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A Survey on Surveillance using Facial Recognition

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***Abstract* – In the coming world of digitalization the human life is going to be much faster than it is now. And the most important part of the human life is going to be the security. In our day to day life we are using some usual methods for the security purpose some of them are passwords, biometric scan, one time password (OTP) and retinal scan. But as the technology grows and techniques are going to be invented these thing are not going to be the most secure methods to keep secure the data. For that purpose we have to step forward and apply new method for keeping surveillance and security i.e. the facial recognition techniques which is the most secure and reliable all out of above. In this paper we are going to give the whole survey of the security method that is Facial Recognition and the current stage of it. The use of this technique can make the surveillance much better than it is it has vast application areas we can apply this technique in most of the security systems.**

Keywords – Digitalization, security, surveillance, biometric facial recognition, singular points.

I. INTRODUCTION

Today, the security system methods are a very important area in smart cities, offices, and homes, schools and colleges. Security of the home and the people in our family is most important for everybody. Likewise, the smart security systems can provide Internet of Things (IoT)[1-2]. The IoT can be applied in smart cities in order to give various benefits that enhance people in the city [3]. In other terms, smart houses can be made by utilizing the IoT. It has the power to control and automate exact things of houses such as lights, doors, fridges, distributed multimedia, windows and irrigation systems [4-6]. The IoT is becoming popular in many sides of life, such as security, smart cities, healthcare, transportation, grids and online business. The objectivity of utilizing IoT is to share information and knowledge with everyone in everywhere around the world[7].

Computer vision can give more security system in the IoT platform for smart home. It has power to identify a person in the incorrect area and at the wrong time because this person may be a malevolent one for the environment [8]. Face recognition system evolve to be one of the most

active research field especially in recent years. It has an assortment of large applications like: peoples security, access control, credit card verification, criminal identification, law enforcement, data security, human computer interaction, and digital libraries. Generally, it recognizes persons in public places such as houses, offices, airports, shopping centers, traffic signals and banks. This mechanism provides secure access to the house by detecting motion controlled by the fully programmed system.

The face is the most significant part of human's body. So, it can indicate many emotions of a individual.

For a long time, humans were using the things like smart cards, plastic cards, PIN, tokens and keys for validation, and to get grant access in restricted areas. The most essential features of the face image are nose, eyes and mouth which are related to facial expression [9-10]. Face detection and recognition system is very simple, cheaper, accurate, and non-intrusive process as it is compared to other methods. The system will fall into two categories; face detection and face recognition.

There are many ways to implement face detection such as Haar-like features, Eigenface and Fisher-face. Then, analyzing the geometric features of facial images, such as, distance and location among eyes, nose, mouth and some other were provided by several face recognition techniques [8].

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There are a few techniques for getting the most important and relevant features from the face images to implement face recognition. One of these feature is extraction technique called Local Binary Pattern Histogram (LBPH). LBPH technique.[11]. LPBH describes the shape and texture of a digital image. This technique provides good results and well-organized for real-time applications. Haar-like features and LBPH are strong when compared to the others. According to many studies [12-14] to get fast discriminatory performance and good results, LBPH technique was chosen for face recognition. LBPH generates the binary code that describes local texture pattern. From the LBPH face

image, the nose and eyes area are extracted, and for each image's pixel the LBP histograms will be drawn [9-10].

In this paper, Raspberry Pi 3 is used and Raspberry Pi camera is attached to it. The system will take an image when sensor detects any movement. Then, computer vision is applied to the capture images. Subsequently, the system sends the images to a system via the Internet.

II. WORKING

In the proposed system, a camera is used to achieve the snip when a movement detected by the camera module. Then, computer vision module is applied to the captured images to detect and recognize the person's faces. Then, it will stored locally. This system is very useful and important to keep the surveillance. If there is no motion is detected, the program will not go to face detection and recognition. Fig. 1 describes the flow chart for the proposed system.

In Fig. 1, the motion detection module detects the motion by using camera module. Afterward, the algorithm will search for the human faces as the region of interest is set as the face of a person and then the captured snip of the face will be stored locally for the further comparison. Then, the image will be make available for face recognition. Face recognition can be described as classifying a face either known or unknown via comparing a face and putting away known persons in the database.

This can be finished by comparing the invariant features got from the strategies that catch the delegate variability of the faces or the structure. Face recognition system is classified into steps; face detection and face localization according to Haar-like features. Through using weighted LBPH algorithm, face features will be extracted [12-14]. By utilizing face recognition, the procedure of the person identification can be classified into three main stages as described in Fig. 2

A. Face Representation

The initial step, face representation characterizes in how to display a face and check which algorithms which can be used for detection function. Haar-like feature and AdaBoost classifier are embraced to realize face detection [15].

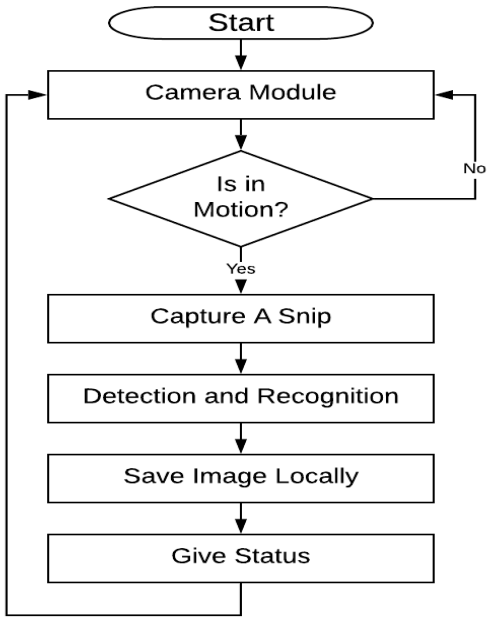

Fig 1: Flow Control of System

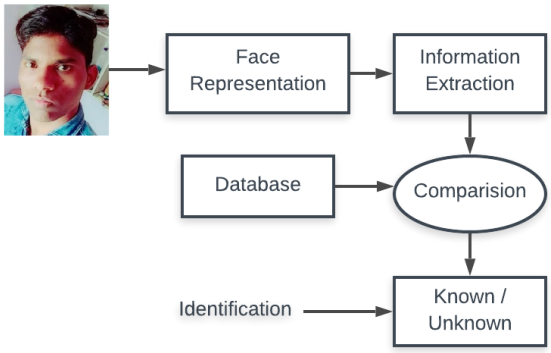

Fig 2: Steps of Working

There are a lot of factors of the captured image, like shine, many redundant data, contrast and image size which affect the precision of face recognition system. So, it is more vital to prepare the caught picture before face recognition. For this purpose, the input face is converted to grayscale and normalize it.

B. Information Extraction

Face image has the most useful and special features which are extracted in the feature extraction stage. Face image with the images from the store will be compared to obtain the features. Feature extraction phase is the core of face recognition system. For the sampling of the face and to measuring matches among images, these features can be utilized.

There are some techniques in face recognition to achieve and bring the most important features from face images. For describing the shape and texture of a digital image, LBPH can be used. This technique provides good results and efficient for real-time applications. Haar-like features and LBPH are robust when compared to the others. LBPH technique is finished via partitioning a

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picture into a number of small regions as shown in Figure 3. The features are extracted from every individual region. To portray the surroundings of pixels in the areas, these features are coded into binary patterns. Each area is processed to calculate the features. These calculated features from all areas are combined to a single feature histogram, which forms a demonstration of the picture.

III. ALGORITHM

In this paper we are using the Local Binary Pattern Histogram (LBPH) algorithm. This is actually a feature extraction technique. Further we classify these image as per the need.

Fig 3: face with grid

LBPH value is computed as follows. There are eight neighbor pixels in the window of the face snip. In the grayscale snip, to calculate the LBPH value for pixels, the pixel is compared to all of its eight neighbors on its left-middle, left-top, left-bottom, right-bottom and right-top. When the middle pixel's value is bigger than the neighbor's value, write zero. Something else, write one. This gives an 8- digit binary value. Binary value generally stored in the middle pixel location of the output image like a decimal number. The whole process is demonstrate in Figure 3. For example, the current pixel has value 157. The comparison starts from the neighboring pixel where the its label is zero. The value of the neighboring pixel with label zero is 150. As it is smaller than the current pixel value which is 157, the 0^{th}- bit position will set as zero in the 8-bit binary array. After that, it will be repeated in the counter clockwise direction. The next label positions one have value 165 which is bigger than the current pixel value. So set the first-bit position in the array is set to one. If the value of the neighboring pixel is equal to the current pixel value, write 1.

After calculating LBPH operator, local features are created through calculating histograms of LBPH over local image areas in local feature extraction process. When LBPH mask is computed for every pixel, the

feature vector of the picture can be constructed by computing the LBPH histogram for each cell. This histogram can be viewed as a 256- dimensional feature vector. After that, the standardization of the LBPH histogram and concatenate histograms of every cell will be completed. This offers a feature vector for the whole snip. The length

150	165	178
167	157	150
143	155	152

→

0	1	1
1		0
0	0	0

Fig 5: Example of LBPH Calculation

1. Creating A Dataset

The datasets are created using the camera module or the camera attached to the computer. We take the 100 samples of images per person and store it in the dataset. We can store the inestimable person's samples. We will give one id number to each person in the dataset[6].

2. Face Detection

The next step is the face detection .the algorithm. It involves four steps:

i Haar-like features
ii Integral image
iii Adaboost training
iv Cascading classifier

i. Haar feature selection

All human faces share some comparable properties. Haar like features are used to detect difference in the black and white portion of the image. These regularities may be detected using Haar Features. Some of the types are shown in fig 3.

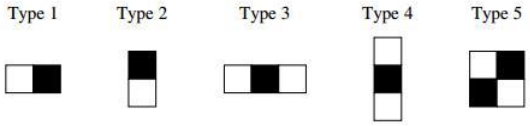

Fig 3. Types of Haar features

We use the two rectangle Haar like feature. Some properties common to human faces are:

1. The eye region is much darker than the upper-cheeks.
2. The nose bridge region is much brighter than the eyes.

Composition of properties forming match able facial features:

- Location and size: eyes, mouth, bridge of nose
- Value: oriented gradients of pixel intensities

We take the image and convert it into 24X24 window and smear each Haar feature to that window pixel by pixel. Each feature is related to a specific location in the sub-window. The value is calculated by applying Haar features is

$$\text{Value} = \Sigma(\text{pixels in black}) - \Sigma(\text{pixels in white})$$

ii. Integral images

The second step of the Viola-Jones face detection algorithm is to convert an input image into an integral image is shown in fig 4. The integral image at the location (x,y) contains the sum of the pixels to the above and to the left of (x ,y)[7].

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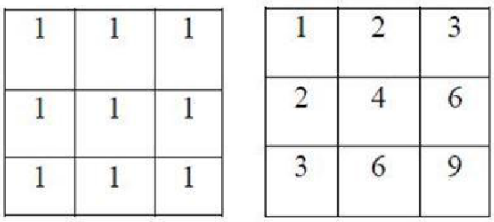

a) b)

Fig 4: (a) input image (b) integral image

This makes the calculation of the addition to the entire pixels within any specified rectangle using only four values. In the integral image, these values are the pixels that resemble with the edges of the rectangle in the input image.

iii. Adaboost machine learning method

The algorithm[5] uses a 24X24 window as the base window size to evaluate all the features in an image. It will results in a 160,000+ features, all the features are not important to us. So we eliminate the features which are not important.

Adaboost is a machine learning algorithm which helps in umpiring only the most outstanding features from 160,000+ features. After these features forms a weighted arrangement of all the features which are used in gaging and deciding any window has or not. These features are weak classifiers.

IV. CONCLUSION AND FUTURE WORK

In this paper, an rooted face detection and recognition with smart security system are proposed to be able to capture an image and recognize it. So, when a face is detected and recognized, the system will show who the person is.

By adding the face recognition system, people will be easily identified and a safer city will be built. Also, a possible solution is proposed to use computer vision in the IoT in this paper. This system helps to improve and

automate the security of industries, cities, homes, towns, schools and colleges. In this paper, LBPH algorithm is used to recognize faces. Also, the result of LBPH algorithm is compared with other algorithm. The results show that LBPH method gives better results under some favorable conditions.

1. We can make this process more faster and more reliable by using the python's library OpenCV and Haarcascades which are effective.

2. This System can be implemented in two things one image capturing and another for face recognition.

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