Data manager
Goal-setting ingredient	Hyper connectivity tool
Manager log	Sensing system through technological implementation

(Source: Self-developed)

Naturally, the key thing that is necessary to reach any organizational success is to develop an intuitive plan. Efficient performance management system gives automatic prompts so that the focused task cannot be skipped unnecessarily [8]. Likewise, PM is denoted as self-evaluation tools of the business by which the entire procedures of the strategic plan can be justified easily.

Figure 1: Role of project management in entire management structure

(Source: Inspired by [5])

On the other hand, IoT works to enable the connectivity of the business; here the connectivity means the link between the strategy and available resources of business over the internet. IoT assures the integration of business procedures through systematic approach which is relevant and necessary to meet the objectives of the business. Available data is managed and processed through the proper system, and for that it is referred to as the data manager of the business.

Application of procedures, knowledge, skills or the experience goes under the criteria of PM in order to fulfill the objectives of business. It consists derivable which are constrained to the inevitable timescale or the targeted budget of any organization. Key conductor of PM is the wide range of varieties with different variables of organization strategy constituting the needs of success. On the other hand, an efficient PM denotes efficient awareness of business that is necessary to precede the organizational activities [9]. Below are several reasons for which the IoT and PM is considered relevant and necessary for organizational success.

Role of PM	Role of IoT
Gives future vision about the organizational success	Boost the entire management
Develop and train the strategy of the business	Creates connectivity and enables every stakeholders of the business
Gives clarity to the business and boost the employees	Create more scope and drive the objectives
Creates opportunities	Set the best conversation

Table 2: Role of PM and IoT in organizational success
(Source: Self-developed)

Consistently monitoring and balancing the organizational performance, through PM the professionals can observe the potential success of the business. Through the PM the strategic plan of the business can be detected early and for that it faces fewer obstacles to conduct the business procedures. Clarity in the business procedures is also established through the proper implementation of PM [7].

Similarly, the role of IoT in organizational success is not less as it helps in boosting the entire management, creating efficient connectivity in the business management [10]. It also works like the efficient data manager of the business which establishes the suitable connectivity among each stakeholder of the business, setting the relevant conversation in the business strategy.

Proposed method

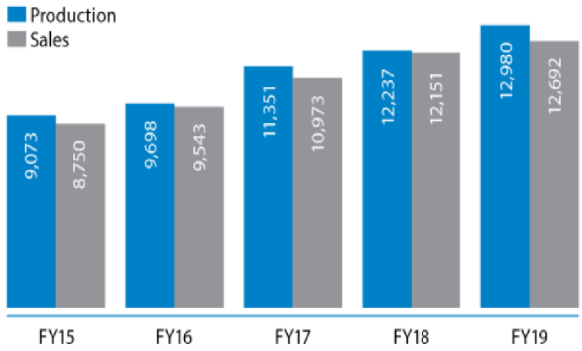
This study has been developed based on secondary **data** including literature review, journals, and multiple documents which discusses performance management and IoT. Collected secondary data has given the best idea about the role and importance of PM, and IoT exploring key features of these in organizational success [11]. The **qualitative analysis** of those second hand data helps in comparing the various roles of PM in management and boosting the employee motivation within the organizational boundary; on the other side it illustrates how IoT establishes relevant networking in the business procedures.

Discussion

Performance management of Tata Steel in India

Organizational success is undoubtedly determined by the PM; hence it maintains the communication in the business management procedures. Tata Steel is one of the huge organizations in India which has been preceding its business for years. In the Kalinagar plant, the company has invested approximately 22,000 core for the next fiscal year [3]. High and flat production management was the great target of the Kakinagarproject, where the company seeks its profit through cost management procedures. Investment amount has to be maintained through the creating more facilities in the business. Boosting employee motivation and employee retention are the significant approaches to continue the business procedures, as the employees are considered as the greatest asset of business. Tata Steel has concentrated on the well-being of its employees to continue the consistency in the business success. Recently, in the covid-19 pandemic time, the company has set a great example declaring the education facilities and aid for those families of the employees of the company who have suffered due to the Covid attack [2]. There is no doubt that the great decision will fuel the motivation of the employee, making them feel safe and giving assurance about their good future on behalf of the company.

Figure 1: production and sales of Tata Steel in last FYP (tons)



(Source: Inspired by [4])

It can be seen that the production and sales of Tata Steel in last FYP of Tata Steel the sales and production of the company has been increasing, where the total production of the company was 9,073 tons and sales was 8,750 tons in FY15, on the other side the production and sales increases as 12980 and 12692 respectively in FY19 [4]. The increase is production and sales are determined by the improvement of performance of the company.

IoT implementation in India

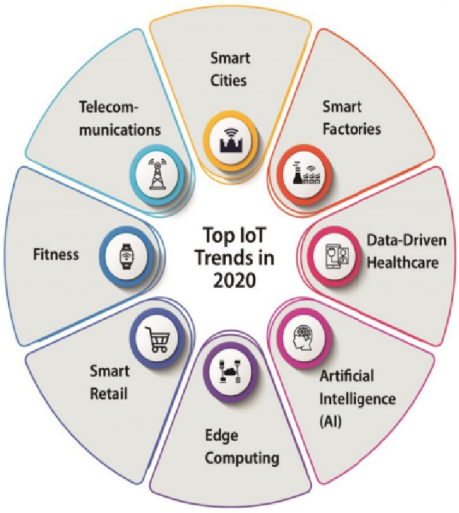


Figure 2: Top IoT trends in India (Source: Inspired by [5])

IoT introduction in India is concentrating on the next level industrial revolution in India, which is now is namely recognized as 4.0 playing the lead role evolving the IoT in the structure of the organizational management [5]. Digital India program is initiated through this technological implementation of IoT by the government of India in recent days [5]. The socio-economic development of India is now determining this unique innovative approach. IoT implementation within the organizational boundary of India is increasing in India over time, and the networking is becoming stronger over time through which the organizations are seeking their success. IoT networking systems are various types including objectives, electronic devices, tags which act like unified identifiers of organizational success with systematic approach. Through the smart implementation organizations are becoming stronger increasing their productivity and sales linearly. According to a report of 2020 about the expenditure on IoT by IDC, it has doubled the growth in 2021 tackling the crucial period of [pandemic with 11.3% CAGR [5]. Smart censoring in every kind of organization whether it is the business organization or the healthcare, the potential business success can be noticed easily. Creating the suitable web through IoT implementation, the organizations are trying to find organizational success in the pandemic period. Without the external inclusion and complex procedures the data are managed properly by the internet-enabled devices.

According to the report of June, 2020, the total investment for IoT was approximately USD 5Bn in 2019, and it was estimated that it will increase USD 20 Bn by the year 2023. The top industries where the IoT implementation can be noticed in a huge range includes fitness, smart retail, telecom communications, artificial intelligence, smart factories, edge computing, and many more [5].

Though the efficiency of IoT inclusion consists of huge efficiency in the organization management spreading necessary networking and managing the available data, the number of challenges is not any less. Weak authorization can act adversely; likewise interoperability and data integrity can also create gaps in the business procedure that is crucial to meet the success [7].

Conclusion

Observing the key features of PM and implementation of IoT in order to meet the organization's success, it can be said that without proper management any organization cannot meet the success. Hence, the entire framework is set under the organized parity of the performance. All types of business management such as cost management, time

management or employee management are specifically determined by the ultimate performance as well as the performance management. Whether it is about the employee retention or the captivation of the management procedures, the PM works as the conductor in each place similarly. In the same field of organizational success the IoT creates integration. AI-based technological implementations are increasing now-a- days where the organizational world is trying to seek the success of eliminating unnecessary haphazardness and obstacles to conduct the business. There are multiple examples that are getting success by the relevant implementation. The qualitative analysis in this article is hopeful in giving the best understanding about the PM and IoT in organizational success to the readers and the peer researchers.

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FACTORS RESPONSIBLE FOR BURNOUT IN SECONDARY SCHOOL TEACHERS IN RAJASTHAN(WITH SPECIAL REFERENCE TO JAIPUR DISTRICT)

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ABSTRACT

Individual burnout has been characterized uniquely in contrast to a few points of view. Notwithstanding, the meanings of burnout being a suffering condition of mental, enthusiastic, and actual fatigue initiated by persistent pressure prompting negative notions toward one's professional self-adequacy. Burnout is a multi-dimensional problem overwhelmingly went with distrust& inconsequence to one's work just by way of sensations of relational separation during work. The burnout is indistinguishably accompanying with psychological, psychosocial and somatic (PPS) disorders. Sociological and biological variables have added to the fast acceleration of burnout condition in the 21st century. Occupation burnout has been discovered to be an urgent hierarchical quandary diminishing position fulfillment and word related efficiency. Despite the fact that side effects and reasons for burnout have been discovered to be sensibly comparable to and uniform, research evidence recommends burnout disorder is more prevailing amongst profession involving human services such as teaching and healthcare service. If not distinguished and controlled early, teacher's burnout may come full circle in persistent uneasiness, and physical and substantial torments, just as occupation deserting. The teaching profession is getting more difficult and unpleasant, attributable to the sweeping changes forced by current neoliberal instructive and administrative frameworks in the types of intensifying workload and pressure on teacher. This paper highlights the factors responsible for Burnout in Secondary School Teachers in Jaipur district of Rajasthan.

Keywords: *Burnout, Teachers, Sociological and Ecological factors, Psychological, Psychosocial and Somatic disorders, Secondary School, Jaipur, Rajasthan, self-efficacy, pessimism and inconsequence, Teachin*

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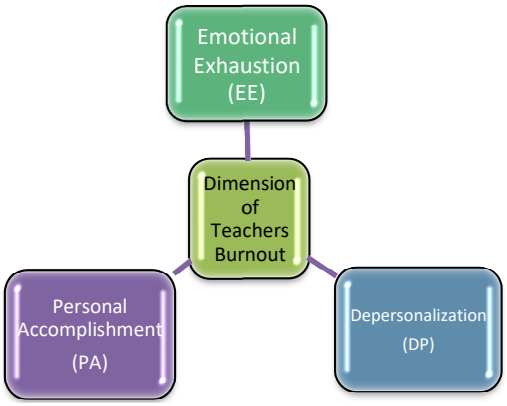
Introduction

Burnout is a delayed reaction to long-lasting emotional and interactive stressors at work, and is characterized by three dimensions: passionate exhaustion, depersonalization and diminished individual achievement. Enervation is depicted as the sensation of not having the option to offer anything else of oneself at anemotional level; depersonalization as an inaccessible attitude towards work, customers and associates; and diminished individual accomplishment as the sensation of not performing errands sufficiently and of being inept busy working. In general terms, burnout is the body's reaction to the disappointment of the adapting practices that individuals normally utilize to accomplish stressors at work.

Burnout equally influences females and males and the predominance rates range from 10% to half, contingent upon profession, evaluation tools and populace. In spite of the fact that it can happen in a scope of occupations, burnout has been found to happen generally in people-oriented professions like medication, nursing, social work, counseling and teaching.

Dimensions of teachers Burnout



Dimension of Teachers Burnout

Factors Affecting Burnout

1. **Factors affecting emotional exhaustion**

The factors affecting the emotional exhaustion are includes, student misbehavior, demonization, lack of collective decision making, work-load, pedagogical obstacles, Self-efficacy, Unfriendly emotions from judgments that teachers make about student behaviors, work pressure, classroom

environment and self-esteem, Changes in teacher's perceptions of classroom burden, student's troublesome behavior and autonomous motivation, disrespect, Teaching-related and non-teaching-related workload.

Student's troublemaking behavior is the most important factor in forecastingemotional exhaustion among teachers.

2. **Factors affecting depersonalization**

Factors affecting depersonalization includes, Lack of shared decision making and workload, Self-efficacy, emotional exhaustion, role conflict, self-esteem & school environment, personality types and emotional intelligence, disrespect and lack of sociability.

Self- efficacy can affect three dimensions of burnout but it is one of the most significant factors which lead to depersonalization.

Factors affecting reduced personal accomplishment

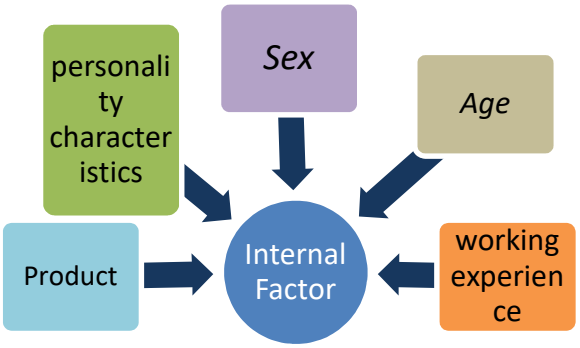
The factors affecting reduced personal accomplishment is inclined by the following factors: Student misbehavior and demonization, self-efficacy, teaching efficacy, self-esteem and depersonalization, personality types and emotional intelligence, lack of sociability, extraversion, agreeableness, conscientiousness and openness to experience.

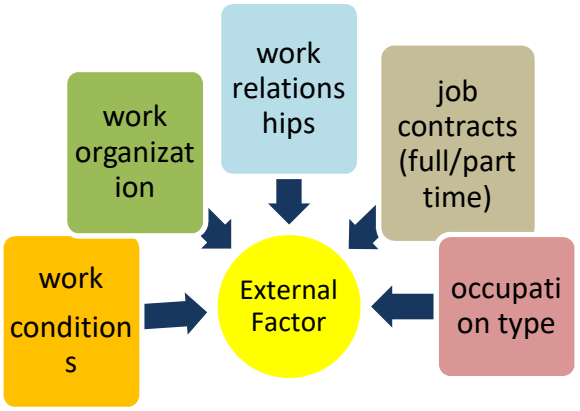
Burnout

The burnout factors may also be categorized in two categories;

1. Internal burnout factors
2. External burnout factors

The internal factors of burnout are feelings, personality characteristics, sex, age and working experience whereas external burnout factors are work conditions, work organization, work relationships, job agreements (full/part-time job), and type of occupation.The internal factors were expected to be the more significant than external burnout factors.





Internal and External factors

Jaipur

Jaipur is the capital of Rajasthan, is one of the major educational destinations in India. It is universally known as the "PINK-CITY". The Jaipur is situated at the doorstep of the NCR of India. It offers high potential for various educational developments.Numbers of government and private secondary schools were registered with Government of Rajasthan with inadequate numbers of teacher per school which ultimate resulted into job stress.

The Problem

Burnout is reflected in emotional enervation and lethargy, physical fatigue, lack of energy, pessimism, inappropriate anger, depression and lack of personal achievements. It is noticed that in Jaipur as well as in whole Rajasthan, teachers of secondary level school are also showing symptoms of burnout, which directly or indirectly affect their teaching performance which ultimately resulted into performance of the students as well as the respective school.

Significance of Paper

A teacher occupies a substantial place in the educational process. In fact, the effect of teachers on students cannot be assessed. A teacher, who is under going burnout, could be depersonalized, emotionally drained orperceive a lack of personal accomplishment, since burnout is viewed as a composite of depersonalization, emotional enervation and lack of personal accomplishment.

Consequently, an individual who is experiencing burnout may not be able to perform the role of teacher effectively.This paper will be beneficial for the teachers.They can be use the knowledge of factor responsible for burnout as well as a pro-active behavior for the burnout process, so that it can be overturned in the initial stages through effective managing strategies. The educational institutions may also develop their models to reduce burnout of teachers in their campus.

Review of literature

Review of related literature is presented below in brief to understand the activities undertaken so far in this regards.

Gregorio & Liston, (2018)[1] in their study observed that the digitalization of education has also produced new transactional and administrativetensions for teachers. Although the occurrence and spread of digital technology have offered appealing solutions for availability and ease of education but the rise of electronic learning platforms has deepened pressure on teachers on these two grounds.

First, teachers must be determinedly on notice for e-mails and messages from students, colleagues, and administrators. This has added work on teacherseven when they are not at work.

Second, whereas teachers are now expected to have extensive technological skills, teacher training programs, typically do not offer, sufficient technological and information literacy training.

According to **Jiang (2017)**[2], teachers' occupation stress can also lead them to burnout, that is, indolence, slackness, and lack of professionalism and unintentional improvement for teaching quality. This phenomenon is called job burnout..

According **to Wang, Wu et al., (2015)**[3]in their study report highlights that it is possible that the teacher's occupation stress is more likely to harm their physical and mental health, thereby degrading their teaching quality and behaviors and quality of life.

Durr et al. (2014)[4]in their article stated that teacher's burnout, which is primarilyencompassedwith the depletion of mental and emotional resources, may lead to a long-lasting depreciation of instructional quality, professional development and student achievement.

Roloff& Brown, (2011)[5]in their article specified that burnt-out teachers feel a sense of diminished personal value and as though they are incompetent in their careers. According to them, burnout is caused by an interaction of environmental and physiological factors.

According to **Shukla & Trivedi (2008)**[6], burnout is reflected in emotional tiredness and lethargy, physical fatigue, lack of energy, psychosomatic illness, increased alcohol and drug consumption, pessimism, inappropriate anger, despair and lack of personal achievements. In their article they also highlighted that teachers are also showing symptoms of burnout, which directly or indirectly affects their teaching ability &performance.

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Amen, (2006)[7] in his study report suggested that teachers may also take steps to avoid burnout. For that they may decline some requests from family, friends, co-workers, and administrators. Teachers should only accept the tasks that are related to their personal or professional development.

According to **Garmon (1997)**[8]**,** the perception of high standards is necessaryfor school's reputation. For that, teachers are encouraged not to "fail too many, but keep the standards high". Teachers are also communicated to expect and demand more than has ever been demanded before, but to be sure that all students achieve superiority. According to him, this is an impossible task which sets a teacher up for long-lasting stress.

Maslach (1984)[9]in her study defined burnout as the defeat of apprehension for the people with whom one is working. Further, she explained burnout as the syndrome of emotional enervation and pessimism that results from interpersonal contact. She also states that for the people who work continuously with some other people, long term pressure can be emotionally draining and can lead to the burnout

Freudenberger (1977)in his article describes burnout as physical and emotional tiredness resulting from excessive demands on energy, strength or resources. According to him, when hindrance, tension or anxiety persist or increase, stress develops into a syndrome labeled as burnout.

Methodology/Approach

A systematic review was undertaken of teachers and burnout related literature in educational and management journals. Journals appraised included all those in the Education and allied subject area, the journals of educational management and selected papers of eminent educationalist as well as research done in the field of education. Government policies and plan was also taken into consideration.

Future scope

Ministry of Education may design their plan and programme based on the factual requirement and the support from the education department of the state so that stress observed by the secondary school teachers could be minimized or eradicated.

Government may prioritize their activities and may identify the much needed requirement of that secondary school teacher which ultimately resulted into quality education and output. This process may be replicate in other department also.

Conclusion

This paper has summarized a broad range of empirical research and related literature. The purpose of this paper is to summarize the starting points including new effortsfor better understanding the links between Teacher and Burnout. There seems a confidence that both technical support and unrestricted work provides a bridge between Teacher and Burnout status.

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[8]*Garmon, J.F. (1997). Improving faculty morale improves the value of a college, Community College Week. p.4.*

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HIDDEN POWER OF BEING SIMPLE: LEARNINGS DURING COVID 19

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ABSTRACT

Since COVID 19 emerged across the globe it was observed that major mental health outbreak effects were spreader everywhere. It was not restricted to a particular culture, race, region or religion. It has left effects on everyone equally. Suddenly the call for mental health professionals was at its peak, no one has seenit like this ever before. But as everything in life leaves us with lessons. Pandemic has taught us both positive and negative ones. Lot of research has already been published citing the negative effects of living and surviving this pandemic. Here is an attempt to look at the other side and to focus on what all went positive during this period. We conducted a focus group discussion to understand its impact on the psychological health of undergraduate students. After doing thematic analysis three interrelated themes emerged: Self Care, Work and Realization along with several subthemes. In conclusion, these findings can be used to design mental health first aid modules and to do more research to understand the positive side of this pandemic

Keywords: *COVID 19, Psychological Impact, Resilience, Work, Self Care*

Introduction

In late 2019 a Coronavirus outbreak took place in China and in a few months it spreaded all over the globe killing millions of people. On 30 January 2020 the World Health Organization (WHO) declared the outbreak of COVID 19 as an International Public Health Emergency. This pandemic has not only made us weak physically but in a much larger way impacted us Psychologically as well (Xiang et al, 2020). It has swept away the world economies with its effects which are mostly negative and this negative impact has spreaded not only to frontline workers and patients but also to others whether it is in job sector where people are losing their jobs with no foresight when they will be employed again, fresh graduates are facing a bleak future with no estimate of when they will get their first jobs; in schools and colleges students are not able to anticipate when they will be back to their classrooms and will be able to enjoy their normal lives, play with friends, go for school trips etc, older age groups are facing issues in their own ways, not being able to meet family or friends and self-help groups, not able to go out for walks is affecting them tragically. Corona is not treating any socioeconomic strata in a different way. It is impacting everyone rich or poor, children, adults or old people in the same way by putting everyone at equal risk of getting infected with the virus.

Symptoms observed were high fever, sore throat, problems in breathing etc. In all these last month's everyone has seen how lives have changed drastically because of a pandemic. Everywhere one can find soaring rates of virus, it is not only making people weak physically but is also strongly impacting people psychologically.

Numbers are available now which suggests that common people and frontline workers are worst affected and are in much need of psychological help to combat stress (Kang et al, 2020) (Qiu et al, 2020).

Various factors can be attributed to factors like gender, social support, media exposure, isolation, instances of experiences with infection (Brooks et al, 2020) (Li et al, 2020)

Not everyone realizes it but to cope with it and to come out of this we need to have a positive outlook so that we can come out of this with a positive and healthy state of mind.

Therefore, this study is designed to identify that in spite of all negative activities, news, perceptions around is there still a positive ray of hope existing and guiding lives for a better future

Participants and Data Collection

Focus Group Discussion Method was used with a group of 12 undergraduate students from University of Delhi. It was facilitated by the author who is trained in conducting Focus

Group Discussions and all participants were purposely chosen on the basis of experience with the author and were sent an invitation letter to accept and attend the meeting. As in a pandemic situation it was not possible to have a face to face focus group discussion so a meeting was called on zoom on a fixed time, all participants joined and were debriefed about the topic and instructions were given clearly in the preferred language.

Procedure and Topic Guide

Topic has been developed after a thorough review of literature and realization that pandemic has led to a lot of focus on negative things, perceptions and happenings but the best part out of it which very less people are focusing on is that in spite of this there is a positive sense of being which is letting many people to have a hope and to look forward that not soon but one day everything will be fine. This became the groundwork for the idea to work on this topic and participants when invited are very much enthusiastic to participate in this. Experiences have been mapped by understanding perception of the narratives told. Critical Incidents were carefully noted down and effort was made to understand the source of positivity coming from and also to understand different perspectives related to it.

Methodology

Focus Group Discussion, data collection and analysis were concurrent. It was continued until data saturation was achieved and hence a lot of perspectives, ideas, critical incidents and suggestions came into light. Hence a rich raw data was collected which was later analyzed with the help of thematic analysis and three (3) major themes were emerged which comprised of (15) sub themes in total

Lot of responses were received like being hopeful, coping in a healthy manner, renewal of relationship with family, being more self-dependent, new found hobbies, constructive coping, hygiene conscious, gratitude, family collective activities, more focused towards work, learning oriented- focus towards online courses more, self-care- meditation, reading books, writing blogs, life more routined, more scheduled and productivity increased, realization- it's not a rat race, focus more on yourself, save yourself first, definition of productivity changed, comfort with technology ,less expenditure on luxuries, health cautiousness

Thematic Analysis was done and it was found that three major themes emerged out of it- Self Care which comprises of involvement in Hobbies (art, workout) , New Habits (art, writing blogs, meditation, Hygiene Conscious); Second theme identified was Area of Work it has sub themes like discipline, productive, Comfort with technology; Last theme identified was Realization it has following sub themes To slow down, Stay hopeful, Constructive Coping, Family Matters, Gratitude, Simple Living.

Results

Focus Group Discussion was done with 12 Participants, all were undergraduate students. Distribution of male and females was equal. The three major key and inter related themes identified were : Self Care, Work and Realization and this helped in understanding the positive perception that participants were having or trying to work on it to maintain their mental health

Self Care

All participants unanimously responded that earlier in pre covid times they never used to engage and realize the importance of self-care. Fast paced life, coming to college, going back home, travelling, socializing on weekends never left them any opportunity to work on self- care and its realized now but it was impacting both physical and mental health. One of the participants said that this realization was late but being quarantined at home made many people cautious and most importantly value it. Many of the participants agreed with this. After analysis was done following sub themes emerged:

Hobbies

Majority of the people agreed that because of the fixed routine schedule they were not able to focus much on their passion turned hobbies like drawing, coding, reading books etc. But quarantine has given enough time to complete their coursework diligently and at the same time to engage in their hobbies too. Many

participants told that they found new hobbies like gardening, sports, reading books, learning music etc

Meditation

Few participants were doing it earlier but since most of them were feeling anxious, uncertain and stressed about what future has in store for them and the many started practicing it and a common response was that they studied about it thoroughly understood its scientific importance and then chose to do it, some of them find it difficult to do but in sometime they got eased to do it and effects were seen. Most of them said that it helps in calming down and now they are doing it on a continuous basis

Physical Activity

This became a sub theme because very few participants are doing it but effects are clearly seen on mental health in other sub themes and hence became an important source of information in this discussion. Participants shared that engaging in physical activity helps in regulating mood and calming down one's self and hence act as a major stimulator in which people are finding their "Me time" and feel a sense of calmness once again as experienced during meditation. As reported by few participants doing any kind of physical activity be it playing sports, doing yoga or doing aerobics it helps in relieving stress which most of the people were experiencing now a days

Writing Blogs

As participants were undergraduates it was found that many of them were having interests in many creative things but most commonly most of them were engaged in Blogging. Participants were writing blogs in different areas like mental health, how to cope with stress, managing at home, breaking stereotypes to name a few and this has again helped them in breaking their usual routine and to experience a new world of their own and one of them said that it's a great feeling to be of some help to someone

Hygiene Conscious

This is the subtheme on which every participant agreed and responses received were that in pre covid times hygiene was not taken seriously, masks were used but for protecting ourselves from pollution, dining out used to happen very frequently and hygiene was not part of the thought process while eating at a street vendor. Now face masks and hand sanitizers are part of our normal routines and one of the essentials that can't be missed on. Everyone was of the opinion that it took a pandemic to realize the importance of being hygienic but now as it is a habit it is the positive addition to our behavior

Statements supporting Theme "Self Care"

"Although it took us a pandemic to realize that hygiene is important, but it's good that people are now following it"

"I am an artist now since college is closed I get lot of time for my art and I am very grateful for that"

"Quarantine has made us realize to be a better human. For example, Doing household chores, being there for each other and experiencing that we are each other's support system"

"Self care was much neglected earlier, people who never knew what are their hobbies are now having list of hobbies and activities to work on, i am also one of them, enjoying lockdown period"

"Lot of nutritious food we are taking now, everyone takes turmeric milk, new addition to routines"

"Self Care is important try to have hobbies offline"

"This time has taught us self - dependency, it made us realize that you should know everything"

"It is important to do self-care, we took it for granted earlier, pandemic made us realize its importance"

Work

This is the second major theme which emerged from the data as participants were concerned about their classes that never took place because of pandemic, the conversations that they used to have professors, the opportunity to engage in research work and the summer holidays before beginning of next semester that were used for gaining practical exposure into the theoretical part that they get acquainted with in their classrooms. Many participants are doing some work of their own and as it requires going out it was not a possible option in quarantine which affected a lot of participants and this has led to experiencing of stress and uncertainty on one hand but on the other hand it also helped in finding a new set of positive ideas to explore and to work upon

Disciplined Routine

Participants reported that even though college is closed they still have a routine to follow. As everyone is at home and parents are very enthused and are following a routine, they are making sure that participants follow their routine too which is good learning. As participants said that in this time with no goals earlier on how to go about it parents really helped in maintaining a routine for the day which is keeping them active like getting up in morning, doing work, having meals together etc and most of them agreed that because of this family ties have strengthened

More Productive

Every Participant in one way or the other has agreed to this sub theme that quarantine has made them more productive. Productivity in terms of working on a task, being busy with their hobby or learning something new. As distractions were less in terms of going out, meeting people, travelling etc. Not much time wastage is their because of less distractions and hence this period has proved to be much more effective

Comfort with Technology

This is again one of the sub themes on which almost all the participants agreed that this is the biggest learning for everyone in this pandemic as you can't go outside and everything is suddenly digital now from taking classes to submitting assignments to giving exams for the participants. Here participants shared many experiences in which their parents who never used to be very comfortable with technology have learned it and are using it efficiently now. Some of them told me that their younger brothers and sisters who are in school have learned so much now about writing homeworks, operating zoom for classroom learning etc. Hence quarantine has proved to be a good learning period for every age person today

Statements supporting Theme "Work Area"

"Everything has turned online suddenly like online internships, lecture, submissions in both metro and non-metro cities"

"Work transitions has happened, earlier stadiums are booked for an event for certain no. of people now everything has shifted to zoom and it is working in an amazing manner- since no costs of travelling or taking out time"

"More productive now as instead of reading books now I am doing MOOC Courses and learning from across the globe, it's a new experience and completely enriching"

"This quarantine has made me actually discover my new spiritual self. I keep on reading books and learn new things. I am really enjoying this time to getting to know myself better"

"Work pattern has changed now. Earlier I used to go for internships and have to be there from 9 to 5pm, in spite of how much work I am doing and now I am given a task to complete, and if I complete it earliest I save rest of the working hours to me, it has increased my efficiency"

"I realized that it doesn't have to be a rat race, be mindful and do only which you are capable of doing"

"Definitions of productivity has changed and we should think and work accordingly"

"Now students from earlier classes are very comfortable with technology, we are thinking for a better now and reaching for a better connectivity "

"Earlier there used to be many distractions in our routines as we can go out anytime, with anyone, lots of events happenings around, but now with none of this getting lot of time to work on productive things"

Realization

This is the last theme which emerged from data and has variety of themes in this and this theme talks about how quarantine has made them realize so many things ranging from self-love, avoiding competition as a rat race and to be productive at your level, how one can enjoy simple living and lastly to practice gratitude

New Productivity

Every participant reported that whenever they were scrolling through social media or while getting connected with people it was felt by everyone that since they are not participating in this race they are left behind. It is a feeling which was either experienced by some participants earlier and they surpassed it and with some it was experienced even at present and they are realizing that it has no end. If someone else is doing so many things it doesn't mean that one has to do it too. As the time changed, the definition of productivity has changed too.

Gratitude

Few participants reported that lower socioeconomic strata were the worst hit in this pandemic. As many of them were not paid, rest of them migrated back, many lost their lives and this made them realize one thing that having food three times a day, having roof over head and being with family is the biggest thing now a days is one of the greatest blessings in this situation

Simple Living

Participants reported that if someone would have asked them to live like this- being at home, not stepping out for more than 3 months, not able to travel, not able to socialize and dine out. This would have been incomprehensible to imagine. Most of them agreed that we have survived this and at the same time made them realized that even in this globalized world one can live a simple life

Constructive Coping

As some participants are still midway for this some of them gave very positive responses which led to the formation of this sub theme which points out the way coping is being done during these times. There are two ways of coping either you can avoid the problem or situation or you can approach the problem and solve it from the roots so that relapse will not happen, as pandemic has made one realize how to practice self-love it has also made the participants realize that avoidance is not the right way to solve an issue and hence problem should be approached and solved in a constructive manner

Statements supporting Theme "Realization"

"As people are now living with the family, this time has given us opportunity to work on our relationships again, sometimes good sometimes bad, but it's worth it in the end"

"It doesn't matter from where you come or what is your status our primary concern is that our basic necessities are fulfilled and our family is safe and I am grateful for that"

"Family has come much closer, earlier only mother and grandmother used to decide that what will be cooked for dinner, now whole family is participating in this"

"Everyone is taking part in doing household chores, no gender role work thing exist now"

"Less Greed among people, instead of earning lot of money and luxuries now everyone has this thought of just to have work"

"Earlier the sacrifices that parents used to do now children are also doing, they are realizing difference between necessity and luxury"

"Earlier on weekends we used to go to malls for shopping, now we have realized that they are not essentials and I can survive because of that"

"We can cook and bake everything at home, it is a new found realization. People are baking as it helps in relieving stress"

"Good to see flexibility that people are using for coping in their professions by making masks and sanitizers, lot of opportunity has also opened for social entrepreneurships"

Discussion

COVID 19 has impacted mental health of the general public, patients, frontline workers, older age people (Q.Chen et al, 2020) (Yang et al, 2020). Studies have suggested that a huge impact on mental health can be seen in college going students in the form of anxiety, worry, stress to name a few (Mei et al, 2011). Various

studies have been done which talk about the effects of viruses on studies of college students (Cornine et al, 2020) and concern about finding employment in future (C.Wang et al, 2020). As social distancing has now entered our lives this could also be a major reason to feel the impact on mental health as lives and routines changed drastically in this pandemic.

Media is also playing a prominent role in this as all day overwhelming and sensational headlines and news keeps flashing about the no. of deaths, increasing no. of people getting infected and erroneous news, it has been found in researches that it has led to anxiety and fear (Ayittey et al, 2020)

As everywhere researches are being done to understand what all negative impacts people are facing because of pandemic this research aimed at focusing that since it has been few months in quarantine an effort was done to understand how people still perceive living in this pandemic

But no qualitative study has been conducted uptil now to understand the pandemic experiences students are going through. Main goal of this study is to understand the perceptions college students are having during pandemic situation and how in the middle of being quarantined students are using positive thoughts to deal with the situation

Results have shown that students are still hopeful, using this time to understand themselves, developing new hobbies, doing online courses and webinars, realizing that they should be self-dependent and apart from studies focusing on other areas too. As everyone was sharing their experiences and how they are coping it was found that being quarantined at home was tough initially but after a point of time resilience developed and they started finding healthy ways of coping

Focus Group Discussion was ended with following insights on what all can be done more and to be shared with other people too for giving support to their mental health, to practice Self-Acceptance, have fixed time for watching news and from a credible source, keep exploring new hobbies, if needed seek professional help, stay resilient as this too shall pass, connect with friends and family, practice meditation to name a few

Limitations of the study are that collecting data with a mixed method approach could have been helpful in generating more data so that results could have been generalized. Data should have also been collected from the neutral perspective so as to understand both positive and negative experiences college students are facing. Future researchers can do mixed method research with different populations and across generations too. Understanding positive and negative impact will help in gaining understanding of the bigger picture existing in society presently and can act as a guide for mental health professionals to develop insights and deal accordingly.

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UKRAINIAN CRISIS AND GEOPOLITICAL DEVELOPMENTS IN RUSSIA AND WEST

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ABSTRACT

The purpose of this research paper is to take a look at Russia's and America behaviors and movements within side the Ukraine disaster in an effort to apprehend why the warfare led to a geopolitical strength struggle. Since the modern-day debate is packed with biased facts and propaganda, these thesis pursuits to take a look at the behaviors and movements from each aspect objectively to get complete information in their involvement within side the disaster. It is a desk-take a look at for the reason that records are accrued from books and articles. It is qualitative because of the reality that it investigates this unique warfare with the aid of using the use of numerous reasserts to benefit an in-intensity information of a two-sided angle. The technique textual content evaluation is used on 4 selected articles with a purpose to be located in an effort to discover the underlying motives of Russia's and America ongoing involvement within side the disaster. It is an adductive reasoning while the principle offensive realism is used because the theoretical lens in an effort to spotlight the maximum vital facts of the selected articles with a purpose to be examined. The 3 class's diplomacy, financial system and navy were carried out to define Russia's and America underlying motives in their behaviors and movements within side the Ukraine disaster in an effort to solution the studies questions. The end result indicates from an offensive realism angle that Russia and America are concerned within side the disaster because of their strategic interest to dominate the Black Sea Region for private gains. It is proven that each state acted upon self-interest to benefit greater strength and to lesser their rival's strength in an effort to avoid each other to grow to be a territorial hegemony within side the Black Sea Region. It is recommended that the final results of the Ukraine disaster might have been one of a kind without their involvement.

Keywords *– Black Sea Region, international security, Ukrainian crisis, US, Russia, Power*

Introduction

Again, and once more though Ukrainians lost their ancienter act of declared independence of twenty-two January and 1 November 1918, 15 March 1939 and 30 June 1941 they persevered their battle for independence. At the idea of this battle, however, the Ukrainian human beings lay a deep cognizance in their past, their countrywide and ethnic individuality, and their national rights, which in the long run caused Ukraine's independence on 24 August 1991.

As the nation is interdependent with regular interactions primarily based on an intensive and carefully formulated overseas coverage which seeks to sell and defend the national Interest, Ukraine after independence tried to articulate its national interest to offer a conceptual foundation to its independent foreign and protection coverage. But the mission of defining and articulating the country wide pursuits had been proved hard for Ukraine. Lacking a single unified country wide 'outlook' and system of values and pursuits, in conjunction with a deeply divided society in phrases of political, monetary, ethnic, social and non-secular foundation, Ukraine was stuck in a hard situation. Thus, because gaining independence in 1991, Ukraine has been a nation in transition and its miles present process intense monetary crises, and dramatic political transformations. But these days Ukraine is not a centralized authoritarian regime. It is making an attempt to grow into a democratic kingdom. Adopting the formulation of 4-pronged transition of state and state building, democratization, mercerization, and above all, the coverage of non-alignment, Ukraine below the management of its first President Leonid Kravchuk maintained its independent sovereign stand within side the global sphere despite its dependence upon the West for political help and upon Russia for monetary development. Then, thru the success transition to democratic power through the presidential election of 1994, Ukraine below the management of Leonid Tuchman brought a sensible technique to its overseas coverage and made a complete attempt to reshape its geo-political surroundings through a coordinated and systematic method to steady a protracted term, collectively useful and collectively

reinforcing connections with Russia and the West. As a result, Ukraine's overseas coverage was carefully watched with interest through the rest of the world. Not only was it a degree of the state's democratization however within side the West there has been developing interest in Ukraine as a strategic ally. Europe and America had paid unique interest to Ukraine, with the special agreement signed among NATO and Ukraine, even as Russia had dropped a number of its rhetoric and commenced to deal on a more same basis with Ukraine with the Friendship and Border Agreement signed in May 1997.

However, because of political infighting, corrupt vested interests, loss of domestic reforms and continual troubles with Western investors, it has become obtrusive through the end of 1997 and -early 1998 that Ukraine did now no longer stay as much as the expectancies and hopes for the tempo of transition within side the country. By the way, those domestic troubles increasingly manifested themselves in Ukrainian foreign policy. Viewed from this perspective, the Kuchmagate disaster, the delegitimisation of the oligarchic elite, and fragility of Tuchman's geopolitical stand had produced a critical home and overseas coverage disaster. At any such juncture, on the only hand, the growing political disaster in Ukraine in early 2001, after which the terrorist assaults towards the U.S, and the ensuing dramatic extrude of global putting did now no longer matched with the trend that had emerged earlier. The as soon as promising partnership among Ukraine and the West got here to a standstill. As Ukraine is of extraordinary importance for European security, the West however, endured its Ukrainian policy to convey it lower back to its sphere of influence.

But on the alternative hand, Russian-Ukrainian relationship started out to take a brand-new shape. While Ukraine-West relationship become struggling Moscow won maximum out of Ukraine's weakness. Russia's provider of friendship to embattled President Tuchman, who become desperately seeking out political support, unfolded a new option in in Ukraine-Russian relationship. The growing political rapprochement, army cooperation and Russian financial presence in Ukraine by the way cleared the manner for a shift closer to Russia in Ukraine's 'multi-vector' foreign policy.

Objective of the Study

• Keeping in thoughts the want of an analysis of the "evolution of Ukrainian foreign policy"in a chronological order, the prevailing research has made tries to make a theoretical evaluation of "Ukraine's foreign policy"- close to the character of its state sovereignty, the political system, and the domestic compulsions. Further, an evaluation may be made with the aid of using giving a comparative evaluation of Ukraine's extrade of priorities from West to East and vice-versa and the influences upon its ambition of Euro-Atlantic integration.

• Efforts had been made to pay attention at the role of the Ukrainian public and elite's opinion within side the matter of formulation of Ukrainian foreign policy. The observe targets to mention numerous questions concerning Ukraine's non-bloc status and semi-alignment, demanding situations and possibilities to Ukraine's geopolitical options, Ukraine's role within side the new European safety structure etc. Finally, the goal of the proposed study could be to make a chronological observe of the evolution of Ukraine's overseas coverage in terms of the West and NATO, on the one hand, and closer to Russia and CIS, at the other, at some point of the period from 1994 to 2004.

Hypothesis

1. An acute requirement of aid, help and technology has been a guiding issue in shaping Ukraine's foreign policy.
2. Ukraine's failure to reduce its dependence on Russia for energy supply and marketplace for its merchandise in addition to the presence of a huge Russian speaking people on its territory have created a compelling state of affairs for it to keep close relations with Russia.
3. Due to its geo-political state of affairs within side the heart of Europe and the choice to be included into the European economic, political and navy structures, and the compulsions of preserving relations with Russia, Ukraine's policy priorities have alternated among the East and the West.

Methodlogy of the Study

The interest is to carefully read the specifically selected material about the crisis so as to get essential information. Hence, this research paper may be a qualitative desk-study with the tactic text analysis since the aim is to travel into depth of the two great powers behaviors and actions by cautiously reading the chosen materials from different perspectives. This might hopefully highlight their specific characteristics and their relationship towards one another within the crisis. Seeing that the Ukraine crisis isn't directly observable due to its complexity and altering formulation through the years, it thus requires one or several theories so as to make a deeper understanding of the two actors' behaviors and actions. Hence, the idea, offensive realism, are going to be presented within the theoretical Research.

Related Works

Geo-Political Importance of Ukraine The look of Ukraine as an unbiased nation within side the geo-political area of Central and Eastern Europe is of super importance for European safety, and improvement of nearby multi-lateral relations. Its unbiased life creates a stabilizing geopolitical distance among Russia, on the only side, and East-Central and Western Europe, at the other. It is a essential determinant within side the formation of the destiny Russia and has the efficiency for severe ethnic struggle and separatism. As it serves as Moscow's 'bridge' to the West, a 'buffer' towards invasion from the West and controls key positions in Eurasia, it will become Europe's 'Linchpin' and 'strategic pivot'. This predominantly protecting geopolitical function of Ukraine within side the tricky surroundings of Central and Eastern Europe, however, created complicated state of affairs for Ukraine to take initiative at the established order and upkeep of equilibrium within side the continent. It has confronted the trouble of geo-political orientation, that's the defining characteristic of its foreign, and safety coverage at some stage in the years due to the fact independence.

Ukrainian Foreign Policy towards Russia However, Russo-Ukrainian members of the family moved right into an extra sensible aircraft with the reelection of Tuchman as President. Tuchman' s guidelines contemplated his information of seven home dynamics and had been capable of mirror his home achievement to members of the family with Moscow. Ukraine's members of the family with Russia essentially developed round the difficulty of the inviolability of Ukraine's borders, the destiny of Crimea, Russians in Ukraine, the Black Sea Fleet and Kiev's strength money owed to Moscow. Its relation with the CIS remained positive. Ukraine confirmed its willingness to transport in the direction of extra integration with Russia and the CIS however it underlined its competition to political and army integration.

As Tuchman understood that the capacity to keep Ukraine's independence essentially lies upon its monetary reform and improvement, his management made efforts to restore monetary members of the family via pleasant members of the family with Russia. Ukraine on twelfth August 1994 signed a Treaty on Friendship, Cooperation and Partnership with Russia and facet-via way of means of-facet have become a promoter of monetary cooperation in the CIS. In January 1995, for the established order of a joint mission Financial Industrial Conglomerates (FICS), each Ukraine and Russia sanctioned a presidential decree. In February 1995, Ukraine signed a bilateral Free Trade Agreement with Russia. But Ukraine averted the treaty on 'Customs Union', which become signed via way of means of Russia, Belarus and Kazakhstan in January 1995, fearing Russian dominance within side the Union.

To alleviate monetary pressure, Ukraine, but remained worried with more CIS political and army integration. Accordingly, Tuchman more advantageous "Ukrainian cooperation with Russia and" different CIS states in army-commercial sphere. He additionally "signed Customs Legislation and joined the CIS Common Air Defense Structure in February 1995." Later on, in May 1997, Russia-Ukrainian negotiation and eventual rapprochement within side the Black -Sea-Fleet-Accord (Shirr 1997:33) occurred so that it will make stronger bilateral members of the family. Thereafter, Ukraine determined to set up coordinated structural coverage within side

the monetary sphere for the improvement of joint protection and area projects, the advertising of Russia-Ukrainian economic commercial organizations which includes the constructing of a Russia Ukrainian satellite TV for pc release vehicle, and the established order of a joint strength concept, that can sell the deliver and delivery of Russian oil and gas.

Though Ukraine moved to pursue a pro-Russian overseas coverage while it become turning into increasingly lonely at the global scene, it couldn't surrender its imaginative and prescient of Euro-Atlantic integration. Therefore, it is making an attempt to restore the harm because of its failure to reform itself. The sending of 2000 Ukrainian troops to Iraq in summer time season 2003 to function peace-maintaining forces become a try on this path to earn good-will in Washington and to solidify Ukrainian-Polish-NATO-US members of the family. The opportunity is that the Iraq problem might also additionally sell Ukraine's probabilities to restore the broken members of the family with the West and can assist to benefit NATO club within side the 1/3 spherical of growth on the 2007 summit. However, a whole lot relies upon Ukraine's capacity to boost up home reforms, accelerated transparency and openness of its political and monetary systems, and the country's deeper integration into global and local monetary, political and protection structures. Ukraine's achievement and capacity to supply on those troubles in tom will expand its inner electricity and global standing.

Ukraine's Foreign Policy towards the West The Euro-Atlantic integration of Ukraine, which changed into initiated via way of means of President Leonid Kravchuk, changed into similarly carried ahead via way of means of Leonid Tuchman thru his pragmatic coverage measures of preserving stability among the West and Russia. In the autumn of 1994, Tuchman introduced the lengthy awaited programmed of liberal monetary reform and acceded to Nuclear “Non-proliferation Treaty” (NPT) in December. These steps, on the only hand, helped to crystallize the system of a brand-new Western coverage in the direction of Ukraine, and however contemplated Kiev's reaction to the brand-new Western stance in terms of Ukraine. The choice on NATO's eastward growth taken in advance in December 1994 similarly raised the Western stake in Ukraine and triggered a boom in political guide and monetary help to Kiev.

• During 1995-96, Ukraine made critical steps in its quest to sign up for Europe. It joined the Council of Europe and the Central European Initiative. Membership of the EU and WEU and the Central European Free Trade Area have been brazenly proclaimed as strategic four purpose via way of means of the Ukrainian leaders. But, Ukraine's family members with the EU and WEU have remained some distance much less superior than people with NATO. In September 1995, Ukrainian officers commenced to speak approximately growing a 'unique partnership' with NATO which could pass similarly than the binds provided as a member of 'Partnership for Peace (PFP) programmed. Ukrainian negotiators requested for a unique 'partner status' in NATO, to encompass the whole thing however an 'article-S' safety guarantee (Latrobe 1996:148). The formidable draft settlement referred to as for the outlet of a unique NATO facts centre in Kiev. Simultaneously, with a view to hose down Russia's objections to NATO growth, Ukraine had careworn that any growth ornate had to consider Russia's critiques and have to be evolutionary in nature without stationing nuclear guns within side the territory of recent member states.

Acknowledgement

In our research, we needed data and information for authentic sources to get reliable statistical results and carry out necessary comparative studies. We are obliged to the official websites such as the department of state, Esri and Delorme which are useful for us to collect the data.

Study Area

In our research, we wished to observe significant areas of nations which was involved in the Ukrainian crisis, The Ukrainian crisis is that the collective name for the 2013–14 Euromaidan protests related to emergent movement of integration of Ukraine into the ecu Union, the 2013–14 Ukrainian revolution and therefore the ensuing pro-Russian unrest.

The crisis began on 21 November 2013, when then-president Viktor Yanukovych suspended preparations for the implementation of an association agreement with the ecu Union. the choice sparked mass protests from proponents of the agreement. The protests, in turn, precipitated a revolution that led to Yanukovych's ousting in February 2014. The ousting sparked unrest within the largely Russophone eastern and southern regions of Ukraine, from where Yanukovych had drawn most of his support. Subsequently, an ensuing political crisis developed after Russia invaded said regions and annexed the then-autonomous Ukrainian region of Crimea in March 2014. As Russia's invasion emboldened the Russophone Ukrainians already in upheaval, the unrest within the Donetsk and Luhansk oblasts evolved into a war against the post-revolutionary Ukrainian government. As that conflict progressed, the Russophone Ukrainian opposition became a pro-Russian insurgency, often supported and assisted by the Russian military and its Special Forces. A map of the 2014 pro-Russian protests and unrest in Ukraine, by oblast. Severity of the unrest, at its peak, is indicated by the coloring. 'RSA' indicates 'Regional State Administration', the name for the governments of the oblasts (regions) of Ukraine.

FIGURE 1- By Author- RGloucester

Crimea

source–
"https://www.vox.com/2014/9/3/18088560/ukraine-everything-you-need-to-know

Crimea is taken into account by most of the world to be a region of Ukraine that's under hostile Russian occupation. Russia considers it a rightful and historical region of Russia that it helped to liberate in March. Geographically, it's a peninsula within the Black Sea with a location so strategically important that it's been fought over for hundreds of years.

From Ukraine's 1991 independence up through February 2014, it had been a Ukrainian region that had special autonomy and enormous Russian military bases (kind of like how the US has bases in Japan and Germany). Crucially, Crimea spent a really while before 1991 as a part of the Soviet Union and therefore the Russian Empire, and most of its citizens are Russians themselves. In late February, a couple of days after Ukraine's pro-Moscow president was ousted from power, strange bands of armed gunmen began seizing government buildings in Crimea. Some Crimeans held rallies to point out support for the ousted president and, in some cases, to call to secede from Ukraine and re-join Russia. The bands of gunmen grew until it became obvious they were Russian military forces, who forcefully but bloodlessly brought the whole peninsula under military occupation. On March 16, Crimeans voted overwhelmingly for his or her region to become a neighborhood of Russia.

Most of the world sees Crimea's secession vote as illegitimate for a couple of reasons: it had been held under hostile Russian military occupation with no international monitoring and lots of reports of intimidation, it had been

pushed through with only a few of weeks' warning, and it had been illegal under Ukrainian law. Still, legitimate or not, Crimea has effectively become a part of Russia. The US and European Union have imposed economic sanctions on Russia to punish Moscow for this, but there's no sign that Crimea will return to Ukraine.

Data Collection

To conduct our study on affected areas of world after the Ukrainian crisis and geopolitical development in Russia and West. However, also the analysis, is intended to answer Russia's actions and behavior in the Ukraine crisis and US actions and behavior in the Ukraine crisis.

Conclusion and Recommendation

Putin will retain to leverage situations and permitting methods to control the important thing drivers of war—nearby instability, Russian regime stability, the West's response, and his very own dreams and objectives—to preserve Russian hegemony:

• The legacy of Moscow's manages over nearby relations. A motive force of violent war following the breakup of the Soviet Union became the newly unbiased countries' incapability to have interaction bilaterally to clear up interstate and intrastate tensions that Moscow brokered previously. The Putin regime these days is looking for to keep or reassert its position as nearby electricity dealer to preserve hegemony.

• Monopolization of the war narrative. Moscow has efficiently harnessed help for the battle in Ukraine via way of means of turning the Maiden narrative on its head, arguing that Ukraine's political transition became a strategic flow via way of means of the West to make Russia greater vulnerable. This revisionist account of contemporary occasions has allowed Russia to monopolize the war narrative in the course of many neighboring countries. Governments with an already Authoritarian bent have seized on that narrative to crack down on civil society, arguing that the West is manipulating famous actions to destabilize the area.

• Closing of civil society area. The area for civil society to function and mature is swiftly last in Russia and maximum neighboring countries. This method impacts war dynamics within side the area via way of means of last societal retailers for dissent and authorities' engagement. Without numerous social views on most of the area's unresolved conflicts, autocratic regimes manage the war narratives, hardening societal opinion towards their decision to deflect any attention on inner issues.

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A STUDY ON FORMERS PERCEPTION ON THE IMPACT OF MILLET PRODUCTION AMONG THE YOUNGER GENERATION IN SALEM DISTRICT

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ABSTRACT

In India, Millet product are taken into consideration a healthy and important food, however in other countries it's far a critical food protection and cash crop. But its manufacturing is controlled by using many elements. However, information on farmer restrictions and one of a kind alternative is scarce. A study changed into carried out; Identify extraordinary options in Millet product types, and evaluate farmers' barriers to methods of production and handling Millet. Participation within the look at includes a rural evaluation and a survey. More than 95% of the farmers used broadcasting as a technique of planting, which changed into identified via the farmers as excessive hard work necessities particularly for weeding. All other barriers are floods, rains, storms and low-yielding plants within the districts. It is likewise pronounced that the farmers have evolved a few coping mechanisms to face the boundaries. Depending on the choice for brand spanking new crop, growers may also pick excessive grain yield, brown seed shade, small head shape, flood, rain, storm, ailment tolerance, excessive sewing potential, moderate plant peak (1 ± 0.2 m), early maturity, dispersal tolerance and ease. Radiation without compromising homes. The observe further discovered that a sizable part of the farmers had confined or no expertise approximately the disorder affecting millet crops, its reasons and techniques of coping. Millet products specifically are high in nutrients, making it healthier for human beings to shop for, for this reason growing the fee of millet products. This study is an empirical evaluation designed to degree the effect of farmer notion in houses with a sample of one hundred eighty younger technology humans.

Keywords: Farmer perception, Impact of millet younger generation, Millet production.

Origin and the History of Millets

India is the second largest food producing country in the world, and it has the ability to become the largest food producer in the world. Food industry in India includes many varieties of food products like milk and milk products, fruits, vegetables, beverages; and amidst these products, millets are produced and consumed on the largest scale. The harvest period of millets is considerably short when compared to other cereals. The maximum time frame from sowing of seeds to harvesting the yield takes up to three to four months' time. The most commonly grown millets in India are Sorghum, Pearl, and Finger millet. Millets as such have played significant role and is an integral part of the growth of agriculture. It has helped in retaining the sustenance of agriculture and it could enhance the growth of agriculture as well. Millets are considered to be the drought tolerant grains, people have stated on large numbers, due to scarce water supply and availability they have shifted their focus on the growth of such grains. In addition, for enhancing the production and utilization of food, the funds have been allotted for the scientific research. At global levels of the production, millet is one of the most significant drought resistant vegetation's and holds 6th position on the list of cereals.

Benefits of Millets

Millets have a high fiber content which makes one feel full of energy despite consuming in lesser quantities, it even restricts the overall intake of carbohydrate. Millets are widely used to make variety of dishes in various parts across India. It is highly used for the incredible nutrient rich composition. India is the second largest diabetes capital of the world, and this pushes the public towards millets which in parallel connects to the increased produce of the same. problems pertaining to health are controlled with continual use of millets, and on a larger extent prevent the spread of epidemics. Millets are a rich source of fiber, and minerals like magnesium, phosphorous, iron, calcium, zinc and potassium. Millets are good supplements to offer cure from coronary diseases, millet products like Pearl millet, finger millet, sorghum millet, proso millet and foxtail millet are powerhouses of nutrition. These millet products help in improving the functioning of the heart, retains it in good state,

and also reduces coronary blockages. Millets are highly enriched with the goodness of magnesium thus, effectively lessens risk of blood pressure and menace of stroke and heart attacks.

Demand for Millet-based Products on the Farmers Perception

The market is now teeming with food products made from millets such as ragi biscuits or pasta and noodles made of barnyard millet, ladoo made of thinai and many more," farmers says , that makes products using millets. According to, research manager at Tamil Nadu Agricultural University's Technology Business Incubator, about five startups, including a farmer society, are involved in millet-based product-making currently. They make millet flakes, noodles, cookies, ready-to-cook powders. With amassed perception among consumers the demand for these products are up. Even the neighborhood stores now sell millet-based food items Some of these companies also run training programs for farmers to increase millet cultivation. As the demand for millet-based food increases, so does the production of millet. Perception among farmers and knowledge about millet cultivation should be improved, he said These are normally three to four month crops. There are two major seasons to sow millets in India June-July and September-October. Low water requirements of millets make them farmer-friendly crops, especially in drought prone areas, City-based endocrinologist P. Velayutham says millets have several health benefits. With higher volume of fibre, iron, vitamin B and calcium these help with better absorption of nutrients and minerals.

Food- The Basic Necessity

Food refers to the ones objects obtained either from plant life or animals which have the requirements to offer the required factors to sustain the existence. Food is combination of protein, carbohydrate, and fats help in retaining health, increase and repair of the body. Food provides the supplements required via the frame which consist of; minerals, vitamins, iron, carbohydrates, calcium, potassium etcetera. Food gives the vitamins crucial for the regular prosperous. Since time immemorial, it's been tuned that ways of acquiring dispersed food could require expenditure of power.

Previously it was via hunting and agriculture all human beings received food, now the instances have changed, food industries deliver the necessities to the arena population. Agencies like International Association for Food Protection, World Resources Institute, World Food Programme, Food and Agriculture Organization, and International Food Information Council have been tracking the food supply.

Millet Industry Trends

Millets Market size become over USD nine Billion fashionable 2018 and could witness more than 4.5% CAGR at some point of the forecast timespan. Growing inclination of city populace toward healthy food in Asia The city lifestyle choices and related food conduct have given upward push to quantity of diseases which include diabetes, weight problems and cardiovascular troubles as per coronary heart attack, coronary artery disorder, arrhythmias and many others. Millets have excessive content of proteins and minerals including calcium, iron and so on. That can assist in fending off such diseases. Therefore, growing awareness among population concerning health blessings associated with millets consumption will improve industry growth by means of 2025.

Farmers' Perceptions of Constraints for Scaling-up

The elements that count farmers, 59 scaling factors do not forget 39 to be applicable to farmers. At age 39, farmers identified a loss of fee introduced beyond implementation measures, a loss of predictable and sustainable advertising facilities, and a loss of technical physical inputs essential barriers to measuring decided on dealers within the examine location. The assessment of the 3 dealers using Scala shows that the use of fertilizers and advanced seeds meets the scaling resource requirements well, while the small scale irrigation scales meet the resource requirements handiest in part. Based on the common (ratings) of the findings from the three focus organization

discussions, each agent suggests the scaling rankings. When taken into consideration personally, the farmers find that in addition to ordinary constraints each Agent is similarly restrained with the aid of other scaling-up factors. They find that the usage of fertilizers is further confined with the aid of the financial risks confronted by using the farmers, the know-how needed, the effect of Agent at the land and water assets, and the constrained contribution of an Agent to the farmer's autonomy. Improved seeds are perceived to be similarly restricted with the aid of lack of mechanisms for international standardization, loss of contribution of Agents closer to farmer autonomy, loss of processing centers, and shortage of initial natural inputs. The farmers understand small-scale irrigation to have the maximum range of constraints of the three Agents. They indicated the shortage of mechanisms for worldwide standardization, lack of understanding regarding Agents, the associated financial hazard, the bad effect of Agent on land and water assets, the adorability, suitability, and adaptability of the Agents as other major constraints for scaling-up.

Objectives of This Study

1. To study the demographic profile of the respondent.
2. Toanalyse the farmer perception and themillet products among younger generation.
3. To study the research gap between perception and impact of millet products.
4. To finalize the further suggestion to extent of perception about millet products.

Limitations of The Study

1. The study is limited to only 180 respondents due to time constraints.
2. Farmers are spread over Salem district, thus gathering and analysing information is time consuming and difficult
3. Subsequently farmer response was highly higher in suburban and suburban areas, the researcher needed to journey to remote places, so the far flung rural regions ought to be explored with much less journey canters.
4. Respondents from city areas were true contributors, while respondents of rural factors and the farmer's assessment of the areas did now not show a whole lot concerned participation, as they had other chores.
5. The examine is constrained best to Salem District.

Research Methodology

This article offers an outline of research techniques that had been followed in this study. It provides information on the of millet former perception products among younger generation. This becomes important criterion in the study, who the participants were and the way they were sampled forms the next crucial part of this study.

The researcher describes the research design chosen for the purpose of this research and the reasons for having chosen the particular design is elaborated additionally. The tools used for data collection are given and defined too, and the methodologies adapted throughout the research process are included. The researcher additionally discusses the strategies implemented for analysis of the data. Finally, the problems that were observed within the techniques are also discussed.

Research Design

A cross sectional study design was farmer in this article. Under this design, data from farmer perception respondents were collected from the representative population at a single point of time without repetition. The design has been functional as it could provide the necessary descriptions**,** and determination of relationships between variables has been made possible with it as well. This design is ideal when resources are limiting to permit longitudinal studies.

Sampling Frame

In this study, the sampling frame indirectly includes farmers, consumers, processors and traders both wholesalers and retailers and directly includes domestic families of Salem district. Altogether the study covers about 180 respondents. The respondents were selected on the basis of their potential farmer perception of millet products and its impact of younger generation.

- **Universe:** Salem District is covered in this article.

- **Population:** Younger Generation in Salem District are considered to the respondent groups in the Article.
- **Sample Size:** The sample size is 180 respondents, the residents of Salem District.
- **Sampling Method:** Multi stage Sampling Method has been farmers for this study.

Sampling Technique and Sample Size

This study applies Multi stage sampling namely Simple Random sampling and Snowball sampling.

Simple Random sampling: Randomly the samples are selected from heterogeneous population to carry out the study.

Snowball sampling: In the second stage, Snowball sampling is used to shortlist the Younger Generation of millet products.

Stratified Sampling

These techniques have been recommended in social science research by C.R. Kothari, 2014 as they focus directly to the area intended to be studied. Selection of wards and Salem District was done during the Study. The sample size consisted of 180 respondents from Salem district. The choice of this sample size was based on the fact that a sample size of greater than 180 respondents is good for statistical inferences, as suggested in his work.

Farmer Selection and Data Collection

Data for this study were gathered from both primary and secondary sources.

Primary Data- Primary data were collected through direct interviews to get an in-depth obtained are classified for answering the research question

Scope of The Study

This study examines the views of farmers and the impact of millet on the younger generation and the acceptance of food items, which is still in its infancy in India. The findings will be useful for researchers, business planners, policymakers, charities, business management activists and more. Further findings will provide information with feedback from farmers. Consumer acceptance of these products helps to provide potential recommendations for implementing positive changes for effective market penetration that understanding of issues related to millet products consumption in the study area. Then the Survey was conducted, which involved personal interview using pre-tested questionnaires.

Secondary Data- Secondary data on millet products and food industries were obtained from various sources including the articles, journals, books, and websites.

Tools for Analysis

1. Chi Square Test
2. Fried man Test

Statistical Tools Applied

To consider the socio-economic upliftment of Formers Perception on the Impact of Millet Production among the Younger Generation in Salem District data through SPSS version 21.

Introduction

Analysis according to Polit and Hungler is a process of arranging and synthesizing data which would help in answering research questions and further pave way for testing hypothesis. It also refers to calculating the available resources and looking for patterns of relationships existing between the computed data groups. According to Kothari C. R, analysis of data generally includes many relevant operations, which are performed and further summarized and organized in a way to answer the research questions. In this chapter, the analysis is done with the data collected which are further processed systemically, tabulated and appropriated for interpretations. The results

are acceptable to the consumer. The outcomes of the study can be used effectively in other areas where similar socio-economic conditions exist with necessary changes. This will bring about a huge economic change among the farmers.

Thoughts Related to Millet Products

Describes the opinions on factor coming to mind on hearing the term Millets. Some of the statements dealt are “Healthy and Nutritious, Easy Availability, taste, affordability, energizing, controls diseases”. Majority of the respondents strongly Agreed with these factors.

Factor comes in mind when hearing the term Millet products

Factor	SDA		DA		N		A		SA		Total
	N	%	N	%	N	%	N	%	N	%	
Healthy and Nutritious	8	1	17	2	9	1	61	5	101	**91**	180
Easy Availability	7	1	64	6	23	2	75	7	143	**85**	180
Millets taste better	7	1	24	2	15	1	82	7	174	**88**	180
Millets are affordable	5	0	210	19	15	1	94	17	178	**62**	180
Millets save energy	3	0	26	2	4	0	113	19	166	**78**	180
Controls disease	3	0	35	3	7	1	163	24	104	**72**	180

For analyzing the factors mentioned above, Friedman's test was used and the results are given in Table.

Friedman Test- Factor comes in mind when hearing the term Millet products

	Mean	SD	Mean Rank	Reliability
Healthy and Nutritious	4.85	0.56	**3.87**	0.566
Easy Availability	4.69	0.82	**3.64**	
Millets taste better	4.81	0.62	**3.77**	
Millets are affordable	4.21	1.18	2.96	
Millets save energy	4.72	0.62	3.46	
Controls disease	4.65	0.68	3.29	

It could be noted from the above table for the 6 Factors "Healthy and Nutritious" was ranked first. It is followed by "Millets taste better", and "Easily Available nearby" was ranked third.

Price of Millet Products as Compared to Normal Food Products

The opinion on price of millet products as compared to normal food products with respect to the profile of the respondents was analyzed "Age, Gender, Level of Education, Occupation, Marital Status, Type of family, Place of Residence, Monthly income, Size of family" were analyzed and result is shown.

Prices of millet products as compared to normal food products

		Prices of millet products as compared to normal food products										Total
		Higher		Lower		Same/ Average		Reasonable		Don't Know		
		N	%	N	%	N	%	N	%	N	%	
Age	20 – 30	56	5	35	3	30	3	47	18	151	23	169
	30 - 40	21	2	15	1	9	1	91	8	94	8	130
	40 - 50	17	2	12	1	11	1	51	5	68	6	159
	Above - 60	27	2	11	1	10	1	56	5	50	4	154
Gender	Male	85	8	52	5	37	3	175	25	327	29	176
	Female	36	3	21	2	23	2	120	11	136	12	136
Level of education	School level	57	5	34	3	42	4	125	20	268	24	126
	Graduate or diploma	12	1	11	1	3	0	58	5	53	5	137
	PG level	9	1	8	1	2	0	35	3	41	4	95
	Illiterate	43	4	20	2	13	1	77	7	101	9	145
Occupation	Government Employee	36	3	21	2	26	2	171	15	235	21	129
	Private Employee	26	2	26	2	9	1	121	11	98	9	160
	Farmer	38	3	16	1	19	2	75	7	78	7	126
	Business man	21	2	10	1	6	1	28	3	52	5	117
Marital Status	Single	52	5	27	2	21	2	159	14	132	21	141
	Married	69	6	46	4	39	4	136	21	121	21	121

Type of family	Joint family	71	6	34	3	28	3	156	18	128	24	179
	Nuclear family	50	4	39	4	32	3	69	18	175	18	115
Place of residence	Rural	94	8	53	5	46	4	139	25	131	32	123
	Urban	17	2	10	1	12	1	36	3	41	4	116
	Semi-urban	10	1	10	1	2	0	80	7	71	6	163
Monthly income	Below 10,000	90	8	49	4	52	5	174	25	144	30	179
	Rs.10000 -20000	20	2	12	1	6	1	35	3	50	4	123
	Rs.20000 - 30000	2	0	5	0	1	0	62	6	51	5	121
	Above Rs.30000	9	1	7	1	1	0	24	2	28	3	69
Size of family	1 - 2	42	4	17	2	20	2	144	13	126	20	149
	3 - 4	35	3	31	3	22	2	89	8	113	10	170
	5 & above	44	4	25	2	18	2	162	15	124	11	173
Total		121	11	73	7	60	5	125	36	163	42	180

Regarding price of millet products as compared to normal food products, Table shows that 11% of the respondents selected Higher, 7% of the respondents opted Lower, 5% of the respondents went with Average, 36% of the respondents stated reasonable and 42% of the respondents opted Don't Know. Hence, it is found from the analysis that majority of the respondents didn't know about the prices of millet products.

Null Hypothesis: There is no significant association between the profile of the respondents and the Prices of millet products as compared to normal food products.

Further in order to find the association between the demographic variables and their Opinion about Prices of millet products as compared to normal food products the chi- square test was used and result of the test shown in table.

Findings

- ✓ The majority of the farmer perception's consumers in rural areas are consuming traditional food.
- ✓ The younger generation is mostly employees
- ✓ For more than ten years the purchasing process of millet products has been increasing and many younger generation consumers are consuming different types of millets.
- ✓ These are the millets that are mostly bought by the younger generation finger millet, pearl millet, foxtail millet, maize millet, Little millet and Kodu millet.
- ✓ Farmers' opinion on millet products but the productivity of cereals is very high.

Suggestion

- ➢ Farmers' perception of millet production is high in both rural and urban areas.
- ➢ Millet products are consumed more in rural areas because it is not consumed much in urban areas
- ➢ Millet products are healthy for everyone, and it is essential to consume this type of millet products.
- ➢ Millet products can be converted into value-added products for young people to consume
- ➢ This has a huge impact on millet products among the youth, which can increase the productivity of millet products

Conclusion

This article reveals that the role of millet in farmers' perception has a major impact on the younger generation. most of the younger generation in rural areas consume more millet products. Many educated youths today are interested in agriculture and farming as fast food is not as available in the present generation. If so, the malnutrition of the people will be greatly reduced. As the habit of consuming millet products increases, tradition and traditional foods will be preserved. This is because it does not require any pesticides like other foods. Natural methods alone are sufficient.

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"A STUDY ON IMPACT OF PERSONALISATION ON LIFE INSURANCE PRODUCTS AMONG CUSTOMERS IN BENGALURU CITY"

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ABSTRACT

Life insurance industry is rapidly developing among other industries & stimulates businesses to deliver value services to customers. Insurance products are available on Omni channel and is made easy to deliver it to the customers according to their needs. This paper aims in analysing the impact of personalisation on Life Insurance products by identifying dependent and independent variables. To gain more understanding among the variables a questionnaire was distributed to the policy holders in Bengaluru city. The analysis was carried out by using descriptive statistics. We find that the impact of personalisation has led to increase in the customer retention rate, effective customer relationship management and likely increase in the willingness to repurchase which would enhance customer loyalty.

Keywords: *Life Insurance, Personalisation, Customer Retention, Customer Relationship Management, Customer Loyalty.*

Introduction

Insurance is a system under which an insurer usually agrees for a consideration in advance and promises to reimburse the insured or to render services to the insured if certain accidental occurrences result in huge losses during a given time. It is thus a method of coping with risk.

The primary function of insurance is to substitute certainty for uncertainty with regards to the economic cost of loss-producing events. It transfers the risk of financial losses because of specified but unpredictable events from an individual or organization to an insurer in return for a fee or premium.

Society in general benefits from a competitive insurance market that can make use of calculated risk pricing to encourage better risk management practices. The prospect of low premiums can alter behavior, encouraging individuals and businesses to reduce their risks where they can by altering their behavior. Insurers invest the premium profits they receive, making them the biggest institutional investors.

Review of literature

KanbiroOrkaido , (2019), Factors Affecting Financial Performance of Insurance Companies Operating in Hawassa City Administration, Ethiopia , talks about to investigate factors that affect performance of 17 general insurance companies and researchers have considered them as target populations of this study. This study is a causal study because it shows the cause-and-effect relationships of the two variables called independent and dependent variables. Ordinary least square model and (linear regression analysis) for analysis SPSS version 20.0 were the tools used. The conclusion was that there was a significant effect between the growths of gross written premiums.

M. Sugantha (2018),in the article "Marketing of life insurance services by life insurance corporation of India" aims to identify the foremost method related to the procurement of life insurance policies among a) Prompt services, b) Cold calls, c) Referral marketing, d) Educating the policyholders, and e) Frequent follow-up actions. CHI – SQUARE TEST was tested as a tool. An important contribution of this study is how trust is developed and sustained over different levels of customer relationship in the life insurance sector.

Kuldeep Chaudhary, (2018), in the article "Service Quality Expectation and Perception in Life Insurance Services" speaks about the service quality expectation and perception of customers and to determine the gap in service quality expectation and perception of customers of Indian life insurance services. The methodology used was descriptive in nature and is also empirical. The human and non-human element in the service delivery were considered. In Conclusion, besides

improving the customization of insurance, the service providers need to be more socially responsible towards customer, society, and ecosystem.

Statement of the Problem

The face of the Indian life insurance industry has been changing at a rapid pace and the results are anything but inconspicuous. Over the last decade-and-a-half, there have been various regulatory changes as well as innovations by life insurers. Statistically speaking, 1 billion people across 206 million households, earning below Rs 3.5 lakh a year, represent the 'blue ocean'. With every 5 percent increase in coverage of households under life insurance, nearly one crore additional insured lives will be added to the industry. However, reaching out to this segment is fraught with specific challenges which need to be addressed and answered: Awareness regarding insurance is low and the product is not well understood.

Objectives of the Study

Indian life insurance industry has undergone a sea change. It has experienced new challenges of intense competition and struggle for survival since the introduction of insurance reforms since 1999. The reforms in the insurance sector are continuous and they should be made more transparent, viable and sound in the changing economic environment. Hence, the major focus of the present study is on the following objectives:

- To determine on what basis customers, choose their insurance policies.
- To study how insurance companies, retain their customers.
- To discover which insurance company is the most popular among customers.
- To determine the most profitable path in terms of insurance for both employees and customers.
- To determine the major attribute or factor which contributes to customer buying decision.
- To identify, choose and analyse the variables determining the personalization of Life Insurance products.

Research Methodology

The study is based onprimary and secondary data. The data is collected from the respondents in the form of a questionnaire. The questionnaire was sent nearly to 500 customers of life insurance products in which 206 respondents have submitted the questionnaire. The data is also collected from periodicals, websites as well as from reputed journals for the reference. The sampling method used will be convenient sampling. The data collected from different sources was analysed by using Statistical Package for Social Sciences-SPSS-16. A combination of univariate and multivariate statistical tools like mean, standard deviation test etc., was employed to analyse the data.

Data Analysis & Interpretation

The results are summarized in tabular form and various tests have been done to find out the relation between the variables. The Independent variables considered are CRM (Customer Relationship Management) & PS (Personalization). The dependent variables studied are IRR (Increased Retention Rates), CT (Commitment), WRP (Willingness to repurchase), CS (Customer Satisfaction) & CL (Customer loyalty). The following are measure statistically in detail through various tools.

Table Showing Descriptive Statistics of all the Variables

Descriptives

			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
							Lower Bound	Upper Bound			
Personalisation of Life Insurance	More		164	4.03	0.300	0.023	3.99	4.08	3	5	
	Average		40	3.13	0.753	0.119	2.88	3.37	1	4	
	Less		2	1.75	1.061	0.750	-7.78	11.28	1	3	
	Total		206	3.83	0.597	0.042	3.75	3.92	1	5	
	Model	Fixed Effects			0.432	0.030	3.77	3.89			
		Random Effects				0.589	1.30	6.37			0.515
Willingness to re-purchase	More		164	4.11	0.370	0.029	4.05	4.17	3	5	
	Average		40	3.46	0.666	0.105	3.25	3.67	2	4	
	Less		2	2.20	0.283	0.200	-0.34	4.74	2	2	
	Total		206	3.97	0.539	0.038	3.89	4.04	2	5	
	Model	Fixed Effects			0.442	0.031	3.90	4.03			
		Random Effects				0.441	2.07	5.86			0.288
Retention rate	More		164	4.06	0.381	0.030	4.00	4.12	2	5	
	Average		40	3.16	0.706	0.112	2.93	3.39	2	4	
	Less		2	2.90	0.141	0.100	1.63	4.17	3	3	
	Total		206	3.87	0.588	0.041	3.79	3.95	2	5	
	Model	Fixed Effects			0.461	0.032	3.81	3.94			
		Random Effects				0.522	1.62	6.12			0.405
CRM	More		164	4.09	0.303	0.024	4.05	4.14	3	5	
	Average		40	3.36	0.669	0.106	3.14	3.57	2	4	
	Less		2	2.30	0.707	0.500	-4.05	8.65	2	3	
	Total		206	3.93	0.522	0.036	3.86	4.00	2	5	
	Model	Fixed Effects			0.403	0.028	3.88	3.99			
		Random Effects				0.475	1.89	5.98			0.334

Commitment	More		164	3.32	0.567	0.044	3.23	3.41	1	4	
	Average		40	2.81	0.585	0.092	2.63	3.00	1	4	
	Less		2	1.00	0.000	0.000	1.00	1.00	1	1	
	Total		206	3.20	0.640	0.045	3.11	3.29	1	4	
	Model	Fixed Effects			0.569	0.040	3.12	3.28			
		Random Effects				0.418	1.40	5.00			0.257
Commitmentand Loyalty	More		164	3.71	0.629	0.049	3.61	3.81	3	5	
	Average		40	3.21	0.649	0.103	3.00	3.42	2	5	
	Less		2	2.75	0.354	0.250	-0.43	5.93	3	3	
	Total		206	3.60	0.664	0.046	3.51	3.70	2	5	
	Model	Fixed Effects			0.632	0.044	3.52	3.69			
		Random Effects				0.296	2.33	4.88			0.128
Customer Satisfaction	More		164	3.63	0.442	0.034	3.56	3.70	3	5	
	Average		40	3.40	0.485	0.077	3.25	3.55	2	4	
	Less		2	2.17	0.707	0.500	-4.19	8.52	2	3	
	Total		206	3.57	0.479	0.033	3.51	3.64	2	5	
	Model	Fixed Effects			0.452	0.031	3.51	3.63			
		Random Effects				0.231	2.58	4.57			0.078
Customer Loyalty	More		164	4.12	0.445	0.035	4.05	4.18	3	5	
	Average		40	3.69	0.806	0.127	3.43	3.95	2	5	
	Less		2	3.25	1.061	0.750	-6.28	12.78	3	4	
	Total		206	4.02	0.567	0.039	3.95	4.10	2	5	
	Model	Fixed Effects			0.538	0.037	3.95	4.10			
		Random Effects				0.257	2.92	5.13			0.097

Interpretation: From the above table of analysis, the descriptive statistics has been calculated for all the dependent & independent variables. It is noticed that the Mean of WRP is 4.13 which is maximum compared to all the variables. The standard deviation of CT is 0.640 which has a greater spread out. The standard is error is 0.033 which is likely less that signifies the sample average is highly accurate reflection of the actual mean population.

Table Showing the Correlations between the Variables

Correlations										
		IMPACT OF PERSONALIZATION ON LIFE INSURANCE PRODUCTS	Personalisation of Life Insurance	Willingness to re-purchase	Retention rate	CRM	Commitment	Commitment and Loyalty	Customer Satisfaction	Customer Loyalty
IMPACT OF PERSONALIZATION ON LIFE INSURANCE PRODUCTS	Pearson Correlation	1	-.691**	-.568**	-.618**	-.638**	-.426**	-.323**	-.292**	-.329**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N	206	206	206	206	206	206	206	206	206
Personalisation of Life Insurance	Pearson Correlation	-.691**	1	.366**	.543**	.439**	.272**	.210**	.254**	.324**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000	0.002	0.000	0.000
	N	206	206	206	206	206	206	206	206	206
Willingness to re-purchase	Pearson Correlation	-.568**	.366**	1	.446**	.394**	.194**	.235**	.319**	.210**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.005	0.001	0.000	0.002
	N	206	206	206	206	206	206	206	206	206
Retention rate	Pearson Correlation	-.618**	.543**	.446**	1	.557**	.282**	.340**	.261**	.340**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000
	N	206	206	206	206	206	206	206	206	206
CRM	Pearson Correlation	-.638**	.439**	.394**	.557**	1	.344**	.314**	.385**	.225**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.001
	N	206	206	206	206	206	206	206	206	206
Commitment	Pearson Correlation	-.426**	.272**	.194**	.282**	.344**	1	0.000	.152*	0.111
	Sig. (2-tailed)	0.000	0.000	0.005	0.000	0.000		0.996	0.029	0.112

	N	206	206	206	206	206	206	206	206	206
Commitment and Loyalty	Pearson Correlation	-.323**	.210**	.235**	.340**	.314**	0.000	1	.172*	.275**
	Sig. (2-tailed)	0.000	0.002	0.001	0.000	0.000	0.996		0.014	0.000
	N	206	206	206	206	206	206	206	206	206
Customer Satisfaction	Pearson Correlation	-.292**	.254**	.319**	.261**	.385**	.152*	.172*	1	.233**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.029	0.014		0.001
	N	206	206	206	206	206	206	206	206	206
Customer Loyalty	Pearson Correlation	-.329**	.324**	.210**	.340**	.225**	0.111	.275**	.233**	1
	Sig. (2-tailed)	0.000	0.000	0.002	0.000	0.001	0.112	0.000	0.001	
	N	206	206	206	206	206	206	206	206	206

{. Correlation is significant at the 0.01 level (2-tailed).}**

{*. Correlation is significant at the 0.05 level (2-tailed).}

Interpretation

From the above table of analysis, it is observed that PS has a weak association between WPR, IRR, CRM, CT whereas it can be noticed that there is a moderate correlation between CRM & IRR,RR& PS & RR &CRM. The strong relationship is noticed with PS & IRR & PS & CRM which signifies that the personalization of life insurance products has more impact on the increased retention rate and in retaining and managing the customers effectively. The other variables represent that there is a weak association.

Table Showing ANOVA

ANOVA						
	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Personalisation of Life Insurance	17.612	2	.187	203	94.346	.000
Willingness to re-purchase	9.934	2	.196	203	50.770	.000
Retention rate	13.900	2	.212	203	65.411	.000
CRM	11.471	2	.162	203	70.624	.000
Commitment	9.026	2	.324	203	27.852	.000
Commitmentand Loyalty	4.722	2	.399	203	11.826	.000
Customer Satisfaction	2.843	2	.204	203	13.929	.000
Customer Loyalty	3.556	2	.289	203	12.282	.000

Interpretation

From the above ANOVA Table, it is observed that the F value is larger for PS compared to other variants. The second larger variation is found in CRM. The variations in the cluster are not the same & hence there is no statistical significance among the variables.

Conclusion

The insurance industry in India has grown exponentially over the last decade and has opportunities for further development. Life insurance is very important type of insurance and is essential for everyone's life. But in India the penetration level of insurance industry is very low compared to other developed and developing countries where this industry has reached a saturation level as almost all the lives have been insured.

Customers are an integral part of the industry. Thus, both private and public sector companies compete and differentiate their products from others by the usage of innovative products, services and offering better premium facilities, advanced technologies etc. The insurance companies must consider the underlying facts and reasons that drive customer's investment decision in life insurance.

In the current scenario, insurance players should concentrate in four major areas such as flexibility of the product, Personalization (Relationship with customer in life Insurance), Experimentation (exploring new channels) and communication (via mobile and print media). Finance activity cannot ensure the social welfare of the population until it is accompanied by insurance.

Future Research

The insurance industry in India has seen tremendous changes over the decades. Digitalisation and mobile advances have led to

quality increments in which customers are able to access their information without the agents. The past decades have also led to new challenges. The future study can focus on the returns of the shareholders and product innovation as a key determinant.

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A STUDY ON FAMILY CLIMATE AND ACADEMIC ACHIEVEMENT OF HIGH SCHOOL STUDENTS

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ABSTRACT

Effective and favourable parenting and family climate are very much essential for overall development of children and family and they are significant contributors for personal, academic and professional and social development of their children and it is also influencing academic performance of their school students. The findings show that significant difference exits in family climate with respect to gender, type of school, locality of school, medium of instruction and type of family of high school students. Family climate is highly, significantly and positively related with academic achievement of high school students. Hence, parents should provide all facilities and favourable family climate to their high school students in order to enhance their academic achievement. Parents must support and motivate their high school students to improve their academic activities. Furthermore, parents should interact and discuss frequently with their high school students and solve their problems efficiently.

Key Words: *Academic Achievement, Family Climate, High School Students.*

Introduction

Family climate is the emotional and physical atmosphere and status of the family as it is bad or good or enthusiastically functional cultural unit. Family climate is persistently and very deeply influencing life of individuals through which they get warm experience and happiness (Govindarajan, 2018). Family is in fact a social system that creates association among members of family and it is influencing dynamic of the family. In the present day complex social and personal life system, it is necessary to understand exclusive relation among parents and their children (Singh and Devi, 2018). Effective and favourable parenting and family climate are very much essential for overall development of children and family and they are significant contributors for personal, academic and professional and social development of their children (Varsha and Ritu, 2015). Children are highly adjustable, achievers and largely successful if they are growing in the better family climate and having good relation among their family members. Thus, family climate is playing an important role in creating good attitude for people, community and society and intellectual development of children and is helping them to attain their personal desires and objectives and it is also influencing their academic achievement (Kumar and Lal, 2014).

Academic achievement is the attainment of capabilities to perform well in school activities it may be specific or general in a particular subject and it is the self assessment of objective of individual student in school system and it usually exhibits outcomes from learning of students (Kuldip, 2014). Academic achievement is the skill, knowledge and attitude developed among school students in the subjects which is assessed by marks scored by them in those subjects through examinations (Manika and Khatoon, 2011). Academic achievement is the degree to which a student have achieved their educational objectives in short or long run. Generally academic achievement of students is assessed by means of examinations at school level. As students are coming from different cultural, social and family back grounds and they are undergoing different learning situations(Tella and Tella, 2003), it is very essential to find learning interest and styles of students in order to encourage and help them to achieve greater heights in their academics. Further, family climate is mainly and significantly influencing academic performance of school students. With this back drop, the present research is made to study family climate and academic achievement of high school students.

Review of Related Literature

Das (2020) found that there existed significant difference among gender of ninth grade students and their family climate and family climate was positively relating with academic achievement of ninth grade students. Family

climate was higher to female ninth grade students in comparison with female.

Mishra (2019) concluded that male adolescent students were having favourable family climate in comparing with female adolescent students and significant difference was witnessed among them with respect to their family climate.

Shanoji and Wani (2018) revealed that significant difference existed amongst family climate and private and government school students. Family climate was positively and significantly related with academic achievement of secondary students.

Dandagal and Yarriswami (2017) indicated that there existed no significant difference among gender and medium of instruction of secondary students and locality of schools and their family climate and there exited significant differences amongst type of school of secondary students and their family climate. Family climate has positive and significant relation with academic achievement of secondary students.

Xia et al (2016) showed that significant difference exited among gender of sixth grade students and their family climate. Family climate was having reciprocal relation with school attachment of sixth grade students and it was not significantly relating with their academic achievement.

Shafeeq and Tazeen (2015) found that significant difference exited among male and female secondary school students and their family climate and significant difference exited amongst type of school of secondary students and their family climate. Academic achievement of secondary students was not significantly related with their family climate.

Yunus et al (2014) concluded that there exited significant difference amongst family climate and gender of primary school students and family climate had no impact on academic performance and adjustment of primary school students.

Objectives of The Study

1. To find difference in family climate with respect to gender, type of school and locality of school of high school students.
2. To find difference in family climate with respect to medium of instruction and type of family of high school students.
3. To assess relation amongst family climate of high school students and their academic achievement.

Hypotheses of the Study

1. There is no significant difference in family climate with respect to gender, type of school and locality of school of high school students.
2. There is no significant difference in family climate with respect to medium of instruction and type of family of high school students.
3. There is no significant relation amongst family climate of high school students and their academic achievement.

Methodology

Method of Study

This study is carried out in Tiruvannamalai District. Survey method is used for this study.

Tools Used in the Study

Family Climate Scale developed and standardized by the Research Scholar through pilot study is used for this study. Academic achievement of high school students is determined based on their marks scored in Secondary Board Examination, thus, it is used to assess academic performance of high school students.

Sampling Method

Random sampling method is used for selection of high school students and data are collected from 300 high school students by using questionnaire.

Statistical Techniques Employed

Percentage analysis is done to understand profile of high school students. Mean, standard deviation, t-test and ANOVA test are employed to inspect difference in family climate with respect to gender, type of school, locality of school, medium of instruction and type of family of high school students.Relation among family climate and academic achievement of high school students is assessed by using correlation analysis.

Results

Profile of High School Students

The profile of high school students is disclosed in Table-1. The results show that 53.67 per cent of high school students are in male category, whilst, 46.33 per cent of them are in female category and 44.00 per cent of them are studying in private schools, whilst, 23.33 per cent of them are studying in Government aided schools. The results also indicate that 37.67 per cent of them are studying in schools located in urban area, whilst, 27.00 per cent of them are studying in schools located in rural area, 59.00 per cent of them are studying in English medium, whilst, 41.00 per cent of them are studying in Tamil medium and 68.67 per cent of them are having nuclear family and 31.33 per cent of them are having joint family.

Table-1. Profile of High School Students

Profile	Number(n=300)	Percentage
Gender		
Male	161	53.67
Female	139	46.33
Type of School		
Government	98	32.67
Government Aided	70	23.33
Private	132	44.00
Locality of School		
Urban	113	37.67
Semi – Urban	106	35.33
Rural	81	27.00
Medium of Instruction		
Tamil	`123	41.00
English	177	59.00
Type of Family		
Joint	94	31.33
Nuclear	206	68.67

Family Climate and Profile of High School Students

The difference amongst family climate and profile of high school studentsis disclosed as below.

Gender and Family Climate

The difference amongst gender of high school students and their family climate is disclosed in Table-2.

Table-2. Gender and Family Climate

Gender	Number	Mean	Standard Deviation	t-value	Sig.
Male	161	326.55	12.36	3.635**	.000
Female	139	320.52	13.07		

** Significant in 1% level

Mean value of family climate is 326.55 for male and it is 320.52 for female high school students and it indicates that family support is higher for male as compared to female high school students.

The t-value is 3.635 revealing that there exits significant difference amongst gender and family climate of high school students. In consequence, null hypothesis is not accepted.

Type of School and Family Climate

The difference amongst type of school of high school students and their family climate is disclosed in Table-3.

Table-3. Type of School and Family Climate

Type of School	Number	Mean	Standard Deviation	F-value	Sig.
Government	98	320.76	11.90	7.530**	.000
Government Aided	70	323.79	12.56		
Private	132	325.53	10.67		

** Significant in 1% level

Mean value of family climate is varying from 325.53 for high school students studying in private schools to 320.76 for high school students studying in Government schools and it indicates that family support is higher for high school students studying in private schools as compared to others.

The F-value is 7.530 revealing that there exits significant difference amongst type of school and family climate of high school students. In consequence, null hypothesis is not accepted.

Locality of School and Family Climate

The difference amongst locality of school of high school students and their family climate is disclosed in Table-4.

Table-4. Locality of School and Family Climate

Locality of School	Number	Mean	Standard Deviation	F-value	Sig.
Urban	113	326.35	13.89	6.929**	.000
Semi – Urban	106	323.91	14.06		
Rural	81	318.77	10.76		

** Significant in 1% level

Mean value of family climate is varying from 326.35 for high school students studying in schools located in urban area to 318.77 for high school students studying in schools located in rural area and it indicates that family support is higher for high school students studying in schools located in urban as compared to others.

The F-value is 6.929 revealing that there exits significant difference amongst locality of school and family climate of high school students. In consequence, null hypothesis is not accepted.

Medium of Instruction and Family Climate

The difference amongst medium of instruction of high school students and their family climate is disclosed in Table-5.

Table-5. Medium of Instruction and Family Climate

Medium of Instruction	Number	Mean	Standard Deviation	t-value	Sig.
Tamil	`123	321.68	13.53	3.208**	.000
English	177	325.70	12.16		

** Significant in 1% level

Mean value of family climate is 325.70 for high school students studying in English medium and it is 321.68 for high school students studying in Tamil medium and it indicates that family support is higher for high school students studying in English medium as compared to Tamil medium.

The t-value is 3.208 revealing that there exits significant difference amongst medium of instruction and family climate of high school students. In consequence, null hypothesis is not accepted.

Type of Family and Family Climate

The difference amongst type of family of high school students and their family climate is disclosed in Table-6.

Table-6. Type of Family and Family Climate

Type of Family	Number	Mean	Standard Deviation	t-value	Sig.
Joint	94	325.59	11,42	3.086**	.000
Nuclear	206	321.73	14.18		

** Significant in 1% level

Mean value of family climate is 325.59 for high school students having joint family to 321.73 for high school students having nuclear family and it indicates that family support is higher for high school students having joint family as compared to nuclear family.

The t-value is 3.086 revealing that there exits significant difference amongst type of family and family climate of high school students. In consequence, null hypothesis is not accepted.

Relation Amongst Family Climate and Academic Achievement of High School Students

The correlation analysis is done to assess relation amongst family climate and academic achievement of high school students andthe result is disclosed in Table-7.

Table-7. Family Climate and Academic Achievement of High School Students

Particulars	Correlation Coefficient(r)
Family Climate and Academic Achievement of High School Students	0.63**

** Significant in 1% level

The correlation coefficient amongst family climate and their academic achievement of high school studentsis 0.63and it explains that they are highly, significantly and positively related. In consequence, null hypothesis is not accepted.

Conclusion

The findings reveal that significant difference exits in family climate with respect to gender, type of school, locality of school, medium of instruction and type of family of high school students.Family climate is highly, significantly and positively related with academic achievement of high school students. Hence, parents should provide all facilities and

favourable family climate to their high school students in order to enhance their academic achievement. Parents must support and motivate their high school students to improve their academic activities. Furthermore, parents should interact and discuss frequently with their high school students and solve their problems efficiently.

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EVOLUTIONARY ALGORITHM (EA) BASED FEATURE SELECTION AND DEEP LEARNING METHODS FOR HEALTH BIG DATA CLASSIFICATION

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ABSTRACT

A massive high throughput data which is termed as Big data is generated by rapid progress in modern technologies. New insights are computed using the opportunities created by this via Machine Learning (ML) algorithms. For medical information's intelligentization, it is highly important to have medical big data classification. For big data classification, Fuzzy k Nearest Neighbour algorithm is used in recent works.

Two approximate techniques for speeding up classification process runtime without any quality lose is proposed in this work. Techniques are termed as Local Hybrid Spill Tree FkNN and Global Approximate Hybrid Spill Tree FkNN. Still there is a need for enhancing big data classification accuracy. There are many features called attributes in Big data. However, all these features are not relevant or necessary. ML algorithm performance is degraded by these features. For minimizing time consumption and dataset's dimensionality, an essential pre-processing step called Feature Selection (FS) is used. For EAs and FS, objective function is used as classification accuracy and it achieves high accuracy even with high features count. In two major stages, this research work is performed. Adaptive cuckoo search based feature selection and weighted convolutional neural network based classification.

Feature selection is used for two purposes, features count is reduced for decreasing computation time and enhancing classification accuracy, which is contradictory. A single objective function is used for achieving this. For medical data classification, better performance is shown by deep learning algorithms and enhances classification accuracy when compared with other techniques. With respect to f-measure, accuracy, recall and precision, proposed model's effectiveness is demonstrated using experimentation results.

Keywords: *Weighted convolutional neural network, Hybrid Spill Tree, adaptive cuckoo search, Convolutional neural network, Feature Selection, objective function, Big data, Fuzzy k Nearest Neighbors.*

1. Introduction

Electronic health records (EHR) collection is made highly convenient due to the growth in medical data. In this digital computing and healthcare world, at a rate which exceeds boundary range, information are collected and generated, which is termed as big data. In various science and engineering field like biomedical science, biological science and physics, Big data technologies are applied.

Technologies for storing and processing exponentially growing data sets with unstructured, semi structured and structured data is required by big data [1,2].

Big data is characterized using three parameters called velocity, variety and volume. Huge data count is referred as volume, data types count is referred as variety and data processing's speed is referred as velocity. All three characteristic's expansion results in Big data management problems.

There exist web, video, audio, geospatial data in Big data in addition to strings and numbers. Community services, patient care and early disease detection are assisted by medical data's accurate analysis in biomedical and healthcare communities [3,4,5].

To deal with Big data, implemented various effective techniques in recent days. In specific, in Big data analysis, an important role is played by classification and clustering. This used for retrieving, searching or classifying data. In applications like semantic ontology, data mining,bio-informatics,machine learning,pattern recognition, these techniques are highly useful.

To cluster as well as classify Big Data analysis problems, there exist various algorithms and it is necessary for finding proper algorithms [6,7] which produces better results.

Two approximate techniques for speeding up classification process runtime without any quality lose is proposed in this work. Techniques are termed as Local Hybrid Spill Tree FkNN and Global Approximate Hybrid Spill Tree FkNN. Still there is a need for enhancing big data classification accuracy. There are many features called attributes in Big data. However, all these features are not relevant or necessary. ML algorithm performance is degraded by these features [8].

For minimizing time consumption and dataset's dimensionality, an essential pre-processing step called Feature Selection (FS) is used. For EAs and FS, objective function is used as classification accuracy and it achieves high accuracy even with high features count. In two major stages, this research work is performed. Adaptive cuckoo search based feature selection and weighted convolutional neural network based classification.

Feature selection is used for two purposes, features count is reduced for decreasing computation time and enhancing classification accuracy, which is contradictory. A single objective function is used for achieving this. For medical data classification, better performance is shown by deep learning algorithms and enhances classification accuracy when compared with other techniques. With respect to f-measure, accuracy, recall and precision, proposed model's effectiveness is demonstrated using experimentation results.

The paper is structured in following five sections. Section I provides big data healthcare classification significance. Section II reviews about various techniques for big data classification. Next, Section III produces design methodology for proposed big data classification model. Section IV describes experimental study and includes multiple analyses of results. The Section VI concludes thiswork and outlines future work.

2.**Literature review**

For big data classification, various techniques are reviewed in this section.

In input ECG signal, available nonlinear and linear delays are removed initially using a IIR and FIR filters proposed by Varatharajan, et al [9]. From input ECG signal, unwanted frequency components are removed using this filters. In input ECG signal, available features are reducing using Linear Discriminant Analysis (LDA). From input ECG signal, more features are classified using weighted kernel function with SVM model.

For proving proposed Support Vector Machine (SVM) based on Linear Discriminant Analysis (LDA) with an enhanced kernel technique's effectiveness, with respect to Mean Square Error (MSE), specificity, sensitivity, analysed this Support Vector Machine (SVM) based on Linear Discriminant Analysis (LDA) with respect to other machine learning techniques.

A churn prediction model is developed by Ahmad, et al [10] for assisting telecom operators for predicting customers who are highly to be churn. On big data platform, machine learning techniques is used for developing this model and creates a new technique for feature selection and engineering. Adopted an Area Under Curve (AUC) standard measure for measuring this model's performance and around 93.3% AUC value is obtained. In prediction model, customer social network is used by Social Network Analysis (SNA) features extraction, which is an another major contribution.

Against AUC standard, model's performance is enhanced to 93.3% from 84 by using SNA. Through Spark environment, this model is tested and prepared. Large dataset formed via transformation of big raw data which is provided by SyriaTel Telecom Company is used in experimentation. In experimentation, algorithms like Extreme Gradient Boosting "XGBOOST", Gradient Boosted Machine Tree "GBM", Random Forest and Decision tree are used.

For predicting diabetes disease, WEKA tool based classifier model is built byMir and Dhage [11] . Algorithms like simple CART, Random Forest, Support Vector Machine and Naïve Bayes are employed in this. Best algorithm based on effective performance is recommended to predict diabetes disease. Evaluated the performance of every algorithm in experimentation result. In disease prediction, better performance is produced by Support Vector Machine algorithm and it has high accuracy.

For reconstructing missing data, a latent factor model is used by Chen, et al [12]. On cerebral infarction's regional chronic disease, experimentation is conducted. From hospital unstructured and structured data are collected and are used for proposing new multimodal disease risk prediction algorithm based on convolutional neural network (CNN).

In medical big data analytics, both data types are not concentrated in any of the available work. Around 94.8% prediction accuracy is obtained using proposed algorithm which is

greater than various typical prediction algorithms. When compared with unimodal disease risk prediction algorithm based on CNN, this has a fast convergence speed.

Across genome, for modelling DNA copy number change, Bayesian hidden Markov model (HMM) with Gaussian Mixture (GM) Clustering technique is proposed by Manogaran et al [13]. Different available techniques like segment neighbourhood, binary segmentation and Pruned Exact Linear Time techniques are used for making comparison with proposed Bayesian HMM with GM Clustering technique. Proposed change detection algorithms, effectiveness is demonstrated in experimentation results.

On large-scale insurance business data mining, a heuristic bootstrap sampling technique which is combined with ensemble learning algorithm is exploited by Lin, et al [14]. An ensemble random forest algorithm is proposed using memory cache technique which is optimized by Spark and parallel computing capability. For analysing potential customers, from China Life Insurance Company, insurance business data is collected.

For evaluating algorithm's performance, G-mean and F-measures are used. Within imbalanced data, with respect to accuracy and performance, SVM and other classification algorithms are outperformed by ensemble random forest algorithm as shown in experimental results. When compared with traditional artificial technique, product marketing's accuracy is enhanced using this.

For big data classification, Spark framework based effective ELM is proposed by Duan et al [15]. Three parallel sub algorithms are included in this system.

Majority of computations are performed locally by partitioning respective datasets in a reasonable manner. Matrix V decomposition algorithm, matrix Û decomposition algorithm and hidden layer output matrix calculation algorithm are used for the same. At the same time, in distributed cache and memory, intermediate results are retained. For every task, instead of different copies, diagonal matrix is retained as broadcast variable, which minimizes cost and SELM's learning ability is strengthened using these actions.

At last, for classifying large datasets, this SELM algorithm is implemented. For validating proposed algorithms effectiveness, extensive experimentation is conducted. On a cluster having ten nodes, 8.71× speedup is achieved using our SELM and with 15 nodes, 13.79×speedup is achieved, with 20 nodes, 18.74× speedup is achieved, with 25 nodes, 23.79 × speedup is achieved, with 30 nodes, 28.89× speedup is achieved and with 35 nodes, 33.81 × speedup is achieved.

3.Big Data Classification Using Weighted Convolutional Neural Network

Proposed big data classification model's stages are explained in this section. There are two phases in this model. Feature extraction based on adaptive cuckoo search optimization is done in first stage and weighted convolutional neural network based big data classification is done in the second stage. Proposed model's overall architecture is shown in Figure 1.

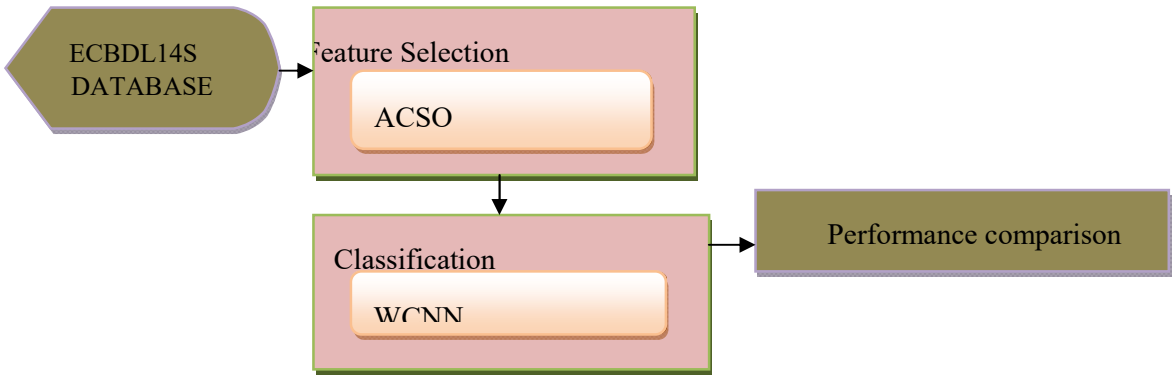

Figure:1.Overall architecture of the proposedmodel

3.1.Feature selection using adaptive Cuckoo Search optimization

There may be lot of features in input ECGDL14S database. So, for getting classification results, it may require more time. So, for avoiding this problem, an adaptive Cuckoo Search (CS) algorithm based on feature selection model is used in this work. Classification accuracy is enhanced while minimizing time consumption by using this technique.

A novel meta-heuristic model is cuckoo search. Some cuckoo species, obligate brood parasitism is inspired in this algorithm. Cuckoos will lay its eggs in other host birds nests. Direct conflict is engaged by some host nest.

If eggs that are not belonging to it are discovered by host bird, those eggs will be thrown away or its nest are abandoned simply. New nest are build elsewhere. Some other species have evolved in such a way that female parasitic cuckoos are very specialized often in mimicry in colour and eggs pattern of a few selected host species.

It eggs probability of being abandoned is minimized because of this and its reproductively is increased [16-19]. On the other side, various animals flight behaviour is shown in different studies and insects have Levy flight's typical characteristics. CS algorithm is proposed by considering this flight and breeding behaviours.

Next three idealized rules are followed in CS algorithm.

1) At a time, one egg is laid by every cuckoo and dumps its egg in a nest which is randomly selected;

2) Best nests with high eggs quality will carry over to next generations;

3) There will be fixed available host nests, and egg laid by a cuckoo is discovered by host bird with a probability $p_a \in [0, 1]$. In this case, host bird can either throw egg away or abandon nest, and build a completely new nest.

The n nests fraction p_a is used for approximating this final assumption as suggested by authors and new nests with new random solutions are used for replacing it.

In a feature selection problem, objective function so called classification accuracy corresponds to solution's fitness. A solution is represented using every egg in a nest in this algorithm and new solution is represented by cuckoo egg. In nests, not-so-good solutions are replaced using new as well as potentially better solutions called cuckoos. Cuckoo Search (CS)'s basic steps are summarized according to these three rules.

In above three idealized rules, new bird's nest location path search is expressed as,

$$h_i^{(t+1)} = h + \alpha \oplus \text{Levy}(\lambda); i = 1,2, \dots \dots \dots, n \quad (4)$$

In t generation, i^{th} bird's nest position is represented as $h_i^{(t+1)}$, step size control parameter is expressed as α and $\alpha > 0$.In general, $\alpha = 1$ Levy(λ) is Levi's random search path and it is given by,

$$Levy\ (\lambda) = t^{-\lambda}; 1 < \lambda < 3 \quad (5)$$

There is a step size limitation in traditional cuckoo search algorithm. At initialization, CS algorithm's discovery probability is set to a fixed value and in subsequent iterations, it will not get changed. With large step size, search accuracy is minimized and convergence is easy in this. Search speed is minimized and it may be trapped with local optima with minimum step length.

An improved CS algorithm is introduced in this work for overcoming those issues.

Iterations count is combined with step size in ICO algorithm and at integration's beginning, long set size is set and it is reduced as iteration progresses. In iteration, algorithm has a long step size. Global optimization is achieved while enhancing iterative speed in this technique. For achieving local optimization, with a small step size, accuracy is enhanced in algorithm iteration's latter part. Enhanced formula is expressed as,

$$\propto_i = a_{max} * \frac{1}{\left(\frac{a_{max}}{a_{amin}}\right)^{\frac{t}{T}}} * ran_i * 0.01 \quad (6)$$

Where, minimum step size is represented as a_{amin}, maximum step size is represented as a_{max}, total iterations count is represented as T. Current iteration number is represented as T, dataset's i^{th} dimension scope is represented as ran_i.

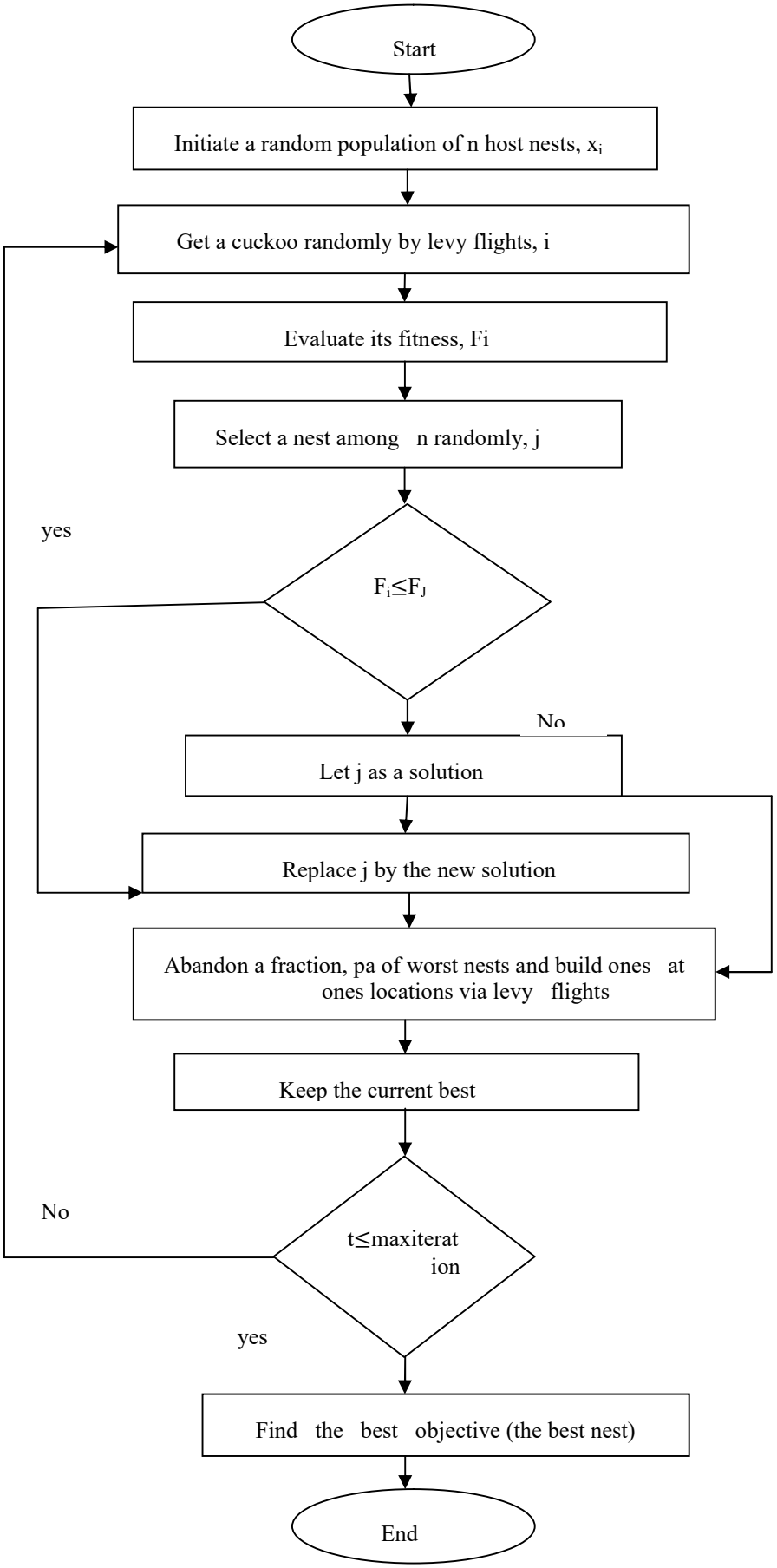

Figure: 2.Flow chart of cuckoo search optimization

Algorithm for ICSO
INPUT:ECBDL14S database
OUTPUT: Optimal features
1: Initial population of N host nest $x_i \forall_i$, i = 1, ..., n is generated
2: **while** t < Max Generation or (stop criterion) **do**
3: Using Levy flights, cuckoos are obtained randomly and its fitness F_i is evaluated.
4: Among N, a nest j is randomly selected.
5: **if** $F_i > F_j$ **then**
6: New solution is used for replacing j.
7: **end if**
8: Abandoned a fraction (p_a) of worse nest and built new ones.
9: Best solutions are maintained (or nest with quality solutions).
10: Solutions are ranked and current best solution is computed.
11: end while

3.2. Classification Using Weighted Convolutional Neural Network

Weighted Convolutional neural network (CNN) is used for classifying big data after feature selection.
There is a structural difference between CNN and regular artificial neural network. CNN layers are selected for matching input data spatially, where in conventional ANN, input is flattened as a vector. There exist a single or multiple sub sampling or convolution layers block in typical CNN and also it has output layer and one or more fully connected layers.

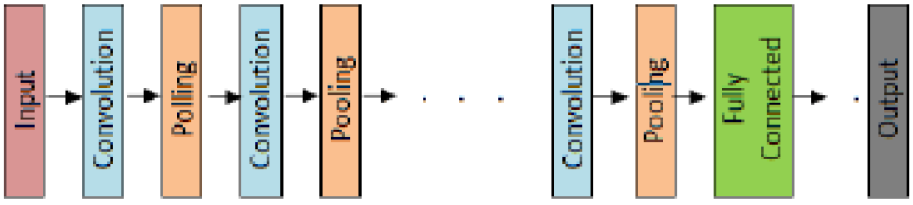

Figure: 3.Typical CNN

Drawbacks of Traditional CNN

For reducing dimension, pooling operation is used in CNN's convolutional architectures. In some cases, some information may lot because of this. So, weighted CNN is used in this work for rectifying this.

Weighted CNN

Three layer types are there in CNN, namely, fully connected, sub sampling and convolution layer. A convolutional neural network (CNN)'s typical architecture is shown in Figure 1. In following sections, brief explanation about every layer is presented [20-23].

Convolution layer

Selected features are given as an input to this proposed work. With a kernel called filter, convolved the input features in this convolution layer. The *n* output features maps are generated using kernel and input feature's convolution results. In general, filter corresponds to convolution matrix kernel. Input and kernels are convolved for computing output features, which are termed as feature maps with i*isize.
Multiple convolutional layers are included in CNN. Feature vectors are given at next convolutional layers inputs and outputs. In every convolution layer, there exist n filters bunch. With input, these filters are convolved and in convolution operation, applied filters count is similar to generated feature maps (*n**) depth. At certain input location, every filter map is assumed as a specific feature.

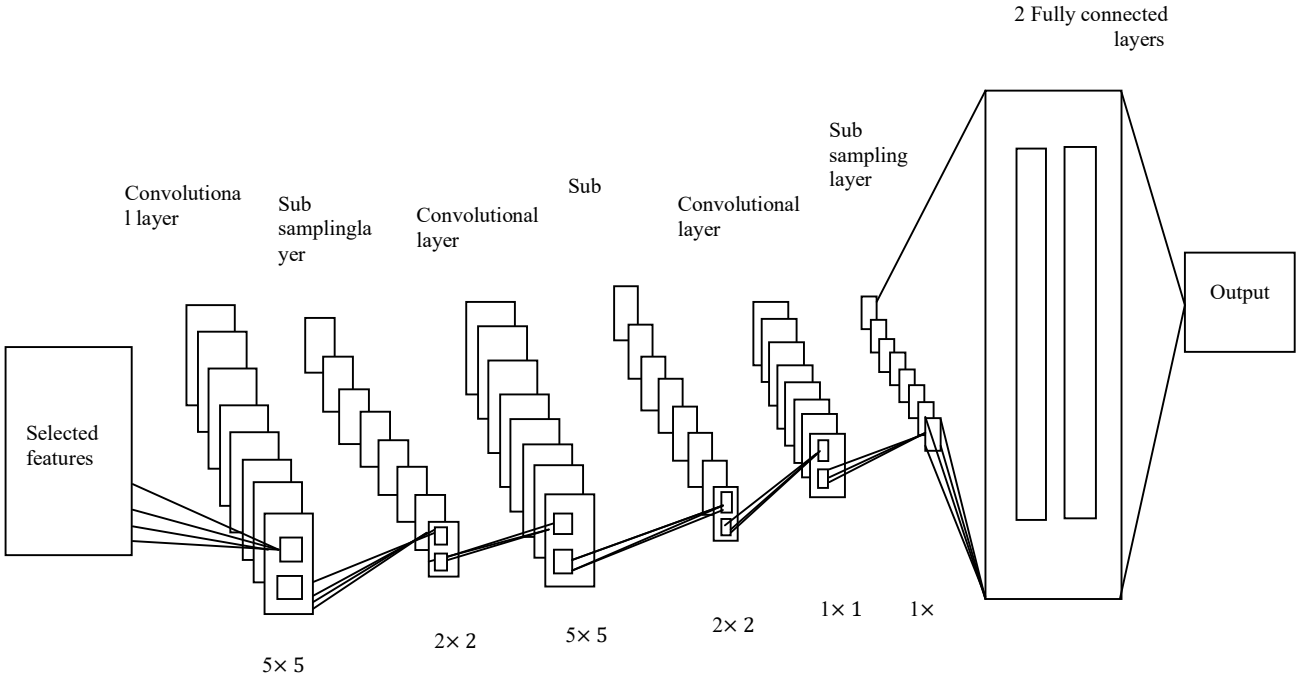

Figure.4: Convolutional Neural Network architecture

The l-th convolution layer's output is represented as $C_i^{(l)}$. This contains feature maps and is computed as

$$C_i^{(l)} = B_i^{(l)} + \sum_{j=1}^{a_i^{(l-1)}} K_{i,j}^{(l-1)} * C_j^{(l)} \quad (9)$$

Where, bias matrix is represented as $B_i^{(l)}$, convolution filter is represented as $K_{i,j}^{(l-1)}$, it has a $a*a$ kernel size. In $(l-1)$ layer, j-th feature map is connected with the i-th feature map of same layer using this kernel.

Feature maps are available in output $C_i^{(l)}$ layer. In expression (10), input space is represented as a first convolutional layer $C_i^{(l-1)}$, that is, $C_i^{(0)} = X_i$. Feature maps are generated using kernel. For convolutional layer output's nonlinear transformation, activation function is applied after convolution layer.

$$Y_i^{(l)} = Y(C_i^{(l)}) \quad (10)$$

Where, activation function output is represented as $Y_i^{(l)}$, received input is represented as $C_i^{(l)}$.

Sub sampling or pooling Layer

Spatial dimension reduction of feature maps which are extracted from previous convolution layer is mainly concentrated in this layer. Between feature map and mask, sub sampling operation is performed. Proposed various sub sampling techniques like maximum pooling, sum pooling and averaging pooling.

Max pooling is most commonly used technique. In this, output feature corresponds to every block's maximum value. For tolerating rotation and translating input images, convolution layer is assisted by sub sampling layer [23,24].

Fully Connected layer

A traditional feed forward network is a final CNN layer and it has one or more hidden layers. Softmax activation function is used in output layer.

$$Y_i^{(l)} = f(z_i^{(l)}),$$

$$\text{Where} z_i^{(l)} = \sum_{i=1}^{m_i^{(l-1)}} w_{i,j}^{(l)} y_i^{(l-1)} \quad (11)$$

Where, weights are represented as $w_{i,j}^{(l)}$, for forming every class's representation, these weights are tuned using complete fully connected layer, transfer function is represented as f and non-linearity is represented using this. Within fully connected layer's neurons, nonlinearity is built and are not built as a separate layers like in pooling and convolution layers.

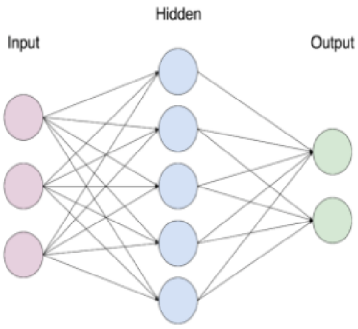

Figure:5. Fully Connected Layer

Fuzzy membership function is used for computing weights in above expression, which is expressed as $(w_1 = 0.3, w_2 = 0.4, w_3 = 0.5, w_4 = 0.7)$ and in a following manner, it is computed as,

$$o^2 = u_i^{(j)}\left(a_i^{(2)}\right)$$

Where, membership function is represented as $u_i^{(j)}(.)$, $u_i^{(j)}(.): R \rightarrow [0,1]$, i=1,2,…,M, j =1,2,….,N using a Gaussian membership function.

4.Results and Discussion

This section analyses the results of the experiments carried out on the proposed model. The implementation of this model is carried out with the help of MATLAB. In comparison of the already variable HMM,FKNN algorithm and the proposed WCNN are done in terms of precision, recall, accuracy and F-measure for the COV(https://archive.ics.uci.edu/ml/datasets/covertype),ECBDL14s (https://archive.ics.uci.edu/ml/datasets/Dermatology) and poker databases (https://archive.ics.uci.edu/ml/datasets/Poker+Hand).

Predicting forest cover sort from just cartographic variables in the COV database. The US Forest Service (USFS) Area 2 Resource Information System (RIS) data was used to assess the real forest cover type for a given observation (30 x 30 meter cell). Independent variables were generated using data from the United States Geological Survey (USGS) and the United States Forest Service (USFS). The data is in its natural state (not scaled) and contains conditional (0 or 1) columns for qualitative independent variables (wilderness areas and soil types).

This study area encompasses four wilderness areas in the Roosevelt National Forest in northern Colorado. In these areas, established tree cover types represent forests with little human-caused disturbances, so they are more a part of natural cycles than forest management practices. The ECBDL14s database has 34 properties, 33 of which are linear and one of which is mis nominal. In dermatology, the differential diagnosis of erythemato-squamous diseases is a great challenge. They both have erythema and scaling as therapeutic characteristics, with only minor exceptions. Psoriasis, seboreic dermatitis, lichen planus, pityriasis rosea, cronic dermatitis, and pityriasis rubra pilaris are all diseases of this category. A biopsy is normally expected for diagnosis, but these diseases share many histopathological features as well. Another challenge in differential diagnosis is when a disease can display symptoms of another disease in the early stages but then develop characteristic features later. Patients were first tested scientifically using a compilation of 12 criteria. Following that, skin samples were taken to determine 22 histopathological characteristics. An examination of the samples under a microscope determines the values of the histopathological features.The family history attribute in the dataset created for this domain has a value of 1 if either of these diseases has been observed in the family, and 0 otherwise. The patient's age is reflected by the age function. Any other characteristic (clinical and histopathological) was graded on a scale of 0 to 3. Here, 0 denotes the absence of the function, 3 denotes the maximum sum possible, and 1, 2 denotes the relative intermediate values.

1) Precision

Result's percentage showing relevance is indicated using precision and it expressed as

$$\text{Precision} = \frac{Truepositive}{truepositive + falsepositive} \quad 1$$

2) Recall

Overall relevant result's percentage which are classified using proposed algorithm is indicated using recall and is expressed as

$$\text{Recall} = \frac{True\ positive}{true\ positive + False\ \ Negative} \quad 2$$

3) **Accuracy**

Classification models are evaluated using accuracy metric. It defines predictions fraction that are correctly found using this model and is expressed as:

$$\text{Accuracy} = \frac{True\ positive + True\ Negative}{Total}$$

4)R**untime**

Runtime is a system which is primarily used in software development for describing time period during program is running and it will be calculated by tic starts a stopwatch timer.toc Stop the timer with the toc function.

TABLE: 1.Performance Comparison Results

METRICS	METHODS	DATABASES		
Runtime (S)	HMM	COV	ECBDL14S	poker
	FKNN	800	825	820
	WCNN	750	780	790
Accuracy (%)	HMM	70	72	73
	FKNN	75	75	75
	WCNN	78	79	78
Precision (%)	HMM	75	74	75
	FKNN	76	75	77
	WCNN	79	78	79
	HMM	75	74	75
Recall(%)	HMM	80	85	82
	FKNN	82	85.5	83.3
	WCNN	85	87	85

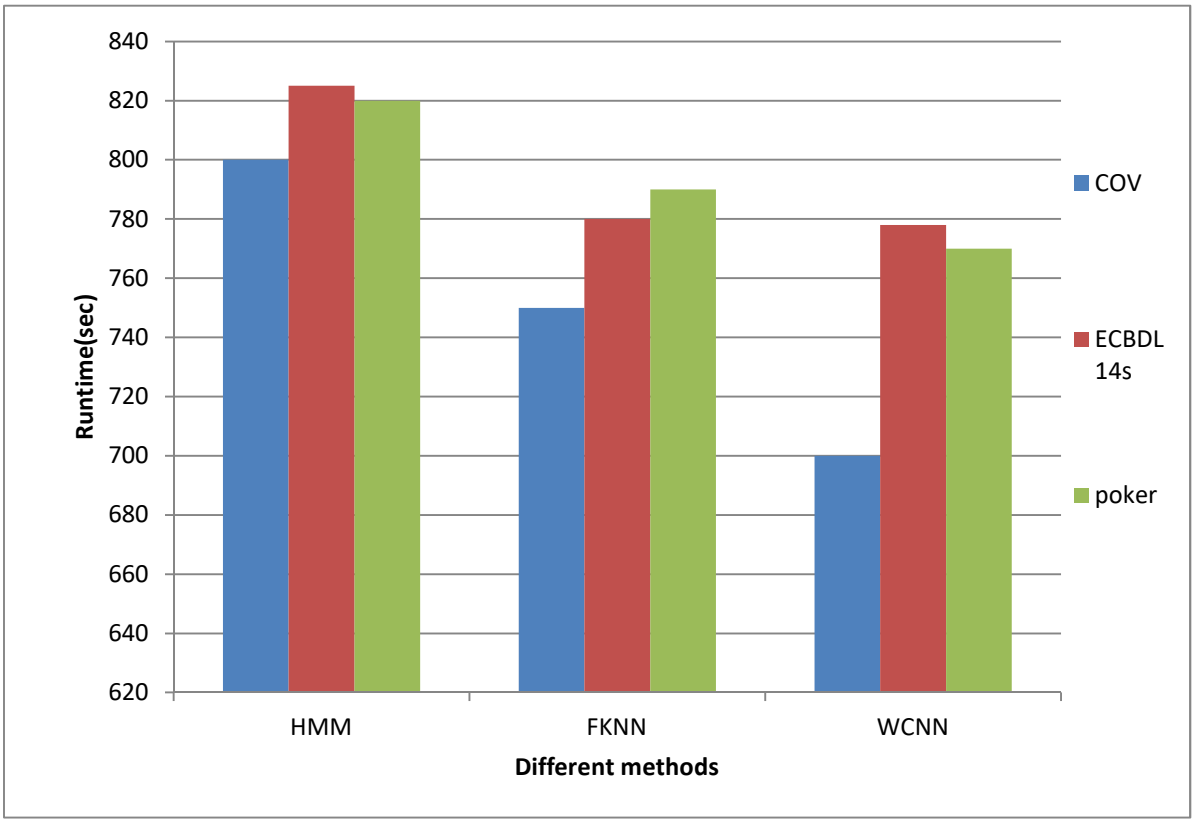

Figure: 6. Runtime results vs. classification methods

The above figure shows the Performance comparison for Runtime metrics with the classifiers HMM, FKNN proposed WCNN schemes. In X axis of above graph, represented various techniques and Runtime values are represented in Y-axis. As indicated in results,, it is assured that newly introduced WCNN model produced lower Runtime results which is 700(s) for COV dataset while available, HMM and FKNN technique yields only 800(s),750(s) respectively.

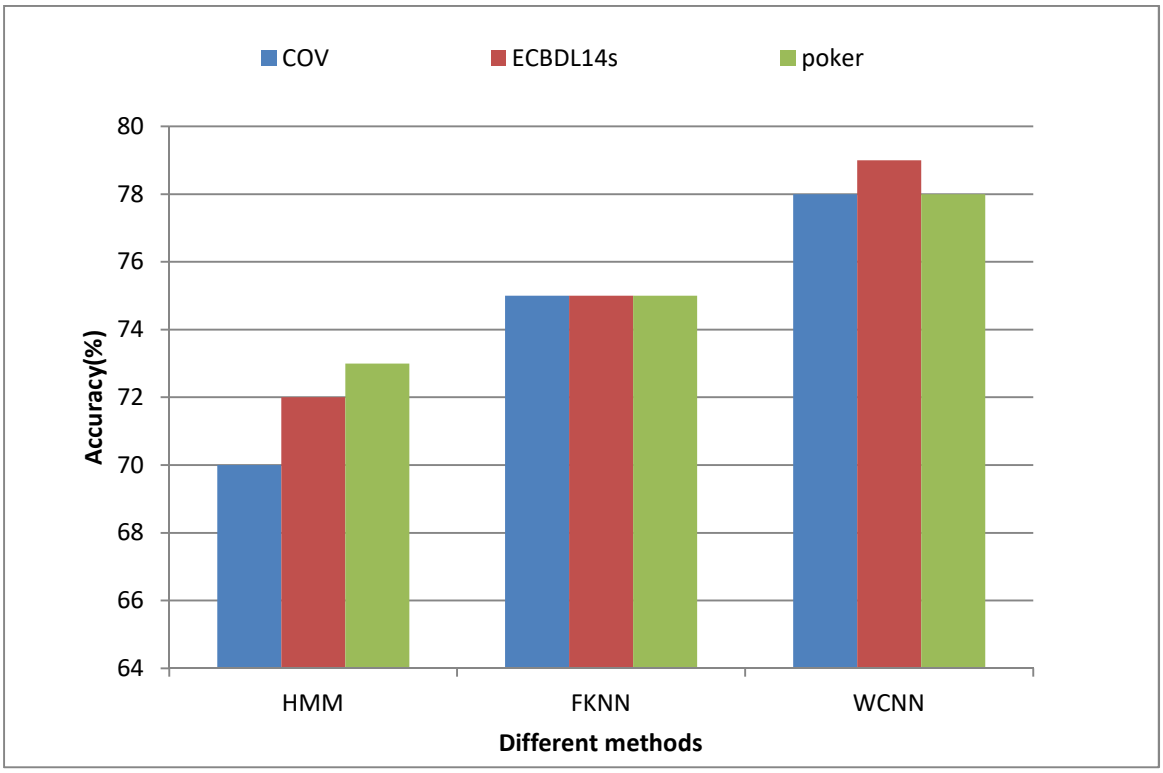

Figure: 7. Accuracy results vs. Classification methods

Accuracy metric performance comparison between existing classifierHMM and FKNN proposed WCNN scheme is shown in the above figure. In Proposed work, fitness function is used by hybrid features for significant features selection by which WCNN accuracy get enhancedIn X axis of above graph, represented various techniques and accuracy values are represented in Y-axis. As indicated in results, it is assured that the newly introduced WCNN model produced higher Accuracy results 78% for COV dataset while available HMM and FKNN technique yields only 70% and 75% respectively.

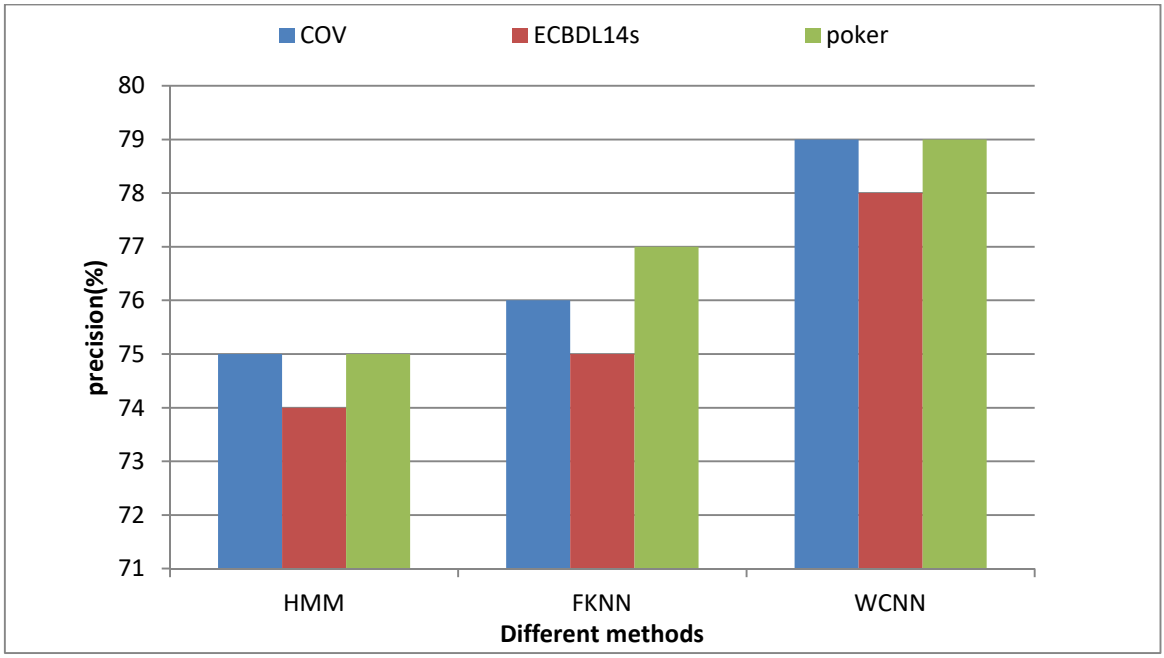

Figure .8: Precision results Comparison of Various Classifiers

Proposed WCNN's efficiency is shown in above figure by comparing this with available HMM and FKNN methods in terms of precision. Proposed work uses feature selection as pre-processing step and it increases the precision of the result. In X axis of above graph, represented various techniques and precision values are represented in Y-axis. As indicated in results, it is assured that newly introduced WCNN model produced precision results of 79 % for COV dataset while available HMM and FKNN techniques yields only 75% and 76% respectively.

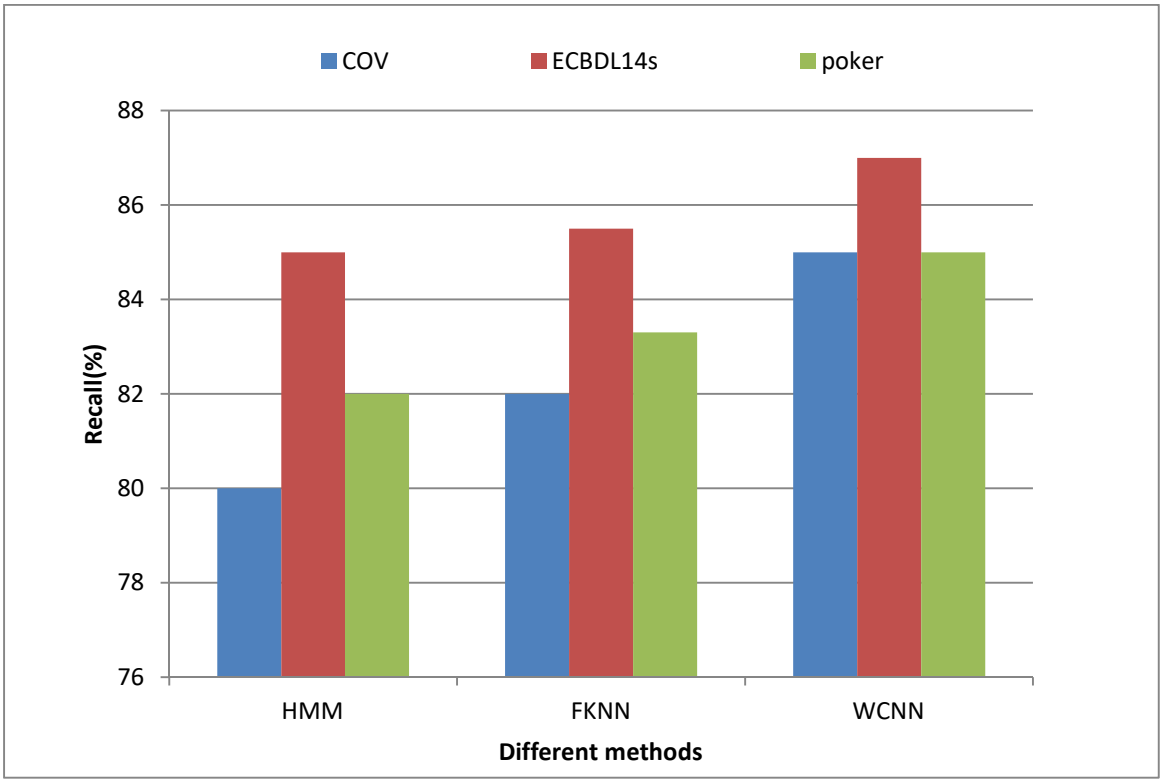

Figure: 9. Recall results vs. classification methods

Figure:9.Shows the Performance comparison forthe existing classifier HMMandFKNN proposed WCNN scheme interms of recall. Proposed work uses fuzzy function for weight value calculation in CNN which increases the recall rate. In X axis of above graph, represented various techniques and recall values are represented in Y-axis. As indicated in results, it is assured that the newly introduced WCNN model produces higher recall results of 85% for Cov dataset while available HMM and FKNNtechniques yields only 80% and 82% respectively.

5.Conclusion and Future Work

Huge amount of information are generated in recent days. Due to the developments in network resources, storage and its affordability, at an exponential rate, data are generated in technologies like Internet.

It is widely accepted that have entered the Big Data era. For big data classification, an enhanced framework is provided in this work. In which Feature selection is done by using adaptive cuckoo search computations and it is reduces the time consumption.And then classification is done by using weighted convolutional neural network. The deep learning algorithm performs medical data classification and improves the classification efficiency of algorithm than other methods.Better performance with respect to accuracy and f-measure is provided by proposed model as shown in experimental results. However deep learning produces more computational complexities so need to use other model in future.

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A THEORETICAL STUDY OF ELECTRICAL RESISTIVITY OF POLYPYRROLE/PVC POLYMER BLENDED FILMS AT HIGH PRESSURE

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ABSTRACT

The electrical resistivity of polymer semiconducting materialsshows variation with temperature and pressure. In this paper, the pressure dependency of the electrical resistivity of polypyrrole/PVC thin films has been studied theoretically. A formula $R= A (P/P_c)^{\alpha} exp (\beta P/P_c)$ has proposed for the theoretical analysis of the pressure effects on the electrical resistivity of polypyrrole/PVC blend thin films. The constants A, αand β are adjustable constant and P_c is arbitrary pressure. In this study, the pressure range has divided in three sub-ranges (I) 0 to 2 GPa (II) 2GPa to 4.5GPa and (III) 4.5GPa to 14GPa,The calculated values of resistivity found close agreement with experimental values in pressure sub ranges (I) and (III). At low pressure sub range (I), the variation in resistivity is described by $(P/P_c)^{\alpha}$. The assumption that electrical resistivity varies as exp $(\beta P/P_c)$ holds well in high pressure sub-range (III). The value of β has found close to 0.3 in different set of calculations.

Key Words: *-Electro-active polymer, resistivity, High pressure, conducting polymer, resistivity, volume effect*

Introduction

Electro-active polymers such as polypyrrole, polyvinyl and polythiophens are well known for their high electrical conductivity [1, 3] and good environmental stability. In recent years numbers of experimental studies have been carried out to the study of the variation of electrical properties of electro-active polymers with temperature and pressure [4, 8]. It has been found that the structural and electro-optical properties vary with high pressure [9, 10]. Recently, the pressure dependencies of electrical properties of polymer materials have been studied theoretical for polystyrene thin film andpolyethylene polymer[11, 12]. The effects of pressure on electrical properties for organic and inorganic materials have been also studied earlier [13, 15].

In the present paper, the theoretical analysis has done for electrical resistivity of polypyrrole / PVC blends thin films at high pressure. A simple formula has derived for studying pressure dependence of electrical resistivity of polypyrrole / PVC blends thin films. The theoretical data has compared with experimental studies which havereported by K. M. Kesharwani [13]. Polypyrrole is an organic polymer which is insulator in normal condition but blending with Polyvinyl chloride (PVC) shows its resistivity decreases as a function of pressure.

Theory

The molecular separation decrease with applying an external pressure P on some material, On the basis of this pressure effects following two assumptions have used for driven the relation between electrical resistivity and pressure.

I. The electronics shells of the neighbour molecules overlap due to pressure, in this condition a force of repulsion becomes important. This repulsive interaction tends to decrease the electrical resistivity R with increase in pressure. It means R is proportional to Pressure P^{α}, where α is a constant.
II. At very high pressures, the pathways of the electrons [10] come too close to each other due to which mean free time between charge carrier collisions decreases with increase in P. This extra resistance may be taken to be proportional to exp ($\beta_0 P$). Here β_0 is a constant.

The combined effect of above two processes may be written as

$R= A_0 P^{\alpha} exp (\beta_0 P)$ ---------- (1)

The above two effects oppose each other. One can, therefore, expect that at some critical pressure P_c the resistivity to be minimum. By using critical pressure $P_c$equation (1) has modified as where A_0 and β_0 replaced by another constants

$R= A (P/P_c)^{\alpha} exp (\beta P/P_c)$ ---------- (2)

Where $A_0 = A/ (P_c)^{\alpha}$ and $\beta_0 = \beta/P_C$

Calculations

The electrical resistivity of Polypyrrole/PVC thin films at high pressure has been reported experimentally [13]. The theoretical calculations of resistivity have calculated by using equation (2). The parameter A, α and β have been calculated by using equation (2) with simple algebraic mathematical operations. The value of these parameters have been fixed in a manner, so as to obtained best fit with experimental values, for which the Δx has been calculated minimum

$$\Delta x = \sum_{i=1}^{n} [R_e(P_i) - R_t(P_i)]^2$$

Where

$R_e(P_i)$ ⟶ Experimental resistivity as a function of pressure

$R_t(P_i)$ ⟶ Theoretical resistivity as a function of pressure

The theoretical calculations compared with experimental data in figure (1) for constant temperature 300K and in figure (2) for constant temperature 330K. The value of parameters A, α and β used for these calculations are given in table (1) and table (2).

Figure (1); -Resistivity (ohm-meter)VsPressure (GPa) for polypyrrole / PVC film at 300K Temperature

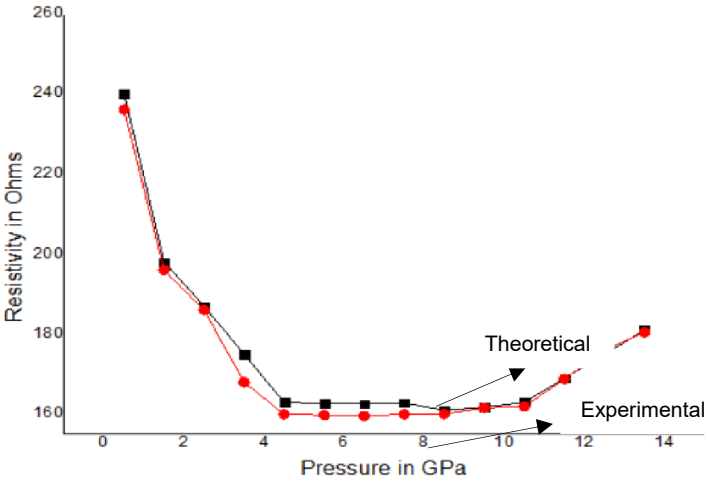

Figure (2); - Resistivity (ohms-meter) Vs Pressure (GPa) for polypyrrole / PVC film at 330K Temperature

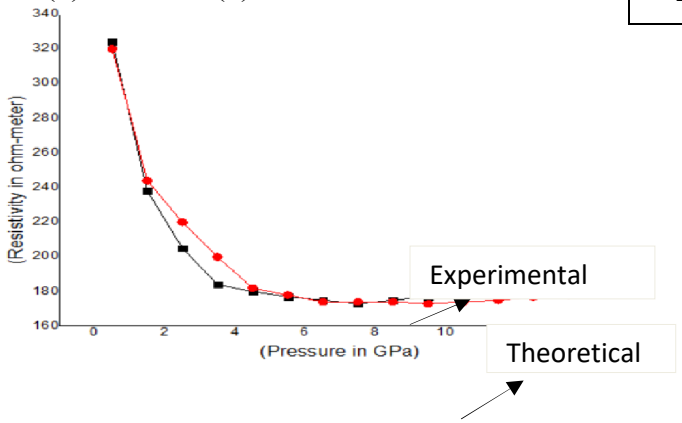

Table 1:- Calculated Values of Parameter A, α and β

Figure No.	Temperature	A	α	β	α/ β
1	300K	115	-0.509	0.309	1.65
2	330K	106	-0.417	0.299	1.40

Table 2:- Calculated values of Δx in three pressure sub ranges

Figure No	Temperature	Δx in sub-range I (0 to 2GPa)	Δx in sub-range II (2 to 4.5GPa)	Δx in sub-range III (4.5 to 14GPa)
1	300K	2.5×10^{2}	8.5×10^{2}	0.7×10^{2}
2	330K	1.3×10^{2}	5.4×10^{2}	1.2×10^{2}

Observation

In the presented study pressure range 0 to 14 GPa has divided in three sub ranges (I) 0 to 2 GPa, (II) 2 to 4.5 GPa and (III) 4.5 to 14 GPa. Table 1 is showing the calculated parameters for the theoretical calculation of resistivity. In figure (1), the calculated results are presented for A=115.0 Ohms, α = -0.509 and β = 0.309 at constant temperature 300K. It has been found that that calculation shows fairly good agreement with experimental results in

pressure sub ranges (I) and (III). However, agreement is not up to the mark in the criticalpressure sub range (II). In table 2, $\Delta x = 8.5\times10^{2}$ is highest square of difference in pressure sub-ranges (II) which is showing disagreement of the theory in this pressure sub range.

In figure (2), the calculated results are compared with experimental data for the parameter A = 106 Ohms, α = -0.417 and β = 0.299 at constant temperature 325K. Here, the agreement in theory and experiment is excellent in pressure sub-ranges (I) and (III) but there is a marked discrepancy in pressure sub-range (II) with highest value of square of difference $\Delta x = 5.4\times10^{2}$. The value of β is almost similar 0.3 for both system 300K and 330K which is also found similar to β=0.3 in the study of polystyrene thin films [11].

Conclusions

From the present calculations, it is clear that different types of mechanism for current transport are working in the three pressure sub-ranges. The results are not surprising. In layered semiconductors [15], various types of transport mechanisms have been observed in different temperature range. From the present work, the following conclusions are drawn –

(1) The parameter α is negative and β is always positive in various mode of calculations.
(2) The value of parameter β is almost constant quite close to 1/3. As it is evident from figure (1) and figure (2), the assumption that electrical resistivity varies as exp (β P/P_c) holds well in pressure sub-range (III).
(3) At low pressure, the variation in resistivity is described by $(P/P_c)^{\alpha}$. However, in pressure sub-range (II), theory does not take stock well of the situation.

Acknowledgement

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ENERGETIC RESOURCE FORECAST AND DISTRIBUTION FOR CLOUD INFORMATIONHUBVIA THE VERSATILE GENESIOLOGICAL ALGORITHM

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ABSTRACT

Sequentially to optimize the resource operation of material equipment, the workload calculation of virtual machines (VMs) is very important but demanding. The majority of accessible journalisms spotlight on each resource forecast or distribution independently, however mutually of them be extremely interconnected. In this paper, we suggest a Versatile Genesiological Algorithm(GA) to energetically predict the resource deployment and power utilization in cloud information hub.[1]We prepare a Versatile development dilemma of resource distribution, which believes the CPU and memory consumption of VMs and PMs, and the energy utilization of information hub. The suggested GA predicts the resource requisite of subsequently instance gap as per the past information in earlier instance gaps. We additionally suggest a VM position design to assign VMs for subsequent instance gap depend on the forecast outcomes of GA. In our replication-supported investigation, the best clarification for resource forecast over steady and unbalanced operation inclination is establish by the suggested GA. The forecast outcome be better to the earlier suggested Grey predicting form. Outcomes illustrate that the suggested VM assignment design not simply boosts the normal operation stage of CPU and memory but also reduces the energy utilization of cloud information hub.[4]

Keywords: *Cloud Information Hub, Genesiological Algorithm (GA), Versatile Development, Resource Distribution, Resource Forecast.*

1. Introduction

CLOUD computing has turn into a admired research topic for the reason that its lofty scalability, elasticity, and expenditure-competence gratify rising calculation necessity [1]. It put together the characteristics of grid computing [2] with the capacities of a virtualization method. Innovative announcement prototypes on the foundation of computer submissions are separated with Internet announcement between several computers in data hubs [3]. Isolated host gives cloud examinations so that customers can distribute data and work together jobs in clouds. Cloud computing gives with huge computing [4], distribution storeroom [5], green computing [6], load balancing [7], and scalable service with most favorable structure and organization outlay [8].

The prerequisite and consumption of virtual machines (VMs) and physical machines (PMs) manipulate resource allotment. Researchers examine how to forecast the resource consumption of cloud data hub [9]–[12]. Overall, the past data are consumed to predict the upcoming propensity of resource obligation. The final aim of resource forecast is correct so that suppliers can assign resources supported on the exact predict outcomes. There as on of resource forecast and allotment not only reduces unnecessary resource expenditure but also convince arriving customer orders with proper resource finances. Though, the majority of obtainable journalisms spotlight on calculation or distribution independently.

The two matters must be measured and explained together appropriate to involved relation among them.[20]

We recommend a Versatile Genesiological Algorithm (GA) to estimate resource consumption in subsequently occasion period, which comprises central processing unit (CPU) and memory consumption, and power utilization. The VM assignment algorithm is additional projected for make best use of resource consumption and reduce power utilization. It assigns VMs supported on the resource forecast outcomes of the projected GA. This paper intends to forecast resource orders precisely for decreasing the power utilization of cloud data hub.[17]

2. Related Works

Resource forecast and distribution for cloud data hub has been extensively deliberate in the journalism, e.g., workload representation[13], workload classification and forecast [14], prognostic form for workload predicting [15], and traffic diminution [16]. Power

effectiveness subjects and authority administration methods have been talk about. The projected adaptive algorithm with separable resource and imbursement financial plan reduces the cloud job implementations pan. The projected algorithm in [23] set aside resources for media Streaming requests and decreased the financial price of resource allotment in cloud. In [21], Hossain *et al*. have projected three consolidation systems to reducere location power transparency in venture data hubs. In [22], VM assignment difficulty for declining power expenditure was considered. .The writers projected sale-foundation and honest gluttonous devices for energetic VM stipulation and allotment. The aim in active VM allotment is the similar, but techniques are diverse. Heuristic and greedy-based algorithms were projected in [20] and [21]. We make use of GA to guess resource obligations in progress, and then projected VM assignment algorithm to make the most of resource consumption and to reduce power utilization.

The projected technique may be not capable to forecast a small number of burdens, though the amount of surprising burdens is little. Additionally, the writers did not demonstrate that how the heuristic algorithm forecasts the CPU and memory consumption in their trials. Last, the distinct figure linear indoctrination difficulty is dissimilar in our effort, A assessment of connected efforts is given in Table I.[13]

In this paper, we projected Versatile Genesiological Algorithm GA to forecast resource order animatedly and to reduce power utilization by make best use of the resource consumption of every lively PM.

Three purposes of the paper are planned as follows.

- E*nergetic Resource Forecast*. Together CPU and memory consumption should be forecasted exactly by the projected
- GA, no issue what kind of consumption propensity is.
- *Resource Consumption Maximization*. The resource consumption of an lively PM should be make best use of by means of the projected VM assignment algorithm; thus, the amount of lively PMs can be reduced.
- *Energy Preservation*. The amount of lively PMs should be reduced for decrease authority expenditure.[7]

The involvements of this paper are sum up as follows.

- A difficulty in resource allotment for cloud data hub is devised at the same time as make best use of both CPU and memory of every lively PM and reduce the power utilization of data hub.[10]
- The projected GA precisely forecasts the CPU and memory consumption in subsequently time gap, no substance the consumption propensity is steady lift and drop propensity or unbalanced variation propensity.
- The projected VM assignment algorithm moves VMs for the subsequently occasion gap found on the predict consequence of the projected GA. With the help of the VM assignment algorithm, there source consumption of each lively PM is make best use of, and the amount of lively PMs is reduced.[13]

Table 1: Comparison of Related Work [11]

Literatures	Grey Model	Skewness	Heuristics	Proposed GA
Optimization Method Offered	X	X	X	O
Resource utilization prediction	O	O	0	O
Diff. tendencies of resource utilization	X	O	X	O
VM migration considered	O	O	0	O
Energy Conservation	O	O	0	O
Dynamic Resource Allocation	X	O	O	O
No. of VMs & PMs	75&15	1400 & 40	1200 PMs	500 & 100
Resource Considered	CPU, memory	CPU, memory, n/w workload	CPU, memory	CPU, Memory Energy
Approach proposed	heurstics	Heurstics	heurstics	Meta Heurstics

Where, O - supported X - unsupported

3. Crisis Formulation
System Architecture

The system architecture is confined in Fig. 1. Network transportation is collected of routers, switches, and PMs. In this, VMs are layered in PMs. To observe and predictre source consumption, a administration nodule is organized in one disconnect PM. According to composed the past data, the administration nodule forecasts and transfers resource obligations for subsequently occasion gap. The old scheme structural design can be functional toa number of renowned data hub arrangements, e.g., tree organization, fat-tree, VL2, and BCube. [14]

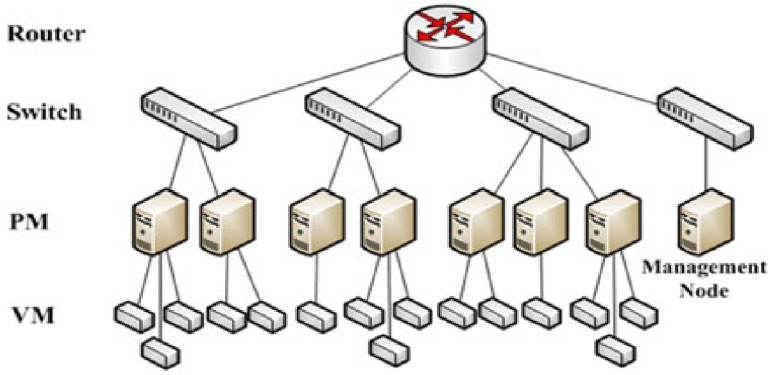


Figure 1: System Architecture.

These two data hub organizations are layered with layer 3 routers (comprise core routers and access routers) and layer 2 switches (include L2aggregation switches and L2 switches). The fat-tree organization is also alike to these two organizations, but it has a extra authentic meaning on connection such as ary and pods. As the scheme structural design in this effort is a tree-based and layered design, it can be functional to these arrangements with a small alteration of the unique arrangement.[9]

Table 2: Definition of Symbols[18]

Variable	Definition
$V = \{v_1, \ldots, v_m\}$	Set of VMs
$P = \{p_1, \ldots, p_n\}$	Set of PMs
$\mathbb{P}_j$	Binary decision variable of PM status
$\mathbb{V}_{i,j}$	Binary decision variable of VM allocation
$v_{i,j}^{\text{cpu}}$	CPU utilization of VM v_i in PM p_j
$v_{i,j}^{\text{mem}}$	Memory utilization of VM v_i in PM p_j
$v_{i,j}^{\text{eng}}$	Energy consumption of VM v_i in PM p_j
$v_{i,j}^{\text{bytes per request}}$	The average number of bytes used per request
$v_{i,j}^{\text{maximum bytes}}$	The maximum bytes allocated to VM v_i in PM p_j
p_j^{cpu}	CPU utilization of PM p_j
p_j^{mem}	Memory utilization of PM p_j
p_j^{eng}	Energy consumption of PM p_j
$T_{p_j}^{\text{cpu}}$	CPU time of PM p_j
p_j^{idle}	Power consumption of PM p_j in idle state
p_j^{max}	Maximum power consumption of PM p_j
$p_i^{\text{CPU clock cycle}}$	The number of clock cycles of PM p_j

4. Projected Algorithms
Resource Forecast by GA

There are a lot of metaheuristic algorithms for solving versatile crisis, such as simulated annealing (SA) [22], Tabu search(TS) [21], ant colony optimization (ACO) [23], particle swarm optimization (PSO) [15], and GA [16]. SA is a objective procedure that alters particle metal by warming and chilling. The entity is to obtain fresh molecular agreement. On the other hand, SA is simple to drop into limited hunt so that it is improper for judgment the best explanation. TS is offered with memory capability, which records preceding progress and preserves Tabu inventory. TS is superior and greater to SA since it has lesser possibility of obtaining provincial best resolution. Though, extreme memory obligations may guide to ignore the most favorable resolution.

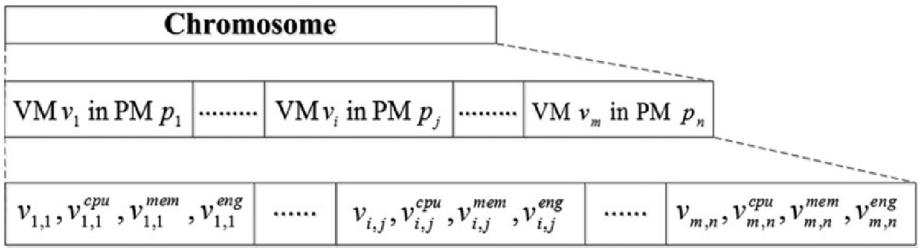


Figure 2: Proposed Genetic Material.

ACO depends on the amount of pheromones to resolve optimization crisis. On the other hand, it is not appropriate for recursively forecasting the resource consumption of data hub. In [7], have done an entire review work of metaheuristic scheduling techniques for clouds. PSO is appropriate for work out permanent optimization crisis but distinct difficulties. We believe that the inhabitants-founded GA is more suitable to predict resource consumption. In accumulation, the versatile GA gives improved explanations than lone purpose GA.

As the described crisis in this effort is an versatile dilemma, we use the idea of versatile GA to resolve the crisis. We resolve the versatile crisis of resource allotment for data hub supported on the forecast consequences of the recommended GA. GA is further well-organized and quicker than the Brute force search in phrases of search time and solution space. The obtained answer of GA subsequent to a absolute development procedure frequently do better than heuristic algorithms. The proposed chromosome is as shown in Fig. 2. [12]

The flowchart of the recommended GA for resource prophecy is shown as Fig.3. In the commencement, the information of resource consumption in preceding moment gap is stared as chronological facts. After that, these chronological facts are gathered into the companion pond. Note that we wait to realizelively resource prophecy and allotment; GA is constantly performed in the administration nodule. Two genetic materials are casually opt fore to be the parent genetic materials. In intersect process, parent genetic materials assistant with each other under intersect prospect *pc*. If the fitness value of offspring is better than parent genetic materials, it will be put into collection pond as a new generation. If not, GA implements transformation process with alteration possibilit y*pm*. If the fitness value of progeny is better than parent strings after transformation process, it will be put into collection pond as a new generation. On one occasion an progeny is located into the collection pond, the time state of assignment procedure should be scrutinized. The time involvedness of GA is majorly make a decision by its encoding, assortment, strength computation, intersect and transformation process with GA's invention integer and inhabitants volume.[5]

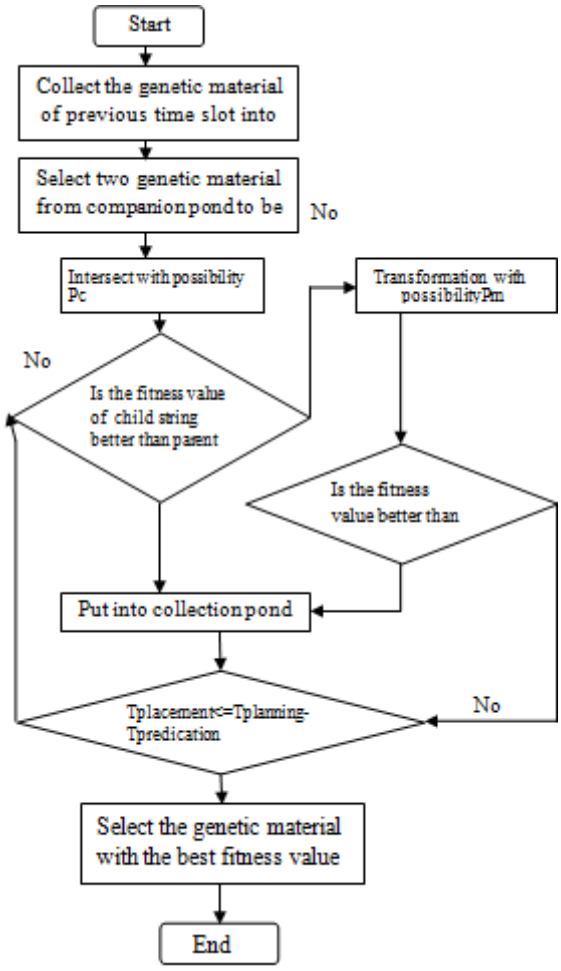


Figure 3: Flowchart of Proposed GA.

VM Position Algorithm

Following by means of GA to predict resource consumption the VM position algorithm is recommended to change VMs for make the most of resource consumption. The process of the recommended VM position algorithm is shown in Algorithm 1.[17]

Algorithm 1: VM Position Algorithm.

Input: V, P, $C^{\max}$, $M^{\max}$, $E^{\max}$

01 $\Omega_1 = v_m, \Omega_2 = p_n, \Delta = \phi$
02 **while** $\Omega_2 \neq \phi$
03 **repeat**
04 $y = f(j) = \max_{j \in \{1 \ldots n\}} [(C^{\max} - p_j^{\text{cpu}}) + (M^{\max} - p_j^{\text{mem}})]$
05 $y^* = \arg\max f(j)$
06 $S = f_d(\Omega_2, p_j, y^*)$
07 $\Delta = \Delta \cup S[1]$
08 **if** $(p_{S[n]}^{\text{cpu}} < C^{\max})$ and $(p_{S[n]}^{\text{mem}} < M^{\max})$
09 $v_{i,j} = v_{i,n}$
10 $p_{S[1]} = \phi$
11 **end if**
12 **until** $v_{i,j} = \Delta$
13 **end while**

According to the prophecy outcome of GA, the VM position algorithm intends to make the most of the regular of CPU and memory consumption and reduce the entire power utilization of data hub with the smallest amount of lively PMs. The position algorithm is accomplished at the end of each time slot after forecast. It should be come to an end and achieved before next time slot.

5. Recreation Outcomes

Resource Forecast Outcome

The implementation instance and invention of GA are examined when slot is timed from 0 to 30. The outcomes of implementation instance under steady and unbalanced propensity are confined in Fig. 4(a) and (b), and outcomes of invention under steady and unbalanced propensities are shown in Fig. 4(c) and (d).[10]

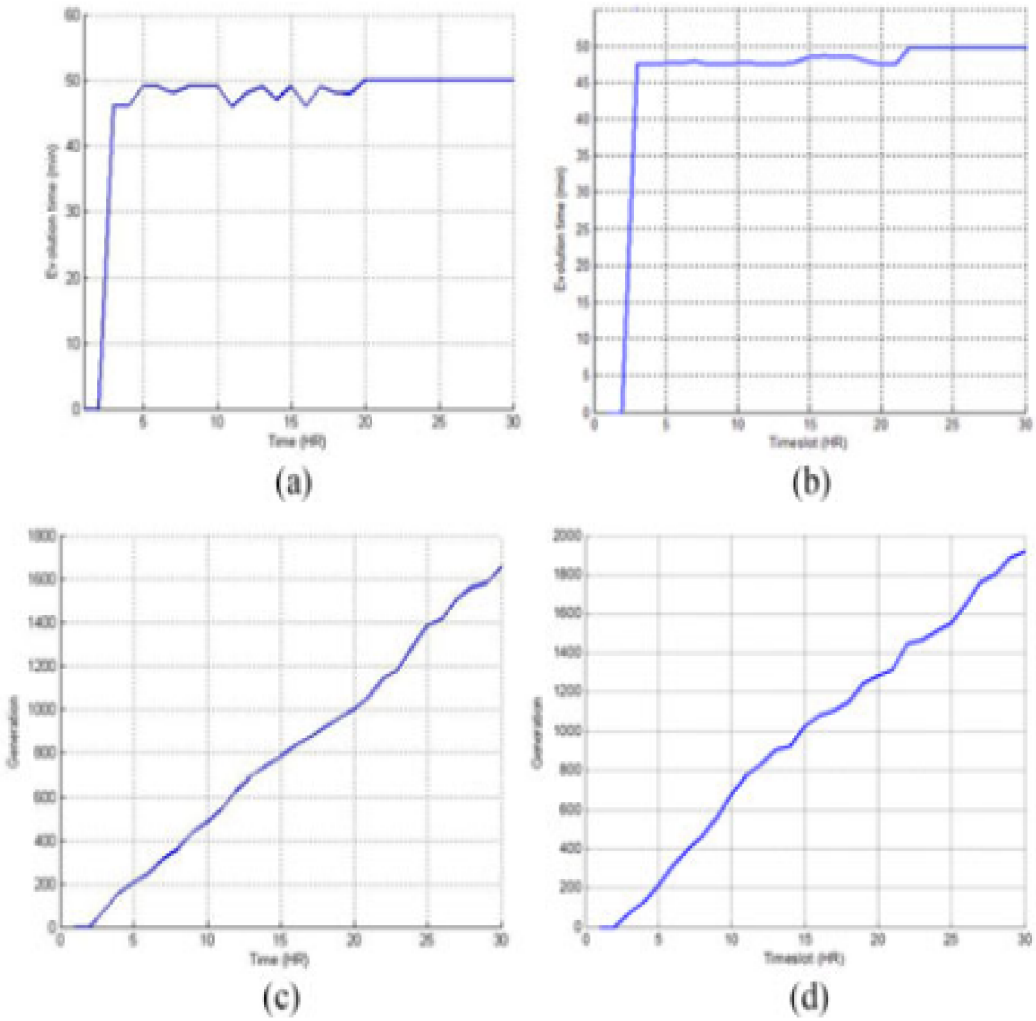


Figure 4: Implementation Instance and Invention of GA in the Diverse Time Gaps. (a) Implementation Time of Steady Propensity. (b) Implementation Time of Unbalanced Propensity. (c) Invention of GA in Steady Propensity (d) Invention of GA in Unbalanced Propensity.

The clarification achieved by GA for resource forecast under steady and unbalanced propensity is as shown in Fig. 5(a) and (b), particularly. In these two figures, yellow dots stand for standard results as well as progeny and red dots stand for the best results in 30 instance gaps. It can be scrutinized that the number of forecast outcomes under steady propensity is fewer than unbalanced propensity. [10]

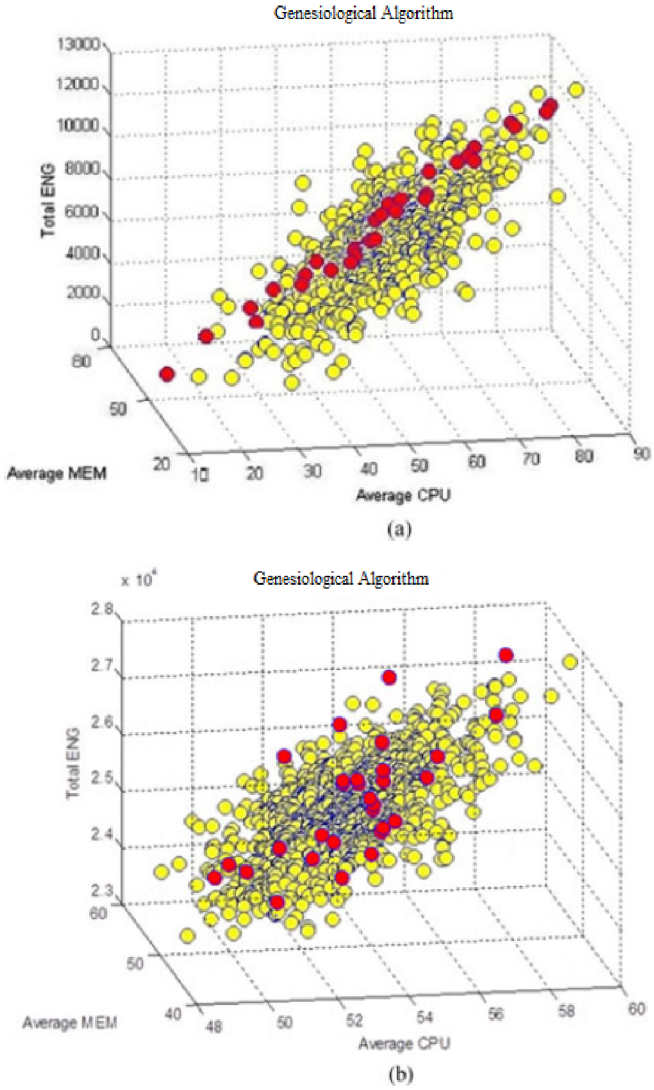
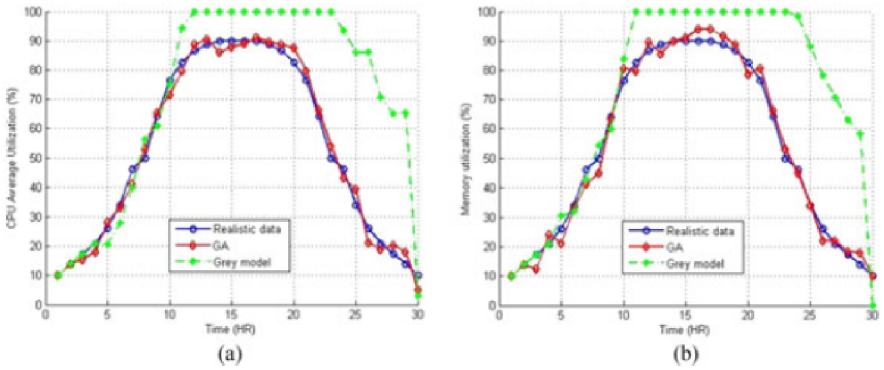


Figure 5: Best Result Achieved by GA for Resource Forecast. (a) Results Achieved by GA under Steady Propensity. (b) Results achieved by GA under Unbalanced Propensity.

The forecast outcomes of GA and Grey model are examined when slot is timed from 0 to 30. The forecast outcomes of resource consumption and power utilization under steady hoist and drop propensity are shown in Fig. 6. The standard CPU and memory consumption of PMs are shown in Fig. 6(a) and (b), and the energy utilization of data hub is shown in Fig. 6(c). [16]



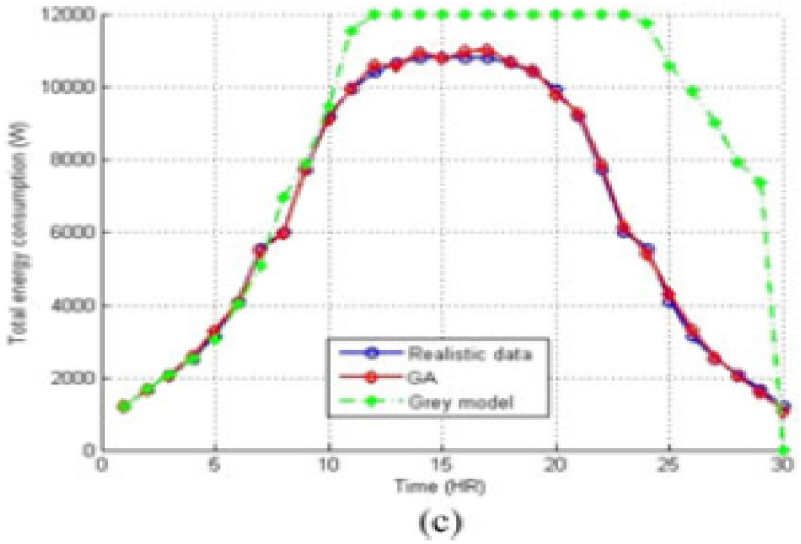
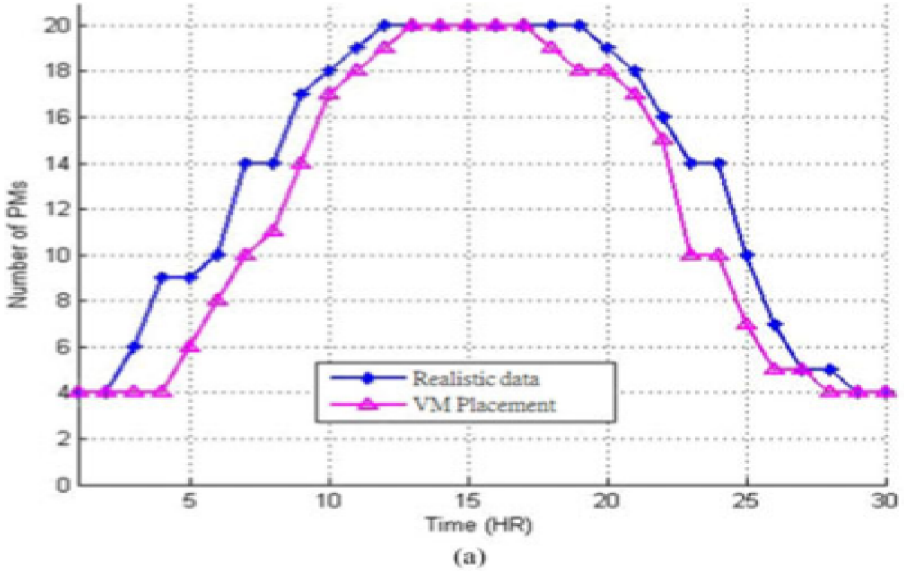


Figure 6: Forecast Outcomes of the GA and Grey Model under Steady Lift and Drop Propensity. (a) CPU Consumption. (b) Memory Consumption. (c) Energy Utilization.

VM Position Outcomes

The position outcome of the recommended VM position is examined. The VM position algorithm is accomplished of wandering VMs from a PM with little consumption to a PM with high usefulness, so that the standard of CPU and memory consumption can be recovered. In accumulation, the PM with little resource consumption is close up after all VMs are wandered. As a result, the energy utilization of data hub can be decreased. The recommended VM position algorithm realizes the privileged standard resource consumption of PMs and the lesser energy utilization of data hub than others proposals. The complicated resource allotment crisis of unbalanced consumption can be resolved by the recommended approach. The amount of lively PMs after VM position is examined.[12]

The outcomes of steady and unbalanced propensity are depicted in Fig. 7 (a) and (b). It can be examined that VM position algorithm professionally reduces the amount of lively PMs in equally resource propensity. The lesser energy utilization is featured to the actuality that fewer lively PMs with advanced resource consumption are accomplished. The enhancement in amount of lively PMs under unbalanced propensity is further noticeable than that under steady.



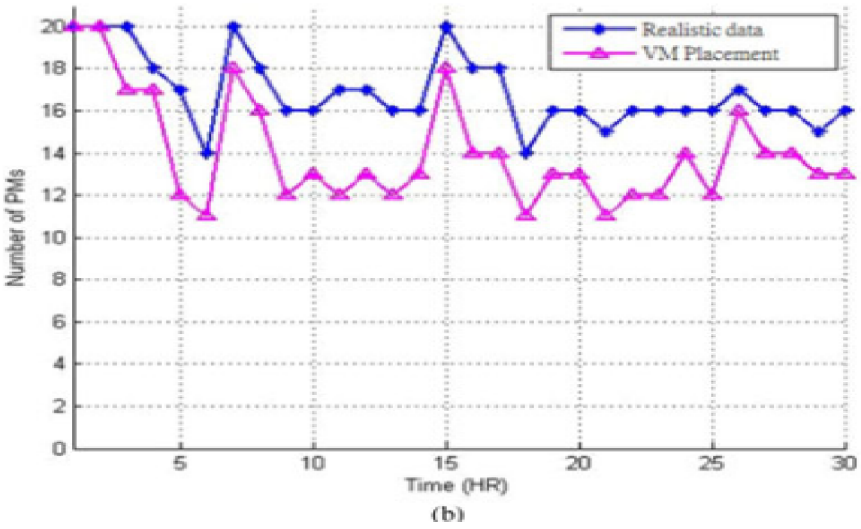
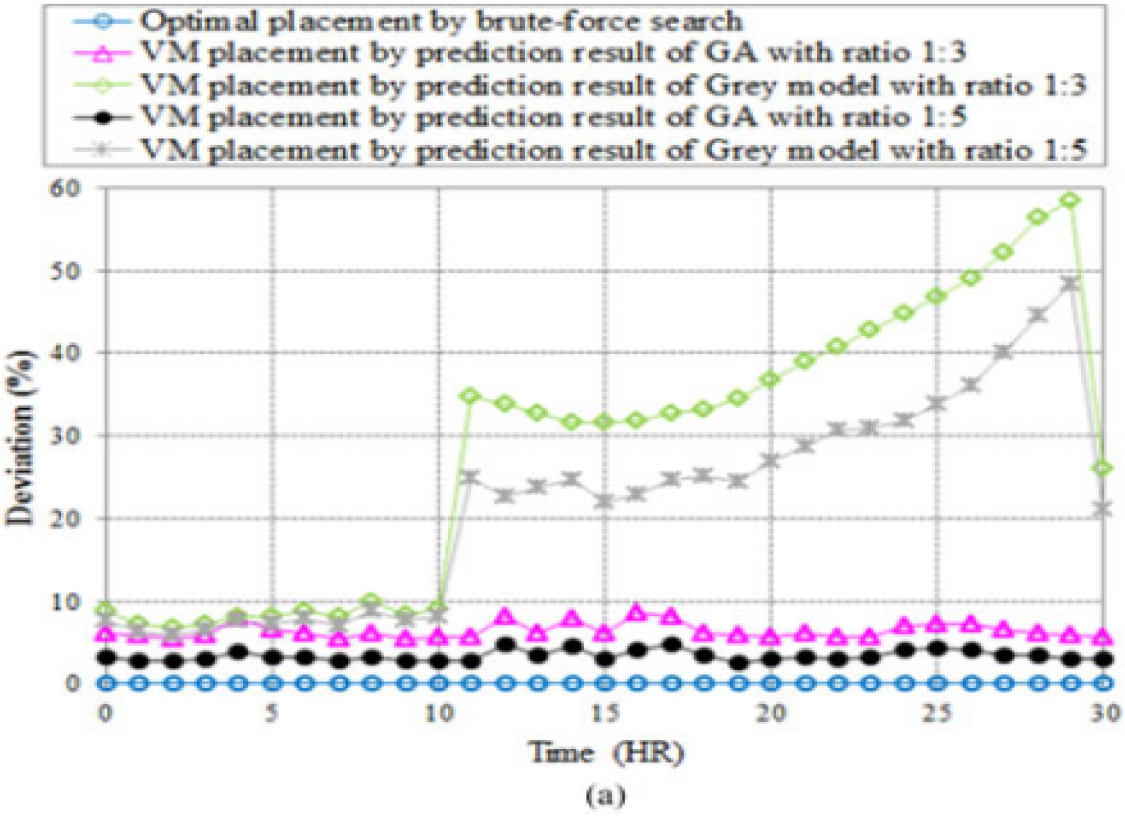


Figure 7: Amount of Lively PMs after VM Position. (a) Amount of lively PMs in the Steady Propensity. (b) Amount of Lively PMs in the Unbalanced Propensity.

The variation of the recommended VM position algorithm from the best position outcome is shown in Fig.8. The best position outcome is achieved by means of the brute-force search technique supported on the resource consumption of past information. The brute-force search technique comprehensively investigates all probable VM position outcomes and chooses a clarification with the most excellent strength significance as best resolution. Still even if it is tough to calculate the resource consumption under unbalanced propensity, the position outcome with GA's forecast immobile come near the best outcome appropriate to the superior forecast outcome of the recommended GA.[15]



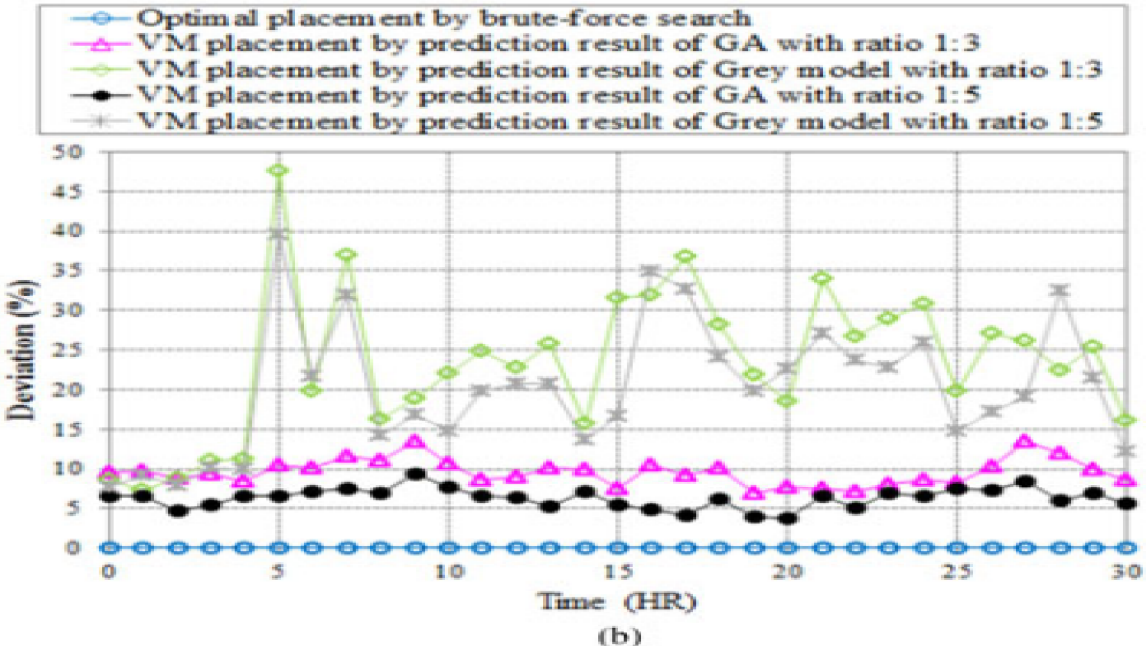


Figure 8: Variation of the Suggested Algorithm from the most Favorable Result (a) Variation under Steady Lift and Drop Propensity. (b) Variation under Unbalanced Instability Propensity[4]

6. Conclusions

Aiming the dispute matters of cloud resource optimization, we have suggested a innovative forecast method supported on GA for attractive forecast correctness in cloud information hub. We have also recommended a VM position algorithm for civilizing the standard of resource consumption and dropping the energy utilization of data hub supported on the forecast outcomes from GA. Recreation outcomes demonstrated that the suggested GA is better in forecast correctness to the Grey model in conditions of CPU consumption, memory deployment, and energy utilization no issue in steady or unbalanced consumption propensity. Additionally, the recommended VM position algorithm gets better the resource consumption of PMs and reduces the energy utilization of information hub with fewer lively PMs. We have also demonstrated that the suggested technique under minor consumption give ways extra understandable developments on resource consumption and energy preservation. Furthermore, he forecast method develop into additional precise in superior relation of PMs to VMs because of the better capacity and variety of chronological information. In the future, we look forward to assessment the suggested GA with the Google information hub suggestions to authenticate its forecast correctness. Additionally, we propose to evaluate the recommended GA in opposition to other metaheuristics, and understand the advised method to sensible cloud atmospheres.

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LEXICOGRAPHIC GOAL PROGRAMMING APPROACH FOR TIME MANAGEMENT INFOOD MAKING INDUSTRY FOR LARGE PROJECTS WITH THE HELP OF MOST

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ABSTRACT

In this highly competitive industrial environment, the growth and development of any new firm or industry and making market is very difficult. To develop unique concept for the management model in the industry to achieve the targets of large projects, operation research analyst and data scientist are working in this field to enhance the production and growth of the industry. The paper contains optimal method which will surely help operation research analyst in making unique and productive concept for increasing production in food making Industry. The constraints associated with the time management in the industries are time allocation in selection of market area according to demand of food, time optimization in assignment of man power, time management in enhancing flexible online delivery of the food, time associated with use of machines, time in decision making of current cost of food according to session, time management in developing innovative ideas for the development of the firm as per changed COVID environment and time allocation in advertisement of the firm. To achieve above multiple conflicting goals, lexicographic goal programming and MOST (Management operation system technique) is used which gives a direct impression to the management to assess the present status of the project and expected date of completion of various activity as on the date of review and hence the optimal solution will enhance economic growth in the country.

Keywords: *Multiple Objective Programming, Lexicographic Goal Programming, MOST, Operation Research Analyst, Time Management.*

1. Introduction

Goal programming is a method to solve multiple objective programming. This is an extension of linear programming. Goal programming was first used by Charnes, Cooper and Ferguson in 1955, for optimal estimation of executive compensation by linear programming. The actual name was first appeared in 1961 by Charnes and Cooper, for management models and industrial applications of linear programming (O.R. theory and application by J K SHARMA). The major strength of goal programming is its ease of use and simplicity, due to which it contains large number of application in every field. Goal programming is branch of multiple optimizations, which in turn is a branch of multiple criteria decision making (MCDM) [S-Kalavathy]. Iserman [1982], Sherali [1982], Ignizio [1983] introduced lexicographic goal programming. Lexicographic goal programming is used when priority level of each goal is clear. It is also called pre-emptive goal programming. In lexicographic goal programming models priority level is set with all the goals. The goal with higher priority level is achieved first after that goal with second priority level is achieved but not at the cost of first goal and so on. MOST (Management operation system technique) is graphical presentation of PERT (Program evolution and review technique) to a time scale. The target date is taken as zero date of completion of the project. The expected date of start and completion of other activities based on zero date of completion are shifted to left side of the graph indicating inter-dependencies of the activities by a line. This gives a direct impression to the management to assess the present status of the project and expected date of completion of various activities as on the date of review (O.R. theory and application by J K SHARMA). Here, in present paper lexicographic goal programming and MOST helps in achieving the multiple goals associated with the large projects such as time allocation in selection of market area according to demand of food, time optimization in assignment of man power, time management in enhancing flexible online delivery of the food, time associated with use of machines, time in decision making of current cost of food according to session, time management in developing innovative ideas for the development of the firm as per changed COVID environment and time allocation in advertisement of the firm.

2. Methodology: Combination of Two Methods to Provide Innovative Optimal Solution

2.1 Lexicographic Goal Programming Model

Minimize $Z = \sum P_i(d_i^+ + d_i^-)$
Subject to constraints
$\sum Aij\ Xj + d_i^- - d_i^+ = b_i$
With non-negative restriction
$Xj, d_i^+, d_i^- \geq 0$
Where Aij = decision matrix associated with the Goals.
d_i^+= Over achievement of the i^{th} goal.
d_i^-= under achievement of the i^{th} goal.
P_i=priority level associated with i^{th} goal.

2.2 MOST (Management Operation System Techniques)

MOST is a graphical representation of PERT (Program Evaluation and Review Technique) to a time scale. The target date is taken as a zero date of completion of project. The expected date of start and completion of other activities based on zero date of completion are shifted to the left side of the graph indicating inter-dependencies of the activities by a line. The completion of various activities on a date of review are drawn on the same graph with solid horizontal lines so that target and completion, even in parts, may be shown in the same graph. This gives a direct impression to the management to assess the present status of the project and expected date of completion of various activities as on the date of review. This will help in achieving the large projects goals and growth in the industry.

2. Goals to Inhance Production in Food Manufacturing Industries

Let
X1 = Time taken by workers per day.
X2 = Time taken by operation research analystper day.

- **GOAL 1** = time allocation in selection of market area according to demand of food.
- **GOAL 2** = time optimization in assignment of man power.
- **GOAL 3** = time management in enhancing flexible online delivery of the food.
- **GOAL 4** = time associated with use of machines.
- **GOAL 5** = time taken in decision making of current cost of food according to session.
- **GOAL 6** = time management in developing innovative ideas for the development of the firm as per changed COVID environment.
- **GOAL 7** = time allocation in advertisement of the firm.

2.1 Priority Level Associated with each Goals with the Help of Case Study

- **P1** = GOAL 2 should be achieved first.
- **P2** = GOAL 6 should be achieved after the fulfillment of GOAL 2.
- **P3** = GOAL 1 should be achieved after the fulfillment of GOAL 6.
- **P4** = GOAL 4 should be achieved after the fulfillment of GOAL 1.
- **P5**= GOAL 5 should be achieved after the fulfillment of GOAL 4.
- **P6** = GOAL 3 should be achieved after the fulfillment of GOAL 5.
- **P7** = GOAL 7should be achieved after the fulfillment of GOAL 3.

2.2 Positive and Negative Deviations Associated with each Goal

- **f1** = underachievement of time allocation in selection of market area according to demand of food.
- **m1** = overachievement of time allocation in selection of market area according to demand of food.
- **f2** = underachievement of time optimization in assignment of man power.
- **m2** = overachievement of time optimization in assignment of man power.
- **f3** = underachievement of time management in enhancing flexible online delivery of the food.
- **m3** = overachievement of time management in enhancing flexible online delivery of the food.
- **f4** = underachievement of time associated with use of machines.
- **m4** = overachievement of time associated with use of machines.
- **f5**= underachievement of time in decision making of current cost of food according to season.

- **m5=** overachievement of time in decision making of current cost of food according to season.
- **f6=** underachievement of time management in developing innovative ideas for the development of the firm as per changed COVID environment.
- **m6**= overachievement of time management in developing innovative ideas for the development of the firm as per changed COVID environment.
- **f7**=underachievement of time allocation in advertisement of the firm.
- **m7**= overachievement of time allocation in advertisement of the firm.

3. Lexicographic Goal Programming Model Formulation for Food Makking Industries

Lex min Z =P1m2 + P2f6 + P3m1 +P4f4 +P5f5 + P6m3 + P7m7
Subject to constraint

$$\sum_{i=1}^{7}\sum_{j=1}^{2} Aij\ Xj + fi - mi = bi$$

With non-negative restriction
Xj, fi, mi ≥ 0, Where Aij = decision matrix associated with the Goals

4. An Illustrative Example of Momo's making Industries to Optimize the Time in the Achievement Goals Associated with Large Projects

A Momo's making company has efficiency to make 22000 Momo's in a day. Currently the company is producing 14000 Momo's in a day. The company receives a large project in which company has to deliver 18000 Momo's per day. Working hours of company is divided in two shifts 10am to 10pm and 10 pm to 4 am. The following are the work associated with the number of workers and number of operation research analyst available for respective work with availability of time per day shown in the Table 1.

Table 1:GOALS and Number of Hours Available to Complete the Goals

GOALS	Number of Worker (Ai1)	Number of Operation Research Analyst (Ai2)	Number of Hours Available (bi)
GOAL 1	2	1	8
GOAL 2	0	3	6
GOAL 3	5	2	8
GOAL 4	3	1	7
GOAL 5	0	2	4
GOAL 6	1	2	4
GOAL 7	4	0	5

4.1. Lexicographic Goal Programming Model for Time Management in Momo's making Industry with the help of Above Table.

Lex min Z = P1m2 + P2f6 + P3m1 +P4f4 +P5f5 + P6m3 + P7m7
Subject to
Hard Constraints
To achieve the target of 18000 Momo's, the company have maximum of 12 hours per day.
4X1 + 3X2 ≤ 20
Soft constraints
2X1 + 1X2 + f1 – m1 = 8
0X1 + 3X2 + f2 – m2 = 6
5X1+ 2X2 + f3 – m3 = 8
3X1+ 1X2 + f4 – m4 = 7
0X1+ 2X2 + f5 – m5 = 4
1X1 + 2X2 +f6- m6 = 4
4X1+ 0X2 + f7 – m7 = 5
With non - negative restriction
Xj, fi, mi ≥ 0
Now, after the formulation of optimization model for Momo's making company, the decision maker still faces complexity after the start of work. The pressure is always on the operation manager to complete the project on time. To solve such problems MOST network diagram gives the estimated time for completion of work and also give current information regarding the running project.

4.2 MOST Network Diagram for Momo's Making Company

Table 2: Represents the Goals with their Time duration and Preceding Goals.

GOALS	PRECEDING (GOALS)	GOALS DURATION
G1	-	8
G2	-	6
G3	-	8
G4	-	7
G5	G1,G2	4
G6	G5	4
G7	G6	5

Using the precedence relationship among the activities, the resulting network is shown in fig. 1 below.

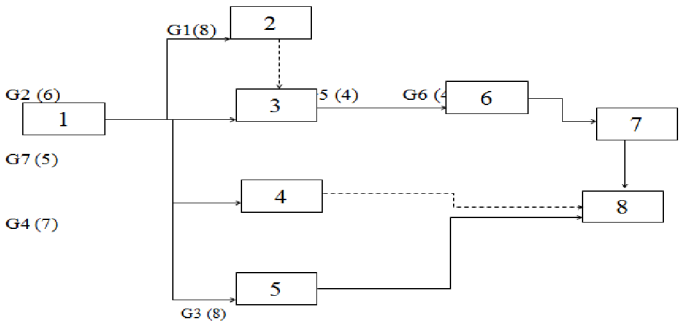

Figure 1

Now, to calculate the project completion time, we compute the earliest time, Ei and late finish time Lj for each goal of the project. For it we proceed as follows:

Ei = Earliest occurrence time of event i.

Lj = Latest occurrence time of event j.

tij = Duration of activity(i , j).

- Forward pass calculation = starting from initial node 1 with starting time of the project zero (E1 = 0). Proceed through the network visiting nodes in an increasing order of node number and end at final node of the network.
- Backward pass calculation = starting from final node of the project and proceed through the network visiting nodes in decreasing order.
- Total Float = Difference between earliest finish time and latest finish time of activity.

Goals Chart with Earliest Finish Time and Latest Finish Time of each Goal

Here, Ei= max {Ei-1 + tij}

Lj-1 =min {Lj – tij}

where i = 1, 2, 3, 4, 5, 6, 7, 8.

j = 2, 3, 4, 5, 6, 7, 8.

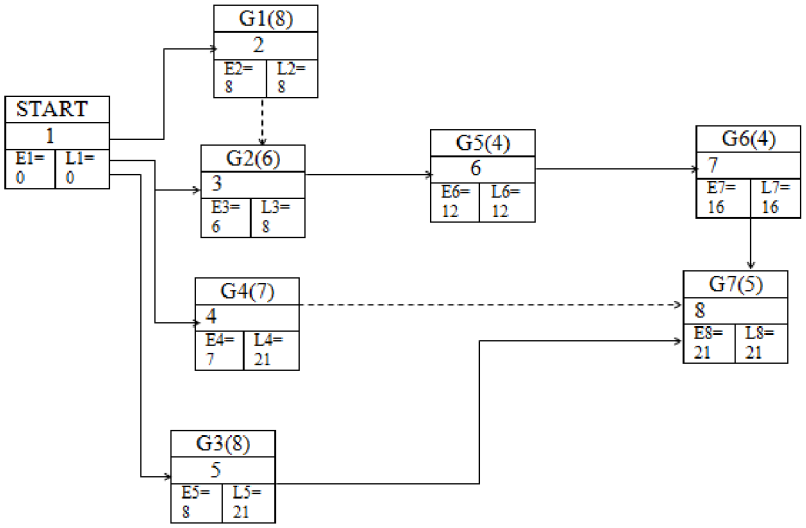

Figure 2

Forward Pass Calculation

E1 = 0 ;
E2= E1+ t12 = 0 + 8 = 8;
E3 = E1 + t13 = 0 + 6 = 6;
E4 = E1 + t14 = 0 + 7 = 7;
E5 = E1 + t15 = 0 + 8 = 8 ;
E6 = Max { E2 + t26, E3 + t36} = 12;
E7 = E6 + t67 = 16;
E8 = Max {E7 + t78, E4 +t48, E5 + t58} = 21.

Backward Pass Calculation

L8 = E8 = 21;
L7 = L8 – t78 = 16
L6 = L7 - t67 = 12;
L5 = L8 - t58 = 21;
L4 = L8 – t48 = 21;
L3 = L6 – t36 = 8;
L2 = L6 - t26 = 8;
L1 = min {L2 - t12, L3 - t13, L4 - t14, L5 - t15} = 0.

The critical path analysis from fig. 2 is:
1 ⟶ 2678 ⟶ and the project duration time is of 21 hours.

Thus, to achieve the goals per day, company should work one hour extra.

Time Scale for Current Status of Project

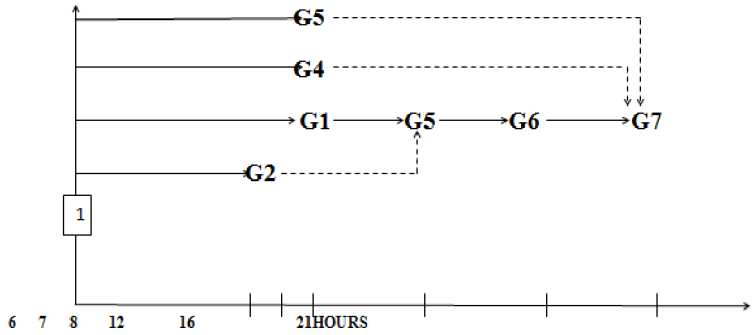

Figure 3

Result

With the use of lexicographic goal programming approach we find the method to enhance the production in food making industries with hierarchy of priority attached with each goal. Goal with higher priority level should be achieved first after that goal with second priority level achieved but not at the cost of first priority level. With the help of excel solver, the following results are obtained:X1 = 3.875 ; X2 = 1.5; f1 = 0; f2 = 0; f3 = 0; f4 = 0; f5 = 1; f6 = 0; f7 = 0; m1 = 1.25; m2 = 0; m3 = 14.375; m4 = 6.125; m5 = 0; m6 = 2.875; m7 = 10.5 and Min Z = 127515.4. After optimization, with the help of MOST network diagram, we determine the earliest time (Ei) and latest time (Li) of the project shown in fig 2. We find from above calculation of two methods that the Momo's making company should add 1 hour extra in their total working time to achieve the target of the project (Shown in Fig.2). The time scale present in fig.3 gives complete information about the project.

Conclusion

In this paper lexicographic goal programming is used which surely help industries in decision making and help them in time management for growth and development of industries. It will also help entrepreneurs in seeking ideas for the establishment of new firm and reduces the complexity of decision making. This paper helps industries to increase their production by applying advance techniques and whenever they got any large project, this paper will surely help them in decision making in assigning manpower and time accordingly. The paper contains MOST network diagram which gives a direct impression to the management to assess the present status of the project and expected date of completion of various activities as on the date of review.

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