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AUTOMATED HYBRID SURVEILLANCE ROBOT

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ABSTRACT
This paper proposes a Raspberry Pi based automated robot which fulfils the purpose of surveillance. The robot provides autonomous movement around the facility where it is deployed and will move around the obstacles in its way by detecting them. It detects any kind of human motions in the facility and alerts the registered users through SMS alert. It also captures the image of the commotion by using a Pi camera.

KEYWORDS- Raspberry Pi, GSM Module, Motion Detection.

INTRODUCTION

Security has been a major issue with homes, offices, factories or any place in this world. Theft has been on a constant rise and there isn't a perfect solution to it. There are also simple human mistakes; e.g, fire which cannot be predicted and cause loss of all kinds of resources. In security systems, sensors always play an important role. The ultrasonic sensor, microwave sensor, photo-electric sensor, passive infrared (PIR) sensor, noise detector etc. are frequently used sensors.User friendliness and simple installation are main reasons behind the popularity of wireless security system [1].Robotics is the branch of technology which deals with the construction, design, operation and application of robots [2]. Robots usually have control modes that needs to be switched between to function in different ways and in different locations. There have been prototypes which have helped in discovering inaccessible locations such as dense forests, mines etc. [3]. The goal is to construct a self-reliant small, land-based surveillance robot. This robot would be superior to other surveillance robots due to its lower price and the fact that a heavy base station is not required to obtain control over the robot.It provides real time surveillance andmoves around the facility using its ability of obstacle detection using IR sensor. The robot has the ability to detect any kind of human motion in the facility using PIR sensor. Then the user is alerted via SMS and the images captured by the Pi camera can be viewed[4][5].

BLOCK DIAGRAM WITH DESCRIPTION

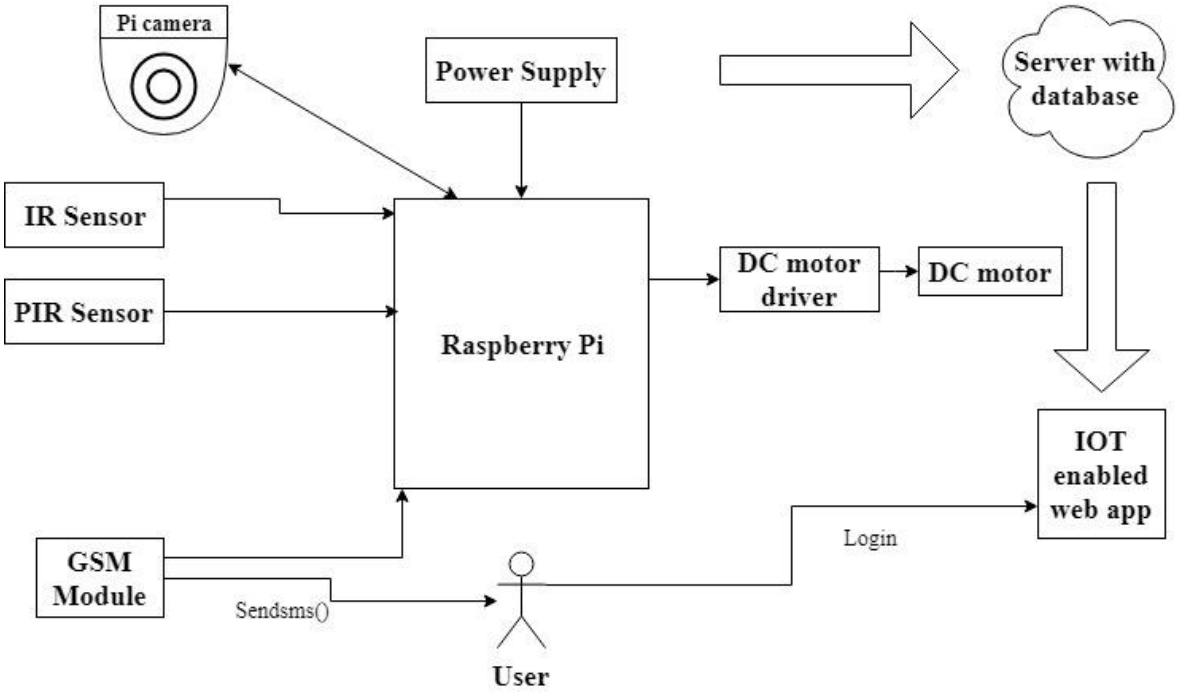

Figure 1. Block Diagram

DC MOTOR DRIVER:

The motor driver actually consists of two sub motors i.e. right and left motor. Raspberry Pi sends signals to the motor driver which in turn drives the two sub motors to turn either in right or left direction depending upon the signal. This is done by turning the motors in clockwise or anticlockwise direction [6].

RASPBERRY PI:

Raspberry pi is an ARM based credit or debit card sized single board computer. In our project, the Raspberry Pi 3 Model B is the microprocessor of choice. It controls the entire operation of the robot through a python program [7] [8].

PIR SENSOR:

SB612A is a pyro electric sensor used for human detection. It detects human motion depending upon whether they have moved within the sensor range. The process of object detection and tracking by using three-frame differencing approach requires some kind of pre-processing on input and post processing the output to get higher accuracy in detection [9].

IR SENSOR:

IR sensor consists of IR transmitter, receiver, resistors and an LED.It uses the heat of an object as a parameter to detect motion. Input voltage is 5V, and output voltage is digital value 0 or 1. Wave length is up to 6cm adjustable.

GSM MODULE:

The GSM (Global System for Mobile communication) module uses a SIM card and operates similar to a mobile phone. We use AT commands to fetch the information and control the SIM card.

PI CAMERA:

The Pi Camera Module is used to take high-definition photographs. The camera is compatible all models of Raspberry Pi 1, 2, and 3. The camera is trigerred whenever motion is detected.

METHODOLOGY

FLOWCHART:

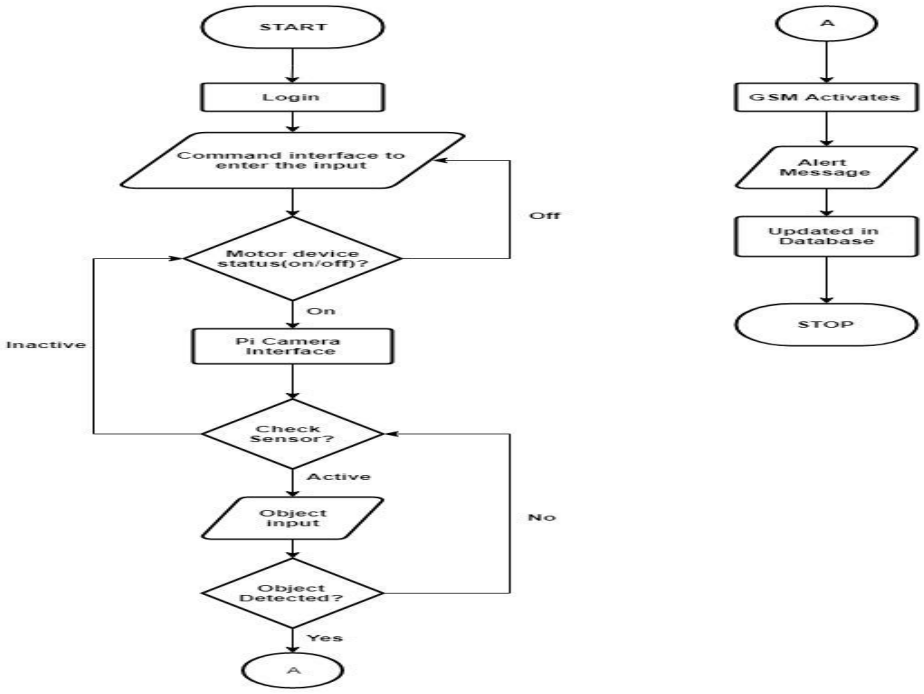

Figure 2. Flowchart of Working Model

The flowchart works as mentioned below:

1. The user of the model will first enter the command to turn on the robot.
2. The motor device status is checked to see whether it is on/off. If it is off, then the execution goes back to step-1.
3. If it is on, the Pi Camera interface is turned on.
4. Now the sensor is checked to verify whether any object or motion has been detected.
5. The GSM module is activated after the object is detected.
6. GSM module will now send an alert SMS to the authenticated users.
7. The user can view the images captured by the Pi Camera.

SEQUENCE DIAGRAM:

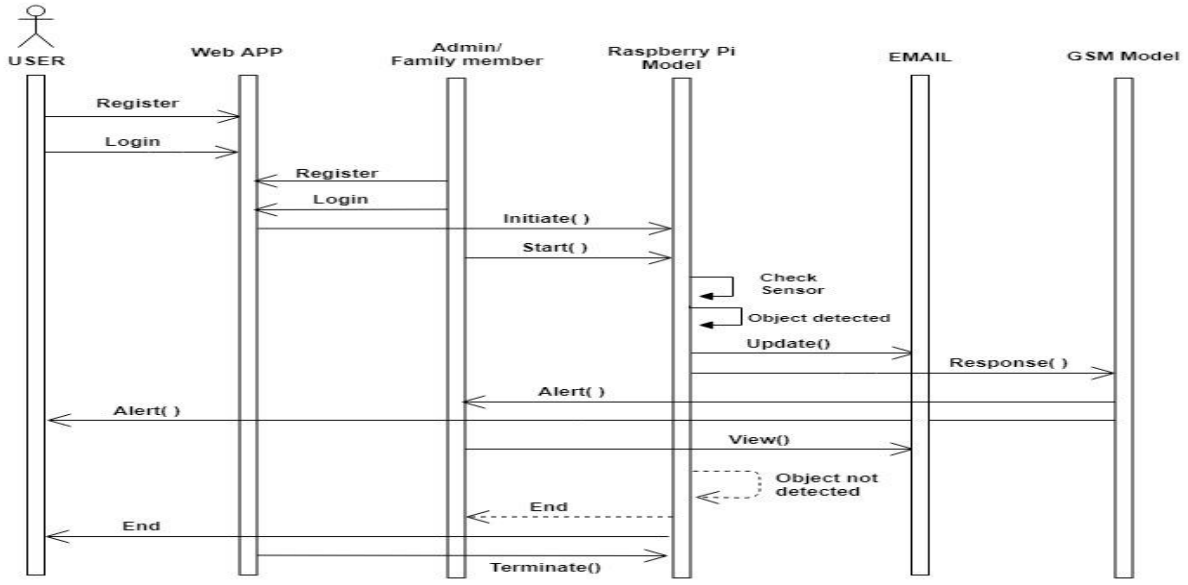

Figure 3. Sequence Diagram

The sequence diagram works as mentioned below:

1. The user and admin will first register and login to the web application.
2. The user will then initiate the robot.
3. The Raspberry Pi will check the sensor and will detect the objects. This information will be updated in the web application.
4. GSM Module will receive a response from Raspberry Pi.
5. GSM Module will then send an alert SMS to the authenticated users and admin.
6. The Raspberry Pi will send an email attached with the image captured by the Pi camera.
7. The user will then view the picture through his email. The process ends.
8. In the case of no object being detected, the process ends.

ALGORITHMS USED

Step 1: Start
Step 2: [user interface]
Login to web URL to start the web application and given device.
Step 3: [Device Start the process]
In Web URL user provides the initiation process by entering the specific action and event
if (URL==initiate())
{//The Device accesses the location with different available sensors then (Kalman Filter)
if(Ultrsonic_Sensor_reading==YES)
{Rotate in a Direction}
//Obstacle in a given Path ((Kalman Filter)
if (Obstacle==YES)
{Rotate in Semi degree and radians based on priority
Case 1: Rotate Left
Case 2: Rotate Right
Case 3: Rotate Reverse}
//Motion of objects is identified and detects (Adaptive Colour Matching)
if (PIR==YES)
{User is identified and generates an alert by sending an SMS message to Authenticated Mobile users}
if (Pi_camera==YES)
{Rotate in a direction
Captures image
Image will be sent to the user through email
Also generates an alert by sending an SMS message to Authenticated Mobile users}
if (Fire_sensor==YES)
{Fire break out is identified and generates an alert by sending an SMS message to Authenticated Mobile users}
if (Sound_sensor==YES)
{Sound above permissible level is detected and generates an alert by sending an SMS message to Authenticated Mobile users}}
Step 4: [Stop]
Terminate

SNAPSHOTS

Figure 6. Web application login

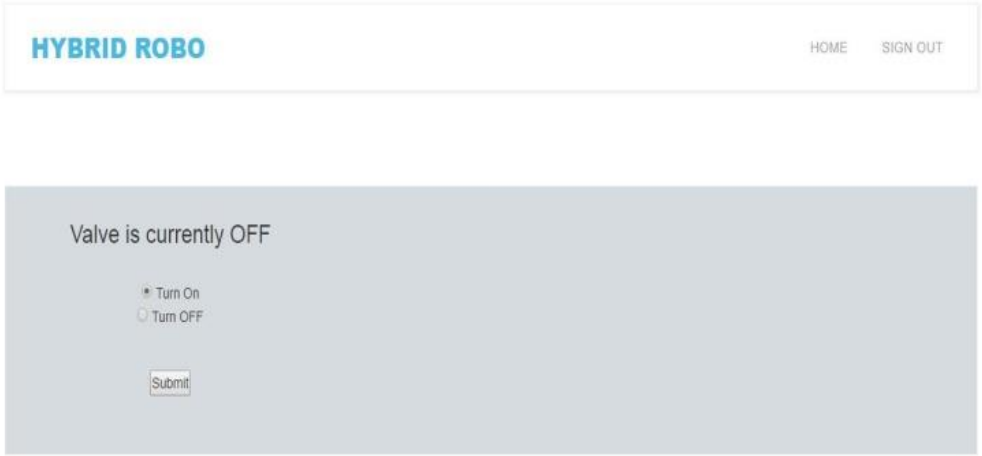

Figure 7. Main page of web application

Figure 8. Obstacle detection and avoidance by robot

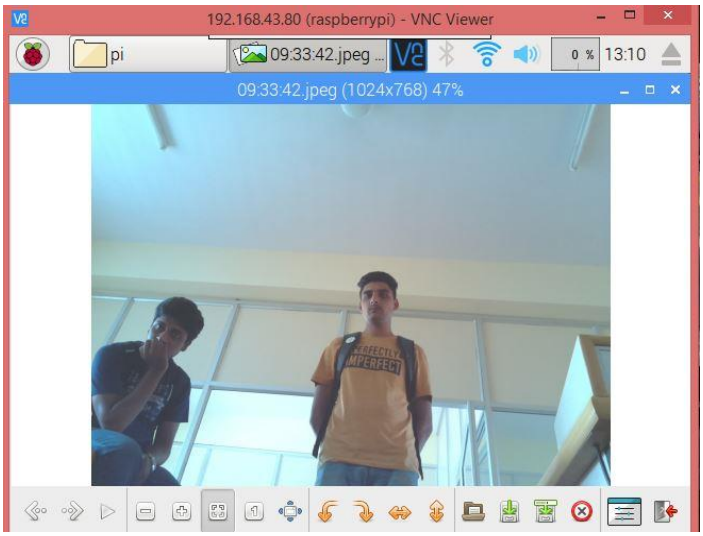

Figure 9. Image captured by Pi camera

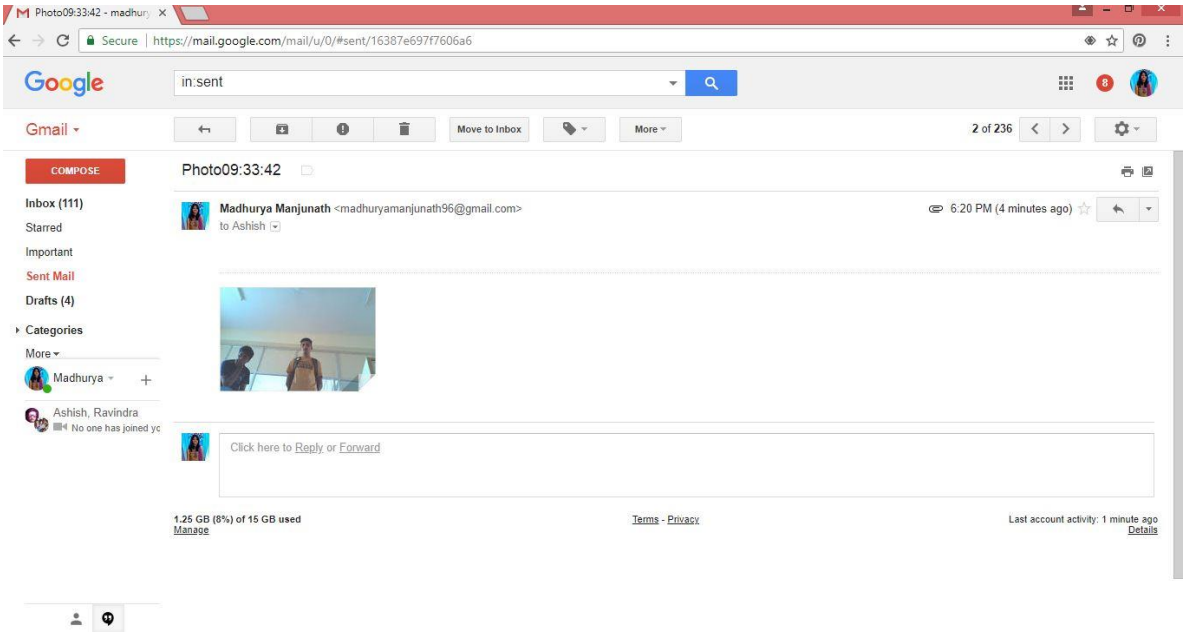

Figure 10. Sent email

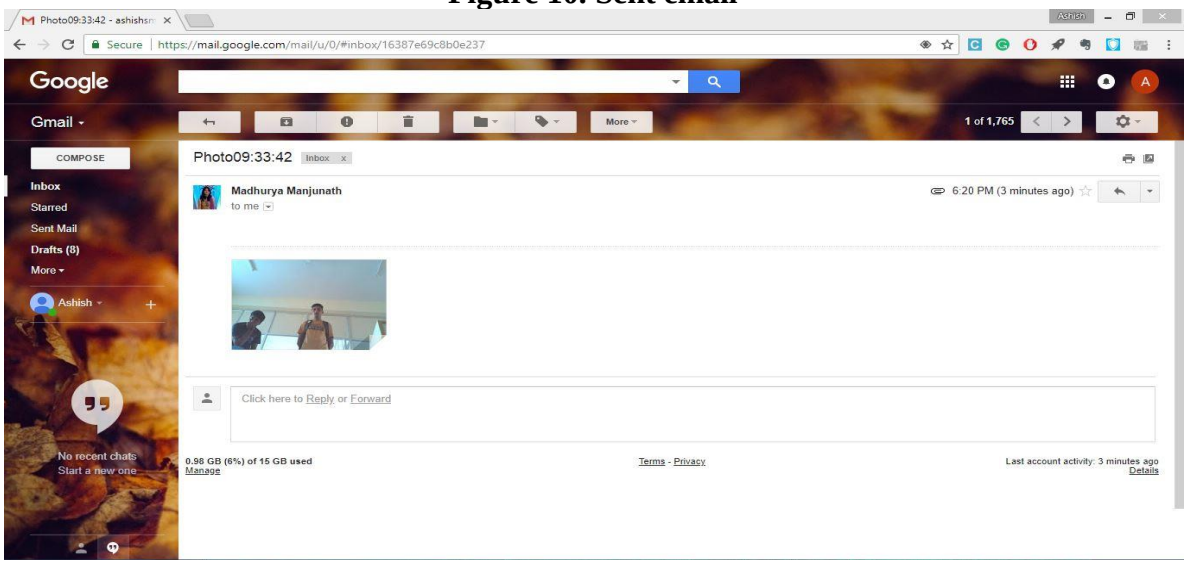

Figure 11. Received email

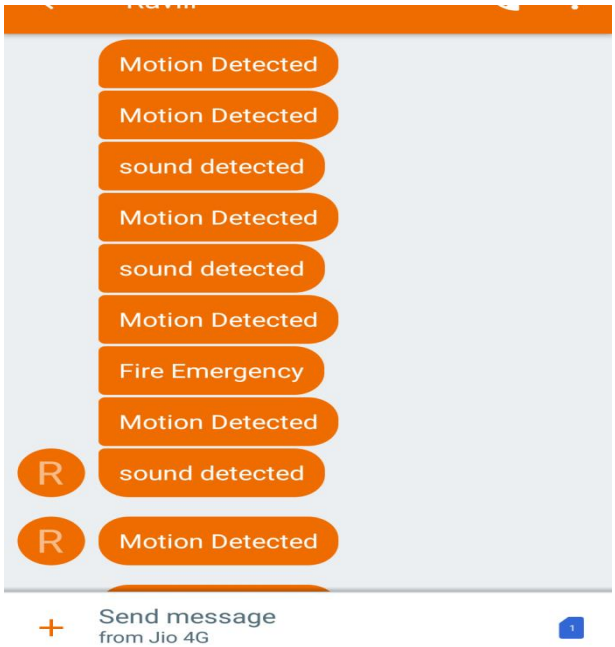

Figure 12. SMS Alerts

ADVANTAGES

1. This robot it alerts the user automatically in case of a mishap without needing 24x7 monitoring.
2. Mobility is a favourable feature of this robot since it moves around the premises on its own.
3. Can be deployed in areas which are not easily accessible by humans.
4. Affordable and does not exceed the budget of many households.

FUTURE SCOPE

1. Implemented with a better base design and casing.
2. The robot may have the ability to change its path according to the sound it detects.
3. The camera will be 360° rotatable.
4. The security to the robot may be provided using buzzers.

CONCLUSION

The proposed robotenables the user to monitor their homes from remote locations. It uses motion detection as a central feature. It sends real time SMS alerts to the user.This system can work without any special modifications in the place where it is being installed.

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