Online ISSN : 0975-4172
Print ISSN : 0975-4350
DOI : 10.17406/GJCST

Global Journal

of Computer Science and Technology: G

Interdisciplinary

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Highlights

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Teacher in a Digital Era

Discovering Thoughts, Inventing Future

VOLUME 17 ISSUE 3 VERSION 1.0

Global Journal of Computer Science and Technology: G
Interdisciplinary

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Volume 17 Issue 3(Ver. 1.0)

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Framingham Massachusetts Pin: 01701,
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USA Toll Free: +001-888-839-7392
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Offset Typesetting

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Global Journal of Computer Science and Technology: G Interdisciplinary
Volume 17 Issue 3 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

From Forward Prediction Error and Backward Prediction Error to Orthogonal Data in Space(Lattice Predictor) and the Origin of a System to Pick up Another

By Dr. Ziad Sobih
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Abstract- In this paper, we will develop another class of linear filter which involve order update and time update. These filters have the important fact of order update. We will show a computationally efficient modular lattice-like architecture. This lead to a filter with computational complexity linear with the order which is the length.

The design of order recursive adaptive filter can take two approaches.

1. Stochastic [16] gradient approach. This is Wiener theory.

2. Least squares approach. This is Kalman filter theory.

The second approach is code demanding. We will start with the first approach.

Keywords: wiener theory, prediction, filters, stochastic gradient, learning and lattice filter.

GJCST-G Classification: J.2

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I. Introduction

The adaptive gradient lattice (GAL) filter is due to Griffiths (1977) and may be viewed as a natural extension of least mean square as they both use stochastic gradient [16] approach. First, we derive the recursive formula for order update then we find the updates for the desired response.

II. Multistage Lattice Predictor [18]

Figure 2 is a single stage lattice predictor. The input and output are characterized by a single parameter km. We assume that the input is wide sense stationary. To find km, we start with the cost function.

$$J_{fb,m}=\frac{1}{2}\,E[|f_m(n)|^2+|b_m(n)|^2] \qquad (1)$$

Where fm(n) is the forward prediction error and bm(n) is the backward prediction error and E is the expected value. The relation for the lattice from stage m-1 to m is

$$f_m(n)= f_{m-1}(n) + k_m^{*}b_{m-1}(n-1) \quad (2) \qquad (2)$$

$$b_m(n) = b_{m-1}(n-1) + k_m f_{m-1}(n-1) \qquad (3)$$

Using equations 1 and 2 and 3 we will have for

$$J_{fb,m}=\frac{1}{2}(E[|f_{m-1}(n)|^2]+E[|b_{m-1}(n-1)|^2])(1+|k_m|^2)$$
$$+k_m E[f_{m-1}(n)\ b^{*}_{m-1}(n-1)]$$
$$+k_m^{*}[b_{m-1}(n-1)\ f^{*}_{m-1}(n)] \qquad (4)$$

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This is a max-min problem. We want to find the min j as km change. Differentiating

$$\frac{\partial J}{\partial k}= k_m(E[|f_{m-1}(n)|^2]+E[|b_{m-1}(n-1)|^2])$$
$$+2E[b_{m-1}(n-1)f^{*}_{m-1}(n)] \qquad (5)$$

Equating to zero we find that the optimum value of km to make j minimum.

$$k_{m,o}= -\,2\,E\,[b_{m-1}(n-1)\ f^{*}_{m-1}(n)]$$
$$/\,(E[|f_{m-1}(n)|^2+|b_{m-1}(n-1)|^2]) \qquad (6)$$

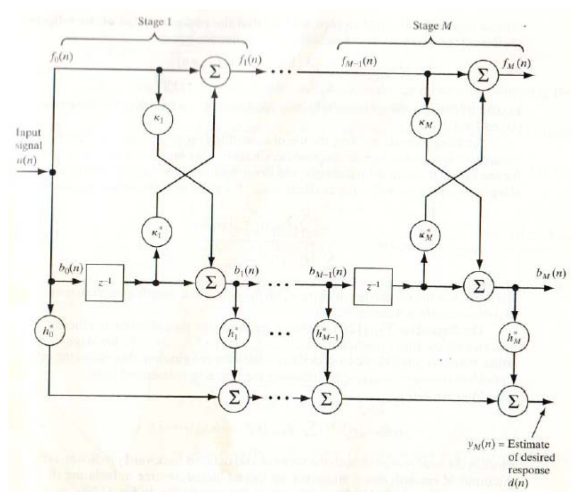

Figure 1: Lattice filter

This is Burg formula (1968).

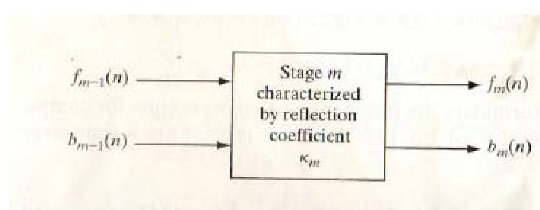

Figure 2: Block diagram

This formula assumes that the process is ergodic. This means we can use time averages. We get

Global Journal of Computer Science and Technology (G) Volume XVII Issue III Version I Year 2017
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for the reflection coefficient km for the m stage in the lattice predictor

$$k_m(n)= - 2 \sum_{i=1}^{n} [b_{m-1} (i-1)\, f^*_{m-1}(i)]$$

$$/ (\sum_{i=1}^{n} [|f_{m-1}(i)|^2+|b_{m-1}(i-1)|^2]) \qquad (7)$$

It is clear that the estimate is data dependent.

Equation 7 is a block estimator for the reflection coefficient km. It is time now to find a recursive formula to update km.

First, we find

$$E_{m-1}(n)=\sum_{i=1}^{n} [|f_{m-1}(i)|^2+ | b_{m-1}(i-1)|^2] \qquad (8)$$

This is the total energy of the forward and delayed backward error at the input of the m stage. Doing some math, we will have the recursive formula.

$$E_{m-1}(n)=\sum_{i=1}^{n-1} [|f_{m-1}(i)|^2+ | b_{m-1}(i-1)|^2]$$

$$+[| b_{m-1} (n-1)|^2+| f^*_{m-1}(n)|^2]$$

$$=E_{m-1}(n-1)+| b_{m-1} (n-1)|^2+| f_{m-1}(n)|^2] \qquad (9)$$

At this point, we need a recursive formula for equation 7 and we will start by writing the top as

$$\sum_{i=1}^{n} [b_{m-1}(i-1)\, f^*_{m-1}(i)]$$

$$= \sum_{i=1}^{n-1} [b_{m-1} (i-1)\, f^*_{m-1}(i)] + [b_{m-1} (n-1)\, f^*_{m-1}(n)] \qquad (10)$$

Substituting equations 9 and 10 into 7, we will find that

$$k_m(n) = \sum_{i=1}^{n-1} [b_{m-1} (i-1)\, f^*_{m-1}(i)] + [b_{m-1} (n-1)\, f^*_{m-1}(n)]$$

$$/ E_{m-1}(n-1)+ | b_{m-1} (n-1)|^2+| f_{m-1}(n)|^2] \qquad (11)$$

Equation 11 is not a pure recursive form, so we need to do some more steps.

First use km(n-1) in place km in equation 2 and 3 and write them as

$$f_m(n) = f_{m-1}(n) + k_m(n-1)^* b_{m-1}(n-1) \qquad (12)$$

Second use equation 12 and 13 with 9 to write

$$b_m(n) = b_{m-1} (n - 1) + k_m(n-1)\, f_{m-1}(n - 1) \qquad (13)$$

$$2b_{m-1}(n-1)f^*_{m-1}(n)=b_{m-1}(n-1)f^*_{m-1} +f^*_{m-1}(n)b_{m-1}(n-1)$$

$$=b_{m-1}(n-1)(f_m(n)-k^*_{em}(n-1)b_{m-1}(n-1))^*$$

$$+f^*_{m-1}(n)(b_m(n)-k_{em}(n-1)f_{m-1}(n))$$

$$=-k_{em}(n-1)(|f_{m-1}(n)|^2+|b_{m-1}(n-1)|^2)$$

$$+(f^*_{m-1}(n)b_m(n)+b_{m-1}(n-1)f^*_m(n))$$

$$= - k_{em}(n-1)E_{m-1}(n)+k_{em}(n-1)E_{m-1}(n-1)$$

$$+(f^*_{m-1}(n)b_m(n)+b_{m-1}(n-1)f^*_m(n))$$

Then we use equation 7 for (n-1) to write equation 11 as

$$2\sum_{i=1}^{n-1} b_{m-1}(i-1)f_{m-1}^*(i)+2b_{m-1}(n-1)f^*_{m-1}(n)$$

$$=k_{em}(n-1)E_{m-1}(n-1)-k_{em}(n-1)E_{m-1}(n)+k_{em}(n-1)E_{m-1}(n-1)$$

$$+(f^*_{m-1}(n)b_m(n)+b_{m-1}(n-1)f_m^*(n))$$

$$= -k_{em}(n-1)E_{m-1}(n)+(f_{m-1}^*(n)b_m(n)+b_{m-1}(n-1)f^*_m(n))$$

This mean

$$k_{em}(n)=k_{em}(n-1)-(f^*_{m-1}(n)b_m(n)+b_{m-1}(n-1)f^*_m(n))/E_{m-1}(n)$$

$$m=1,2,\ldots\ldots,M. \qquad (14)$$

At this point, we will make two modification to equations 9 and 14.

1. We will introduce a step size parameter to control the adjustment.

$$k_{em}(n)=k_{em}(n-1)-[\mu_e/E_{m-1}(n)](f^*_{m-1}(n)b_m(n)$$

$$+b_{m-1}(n-1)f^*_m(n))$$

$$M=1,2, \ldots\ldots,M. \qquad (15)$$

2. We introduce an averaging filter to the energy estimator

$$E_{m-1}(n)=\beta E_{m-1}(n-1)+(1-\beta)(|f_{m-1}(n)|^2+|b_{m-1}(n-1)|^2) \qquad (16)$$

Equation 16 take the fact that we are dealing with nonstationary environment, and we have statistical variation. This will equip the estimator with memory were the present value and immediate past is used.

III. Desired Response Estimator [14]

Let us say we want a desired response d(n). we consider the structure shown in figure 3 which is part of figure 1. We have the input vector bm(n) and the parameters of the filter hm(n) which will converge with time to give the desired response.

For the estimation of the vector h we use the stochastic gradient approach. We find that the order update for the desired response d(n) is

$$y_m(n)= \sum_{k=0}^{m} h_{ek}^*(n)b_k(n)$$

$$= \sum_{k=0}^{m-1} h_{ek}^*(n)b_k(n) + h_{ek}^*(n)\, b_k(n) \qquad (17)$$

$$= y_{m-1}(n) + h_{ek}^*(n)\, b_k(n)$$

The error is

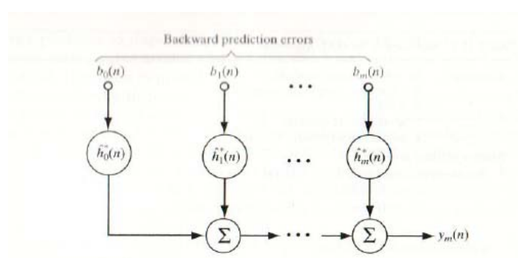

Figure 3: The coefficients h

$$e_m(n)=d(n)-y_m(n) \qquad (18)$$

The time update for the mth coefficient of figure 3 is

$$h_{em}(n+1)=h_{em}(n)+[\mu/||\mathbf{b_m}(n)||^2]b_m(n)e^*_m(n) \qquad (19)$$

The squared Euclidean norm is defined as

$$||\mathbf{b_m}(n)||^2 = \sum_{k=0}^{m} |b_k(n)|^2$$

$$=|b_m(n)|^2 + \sum_{k=0}^{m-1} |b_k(n)|^2$$

$$= ||\mathbf{b_m}(n)||^2 + |b_k(n)|^2 \qquad (20)$$

IV. Adaptive Forward Linear Prediction [17]

Conceder the 4th order filter in figure 4 at time n. The forward prediction error is

$$f_m(i)=u(i)-\mathbf{w}_{ef,m}^{H}(n)\mathbf{u}_m(i-1) \qquad (21)$$

The forward prediction problem is to find u(i) at time i from the vector u(i-1)…………u(i-m) using the filter in figure 4 of the weight vector wm1(n)…………..wmm(n).

We refer to fm(i) as the forward a posteriori prediction error, since its value is based on the current weight vector wfm(n). We defined forward a priori prediction error as

$$\mathbf{u(i-1)}=[u(i-1), u(i-2),\ldots\ldots,u(i-m)]^T$$

$$\mathbf{w(n)} =[w_{f,m,1}, w_{f,m,2}(n),\ldots\ldots,w_{f,m,m}(n)]^T \qquad (22)$$

The update formula for the weights vector for the forward predictor is

$$\eta_m(i)=u(i)-\mathbf{w}_{ef,m}(\mathbf{n-1})\,\mathbf{u}_m(\mathbf{i-1})$$

$$I = 1, 2, \ldots\ldots, n. \qquad (23)$$

k is the gain vector defined by

$$\mathbf{k}_m(\mathbf{n-1})=\boldsymbol{\phi}_m^{-1}(\mathbf{n-1})\mathbf{u}_m(\mathbf{n-1}) \qquad (24)$$

In equation 24 we have the inverse of the correlation matrix defined.

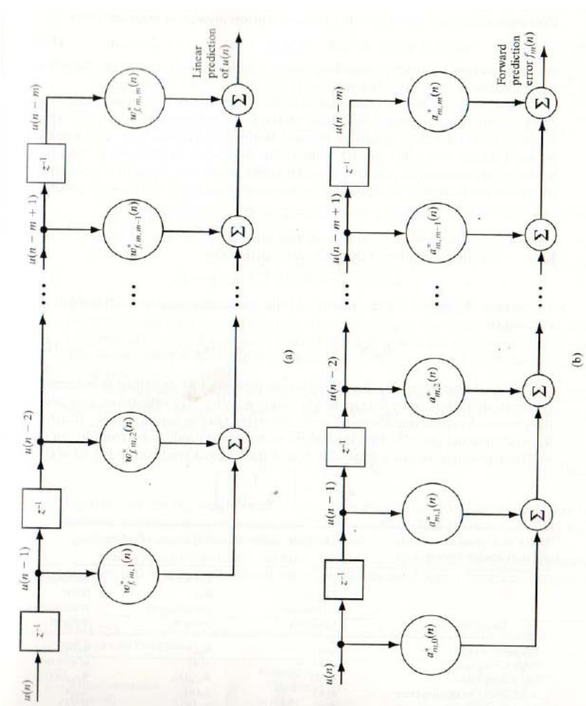

Figure 4: Forward prediction

$$\boldsymbol{\Phi}_m(\mathbf{n-1})=\sum_{i=1}^{n-1} \lambda^{n-1-i}\mathbf{u}_m(\mathbf{i})\mathbf{u}_m^{H}(\mathbf{i}) \qquad (25)$$

At this point, we have described the adaptive filter forward prediction problem and using the weight vector w,f,m(n). Also, the forward prediction error problem is important and we are going to approach the solution using the knowledge we have so far. Let us say we have am(n) were [15].

$$\mathbf{a}_m(\mathbf{n}) = \begin{bmatrix} 1 \\ -\boldsymbol{w} \end{bmatrix} \qquad (26)$$

Table 2: Notation

Quantity	Linear estimation (general)	Forward linear prediction of order m	Backward linear prediction of order m
Tap-input vector	$\mathbf{u}(n)$	$\mathbf{u}_m(n-1)$	$\mathbf{u}_m(n)$
Desired response	$d(n)$	$u(n)$	$u(n-m)$
Tap-weight vector	$\hat{\mathbf{w}}(n)$	$\hat{\mathbf{w}}_{f,m}(n)$	$\hat{\mathbf{w}}_{b,m}(n)$
A posteriori estimation error	$e(n)$	$f_m(n)$	$b_m(n)$
A priori estimation error	$\xi(n)$	$\eta_m(n)$	$\beta_m(n)$
Gain vector	$\mathbf{k}(n)$	$\mathbf{k}_m(n-1)$	$\mathbf{k}_m(n)$
Minimum value of sum of weighted error squares	$\mathcal{E}_{min}(n)$	$\mathcal{F}_m(n)$	$\mathcal{B}_m(n)$

Where the first element of the vector am(n) is one. The forward a posteriori prediction error and the forward a priori prediction error

$$f_m(i) = \mathbf{a}_m^{H}(\mathbf{n})\mathbf{u}_{m+1}(\mathbf{i})$$

$$i = i=1, 2,\ldots\ldots, n, \qquad (27)$$

And

$$\eta = \mathbf{a}_m^{H}(\mathbf{n-1})\mathbf{u}_m(\mathbf{i})$$

$$i=1, 2, \ldots\ldots, n, \qquad (28)$$

The input vector of size m+1 is the following,

$$\mathbf{u}_{m+1}(\mathbf{i}) = \begin{bmatrix} u(i) \\ \boldsymbol{u(i-1)} \end{bmatrix}$$

Because of orthogonality we have the condition,

$$\sum_{i=1}^{n} \lambda^{n-1}\mathbf{u(i-1)}f_m^{*}(i) = \mathbf{0} \qquad (29)$$

The weight vector w f,m(n) can also be found by minimizing the sum

$$F_m(n) = \sum_{i=1}^{n} \lambda^{n-1}|f_m(i)|^2 \qquad (30)$$

The solution using am(n) is the solution to the same minimization problem using a more elegant form.

Table 3: Forward and backward equations

Linear estimation (general)	Forward linear prediction of order m	Backward linear prediction of order m
$\sum_{i=1}^{n}\lambda^{n-i}\mathbf{u}(i)e^*(i)=\mathbf{0}$	$\sum_{i=1}^{n}\lambda^{n-i}\mathbf{u}_m(i-1)f_m^*(i)=\mathbf{0}$	$\sum_{i=1}^{n}\lambda^{n-i}\mathbf{u}_m(i)b_m^*(i)=\mathbf{0}$

At this point, we use equation 21 in equation 30 and next equation 23 and the condition of equation 29 to get the recursion equation,

$$F_m(n) = \lambda F_m(n-1) + \eta_m(n) f^*_m(n) \quad (31)$$

In this equation the product at the end is a real value.

V Adaptive Backward Linear Prediction [17]

Consider the backward linear predictor of order m. This is in Figure 12.5(a) for operation at time n. The tap weight vector is optimized using least squares sense until time n. Let [15].

$$b_m(i) = u(i-m) - \mathbf{w}^H_{eb,m}(n)\mathbf{u}_m(i)$$

$$i = 1, 2, \ldots, n, \quad (32)$$

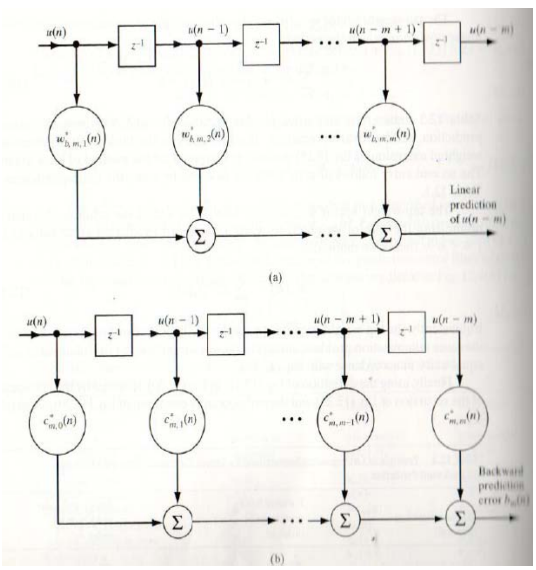

Figure 5: Backward prediction

This is the backward prediction error for the input vector um(i). We have

$$\mathbf{u(i)} = [u(i), u(i-1), \ldots, u(i-m+1)]^T$$

And

$$\mathbf{w}_{eb,m}(n) = [w_{eb,m,1}(n), w_{eb,m,2}(n), \ldots, w_{eb,m,m}(n)]^T$$

bm(i) is the backward a posteriori prediction error. It is dependent on the current value of the vector wb,m(n). we may define the backward a priori prediction error as

$$\beta_m(i) = u(i-m) - \mathbf{w}^H_{eb,m}(n-1)\mathbf{u}_m(i)$$

$$I = 1, 2, \ldots, n, \quad (33)$$

The computation is based on past weight vector wb,m(n).

To do recursion for adaptive backward linear prediction, we modify the RLS algorithm. The following is the recursion for updating the tap weight vector.

$$\mathbf{w}_{eb,m}(n) = \mathbf{w}_{eb,m}(n-1) + \mathbf{k}_m(n) \beta^*_m(n) \quad (34)$$

In equation 34 we have the backward priori prediction error and we have

$$\mathbf{k}_m(n) = \boldsymbol{\phi}^{-1}_m\mathbf{u}_m(n) \quad (35)$$

The matrix we have in equation 35 is the inverse of the correlation matrix

$$\boldsymbol{\phi}_m = \sum_{i=1}^{n} \lambda^{n-1}\mathbf{u}_m(i)\mathbf{u}_m^H(i) \quad (36)$$

We may analyze this problem as a backward prediction error filter problem. In this case, the tap weight vector is cm(n) which we can find from figure 12(b)as

$$\mathbf{c}_m(n) = \begin{bmatrix} -\boldsymbol{w} \\ 1 \end{bmatrix} \quad (37)$$

In this vector cm,m(n) is one and the input vector u m+1(i) of size m+1. In this case, the backward a posteriori prediction error and the backward a priori prediction error can be found as

$$b_m(i) = \mathbf{c}_m^H(n)\mathbf{u}_{m+1}(i)$$

$$i = 1, 2, \ldots, n, \quad (38)$$

$$\beta_m(i) = \mathbf{c}_m^H(n-1)\mathbf{u}_{m+1}(i)$$

$$i = 1, 2, \ldots, n, \quad (39)$$

The input vector is

$$\mathbf{u}_{m+1}(\mathbf{i}) = \begin{bmatrix} u(i) \\ u(i-m) \end{bmatrix}$$

The tap weight vector is orthogonal to the backward linear prediction error. This mean

$$\sum_{i=1}^{n} \lambda^{n-1}\mathbf{u}_m(i)b_m^*(i) = \mathbf{0} \quad (40)$$

The tap weights vector wb,m(n) may also beseen as minimizing the sum

$$B_m(n) = \sum_{i=1}^{n} \lambda^{n-i}|b_m(i)| \quad (41)$$

for $1 < i < n$

Also, we can find cm(n) as a solution to the same minimization problem.

Using equation 32 in equation 41then equation34 and the orthogonality condition of equation 40 we get the recursion.

$$B_m(n) = \lambda B_m(n-1) + \beta_m(n) b_m^*(n) \quad (42)$$

To end this discussion, it is important to note in the case of backward prediction the input vector um+1(n) is partitioned with the desired response u(n-m) as the last entry. As in the case of forward prediction, the input vector um+1(n) is partitioned with u(n) as the first entry.

VI. Conversion Factor [18]

First, we defined the vector k as

$$\mathbf{k}_m(n) = \boldsymbol{\phi}^{-1}_m(n) \mathbf{u}_m(n)$$

km(n) is the tap weight vector of the filter that operates on the data u(1), u(2)……..u(n) to produce the special response

$$d(i) = \begin{cases} 1 & i = n \\ 0 & i = 1, 2, \ldots\ldots\ldots, n-1 \end{cases} \quad (43)$$

d(i) is an n by 1 vector, and the name of it is the first coordinate vector. This vector has the property that its dot product with any time-dependent vector is the last element of that vector.

First, we have to say that things are normalized. Second, we define the estimation error as

$$\begin{aligned} \gamma_m(n) &= 1 - \mathbf{k}^H_m(n)\ \mathbf{u}_m(n) \\ &= 1 - \mathbf{u}^H_m(n)\ \boldsymbol{\phi}_m^{-1}(n)\ \mathbf{u}_m(n) \end{aligned} \quad (44)$$

Were the estimation error is the output of the filter with tap weights km(n) and input um(n) as in figure 6. We can see from the equation 44 that the estimation error is real moreover it is between zero and one.

$$0 < \gamma_m(n) < 1 \quad (45)$$

Know it is time to simplify things

$$\gamma_m(n) = 1 / [1 + \lambda^{-1}\mathbf{u}_m^H(n)\boldsymbol{\phi}_m^{-1}(n-1)\mathbf{u}_m(n)] \quad (46)$$

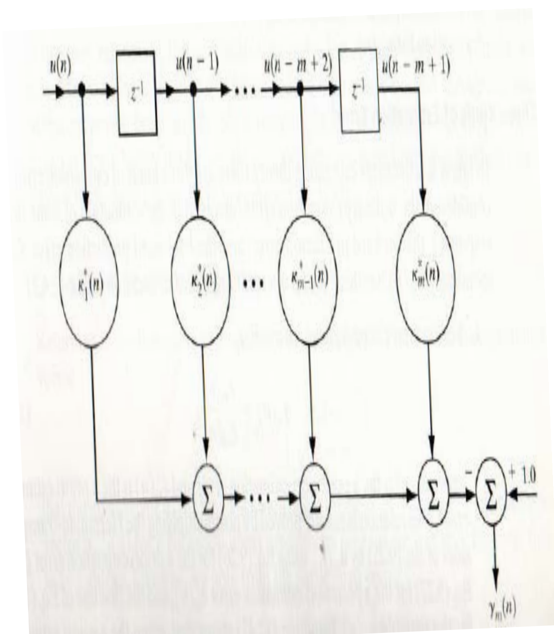

Figure 6: Conversion factor

Lambda between zero and one so the estimation error is bounded as in equation 45.

It is good to see that the estimation error is the output of the filter of figure 6 of the tap weight vector km(n).

VII. Some Useful Interpretation of the Estimation Error [14]

Depending on the way it is used the estimation error can have three different interpretations

1. The estimation error can be seen as the likelihood variable (Lee 1981). This is due to the statistical formulation of the tap input function in terms of its log-likelihood function. We say that the input has joint Gaussian distribution.
2. The estimation error can be seen as the angle variable (Lee 1981). This can be seen from equation 44. We may say

$$\gamma_m^{1/2}(n) = \cos\varphi_m(m)$$

Were phi is the angle of plane rotation.

3. The estimation error can be seen as the conversion factor (Carayannis 1983). It can be used to find an a posteriori estimation error from the a priori estimation error.

It is due to the third interpretation we use the term conversion factor.

VIII. Three Kinds of Estimation Error [14]

In linear least square estimation theory, we have three kinds of estimation error. The ordinary estimation error, the forward prediction error, and the backward prediction error. This means we have three interpretation as a conversion factor.

1. The recursive least squares estimation

Where we have the estimation error is equal to the posteriori error divided by the a priori estimation error. This can be seen from equation 44.

2. For adaptive forward linear prediction

$$\gamma_m(n-1) = f_m(n)/\eta_m(n) \quad (48)$$

This can be seen by post-multiplying the Hermitian transposed sides of equation 23 by um(n-1) and then using equations 21 and 22 and 24 and 44.

3. For adaptive backward linear prediction

$$\gamma_m(n) = b_m(n)/\beta_m(n) \quad (49)$$

As in 2 if we multiply equation 34 by um(n) and use equations 32 and 33 and 35 and 44 we can find 49. The estimation error can be seen as the multiplicative correction.

As we see the estimation error is the common factor (either regular or delayed) in the conversion from a priori to a posteriori estimation error. This is in ordinary estimation or forward prediction or backward prediction. We can use this conversion factor to find em(n) or fm(n) or bm(n) at time n before the tap weight has been computed (Carayannis 1983).

IX. Least Square Lattice Predictor [13]

Using the time shifting property of the input data we write the partitioned vector.

$$\mathbf{u}_{m+1}(\mathbf{n}) = \begin{matrix} \boldsymbol{u(n)} \\ u(n-m) \end{matrix}$$

We see that the input vector um(n) for the backward linear predictor of order m-1 and the input vector u(m+1)(n) for the backward linear predictor of order m have the same m-1 input entries. Let us move know to the partitioned vector.

$$\mathbf{u}_{m+1}\,(\mathbf{n}) = \begin{matrix} u(n) \\ \boldsymbol{u(n-1)} \end{matrix}$$

The input vector um(n-1) for the forward linear predictor of order m-1 and the input vector u m+1 (n) for the forward linear predictor of order m have the same last m-1 entries. The question is can we carry over the information from stage m-1 to stage m.

The answer to this question is yes. And it employs modular structure known as lattice predictor.

To find this important filtering structure, we use the principle of orthogonality, and with the umbrella of Kalman filter theory, we find the least squares lattice predictor.

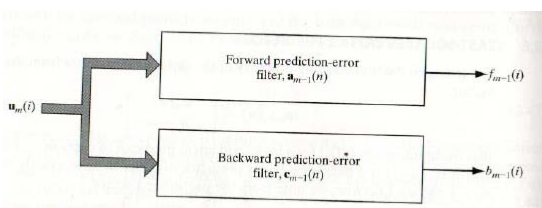

Figure 7: Block diagram

Let us begin with figure 7. The input is um(n). The upper part is a forward prediction error filter with tap weight vector a (m-1)(n) and output f (m-1)(i). The lower part is a backward prediction error filter with tap weight vector c (m-1)(n) and output b (m-1) (i). The problem we want to solve may be stated as.

Given the forward prediction error f (m-1)(i) and the backward prediction error b (m-1)(i) find their order update value f m (i) and b m (i) efficiently.

We mean by efficient manner is to use the information in f(m-1)(i) and b(m-1)(i) plus the input data is enlarged by the past sample u(i-m).

The past sample u(i-m) needed to compute fm(i) can be found from b (m-1)(i-1). Thus treating this as input to the one tap least square filter and f (m-1)(i) as the desired response and f m (i) as a result from least square approximation we can write

$$f_m(i) \;=\; f_{m-1}(i) \;+\; k^*_{f,\,m}(n)\, b_{m-1}(i-1)$$

$$i = 1, 2, \ldots\ldots, n, \tag{50}$$

This is Figure 8

To find the coefficient of this filter we use the principal of orthogonality. According to this principal, the error produced by this filter f m (i) is orthogonal to the input b (m-1) (i).

$$\sum_{i=1}^{n} \lambda^{n-1} b_{m-1}(i-1) f^*_m(i) \;=0 \tag{51}$$

Substituting equation 50 into equation 51 and solving for the coefficient.

$$k_{f,\,m}\,(n) = \sum_{i=1}^{n} \lambda^{n-1} b_{m-1}(i-1) f^*_{m=1}(i)$$

$$/\, [\sum_{i=1}^{n} \lambda^{n-1}\, |b_{m-1}(i-1)|^2] \tag{52}$$

It is clear that

$$B_{\,m-1}(n-1) = \sum_{i=1}^{n} \lambda^{n-1}\, |b_{m-1}(i-1)|^2 \tag{53}$$

Where in the last line we used the fact that

$$b_{m-1}(0) \;=\; 0 \quad \text{for all m} \;>\; 1$$

In equation 52 we have introduced the notation of exponentially weighted cross-correlation between forward and backward prediction error.

$$\Delta_{m-1}\,(n) = \sum_{i=1}^{n} \lambda^{n-1} b_{m-1}(i-1) f^*_{m-1}(i) \tag{54}$$

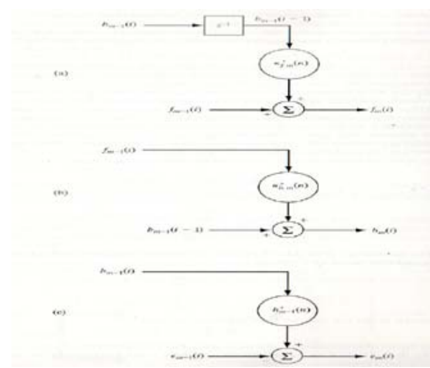

Figure 8: Recursion

Using equation 53 and equation 54 in equation 52 we see that the coefficient is

$$k_{f,\,m}\,(n) \;=\; \Delta_{m-1}\,(n) \;\;/\;\; B_{\,m-1}(n-1) \tag{55}$$

We use the same method to find the order update for backward prediction error b m (i). The input is f(m-1)(i). The filter is figure 8 (b). It is clear that

$$b_m(i) \;=\; b_{m-1}(i-1) \;+\; k^*_{b,\,m}(n)\, f_{m-1}(i)$$

$$i = 1, 2, \ldots\ldots, n, \tag{56}$$

Know it is time to determine the coefficient and to do this we use the orthogonality principal. The error b m(i) has to be orthogonal to the input f (m-1) (i). Thus we write

$$\sum_{i=1}^{n} \lambda^{n-1} f_{m-1}(i) b^*_m(i) \;=0 \tag{57}$$

Substituting equation 56 into equation 57 and solving for the coefficient.

$$k_{b,\,m}\,(n) = \sum_{i=1}^{n} \lambda^{n-1} f_{m-1}(i) b^*_{m-1}(i-1)$$

$$/\, [\sum_{i=1}^{n} \lambda^{n-1}\, |f_{m-1}(i)|^2] \tag{58}$$

Let us put

$$F_{m-1}(n) = \sum_{i=1}^{n} \lambda^{n-1} |f_{m-1}(i)|^2 \qquad (59)$$

This mean equation 58 can be written as

$$k_{b,m}(n) = \Delta^*_{m-1}(n) \;/\; F_{m-1}(n) \qquad (60)$$

Equation 50 and 56 are the basic to lattice predictor. For physical interpretation we define

$$\mathbf{f}_m(n) = [f_m(1), f_m(2), \ldots\ldots., f_m(n)]^T$$

$$\mathbf{b}_m(n) = [b_m(1), b_m(2), \ldots\ldots., b_m(n)]^T$$

$$\mathbf{b}_m(n-1) = [0, b_m(1), b_m(2), \ldots\ldots., b_m(n-1)]^T$$

Based on equation 50 and 56 we may make the following statements using the terminology of projection theory.

1. The result of projecting the vector b (m-1) (n-1) onto f (m-1) (n) is represented by the vector f m(n) and the forward reflection coefficient is the parameter needed to make this projection.
2. The result of projecting the vector f (m-1)(n) onto b (m-1)(n-1) is represented by the vector b(m)(n) . The back word reflection coefficient is the parameter needed to make this second projection.

So we have the pair of interrelated order update recursions.

$$f_m(n) = f_{m-1}(n) + k^*_{f,m}(n)\, b_{m-1}(n-1) \qquad (61)$$

And

$$b_m(n) = b_{m-1}(n-1) + k^*_{f,m}(n)\, f_{m-1}(n) \qquad (62)$$

m is the order of the filter and n is the time index. The initial condition is

$$f_0(n) = b_0(n) = u(n) \qquad (63)$$

Where u(n) is the input at time n. And m is the prediction order from zero up to M. We have M stages least-squares lattice predictor in figure 9. An important feature is the lattice structure which implies linear complexity with the order.

X. Least Squares Lattice Version [13]

The forward prediction error and backward prediction error are determined by equations 27 and 38 as

$$f_m(n) = \mathbf{a_m^H(n) u_{m+1}(n)}$$

And

$$b_m(n) = \mathbf{c^H_m(n)\;\; u_{m+1}(n)}$$

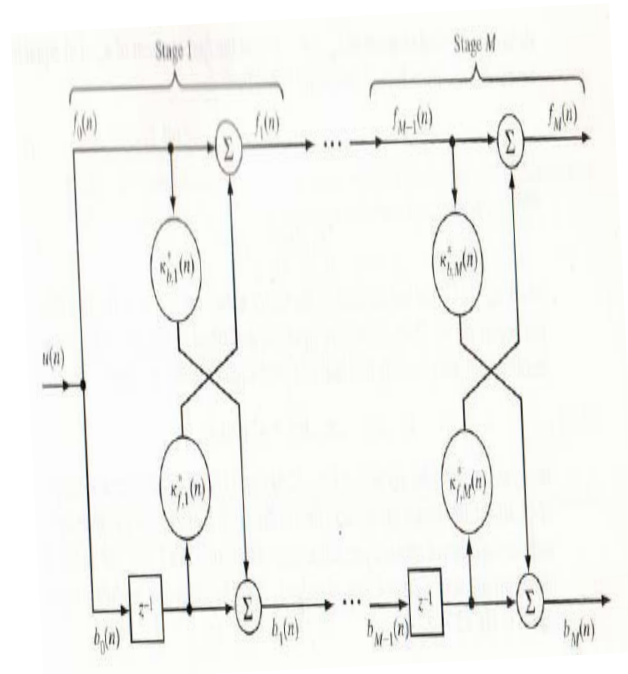

Figure 9: Lattice predictor

In the two equations, a m (n) and c m (n) are the tap weight vectors of the filters to calculate the backward and forward prediction error. The forward prediction error f (m-1)(n) and the backward prediction error b (m-1)(n) are defined as

$$f_m(n) = \mathbf{a_{m-1}^H(n) u_m(n)}$$

$$= \begin{bmatrix} \mathbf{a(m-1)(n)} \\ 0 \end{bmatrix}^H \begin{bmatrix} \mathbf{u(m)(n)} \\ u(n-m) \end{bmatrix}$$

$$= \begin{bmatrix} \mathbf{a(m-1)(n)} \\ 0 \end{bmatrix}^H \mathbf{u_{m+1}(n)}$$

$$b_{m-1}(n-1) = \mathbf{c_{m-1}^H(n-1) u_m(n-1)}$$

$$= \begin{bmatrix} 0 \\ \boldsymbol{c(m-1)(n-1)} \end{bmatrix}^H \begin{bmatrix} u(n) \\ \boldsymbol{u(m)(n-1)} \end{bmatrix}$$

$$= \begin{bmatrix} 0 \\ \boldsymbol{c(m-1)(n-1)} \end{bmatrix}^H \mathbf{u_{m+1}(n)}$$

The four prediction errors just defined have the same input u(m+1)(n). substituting in 61 and 62 and comparing terms we get

$$\mathbf{a_m(n)} = \begin{bmatrix} \mathbf{a(m-1)(n)} \\ 0 \end{bmatrix} + k_{f,m}(n) \begin{bmatrix} 0 \\ \boldsymbol{c(m-1)(n-1)} \end{bmatrix} \qquad (64)$$

And

$$\mathbf{c_m(n)} = \begin{bmatrix} 0 \\ \boldsymbol{c(m-1)(n)} \end{bmatrix} + k_{f,m}(n) \begin{bmatrix} \boldsymbol{a(m-1)(n)} \\ 0 \end{bmatrix} \qquad (65)$$

Equation 64 and equation 65 might be viewed as the least squares version of the Levinson Durbin recursion. Keeping in mind that the last element c (m-1)(n-1) and the first element a (m-1)(n) is equal to one. We see from 64 and 65 that

$$k_{f,m}(n) = a_{m,m}(n) \qquad (66)$$

And

$$k_{b,m}(n) = c_{m,0}(n) \qquad (67)$$

Where a m,m(n) is the last element of the vector am(n) and c m,0(n) is the first element of the vector cm(n). we generally find.

$$k_{f,m}(n) = k_{b,m}^{*}(n)$$

The order update equations 64 and 65 show a very good property of the lattice predictor of order M. we can say such a predictor have a chain of forward prediction error filters of order 1,2,………,M and a chain of backward prediction error filters of order 1,2,………,M all in one modular structure shown in figure 9.

XI. Time Update Recursion [17]

From equation 55 and 60 we find that the reflection coefficients (backward and forward)are uniquely determined by three quantities. Equation 31 and 32 provide the time update for two of them. We still have to find the time update equation for the third quantity (exponential cross-correlation).

To proceed, we recall the two equations with (m-1) in place of m.

$$f_{m-1}(i) = u(i) - \mathbf{w}^{*}_{f,m-1}(n)\ \mathbf{u_{m-1}(i-1)}$$

$$i = 1, 2, \ldots\ldots\ldots, n,$$

And

$$\mathbf{w_{ef,m-1}(n)=w_{ef,m-1}(n-1)} + \mathbf{k_{m-1}(n-1)}\ \eta_{m-1}^{*}(n)$$

Substituting in equation 54 we get

$$\Delta_{m-1}(n) = \sum_{i=1}^{n} \lambda^{n-1}[u(i)-\mathbf{w_{ef,m-1}}^{\mathbf{H}}\mathbf{(n-1)\ u_{m-1}(i-1)}]^{*} b_{m-1}(i-1)$$

$$-\eta_{m-1}(n)\mathbf{k}^{\mathbf{T}}_{\mathbf{m-1}}\mathbf{(n-1)}\sum_{i=1}^{n} \lambda^{n-1} b_{m-1}(i-1)\mathbf{u}^{*}_{\mathbf{m-1}}\mathbf{(i-1)}$$

This equation simplifies as follows,

First, the second term in the equation is zero using the principal of orthogonalization which states.

$$\sum_{i=1}^{n} \lambda^{n-1}\mathbf{u}_{\mathbf{m}-1}(i-1) b^{*}_{m}(i) = \mathbf{0}$$

Second, the first term inside the brackets we have the a priori forward prediction error.

$$\eta_{m}(i)=u(i)-\mathbf{w}_{\mathbf{ef,\ m}}\mathbf{(n-1)\ u_{m}(i-1)}$$

$$I = 1, 2, \ldots\ldots., n.$$

This mean delta is

$$\Delta_{m-1}(n) = \sum_{i=1}^{n} \lambda^{n-1} b_{m-1}(i-1)\eta^{*}_{m-1}(i) \qquad (68)$$

We can write this summation as

$$\Delta_{m-1}(n) = \sum_{i=1}^{n-1} \lambda^{n-1} b_{m-1}(i-1)\eta^{*}_{m-1}(i)$$

$$+ \ b_{m-1}(i-1)\eta^{*}_{m-1}(i)$$

$$\Delta_{m-1}(n) = \lambda\sum_{i=1}^{n-1} \lambda^{n-1-I}\ b_{m-1}(i-1)\eta^{*}_{m-1}(i)$$

$$+ \ b_{m-1}(i-1)\eta^{*}_{m-1}(i)$$

We know that the first term is simply delta (m-1)(n-1) so we write.

$$\Delta_{m}(n) = \lambda\ \Delta_{m}(n-1) + \eta^{*}_{m-1}(n)\ \ b_{m}^{*}(n-1) \qquad (69)$$

Which is the desired equation. This is similar to equation 31 and 42 in that of these three updates the correction term has the product of posteriori and a priori prediction errors.

XII. Exact Decoupling Property of the Least Squares Lattice Predictor [18]

An important property of this predictor is that the backward prediction errors at different stages are uncorrelated. This is plus that they are orthogonal. Keep in mind that the input u(n) might be a correlated sequence. This means we are transforming a correlated sequence to uncorrelated one.

$$[u(n), u(n-1), \ldots\ldots\ldots, u(n-m)]$$

$$\leftrightarrow [b_{0}(n), b_{1}(n), \ldots\ldots.,\ b_{m}(n)] \qquad (70)$$

The transformation here is reciprocal which mean that this filter keeps the information content of the input data.

The tap weight vector of the filter is cm(n)

$$\mathbf{c_{m}(n)} = [c_{m,m}(n),\ c_{m,m-1}(n), \ldots\ldots., 1]$$

We want to find the backward a posteriori prediction error bm(i) using the input u(m+1)(i).

$$\mathbf{u_{m+1}(i)} = [u(i), u(i-1), \ldots\ldots\ldots, u(i-m)]$$

$$i > m$$

We can express bm(i) as

$$b_{m}(i) = \mathbf{c^{H}_{m}(m)u_{m-1}(i)}$$

$$= \sum_{k=0}^{m} c^{*}_{m,k}(n)u(i-m+k)$$

$$m < i < n$$

$$m = 1, 2, \ldots. \qquad (71)$$

Let

$$\mathbf{b_{m+1}(i)} = [b_{0}(n),\ b_{1}(n), \ldots\ldots., b_{m}(i)]_{T}$$

$$m < i < n$$

$$m = 1, 2, \ldots.$$

Be (m+1) by 1 backward a posteriori prediction error vector. Substituting equation 71 into this vector we have the transformation [19]

$$\mathbf{b_{m+1}(i)} = \mathbf{L_{m}(n)}\ \mathbf{u_{m+1}(i)} \qquad (72)$$

Where the m+1 by m+1 transformation matrix

$$\mathbf{L_{m}(n)} = \begin{matrix} 1 & 0 & 0 \\ c(1,1)(n) & 1 & 0 \\ c(m,m)(n) & c(m,m-1)(n) & 1 \end{matrix} \qquad (73)$$

This is a lower triangular matrix. It is an m by m matrix and note the following.

1. A non zero element of row l in the matrix Lm(n) is the tap weight of the backward prediction filter of order (l-1).
2. The diagonal elements of Lm(n) are equal to unity. This is because the last tap weight of this filter equals unity.
3. The determinant of the matrix Lm(n) is one for all m.

This mean the inverse matrix exist. This means that the reciprocal nature of equation 70 is confirmed.

The correlation between the backward prediction errors of orders k and m is zero.

Using the principal of orthogonality, it is clear that the error bm(i) is perpendicular to the input uk(i) and this means that the correlation is zero for m not equal k. This means that bm(n) and bk(n) are uncorrelated in the time-averaged sense.

This property makes this system an ideal device for exact least squares joint process estimation. We might use the sequence of bm(n) in figure 9 to perform the least squares estimation of the desired response as in figure 10. We may write

$$e_m(n) = e_{m-1}(n) - h^*_{m-1}(n) \quad b_{m-1}(n)$$

$$m = 1, 2, \ldots\ldots, M+1 \qquad (75)$$

The initial condition of the joint process estimation is

$$e_o(n) = d(n) \qquad (76)$$

The parameter h(m-1)(n) are called joint process estimation or regression coefficients. Thus the estimation of the desired response d(n) may go as a stage by stage basis, jointly with the linear prediction process.

Equation 75 is shown in figure 8(c). We use i in the figure to be consistent with 8(a) and 8(b). the input is b(m-1)(i) and the desired response is e(m-1)(i).[18].

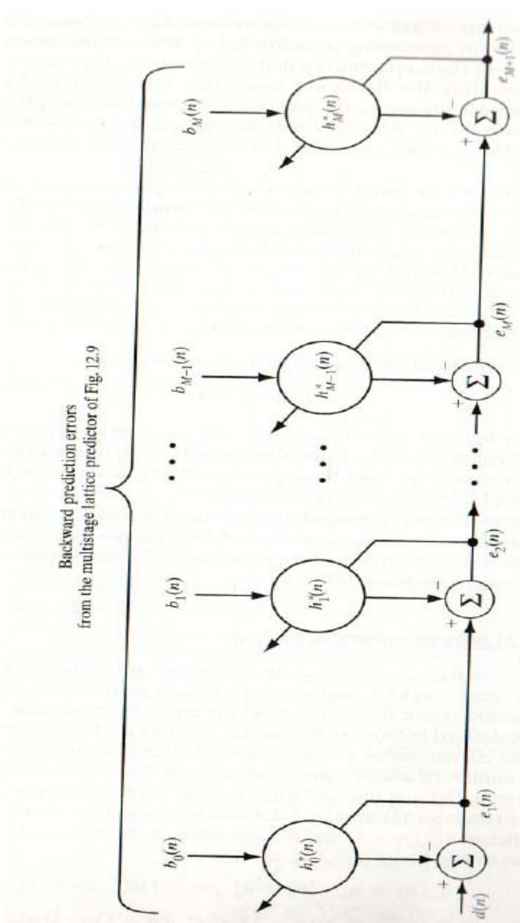

Figure 10: Correction

It is a desire to put the lattice problem not in term of the posteriori or a priori errors. This introduces the notation of angel.

XIII. Simulation Results

In this part, we will use mat lab. The desired response is an output of a Wiener filter of the first order and coefficient a=.3. The input is random signal. This input is given to the Wiener filter and the lattice predictor also first order. We feed the desired signal d(n) to the lattice predictor. The block diagram of the system is figure 11. As we can see from the simulation results, the coefficient h1 will pick up the value of a=.3 of the Wiener filter (figure 12).

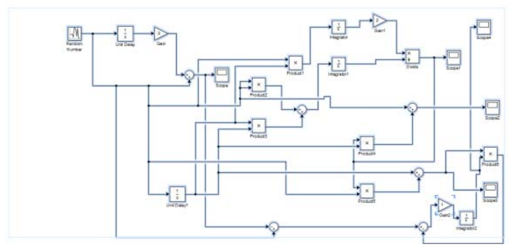

Figure 11: Mat Lab simulation

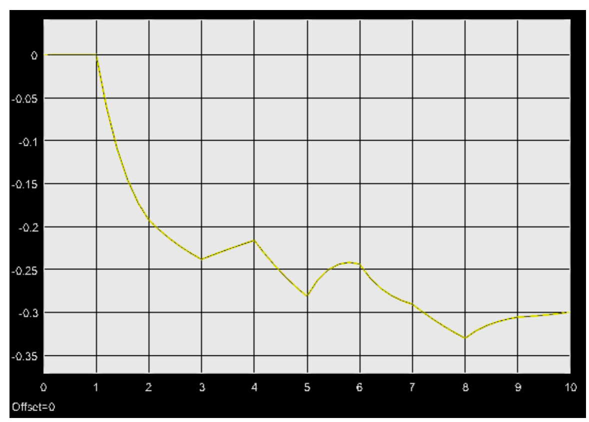

Figure 12: Simulation results

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Global Journal of Computer Science and Technology: G
Interdisciplinary
Volume 17 Issue 3 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Teacher in a Digital Era

By Mrs. Manisha Sharma
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Introduction- Technology nowadays has entered into every walk of life. In this era of technology, the digital revolution has transformed almost everything from our work at our organizations to our daily routines. It is transforming the way children and young people play, access information, communicate with each other, learn, relearn and unlearn. But now this revolution has profoundly entered in the Education sector and that is also at all levels i.e. school level, College level and University level. Now we talk of use of Interactive smart boards, hybrid or blended learning, flipped classrooms and digital libraries etc. during teaching learning processes. Due to this, most of the teaching and learning processes in the classrooms these days are changing from autocratic style to democratic or participatory style where learners play an active role. On the other hand, Teachers, Instructors and Higher Faculties are facing unprecedented changes with often larger classes, more diverse students with diverse needs, demands from State, Society and employers who want more accountability and above all, all this with ever changing technology. To handle change of this nature, the role of a teacher and instructor becomes more challenging and demanding and hence requires attention. Thus the teachers in this ever changing digital era need a good balance of theoretical and practical knowledge to provide a solid foundation for their teaching.

GJCST-G Classification: H.3.7

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Teacher in a Digital Era

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I. Introduction

Technology nowadays has entered into every walk of life. In this era of technology, the digital revolution has transformed almost everything from our work at our organizations to our daily routines. It is transforming the way children and young people play, access information, communicate with each other, learn, relearn and unlearn. But now this revolution has profoundly entered in the Education sector and that is also at all levels i.e. school level, College level and University level. Now we talk of use of Interactive smart boards, hybrid or blended learning, flipped classrooms and digital libraries etc. during teaching learning processes. Due to this, most of the teaching and learning processes in the classrooms these days are changing from autocratic style to democratic or participatory style where learners play an active role. On the other hand, Teachers, Instructors and Higher Faculties are facing unprecedented changes with often larger classes, more diverse students with diverse needs, demands from State, Society and employers who want more accountability and above all, all this with ever changing technology. To handle change of this nature, the role of a teacher and instructor becomes more challenging and demanding and hence requires attention. Thus the teachers in this ever changing digital era need a good balance of theoretical and practical knowledge to provide a solid foundation for their teaching.

II. Challenges in Front of Teachers in Digital Age

In this digital age, teachers are confronting with new challenges every day in respect of students, their individual needs, new hardwares and softwares and own developmental needs.

Diverse Students	Nothing has changed more than students themselves in this technological era in the last 10-20 years. Technology has facilitated in multi fold ways to the students. Students have now got access to multiple knowledge via internet on their laptops, mobile phones and Tablets etc. A student is also curious by nature. As a result of that, students have become • More knowledgeable • More Interrogative • More Competitive • And more demanding from their teachers. It has changed the way in which a student understands any concept. An average teacher who himself is not tech savvy, can't get recognition and respect from these kinds of students. Moreover due to Globalization of Education in the last decade has put a greater impact on the type of students available in the classrooms. Now we have more diverse students in the classes with diversity reflecting in their family backgrounds, economic conditions, physical conditions, traditions, cultures, Languages and ways of doing things etc. This diversity has gone prominent with RTE Act, 2009 where all schools have been directed to have inclusive classroom settings which have made this diversity more prominent in the class rooms. A teacher's role in such a scenario has become utmost important and stringent.
Pupil- Teacher ratio	In India and most of the other countries of the World, Government bodies have fixed pupil teacher ratio to near about 40. But there are institutions that have more than 40 students sitting in one class making the teaching learning situation even more nagging for the teacher. In India, a survey has been conducted by IBM at various levels to record the actual no. of students per teacher present in the classrooms. It has been found that the current ratio for Primary, Secondary and Higher secondary Education

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Global Journal of Computer Science and Technology (G) Volume XVII Issue III Version I Year 2017

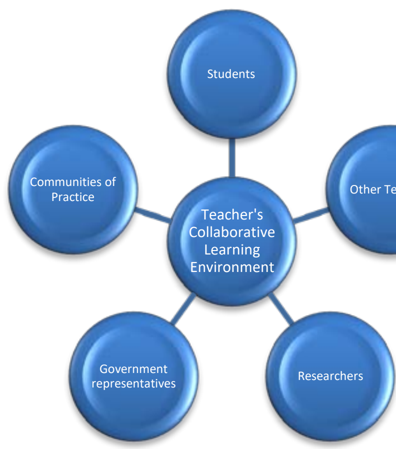
	stands at 1:43, 1:34 and 1:34 respectively where 1.4% of the Primary schools have no teachers while 19% have single teacher and 43% have two teachers. 0.9% of the primary schools have a teacher-student ratio of worse than 1:100 and another 26% have a ratio of worse than 1:60. For a single teacher to give personalized learning solutions is the thing which is not possible for this much strength of students in one class. As student number increases, teacher regress to a greater extent on information transmission and curriculum completion than on questioning, exploration of ideas, discussions and the development of critical or original thinking. Yet these are the very skills which are to be developed in students in a knowledge-based society's classroom.
Digital natives	A student these days are never alone while learning. They are always 'on'. They always have their digital natives around them on facebook, twitter, Instagrams, YouTube, WeChat etc. with the help of whole lot of applications (apps) such as iPads, mobile phones and tablets etc. So they don't even care what teacher is teaching in the class if it is no way in addition to what is available on the internet. Facilitating digitalization in classes also does not guarantee that children will use it only for classroom lectures. They may use it for various other things like chatting, being socially happening, playing video games, watching movies and commenting around etc. Most students these days come to schools, colleges and Universities well immersed in social media where their life revolves around such media in being happening around. For such cases, commentators like Mark Prensky (2001) argue that digital natives learn and think fundamentally differently.
Knowledge Based Job Market	Knowledge Based Job Market is becoming demanding day by day. While appointing personnel, their demands have not just got limited to good manual skills but good technological skills as well. It is a real tough task for a teacher to prepare students for the oneous professional needs and rigorous job market which is dynamic in nature. New technologies, methods and processes are entering in every field at a much more faster rate than anyone could train. Curriculum in schools, colleges and universities are not changing in that speed to keep pace with changing technology.
Lifelong Learning	Education sector nowadays have become lifelong learning market where new courses, workshops and seminar are taking place in order to make teachers as well as students to well verse with the changing technologies in the field of teaching learning as well as job market. So the situation of a teacher has become more of draconian kind of where she is afraid of hit by new technologies and education needs every additional day.
Job Issues	A teacher herself is also an employee of an organization called school or college or university. So there are certain her own professional needs which are posing new challenging in front of her every coming day. A teacher is engaged in multiple and multi-level tasking in any school, college and University that they have either less or no time for innovations in their teaching. A report by Yashpal Committee "Learning Without Burden" has extensively highlighted the ills of the present education system. Briefly it talks of how education system has now become more centralized, examination driven, joyless, impersonal and utterly irrelevant to the child's world. It deprives teachers of the freedom to organize teaching learning and meaningful participation of students in the classrooms.

III. Teaching Skills in Digital Age

In the digital era, the teacher plays a key role not as a fellow-learner, but also as a link to the knowledge community, or state of the art in that discipline. Hence in additions to general teaching skills, some more skills are needed to be embibed in a teacher to play his role effectively as a Facilitator of learning.

- *Networking Skills*

Networking skills facilitate collaborative learning. Not only students, but the teacher too learns and teaches better in a collaborative learning environment. Collaborative Learning Environment of a teacher consists of many individuals and groups. First of all, it is influenced by those Students whom he/she is teaching for the reason that current society is knowledge society. So students already have online access to the material, the teacher wants to teach in the class. Hence they would be having some prior knowledge of the same curriculum influencing and determining what curriculum teacher is taking up in classroom.



Secondly, Teachers of the same subject area who are working in the Institution for the same subject to another sections and classes could be of great help. At the same time, teachers teaching same subject in another schools could be useful in providing knowledge because in digitalized world, it is easy to connect anywhere anytime using Social Media like Skype, We chat, hangouts, yahoo chat, google chat etc. for sharing of knowledge.

Moreover, if the subject matter is the one of the kind like economic policies, foreign policies of a particular country or comparison of certain Govt. Regulations or case studies, communication with Government Department could be of great help in delivery of right subject matter. Many departments of the Government facilitates online access to its archives containing loads of correct information. In addition to this, Government also provides access to online digital libraries free of cost to make authentic information accessible to all.

In addition to that, Communities of practice are a powerful manifestation of informal learning. They generally evolve naturally to address commonly shared interests and problems. By their nature, they tend to exist outside formal educational organisations. Last but not the least, the researchers of that particular subject area could be of a great source to know about latest inventions and discoveries in the area.

- *Communications Skills*

To the traditional communication skills of reading, speaking and writing coherently and clearly, there is a need to add social media communication skills in this digital age to education. These skills include a no. of technological skills like the ability to create a short YouTube video, conducting Webinars, creating online digital library, preparing online Docs, to capture the demonstration of a process, the ability to reach out through the Internet to a wide community of people with one's ideas, to share information appropriately, to give and take feedback, and to identify trends and ideas from everywhere. A teacher can add to his/her knowledge beyond limits with effective communication skills. Social Media Communication skill is one of the prominent skill with which a teacher can reach out to a distant expert of the area or a learner's community to reach out solutions to various problems in his/her daily lesson plans.

- *Thinking skills*

Of all the skills needed in a knowledge-based society by a teacher, thinking skills like critical thinking, problem-solving, creativity, originality and strategizing are of the utmost importance. Education is increasingly becoming dependent on the creation of new knowledge, new services and new processes to increase competitiveness and generate knowledge. Teachers are actually in a knowledge hub where it depends totally on the efficiency of a teacher to choose the reliable and accurate data from all the available sources.

- *Nurturing skills*

The teacher in a nurturing approach keeps the needs and demands of the students first and thereby adopt a highly dedicated and unselfish approach to discuss relevant topics. Nurturing skill of a teacher needs them to hold back the transmission and sharing of their knowledge until the student is ready for it and thus denying to many subject experts their own identity and needs to a larger extent. There is a strong emphasis on the teacher focusing on the interests of the student and delivering contents of knowledge and persuading them to connect to the World on empathizing with how the learner approaches learning. Nurturing in this connection helps the learners to grow with the topic by facing different challenges at different levels and thereby understanding the very spirit of the topic and use it strategically.

- *Management of Knowledge*

Knowledge is dynamic in every aspect. It is not only rapidly changing with new innovations, researches and developments in the field of education over the Internet, but the sources of information are also increasing, with a great deal of variability in terms of reliability or validity of the sources and information. This knowledge can be useful for learners only when teacher has the skills to manage and correlate it. The key skill in a knowledge-based society for a Teacher also like other professions is knowledge management i.e. how to find, analyse, evaluate, use and disseminate information, within a particular context from the knowledge pool. The one who can correlate learners' needs and desires with the objectives of curriculum to achieve desired educational goals is the teacher required in the present digitalized world.

A teacher is the centre of any teaching learning process. In this digital era, a teacher has got a no. of responsibilities in addition to his/her prior role to keep pace with the changing technologies and changing teaching learning environments. A teacher is accountable to the society which trust him/her for shaping its coming generations for better civilizations and to the nation which trust him/her for making its future more bright and progressive. To deal with this accountability, a teacher need to use ICT effectively with its traditional techniques of teaching to facilitate critical and innovative thinking in his/her classrooms and it is only then one can dream of a knowledge society and a better digitalized education World around us.

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Global Journal of Computer Science and Technology: G Interdisciplinary
Volume 17 Issue 3 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Citrus Fruit Feature Extraction using Colpromatix Color Code Model

By V. Kavitha & Dr. M. Renuka Devi
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Abstract- Classification of citrus fruit more precisely and economically under natural illumination circumstances. The aim of this paper was to develop a robust and feature extraction techniques to discover citrus fruit features with different dimensions and under different illumination conditions. To identify object residing in image, the image has to be described or represented by certain features. In this paper, proposed a citrus fruit feature extraction process for deriving the classification. The proposed system present two tasks namely, 1) Image pre-processing: it is carried out using Hybrid Noise filter to remove the noise; ii) Citrus fruit features extraction: Feature extraction using new Colpromatix color space model, Size, Texture, Shape, and Coarseness. The Image Shape is an important visual feature of an image. Difference features representation and description techniques are discuss in this review paper. Feature extraction techniques play an important role in systems for object recognition, matching, extracting, and analysis. It also presents comparison between various techniques.

Keywords: citrus, texture, shape, texture, features.

GJCST-G Classification: H.5.2

CITRUSFRUITFEATUREEXTRACTIONUSINGCOLPROMATIXCOLORCODEMODEL

Strictly as per the compliance and regulations of:

Citrus Fruit Feature Extraction using Colpromatix Color Code Model

V. Kavitha[α] & Dr. M. Renuka Devi[σ]

Abstract- Classification of citrus fruit more precisely and economically under natural illumination circumstances. The aim of this paper was to develop a robust and feature extraction techniques to discover citrus fruit features with different dimensions and under different illumination conditions. To identify object residing in image, the image has to be described or represented by certain features. In this paper, proposed a citrus fruit feature extraction process for deriving the classification. The proposed system present two tasks namely, 1) Image pre-processing: it is carried out using Hybrid Noise filter to remove the noise; ii) Citrus fruit features extraction: Feature extraction using new Colpromatix color space model, Size, Texture, Shape, and Coarseness. The Image Shape is an important visual feature of an image. Difference features representation and description techniques are discuss in this review paper. Feature extraction techniques play an important role in systems for object recognition, matching, extracting, and analysis. It also presents comparison between various techniques.

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I. Introduction

Image processing is one of the mostly increasing areas in computer science. As technology advances, the analog imaging is switched to the digital system now-a-days. Every day capture huge amount of images which are very difficult to maintain manually within a certain period of time. So the concept and application of the digital imaging grows rapidly. Digital image processing is used to extract various features from images [1] [13]. This is done by computers automatically without or with little human intervention.

(Post-harvest) process of fruits and vegetables is concluded in several steps: washing, sorting, grading, packing, transporting and storage [12]. The fruits sorting and grading are considered the most important steps of handling. Fruit grading: involves the inspection, assessment and sorting of various fruits regarding quality, freshness, legal conformity and market value. Fruit grading often occurs by hand, in which fruits are assessed and sorted. Machinery is also used to grade fruits, and may involve sorting products by size, shape and quality. For example, machinery can be used to remove spoiled fruits from fresh product.

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Categorization is a several process of assembling items analytically, and has two general, until now distinct meanings:

1) *Ordering:* organizing items in a sequence ordered by some condition;
2) *Categorizing:* clustering items with similar properties.

Categorization of agricultural products is accomplished based on appearance (color and absence defects), texture, shape and sizes. Manual sorting is based on traditional visual quality inspection performed by human operators, which is tedious, time-consuming, slow and non-consistent. It has become increasingly difficult to hire personnel who are adequately trained and willing to undertake the tedious task of inspection. A cost effective, consistent, superior speed and accurate sorting can be achieved with automated sorting.

Color and size are the most important features for accurate classification and sorting of citrus. Because of the ever-growing need to supply high quality fruits and vegetable products within a short time, automated grading of agricultural products is getting special priority among many farmer associations. The impetus for these trends can be attributed to increased awareness by consumers about their better health well-being and a response by producers on the need to provide quality guaranteed products with consistency. It is in this context that the field of automatic inspection and machine vision comes in to play the important role of Quality control for agricultural products. Fruit size estimation is also helpful in Planning, packaging, transportation and marketing operations. Among the physical attributes of agricultural materials, volume, mass and projected areas are the most important.

The feature can be described as a behavior of one or more estimations, where each of estimation determines some significant property of an object [10]. Moreover, features characterized some significant aspects of an object. Researchers arrange the numerous features as follows:

Ordinary features: These features include the features that are independent of applications such as *color*, *texture* [11] and *shape*. According to the conceptual level, they can be further split into:

- *Pixel-level features:* those features that can be measures at each pixel, e.g. color and location.

- *Local features:* it includes the features that can be computed on the results of the division of image into three planes i.e. red, green and blue plane by image segmentation
- *Global features:* these feature are determined over the while image.

Domain-specific features: it includes the features that are specific to a particular application such as human faces, fingerprints and conceptual features. These are often specific to a particular domain.

The aim of this work is to develop a citrus fruit feature extraction process is to effectively partitioning objects in images to facilitate fruit defect detection. In this paper, we present citrus fruit image Feature extraction process in a segmentation scheme using Colpromatix Color, Size, Shape, Texture and Coarseness is used to over-segment the original image because it is known to give a good feature extraction result and time efficiency.

The rest of the paper is organized as follows: Literature Review is detailed in Sect. 2. In Sect. 3, Research methodologies acquire orange fruit images and conclusion is in Sect. 4.

II. Literature Review

Rapid color grading for fruit quality evaluation using direct color mapping [2] presented an effective and user-friendly color mapping concept for automated color grading that is well suited for commercial production. User friendliness is often viewed by the industry as a very important factor to the acceptance and success of automation equipment. This color mapping method uses preselected colors of interest specific to a given application to calculate a unique set of coefficients for color space conversion. The three-dimensional RGB color space is converted into a small set of color indices unique to the application. In contrast with more complex color grading techniques, the proposed method makes it easy for a human operator to specify and adjust color-preference settings Tomato and date maturity evaluation and date surface defect detection are used to demonstrate the performance of this novel color mapping concept.

In [3] authors introduced an intelligent system which tackles the most difficult instance of this problem, where two-dimensional irregular shapes [9] have to be packed on a regularly or irregularly shaped surface. The proposed system utilizes techniques not previously applied to packing, drawn from computer vision and artificial intelligence, and achieves high-quality solutions with short computational times. In addition, the system deals with complex shapes and constraints that occur in industrial applications, such as defective regions and irregularly shaped sheets.

Image Texture Feature Extraction Using GLCM Approach [4] has discussed a feature Extraction is a method of capturing visual content of images for indexing & retrieval. Primitive or low level image features can be either general features, such as extraction of color, texture and shape or domain specific features. In this paper authors presented an application of gray level co-occurrence matrix (GLCM) to extract second order statistical texture features for motion estimation of images. The Four features namely, Angular Second Moment, Correlation, Inverse Difference Moment, and Entropy are computed using Xilinx FPGA. The results show that these texture features have high discrimination accuracy, requires less computation time and hence efficiently used for real time Pattern recognition applications.

Contrast enhancement and intensity preservation for gray-level images using multi-objective particle swarm optimization [5] proposed the contrast enhancement is achieved by maximizing the information content carried in the image via a continuous intensity transform function. The preservation of image intensity is obtained by applying gamma-correction on the images. Since there is always a trade-off between the requirements for the enhancement of contrast and preservation of intensity, an improved multi-objective particle swarm optimization procedure is proposed to resolve this contradiction, making use of its flexible algorithmic structure. The effectiveness of the proposed approach is illustrated by a number of images including the benchmarks and an image sequence captured from a mobile robot in an indoor environment.

In [6] authors considered regularity analysis for patterned texture material inspection. Patterned texture-like fabric is built on a repetitive unit of a pattern. Regularity is one of the most important features in many textures. In this paper, presented a new patterned texture inspection approach called the regular bands (RB) method is described. First, the properties of textures and the meaning of regularity measurements are presented. Next, traditional regularity analysis for patterned textures is introduced. Many traditional approaches such as co-occurrence matrices, autocorrelation, traditional image subtraction and hash function are based on the concept of periodicity. These approaches have been applied for image retrieval, image synthesis, and defect detection of patterned textures. In this paper, a new measure of periodicity for patterned textures is described. The Regular Bands method is based on the idea of periodicity. A detailed description of the RB method with definitions, procedures, and explanations is given. There is also a detailed evaluation using the Regular Bands of some patterned textures.

In [7] authors illustrated a comprehensive survey of 48 filters for impulsive noise removal from color images is presented. The filters are formulated using a uniform notation and categorized into 8 families. The performance of these filters is compared on a large set of images that cover a variety of domains using three effectiveness and one efficiency criteria. In order to ensure a fair efficiency comparison, a fast and accurate approximation for the inverse cosine function is introduced. In addition, commonly used distance measures (Minkowski, angular, and directional-distance) are analyzed and evaluated. Finally, suggestions are provided on how to choose a filter given certain requirements.

Measurement of Color of Citrus Fruits using an Automatic Computer Vision System [8] authors presented a key aspect for the consumer to decide on a particular product is the color. In order to provide as soon as possible fruit available to consumers, citrus begin to be collected before they reach their typical orange and therefore are subject to certain degreasing treatments, depending on their initial coloration. Recently, there has been developed a mobile platform that is capable of performing this process in the field while the fruit is harvested. However, due to the restrictions of working in field conditions, the computer vision system equipped in this machine is limited in its technology and processing capacity compared to conventional systems. This work evaluates this automatic inspection system of citrus color and compares it with two other devices; a characterized computer vision system and a spectrophotometer used as reference in the analysis of color on food.

III. Research Methodology

The research methodology considers the Citrus fruit classification process of Feature Extraction process is derived in this part. We introduce a tractable feature extraction process of Colpromatix color code for Gray and RGB color space, Size, Shape, Texture and Coarseness which is a natural extension of image feature extraction process. The overall feature extraction process flow diagram is described in figure 1.

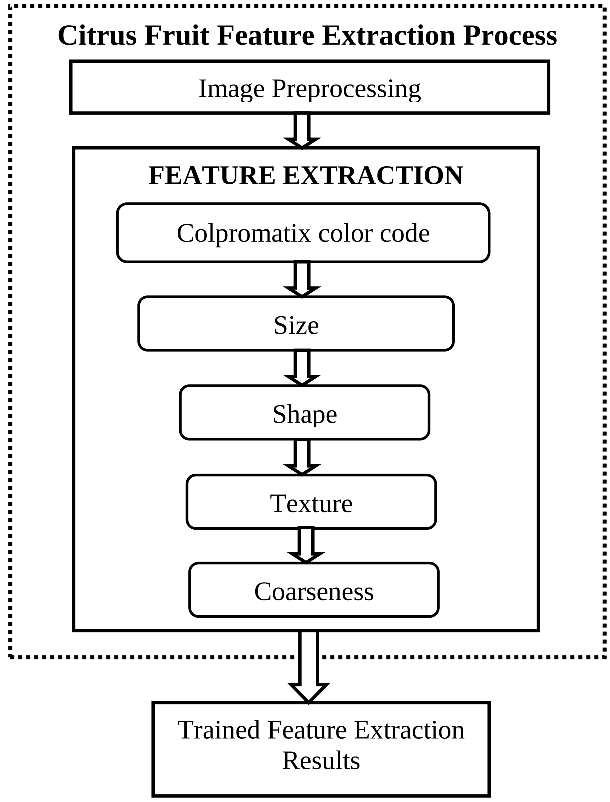

Fig. 1: Proposed Flow Diagram

a) *Image Preprocessing*

Image preprocessing is a mining technique that performs transforming raw image data into a reasonable format. In this process, original images pixels size (1027 x 768 x 3) is resized into (256 x 256 x 3) dimensions without pixel loss using '*bicubic'* method. After that, images must be of the same size and are supposed to be associated with indexed images on a common color map. In preprocessing, we introduced Hybrid Noise filter (*HNF*) to remove noise in a citrus image. The *HNF* is a new method enhanced version from Gaussian and Wiener filter. The noise is evenly distributed over the pixels. This means that each pixel in the noisy image is the sum of the true pixel value and a random Gaussian distributed noise value. For this noise removal, the maximum likelihood de-noised answer would just be a local mean, which can do with convolution (conv2) method. The peak signal noise ratio (PSNR) and Mean square error (MSE) ratios are compared to the Gaussian and HNF is described in table 1 and 2.

Table 1: Comparison of MSE ratio with Gaussian and HNF method

Images	Gaussian	HNF method
Image 1	97.5055	68.0320
Image 2	98.1133	68.4084
Image 3	98.0081	68.1074
Image 4	98.2375	64.7535
Image 5	98.0727	68.3908

Table 2: Comparison of PSNR ratio with Gaussian and HNF method

Images	Gaussian	HNF method
Image 1	28.2745	29.8377
Image 2	28.2475	29.8137
Image 3	28.2522	29.8329
Image 4	28.2420	30.0522
Image 5	28.2493	29.8148

In table 1 and 2, the *HNF* method outperforms MSE and PSNR ratio than Gaussian filter. The *HNF* de-noised results are shows in figure 1.

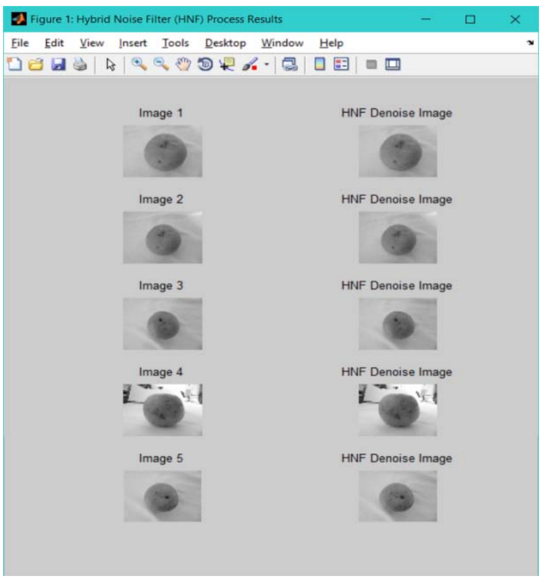

Fig. 1: Hybrid Noise Filter (HNF) Process Results

b) Image Feature Extraction

Image feature extraction is done without local decision making; the result is often referred to as a feature image. Consequently, a feature image can be seen as an image in the sense that it is a function of the same spatial (or temporal) variables as the original image, but where the pixel values hold information about image features instead of intensity or color. Feature extraction is a mining technique that involves transforming raw data into a comprehensible format. Feature extraction is a proven method of resolving Colpromatix Color code, Texture Shape, and Coarseness.

c) Color Feature Extraction

The feature extraction process is start with Color Space model. The color descriptors, RGB colormap features are extracted using color descriptors (i.e., mean and standard deviations of R, G and B). We introduce a tractable a Colpromatix color space code for Gray and RGB color space models. A Colpromatix image (sometimes styled Colpromatix color or Colpromatix color) is derived from a grayscale image by mapping each intensity values (0 to 255) to a color according to a table or function. The intensity values of citrus images described in table 3.

Table 3: Gray Intensity values ranges for color space model

Colors	Intensity Vales
Yellowish Gray	0 to 63
Yellow	64 to 95
Orange	96 to 127
Red	128 to 59
Purple	160 to 191
Light Blue	192 to 223
Green	224 to 255

Colpromatix color is typically used when a single channel of data is available (e.g. temperature, elevation, soil composition, tissue type, and so on), in contrast to false color which is commonly used to display three channels of data. The results of Colpromatix Feature extraction is described in figure 2 and 3. In figure 2 represents an input Gray model image. The gray model image is converted into Colpromatix color format intensity changes according to table 1. The Color feature extraction result finds the disease portions 90% located clearly in black color represents in figure 3.

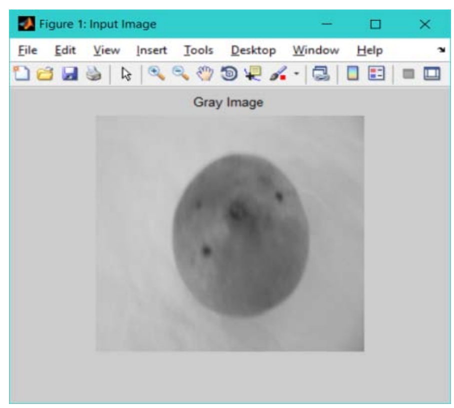

Fig. 2: Input Citrus Gray Image

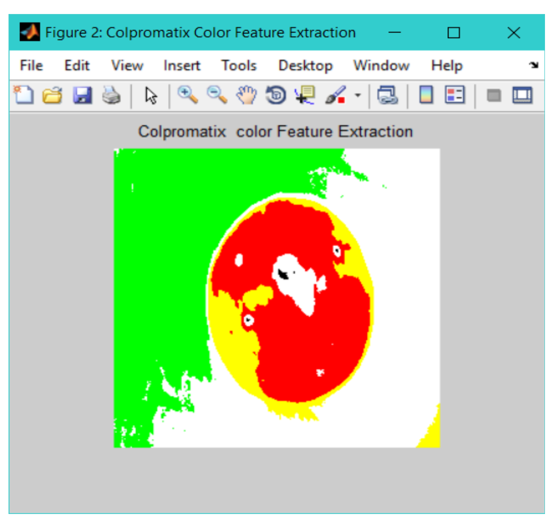

Fig. 3: Result of Colpromatix Color Feature Extraction

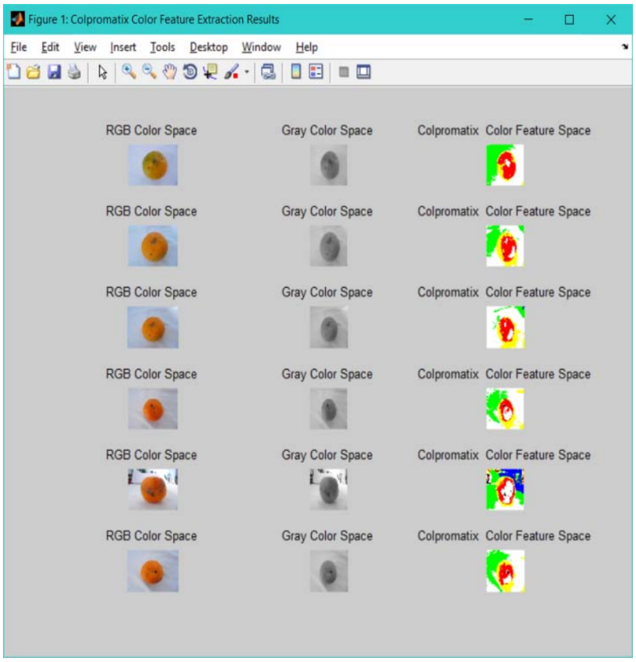

Fig. 4: Result of Colpromatix Color Feature Extraction; First column shows input RGG Color space mode; Second column shows Gray Color Space; Third column shows the Colpromatix Color space result model.

d) Texture Feature Extraction

The texture feature refers to surface characteristics and appearance of an object given by the dimension, shape, density, display, proportion of its elementary parts. After Colpromatix color descriptors stage to collect such features through texture analysis process is called as texture feature extraction. Due to the signification of texture information, texture feature extraction is a key function in citrus image segmentation functions in 9 levels described in figure 5 and 6.

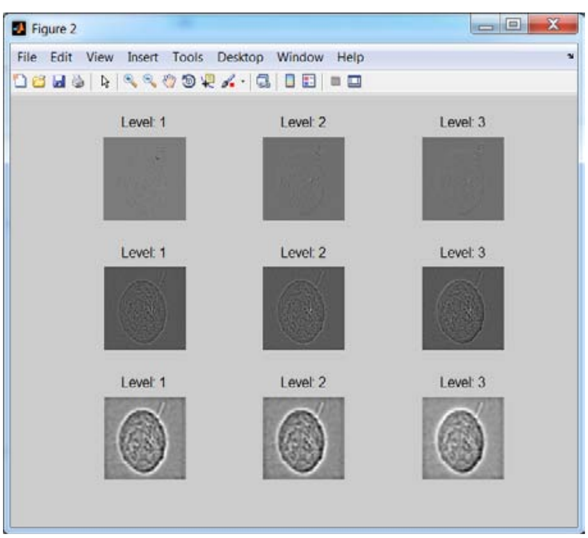

Fig. 5: Texture Feature extraction result of image 1

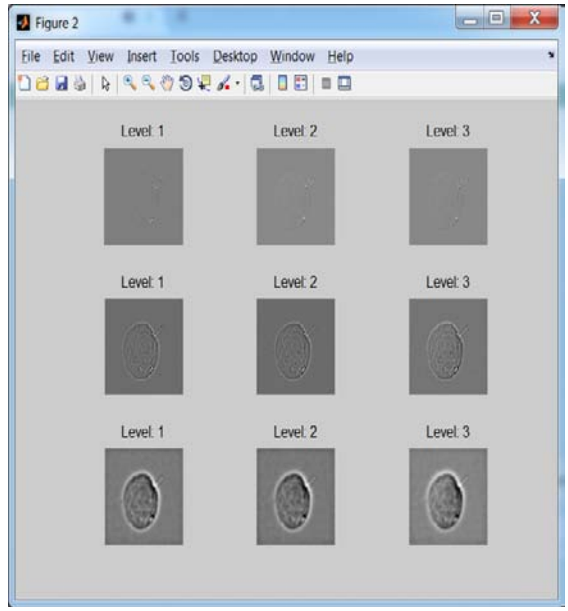

Fig. 6: Texture Feature extraction result of Image 2.

e) Shape Feature Extraction

For shape feature extraction, Citrus object is a significant and essential feature for describing image content, and can be thought of as an outline of the object [14], invariant to rotation, scale and translation [15]. Shape features are frequently used for finding and identical shapes, classifying objects measurement of shapes. Moment, perimeter, region and direction are some of the important characteristics used for shape feature extraction technique. The shape of an object is determined by its outside boundary abstracting from other properties such as color, content and texture composition, as well as from the object's other spatial properties.

It performs simple geometrical calculation such as shape formula. In here, it detect the edge location of "1" from the image, it perform the computation and verify the circular objects. To detect it, the radius level of the object must be given in order to detect the required round objects size. It detects 75% of it. In this step, some unrelated object are find out using padarray method detected due to it has the similar shape region because of the object base on the edge of each object.

The equation of the a shape is,

$$r^2 = (x - a)^2 + (y - b)^2 \qquad \text{eqn. (1)}$$

Here *a* and *b* represent the coordinates for the centered, and *r* is the radius of the circle. The shape feature results displayed in figure. 7 & 8.

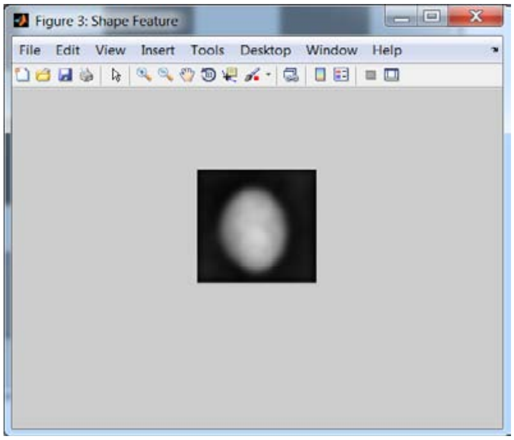

Fig. 7: Shape Feature extraction result image of A.jpg

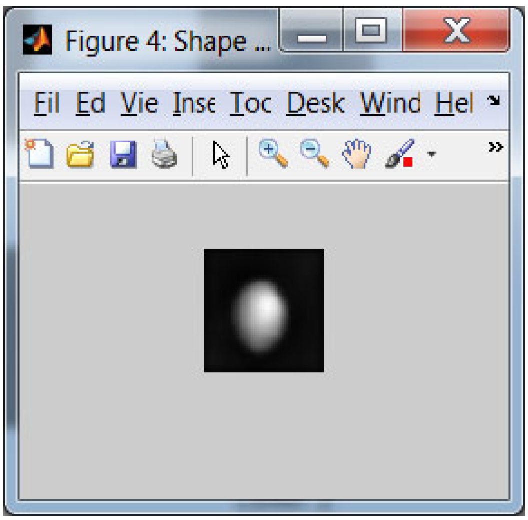

Fig. 8: Shape Feature extraction result image of B.jpg

f) Coarseness Feature Extraction

Coarseness relates to distances of prominent spatial variations of intensity-levels. It implicitly refers to the dimensions of the primitive elements forming the texture. The computational process accounts for differences between the average pixels for the non-overlapping blocks of different sizes in the following procedure:

Algorithm 1: Coarseness Feature Extraction

Step 1: At each pixel (x, y), compute 6 averages for the blocks of size $2^k \times 2^k$, $k=0,1,\ldots,5$, around the pixel.

Step 2: At each pixel, calculate absolute differences $A_k(x, y)$ between the pairs of non-overlapping averages in the horizontal and vertical orientations.

Step 3: At each pixel, find the value of k that maximizes the difference $A_k(x, y)$ in either direction and set the best dimension $D_{best}(x, y)=2^k$.

Step 4: Calculate the coarseness feature $F_{Coarseness}$ by averaging $D_{best}(x, y)$ over the entire image.

$$F_{Coarseness} = \frac{1}{mn}\sum_{x}^{m}\sum_{y}^{n} D_{best}(x,y) \qquad eqn. (2)$$

where $m \times n$ are the image total pixels, and D_{best} is the best demission that gives the highest difference of averages between non overlapped neighborhoods on opposite sides in both horizontal and vertical orientations for every pixel (i, j).

IV. Conclusion

In this paper reviewed the advancement of the information and communication technology in the field of citrus image preprocessing and feature extraction. Citrus fruit image processing approaches used in the field of agriculture and food industry for fruit classification of two processes is explored in this paper. Most of the work in this image processing is composed of the mainly two main steps (1) Image preprocessing and (2) feature extraction for training. In the first step image preprocessing is carried out using Noise removal method, in the second step Citrus fruit feature extraction process are extracted from the preprocessed image region, of fruit diseases. The proposed feature extraction method of Colpromatix color space model process and analyze the disease locations effectively. Texture feature extraction gives the efficient values when compared to the other methods. These methods can be applied to citrus fruit classification for grading.

The further work is to do graph based recursive process segmentation and Post processing of Naive Bayesian classification algorithms.

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Global Journal of Computer Science and Technology: G Interdisciplinary
Volume 17 Issue 3 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Prediction and Judgmental Adjustments of Supply-Chain Planning in Festive Season

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Keywords: *supply-chain planning, shipment load, forecasting.*

GJCST-G Classification: *D.4.8*

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Strictly as per the compliance and regulations of:

Prediction and Judgmental Adjustments of Supply-Chain Planning in Festive Season

Megha Chhabra [α], Deepti Sahu [σ] & Gunjan Agarwal [ρ]

Abstract- For a robust performance, Shipping costs planning in festive seasons is given the input data as free from trends, season-of-year effects etc. Seasonal forecasting for supply-chain planning with past few years of similar data impact shipping costs. Additionally, during a festive season of the year, unbiased and accurate prediction of shipment load plays a major role in bringing up sales. Time-series forecasting methods can be useful to remove traditional fluctuations due to gap in months-of-year of festivals. We describe exponential smoothing techniques and trend fitting methods and compare the predictive accuracy. The accuracy is compared using root-mean square error and median absolute deviation. The exponential smoothing shows changing behavior with increased data size and data item values. The data is compared with and without tuning the seasonal effects due to festive season.

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I. Introduction

Supply-chain holds a huge planning propaganda as a baseline to project sales and revenue generation based on it. Specially a case of modern era, where the comfort to customer can help an organization to retain the customer and thereby increase more sales and generate more business of the products. In addition to it, the planned resource production prediction helps generating less of the cost of production and more of the effort on quality productivity. Supply chain managements involve huge planning horizon for demand forecasting. For the purpose they use forecast systems for initial forecast followed by judgmental adjustment by the company experts to adjust exceptional events in the planning process. The manual adjustments made raise questions related to improvement of accuracy and type of adjustments made. Effective Short-term forecasting is important for improving supply chain management [26], irrespective of the type of business. Multiple applications of the prediction analysis and adjustment behavior in prediction accuracy can be seen in past few years [14]-[16], [18]-[20]. According to the literature of economic forecasting, accuracy of the statistical decisions can be improved when experts consider the changes in the statistical models according to the changes coming from occurrence of special events [1]-[8], [10], [11] and [22]-[23] showed that the suggested judgmental adjustments tend to improved accuracy marginally but may also introduce bias. Since it's a human added knowledge as a judgement factor, it is more likely to make error in level of adjustment and make room for error as experimental evidences suggest [24]-[26]. Forecasters make decisions on the basis of noisy and randomly fluctuating events in time series [9].

Several methods, techniques have been used in literature to forecast load demands. We used exponential smoothing technique and trend fitting for prediction.

This study presents effect of seasonal demand on prediction methodology of above mentioned models using reference data of handlooms business sector for predicting shipment load for four different Handlooms companies. The proposed methods are used to predict one month's demand. The outcome of both models is analyzed and accuracy is compared.

II. Time Series Models

A time series is sequential nature of data produced during a certain period of time. Assuming no major disrupting to critical parameters of a recurring event, the future prediction is always related to past data. Two time-series analysis models, namely, multiplicative decomposition and the smoothing technique use the dependency of future data to the past events, and model the behavior as follows:

a) *Smoothing Techniques*

Smoothing techniques are used to smoothen out random variations in the data due to irregular components of the time series. They provide a clearer and better view of data and it is easy to understand.

1) *Moving averages:* A moving average (MA) is an average of the data provided for certain number of time period. The method is called "moving" because it is obtained using summing and averaging the values from a given number of periods say n, each time deleting the oldest value and adding the new one. The moving average is calculated as:

$$MA_{t+1} = \sum_{i=1}^{n-1} \qquad (1)$$

Where t= current period.

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D= actual data exchanged each period.
n = length of the time period.

2) *Weighted moving Average (WMA):* In MA each observation is given equal weightage, which in real situations is less likely to occur. It may be desired to place more weight on certain period of time than others. When certain inputs are weighted differently than others, the moving average outcome of those inputs is called weighted moving average(WMA). In this case, different values may be assigned to compute a weighted average of the most recent n values.Hence, Weighted Moving average is given as:

$$WMA_{t+1} = \sum(\text{Weight for period n})(\text{data value in period n})/\sum\text{Weights} \quad (2)$$

3) *Exponential smoothing Technique:* An exponentially weighted moving average is a means of smoothing random fluctuations that has the following desirable properties: (1) declining weight is put on older data, (2) it is extremely easy to compute, and (3) minimum data is required [18]. Exponential smoothing methods are widely used in industry. Their popularity is due to several practical considerations in short-range forecasting [21]. A type of MA forecasting technique which weighs past data from previous time periods with exponentially decreasing importance in the forecast so that the most recent data carries more weight in the moving average. For finding trend effect, adjusted exponential smoothing gives a better answer. Hence,

Trend adjusted forecast:

$$(F_t)_{adj} = F_t + (1-\beta)/\beta * T_t \quad (3)$$

For which; $F_t = F_{t-1} + \alpha(Y_{t-1} - F_{t-1})$, and Trend factor: $T_t = \beta\,(F_t - F_{t-1}) + (1-\beta) * T_{t-1}$

Where

$(F_t)_{adj}$ = trend-adjusted Forecast,

F_t = New forecast, F_{t-1} = Old forecast, Y_{t-1}= Observed data

α= Simple exponential smoothing factor

β = Smoothing constant for trend

T_t = exponentially smoothed trend factor

b) *Trend Projections*

When a time series reflects a change from a consistent pattern to a real time increase or decrease in the variable of interest example shipping load or admissions in school etc, trend component of the series is demonstrated in that pattern. The trend projection model is:

$$Tt = b0 + b1*t$$

$$\text{And } b0= (\sum Y/n) - b1*(\sum t/n) \text{ and } b1 = (\sum t*Y_t - (\sum t \sum Y_t)/n) / (\sum t^2-(\sum t)^2/n) \quad (4)$$

Where,

Tt= Trend value for the variable of interest in period t.

b0= Intercept of the trend projection line.

b1= Slope of the line.

c) *Trend and seasonal component*

To occupy the Seasonal festive pattern, time series decomposition model breaks down, analyzes and forecasts the seasonal and the trend components. The method is often referred as Time series decomposition, since the technique is analyzing seasonal indexes after decomposing the series in order to identify seasonal components called as seasonal indexes. These helps deseasonalize the series. This deseasonalized series helps in projecting trend projection line. Lastly, seasonal indexes are used to seasonalize the trend projection. [27].The steps involved are as follows:

1. Identify the quarters, months etc. and calculate centered moving averages (CMA).
2. Determine seasonal and Irregular factorsStIt= Yt / CMAt.
3. Determine average seasonal factors corresponding to the seasons At.
4. Scale the seasonal factors St and then determine the deseasonalized dataYt' =Yt/St .
5. Determine trend line of deseasonalized data.
6. Determine deseasonalized predictions.

III. Experimentation

The data is input to both the methods with and without tuning the seasonal effects. In order to fit the seasonal component, extent of seasons is fixed for a month's duration. For example, Ludhiana manufacturers tend to see a huge impact on sale during Diwali, Baisakhi etc. Data is selected and analyzed from four Ludhiana-based handloom manufacturers. For a better accuracy rate, last three years data is analyzed. In the given market trend of last three years, Each festive month's shipment load is recorded and analyzed to forecast next festive season's shipment load.

a) *Data*

The data is collected for the festive season's months of Punjab for Ludhiana based four Handlooms manufacturers for the last three years. Table 1 is organized structure of observed shipment load for the festive season of Lohri (Jan), Holi (March), Vaisakhi (April), Rakhsha-Bandhan (August), Krwachauth(Sep-Oct), Diwali and E-id (Oct-Nov), Guru-Nanak Jayanti (Nov) and finally Christmas(Dec) for all four handlooms. Along with these values, table1 also contains one last entry as observed value of Lohri (Jan'17).

The graphical representation of the observed data along with its linear trend fitting is shown in graph1. The graph shows observed shipment lad of all four handlooms over the seasonal period of last three years along with one last entry as observed shipment load of Jan'17 which is value of interest here.

b) *Results*

All three Smoothing averages and trend fitting with and without tuning the trend effect are applied on the data collected and outcome is predicted for festive season of Lohri (Jan'17). The results are compared with already observed value for Lohri (Jan'17).

i. *Smoothing Technique*

- *Moving averages:* Here the moving average (MA) is an average of the data provided for observed shipment load of all four Handlooms for festive seasons of past three years. Table 2 shows 3-month and 4-month MA. The outcome MA_3 and MA_4 are the two averages predicting the shipment load for festive season of Lohri (Jan'17) using Moving averages. MA_3= 2150 and MA_4 =2543.77. In comparison to the observed value of Lohri (Jan'17) as 2250, the question arises which moving average gives better result. For finding the accuracy level, Sum of squares SSE, mean square error MSE and root mean square error RMSE are found. Table 7 shows the overall comparison.

Table 1: Observed shipment load for the festive season of 2016 for Ludhiana based four Handlooms supply-chain companies

Year	1		2			3		
Festive Month	Season (t)	Observed Shipment Load (Units per pack of Handlooms)(Y)	Festive Month	Season (t)	Observed Shipment Load (Units per pack of Handlooms)(Y)	Festive Month	Season (t)	Observed Shipment Load (Units per pack of Handlooms)(Y)
(Jan'14)	1	2500	(Jan'15)	1	2200	(Jan'16)	1	2300
(March'14)	2	1130	(March'15)	2	1145	(March'16)	2	1130
(April'14)	3	2200	(April'15)	3	2500	(April'16)	3	2400
(August'14)	4	2250	(August'15)	4	2300	(August'16)	4	2250
(Sep-Oct'14)	5	3450	(Sep-Oct'15)	5	3400	(Sep-Oct'16)	5	3350
(Oct-Nov'14)	6	3000	(Oct-Nov'15)	6	2800	(Oct-Nov'16)	6	3000
(Oct-Nov'14)	7	3330	(Oct-Nov'15)	7	2850	(Oct-Nov'16)	7	3150
(Nov'14)	8	1100	(Nov'15)	8	1200	(Nov'16)	8	1400
(Dec'14)	9	1700	(Dec'15)	9	1950	(Dec'16)	9	1900
Year			4			(Jan'17)	1	2250

- *Weighted moving Average (WMA):* The expert planner/ analysts of the companies decide to weigh the past three month's sales. WMA calculated using average weightage given to past values for the combined data is shown in table 3. Using observed Shipment load for the last three months from table1, WMA is calculated for festive season of Lohri (Jan'17) as follows: WMA for Lohri'17= 2233.33.

Graph 2 shows Observed Vs Forecasted shipment load with 3period moving average for the festive season of past three years for Ludhiana based four Handlooms supply-chain companies. The graph illustrates that with 3 period moving average the next forecasted value that is Jan'17 reduced than observed value. Where as in graph 3 shows with the 4-period moving average the forecast increases.

- *Exponential smoothing Technique:* Since trend is expected out of festive season demands of the handlooms in the market hence, adjusted exponential smoothening $(F_t)_{adj}$ is obtained as a result. Therefore using eq 3, trend adjusted forecast is calculated with $\alpha = 2/(n+1)$ i.e.= $2/(27+1) = 0.1$, and initial $T_t = 0$ and $\beta = 0.1$. The adjusted forecast in table4 gives final $(F_t)_{adj}$ =2280.922 which is close to simple exponential smoothing without any tuning for trend effects F_t =2312.219

Accuracy of forecast is better judged by finding mean square error for different values of smoothing constant α ($0< \alpha\leq1$). In order to get which smoothing factor gives better result, comparison between forecasts for α=0.1 and α=0.8 is shown in table 5. Result shows for α=0.8 is relatively gives more root mean square error hence less accurate forecast for large data set. It is observed that the data with larger fluctuations over the period of time more than a year does not predict accurate using exponential smoothing.

ii. *Trend Fitting:* Using eq6 the model can be fitted using table1 data. To occupy the Seasonal festive pattern, time series decomposition model breaks down, analyzes and forecasts the seasonal and the trend components. The given data set has distinct nine seasons hence the forecast is effected by the trend and seasonal component. Table 6 shows before and after seasonal and trend decomposition effect comparison of trend fitting. The forecasted value comes out to be T = 2378and 2322 resp. for Jan'17.

The accuracy so measure for all the methods applied are shown in table 7. Accuracy is compared by calculating MSE and RMSE of all the forecasts so far applied in this work. The lesser the RMSE better is the forecast. As shown in table 7, Trend fitting after trend deseasonalization gives least RMSE and hence is the best forecast seen.

IV. Conclusion

The techniques used in this case study shows following results based on forecast and the measure of error based on MSE and RMSE:

- The moving average method is simple to use. It works well with time series that do not have trend or seasonal components. With little data, limited to on period ahead, it works better. It this case study, with the data for past three years which included trend effects, it does not give effective result. The outcome of the smoothing Technique shows results for the moving averages MA_4 gives lesser RMSE and hence is better forecast than MA_3.

Table 2: Forecasting Jan'17 using 3-Month moving average and 4-Month moving average

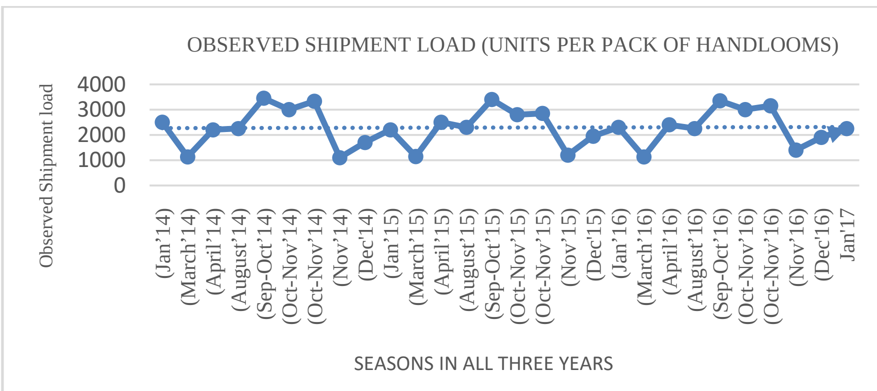
Festive Month	Year	Season(t)	Observed Shipment Load (Units per pack of Handlooms) (y)	MA_3	MA_4	CMA_4
(Jan'14)	1	1	2500			
(March'14)		2	1130	1943.333		
(April'14)		3	2200	1860	2020	2138.75
(August'14)		4	2250	2633.333	2257.5	2491.25
(Sep-Oct'14)		5	3450	2900	2725	2866.25
(Oct-Nov'14)		6	3000	3260	3007.5	2863.75
(Oct-Nov'14)		7	3330	2476.667	2720	2501.25
(Nov'14)		8	1100	2043.333	2282.5	2182.5
(Dec'14)		9	1700	1666.667	2082.5	1809.375
(Jan'15)	2	1	2200	1681.667	1536.25	1711.25
(March'15)		2	1145	1948.333	1886.25	1961.25
(April'15)		3	2500	1981.667	2036.25	2186.25
(August'15)		4	2300	2733.333	2336.25	2543.125
(Sep-Oct'15)		5	3400	2833.333	2750	2793.75
(Oct-Nov'15)		6	2800	3016.667	2837.5	2700
(Oct-Nov'15)		7	2850	2283.333	2562.5	2381.25
(Nov'15)		8	1200	2000	2200	2137.5
(Dec'15)		9	1950	1816.667	2075	1860
(Jan'16)	3	1	2300	1793.333	1645	1795

(March'16)		2	1130	1943.333	1945	1982.5
(April'16)		3	2400	1926.667	2020	2151.25
(August'16)		4	2250	2666.667	2282.5	2516.25
(Sep-Oct'16)		5	3350	2866.667	2750	2843.75
(Oct-Nov'16)		6	3000	3166.667	2937.5	2831.25
(Oct-Nov'16)		7	3150	2516.667	2725	**2543.75**
(Nov'16)		8	1400	**2150**	2362.5	
(Dec'16)		9	1900			
Jan'17	4	1	2250			

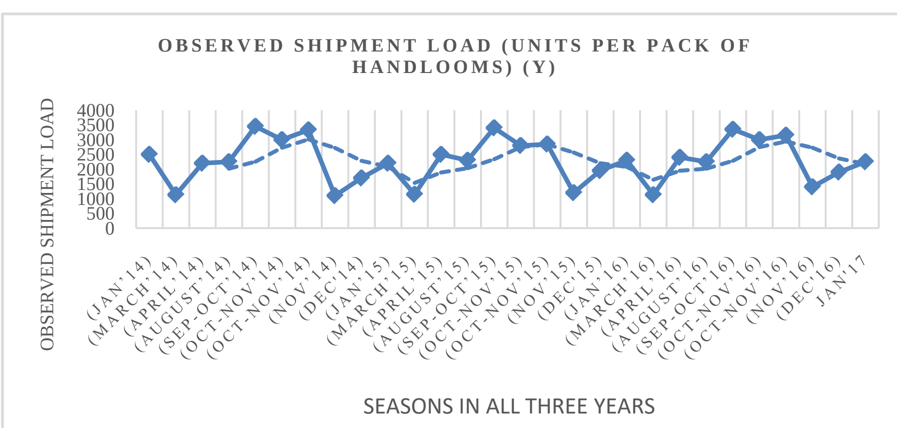
Table 3: Weighted moving average for last three months

.Season (t)	Weights (w)	Values (y)	weights*value	Festival
Last Month	1/2	1900	950	Christmas
Two months ago	1/6	1400	233.33	Gurunanak Jayanti
Three Months ago	1/3	3150	1050	Eid
Forecasted value			**2233.33**	Lohri(Jan'17)

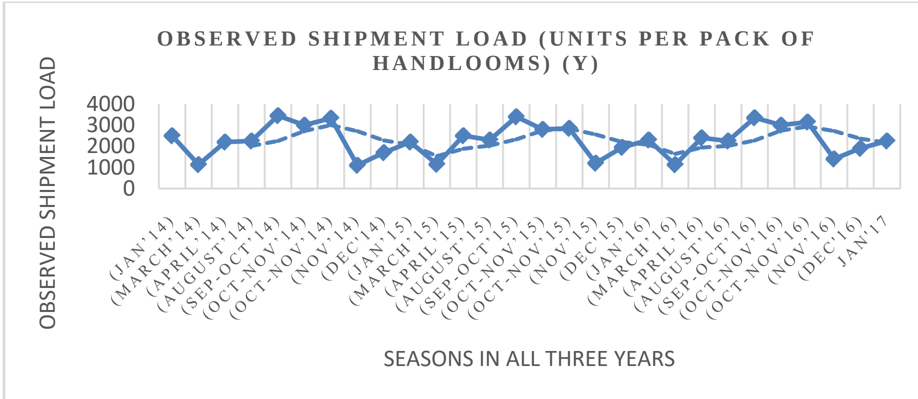
Graph 1: Observed shipment load for the festive season of 2016 for Ludhiana based four Handlooms supply-chain companies.



Graph 2: Observed Vs Forecasted shipment load with 3period-moving average for the festive season of past three years for Ludhiana based four Handlooms supply-chain companies.



Graph 3: Observed Vs Forecasted shipment load with 3period-moving average for the festive season of past three years for Ludhiana based four Handlooms supply-chain companies.



- Using Weighted moving averages, given the understanding of the owner of the sales-market head, the weights assigned to the various months of certain period 'n' hugely impacts the forecast value accuracy level. In the given data set, the weights assigned by the stakeholder proves to give best outcome of all forecasts. WMA is the best suited outcome for the dataset.
- Due to large variation of shipment load in various sequential months, Exponential smoothing technique could not predict better results for data with such huge variation. Setting α=0.8 gives poor forecast of the observed shipment load of Lohri (Jan'17).
- The trend adjustments made in data due to seasonal effect of festivals dramatically improves projection using trend line projection. RMSE comparison between other techniques and trend projection shows trend projection with trend deseasonalization gives best of all results and closest forecast to actual observation.

Table 4: Forecasting Jan'17 using exponential smoothing average with α= 0.1

Festive Month	Year	Season(t)	Observed Shipment Load (Units per pack of Handlooms) (*y*)	Old Forecast F_{t-1}	New Forecast ($F_t = F_{t-1} + 0.1(y_{t-1} - F_{t-1})$)	Adjusted forecast $(F_t)_{adj} = F_t + (1-\beta)/\beta * T_t$
(Jan'14)		1	2500	2500	2500	2500
(March'14)		2	1130	2500	2363	2239.7
(April'14)		3	2200	2363	2346.7	2221.06
(August'14)		4	2250	2346.7	2337.03	2215.251
(Sep-Oct'14)		5	3450	2337.03	2448.327	2438.893
(Oct-Nov'14)		6	3000	2448.327	2503.494	2544.654
(Oct-Nov'14)		7	3330	2503.494	2586.145	2697.575
(Nov'14)		8	1100	2586.145	2437.53	2404.064
(Dec'14)	1	9	1700	2437.53	2363.777	2267.28
(Jan'15)		1	2200	2363.777	2347.4	2245.812
(March'15)		2	1145	2347.4	2227.16	2027.515
(April'15)		3	2500	2227.16	2254.444	2099.319
(August'15)		4	2300	2254.444	2258.999	2123.487
(Sep-Oct'15)		5	3400	2258.999	2373.099	2353.828
(Oct-Nov'15)		6	2800	2373.099	2415.789	2436.867
(Oct-Nov'15)		7	2850	2415.789	2459.211	2517.259
(Nov'15)	2	8	1200	2459.211	2333.289	2272.204

(Dec'15)		9	1950	2333.289	2294.961	2205.488
(Jan'16)		1	2300	2294.961	2295.464	2215.392
(March'16)		2	1130	2295.464	2178.918	2001.961
(April'16)		3	2400	2178.918	2201.026	2061.663
(August'16)		4	2250	2201.026	2205.924	2084.904
(Sep-Oct'16)		5	3350	2205.924	2320.331	2314.38
(Oct-Nov'16)		6	3000	2320.331	2388.298	2444.113
(Oct-Nov'16)		7	3150	2388.298	2464.468	2583.255
(Nov'16)		8	1400	2464.468	2358.021	2369.127
(Dec'16)	3	9	1900	2358.021	2312.219	**2280.992**
Jan'17	4	1	2250			

Table 5: A comparative study of forecasts by setting α=0.1 and α=0.8 for all four handlooms for the last three years data

Festive Month	Year	Season (t)	Observed Shipment Load (Units per pack of Handlooms) (*y*)	Old Forecast α=0.1	New Forecast α=0.1	Old Forecast α=0.8	New Forecastα=0.8
(Jan'14)		1	2500	2500	2500	2500	2500
(March'14)		2	1130	2500	2363	2500	1404
(April'14)		3	2200	2363	2346.7	1404	2040.8
(August'14)		4	2250	2346.7	2337.03	2040.8	2208.16
(Sep-Oct'14)		5	3450	2337.03	2448.327	2208.16	3201.632
(Oct-Nov'14)		6	3000	2448.327	2503.494	3201.632	3040.326
(Oct-Nov'14)		7	3330	2503.494	2586.145	3040.3264	3272.065
(Nov'14)		8	1100	2586.145	2437.53	3272.06528	1534.413
(Dec'14)	1	9	1700	2437.53	2363.777	1534.413056	1666.883
(Jan'15)		1	2200	2363.777	2347.4	1666.882611	2093.377
(March'15)		2	1145	2347.4	2227.16	2093.376522	1334.675
(April'15)		3	2500	2227.16	2254.444	1334.675304	2266.935
(August'15)		4	2300	2254.444	2258.999	2266.935061	2293.387
(Sep-Oct'15)		5	3400	2258.999	2373.099	2293.387012	3178.677
(Oct-Nov'15)		6	2800	2373.099	2415.789	3178.677402	2875.735
(Oct-Nov'15)		7	2850	2415.789	2459.211	2875.73548	2855.147
(Nov'15)		8	1200	2459.211	2333.289	2855.147096	1531.029
(Dec'15)	2	9	1950	2333.289	2294.961	1531.029419	1866.206
(Jan'16)		1	2300	2294.961	2295.464	1866.205884	2213.241
(March'16)		2	1130	2295.464	2178.918	2213.241177	1346.648
(April'16)		3	2400	2178.918	2201.026	1346.648235	x2189.33
(August'16)		4	2250	2201.026	2205.924	2189.329647	2237.866
(Sep-Oct'16)		5	3350	2205.924	2320.331	2237.865929	3127.573
(Oct-Nov'16)		6	3000	2320.331	2388.298	3127.573186	3025.515
(Oct-Nov'16)		7	3150	2388.298	2464.468	3025.514637	3125.103
(Nov'16)		8	1400	2464.468	2358.021	3125.102927	1745.021
(Dec'16)	3	9	1900	2358.021	**2312.219**	1745.020585	**1869.004**
Jan'17	4	1	**2250**				

Table 6: A comparative study of forecasts before and after seasonal and trend decomposition effect comparison of trend fitting for all four handlooms for the last three years data

Festive Month	Year	Quarters (t)	Observed Shipment Load (Units per pack of Handlooms) Y_t	Season	3 period	Seasonal irregular factor	Scaling factor	Deseasonalized data	Deseasonalized trend projection	Trend line	Trend projection	Trend line
				t	CMA	S_tY_t	S_t	$Y_t/S_t = Y'_t$	Y'_t*t	$T'_t=b0+b1*t$	Y_t*t	$Tt=b0+b1*t$
(Jan'14)		1	2500	1			1.238	2018.96	2018.96	2228.92	2500	2264.1
(March'14)		2	1130	2	1943.3	0.581	0.594	1903.16	3806.32	2234.45	2260	2266.2
(April'14)		3	2200	3	1860	1.183	1.229	1789.53	5368.59	2239.98	6600	2268.4
(August'14)		4	2250	4	2633.3	0.854	0.846	2659.24	10636.94	2245.51	9000	2270.5
(Sep-Oct'14)	1	5	3450	5	2900	1.19	1.185	2910.24	14551.19	2251.05	17250	2272.7
(Oct-Nov'14)		6	3000	6	3260	0.92	0.931	3220.8	19324.8	2256.58	18000	2274.8
(Oct-Nov'14)		7	3330	7	2476.7	1.345	1.31	2542.5	17797.5	2262.11	23310	2277
(Nov'14)		8	1100	8	2043.3	0.538	0.544	2021.34	16170.69	2267.64	8800	2279.1
(Dec'14)		9	1700	9	1666.7	1.02	1.122	1515.61	13640.48	2273.17	15300	2281.3
(Jan'15)		1	2200	10	1681.7	1.308	1.238	1776.68	17766.81	2278.7	22000	2283.4
(March'15)		2	1145	11	1948.3	0.588	0.594	1928.42	21212.63	2284.24	12595	2285.6
(April'15)		3	2500	12	1981.7	1.262	1.229	2033.56	24402.7	2289.77	30000	2287.7
(August'15)		4	2300	13	2733.3	0.841	0.846	2718.33	35338.29	2295.3	29900	2289.9
(Sep-Oct'15)	2	5	3400	14	2833.3	1.2	1.185	2868.06	40152.86	2300.83	47600	2292
(Oct-Nov'15)		6	2800	15	3016.7	0.928	0.931	3006.08	45091.2	2306.36	42000	2294.2
(Oct-Nov'15)		7	2850	16	2283.3	1.248	1.31	2176.01	34816.21	2311.89	45600	2296.3
(Nov'15)		8	1200	17	2000	0.6	0.544	2205.09	37486.59	2317.43	20400	2298.5
(Dec'15)		9	1950	18	1816.7	1.073	1.122	1738.49	31292.87	2322.96	35100	2300.6
(Jan'16)		1	2300	19	1793.3	1.283	1.238	1857.44	35291.34	2328.49	43700	2302.8
(March'16)		2	1130	20	1943.3	0.581	0.594	1903.16	38063.16	2334.02	22600	2304.9
(April'16)		3	2400	21	1926.7	1.246	1.229	1952.22	40996.54	2339.55	50400	2307.1
(August'16)		4	2250	22	2666.7	0.844	0.846	2659.24	58503.19	2345.08	49500	2309.3
(Sep-Oct'16)	3	5	3350	23	2866.7	1.169	1.185	2825.88	64995.33	2350.61	77050	2311.4
(Oct-Nov'16)		6	3000	24	3166.7	0.947	0.931	3220.8	77299.2	2356.15	72000	2313.6
(Oct-Nov'16)		7	3150	25	2516.7	1.252	1.31	2405.07	60126.68	2361.68	78750	2315.7
(Nov'16)		8	1400	26	2150	0.651	0.544	2572.61	66887.84	2367.21	36400	2317.9
(Dec'16)		9	1900	27			1.122	1693.92	45735.73	2372.74	51300	2320
Jan'17	4	1	**2250**	28				b1	5.532	b1	2.152	
								b0	2223.39	b0	2261.91	
								T'(28)	2378.27	T(28)	2322.17	

Table 7: Comparison of accuracy of forecast using SSE, MSE and RMSE for all techniques applied

Error measure	Smoothing techniques				Trend fitting	
	Moving averages		Exponential smoothing		Normal	Deseasonalized
	MA3	MA4	α= 0.1	α= 0.8		
SSE	21470355.56	15913144.53	16949382.13	22536138.72	15230927.11	6568052.846
MSE	795198.3539	589375.7234	627754.8936	834671.8046	564108.4115	243261.2165
RMSE	891.7389494	767.7080978	792.309847	913.6037459	751.0715089	**493.2151828**
Forecasted value	2150	2544	2358	1745	2378	**2322**

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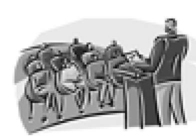

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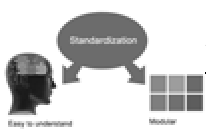

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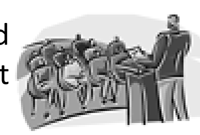

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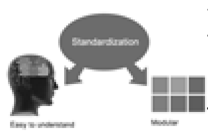

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Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

Color Charges: It is the rule of the Global Journals Inc. (US) for authors to pay the full cost for the reproduction of their color artwork. Hence, please note that, if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a color work agreement form before your paper can be published.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

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The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

As changes to proofs are costly, we inquire that you only correct typesetting errors. All illustrations are retained by the publisher. Please note that the authors are responsible for all statements made in their work, including changes made by the copy editor.

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Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.
- Do not give permission to anyone else to "PROOFREAD" your manuscript.
- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	C-D	E-F
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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ISSN 9754350