

IoT based Intrusion Detection and Tracking System

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Abstract - In this digital era, as we are approaching towards making our homes smart homes, the requirement to build an affordable and effective Intrusion detection system is a necessity with the events of robbery/ Burglary on the rise. The current intrusion detection system in use are expensive and not cost effective, therefore cannot reach every household. The demand for such system continues to rise if they are available at an affordable price for each household. Motion Sensors are being used in most of the prevailing Intrusion detection systems to detect the presence of an intruder. In our system usage of Passive Infrared sensor (PIR) is made for motion detection. Passiveness provided by the PIR sensor, works well in dark and Undetectable. In object tracking, a novel tracking framework which is called 'Tracking-Learning-Detection' was proposed by Zdenka Kalal. The object tracking task is decomposed into tracking, learning and detection by this framework. In every frame that follows, the tracker and the detector work simultaneously to obtain the location of the object independently, and the learning acts as an information exchanging centre between tracker and detector. The experimental results on the public data set show that the proposed algorithm has better tracking performance and robustness.

Key Words: Tracking-Learning-Detection (TLD), passive infrared sensor (PIR), IOT, PI Camera/Camera module, Cloud Computing, motion detection, Tracking, Frames.

1. INTRODUCTION

The home protection systems have grown famous currently as house owners search for procedures that make certain the safety of their private area and enhance their home values. These days the want to construct a cheap and powerful intrusion detection system is a necessity with the activities of intrusion or robbery at the upward thrust and as we are drawing near towards making our residence a clever residence in this digital era. The call for such system goes to increase swiftly if it comes with an affordable fee to every household. In most of the intrusion detection system, motion sensors are used to discover the presence of an intruder. Current advancements in semiconductor technology have enabled cost-effective solutions to seamlessly combine wireless

network connectivity in embedded structures and sensors, which in turn cause keen interest in internet of things (IoT) based intrusion detection which will be effective as well as affordable.

We are using PIR sensor to detect motion which is connected to raspberry pi through GPIO pins. Raspberry pi is also connected with camera module to capture video. When a PIR sensor detects motion, it sends the details of intrusion to the raspberry pi. Once the raspberry pi receives details, it sends email to the user.

In addition, intrusion detection our paper features object tracking. Whenever intrusion detected raspberry pi captures video of intruder using camera module and upload it to cloud. Later we will use this video for object tracking. Object tracking is an important branch of computer science and artificial intelligence in recent years. Related studies have developed rapidly, and this development momentum will maintain a fairly long period of time. Complexity of the tracking scene, there may be no uniform technique to the object tracking. TLD (tracking-Learning-Detection) framework is a long-time tracking algorithm proposed by Zdenka Kalal. This framework consists of three modules: tracking module, detection module, learning module. It is difficult to accurate the float errors of the tracking algorithm with the conventional tracking algorithm and tracking error could be accrued. Moreover, they are easy to fail if the item disappears from the camera view. Further, the object model develops in an offline way, if the object model has a large alternate, the tracking will inevitably result in failure. TLD is an amazing idea to combine the detection algorithm with the tracking algorithm and to update the target model through the learning module in real time.

2. RELATED WORK

M. Moghavvemi used PIR sensors in his paper to detect human presence in an area and raise the alarm if an intrusion is detected. He developed a real-time occupancy map on a PC and used frequency modulation technique for wireless transmission. Jaeseok Yun used PIR sensors to find the direction of human movement. He used an array of 4 PIR sensors to find movement in eight different directions.

ZigBee is mostly used in Wireless Sensor Network (WSN) owing to its low power consumption, low cost, and reliable data transfer. Yiming Zhou used ZigBee technology to develop a low-cost irrigation system. Dae Man-Han used ZigBee sensor network to design a Smart Home Energy Management System (SHEMS) which divides and assigns various tasks to different components. R. K. Kodali used PIR sensors and TI CC3320 Launchpad to sense motion and alert the user about intrusion through voice call. However, in his system every module is identical and requires TI Launchpad to alert the user which can add to the cost of the system.

3. HARDWARE SPECIFICATION

3.1 PIR SENSOR

The primary part of a PIR sensor is the pyroelectric sensor which is available behind the plastic top as can be found in Fig 1. The pyroelectric sensor is really partitioned into two parts. At the point when there is no movement, the two parts get a similar measure of IR radiations from the encompassing. Be that as it may, when an object crosses the sensor, the IR radiation level got at one half is more than the radiation at the other half. The PIR responds to this change and makes the output HIGH. The scope of discovery goes up to 6meters, and it sets aside some effort to stable itself as per the encompassing when it is powered ON.

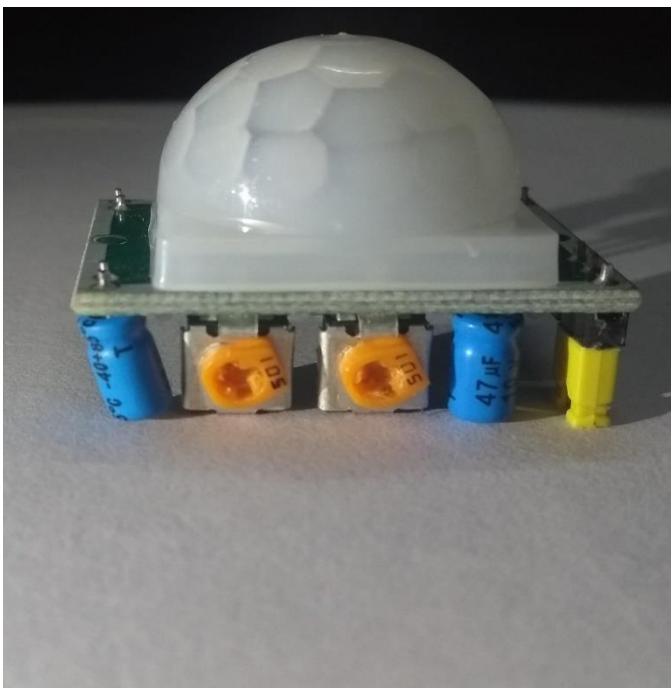


Fig. 1 PIR Sensor

3.2 WIFI-MODULE

ESP8266 Wi-Fi module is a framework on-chip which accompanies a coordinated TCP/IP protocol stack that can give any microcontroller interfaced it, an entrance to Wi-Fi network. It is likewise controlled utilizing AT commands and can be customized either by utilizing FDTI link or Raspberry Pi. In this paper, we are utilizing ESP8266 12E which is modified utilizing Raspberry Pi. Fig 2. demonstrates an ESP8266 Wi-Fi module.



Fig. 2 WI-FI module

3.3 RASPBERRY PI

Raspberry Pi- An SD card inserted into the slot on the board acts as the hard drive for the Raspberry Pi. It is powered by USB and the video output can be hooked up to a traditional RCA TV set, a more modern monitor, or even a TV using the HDMI port. This gives you all the basic abilities of a normal computer. It also has an extremely low power consumption of about 3 watts.

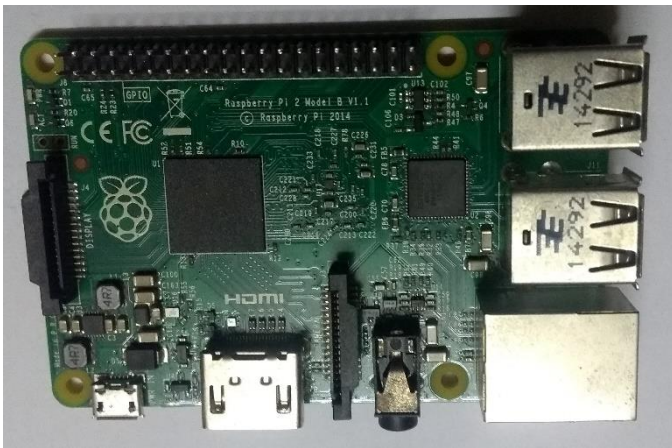


Fig. 3 Raspberry Pi

3.4 PI CAMERA / CAMERA MODULE

The Raspberry Pi Camera v2 is the new official camera board released by the Raspberry Pi Foundation. The Raspberry Pi Camera Module v2 is a high quality 8-megapixel Sony IMX219 image sensor custom designed add-on board for Raspberry Pi, featuring a fixed focus lens. It's capable of 3280 x 2464-pixel static images, and also supports 1080p30, 720p60 and 640x480p90 video. It attaches to Pi by way of one of the small sockets on the board upper surface and uses the dedicated CSI interface, designed especially for interfacing to cameras.



Fig. 4 Camera Module

4. SYSTEM ANALYSIS

4.1 EXISTING SYSTEM

The current system using PIR sensor involves only object detection, but it does not feature object tracking. PIR sensors are used to detect motion and ZigBee is used to create a Wireless Sensor Network. The system is made up of two parts: The Sensor node and the Central node. The sensor nodes contain PIR sensors. If at any point of time the sensor recognizes motion, it sends the details of interruption to the central node wirelessly through ZigBee. Once the central node receives the details, it sends a text-based notification to the client's phone through GSM module.

Global System for Mobile communication issued to send text-based notifications to the concerned client when intrusion is detected but user cannot see the live update. The current system uses ESP8266 which is not powerful when compared to devices like Raspberry Pi. Current System uses thing speak cloud to update information of the intruder, however it does not support video transmission of the same.

4.2 PROPOSED SYSTEM

The proposed system features object tracking along with object detection. On the occurrence of any kind of intrusion, the user is informed about this by sending an appropriate mail associated with them. Throughout this duration, the video is captured which can be later accessed by the user. The proposed system uses raspberry pi which is advantageous over Arduino.

The proposed system is built on a private cloud which increases throughput and minimizes delay to a bare minimum.

Following are some of the advantages of the proposed system which include video surveillance which is required for object tracking.

The current system uses Arduino which is not powerful when compared to devices like Raspberry Pi in terms of clock speed and processing speed.

The proposed system is built on a private cloud which increases throughput and minimizes delay to a bare minimum.

5. WORKING CIRCUIT

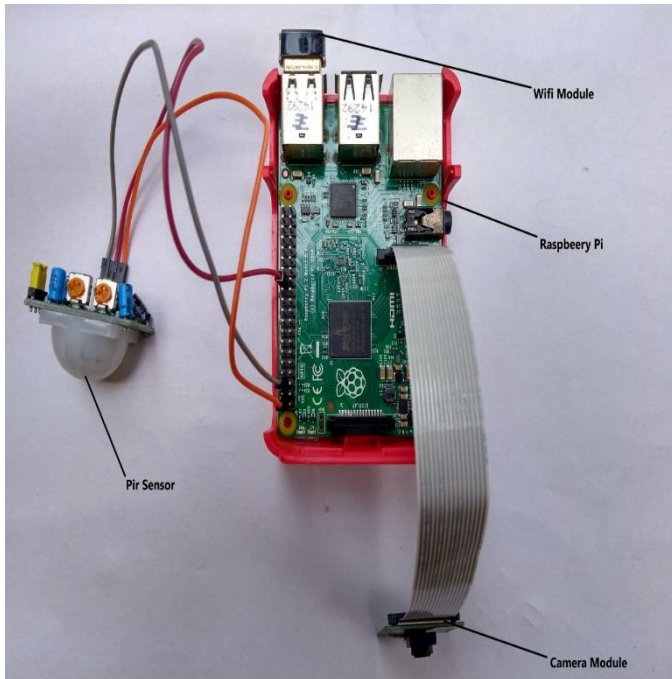


Fig 5. A Working Circuit

A Major part of working circuit includes Raspberry PI. Raspberry PI is attached with a PIR sensor. Pins of PIR such as Ground, DC voltage And Output are connected to GPIO pins of Raspberry PI. Whenever motion gets detected via the PIR sensor, it sets the Output pin HIGH. Alongside, an Email is sent to the User, using SMTP protocol by Raspberry PI.

Camera Module (PI Camera) is attached to CSI connector pin of the Raspberry PI. As soon as motion gets detected, the camera gets activated and records a 20second long video.

This video gets uploaded to cloud.

Using Cloud API, the video is fed as an input to TLD algorithm. Based on the input video, any motion detected will be covered by a bounding box. The TLD algorithm then tracks the movement of that object over a certain coverage point. The final output video is then stored on Website which can then be accessed by the User.

6. IMPLEMENTATION RESULTS

Below are the screen shorts captured during intrusion detection and tracking.

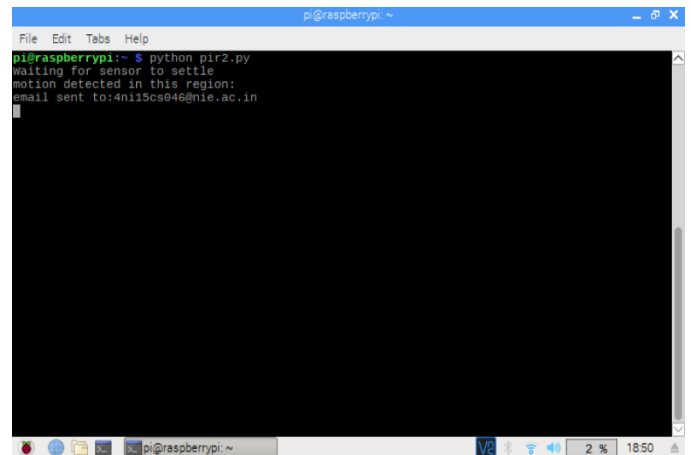


Fig. 6 Raspberry PI console during motion detection

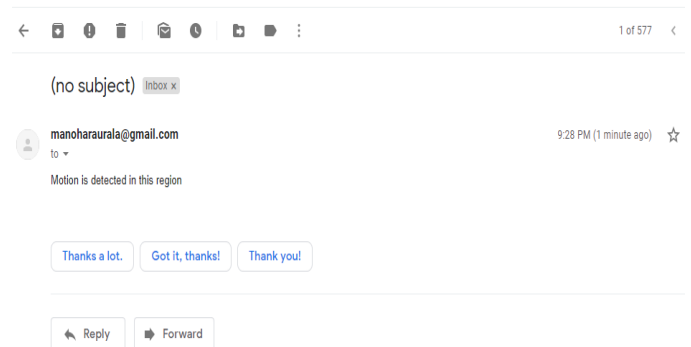


Fig. 7 E-mail received during motion detection

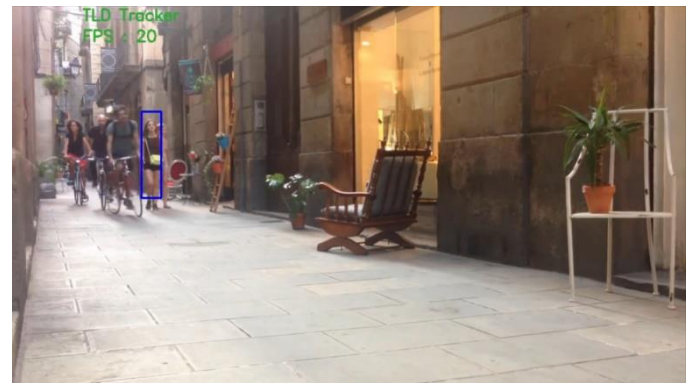


Fig. 8 Object tracking after motion detection

7. CONCLUSIONS AND FUTURE ENHANCEMENTS

Nowadays the need to build an affordable and effective intrusion detection system is a necessity with the events of intrusion or burglary on the rise. We are approaching towards making our house a smart house in this digital era. The demand for such system is going to increase rapidly if it comes with a feasible price to every household. In most of the prevailing intrusion detection systems,

motion sensors are used to detect the presence of an intruder.

We have thoroughly understood the drawbacks of existing systems and have aimed to find feasible solutions for them. Below are some of the recommendations for future work:

- Fire detection capabilities
- Fence Detection.
- Addition of Audio capability

These would greatly improve the system while improving the overall security of the area under surveillance.

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