A Novel Approach for Identification of Unaided Person Using Finger Print Impression or Facial Recognition

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Abstract- *There are various algorithms to identify a person's finger print impression or face recognition. Some of the most effective include Minutiae Matching, DCT using RBF Neural Network. But the algorithms using Support Vector Machine (SVM) proved to be most efficient. The use of SVM with the algorithms increases their accuracy and efficiency with respect to time and results. As SVM is a classification algorithm, it has the capability to classify the points or sets in much precious manner. There are various applications that use SVM for classification purpose. A thorough search has resulted into selecting SVM for the system. Different phases of the system use the SVM differently. But what makes it most reliable is its advantage of redundancy. The use of SVM increases systems accuracy and response time. Although, the configuration of the phone does matter a lot, as this is an android based system. As the world is growing more prone to the technology and smart phones, there are well developed and high configured phones. The majority of them use Android today. So an android based system is developed for compatibility and ease of use to users.*

Keywords- Android, Finger Print Impression, Facial Recognition.

I. INTRODUCTION

There have been various systems to identify a person. There have been systems to send alert messages from a remote location. The systems capable of doing this are all great in there own way. But they are not enough capable of reducing a man's job of tracking a member of a person's family or someone they know. An authority has to use this multiple systems for the identification and alerting process. Sometimes it has to be done manually. The individual systems capable of doing this sometimes may be expensive for an organization. If not, the manual processes to be done, does take a long time and also consume more energy. There have been many cases of lost / missing person, in a bomb blast or mass shooting. The world already faces many serious attack by terrorists. Besides there are people who lose there family or leave there family member for their personal reasons or reasons unknown. To help such families / friends, the police or the concerned authority have a lot of paper work to catch on. Also this takes a long time. Identification of Unaided Person Using Finger Print Impression or Facial Recognition uses a person's registered data to later identify him or her and send alert to their family, friends, police or hospital authorities, with respect to the situation.

II. RELATED WORK

The research for the system included study of some algorithms for facial recognition like DCT using RBF neural network, principal component analysis using eigenfaces, Fisherface algorithm, etc. And for finger print impression pre-processing algorithms, pattern-based algorithms, alignment-based algorithm, etc., were referred to. The most effective algorithm for identification and recognition of finger print impression and facial recognition were the machine learning algorithms based on Support Vector Machine (SVM). It is a supervised machine learning algorithm used for classification and regression problems. SVM is the best frontier to segregate the classes using hyper-plane / line. The maximum distance between the nearest data point and the hyper plane is called as Margin. This margin helps us to segregate the classes accurately. The SVM has many advantages amongst which the most useful for our system are redundancy and its ability to avoid over fitting. The system needs to be redundant because there will be a huge data that needs to be verified as much precisely as possible. With the technology running around the new developed system need to be very precise and redundant. They carry a high processing power in order to process large data in short amount of time. The SVM classifier's functionality is very simple to understand. Initially the input data is provided to the classifier as training data. The classifier maps the extraction points from the input and stores in the memory. Now when input data is given to the classifier, known as test data, this data is compared with the training data. The classifier first extracts the feature extraction points and maps it with the training data points extracted before. The

efficiency of the result depends on how exactly and accurately the points from the training data and test data are mapped to each other.

III. SYSTEM ARCHITECUTRE

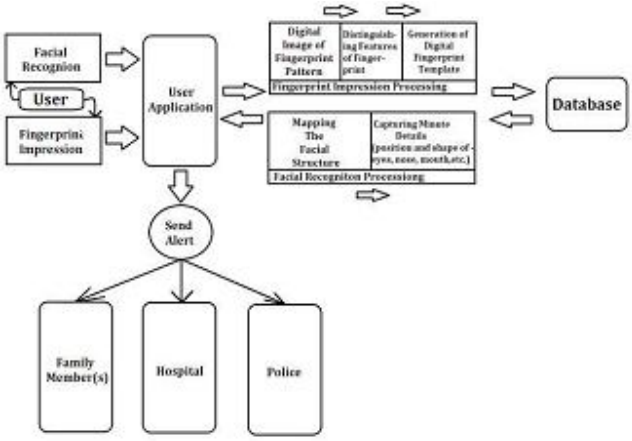

Fig No.: 01 – System Architecture

The system architecture above shows the working of the system. This is an android application. User is the person who is to be identified. The identification of the person is done using two methods. The first method is by their Fingerprint Impression and the second method is through the facial recognition. The test data captured is processed and compared with the training in the database. After the points are mapped and they are matched, an alert is sent to the nearby hospital, nearby police authorities and as well as to the person's family members associated in his / her registered details.

System Modules

1. Smart phone with Android OS.
2. Face Recognition.
3. Fingerprint Impression Recognition.
4. Fingerprint scanner.
5. Database.

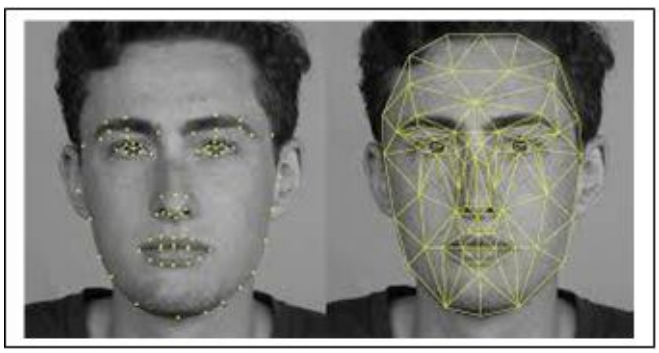

Fig No.: 02 – Measuring Facial Features

Facial Recognition:

Facial Recognition technology was commonly viewed as something straight out of
science fiction. But over the past decade, this groundbreaking technology has not
just become viable, it has become widespread. In fact, its difficult to read technology
news these days without seeing something about face recognition. The technique is
capable of identifying a person using just a picture or a sketch. The system then
matches the particular features and measures the particular attributes. But with the
time, as the person grows the face goes under changes like the facial structure may
change or wrinkles may change the look and many other attributes affect the recognition process. Also it may affect if someone goes under plastic surgery.

The Facial Recognition system uses Discrete Cosine Transform and Radial Basis

Function Neural Network. It consists of 2 modes:

- Feature Extraction
- Template Database + Matcher

The Feature Extractor transforms a face into digital string. This digital string is saved
in a database as the unique facial signature of an individual. When required a search
is performed against the database to identify the individual. The Feature Extraction
has 3 sections, namely, Discrete Cosine Transform(DCT), Clustering Algorithm and
Fisher Linear Discriminator(FLD). The Feature Extraction reduces the dimension of
the original face into a very compact and unique facial signature using DCT. The
Template Database + Matcher use RBF Neural Network.

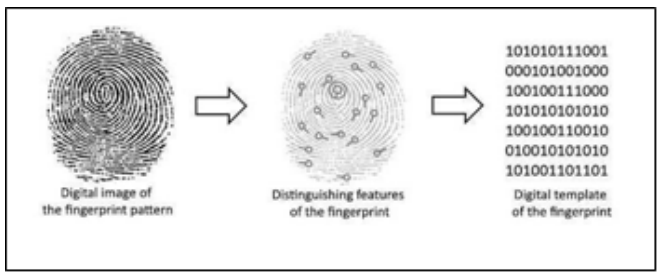

Fig No.: 03 – Conversion of Fingerprint Impression

Fingerprint Impression Recognition:

Fingerprint Impression Recognition is one of the efficient method to identify someone using fingerprint impression, Global Minutiae Matching and Support Vector Machine (SVM).

Global Minutiae Matching takes 2-class model using sets of minutiae from fingerprints from same and different person. The similar set of fingerprints is extracted and
given to the recognizer; using the genuine match the similarity score is calculated.

From the given potential list, to eliminate false matches, a static classifier such as
Support Vector Machine (SVM) is used.
First the enrollment phase takes place which involves getting the fingerprint along
with some identification like user name. The user name will be used just to check
whom does the fingerprints belong to. The fingerprints will be stored in the system.
The fingerprints stored in the system are the fingerprints template and not the actual
image of the prints. The identification process is performed in 2 phases. In the 1st
phase SVM is trained. In this, after the enrollment, The representation used for the
storage of the prints is Minutiae points list. The list of points has the points of irregularity in the fingerprint ridges. There are 30-50 of irregularity points present on
each fingerprint.
For the verification phase, a template that contains the information of the minutiae points for testing is generated. Then the generated template is compared with
the users stored fingerprints. For matching the prints and to arrive at a result, the
recognizer is provided with reference prints. This is required to map the prints from
2 templates, using the translation and rotation parameters.

Fingerprint Scanner:

Fingerprint scanner is a device that is used for scanning a fingerprint and then using at the time of identification and recognition.

Database:

Database is used for maintaining the records of the users. The databases used for facial recognition and fingerprint impression are different. The database used for saving facial scans and fingerprint impressions is S3 and for saving the records of the users DynamoDB is used.

IV. ALGORITHMS

Fingerprint Recognition using SVM Algorithm –

Step 01: Sort the template and input minutiae set by radial angle and radial distance in descending order.

Step 02: Consider, the reference minutiae points and convert into polar coordinate
system with respect to reference minutiae by following:

For all minutiae (xi, yi, θi) ↑, apply the following:
Step 03: Find the minutiae type, if it is same, then proceed to step4. Else find
next minutiae.

$$\begin{pmatrix} r_i \\ a_i \\ \theta_i \end{pmatrix} = \begin{pmatrix} \sqrt{(x_i - x')^2 + (y_i - y')^2} \\ \tan^{-1}\left(\frac{y_i - y'}{x_i - x'}\right) \\ \theta_i - \theta' \end{pmatrix}$$

Where, (x x , y x , θ x) ↑, is the coordinate of reference minutiae and (r i , a i , θ i) ↑ is in the
polar coordinate system (r i represents the radial distance, a i represents radial angle
and θ i the orientation of minutiae with respect to reference minutiae).
Step 04: For each set of minutiae calculate the following (L=number of points
recorded).

- Radial Distance =1/L (Σ| r(di)-r(di)|), for 0≤ i≤ L
- Radial Angle =1/L (Σ | a i − a j |), for 0≤ i≤ L
- Minutiae direction = 1/L (Σ | θ i − θ j |), for 0≤ i≤ L

Step 05: Compute the similarity score of two minutiae sets by summing the radial distance, radial angle and direction.

Step 06: Let, ε be the threshold assumed. If the similarity score greater than ε
then we conclude two minutiae pair is matched.

Step 07: Calculate the matching score using: Match score =m 2 /(M i ∗ M x)

Where, m is the total number of matched minutiae pairs, M i , M x is the number of
minutiae points in the input and the template fingerprints.

Step 08: Record the maximum number of matching minutiae pairs.

Facial Recognition using SVM Algorithm -
Step 1: The eigenfaces, the image index along with the projected image are loaded
into the computer system.

Step 2: The image to be tested is allowed to go through the feature extraction process
in order to get its feature vector.

Step 3: This feature vector of the test image is then compared with the projected
images of the training set in the database.

Step 4: The Euclidean distance between this tested image and the projected image in the database is then calculated.

Step 5: The smallest Euclidean distance that corresponds to an image in the training
set is assumed to be a match. It is selected along with its index.

Step 6: If the index of the test projected image and the projected image of the training set happens to be the same, then there is a valid match. Otherwise, it failed the
test of success.

Step 7: This process is repeated for the rest of the images to be tested.

V. MATHEMATICAL MODEL

Let G is the proposed system,
Such That G= {Q, ε, δ, q0, qf}

Where, Q = Set of States,
ε = Set of Inputs,
δ = Set of Transitions or functions,
q0 = Start state,
qf = Final State.

Q= {q0, q1, q2, qf}
ε= {FP, FR, Exit}
Where, FP= Fingerprint, FR= Facial Recognition.

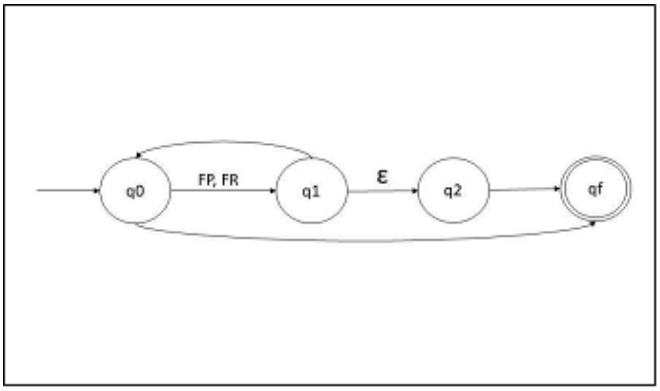

Fig No.: 04 – Mathematical Model Representation using Finite Auto Meta

Where,
q0= FP or FR Scanning
q1= FP or FR Processing
q2= Send Notification
qf= Stop FP or FR Scanning

$\delta (q0, \{FP, FR\}) = q1$ (1)
$\delta (q1, \varepsilon) = q2$ (2)
$\delta (q2, \varepsilon) = qf$ (3)
$\delta (q0, exit) = qf$ (4)

VI. EXPECTED RESULTS

The system results are assumed as it is a prototype and there are no exact references to refer from. This android application is capable of performing registration, fingerprint recognition, facial recognition and sending alert message to the associated contacts. The below snapshots show us the expected results of the system.

Fig No.: 05 – Snapshot of the system's login module

Fig No.: 06 – Snapshot of the system's registration module

Fig No.: 07 – Snapshot of the system's recognition module

Fig No.: 08 – Snapshot of the system's alert module

VII. CONCLUSION

As there are no existing systems, the testing of the system is done considering various parameters of different individual systems. Different parameters like time with respect to storage and retrieval of data, size of image, delay time depending upon the network connectivity, etc were taken into consideration. The system's working principle is interpreted systematically. The results obtained are expected results as it is a prototype. And these results will be further examined and tested for more precise and efficient output.

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