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IOT Based Smart Surveillance System

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ABSTRACT

Internet of Things offers user interoperability and connectivity between devices, systems, services, networks and in particularly control systems. This paper details the design and development of IoT based security surveillance system using Raspberry Pi Single Board Computer (SBC) with Wi-Fi network connectivity. Adding wireless fidelity to embedded systems will open up various feasibilities such as worldwide monitoring and control, reliable data storage etc. This system comprises of sensor nodes and a controller section for surveillance. Remote user alerts, video streaming, and portability are the prime features of the system. Wi-Fi enabled microcontroller processes the sensor-based events upon receiving the event notification, the controller enables the camera for capturing the event, alerts the user via email and SMS and places the video of the event on client mail. Raspberry Pi eliminates the need for a wireless transceiver module in a sensor node, thus it makes the node compact, cost-effective and easy to use. The biggest advantage of the system is that the user can seek surveillance from anywhere in the world and can respond according to the situations.

Keyword: Internet of Things (IoT), Raspberry Pi, Picamera, PIR sensor, Twilio.

1. INTRODUCTION

In today's day to day, life engineers play a crucial role and became the greatest part of our society. The aim of this proposed project is to provide security and privacy using IoT and automation which is being expanded because of straightforwardness through smart phones, internet, and wireless communication. The aim of this project is achieved by programming an embedded system (microcontroller). These embedded systems are designed to do a specific task, unlike general purpose computers. The quality of services is getting improved by automation and Internet of Things ^[1]. Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction ^[2]. Mostly used platforms for these IoT applications are Raspberry Pi and Arduino.

Raspberry Pi is a complete Linux credit card sized low price affordable computer that can provide all functionalities of a computer/laptop, at even low power consumption ^[3]. Arduino is no longer used in application platform due to the dispatch of Raspberry pi which provides easy use support and documentation. In this system, passive infrared ray sensor is used to trigger the motion using pyro electric principle. This principle is about detecting the change in the infrared levels emitted by the surrounding objects. This system is developed by integrating Raspberry Pi with Pi camera and PIR sensor establishing a wireless network by transmitting a time-bounded video via Email and SMS alert through an online platform called as Twilio ^[4].

2. WORK FLOW

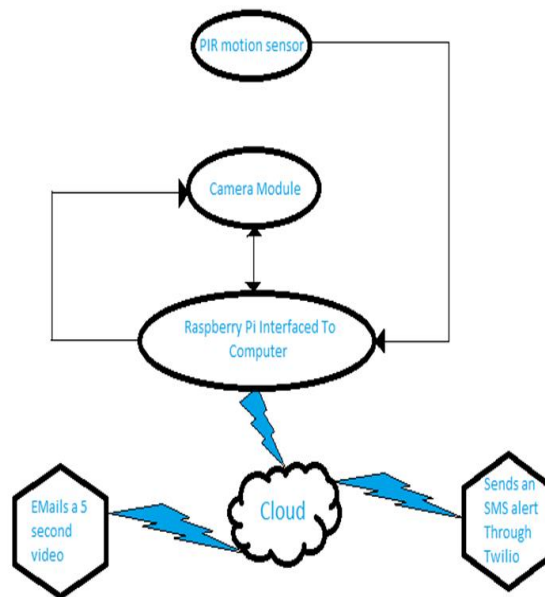


Fig.2.1: Design Flow of Proposed System

The above process is an infinite flow that starts from PIR sensor. The PIR sensor shown in the ellipse is used to detect motion. If the motion is detected the camera module starts detecting and a 5-second video is captured, E-Mailed and the process is repeated and if the motion is not detected the process is repeated ^[5].

3. BLOCK DIAGRAM

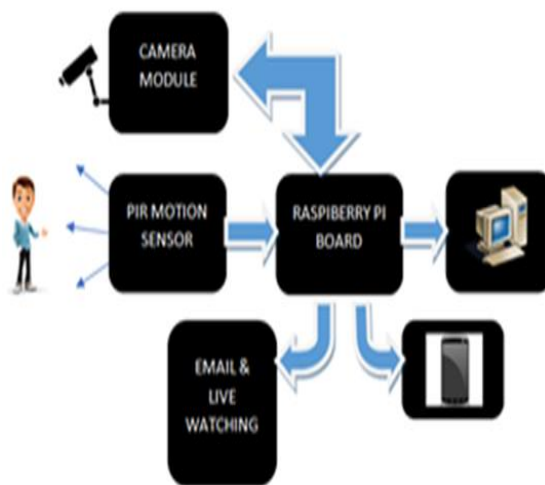


Fig.3.1: Block Diagram of Smart Surveillance System

When a motion is detected at door by the motion sensor, camera module interfaced to Raspberry Pi is activated which captures a prescribed timed video that is saved in SD card of RPi and sent as Email alert via TCP/IP and parallelly an SMS through Twilio account about the intruder/activity is sent ^[6]. This helps the authorized user to be intimated when the internet connection is not so well.

4. COMPONENT SET

This includes RPi, PIR sensor, Picamera module.

4.1. Raspberry Pi

Raspberry pi is a small credit-card sized computer capable of performing various functionalities such as in surveillance systems, military applications, etc. It is the main element in the field of the internet of things ^[7]. It provides access to the internet and hence the connection of automation system with remote location controlling device becomes possible. Raspberry Pi is available in various versions. The other major advantage is that it is a simple circuit and the operating system used here is Raspbian OS. The processor at the heart of the Raspberry Pi system is a Broadcom BCM2835 system-on-chip (SoC) multimedia processor.

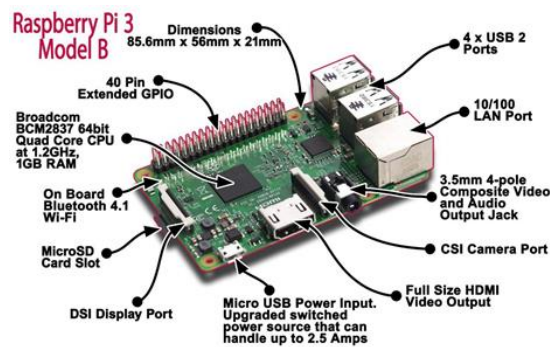


Fig 4.1 Raspberry Pi 3 Model B along with its Specifications

4.2 PIR Sensor

The PIR (Passive Infra-Red) Sensor is a Pyro electric device that detects human body motion by measuring changes in the infrared levels emitted by surrounding objects [8]. This motion can be detected by checking for a high signal on a single I/O pin. Incorporating a Fresnel lens and motion detection circuit. High sensitivity and low noise. The output is a standard 5V active low output signal. The module provides an optimized circuit that will detect motion up to 6 meters away inexpensive and easy to use, The Output can be connected to GPIO pins of Raspberry Pi directly to monitor signal [9].

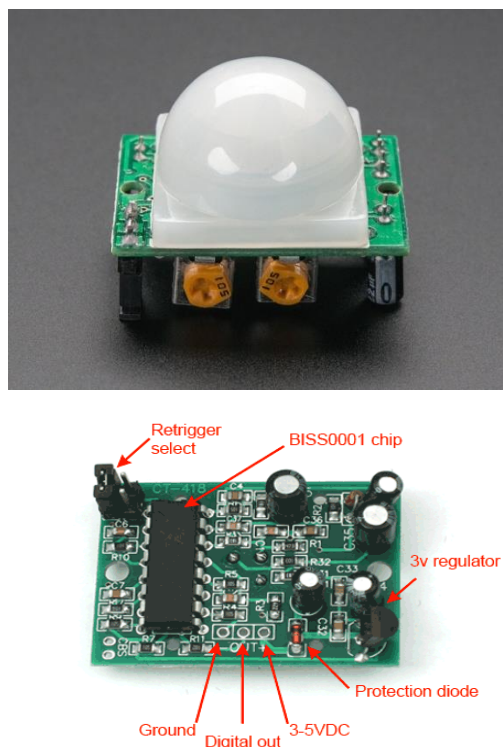


Fig 4.2 External View of PIR Sensor

4.3 Picamera Module

The Raspberry Pi Camera Module is a custom designed addon for Raspberry Pi [10]. It attaches to Raspberry Pi by way of one of the two small sockets on the board upper surface. This interface uses the dedicated CSI interface, which was designed especially for interfacing to cameras. The Raspberry Pi Camera Module is a 5MP CMOS camera with a fixed focus lens that is capable of capturing still images as well as high definition video. Stills are captured at a resolution of 2592 x 1944, while video is supported at 1080p at 30 FPS, 720p at 60 FPS and 640x480 at 60 or 90 FPS [11]. The camera is supported in the latest version of Raspbian, Raspberry Pi's preferred operating system.



Fig 4.3 Picamera Module

5. SOFTWARES USED

5.1 Python

Python is an interpreted high-level programming language for general-purpose programming ^[12]. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, and a syntax that allows programmers to express concepts in fewer lines of code, notably using significant whitespace. Python is an interpreted language that compiles sequentially and generates a byte code which supports the code to run on any kind of computer ^[13].

5.2. Twilio

Twilio is a cloud-based service that enables powerful communication between mobile devices, applications, services, and systems throughout the business in order to bridge the gap between conventional communications ^[14]. Twilio has taken the global telecom network and turned it into a cloud communications platform with these capabilities like Voice, Video, Messaging, Authentication, Connectivity, Monitoring, and Support. Twilio provides APIs for Text Messaging, VoIP & Voice in the cloud ^[15].

6. RESULTS

The Experimental setup of Smart Surveillance System is as shown below.

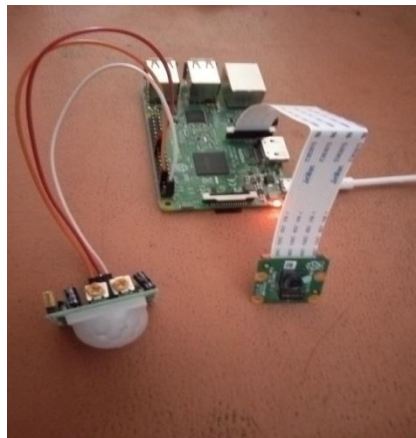


Fig 6.1 Experimental Setup

The PIR sensor and Picamera are interfaced to RPi board. When the intruder approaches the PIR sensor as shown in the below image.

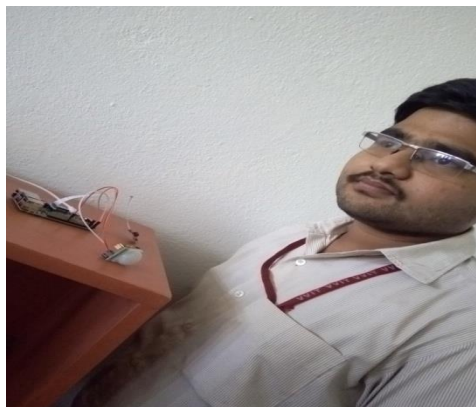


Fig 6.2 Image of Intruder Approaches PIR Sensor

When a motion is detected by the motion sensor, Video is recorded by picamera which is stored in RPi and mailed using SMTP protocol with the help of Wi-Fi. The sent mail would appear as shown below.

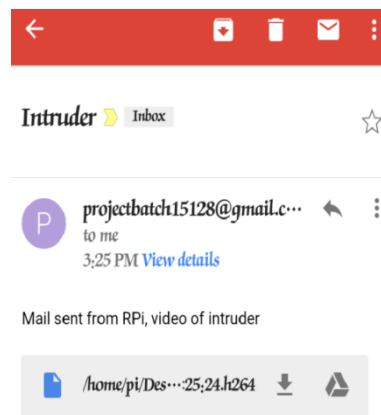


Fig 6.3 Screenshot of Email Alert in Smart Phone

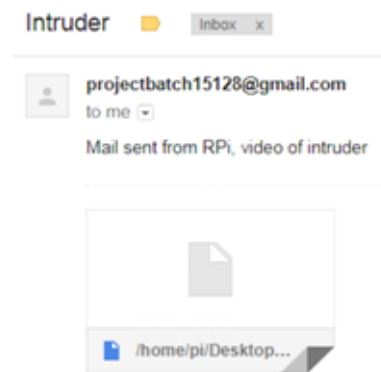


Fig 6.4 Screenshot of Email Alert in Desktop

SMS can be sent using raspberry pi through a cloud-based platform called Twilio about the intruder/activity.

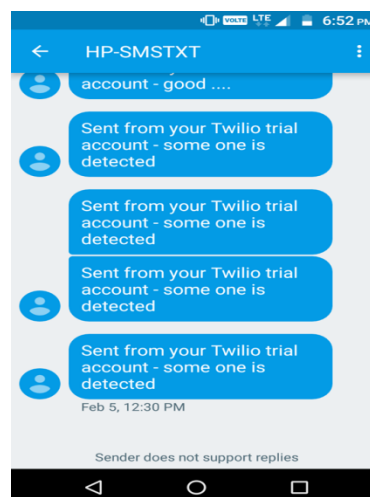


Fig 6.5 Screenshot of SMS Alert Through Twilio

7. CONCLUSION

The IOT based smart surveillance system has been aimed to design in such a way that it can fulfill the needs of the user for particular surveillance area. It has countless applications and can be used in different environments and scenarios. When the motion is detected in the surveillance area the video is recorded. Email alert and SMS notification are sent to the user informing about the motion detection. The user can view the video from the remote area with the help of internet or Wi-Fi connection.

8. FUTURE SCOPE

Future scope of the project includes live video streaming in addition to digital processing techniques, zoom in and zoom out options can be added to updating the position of the camera. Providing door access to the persons based on the digital processing techniques. A specific app can be developed for the purpose of transmitting video to an authorised person.

9. REFERENCES

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