Implementation of Face Recognition Algorithm Using Python and Its Performance Evaluation in Real Time

Abstract: ***The purpose of this project is to develop a Face Recognition application which is able to collect face images and recognize the face by comparing with the database of the system. Face Recognition system is a powerful technique which is used to recognize faces from images or videos. Algorithm used in this project is Local Binary pattern Histogram (LBPH) which is a very powerful method to describe the texture of an image. At first the face image is divided into small regions and histogram is calculated for each region of the image then the histogram is concatenated into a single vector and thus the texture of the image is represented. Recognition system is proposed in this project with Raspberry Pi 3 and Zed Board platforms using OpenCV based machine. Initially an USB camera is connected to the hardware platforms and the application is dumped into the boards, the camera interface will capture continuous images and these images are processed with help of OpenCV and compared with existing database.***

Keywords: RaspberryPi3, ZedBoard, OpenCV, LBPH.

1. INTRODUCTION

Human face has lots of emotion and reality of representing an individual person. Face recognition has been very important and challenging technique in very specified applications like authorization purpose in security system, personal identification and others. Human face has a major role in social life to convey emotions to one another. Human's has great ability to recognize human face and it is remarkable. In present generation recognition of human face is essential for various reasons and face recognition technique has been researched over the years and it's been very popular for recognition of an individual.

Face recognition technique is the slightly noisy and best technique for authentication

purpose. This technique works on human face with most similar features of an individual. Face recognition system characterizes human face features from an image or a video and compares with the image present in the database. These features consist of distance between the eyes, nose, cheeks and jawline etc. Remaining biometrics like fingerprint, iris scanning etc are easy to hack and it takes user permission for further process. But, in case of face recognition human permission is no longer needed and without their presence we can capture image and forward the process.

Verification and Identification are two types of methods for recognizing a face.

Verification:

Verification is described as comparing one person with the database. It asks the person like "who are they" by the information given by the person it compare the details available in the database with details given by the person. Verification in general terms can be said as comparing 1 on 1 person with details given by them.

Identification:

Identification is described as checking every person present in the database without any details given by the person. It is like 1 to n persons checking all over the database.

2. LITERATURE SURVEY

Face recognition technology is a system which can be used to check whether the person is authorized or not from an image or a video. The system can be utilized in a multiple way but in general it works by comparing features of images with image present in the database. During 1964 to 1965, they dedicated their time on how to use the computer to recognize human faces. They were proud of their work, but the fund was given by some private agency the complete work did not get into the public, due to the security reasons small work was published. They gave a large set of data with images in which they wanted to select the small amount of data by comparing the basic similarities of the data.

Face Detection

General description of face detection means, detecting a face in a particular image or a video. Over the years many researchers have found that face detection is an essential technique for detecting a face from an image. Detecting a face depends on the significant approach and modelling of an image. Here approach means the quality of an image in a standard resolution, head positions, lighting conditions like colour of an image, shadowing, noise of an image etc. Including all these conditions a face has to

be detected in a particular scene of an image. Detection of face has many classifications like skin colour, texture representation and motion information. Usually face detection works with the help of cascade classifiers like Haar classifier.

Fig1: Face recognition process

Face Recognition Algorithm

Face Recognition is implemented using Local Binary Pattern (LBP) algorithm. An

LBP algorithm is very popular for texture description and feature extraction. Initially a face image is divided into several small blocks from which the features are extracted, these features consists of binary patterns which describe the nearby pixels of the region. Then the features that are obtained from the regions are concatenated into a single vector histogram, which describes the graphical representation of the image. Images will then be compared by measuring the distance (similarity) between their histograms. Many researches have worked and also working on LBPH algorithm because the accuracy of the method is high when compared with other algorithms and also it is the most popular technique for face recognition because it has high accuracy and speed. LBPH has achieved success in different head positions, lighting conditions etc.

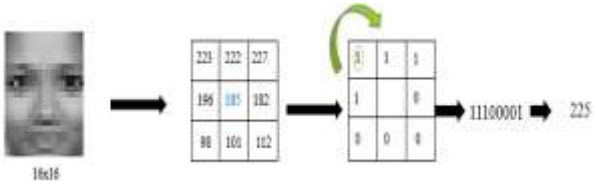


Fig 2: Calculating the original LBP code

In the above example the image is divided into 16 blocks each block of pixel is converted into 3x3 matrix neighbourhood. In this the central pixel acts as a threshold value if the surrounding pixel

values are greater than threshold value '1' is taken or else '0'. Then this matrix forms into a binary matrix form this binary digit is converted into decimal form.

Algorithm Flow chart:

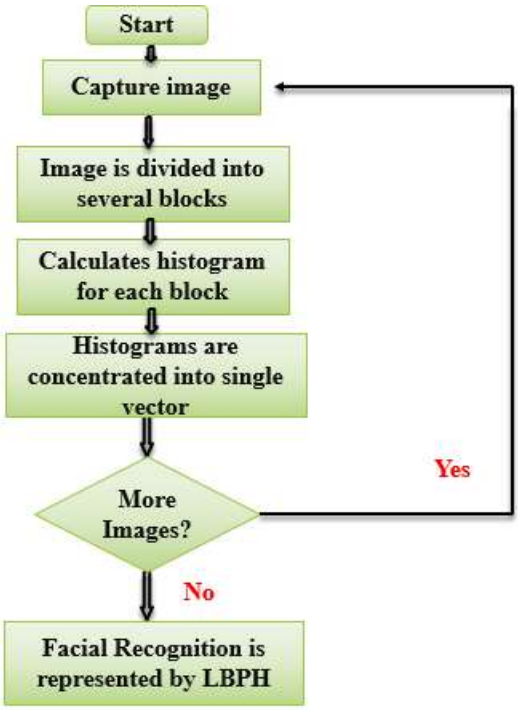


Fig 3: Algorithm flow chart of LBPH process

In the above flowchart the process flow of LBPH algorithm is given. As mentioned at
first the camera interface will capture the images. The captured images will be given
to the next section, here the image will be divided into several blocks say (16x16). For each block a histogram will be created in the next section. These histograms are
combined and concatenated to form a single histogram vector. Then the face
recognition will be happened by the LBPH algorithm.

3. IMPLEMENTATION:

Face Recognition system has been implementation using LBPH algorithm on Raspberry Pi 3 and Zed board. The flow of the working process is given in the below flow chart.

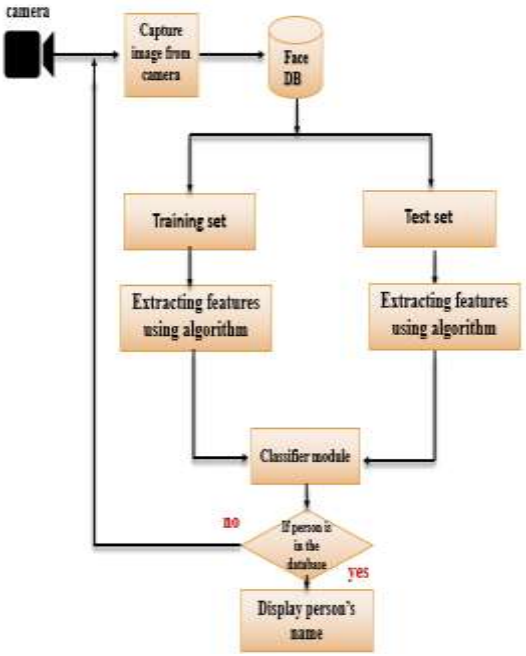


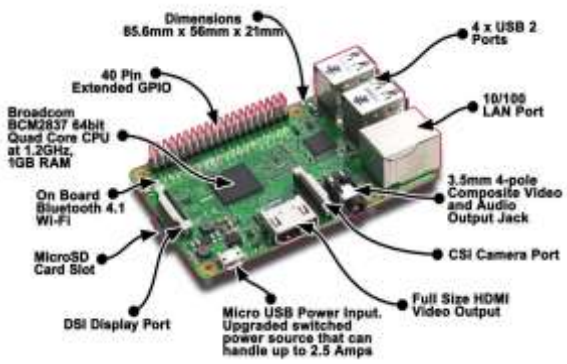
Fig 4: Project flow chart using LBPH algorithm

In the above flowchart the detailed process of project is described. Initially a USB camera which will be connected to the hardware of the system will capture the images. After capturing, the images will be stored in the face database which is created by the python script. From database the images which are captured for testing samples are taken and given to the LBPH algorithm. In this test set section, the test
samples are taken and given to the next section which is extracting features using
LBPH algorithm. In this section the LBPH algorithm will perform the operation and extracts the necessary features. Next comes the training set section in which the
training samples are given to the next section which is extracting the features using LBPH algorithm. After extracting features from both the training and test set these features combined and compared using the classifier module. In this project I have used the Haar classier to compare the features of both the data sets. If the person is in the database or the person is a known person then it will display on the monitor as person's name or else it will display as no match.

4. RELATED WORK:

The brief introduction of different modules used in this project is discussed below:

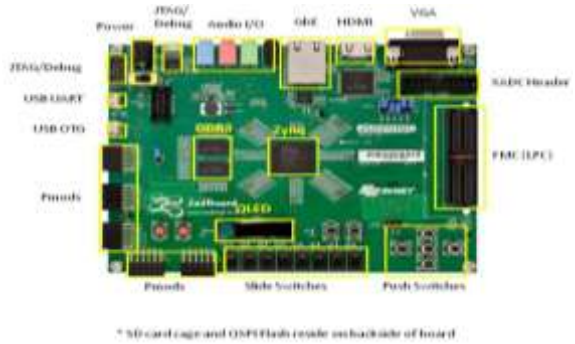
Raspberry Pi 3 Board:



Raspberry Pi 3 Model B is the popular version which is widely used now a days because it has built in wi-fi, Bluetooth with processing speed of 1.4 GHz and it has the power up gradation with processor of Quad Core Broadcom BCM2837 64bit ARMv8. Because of its features it has become the best hardware platform

for beginners who are willing to learn about the Internet of Things.

Zed Board:



ZedBoard™ is a low-cost development board for the Xilinx Zynq®-7000 SoC. This board contains everything necessary to create a Linux, Android, Windows® or other OS/RTOS-based design. Additionally, several expansion connectors expose the processing system and programmable logic I/Os for easy user access. Take advantage of the Zynq-7000 SoC's tightly coupled ARM® processing system and 7 series programmable logic to create unique and powerful designs with the ZedBoard.

5. RESULTS:

5.1 Face Recognition Results on Raspberry Pi 3

In this section the results of Face Recognition application on Raspberry Pi 3 board is shown.

Fig 5: Face Recognition Set Up on Zed Board

USB camera which is connected to the hardware board will capture unknown person images of count 21(as mentioned in the program), while capturing the images give different expressions and angles of face. After the images are captured application will train the captured images into the database. Then the person is recognized and the output is displayed on the monitor which shows the person's name.

Fig 6: Face Recognition of known person

5.2 Face Recognition Results on Zed Board

Fig 7: Face Recognition Set Up on Zed Board

Fig 8: Face Recognition of known person

5.3 Performance Evaluation of Raspberry Pi 3 and FPGA Platform

Platform	OS	Memory FootPrint(For 1 person)	Time		
			Image Capture Time	Training Database Time	Recognizer
Raspberry Pi 3	Ubuntu	1.5MB	1 min	0.72 sec	0.1892 sec
FPGA	Ubuntu	1.5MB	1 min	0.789 sec	0.962 sec

4. CONCLUSION:

Face recognition technology is generally very costly for developing top secure applications. Due to advances in embedded technology, the equipment cost has been drastically reduced and it's successfully integrated for several applications. Hence, now-a-days these applications are reliable and highly accurate.

Face recognition system has specific requirements while using Face Recognition, face should be facing straight towards the camera and spine should be erect. In many places we can use face recognition system like in ATM's, for identifying duplicate voters in elections, verification of visa and passport, verification of driving license, authentication of identities in exam centres, employee identification in government and private sectors.

FUTURE SCOPE:

The current face recognition system recognizes the frontal view of the face but there is scope for future improvement. In future, I would like to improve my code for assisting blind people for easier recognition of objects using ultra sonic sensor and text to voice converter. Using this mechanism, the blind people can hear the person's/object's name from a safe distance.

REFERENCES

[1] Unsang Park, "Face Recognition: face in video, age invariance, and facial marks" Michigan State University, 2009.

[2] T. Ahonen, A. Hadid and M. Pietikainen, "Face description with Local Binary Patterns", Application to Face Recognition. Machine Vision Group, University of Oulu, Finland, 2006.

[3] T. Ahonen, A. Hadid, M. Pietikainen and T. M aenpaa. "Face recognition based on the appearance of local regions", In Proceedings of the 17th International Conference on Pattern Recognition, 2004.

[4] R. Gottumukkal and V.K. Asari, "An Improved Face Recognition Technique Based on Modular PCA Approach" Pattern Recognition Letters, vol. 25, pp. 429- 436, Mar. 2004.

[5] T. Ojala, M. Pietikainen and D. Harwood, "A comparative study of texture measures with

classification based on feature distributions" Pattern Recognition vol. 29, 1996. 6. M. Turk and A. Pentland

[6] M. Turk and A. Pentland, "Eigenfaces for recognition", Cognitive Neuroscience, 3:72{86, 1991.

[7] M. Kirby and L. Sirovich, "Application of the Karhunen-Loeve procedure for the characterization of human faces" IEEE Transactions on Pattern Analysis and Machine Intelligence, 12(1):103{108, 1990.

[8] W. Zhao, R. Chellappa, P. J. Phillips, and A. Rosenfeld, "Face recognition: A literature survey" ACM Computing Surveys (CSUR), 35(4):399{458, 2003.

[9] S. Z. Li and A. K. Jain (eds.), "Handbook of Face Recognition" Springer-Verlag, Secaucus, NJ, 2005.

[10] S´ebastien Marcel, Yann Rodriguez and Guillaume Heusch's "On the Recent Use of Local Binary Patterns for Face Authentication", International Journal of Image and Video Processing, special issue on Facial Image Processing, Manuscript received May 1, 2006; revised October 20, 2006; accepted May 25, 2007.

[11] R. Chellappa, C. Wilson, and S. Sirohey, Human and Machine Recognition of Faces: A Survey, Proc. IEEE, vol. 83, no. 5, pp. 705- 740, 1995.

[12] Y. Rodriguez and S. Marcel, "Face Authentication Using Adapted Local Binary Pattern Histograms," Proc. Ninth European Conf. Computer Vision, pp. IV: 321-332, 2006.

Author's Profile

T. VEENA TAPASWI[1], Dr. KOTA SOLOMON RAJU[2], O.V.P.R. SIVA KUMAR[3]

[1] P.G Student, Department of Electronics and Communication Engineering, Geethanjali College of Engineering and Technology, Cheeryal, Keesara, Hyderabad, Telangana.

[2] Principle Scientist, Department of Digital System Groups, CSIR - Central Electronics Engineering Research Institute (CSIR - CEERI), Pilani, Rajasthan, India.

[3] Professor, Department of Electronics and Communication Engineering, Geethanjali College of Engineering and Technology, Cheeryal, Keesara, Hyderabad, Telangana.