



# A Novel IOT Approach for Human Presence Detection and Home Monitoring System

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## Abstract

Due to hardware limitations of Raspberry pi, motion detection is implemented by comparing the last two consecutive images saved locally. In this work, can be identified intruder motion there by securing the area. When a face is identified, the algorithm will check the database. If the face is in the database, it will show whose face is it. If the face that are identified is not in database, it will show as “unknown”. At that particular instant of time, the server notifies to the user and all the images from the point of identification are uploaded to a cloud server and sent via email. Through the website we can observe the room and control operations can be done by raspberry pi. This works aims to describe a security system using low processing raspberry pi using Internet of things.

Key Words –IOT, Raspberry Pi, Webcam

## 1. Introduction

The IOT is the network of physical object which are assigned unique IP address for each interface and contain embedded technology to communicate and sense or interact with their internal states or the external environmental. In this modern age, people keep on moving around the world, posing a lot of security problems particularly when the person is not present in his or her home. This project is focused to develop the computational model of face recognition which is fast, simple and accurate in different environments. Local binary pattern face recognition algorithm (LBPH) is used in this work. In the motion detection method, if face is detected, the photo that has been taken by the camera is checked with the photo stored in the database. This is done through LBPH face recognizer algorithm. Then the algorithm will check the face stored in database. If the face is in the database, it will show identify the face. If the face that is identified is not in database, it will show as “unknown”. The main advantage of this work is that we can identify the person is entering in home or office.

## 2. Security system

This proposed method uses the motion detection using low cost computing device. In this work raspberry pi 3 model B is used to connect logic tech c270 webcam to capture the intruding activities.

The proposed system is divided in two parts

- 1) Server Side
- 2) Client Side

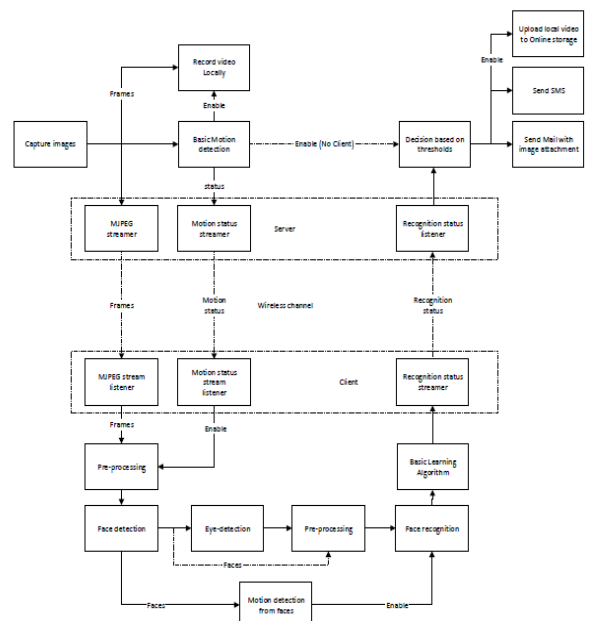


Figure 1 Functional Block diagram of security system.

### 2.1. Server side

In the server side operation is divided into

- Basic motion detection
- Server Algorithm
- Message sending

- Mail sending
- Cloud storage
- Client-server communication
- Decision making

The Gaussian Mixture Model algorithm is used for basic motion detection method. This algorithm is generally used in pre-processing stage in large image process project. In addition to background subtraction, this also has ability to neglect small changes in the background such as changes in lighting condition etc which should not be perceived as motion. The segmentation approach also allows shadow from the images to be removed.

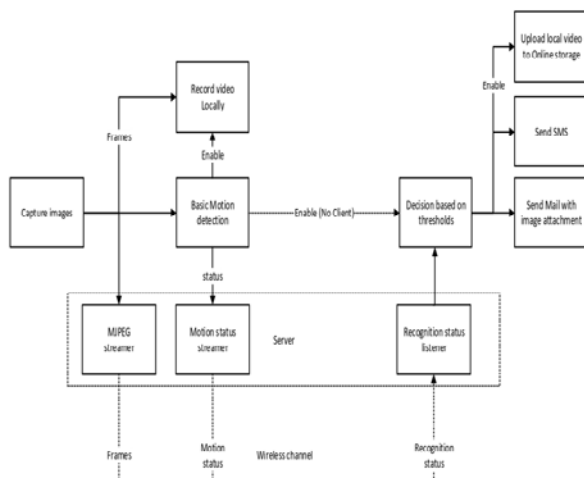


Figure 2 Functional block diagram of server side

### 2.1.1. Server side algorithm.

- Step 1: To simplify motion detection, the first frame of the video file is considered to contain no motion and thus just background
- Step 2: We convert the image to grayscale since color has no bearing on our motion detection algorithm. This also reduces the amount of data to be processed
- Step 3: The images is Gaussian blurred to smooth the images. This removes white pixels lying outside the clusters. This also helps to obtain a smoother contour
- Step 4: The difference between the initial frame and subsequent new frames from the video stream is calculated and the absolute value of their corresponding pixel intensity differences is obtained|
- Step 5: If the delta is less than 25, the pixel and set it to black (background) and if the delta is greater than 25, set it to white (foreground)
- The background of the image is represented as black, whereas the foreground (and where is motion) is white
- Step 6: The image is dilated to fill the holes.
- Step 7: If the contour area is larger than the supplied min-area, there is motion detection, otherwise if the contour area is less, the text status shows as unoccupied

- Step 8: If server side motion is detected then text status is shown as occupied. The start time is set and video is captured.
- Step 9: Server sends the text status and the frames to client.
- Step 10: Client sends the text status to server if unknown person is detected
- Step 11: The server side notify to user via email or message. The data are uploaded to cloud.
- Step 12: To observe the room through the website, enter the IP address and port address in the browser as shown below.

<http://0.0.0.0:5000/>

### 2.2. Client side

In the Client side, operation is divided into

- Face detection
- Eye detection
- Face Recognition
- Motion detection using face
- Client-server communication

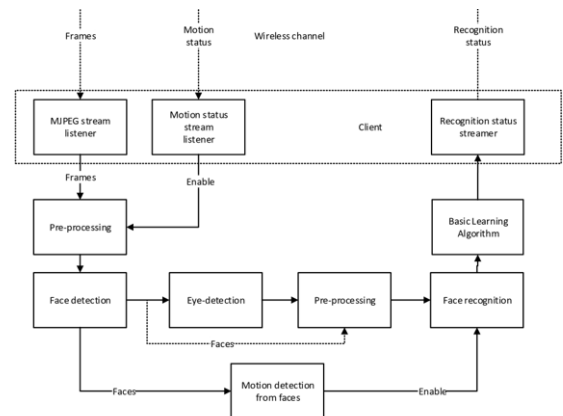


Figure 3 Functional Block Diagram of Client Side

### 2.2.1. Client side algorithm.

- Step 1: Client receives the text status and frames from server.
- Step 2: Face detection algorithm will start and Faces are detected from frames.
- Step 3: Detected face of the image will be cropped before the eye detection algorithm is executed.
- Step 4: If eye is detected, check for least two number of eyes in the cropped face.
- Step 5: If the head is in slanting position, the eye detection algorithm will check the degree of angle the head is slant, and make it straight.

- Step 6: Load faces from trained database and Face Recognition algorithm will start when the message comes from the face detection procedure.
- Step 7: The photo that has been taken by the camera is checked with the photo stored in the database. This is done through LBPH face recognizer algorithm.
- Step 8: Create a registry of names mapped to faces
- Step 9: Compare face to get closest match in database. Find the name of predicted face in the registry.
- Step 10: The distance of frame is calculated to know how much similarity is there.
- Step 11: If this calculated distance is more than the value of threshold it is shown as unknown, otherwise it is the person in the database.
- Step 12: If the unknown person is detected, register list of unknown person cycle will be added by two cycle.
- Step 13: If the known person is detected, register list of known person cycle will be added by one cycle and average sum of distance will be calculated.
- Step 14: When the cycle list of person in database are compared, highest cycle will be the known person.
- Step 15: If text status continuously shows as “unknown” in frame, the client sends message to server that an unknown person is detected.
- Step 16: If the unknown person is detected then it will notify the user via email and message. The data are uploaded to the cloud.

### 3. Result and discussion

Motion detection is the process of detecting a change in the position of an object relative to its surroundings or a change in the surroundings relative to an object. In this work, can be identified intruder motion there by securing the area. When a face is identified, the algorithm will check the database. If the face is in the database, it will show whose face is it. If the face that are identified is not in database, it will show as “unknown”. At that particular instant of time, the server notifies to the user and all the images from the point of identification are uploaded to a cloud server and sent via email. Through the website we can observe the room and control operations can be done by raspberry pi.

The photos and videos are sent directly to a cloud server, when the cloud is not available then the data is stored locally on the Raspberry Pi memory and sent when the connection resumes. The hardware cost of the security system developed is an amount of Rupees Four Thousand. The other commercially available security systems are highly expensive compared to this proposed security system.

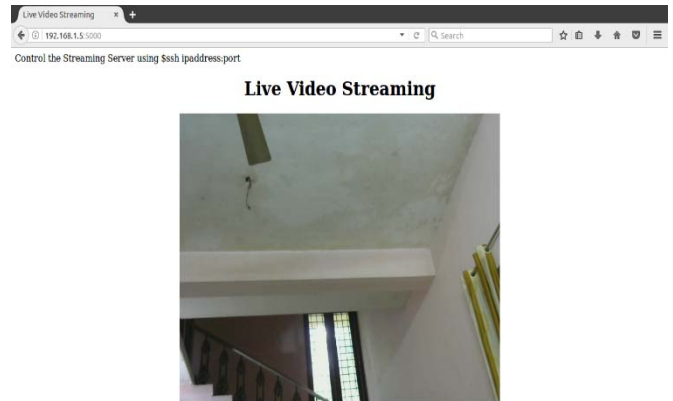


Figure 4 Video Streaming through website

In this modern age, people keep on moving around the world, posing a lot of security problems particularly when the person is not present in his or her home. With this work, user can monitor what is happening in home or office remotely as shown in figure 4. The main advantage of this work is that we can identify the person is entering in home or office.

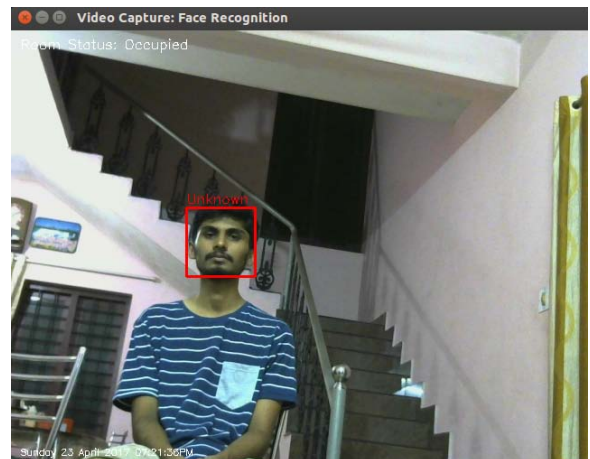


Figure 5 Detect the unknown person

This project is focused to develop the computational model of face recognition which is fast, simple and accurate in different environments. Local binary pattern face recognition algorithm (LBPH) is used in this work. It shows proper result when variation is generated by external source and it requires training of only 4 to 5 images for proper result

In the motion detection method, if face is detected, the photo that has been taken by the camera is checked with the photo stored in the database. This is done through LBPH face recognizer algorithm. Then the algorithm will check the face stored in database. If the face is in the database, it will show identify the face as shown in figure 6. If the face that is identified is not in database, it will show as “unknown” as shown in figure 5.

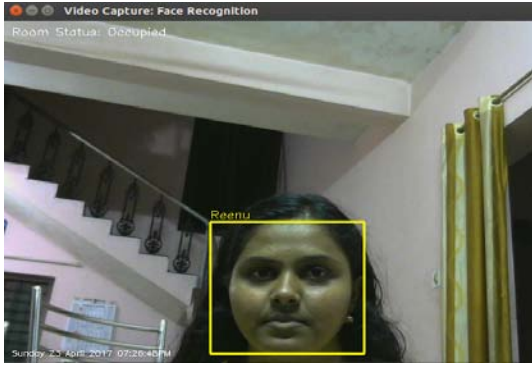


Figure 6 Detect the known person

Communication between client and server are shown on the output window of raspberry pi as notification as shown in figure 7.

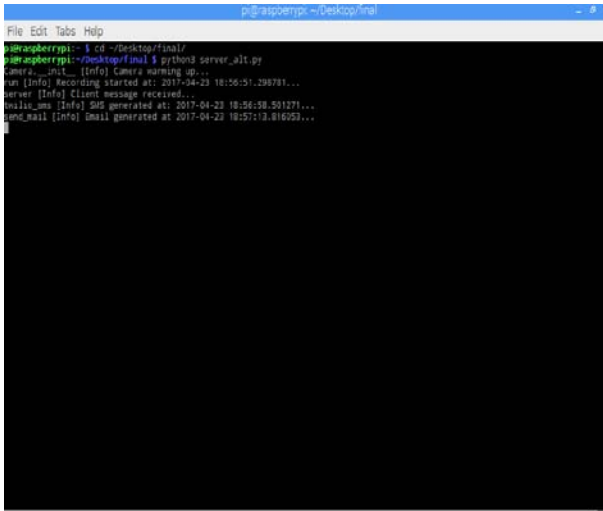


Figure 7 Raspberry pi output window

In face recognition method when the unknown person is detected the user will be notified through email and SMS as shown in figure 8 and 9

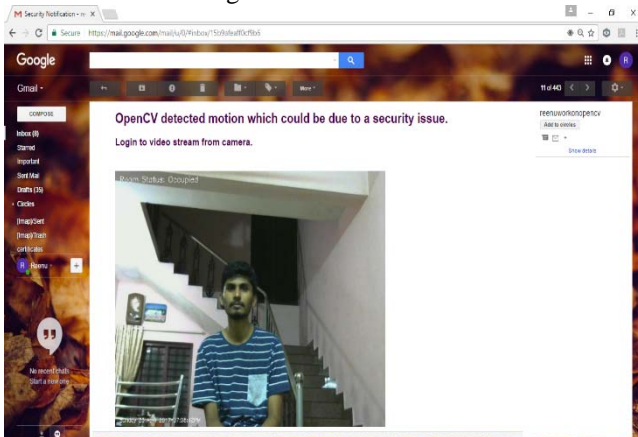


Figure 8 Sending mail to registered mail address

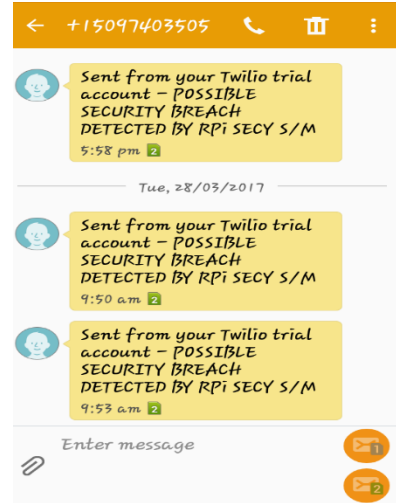


Figure 9 : Sending SMS to the registered phone number

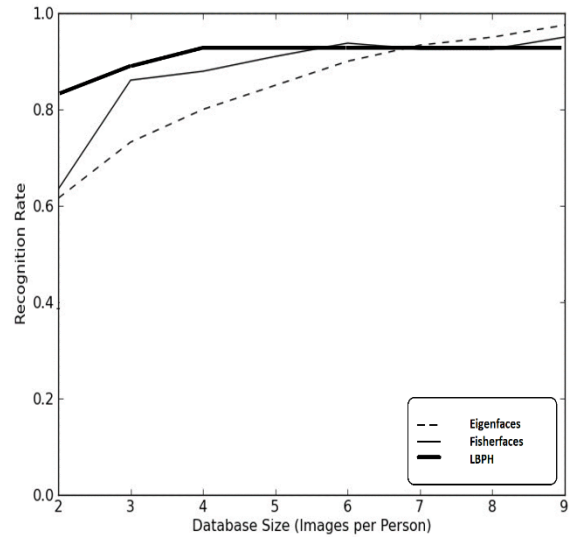


Figure 10: Comparison of face recognition algorithm

As evident from figure 10 the recognition rate and the performance of Fisher faces and Eigen faces algorithms increase within increase in the number of images per person in the database. The graph can be extrapolated without losing this characteristic. Basic idea of local binary patterns is to summarize local structure in an image by comparing each pixel with its neighborhood. This eliminates the need for multiple images in the recognition database. Hence LBPH algorithm is used in this thesis.

#### 4. Conclusion

The face recognition algorithm was implemented in IoT device considering its resource and storage space limitations. Further, the whole cost of the system was designed to be low. Due to hardware limitation of Raspberry Pi, motion detection is implemented by comparing the last two consecutive images saved locally. With this work, the presence of an intruder can be notified to the user. The probability of false detection is reduced considerably by using two stages of motion detection. First a basic algorithm is used for conformation of motion. The



presence of human face and its motion is verified. Next a face recognition algorithm is run to identify the authorized person. If an unauthorized person is found, it is notified to the user via mail and SMS. With this thesis, user can monitor what is happening in home or office remotely. Comparing the three different face recognition algorithms, the recognition rate and performance of LBPH algorithm is more compared to Fisher face and Eigen face algorithms. Hence LBPH algorithm is used in this work.

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