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Aims and Scope

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Contents

Robot Based Object Identification

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ABSTRACT

In this paper, a new approach for detecting and matching the overlapping symmetric and asymmetric real objects and multiple patterns obtained in various views using an automated robot sensing is proposed. The proposed system introduces a system supervising using sensors and a webcam or mobile camera to record, transmit and analyze the objects. The goal of the proposed system is to recognize the identity, position, and orientation of randomly oriented objects. In order to identify and match the symmetric and asymmetric overlapping objects, an automated robot must be equipped with a set of sensors that provide information about the presence of a matching object around.

Keywords: Object Identification, Feature Extraction, Robot Sensing, Pattern Matching, Robot Vision.

INTRODUCTION

Robot vision is an interesting and rapidly growing field. The Robots are used in several places which are helping humans in several aspects of life. The rapid progress has reduced the coverage of less significant areas. The main focus is to develop simple descriptions from captured and sensed images using some automated system. To recognize an object refers to fact of assigning a set of symmetric, asymmetric overlapping point to the known classes for identification. Autonomous robots operating in human environments give some extremely challenging research topics in planning and dynamic perception whether it is in any field the workplace, a play ground or in a household. In order to navigate and interact with, such an environment, accurate and strong dynamic observation is a must.

Predicting shapes represents an important domain of recognizing image objects, based on their shape information and object characteristics. [1] The identification of the object by efficient and accurate automated system for connected or overlapping objects in an image leads to the decreased execution time and elapsed time. Each sensed image contains up to several hundred objects, which were manually arranged not to overlap or touch each other. The proposed approach is divided into three stages. In the first stage the robot will capture the image and will send the image to the main computer, in this stage multiple thresh-holding values for the image are defined. Over segmentation and erosion is applied on binary image to erode away the boundaries of regions of foreground pixels.[9] match the object with prescribed dimensions. In the second stage features of the current object whose user is going to predict the shape are matched with the preloaded features in data set of known classes.[7] in the Third stage, the equivalence distance to which the current object matched in data set is considered. In this stage, the robot will move towards the identified object, the distance travelled by the robot to capture the object depends upon the diameter of the wheel of the robot. Robot will bring the required object to the player.

MORPHOLOGY

The term Morphology refers to set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image.[2] Morphological operations affect the structure or shape of an object. All these operations are applied on binary images.

STRUCTURING ELEMENT

Structuring element consists of matrix of 0's and 1's. Its size is smaller than the image and its origin identifies the pixel to be processed. The structuring element used for processing the images under prediction is disk shaped.[10]

If A and B be two sets in Z^2 then,

$$A \oplus B = \{ | \, (B)_z \cap A \neq \phi \}$$

Where A is image and B is the structural element.

MORPHOLOGICAL OPERATIONS

The two principal morphological operations are dilation and erosion. The proposed work is based on the implementation of erosion on to extract features of objects.

EROSION

Erosion shrinks objects by etching away (eroding) their boundaries. When using erosion structural element also passes through all pixels of the image.[4] if at a certain position every single pixel structuring element coincides with a single pixel binary image, then the logical disjunction of the central pixel structuring element with the corresponding pixel in the output image. The method of erosion for prediction of overlapping and connecting images is specially used in this algorithm to increase the efficiency and improve execution time.

$$a \oplus b = \{z \mid [\,(b)_z\ \varepsilon\ a]+$$

Where a is an image and b is structuring element in z^2.

FUZZY LOGIC

A fuzzy system is represented by if-then rules in the form:

if i_1 *is* vi_1*, 1 and ... and* i_m *is* vi_m*, 1*

then o1 is vo_1*, 1 and ... and* o_n *is* vo_n*, 1*

where m is input and n is output, r is fuzzy rules in the system. The rules r defines the fuzzy rules which is an exponential function of the number of the inputs i and the number of linguistic values l taken by input.

$r = l_i$

if a fuzzy system has n inputs and single output then its fuzzy rules can be of the form:

if x_1 is a_{1j} and x_2 is a_{2j} . . . and xm is a_{jm}

then y is bj

Dataset

It is a collection of data elements. The following name/value pairs are used when a dataset is constructed:

1. varnames: this gives the variables with the specified variable names.

{name_1,...,name_m}

2. obsnames: this gives the n observations in a with the specified observation names.

{name_1,...,name_n}

II. OPERATIONAL STAGES

The proposed technique is to identify the expected object using a robot on the basis of estimated values for dependent variables from previously unseen predictor values based on the variation in a learning database are used to predict the objects in the shape. Main focus of work is to predict the shape by using a automated machine on the basis of defining morphological operation which describes all boundary points of a shape. Prediction of the object by an automated efficient, accurate, computationally fast and invariant technique for connected or overlapping objects in an image is the main consideration so that execution time and elapsed time is decreased.

BASIC STEPS

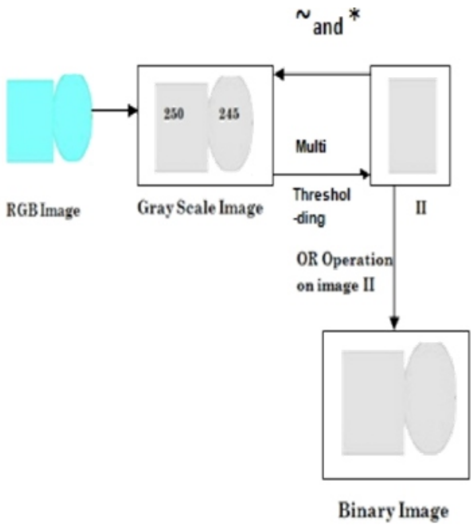

Figure 1: Basic Steps

In the first stage the robot will capture the image and will send the image to the main computer, in this stage multiple thresh-holding values for the image are defined. Over segmentation and erosion is applied on binary image to erode away the boundaries of regions of foreground pixels.[9] match the object with prescribed dimensions.

LEVEL I

I. Acquire Image: First step is to ACQUIRE AN RGB image USING WEBCAM OR ANDROID MOBILE and convert that image to gray scale image by defining multi- thresholding.

II. Over segmentation: Apply over-segmentation and convert the image to binary image.

III. Erosion: Apply erosion on binary image to erode away the boundaries of regions of foreground pixels.

IV. Feature finding: Find the features and edges for the current image with the help of fuzzy logic operations and will be loaded into memory for use whenever it is needed.

Working Steps for Level I

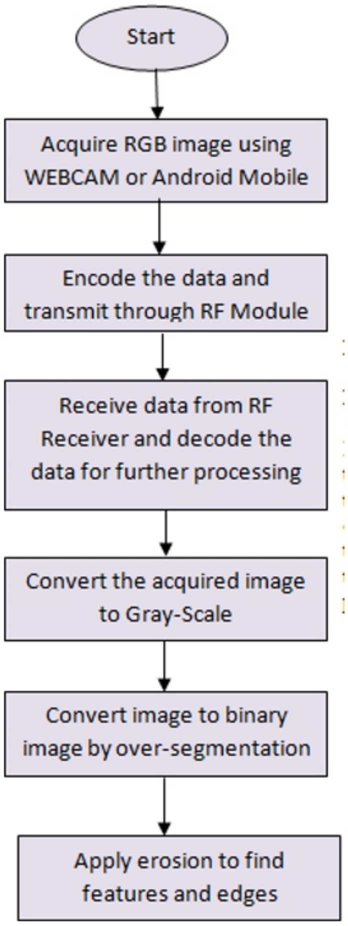

Figure 2: Working Steps for Level I

LEVEL II

In the second stage features of the current object whose user is going to predict the shape are matched with the preloaded features in data set of known classes.

Working Steps for Level II

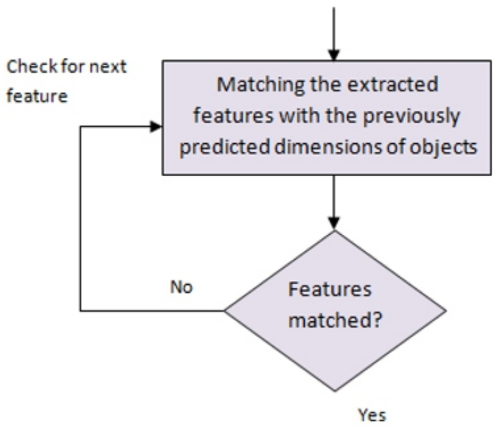

Figure 3: Working Steps for Level II

LEVEL III

In the Third stage, the equivalence distance to which the current object matched in data set is considered. In this stage, the robot will move towards the identified object, the distance travelled by the robot to capture the object depends upon the diameter of the wheel of the robot. Robot will bring the required object to the player.

Working Steps for Level III

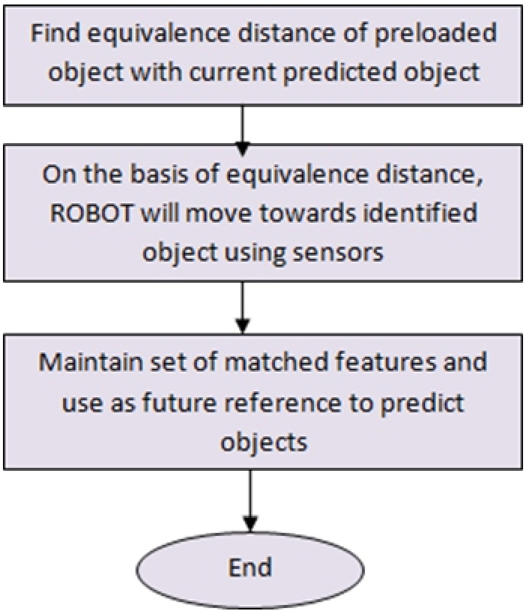

Figure 4: Working Steps for Level III

III. EXPERIMENT SETUP

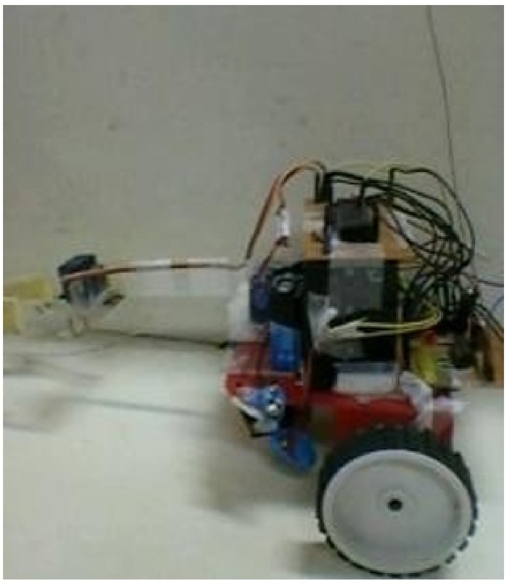

Figure 5: Working model of IMGROB robot

Figure 6: Remote to control the functionalities of IMGROB robot

III. RESULTS

For the purpose of testing the experimental results, different input values are considered and the results obtained from the IMGROB robot are graphically analyzed.

Table1: Table imgrobtbl for the predicted time values

Objects per captured image	Time taken for predicting the objects				
	Triangle	Rectangle	Eclipse	Circle	Polygon
10	5.22	5.28	5.43	5.77	6.18
13	7.21	7.22	7.5	7.86	8.18
15	8.6	8.62	8.75	9.13	9.72
22	29.49	23.20	13.24	13.94	33.50

The predicted time values Table1 above shows the predicted values for time which may vary depending upon the distance among objects of input images and number of objects per image.

1. Output surface for Triangular shaped objects by robot

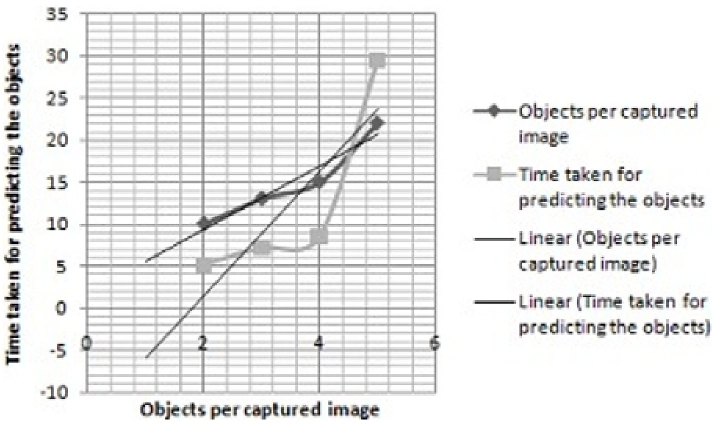

Figure 7: Output surface for Triangular shaped objects by robot

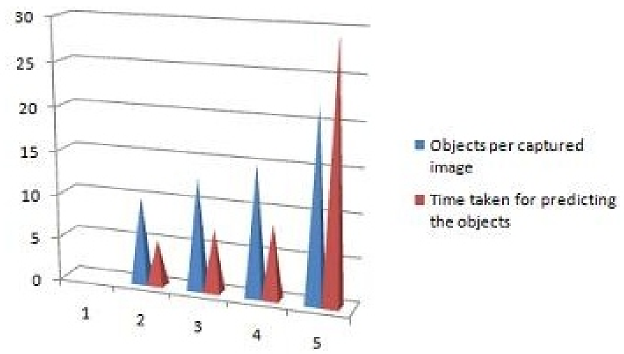

Figure 8: Point description of Triangular shaped identified objects

This output surface shows the variation in the values of triangle predicted in all the images. The predicted values vary as the number of objects in the image increases.

2. Output surface for Rectangular shaped objects by robot

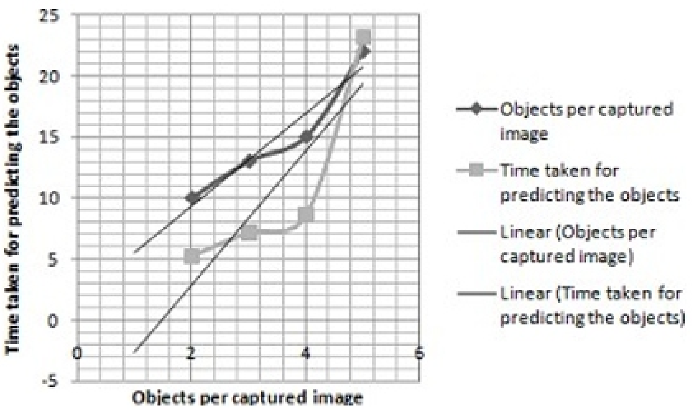

Figure 9: Output surface for Rectangular shaped objects by robot

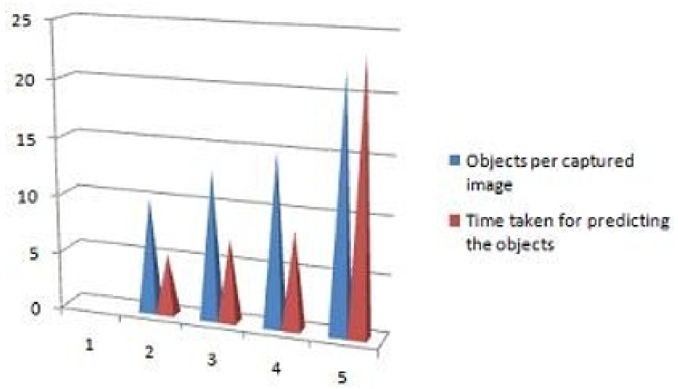

Figure 10: Point description of Rectangular shaped identified objects

This output surface shows the variation in the values of rectangle predicted in all the images. The predicted values vary as the number of objects in the image increases.

3. Output surface for Eclipse shaped objects by robot

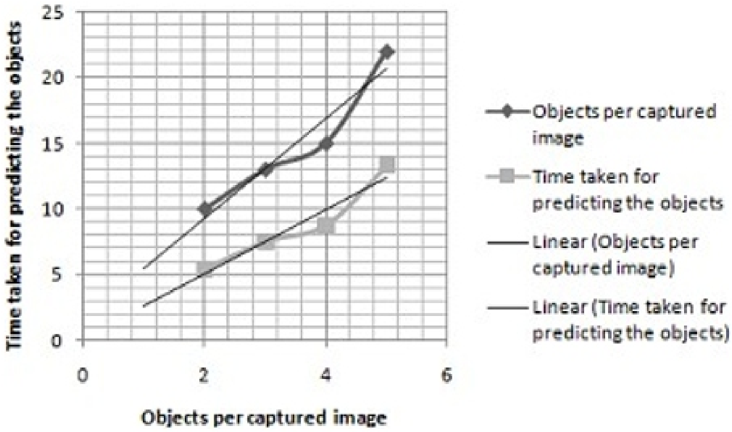

Figure 11: Output surface for Eclipse shaped objects by robot

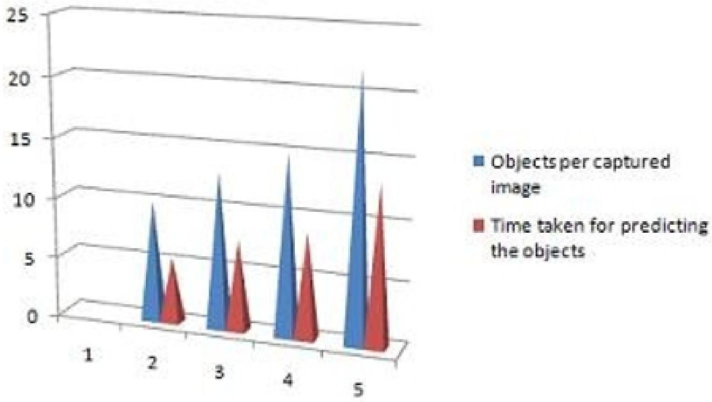

Figure 12: Point description of Eclipse shaped identified objects

This output surface shows the variation in the values of eclipse predicted in all the images. The predicted values vary as the number of objects in the image increases.

4. Output surface for Circular shaped objects by robot

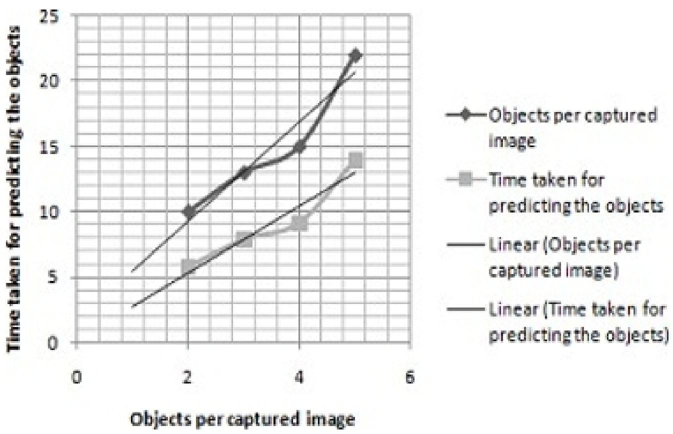

Figure 13: Output surface for Circular shaped objects by robot

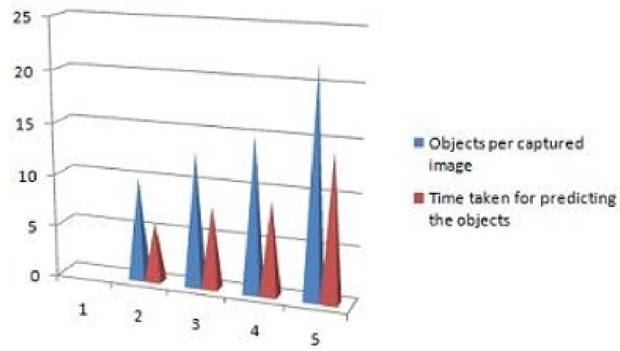

Figure 14: Point description of Circular shaped identified objects

This output surface shows the variation in the values of circle predicted in all the images. The predicted values vary as the number of objects in the image increases.

5. Output surface for Polygon shaped objects by robot

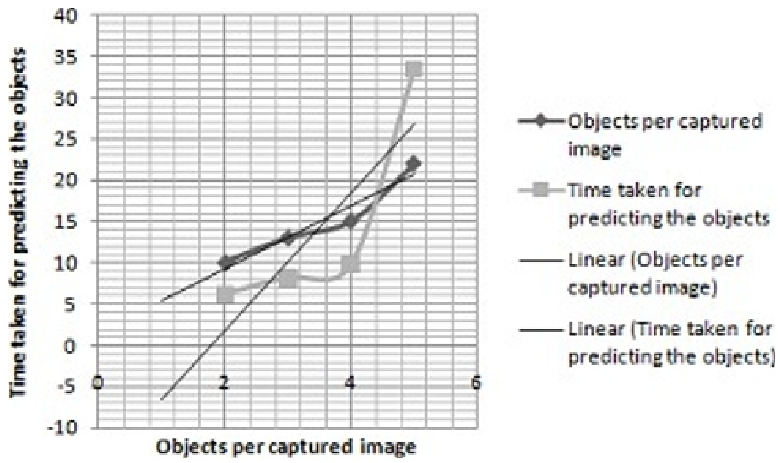

Figure 15: Output surface for Polygon shaped objects by robot

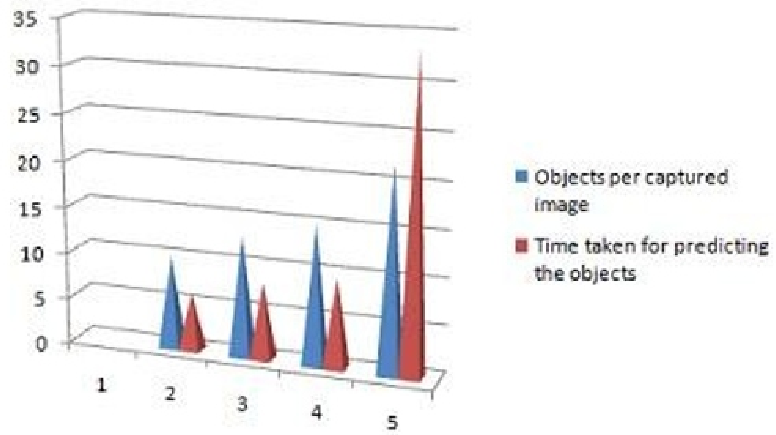

Figure 16: Point description of Polygon shaped identified objects

This output surface shows the variation in the values of polygon predicted in all the images. The predicted values vary as the number of objects in the image increases.

V. CONCLUSION AND FUTURE SCOPE

The proposed technique is an efficient technique for identifying the common objects which may be present in any play ground. The idea proposed is based on the fact that the designed robot is capable to identify even the adjoining or overlapping objects correctly. The proposed work can be extended to do and enhance Image definition to define the image based on characteristics of objects predicted.

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Detection of Singular Points from Fingerprint Images using an Innovative Algorithm

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A B S T R A C T

Fingerprint scrutiny is typically based on the location and pattern of detected singular points in the images. These singular points (cores and deltas) not only represent the characteristics of local ridge patterns but also determine the topological structure (i.e., fingerprint type) and largely influence the orientation field. In this report, there is an innovative algorithm for singular points detection. After an initial detection using the conventional Poincare Index method, a so-called DORIVAC feature is used to remove spurious singular points. Then, the optimal combination of singular points is selected to minimize the difference between the original orientation field and the model-based orientation field reconstructed using the singular points. A core-delta relation is used as a global constraint for the final selection of singular points.

Keywords- Orientation field, Poincare´ Index, Singular points, topological structure.

I. INTRODUCTION

Fingerprint is the pattern of ridges and valleys [1] on the surface of a fingertip. The ridges are black and the valleys are white. Its orientation field is defined as the local orientation the ridge- valley structures. The minutiae are defined as ridge endings and bifurcations. The singular points can be viewed as points where the orientation field is discontinuous, which can be classified into two types: core and delta [2]. Fig. 1 lists five typical types of fingerprints with singular points noticeable. As an important topological characteristic for fingerprints, singular points can be used for fingerprint indexing (i.e., classification for fingerprint types) [3], [4] as well as for fingerprint arrangement and orientation field modeling [5], [6] and so forth.

Several previous works have addressed singular point detection and analysis in fingerprint images. They can be approximately classified into two groups.

The first approach is mainly based on using the Poincare´ Index to consider the irregular orientation distribution about singular points [2], [3], [7], [8], [9]. This sort of algorithm usually calculates the sum of the orientation changes along a close circle about the point to judge whether it is a singular point.

The second form of approach uses probability analysis, ridge analysis, shape analysis, or template matching [10], [11], [12], [13], [14], [15], [16] and [17]. Compared with these latter techniques, Poincare´ Index-based detection techniques are generally stronger to image rotation and relatively easy to compute, so they are more extensively used in real applications.

Poincare´ Index-based algorithms usually result in many forged detections (especially for low- quality fingerprint images), even after post-processing. The forged detected points can greatly degrade the performance of these algorithms in lots of applications. The forged detections result because 1) the Poincare´ Index feature alone is not sufficient for accurate singular point detection and 2) most post-processing approaches use only local characteristic of singular points, which is not enough to discriminate true singular points from forged detections caused by creases, scars,blurs, damped prints, etc. In the orientation field, some forged detection actually has almost the same local patterns as true singular points. To accurately distinguish the genuine singular points, global discriminative information should be incorporated into the detection.

This paper, concentrate on to singular point detection based on an innovative so-called Difference of the ORIentation Values Along a Circle (DORIVAC) characteristic and global restrictions. Compared with previous studies, the contributions of this paper lie in the following aspects: 1) Paper is proposed using the DORIVAC feature for singular point verification, which can provide more discriminative information to get rid of forged detections and 2) based on an analysis of core-delta relationships, to select the best combination of singular points by global restrictions. The optimal singular points are selected to minimize the variation between the detected orientation field and model-based orientation field reconstructed using the singular points.

The rest of this paper is organized as follows: Part II analyses the topological structure of fingerprints. In Part III, the DORIVAC feature is proposed to remove forged SPs. Part IV discusses how to select the optimal combination of cores and deltas using global information. Part V finishes with conclusions.

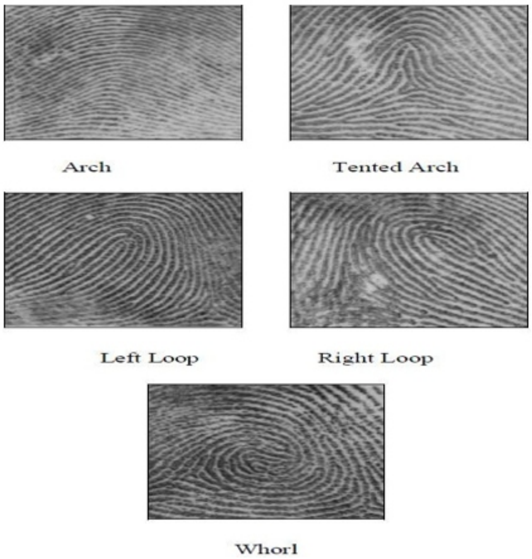

Fig 1: Various types of fingerprints with cores (marked with circles) and deltas (marked with triangles). (a) Plain arch. (b) Tented arch. (c) Left loop. (d) Right loop. (e) Whorl

II. TOPOLOGICAL ANALYSIS FOR FINGERPRINT STRUCTURES

A. Mathematical Background:

Definition. Let V (u, v) =p(u, v) + i. q(u, v) be a continuous 2-dimensional vector field. Then, the Poincare´ Index of V (u, v) along an arbitrary simple closed path γ is defined as

$$I(\gamma) = \frac{1}{2\pi} \int_{(u,v)\in\gamma} d\emptyset(u,v) \qquad (1)$$

where $\emptyset(u,v) = \arg V(u,v)$ is the angle at point (u, v) and $\emptyset \in [0,2\pi)$. The integration is taken anticlockwise along γ .The Poincare´ Index is always an integer. By computing I beside a simple closed circle around a point P, one can find whether P is a singular point $(I \neq 0)$ or a common point $(I = 0)$

Suppose that a area Ω has an exterior boundary, Γ_{Ext}, and an interior boundary, Γ_{Int} , as shown in Fig. 2. The singular points inside Ω are indicated by the circles, $\{\gamma_k | k = 1,2,3 \ldots\}$. C is a simple closed path inside Ω. Two important properties of the Poincare´ Index can be formulated as follows and their evidence can be derived from Complex Function Theory [19].

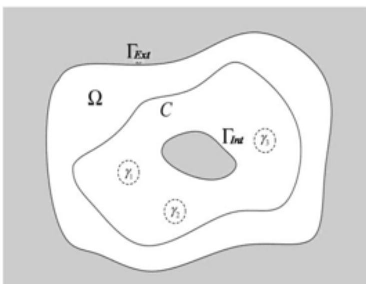

Fig. 2. Region Ω with its boundary $\partial\Omega = \Gamma_{Ext} \cup \Gamma_{Int}$ $\{\gamma_i, i = 1,2,3,\}$ are the circles around the singular points inside Ω. C is a simple closed path in Ω.

Property 1. The Poincare´ Index along the boundary of a given area is equal to the sum of the Poincare´ Indices of the singular points inside this area, i.e.

$$\sum_k I(\gamma_k) = I(\Gamma_{Ext}) - I(\Gamma_{Int}) \qquad (2)$$

Property 2. If two simple closed paths are homotopic, and there are no other singular points between them, their Poincare´ Indices are the same. For example, I(C) = I (Γ_{Ext}), in Fig. 2.

B. Analysis of Fingerprint Images:

For oriented texture images, such as fingerprints and fluid flow, it is natural to establish their connection with 2-dimensional topology theory. This can relate the above definitions and properties on these images. The singular points in fingerprints are found to be steady with the singular points defined in topology. In Fig. 3, we list two typical singular points for fingerprints, their Poincare´ Indices, and their local patterns in the orientation field O.

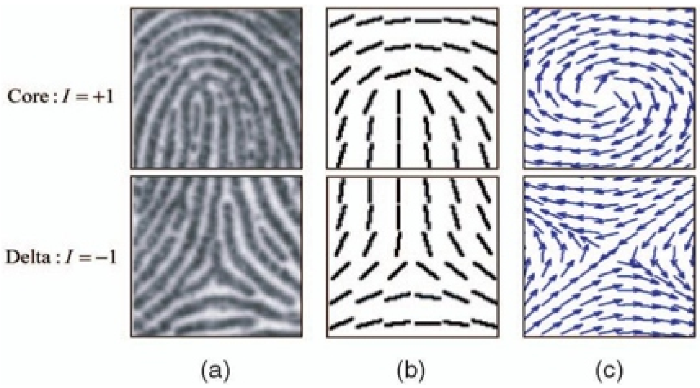

Fig. 3. (a) Singular points in fingerprints with the Poincare´ Indices, (b) their local patterns in the orientation field O, and (c) the vector field V.

A remarkable conclusion for fingerprints can be assumed based on Property 1. Since fingerprints usually do not have interior boundary Γ_{Int} and only have isolated singular points (cores and deltas) with known Poincare´ index (+1 for core, -1 for delta), (2) can be written as

$$N_{cores} - N_{deltas} = I(\Gamma_{Ext}) \qquad (3)$$

where N_{cores} is the number of the cores, N_{deltas} is the number of the deltas, and Γ_{Ext} is the exterior boundary of the fingerprint.

Earlier works have pointed out that cores and deltas should appear in pairs [9]. Two views of actual thumb are shown as an example in Figs. 4a and 4b with the cores and the deltas marked. For the simple closed path Γ_{Ext} consisting of this kind of boundaries, I (Γ_{Ext}) = 0, and then $N_{cores} = N_{deltas}$.

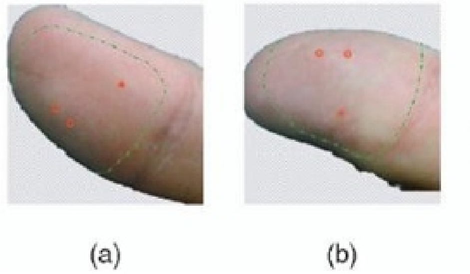

Fig. 4. (a) Left and (b) right views of a real thumb with singular points and boundary marked.

As for Property 2, we know that the Poincare´ Index can be calculated along any simple closed path as long as it is homotopic with the closed circle around the same points. This allows to adaptively choose the integral path for the boundary, for example, to choose the path where the orientation confidence is much higher.

III. USING DORIVAC FEATURE TO REMOVE FORGED SINGULAR POINTS

A. DORIVAC Feature:

Many earlier researchers have shown that Poincare´ Index-based methods can usually detect nearly all true singular points when the Index is calculated along small area boundaries, but this also guides to much forged detection. If a bigger area is chosen, true singular points will be easy to miss [9]. In order to get rid of forged detections while conserving a good detection rate, an innovative feature is advised here extended from the Poincare´ Index, which can provide more perceptive features and be used to confirm the trueness of each finding after using Poincare´ Index algorithm.

The Poincare´ Index is defined as the sum of the orientation differences beside a closed ring L. For a given point P, suppose that the set of sampled points along L is $\{T_1; T_2; T_3; \ldots; T_{N-1}\}$ and o_i is the orientation of point T_i. Then, the Poincare´ Index of P can be computed by [3] [5]

$$Ip = \frac{1}{\pi}\sum_{i=i}^{N-1} f(o_{i+1} - o_i) = \frac{1}{\pi}\sum_{i=i}^{N-1} f(\delta o_i), \qquad (4)$$

$$f(x) = \begin{cases} x, & |x| \le \frac{\pi}{2}, \\ \pi - x, & x > \frac{\pi}{2}, \\ \pi + x, & x < -\frac{\pi}{2}, \end{cases} \qquad (5)$$

The Poincare´ Index is only the sum of δo_i. It contains no information about the arrangement of $\delta o_i, i = 1,2,3, \ldots, N-1,$ and it cannot explain the singular point fully. So, when there are creases, scars, smudges, or damped prints in the fingerprint images, the Poincare´ Index method will easily outcome in many forged singular points. Post-processing steps are therefore frequently essential. In this paper, two simple set of laws are used through post-processing:

1) If a delta is too close to a core (the distance between them is smaller than 8 pixels), eradicate both of them as well as
2) In a very small area (a circular region with a radius of 8 pixels), if there is more than one core (or delta), an average core (or delta) can be calculated instead.

Suppose that there are N cores (or deltas) in such a area, $\{(u, v_i), i = 1,2, \ldots .N\}$ Then, the average core (or delta) (u, v) is calculated by

$$u = \frac{1}{N}\sum_{i=1}^{N} u_i \quad (6)$$

$$v = \frac{1}{N}\sum_{i=1}^{N} v_i \quad (7)$$

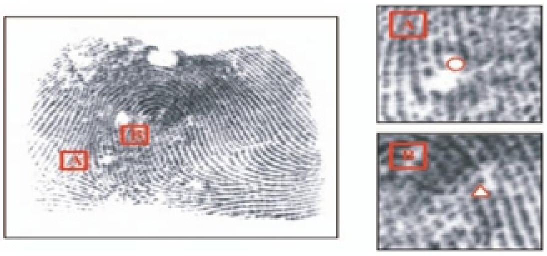

Fig. 5. Two examples of forged singular points detected using a conventional Poincare´ Index-based method and post-processing steps, in which the false core is marked with a circle and the false delta is marked with a triangle.

However, even after this post-processing step, much forged detection still remains. Fig. 5 shows two examples from a cheap-quality fingerprint, illustrating points that are wrongly detected as a core and a delta by using the Poincare´ Index method and this post-processing.

In order to additional remove the forged points, an innovative characteristic is used, which contains more information about the singular point. The characteristic on point P, which consists of the DORIVAC about P, i.e.,

$$\text{DORIVAC}\ (P) = [\delta o_1, \delta o_2, \ldots .\delta o_{N-1}] \quad (8)$$

As DORIVAC contains all δo_i, it can illustrate the singular point more absolutely. The Poincare´ Index can be seen as the summation of DORIVAC features and DORIVAC features can be considered as an extended form of Poincare´ Index. Fig. 6 shows six singular pointsdetected by the Poincare´ Index method and their DORIVAC features are plotted as curves (among them, Figs. 6a, 6b, 6c, and 6d are true and Figs. 6e and 6f are forged detections).

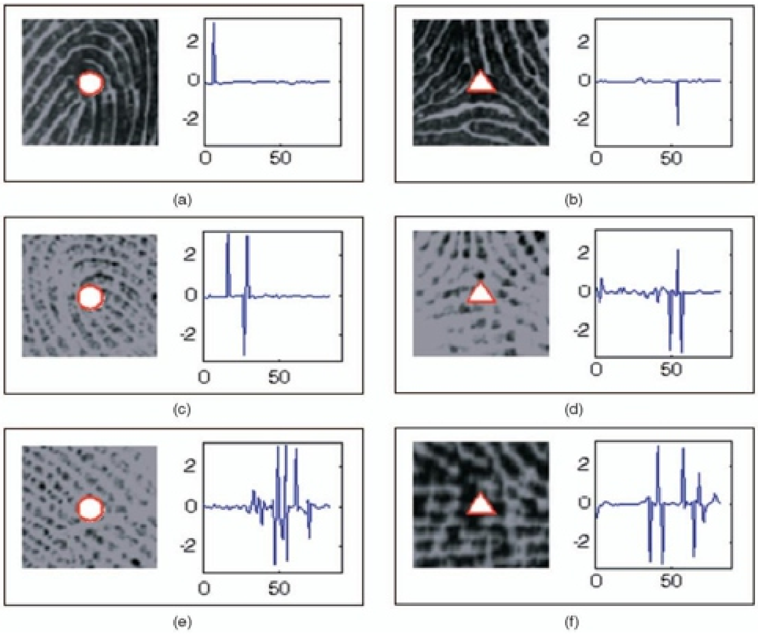

Fig. 6. Singular points detected by using the Poincare´ Index algorithm and their DORIVAC features (plotted as curves): (a), (b), (c), and (d) are true while (e) and (f) are forged.

Since the orientation field is defined in [0, π), there will be one DORIVAC feature pulse for each singular point (positive pulse for core, and negative pulse for delta) if the orientation field is detected completely. See Figs. 6a and 6b for examples. Although the noise around the true singular points may change the curves a little, there exists a clearly obvious difference between true and forged singular points. These phenomena can be observed in Fig. 6.

After post-processing steps, the detected singular points are isolated, i.e., there is only one singular point for any fairly large region. Thus, it is more suitable to calculate the DORIVACfeatures along a large circle. Then, N can be a large number, and accordingly, the curves of DORIVAC features will be more continuous.

B. Removing Forged Singular Points :

To distinguish true singular points from forged ones, a two-step classifier is projected as below. For each point with nonzero Poincare´ Index in the applicant set S, the DORIVAC feature is calculated. If there is exactly one pulse (i.e., positive pulse for core and negative pulse for delta) with the height nearly up to π, it is a legitimate singular point and will be kept in the final set S of singular points; otherwise, it will be removed from applicant set S and placed into an supplementary set S' of applicants for further processing. This process is outlined in Algorithm 1.

Algorithm 1:- Pseudo-code of the first step for removing forged Sps

1. for each detection point P in S do
2. DORIVAC (P) = $[\delta o_1, \delta o_2, \ldots\ldots, \delta o_{N-1}]$;
3. if $\exists! \, k \in [1, N-1], that \; |\delta o_k| > t, then$
4. keep P in S;
5. end
6. else
7. remove P to S´
8. end
9. end

The supplementary point set S' can contain a mixture of true singular point and forged detections. The classifier is designed, based on training samples to differentiate between the true points (e.g., Figs. 6c and 6d) and the forged ones (e.g., Figs. 6e and 6f).

Since it is time consuming to physically tag true and forged singular point samples for the training of the classifier, the taster learning methods are used suitable for small-numbered samples. The Support Vector Machine (SVM) is chosen to design the classifier [20]. SVMs try to find a best separating hyper-plane in the feature space and lessen the classification error for the training data using a nonlinear transform function.

In this problem, the missed detection rate (classifying true singular points as forged ones) should be very small. The separating hyper-plane is defined by and b. In this paper, an optimal b0 is selected to move the separating plane to a suitable position that will misclassify less than 2 percent of true singular points as forged ones and, meanwhile, decrease the error of classifying forged singular points as true ones.

From the definition of DORIVAC features, it is observed that this vector is sensitive to image rotation. To prevail over the influence of image rotation, the training set is enlarged by rotating each fingerprint sample image by 10 degree increments. All of the samples are used for training the SVM classifier to make it insensible to image rotation.

Based on the SVM result, the decision can be made whether a point P in S' should be moved back to the final candidate set S or not. After this two-step classification process, a set of the forged singular points are removed. For example, Figs. 6e and 6f can be successfully judged as forged singular points while the other four are kept as true ones.

IV. SINGULAR POINTS SELECTION WITH GLOBAL INFORMATION

As pointed out earlier, local features alone are not enough to fully distinguish the true singular points from forged detections, which can actually have similar local characteristics as the true ones. This inspires to incorporate more global discriminative information for detection.

A. Removing Invalid Combinations:

The core-delta relation deduced in Part II is used as a global restriction for selecting the best set of final singular points. In real applications, many fingerprint images captured by optical or capacitive sensors are not complete. Often they will lose one or two deltas. In this case, the number of cores is not necessarily equal to the number of deltas. Nevertheless, (3) still presents us a global topological restriction for singular points. Suppose the effective region of the fingerprints is Ω. By computing we can know that only a few combinations of the singular points are valid. In Table 1, most of the possible combinations of singular points are listed for fingerprints with the Poincare´ Index and the possible types (PA—plain arch, TA— tented arch, LL—left loop, RL—right loop, TL—twin loop).

TABLE I : FREQUENT COMBINATIONS OF SINGULAR POINTS IN A COMPLETE FINGERPRINT

I(	Core	Delta	Possible Types
	0	0	PA
	1	1	LL,RL,TA
0	2	2	TL,Whorl
	1	0	LL,RL,TA
1	2	1	TL, Whorl
2	2	0	TL, Whorl

By calculating the global Poincare´ Index I ($\partial\Omega$) some invalid combinations of singular points can be removed. For example, when the global Poincare´ Index is equal to 1, the combinations of 1-core-0-delta and 2-core-1-delta are calculated and other situations are not considered. This speeds up the algorithm greatly.

B. Selection of Optimal Singular Points:

As known, singular points can be used to determine the global structure of the orientation field of fingerprints. The basic idea is to select the best singular points by decreasing the difference between the original orientation field and the model-based orientation field rebuilt using the singular points.

Denote the original orientation field as O_0 and the rebuilt orientation field as O(Θ.s), where Θ is the model's parameter. The original orientation field, O_0, is calculated by the hierarchical gradient-based method [21]. As for the model-based rebuilt orientation field, O(Θ.s), the Zero- Pole model proposed by Sherlock and Monro [5] is choose, considering both the model accuracy and the computational efficiency.

V. CONCLUSION

To sum up, the paper is focused on the detection of singular points in fingerprints. The contributions lie in two aspects. 1) a new feature, DORIVAC, in addition to the Poincare´ Index, which can successfully remove forged detections and 2) the topological relations of singular points is taken as a global restriction for fingerprints The optimal singular points can be selected by decreasing the difference between the original orientation field and the model-based orientation field rebuilt from the singular points.

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A Review on Wireless Communication Network in Smart Grid

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ABSTRACT

Smart grid revolutionizes the current electric power infrastructure by integrating with communication and information technologies. With wireless sensor network, smart grid enables both utilities and customers to transfer, monitor, predict, and manage energy usage effectively and costly. In order to build a reliable wireless sensor network for smart grid, an application review and taxonomy of relevant cyber security and privacy issues is presented in this paper. A unified framework for identification of applications and challenge issues of wireless sensor network in smart grid is developed. This paper focuses on identifying requirements for distribution feeder level communications. Due to the large number of distribution components connected to the distribution level feeders, a massively deployed wireless communication network is identified as the potential technology for this application. This network would allow prioritized communication: high priority for abnormal events and system control operations, and low priority communication for asset management tasks. A three-layer wireless communication architecture is proposed in this paper to increase the reliability and reduce the latency of event notification.

KEYWORDS – Communication Network, Distribution System, Smart Grid, Power System, Wireless Sensor Network.

INTRODUCTION

Smart grid can provide efficient, reliable, and safe energy automation service with two-way communication and electricity flows. Through wireless sensor network, it can capture and analyze data related to power usage, delivery, and generation efficiently. According to the analysis results, smart grid can provide predictive power information (e.g., meter reading data, monthly charge, and power usage recommendation) to both utilities and consumers. It can also diagnose power disturbances and outages to avoid the effect of equipments failure and natural accidents. Based on wireless sensor network, energy usage and management information, including the energy usage frequency, phase angle and the values of voltage, can be read real time from remote devices.

Reliable communications at the distribution level has high importance for the smart grid. There has already been significant work done on power system communication needs and applications. Even though 80% of consumer interruptions are attributed to distribution component failures at the feeder level, getting reliable information is currently a challenging task. Because of this, only limited monitoring is done on components in the distribution system and the associated communication infrastructure. Due to these difficulties, distribution failure/abnormality analysis is done by harvesting information from the components at substation level. There has been a significant amount of work to analyze such data, but even analyzing the whole feeder using information from substations will not capture all necessary information. Accurate prediction and location of distribution failures are still in an early stage of development. If the communication infrastructure is improved a more reliable approach could be taken and this would also aid better asset management strategies.

DESIGN FOR DISTRIBUTION SYSTEM & COMMUNICATION SYSTEM REQUIREMENTS

Traditional system control and data acquisition (SCADA) level communication has limited bandwidth, 75 bits/s to 2400 bits/s. Greater bandwidth is necessary if the information from the components is going to be used not only for monitoring (abnormality detection), but also for control and asset management tasks. Intra-substation communication is moving from binary or analog communication to Ethernet and TCP/IP based wide area network. Smart meter technologies are capable of using TCP/IP based communication to/from the control center. standard ANSI C12.22 standardizes the communication network for smart meters. Advancements in signal processing with low cost processors and networking technologies have made communication through TCP/IP more secure, cheaper and reliable. Using a common networking protocol for all the different levels of communication in a distribution system will optimize the infrastructure at the control center and increase its performance. Based on the above discussion, this work recommends a similar approach for the entire distribution system. The proposed communication network with different levels of communication is presented in Figure 1.

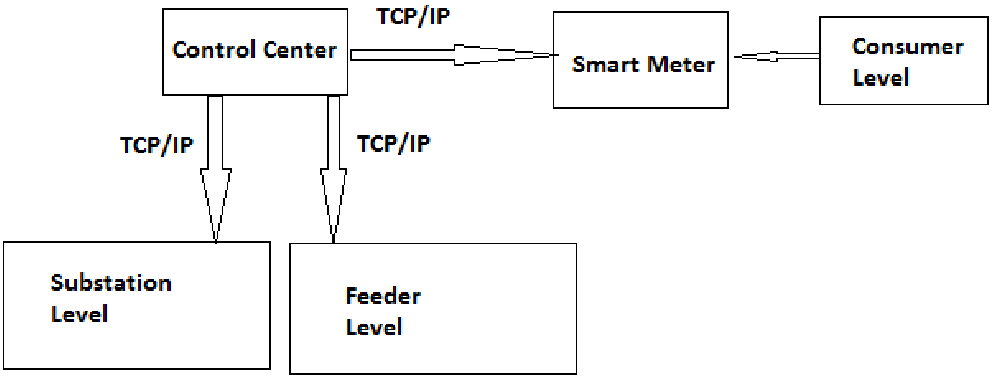

Figure 1: Communication Network for Distribution System

Figure 1 shows three levels of communication. Each of these networks would have two states of communication. The higher priority state would be the abnormal event state, where a detected event with estimated location would be transmitted to the control center for further action. The low priority will transmit component condition data for asset management tasks. It is also necessary to increase security of transmitted data to mitigate the effect of hacking and modifying data. Security and connectivity of components should be given a higher priority at the consumer level. Utilities have the burden of ensuring all components used are connected to the appropriate smart meter. These will all have significant impacts on choosing the medium of communication.

Wireless Sensor Network Applications in Smart Grid

For distributing energy power from power plants to end customers, smart grid contains three major processes: power generation, power delivery, and power utilization, wherein seven specific domains are going on: power plant domain, substation domain, distribution domain, market domain, operation domain, service provider domain, and customer domain. The collaborative and context-awareness nature of WSN brings several advantages over traditional sensing including greater fault tolerance, improved accuracy, larger coverage area, and extraction of localized features. Sensor nodes can monitor the overall network and to communicate with the control center in the power utility (e.g., a substation), in order to help operators decide the appropriate actions. The sensor node can communicate with the task manager via Internet or satellite. As shown in Figure 2, for developing a wireless sensor network for smart grid, there are three alternatives based on the IEEE 802.15.4 protocol: ZigBee, WirelessHART, and ISA100.11a. For example, ZigBee is a choice for smart grid system networking within home. Wireless- HART or ISA100.11a can be used in substation or a generation plant.

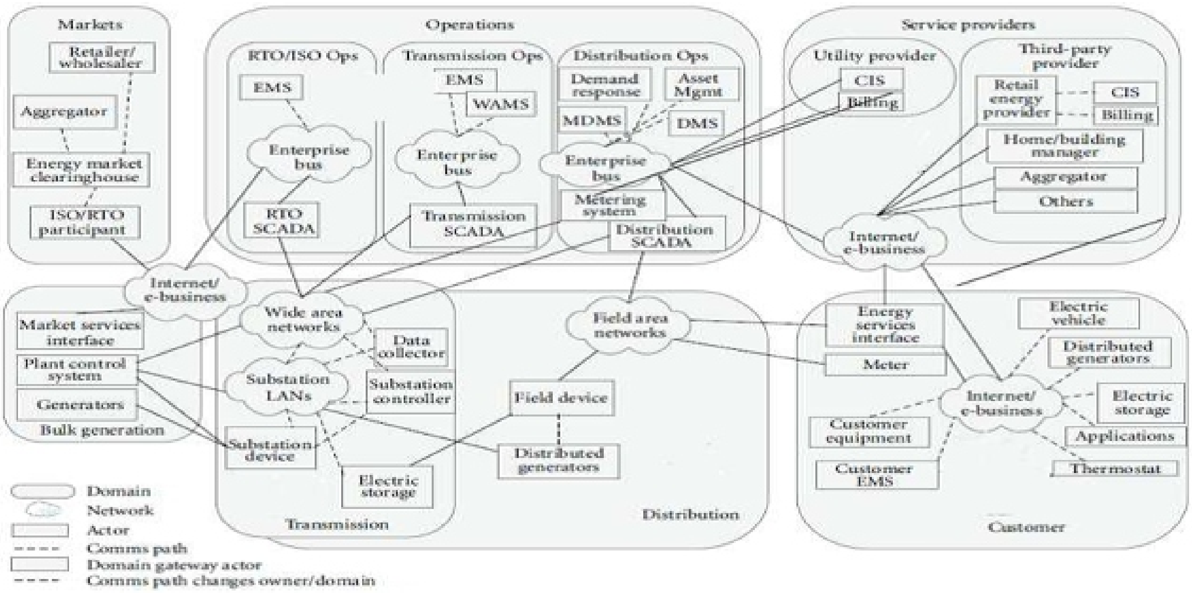

Figure 2: NIST Smart Grid Framework

Challenges of Wireless Sensor Network in Smart Grid

Although the wireless sensor networks have been facilitating different smart grid operation processes, the characteristics of differentWSNs applications are vastly different in features, data rate, and related standards. Common challenges associated with wireless sensor networks are probabilistic channel behavior, accidental and directed interference or jamming, and eavesdropping or unauthorized modification of the communications if not protected by authentication and encryption.

Security Requirements. Secrecy, integrity, and availability are three fundamental security requirements, and previous research has provided several basic goals for establishing secure smart grid over the wireless sensor network . The target of secrecy is to prevent passive attacks and unauthorized access to sensitive data, that is, power usage and billing information.

Integrity. The target of integrity is to ensure that the transmitted data is not illegally modified (e.g., changing, deleting, creating, delaying, or replaying data) from the sender to the recipient, and the identity and content of the received data must be verified to be the same as the original source. An authentication method could be developed for ensuring that the origin and destination of information is correctly identified, the injection of corrupted data by unauthorized entities must be prevented.

Availability. The target of availability is to ensure the wireless sensor network services to be available to authorized users on time, even in presence of an internal or external attack (e.g., denial of service attack). To reach this target, both additional communication among nodes and a central

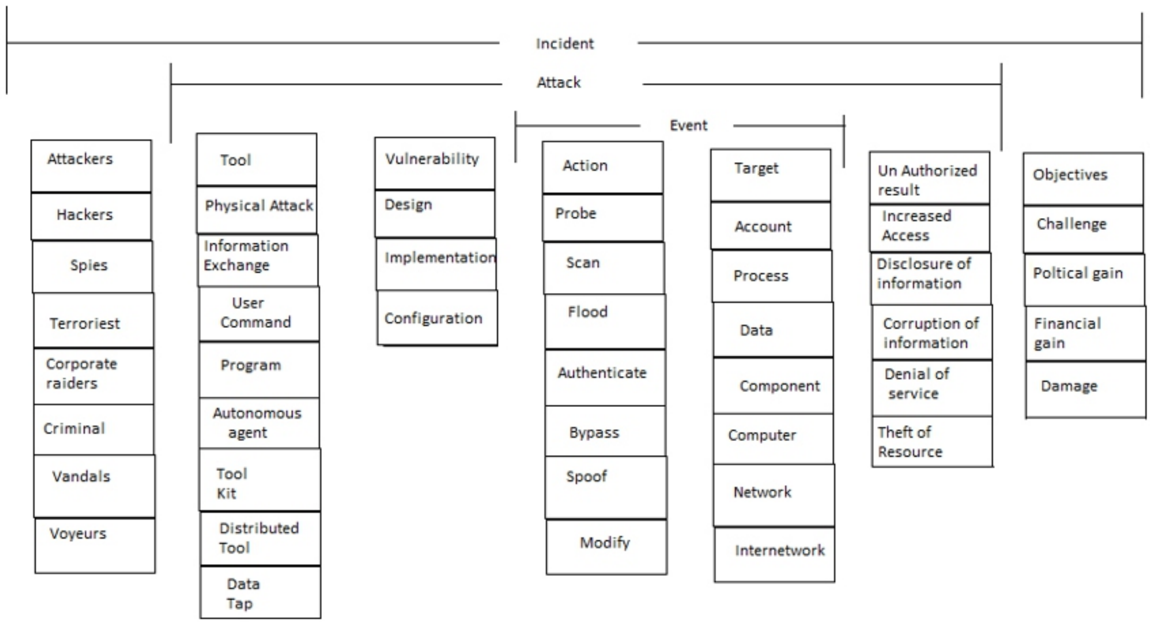

Figure 3: Attack taxonomy by CERT Coordination Center.

Attacks Taxonomy. CERT taxonomy focuses on incidents, and an incident within CERT taxonomy means that an attacker executes one or more attacks to achieve specific objectives. Additionally, based on the target each incident, different tools are used to exploit vulnerabilities to produce an unauthorized result.

Device Issues. Devices related with wireless sensor network include smartmeter and AMI devices. These devices bring significant advantages for users and create challenge issues at the same time because date and signals transmitted by these devices contain the information about presence of people at their residence and what appliances are in use. Depuru et al. listed certain sections of people who might be interested in collecting and analyzing the data transmitted through wireless network, including revengeful exspouses, civil litigant, illegal consumers of energy, extortionists, terrorists, political leaders with vested interests, thieves, and so forth .

CHOICE OF THE COMMUNICATIONS MEDIUM

Potential communication media for distribution system networking include power line carrier (PLC), wireless, and dedicated wired. When the substation is considered due to the confined physical space, a dedicated wired medium such as Ethernet is the best choice. When feeders are considered, PLC is well-suited, because it is a medium that is available throughout the distribution system. PLC has potential to transmit data at a maximum rate of 11 kbit/s; when the PLC has sufficient robustness and reliability, this maximum data rate can be achieved only in a narrow frequency range of 9-95 kHz. This low rate of communication is not ideal for secure communication. Therefore, if more information has to be sent from all the components in a feeder, higher bandwidth is required. Current developments in broadband over power line (BPL) technologies suggest that it is a promising technology. The distribution system will be affected by unpredictable voltage transients and harmonics, and these affect the reliability and speed of BPL. High frequency BPL signals need to bypass transformers to avoid high attenuation. BPL signals may also be blocked by voltage regulators, reclosers and shunt capacitors which are common for long radial feeders. The attenuation in a radial distribution feeder is high and this would increase the number of regenerators needed. It is expected that a typical 20-mile rural feeder would need 30-110 regenerators. This shows that even though the medium is free, BPL costs are significant. Another option is dedicated wired communication. One of the problems with copper wire connections is interference and attenuation. Fiber optic cables are a solution for interference but increase the cost. It should be noted that investment for a fiber optic network would be $10-100 million for 100 nodes. Newly developing communities could install a fiber optic communications network close to the feeders, so that this infrastructure could be shared for both smart grid and consumer communication needs. One of the advantages of this medium is that the utility has to bear only the terminal equipment cost and costs associated with leasing the line. This will reduce the overhead for the utility while improving communications. On the other hand the utility will not have control over the medium as it will not own the dedicated wired medium in most cases. This will require physical connections and will reduce the flexibility. Further when a pole goes down, the communication link will be broken and may result in poor performance. Wireless communication is another promising alternative for distribution level communication. One of the important characteristics of wireless communication is the feasibility of communication without a physical connection between two nodes. This would ensure the continued communication even with a few poles down. Wireless Fidelity (WiFi / IEEE Standard 802.11), ZigBee (IEEE Standard 802.15.4) or Worldwide Interoperability for Microwave Access (WiMAX / IEEE Standard 802.16) could be utilized in the distribution system with minimal interference. Another advantage of using wireless communication is that the utility has to own only the terminal units, which are relatively cheap and could be integrated with cost effective local processors. When multi- hopping is used in wireless communication, especially in WiFi and ZigBee, the range of communication can be extended and the nodes located in the feeder could be able to communicate with the control center. Disadvantages of wireless communication would be interference in the presence of buildings and trees which could result in multi-path; this can be avoided with improved receivers and directional antennas, which will increase the cost. Another major concern with wireless medium is easy accessibility, which could result in security issues. This can be avoided by using secure protocols. Rural feeder sections would be long and range of communication could become a concern; however, directional antennas could mitigate this issue. Both PLC and wireless communication are promising in the distribution level communication. Based on the need and the availability of the technology a combination of both could be used for improved communication infrastructure.

B. Feeder Level Requirements

At the smart meter level, a consumer will have three types of appliances, the ones which will not be controlled by the smart meter, e.g.: lights, cooker, etc, the ones which can be controlled by the smart meter, e.g.: washer, dryer, air condition, etc and the ones which needs to be controlled by the utility through the smart meter, eg electric vehicles (EV). This paper suggests three different types of communication for these three types.

The ones which need not be controlled by the smart meter needs only unidirectional communication, whereas the other two will need bidirectional communication. In order to minimize the cost the ones which may not be controlled could use PLC as the medium for communication. Due to the large amount of data and the possibility to communicate with the smart meter from different locations EVs needs to have wireless capabilities and should be able to have a secured connection to the smart meter via Internet. It should be noted that for controlled charging applications, EVs may have to communicate with the utility while on road and from locations where wired communication is not possible. To minimize the cost, overcome the restriction of range issue of sensor nodes, and increase the redundancy, a three layer communication model. This “no new wires” technology is developed to ensure easy installation on the existing system.

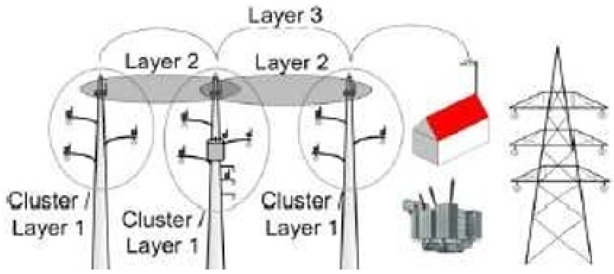

Figure 4: Three-Layer Communication for Distribution Feeder

Wireless sensor nodes with minimum processing capacity and with short transmission range are installed on the towers of the distribution system. Functionality of both transmitter and receiver are combined in these wireless sensor nodes. Since these sensors need to be deployed massively, the cheaper wireless sensor nodes are more economical. Each tower with the group of sensors is termed as the cluster.

CONCLUSIONS

This paper identifies requirements for distribution level communication and proposes three- layer wireless communication architecture. Various design choices made for this architecture are explained in terms of cost, reliability, and smart grid applicability. The number of applications of smart grid over wireless sensor networks has been steadily increasing, such as wireless automatic meter reading and remote monitoring systems. We have presented known attacks that can disrupt wireless sensor network in smart grid communication based on CERTtaxonomy. We modified the taxonomy based on the security analysis. We have discussed the recent trends of wireless sensor networks and illustrated basic security requirements to safeguard smart grid against these attacks. It is important to note that there is no single implementation that will define the communications architecture of smart grid. Although we realized security issues, the solutions may also require management effort with policy. It is misleading to suggest that IT people should take the full responsibility for wireless smart grid network security. However today, there are little common rules or standards for the data exchange or resources usage in the wireless smart grid communication.

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A Hybrid Model to Perform Segmentation on Biometric Images

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A B S T R A C T

Biometric Image segmentation is about the extraction of biometric features from a biometric image. This paper is divided in two stages namely the ROI identification and the feature extraction. To perform the ROI extraction, high level segmentation is required whereas for feature extraction, low level segmentation is done. In this paper, a hybrid model has been defined high level segmentation for hand image. For this two main approaches have been combined called morphological operator approach and the watershed segmentation approach. In this paper, in the primary stage the median filter has been applied to get the smoothness over the image. After the preprocessing, the watershed algorithm has been applied to perform the edge detection and morphological operator approach has been used to perform the region extraction and the region growing. As the final stage the adaptive thresholding has been defined to control the segmentation process and to obtain the object covered by the boundary. The paper is about defining the exact boundaries of the objects presented in a color space. The result analysis has been driven under different parameters. The work has been implemented in MATLAB environment.

KEYWORDS – Segmentation, Roi, Watershed Algorithm, Biometric, Morphological Operators, Image Filtration, Feature Extraction, Boundary Specification.

1. INTRODUCTION

Biometric Image segmentation is a promising research field in computer vision. It's basically use applications are development of more effective and friendly interfaces for human computer interaction, face detection, faces tracking, content-based image retrieval systems and gesture analysis. It can also be used for medical applications. Biometric Image segmentation is used to determine whether the color pixel is a Biometric Image or a non Biometric Image [1]. The face ROI extraction is either used as an individual application or it can be used as the preprocessing stage for many biometric applications. The extraction of face from multi-person image is used to count the number of persons in an image. The face detection is also the preliminary stage for gender recognition or the facial expression recognition [3][4].

The extraction of features based on the color analysis is also influenced by number of other factors. One of such factors is the lighting condition. If the image is brighter or darker, there is less difference between the facial image and its background so that there arises the requirement to change the threshold values respectively. It is required to take a dynamic decision to achieve an effective outcome from the ROI extraction process [2][3].

Skin Color analysis based face detection is one of the most popular and effective ways to perform ROI extraction from biometric image. This kind of segmentation is based on the color model. One of the most effective color models for such kind of extraction is YCbCr (Luminance, Chrominance(R), and Chrominance (B)). To identify the facial area over the biometric image, Chrominance (Red) has been generally used by earlier researchers [4][5].

2. PROPOSED WORK

To perform the biometric identification, one of the foremost tasks is to perform ROI extraction from biometric image. There are number of existing approaches adapted by different authors to per such kind of ROI extraction. But there are still some impurities while performing the ROI in such images. In this paper, a hybrid model is presented to perform the image segmentation on color biometric images. The presented model is a mathematical model in which basic image processing and segmentation approaches have been combined to perform the effective image component extraction and structure identification.

The paper deals with the method to perform the internal feature identification from an image. The proposed work begins with the pre-processing stage, where the transformation of the color image is performed. Here the transformation is has been performed to the grayscale image and the negative image. Once the transformation is has been done, the next step is to smoothen the image features, for that the median filter has been applied at the preprocessing stage. The next stage of the proposed work is to perform the image segmentation and feature selection. For this, the morphological operators have been used along with watershed algorithm. Just after the implementation of image segmentation, the final post processing has been done to present the effective results. The proposed work is about to identify the internal feature of the image, for this the sliding window based analysis has been performed.

Biometric Image segmentation algorithm is designed to determine whether the color pixel is a Biometric Image or a non Biometric Image. Biometric Image is a good feature for the detection of human face. Color allows fast processing. There are different color spaces which have been used for Biometric Image segmentation but color classification is done by using chrominance component because it is expected that Biometric Image segmentation might become more sturdy to lighting variations if luminance component is discarded [6][7]. The algorithm of the proposed work is given as under:

Algorithm (Img)
/*Img is the input image to the system*/

1. NImg=Normalize Image(Img)

/*adjust the size, brightness and contrast of input image*/

2. VImg=Change Model(Nmg,YCbCr)

/*Change the Color Model of Normalize Image*/

3. CImg=Get Chrominance(VImg)

/*Get the chrominance Blue image for the processing*/

4. Perform the Regional Feature Extraction from the Cimg

5. Perform the Boundary Extraction using Morphological Operators

6. Perform the ROI extraction using Watershed Algorithm

7. Perform Hole Filling using Morphological Operators to avoid small regions

8.Apply the boundary to the extracted region and present it as result

}

In earlier system, YCbCr algorithm was designed for Biometric Image segmentation in which Biometric Image portion and non Biometric Image portion were differentiated by tracing a group of pixels of an image. A Biometric Image threshold to segment people within the image was used for a particular color complexion and no filtering of noise removal and morphological operations were applied. In earlier system, YCbCr provided a better performance when Y is greater than 80 threshold values, Cb value lies between 85 to 135 and Cr value lies in the range of 135 to 180. However to find human Biometric Image from different races, the thresholds given above works only with a Caucasian people Biometric Image because the first threshold only finds people with white Biometric Image and the second threshold segments people of different places of the world but some pixels are detected as Biometric Image but really not. This is the reason to propose a new Biometric Image threshold to segment people.

To overcome the limitation of existing skin color based segmentation approach, a hybrid model is presented to perform the ROI extraction over the biometric image. The ROI extraction defined in the

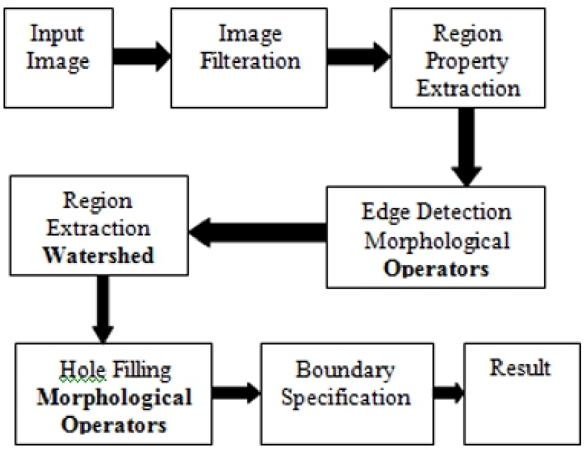

Figure 1: RESULT

2.1. IMAGE FILTRATION

Image filtration deals with converting the raw input image to normalized image. To perform such conversion, a series of mathematical operations have been performed. The first filtration operation is the noise removal from the image. To perform the noise removal, the median filter or Gaussian filter can be used. Just after the noise removal, the image enhancement and image resizing is performed. After these operations the image is transformed to a normalized image so that thresholding can be applied safely on such image [7].

2.2. HIGH LEVEL SEGMENTATION

Once the normalized image is obtained, the next step is to perform the skin segmentation. This work is again divided in two sub stages. In first stage, the color model of normalized image is changed to YCbCr. From this color model, Chrominance (Red) image is taken for subsequent processing. Chrominance (Red) is able to identify the skin area effectively. Once the area is recognized, a fix value based thresholding is applied to extract the skin ROI from the image [8][9].

2.3. MORPHOLOGICAL OPERATORS

Morphological operators are the mathematical operators that are used in this proposed work in two stages. In first stage, it is used to perform the edge detection and secondly they are used as the post-processing stage to perform hole filling. Morphological operators are able to analyze the geometrical structure and take the adaptive decision regarding the size, shape, convexity of the image. The obtained results shows the effective extraction of the ROI on biometric image [10][11].

2.4. WATERSHED ALGORITHM

Watershed algorithm is generally applied to a gradient image that uses the flooding process for the segmentation. In real environment, as the water level is increased, the water flow to the lower areas and fill within the down areas. In same way, after the identification of the bounds of the biometric region, the watershed algorithm is used to identify the biometric skin area. This algorithmic process is divided into two stages. In first stage, the ordering of the area is done based on the gray scale values and, later on flooding is performed to find the light gray areas that represent the low regions and dark gray areas that represent the boundaries of the biometric image. In this paper, watershed algorithm accurately identifies the biometric skin area [13].

3. RESULTS

The presented work has been implemented in MATLAB environment. The biometric hand and face images have been taken to implement the algorithm. The results obtained with the simulations performed are listed below:

CONCLUSIONS

In this paper, a segmentation approach on the biometric images is shown. The biometric image can be a face, hand or any other skin image. The presented hybrid model is the combination of watershed algorithm and the morphological operators. The obtained results from the system show the effective extraction of the hand area over the image.

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Prediction of Epileptic Seizure from EEG Signal by DWT And ANN Technique- A Review

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A B S T R A C T

Prediction of EEG signals has core issues on EEG based brain mapping analysis. Epilepsy is the most common neurological disorder which is characterized by sudden and recurrent neuronal firing in the brain. It can be detected by analyzing EEG of the subject. EEG recorded in the absence of an external stimulus is called spontaneous EEG; EEG generated as a response to external or internal stimulus is called an event-related potential (ERP). The amplitude of EEG of a normal subject in the awake state recorded with the scalp electrodes is 10–100 mV. In case of epilepsy, the EEG amplitudes may increase by almost an order of magnitude. In the cortex, amplitudes are in the range 500–1500 mV. It can easily display wave patterns like alpha, beta, delta, etc according to human behavior. EEG input signals are in stationary and non stationary form. It is very difficult to predict it. Various comparison and classification techniques are used to measure irregularities present in the EEG signals. Wavelet transform is the effective method for time frequency representation signal analysis. Artificial neural network is used for signal classification and tests carried out by hidden layer.

The classification of EEG signals has been performed using features extracted from EEG signals. Electroencephalogram is a medical technique that records the electrical activity in the brain. The EEG signals were decomposed into time–frequency representations using discrete wavelet transform and seizure signals were classified using a linear classifier .

Keywords—Electroencephalography, Epilepticseizure, EEGsignal , Dwt, Feature Analysis.

I. INTRODUCTION

An EEG machine is a recording device connected by wires to electrodes pasted at key points on the patient's head. Electroencephalogram is the recording of electrical activity along the scalp produced by the firing of neurons within the brain. The electrodes pick up signals produced by electrical discharge of neurons in the related areas of the brain. The different electrodes are used to recognize EEG test over the skull. Epileptic seizures are seen as a sudden abnormal function of the body, often with loss of consciousness, an increase in muscular activity or an abnormal sensation. It may occur in the brain locally called as partial seizures, which are seen only in a few channels of the EEG recording, or involving the whole brain called as generalized seizures, which are seen in every channel of the EEG recording. EEG is the most useful and cost effective tool for the study of Epilepsy. There is use of wavelet based features for the classification between normal and seizure EEG signals. EEG has been considered a successful tool in neuroscience to diagnose diseases and disorders.[1]

II. STANDARDS OF EEG MEASUREMENT

EEG is usually registered by means of electrodes placed on the scalp. They can be secured by an adhesive like embedded in a special snug cap. The resistance of the connection should be less than 5KOhms, so the recording site is first cleaned with diluted alcohol, and conductive electrode paste applied to the electrode cup. Knowledge of exact positions of electrodes is very important for both interpretation of a single recording as well as comparison of results, hence the need for standardization. Silva et al. [12] explained electrode system for EEG measurement which has the inter electrode distance of about 4.5 cm corresponds to placing 10-20 electrodes over the head. Gevins and S. L. Bressler [10] indicating sampling with 128 electrodes system which has inter electrode distance 2.25cm corresponds over the head. Electroencephalographic signals recorded according to such a system using a high spatial sampling frequency are called high-resolution EEGs. Several systems use 256 electrodes [12] to obtain a finer sampling of the electrical activity at the scalp. Recordings under these conditions are important for an appropriate application of signal analysis methods.

III. DATA DESCRIPTION

EEG signals are extracted from sophisticated machines in highly secured and de- noised labs are easily prone to artifacts and several other type of non-separable noise. EEG signal when analyzed has a very low frequency in the range of hertz. These EEG signals can be classified based on their frequency bands. The classification is shown in the Table mentioned bellow, it also mentions the region of brain from where it is extracted.

Type	Frequency	Location
Delta	Up to 4	Frontally in adults, posteriorly in children; high amplitude waves
Theta	8-Apr	Found in locations not related to task at hand
Alpha	13-Aug	Posterior regions of head, both sides, higher in amplitude on non-dominant side.
Beta	13-30	Both sides of Brain, symmetrical distribution, most evident frontally; low amplitude waves
Gamma	31-100	Somatosensory cortex

Table 1: Classification of EEG Signals based on their frequency

Also it is very difficult to extract EEG signal from the brain and separate the artifacts, based on the classification of their frequency it generates signals of those frequency and data will be simulated.

IV. SEIZURE DETECTION

The seizure detection problem is basically a classification between normal and seizure EEG signals. Y.U. Khan and O. Farooq, 2009 [8] explained the preprocessing system of EEG signal. This processing system can generally be subdivided to three functional parts preprocessing, feature extraction and classification. Normally the EEG data is corrupted by the artifacts which are electrical signals that are picked up by the scalp electrodes that do not originate from cortical neurons. There are various sources of articraft, one of the most common causes of artifacts is eye movement and blinking. Strong signals from A/C power supplies with 50Hz line frequency is another source of artifact. Signals originated due to muscle movements are another artifact. So the first step is to preprocess the data to remove these artifacts. The next step is to process the filtered signal and extract features that represent or describe the status and conditions of the system. Such features are expected to distinguish between normal and seizure.

Data Collection: Data collection is a process of gathering information from a variety of sources to get and accurate picture. The collection of data from surveys, independent or networked locations via data capture, data entry.

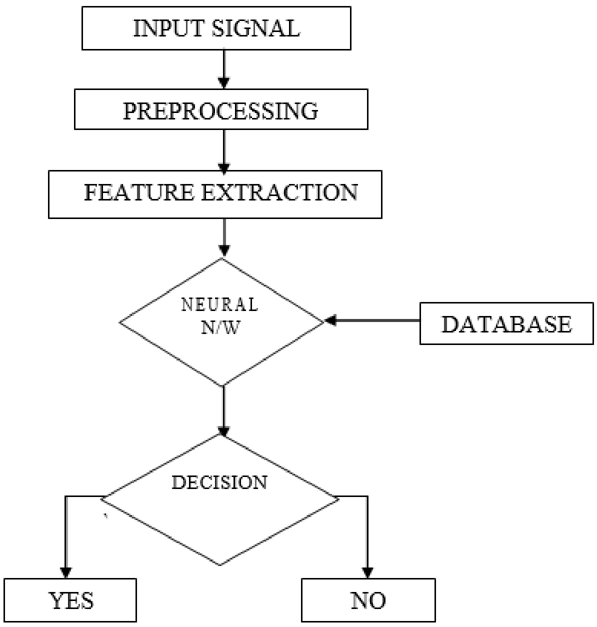

Figure1: EEG Preprocessing System

Preprocessing: It describes any type of processing performed on raw data to prepare it for another processing procedure. Data preprocessing transforms the data into a format that will be more easily and effectively processed for the purpose of the user. There are a number of different tools and methods used for preprocessing such as sampling, de-noising, filtration, normalization etc.

Feature Extraction: Features are functions of the original measurement variables that are useful for classification or pattern recognition. Feature extraction is the process of defining a set of features, or image characteristics, which will most efficiently or represent the information that is important for analysis and classification. A neural network consists of an interconnected group of artificial neurons, and it processes information using a connectionist approach to computation. In most cases a neural network is an adaptive system changing its structure during a learning phase. Neural networks are used for modeling complex relationships between inputs and outputs or to find patterns in data.

The last step is the classification and diagnostics. In this step, all the extracted features are submitted to a classifier that distinguishes among different classes of samples, for example, normal and abnormal. In the seizure detection problem this step is the classification between normal and seizure EEG signals.

V. Modeling and characterization of EEG signal:

The impact of EEG signal processing and modeling with respect to inter ictal activity, or epilepti form transients, and thus to the characterization of the irritative zone, can be considered according to two dimensions spatial and temporal. The spatial approach focus on the identification of brain areas responsible for the occurrence of epilepti form transients and their topographic properties .The temporal approach targets on the evolution of the occurrence of these transients.

A. The Equivalent Dipole Source Concept

The most common source model is the dipole layer. The main neuronal sources of epilepti form spikes consist of cortical patches and are capable of producing strong current dipoles, whereas the layer IV spiny stellate and layer III a spiny stellate cell with closed-field configurations produced weaker current dipoles. Baumgartner et al. [3] introduced dipole layers in strong and weak current dipoles.

B. Requirements for Time and Spatial Sampling

In order to apply EEG analytical tools to detect any kind of activity one has to perform a proper sampling both in time and space. These events have high-frequency temporal and spatial components and that their occurrence may involve very limited extent of the cortex. Some spikes may be accounted for a radial dipole localized in the crown of a cortical gyrus. J. Britz et. al 2008 [12] has applied 256 electrodes to obtain a finer sampling of the electrical activity at the scalp to acquire EEG signal. To perform the analysis of sources of various kinds of cortical phenomena, including epileptiform spikes, using high-resolution, EEGs introduced a de-blurring operation, i.e., a method to minimize the blur distortion that takes place in the transfer from the cortical surface to the scalp. The optimal potential distribution the cortical surface that provides the best-fit forward solution to the measured scalp distribution, using an appropriate volume conductor model.

C. From Topographical Maps to Source Modeling

The simplest and most general form of analysis of epileptiform transients is to perform topographical maps of the transients. The case of epileptiform spikes that are characteristic Epilepsy of Childhood that EEG analysis in providing insight into the abnormal neuronal processes underlying these events. In these cases there is a focus of epileptiform transients. G. Huiskamp et. al. 2004 [13] described a single or multiple dipolar sources depend on the nature of the epileptic condition, but is also affected by the analytical methodology applied.

VI. EEG CLASSIFICATION AND ITS OPTIMIZATION TECHNIQUES

P.K. Kulkarni (2013) used improved approximate Entropy hybrid technique for classification EEG signals for identification of epilepsy seizure. The system is combination of multi- wavelet transform and artificial neural network. FFNN is one of the artificial intelligence techniques, which is used for generating training dataset. From the generated dataset, the types of EEG signal classified as normal and epilepsy seizures signal. Approximate Entropy algorithm is enhanced to measure irregularities present in the EEG signals. The technique is implemented, tested and compared with existing method, based on performance indices such as sensitivity, specificity, accuracy parameters. EEG signals are classified as normal and epilepsy seizures with acceptable accuracy [2].

R Harikumar, M. Balasubramani, Saravanan S. (2013) explained implementation of a wavelet neural network (WNN) with learning ability on Field Programmable Gate Array for epilepsy detection. The electro- encephalography (EEG) signals were first pre-processed using discrete wavelet transforms (DWTs). Three different activation functions were used in the hidden nodes of WNNs Gaussian, Mexican Hat, and Morlet wavelets. The best combination to be used was the WNNs that employed Morlet wavelet as the activation function, with Daubechies wavelet of order 4 in the feature extraction stage. A more suitable method is the particle swarm optimization (PSO) that is a population-based optimization algorithm. In the approximation of a nonlinear activation function, there is use of Taylor series and a look-up table (LUT) to achieve a more accurate approximation. [4]

Sang-Hong Lee 2014 stated a method that uses a wavelet transform (WT) and a fuzzy neural network to select the minimum number of features for classifying normal signals and epileptic seizure signals from the electroencephalogram (EEG) signals of people with epileptic symptoms and those of healthy people. WT was used to select the minimum number of features by creating its coefficients. with the highest accuracy. It is obtained by using a non-overlap area distribution measurement method which is based on a neural network with weighted fuzzy membership functions resulted in satisfactory performance in terms of sensitivity, specificity, and accuracy[5].

VII. CONCLUSION

Electrode measurement systems are used to acquire EEG signal. The EEG signal is classified between normal and seizure EEG signal. In order to apply EEG analytical tools to detect any kind of activity, there is need to perform a proper sampling in time and space. Epilepsy can be described by a single or multiple dipolar sources depend on the nature of the epileptic condition. Field Programmable Gate Array implements classifiers to solve the statistical, identification and control problems and requires hardware implementation. To detect irregularities there is use of improved approximate Entropy hybrid technique for classification of EEG signals and for identification of epilepsy seizure. WT is used to select the minimum number of features by creating its coefficients with the highest accuracy. It is obtained by using a non-overlap area distribution measurement method. In the future, a recurrent wavelet neural network will be proposed for solving identification and control problems.

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