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### Two-Handed Sign Language Recognition for Bangla Character Using Normalized Cross Correlation

### By Kaushik Deb, Helena Parvin Mony & Sujan Chowdhury

Chittagong University of Engineering and Technology, Chittagong, Bangladesh

*Abstract* - Sign language detection and recognition (SLDR) using computer vision is a very challenging task. In respect to Bangladesh, sign language users are around 2.4 million [1]. In this paper, we try to focus for communicating with those users by computer vision. In this respect, an efficient method is propose consists of two basic steps: (a) refinement and (b) recognition. Initially in refinement, a Red-Green-Blue (RGB) color model is adopted to select heuristically threshold value for detecting candidate regions (i.e. hand and wrist band sign regions). After the candidate regions are obtained by applying color segmentation, then procedures for refining the candidate region are followed by using two different color wrist band regions and filtering. Finally, statistically based template matching technique is used for recognition of hand sign regions. Various hand sign images are used to test the proposed method and results are presented to provide its effectiveness.

Keywords : RGB color model, Color segmentation, Template matching.

GJCST Classification: 1.2.9



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## Two-Handed Sign Language Recognition for Bangla Character Using Normalized Cross Correlation

Kaushik Deb <sup>a</sup>, Muhammad Ibrahim Khan<sup>a</sup>, Helena Parvin Mony<sup>a</sup> & Sujan Chowdhury<sup>a</sup>

Abstract - Sign language detection and recognition (SLDR) using computer vision is a very challenging task. In respect to Bangladesh, sign language users are around 2.4 million [1]. In this paper, we try to focus for communicating with those users by computer vision. In this respect, an efficient method is propose consists of two basic steps: (a) refinement and (b) recognition. Initially in refinement, a Red-Green-Blue (RGB) color model is adopted to select heuristically threshold value for detecting candidate regions (i.e. hand and wrist band sign regions). After the candidate regions are obtained by applying color segmentation, then procedures for refining the candidate region are followed by using two different color wrist band regions and filtering. Finally, statistically based template matching technique is used for recognition of hand sign regions. Various hand sign images are used to test the proposed method and results are presented to provide its effectiveness.

*Keywords : RGB color model, Color segmentation, Template matching.* 

### I. INTRODUCTION

ccording to sociolinguistic survey deaf, dumb and sign language users are neglected by society. In time to time, the scenario becomes changed. In the modern world, they are also treated as imaginative, creative and as intelligent as any other normal human being. But their disabilities is the main obstacle to lead a normal social life. According to study, instead of verbal communication, the deaf and dumb people use sign language, which is a visual form of communication including the combination of hand shapes, orientation and movement of the hands, arms or the body, and facial expressions. Sign language is the organized collection of gestures. Gestures are usually understood as hand and body movement which can pass information from one to another. In this paper we work with two hand gesture. Many researchers have attempted to recognize sign language through various techniques. However none of them have ventured into the area of Bangla sign language. However, Banglasign language users the community is largest community among the language based minority communities in Bangladesh. We focused our research on deaf and dump that live in Bangladesh. This paper propose a framework for Bangla SLDR. The basic concept involves the use of wearing two different color wrist bands by the disabled person who makes the sign and will interact with the system by gesturing in the view of the camera. Shape and position information about the hand will be gathered using detection of skin and wrist band color. The SLDR task is quite challenging from sign images due to viewpoint changes, uneven illumination condition during image acquisition. As far as detection and recognition of hand sign region are concerned, researchers have found various methods of hand sign detection and recognition. For example, glove based recognition strategy had developed in Pakistan sign language, described in [4]. Authors describe the use of statistical template matching for gesture recognition in Boltay Haath. In [2], the model describes the development of a video-based continuous sign language recognition system. The system is based on continuous density Hidden Markov Models (HMM) with one model for each sign which is developed for German sign language. According to [3], the one-state transitions of the English language are projected into shape space for tracking and model prediction using a HMM like approach. In [5], accomplished a computer based method to generate American sign language gestures from natural speech and display them through a 2D animated character. The domain is chosen as the sequential generation of gestures of letters in a text, corresponding to the speech. In the second segment of the work, we have implemented a system to generate American Sign Language gestures from speech and display them by a 2D Virtual Human.

However, to the best of our knowledge all previous work on Bangla hand sign recognition is done only on one hand. In this respect, the main emphasis of this paper is to develop computerized sign language recognition system for two-handed Bangla sign language. In this regard, ten (10) different hand sign created by various people and matched it with our dataset and get better result and ensure its effectiveness.

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### 11. Description of Two- Handed Sign

The sign language used by the deaf community in Bangladesh is called Bangla Sign Language Anthology (BSLA) controlled by Centre for Disability Development (CDD). Like other sign languages of the world, it is a rich and complex visual-spatial language, with a vocabulary and syntax of its own. It is different from other sign languages and, of course, from spoken language such as English. It includes hand shapes and movements, facial expression and body movements to express meaning, and can be used to express a full range of meaning. Various types of two handed Bangla sign language images are shown in Figure 1. All signs have two different color wrist bands, one is red and another is swan. Each sign of these images consist of four different colors: red, swan, skin color and black (background color). Color is an identifiable feature and wrist band color is an invariant manner is of main objectives of the proposed color based hand sign extraction method.



Fig. 1. Two -handed sign images.

### III. THE PROPOSED FRAMEWORK

The following block diagram shows the working approach towards the solution of the stated problem. In order to fulfill our desired goal, the proposed framework divides the whole process into two basic steps: a) detection and b) recognition.



*Fig.2.* The proposed hand sign recognition framework.

### IV. DETECTION ALGORITHM ARCHITECTURE

According to our proposed framework first portion is detection module as shown in Figure 3. Detection means find out proper candidate region that will be used as an input in algorithmic implementation of recognition. The propose detection module consists of three major steps i.e. color segmentation, centroid calculation and localizing the edge of two wrist bands. The output of the initial step will be the binary image. In second step, center is calculated to detect the edge point. Finally, candidate region is extracted by removing forearm pixel.





#### a) Color segmentation

Color is a distinctive feature of image. In this proposed method, candidate region is detected based on its color properties. For detecting hand and two wrist bands region a threshold values are obtained using heuristical approach on different hand images. The result of this step is two binary masks (where 0 means background and 1 means possible sign) which represent candidate locations.

Pixels belongs to hand sign if

$$(I_{i,j}^{R} > .40) \& (I_{i,j}^{G} > .36) \& (I_{i,j}^{B} > .30)$$
 (1)

Pixels belongs of red band sign if

$$(I_{i,j}^{R} > .40) \& (I_{i,j}^{G} > .007) \& (I_{i,j}^{B} > .02)$$
 (2)

And pixels belongs of swan band sign if

$$(I_{i,j}^{R} > .01) \& (I_{i,j}^{G} > .57) \& (I_{i,j}^{B} > .50)$$
 (3)

Where  $I_{i,j}^{R}$ ,  $I_{i,j}^{G}$ ,  $I_{i,j}^{B}$  pixels are belongs to red, green and blue component of input image I with coordinates (i, j). A hand sign image and its color segmentation results are shown in Fig. 4.



*Fig.4.* A hand sign image (left) and its color segmentation results (right) using an RGB color model.

In color segmentation, we get three different regions, such as skin color region and two wrist band color region. The skin color is discrete and it is separated by wrist band color. In order to obtain the full desired binary image we have to make an OR masking operation. Obtained binary image still contain noises and that is not ideal. These noise means forearm pixels of hand.

As there is no difference between the color ranges of a skin pixel of the hand and a skin pixel of the forearm, our next approach is to remove forearm pixel from the position information. We can obtain it using centroid calculation and localizing the wrist band which is described in later part. In first step, calculate the centroid of band and hand and in next step try to find the edge point, which will help us to remove the noise and obtain the candidate image for further decision.

#### b) Centroids calculation

By averaging the position of the pixels that is detected earlier, it is possible to calculate the centroid of both the hand and two wrist bands.

The following equation used to find the hand & band centroid is as follows:

$$C_{hand, band} = \frac{1}{\left|N\right|} \sum_{i=1}^{N} X \tag{4}$$

Where N is total number of pixels

#### c) Localizing the edge of two wrist band

In this step we try to find out the edge of the two wrist bands. It was considered that if the distance and angle of the edges of the wrist band relative to the hand centroid, the forearm skin pixels could be removed by comparing their distances and angles with them.

The equation used for vector joining for two centroid is

$$C_{dif} = (x_{dif}, y_{dif}) = C_{hand} - C_{band}$$
(5)

The yaw angle of the hand is :

$$\theta_{hand} = \tan^{-1} \left( \mathbf{y}_{diff} / \mathbf{x}_{diff} \right)$$
(6)

Horizontal & Vertical Line through center of band are found by this equation

$$P_{1}(s_{1}) = C_{band} + s_{1} \begin{bmatrix} \cos\left(\theta_{hand} + \frac{\pi}{2}\right) \\ \sin\left(\theta_{hand} + \frac{\pi}{2}\right) \end{bmatrix}$$
(7)

Where  $(-35 < s_1 < 35)$ 

For each  $s_1$  count the number of wrist band pixels  $n(s_1)$  along the line:

$$P_{2}(S_{1}, S_{2}) = P_{1} + S_{2} \begin{bmatrix} \cos(\theta_{hand}) \\ \sin(\theta_{hand}) \end{bmatrix}$$
(8)

Where (-50  $< s_2 < 50$ )

The edges points of the band left and right are equal to  $P_1(s_1)$  when  $n(s_1)$  falls below a certain threshold. In this way, find the edge point of two wrist band as well as maximum & minimum radius of band & hand.

### $r_{band} = \max \left( |band_{left} - C_{band}|, |band_{right} - C_{band}| \right) (9)$

In this way, removing the forearm and band pixels and extract the candidate sign as shown in Figure 5. During this step, main geometrical properties of sign candidate such as area, is computed. And also combination of pixel position and priority based information is used to remove erroneous detected pixels.





*Fig.5.* A binary sign image with forearm pixel (a), candidate detected by proposed method (b) after removing forearm pixel.

### V. SIGN RECONIZED ALGORITHM

Next step of proposed framework is recognizing the hand sign after extracting the candidate regions from detection step. In this paper, template matching with the use of normalizes cross-correlation to perform recognition for different types of hand sign. The proposed recognition scheme is shown in Figure 6.



*Fig.6.* The proposed hand sign recognition scheme.

Before recognition scheme, the candidate hand signs are normalized. Normalization is to refine the hand signs into a block containing no extra white spaces (i.e. pixels) in all four sides of the hand sign. Then each hand sign is fit to equal size. Fitting approach is necessary for template matching. For matching the candidate hand

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sign with the template, input candidate sign images must be equal sized with the template sign. Here the sign are fit to  $96 \times 72$ . For recognition of hand sign, we use the database where containing 10 prototypes for the hand signs with the size of  $96 \times 72$ . The database formed is shown in Figure 7.



## *Fig. 7.* Template (10 prototypes for the hand sign images with Bangla meaning) used for pattern matching.

To measure the similarity and find the best match, a statistical method correlation is used [7]. Correlation is an effective technique for image recognition. This method measures the correlation coefficient between a number of known images with the same sized unknown images or part of an image with the highest correlation coefficient between the images producing the best match.

Let *t* be a template image and  $\overline{t}$  its average of binary image. Let us assume that *c* is a candidate hand sign image, having the same size of the template and let  $\overline{c}$  be its average of binary image. We use the normalized cross-correlation function between the image pair and define in the discrete case as follows.

$$Ncc_{ct} = \frac{\sum_{x=0}^{m-1} \sum_{y=0}^{n-1} (c-\bar{c})(t-\bar{t})}{\sqrt{\sum_{x=0}^{m-1} \sum_{y=0}^{n-1} (c-\bar{c})^2 (t-\bar{t})^2}}$$

Where  $Ncc_{ct}$  is the correlation coefficient. The candidate hand sign recognition process is based on the value of the correlation coefficient. If the value of the correlation coefficient exceeds a threshold set by the user, then the similarity measure is large enough and input hand sign can be assumed to present. Finally, a red box on the target hand sign is plotted as shown in Figure 8.

Illustration of hand sign recognition is portrayed in Figure 8.



*Fig.8.* Illustration of hand sign recognition: (a) extracted candidate binary hand sign image, (b) gesture image, (c) and (d) candidate hand signs measuring the similarity by NCC and recognized gesture sign converted to text, respectively.

### VI. RESULT DISCUSSION

All experiments were done on core-i3 2.53 GHz with 2 GB RAM under MATLAB environment. In the experiments, 80 images were employed and the size of the images is 320×240 pixels. Some images are shown in Figure 7. The hand sign detection and recognition results, and average computational cost for hand sign recognition are shown in Tables 1, 2, and 3.

Table 1 : Detection results.

Input Image	Detected hand sign	Success rate (%)
80	78	97.5

#### Table 2: Recognition results.

Stage	Success rate (%)
Recognition of hand sign	96

Table 3 ·	Average	com	nutational	l cost
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Computational Time of Refinement Step		Computational Time of Recognition Step	
Stage	Avg. Time(s)	Stage	Avg. Time(s)
Color segmentation	.39	Normalization	.21
Remove forearm pixel	.27	Plotted output	1.92
		Convert to text	.37
	.66		2.50

### VII. CONCLUSIONS

In this paper, we adopt a new method for automatic recognition process of sign language to develop the quality of life of these disable people. Initially in refinement, a Red-Green-Blue (RGB) color model is adopted to select heuristically threshold value for detecting candidate regions (i.e. hand and wrist band sign regions). After the candidate regions are obtained by applying color segmentation, then procedures for refining the candidate region are followed by using two different color wrist band regions and filtering. And also combination of pixel position and priority based information was used to remove any erroneous detected pixels. Finally, we focus in this paper on the conducting an experiment using template matching technique with the use of normalized crosscorrelation to perform for recognition of hand sign regions.

While conducting the experiments, different illumination conditions and varied distances between hand sign and camera often occurred. In such cases, confirmed the result is very effective when the proposed method is used. However, the proposed method is sensitive with different back ground condition and rotated hand sign images. We leave these issues for consideration in future studies.

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### A Study on Efficient Digital Signature Scheme for E-Governance Security

By Mr. Nikhilesh Barik & Dr. Sunil Karforma

Burdwan University ,West Bengal ,India

*Abstract* - E-governance is the latest technological trend in the governance process all over the world whose application attribute can be Variety, Embedded, Rapidly, Year-round ,Simple, Moral, Ample, Responsive and Transparent i.e. in short VERY SMART processes are called E-governance. So for these system data should deliver speedy, space efficient, cost effective and secure way among other governments and its citizens.

This paper proposes a signed transmission scheme using standard RSA Digital Signature with implemented version of MD5 algorithm to ensure Message Integrity, Privacy, Nonrepudiation and Authenticity.

Keywords : E-governance, RSA, Message integrity ,Digital Signature, Privacy, MD5.

GJCST Classification: D.4.6



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## A Study on Efficient Digital Signature Scheme for E-Governance Security

Nikhilesh Barik $^{\alpha}$  & Dr. Sunil Karforma $^{\sigma}$ 

*Abstract* - E-governance is the latest technological trend in the governance process all over the world whose application attribute can be Variety, Embedded, Rapidly, Year-round ,Simple, Moral, Ample, Responsive and Transparent i.e. in short VERY SMART processes are called E-governance. So for these system data should deliver speedy, space efficient, cost effective and secure way among other governments and its citizens.

This paper proposes a signed transmission scheme using standard RSA Digital Signature with implemented version of MD5 algorithm to ensure Message Integrity, Privacy, Non-repudiation and Authenticity.

*Keywords* : *E*-governance, *RSA*, *Message* integrity, *Digital Signature, Privacy, MD5*.

### I. INTRUDUCTION

long with the development of Internet, the Egovernance [8] has become a new pattern of activity for any Government. Almost all electronic transaction system used in E-governance needs a secure communication channel between the client and the server. During any type of these transaction ,we should involve a suitable cryptographic algorithm like RSA, DES, Elgamal, ECC etc. using Digital Signature (DS) where integrity, privacy, and non-repudiation can be imposed. Digital Signature works on the principle of public key cryptography[9]. Public key cryptography is based on a concept of key pairs, private key and public key. Public and private keys are nothing but large prime numbers generated by mathematical algorithms. The key pairs are used for both signing and encrypting the message. Public key helps to prove unequivocally that you are who you claim to be. The reliability of Digital Signature is same as that of a paper document with hand written Signature.

Now many of the government setting up the core infrastructure and policies to implement a number projects for their nation and state related to G2G concern like Income Tax filling, Banking Services, Provident Fund status ,passport & visa information ,Voter Id, National citizen card status, insurance & risk management ,pension plan status, details members of legislative, assembly and parliament ,trade license key or agreement, pan card verification, etc.

In E-governance[5] large amount of packets would be transferred between Government to Government using internet which is unsecure and time consuming. Intruders can change the information according to their requirements. So to ensure speedy communication and reduce the unauthorized access through information and communication technologies(ICT), it is required to use some techniques impose data Integrity, Privacy and Authenticity which must maintained with less communication costs using available bandwidth.

Section 2 describes Framework for signed G2G model. In section 3, proposed techniques has been discussed, Section 4 represents analyses of the proposed technique and implementation area. Section 5 draws a conclusion followed by references.

### II. FRAME WORK OF SIGNED G2G MODEL

G2G model implies simulations of Government to Government [5] services electronically. It can also be



Figure 1: Simple model of G2G.

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referred to electronic transaction between two or more governments, central to its states/provinces or one country to other,etc. It can be used to vertical and horizontal Governmental integration.

G2G is the online non-commercial So interaction between two Government organizations, two departments of a Government organization.

Following block diagram shows the proposed scheme using Digital Signature to ensure Authenticity in anv G2G model [1].

Compute Message Digest (H) Encrypt the message Digest (H) E-GOV over Original Message to compute Digital Signature DS Sender data (M) м Original Message M Received M1\_DS and signature DS by Send by INTERNET Receiver Govt Sender Govt RECEIVER GOVERNMENT Decrypt the Digital Signature DS Start verification Compute Message Digest (H2) with Received over Message (MI) with same to, compute H1 Message MI and Message Digest Algorithm Signature DS YES NO Proceed with Discard the Is Sender Gov Message H1=H2? data Ml

SENDER GOVERNMENT

Figure 2: Block Diagram of Digital Signature application to ensure Authenticity in any G2G model.

#### **PROPOSED SCHEME** III.

Here Digital Signature [10] should be imposed by the sender government and Digital Signature should be verified by Receiver government in reality. First the message is hashed into a message digest. Using this hashed value a Signer (government) digitally signs (encrypt) the message (transaction) using his private key. This DS is attached to the original message and send by the sender Government.

After receiving the message, the receiver has to use the sender's public key to decrypt (we can say design) the message digest and to ensures integrity authenticity. Confidentiality is achieved by comparing designed message and message digest using same algorithm used. As in an electronic transaction system an intruder should not be able to find out what transaction a particular user is executing if confidentiality is properly maintained. If the hash values of sender and receiver are equal, it serves to prove that the message

has not been tampered. With changing even one letter in the message, the hash value would be changed. Hence message integrity is assured.

Non-repudiation is the cryptographic term describing the situation when the originator of a message cannot deny having sent it. Non-repudiation prevents from denying previous commitments or transactions from an entity.



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a) Use Of Cryptographic Hash Implemented Version Of Md-5.



*Figure 3* : Sample Output By Implemented Version Of Md-5 Hash.

Cryptographic hash function [6] will be used to verify the integrity of the data i.e. to ensure that the message has not been tampered with after it leaves the sender Government but before it reaches the receiver Government. So we perform the hash operations (some time called message digest algorithm) over a block of encrypted data to produce its hash, which is smaller in size than the original message[9,1].

Implemented Version of MD5 follows the all properties of standard hash function [2]. So when it operates on encrypted message M ,lt returns a fixed-length hash value H. So that H = MD5(M).

No two messages produce the same message digest, otherwise message integrity violates. We are using Implemented Version of MD5 which performs better with respect to the standard MD-5 algorithm. Though standard output is generated and displayed in the above diagram but This Implemented Version of MD5 can be customize according to the requirements of the user. Here is the performance chart of Implemented Version of MD5 over standard MD5 for a certain hardware system.



*Figure 4 :* Comparative study of time consumed (in ms) to create message digest by Implemented Version of MD5 and standard Java MD-5

- i. All methods and classes are made final .
- ii. Used System arraycopy for copying data into array.
- iii. Pre-computed the String lengths and stored.
- iv. Manually Implemented of the getHexString() Method.
- v. Restructuring all the loops [4].

### b) Digital Signature

Digital Signature [10] is one of the major development in network security . The need for Digital Signature has arisen with the rapid growth of digital Signature communications. А Digital algorithm authenticates the integrity of the signed data and identity of the signatory. Authentication in a Digital Signature is a process whereby the receiver of a digital message can be confident of the identity of the sender and/or the integrity of the message. RSA encryption is guite slow because of large key size and modular exponentiation operations that have to be used to ensure security. For the same reason, RSA's Digital Signature is slow as well [7]. The length of transmitted Signature equals the length of transmitted message. In other words longer the message, the longer the Digital Signature. So, the proposed scheme uses Secure Hash Algorithm[11] (MD5) to obtain condensed version of message, which will go as input for RSA Digital Signatures algorithm as shown in Figure-2. Properties like pre image resistant & collision resistant and the signing algorithm should sign on the message digest, rather than the original message are also maintained in this implemented version of MD5.

#### c) Hashed Rsa Digital Signature Generation Algorithm Digital signing with RSA is roughly equivalent to encrypting with a private key. Basically, the Sender Government employee computes a message digest, then encrypts the value with his private key. The Receiver Government employee also computes the digest and decrypts the signed value, comparing the two. Of course, the verifier has to have the valid public key for the entity whose Signature is to be verified, which means that the public key needs to be validated by

some trusted third party or transmitted over a secure medium such as an authenticated courier.

Digital signing works because only the person with the correct private key will produce a "Signature" that decrypts to the correct result. An attacker cannot use the public key to come up with a correct encrypted value that would authenticate properly.

The RSA public-key cryptosystem can be used to authenticate another person. In general, the RSA algorithm is usually smaller than the private exponent . This means that verification of a Signature is faster than signing. This is desirable because a message will be signed by an individual only once, but the Signature may be verified many times. To make it faster modified Hashed-RSA Algorithm is presented as following. This algorithm takes Implemented Version of MD5 hashed data instead of plaintext.

The RSA scheme was the first implementation of public key cryptography. Let  $(\alpha, n)$ ,  $(\beta, n)$  be the public and private key of a RSA cryptosystem. The Signature on the message is computes as follows:

Step 1. Sender Government uses Implemented Version of MD5 message digest algorithm to calculate H over message M, i.e H = MD5(M).

**Step 2.** Now Sender Government once again encrypt the message digest H by the Private-key ( $\alpha$ ) of the sender Government to produce Digital Signature DS i.e. DS= (H)  $^{\alpha}$  mod n

**Step 3.** Now Sender Government send the original message M along with the Digital Signature DS to the receiver government.

d) Hashed Rsa Digital Signature Verification Algorithm The verification process is just reverse of Signature generation process. At the receiver end we have signed message which contains RSA encrypted key and Digital Signatures.

**Step 1.** Receiver Government uses same message digest algorithm Implemented Version of MD5 to calculate another message digest H2 over received message M1, i.e H2 = MD5 (M1).

Step 2. Now receiver Government uses sender government's the public key ( $\beta$ ) to decrypt Digital Signature DS i.e. H1 = (DS)<sup> $\beta$ </sup> mod n

**Step 3.** Now receiver Government compare H1 and H2 .This failure of matching implies that document is not authentic or a possible computation error has occurred otherwise receiver government received correct and unaltered message from sender government.

### IV. ANALYZING THE PROPOSED TECHNIQUE

As there is general lack of awareness regarding the benefits of E-Governance as well as the process involved in implementing successful G2G (or G2G2G) projects, the administrative structure is not geared for

storing and retrieving maintaining, governance information electronically and transactions are be made in non secured way. So day by day corruption is increasing from different ends. The privacy of each user and system data is of crucial importance for E-Governance system that meets user expectations and acceptance. Now a days each Government sector move away from paper documents with ink Signatures or authenticity stamps, Digital Signatures can provide added assurances of the evidence to provenance, identity, and status of an electronic document as well as acknowledging informed consent and approval by a signatory.

Some e-Governance projects can be implemented by this concept are :

- i. **E-district** : Objective is to divide all states by edistrict so that one actual district can have minimum one maximum any number of e-district with e-DM to run the every policy related to egovernance like e-Seva, which is already implemented in states like Andhra Pradesh and Rajasthan in India.
- ii. **E-Tourism Card** : Any state /country can provide this card with duration so that any tourist can buy /issue this card for visit every tourist spot of that state/country.
- iii. **E-Pay** : Every government should pay the monthly weight age (salary ) by net banking though this have been implemented by many employer privately.
- iv. **E-Coordination** : An application package is required to maintain all documents of very close interaction between the government department and the agency developing the solutions.
- v. **E-Suggestion** : A team must require to understand and accept all suggestions from every end and forward those to proper places.
- vi. **E-Health Card** : Government can provide this card to poor people for their health checkup in all district government hospitals.
- vii. **E-Voting Card :** Any kind of decision where voting is required for different places of state or country can use this card.

Also the United States Government Printing Office publishes electronic versions of the budget, public and private laws, and congressional bills with Digital Signatures. Universities including Penn State, University of Chicago, and Stanford are publishing electronic student transcripts with Digital Signatures.

### v. Conclusion

The importance of high confidence is require for any kind of transmission of data in various department of any government sector and it is obvious in case of administrative decision and financial context. Also in many scenarios the sender Government and receiver Government may have a need to show their higher authority that the message has not been altered during transmission. In this paper, we have proposed asymmetric encryption with Digital Signature to maintain data integrity customize hash function. The result will be more efficient when someone apply dual Digital Signature. VERY SMART concept is more applicable by ECDSA instead of RSA Digital Signature.

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### Fixed and Variable Size Text Based Message Mapping Techniques Using ECC

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*Abstract* - Elliptic Curve Cryptography recently gained a lot of attention in industry. The principal attraction of ECC compared to RSA is that it offers equal security for a smaller bit size, thereby reducing processing overhead. ECC is ideal for constrained environment such as pager, PDAs, cellular phones and smart cards. ECC Encryption and Decryption methods can only encrypt and decrypt a point on the curve and not messages. This paper presents the implementation of mapping of text message into multiple points on Elliptic Curve with an Initial Vector (IV) using ECC. Further it also includes the transformation of fixed and variable size word in source text on to Elliptic Curve. These proposed methods enhance the security of ECC with multi fold encryption.

Keywords : Elliptic Curve Cryptography, finite fields, Smart Cards, public key cryptography, discrete logarithm.

GJCST Classification: G.2, B.6, E.3, C.3



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## Fixed and Variable Size Text Based Message Mapping Techniques Using ECC

Jayabhaskar Muthukuru <sup>a</sup> & Prof. Bachala Sathyanarayana <sup>o</sup>

Abstract - Elliptic Curve Cryptography recently gained a lot of attention in industry. The principal attraction of ECC compared to RSA is that it offers equal security for a smaller bit size, thereby reducing processing overhead. ECC is ideal for constrained environment such as pager, PDAs, cellular phones and smart cards. ECC Encryption and Decryption methods can only encrypt and decrypt a point on the curve and not messages. This paper presents the implementation of mapping of text message into multiple points on Elliptic Curve with an Initial Vector (IV) using ECC. Further it also includes the transformation of fixed and variable size word in source text on to Elliptic Curve. These proposed methods enhance the security of ECC with multi fold encryption.

*Keywords : Elliptic Curve Cryptography, finite fields,Smart Cards, public key cryptography, discrete logarithm.* 

### I. INTRODUCTION

liptic curve cryptography was independently proposed by Koblitz and Miller in 1985[1]. Unlike standard public-key methods that operate over integer fields, the elliptic curve cryptosystems operate over points on an elliptic curve. Similar to other Public Key encryption techniques, the security level of ECC also depends on the sizes of the keys used. The sizes of the cryptographic keys can be decided considering the following points [4].

- The approximate duration for which the information requires to be kept secure.
- The allowable level of impracticability of an attack to be carried out.
- The advancements in the computational resources, which are available to the attackers.
- The progress in the area of cryptanalysis.

Cryptographic algorithms based on discrete logarithm problem can be efficiently implemented using elliptic curves [2].

Elliptic curve cryptography is emerging as an attractive public-key cryptosystem for resource constrained devices like smart cards because compared to traditional cryptosystems like RSA/DH, it

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Author <sup>°</sup> : Professor, Department of Computer Science & Technology, Sri Krishnadevaraya University. Ananthapur, A.P. India. E -mail : bachalasatya@yahoo.com offers equivalent security with smaller key sizes, faster computation, lower power consumption, as well as memory and bandwidth savings [3].

### II. ELLIPTIC CURVE ARITHMETIC

Elliptic curves are not like an ellipse or curve in shape. They look similar to doughnuts. Geometrically speaking they somehow resemble the shape of torus, which is the product of two circles when projected in three-dimensional coordinates. ECC makes use of elliptic curves in which the variables and coefficients are restricted to elements of a finite field. There are two families of elliptic curves defined for use in cryptography: prime curves defined over odd prime field  $F_P$  and binary curves defined over Galois field  $GF(2^m)$ .

#### a) Geometrical Definition Of Point Addition And Point Doubling Using Chord-And-Tangent Rule

For any two points  $P(x_1, y_1) \neq Q(x_2, y_2)$  on an elliptic curve, EC group law point addition can be defined geometrically (Figure 1) as: "If we draw a line through P and Q, this line will intersect the elliptic curve at a third point (-R). The reflection of this point about x-axis,  $R(x_3, y_3)$  is the addition of P and Q".



*Fig. 1.* Addition: R=P+Q

For P=Q, point doubling, geometrically (Figure 2) if we draw a tangent line at point P, this line intersects elliptic curve at a point (-R). Then, R is the reflection of this point about x-axis.



Fig.2. Doubling: R=P+P

#### b) Point Multiplication

The dominant operation in ECC cryptographic schemes is point multiplication. This is the operation which is the key to the use of elliptic curves for asymmetric cryptography---the critical operation which is itself fairly simple, but whose inverse (the elliptic curve discrete logarithm) is very difficult. ECC arranges itself so that when you wish to performance operation the cryptosystem should make easy encrypting a message with the public key, decrypting it with the private key the operation you are performing is point multiplication. Scalar multiplication of a point P by a scalar k as being performed by repeated point addition and point doubling for example 7P = (2((2P) + P) + P).

### c) Elliptic Curve Over $F_P$ And $F_2^m$

Definition of elliptic curve over  $F_P$  as follows [5]. Let p be a prime in  $F_P$  and a,  $b \in F_P$  such that  $4a^3 + 27b^2 \neq 0 \mod p$  in  $F_P$ , then an elliptic curve E ( $F_P$ ) is defined as

$$E(F_P) := \{ p(x, y) , x, y \in F_P \}$$

Such that  $y^2 = x^3 + ax + b \mod p$  together with a point O, called the point at infinity. Below is the definition of addition of points P and Q on the elliptic curve E (F<sub>p</sub>). Let P(x<sub>1</sub>, y<sub>1</sub>) and Q(x<sub>2</sub>, y<sub>2</sub>) then

$$R=P+Q= \left\{ \begin{array}{ll} O & \text{ If } x_1=x_2 \text{ and } y_2=-y_1 \\ \\ Q=Q+P & \text{ If } P=O \\ \\ (x_3,y_3) & \text{ otherwise} \end{array} \right.$$

Where

$$x_{3} = \begin{cases} \lambda^{2} - x_{1} - x_{2} & \text{If P} \neq \pm Q \text{ (Point Addition)} \\ \\ \lambda^{2} - 2x_{1} & \text{If P} = Q \text{ (Point Doubling)} \\ \\ y_{3} = \lambda(x_{1} - x_{3}) - y_{1}, \text{ and} \end{cases}$$

$$\lambda = \begin{cases} \frac{y_2 - y_1}{x_2 - x_1} & \text{If P} \neq \pm Q \text{ (Point Addition)} \\ \\ \frac{3x_1^2 + a}{2y_1} & \text{If P} = Q \text{ (Point Doubling)} \end{cases}$$

The point p(x, -y) is said to be the negation of p(x, y).

The elliptic curves over  $F_2^m$  is defined as follows.

Denote the (non-super singular) elliptic curve over  $F_2^m$  by E ( $F_2^m$ ). If a, b  $\in F_2^m$  such that b  $\neq 0$  then

$$E(F_2^m) = \{p(x, y), x, y \in F_2^m\}$$

such that  $y^2 + xy = x^3 + ax^2 + b \in F_P^m$  together with a point O, called the point at infinity.

The addition of points on E  $(F_2^m)$  is given as follows: Let P(x<sub>1</sub>, y<sub>1</sub>) and Q(x<sub>2</sub>, y<sub>2</sub>) be points on the elliptic curve E(F<sub>2</sub><sup>m</sup>), then

$$R = P + Q = \begin{cases} O & \text{ If } x_1 = x_2 \text{ and } y_2 = -y_1 \\ Q = Q + P & \text{ If } P = O \\ (x_3, y_3) & \text{ otherwise} \end{cases}$$

Where

$$x_{3} = \begin{cases} \lambda^{2} + \lambda + x_{2} + x_{1} + a & \text{If } P \neq \pm Q \text{ (Point Addition)} \\ \\ \lambda^{2} + \lambda + a & \text{If } P = Q \text{ (Point Doubling)} \end{cases}$$
$$y_{3} = \lambda (x_{1} + x_{3}) + x_{3} + y_{1}$$

and

$$\lambda = \begin{cases} \frac{y_2 + y_1}{x_2 + x_1} & \text{If } P \neq \pm Q \text{ (Point Addition)} \\ \\ x_1 + \frac{x_1}{y_1} & \text{If } P = Q \text{ (Point Doubling)} \end{cases}$$

### III. ELLIPTIC CURVE CRYPTOGRAPHY

Elliptic curve cryptosystems over finite field have some advantages like the key size can be much smaller compared to other cryptosystems like RSA, Diffie-Hellman since only exponential-time attack is known so far if the curve is carefully chosen [5] [1] and Elliptic Curve Cryptography relies on the difficulty of solving the Elliptic Curve Discrete Logarithm Problem ECDLP, which states that, "Given an elliptic curve E defined over a finite field  $F_P$ , a point  $P \in E$  ( $F_P$ ) of order n, and a point  $Q \in E$  ( $F_P$ ), find the integer k  $\in$  [0,n –1] such that Q = k P. The integer k is called the discrete logarithm of Q to the base P, denoted k =  $log_PQ$ ".

### a) Elliptic Curve Encryption/Decryption

Consider a message 'Pmt' sent from A to B. 'A' chooses a random positive integer 'k', a private key 'n<sub>A</sub>' and generates the public key  $P_A = n_A \times G$  and produces the cipher text 'Cm' consisting of pair of points Cm = { kG , Pmt + kP<sub>B</sub> } where G is the base point selected on the Elliptic Curve,  $P_B = n_B \times G$  is the public key of B with private key 'n<sub>B</sub>'.

To decrypt the cipher text, B multiplies the 1st point in the pair by B's secret & subtracts the result from the 2nd point Pmt +  $kP_B - n_B(kG) = Pmt + k(n_BG) - n_B(kG) = Pmt$ 

### IV. PROPOSED MAPPING METHODS

The proposed method the text message could be represented with all 256 symbols included in the standard ASCII codes.

#### a) Fixed Length Block Mapping Technique

In ECC the computation basically consists of an affine point Pm(x, y). This point and Base point (G) may represent the same point or both may be different. Base point implies it has the smallest (x, y) co-ordinates, which satisfy the EC. Following are the mapping algorithm for fixed length block message.

Notation : m - Message

8	
IV - Initial Vector	
K - Block Size	
G - Base point	
Pmt - Transformed point	
Cm - Cipher text	
AT - ASCII Value of the text	
Encryption Algorithm :	
Step 1: Begin	
Step 2: $n = m/k$	
Step 3: XORed_str = IV	
Step 4: for $i = 1$ to n	
Step 4.1: XORed str = XORed str ⊕ Block[i]	
Step 4.2: AT = ASCII(XORed str) //ASCII value of	of
XORed_str in base 256 format	
Step 4.3: Pmt = AT * Pm	
Step 4.4: $Cm[i] = \{ kG, Pmt + kP_B \} //Pmt$ encrypte	d

using ECC (Presented in section II)

Step5: End.

Decryption Algorithm: Step1: Begin Step 2: XORed\_str = IV Step 3: for i = 1 to n Step 3.1: Pmt = Pmt +  $k(n_BG) - n_B(kG)$  // get Pmt using private key  $n_B$  (Presented in section II) Step 3.2: Get Pm, AT //Calculate these values from Pmt using discrete logarithm Step 3.3: XORed\_str = Text(AT ) //generate string using AT which is in base 256 format Step 3.4: Decrypt\_block[i] = XORed\_str  $\oplus$  Block[i] Step 3.5: XORed\_str = Block[i] Step 4: End

#### b) Variable Length Block Mapping Technique

In this mapping technique we consider each word as a block and null characters are padded to IV or message block if their lengths are not same. The other encoding and decoding techniques are same as fixed length block mapping technique.

### v. Implementation of Proposed Method

The typical Elliptic Curve is represented by:

 $y^2 = x^3 + 3x - 3 \pmod{1386491}$ 

The base point G is selected as (1, 1). Base point implies that it has the smallest (x, y) co-ordinates which satisfy the EC.

### a) Fixed Length Block Mapping Implementation

Under fixed length block implementation we have implemented for single character block and two characters block and presented the results.

For single character block mapping results shown in table 1 and their graphical representation is shown in Fig.3, Fig.4 and Fig.4 for the plaintext message "A#2AAZ"

For two characters block mapping results shown in table.2 and their graphical representation is shown in Fig.6, Fig.7 and Fig.8 for the plaintext message "Aa@\$59Aa@\$"

Plaintext			
Block	Mapping Point	Encrypted Point	Decrypted Point
А	(845227, 1303111)	(612399, 1262010)	(845227, 1303111)
#	(824245, 1138831)	(520953, 403024)	(824245, 1138831)
2	(867657, 460591)	(591611, 904819)	(867657, 460591)
А	(603452, 158814)	(725362, 106713)	(603452, 158814)
A	(867657, 460591)	(591611, 904819)	(867657, 460591)
7	(1255016, 1103602)	(19218, 623927)	(1255016, 1103602)

*Table 1:* Mapping points for plaintext "A#2AAZ" and IV = "2"



#### Table 2: Mapping points for plaintext "Aa@\$59Aa@\$" and IV = "24"

Plaintext Block	Mapping Point	Encrypted Point	Decrypted Point
Aa	(503400, 797492)	(1378250, 715061)	(503400, 797492)
@\$	(978908, 708756)	(153590, 704662)	(978908, 708756)
59	(1085662, 709747)	(756400, 1273838)	(1085662, 709747)
Aa	(1202808, 1273936)	(1204937, 625801)	(1202808, 1273936)
@\$	(41405, 1007904)	(436269, 1049661)	(41405, 1007904)



Variable Length Block Mapping Implementation b)

Under variable length block implementation we have implemented for one word block presented the results.

Mapping results shown in table 3 and their graphical representation is shown in Fig.9, Fig.10 and Fig.11 for the plaintext message "A to Z 1 to 10 ! to )"

Plaintext Block	Mapping Point	Encrypted Point	Decrypted Point
А	(1143751, 1132381)	(1269235, 391778)	(1143751, 1132381)
to	(84586, 283729)	(1353127, 582406)	(84586, 283729)
Z	(321420, 867260)	(699790, 1214960)	(321420, 867260)
1	(988208, 942508)	(453764, 347504)	(988208, 942508)
to	(802250, 650335)	(672017, 694990)	(802250, 650335)
10	(416579, 1085820)	(4704, 95182)	(416579, 1085820)
!	(257086, 28323)	(1279171, 987239)	(257086, 28323)
to	(589667, 1090547)	(1356372, 1172684)	(589667, 1090547)
)	(680970, 712757)	(1345141, 1117444)	(680970, 712757)





If a block of message using same mapping point from plaintext to cipher text throughout encrypted message[6][8] then It is easy to decipher using substitution ciphers with frequency analysis because the simple mappings preserve letter frequencies of the plaintext message[7]. The main disadvantage of the existing methods [6] [8] is attacker need not require private key of the receiver when attacker uses letter frequency attack to decipher plaintext message. In proposed mapping methods if a block of message is repeated then every time it maps to different points. So it is difficult to decipher using uses letter frequency analysis. It hides letter frequencies of the plaintext message.

### VI. CONCLUSION

This paper presented a method to embed the message blocks in point form before using Elliptic Curve Cryptosystem. The modified scheme is believed to be secure because it involves multi fold encryption. Even security is needed to protect data during their transmission also, as there are many people hiding in the cyber space who have the inclination skills to steal from both individuals and corporations. In the proposed methods if a block of message is repeated then every time it maps to different points. Proposed methods strengthen the cryptosystem, i.e., for an intruder it would be very difficult to guess on which points the message blocks are mapped and it hides letter frequencies of the plaintext message.

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### **Cleaning Robot**

### By Nikita Prashar, Tejashree Thorat, Abhishek Galande & Ritesh Durande

Pune University

*Abstract* - A new service robot designed for cleaning tasks in home environments is introduced. System has three subsystems: electrical, software and mechanical of which microcontroller, sensors (opponent and light) and motor are the electrical and mechanical subsystems respectively and the software subsystem is the brain of the robot.

The cleaning robot uses a microcontroller to detect obstacles and manipulates its direction as per the inputs . It is programmed to accept inputs to sense obstacles around it and control the robot to avoid any collisions. In case of an obstacle, or a potential collision, the microcontroller controls the wheels of the robot by a motor driver to avoid collision. The vacuum cleaner at the bottom of the robot performs the cleaning process.

Keywords : Service Robot, Odometric Correction, Path estimation, Microcontroller.

GJCST Classification: 1.2.9



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## **Cleaning Robot**

### Nikita Prashar<sup> $\alpha$ </sup>, Tejashree Thorat<sup> $\sigma$ </sup>, Abhishek Galande<sup> $\rho$ </sup>, Ritesh Durande <sup> $\omega$ </sup>

*Abstract* - A new service robot designed for cleaning tasks in home environments is introduced. System has three subsystems: electrical, software and mechanical of which microcontroller, sensors (opponent and light) and motor are the electrical and mechanical subsystems respectively and the software subsystem is the brain of the robot.

The cleaning robot uses a microcontroller to detect obstacles and manipulates its direction as per the inputs. It is programmed to accept inputs to sense obstacles around it and control the robot to avoid any collisions. In case of an obstacle, or a potential collision, the microcontroller controls the wheels of the robot by a motor driver to avoid collision. The vacuum cleaner at the bottom of the robot performs the cleaning process.

*Keywords : Service Robot, Odometric Correction, Path estimation, Microcontroller.* 

#### I. INTRODUCTION

One of the basic requirements at household is cleaning which is an iterative process and required on daily basis consuming both time and energy. Cleaning Robot is an approach to make cleaning an easy and time efficient task also to give comfort to the human by doing the domestic works. The functions of a Cleaning Robot are: 1) Detecting the position of the area to is cleaned 2) Path estimation to reach that position 3) Cleaning the area with the help of Vacuum Cleaner which is attached to it.

### II. SYSTEM OVERVIEW

The concept of this system is shown in *Fig. 1.* A camera is set in the ceiling of the room which is to be cleaned in a position in which it can have a complete view of the floor. Then, camera takes images of the floor and transmits them to the user's PC display. Next, the user is provided with two modes of cleaning a) Automatic Mode in which Robot automatically detects the dust and cleans it and b) Manual Mode in which user can select a desired position to be cleaned by clicking on it on the image being generated on the screen. In automatic mode the first the position of the robot is estimated and then the destination position i.e. area to be cleaned is calculated. Then, clicked

coordinates are forwarded to the robot, and the robot moves to the location and cleans the dust. Moreover, it is possible to avoid robot approaching certain places one can predefine the areas where robot should restrict its movement. As web cameras became cheap, the installation cost is low.

When the robot moves in the indoor environment, there are plenty of obstacles around the robot making difficult to find and measure landmarks for correcting position. This system calculates a relative position of the robot by using the camera fixed to the ceiling. As a result, the position and posture can be measured and corrected. Odometric Correction is used for avoiding error free movement.



*Fig 1.* Room with the cleaning robot and ceiling mounted camera.

### III. SYSTEM STRUCTURE

#### a) Clean Assist\_ The Cleaning Robot

CLEAN ASSIST is an integrated Robot, a basic working robot is created and at the bottom of which a vacuum cleaner is attached which would suck the dust and clean the area.

#### b) Web Camera

Web camera with resolution 5 megapixel has been used for capturing the images and videos of the room to be cleaned

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### IV. System Working

First of all the snap of the clean room is captured and saved for reference in the secondary storage in the monitor. The camera keeps capturing images continuously and Gaussian blur algorithm is applied to reduce the noise in the captured image after that if any change is encountered with respect to the reference image then blob algorithm is applied to detect points or regions in the image that are either brighter or darker than the surrounding that will be the dust which has to be cleaned as it is done with reference to the snap of the clean room already captured.



a. Image Captured

b. Cluster Detection

Image captured

*Fig 2.* Blob Algorithm.



Original Image



*Blur Image Fig 2.* Gaussian Blur Algorithm.

Now the monitor does the geometric transformation of the coordinates and then determines the shortest path between the robot and the garbage by locating the current position of the robot and the

garbage and then calculating the distance between them. *Fig. 2.* Shows the basic concept of how cleaning takes place. Robot moves to the desired area and sucks the garbage using vacuum cleaner and makes a record of clean and unclean area and stores it in the secondary storage.



Fig 2. Concept of house cleaning.

### V. APPLICATIONS

#### a) Cleaning

The robot can easily navigate an area using the camera which is mounted on the roof and with the help of the vacuum cleaner attached to it clean the room.

#### b) Defense

The robot can keep a check on trespassers in an restricted area on an event of any movement can raise an alarm to alert the forces

#### c) Autonomous Playing Robot

The robot can sense the movement and hence can be modified to play games in which an object has to be traced or a ball ca be followed.

#### d) Security

It can provide security as it constantly captures the images and videos and can sense movements; it can be used to raise an alarm in case an unwanted movement is noticed.

### VI. CONCLUSIONS

The implementation of Clean Robot will provide quick clean-up of spills and concentrated messes and it will be easy to use. Following are the advantages of the above system:

a) Reach Remote Areas – It can clean in areas with hazardous environments; areas beyond the reach of humans as could be fatal.

- b) Availability 24\*7 A machine can be used anytime and anywhere, it does not get tired and is never busy.
- c) Cost Reduction Saves on labour costs and time, as a single machine can do the work of multiple labourers in lesser time.
- d) Record Maintained Maintains a log of cleaned and un clean area in the secondary storage.

### VII. ACKNOWLEDGMENT

The completion of this paper on **"Cleaning Robot"** has given immense pleasure and knowledge. We are sincerely thankful to Principal Dr R.D. Kanphade, Prof. P.D Ganjewar (HOD-COMP & IT), guide Prof. Umesh Talware who have cooperated with us at different stages during the preparation of this paper.

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### Management of Business Process & Database for Power Utilities

### By Utkarsh Seetha & Rajneesh Gupta

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*Abstract* - Through this study we would like to underline the particulars of the IT System and business process requirements of IT Package need to be architected for better understanding of ongoing business in power utilities. This research details the requirements need to be addressed for better synchronization within current system and the upcoming IT solution.

The objective of this research includes the study of current ongoing business process of power utilities and understands the business and administrative impact due to the IT system inclusion. This study will show the existing business process and how the current process will work in the forthcoming IT environment.

Keywords : Rapdrp, Utilities, Nc, Rc, Dc, Pdc, Gis, Mdas, Iams, Ea, Mis, Eam

GJCST Classification: H.2



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### Management of Business Process & Database for Power Utilities

Utkarsh Seetha<sup>a</sup> & Rajneesh Gupta<sup>o</sup>

Keywords : Rapdrp, Utilities, Nc, Rc, Dc, Pdc, Gis, Mdas, Iams, Ea, Mis, Eam

#### I. OBJECTIVE

hrough this study we would like to underline the particulars of the IT System and business process requirements of IT Package need to be architected for better understanding of ongoing business in power utilities. This research details the requirements need to be addressed for better synchronization within current system and the upcoming IT solution.

The objective of this research includes the study of current ongoing business process of power utilities and understands the business and administrative impact due to the IT system inclusion. This study will show the existing business process and how the current process will work in the forthcoming IT environment.

#### II. OVERALL SOLUTION DESCRIPTION

The overall solution describes the required software modules need to be installed to run the business process for the purpose of the Subdivision Automation of State Electricity Departments in respect to the business functionality. This solution covers the functionality as mentioned and required in the Document as this is an advanced engineered office management tool. It is developed to manage all types of useful databases, analyzes them by applying standard concepts and implement them in a manner consistent with its purpose or design the logic of electrical engineering and subdivision level management in a modernize way.

After a deep study of RAPDRP requirements and the difficulties of DISCOMs, our research has suggested the solution with additional amenities. DISCOMs related business functionality would be customized in the product on the base of the Document.

The business process solution has the capability to integrate with other Process Applications as per the requirement captured in system study and suggested by Document. The integration architecture of

BPA solution is based on SOA (Service Oriented Architecture) and due to this it is easily mapped with the integration middleware for exposing the business functionality to external systems as well as to consuming the business functionality of external systems and other future needs which will be fulfilled by the installed hardware, networking equipments and storage devices for coming decades.

#### Features :

- Point to Point mapping of all ongoing business
  process
- Flawless Integration of all Functions
- Increase business Operational Efficiency
- Business Process Streamlining
- Enhance Customer Service
- Business Assessment Support for Strategic Issues
- Business Revenue Augmentation
- Process Scalability, Flexibility for future application integration

#### III. RESEARCH SCOPE

The scope of this research will not limited to the study of current business process but also give suggestions and recommendations on how to improve the productivity, scalability, reliability and flexibility with the use of Information Technology in Utility business.

#### IV. IMPLEMENTATION MYTHOLOGY

This research will study following business process of the power utilities and suggesting/Providing the solution for all :

- Meter Data Acquisition
- Energy Audit

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- New Connection
- Disconnection & Dismantling
- GIS based customer Indexing and asset mapping
  - GIS based integrated network analysis module
- Centralized Customer Care Services
- Management Information System (MIS)
- Web Self Service
- Identity and Access Management system
- System Security Requirement
- Development of Commercial Database of Consumers
- Metering

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- Billing
- Collections

- Asset Management
- Maintenance Management

### During the study of the above listed modules we have segregated all of them into the following categories for better understanding of business process:

Solution Offerings	Solution\System Features and Strengths
Field / Subdivision Automation	<ul> <li>Billing and collection</li> <li>New Connection/ Disconnection / Load Extension</li> <li>Electrical System Augmentation</li> <li>Power Network Control</li> <li>Store &amp; Inventory</li> <li>Meter Management</li> <li>Vigilance &amp; Enforcement</li> <li>Revenue Section</li> <li>Energy Audit</li> <li>Consumer Grievance</li> </ul>
Advanced/ Smart Metering Infrastructure	<ul> <li>Two way Communication</li> <li>Real Time Meter status, tamper detection, Energy Audit</li> <li>Event based Remote disconnect function</li> <li>Load Cycling and Load limiting functions</li> <li>Capability of time of use of tariff</li> <li>In built Pre Paid System</li> <li>Monitoring of Automatic Outages and its restoration</li> <li>Integration with complete IT Infrastructure</li> <li>Contribution in building Smart Grids.</li> </ul>
AMR/ LT SCADA	<ul> <li>GPRS based devices that are highly reliable in terms of scalability and performance</li> <li>Identification of suspected cases for theft or pilferage.</li> <li>Remote switching (ON/OFF) of the consumers supply through centralized SCADA software</li> <li>Monitoring of captive diesel generator sets consumption and operating hours, load patterns and other important parameters</li> <li>Comparison of consumption of two sources of supply to monitor any unauthorized electricity extraction, etc</li> <li>Monitor Captive Power generation utilization by industrial customers.</li> </ul>
Energy Audit Services	<ul> <li>Addresses High AT &amp; C Losses and Poor Network infrastructure.</li> <li>Based on field proven methodologies supported with Industry wide benchmarking.</li> <li>IT based powerful tools to handle huge Databases and extract the useful information to review at all levels of utility.</li> <li>Data Security, integrity remains intact with reliable security features.</li> <li>Data Analysis supported by BEE certified Energy Auditors.</li> <li>Service Model that minimizes the investment required by the Utility.</li> <li>Hierarchical accounting for performance tracking of Electrical System &amp; Geographical Administrative Hierarchies.</li> <li>Coverage of entire Power System Network</li> </ul>
Integrated Energy Management	<ul> <li>Capture detailed near real-time consumption data for each energy-consuming process</li> <li>Transmits data efficiently</li> <li>Storage of data in a secure, centralized warehouse</li> <li>Providing analytic and operational functionality that can forecast peaks and control processes based on this analysis.</li> </ul>
Sub Station set up/ Distribution Automation	<ul> <li>Technology and products from a very old firm that played vital role in America's rural electrification in last 60-70 years.</li> <li>Highly reliable, line mounted products that creates self healing networks, save land requirements, manpower &amp; cost that helps in fast rural electrification.</li> <li>Enable Discoms to release high voltage industrial connections with huge saving in costs.</li> </ul>

#### V. APPLICATION SOLUTION OVERVIEW

Following solution has come up during the initial system study:



#### VI. NEW CONNECTION

#### Objective:

The proposed system should serve the prospective consumers to avail the electricity supply from the Utility. At present, applicants register their requests in concerned Sub-Division for New Connection at their premises.

The proposed system should aim at enhancing the customer's convenience, when an application for new connection is received. It should enable the customer to collect, submit applications, and deposit the demand amount at Consumer Section. The system should enable updating customer data to be captured in the GIS based customer indexing database in a reliable way. The system should ensure validates and checks whether the integrity of this data is maintained. Revenue Section should release the New Connection after completing all required activities, and send the consumer data for billing. This module should also check the customer record with existing consumer records (i.e. Defaulters and disconnected consumers). New Connection module should have integration with various set of services, some them may be common with other module :

- 1. GIS Based application for Feasibility Checking, VR Map & Report Generation
- 2. Asset Management for issuing and receiving meter/item from the Store
- 3. Billing application to generate new consumer's electricity bill

# VII. DISCONNECTION & DISMANTLING

#### Objective:

This Module aims at improving recovery through a disciplined disconnection and dismantling mechanism that serves as a deterrent for defaulters.

It is capable of generating the defaulter consumer's list; i.e. the consumers who do not make their bill payment by the due date or the date on which list is generated, whichever is later. This module also generates the disconnection notices list automatically as per utility defined criteria, and dispatches disconnection notices to consumer via email. It is also capable of registering disconnection request made by consumer. Finally it updates the consumer status, which may affect the consumer's next billing.

This module should have integration with following applications:

- 1. Dismantling Module provides the dismantling information for New Connection Module
- 2. Asset Management for receiving the items/meter.
- 3. Billing Application to generate the final bill.
- 4. GIS Application for updating dismantling information in GIS Database.

#### VIII. MANAGEMENT INFORMATION System (Mis)

#### Objective:

The main objective of MIS system is to have mainly two modes of Reporting

Basic Internal Reporting – The system must provide basic low-cost, integrated reporting that does not require administration, external processors or external storage. Both real time reports and historical reports are required. Historical reports must be available for hourly or half hourly intervals. The proposed system must be capable of displaying reports on a video display terminal in real time or emailing them.

Custom Reporting - Fast, easy creation of custom reports from scratch is required as is modification of existing reports to customize them for reporting purposes. Report customization must include the ability to create custom data items and define custom calculations.

#### IX. WEB SELF SERVICE

#### Objective:

The goal is to provide a high quality experience for the customers and business associates that will provide them a user friendly portal that will make it easy for them to communicate with the utility though the web instead of direct phone calls or visits. This portal will also act as a source of information for the customers regarding policies and procedures. This in turn will improve customer satisfaction and reduce work load on the employees.

Web Self Service should provide the facility to the consumer to register complaints or lodge grievances himself online by creating his username. This facility should enable the consumers to get the access to the personalized form of application, where they can themselves lodge complaints and grievances, and get access to the varied useful information.

This application should enable the consumer to register no-current complaints and grievances themselves. The user should be able to view all the personal information including his account number. The user should be able to view the details of all the Energy Bill payments made by him, his current bill, the information of complaints lodged by him in this application or lodged at CRM or at Customer Care Center for him. The user should be able to view the duplicate copy of his Current Bill, this can also be printed.

This application should have integration with following applications:

- 1. CRM Application for processing of complaints and grievances.
- 2. Customer Care Center for processing the complaints and viewing grievances.
- 3. Billing Application for viewing and printing of Duplicate Bills.

#### X. IDENTITY AND ACCESS Management System

#### Objective:

Utilities are envisaging an enterprise level Identity and Access Management System which has features of Adapter/Connector Support, Access Rights Capabilities and Access Control and other key features like Mechanism to essentially allow or deny specified user IDs to access other key feature envisaged in the system are:

The Identity and access management solution shall support two factor authentications (Biometrics, tokens etc.) The solution shall have feature to generate reports in the lines of ISO 27001 standard. The solution shall provide secure environment for transmitting Information across the Internet. The Access Management solution should be capable of running on web servers as well as application servers.

#### XI. SYSTEM SECURITY REQUIREMENT

The system must be capable of generating log trails, which contain details about any read / write access to sensitive data. Details must relate activity to an identifiable person. They must be configurable, so that filters and switches can be used to lower performance overheads and focus on areas of concern. It is important that the audit trail that is generated contain enough information to support after-the fact investigation of loss or impropriety.

#### XII. DEVELOPMENT OF Commercial Database of Consumers

Database Migration and Data Store Creation has the structured process in which commercial data available in the DISCOMs, asset data and the data captured from GIS survey would be considered. The Data Migration and Data Store creation process follows the flow as illustrated in the diagram:



The Commercial Data Creation is done by using the existing Automated Data as well as for some cases it is done by using the approach of Data Punching. For the purpose of the Data Punching, Application provides the interfaces which internally create the commercial data in the same manner in which the Automated Process does.

As shown in the diagram the Data Migration and Data Store creation process has the following steps:

- 1. Initially before starting the GIS Survey work, existing commercial data will be taken from the discom for the particular town/location for which GIS Survey has to be done. The migrated existing data will be delivered to the GIS Survey Team for the Survey purpose.
- 2. After the completion of the GIS Survey work, GIS Survey Team will provide the Survey Data to the Data Migration Team which will update the migrated data (Data prepared in Step.1). The GIS Survey Team will provide the Commercial, Technical and Asset Data.
- 3. In the final step, the Data Migration Team will define a cut over date in consultation of the discom for the first billing from the IT Package for the particular Town/Location. At this time, Discom will again provide the Commercial Data which will be used for final data update

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# Training Need Analysis & Methodology for Using IT in Power Utility

### By Utkarsh Seetha

Singhania University

*Abstract* - The global competition and swiftness of changes emphasize the importance of human capital within organizations, as well as the swiftness and ways of knowledge gaining of that capital. In the economy where uncertainty is the only certainty, knowledge is becoming a reliable source of sustained competitive advantage. Knowledge is becoming basic capital and the trigger of development. Previously built on foundations of possessing specific resources and low costs, present day competition is based on knowledge possessing and efficient knowledge management. Modern organizations therefore use their resources (money, time, energy, information, etc.) for permanent training and advancement of their employees. Organizations which are constantly creating new knowledge, extending it through the entire organization and implementing it quickly inside the new technologies, develop good products and excellent services.

GJCST Classification: C.0,H.5.2



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## Training Need Analysis & Methodology for Using IT in Power Utility

Utkarsh Seetha

#### Abstract - Bpa, Itia, Pfc, Mdas, Erp

#### I. INTRODUCTION

he global competition and swiftness of changes emphasize the importance of human capital within organizations, as well as the swiftness and ways of knowledge gaining of that capital. In the economy where uncertainty is the only certainty, knowledge is becoming a reliable source of sustained competitive advantage. Knowledge is becoming basic capital and the trigger of development. Previously built on foundations of possessing specific resources and low costs, present day competition is based on knowledge possessing and efficient knowledge management. Modern organizations therefore use their resources (money, time, energy, permanent training information, etc.) for and advancement of their employees. Organizations which are constantly creating new knowledge, extending it through the entire organization and implementing it quickly inside the new technologies, develop good products and excellent services.

Understanding the phenomenon of employee training requires understanding of all the changes that take place as a result of learning. As the generator of new knowledge, employee training is placed within a broader strategic context of global organizational management, as a planned staff education and development, both individual and group, with the goal to benefit both the organization and employees.

Thus, the continuous employee training has a significant role in the development of individual and organizational performance.

#### II. OBJECTIVE

In this research we will find out the current strength and knowledge of the utility employees for adopting the new IT system. This will be done through Training Need Analysis (TNA).

After TNA we will focused on the survey results. Based on the results we will develop the most adoptable and suitable training methodology which will help employees to adopt the change management and includes proper Knowledge Transfer (KT) for all the project areas.. This research details the project requirements, which are to be met by the applications and interfaces required between different hardware and software systems.

The objective of this research includes the software solution, availability, readiness for metering, billing, collection (MBC) and several other business processes of the utilities.

#### III. PURPOSE OF THIS RESEARCH

This research is intended to accomplish the requirements for the RAPDRP project in terms of

- a) Training Need
- b) Objective of the Training
- c) Benefits of the Training
- d) Training Approach & Methodology
- e) Delivery Implementation and
- f) Training Impact Analysis.

This research will give a comprehensive step by step guidance, approach and methodology toward training for the Discom users over newly implemented IT system.

This training module covers 87 towns comprising of 185 Sub Division offices of Rajasthan Electricity Distribution Companies of RAPDRP area and Non-APDRP areas that constitute 24 circles with their respective Sub-divisions and other offices

#### IV. TNA (TRAINING NEED ANALYSIS)

Training is a learning process that involves the acquisition of knowledge, sharpening of skills, concepts, rules, or changing of attitudes and behaviors to enhance the performance of existing system.

The purpose of training needs is to identify performance requirements or needs within an existing system in order to help direct resources to the areas of greatest need, those that closely relate to fulfilling the organizational goals and objectives, improving productivity and business processes



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Author <sup>a</sup> : Restructured Power Development and Reforms Programme Current Department/Project

The needs assessment is the first step in the establishment of a training and development Program. It is used as the foundation for determining instructional objectives, the selection and design of instructional programs, the implementation of the programs and the evaluation of the training provided. These processes form a continuous cycle which always begins with a needs assessment.

In order to improve upon the business processes, resolve the bottlenecks of the existing system to ensure end to end visibility of each and every process, the Department has embarked on a key initiative aimed at the establishment of Systems and Processes to provide simplified, convenient, anytime and anywhere services to various stakeholders. In addition, the there is a need to increase the focus of the Department's staff on developing core competence and enhancing their performance standards so that the system will be self sustained in coming years.

#### V. SCOPE OF THE TRAINING ACTIVITY

As per SRS and RFP of Power Finance Corporation, the training activity is divided into two categories:

- Core team training
- End user training

The Detailed training structure will be as follows:



#### VI. CORE GROUP TRAINING

This is the training for the core group of implementation team of the Discom. The Discoms team will comprise of members from all the Business Functions and IT. Each member would be trained in the relevant function/module. This Training would be required to be given to approximately 9-12 personnel of Discom.

- Certified Functional, Technical, System administration and Database management training for core team of Discom will be arranged by ITIA and OEMs.
- The training has to be conducted using official OEM curriculum mapped with the applications to be implemented in the Discom.
- The Training will be conducted at the Data Center of JVVNL Discom.
- The Training will be conducted by the Instructors of ITIA and OEMs

The Core team training activity further divided into two parts:

- Functional Training
- Technical Training

(li) - Database Training

#### VII. FUNCTIONAL TRAINING

Functional Training will be given by ITIA BPA team and Partners.

S.No.	Training	Team	Modules	Stage
01	Functional Training	Core Functional Team Members	As per the Application, Documents provided by the ITIA	Before Implementation Contiguous training during implementation Handholding during post "Go Live" Stage

#### VIII. TECHNICAL TRAINING

Technical Training activity further divided into two parts: (i) - System Administration Training

Technical Training will be given by ITIA team and  $\ensuremath{\mathsf{OEMs}}$ 

(i) - System Administration Training

S.No.	Training	Team	Modules	Stage
01	System Administration	Core Team Members (ERP	As per the Application,	Before Implementation Contiguous training
		Application Administrators)	Documents provided by the ITIA	during implementation Handholding during post "Go Live" Stage

(ii) - Database Training

S.No.	Training	Team	Modules	Stage
01	Database Administration	Database Administrators (IT System Group)	As per the Application, Documents provided by the ITIA	Before Implementation Contiguous training during implementation Handholding during post "Go Live" Stage

#### IX. TRAIN THE TRAINER (DISCOM Master Trainer Training)

This is also known as "End User" Training. ITIA will provide training to group of teams on a "Train the Trainer" basis. ITIA will train the group of trainers called "Master Trainer" which will then train all of the Discoms end user.

- As per the SRS and RFP, ITIA will train approx 900 Discom Trainers "Master Trainers" (300 per Discom)
- Each Discoms Master Trainer will further impart the training down the line
- These Discoms Master Trainers are champions and from all the business areas.
- To train these Master Trainers, ITIA will conduct Train the Training workshops.
- The workshop will be conducted at CCC of the Discom

Train the trainer workshop/training activity further divided into two parts:

- Basic Computer Training
- Role Base Training

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# Effort Distribution in COTS Components Integration: A Simulation Based Approach

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*Abstract* - Component Based Development lays emphasis upon composing software from pre-existing commercially off the shelf (COTS) components. Component repositories are searched for the existing components according to requirement specifications and then components are integrated in the system. Though all the components are important for the success of a Component Based Software, some of them may be more important than others. While distributing the cost, efforts, time and other resources, starting from component requirement specification to component integration, we need to differentiate between more and somewhat less important components and distribute the resources accordingly. In this paper we have developed a simulator for identifying the critical components in a component based system for optimum distribution of the resources while integrating the components in the system. This simulator can be used to plan the distribution of available resources in a better way. This will help to overcome the problems of cost and time overrun while integrating and deploying components in a Component Based System (CBS).

Keywords : Component Based Software, COTS, Simulation, Component Integration and Deployment, Erlang

GJCST Classification: I.6 , I.6.8



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### Effort Distribution in COTS Components Integration: A Simulation Based Approach

P K Suri<sup> a</sup> & Sandeep Kumar<sup> o</sup>

Abstract - Component Based Development lays emphasis upon composing software from pre-existing commercially off the shelf (COTS) components. Component repositories are searched for the existing components according to requirement specifications and then components are integrated in the system. Though all the components are important for the success of a Component Based Software, some of them may be more important than others. While distributing the cost, efforts, time and other resources, starting from component requirement specification to component integration, we need to differentiate between more and somewhat less important components and distribute the resources accordingly. In this paper we have developed a simulator for identifying the critical components in a component based system for optimum distribution of the resources while integrating the components in the system. This simulator can be used to plan the distribution of available resources in a better way. This will help to overcome the problems of cost and time overrun while integrating and deploying components in a Component Based System (CBS). Component Based Software, Keywords COTS,

Simulation, Component Integration and Deployment, Erlang

#### I. INTRODUCTION

A lthough Component Based Software Engineering is new paradigm in software engineering, it may be likened to traditional engineering branches like civil or mechanical engineering, where emphasis is not laid on developing as such; rather it is on designing and composing. Almost similar approach is followed by the Component based software engineering where instead of developing the application from scratch, predeveloped and pre-tested black box components are integratedtogether to compose a new software. Due to this reasonthese black box components are also known as Commercially–Off-The-Shelf (COTS) components [1]. This is so because they are developed by someone else and used by someone else. Every component has some clearly defined interfaces.

Through these interfaces it takes services from other components and provides services to other components. This give and take of the service by

components is called interaction [2]among components. But before the components can interact with each other, they must be integrated together. Process of integrating the components in a component based system is not as easy and straightforward as it seems to be. Existing components may be part of some other applications. From there they are collected into component repositories. Depending upon the requirements of the current application, component repositories are searched for the required components. Different components may be found in different repositories. Then these components are integrated together to compose a new application. This process is shown in fig.1.

So developing Component Based Software does not mean developing everything afresh. One thing that is very important here is that sometimes it may happen that no component satisfying the user requirements is found in any of the component repositories; in that case we may have to develop a new component. Although developing a new component follows the usual procedure of developing any software module, here wewill assume that we don't need to develop any new components, rather we have all the required components in one or the other repositories and we only need to identify and search them according to our requirements and then integrate them in the system. Finding a component that meets the user requirements in itself is a tedious task and involves many activities. Composing existing components to form a new application follow certain predefined procedure. This procedure consists of many steps [3], [4], [5], [6]. Although different researchers have given different models of composing component based software, there are certain things where almost all of them agree upon.

There are following six broad activities that are essential for component integration:

- a) Component Requirement Specification
- b) Component Requirement Review
- c) Component Identification and Selection
- d) Component Adaptation
- e) Component Integration
- f) Component Deployment

A brief description of these activities is given below.

a) Component Requirement Specification This isconcerned with providing a formal

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documented consensus regarding the requirements, scope and boundaries of a software component [15]. It is important to document customer's vision of the component after analyzing the customer requirements. Depending upon the customer's requirements, an existing component may be reused or may be adapted deployment review the requirements thoroughly[14]. In this phase all the component related requirements are reviewed by stakeholders.

#### c) Component Identification and Selection

Success of a Component Based Software depends a lot upon our ability to select a suitable component according to user requirements [8], [9], [10], [11]. This selection and identification process involves four steps [4]: Search, Screen, Evaluate and for reuse. In the worst case a new component may have to be developed. This is a very important phase



Fig. 1. Storage and Searching of COTS Components

because quality of the component selected and ability of the component to perform a specified task depends upon how well the requirements have been understood and documented.

#### b) Component Requirement Review

Every software component has a clearly specified functionality. Conceptual Design of a component and its functional requirements are specified in component requirement specification document. It is very important that requirements specified in this document are complete, adequate, without any ambiguity, feasible to implement and consistent with the intended component. To avoid any problems related with these attributes, it is important that all the parties' involved in component selection, integration and Analyse. The search process may give a list of many candidate components and it becomes very important to select best suited component. One such technique of component selection is given by Suri et al in [12].

#### d) Component Adaptation

All the components that have been selected using the Component integration and selection process may have been developed using different platforms, by different teams of people for different applications. So it is very important that component services are provided through a standard published interface so that components are able to interoperate. Practically it is quite difficult to find a software component that can fulfill the hundred per-cent user requirements. So it becomes very important to adapt the component for the present application. Rine et al [13]have proposed the use of adapters to adapt the components according to present application.

#### e) Component Integration

Next job is to integrate the components so that they can interact with each other. Vigder [16]identified three important components of the component integration. These are: Wrappers, Glue and Component Tailoring. Through wrappers, underlying components are isolated from other components in the system. Glue provides the functionality to combine the components and through Component Tailoring, functional ability of a component is enhanced. Testing and validation are also part of the component integration process. Components may have been tested earlier but it is very important to test them for the present application too. Generally internal structure of a component is not known so most appropriate for testing the components is Black Box Testing[1],[17], [18]. Also it is very difficult to test all the components when number of components in the system is very large. This search space can be reduced using a technique proposed by Suri and Kumar[19].

#### f) Component Deployment

According toNing[20], deployment involves packaging components so that they can connect, disconnect and reconnect at runtime. A tool called packager is proposed for the purpose.

#### II. PROBLEM STATEMENT

Each component based system may consist of hundreds to thousands of components. These components are developed using different technologies on different platforms. Depending upon the user requirements, component libraries are searched for the suitable components. Once suitable components are found, they are integrated or composed to create the system. While integrating these components in a Component Based System (CBS), we need to put in efforts and resources in each step or activity that leads to component integration. All components of a CBS are not equally important. So that the available resources, time, efforts can be utilized optimally, it is important that a plan of the schedule of component integration be prepared. This plan must contain the details of the efforts, may be in person-hours, to be put in various component integration activities. There are certain components that are heavily loaded as compared to other components because they need to be accessed more frequently for getting some job done. For example the initial component, that provides an interface to the user for the input, is accessed every time user has to work on the system. Similarly, the component that get output to the user is also accessed each time user needs an output. There may be other components in the systems that are not accessed so frequently. It is very important to identify these critical components so that they can be allotted more time and efforts. Identifying such components is the main theme of this paper.

#### III. PROPOSED SIMULATION MODEL

Here a Component Based System is represented with the help of an activity network. The network consists of nodes and edges. Nodes in the network represent the individual components of the system. Edges represent the flow of execution between various components. An edge from component C<sub>i</sub> to component C<sub>i</sub> represents an interface link ('provide' or 'gets' interface) from C<sub>i</sub> to C<sub>i</sub>. Many components in sequence starting from the first component and terminating into the last component make an interfaces path. To achieve an artifact result, execution starts from the first component that provides a user interface. The control keeps transferring from one component to another, through interface links. When a component is integrated in the CBS, six activities: Component Requirement Specification, Component Requirement Review, Component identification and selection, Component Adaptation, Component Integration and Component Deployment are to be performed, in that order. These activities are stochastic in nature because time taken by each of these activities and efforts required in fulfilling these activities are distributed exponentially. If we assume that on average, each of these six activities take constant efforts (sav  $\beta$ ), then effort required for integrating and deploying a component is governed by Erlang-6 distribution [24]. Because if there are k independent stochastic random variables  $v_1$ ,  $v_2$ ,  $v_3$ ,...., $v_k$ , having same exponential distribution.

 $f(v_i) = \mu k e^{\mu k v}$  given that  $v_i > 0$ ;  $\mu > 0$  and k is a positive integer, then  $V = \sum v_i$  is governed by Erlang distribution.

So all six stochastic variables so obtained are composed using above formula and then weight so obtained is assigned to the corresponding component. Weight assigned to a component is distributed equally among all interface links terminating into that component node. This weight computed is governed by Erlang-6 distribution. Because efforts required for integrating each component are stochastic and not deterministic in nature, it will be erroneous to assume single effort estimate for the each component's integration. Due to stochastic nature of the component integration efforts, we take three types of effort estimates as

- Minimum Effort Estimate (E<sub>min</sub>): The minimum possible efforts required for integrating the component. We will require minimum efforts if everything goes well, there are no employee switchover, and no new requirements, no conflicting requirements and we are in an ideal situation.
- Maximum Effort Estimate (E<sub>max</sub>): The maximum possible efforts required for integrating the component. This is the effort requirement when everything goes bad.
- Normal Effort Estimate (E<sub>nor</sub>): This is the effort required if the component is integrated under normal circumstances. All practical problems that may arise have been considered.

Taking these three types of efforts into

consideration following may hold true for Mean Efforts Required (µ) and Standard Deviation ( $\sigma$ )

Mean of Efforts ( $\mu$ ) = ( $E_{min}$  + 4\* $E_{nor}$  +  $E_{max}$ )/6 Standard Deviation ( $\sigma$ ) = ( $E_{max} - E_{min}$ )/6 Variance = ( $\sigma$ )<sup>2</sup>

## IV. WHY SIMULATION FOR THIS PROBLEM

Each activity of component integration process is stochastic in nature. As we have assumed that efforts required in performing each activity follow beta distribution, it is possible to identify the critical components along one interface path. But sometimes results given by this process may be wrong. In many cases we can assume that efforts required are available in the form of a discrete or continuous frequency distribution. In some cases in addition to the components along critical interface path there may be other components that are near critical and are also important and need a fair share of the time and efforts. In this case total efforts required along near critical path may be slightly less than the critical path, but quite possible that may have happened because the variance along the near critical path is slightly more than the critical path. So it is important that near critical path is also tested because if we run the simulator for many number of times, then near critical components may also sometimes become critical. This is why simulation as a tool has been used for identifying the critical components.

#### V. ASSUMPTIONS

Following assumptions have been made for the proposed simulation model :

- Each node of the network represents a component.
- Directed edge from component C<sub>i</sub> to component C<sub>j</sub> means that a 'provides' and/or 'gets' relationship exist between these two components.
- Integrating each component involve six phases (component requirement specification, component requirement review, component identification and selection, Component Adaptation, Component Integration, Component Deployment).
- Effort required in carrying out each of these phases is constant and exponentially distributed.
- Effort required in integrating and deploying each component is governed by Erlang-6 distribution.
- All the components (nodes) are assigned numbers in topological order according to Fulkerson's i-j rule[23].
- Any execution in the CBS starts with the first component that provides an interface to the user and terminates with nth interface that provides the

final output interface. In between many components are accessed along different interface paths.

- Each component is assigned a weight which is effort required in integrating corresponding component.
- All the interface links terminating into a component node are assigned the equal weight. This weight is equal to the weight assigned to the component towards which these links are directed/ number of components.
- Total weight W is the sum of all link weights along a path and represents the total efforts required in integrating all the components along that path.
- Path with maximum total weight is a critical path and all the components that fall along that path are critical components. All the interface links along this path are also critical interface links.

#### VI. NOTATIONS

ORIGIN[]:		Array containing originating
		component number of all the
		execution links.
TERMINAL[]:		Array containing terminating
		component number of all the
		execution links.
S :		Starting or First Component of the
		CBS.
F :		Finishing or Last component of the
		CBS
ORIGIN[i]:		Originating (tail end) Component of
		link i.
TERMINAL[i]	:	Terminating (head end) Component
		of link i.
WT[i]	:	Array containing weights assigned
		to all the interface links.
LSW[i]	:	Least cumulative starting weight of
		link i.
LTW[i]	:	Least cumulative terminating weight
		of link i
MSW[i]	:	Most cumulative starting weight of
		link i.
MTW[i]	:	Most cumulative terminating weight
		of link i.
MinCW[i]	:	Minimum weight that can be
		assigned to component i.
		5
MaxCW[j]	:	Maximum weight that can be
		assigned to component j.
M :		Number of components in the CBS.
N :		Number of interface links in the
		system.
Crit_M[j]:		Criticality index of the jth component
Crit_N[i] :		Criticality index of the ithinterface
		link.

#### VII. ALGORITHM DESCRIPTION

One of the most important question that arises during the effort and resource allocation is that which are the components and interfaces in the system that are most important for the overall working of the system, so that they can be allocated efforts and resources in bulk. These are the components and interfaces that fall along the path that has got the maximum weight of all possible paths. This path is called the critical path and components and interfaces along that path are called critical components and critical links respectively. Pseudo code below in this section describes the process to find the critical components and interfaces. In this process first we move in the forward direction in the network of components. While moving in the forward direction we compute the least cumulative terminating weights of all the links by adding link weights to their least cumulative starting weights. At the end of the forward process we compute the minimum weight that can be assigned to the Mth component (output interface component). Next we traverse the network in backward direction finding most cumulative starting weight of each link by using most cumulative terminating weight and link weights. The procedure is describes as follows:

- Initially assign weights to all the interfaces or execution links. These weights are generated using a random number generator. Samples so generated follow Erlang-6 distribution. Theseweights are stored in the array WT[i], for i = I to N.
- 2. Traverse the component network in forward direction.
- a. Set the minimum component weight MinCW[j] for all components ( j = 1 to M) to zero.
- b. Each component node may have many execution links terminating into it. Once all the execution links enter into the present component, compute the minimum component weight. This is equal to the maximum of the weights of all the execution links entering into that component node. Call it MinCW[j] for the jth component. By definition MinCW[1] is zero.

This process is repeated for all combinations of links and components and finally minimum component weight of last component i.e. Mth component is computed. Call it MinCW[M]. Assign this to W (this is sum of weights of all components along that path).

- 3. Traverse the component network in backward direction.
- Assign the minimum component weight computed in step 2 to the last component of the network, call it MaxCW[M] = W. This weight is also assigned as maximum terminating cumulative weight of all links terminating into Mth component i.e. MTW[all execution links terminating into M] = MaxCW[M].

Moving further maximum starting weight of link N is computed as MSW[N] = MTW[N] - WT[M].

- Moving further backwards, maximum starting cumulative weight of each execution link is computed as MSW[i] = MTW[i] - WT[i].
- c. Next, maximum weight that can be assigned to a component 'j' is computed. Call it MaxCW[j]
- d. Compute maximum terminating weight MTW of all the links starting from component j. They are assigned the value MaxCW[j].

All the components for which MaxCW = MinCW, are critical components and form a critical path. Similarly all the interface links that are part of this critical path are critical interface links. This algorithm is repeated many times, each time for a different set of random weights assigned to the execution links. This is done to accommodate the error element, E. Due to this error sometimes, components that may have remained near critical in some previous run, may become critical in some other simulation runs. This way we can find out how many times a particular component and interface link becomes critical. More number of times a component becomes critical, more efforts we need to put in while integrating this component in the system to safeguard our system from failure. Same is true for interface links too. Formally the algorithm is described in fig.2.

#### VIII. CASE STUDIES

#### a) Case Study 1

We experimented with the simulator developed in C Language over Window 7.0 Platform using DosBox0.73. Two case studies for experiment were conducted. In the first case study, a CBS consisting of 8 components was considered. The execution flow through interface links of the CBS is shown in figure 3. There are a total of 11 interface links and 8 components in this system. Each component in the system is integrated using six steps described above. Each interface link connects two components. At the tail end of the interface is the originating component and at the head end is terminating component. The details about originating components, terminating components and criticality indices of each interface link are given in table 1. Table 2 contains the information about criticality indices of the components. This information is also depicted in graphs in fig. 4 and fig. 5 respectively.

#### b) Case Study 2

For the second case study, we have taken a CBS with eight component nodes and 13 interface links. The graphic representation of the system is shown in fig 5. Table 3 contains information about the originating and terminating component of each interface link and also the criticality indices of the interface links after the simulation run are performed 1000 times. Table 4 contains the criticality indices of different components

for 1000 simulation runs. Criticality indices of interface links and components are also depicted in fig. 6 and fig.7 respectively.

1.	Input the values for RUNS, N, M, E and Populate
arra	ys ORIGIN[] and TERMINAL[] accordingly.
2.	for $i = 1$ to N (Set Crit E[i] = 0)
З.	for $j = 1$ to M (Set Crit_E[j] = 0)
4.	for $x = 1$ to RUNS repeat steps 5 to 9 in step of 1.
5.	fori = 1 to N (Generate random variants and store
	them in array WT[i]).
6.	Start forward pass
	a. Set MinCW[1] = 0
	b. Compute MinCW for all component
	nodes as follows
	i. LSW[i] = MinCW of the node at
	tail end
	ii. $LTW[i] = LSW[i] + WT[i]$
	iii. MinCW[j] = max{LTW(all
	interface links terminating into
	component node j)}
7.	Start Backward Pass
	a. Assume MaxCW[M] = MinCW[M]
	(MinCW[M] was computed in forward
	pass).
	b. fori = I to N (MTW [i] = MaxCW of the
	node at head end).
	c. $MSW[i] = MTW[i] - WT[i]$
	d. Compute MaxCW for all component
	nodes (except last node, M) as follows
	MaxCW[j] = min {MSW(all links
	originating from component j)}
8.	Update Criticality index of interface links
	If $(MSW[i] - LSW[i] \le E$ (Increment
~	Cri_E[i] by 1)
9.	
	If $(MaxCW[J] - MinCW[J] \le E$ (Increment
10	for $I = I$ to N (Print Crit F[i])
11	for $i = 1$ to M (Print Crit C[i])
12	Stop
•	p.

Fig.2. Algorithm for finding Critical components and Interface Links



#### Fig. 3. CBS Component Network 1

Interface Link	Originating Component	Terminating Component	Mean Weigh (Efforts)	Standard Deviation	Criticality Index
A	1	2	μ1	σ1	.912
В	1	3	μ2	σ2	.260
С	2	3	μЗ	σ3	.610
D	1	4	μ4	σ4	.912
E	3	5	μ5	σ5	.958
F	4	5	μ6	σ6	.610
G	4	6	μ7	σ7	.000
Н	5	7	μ8	σ8	.502
I	5	6	μ9	σ9	.499
J	6	8	μ10	σ 10	.500
K	7	8	μ11	σ 11	.502

Table 1. Originating Component, Terminating Component and Criticality Indices of Interface Links.

Component	Criticality Index
1	1.0
2	.912
3	.938
4	.061
5	1.0
6	.500
7	.629
8	1.0

Table 2. Component Criticality Indices







Fig.5. Graph of Criticality Indices of Components



Interface Link	Originating Component	Terminating Component	Mean Weigh (Efforts)	Standard Deviation	Criticality Index
A	1	2	μ1	σ1	.970
В	1	4	μ2	σ2	.026
С	2	3	μЗ	σ3	.031
D	2	4	μ4	σ4	.918
E	2	5	μ5	σ5	.021
F	3	7	μ6	σ6	.031
G	4	5	μ7	σ7	.940
Н	4	6	μ8	σ8	.004
I	5	6	μ9	σ9	.469
J	5	7	<i>μ</i> 10	σ 10	.491
K	5	8	µ11	σ 11	.004
L	6	8	µ12	σ 12	.474
М	7	8	µ13	σ 13	.523

Table 3. Originating Component, Terminating Component and Criticality Indices of Interface Links.

Component	Criticality Index
1	1.0
2	.970
3	.031
4	.944
5	.964
6	.474
7	.523
8	1.0

Table 4. Component Criticality Indices



Fig.7. Graph of Criticality Indices of Interface Links



#### IX. DISCUSSION AND CONCLUSION

З

4

Component Number

5

6

7

8

2

1

0

From above discussed case studies 1 and 2 important conclusions were drawn. In the first case study it was found that interface links A, D and E are the most critical interface links. These links provide interfaces between components 1-2, 1-4 and 3-5 respectively. Links C (2-3) and F (4-5) are also important but not as important as A,D and E. Interface Link G (4-5) is the least critical link. Out of 8 Components of the CBS Components 1,2,3,5 and 8 are most critical and we should allocate most of the resources and efforts while integrating and deploying these components in the system. Similarly in case study 2, we found that interface links A (1-2), D (2-4) and G (4-5) are the most critical ones and H (4-6) and K (5-8) are the least critical. As far as components are concerned, components 1,2,4,5,8 are the most important for the overall success of the system and a good number of efforts must be put in while integrating them.

So as we saw this simulator can be a handy tool for the project team that has to decide on how much efforts, time and cost should be put in while specification and review of requirements and identification, selection, adaptation, integration and deployment of the different components in a component bases system.

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### Iteration Based Risk Tracker Evolutionary Algorithm with Component Based Development

### By Dr.S.Murali Krishna & Saroj Kumar Gupta

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*Abstract* - This paper presents a component based development (CBD) model for each iteration of software development. Risk management is a major part of software planning and risk tracking is one of the important functions of risk management and without proper tracking, it is quite difficult to control risk. Software industry is more deeply in recent years about it. From the beginning of the development to the end of the development assessing the software quality and assurance of software quality become an important, with this regards in this proposed paper a novel evolutionary algorithm is used for a feasible solution.

Keywords : TELOS, Risk Analysis, Risk Tracker, CBD.

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### Iteration Based Risk Tracker Evolutionary Algorithm with Component Based Development

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#### INTRODUCTION I.

n the last two decades, constrained optimization problems (COPs) have received much attention by most researchers and practitioners. The models for most real-world applications are established in the form of constraints imposed upon the objective function. In General, most of constraint handling techniques previously discussed will inevitably solve two important problems: (1) how to generate the feasible solutions, (2) how to direct the search to find the optimal feasible solution. And Risk management is also a major part of software planning and risk tracking is one of the important functions of risk management. Without proper risk tracking, it is quite difficult to control risk while developing any software. A component based model is presented for recognizing the characteristics of diverse information extracted from solutions. Simultaneously in the component based model, the interrelationship between each dimensional component (i.e. decision variable) of solution and constraints is revealed. A novel measurement of feasibility is defined[1]. Different from traditional measurement, the definition in this research paper is only related to a component of solution along with risk occurred during development phase and risk tracking is one of the proposed solution in this paper. The feasibility of components is measured so as to direct which component needs to be transformed at a lower cost.

designed to determine the difficulty in carrying out a

designated task. Generally, a feasibility study precedes technical development and project implementation. In other words, a feasibility study is an evaluation or analysis of the potential impact of a proposed project. Five common factors (TELOS)

FEASIBILITY FACTOR (TELOS)

A feasibility study is an evaluation of a proposal

#### Technology and System Feasibility a)

The assessment is based on an outline design of the system requirements in terms of Input, Processes, Output, Fields, Programs, and Procedures. This can be quantified in terms of volumes of data, trends, frequency of updating, etc. in order to estimate whether the new system will perform adequately or not. Technological Five common factors (TELOS)

#### b) Technology and System Feasibility

The assessment is based on an outline design of the system requirements in terms of Input, Processes, Output, Fields, Programs, and Procedures. This can be quantified in terms of volumes of data, trends, frequency of updating, etc. in order to estimate whether the new system will perform adequately or not. Technological feasibility is carried out to determine whether the company has the capability, in terms of software, hardware, personnel and expertise, to handle the completion of the project.

#### c) Economic Feasibility

Economic analysis is the most frequently used method for evaluating the effectiveness of a new system. More commonly known as cost/benefit analysis, the procedure is to determine the benefits and savings that are expected from a candidate system and compare them with costs. If benefits outweigh costs, then the decision is made to design and implement the system. An entrepreneur must accurately weigh the cost versus benefits before taking an action. Cost Based Study: It is important to identify cost and benefit factors, which can be categorized as follows: (1) Development costs; and (2) Operating costs. This is an analysis of the costs to be incurred in the system and the benefits derivable out of the system. Time Based Study: This is an analysis of the time required to achieve a return on investments and the benefits derive from the system. The future value of a project is also a factor.

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#### d) Legal Feasibility

Determines whether the proposed system conflicts with legal requirements, e.g. a data processing system must comply with the local Data Protection Acts.

#### e) Operational Feasibility

Is a measure of how well a proposed system solves the problems, and takes advantages of the opportunities identified during scope definition and how it satisfies the requirements identified in the requirements analysis phase of system development.

#### f) Schedule Feasibility

A project will fail if it takes too long to be completed before it is useful. Typically this means estimating how long the system will take to weaknesses of the waterfall model. It starts with an initial planning and ends with deployment with the cyclic interaction in between. The iterative and incremental development is an essential part of the Rational Unified Process, the Dynamic Systems Development Method, Extreme Programming and generally the agile software development frameworks[2][3].

#### III. ITERATIVE DEVELOPMENT

Iterative development slices the deliverable business value (system functionality) into iterations. In each iteration a slice of functionality is delivered through cross-discipline work, starting from the model requirements through to the testing deployment.



Fig. 1. Iterative cyclic software development process

The unified process groups Iterations into phases: Inception, Elaboration, Construction, and Transition.

- Inception identifies project scope, risks, and requirements (functional and non-functional) at a high level but in enough detail that work can be estimated.
- Elaboration delivers a working architecture that mitigates the top risks and fulfills the non-functional requirements.

- Construction incrementally fills-in the architecture with production-ready code produced from analysis, design, implementation, and testing of the functional requirements.
- Transition delivers the system into the production operating environment.



Fig. 2. Iterative software development

#### IV. RISK ANALYSIS AND TRACKER

In development process risk analysis and management is a major part of software planning and risk tracking is one of the important functions of risk management without proper tracking, it is quite difficult to control risk. In this proposed model software risk tracking is an important function of software risk management. It is not sufficient to identify risk, prioritize them, generate risk plan and provide assessment about probability of risk but it is important to track them for controlling. So a strategy is proposed to development using risk tracking Pareto Distribution[4]. Risk tracking diagram is given below.

In development process risk analysis and management is a major part of software planning and risk tracking is one of the important functions of risk management without proper tracking, it is quite difficult to control risk. In this proposed model software risk tracking is an important function of software risk management. It is not sufficient to identify risk, prioritize them, generate risk plan and provide assessment about probability of risk but it is important to track them for controlling. So a strategy is proposed to development using risk tracking Pareto Distribution[4]. Risk tracking diagram is given below.



#### Fig 3. Risk Tracking

During data collection about the risk, top nine risks which effect the development of software are identified.

- 1. Business Domain,
- 2. Communication,
- 3. Customer,
- 4. Environmental/Natural cause,
- 5. Project Management,
- 6. People/ HR,
- 7. Quality Process,
- 8. Technology,
- 9. Infrastructure.

Algorithm steps for development of software risk tracker (*Risk tracker Algorithm*)

- 1. Input the data related to different risk type and categorized them into different classes.
- 2. Check the severity of risk based on risk description, it may be low, medium, high or very high.
- Determine impact and Loss Expected (LE). It is calculated in rupees in terms of impact and their consequences. This may be one time of low impact, two times of medium, three times of high and four times of very high risk. LE = impact\* 10K consequences Rs.
- 4. Now rank risk from 1 to 5 on the basis of highest to lower LE using Pareto Distribution. This will ranks the risk on the basis of LE.
- 5. Plot the bar chart of risk and their LE which considers impact and consequences.

#### V. THE PROPOSED ALGORITHM (CMR)

A component based model is presented. Two main technologies are studied in this model extraction and partition technology. The former is used to realize which component of a solution needs to be transformed at a smaller cost, and the latter is for directing the transformation of the infeasible component into the feasible one.

#### a) Extraction Technology

For a constrained optimization problem, each constraint is only correlative with certain

components, namely, each component only impacts upon some specific constraints. Therefore, the interrelationship between each dimensional component of solution and constraints is revealed.

$$g01: Min \ F(x) = 5\sum_{i=1}^{4} X_i - 5\sum_{i=1}^{4} X_i^2 - \sum_{i=5}^{13} X_i$$

$$g_1(x) = 2x_1 + 2x_2 + x_{10} + x_{11} - 10 \le 0$$

$$g_2(x) = 2x_1 + 2x_3 + x_{10} + x_{12} - 10 \le 0$$

$$g_3(x) = 2x_2 + 2x_3 + x_{11} + x_{12} - 10 \le 0$$

$$g_4(x) = -8x_1 + x_{10} \le 0$$

$$g_5(x) = -8x_2 + x_{11} \le 0$$

$$g_6(x) = -8x_3 + x_{12} \le 0$$

$$g_7(x) = -2x_4 - x_5 + x_{10} \le 0$$

$$g_8(x) = -2x_6 - x_7 + x_{11} \le 0$$

$$g_9(x) = -2x_8 - x_9 + x_{12} \le 0$$
where  $0 \le x_1 \le 1(i = 1)$ 

Where  $0 \le x_i \le 1$  (i = 1, ..., 9),  $0 \le x_i \le 100$  (i = 10, 11, 12) and  $0 \le x_{13} \le 1$ .

The optimum satisfied where  $f(x^*) = -15$ . The first dimensional component  $x_1$  appears in some inequality constraints including  $g_1$ ,  $g_2$  and  $g_4$ . It means that the change to  $x_1$  will impact on whether the constraints  $(g_1, g_2, g_4)$  are satisfied or not. By analogy, the correlative constraints of each dimensional component in this test function can be deduced in Table I. Supposing the correlative constraint set of the ith dimensional component is marked as CRG<sub>i</sub>. The population size is represented as  $N_{\rho}$  and the dimension of constrained problem is D. After the above deduction, it is known that the *ith* dimensional component needn't to change when all correlative constraints are satisfied, or this component should change when there is at least one correlative constraint isn't satisfied. However, if the correlative constraint set is empty, it means that the feasibility measure of solution isn't relevant to this component. In order to determine whether the component to change, some definitions are given.

#### Definition 1 (Feasible Component)

For  $x_i \in X$ , i = 1, ..., D,  $\forall g_j \in CRG_i$ , if  $max[0, g_i] = 0$ , then  $x_i$  is a feasible component.

then  $x_i$  is a feasible component.

#### Definition 2 (Infeasible Component)

For  $x_{i \in} X$ , i = 1, ..., D,  $\forall g_{j} \in CRG_{i}$ , if  $max[0, g_{j}] \neq 0$ , then  $x_{i}$  is an infeasible component.

#### Definition 3 (Feasible Solution)

For  $X_i$ ,  $i = 1, ..., N_p$ ,  $\forall x_j \in X_i$ , if  $x_j$  is a feasible component, then  $X_j$  is a feasible solution.

#### Definition 4 (Infeasible Solution)

For  $X_{i}$ ,  $i = 1, ..., N_p$ ,  $\exists x_j \in X_i$ , if  $x_j$  is an infeasible component, then  $X_i$  is an infeasible solution.

According to these definitions, a feasible solution is constituted by feasible components, and an infeasible solution maybe constituted by feasible and infeasible components. Therefore, the infeasible solution merely needs to be modified its infeasible components for transforming into feasible solution; the rest feasible components don't need change.

#### b) Partition Mechanism

various dimensional Based on the components, partition mechanism is applied to direct the transformation of infeasible component into feasible one. The number of partition regions depends on the dimensions of constrained problem. Each dimensional partition region will conserve many solutions which contain the relevant dimensional feasible components. In other words, if the *ith* dimensional component of a solution is feasible, the *ith* partition region includes this solution. If the solution includes many various dimensional feasible components, it will be conserved in many related partition regions. The example of the above proposed test function is displayed in figure 4.

According to the number of solutions in each partition region and feasibility proportion of the current population, various kinds of multi-parent crossover operators are designed for solution feasibility or population diversity. An opposition based mutation with a probability is embedded in CMR to accelerate its convergence speed. The generation for the new offspring is shown in Algorithm 1. Let us define the meeting of the following terms:  $N umf c_j$  is the number of solutions in the *jth* partition region;  $P_m$  is mutation rate and  $P_f r$  is feasibility proportion of the current Population,  $[M in'_j, M ax'_j]$  is the range of the *jth* component in the *ith* generation;  $rd_1, rd_2, rd_3$  are different random numbers sampled in [-0.5, 1.5], simultaneously,  $rd_1 + rd_2 + rd_3 = 1$ .

Algorithm1 Offspring Generation with Genetic Operators

for i = 0 to  $N_p$  do

for j = 0 to D do

if rand(0, 1) <  $P_{fr} \wedge Num fc_i \ge 3$  then

select three parents  $\mathsf{P}_{\mathsf{r1j}}$  ,  $\mathsf{P}_{\mathsf{r2j}}$  ,  $\mathsf{P}_{\mathsf{r3j}}$  randomly from the jth partition region;

 $r_{ij} = r^{d1P}r_1j + r^{d2P}r_2j + r^{d3P}r_3j;$ 

else

select three parents  $\mathsf{P}_{\mathsf{r1j}}$  ,  $\mathsf{P}_{\mathsf{r2j}}$  ,  $\mathsf{P}_{\mathsf{r3j}}$  randomly from the current population;

$$\label{eq:relation} \begin{split} {}^{x}{}_{ij} &= {}^{rd} \mathbf{1}^{P} r_{1} j \, + \, {}^{rd2P} r_{2} j^{d3P} r_{3} j; \\ & \text{end if} \\ \text{if rand}(0,\,1) \leq P_{m} \text{ then} \\ x_{ij} &= M \text{ in}^{t}_{j} + M \text{ ax}^{t}_{j} \text{-} x_{ij} \\ \text{end if} \end{split}$$

end for end for

#### c) The Novel Ranking Method

Ranking method presents a new view on balancing the dominance of penalty and objective functions. Many researchers have done some study on ranking methods with various lexicographic orders, such as stochastic ranking, Pareto ranking. In general, feasible solutions are ranked highest and better than all infeasible solutions. However, infeasible solutions with superior objective function value are more efficient to guide the population toward the optimum feasible, especially when the feasible regions are disjoint or the optimum lies on the boundary of the feasible region. Therefore, we tend to remain the important feasible and infeasible solutions. A novel ranking strategy is designed to accomplish the above goal. The essential comparison rules between adjacent pairs can be summarized as the following three points: 1) two feasible solutions are compared only based on their objective function values; 2) two infeasible solutions are compared only based on their objective function values, while at least there are one's objective function value less than the value of best feasible solution in the current population; 3) In the remaining situations, two solutions are compared based on the amount of their constraint violations[9]. After the comparisons, infeasible solutions with superior objective function value are ranked highest, followed by all feasible solutions and other infeasible solutions with greater constraint violation value are ranked to the lowest level.

Considering little feasible [5] solutions for the population at the early evolutionary stage, the ranking strategy should pay more attention to feasibility or constraint violation for a solution. So the whole ranking method is described in Algorithm 2. Where Pr is a proportion constant in [0, 1].

Algorithm 2. Ranking Method

#### if $P_{fr} \leq P_r$ then

compare the adjacent pair according to the amount of their constraint violations, regardless of feasible or infeasible solutions;

#### else

compare the adjacent pair according to the above rules 1),2),3);

end if





#### EXPERIMENT VERIFICATION VI.

Four benchmark test functions are applied in this paper, and the results of the CMR algorithm are compared against three state-of-the-art algorithms: the SR(Stochastic Ranking), the KM (Koziel & Michalewicz), and the SAFF(Self Adaptive Fitness Formulation). For each test case, 30 independent runs are performed. In the following experiments, the parameters for the CMR algorithm are as follows: the population size  $N_{\rho} = 60$ , the maximum generations is 5000, the mutation rate  $P_m$ = 0.25 and  $P_r = 0.3$ ,  $\varepsilon = 10^{-4}$ . The experiments are performed on a computer with Intel Core-2 CPU 1.83GHz and 1GB of RAM, by using the visual C++ compiler.

The rest benchmark functions g02 - g04 are described as following:

Table I Statistical Results for G01- G04 Functions

Alg.	Best	Mean CO1(15	n Worst	st. dev
17.1	14706	GUI(-15.	0000)	
KM	-14.786	-14.708	-	-
SAFF	-15.000	-15.000	-15.000	0.0E + 00
SR	-15.000	-15.000	-15.000	0.0E+00
CMR	-15.000	-15.000	-15.000	0.0E+00
Alg.	Best	Mea	n Worst	st. dev
Alg.	Best	Mean G01(-15.	n Worst 0000)	st. dev
<b>Alg.</b> KM	<b>Best</b> -14.786	Mean G01(-15. -14.708	n Worst 0000) -	st. dev -
<b>Alg.</b> KM SAFF	<b>Best</b> -14.786 -15.000	Mean G01(-15. -14.708 -15.000	<b>worst</b> 0000) -15.000	<b>st. dev</b> - 0.0E+00
Alg. KM SAFF SR	Best -14.786 -15.000 -15.000	Mean G01(-15. -14.708 -15.000 -15.000	<b>n Worst</b> 0000) -15.000 -15.000	<b>st. dev</b> - 0.0E+00 0.0E+00

In this section, the main steps of CMR algorithm can be described in figure 5.

g02 : 
$$M \inf(X) = -(\sqrt{2})^n \prod_{i=1}^n x_i$$
  
 $h(X) = \sum_{i=1}^n x_i^2 - 1 = 0$ 

Where n = 10 and  $0 \le xi \le 1$  (i = 1, ..., n). The optimum satisfied where  $f(x^*) = -1$ .

$$g03: Min f(X) = -[sin3(2\pi x1)sin(2\pi x2)]/[x31(x1 + x2)]$$
  
s.t.  $g1(X) = x21 - x2 + 1 \le 0$   
 $g2(X) = 1 - x1 + (x2 - 4)2 \le 0$ 

Where  $0 \le x_1 \le 10$  and  $0 \le x_2 \le 10$ . The optimum satisfied

Where  $f(x^*) = 0.095825$ .

$$g04: Min f(X) = x_1^2 + (x_2 - 1)^2$$
  
 $h(X) = x_2 - x_2 = 0$ 

Where  $-1 \le x_1 \le 1$  and  $-1 \le x_2 \le 1$ . The optimum satisfied

Where f ( $x^*$ ) = 0.75.

Table 1 summarizes the results from the conducted experiment. The statistical results include the known optimal solutions for each test function, the best, mean, worst objective function values, and the standard deviations. "-" means that solutions were not found or not available. In the comparison, CMR can consistently find the optimal solutions in four test functions (q01, g02, g03, and g04) as other compared algorithms. All best, mean and worst objective function values of CMR were equivalent to the optimums for the above functions. Especially, CMR has better capability to deal with function g02 and has slightly better standard deviations than SR, SMES and others. The experimental results illustrate the performance of CMR algorithm is similar to the compared algorithms in terms of the solutions quality. With slightly better standard deviations, CMR is more robust and stable in obtaining consistent results than all the compared optimization algorithms. In all experiments, feasible solutions were continuously found for all the test functions in 30 runs. These results revealed that CMR has the substantial capability to deal with different kinds of COPs.

#### VII. CONCLUSION

In this paper we have presented a Iteration based risk tracker evolutionary algorithm with component based development, which is based on a component based model and a new ranking method. Extraction and partition studied in this model are two main technologies. The performance of this algorithm has been extensively investigated by experimental studies with the risk tracker applier on each iteration. The experimental results illustrate the CMR performance in terms of the quality of the resulting solutions, especially for robustness stability and feasibility in obtaining consistent results. In our future work, multi linear cost optimization process is studied for Extraction and Partition of various models.



Fig. 5 The Flow Chart of CMR algorithm

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- Font type of all text should be Swis 721 Lt BT.
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- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
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- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
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1. General,

- 2. Ethical Guidelines,
- 3. Submission of Manuscripts,
- 4. Manuscript's Category,
- 5. Structure and Format of Manuscript,
- 6. After Acceptance.

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#### References

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- Fundamental goal
- To the point depiction of the research
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  of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

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- Single section, and succinct
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- 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 if generally accepted information, 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:

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References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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