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Enhanced Home Security Using IOT and Raspberry PI

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Abstract - *A smart home application features great help to our everyday life. This system rejuvenates facilities of a house to evolve into a smart home by adding more security features. The improvement in security aspect offers innovative and productive scope to the means of living. All these characteristics is adapted by using Internet of Things (IoT) and Raspberry Pi. The recognition problem is always questionable in smart home applications. So, a recovery is done to identify the intruder as known or unknown by the use of image processing techniques for face recognition. This tend to solve many issues in terms of authentication. This protection mechanism notifies the user accordingly, giving a clear picture of the scenario happening at the user's house. The sensor based system highlights many features enabling it to be widely used. Fire sensor detects any temperature increase in the living room and posts its status in the URL given to the user. The gas sensor helps in detecting the presence of any gas leakage based on the intensity of the gas in air. With the help of DC motor, auto door locking mechanism is actuated. This is very useful. All the statuses are processed between the sensors and the user via IoT. Raspberry Pi connects all the components and brings forth the proper functioning of the whole package. The procedures that are used here are very simple. Hence, even novice users could understand the system's advanced features and use it with ease. The use of surveillance camera also helps in identifying the presence of flame and thus a buzzer is activated in the case of fire detection*.

Key Words: **Raspberry PI, intruder, Internet of Things (IOT), image processing, face recognition, Home Automation, fire detection.**

1. INTRODUCTION

This paper deals with the security bases home automation system. Home Automation Systems are of great use to the people since they help in maintaining a secured home environment and makes handling household works easier, thus creating a smarter and efficient way of living

There are number of security based home automation system based on raspberry pi controller.

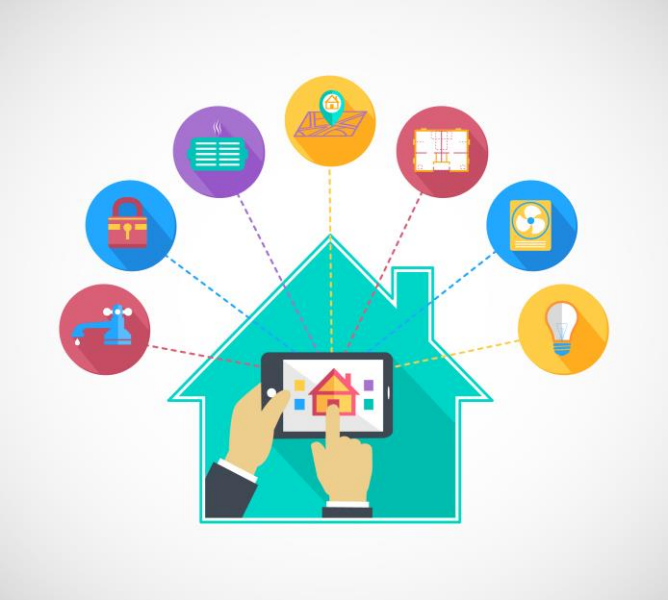

Fig -1: Home Automation System

Huu-Quoc Nguyen et. Al., [1] proposes an easy framework observing in light of Raspberry Pi, a solitary board PC which takes after Motion Detection calculation written in Python as a default programming condition. What's more, the framework utilizes the movement recognition calculation to altogether diminish capacity use and spare venture costs. The calculation for movement identification is being executed on Raspberry Pi, which empowers live surveillance camera alongside recognition of movement. The live camcorder can be seen from any web program.

The principle target of the framework in [2] is to exhibit the capacity of picture handling calculations on a little processing stage. Particularly to make a street sign acknowledgment framework in view of an inserted framework that peruses and perceives speed signs. The paper depicts the attributes of speed signs, necessities and challenges behind executing a constant base Raspberry pi framework and how to manage numbers utilizing picture handling procedures in light of shape and measurement examination.

Wilson Feipeng Abaya et. Al., [3] proposes a system with night vision capability. The system consists of raspberry pi controlled PIR Sensor and a modified camera which is modified to acquire images of considerable resolution even in the night time. Also a smoke sensor is attached in the system. The alert message is sent to the mail of the user. Patchava VamsiKrishna et. Al., [4] proposes a system based on GSM and Raspberry Pi combined to detect

the intruder and send SMS to the user with the help of openCV. Face recognition based surveillance and door opening mechanisms has also been introduced[5].

Some of the drawbacks in the existing systems include

- Memory management is an important issue to be considered in real time surveillance
- In home surveillance, alert is sent to the users even for authorized people
- Cost issues
- Accuracy of face recognition is less
- Detecting face from low resolution video is difficult
- No Automated door locking system
- Fire and gas leakage system are not automated
- No cloud back up of surveillance videos

This paper aims at creating an integrated Smart security system based on sensors and actuator with image processing techniques added to it, Sensors and actuators perform gas leak detection and manages door locking mechanism. The system notifies the user about the intruder via IOT module. The system also proposes an image processing based surveillance in which the intruder face and fire or flame detection can be done.

2. SYSTEM DESIGN

The proposed system includes gas sensor for detecting gas leakage and to actuate exhaust fan, IR sensor to detect door open/close condition and actuates motor, PIR sensor detects intrusion and activates camera to capture surveillance video.

From the video key frames are detected using background subtraction algorithm and hallucinated by Singular Value Decomposition [6] to obtain high resolution images. Face region is segmented from the key frames using Viola Jones algorithm [7].

The face segmented is processed using alignment free partial face recognition system[8] to check if it is intruder or authenticated one. The user is notified about the intruder and the video is uploaded to the backup drop box.

The camera continuously monitors the home and fire flame is detected using multi expert system[9] which tests for color, shape and the growth of the fire[10].

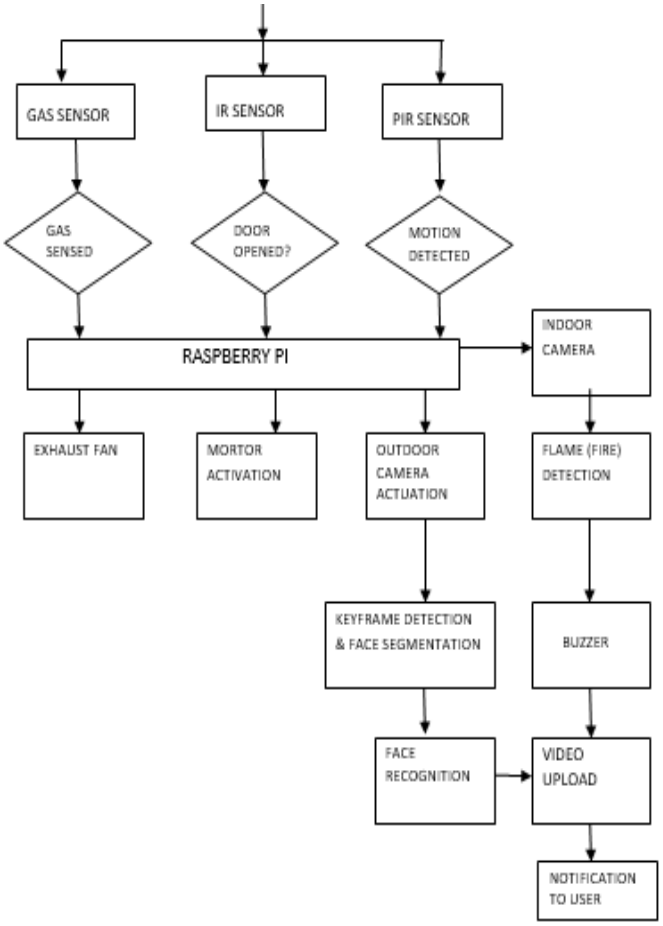

Fig – 2: System Design

2.1 IMPLEMENTATION

step1: The sensors continuously monitor the environment to find gas leakage, door open/close and intruder detection

step2: The actuators are activated based on the sensor signals

step2.1: Exhaust fan is activated whenever gas leakage is sensed

step2.2: Motor is activated when IR Sensor senses the open door

step2.3: Camera is activated when PIR senses intruders

step3: Video obtained from camera is processed to obtain the key frames using background subtraction algorithm

step4: Key frame is hallucinated using singular value decomposition method

step5: Face is detected from the key frame using Viola Jones Algorithm

step 6: The detected Face is identified using non alignment partial face recognition algorithm using the modified Gabor Filter and Multi Keypoint Detection Method.

step 7: The surveillance video is uploaded to the cloud dropbox [11] using IOT Module in the kit.

Step 8: The Fire recognition is done by

Step 8.1: Color recognition i.e., dominance of Red color is checked for in RGB Frame

Step 8.2: The shape of the flame is analyzed

Step 8.3: The growth of Flame is analyzed.

And buzzer is actuated.

The system can be implemented in real time environment. The sensors and actuators are controlled by the Raspberry Pi controller. The system acts as smart home security system by efficient intruder, gas leakage and fire detection and also manages automated door locking mechanism.

In Key Frame Detection algorithm, firstly, the current frame image and the background image difference subtraction to get difference image and the difference image carry on binaryzation processing. The current frame will be as the key-frame if the difference exceeds a certain critical threshold.

Hallucinated image is obtained by selecting the first few significant singular values of Eigen values of decomposed matrix of the image.

Face Segmentation is done using the Viola Jones method which is based on HAAR Features and recognition is done by Multi Key pointer descriptor described in [8].

Fire recognition is done by comparing the R, G and B values of the fire blob segmented and the growth of the fire is found by comparing the correlation values of fire size in consecutive frames.

Fig – 3: Raspberry Pi

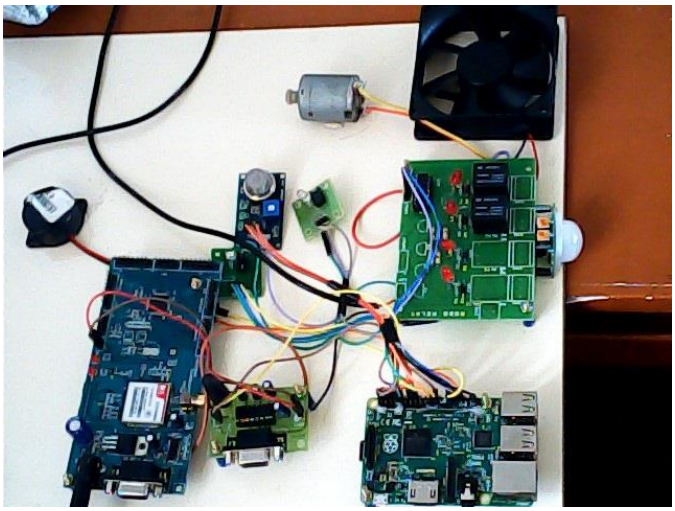

Fig – 4: Implementation Kit

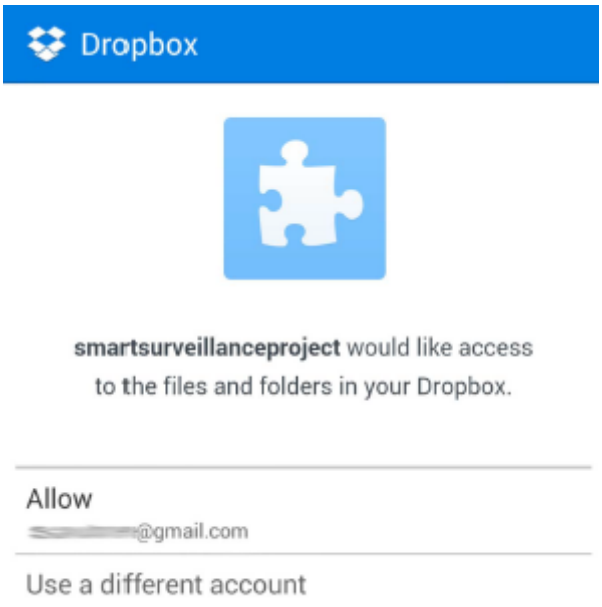

Fig – 5: Drop Box Account

3. RESULTS

The entire system performance can be measured in terms of sensor accuracy, Face detection and recognition accuracy and fire detection accuracy. In this phase, the performance of sensors accuracy is accessed and in next phase face recognition and fire flame detection.

Accuracy of the security system is important to ensure the reduction of false alarming and to effectively identify the condition of the environment.

Table -1: Accuracy

	Gas Leakage	Intrusion Detection	Door Open/close	Face Recognition	Fire Recognition
Week 1	100	95	92	90	95
Week 2	100	94	93	92	94
Week 3	100	97	95	94	94

3. CONCLUSIONS

The system includes gas sensor for detecting gas leakage and to actuate exhaust fan, IR sensor to detect door open/close condition and actuates motor, PIR sensor detects intrusion and activates camera to capture surveillance video.

From the video key frames are detected using background subtraction algorithm and hallucinated by Singular Value Decomposition to obtain high resolution images. Face region is segmented from the key frames using Viola Jones algorithm. Recognition is done using multi key point descriptor. Fire detection is done using color and shape evaluation and fake fire is recognized using growth evaluation.

Future work may include additional features like electronic device control, power management could be added to the home automation system. Additional sensors and actuators could be added to the system.

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