

Remote Intruder Detection System

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Abstract—The proposed method discussed here secures a precious thing in a secure room and do the surveillance without any human intervention. Any motion around the secure object during a predefined restricted time period is identified instantly and notified to the security personal staying at a remote room via Wi-Fi. The personal at that room is alerted by an alarm and readily the person can view the image of the intruder in the screen of the computer in front of him or her.

Keywords-Surveillance; Raspberry Pi; PIR sensor; Motion Detection; IoT; WoWLAN.

I. INTRODUCTION

Surveillance issue is the most vital issue for any organization now-a-days. Each and every organization want to safe guard their data, products, resources, machineries etc in their own way.

This paper suggests a mechanism where the system is basically detecting any person or object say Y in a secure room where a precious or confidential object, say X, is been stored at a restricted period of time (mainly at night). There is a PIR Motion Sensor around the object X which senses the presence of Intruder Y, at first. The camera is attached to a chip called Raspberry PI, which takes the input from the camera and sends a signal, through the wireless media, to the computer that is present in a room of security personal, at a remote distance.

A security personal is present at that room and he or she need not to be even in alert state. Even the computer remains in standby power state. There is an Wireless connection between the server and client computer.

After getting the signal from the Raspberry Pi the computer is starting-up and two applications open automatically. The first application plays an alarming tone and the second application opens up the interface which shows the picture of the intruder, caught through the camera, installed at the secure room. According to that the security personal takes the action.

II. PROPOSED WORK

A. Motion Detection through Raspberry Pi

The Remote Intruder Detection System (RIDS) proposed in this paper uses a IoT tool called Raspberry Pi3B with two more accessories – Pyroelectric Infrared (PIR) Motion Sensor and a Raspberry Pi Camera Board, with the OS running behind as Raspbian OS. The advantage of using these setup is mainly the lower cost. Another option can be using a CCTV camera [1] which costs higher. Moreover, as the system is fully automated

until the security personal is notified, no human intervention is needed in-between.



Figure 1. Raspberry Pi3 Model B.

The camera does not take any picture and remains in standby mode in normal time. The PIR Motion Sensor [2] is installed around the confidential object, X, and works like a trigger whenever it senses any movement [3] around X. The PIR Sensor is attached with Raspberry Pi through the appropriate General-purpose input/output (GPIO) pins on the board. The Raspberry Pi Camera immediately captures the pictures of the moving object(s) until it senses movements around and sends an activation signal to the remote PC, at the security room. This thing is implemented through a Python code. Here, RIDS uses the Wake on Wireless LAN (WoWLAN or WoW) [4] technology for activating the remote computer through a signal sent by the Raspberry Pi via Wi-Fi.

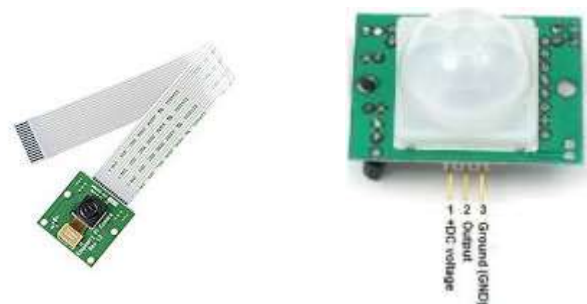


Figure 2. Raspberry Pi Camera and PIR Motion Sensor

B. Activating the Remote Computer through WoWLAN

We can send a special network message to turn on or awake a computer by using Ethernet or token ring computer standard, called Wake-on-LAN (WoL). The message is sent by a network device to the target computer and both the devices should be connected via LAN. The sender device uses a program to send the special message, called Magic Packet. This Magic Packet uses the MAC address of the target computer. On receiving the packet, the target computer's Network Interface Card (NIC) instructs the computer's power supply or motherboard to initialize the wake-up. WoWLAN is the supplementary standard of WoL, where the wake-up signal is sent through Wi-Fi. Although, in functionality point of view there are some differences between WoL and WoWLAN and WoWLAN works with some limitations.

The NetworkManager snap allows its users to configure one or more triggers to allow the device it operates on to be woken up remotely. The snap provides two configuration options which will allow the users to enable or disable WoWLAN:

- wifi.wake-on-wlan
- wifi.wake-on-wlan-password

The NetworkManager snap uses the *nmcli* utility to configure WoWLAN per connection.

III. PROJECT IMPLEMENTATION

The project works through the following modules :

A. Set up Raspberry Pi

At first Raspbian OS is installed from New Out Of the Box Software (NOOBS) which is pre-installed in NOOBS SD card. Alternatively, it can be downloaded from the website of Raspberry Pi [5]. The power supply is provide to Raspberry Pi through Raspberry Pi Micro USB Power Cable and it is connected with the monitor through a HDMI cable. Keyboard and Mouse is connected to it via the USB port. Finally, the Camera (Figure 2) is connected with the appropriate port and the PIR Sensor (Figure 2) is connected via GPIO pins.



Figure 3. Raspberry Pi GPIO pins

B. Motion Detection and Image Capture

A Python script runs behind the PIR Motion Sensor [6] to find out any movement in front of it. Whenever it detects any movement it triggers the Raspberry Camera [7] to capture the image of that object.

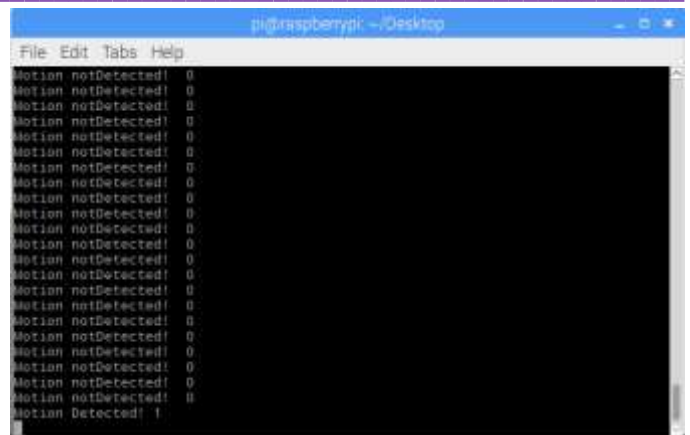


Figure 4. Figure 4. Motion Detection

The PIR sensor has three pins: ground, digital out and 3-5VDC in. At idle stage, when there is no motion detected in front of the sensor, the digital out stays low, however whenever any motion is detected, the digital out pulses high (3.3V) and the Raspberry Pi senses this. The PIR sensor that is used here is having a range of approximately 7 meters, and a 110° x 70° detection range, so it is a great tool for monitoring a door or the corner of a room.

Figure 4 shows the output of of the above mentioned Python code. Normally when the PIR Sensor remains in idle state it sends “ Motion notDetected ! 0” signal to the user screen. Whenever it senses some object moving in front of it immediately it sends “Motion Detected! 1” signal to the screen. Moreover, it activates the Raspberry Pi Camera immediately to capture a snapshot of the moving object which is controlled via the same Python script.

Once the Python script is been written the Monitor is been detached from the Raspberry Pi and system works fine without it.

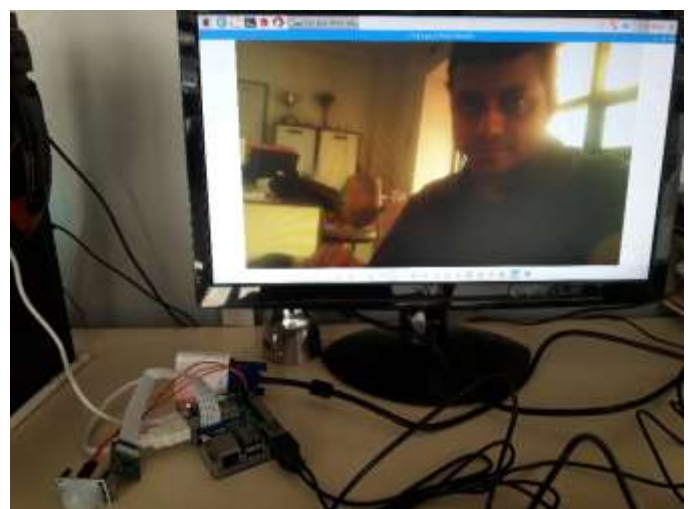


Figure 5. Image Capturing

C. Woken up Remote Computer at Security Room

First of all, WoWLAN was configured in the remote computer residing at the security room. A special message, called 'Magic Packet' is sent to the remote computer via Wi-Fi, after capturing the picture. This signal is converting the state of the remote computer from standby power state to active turn on state. All these can be achieved through using the technology WoWLAN, discussed earlier. Moreover, it sends the picture of the intruder through Wi-Fi network to the remote computer.

D. Alert Generation and Monitoring

Figure 6. Start-up Screen at Remote Computer

On startup, the Remote Computer or Laptop first opens up the media player to run an alarm tone. This tone alerts the security personal that some object is entered inside the secure room.

To do this a shell scrip was already written and named as startalarm.sh. Finally, the following command was executed :

```
# update-rc.d startalarm.sh defaults 100
```

This script runs each and every time whenever the Remote Computer boots up.

Now the image captured and sent through Wi-Fi by Raspberry-Pi is displayed on the desktop of the Remote System. If the security personal finds that the object is a vulnerable intruder he or she takes the appropriate action, accordingly. All the above operations will be performed via the same script mentioned above.

IV. BLOCK DIAGRAMS

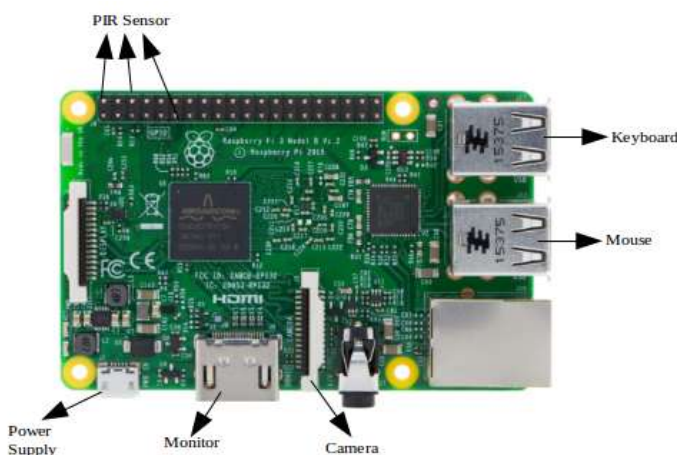
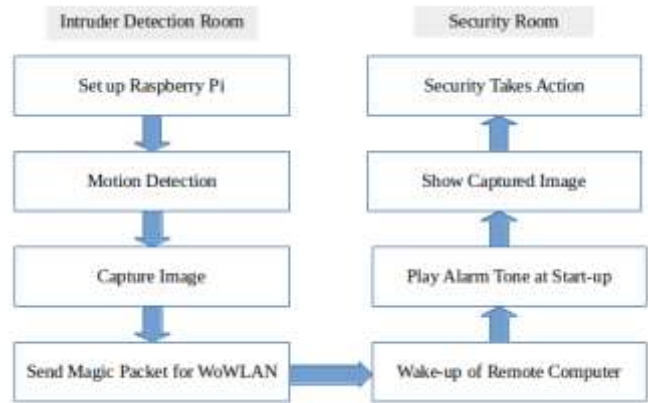


Figure 6. Connections to accessories with Raspberry Pi 3B



Logical Work Flow Diagram

V. CONCLUSION

The Remote Intruder Detection System (RIDS) proposed in this paper is a kind of surveillance system which has some added features than the other common surveillance systems :

- First of all, intruders, in this model, are totally unaware that their activities are being watched remotely.
- As the system is based on Wireless Communication, it nullifies the chances of disconnecting the network as the primary goal of the intruders are to cut down the communicating wire.
- Generally a wired communication is a clumsy and costly connectivity but this model uses wireless connectivity and in-turn it reduces the cost and complexity as well.
- As the cost of Raspberry Pi and its accessories are very nominal it saves the cost of using a full-fledged computer or laptop at the Intruder Detection room. Moreover, using the Raspberry Pi Camera module saves the cost of CCTV camera.
- Because the Remote Computer at the Security Room stays in standby power state, it saves the power consumption there.
- The security personal at the Remote Room need not have to monitor the surveillance system, all the time. Even he or she falls asleep the alarm system alerts him or her about the intruder and even the intruder does not get any hint about it.
- As the security personal stays at the Remote location which is not visible by the intruder, the person becomes safe from the hand of possible attack by the intruder.

All the above features will provide an extra edge to this modern security system over the conventional security systems.

This project can be implemented at different public domains, such as in jewelery shops, post offices, banks, autonomous bodies, etc.

In jewelery shops, we can implement this security-alert model to prevent robbery or any other kind of breach-of-security. In post offices, we can apply this model to protect the vault with the help of Local Administration or Police. Public sector banks and private sector banks as well, may utilize this security-alert architecture for the safety of their vaults and lockers with the help of Local Police. Different private and public Insurance companies can protect their departments, mainly those departments, who are directly related to monetary (cash) transactions with the public, by using this remote security-alert system.

Different Governmental organizations or departments, for example, Income Tax, DRDO, and private companies may utilize this architecture to protect and to maintain privacy of their secret documents other than money.

REFERENCES

- [1] Victor Bautista Saiz, Hospitalet de Llobregat Barcelona “GPU: Application for CCTV systems” International conference on security technology (ICCST), pp, 1-4, Rome, October 2014.
- [2] Priya B. Patel, Viraj M. Choksi, Swapna Jadhav, M.B. Potdar “Smart Motion Detection System using Raspberry Pi” International Journal of Applied Information Systems (IJ AIS).
- [3] Aamir Nizam Ansari, Mohamed Sedky, Neelam Sharma, Anurag Tyagi, Faculty of Computing, Engineering and Sciences, Staffordshire University, Stoke -on-Trent, United Kingdom ”An Internet of Things Approach for Motion Detection using Raspberry Pi” presented at the International Conference on Intelligent Computing and Internet of Things (ICIT),2015.
- [4] Patrick Luberus, Alfandika Nyandoro “Implementing Wake-on-LAN in Institutional Networks” Journal of Applied Business and Economics vol. 16(1) 2014.
- [5] “NOOBS – New Out Of the Box Software” retrieved from <https://www.raspberrypi.org/downloads/noobs/>
- [6] Nanyang Senba “PIR Motion Detector Module” retrieved from <http://akizukidenshi.com/download/ds/senba/SB612A-Advanced.pdf>
- [7] “The Camera Module” The MagPi issue 14 Jul 2013 retrieved from <https://www.raspberrypi.org/magpi-issues/MagPi14.pdf>