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Article 2

Home Monitoring System (HMS) using Raspberry Pi Model B

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Abstract
Nowadays, numbers of robbery crime keeps increasing as reported by Royale Malaysian Police(RMP) which usually occurs in daylight and also when the owner is not around. This scenario makes the people feel unsafe when leaving their properties since there is a limited monitoring system available. As the current surveillance system needs larger space, expensive and unreliable hence most people usually don't care with their belonging anymore. Besides, if the person does not have a proper security system, their belongings become the target of crime. Thus, HMS is proposed and developed to cater the security issues related to home security. It is designed with condition such as signal is recorded as the intruder move near a motion sensor. Motion sensor generated a TRUE input that detected a signal based on the moving object. Raspberry Pi model B is proposed as a server that responsible to send data directly to database thus the owner can view and easily identify the entity of the moving object when the data recorded via web application. Experimental results showed the ability of the motion sensor to detect movement increase when the distance of movement at the area of sensor decreases. Does, some recommendation had been made in order to improve the performance of the system detection.

Keywords: *Monitoring, Sensor, Raspberry PI, Surveillance*

Introduction

Nowadays, due to high living cost, migration of illegal immigrant and high employability security is a major concern especially involving luxurious properties. Reports, news, media social and television showed huge number of crimes for instance a breaking in either at home, shop, office and others even on during daylight as stated in Malaysian Insider (2015) and the research of Criminal Investigation Department who is Chief Datuk Mohd Adnan said that gangs targeted mostly on residential area after the owner leaves the house. According to statistics reported by PDRM, since 2009 property crime like house break-ins and theft makes up the bulk with about 80% of the crime rate Mohit et al (2010). However, many security systems that have the high capability to alert notify and record the event but cost is an issue and cannot be afford by an ordinary people. Some of the security system require high maintenance fees, bidder storage and can cause high electricity Nguyen et al (2015).

In addition, reported by Adriansyah and Dani (2014) that it may cause higher in maintenance cost due to the implementation of this system. The methodology for the development of the proposed system based on setup, configures and testing purposes. Raspberry Pi configured to integrate with PIR sensor, camera module and database. The practice of this system is the motion detection sensor detects the movements of an object in real time and it will capture an image of that moving object so the user can check the image on web application. Thus, the user receives their security concern and enables them to evaluate the received image. There are two types that are generated by Raspberry Pi such as static image and small size video. Static image defines as a not moving image

while video image define as a moving image such as video or animation. This project system focused on capturing static image.

Related Work

i. Study by Kaltiokallio and Bocca (2011)

This project aimed to process the receiving signal strength indicator (RSSI). It also used Wireless Sensor Network to extract useful information upon receiving RSSI signal. This project differs to HMS since it uses motion sensor to detect and capture image of the moving object. However, this project has similarity with HMS in which both emphasis on motion detection to detect motion change cause by human. Lastly, this project indicates that changes in motion can be detected using RSSI rather than using motion sensor.

ii. Advanced Raspberry Pi Surveillance (ARS) System by Vamsikrishna et al (2015)

Vamsikrishna et al (2015)proposed a method by using Simple CV as a simple computer vision library, ARS system captures surrounding and detects human presence. This presence of motion notifies the user. This notification process is completed by sending short message service. Apart from that, ARS system used MPEG-Streamer to allow user see the live streaming anywhere. This shows the limitation of the system when user can only see this live streaming video anywhere over internet only. However, this project has similarity to my project since both use current technology, which is Raspberry Pi.

Methodology

Methodology is a specific step taken during the project. Table 1shows the flow of methodology design process.

Table 1: Phase' Activity

PHASE	KEY ACTIVITIES	DELIVERABLE
INFORMATION GATHERING	Feasibility study Primary Study: - -Identify research area -Identify problem statement -Identify research objective -Identify research scope -Identify research significant	Findings: Review related articles and journals
PROJECT REQUIREMENT	Instrument design - Hardware requirement - Software requirement System design	System requirement: - Raspberry Pi - PIR Sensor -USB WIFI Dongle - PHP language - MySQL Database -PhpMyAdmin
DESIGN AND DEVELOPMENT	Develop solution as requirements.	Integrate the Raspberry Pi and the Home Monitoring System for the motion detection using PHP language.
TESTING AND EXPERIMENTATION	Testing on: - -Usability Test -Functionality Test -Network Test	-Raspberry Pi and PIR Sensor module was installed and configure. -Repeat if testing fails.
DOCUMENTATION	Writing report	Full set of report

i. Phase 1: Information Gathering

Information Gathering phase covers on literature review, which has been briefly explained in Literature Review section. The information is taken from journals, articles and websites that are related for this project. Current issues related to home security searched in order to develop a product that might contribute to overcome the problem for example current CCTV required large space to implement while R-PI need small space.

ii. Phase 2: Project Requirement

Project requirement, which showed the equipment that used to develop all of the designs needed in this project. These requirements are dividing into two categories, which hardware and software. Hardware requirement needed for this system such as Raspberry Pi 3 Model B, PIR Sensor, USB WIFI Dongle and male-to-male wire while software requirement includes Raspbian OS, PhpMyAdmin and MySQL.

iii. Phase 3: Design and Development

In the development phase, it involved the installation step of Raspbian OS in Raspberry Pi 3 model B, the placement of every electronic part on Raspberry Pi and its own coding which will make the electronic part to work. The Raspbian OS was chosen as the operating system for this project. There are many operating systems that can be installed in Raspberry Pi, which includes Archilinux, Pidora, Raspbmc and others. However, Raspbian is the easiest API compared to others. This phase also focuses on the step taken in the making of the R-PI. The schematic diagram of the proposed

system was sketched in order to explain how the system works as shown in Figure 1. Then, work flow of program design was presented and steps taken one very phase were explained.

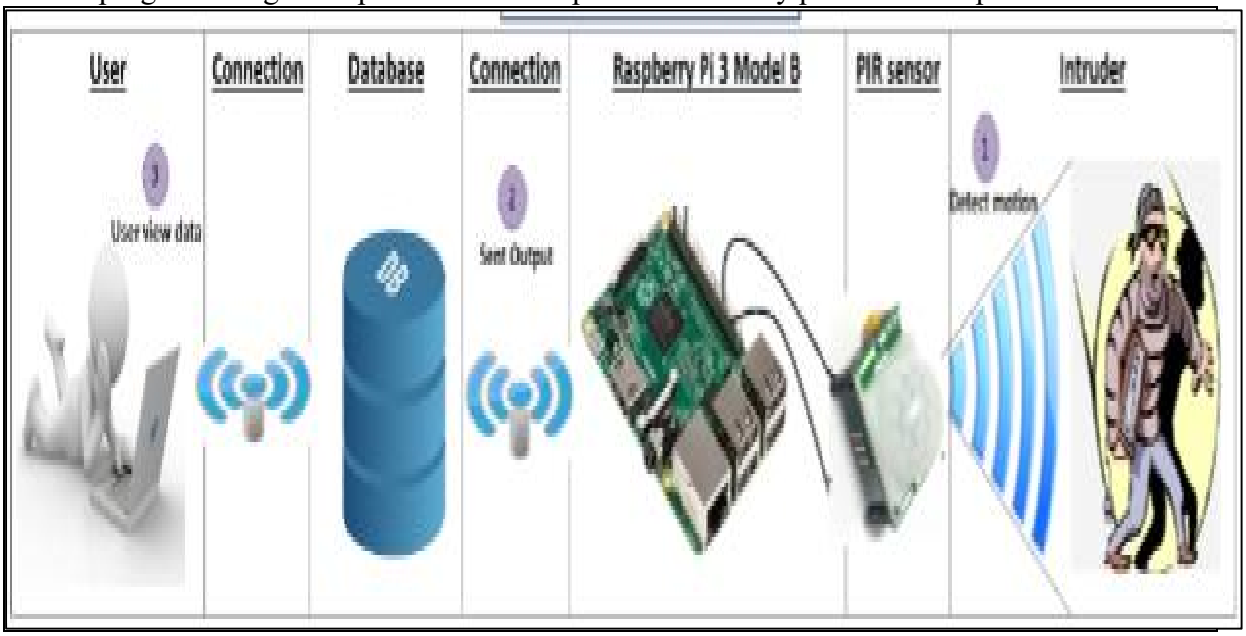

Figure 1: Schematic Diagram for HMS

HMS consists of Home Surveillance, Raspberry Pi, Motion Sensor, web application and script coding. However, the main part for the technique or algorithm used to solve this problem is the programming part. HMS being coded in PHP and Python language since the usage of Python language is simpler but has a long coding for overall system as shown in Figure 2.

```
        fromgpiozeroimportMotionSensor
        frompicameraimport PiCamera
camera = PiCamera
pir – MotionSensor(4)
while True
        pirwait_for_motion()
        camera start_preview()
        pirwait_for_no_motion()
        camera stop_preview()
```

Figure 2: Coding for HMS in Python Language

iv. Phase 4: Testing and Experimentation

In testing phase, HMS was tested on several scenarios selected in order to evaluate the functionality and usability of the HMS. Network test consist of two experimentations that test based on time taken.

v. Phase 5: Documentation

Final phase involved the documentation of the result and write up to thesis completion. The thesis also compared with other research project to ensure this project is suitable based on current technology.

Results and Findings

Respondents involved in this study consist of 30 peoples with 15 females and 15 males that involved in pre-study and post survey. Respondents that have been selected consist of students, lecturers, government servants and housewives. A functionality and usability test were conducted by allowing several people to evaluate the proposed system.

i. Functionality test

Table 2 shows the results tested collected from experiment to measure the real time detection of PIR sensor with reflex to distance. Scenarios were configured based in three different distances for instance 4, 8 and 10 meters. Scenario 1 is conducted at 4 meters distance, with time of the movement is at 11.00 p.m. and the response time of the PIR sensor to detect the movement is also at 11.00 p.m. Then, scenario 2 is tested for 8 meters distance with the time of the movement is at 11.10 p.m. Finally, scenario 3 is conducted at 11.23p.m. to detect the movement at 10 meter distance. It showed that from the distance of 4 meters, 8 meters and 10 meters, the PIR sensor enable to detect the movement with less than 60 seconds. Therefore, with the far distance from PIR sensor, the effectiveness is become less effective. The outcome showed that a PIR motion sensor enable to detect the motion movement based on three different distances successfully but the effectives of the PIR sensor parallel with distance.

Table 2: PIR sensor vs distance

Distance (meter)	Time of Movement	Time of the PIR sensor to Detect Movement	Time taken to detect the movement (seconds)
4	11.00 p.m.	11.00 p.m.	03
8	11.10 p.m.	11.10 p.m.	15
10	11.22 p.m.	11.23 p.m.	60

Table 3 shows details of the result collected from Experiment 2 to measure the data store inside database when PIR detected a movement of intruder. Based on 4 meters distance, the time of the PIR sensor detected movement is at 11.00 p.m. and the time of the data stored in database is received at 11.00 p.m. which showed no delay in time. As for the 8 meters distance, the result showed that a PIR sensor detected a movement at 11.10 p.m. and the time of the data stored is at 11.11 p.m. Based on the results of the 8 meters distance showed that the delay time is 60 seconds. Lastly, based on the 10 meters away, the delay time of the PIR sensor to detect the movement and send the data to database is around 120 seconds which from 11.23 p.m. to 11.25 a.m. This showed that some delay occurs when distance is far away from PIR motion sensor but detection record still accepted by database.

Table 3 Database response time

Distance (meter)	Time the PIR sensor Detect Movement.	Time the data Stored in Database
4	11.00 p.m.	11.00 p.m.
8	11.10 p.m.	11.11 p.m.
10	11.23 p.m.	11.25 p.m.

ii. Usability Test

This section was performed to evaluate the effectiveness of the system. Post study was conducted with 30 respondents using usability test.

Figure 3 demonstrated a result based on HMS contribution to reduce crime theft especially on house break cases in the future. From the result presented showed that 75% of the respondent confident that HMS enable to reduce that crime since the characteristics of system which can alert the owner with real time notification. In contrast, only 25% of respondents are unsatisfied with HMS to show a reducing in house breaking case. This can be concluded that one third of respondent believes HMS as an alternative to reduced crime cases and can be implemented as home security system.

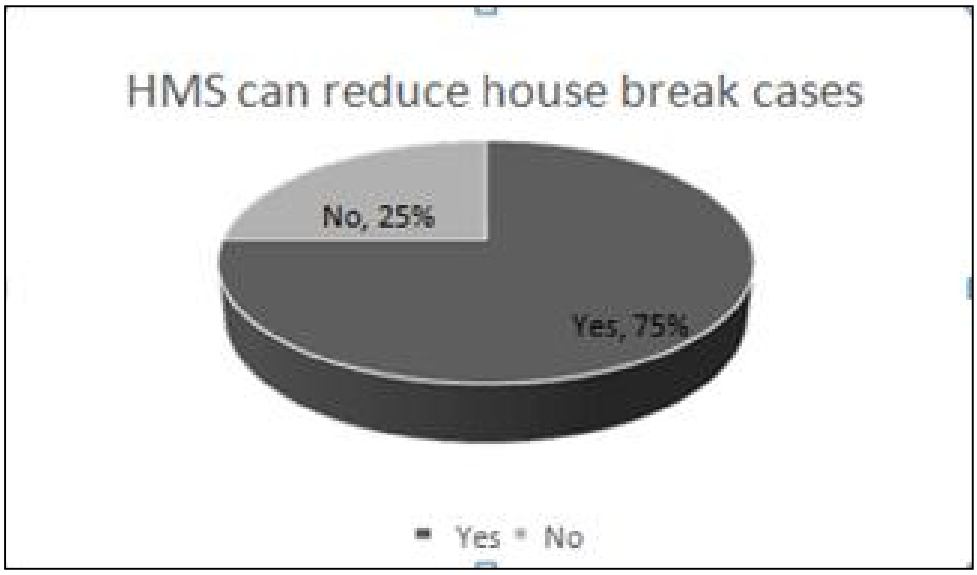

Figure 3 Breaking cases survey

Figure 4 showed the result collected from post study to analyze users' perception on implementing HMS. From the result presented showed that about 50% of respondents satisfied with the performance of HMS, 35% give a positive feedback and only 15% of total respondents request a better monitoring system.

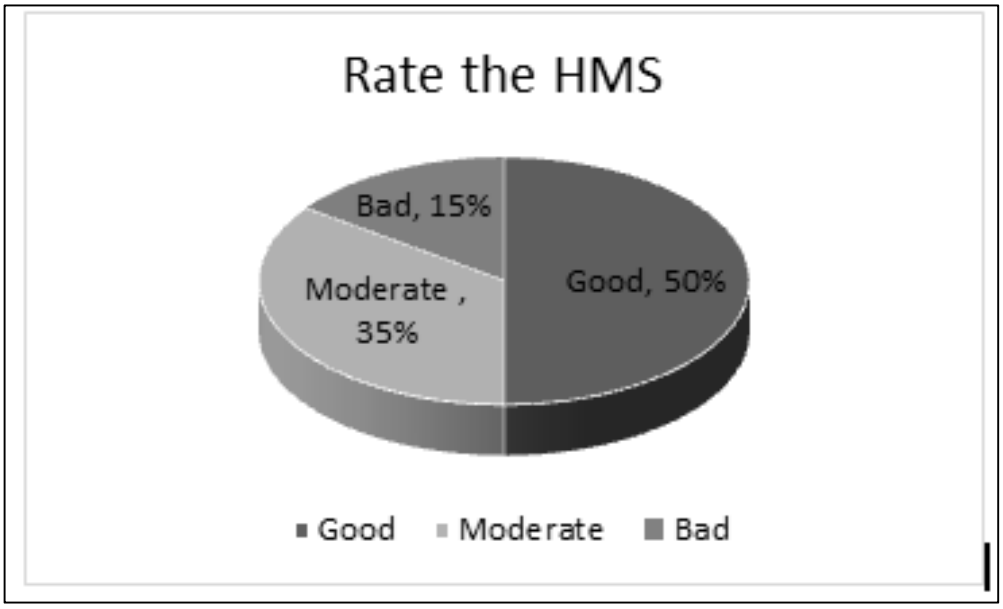

Figure 4 Users' perception against HMS

Discussions

This project is designed to ensure the owner of house can be check if there are house break activity occurs at their place and at the same time shows the method on sending data taken using Raspberry Pi 3 to the database. Home Monitoring System (HMS) was developed based on several phases presented detailed in previous section, which all the software needed such as Raspbian OS was installed in order to have a programming environment in the Raspberry Pi. Then, PIR sensor module was installed and tested using some program to ensure its functionality. Lastly, some software to develop web application and database was installed which allow the Raspberry Pi send the notification with attachment of the output from PIR sensor to the web and stored in database.

Conclusion

In conclusion, the development of the movement sensor with database through web application has been successfully developed according to its objectives and desired Specifications.

References

Kaltiokallio, O., & Bocca, M. (2011). Real-Time Intrusion Detection and Tracking in Indoor Environment Through Distributed RSSI Processing. *17th IEEE International Conference on Embedded and Real-Time Computing Systems and Applications*, 61–70. https://doi.org/10.1109/RTCSA.2011.38

Nguyen, H., Thi, T., Loan, K., Mao, B. D., & Huh, E. (2015). Low Cost Real-Time System Monitoring Using Raspberry Pi. *Ubiquitous and Future Networks (ICUFN), 2015 Seventh International Conference on*, 857–859. Retrieved from http://doi.org/10.1109/ICUFN.2015.7182665

Vamsikrishna, P., Hussain, S. R., Ramu, N., & Rao, P. M. (2015). Advanced Raspberry Pi Surveillance (ARS) System. In *2015 Global Conference on Communication Technologies (GCCT)* (pp. 860–862).

For Journals:

Mohit, M. A., Mohamed, H., & Elsawahli, H. (2010). Crime And Housing In Malaysia : Case Study Of Taman Melati Terrace Housing. *Asian Journal of Environment-Behaviour Studies*, *1*(3), 26–36.

M ohit, M. A., Mohamed, H., & Elsawahli, H. (2010). Crime And Housing In Malaysia : Case Study of Taman Melati Terrace Housing. *Asian Journal of Environment-Behaviour Studies*, *1*(3), 26–36.

Malaysian Insider. (2015). Selangor cops cripple house break-in gang - The Malaysian Insider. Retrieved December 2, 2015, from http://www.themalaysianinsider.com/citynews/greaterkl/article/selangor-cops-cripple-house-break-in-gang/selangor-cops-cripple-house-break-in-gang

Adriansyah, A., & Dani, A. W. (2014). Design of Small Smart Home System Based on Arduino. *Electrical Power, Electronics, Communications, Controls, and Informatics Seminar (EECCIS)*, 121–125. Retrieved from http://doi.org/10.1109/EECCIS.2014.7003731