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Application of Matrices in Human's Life

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Abstract: In this paper, applications of matrices in human's life may be presented by being used the basic concepts of matrices, i.e., addition and multiplication of two matrices, and then, being obtained the determinant of a matrix and the corresponding eigen-values and eigen-vectors. The inverse of a given matrix may be obtained by Gauss's Elimination and Gauss-Jordan. It is essential for this paper.

Keywords: Markov Process, Stochastic Matrix, Gauss Elimination, Gauss-Jordan, eigen-values and eigen-vectors.

1. INTRODUCTION

This paper contains three parts. Firstly, the basic concepts, i.e., definition of a matrix, operations of matrices, classes of real square matrices, will be introduced.

In second portion, matrix eigen values problems containing eigen-values and eigen-vectors, i.e., in Economics, in Engineering problems. Eigen values may be obtained with determinant of $(A - \lambda I)$ is equal to zero and then, the corresponding eigen-vector may be obtained.

Finally, the problem of human's life, Deformation of circular to ellipse, Mixing problem including two tanks, Electrical network problems will be solved with applications of matrices eigen-value problems.

2. TYPESET TEXT

2.1 Definition of a Matrix

A matrix is a rectangular array of numbers (or functions) enclosed in brackets. These numbers function are called entries or elements of the matrix.

A matrix can be denoted by capital boldface letters A, B, C and so on or by writing the general entry in brackets; thus **A**=[a_{jk}], and so on. By an $m \times n$ matrix, we mean a matrix with m rows and n columns. Thus an $m \times n$ matrix is of the form

$$A = [a_{jk}] = \begin{bmatrix} a_{11} & a_{12} \dots & a_{1n} \\ a_{21} & a_{22} \dots & a_{2n} \\ a_{m1} & a_{m2} & a_{mn} \end{bmatrix}$$

A matrix that is not square is called a rectangle matrix. A matrix is a rectangular array of numbers (or functions) enclosed in brackets. These numbers function are called entries or elements of the matrix.

In the double-subscript notation for the entries, the first subscript always denotes the row and the second the column in which the given entry stands. Thus a_{23} is the entry in the second row and third column.

If $m = n$, we call A an $n \times n$ square matrix. Then its diagonal containing the entries a_{11} , a_{22}, … , a_{nn} is called the main diagonal or principal diagonal of A. A matrix that is not square is called a rectangle matrix.

2.2 Inverse of a Matrix

The inverse of a matrix may be obtained by Gauss-Jordan Elimination in the form

A $A^{-1} = A^{-1} A = I$

2.3 Matrix Eigenvalue Problem

The matrix eigen-value problem may be solved as following procedure.

$$AX = \lambda X \rightarrow (A - \lambda I)X = 0 \;\&\; |A - \lambda I| = 0$$

2.4 Vectors in terms of Matrices

If a matrix has only one row, then the matrix is said to be a row vector and a matrix with only one column is known as a column vector. In both cases, its entries are vector components and denote the vector by $a = [a_j]$.

2.5 Definition of Matrix Addition

Addition is definition only for matrices A= $[a_{jk}]$ *and* B= $[b_{jk}]$ of the same size; their sum, written A + B , is then obtained by adding the corresponding entries. Matrices of different sizes cannot be added.

2.6 Definition of Scalar multiplication

The product of any matrix A, whose dimension is $m \times n$, i.e., A has m number of rows and n number of columns. In notation, A = $[a_{jk}]$, where j = 1, 2, 3, . . ., m and k = 1, 2, 3, . . ., n, and any scalar c may be written by cA. The product of a matrix and any scalar is also another matrix of same dimension as given matrix. So, cA is also an $m \times n$ matrix.

c A= $[ca_{jk}]$ obtained by multiplying each entry in A by c.

2.7 Properties of matrices

Addition of matrices which have same dimensions obey commutative, associative, identity, inverse properties. In symbol,

(a) $A + B = B + A$

(b) $(U + V) + W = U + (V + W)$

(c) $0 + A = A$

(d) $A + (-A) = 0$

Both multiplication of a scalar with the sum of two or more matrices and multiplication of a matrix with the sum of two or more scalars obey the distributive law. Moreover, scalar multiplication of the matrix, it is obtained by the scalar multiplication of a given matrix with a scalar, with another scalar obey the associative law. Lastly, scalar multiplication obey the identity property. These are

(a) $c(A + B) = cA + cB$

(b) $(c + k)A = cA + kA$

(c) $c(kA) = (ck)A$

(d) $IA = A$

2.8 Nodal Incidence Matrices

(e) In a Nodal Incidence Matrix, its entries may be written as

(f) $a_{jk} = \begin{cases} +1, & if\ branch\ k\ leaves\ node\ j \\ -1 & if\ branch\ k\ enters\ node\ j \\ 0, & if\ branch\ k\ does\ not\ touch\ node\ j \end{cases}$

2. 9 Transposition of a matrix

Consider a matrix $A = [a_{jk}]$ is of the form

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \dots & a_{1m} \\ a_{21} & a_{22} & a_{23} \dots & a_{2m} \\ a_{31} & a_{32} & \cdots & a_{3m} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nm} \end{bmatrix};$$

$$A^T = \begin{bmatrix} a_{11} & a_{21} & a_{31} \dots & a_{n1} \\ a_{12} & a_{22} & a_{32} \dots & a_{n2} \\ a_{13} & a_{23} & \cdots & a_{n3} \\ \vdots & \vdots & \vdots & \vdots \\ a_{1m} & a_{2m} & \cdots & a_{nm} \end{bmatrix}$$

Although A is an $n \times m$ matrix A^T is now a $m \times n$ matrix. Hence a matrix and its transport matrix may not have the same dimension. But a square matrix and its transport have same dimension.

2.10 Classes of Real Square Matrices

(Symmetric, Skew-symmetric, and Orthogonal)

Definitions

Consider a real square matrix A = $[a_{jk}]$. Then,

(a) $A^T = A$, i.e., $a_{kj} = a_{jk}$. Then, A is symmetric.

(b) $A^T = -A$, i.e., $a_{kj} = -a_{jk} \rightarrow$ A is skew-symmetric.

(c) $A^T = A^{-1}$, i.e., $A^T = A^{-1} \rightarrow$ A is orthogonal matrix.

3. MATRIX EIGEN VALUE PROBLEM

3.1 Solution of Linear Systems:

Fundamental Theorem for linear systems

3.1.1Existence

A linear system of m equations in n unknowns $x_1, x_2, x_3, \dots, x_n$ may be

$$x_1 + a_{12}x_2 + a_{13}x_3 + \cdots + a_{1n}x_n = b_1$$
$$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + \cdots + a_{2n}x_n = b_2 \quad (1)$$
$$\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$
$$a_{m1}x_1 + a_{m2}x_2 + a_{m3}x_3 + \cdots + a_{mn}x_n = b_n$$

This may be written by $AX = b$, where

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \vdots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix},$$

$$\tilde{A} = \begin{bmatrix} a_{11} & \cdots & a_{1n} & | & b_1 \\ \vdots & \vdots & \vdots & | & b_2 \\ a_{m1} & \cdots & a_{mn} & | & b_n \end{bmatrix},$$

$$X = \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix},\ b = \begin{bmatrix} b_1 \\ \vdots \\ b_n \end{bmatrix},$$

The given linear system is consistent, that is, it has solutions, if and only if the coefficient matrix A and the augmented $\tilde{A}$ have the same rank, say p, i.e., rank of A = rank of $\tilde{A} \leq n$.

3.1.2 Uniqueness

The system (1) has precisely one solution if and only if A and $\tilde{A}$ have the common rank r and r = n. Rank of A = Rank of $\tilde{A}$ = r = n.

3.1.3 Infinitely many solution

The system (1) has infinitely many solutions if and only if A and $\tilde{A}$ have the common rank r, where $r < n$.

rank of A = rank of $\tilde{A} < n$.

3.2 Cramer's Rule

$$x_1 + a_{12}x_2 + a_{13}x_3 + \cdots + a_{1n}x_n = b_1$$
$$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + \cdots + a_{2n}x_n = b_2$$
$$\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$
$$a_{m1}x_1 + a_{m2}x_2 + a_{m3}x_3 + \cdots + a_{mn}x_n = b_n$$

Then, $x_1 = \frac{D_1}{D}, x_2 = \frac{D_2}{D}, \dots, x_n = \frac{D_n}{D}$, where

$$\det A = D = \begin{vmatrix} a_{11} & a_{12} & a_{13} \dots & a_{1m} \\ a_{21} & a_{22} & a_{23} \dots & a_{2m} \\ a_{31} & a_{32} & \cdots & a_{3m} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nm} \end{vmatrix}$$

$$.D_1 = \begin{vmatrix} b_1 & a_{12} & a_{13} \dots & a_{1m} \\ b_2 & a_{22} & a_{23} \dots & a_{2m} \\ b_3 & a_{32} & \cdots & a_{3m} \\ \vdots & \vdots & \vdots & \vdots \\ b_n & a_{n2} & \cdots & a_{nm} \end{vmatrix}, D_2 = \begin{vmatrix} a_{11} & b_1 & a_{13} \dots & a_{1m} \\ a_{21} & b_2 & a_{23} \dots & a_{2m} \\ a_{31} & b_3 & \cdots & a_{3m} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & b_n & \cdots & a_{nm} \end{vmatrix}$$

3.3 Applications of Matrices

(*EIGEN-VALUED PROBLEMS IN HUMAN'S LIFE*)

3.3.1 Matrix Time Vector, Weight Watching.

Suppose that in a weight-watching program, a person of 185 pounds burns 350 calories per hour in walking (3 miles per hour), 500 calories per hour in bicycling (13 miles per hour) and 950 calories per hour in jogging (5.5 miles per hour). Bill, weighing 185 pounds, plans to exercise according to the matrix shown. Verify the calculation.

(W= Walking, B= Bicycling, J= Jogging).

$$\begin{Bmatrix} \text{Monday} \\ \text{Wednesday} \\ \text{Friday} \\ \text{Saturday} \end{Bmatrix} \begin{bmatrix} w & b & j \\ 1.0 & 0 & 0.5 \\ 1.0 & 1.0 & 0.5 \\ 1.5 & 0 & 0.5 \\ 2.0 & 1.5 & 1.0 \end{bmatrix} \begin{bmatrix} 350 \\ 500 \\ 950 \end{bmatrix} = \begin{bmatrix} 825 \\ 1325 \\ 1000 \\ 2400 \end{bmatrix} \begin{matrix} \text{Monday} \\ \text{Wednesday} \\ \text{Friday} \\ \text{Saturday} \end{matrix}$$

Total calories lost = 5500 or 1.6 lb per week.

3.3.2 Markov Process with Stochastic Matrix

Suppose that the 2004 state of land use in a city of 60 mi^2 of built-up area is Commercially Used, C 25%, Industrially Used, I 20% and Residentially Used, R 55%. Apply Markov Process to be determined the probabilities of state of land in Commercially Used, Industrially Used and Residentially Used in 2009, 2014 and 2019.Assume that the transition probabilities for 5-year intervals are given by the Stochastic Matrix A.

$$A = \begin{bmatrix} From\ C & From\ I & From\ R \\ 0.7 & 0.1 & 0 \\ 0.2 & 0.9 & 0.2 \\ 0.1 & 0 & 0.8 \end{bmatrix} \begin{matrix} To\ C \\ To\ I \\ To\ R \end{matrix}$$

A is a stochastic matrix, that is, a square matrix with all entries nonnegative and all column sums equal to 1. Our example concerns a Markov process, that is, a process for which the probability of entering a certain state depends only on the last state occupied (and the matrix A), not on any earlier state.

Solution: Markov Process with Stochastic Matrix

Let the column vector x denote the 2004 state. Then,

$$y^T = x^T A,\ z^T = y^T A,\ u^T = z^T A,$$

$$A = \begin{bmatrix} 0.7 & 0.1 & 0 \\ 0.2 & 0.9 & 0.2 \\ 0.1 & 0 & 0.8 \end{bmatrix},$$

$x = \begin{bmatrix} 25 \\ 20 \\ 55 \end{bmatrix}$ and $x^T = \begin{bmatrix} 25 \\ 20 \\ 55 \end{bmatrix}^T = [25 \quad 20 \quad 55]$.$y^T, z^T, u^T$must be calculated for required solutions.

Let y denote the 2009 state. Then,

$$y^T = x^T A = [25 \quad 20 \quad 55] \begin{bmatrix} 0.7 & 0.1 & 0 \\ 0.2 & 0.9 & 0.2 \\ 0.1 & 0 & 0.8 \end{bmatrix}$$

$$y^T = [19.5 \quad 34 \quad 46.5]$$

Let z denote the 2014 state. Then,

$$z^T = y^T A = [19.5 \quad 34 \quad 46.5] \begin{bmatrix} 0.7 & 0.1 & 0 \\ 0.2 & 0.9 & 0.2 \\ 0.1 & 0 & 0.8 \end{bmatrix}$$

$$z^T = [17.05 \quad 43.8 \quad 39.15]$$

Let u denote the 2019 state.

$$u^T = z^T A = [17.05 \quad 43.8 \quad 39.15] \begin{bmatrix} 0.7 & 0.1 & 0 \\ 0.2 & 0.9 & 0.2 \\ 0.1 & 0 & 0.8 \end{bmatrix}$$

$$u^T = [16.315 \quad 50.660 \quad 33.025]$$

In 2009, the commercial area will be 19.5% (11.7 mi^2), the industrial 34% (20.4 mi^2) and the residential 46.5% (27.9 mi^2).

For 2014, the commercial area will be 17.05%(10.23 mi^2), the industrial 43.8% (26.28 mi^2)and the residential 39.15% (23.49 mi^2).

The next 5 year after 2014, the commercial area will be16.315% (9.789 mi^2), the industrial 50.660 % (30.396 mi^2) and the residential area33.025% (19.815 mi^2).

3.3.3 Gauss- Jordan Elimination

Solve the system of equations

$$2x + y + z = 4$$

$$x + 2y + z = 8$$

$$2 + y + 2z = 4\ .$$

Firstly write the given system of equations in the form $AX = B$. Then find $A^{-1}$by being used the Gauss-Jordan's Elimination method.

Solution:

$$\begin{bmatrix}2 & 1 & 1\\ 1 & 2 & 1\\ 1 & 1 & 2\end{bmatrix}\begin{bmatrix}x\\ y\\ z\end{bmatrix} = \begin{bmatrix}4\\ 8\\ 4\end{bmatrix} \rightarrow AX = B$$

$$X = A^{-1}B, \text{where } A = \begin{bmatrix}2 & 1 & 1\\ 1 & 2 & 1\\ 1 & 1 & 2\end{bmatrix}, X = \begin{bmatrix}x\\ y\\ z\end{bmatrix}, B = \begin{bmatrix}4\\ 8\\ 4\end{bmatrix}$$

Process: Expand A | I.

Start scaling and adding rows to get I | A^{-1}

$A|I =$

$$\begin{bmatrix}2 & 1 & 1 & 1 & 0 & 0\\ 1 & 2 & 1 & 0 & 1 & 0\\ 1 & 1 & 2 & 0 & 0 & 1\end{bmatrix} \xrightarrow{\frac{1}{2}R_1} \begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 1 & 2 & 1 & 0 & 1 & 0\\ 1 & 1 & 2 & 0 & 0 & 1\end{bmatrix}$$

$$\begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 1 & 2 & 1 & 0 & 1 & 0\\ 1 & 1 & 2 & 0 & 0 & 1\end{bmatrix}$$

$$\xrightarrow{R_{21}(-1)\&R_{31}(-1)} \begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 0 & \frac{3}{2} & \frac{1}{2} & \frac{-1}{2} & 1 & 0\\ 0 & \frac{1}{2} & \frac{3}{2} & \frac{-1}{2} & 0 & 1\end{bmatrix}$$

$$\begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 0 & \frac{3}{2} & \frac{1}{2} & \frac{-1}{2} & 1 & 0\\ 0 & \frac{1}{2} & \frac{3}{2} & \frac{-1}{2} & 0 & 1\end{bmatrix} \xrightarrow{R_2\left(\frac{2}{3}\right)} \begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 0 & 1 & \frac{1}{3} & \frac{-1}{3} & \frac{2}{3} & 0\\ 0 & \frac{1}{2} & \frac{3}{2} & \frac{-1}{2} & 0 & 1\end{bmatrix}$$

$$\begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 0 & 1 & \frac{1}{3} & \frac{-1}{3} & \frac{2}{3} & 0\\ 0 & \frac{1}{2} & \frac{3}{2} & \frac{-1}{2} & 0 & 1\end{bmatrix} \xrightarrow{R_{32}\left(\frac{-1}{2}\right)} \begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 0 & 1 & \frac{1}{3} & \frac{-1}{3} & \frac{2}{3} & 0\\ 0 & 0 & \frac{4}{3} & \frac{-1}{3} & \frac{-1}{3} & 1\end{bmatrix}$$

$$\begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 0 & 1 & \frac{1}{3} & \frac{-1}{3} & \frac{2}{3} & 0\\ 0 & 0 & \frac{4}{3} & \frac{-1}{3} & \frac{-1}{3} & 1\end{bmatrix} \xrightarrow{R_3\left(\frac{3}{4}\right)} \begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 0 & 1 & \frac{1}{3} & \frac{-1}{3} & \frac{2}{3} & 0\\ 0 & 0 & 1 & \frac{-1}{4} & \frac{-1}{4} & \frac{3}{4}\end{bmatrix}$$

$$\begin{bmatrix}1 & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & 0 & 0\\ 0 & 1 & \frac{1}{3} & \frac{-1}{3} & \frac{2}{3} & 0\\ 0 & 0 & 1 & \frac{-1}{4} & \frac{-1}{4} & \frac{3}{4}\end{bmatrix}$$

$$\xrightarrow{R_{23}\left(\frac{-1}{3}\right)\&\,R_{13}\left(\frac{-1}{2}\right)} \begin{bmatrix}1 & \frac{1}{2} & 0 & \frac{5}{8} & \frac{1}{8} & \frac{-3}{8}\\ 0 & 1 & 0 & \frac{-1}{4} & \frac{3}{4} & \frac{-1}{4}\\ 0 & 0 & 1 & \frac{-1}{4} & \frac{-1}{4} & \frac{3}{4}\end{bmatrix}$$

$$\begin{bmatrix}1 & \frac{1}{2} & 0 & \frac{5}{8} & \frac{1}{8} & \frac{-3}{8}\\ 0 & 1 & 0 & \frac{-1}{4} & \frac{3}{4} & \frac{-1}{4}\\ 0 & 0 & 1 & \frac{-1}{4} & \frac{-1}{4} & \frac{3}{4}\end{bmatrix} \xrightarrow{R_{12}\left(\frac{-1}{2}\right)} \begin{bmatrix}1 & 0 & 0 & \frac{6}{8} & \frac{2}{8} & \frac{-2}{8}\\ 0 & 1 & 0 & \frac{-1}{4} & \frac{3}{4} & \frac{-1}{4}\\ 0 & 0 & 1 & \frac{-1}{4} & \frac{-1}{4} & \frac{3}{4}\end{bmatrix}$$

$$I|A^{-1} = \begin{bmatrix}1 & 0 & 0 & \frac{6}{8} & \frac{2}{8} & \frac{-2}{8}\\ 0 & 1 & 0 & \frac{-1}{4} & \frac{3}{4} & \frac{-1}{4}\\ 0 & 0 & 1 & \frac{-1}{4} & \frac{-1}{4} & \frac{3}{4}\end{bmatrix} \rightarrow A^{-1} = \begin{bmatrix}\frac{3}{4} & \frac{-1}{4} & \frac{-1}{4}\\ \frac{-1}{4} & \frac{3}{4} & \frac{-1}{4}\\ \frac{-1}{4} & \frac{-1}{4} & \frac{3}{4}\end{bmatrix}$$

$$X = A^{-1}B = \begin{bmatrix}\frac{3}{4} & \frac{-1}{4} & \frac{-1}{4}\\ \frac{-1}{4} & \frac{3}{4} & \frac{-1}{4}\\ \frac{-1}{4} & \frac{-1}{4} & \frac{3}{4}\end{bmatrix}\begin{bmatrix}8\\ 8\\ 4\end{bmatrix} = \begin{bmatrix}3\\ 3\\ -1\end{bmatrix} \rightarrow X = \begin{bmatrix}x\\ y\\ z\end{bmatrix} = \begin{bmatrix}3\\ 3\\ -1\end{bmatrix}$$

3.3.4

Mixing problem involving two tanks

Tank T_1contains initially 100 gal of pure water. Tank T_2 contains initially 100 gal of water in which 150 lb of fertilizer are dissolved. Liquid circulates through the tanks at a constant rate of 2gal/min and the mixture is kept uniform by stirring. Find the amounts of fertilizer $y_1(t)\ and y_2(t)$ in $T_1\ and\ T_2$ respectively, where t is time.

Solution:

Let $y_1(t)$ =amount of fertilizer in tank T_1 and

$y_2(t)$ = amount of fertilizer in tank T_2.

Hence, the time rate of change of $y_1(t) = {y_1}'(t)$ and the time rate of change of $y_2(t) = {y_2}'(t)$.

Tank.1: (100) gal of water contains $y_1\ lb$ of dissolved fertilizer.

(2) gal of water contains $\frac{2}{100}y_1$lb of dissolved fertilizer.

Tank.2: (100) gal of water contains $y_2$lb of dissolved fertilizer.

(2) gal of water contains $\frac{2}{100}y_2$lb of dissolved fertilizer.

In tank1,${y_1}'(t) = \frac{Inflow}{min} - \frac{outflow}{min} \rightarrow {y_1}' = \frac{-2}{100}y_1 + \frac{2}{100}y_2$

In tank2,${y_2}'(t) = \frac{Inflow}{min} - \frac{outflow}{min} \rightarrow {y_2}' = \frac{2}{100}y_1 - \frac{2}{100}y_2$

$$\begin{bmatrix}{y_1}'\\ {y_2}'\end{bmatrix} = \begin{bmatrix}\frac{-2}{100} & \frac{2}{100}\\ \frac{2}{100} & \frac{-2}{100}\end{bmatrix}\begin{bmatrix}y_1\\ y_2\end{bmatrix} \rightarrow y' = A\,y$$

Let $y = xe^{\lambda t} \rightarrow y' = \lambda xe^{\lambda t} = \lambda y = Ay$

$\lambda xe^{\lambda t} = Axe^{\lambda t} \rightarrow A\boldsymbol{x} = \lambda\boldsymbol{x}$

$(A - \lambda \mathrm{I})\boldsymbol{x} = 0 \rightarrow \det(A - \lambda\, I) = 0$

$$\begin{vmatrix}-0.02 - \lambda & 0.02\\ 0.02 & -0.02 - \lambda\end{vmatrix} = 0 \rightarrow \lambda = 0\,, \lambda = -0.04$$

$[\,A - \lambda\, I]\boldsymbol{x} = 0$

$$\begin{bmatrix}(-0.02 - \lambda) & 0.02\\ 0.02 & (-0.02 - \lambda)\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} = \begin{bmatrix}0\\ 0\end{bmatrix}$$

$(-0.02 - \lambda)x_1 + 0.02x_2 = 0$

$0.02x_1 + (-0.02 - \lambda)x_2 = 0$

For $\lambda = 0\,,\ x_1 = x_2 = 1 \rightarrow \underline{x_1} = \begin{bmatrix}1\\ 1\end{bmatrix}$

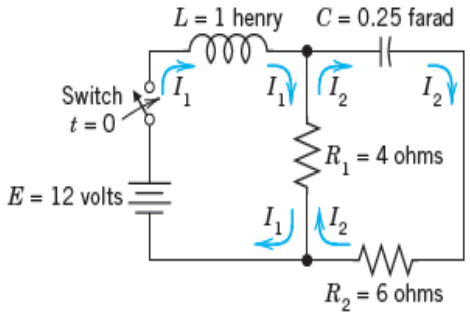
For $\lambda = -0.04$, $x_1 = 1, x_2 = -1 \rightarrow \underline{x_2} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

$y = c_1 x_1 e^{\lambda_1(t)} + c_2 x_2 e^{\lambda_2(t)}$,

$y_1(0) = 0 , y_2(0) = 150 \rightarrow c_1 = 75 , c_2 = -75$

$y_1 = 75 - 75e^{-0.04t}$ and $y_2 = 75 + 75\, e^{-0.04t}$

3.3.5 Electrical Network



Find the current $I_1(t)$ and $I_2(t)$ in the network in figure. Assume all the currents and charge to be zero at t=0, the instant when the switch is closed.

Solution: Electromotive force,

$E(t) = E_l + E_R + E_c, E_l = l\, I', E_R = R\, I, E_c = \frac{1}{c}\int I\,(t)dt$

For the left loop yield

$E = E_l + E_{R_1}$

$12 = l\, I_1' + R_1(I_1 - I_2) \rightarrow 12 = (1)I_1' + (4)(I_1 - I_2)$

$I_1' = -4\, I_1 + 4\, I_2 + 12$ (1)

For the right loop yield,

$E = E_{R_1} + E_{R_2} + E_c \rightarrow 0 = R_1\,(I_2 - I_1) + R_2 I_2 + \frac{1}{c}\int I_2(t)dt$

$$0 = 4\,(I_2 - I_1) + 6I_2 + \frac{1}{0.25}\int I_2(t)dt$$

$$0 = 4I_2 - 4I_1 + 6I_2 + 4\int I_2(t)dt$$

Differentiate both sides,

$0 = 4I_2' - 4I_1' + 6I_2' + 4I_2 \rightarrow 0 = 10I_2' - 4I_1' + 4I_2$

The above equation is solved by equation (1)

$0 = 10I_2' - 4\,(-4I_1 + 4I_2 + 12) + 4I_2$

$0 = I_2' + 1.6I_1 - 1.2I_2 - 4.8$

$I_2' = -1.6I_1 + 1.2I_2 + 4.8$ (2)

$\begin{bmatrix} I_1' \\ I_2' \end{bmatrix} = \begin{bmatrix} -4 & 4 \\ -1.6 & 1.2 \end{bmatrix}\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} + \begin{bmatrix} 12 \\ 4.8 \end{bmatrix}$,

Let $\underline{J'} = \begin{bmatrix} I_1' \\ I_2' \end{bmatrix}, A = \begin{bmatrix} -4 & 4 \\ -1.6 & 1.2 \end{bmatrix}, \underline{J} = \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}, g = \begin{bmatrix} 12 \\ 4.8 \end{bmatrix}$

$\underline{J'} = A\,J + g$ (3)

It is a non- homogeneous first order differentiation equation.

Consider a homogeneous differentiation equation is

$\underline{J'} = A\,J$ (4)

Let $J_h = x\, e^{\lambda t}$. Then,

$J_h' = \lambda\, x\, e^{\lambda\, t} \rightarrow (A - \lambda\, I)\boldsymbol{x} = 0 \rightarrow det(A - \lambda\, I) = 0$

$\begin{vmatrix} -4-\lambda & 4 \\ -1.6 & 1.2-\lambda \end{vmatrix} = 0 \rightarrow \lambda_1 = -2 , \lambda_2 = 0.8$

For $\lambda_1 = -2 \rightarrow x_1 = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$ and

$\lambda_2 = 0.8 \rightarrow x_2 = \begin{bmatrix} 1 \\ 0.8 \end{bmatrix}$

$J_h = c_1 x_1 e^{\lambda_1 t} + c_2 x_2 e^{\lambda_2 t} = c_1 \begin{bmatrix} 2 \\ 1 \end{bmatrix} e^{-2t} + c_2 \begin{bmatrix} 1 \\ 0.8 \end{bmatrix} e^{-0.8t}$

Since g is a constant, let $J_p = \begin{bmatrix} a_1 \\ a_2 \end{bmatrix}$ be the particular solution of (3).

Then, $J_p' = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \rightarrow J_p' = A\,J_p + g$

$\begin{bmatrix} 0 \\ 0 \end{bmatrix} = \begin{bmatrix} -4 & 4 \\ -1.6 & 1.2 \end{bmatrix}\begin{bmatrix} a_1 \\ a_2 \end{bmatrix} + \begin{bmatrix} 12 \\ 4.8 \end{bmatrix} \rightarrow a_1 = 3 , a_2 = 0. \therefore J_p = \begin{bmatrix} 3 \\ 0 \end{bmatrix}$

$J = J_h + J_p = wc_1 x_1 e^{-2t} + c_2 x_2 e^{-0.8t} + \boldsymbol{a}$

$I_1 = 2c_1 e^{-2t} + c_2 e^{-0.8t} + 3$

; $I_2 = c_1 e^{-2t} + 0.8c_2 e^{-0.8t}$

$I_1(0) = 0 , I_2(0) = 0 \rightarrow c_1 = -4 , c_2 = 5$

$I_1 = -8e^{-2t} + 5e^{-0.8t} + 3$ and $I_2 = -4e^{-2t} + 4e^{-0.8t}$

4 CONCLUSION

In my conclusion, matrices can be applied in human's life, i.e., they may be applied not only in various engineering problems, such as in electrical networks, in nets of roads, in production processes, mixing problems etc, but also in economics. All of these were solved in the previous section.

5 ACKNOWLEDGEMENTS

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Modeling and Analysis of Lightning Arrester for Transmission Line Overvoltage Protection

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Abstract:, The grounding of a conductor etc. Most of the over voltages are not of large magnitude but may still be important because of their effect on the performance of circuit interrupting equipment and protective devices. An appreciable number of these over voltages are of sufficient magnitude to cause insulation breakdown of the equipment in the power system .Lightning is one of the most significant source of over voltages in overhead transmission lines. The lightning over voltages could lead to failure of the devices connected to the transmission line. Surge arresters are an important means of lightning protection in distribution systems. Therefore, it is necessary to analyze influence of such over voltages in order to applying the line surge arrester for improving the reliability of transmission line system. Determination of the maximum voltages induced on the overhead line by direct stroke is a complex problem. For estimating the flashover due to direct strokes, it is necessary to calculate the maximum voltage induced on the line. The effect of direct lightning on transmission lines have been analyzed with and without the help of surge arrester.

Keywords: Lightning overvoltage, Basic insulation level, Lightning arrester, Overvoltage protection, Discharge current

1. INTRODUCTION

Lightning overvoltages occurring in an electrical power systems are very dangerous phenomenon, which may cause damages of insulation systems in electrical devices installed in the electrical network. For this reason, from insulation coordination viewpoint limitation of overvoltages values occurring during lightning strokes is very important to increase supply reliability in electrical network.There are two main ways in which a lightning may strike the power system are direct stroke and indirect stroke. In the direct stroke, the lightning discharge (i.e. current path) is directly from the cloud to the subject equipment e.g. an overhead line. From the line, the current path may be over the insulators down the pole to the ground. The overvoltages set up due to the stroke may be large enough to flashover this path directly to the ground. Indirect strokes result from the electrostatically induced charges on the conductors due to the presence of charged clouds. For this purpose, special devices such as Metal Oxide Surge Arresters (MOSA) are installed in electrical power networks for protection against overvoltages. Estimation of overvoltages values occurring in power system is necessary to predict effects of lightning strokes. However, because of lightning strokes randomness and inability to precise measurement of lightning overvoltages in real power system, calculations of overvoltages in power systems during transient states is the only method to estimate expected values of overvoltages in electrical power system. Thus, in order to analyze and calculate lightning transient states in power networks, dedicated simulations are necessary. This paper deals with frequency-dependent surge arresters models and transmission lines models utilized for overvoltages studies by means of Matlab simulation software. In this work an analysis of the lightning performance of 230 kV Taungdwingyi - Myaungdakar transmission line.

2. LIGHTNING OVERVOLTAGE IN TRANSMISSION LINES

In case of indirect lightning stroke in overhead lines, part of lightning current flows to the ground through tower constructions and shielding wires. Lightning phenomenon is caused by a peak discharge during which the charge accumulated in the clouds discharges into the neighboring cloud or to the ground. The mechanism of charge formation in the cloud and their discharge, as well as the numerous the factors which help the formation or accumulation of charge in the clouds are complex, and unpredictable. But during thunderstorms, positive and negative charges become separated by heavy air currents with ice crystals in the upper parts and rain in the lower parts of the clouds, and this clouds separation depends on the height of the clouds[1]. Lightning overvoltages are caused either by direct strokes to the phase conductor of as a result of strokes to earth very close to the line which produces induced lightning surges. Overvoltage induced by indirect lightning on overhead lines can cause damage to the power system. The current waveform is generally a unidirectional pulse rising to a peak value in about 3 s and falling to small values in several 10 s. In this paper describe insulation level and selection of arrester.

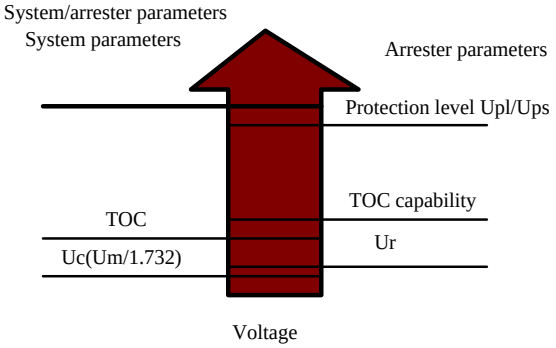
3. LIGHTNING ARRESTER FOR OVERVOLTAGE PROTECTION

The earthing screen and ground wires can well protect the electrical system against direct lightning strokes but they fail to provide protection against travelling waves which may reach the terminal apparatus. The lightning arresters or surge diverters provide protection against such surges .A lightning arrester or a surge diverter is a protective device which conducts the high voltage surges on the power system to the ground .The action of the lightning arrester or surge diverter is

as under (i) Under normal operation, the lightning arrester is off the line i.e. it conducts **no current to earth or the gap is non-conducting. (ii) On the occurrence of overvoltage, the air insulation across the gap breaks down and an arc is formed, providing a low resistance path for the surge to the ground. In this way, the excess charge on the line due to the surge is harmlessly conducted through the arrester to the ground instead of being sent back over the line.(iii) It is worthwhile to mention the function of non-linear resistor in the operation of arrester. As the gap sparks over due to overvoltage, the arc would be a short-circuit on the power system and may cause power-follow current in the arrester. Since the characteristic of the resistor is to offer high resistance to high voltage (or current), it prevents the effect of a short- circuit. After the surge is over, the resistor offers high resistance to make the gap non-conducting.

4. SELECTION OF LIGHTNING ARRESTER FOR HIGH VOLTAGE TRANSMISSION LINE

The Metal Oxide resistor column, together with the accompanying supporting construction, comprises the actual active part of the arrester. The column consists of individual Metal Oxide resistors stack on top of each other. Their diameter decisively determines the energy absorption and the current carrying capability. It is within a range of about 30 mm when used for distribution system, and up to 100 mm or more for high-voltage and extra-high voltage system. Metal Oxide resistors vary in height between 20 mm and 45 mm.



Vocabulary
Um =Maximum system voltage ,
Uc=Continuous operating voltage
Ur =Rated voltage ,
TOV =Temporary overvoltage
T =TOV strength factor,
K=arth fault factor Ups Switching impulse protective level
Upl=Lightning impulse protective level ,
Uw=Switching impulse withstand level
Uwl=Lightning impulse withstand level

$$\text{System voltage} = 230\text{kV (ph to ph)},$$

$$\text{Maxinum voltage, Um} = 1.1 \times 230 = 253\text{kV}$$

$$\text{Fault clearing time} = 1\text{s},$$

$$\text{Creepage distance} = 14300\text{mm}$$

$$\text{Ur} = 0.72 \times 253 = 182.16 \text{(from table1)}$$

According to the available arrester ratings, the rated voltage is selected as 228Kv (from table 2)

Table 1. Arrester Ratings

System Earthing	Fault Duration	System Voltage Um (kV)	Min. Rated Voltage, Ur (kV)
Effective	≤ 1 s	≤ 100	≥ 0.8 x Um
Effective	≤ 1 s	≥ 123	≥ 0.72 x Um
Non-effective	≤ 10 s	≤ 170	≥ 0.91 x Um ≥ 0.93 x Um (EXLIM T)
Non-effective	≤ 2 h	≤ 170	≥ 1.11 x Um
Non-effective	> 2 h	≤ 170	≥ 1.25 x Um

Table 2.Available arrester for HV and EHV system with important parameters

Max. System Voltage	Rated Voltage	Max. continuous operating voltage		TOV capability 2)		Max. residual voltage with current wave		
		as per	as per			30/60 µs		
U_{mkVrs}	U_{rkVrs}	U_{ckVrs}	$MOOV_{kVrs}$	$1s_{kVrs}$	$10s_{kVrs}$	$1KAKV_{peak}$	$2KA\ KV_{peak}$	$3KA\ KV_{peak}$
245	180	144	144	209	198	354	364	371
	192	154	154	218	207	389	380	387
	216	156	174	246	233	416	427	435
	228	168	180	259	246	438	451	459
300	228	182	182	259	246	438	461	459
	240	191	191	273	258	461	475	484

$$\text{Discharge class} = 3 \text{(from table3)}$$

$$\text{Nomdischar gecurrent} = 10\text{kA}$$

$$U_{pl} = 2.350 \times 228 = 535.8\text{kV}$$

$$U_{pl} = 2.350 \times 228 = 535.8\text{kV}$$

Lightning impulse voltage level, $\frac{U_{ps}}{U_r} = 1.981$(table4)

$Ups = 1.981 \times 228 = 451.668kV$

Table3. Selected arrester parameters

Arrester type	Line discharge	Energy capability(2 impulses)	Normal application range(U_m)
EXLIM R	2	5.0	≤ 170 kV
P EXLIM R	2	5.1	≤ 170 kV
EXLIM Q	3	7.8	170 - 420 kV
P EXLIM Q	3	7.8	170 - 420 kV
EXLIM P	4	10.8	362 - 550 kV
P EXLIM P	4	12	362 - 550 kV
HS P EXLIM P	4	10.5	362 - 550 kV
EXLIM T	5	15.4	420 - 800 kV
HS P EXLIM T	5	15.4	420 - 800 kV

Table4. Switching impulse protective, Lightning impulse voltage level

Arrester type	Nom Dischargecurren	Up/Ur at 10kA_p	Up/Ur at 20kA_p	Ups/Ur
EXLIM R	10	2.590		2.060 at 0.5 kAp
P EXLIM R	10	2.590		2.060 at 0.5 kAp
EXLIM Q	10	2.350		1.981 at 1.0 kAp
P EXLIM Q	10	2.350		1.981 at 1.0 kAp

With 253kV Maximum system voltage, the insulation levels are selected as:
Basic insulation level (BIL) Uwl=900Kv (from table 5)
Basic switching level (BSL) Uws=720Kv (from table 5)

Table5. Insulation level of substation

Max system voltage,kV		IEC(10)		ANSI (11)	
IEC	ANSI	BIL,kV	BSL,kV	BIL,kV	BSL,kV
72.5	72.5	325	-	300,350	
100		450	-		
123	121	550	-	450,550	
145	145	650	-	550,650	
170	169	750	-	650,750	
245	242	950	-	750,900	-,720
300		1050	850		
362	362	1175	950	900,1050	720,825
420		1300	1050		
525	550	1425	1175	1300,1550	1050,1175
765	800	1800	1425	1800	1425

$$\text{Margin for lightning impulse} = \left[\frac{U_{WL}}{U_{PL}} - 1\right] \times 100$$

= 67.973

$$\text{Margin for lightning impulse} = \left[\frac{U_{WS}}{U_{PS}} - 1\right] \times 100\ \%$$

= 59.409

Since protection margin is greather than 20%,arrester can provide adequate protection to substation.

5. MODELING OF OVERVOLTAGE PROTECTION SYSTEM

Table6.Transmission line parameters

SN	Name	Parameter
1	Line Length	143.43km
2	Positive/negative Sequence Impedance	6.798+j45.0504ohm
3	Zero Sequence Impedance	44.076+j157.7079 ohm
4	Positive/ negative Sequence Susceptance	1.6193247μS
5	Zero Sequence Susceptance	1.094355124μS
6	Load at Taungdwingyi Bus	12 MW (0.82 lagging)
7	Load at Shwedaung Bus	8 MW (0.8 Lagging)
8	Type Conductor	605M

The detailed study for lightning protection is executed at Shwedaung-Taungdwingyi 230 kV single bundled single circuit transmission line. Two generators of 230 kV are used in the study, each located at each ends of line to study and simulate the lightning protection on transmission line 143.43 km in length. The important parameters for the model are shown in Table 6.

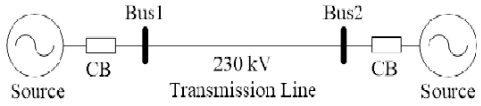
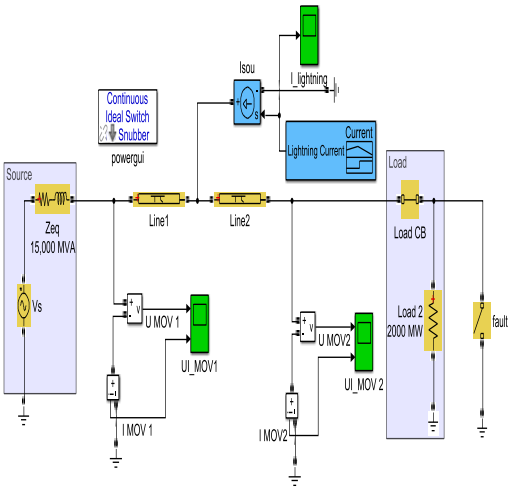


Figure 2. Transmission line

Below figure shows a 230 kV transmission system without two transmission line arrester placed at the sending end and the receiving end of the line. Over the system a lightning surge was induced and the resulting simulation was carried out by using MATLAB software.



5.1 SIMULATION RESULT WITHOUT LIGHTNING ARRESTER

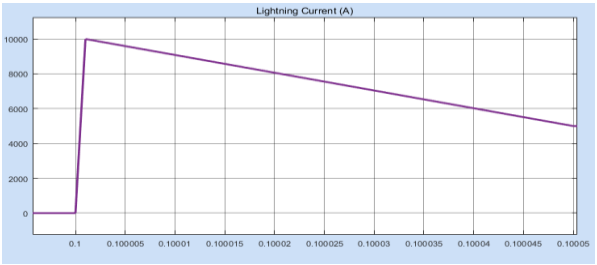


Figure4. Simulation result of without lightning arrester for lightning current

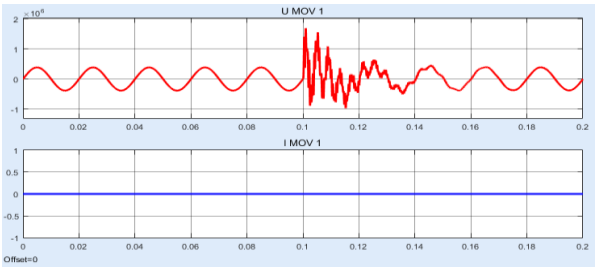


Figure5. Simulation result of without lightning arrester(MOV1) for lightning voltage

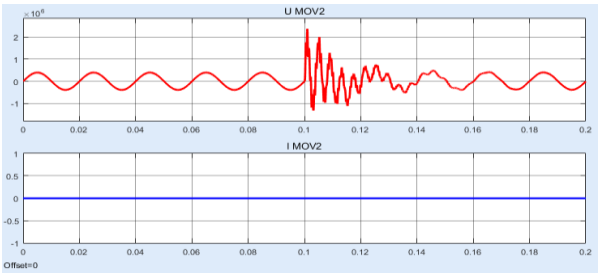


Figure6. Simulation Result of Without Lightning Arrester(MOV2) for Lightning Voltage

5.2 SELECTION OF LIGHTNING ARRESTER PARAMETER

The objective of arrester application is to select the lowest rated surge arrester which will provide adequate overall protection of the equipment insulation and have a satisfactory service life when connected to the power system. A higher rated arrester increases the ability of the arrester to survive on the power system. Both arrester survival and equipment protection must be considered in arrester selection. The proper selection involves decisions in three areas:Selecting the arrester voltage rating. This decision is based in whether or not the system is grounded and the method of system groundingSelecting the class of arrester. In order of protection, capability and cost as follow: (i)Station class (ii) Intermediate class (iii) Distribution class.

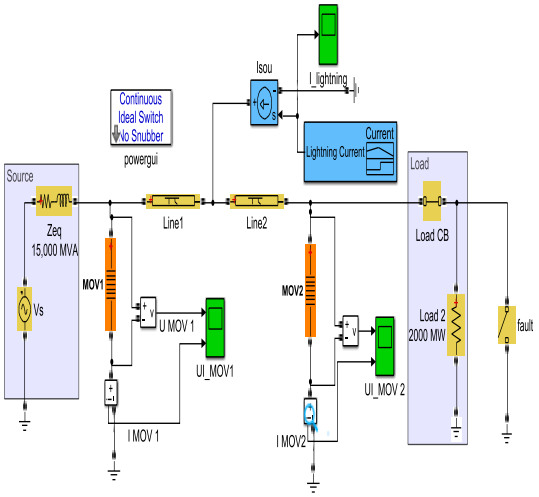


Figure7. Molding for lightning protection with lightning arrester

4.3SIMULATION RESULT (WITH LIGHTNING ARRESTER)

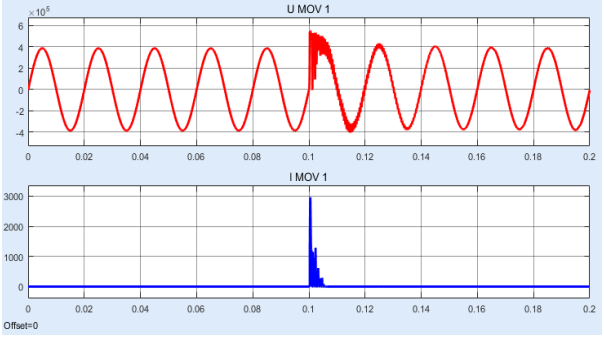


Figure8. Simulation result of with lightning arrester(MOV1) for lightning voltage

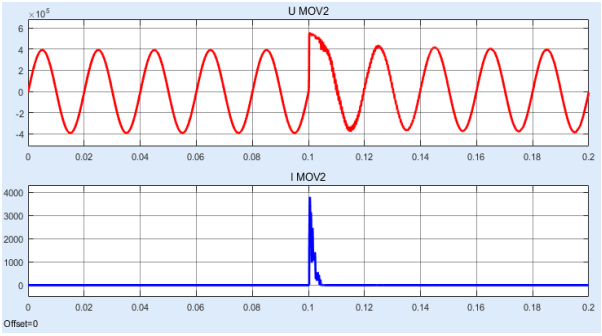


Figure9. Simulation result of with lightning arrester (MOV2) for lightning voltage

6. COMPARISON AND ANALYSIS

To evaluate the overvoltage protection performance of MOV, the voltage level at substation for without MOV and with MOV is compared. The comparison results is expressed in Table 7.

Table7. Comparison for voltage level at substation

SN	Case	MOV Name	V_MOV (kV)	I_MOV (A)
1	Without MOV	MOV1	1685.9	0
2		MOV2	2363.1	0
3	With MOV	MOV1	549.1	2964
4		MOV2	556.5	3800

According to the simulation results, the voltage levels at substations for without MOV are much larger than basic insulation levels. It means substation equipments will damage under lightning overvoltage. With MOVs, the substation voltage level is less than basic insulation level and thus the substation equipments will safe under lightning overvoltage condition.

7. CONCLUSION

For the analysis of surge arrester in 230kVtransmission line, MATLAB software is employed for the simulation of the selected transmission line as well as the lightning surge and MOV arrester. In the simulations, the lightning strike is applied at the middle of transmission line and the voltage levels at substations are observed. According to the simulation results, the suggested MOVs can protect both substations from lightning over voltages and can protect substation equipments. This paper will help and give the electrical knowledge of the overvoltage protection system by surge arrester in transmission lines and substation equipments.

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Investigation and Chemical Constituents of Muskmelons

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Abstract: Three different varieties of muskmelons (Cucumis melo) bought from local market in the city of Toungoo, Pegu Region, Myanmar, were analyzed in this research. pH of these muskmelon ranged from 6.35 to 6.89 and found to be comparable. Highest protein content of 10.66% was observed in white-fleshed, non-netted, smooth surface melon, Muskmelon samples contained low fiber contents of 2.35% to 5.00% and thus, it was not a good source of fiber. Highest available carbohydrate content of 55.61% was observed in green-fleshed netted melon. By AAS analysis potassium was found to be the highest (5016-5037mg/100g) followed by sodium (1249-1487/100g), calcium (312.0-715.1mg/100g), manganese (11.3-15.7mg/100g), copper (5.9-11.6mg/100g) and zinc (2.6-5.1mg/100). Iodometric titrimetric analysis revealed that total sugar contents were in range of 9.00-9.72%. Lowest reducing sugar (1.50%) was found in white-fleshed, non-netted melon. Lowest reducing sugar as a percentage of total sugar of 15.43% was also observed in white-fleshed variety.

Key words: Cucumis melo, muskmelon, calorific value, elemental values, total sugar, reducing sugar

1. INTRODUCTION

Fruits and vegetables have been recognized as a good source of vitamins and minerals. They have been especially valuable for their ability to prevent vitamin C and vitamins A deficiencies. Some of the good things in fruits and vegetables include vitamins, minerals, flavonoids (plant chemical that act like antioxidants) saponins (plant chemicals that have a better taste) phenols (organic compounds in foods) carontenoid (vitamin A-like compounds) isothiocyanataes (sulfur-compounds) and several types of dietary fiber. Diets containing substantial and varied amount of fruits and vegetables could prevent 20 percent or more of all cases of cancer. Higher intake of fruits and vegetables could reduce the risk of a stroke by up to 25 percent. Higher intake of fruits and vegetables seemed to increase the ventilation function of the lungs. Muskmelon is native to northwest India where it spread to China and Europe via the Persian Empire [5]. The varied cultivars produced have been divided into multiple cultivar groups. The muskmelon belongs to Cucurbitaceae family [8]. It is a large sweet fruits. This is produced by an annual trailing vine. It is a round or oblong, green or yellow fruit with horizontal stripes on the rind. Its juicy flesh may be yellow, white, orange or green in colour depending upon the species and has a sweet flavor and a slightly musky smell. Mature fruits are eaten as a dessert fruits used in sorbets, processed and their juice extracted as muskmelon juice.

1.1 Botanical Description

Family	-	Cucuribitaceae
Genus	-	Cucumis
Species	-	C.melo
Botanical name	-	Cucumis melo
English name	-	Muskmelon
Myanmar name	-	Thakwa-hmwei

Figure 1 Three varieties of Muskmelon

1.2 Health Benefits of Muskmelon

Muskmelons have been associated with regulating heart beat and, possible preventing strokes. In addition to health benefits, muskmelon takes care of skin too. It contains Vitamin A, which is useful in maintain healthy skin. The fruit contains

Vitamins A, B, C and minerals like magnesium, Sodium and potassium. It has zero cholesterol and is safe for blood cholesterol patient [3] Muskmelon is a good source of vitamin C, which is an anti-oxidant. This to prevent heart diseases and even cancer [4].

1.3 Carbohydrates

Carbohydrate are polyhydroxy aldehydes, polyhydroxy ketone, or compounds that can be hydrolyzed to them [10]. A carbohydrate that cannot be hydrolyzed to simpler compound is called a monosaccharide [3]. A carbohydrate that can be hydrolyzed to two monosaccharide molecules is called a disaccharide. A carbohydrate that can be hydrolyzed to many monosaccharide molecules is called a polysaccharide. A monosaccharide may be further classified. If it contains an aldehyde group, it is known as an aldose; if it contains a keto group, it is known as a ketose. Depending upon the number of carbon it contains, a monosaccharide is known as a triose, tetrose, pentose, and so on. An aldohexose, for example, is a six-carbon monosaccharide containing an aldehyde group; a ketopentose is a five-carbon monosaccharide containing a keto group. Most naturally occurring monosaccharides are pentoses or hexoses. Carbonhydrates that reduce Fehing's (or Benedict's) or Tollin's reagent are known as reducing sugar [11].All monosaccharide, whether aldose or ketose, are reducing sugars. Most disaccharides are reducing sugar; sucrose (common table sugar) is a notable exception, for it is a non-reducing sugar.

2. MATERIALS AND METHODS

Three different varieties of muskmelon (green- fleshed, netted melon, orange-fleshed netted melon and white-fleshed, non-netted, smooth surface melon) were bought from local market in the city of Toungoo, Pegu, Region, Myanmar. The fruits were washed with water and then cut into slices and dried in the shade at room temperature. The air dried samples were used for analysis.

2.1 Determination of pH

Distilled water (200mL) was placed in a 250 mL round-bottomed flask and it was boiled to remove CO_2. Then, the carbon dioxide-free distilled water was cooled prior to use. The flask was capped to avoid contact with atmospheric air. Muskmelon sample (10g) was placed into the beaker. Carbon dioxide-free distilled water (20mL) was added to the sample and it was stirred for 10 min. Then pH of the sample was measured with a pH meter (Oyster-15) which was previously calibrated with standard buffer solution pH 4 and 7.

2.2 Determination of Protein Content in Three Varieties of Muskmelon

Sample (1.g) was introduced to a Kjeldahl flask. The catalyst mixture (9.0g anhydrous potassium sulphate and 1.0g copper sulphate) and concentrated sulphuric acid 15ml were then added. The flask was partially closed by means of a funnel and the contents were digested by heating the flask in an inclined position, starting first with a gentle heat for about 30 min and then heating was continued vigorously for about 3hr until the solution was totally digested and became clear. The flask was

The fruit provides pretty fair amount of folic acid [5] which is especially important for pregnant women. Thought it offers special benefits to women, men can also get great many benefits. Folic acid in the fruit acts as a mild antidepressant [6]. Research has suggested that muskmelon might reduce the risk of developing kidney and age-related bone loss [7].
shaken gently from time to time during the digestion process. The flask was allowed to cool and about 10ml of distilled water were added and the Kjeldahl distillation apparatus was set up. Into the flask 70ml of 40% sodium hydroxide solution was poured through the side arm together with 200ml of distilled water. The contents were distilled by direct heating. The ammonia evolved was allowed to absorb in 25ml of 4% boric acid solution contained in a receiver flask. The ammonia distillate was titrated with 0.5M sulphuric acid, using methyl red as an indicator solution until a red colour just appeared.

2.3 Determination of Fibre contents in Three Varieties of Muskmelon

Sample (5g) was added into a 500ml conical flask having a 200ml marks. Into the above conical flask hot dilute sulphuric acid (1.25%) was added to the mark and boiled the mixture. Boiling was continued for half an hour. The level was maintained by adding water periodically to prevent the loss by evaporation. It was then filtered through a fine piece of muslin cloth and washed three times with boiling water. The substance on the cloth was transferred carefully into the same flask with 200ml of hot sodium hydroxide solution (1.25%). It was then boiled gently for half an hour maintaining the constant level by adding water at intervals to prevent the loss by evaporation. It was filtered through apiece of fine muslin and washed with boiling water till the washing were neutral. Finally, it was washed with 5 ml of ethanol and 10 ml of ether. The fibre was transferred to a clean and dry crucible. After drying at 105C to constant weight the crucible was cooled and weighed. The fibre was incinerated completely and determined the weight of ash. The difference in weight of the fibre before and after incineration was the weight of fibre.

2.4 Determination of Carbohydrate Content

The total carbohydrate content of food can be obtained as the difference between 100 and the sum of percentages of moisture, protein, fat, ash and fibre [1].

2.5 Determination of Calorific Value

The sample calorific value was estimated (in kcal) according to the formula [2],

Energy = (g protein× 2.44) + (g fat ×8.37) + (g available carbohydrate ×3.57)

2.6 Quantitative Determination of Trace Elements by Atomic Absorption Spectroscopy (AAS)

The amounts of trace elements were quantitatively determined by Atomic Absorption Spectrophotometric method using a Perkin Elmer AAnalyst 800 atomic absorption spectrophotometer (England).The sample (0.1g) was digested for 15min with 2 ml of concentrated hydrochloric acid solution. Then the resulting solution of the sample was evaporated to dryness and dissolved in 6 ml of 25% hydrochloric acid solution (volume by volume) followed by centrifugation. The supernatant

solution was decanted and the clear solution was made up to 100 ml with distilled water. Standard and the clear solution were prepared using analar chemicals and dilution was made using their specific hollow cathode lamps. The prepared solutions were now ready for analysis of trace elements by Atomic Absorption Spectrophotometer.

2.7 Determination of Total Sugar, Reducing sugar and Non-reducing Sugar in Three Varieties of Muskmelon

Total sugar, reducing sugar and non- reducing sugar were determined by iodometric technique (Buzarbarua, 2000).The sample (10g) was ground in a mortar, The ground mass was boiled with distilled water and filtered through a piece of white cloth after cooling, The volume of the filtrate was made up to 205 ml in a volumetric flask with distilled water. The stock solution(12.5 ml) was taken and purified by adding a mixture of 10 ml of 5% $ZnSO_4$ and 10 ml of 5% $Ba(OH)_2$ to the solution. Then, the solution was filtered and filtrate was made up to 100 ml with distilled water in a volumetric flask to obtain purified sugar solution. Purified sugar solution (5 ml) and (5 ml) of Somogyi's reagent were added into three separate test tubes. For the blank, 5 ml of Somogyi's reagent and 5 ml of distilled water were added into another three test tubes. The six tubes covered with glass stoppers were immersed in a boiling water bath for 20 min. After the required time, the mixture of the sample tubes turned brown and the mixture of the blank tubes remained blue. The solution in each tube was placed in a conical flak and 2 ml of freshly prepared KI solution was then added. After a few minutes 2 ml of 2N H_2SO_4 were added to the solution followed by immediate addition of a few ml of thiosulphate from the burette to prevent the liberation of I_2 from KI solution was then added. Next, 1 ml of starch indicator was added and the solution turned blue. The solution was tiratedafainst with thiosulphate solution until the blue colour just disappeared.

Purified sugar solution (30ml) was added in a beaker and hydrolyzed by (0.6 ml) of HCI. The whole mixture was heated for 15 min and cooled. The solution was neutralized with solid Na_2 CO_3 and then the volume made up to 100ml with distilled water in a volumetric flask. The further procedure was carried out in the same manner as in the case of reducing sugar, by mixing 5 ml of Somogyi's reagent and 5 ml of hydrolyzed solution.

3. RESULTS AND DISCUSSION

3.1 pH Content of Three Varieties of Muskmelon

pH values of muskmelon analyzed were 6.57, 6.89 and 6.35 for green fleshed, netted melon, orange-fleshed, non-netted, smooth surface melon, respectively, Table .1 found to be comparable.

3.2 Nutritional Compositions of Three Different Varieties of Muskmelon

The crude fibre contents of these fruits ranged between 2.35% to 5.00% (Table.1).Muskmelon with netted orange flesh had the highest fibre content of 5.00%. The muskmelon studied have low fibre levels; an indication that they cannot be considered as good source of fibre. However, the fibre present in these samples, though of low levels, could contribute to the important role of fibre in the diet, that of helping to stimulate peristalsis, thus aiding the movement of food through the digestive system, thereby preventing constipation [12]. Available carbohydrate contents were 55.61%, 43.64% and 48.69% (Table.1) for green-fleshed, netted melon, orange-flesh, netted melon, and white-fleshed, non-netted, smooth surface melon respectively.

Calorific values were37.78kcal/100g, 202.78kcal/100g and 227.87kcal/100g for green –fleshed netted melon, orange-fleshed netted melon and white-fleshed, non-netted, smooth surface melon respectively (Table 1). High calorific values in these muskmelons mean that it can be considered as an important source of energy and thus, it can be used as food especially for people engaged in heavy activity.

3.3 Elemental Concentrations by Atomic Absorption Spectroscopy (AAS)

Mineral concentrations in three varieties of muskmelon are shown in Table. 2. It was observed that white fleshed non-netted melon contained high amount of potassium i.e., 5016 mg/100g, 5037 mg/100g and 500 mg/100g respectively. Thus, muskmelons are rich in potassium, which can help control blood pressure and can prevent the risk of strokes. Potassium in the fruit can also reduce the problem of developing kidney stones. High potassium may also prevent renal calcium loss, in effect preventing bone break down. In diarrhea, it contributes with electrolyte replacement, as well as increased adsorption of nutrients.

Sodium contents were found as 1352 mg/100g, 1249 mg/100g and 1487mg/100g in white-fleshed, non-netted melon, green-fleshed netted melon and orange-fleshed, netted melon respectively. Sodium is associated with potassium in the body in maintaining proper acid-base balance and never transmissions. By high potassium to sodium contents, muskmelon may prevent high blood pressure and its complications.

Calcium contents ranged from 312.01-7.15.1 mg/100g were also observes in three varieties of muskmelon. Calcium content in green-fleshed, netted melon was found to be the highest (715.1 mg/100g) followed by white-flesh, non-netted melon (583.9mg/100g) and orange-fleshed netted melon (312.0mg/100g). Calcium is famous as a bone protector but it plays roles, too, helping nerve cells communicate, muscles contract and to lower blood pressure and prevent colon cancer and premenstrual syndrome.

Magnesium contents in three varieties of muskmelon were in the range of 356.4-45.8 mg/100g and observed to be not much different. Magnesium maintains healthy bones and helps of

Table 1 pH and Nutritional compositions all three varieties of muskmelon

No	Sample	pH	Crude Fibre (%)	Crude Protein (%)	Available Carbohydrate (%)	Calorific value (kcal/100g)
1	Green-fleshed netted melon	6.57	2.35	5.89	55.61	237.78
2	Orange-fleshed netted melon	6.89	5.00	9.11	43.64	202.78
3	White-fleshed non-netted smooth surface melon	6.35	4.76	10.66	48.69	227.87

Table. 2 Elemental concentration (dry weight basis) in three varieties of muskmelon

Sample	Mineral concentration (mg/100)							
	K	Na	Ca	Mg	Fe	Mu	Cu	Zn
White-fleshed non-netted melon	501	1352	583.9	356.4	141.1	11.3	8.3	2.6
Green-fleshed netted melon	5037	1249	715.1	450.8	144.2	14.5	11.6	4.6
Orange-fleshed netted melon	5022	1487	312.0	375.9	137.6	15.7	5.9	5.1

muscle relax as well as regulating mood, nerve and muscle functions.

Iron contents in the muskmelon samples studied were ranged from 137.6 to 144.2 mg/100g and found to be comparable. Iron main function is in hemoglobin, the part of red blood cells that carries oxygen from the lungs to all the cells of the body. It is also important for immunity.

Trace amount of manganese (11.3-15.7 mg/100g), copper (5.9-11.6 mg/100mg), and zinc (2.6-5.1 mg/100g) were also present in these muskmelons. Manganese assists a wide range of bodily functions, including the development of healthy bones, the way of body process carbohydrates, and protective antioxidant activity in the body. Copper helps transport oxygen through the body, maintains hair colour, and is used to make hormones. Zinc helps to keep the skin healthy, aid wound healing, regulates the sense of taste and is important for immune system strength. It is particularly important during pregnancy and for infant development. A deficiency in adulthood has been linked to increase risk of infection, skin and hair problems and a low sperm count.

3.5. Total Sugar, Reducing Sugar and non-reducing Sugar in Three Varieties of Muskmelon

The reducing sugar and total sugar were determined by Somogyi's reagents using iodometric technique (Buzarbarua, 2000). Somogy's devised in 1945, the most accurate and the sensitive method for the detrmination of glucose (reducing sugar) quantitatively by adopting iodometric technique. By this method the concentration of glucose or other reducing sugar from 0.01 g to 3.0g can be determined of glucose or other reducing sugar from 0.01g to 3.0g can be determined accurately.

The iodometric technique is based on the following reactions:

$$2\,Cu\,So_4 + 4KI \longrightarrow Cu_2I_2 + 2K_2SO_4 + I_2$$

$$I_2 + 2(Na_2\,S_2\,O_3.5H_2O) \longrightarrow 2NaI + Na_2S_4O_6 + 10H_2O$$

The above reactions showed that when KI is added to cupric salt, Cu_2I_2 is quantitatively precipitated and simultaneously corresponding to each atom of Cu present one atom of I is liberated. The iodine liberated is titrated against a standard thiosulphate solution in the presence of starch indicator.

If some amount of reducing sugar is added to the Cu SO_4 solution before addition of KI, The liberation of I_2 will be less due to reducing of $CuSO_4$ to Cu_2O by the sugar. As a result, the amount of thiosulphate solution for the titration will be less. The different of these two readings will give the amount of Cu reduced by the sugar present in the unknown simple from which the present of the reducing sugar can be calculated out.

Total sugar content in the muskmelon samples were 9.72%, 9.54 %, and 9.00% respectively, in white- fleshed and orange fleshed varieties (Tables 3 and figure 2). Total sugar contents in these varieties were found to be not much different. These values are in accordance with the literature review of 9.83 % [9] . Lowest amount of reducing sugar was observed in white-fleshed, non-netted melon (1.5%).

Reducing sugar contents of green-fleshed and orange-fleshed melons were nearly the same, i.e., 2.50% and 2.43% respectively. Non-reducing sugar contents were calculated by the difference between total sugar content and reducing sugar content. Non-reducing sugar contents were observed as 8.22%, 7.00%, and 6.57% in the white-fleshed melon, green-fleshed and orange-fleshed melon respectively.

Highest value of reducing sugar as a percentage of total sugar was found in orange-fleshed, netted melon (27.00%) followed by the green-fleshed netted melon (26.21%) and white-fleshed non-netted melon (15.43%).

Table 3 Total sugar, reducing sugar and non-reducing sugar in muskmelon sample

Sample	Total Sugar (%)	Reducing Sugar (%)	Non-reducing (%)	Sugar Reducing sugar as % of total sugar
White-fleshed Non-netted melon	9.72	1.50	8.22	15.43
Green-fleshed Netted melon	9.54	2.50	7.00	26.21
Orange-fleshed Netted melon	9.00	2.43	6.57	27.00

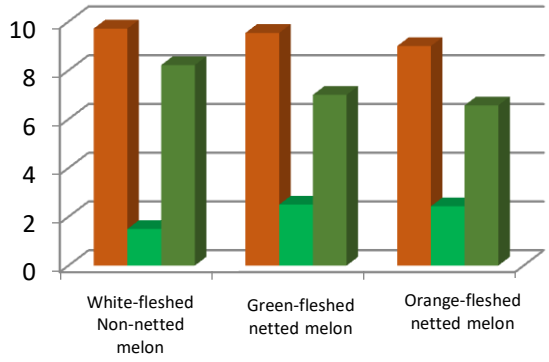

Figure 2 Total sugar, reducing sugar and non-reducing sugar contents in the varieties of muskmelon

4. CONCLUSION

Three varieties of muskmelon (green-fleshed, netted melon, orange-fleshed, netted melon and white-fleshed, non-netted melon were collected from local market in the city of Toungoo, Pegu Region, Myanmar. The experimental results the following interferences can be deduced.

.pH of these muskmelons was in the range of 6.35 to 6.89. Analysis by AAS also revealed that potassium contents in muskmelons ranged from (5016-5037 mg/100g) and found to be the highest among the elements determined. Second highest element was sodium which ranged between 1249-1487mg/100g. Among three varieties of muskmelon highest calcium content of 715.1mg/100g was found in green-fleshed, netted melon and lowest calcium content of 312.0mg/100g was found in orange fleshed netted melon. Magnesium and iron contents in three varieties of muskmelon range between 356.4-450.8mg/100g and 137.6-144.2mg/100g respectively and found to be not much different which each other. Manganese, copper and zinc concentrations in three varieties of muskmelons were 11.3-15.7mg/100g, 5.9-11.6 mg/100g and 2.6-5.1 mg/100g respectively.

Total and reducing sugar contents were determined by conventional titrimetric analysis using iodometric method. White-fleshed, non-netted melon contained high amount of total sugar (9.72%) among these varieties. Reducing sugar contents of green-fleshed and orange- fleshed, netted melons were 2.50% and 2.43% respectively. Total sugar content of green –fleshed variety (9.54%) was slightly higher than that of orange-fleshed variety (9.00%). Non-reducing sugar contents were calculate by difference between total sugar and reducing sugar and found to be 8.22%, 7.00%a and 6.57% in white-fleshed non-netted, green-fleshed, netted and orange-fleshed, netted melons respectively. Lowest reducing sugar as a percentage of sugar was observed in white-fleshed variety. This research contributes the information on the nutrition compositions, elemental concentrations and total and reducing sugar contents of three varieties of muskmelon which are highly priced by Myanmar people.

5. ACKNOWLEDGEMENTS

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Effect of Wind Environment on High Voltage Transmission Lines Span

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Abstract: This paper examines the effects of wind environment on high voltage transmission lines span. Proper analysis of wind and its effects is important on high voltage transmission lines for the purpose of continuity and quality of electrical services. Strong wind has the potential of causing unexpected damages to conductors and thus erupting power transmission of the system. Various literatures on wind effects on high voltage transmission lines were reviewed. The various effects of wind environment on high voltage transmission lines span as well as possible solutions to these effects were examined.

Keywords: Wind effect, Electrical, Transmission Line, Span, Sag, Tension

INTRODUCTION

Transmission of electricity is the process of transporting electricity from the power station where it is generated to different places or point where it is consumed, such as our homes and various industries. Transmission of electricity is done through the electricity conducting wires or cables called transmission lines. These transmission lines and substations play a central role in the transmission system [1]. Power system comprises of three entities, power generation, transmission and distribution. Among these entities, the ineffectiveness in transmission part contributed to most of the losses. These losses depend on the resistance, inductance and capacitance, which are termed as the constants of a transmission line [2]. Therefore appropriate modeling and care is of paramount while designing and erecting a high voltage transmission system. The subsequent performance of the transmission depends on the kind of transmission model used in the system [3]. Instability on transmission line are caused by various factors such as sag, aerodynamic drag, wind, tension, ice loading, conductor size, insulators, line span e.t.c. Strong wind may cause unexpected damage to the power transmission systems, Fig. 1 [4]. Wind speed and turbulence intensity are greatly affected by terrain and climate, Fig. 2 [5]. In terrains where there are mountainous, the terrain effect is manifested in the speed-up of local wind owing to the narrow path caused by the mutual aperture of location of mountain ridge and wind direction. Thus careful study and design are needed when attempting to construct power transmission line in such wind hazardous environment.

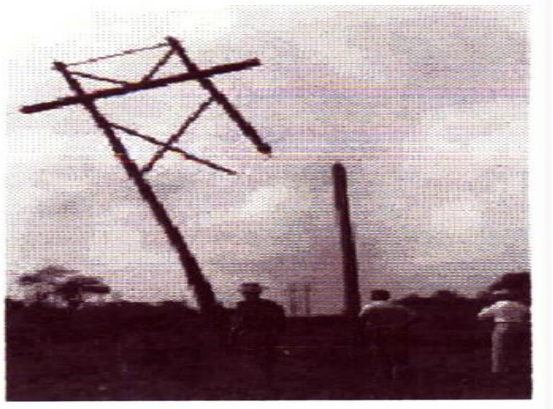

Fig 1: Damage due to strong wind[4]

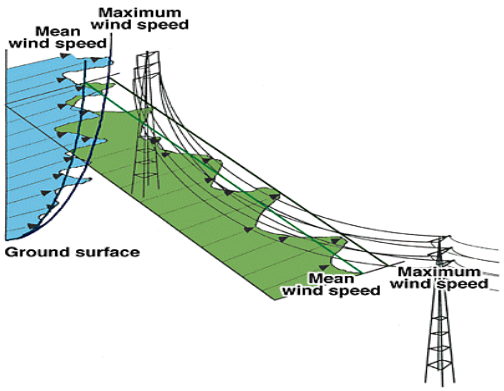

Fig 2:Mean speed and fluctuations of wind[5]

DEFINITION OF TERMS:

Wind: Wind is a perceived movement of atmospheric air usually caused by convention or differences in air pressure. The velocity of wind is a result of air pressure difference due to heating and cooling. When a difference in atmospheric pressure exists, air moves from the higher to lower pressure area resulting in wind of various speeds. The resultant effect of these pressure or velocity on any object is referred to as wind effect.

Electric Power Transmission: This is the bulk transporting of electrical energy, from generating station to substations located near demand centers. Power transmission lines are used to transport electrical energy over long distances.

Transmission Line: A Transmission lines refer to electrical transmission lines or cables such as telephone lines and power lines.

Tension: By tension we mean the magnitude of the pulling force exerted by a string, cable, or similar solid object on another object.

Span: Span is the horizontal distance between two electrical support or tower

Transmission Tower: Transmission tower is a tall structure, usually a steel lattice tower, used to provide support to an overhead power line. They come in a wide variety of shapes and sizes. They are used in high voltage AC and DC systems.

Supporting Tower: These are towers carrying electricity from generating stations to demand centers such as homes, schools and industries. They are usually constructed of steel or concrete because of the heavy cables they carry, whereas the power lines in some cities are usually supported on wooden poles as in the case of Nigeria or placed underground as in the case of other countries.

Sag: Sag is defined as the vertical distance between the point where the line is joined to the tower and the lowest point on the line.

Conductor: These are materials that allow the free flow of heat and current. In other words it allow the passage of heat and electricity

Insulator: These are the opposite of conductors. They are materials that do not allow the free flow of heat and electricity on them. They are used in transmission to insulate the conductor from ground. They are usually made of either glass or porcelain and in some cases, ceramic.

LITERATURE REVIEW

The subject of wind loading on high voltage transmission line was reported in several literatures such as [6-8]. It is discovered that, in all these text, the wind and ice effects are represented by empirical formulae or measurement tables. These formulae and tables are constraint to certain operating, topographical and meteorological conditions and lack generalization. Gust wind loading and sudden strong winds (typhoons) are not included. Recently, few researchers considered the wind effect on tower conductor systems. [9-10] speculate in their studies local wind load on transmission tower conductor systems which was initiated by the unprecedented damage on transmission lines in West Japan caused by Typhoon in 1991. Their results were based on both wind tunnel measurements and numerical simulations. Similar studies were carried out in [11-14]. Some projects [15, 16] include the installation of anti-vibrating devices to damp vibrations caused by the conductors exposed to the dynamic load of wind. Studies also shows that the transmission line conductors may have noncircular cross sections designed to minimize the effects of wind-induced motions and vibrations [17]. In a bit to curb with these effect automatic weather stations may be installed on top of transmission towers to monitor both the mechanical loading of the structures due to wind gusts and the thermal dissipation of conductors for ampacity studies [18]. The impacts of the environmental effect on the thermal ratings of overhead conductors were investigated by many researchers such as [19-22]. Based on the above review, it is obvious that wind (gust wind) and other environmental factors have drastic effects on the stability of high voltage transmission line.

WIND AND TRANSMISSION LINE

(a) Sag: Sag literally means to be bending in shape or size. The difference in level between points of supports and the lowest point on the conductor in overhead transmission line is called sag. Sag is one of the adverse effects of wind on transmission line [23].

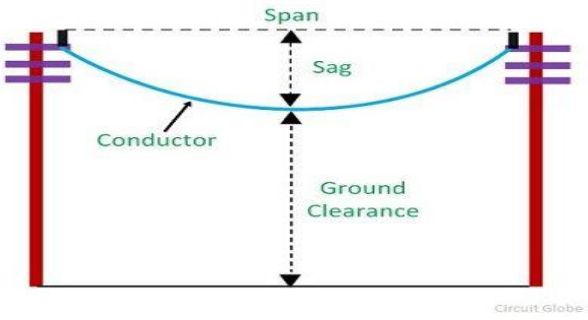

Fig 3: Sag Representation

EFFECTS OF SAG ON TRANSMISSION LINE

It causes power failure: When transmission line sag excessively, it is liable of causing instability in the network resulting to power failure. An overheating electrical transmission line sagging into a tree sparked the greatest power failure in the Western United States in 1996.

It reduces excessive tension: If the conductors of a transmission line are too much stretched between the supporting tower or pole, the stress on the conductors may reach an unsafe level and the conductor may break due to excessive pressure (i.e. tension). It is therefore very important that the conductors are under safe tension. In order to permit safe tension in the conductors, the conductors between two supports must not be fully stretched but are allowed to have a dip or sag.

When too much it increases the cost in transmission line:

The more space in between the transmission towers, the more the transmission line will sag. If there is too much sag in a transmission line, it will increase the amount of conductor used, thereby increasing the cost on conductor more than necessary.

Calculation of sag

The tension on a suspended conductor is governed by the conductor weight, effects of wind, ice loading and temperature differences. Generally, conductor tension is kept less than 50% of its ultimate tensile strength. The sag-tension calculation allows calculating the conductor temperature as well as ice and wind loading simultaneously [24]. The value of sag is calculated for two different scenarios - (i) supports at equal levels and (ii) supports at unequal levels.

When supports are at equal levels

Consider a conductor suspended at supports of equal heights as shown in the figure below. A and B are the support points and O is the lowest point on the conductor [25].

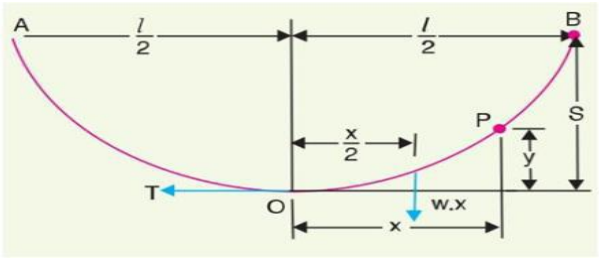

Fig 4: Sag in power line when supports are at equal heights

Let,

l = length of the conductor span (span length)

w = weight per unit length of the conductor

T = tension in the conductor

Consider a point P on the conductor. Considering the lowest point O as the origin, let the coordinates of point P be x and y. Assume the curvature is so small that the curved length is equal to its horizontal projection (i.e. OP = x). The forces acting on the conductor portion OP are -

i. the weight w.x acting at a distance x/2 from the point O
ii. the tension T acting at the point O

Equating the moments of the two forces about point O, we get,

$T.y = w.x * x/2$
or, $y = w.x^2 / 2T$

The maximum sag (dip) is represented by the value of y at either of the support points. At support point A,

x = l/2 and y = S (sag)
therefore, sag $S = w(l/2)^2 / 2T$
therefore, sag $\mathbf{S = w.l^2/8T}$

When supports are at unequal levels

We usually experience supports of unequal heights in hilly areas.

Let,

l = length of the conductor span (span length)

w = weight per unit length of the conductor

T = tension in the conductor

h = difference in levels between the two supports

x_1 = distance of support at lower level (A) from the origin O

x_2 = distance of support at higher level (B) from the origin O

From the above calculation of sag in the previous point,

$$y = w\,x^2\,/2T$$

Now, at support A, x = x_1 and y = S_1

Therefore, $S_1 = w\ {x_1}^2\ /2T$ and $S_2 = w\ {x_2}^2\ /2T$

Also, $x_1 + x_2 = 1$……..(1)

Now $S_2 - S_1 = \frac{w}{2T}\ ({x_2}^2 - {x_1}^2)$

$$= \frac{w}{2T}\ (x_2 + x_1)\ (x_2 - x_1)$$

From equation (1)

$$\frac{w}{2T}\ (x_2 + x_1)\ (x_2 - x_1) = \frac{w \times 1}{2T}\ (x_2 - x_1)$$

But, $S_2 - S_1 = h$

Therefore, $h = \frac{w \times 1}{2T}\ (x_2 - x_1)$

Also, $(x_2 - x_1) = \frac{2T \times h}{w \times 1}$ ----------(2)

Solving equations 1 and 2 we shall have,

$x_1 = \frac{1}{2} - \frac{T \times h}{w \times 1}$ and $x_1 = \frac{1}{2} + \frac{T \times h}{w \times 1}$

How to prevent excessive sagging of transmission Line

Transmission lines that sag under heavy use or inrush wind and high temperatures are seen as the basic bane of transmission line operators [26]. Up till now, utilities have had two basic approaches to dealing with line sag [2]. They could either be: **Re-engineer the line:** re-engineering typically involves (i) reducing the distance between the transmission towers because the more the space between transmission towers or pole, the more the transmission line will sag and (ii) raising tower heights or re-conducting. This is an expensive solution when compared with monitoring it to ensure that sag limits are not breached.

(b) Span Length: The length of a transmission line span is greatly affected by in rush wind. The longer the span gives more sag. Sag is directly proportional to the square of the span length. The force due to wind on the span length is assumed to act horizontally to the conductor. Also the force applied by ice loading is believed to be vertically downwards. Therefore, the total force on the conductor span is the vector sum of the horizontal and vertical forces.

Mathematically,

$$w_t = \sqrt{(w + w_i)^2 + (w_w)^2}$$

where,

w = weight of the conductor per unit length

w_i = weight of the loaded ice per unit length

w_w = wind force per unit length

But when a conductor has wind as well as ice loading,

i. The conductor sets itself in a plane at an angle θ to the vertical plane.
   Where, $tan\theta = {w_w}/{(w + w_i)}$
ii. In this case, sag is given by $S = w_t.l^2 / 2T$.

Here, S is the slant sag, i.e. sag is in the plane where the conductor has set itself. The vertical sag is equal to S.cosθ

(c) Tension: Wind load on the conductor will increase the apparent weight of the conductor thereby resulting in an in increase in tension. This increase in resultant load will result in an effective sag in an inclined direction with the two components, horizontal and vertical components. Sag is inversely proportional to the tension in the conductor. Higher tension increases the stress in the insulators and supporting structures. The increase in tension will increase the cable length due to elastic stretch by an amount given by [27]:

$\Delta L = (To - T) / EA$ (ii)

To = the initial tension in Newton (N)

T = the final tension

E = the coefficient of elasticity

A = the cross section of the conductor in meters.

(d) Pole Movement: Strong wind can result to movement in the utility poles or tower. Any movement or shift in the original position of the pole or tower will have the effect of introducing additional length into the span. This can also result to conductor breaking or collapse of adjacent structures.

CONCLUSION

Proper analysis of wind environment and its effects is important on high voltage transmission line for the purpose of continuity and quality of electrical services. The study have shown some adverse effects of wind environment on high voltage transmission line span such excessive sag, increase in span length, pole movement, tension e.t.c. It has also been known that sag on conductors increases the length of conductor used for transmission. Also, if the tension of the conductor in a transmission is increased beyond it limit it may get broken and the power transmission of the system get erupt, therefore the need to increase tension by fixing the conductors on pole properly. This will help eliminate possible accident that may arise as a result of sag as living thing including human being can accidently touch line conductors.

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Electronic Transcript Management System

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Abstract: There has been a recent shift from manual to an automated approach for transcript management. A management system capable of result input and management as well as a system for graduates to make transcript requests from any internet enabled web browser. This approach is very much effective in transcript and result management for any higher institution within Nigeria operating a similar grading system to that of University of Port Harcourt. The current system for managing results has proven to be inefficient making it a necessity for a faster and efficient approach. Using modern web tools, a web-based transcript management system can be developed to solve the problems of the current system being used.

Keywords: Transcript, Web, Web-Based, Web Browser, MySQL

I. INTRODUCTION

Recent developments in Nigerian higher institutions have seen a rising need to automate transcript management. Several means of achieving this via a software-based approach exists.

Software can be simply referred to as "The programs, programming languages, and data that direct the operations of a computer system" [5].

Result processing can be seen as a continuous process of converting data (scores, grade points, credit units etc.) into a definite and meaningful information such as statement of result, transcripts etc. [1]. Students' performances are judged based on the outcome of their results. If an adequate result management and processing system is not in use, there could be problems which at the end would diminish the aim of which results and consequently transcripts were meant for.

A transcript is documentation of a student's permanent academic record, which usually means all courses taken, all grades received, all honours received, and degrees conferred to a student [6].

As students go through different educational processes to earn a degree, the need for the sending, processing and grading students using paper records become cumbersome and unmanageable.

Currently, sending and receiving paper transcripts remains the most common form of record transfer, even though labour-intensive, manual keying of data must occur on both ends of the transaction [3]. A web-based electronic transcript management and processing system will help in reducing problems that stem from the manual means of processing. In this system, only authorized user(s) would have access to the system.

The web-based transcript management system meant for processing of the transcripts will be done using HTML5, CSS3 and jQuery for front end design, AJAX for interaction with PHP (Hypertext Pre-Processor) which is server side programming language and MySQLi (My Structural Query Language improved). The languages were chosen based on their flexibility and ease while working locally using a XAMPP server.

With proper programming practices, students' Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) can be calculated on computation of the necessary data.

II. CURRENT MANUAL APPROACH

In most Nigerian higher institutions, result management is the duty of the Exams and Records administrative department of the school.

Each department also have copies of every student's result. In processing a student's transcript using University of Port Harcourt as a case study, the following steps are taken as presented in the block diagram of fig. 1.

Firstly, payment is made to a designated bank account. This amount is dependent on the transcript delivery destination. After the payment has been made, the student then goes to the Exams and Records department with a formal letter requesting for his academic transcript. The letter is forwarded to the student's department requesting for copies of his results. These copies are then sent back to the Exams and Records office for compilation and then sent to the office of the Registrar where it is signed and sent back to the Exams and Records office. The transcript is then sealed and sent to the stipulated address through a courier service.

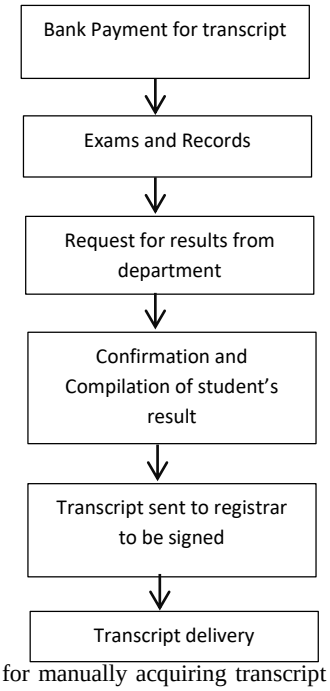

Fig. 1: Steps for manually acquiring transcript in University of Port Harcourt

This method is slow, error-prone and stressful. These problems can be diminished by making use of a computer based processing system or an electronic transcript management system [4].

III. WEB-BASED APPROACH OF TRASCRIPT MANAGEMENT

Steps have been taken towards automation of transcript management with the use of excel spread sheet. Here, the programming is hard coded into the cells, and cell referencing which could be applied to monitor and track students' performances such as cumulative points [2].

In this paper, a web-based system of database management of transcript is our primary focus. MySQL database is made use of. The database is structured in such a way that it allows for proper storage of useful student and staff date. This approach, though tested and found to be working as expected, has however not been put to use widely [7].

Three access levels will be considered to allow for the success of this approach: Administrator, Student and Lecturer access levels. These three levels of access will be powered by the content of their database tables.

Administrator Access Level: The administrator (admin) has complete access and control of other users. The administrator can access the following tables in the database:

Students' personal details: This table contains students' matriculation number and other personal information. Each student can then access their individual portals by making use of their matriculation number and password. Changes can be made to their personal details only by the administrator.

#	Name	Type	Collation	Attributes	Null	Default
1	id	int(11)			No	None
2	fullname	int(11)			No	None
3	mat_number	int(11)			No	None
4	faculty	varchar(11)	latin1_swedish_ci		No	None
5	department	varchar(11)	latin1_swedish_ci		No	None
6	level	varchar(11)	latin1_swedish_ci		No	None
7	password	varchar(11)	latin1_swedish_ci		No	None
8	status	varchar(11)	latin1_swedish_ci		No	None
9	date	date			No	None
10	time	time			No	None

Fig. 2: Students user accounts on the MySQL database

Lecturers' personal details: Personal accounts of lecturers can be created by the administrator which will include the course the lecturer would take for that semester. The information that will be contained in the database for each lecturer can be represented as seen in fig. 3.

#	Name	Type	Collation	Attributes	Null	Default
1	id	int(11)			No	None
2	fullname	varchar(30)	latin1_swedish_ci		No	None
3	web_mail	varchar(11)	latin1_swedish_ci		No	None
4	faculty	varchar(11)	latin1_swedish_ci		No	None
5	department	varchar(11)	latin1_swedish_ci		No	None
6	password	varchar(20)	latin1_swedish_ci		No	None
7	date	date			No	None
8	time	time			No	None

Fig. 3: MySQL database showing the structure of the lecturers' user accounts table

List of all courses: All courses available in the school will also be registered into the database by the administrator.

#	Name	Type	Collation	Attributes	Null	Default
1	id	int(11)			No	None
2	course_name	varchar(20)	latin1_swedish_ci		No	None
3	course_code	varchar(11)	latin1_swedish_ci		No	None
4	course_unit	int(11)			No	None
5	level	int(11)			No	None
6	faculty	varchar(11)	latin1_swedish_ci		No	None
7	department	varchar(11)	latin1_swedish_ci		No	None
8	date	date			No	None
9	time	time			No	None

Fig. 4: MySQL database showing the structure of the list of courses

Lecturers' courses: Every semester, each lecturer is set to teach a particular course which has to be updated by the administrator. This information is updated in the MySQL database and can is represented as seen in fig. 5. Each lecturer can only input results of student for courses he currently handles.

#	Name	Type	Collation	Attributes	Null	Default
1	id	int(11)			No	None
2	course_id	int(11)			No	None
3	lecturer_id	int(11)			No	None
4	date	date			No	None
5	time	time			No	None

Fig 5: MySQL database showing the structure of the course-lecturer table

Transcript requests: When requests for transcripts are made by students, the administrator changes the status of the request to show if it was granted or not as well as the stages of processing it has reached.

#	Name	Type	Collation	Attributes	Null	Default	Extra
1	id	int(11)			No	None	
2	student_id	int(11)			No	None	
3	request_status	varchar(11)	latin1_swedish_ci		No	None	
4	remark	varchar(11)	latin1_swedish_ci		No	None	
5	date	date			No	None	
6	time	time			No	None	

Fig 6: MySQL database showing the structure of the transcript request table

Student Access Level: The student portal allows the user to login to his personal account in order to make register for semester courses, view results and make requests for a transcript.

The courses registered will then be filled with their appropriate scores by the corresponding course lecturer.

#	Name	Type	Collation	Attributes	Null	Default	Extra
1	id	int(11)			No	None	
2	course_id	int(11)			No	None	
3	mat_number	varchar(11)	latin1_swedish_ci		No	None	
4	school_session	varchar(11)	latin1_swedish_ci		No	None	
5	semester	varchar(11)	latin1_swedish_ci		No	None	
6	level	varchar(11)	latin1_swedish_ci		No	None	
7	date	date			No	None	
8	time	time			No	None	

Fig 7: Structure of the course registration on MySQL database table.

With this, every student can register a course once a school session resumes and it will also determine the courses for which the student can be assessed by the lecturer.

Lecturer Access Level: The lecturer's portal is set aside for inputting the result for the course(s) he currently takes. The lecturer can only input scores for students who registered for his course. The score input for a course is represented in fig.8.

#	Name	Type	Collation	Attributes	Null	Default
1	id	int(11)			No	None
2	course_id	int(11)			No	None
3	course_unit	int(11)			No	None
4	mat_number	varchar(11)	latin1_swedish_ci		No	None
5	school_session	varchar(11)	latin1_swedish_ci		No	None
6	semester	varchar(20)	latin1_swedish_ci		No	None
7	lecturer_name	varchar(11)	latin1_swedish_ci		No	None
8	score	int(11)			No	None
9	grade	varchar(11)	latin1_swedish_ci		No	None
10	date	date			No	None
11	time	time			No	None

Fig. 8: MySQL database table meant for inserting courses and their grades for different students who registered for that course.

From fig. 8, scores for a particular course are stored in the results database table which includes the matriculation number, course id, semester the course belongs to as well as the session, lecturer's name, total score, and grade.

Fig. 9 shows an implementation of the tables in the MySQL database using a local host called XAMPP. In the database, tables have been created for specific records as seen in fig. 2-8. Each column is given a name and a data type allowing one to set any one of the column name as primary key. For this work, our primary key is the 'id'. As seen in fig. 9, each data table can be emptied or dropped. For the purpose of this work, a total of seven tables are required.

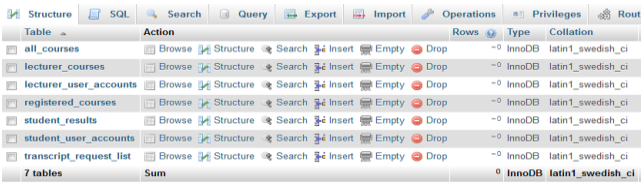

Fig. 9: MySQL database showing the different tables from localhost using XAMPP

Every account listed - administrator, lecturer and student – can be accessed by a user through the flow diagram shown in fig. 10.

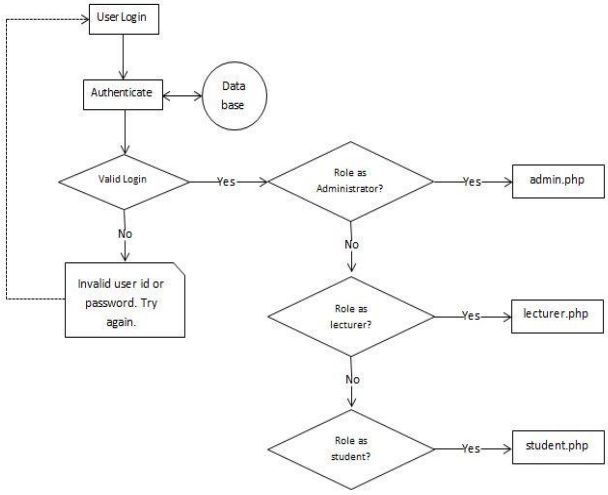

Fig. 10: Flow diagram for logging into the Transcript Management System (TMS)

IV. GRADE POINT AVERAGE (GPA) AND CUMULATIVE CGPA GRADE POINT AVERAGE CALCULATIONS

For a given semester, each student would have a GPA while a combination of all available semester course assessments produces a CGPA.

Necessary information for calculating the semester GPA is available in the results table where the scores and their units are stored. The GPA for a semester is calculated using (1).

$$GPA = \frac{Sum\ of\ total\ available\ scores\ for\ that\ semester}{sum\ of\ all\ units\ offered\ for\ the\ semester} \quad (1)$$

For CGPA calculation, we make use of (2).

$$CGPA = \frac{Sum\ of\ total\ available\ scores\ ever\ taken}{sum\ of\ all\ units\ offered} \quad (2)$$

V. REQUEST FOR TRANSCRIPT

In requesting for a transcript, a student logs into his account and selects the purpose for which the transcript is meant for in terms of delivery recipient. This could be a personal copy, for foreign institution or a Nigerian institution. This will determine the cost that will be paid by the student for the whole process.

Transcript request by students is shown by the following flow diagram in fig. 11.

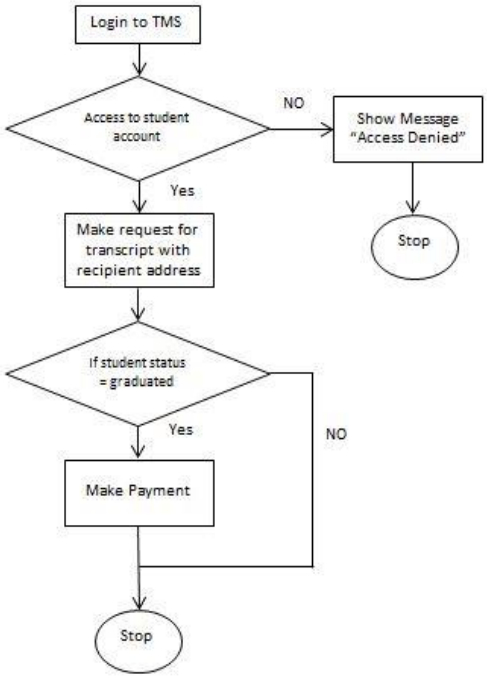

Fig. 11: Flow diagram for student's request for academic transcript

When a request is made by a student for a transcript, it is added to the request table which can be accessed only by the administrator. Here the administrator makes checks for those requests where payment has already been made and prints out the result by clicking on a print command button. This printed document is then sent to the Dean of Student Affairs for his signature. Once this is done, the transcript is then sealed and sent via courier service to the designated address. During this entire procedure, the administrator updates the status of the whole process so the student can view from his personal page.

The processing of the transcript can be summarised by the flow diagram in fig. 12.

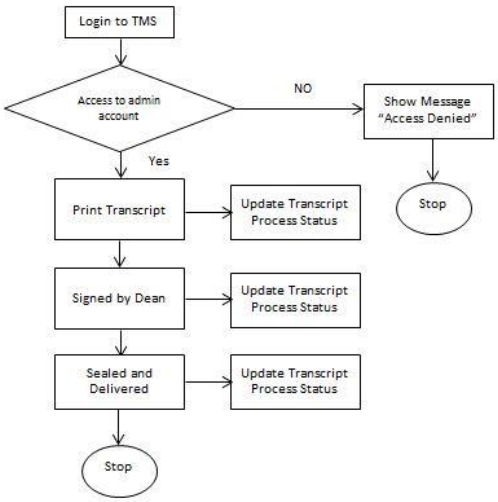

Fig. 12: Flow diagram for administrator processing of academic transcript

With each stage of processing, the administrator updates the status of that transcript request made by the student. This continues until the transcript is delivered to the recipient address.

VI. CONCLUSION

An electronic transcript management system creates an avenue for information management to be convenient, efficient and easy to use. The application will be capable of storing and retrieving academic records with high speed and accuracy, and presenting useful information to its users.

The system provides an efficient means of processing, preserving and displaying students' results, academic records and other relevant notices to students. As part of its benefits, it is stress-free and speed-up the processing of students' examination results. Finally, the system is flexible and runs on a web browser. With this application, the processing of students' results is automated, thereby reducing processing time and increasing accuracy.

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License Plate Detection and Recognition using OCR based on Morphological Operation

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Abstract: — License Plate Recognition has been intensively studied in many countries. Due to the different types of number plates being used, the requirements of an automatic number plate recognition system is different for each country. In this paper, a number plate localization and recognition system for vehicles in Myanmar is proposed. This system is developed based on digital images and can be easily applied to toll gate, car parking systems for the use of documenting access of parking services, secure usage of parking houses and also to prevent car theft issues. The proposed algorithm is based on colour based detection and k-Nearest Neighbour(k-NN) with area criteria tests for number plate localization. The next feature is the Euler Number, which is the same as the number of holes in a binary image. Segmentation of the plate characters was achieved by the application of bwboundaries. Removing noise using morphological operation. The character recognition was accomplished with the aid of optical characters recognition(OCR)by the process of Pattern matching. A comparative analysis on the success rate of the proposed system showed overall better success rate of 96.8% by using OCR.

Keywords: License plate recognition, colour based detection, morphology operation, k-NN, optical character recognition.

INTRODUCTION

Each vehicle has a unique identification number which is called license plate (LP). The license plate has a rectangular shape and contain two parts. Upper part has regional division and the lower part has a group of numbers and letters. Because the growth number of vehicles, which leads to many vehicles related issues, license plate recognition [1]became a very important .In the current information technology era, the use of automations and intelligent systems is becoming more and more widespread. License plate recognition has turned out to be an important research issue. License plate recognition has many applications in toll gate, car parking systems for the use of documenting access of parking services, secure usage of parking houses and also prevent car theft issues and so on.[3]

The system of license plate in Myanmar is based on the residency area in which the vehicle is registered and on the registration order. Some countries have many versions on the form of license plate, for example Tunis, China, Libya, and India. Besides the form, Myanmar also applies colour to the system of license plate, i.e. private vehicle (black), taxi/bus vehicle (red), vehicle owned by monk and/or monastery (yellow), touring vehicle by (blue),and vehicle owned by Ambassador (white). This research is aimed to create a license plate recognition system. This system later can be used as there ference to identify vehicles. The challenge in the process of license plate identification is how to detect and recognize the license plate of vehicles in different type,especially red colour and black colour vehicle plate in Myanmar.

Some previous research in recognition of Indonesian license plate have been carried out. A research employing Fourier transform method and hidden markov model obtained an accuracy of 84.38%. Another research resulted accuracy value of 85% on the character recognition and of 97% on the process of detecting the location of license plate. This research uses contour in detecting the location. The process continues by doing figure segmentation utilizing interconnected figure segmentation, and is ended in the process of classification by using static classification technique by which the segmented figure is translated into the character of ASCII. However, a problem aroused when a character cannot be recognized because of its different shape or italic shape. A high degree of accuracy, that is 96%, is gained in the other previous research.[3]

This research implemented a method of colour based detection to extract feature and k- nearest neighbour(k-NN) as the classification method optical character recognition(OCR) was used to recognize license plate.

RELATED WORKS

The performance of license plate recognition, which use colour based detection to detect and extract location of the license. The license plate properties extraction is obtained and k-Nearest Neighbour(k-NN) based classification. Additionally Hole(Euler Number) was used for filtering. And then, morphological operation was used for removing noise. And Segmenting the each character used bwboundaries function. Finally,opticalcharacter recognition(OCR) was used to recognize the license plate.

In recent years, some developed countries created license plate recognition systems for many applications of their traffic requirements. In regard to plate localization, many techniques have been used in connected domain analysis, mathematical morphology colour model, fuzzy set theory, and statistical classifications. For license plate recognition, mainly the recognition techniques can be divided in to two main categories. The template based method and the supervised learning method as mention in . The template based method usually used in character recognition by comparing each character with stored characters to find

the exact matching or the closest character. The matching technique used is normalized correlation method to indicate how well the chosen character matches with the stored character. This method is sensitive to the noise disturbance, and image orientation. While the supervised-based method has common classifiers that have been used for character recognition, Mark net and Bayes net have been used as mention in, which are Neural Network (NN) as mention in, and support vector machine (SVM) as mention in. Because of the rapid development in digital signal processing and digital image processing, many systems implemented on an embedded digital system to process video stream, such as in .The system consist of modules to detect and recognize characters. AdaBoost technique used to detect license plate, and cascade framework used for license plate recognition, Ami the most recent two decades many research endeavors have been spent to build up the license plate acknowledgment system., some of the distributed work is exhibited, the emphasis will be on the technique utilized for executing those LPR frameworks.[2]

where $I_{bw}(i,j)$= matrix value of RGB
i= row of matrix
j= column of matrix

B. k - nearest neighbours

k-Nearest neighbours algorithm is a method for classifying objects based on closest training examples in the feature space. k-nearest neighbours algorithm is among the simplest of all machine learning algorithm. Training process for this algorithm only consists of string feature vectors and labels of the training images. In the classification process, the unlabeled query point is simply assigned to the label of its *knearest neighbours.*Typically the object is classified based on the labels of its *k* nearest neighbours by majority vote. If *k*=1, the object is simply classified as the class of the object nearest t it. When there are only two classes, *k* must be an odd integer. However, there can still be tie when *k* is an odd integer when performing multiclass classification. After we convert each image to a vector of fixed-length with real numbers, we used the most common distancefunction for k-NN which is Euclidean distance between the points x and u is

$$\boldsymbol{d(x,u) = \sqrt{\sum_{i=1}^{n}(x_i - u_i)^2}} \text{----------2}$$

where, d(x,u) = distance from the sample vector
x = feature of training image
u = feature of test image

C. Hole (Euler Number)

The Euler number, which is the same as the number of holes in a binary image. It is calculated by morphological function. The ratios of holes area to the entire area is another feature, which can be determined when the system calculates the Euler number. Other sample features, such as pressing ration (ratio of object pixels to all pixels), are useful for accurate recognition.

BACKGROUND THEORY

The performance of license plate recognition, which use colour based detection to detect and extract location of the license. The license plate properties extraction is obtained and k-Nearest Neighbour(k-NN) based classification. Additionally Hole(Euler Number) was used for filtering. And then, morphological operation was used for removing noise. And Segmenting the each character used bwboundaries function. Finally, optical character recognition(OCR) was used to recognize the license plate.

A. colour based detection

Because colour information is used to detect the location of a license plate, converting the whole image into gray level, into black and white level, or binary level is not necessary. Detecting an object within its image has always been difficult in image processing. Colour features to localize a license plate.

$$I_{bw}(i,j) = \begin{cases} 1 & \text{ifdesiredRGB} \\ 0 & \text{otherwise} \end{cases} \text{----------1}$$

Euler Number=1- Number of holes in that object

D. Morphological operation

Mathematical morphology analyses images by using operator developed using set theory. It was originally developed for binary image was extended to include grey-level data. The word morphological concerns shapes. In this way morphological operators define local transformations that change pixel values that are represented as sets, he ways in which pixel values changed is formalized by the definition of the hit or miss transformation**.**There were many operators such as dilation, erosion, reconstruction-based operator and other operations. bwareaopen function was used to remove noise.

bw2=bwareaopen(bw,p)----------3

Here, removes from a binary image all connected objects that have fewer the p pixels, producing another binary image bw2. This operation is known as an area opening.

D. Segmentation

Segmentation using bwboundaries.Bwboundaries is a cell array in which each element is the boundary of an object in the binary image *bw.* The clockwise boundary of each object is computed by the boundary function. By default the boundaries are computed using 8-connectivity.

[B,L]=bwboundaries(bw,'noholes');----------4
where, [B,L]= returns a label matrix L
bw= binary image
noholes= search only for object (parent and child)

E. Optical Character Recognition(OCR)

Recognizing text in images is useful in many computer vision applications such as image search, document analysis, and robot navigation. The OCR function provides an easy way to add text recognition functionality to a wide range of application. The OCR functions returns the recognized text, the recognition confidence, and the location of the text in the original image. OCR performs best when the text is located on a uniform like a document. OCR is a field of research in pattern recognition, artificial intelligence and computer vision. OCR can recognize text such as, "Block" or "Line" or "Word". And OCR can declared language such as "English" or "Japanese".

There are two basic types of core OCR algorithm, matrix matching and feature extraction. Matrix matching involves comparing an image to stored glyph on a pixel-by-pixel basis; it is known as "pattern matching", "pattern recognition', or "image correlation". Feature extraction decomposes glyphs into "features" like lines, closed loops, line direction, and line intersections.[4]

T=ocr(Ibw,"TextLayout","Block","Language","English");

----------5

where, T = return value
Ibw= binary image

EXPERIMENTAL RESULTS

A. Design of the proposed system

The proposed system design is as shown in figure 1.

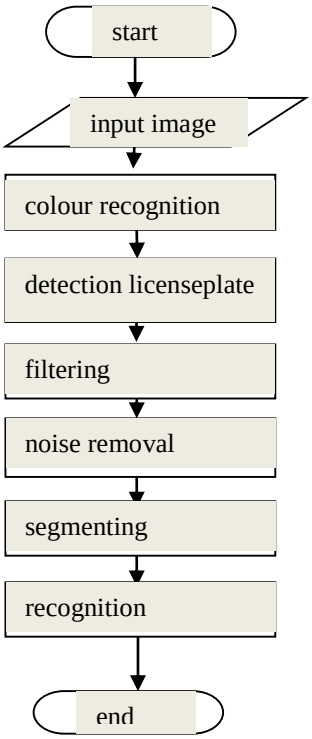

Fig.1Flow chart of the proposed system

B. Implementation of the proposed system

The proposed system consists two parts in implementation. Firstly, the extraction and localization of the license plate. Then, recognition of license plate was perform.This system inthe processof license plate identification is how to detect and recognize the license plate of vehicles in different form and type especially red colour and black colour vehicle plate in Myanmar.

Fig. 2Extraction and localization of saloon type black colour

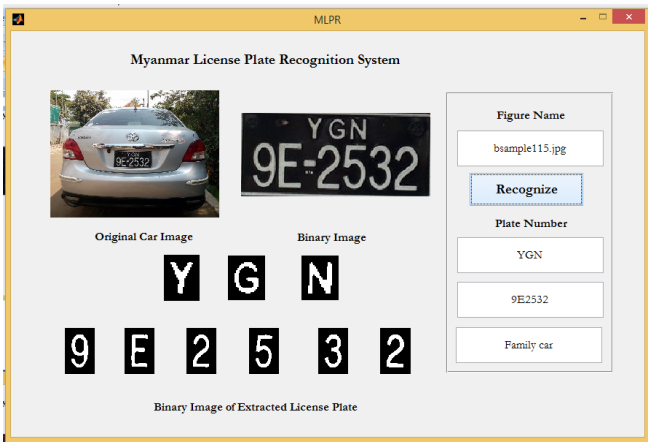

Fig. 3 Recognition of saloon type black colour

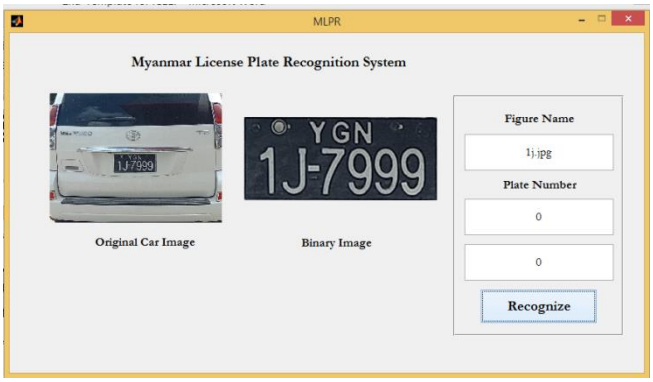

Fig. 4Extraction and localization of surf type black colour

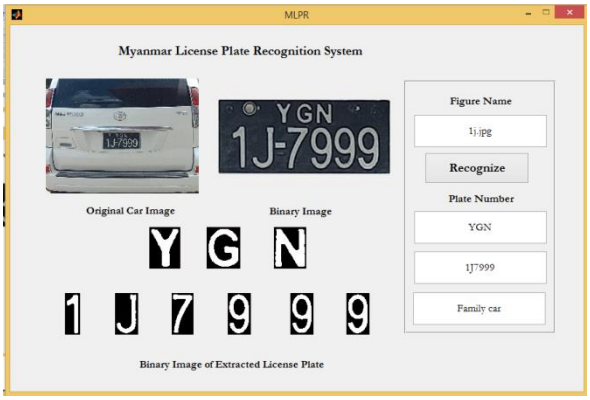

Fig. 5Recognition of highsurf black colour

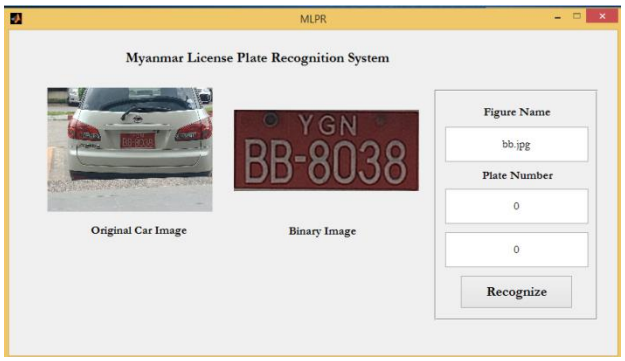

Fig. 6Extraction and localization of taxi

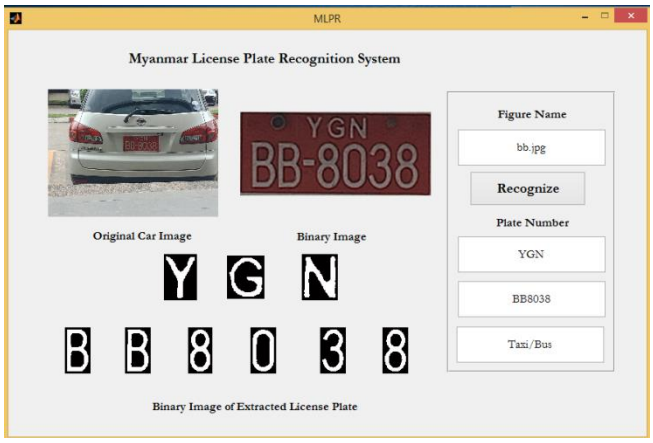

Fig. 7Recognition taxi

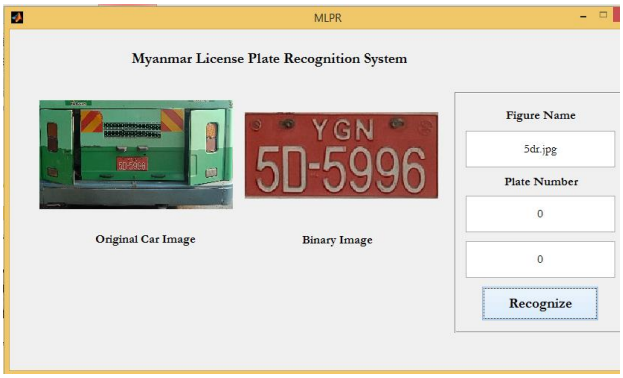

Fig. 8Extraction and localization of bus

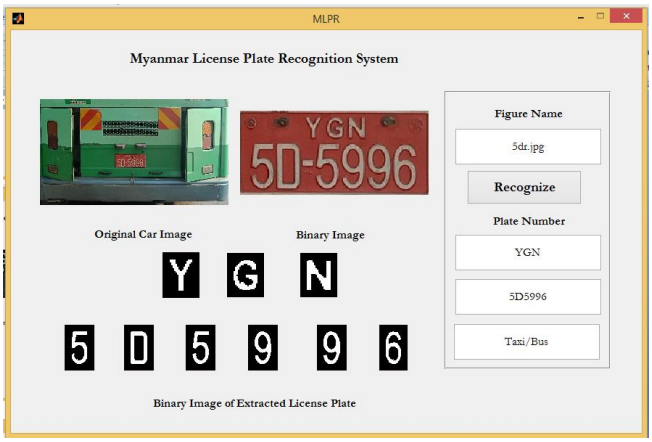

Fig. 9Recognition of Bus

TABLE I
EXPERIMENTAL RESULTS

NO	EXPERIMENTAL RESULT		
	Car Type	**Color**	**percentage**
1	Saloon type	black	75
2	Surf	black	65
3	Taxi	red	72
4	Bus	red	35

The above table show the percentage of result test. The training data set is 26 alpha bats and 10 digits . Total of test data is based on 100 images.

CONCLUSIONS

This paper presents a proposed technique to detect and recognize the Myanmar license plate based on kNN algorithm and OCR. The image for the license plate first pre-processed through several steps; to specify the plate location in the image then cutting the plat part from the image. Then, according to the myanmar license plate features, the proposed algorithm separates the characters and the numbers in the plate, and recognize each character. Next implementation is to handle more various complex conditions such as blurring, low resolution, character noise by enhancing the robustness and selection more character features to increase the character recognition in such conditions. The weak point of OCR algorithm is can recognize "O" as "Q". It can also use ".jpg" and ".png" format. The proposed system should perpendicular with camera.

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