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LOCKER SYSTEM: DEVELOPMENT OF INTELLIGENT SURVEILLANCE USING SECURE ONE TIME PASSWORD AND FACE RECOGNITION

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ABSTRACT

Present day locker systems are not highly secured. In order to overcome the various security issues proposed a locker system using latest technologies like IoT (Internet of Things) coupled with Facial recognition system and generation of OTP (One Time Password). IoT is one of the latest technologies where the various smart electronic devices are connected using the internet with the help of sensors, actuators in order to exchange information. Face recognition system is another application which ensures that only authentic user gets to access the locker by ensuring verification of facial features. To access the locker, the user has to type the locker PIN (Personal Identification Number). The camera module is initiated for the facial recognition after the verification of pin is validated. Using Viola Jones Algorithm an efficient face detection system is developed. Extractions of facial features are being carried out efficiently using GLCM (Grey Level Co-occurrence Matrix), HOG (Histogram of Oriented feature Gradient), and Gabor Filter techniques. After verifying the authentic user an OTP is sent to the registered mobile number. If any of the credentials do not match then the system will capture the intruder's face and simultaneously an email and a SMS (Short Message Service) will be sent to the registered mobile number through which one can inform to the police.

Keywords: GLCM, HOG, PIN, SMS, IoT, OTP.

1. INTRODUCTION

Present technology of today's world is running with the usage of smart devices. Physical connectivity of inter networking of these smart devices is IoT. IoT is a trending technology which deals with the inter networking of physical devices such as vehicles, embedded systems through sensors, actuators, software and electronics which enables the device to exchange information from one to other. IoT allows these devices to be controlled remotely across the existing network, reduces the human effort and has economic benefits along with efficiency, secure and accuracy. The trending technology has become an initiation for the development of smart grids, smart homes, intelligent surveillance and smart cities. Proposed method deals with this current technology which is a part of intelligent surveillance that is security for the locker systems for intruder tracking using face recognition and secure OTP.

Face recognition system is an application which is used to identify or verify the face of the person. Face recognition is used majorly in security surveillances for security purposes. Face recognition is done by extracting features of face by using face recognition algorithms from the subject's face. Input data can be collected from camera where the camera will detect only face by forming rectangular boxes. Face recognition is an application which can be used by the smart devices like grids, cities etc. Proposed system uses this current face recognition application for the increase in the growth of security for the locker system. Proposed method uses Viola Jones algorithm, GLCM feature extraction, Gabor filter and Histogram of oriented gradient feature extraction.

A dynamic password is created which can be used for only one session which incorporates a two way authentication using mobiles. Several algorithms are proposed for generation of one-time password. Proposed method uses a Secure Hash Algorithm. In the proposed framework a novel method for security of locker system has been proposed by using secure one time password and face recognition.

This paper is organized as follows: Section II gives the related work information, in section III given the proposed method, in Section IV given implementation, in Section V given methodology of proposed framework, in Section VI given Results, in Section VII given conclusion, in Section VIII given references.

2. RELATED WORK

[1] The integration of two entities, the IoT and cognitive dynamic systems studies a smart home scenario. By using CDS (Cognitive Dynamic System) paradigm for enabling the internet of things with cognition is the smart home with the application of interest. Therefore the combination of CDS and IOT to form a CIOT (Cognitive Internet of Things) is anticipated to have great advantages comparative to existing smart home systems. Cognitive actions being performed from one cycle to the next the quality of the service and the experience of CIOT is significantly improved.

[2] Applications of IOT includes but not limited in the smart cities and smart homes and logistics is entering the daily operation of many industries. In the smart building arena some of the technical opportunities offered. The technical challenges faced by the IOT are discussed. The evolving Technologies like BMS (Building Management System), PoE (Power of Ethernet), IoT, Cloud services do converge networks can handle the issue save the expenses and future proof their environment and their investments.

[3] Identification of information security requirements in the several sectors which are common in particular that impacts on various services namely energy

water and health management systems. Here study can be done by Interview based where actors were asked about perceptions and attitudes of IoT in the security. Overall view on IoT in CSS (Critical Societal Services), lack of consensus on risks based on IoT security is proposed.

[4] In IoT environment the main challenge of the biometrics based security solutions is end to end communications between the smart things or devices. The infrastructure of biometrics based solutions for IoT was proposed here. The two factor authentication based on passwords along with second level protection may not be efficient for providing end to end communication solutions among several services and devices which are connected to IoT. IoT based solution using biometrics and pairing based cryptography is used here.

[5] A smart home system is proposed through IoT. In this paper security for smart home system is proposed. Cloud services are used to store the information obtained from the sensors used. Community broker is present to establish the connection between the servers and cloud. MQTT (message queue telemetry transport) is an ISO standard used as a light weight message protocol which is used as a messaging service.

[6] Segmentation of image is done using an Otsu's method in which it follows a recursive method.

[7] Extraction of facial parts such as eyes, nose and mouth from inclined face is proposed. By using Viola Jones algorithm consider the face components and Harris Corner Points which are located on the face to detect the corners of the face is presented. Eye Canthus is proposed to locate the points using Harris Corner Points and an inclined angle is drawn between these points using references.

[8] Facial emotions are recognized by using Viola Jones and EHOG (Edge Histogram of Gradients) in the application of psychotherapy is presented. In this paper combination Viola Jones detector with the feature descriptor that is EHOG is used to detect the seven emotions of the person's face. By using support vector machine the emotions can be captured.

[9] Head pose estimation using kinect camera in the applications of several computer vision is presented. A boosted method is proposed to determine the head gesture detection using RGB and profile Viola Jones face detector is to confine the location of search window. By depth face path in RGB the appearance features are extracted. HOG features and support vector machine is used to recognize the gesture.

[10] Recognition of facial emotions through face muscles inspired by FACS (facial action coding system) and Facial action coding system affect interpretation dictionary is proposed. Images of user's face are captured by web camera and emotions are classified by using a computer vision system which uses web services as a platform. Viola Jones algorithm is used for face detection and segmentation. Eye canvas is also used to identify the face emotion.

[11] A set of heuristic light weight features to describe eye regions in the face recognition is proposed. Classification of false positive points and positive points are proposed. Classification is performed by applying simple threshold proportional to the variance of data is done this system. Viola Jones algorithm is proposed. Considering pair heuristics increases performance for detecting the face.

[12] To accurately characterize the intrinsic structures of human face that are invariant to the in plane transformation of training images uses a TIPCA (Transform Invariant PCA method) is proposed. Local Binary Pattern, HOG, Gabor energy filter, SVM (Support Vector Machine) are benefitted by this. TIPCA method is explained face alignment and face coding using Eigen faces are proposed.

[13] Adrogenic hair patterns are used to identify the criminals and its technique is proposed. Hair pattern identification and criminal identification is implemented to recognize by using Gabor filter feature extraction. Algorithm for extracting Gabor filter is proposed.

[14] Facial recognition using HOG, group sparse coding is proposed. Testing samples are identified by the HOG and sparse coding to form sub dictionary. By evaluating the training samples leads to recognize the face. HOG is extracted to represent face image. Standard sparsity concept is focused to identify the sparsity of coefficient vector. [14] Sparse representation classification is presented for the facial recognition in smart phones. A classification algorithm is proposed along with open CV or Eigen face algorithm uses random projection matrices by optimizing to train the images even in the low light conditions are proposed.

[16] A multi model authentication is proposed that uses one time password client allows the user whose functional impairments adversely affect their ability. Secure and inclusive authentication method is presented to perform the easier transactions for users to access.

3. PROPOSED METHOD

A novel method of approach is implemented for the development of security for locker system. A locker system is developed using face recognition and secure one time password. The locker system is attached with the high resolution camera, a screen with keypad. The camera will capture the people face and the captured image will be verified with the database records. Verification and validation of image will undergo further process. Firstly the image is captured is of face of the person. For finding the face from the input image the face discovery calculations are made and the cropping of the face will be done using Viola Jones algorithm. Feature extraction techniques are used for matching the face features relating to the image present in the database records. Viola Jones algorithm is used for pattern matching for extraction of features.

For extracting the features of face will be done using Gabor filter, Grey Level Co-Occurrence Matrix and Histogram of Oriented Gradients. Using the Pinhole camera allocated in the locker in front of the person with the range of 60 to 80 cm distance the face of person can be captured as an image which can be recorded continuously. In a 24*24 pixel sub window when an image has been

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tested to evaluate there are a total of 162,336 possible features. The image detection framework contains a learning algorithm AdaBoost to select the both best features and for training the classifiers which uses them.
Characteristics of Viola Jones:

- Robustness- The detection of face is in high rate which has very low false positivity rate.
- Real Time Application- The processing of detecting is at least 2 frames per second.
- Detect a live image.

In a 24*24 pixel sub window when an image has been tested to evaluate there are a total of F=162,336 possible features. The image detection framework contains a learning algorithm Adaboost to select the best features and for training classifiers of an image. This algorithm constructs a "Strong" classifier to the linear combination of weighted simple "weak" classifiers.

$$p(k) = sign$$

This includes weak classifier which is a threshold function based on feature.

$$M(k) = \theta\left(\sum_t R_t(k) + \alpha\right)$$

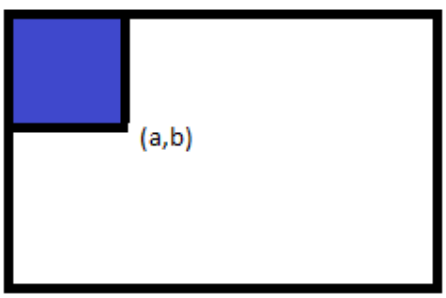

Figure-1. Pixel value of an integral image.

Figure-1 shows the pixel value of an image. At each pixel an integral image captures the image and computes the pixel value. That is the sum of both the pixel value and unshaded region.

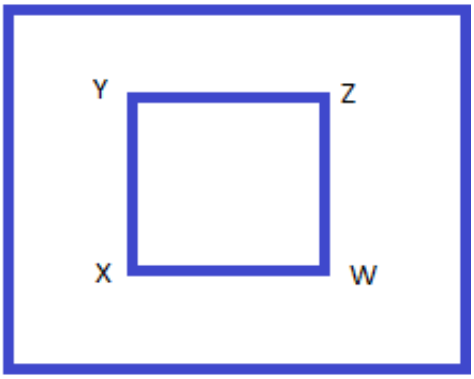

Figure-2. Computation of sum in rectangular region.

Only three additions are required for any size of rectangular frame. Figure-2 shows computation of sum within Rectangular region. Let w, x, y, z are the values of an integral image at the edges of the rectangular frame.

a. Feature selection

For every round of boosting

- Evaluate the rectangular filter on an each image.
- Sort the values by using filter.
- Select the best threshold for every filter (min Z).
- If it is a feature then select filter or threshold.
- Reweight the examples.
- M filters, T thresholds, N examples, L learning frame
- (MN) Adaboost feature selector is used.

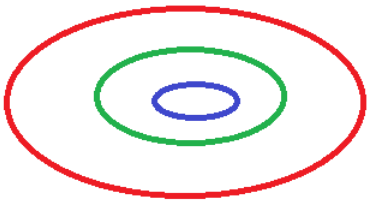

Figure-3. Nested classifiers.

Figure-3 shows a nested setoff classifiers hypothesis classes are presented to build fast classifiers.

a. Graph:

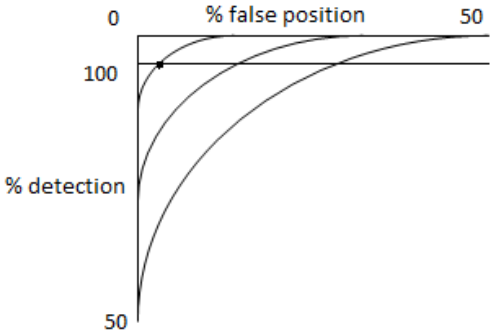

Figure-4. Comparision graph of false position and detection.

Figure-4 shows the graphical comparision and relation between the false position and detection rate of an image classifier. 1st feature classifier achieves 100% face detection rate and about 40% false positivity rate.In 6 features classifier achieves 100% face detection rate and

about 20% false positivity rate.In 20 feature classifier achieves 100% face detection rate and about 1% false positivity rate.

b. GLCM features (Grey level Co-Occurrence matrix)

GLCM based feature extraction involves

a) Spatial features

Spatial Features of an image is considered by its gray level, amplitude and spatial distribution. Amplitude is one of the most important and simplest features of the object image. Amplitude represents body masses and enables discrimination of bones and tissues.

b) Histogram features

A histogram feature of an image refers to the intensity values of the pixel. The histogram shows the pixel of an image at each intensity level. There are 250 possible intensity values for 8 bit gray scale image. It indicates the low contrast region. Some of the histogram features are mean, variance, skewness, median.

c) Color features

The visual attribute of an image is described by its color which results from the light emitted or transmitted or reflected or refracted. The color signal is an extension from scalar signal to vector signal. Color features are derived from the histogram of the image. In CBIR (Content –Based Image retrieval) systems every image is analyzed to compute a color histogram which is added as the collection in the database.

d) Shape features

The shape of the object image refers to its physical structure and its profile. Shape feature is widely used for finding and matching the shapes for recognizing the object. The shape of an object is determined by its properties such as color, content and composition of material.

In GLCM Co-Occurrence matrix and texture feature are the most familiar second order statistical features. GLCM has 2 steps for texture feature extraction.

- Computation of Co-Occurrence Matrix.
- Calculation of texture analysis.

GLCM is the distribution of pixel values (grayscale values) as (delta x, delta y) which are labeled as position operators can be applied to any pixel of image. The Co-Occurrence matrix is very large and sparse in nature which is used to extract the features.

e) Energy

The repetition of the pixel pair to its extent by measuring is defined as energy. Uniformity of an image is measured. The energy value is big when the pixels are same. Equation of the pixel energy is given as

$$E = \sqrt{\sum_{j=0}^{M-1}\sum_{k=0}^{M-1} N^2(j,k)}$$

f) Entropy

Entropy is the concept of thermodynamics. It is defined in such away as the randomness of the measure which is used to characterize the input image texture. Entropy is large in value when all the elements of co-occurrence matrix are same. Equation of Entropy is given as

$$Entropy = \sum_{j=0}^{M-1}\sum_{k=0}^{M-1} (N(j,k))\left(-\ln(N(j,k))\right)$$

g) Contrast

The measure of an identity of pixel and its neighbor is known as contrast. The difference in the color of image and brightness is determined by the contrast.

$$Contrast = \sum_{j=0}^{M-1}\sum_{k=0}^{M-1} (j-k)^2 N(j,k)$$

Gabor Filters are similar to the human visual system where frequency and orientation are used for extracting the features of face. Gabor filter are familiarly appropriate for texture representation and discrimination. Gabor filter is modulated by a sinusoidal plane wave. Image analysis is modeled by using Gabor functions that is Gaussian function. Gaussian function is multiplied by the sinusoidal wave to get the impulse response. Gabor filter uses Fourier transform of the harmonic function and Fourier transform of the Gaussian function. Gabor filter has real and imaginary parts representing orthogonal directions. Gabor filter relates similar to the Gabor wavelets resulting in dilations and rotations.

HOG is a feature extraction of face used to detect the objects mainly used by the Viola Jones detectors. To detect the human faces while capturing the image proposed method uses HOG image descriptors and Linear Support Vector Machine (LSVM). Steps followed during extraction. They are:

- Extraction of HOG descriptors from positive samples.
- Extraction of HOG descriptors from negative samples.
- Training LSVM samples.
- Applying classifiers on samples and computing HOG descriptors.
- Collection of false negative samples from negative mining stage.
- Testing with database.
- By using Euclidean distance face recognition is done.

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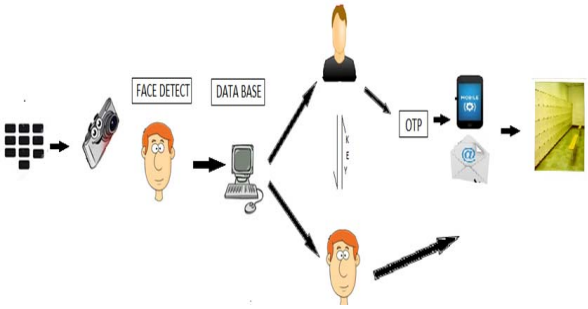

Figure-5. Architecture diagram.

Figure-5 shows the architecture diagram of the proposed system which uses face recognition and secure one time password for secure access of the locker system. In the proposed framework to access the locker the user must enter the locker password. The system will validate the locker password and verifies it. If entered password through input keypad is correct then the camera attached to the system will be initiated for capturing the image of the user. Through camera face of the person is captured and processed. In the proposed framework processing is done by extracting the facial features and face of the user is captured and validates with the present database records. If the captured image is matched with the records then the OTP will be send to the registered mobile number of the owner. If the individual type the OTP then the system confirms the input OTP with the database generated OTP. If the OTP entered as an input matches then the individual can get access his locker.

If the user entered the wrong locker password then the system sends the message to the registered mobile number of owner informing him that someone tried to access the locker system.

If the user entered the right locker password and the camera will be initiated and captures the image. Then the system uses the captured image for checking the image with the database records for verification. If the image doesn't match with the database records then the systems sends the image to the owners Email and the system also informs the owner by SMS. With this information the owner can make a report to the police and can share the image of the intruder with him along with the location of the locker system where it is located.

The camera used is of high resolution where brightness, chroma, contrast can be adjusted based on the owner's convenience. Locker system is also attached with the LED (Light emitting Diode) for night vision and even in the low light conditions. A network keypad used is of 5*5 layers, where the keys are similar to the game plan. Locker system is connected with the internet so that an email of the intruder can be sent to the owner. The system accessibility can be done only by the owner by entering into the database server. The owner can only have the accessibility if he needs to change the locker system password by entering the profile password. If incase the owner forgets the profile password then he can reset the password by means of answering the security questions which are to be kept at the first time of the initialization of the locker.

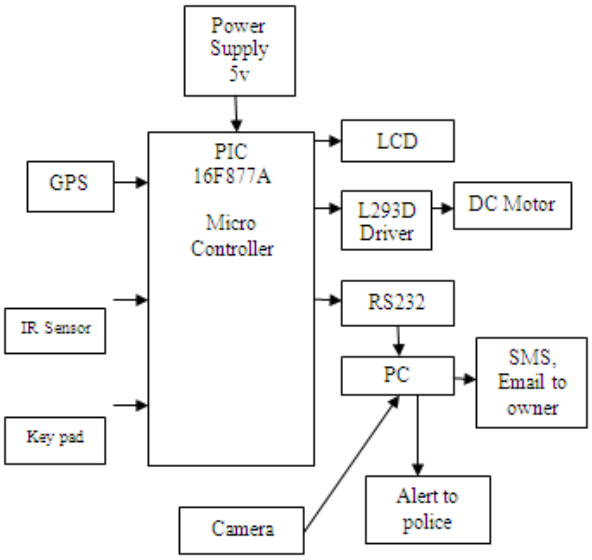

Figure-6. Hardware diagram.

Figure-6 shows Hardware diagram of the proposed framework. Proposed framework uses micro controller, GPS, LCD, Camera, and Power Supply.

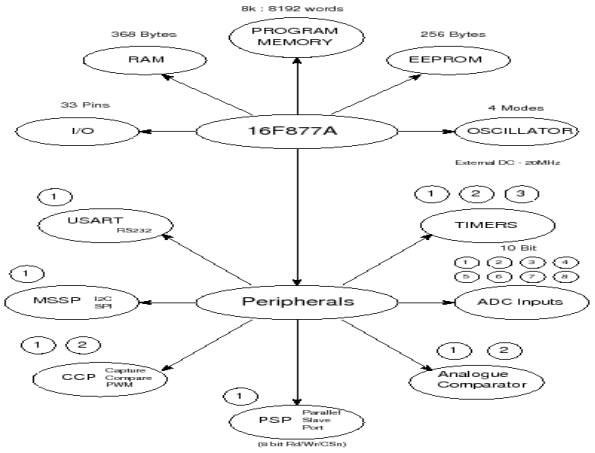

Figure-7. PIC16F877A.

Figure-7 shows PIC16F877A is a high performance RISC CPU machine which contains 35 simple word instructions. Clock input is of 200 MHz, instruction cycle is of 200 ns. Micro controller is of 360*8 bit RAM (data memory). 256×8 of EEPROM (data memory), 8k×14 of flash memory. It consists of wide operating voltage range (2.0 - 5.56) volts. It consists of two 8 bit timer and one 16 bit timer along with ten bit multi-channel A/D converter Synchronous Serial Port (SSP) with SPI (master code) and I2C (master/slave). It can easily erase/write 100000 times cycle enhanced memory.1000000 times erase/write cycle data EEPROM memory.

The hardware of project requires different power supply is of 5v. The interfacing devices will get the supply from the main micro controller. LCD (Liquid Crystal Display) screen is an electronic display module which finds a wide range of applications. A 16*2 LCD display is the very basic module and is used in the framework. A 16*2 LCD means it can display 16 characters per line and there are of 2 lines. Each character is displayed in 5*7 pixel matrix. LCD has two registers namely Command and Data.

MAX232 is used to convert TTL into RS232 which is used as a logic level convertor between the microcontroller and the GSM board or PC. Micro controller is operated at 5v to 12v for transmission. During receiving it converts from 12v into 5v to the micro controller.

The Global Positioning System (GPS) is a satellite based navigation which sends and receives the radio signals. A GPS receiver receives the signal and provides you with the information. By using this technology we can determine the location, velocity and time in any of the weather conditions across the world. On each Key pressed on a keypad, the index of the key is passed to the user defined function. User can available free to define with his own input.

IR Sensor is simple device working as a reflecting infrared light of an object and detecting the reflecting with a photo transistor which is tuned to the same frequency of light. Object detection is determined by placing a reflective surface between the object and the sensor. A large drop of signal will be observed in the output signal when the object is passed between the object and the sensor.

4. METHODOLOGY

Firstly, the user must create his/her profile by giving their details where they can register their mobile number and can create their own security questions along with the answers. All the details are stored in the database where user can keep it secure by setting a profile password. User can also set the locker PIN (Personal Identification Number). Then the user can store the images by capturing through the camera which is attached to locker. At the maximum user can store his/her 6 images with different facial emotions. Then the user must successfully sign out from the locker system and can use the locker by using correct PIN.

Then at each time whenever the user wants to access the locker he needs to enter the correct PIN number. If the PIN entered matches then the camera which is appended to the locker will be initiated and start detecting the face standing near to the system. Then, the captured image will gets verified with the database records if it validates then the system sends OTP to the registered mobile number by means of SMS. Then the user must enter the OTP if the entered OTP is given by the user are correct, then the user can access the locker. The accessing details of locker are stored as log files in the database where owner can check the log details by entering into his profile. Log tables contain the information about image, format of image, and user sign in time, user accessing time, user sign out time and status. The user can view his transaction details in his profile.

The person who is accessing the locker has the chance of entering the locker PIN in within three times. If the user exceeds the chances provided the system gets locked completely and it will be opened only after verification process and also the camera captures the image of the person and sends to the owner via SMS and Email. If the owner lost his registered mobile number or he wants to change his mobile number then the user must go through his profile and by answering security questions he can change. If the owner is being forced by someone to open the locker then the owner can type the PIN in reverse manner. Then automatically an alarm will ring and an alert will sent to the police with the location details.

5. IMPLEMENTATION

a. Face recognition and OTP

The camera attached to the locker system captures the image of the person. Then, the captured image will be taken as the input image. For cropping the face or to detect the face of the person the system uses Viola Jones algorithm method. To extract the features of the face the proposed method uses three extraction methods. They are:

- GLCM
- HOG
- Gabor Filter

By using these three extraction features the input image features can be extracted. Face recognition is done by using Euclidean distance by plotting points on the face and finds the Euclidean distance between each of the points and will recognize the face and checks with the image present in the database.

Segmentation is the process of partitioning an image into multiple segments. The primary goal is to simplify or change the image representation. The image segmentation is extracting the set of contours from the image.

Classification is analyzing the numerical properties of different features of the image and organizes data into categories. Figure-6 shows there are two phases of classification process. They are training and testing. In training phases features of an image are isolated where classes are independent, discriminate and reliable.

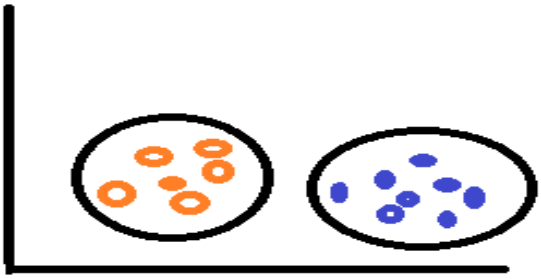

Figure-8. Classification cluster diagram.

OTP is a random generated dynamic password which can be used for only one session which incorporates a two way authentication using mobiles. By using random function an OTP is generated in the proposed method.

Establishing the connection between the hardware and software is done by using embedded part. By using sensors and actuators connection is established that responds for the inter communication between them. Server is always connected to the

6. RESULTS AND DISCUSSIONS

Figure-9. Storing the images in the database.

Figure-9 shows the different types of emotions where images are captured and stored in the database at the time of profile creation. Owner needs to store his images in the database for further processes.

Figure-10. Cropping the faces.

Figure-10 shows the cropping of faces. Formation of rectangular boxes during the capturing of image. By using Viola Jones algorithm proposed method captures the face of the person.

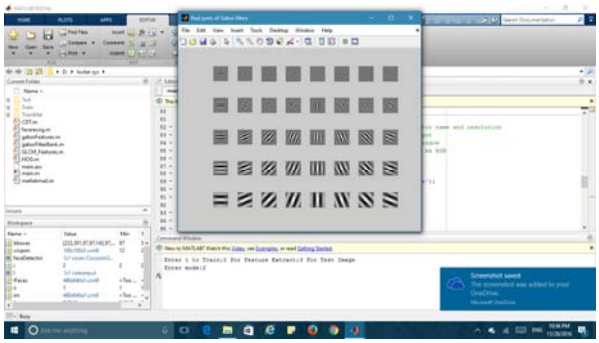

Figure-11. GLCM and Gabor feature.

Figure-11 shows the extraction of features during the time of training and testing of the image.

7. CONCLUSIONS

In this paper a locker system with facial recognition is proposed. Proposed framework is also made provisions for generating OTP for ensuring higher security. Viola Jones algorithm is used for face detection. For extraction of facial features GLCM, HOG, and Gabor Filter are used. OTP is generated by generating random number by using function. Eigen Face Detection Technique is used for face detection. The proposed system has an advantage over the existing system in terms of Security as it incorporates both facial detection and generation of OTP, thus ensuring higher security.

REFERENCES

[1] Shuo Feng, Peyman Setoodeh and Simon Haykin. 2017. Smart Home: Cognitive interactive People-Centric Internet of Things. IEEE.

[2] Daniel Minoli, Kazem Sohraby and Benedict Occhiogrosso. 2017. IoT Considerations, Requirements, and Architectures for Smart buildings-Energy Optimization and Next-Generations Building Management Systems. IEEE. 4(1).

[3] Mikael Asplund, Simin Nadjm-Tehrani. 2017. Attitudes and Perceptions of IoT security in Critical Societal Services. IEEE.

[4] M. Shamim Hossain, Ghulam Muhammad, Sk Md Mizanur Rahman, Wadood Abdul, Abdulhameed Alelaiwi and Atif Alamri. 2016. Toward End-To-End Biometrics-Based Security for IoT Infrastructure. IEEE.

[5] Ying-Tsung Lee, Wei-Hsuan Hsiao, Chin-Meng Huang and Seng-Cho T. Chou. 2016. An Integrated Cloud Based Smart Home Management System with Community Hierarchy. IEEE. 62(1).

[6] M.Siva Sunduri, N. Anusha. 2016. Text Separation in document images through Otsu's Method. IEEE.

[7] Sofia Jennifer J, Sree Sharmila T, Srinivasan R. 2016. Facial Feature Extraction for Head Tilt Images based on Eye Canthus. IEEE.

[8] Henry Candra, Mitchell Yuwono, Rifai Chai, Hung T Nguyen and Steven Su. 2016. Classification of Facial-Emotion Expression in the Application of Psychotherapy using Viola-Jones and Edge-Histogram of Oriented Gradient. IEEE.

[9] Anwar Saeed and Ayoub Al-Hamadi. 2015. Boosted Human Head Pose Estimation Using Kinetic Camera. IEEE.

[10] Ana Carolina, Claudia Cristiana, Bachini, Francisco Javier. 2015. Emotion Recognition System Using Open Web Platform. IEEE.

[11] Lucas Sousa de Oliveria, Dibeo Leandro, Flavio de Barros. 2015. A Fast Eye Localization and Verification Method to Improve Face Matching in Surveillance Videos. IEEE.

[12] Weihong Deng, Jiani Hu, Jiwen Lu, Jun Guo. 2016. Transform Invarient PCA: A Unified Approach to Fully Automatic Face Alignment, Representation, and Recognition. IEEE. 36(6).

[13] Han Su and Adams Wai Kin Kong. 2016. A Study on Low Resolution Androgenic Hair Patterns for Criminal and Victim Identification. IEEE. 9(4).

[14] Yuhua Li, Chan Qi. 2015. Face Recognition Using HOG Feature and Group Sparse Coding. IEEE. 10(8).

[15] Yiran Shen, Mingrui Yang, Bo Wei, Chun Tung Chou, Wen Hu. Learn to Recognize: Exploring Priors of Sparse Face Recognition on Smart Phones. IEEE. 9(1).