IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Special Issue-15, May 2019 E-ISSN: 2347-2693

TerrorBot- Python Based Cascade Classifier to Detect Terrorists and Soldiers

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DOI: https://doi.org/10.26438/ijcse/v7si15.5964 | Available online at: www.ijcseonline.org

***Abstract*-**Most of the defense organization now takes the help of robots to carry out many risky jobs that cannot be done by soldiers. These robots used in defense or usually employed with integrated system, including video screens, sensors, laser gun, metal detector and cameras. The defense robots also have different shapes according to various purposes. Here the new system is proposed with the help of camera through we can trace out the intruders and the robot will be employed with integrated system, including video camera, sensors, gripper and weapon. The intruders face detection by Haar Cascade Classifier and face recognition by LBPH (Local Binary Pattern Histogram). This is specially designed robotic system to protect the country from enemies and to save soldiers life. The proposed algorithm is implemented using Opensource Computer Vision (OpenCV) and image processing with python.

***Keywords*-** Face detection; Haar Cascade Classifiers; Face recognition; LBPH; OpenCV**.**

I. INTRODUTION

Recognition of face is the process of distinguishing people in images or videos by analyzing and comparing patterns. Face recognition algorithms typically extract facial features and compare them to a database and find the similarity.

The face recognition can be attributed to the increase of commercial interest and the development of feasible technologies to support the development of face recognition. Biometric, law enforcement and surveillance, human-computer interaction, multi media management, smart cards, passport check, criminal investigation, access control are major areas of Commercial Interest.

However, face detection is more provocation because of some unstable characteristics, for example glasses and beard will impact the detecting effectiveness. Moreover, different types and angles of illumination will make detecting face generate unequal brightness on the face, which will have influence on the detection process.

To overcome these problems, the system used the haar cascade classifier for face detection and LBPH (local binary patter histogram) algorithm for face recognition implemented using face recognizer function of OpenCV.

The rest of the paper is organized as follows. Section II describes Related work. Section III describes the Methodology. Experimental results are shown in IV

Finally in section V the conclusion of our work will be discussed.

II. RELATED WORK

This section gives an overview on the major human face recognition techniques that apply mostly the frontal faces. The methods considered are Eigenfaces(eigenfeatures) and Fisherface. The approaches are analysed in terms of the facial representation they used.

A. Eigenface

The Eigenface method is one of the most used algorithm for face recognition. Eigenfaces are the principal components divide the face into the feature vectors. The feature vectors information can be obtained from convince matrix. These Eigenvectors are used to quantify the variation between many faces. The faces are characterized by the linear combination of the highest Eigenvalues. Each face can be examine as a linear combination of the eigenfaces. The face can be approximated by using the eigenvectors having the largest eigenvalues.

Eigenface is a practical approach for face recognition. Because of the simplicity of its algorithm, implementation of an Eigenface recognition system, becomes easy. It is efficient in processing time and storage. There is a high mutual relation between the training data and the recognition data. The accuracy of eigenface depends on many things. As it takes the pixel value as comparison for the projection. The accuracy would decrease with varying luminous intensity. Pre-processing of image is required to achieve satisfactory result. An advantage of this algorithm is that the eigenfaces were invented exactly for these purposes what makes the system efficient.

A drawback is that it is sensitive for lightening condition and the position of the head. Disadvantages- Finding the eigenvectors and eigenvalues are time consuming. The size and location of each face image must remain similar eigenface approach maps features to principle subspaces that contain most energy[8].

B. Fisherface

Fisherface is one the most successfully widely used method for face recognition. It is based on appearance method. In 1930 R A Fisher developed linear/ fisher discriminant analysis for face recognition. It shows truthful result in the face recognition process. All used LDA to find set of basis images which maximizes the ration of between – class scatter to within- class scatter. The disadvantages of LDA is that within the class the scatter matrix is always single, since the number of pixels in images is larger than the number of images so it can increase detection of error rate if there is a disparity in pose and lighting condition within same images. So to overcome this problem many algorithms has been proposed. Because the Fisherface technique uses the variation within class, so the problem with variations in the same images such as lighting variations can be overcome.

The fisher face method for face recognition uses both PCA and LDA(Linear discriminant analysis) which produce a subspace projection matrix, similar as used in the eigenface method.. however, the fisher face method is able to take advantage of within class information, minimising variation within each class, yet still maximising class separation. Like the eigenface construction process, the first step of the Fisherface technique is take each image array and reshape into a vector. Fisherface is identical to Eigenface but with enhancement of better classification of different classes image.

Fisherface discards the first three principal components which are responsible for light intensity changes; it is more invariant to light intensity.

The disadvantages of Fisherface are that it is more composite than Eigenface to finding the projection of face space. Calculation a ratio of between- class scatter to within-class scatter requires a lot of processing time. Besides, due to the need of better classification, the dimension of projection in face space is not as dense as eigenface, results in larger storage of the face and more processing time in recognition[6].

III. METHODOLOGY

Renesas microcontroller is the heart of the system, located at the central of the blocks diagram and controls all the operations of the system as shown in Figure 1. An LCD is used to display all the operations going under the microcontroller. The work system include microcontroller for collecting data from various places and accordingly movement of robot. The controller is programmed to turn ON a LASER device(as Gun) to target and hit the unknown persons. Laptop camera is used for detecting the face of the intruders.The work flow of the TerrorBot is shown in the Figure 2.

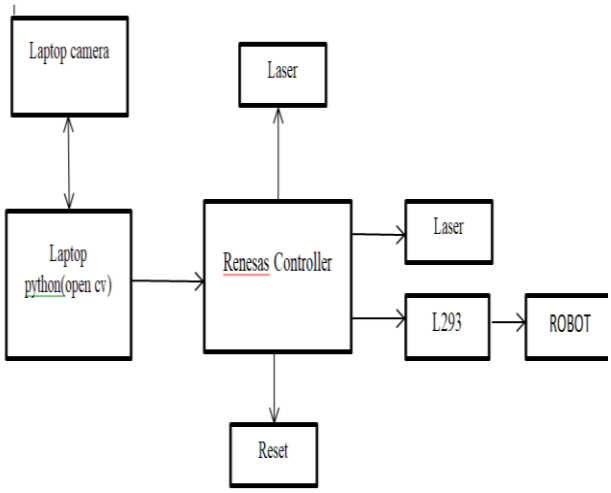

Figure 1: Block Diagram

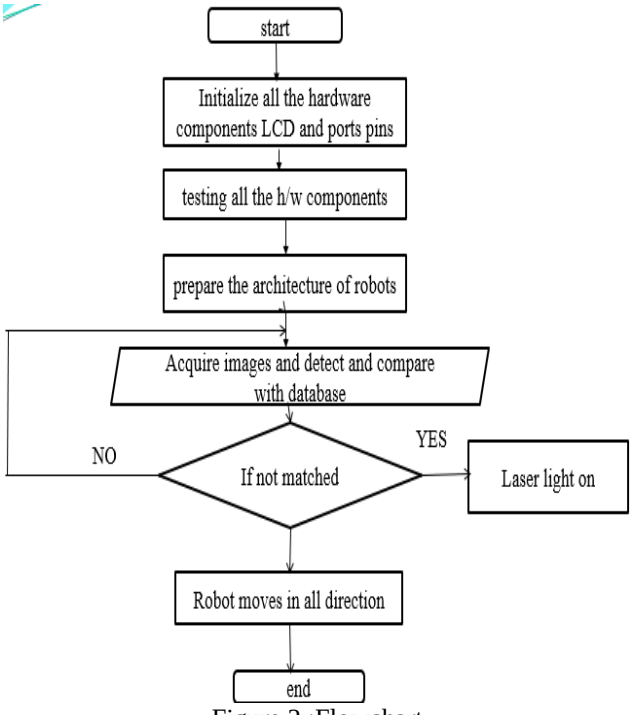

Figure 2 :Flowchart

A. Haar cascade classifier

Viola-Jones Face Detection Method Initially the algorithm needs lot of positive and negative images to train the classifier, then we need to extract features from it. For t his Haar features shown in Figure 3 are used they are just like our Convolutional Kernel. Each feature is a single value obtained by subtracting sum of pixels below white rectangle from sum of pixels below black rectangle.

A) Edge feature

B) Line feature

C) Four-rectangular features

Figure 3:Haar Features

For each feature calculation, we need to find sum of pixels below white and black rectangles. To solve this, they introduced the integral images. It simplifies calculation of sum of pixels, how large may be the number of pixels, to an operation including just four pixels.

Observe Figure 4, top row shows two good features. The first feature selected appears to focus on the property that the region of the eyes is often darker than the region of the nose and cheeks. The second feature selected relies on the property that the eyes are darker than the bridge of the nose. But the same windows applying on cheeks or any other place is unrelated.

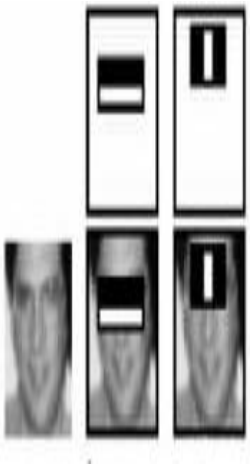

Figure 4: Face Image

Viola-Jones Algorithm using haar features for face detection:

1. For number of scles in image pyramid do
2. Downstream image by one scales
3. Compute integral image for current scale
4. For each shift step of the sliding Detection window
5. do
6. For each stage in the cascade Classifier do
7. For each filter in the stage do Filter the detection window
8. End
9. Accumulation filter outputs within this stage
10. .If accumulation fails to pass per-stage threshold do
11. Break the for loop and reject this window as a face
12. End
13. End
14. If this detection window passes all per-stage thresholds
15. do
16. Accept this window as a face
17. Else
18. Reject this window as a face
19. End
20. End
21. End

B. Local binary pattern histogram for face recognition

Several methods for extracting the most useful features from face images to perform face recognition. One of these feature extraction methods is local binary pattern (LBP)method. This is done by dividing an image into several small areas from which the features are extracted. These features consist of binary patterns that describes the surroundings of the pixels in the regions. The obtained features from the region are concatenated into a single feature's histogram, which forms a representation of the image. Images then be compared by measuring the similarity(distances) between their histograms. According to the several studies face recognition using the LBP method provides very good results, both in terms of speed and discrimination performances. Because of the way texture and shape of images is described, the method seems to be quite robust against face images with different facial expressions, different lightening conditions, image rotation and aging of persons.

i Principle of LBP

The original LBP operator was invented by ojala et al. this operation works with the eight neighbors of a pixel, using the value of this center pixel as a threshold if a neighbor pixel has a higher gray value then the center pixel(or the same gray value) the a one is assigned to that pixel,else its gets a zero. The LBP code for the center pixel is then

produced by concatenating the eight ones are zeros to a binary code as shown in Figure 5.

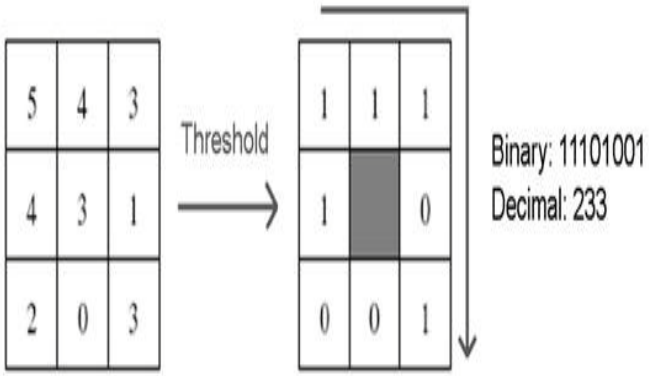

Figure 5: Binary operator

ii Face Recognition Algorithm

To implement the face recognition , proposed the local binary pattern methodology. Local binary patter works on local features that uses LBP operator which summarizes the local special structure of a face image .LPB is defined as a orders set of binary compressions of pixel intensities between the center pixel and its eight surrounding pixels local binary pattern do this compression by applying following formula:

$$LBP(X_c,Y_c) = \Sigma^{7}_{n=0} s(i_n - i_c)2^n$$

Where i_c corresponds to the value of the center pixel (X_c,Y_c), i_n to the value of eight surrounding pixels. It is used to determine the local features in the face and also works by using LBP operator. Feature extracted matrix originally of size 3×3,the values are compared by the value of the center pixel, then binary pattern code is produced and also LBP code is obtained by converting the binary code into decimal one.

LBPH Algorithm

Input: Training image set.

Output: Feature extracted from face image and compared with center pixel and recognition with unknown face image.

1. Initialize temp = 0
2. FOR each image I in the training image set
3. Initialize the pattern histogram, H=0
4. FOR each center pixel $t_c \epsilon$ I
5. Compute the pattern label of t_c, LBP (1)
6. Increase the corresponding bin by 1
7. END FOR
8. Find the highest LBP feature for each face image and combined into single vector.
9. Compare with test face image
10. If it matches it most similar face in database then recognized successfully.

Flowchart of the LBPH

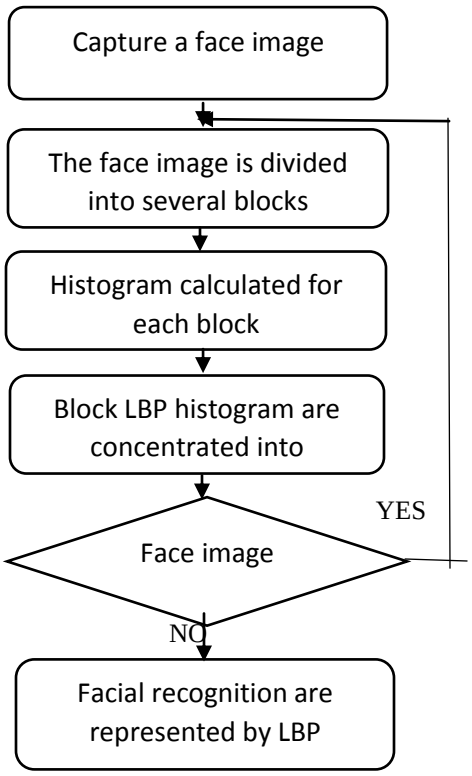

Figure 6: Flowchart of LBPH

IV. SYSTEM DESIGN

1. RENESAS MICROCONTROLLER

The Renesas microcontroller is the heart of the project it is programmed such that it keeps on commanding and controlling the complete action through peripherals connected as shown in Figure7..

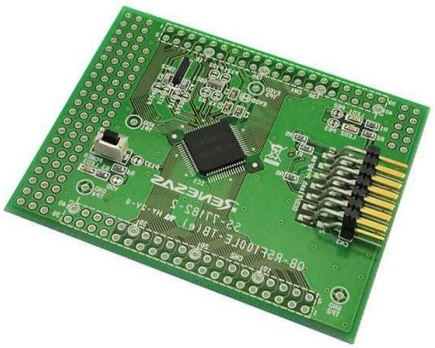

Figure 7:Renesas microcontroller

2. LCD [liquid crystal display]

LCD screen is an electronic display module. It has wide range of applications.

Used to display all the operations going inside the microcontroller as shown in Figure 8.

Figure 8: LCD

3. L293D

L293 is typically motor driver or motion driver IC which allows DC motor to drive on either direction.

Control the movement of the robot as shown in figure 9.

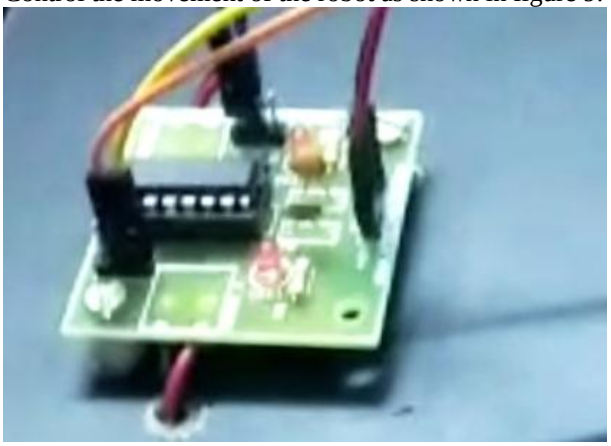

Figure 9: L293D

4. LASER

A laser is a device that emits light through a process of amplification based on the simulation emission of electromagnetic radiation. If unknown detected light will turn on as shown in Figure 10.

Figure 10: Laser

V. RESULTS

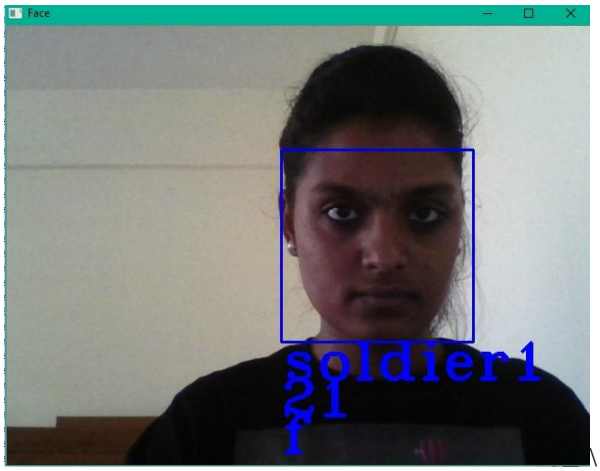

Figure 11: Detection of soldier

The proposed system is tested on datasets which consists of Wide range of face images. We used My SQL database for training face images.

For face recognition, we have used cameras. The implanted algorithm is capable of recognizing soldier and terrorists as shown in Figure 11 and Figure 12.

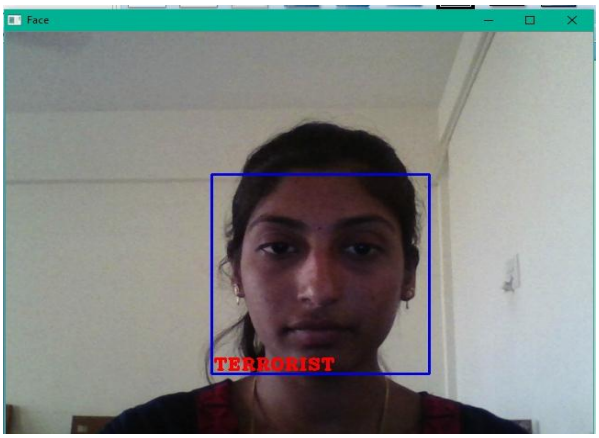

Figure 12: Detection of Terrorist

V. CONCLUSION

Today, defense ground robots & unmanned vehicles are used worldwide. However, the significant growth of the current defense robots come as the nature of combat changes in every region while the globally integrated enterprise replaces nationalistic dominance. This proposer system gives an exposure to design a simple robot that can be used to do multifunction in defense. Manual control is also employed to control the robot from the control room which is located far away from the border area.

ACKNOWLEDGMENT

We express our gratitude to our Principal Dr K Channakeshavalu and Head of the Computer Science Department Dr Arun Biradar ,East West Institute of Technology for supporting us to carry out our project with clear guidance from Associate Professor Mrs Chetana Srinivas.Lastly we would thank everybody who has helped directly and indirectly in the completion of our project.

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