International Research Journal of Engineering and Management Studies (IRJEMS)
Volume: 03 Issue: 04 | April -2019 ISSN: 1847-9790 || p-ISSN: 2395-0126

Smart Security Using Face Detection& Voice Alert

Chavan Aditya S.[1#], Pisal Rucha R..[2#]

Mulla Rahesha Y[3#] Dubal Aditya P.[4#]

Department of Computer Science & Engineering

Sou.Sushila Danchand Ghodawat Charitable Trust's Sanjay Ghodawat Group Of Institutions,

Atigre, Maharashtra, India

adityachavan0@gmail.com, rucha.pisal.rp@mail.com,adityapdubal@gmail.com

mulla.ry@sginstitute.in

Abstract- Face detection is referred as the process of identifying images which are similar to each other. The database will be having 50/60 images of people each looking up, down, sideways, smiling, frowning, grinning, smirking, etc. Face detection is a computer automation being used in a variety of applications that analysis human faces in digital images. It also refers to the cognitive process by which humans locate and attend to faces in a visual scene.

Face detection can be used to detect the licensed face from the other faces. Thus the designed system should be able to detect a particular person having all the different expressions. We aim to create a smart security with voice alert which will secure the gateways on the basis of who we are with the android application. The proposed system contains yale database, which saves the faces with different expressions. This android application should be installed on the device which is connected to the camera. Whenever the camera will detect any motion, the camera will capture the image and check with database. The door will be unlocked when person is authorized, if not the image will be sent on android application for authentication.

Index Terms- detection; yale database; digital images; security; gateways; expressions.

I.INTRODUCTION

The Internet of Things (IoT) is based on the intelligent and the self-configuring nodes which interconnected to each other in a global and dynamic network under-building. Internet of Things (IoT) is actually a network of devices which are usually connected together and then they communicate with each other to perform

some specific tasks which will be done on its own i.e. without any human to human or human to computer disturbance. Internet of Things is usually characterized by the real world and the small things with limited storage and processing capacity, and consequential issues regarding reliability, performance, security, and privacy. IOT has many applications like diverse areas including agriculture, healthcare, retail, transport, environment, supply chain management, infrastructure monitoring etc.

Today, the surveillance system field is a very influential area in smart cities, offices, and homes. For everybody security of the house and the family is very important. Likewise, smart systems can provide IoT means Internet of Things. The IoT can be applied in smart cities in order to give various benefits that enhance citizens. In other terms, by using IoT smart homes can be made. It has the capability to restrain and automate exact things of residency such as lights, doors, refrigerator, distributed multimedia, windows and irrigation systems. The IoT is becoming famous in many sides, such as smart security, smart cities, healthcare, smart transportation, smart grids and online business. The objectivity of utilizing IoT is to share information and knowledge with everyone in everywhere around the world.

Computer vision can present more security system in the IoT platform for smart houses. It has abilities to recognize a person in the incorrect area and at the wrong time because this person may be a malicious one for the environment. Face detection system grow to be one of the most active research areas especially in recent years. It has an assortment of large applications in the ranges: public security, access control, credit card verification, criminal identification, law enforcement commerce, information security, human computer intelligent interaction, and digital libraries. The images taken by the gadget under the uncontrolled environments are usually of limited nature .i.e. diverse human facial expressions, poses, and brightness conditions affect the nature of face images. In face detection, we encounter many of the familiar vulnerability that erupt vision systems in general: brightness, obstruction, pose, and misalignment. It also has a broad spectrum of pragmatic functions. Indeed, if we could compose a highly dependable automatic face detection system, it would have wide implications for identity verification, access control, security, and public safety.

In this system we have used Raspberry Pi 3 and Raspberry Pi camera which are connected to each other. When PIR sensor detects any movement the system will capture the image.

Then, computer vision is applied to the captured images. Subsequently, the system sends the images to a smart phone via the Internet. To see the activity, images and notifications we have used IoT based Telegram. In this paper, the heart of the embedded face detection is Raspberry Pi single-board computer which controls each of the peripherals.

Application of face detection

1. Facial motion capture:

   The process of electronically transforming the actions of a person's face into a digital database using camcorders or laser scanners is known as facial motion capture. Computer animation for films, games, or real-time avatars, etc can be produced by computer graphics (CG) by using this database. Because the motion of CG aspects is derived from the developments of real people, it results in more practical and nuanced computer aspect animation than if the animation were created manually.

2. Facial Recognition:

   To determine or verify a person from a digital image or a video frame from a video source, facial recognition system is adequate. In general, facial recognition work by analyzing selected facial features from given image with faces stored in the database.

3. Photography:

For autofocus, lately digital cameras are used. It is also useful for selecting sector of interest in photo slideshows that use a pan-and-scale Ken Burns effect.

4. Marketing:

The significance of marketers is increased by face detection. Any face that walks by can be integrated by webcam. The system then gauges the race, gender, and age range of the face. A series of advertisements can be played that is specific toward the detected race/gender/age once the information is gathered.

II. eneral Steps For Face Detection

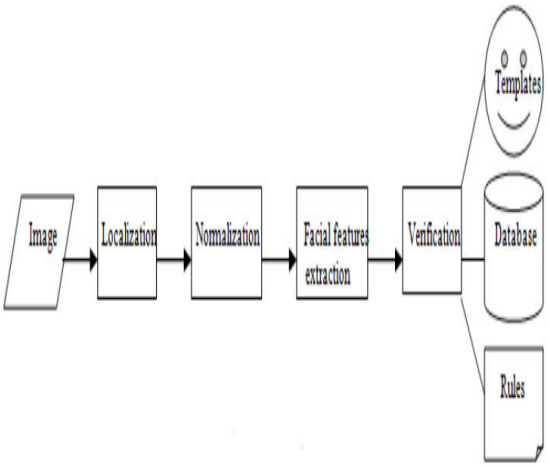

Fig.1. Steps for face detection

A. ocalization:

The region where the face is located is detected in this step. As the number of features is application dependent, a face region only contains some facial features. In this process we

may go through some complications like false disclosure due to the existence of some difficulty on the face, destitute aspect of picture, location of head position, expression, etc. Thus we have to deal with all these limitations to make the face detection process more persuasive.

B. ormalization:

Once the region that contains a face is located, normalization of that region is done. Using this process, we adjust the face region in such a way that all the facial features are in their proper position. To correlate with the entry in that database, we may have to scale, rotate the image or some other transformation.

C. acial feature extraction:

Various facial features like eyes, nose, mouth, etc from the detected face region are extracted in his step. There are three types of feature extraction methods:

1. eneric approach based on edges, lines, and curves.
2. eature arrangement based methods that are used to identify various facial features like eyes, nose, and mouth.
3. olor segmentation based approach that use face color instead of the magnitude values.

Appearance based methods that are able to administer changes in brightness conditions, shape, pose and reflectance and even to handle adaption and limited occlusions.

D. erification:

The relationships between various features with some database entry containing a huge number of faces are verified in this step. Only by database entry verification cannot be done, but also we can use some rule based techniques that uses the interaction of various facial features as its framework, For by using so arrangement based methods where we use a specific template model and try to find out a face region that fits into this model.

III. Technique in Face Detection System

The goal of face recognition is for the machine to understand to be able to “sense”, “understand” and “act upon” the sensed object. The earliest face recognition systems were first attempted during 1964 and 1965, Bledsoe, along with Helen Chan and Charles Bisson who worked on using computer to recognize human faces.

In the first proposed method of face recognition system, feature vector is formed by combining multi-scale facial features (eyes, nose and mouth) into column vector and this vector is used as input to the artificial neural network classifier (BPNN or RBFN) for recognizing face image.

In the second proposed method of face recognition system, weight vector is found by projecting feature vector on Eigen feature space (PCA) or fisher feature space (LDA) and this weight vector is used as input to artificial neural network classifier(using BPNN or RBFN).

In the proposed partial face recognition system, the above cited two face recognition systems are used, in which feature vector is formed by considering only partial face components from eyes, nose and mouth. In all the face recognition techniques proposed in this work require preprocessing of face image stage, feature extraction stage, artificial neural network for classification purpose.

A. Pre-Processing of Face Image

In this module, by means of early vision techniques, face images are pre-processed and enhanced to improve the recognition performance of the system. Based on condition some of the following preprocessing approaches are used in the perspective face recognition system. Different types of pre-processing/enhancement approaches are related to the face recognition process and are listed as fallows with the help of flow chart and analogous face images.

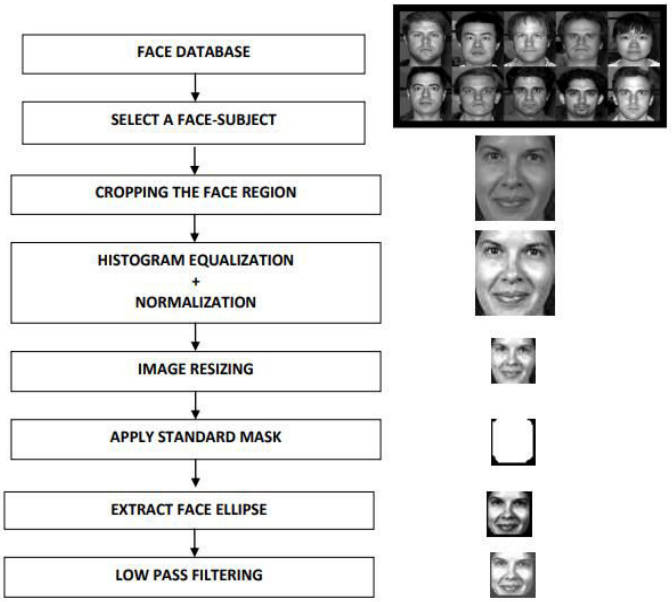

Fig.2. Flow chart representing the Pre-Processing

a. Cropping Face Region:

When the area of an image is much larger compared to that of a face, the region of the image where the face is located is cut out from the image and only this area is used in the process of face recognition. By using cropping technique only main face can be extracted and the redundant data around the face, which detoriate the performance of recognition can be removed.

In this study, the face area is determined manually based on observation of different face

images in the given database and rectangular or square window corner points are selected in such a way that it includes main features of face such as eyes, nose, and mouth. All face images to be trained or tested in recognition process are cropped by using same corner points ('imcrop' function in MATLAB is being used for cropping required part from each face image).

b. Histogram Equalization:

It is usually done on low contradiction images in order to augment image quality and to improve face recognition performance. It changes the dynamic dimension (contrast dimension) of the image and as a result, some important facial features become more conspicuous. Mathematically histogram equalization can be expressed as:

$$S_k = T(r_k) = \sum_{j=0}^{k} \frac{n_j}{n} \quad \text{... eq(2)}$$

Whereas k=0,1,2,…., L-1

Here in equation (2) 'n' is the total number of pixels in an image, 'n_j' is the number of pixels with gray level ' r_k' ,and 'L' is the total number of gray levels endure in the face image.

The result after applying histogram equalization to a sample face image is shown in Figure 3.

Fig .3.Histogram Equalization

Two histogram plots are given in Figure 4. The histogram on the left is of the original face image (between 6-250) and the one on the right is after histogram equalization is applied.

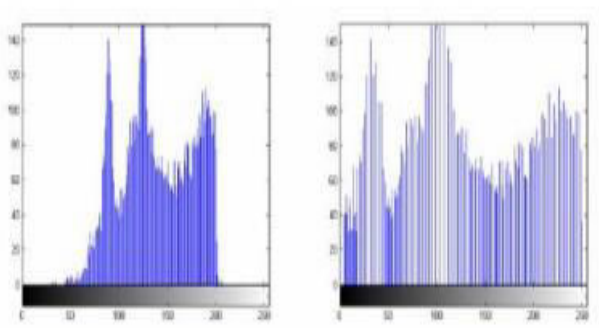

Fig.4.The histogram of an image before and after the histogram equalization.

Illumination Normalization:

Face images taken under different illuminations can degrade recognition performance, especially for face recognition systems based on the subspace analysis, in which entire face information is used for recognition. The entire high and low illumination levels are adjusted so that the image becomes much clearer and noiseless.

Normalization of face image is performed to get zero mean value and unity standard deviation value.

c. Image re-sizing using Bi-Cubic Interpolation method:

The process of image resizing changes the size of the image, in this work, the size of the image is scaled down to reduce the resolution of face image. This reduction in size is done to reduce mathematical complexity in PCA/LDA process and neural network training process .For resizing face image, different interpolation techniques exist in literature ,among them Bi-cubic interpolation method is being used in the proposed work, the advantage of resizing through Bi-cubic interpolation is that, it produces more smoother surfaces than any other interpolation technique(image is being resized to desired dimension by using 'imresize' function in MATLAB) . In Bi-cubic Interpolation technique, it considers 16 neighboring pixels in the rectangular grid and calculates weighted average of these pixels to replace them with a single pixel, it is that pixel, which has got the flavor of all the 16 replaced pixels.

Masking:

By using a mask, which simply has a face shaped region, the effect of background change is minimized. The shape of the mask used in this study is shown in Figure 5.

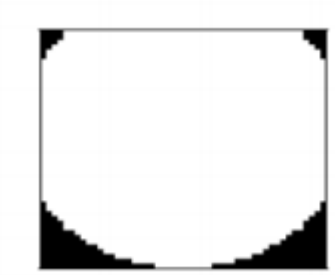

Fig.5.The shape of the face mask used in the pre-processing

d. Low Pass Filtering:

The mean/averaging filter is applied in order to produce the blurry effect, because in the later stages face recognition algorithm include step of face image re-sizing (by using down sampling method) while maintaining the quality of face image. The 5*5 filter is used for this process

$$R = \frac{1}{25}\sum_{i=1}^{25} Z_i \qquad \ldots eq(3)$$

Equation (3) calculates the average value of the pixels, whereas 'z' is the mask, 'i' are mask elements. The mask is then convolved with image to produce filtering effect, for a 5*5 mask used in the implementation, it calculate the average of 25 pixels in that filter mask.

B. Feature Extraction using Multi-scaling concept

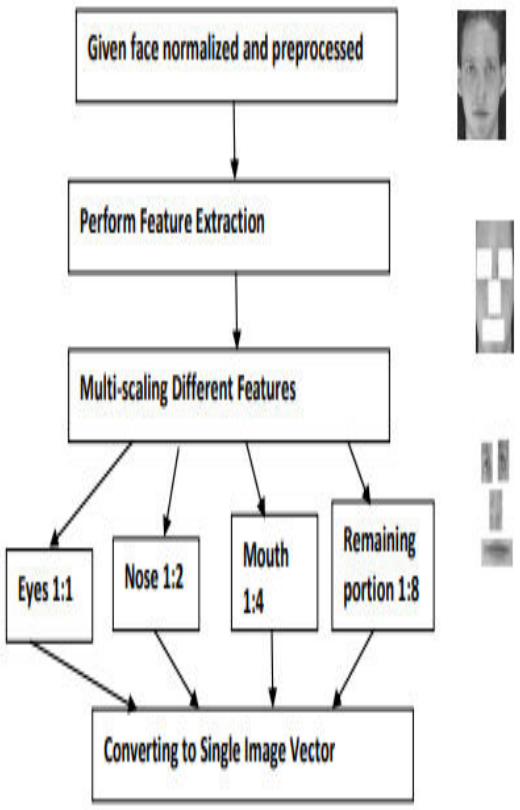

Fig.6.Flowchart for Multi-scale Feature Extraction

It is generally believed that we human beings put different emphasis on different parts of face e.g. eyes, nose, cheeks, forehead and other remaining parts. The existing approaches feature extraction techniques put same emphasize on all parts of a face and results in redundancy of image data from discrimination point of view .This method suffers from unwanted equal weightage on whole face portion of the image effects recognition rate. In the proposed approach of feature extraction, four different facial components - two eyes, nose and mouth of the face are extracted manually from pre-processed face image (all face images to be trained or tested in recognition process are cropped by using same corner points, „imcrop" function in MATLAB is being used for cropping required part from each face image). Dimensionality of these face components are then reduced by down sampling different face components with different resolution ratios based on significant of the component in recognition process. Then feature vector is obtained by scanning two dimensional image patches of different face components in lexicographical order and combining them into a column vector. The size of the final image column vector is N x 1, where N is the total number of pixels obtained from all the four image patches, N depends on the size of face image, resolution and down sampling ratios and which is very much less than the original full image data size. In the proposed work, this feature vector is directly applied to the artificial neural network for classification purpose or after undergoing through dimensional reduction techniques (PCA or LDA) the resultant weight vector is given as input to artificial neural network

Comparative Study Of Face Detection System Approaches

Algorithm	Image-based/Video-based	Database	Performance rate	Advantage	Disadvantage
PCA[107]	Image	AR-Faces	70	Reduces dimensionality	Class seperability remain same
LDA[107]	Image	AR-Faces	88	Reduce dimensionality Increase class seperability	
ICA[108]	Image	FERET	89	Exploits higher order statistics	
Laplacianfaces[27]	image	MSRA Yale PIE	91.8 88.7 95.4	Lower error rate compared to eigenfaces and fisherfaces approach	Problem occur in estimating intrinsic dimensionality of non-linear manifold images
PCNN [95]		FRGC version 2 and Yale	85	Facilitates efficient hardware mapping	
SVM [13]	image	FERET	77-78		
Gabor + ICA [96]		FERET (180 features) ORL (88 features)	98.5 100	Automatic implementation	
Kernel associated Memory Models [97]		FERET ORL XM2VTS	91.6 98 84	Low computational complexity	Huge storage space
Kullback-Leibler divergence (KLD)-based local Gabor binary patterns (LGBP) [98]	image	Alex-Martinez-Robert (AR)	80	Partially occluded faces High precision & stability	High dimensionality
Hybrid Colour and Frequency Features (CFF) [99]	image	FRGC version 2	80.3		
Scale invariant feature transform (SIFT) and multi-scale local binary patterns (MLBP)	Image	MORPH album 2 FG-NET	83.9 47.5	Age-invariant face recognition	It fails when encounters large pose changes
Gabor Image Representation [25]	Image	FRGC version 2	76	Better performance	High dimensionality
Kernal Fisher Analysis + Fractional Power Polynomial Models [25]	Image	FERET	95	Increases discriminant power	
Enhanced side-face image [45]	Video/ Image	-	80	High resolution	Contains less information as side faces are considered
Virtual Frontal-View Face [100]	Image	MIT face database	84.7	Pose variations can be handled more efficiently High performance rate	Somewhat complex
3D Facial Aging Model And Simulation Method	Video/ Image	FG-NET(82,82) MORPF-Album1++(612,612) BROWNS(4,4)	37.4 66.4 28.1	Works with both growth and adult face aging effects	Age estimation is crucial
Gait Energy Image [52]	Video/ Image	-	82.2	Recognition is done by walking properties and Good recognition performance at a distance in a video	Sensitive to nose and facial expressions
3D Morphable Model	Video/ Image	Real-time(live faces)	97	Good performance even with pose and illumination variation Better noise handling	Complexity is high

Conclusion

This paper gives primary idea of how to control home security for smart home, especially for door key locks. It also provides surveillance and is also easy for Android phone users. This project based on Free Open Source Software which is Android platform. So the implementation rate is inexpensive and it is acceptable by a common person. With the wireless Wi-Fi connection in microcontroller permits the system installation in easier using an Android Wi-Fi-enabled phone and Wi-Fi modules. Future scope of our project is very high. We have discussed a simple prototype in this paper but in future it can be extended too many other regions.

Face Detection System is growing day by day and has unlimited applications. The study has shown the overview of the face detection process, its basic model, and applications. In this study different approaches which are widely used for face detection process have been discussed and after comparative study of these approaches it is concluded that .