IoT Smart Anti-Theft Movement Detection System

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Abstract: In Malaysia, burglary or theft break-in cases are rising day by day. With IoT Smart Anti-Theft Movement Detection System, it can avoid any circumstance and unfavorable situations. Any movement during our absence at home can be detected through the camera, then will immediately notify the house owner through a smart phone. Peoples starts to wonder if it is safe to leave their house for a long time without any fully guarantee of security, even some of houses have security guard services but still it cannot be fully guarantee for the security. Next, the absence of a secure and strict security system also makes them more skeptical about the security of their home, even CCTV cameras was used but still the case is increasing. Lastly, if there any accidents or cases in the housing area, normally police will take time to arrive at the scene. The PIR motion sensor generate data from pyroelectric sensor. The PIR motion sensor was created using a pyroelectric sensor that can detect infrared energy level by looking changes in temperatures. A few of experiments have been done and PIR motion sensor will be set to three different level of sensitivity which is low, medium and high. The outcomes of the experiment, it can be conclude the different levels of sensitivity of PIR Motion Sensor have different detection ranges. The security system was tested and demonstrated the result for detection movement, and all objectives were met. Two future recommendation can be suggested to upgrade the system. First, is the hardware placement which is camera. Second recommendation, using friendly mobile application.

Keywords: Home security, Raspberry Pi, PIR motion sensor, Movement detection, Infrared

1.0 INTRODUCTION

Nowadays the security of houses always is an important and useful thing. Theft break-in or burglary is one of the top crimes in Malaysia with the high percentage. There are 15742 cases was reported on 2019. Based on the study, the legacy or current security system cannot provide a concurrent theft notification to the resident immediately. Moreover, houses in an urban area always has high burglary cases. This is one of the reasons why the IoT Smart Anti-Theft Movement Detection System are developed and it can avoid any circumstance and unfavorable situations.

IoT Smart Anti-Theft Movement Detection System has their own objectives. In the future, from the project it can develop a security system by monitoring complex motion and camera with IoT. Next, to intensify a new security system that can take videos as evidence at the scene and on the spot will notify the house owner immediately.Lastly, to evolve a effective security system.

Based on study have been made, from the theory it state different level of sensitivity for PIR motion sensor will have different detection range.
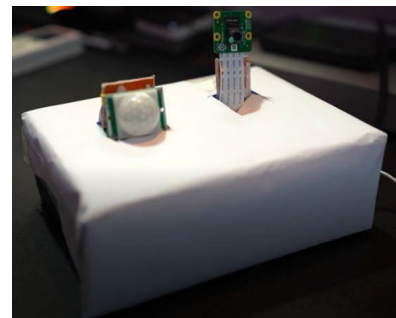
2.0 MATERIALS AND METHODS

Figure 9: The Prototype of Project

Figure 9 shows the prototype design. The Raspberry Pi will be installed in the box and linked to the PIR motion sensor and the Pi camera. The camera and the PIR motion sensor will protrude from the box. This is to make it easier

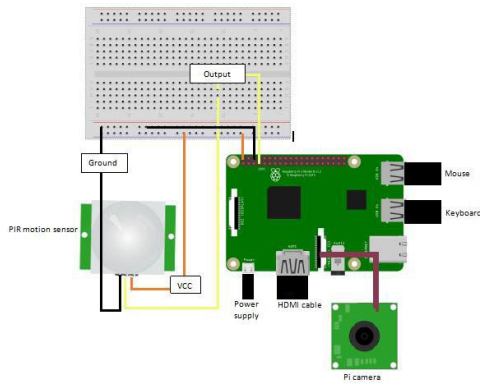to handle and adjust the sensitivity level of the PIR motion sensor.

Figure 10: Circuit Diagram

The diagram on Figure 10 depicts how the connection between hardware is important to each other and forms a working circuit. Raspberry Pi will be powered by a 5V supply, and there will be a Pi Camera on the top of the board. According to the top view of figure raspberry pi, there is a USB port for the mouse and keyboard on the right side. PIR motion sensor is also connected to Raspberry Pi via jumper wires. The PIR motion sensor will detect movement and transmit the data to the Raspberry Pi. The Pi camera will then record the activity for 15 seconds before sending it to the user.
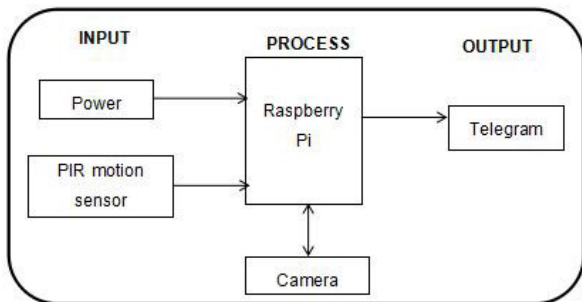

Figure 11: Block Diagram

For block diagram, as the input there are a power supply and PIR motion sensor. First input power supply is function to make Raspberry Pi is in power on and the PIR motion sensor which is detects heat energy in the surrounding environment in a specific range. After the PIR motion sensor receives the data, it will be sent to Raspberry Pi for the next action. Next, the Raspberry Pi will manage all the workloads including sending data from the sensor to the camera, sending video to the mobile application and also a place to processing the video. Once data is reached on the Raspberry Pi, the camera will record a 15 seconds video. The system will operate based on the coding. Lastly, the output is in terms of display for the result. As for outputs, there is a Telegram an instant messaging application. Additionally, because the

Raspberry Pi already has a Wi-Fi network built into it, notifications will immediately be sent to the homeowner via the Telegram mobile application.
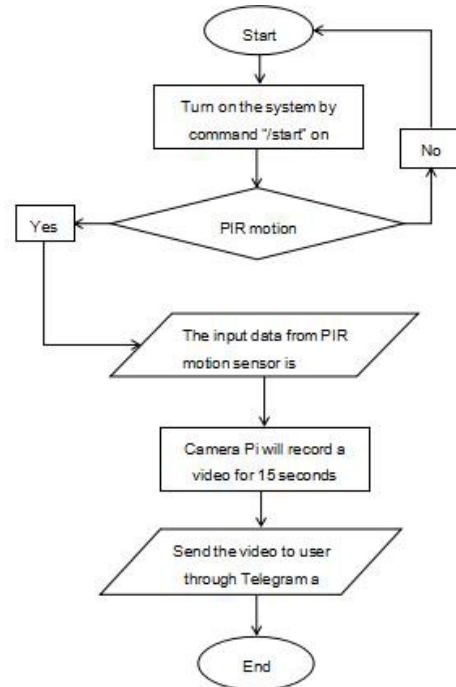

Figure 12: Flowchart

Based on Figure 12 shows the process of the IoT Smart Anti-Theft Movement Detection System. The first step, activate the system by using Telegram with "/start" command in the bot. The second step, the PIR motion sensor will detect heat and IR light. The movement has been detected for the first time at this stage and it is considered a decision stage. The output from the PIR motion sensor will be delivered to the Raspberry Pi in the third step of the flowchart if there is any movement in the house, but if there is none, the step will start over. On the next step, the Pi camera will take over after receiving the information from the Raspberry Pi. Lastly, the recorded video will be sent to the user via Telegram an instant messenger mobile application as a notification.
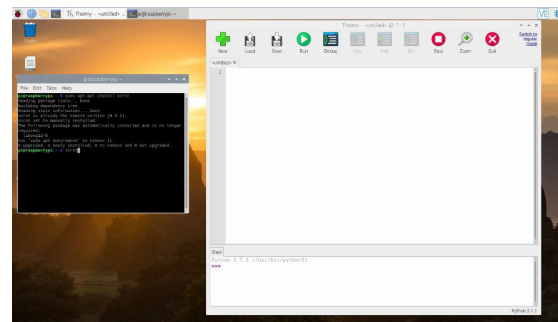

Figure 13: Thonny Python IDE

Figure 13 shows the interface of Thonny Python IDE that generates the coding. This software is the main software development that will be used to construct the program. Based on the newest instant messaging mobile application, Telegram is a second popular online messaging app. Telegram icon, an application messenger, is depicted in Figure 14. The security alert will be sent via Telegram.

Figure 14: Telegram

3.0 RESULTS

This experiment was carried out indoors on a bright day in a light environment to determine the differences in range or distance when the sensitivity level of the PIR motion sensor was changed. The results are shown in the Table 1 for each of the three levels of PIR motion sensor sensitivity with sensitivity level, room temperature and body temperature.

Table 1: Results

Sensitivity Level of PIR Motion Sensor	Range Detection	Room Temperature (°C)	Body Temperature (°C)
Low	2 meter	35.8	36.5
Medium	3.3 meter	35.8	36.5
High	3.5 meter	35.8	36.5

The PIR motion sensor will set to three different level of sensitivity which is low, medium and high. The sensitivity is on the right. PIR motion sensor was shown on Figure 15 .

Figure 15 PIR Motion Sensor

According to Figure 16, if there is no movement within the available range, it will display "No movement detected," but if it detects movement from humans or animals, it will display "Movement detected," as shown in Figure 17. If the movement detected,, the Pi camera will record all the activity occur.
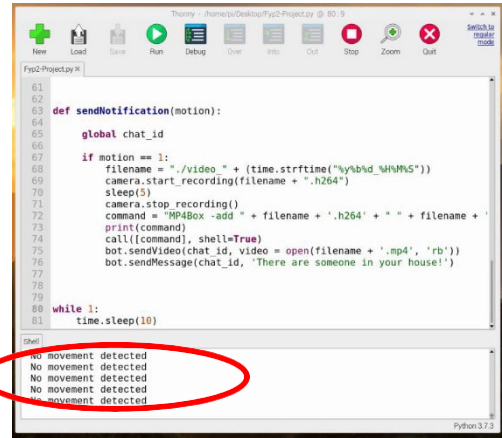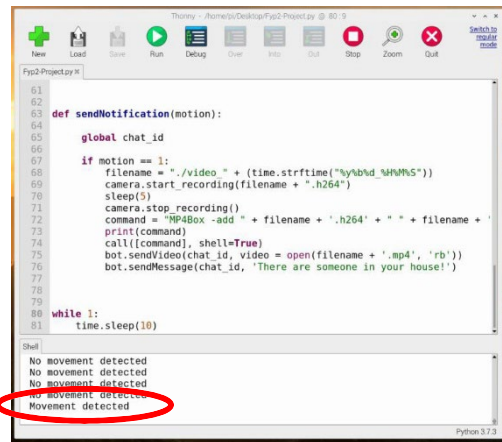

Figure 16 No Movement Detected

Figure 17 Movement Detected

After the Pi camera has recorded the action for 15 seconds, the video will be sent to the user via Telegram. Figure 18 shows the notification that user will receive. Therefore, Telegram cannot play "h264" format video files, the video must be converted first. Figure 19 depicts the user's notification video with a message introduction on the Telegram bot. As a backup method, on the Raspberry Pi desktop, the video for the "h264" and "MP4" file formats will automatically saved as shown in Figure 20.
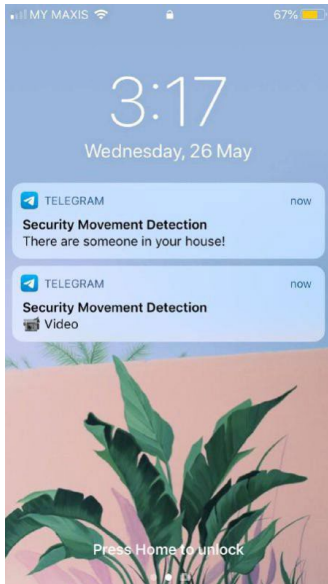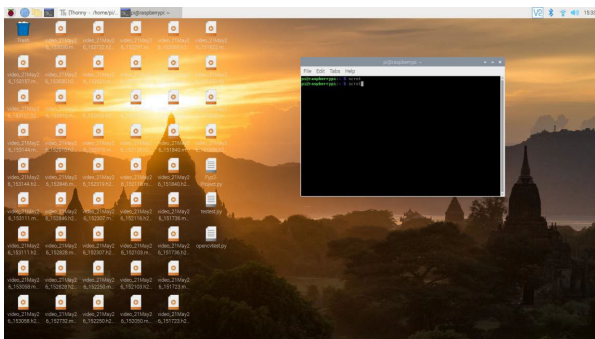
Figure 18 Notifications

Figure 19 Telegram Bot

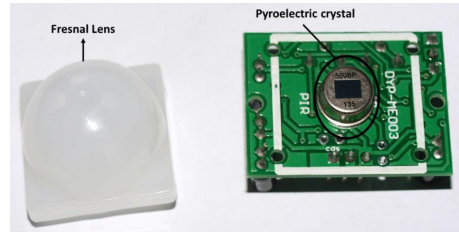**Figure 20 Videos Saved on Raspberry Pi Desktop**

4.0 DISCUSSION

Figure 21 Fresnel Lens and Pyroelectric Crystal

The PIR motion sensor generate data from pyroelectric sensor which is depicted in Figure 21. It is a rectangular crystal in the middle of a round metal can. The PIR motion sensor was created using a pyroelectric sensor that can detect infrared energy level. It can detect body heat by observing temperature changes. These lenses significantly increase the device's sensing area. Figure 22 shows how fresnel lens works in PIR motion sensor
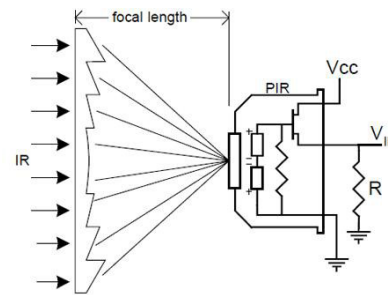

Figure 22 Fresnel Lens

The infrared light results that detect heat from humans and animals were shown in Figures 23 and 24. This is why the PIR motion sensor was popular as motion detection in the 20th century security system.

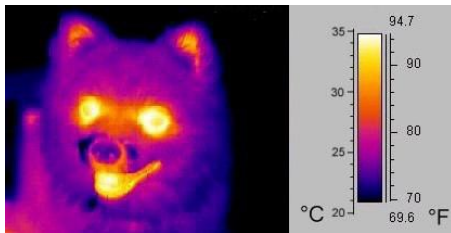**Figure 23 Result IR Radiation of Human Hand**

Figure 24 Result IR Radiation of Dog

5.0 CONCLUSION

Based on the results of the particular case experiment, the security system was tested and demonstrated the result for detection movement, and all objectives were met. Depending on the outcomes of the experiment, it is possible to conclude that different levels of sensitivity of PIR Motion Sensor have different detection ranges. This is due to the fact that high sensitivity levels detect a greater range of 1 to 3.5 meters than low sensitivity levels detect a range of 1 to 2 meters. The system's advantage is that it provides users with real-time updates on what's going on at the scene via mobile notifications. IoT Smart Anti-Theft Movement Detection System is expected to grow in the future, and people will adopt updated security system technology. There are two future recommendation can be suggested to upgrade the system. First recommendation is the hardware placement which is camera. This project can be upgrade by using camera in night mode. This is because in the night mode it can still be function when record the video even when it is dark. Second recommendation, using friendly mobile application. Using telegram is a good platform instant messaging application but only for one user can receive the notification due to telegram do not allowed other person to join the bot because to taking care the user privacy and might be to their rules to prevent third party to interference

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