HOME SECURITY ANDROID APPLICATION ALERT SYSTEM USING RASPBERRY PI

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This report is submitted in partial fulfillment of the requirements for the Bachelor of [Computer Science (Computer Security)] with Honours.

FAKULTI TEKNOLOGI MAKLUMAT DAN KOMUNIKASI
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

[2021]

DECLARATION

I hereby declare that this project report entitled

[HOME SECURITY ANDROID APPLICATION ALERT SYSTEM USING RASPBERRY PI]

is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT : [AMIRUL SYAZWAN BIN SALMI] Date :10-04-2021

I hereby declare that I have read this project report and found this project report is sufficient in term of the scope and quality for the award of Bachelor of [Computer Science (Computer Security)] with Honours.

SUPERVISOR : Ts. Dr. Mohd Rizuan Bin Baharon Date : 10-04-2021

DEDICATION

To my beloved parents, Salmi Bin Hassan and Rohaya Binti Husain the ones who always support and encourage me to get through every challenge in my life until now and always motivate me with their love.

To my helpful and respected Academic Advisor Dr.Nur Fadzilah Binti Othman and Supervisor TS Dr. Mohd Rizuan Bin Baharon, thank you for the guidance from the beginning until the end of final year project.

ACKNOWLEDGEMENTS

Bismillahirrahmanirrahim...

First of all, I would like to give all the praise to Allah S.W.T for giving me the opportunities, strength, and patience for the whole process of completing this project during this Covid-19 pandemic. Without a blessing from Him, I cannot complete this project according to what has been arranged off.

Secondly, I want to thanks to my parents for their nonstop prayers and given everything possible to ensure I complete and succeed in this final year project. Their support has motivated myself so that I never give up and have given my best shot to finish the project which has been started. Thank you for all the love and always take a good care of me.

Next, I would like to give millions of thanks to my awesome supervisor TS Dr, Mohd Rizuan Bin Baharon for guiding me along the way to complete this Final Year Project. The inspiration for developing this project came from the guidance and ideas from him and he has always provided me with precious knowledge and advice which brings my project to a higher level. Because of him, my insight on the project has been widened.

In addition, I would like to thanks to all of my friends, who have always been there for me during my up and down. They also provided me with opinions, useful support and suggestion to contribute to the improvement of this project and with the Covid-19 pandemic they support is what I need to continue this final year project.

ABSTRACT

Leaving house or an office without any surveillance system is insecure. This situation would attract such a bad activity can be happened such burglary activity. In addition, it also allows unauthorized person to get access to the house or office without anyone aware of such an activity has happened. Thus, a system called Home Security Android Application Alert System is invented to provide security feature to the user's property if they are away from their property. Similar to the normal home security system, this home security system detects the presence of an intruder for this project and rapidly alerts the user by sending an alert notice via the system-connected application.

ABSTRAK

Meninggalkan rumah atau pejabat tanpa sistem pengawasan adalah tidak selamat. Keadaan ini akan menarik seperti aktiviti buruk yang boleh berlaku seperti aktiviti pencurian. Di samping itu, ia juga membenarkan, orang yang tidak dibenarkan untuk mendapatkan akses ke rumah atau pejabat tanpa ada yang mengetahui bahawa aktiviti tersebut telah berlaku ... Oleh itu, sistem yang dinamakan Sistem Keselamatan Aplikasi Android Home Security diciptakan untuk memberikan ciri keselamatan kepada harta pengguna sekiranya mereka jauh dari harta benda mereka. Sama seperti sistem keselamatan rumah biasa, sistem keselamatan rumah ini mengesan kehadiran penceroboh untuk projek ini dan memberi isyarat cepat kepada pengguna dengan menghantar notis amaran melalui aplikasi yang disambungkan ke sistem.

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FYP	**-**	**Final Year Project**

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Nowadays, home security system is not very common thing in Malaysia. This is because the majority of Malaysians are unaware of the value and benefits of a home security system. Home security system is a system that program to secure your home, office, room or something important and precious to you from intruder or from a theft. For this project, we built a simple home security system with the use of Raspberry Pi, USB Camera and PIR sensor. The simple home security system that has been built function similarly to standard home security system. For this project, my home security system ~~will~~ detect the presence of intruder and quickly alert the user by sending an alert notification through an application that connected to the system.

Raspberry Pi is a series of small single-board computers. It is a device~~s~~ that enables people to explore computing, and to learn how to program in language like Scratch and Python. The Operating system that for Raspberry Pi is Linux. Raspberry Pi is capable of doing many thing such as browsing the internet and parent detectors to weather stations and many more.

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared light radiating from objects in its field of view. The most often used of the PIR sensor is for motion detectors, but don't give information on who or what moved. In this project, PIR sensors is used to detect motions of intruders after user left their home and has activate the Home security system and if the intruder break into your house the PIR sensor will detect the intruder motion and will sent alert notification to the user through application that connected to the system.

In conclusion, Home security system is a system that function to secure your room, home, or office from intruder. Home security system will detect and notify you if the intruder tried to break in into your property through simple application that connected to the system. This give time to user to make report to the police and arrest

the intruder before too late. This home security system also come with USB camera so that you have evidence who try to steal your property.

1.2 Problem Statement

The main problem in doing this project is some of the CCTV is more expensive than home security system and CCTV system did not provide alert notification features and also common CCTV features monitoring and alarm triggering if intruder break into user house without any emergency security respond implemented. This would be huge loss for user if they buys a very expensive CCTV that only have some basic features in it. Moreover, busy user unable to known the condition and the safety of their house when user is away from their house for certain days or business trips. Last but not least, the complexity of installing and the high cost configuration of the previous version of home security system leads to the not receive much demand and attention from user.

Table 1-1 Summary of the problem statement

PS	Problem statement
PS1	The cost of CCTV system is expensive and not included with alert notification function.
PS2	The CCTV consists of simple security features such as monitoring and alarm triggering but the emergency security respond is not integrated in the implementation

1.3 Project Research Question

Project research question is used to identify how much cost to develop a low budget home security system with implementation of several security features. How to insert the security features that connected successfully to the home security system. Furthermore, how to develop a successful home security system with PIR sensor, USB camera and raspberry Pi and send alert notification through simple application that connected to the home security system that have been build.

Table 1-2 Summary of the Project Research Question

PS	PRQ	Project Research Question
PS1	PRQ1	How to design a low cost home security system?
PS1	PRQ2	How to integrate alert notification system to low cost home security system?
PS2	PRQ3	How to enhance the home security system feature?

1.4 Project Objective

Project objective specifies the enhancements that what you want to achieve at the end of this project. This enhancement is dependent on the problem statement and the project question of this project.

Table 1-3 Summary of Project Summary

PS	PRQ	PO	Project Objective
PS1	PRQ1	PO1	To design a low cost Home Security Application Alert System using Raspberry PI and PIR sensor.
PS1	PRQ2	PO2	To integrate the home security alert system with video message using Telegram.
PS2	PRQ3	PO3	To enhance the security features of Home security system by adding PI camera module.

1.5 Project Scope

Project scope is a certain work that has to be done in order to deliver final result such as product or services with specified features and functions. It ~~also will~~ give you

the early view of the project. In this project, project scope will define the targeted user and some module of the Home Security Application Alert System.

1.5.1 Users

The target user of this project is the house owner that who want to monitor and secure their property using motion detector and camera and if the motion detector sensor detect motion in the owner house while owner are away the system will sent alert notification to the owner through simple application that connected to the system on their smartphone.

1.5.2 System Scope

1.5.2.1 Hardware

(a) Raspberry Pi

The Raspberry Pi Foundation created a series of small single board computer in the UK. It is a credit card sized machine with a low cost price tag. It is a small machine that helps people to learn more about computer, the computer language like Python or create hardware program, automate their home, and Raspberry Pi also use in the industrial applications.

(b) USB camera

A USB camera is a video camera that feeds or streams an image or video to or from a device to a computer network, such as the Internet, in real time. USB camera are small cameras that usually sit on a desk, connect to a user's computer, or are built into the hardware.

(c) PIR sensor

A passive infrared sensor (PIR sensor) is a type of electronic sensor that measures the amount of infrared (IR) light emitted by objects in its field of view. They're most commonly found in PIR-based motion detectors. PIR sensors are widely used in security alarms and automatic lighting systems.

(d) Female to Female jumper

A jump wire (also known as a jumper, jumper wire, jumper cable, DuPont wire or cable) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or often without – simply "tinned"), that is typically used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

1.5.2.2 Software

a) Android Studio Software

Android Studio is Google's official integrated development environment (IDE) for the Android operating system. It is based on JetBrains' IntelliJ IDEA software and is developed specifically for Android development. It can be downloaded for Windows, MacOS, and Linux-based operating systems.

b) SQLite

Since Android was created, all application developers have been using SQLite to store our local data. Often directly with SQL statements, often with an Object-Relational Mapper (ORM) as an abstraction layer. SQLite is an open source software and it is easy to use SQL database and SQLite database is very popular database software among application developer.

1.5.2.3 Modules/Functions

In software, a module is a component of the program. The package is made up of one or more modules that were created separately and will not be integrated until the program is linked.

I. Motion Detector Module

This module is to detect any motion or movement that the sensor can detect on real time

II. Camera Module

This module will pair with the PIR sensor to capture the image of any motion or movement.

III. GUI

Simple android application that will be built to notify user if their safe or not.

1.6 Project Contribution

The estimate performance from this project is described by the project contribution. This section may be referred to as the project objective.

Table 1-4 Summary of the Project Contribution

PS	PRQ	PO	PC	Project Contribution
PS1	PRQ1	PO1	PC1	To capture the image of the motion that have been detected by the PIR sensor
PS1	PRQ2	PO2	PC2	The Raspberry Pi can connected successfully to the PIR sensor, USB Camera and Internet
PS2	PRQ3	PO3	PC3	A successful Home Security Application Alert System with an android program that notify user if the system detect any sign of motion or movement.

1.7 Conclusion

In conclusion, Home Security Application Alert System using Raspberry Pi and PIR sensor. This system basically send alert notification to user through simple android application that connected to the Home Security System if the PIR sensor detect any motion or movement while the user aren't at home. I hope this project will become useful devices for home resident, office room, or server room. Especially to those who want to protect their belonging safe from thief and intruder.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In the previous chapter has been discussed about the problem statement, objectives and the scope of this project. For this chapter, it will explain more about the literature review and summary of the existing project. For this project, the observation and review is made based on the project domain, how to develop the project and the technology that has been used.

This propose project is to develop Home Security Application Alert System using Raspberry Pi. This project required some research on similar project and fact finding to support the project and to study of the problem and solution for better understanding about this project and the techniques that will use in this project. Therefore, literature review is so important and play an important role when a project is carried out. The definition of literature review examines books, scientific publications, and all other references that related to the specific topic, title, field of study, scope, or theory, and overview of these works in relation to the research problem under consideration.

In this chapter, will address all the fact-finding and the study of the literature that related to the project and research about this project will be discussed. The purpose of this literature review is to identify important fact that will help this project and to give a summary of all of the information that can be found in the literature that related to this project.

2.2 Related Work

The definition of home security system is a group of physical electronic components that work together to protect a home. Home security system basically

consist of security camera, motion sensor, entry sensor, siren and password that function to monitoring, detect and alert owner about the safety of their home from intruders.

The domain of this project is focusing in providing the security services to user house or room. This home security system is a system designed to improve and secure the user home and provide alert notification to user if the motion detector detect something. The system is configure to secure the user home and it will helps user prepared if something bad happen such as burglary or unauthorized person enter user home. With this home security system, user home will be more secure and protected.

In this project, for the system work properly and detect the motion, PIR sensor has been used. A PIR sensor also known as Passive Infrared sensor allow you to sense motion and detect the infrared radiation that emit by certain object such as human, animal and even inanimate objects, the application of PIR sensors are used in thermal sensing application, such as security and motion detector. PIR sensor are small, cheap, low-power, easy to use and do not wear out. PIR sensor have an important part of surveillance, automatic lighting control, home automation and another system that used sensor as a part of the system.

According to the FBI latest data, in 2017 there were 1,401,840 burglaries happen in the country and with 67.2% of the burglaries take place in residential properties and the victim suffering total losses over $3.4 billion. In Figure 2.1 shows that security system use by generation to secure their house, in the figure we can see that Baby Boomer generation are the least likely to install security system in their home with only 12% admitting to have one. While millennials generation are the most likely to have security system installed in their home with percentages 45%. According this data and statistic we know security system is very important in present life and future, security system is really useful to secure your property and family.

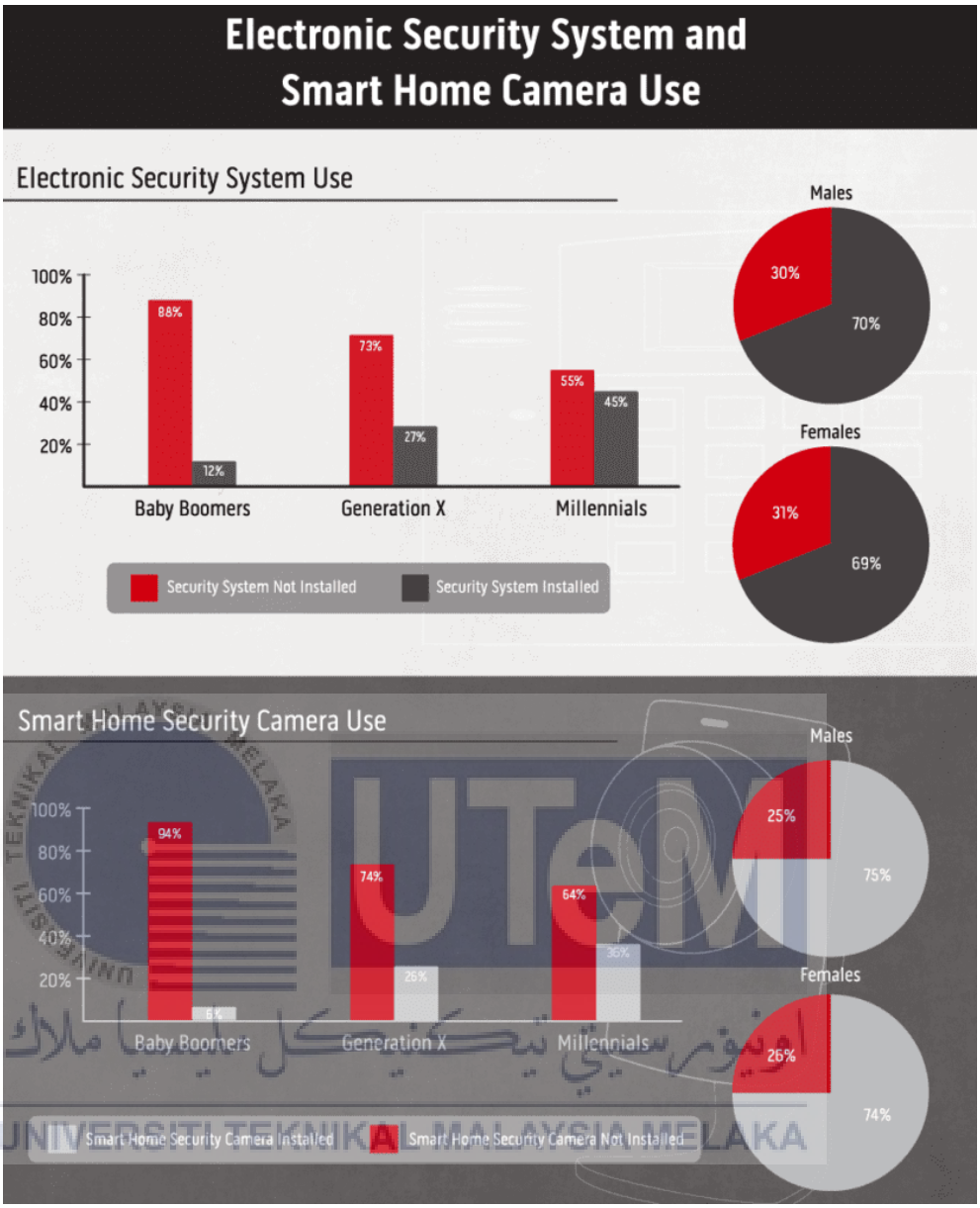


Figure 2-1 Statistic of generation has home security system

2.3 Critical review

2.3.1 Home Based Security Control System based on GSM

Literature review indicates that the home based security control system could be done using Raspberry Pi and GSM. The main reason of this system is to design and implement cheap, flexible, and fast monitoring home security system and functioning to detect burglary, captured the image of a person using camera and sends to email as the alarm get sound on and the leaking of harmful gas or by the smoke that caused by the fire or any suspicious activity that detected by the sensor. In this project, raspberry Pi module, GSM module, PIR sensors, vibration sensor, air quality sensor have been use for the controlling the whole system. (Akash V. Bhatkule, Ulhas B. Shinde and Shrivinas R. Zanwar , 2016).

GSM have many available features communication and it is suitable for the system that low cost, small size, emergency alarm generate and very short response time. (Akash V. Bhatkule, Ulhas B. Shinde and Shrivinas R. Zanwar , 2016). For this system, the user can control the system everywhere. The GSM is used to send data for a specific location with minimal internet connection. User will use AT commands to interact with GSM modem. Literature also indicates that Short Message System (SMS) used to send confirmation text and systems comment. (B.I. Ahmad, 2011)

Another literature review have indicates that the system that have been built a door lock system using face recognition and a home automation system. In this case, we're using the Raspberry Pi, which has a lot of capabilities, capabilities that allow the user to adapt usage in various smart software systems. Using the Raspberry Pi, the webcam is used in this device for small time monitoring (human activity occurs) and no storage space is needed. GSM modules are devices that mobile networks use to determine contact. A SIM card is required to register a network operator or service provider with a GSM or GPRS module. The GSM module sends a message to an authority after comparing the captured images to the stored images. (Kavya N, Bharath Kumar, Darshan V , Hemanth Kumar G, Jagadish, June 2020).

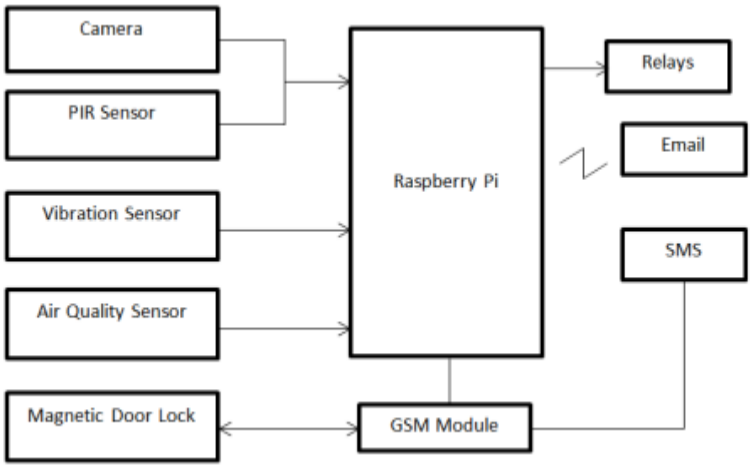


Figure 2-2 Home Security system based on GSM

2.3.2 Development of Smart Home security system based ZigBee

Another literature indicates that A ZigBee-based Smart Home Security System is designed and implemented. The system is intended for use in the protection of homes, banks, and industries, among other things. Everyone is concerned about the protection of their life and property these days, and if we can have a system that can take care of it, it will be a smarter use of technology in everyone's life. The proposed technology is dependable, cost-effective, and efficient. The prototype can control all of the security devices in a home or bank since only one smart server is needed to track and control thousands of devices rather than multiple smart servers. The system uses the ZigBee Module to implement a wireless network because it is more efficient and consumes less electricity. (Aman Sharma, Dr. Anjana Goen, January 2019)

The ZigBee technology will be used in this application. ZigBee is a high-level communication protocol based on IEEE 802.15.4 that is suitable for building Personal Area Networks. This network will connect all of the sensor devices, as well as the microcontroller and relay devices. The benefit of using ZigBee is that it operates on low power and has a sufficient network range. (Aman Sharma, Dr. Anjana Goen, January 2019)

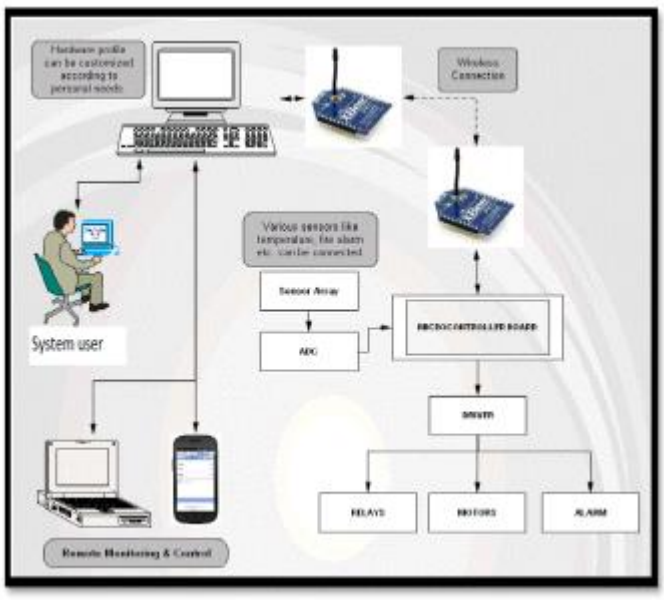


Figure 2-3 ZigBee system architecture

2.3.3 Smart Surveillance Monitoring System Using Raspberry Pi/ Arduino

In another literature review, this purpose of the project is to create a smart surveillance device that can record/capture video/images and send them to a smart phone. It is beneficial because it provides both sides with dependability and privacy. It is authenticated and encrypted on the receiver side, so it only offers the person in question. (Sanjana Prasad , P.Mahalakshmi , A.John Clement Sunder ,R.Swathi)

Raspberry Pi is a smaller, open source and customizable testing tool. It runs the Raspbian operating system and is programmed in Python 2.7.6. It has 512 MB of RAM memory and no hard drive, but it uses an SD card for booting and long-term processes. It is also connected to a USB camera that serves as a spy camera. (Akash V. Bhatkule, Ulhas B. Shinde and Shrivinas R. Zanwar , 2016).

2.3.4 Comparison between Existing Systems

Table 2-1 Comparison between Existing System

Title	Home Based Security Control System based on GSM	Development of Smart Home security system based ZigBee	Smart Surveillance Monitoring System Using Raspberry Pi/ Arduino
Author	Akash V. Bhatkule, Ulhas B. Shinde, and Shrinivas R. Zanwar	Aman Sharma and Dr. Anjana Goen	Pragati Ukey, Anita Shinde, Sneha Kasrung, Satish Kamble and, Jidnyesh Kadu.
Target user	All range	All range	All range
Price	Cheap	Quite Expensive	Cheap
Setup	Medium	Hard	Easy
GUI	Yes	Yes	Yes
Features	-Able to connect with external devices -Able to send alert SMS -Able to send sent all the data collected by the sensor to the user.	-Able to lock the door if unauthorized user enter the room -Able to remotely control and monitor the network enabled devices.	-Able to remotely control and monitor the network using mobile devices. -Able to handle motion detector -allows live monitoring for user

		-Able to send signal to remote user to notify the threat.	
Strength	-able to use Wi-Fi, Bluetooth and Ethernet -Very low cost to build it - Have good graphical design	- Highly reliable and secure -low latency - Power consumption is very low	-able to use Wi-Fi, Bluetooth and Ethernet -Very low cost to build it -simple and easy to control
Weakness	-Require the use of Wi-Fi -Each components in the system have limited warranty. -Not all components have warranty.	- Quite expensive. -Quite difficult to build - If the Zigbee not functioning all system will be not function	- Require Wi-Fi and Bluetooth to communicate -Not all components have warranty -Low performance and need to paid more to upgrade the performance

2.4 Proposed Solution

After doing some research and reviewed on the related project system there are many techniques and methods has been used to build the system. Many Home Security System require and able to connect to Wi-Fi so that user can monitor their property live on their smartphones anywhere in the world (Pragati Ukey, Anita Shinde, Sneha Kasrung, Satish Kamble and,Jidnyesh Kadu, 2017). For the propose system to do that there a couple of thing that system need to function successfully. Firstly, Raspberry Pi as the microcontroller and PIR sensor as the motion detector devices. The reason Raspberry Pi use as microcontroller is Raspberry Pi is more efficient than Arduino and Raspberry Pi have many version than other microcontroller and it quite cheaper but slightly expensive than Arduino.

Secondly, after reviewed related project system articles the placement of the home security also play important roles in the system is fully operate smoothly. The reason why the placement of the home security is important because you cannot place the device opposite to the window and lower than your chest. This is because the system will give you false alarm, if the motion detector devices detect movement outside your house and if you place it lower than your chest it might detect your pet. Since this project under development, the total cost cannot be determine but the hardware costs that use in this proposed project is quite cheaper than before. Finally, in related project that have been reviewed, many application have been use as a medium for user to get the alert notification if the system detect something suspicious. For example, the common medium that have been use in related project system is SMS and email. Thus, in this new propose system we use Telegram as medium. Telegram is Android Application that use a bot to connect to the Raspberry Pi so that user can get the image and footage that system detect through their smartphone.

2.5 Conclusion

In conclusion, a literature review is very important aspect before developing new project. In doing literature review on previous and related project will help the us to determine the important fact on the ability of the hardware and software, the medium that have been used to send the alert message, the problem that connected to the system and critical mistake that previous project have ever done or use in the project. This will make us to build more advance and practical system than the previous system. It like learn from other mistake.

CHAPTER 3: PROJECT METHODOLOGY

3.1 Introduction

In this chapter will be discusses about the project development and the appropriate approach that will be used to develop this project. The definition of project methodology is methodology is essentially a collection of methods, practices, procedures, and regulations. The procedures are particular, stringent and normally involve a range of processes and activities for each point of the life cycle of the project. This project will be developed by using the Waterfall design model.

3.2 Methodology

Methodology that have been use in this project is Waterfall Design model, The Waterfall Design model is chosen as the methodology for developing this project because waterfall model is a linear model of processes dividing development into distinct phases. Every phase is only completed once, unlike iterative models. The outcomes of every previous phase are used in the following phase as assumptions. The waterfall commonly used in system/software development this is because the waterfall model is easily understandable phases and it easy to use. Moreover, one of the advantages of waterfall development is it allows for categorization and control each phases. For each step of development, a schedule can be made with deadlines, and one product can go through the phases of a development process one by one.

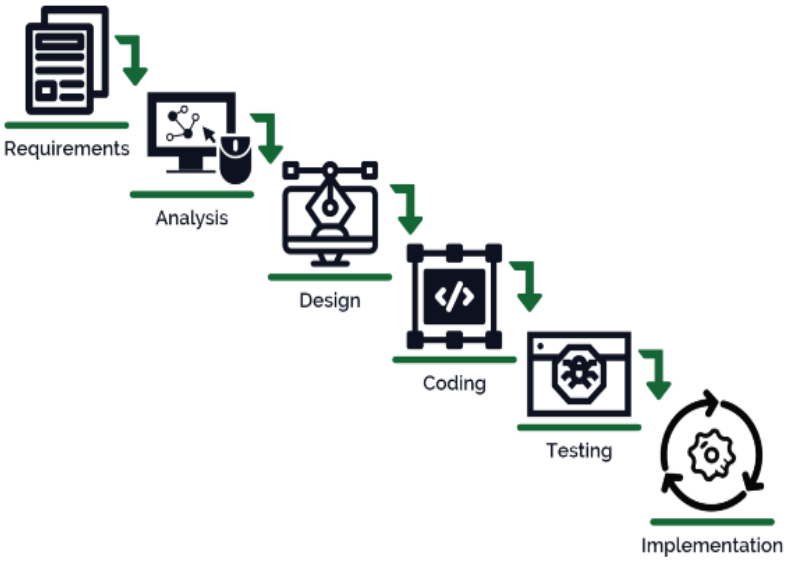


Figure 3-1 Waterfall Design Model

3.2.1 Requirement and Analysis Phase

In this phase, where the collection of fact and ideas is collected before begin the development of the project system. The product requirement must be identified by analyzing and gathering all user need and requirement this step is very crucial in this phase because it will save time to finish the product. After analyzing and gathering all the product requirement, another crucial step in this phase is doing a literature review on previous project that connected to project system product. The reason why literature review is conducted is to analyze the previous version of home security system so that in the end of the literature review we can identify the common problem, devices that have use, the functionality of the device, the cost of the rough cost for creating the project and so many more that have been analyze throughout the literature review. Finally, all the content that have be found of the literature review can be used to expand and upgrade the product system to become more advanced system than the previous system.

3.2.2 Design phase

In design phase, the product design is prepared which is include all the hardware and system requirements. For example, data layers, programming languages, network infrastructure, user interface and many more. It will helps define the overall of system architecture. After obtaining all the detail and facts that want to be used in the next phase that is implementation phase, a draft document with a software construction plan and test plans for individual components have been made.

3.2.3 Implementation Phase

During the implementation phase, the system architecture specified for the design phase includes system programming, troubleshooting and module test. The system design is implemented in the required programming language during the implementation phase. Individual components are individually developed, tested and progressively integrated into the overall product within the scope of module testing. The outcome is a system product that is first tested as a full product in the next phase.

3.2.4 Testing Phase

The testing phase involves the program being integrated into the desired client environment. In general, system items are initially supplied to chosen end users as beta versions. In the analysis phase, the acceptance tests can be applied to verify if the system fits the previously established criteria. A successful beta testing system product is set to release.

3.2.5 Maintenance Phase

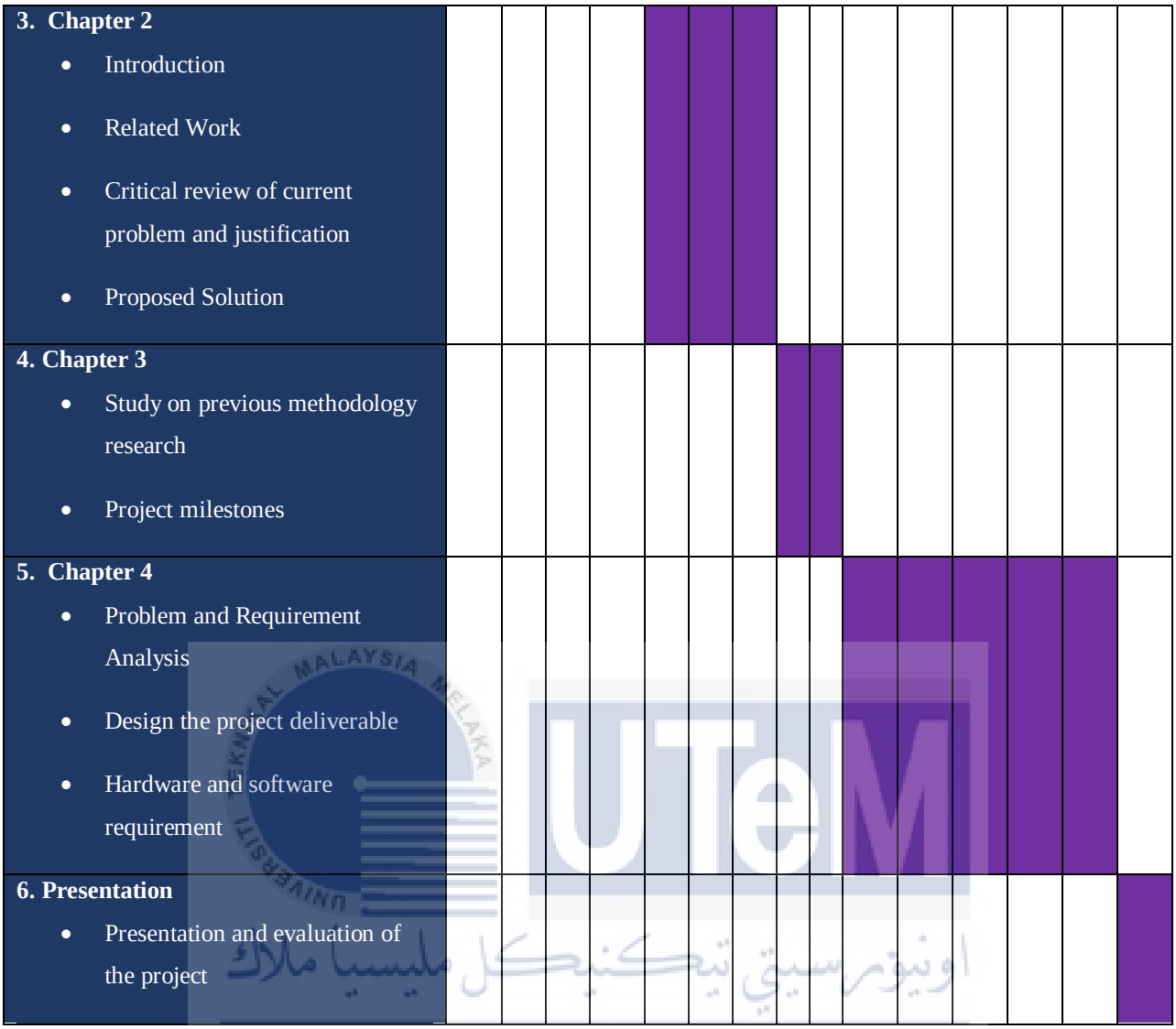
Finally, after successful completion of the test phase, the system is released for the user for productive use. In this phase, the system will be maintenance, delivery and improvement from time to time so that the system will work properly and does not have any mistake that can cause failure to the system.

3.3 Project Milestones

A project milestones is a management tool used to define a point in a project plan. These points may indicate the beginning and end of a project and signify the completion of a significant work phase. The milestones and Gantt chart are important, milestones and Gantt chart is use to reference to the project team as the guideline to make sure that the project will finish and the product will be fully function according to the timetable and plan.

Table 3-1 Milestone Gantt chart

Activities	WEEK														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Proposal • Discuss proposal with Supervisor • Proposal assessment & verification • Proposal improvement or Correction • Proposal submission via email • Proposal Approval and submission via PSM in Ulearn															
2. Chapter 1 • Introduction • Problem Statement • Objectives • Scope of the Project • Expected Outcome															



3.4 Conclusion

In conclusion, Waterfall Design model is methodology for this project development. The reason why Waterfall model is use in this project development is because waterfall model is commonly used by the developer that want build system or software and the Waterfall model is easy and understandable because it not so completed compare to other model. This project methodology consist of 5 phases that developer must follow in order to complete the product.

CHAPTER 4: ANALYSIS AND DESIGN

4.1 Introduction

The Waterfall development process continues with design phase, which follows after the requirement and analysis phase. It is a way to collect and analyze contents, find faults and disassemble a system into its components. It details the implementation of the plan. The design process means that the proposal must be thoroughly planned to fulfill all the needs of the framework. The necessary hardware and software are detailed in the project specifications for this project. To ensure the project can be finished and well planned, the architecture of the block schedule and thoroughness of the analysis were recorded.

4.2 Problem Analysis

In this project, the main problem is with the issues of some basic CCTV system do not have a motion sensor implemented in the system to automatically record the video if the motion sensor detecting some movement in the range of the motion sensor. Thus, this project Home Security System is built to overcome the problem of the basic CCTV system. In this project will be create the Home Security System based on Raspberry Pi, Pi Camera and PIR sensor in order to successfully create Home Security System that can detect any movement and then record or capture the video or picture if the system detect any motion inside the range of the sensor.

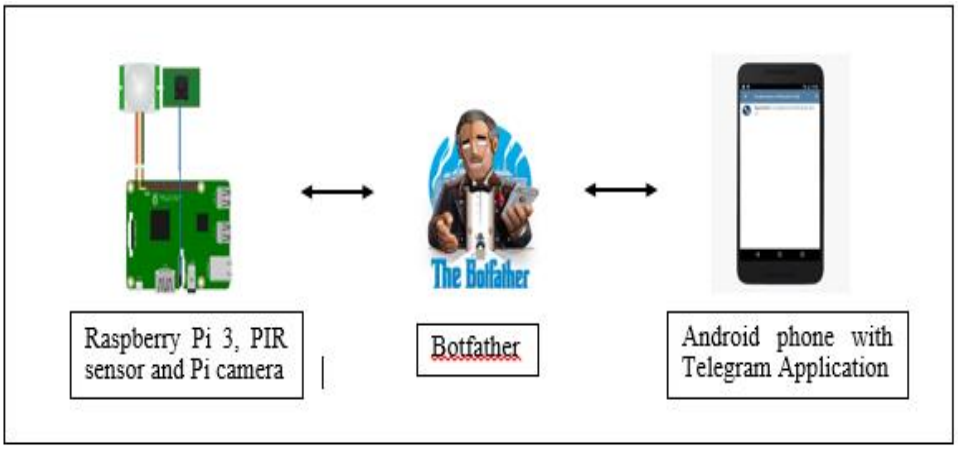


Figure 4-1 System Architecture

To develop the Home Security System using Raspberry Pi, PIR sensor and Pi camera has being chosen as the technique to create the Home Security System that can detecting motion and can transmit the image and video to the user smartphone via android application. When a motion is detected by the system, the system will record and capture the video and picture, then sent the video to the android application. Once system is started, user may control the system from their smartphone using the specific instruction to android application bot.

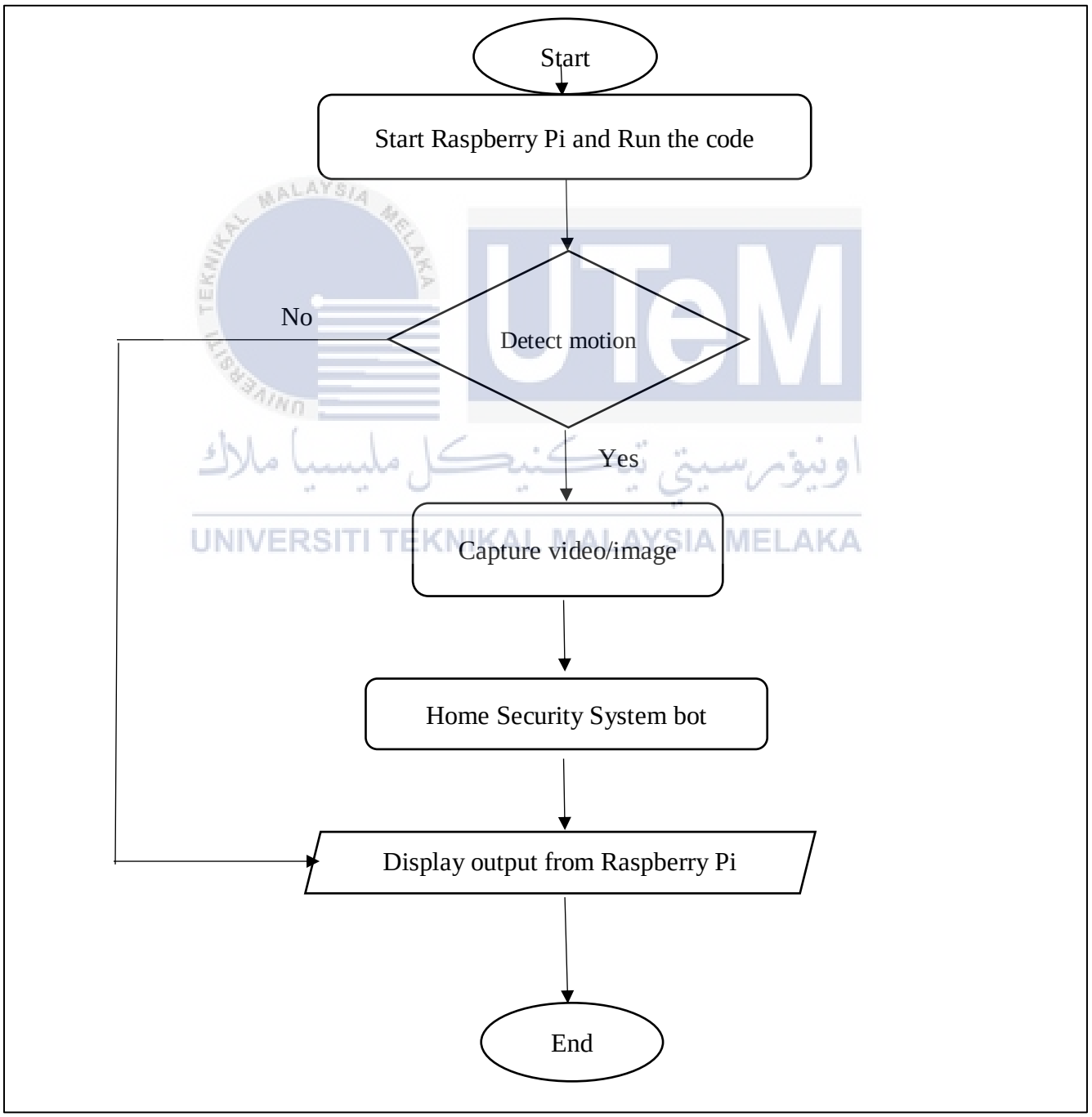


Figure 4-2 System Flowchart

4.3 Requirement Analysis

The Requirement Analysis is focused on the needs or condition of a new or updated product or project, the analysis, the documentation and the validation and management of software or system requirements, taking into account the possible competing requirements of diverse stakeholders. An analysis of requirements is crucial to a system and software project's success or failure. These requirements should be recorded, measured, tested, traceable and stated in detail enough for system design, according to identified business needs or opportunities. (Wikipedia, 2019).

4.3.1 Data Requirement

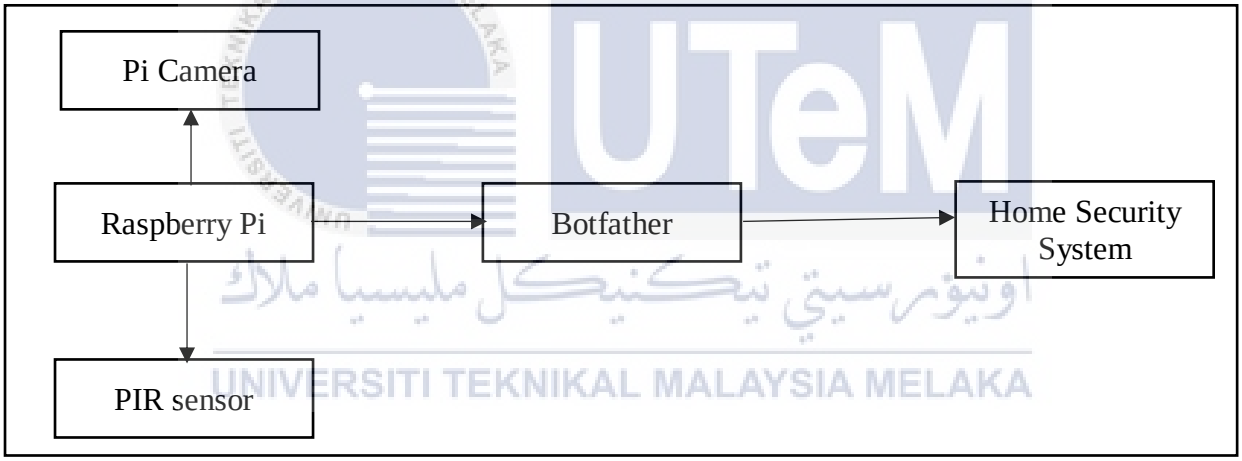


Figure 4-3 Data Model

The data flow of the Home Security Android Application Alert System is shown in Figure 4.3 above. The Raspberry Pi 3 Model B will be connected with PIR sensor and Pi camera in order for this system fully function to receiving input. All the code and instruction will be programmed in the Raspbian Operating System via Thonny Python and sent the input to the user via customized Telegram bot. The customized telegram bot will be created using Botfather. The customized Telegram bot will get instruction from user to start the system and if the motion detected, the sensor will sense it and pi camera will record or capture the video of what the reason the sensor is trigger. Finally, after sensor is trigger, the Raspberry Pi will send the video that have been capture to the user via Telegram bot.

4.3.2 Functional Requirement

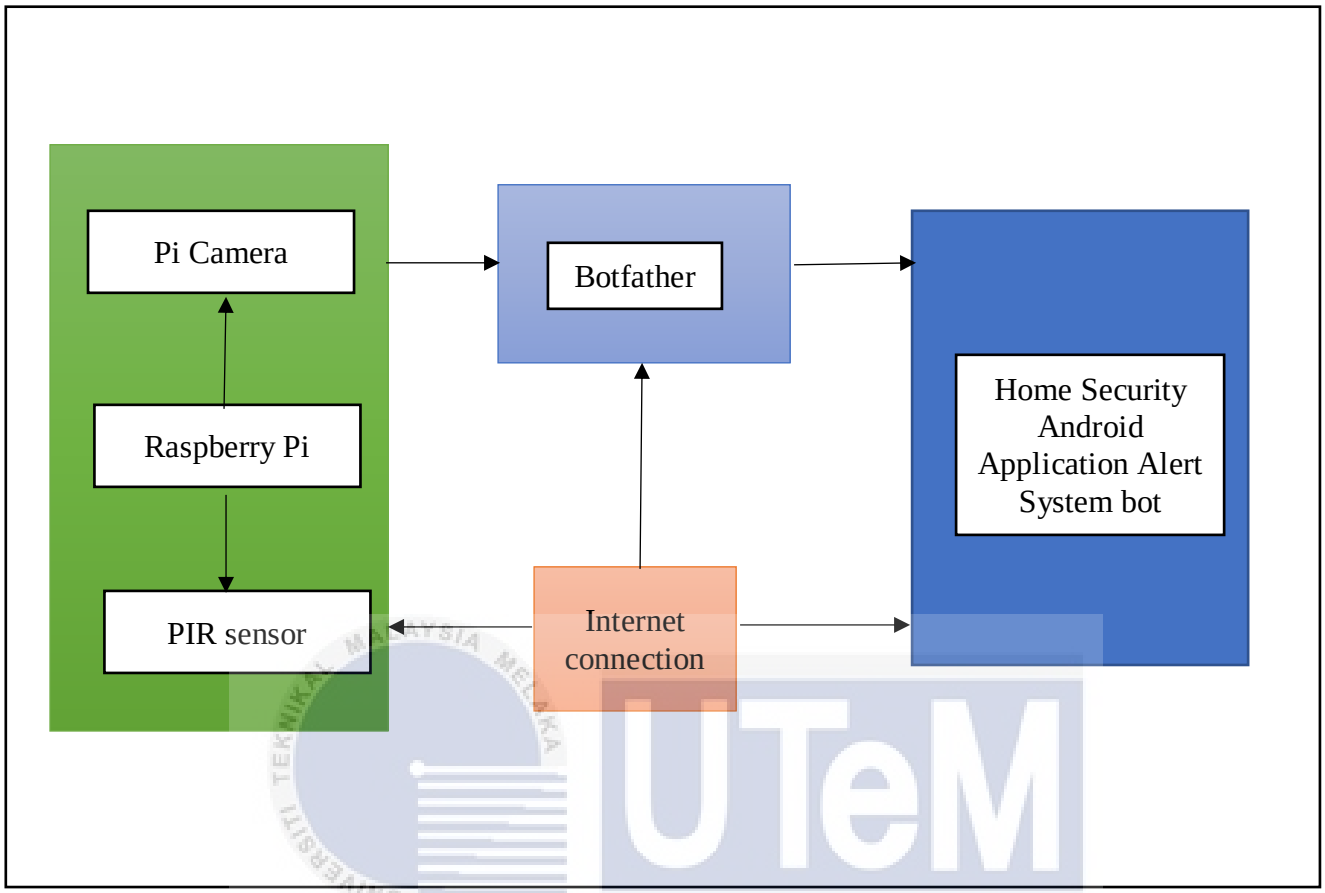


Figure 4-4 Functional Diagram

In this project, Raspberry Pi is a minicomputer that function to control all the function in the system. It will process all the input and output from user and the sensor.

2. **PIR Sensor**

   PIR Sensor is the main hardware in this project, use for detect any motion inside it sensor range. Widely used in security system, the input from PIR sensor will be sent to Raspberry Pi to be process.

3. **Pi Camera**

   Pi Camera will capture image or video based on the motion sensor and the command from the user.

4. **Raspberry Pi Alert System Telegram Bot**

Raspberry Pi Alert System is a platform to control the system via Telegram android application. The user of the Home Security System can control the system by inserting the specific command and instruction and the command that user inserting will be process by Raspberry Pi. This Raspberry Pi Alert System bot notified the user if the sensor detecting any motion or not and if motion detected, the Raspberry Pi will send the video or image to the user.

5. **Botfather**

Botfather is one bot to rule them all, Botfather is function to create new bot account and manage your existing bots. In this project, Botfather is used to create our own bot that acts as a platform to control the system.

4.3.3 Non-functional Requirement

Nonfunctional Requirements (NFRs) define system attributes such as security, reliability, performance, maintainability, scalability, and usability. They serve as constraints or restrictions on the design of the system across the different backlogs. Also known as system qualities, nonfunctional requirements are just as critical as functional Epics, Capabilities, Features, and Stories. They ensure the usability and effectiveness of the entire system. Failing to meet any one of them can result in systems that fail to satisfy internal business, user, or market needs.

In this project, the non-functional requirement is the internet connection for Raspberry Pi and the smartphone that contain the Telegram application have very stable and strong internet connection for the system to fully function. The internet connection also to make sure that Raspberry Pi can send alert notification to the Telegram bot after motion sensor detect any motion inside the sensor range.

Next, another non-functional requirement is the time for PIR sensor to detect the motion inside its sensor range. This is very crucial because PIR sensor need to very sensitive to whatever motion inside the PIR sensor range so that PIR sensor can sense the motion instantly. Last but not least, the Telegram application need to frequently

update from time to time to secure the application from any bug, so that the Telegram application computed smoothly without any error and problem.

4.3.4 Other Requirement

4.3.4.1 Hardware Requirements

1) Raspberry Pi 3 Model B

The Raspberry Pi 3 Model B is Raspberry Pi's third iteration. This powerful single board credit card computer is suitable for several applications. The original Raspberry Pi Model B+ and Raspberry Pi 2 Model B can be replaced. The Raspberry Pi 3 model B is more powerful, 10 times quicker than the Raspberry Pi of the original generation, when preserving the popular board format. It also offers wireless connectivity LAN & Bluetooth, making it the perfect alternative for powerful connecting designs.

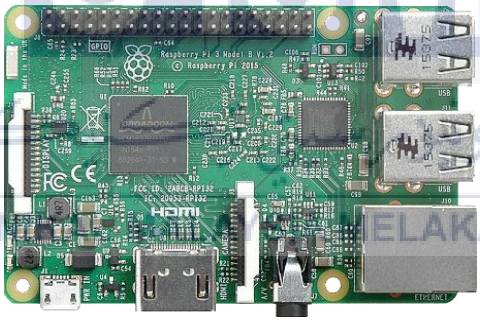


Figure 4-5 Raspberry Pi 3 Model B

2) PIR sensor

PIR sensors allow you to feel movement virtually always to detect if a human has moved within or outside the range of sensors. They are compact, cheap, low power, simple to use and user friendly.

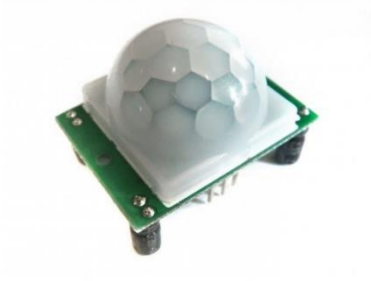


Figure 4-6 PIR sensor

3) Pi Camera

A portable lightweight camera with Raspberry Pi is the Pi camera module. The MIPI camera interface protocol talks with Pi. It is usually used for the processing of images, machine learning or monitoring projects.

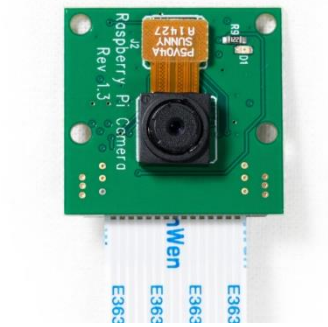


Figure 4-7 Pi Camera Module

4) SD card

Secure Digital is a proprietary non-volatile memory card format, which was created for use in portable devices by the SD Association (SDA). The use of SD card is to store Rasbian Operating System and will inserted into Raspberry Pi.

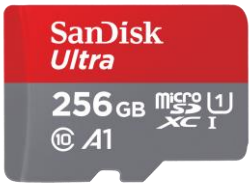


Figure 4-8 SD Card

5) Female Jumper Wired

Small wire wires are wire ducts that can be used on bread boards or elsewhere to link components to one another. This product can be connected easily without solding on both the female and the female heads with plastic heads.

Figure 4-9 Female to female jumper cable

6) Laptop

This project require a laptop minimal 4GB RAM to program the system and to write the project report. Moreover, this project also require the laptop able to run VNC client in order to connect to the Raspbian Operating System and to configure the Home Security Android Application Alert System source code.

Figure 4-10 Laptop Asus

7) Android Smartphone

Android Smartphone is required in this project because the user needed to use Telegram application to insert instruction and Raspberry Pi will be able to send alert notification to user in real time.

Figure 4-11 Xiaomi Mi A2

4.3.4.2 Software Requirements

I. VNC Viewer

The virtual network computer stands for VNC. It'd been developed to remotely operate another computer by creating a cross-platform screen sharing system. That means that a remote user using a secondary device can utilize a computer screen, keyboard and mouse remotely as if it were just outside. The remote user may not only view all of this on the distant pc, but also permits the mouse and the keyboard commands to function from afar on a remote computer so that the connected user has complete control.

Figure 4-12 VNC Viewer

II. Raspbian Operating System

Raspbian is a free, Raspberry Pi-optimized operating system based on Debian. An operating system is a bundle of basic programs and tools for running your Raspberry Pi. But Raspbian offers more than a clean OS: over 35,000 packages, pre-compiled software packaged in a pleasant way that allows quick installation on Raspberry Pi.

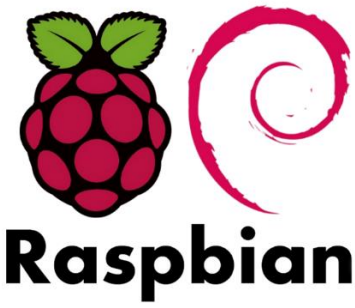


Figure 4-13 Raspbian Operating System

III. Thonny Python

Thonny is a Python built-in development environment for amateurs. It offers several ways to move through the code, evaluate step-by-step expression, visualize the call stack in detail, and use a mode to illustrate the reference and heap principles. In this project, all the code will be configure in Thonny Python frameworks.

Figure 4-14 Thonny Python

IV. Telegram

Telegram is a cloud-based, free, cross-platform instant messaging (IM) program. End-to-end encrypted video calls, VoIP, file sharing and a range of other features are also provided. It was published in August 2013 for iOS and October 2013 for Android.

Figure 4-15 Telegram icon

V. Botfather

Botfather is the one bot to rule them all. Use it to create new bot accounts and manage your existing bots. The Botfather is essential in this project system because the Botfather is the medium between Home Security system and Telegram application.

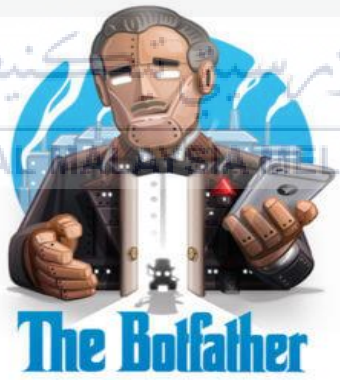


Figure 4-16 Botfather

4.4 High Level Design

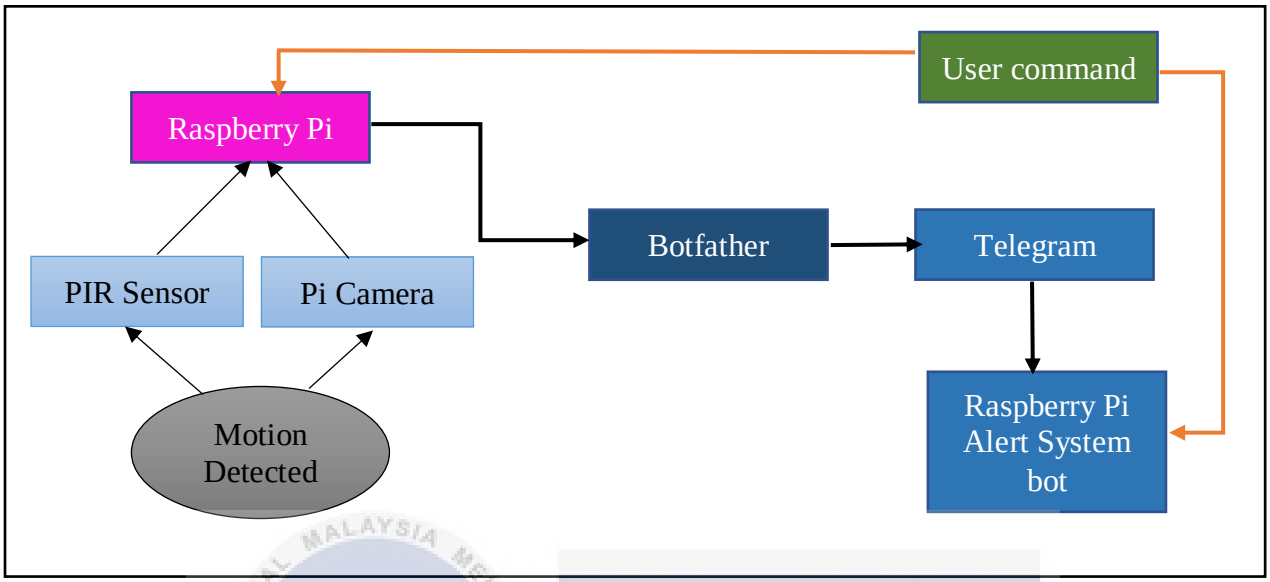


Figure 4-17 High-Level Design Diagram

The architecture used to build a system is specified in high-level design (HLD). The architectural diagram shows an extensive system, which indicates the main components generated for and the interactions of the product. The high-level design graph for this project is shown in Figure 4.16. The figure displays two ways. The first has a black arrow, whereas the other has an orange arrow.

4.4.1 System Architecture

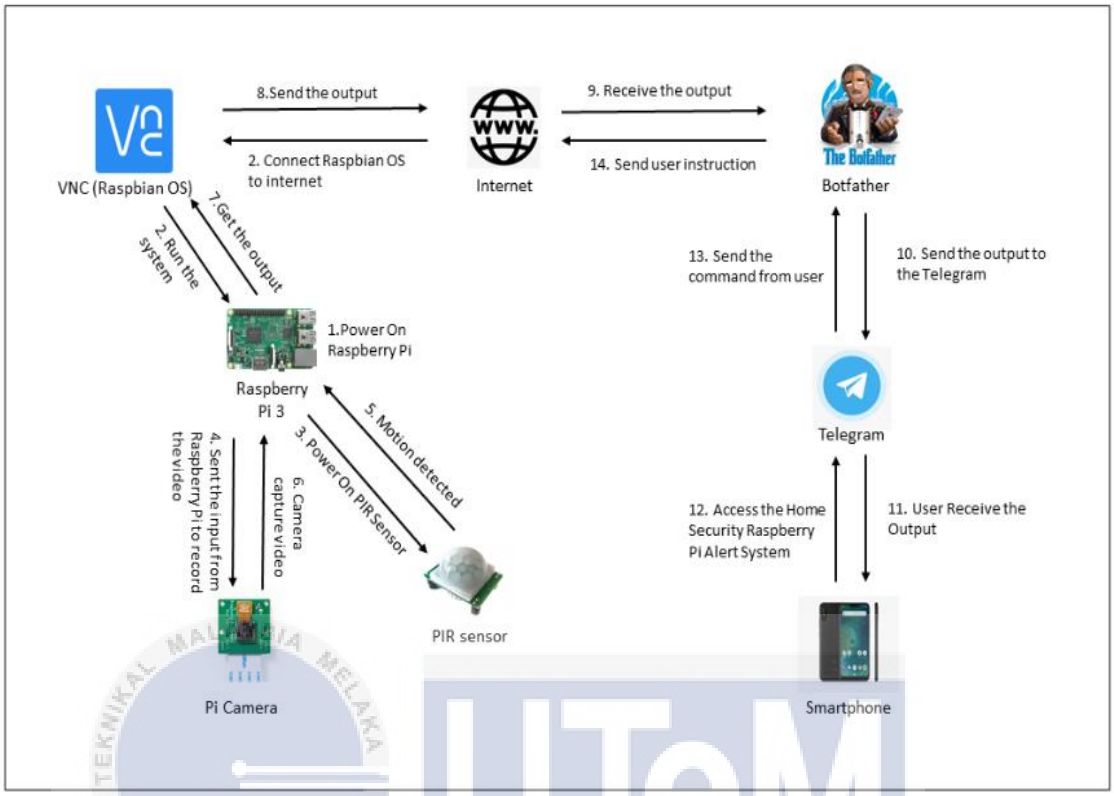


Figure 4-18 System Architecture

The system architecture for this project is displayed in Figure 4.17. The design is designed to understand how the system works. For building the Home Security system, a Raspbian operating system is employed. The Telegram application on the user's smartphone will be used as the system interface because the system is controlled by Telegram bot that developer of the system created.

4.4.2 User Interface Design

The Telegram application interface and the technology is used for this project. The Botfather is used in this project because Botfather can create and customize our very own bot that will act as the system interface and also where the user put the instruction command to control the system. This interface gives the user a basic idea of how the system works. The interface and the project flow design are shown in the figure below.

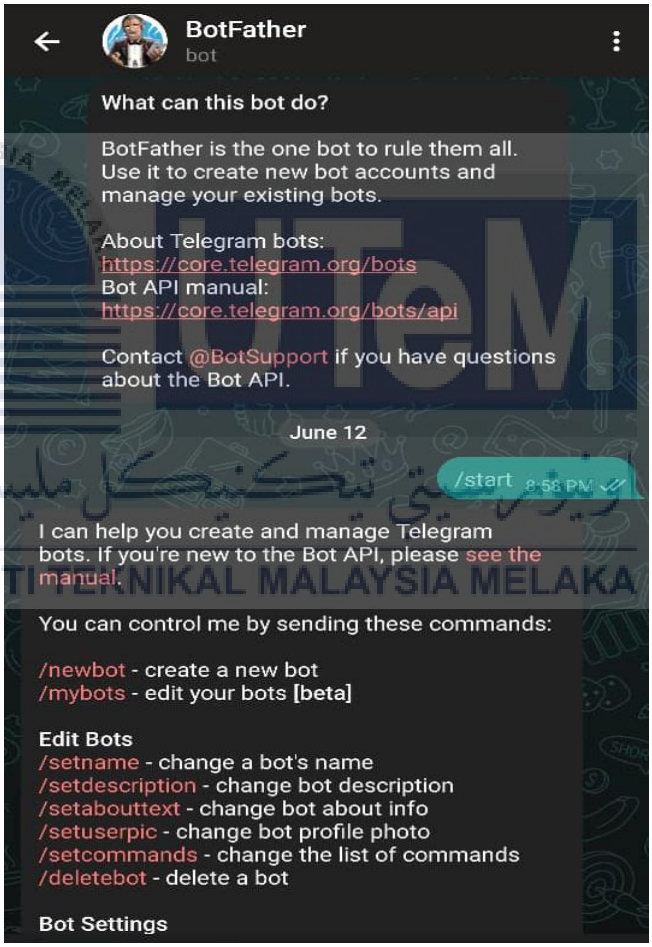
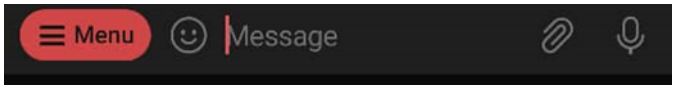
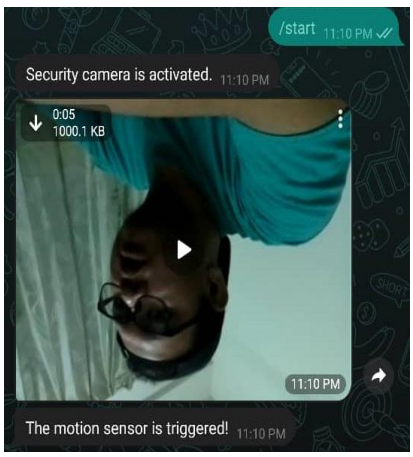
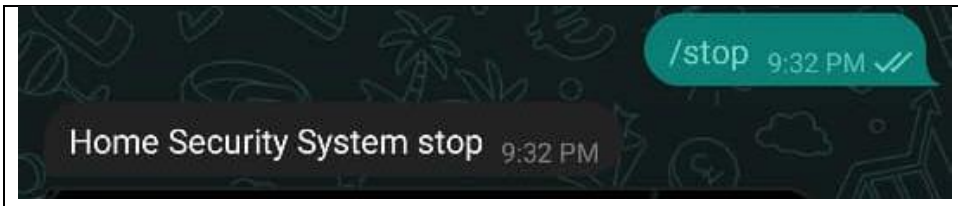


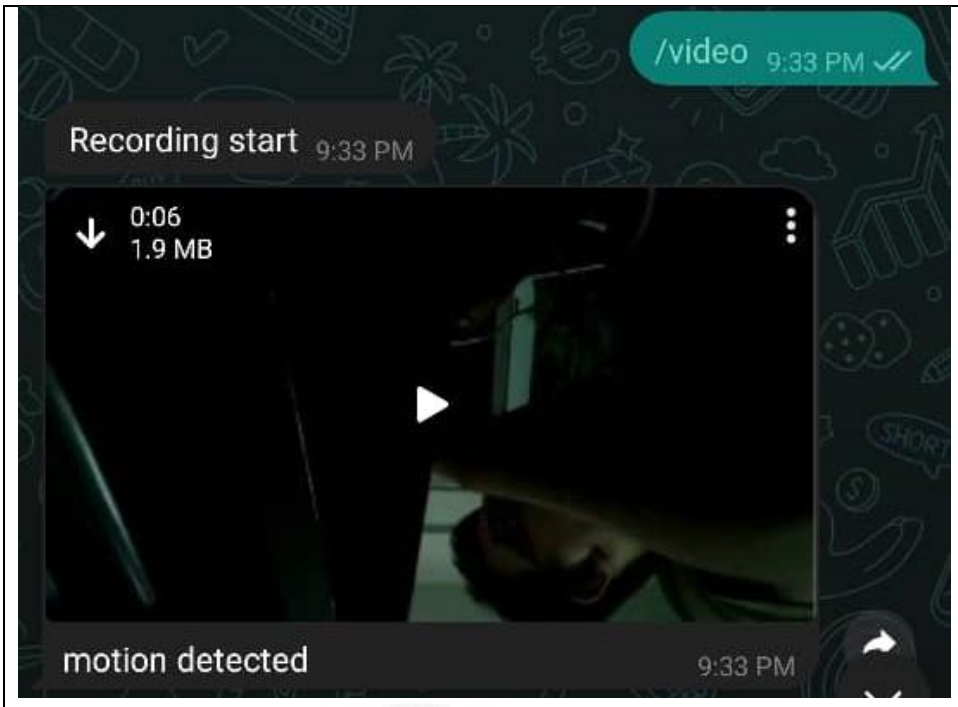
Figure 4-19 Botfather Interface

4.4.2.1 Function of the interface

Table 4-1 Interface Function Table

Table of Interface Function	
	This interface function for the user to put instruction to control the system. Example of commands: • /start : start the home monitoring system • /help : show help
	When user insert the /start command, the system will activate the Pi camera. In the PIR sensor detect any motion, the system will send a video to the user. It will take a few second depend on your internet connection.

	When user inserted the /stop command, the system will be stop immediately.
	When user inserted the /status commend, the system will be notify user if the Home Security System is running or not.
	When user inserted the /photo command, the system will be send to user the photo of the intruder that triggering the alarm. This /photo command is additional feature for the system because if user have a internet problem user can request the system to send the picture of intruder instead of video.

	When user inserted the command /video the system will be sent the intruder video that triggering the sensor.

4.5 Conclusion

Analysis and design are one of the most important parts of this project. In order to ensure the proper functioning of hardware and software, all criteria must be established and researched first. It is considered a pre-implementation step in this chapter and includes the entire system flux before it is implemented for better understanding. The following chapter is Implementation that examines the implementation of the project and its expected outcome.

CHAPTER 5: IMPLEMENTATION

5.1 Introduction

On this chapter we will focus on how software and hardware will incorporate the Home Security System, The monitoring process will ensure that the device is able to operate correctly according the project objective and to obtain feedback from the user. As a developer and the user we will review the system to determine the system performance by implementing the proper to the project system.

In this chapter also, it will show how the installation and execution of the system. The process of the system designing will explain more clearly such as on software and database server installation and execution phases.

5.2 Development Environment Setup

The hardware and software needs involve the creation of the device development environment for the Home Security Alert System. Each setup is presented step by step and explained fully. Chapter 4 provides more information and details on the hardware and software requirements.

5.2.1 Hardware Development Setup

The hardware used in this project is described in Chapter 4. Raspberry Pi 3 model B, which is a small computer that will controlled all the system function and is used for the Home Security Alert System. The Raspberry Pi 3 is equipped with a quad-core 64-bit Broadcom BCM2837 ARM Cortex-A53 SoC processor running at 1.2 GHz. The Raspberry Pi board can receive a hardware control order from the Raspbian OS software programmer. Data from the PIR sensor and the Pi camera will also be sent to the Raspberry Pi and Raspberry Pi will be sent the data to the Telegram. The following indicates the pins of knowledge which can be placed into the Raspberry Pi frame by the hardware.

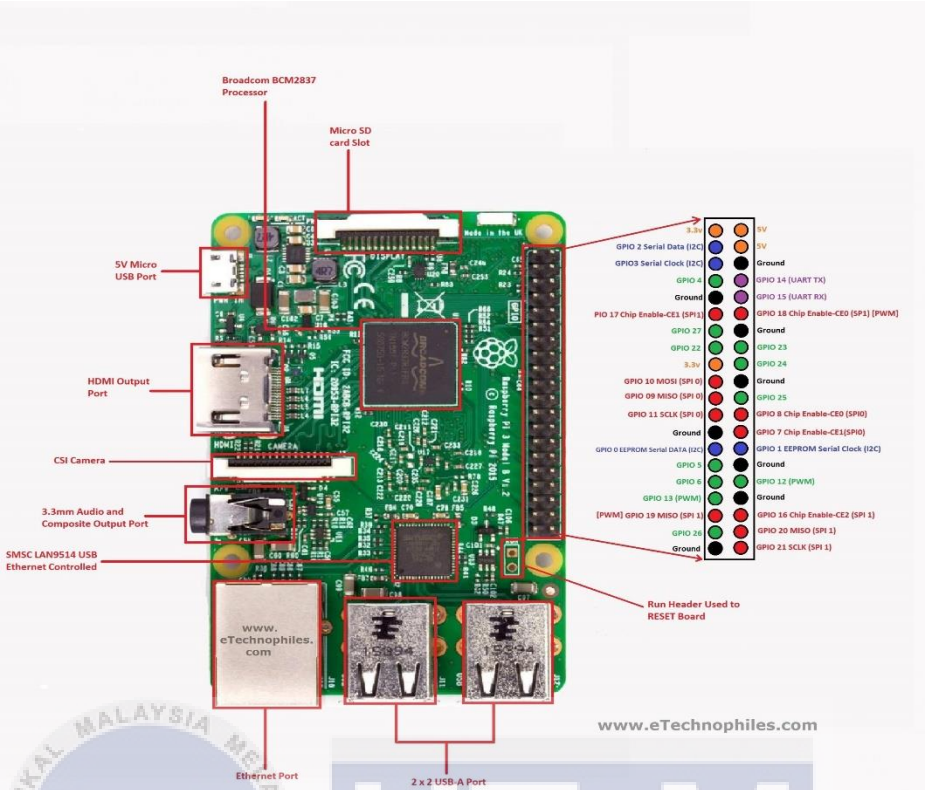


Figure 5-1 Raspberry Pi 3 Model B Specifications

5.2.2 Software Development Setup

In this part, the development of Home Security Notification Alert System will briefly explain about the software setup for the home security system device and android application.

5.2.3 Home Security Android Application Alert System

The coding shows how the Raspberry Pi receive data from the PIR sensor and PI camera. The Home Security System need stable and strong internet connection, run the code and it will collect, retrieve and ready to send alert notification to the user Telegram application.

```
"""
Home Security Android Application Alert System
"""
import time


from source.camera import Camera
from source.telegram import Telebot
from source.sensor import Motion
from setup import TOKEN_ID, REGISTRATION_FOLDER, VIDEO_TIME, CHAT_ID

camera = Camera(REGISTRATION_FOLDER)
bot = Telebot(TOKEN_ID, CHAT_ID)
pir = Motion()


@bot.handler("/start")
def on_start():
    bot.is_listen = True
    return bot.send_message("Home Security System started")


@bot.handler("/stop")
def on_stop():
    bot.is_listen = False
    return bot.send_message("Home Security System stop")
```

Figure 5-2 Coding for user command in telegram

5.2.4 Raspberry Pi and Telegram Communication code.

The code shows how the Telegram application linked with the Home Security System device.


```
"""
Code for connection between Raspbeery Pi and Telegram
"""

TOKEN_ID = '1801887840:AAF7i9qjyZHlg1Hufs7m2ZNoGfVPXe0ilmc'
CHAT_ID = '247888293'

VIDEO_TIME = 5 #only use 5 seconds video format if using mobile hotspot
REGISTRATION_FOLDER = 'tmp/video'
```

Figure 5-3 Home Security System and Telegram communication code

5.2.5 PIR sensor code for detecting movement

The shows below how the PIR sensor that connected to the Raspberry Pi run and function.

```
def main():

    global chat_id
    global motion
    global motionNew

    if GPIO.input(PIR) == 1:
        print("Motion detected")
        motion = 1
        if motionNew != motion:
            motionNew = motion
            sendNotification(motion)


    elif GPIO.input(PIR) == 0:
        print("No motion detected")
        motion = 0
        if motionNew != motion:
            motionNew = motion
```

Figure 5-4 PIR sensor functionality code

5.2.6 Home Security System video recording code.

The code shows below how the Home Security system acts after the PIR sensor detecting the motion and will trigger the PI camera to record a video. This code also will shows, what extension will the video use to save the video.


```
def start_recording(self, delay=60):
    video_h264 = os.path.join(self.registration_folder,
                              'vid-' + time.strftime("%H%M%S-%Y%m%d") + '.h264')
    video_mp4 = os.path.join(self.registration_folder,
                             'vid-' + time.strftime("%H%M%S-%Y%m%d") + '.mp4')
    self.camera.start_recording(video_h264)
    time.sleep(int(delay))
    self.camera.stop_recording()

    error = self.__convert_h264_to_mp4(video_h264, video_mp4)
    self.record = {
        "name": video_mp4,
        "return_code": error,
    }
    return self.record


def __convert_h264_to_mp4(h264, mp4):

    command = "MP4Box -add {} {}".format(h264, mp4)
    try:
        subprocess.check_output(command, stderr=subprocess.STDOUT, shell=True)
    except subprocess.CalledProcessError as err:
        error = 'FAIL:\ncmd:{}\noutput:{}'.format(err.cmd, err.output)
        return error
    else:
        return None
```

Figure 5-5 Home Security System Video Recording Code.

5.2.7 Home Security System capture photo code

The code shows below how the Home Security system acts after the PIR sensor detecting the motion and will trigger the PI camera to capture a video. But, we want Home Security system be so flexible to use, if user having a slow internet connection user can give command to the system to send the photo instead of video recording. This code also will shows, what extension the photo will use to save the photo.

```
def take_photo(self):
    photo = os.path.join(self.registration_folder, 'photo-' +
                         time.strftime("%H%M%S-%Y%m%d") + '.jpeg')
    self.camera.capture(photo)
    return photo

def __del__(self):
    self.camera.close()
```

Figure 5-6 Home Security System capture photo

5.3 Implementation Status

During implementation status, the component will describe about their functions and duration takes to complete the progress.

Table 5-1 Implementation Status

No.	Components	Description	Duration for completed
1.	Assembling Hardware	Process to connect the jumper wires, PIR sensors, PI a camera to the Raspberry Pi.	10 days
2.	Prototype	This process is to setup the idea of the system into a	15 days

		prototype to have a clear picture of the hardware and software on how it works in real environment.	
3.	Upload the code to the Raspberry Pi	This process is to ensure the hardware control.	10 days
4.	Develop System	Thonny Python in the Raspbian OS will ensure the function of this system.	30 days

5.4 Conclusion

In conclusion, the most challenging part was the hardware installation process and programmed configuration and development stages. This chapter is the most important for setup the system. It shows a clear picture of your project and vision of developing the project and to finish your project according project objective. The checking process allows the manufacturer to increases the reliability of the computer by reducing malfunction, and there is a system failure. From end user feedback, it also boosts the user experiences. After this chapter, the next step is the testing phases, in testing chapter the consumer can evaluate the step to check and verify the necessity, as well as to figure out the Home Security Notification Alert System fault and error. This stage will also include the study schedule, the design of the test, the outcome of the test and the interpretation of the test, and will be clarified on the next chapter.

CHAPTER 6: TESTING

6.1 Introduction

In this chapter, we will know the result of the implementation project whereby testing the completed project. This phase is taken to ensure that the Home Security Android Application Alert System works smoothly and achieve customer expectation and also the objective of the project system. The stimulation testing proved, by Raspberry Pi reads the connection between hardware devices such as PIR sensor, Pi Camera and Telegram Application. Testing phase also is a part of a broader process of software verification and validation.

6.2 Test Plan

Testing is meant to demonstrate that a program performs as intended and to identify software faults prior to use. We will test the system using the same software and hardware that was utilized during the implementation phase. Additionally, testing defines the scope, approach, resource allocation, and timetable for the anticipated test activities. The test run's outcome will be verified and corrected prior to handing over the system to the customer.

6.2.1 Test Organization

According to the software and hardware produced, they should perform as expected by the customer. As a result, this process should involve a group of individuals. This is to ensure that their job is separated into several areas such as software testing, hardware inspection, system analysis, and documentation. As a result, a project manager will be assigned to double-check the work flow and system. This will ensure that the system meets client expectations and is handed over on time.

6.2.1.1 System Developer

A system developer is someone who is primarily concerned with investigation and discovery. During the testing phase, system developers will primarily focus on the software component, determining whether the code and programming work as

specified by the customer. Additionally, the system developer will perform four levels of evaluation on the system, including unit testing, integration testing, system testing, and acceptance testing. Each testing level serves a distinct objective in order to make software testing systematic and easily identifiable.

6.2.1.2 End User

End users are those who interact with the system in its natural surroundings. Prior to transferring the system into the production environment, the end user must validate or accept the system. Here, we shall ascertain the extent to which the system satisfies the customer.

6.2.2 Test Environment

A testing environment is the process of configuring software and hardware for the testing team to use. On the other hand, it enables test execution with configured hardware, software, and network. During testing, the system will be connected to the laptop remotely using VNC server. During this process the Raspberry Pi and the laptop need a stable Internet connection to ensure the network connectivity between VNC server and Raspberry Pi is smooth and strong, so that the system will run according the plan without any error and lagging.

6.2.3 Test Schedule

At the outset of the project, the test schedule will include major milestones or jobs with a defined start and end date. Certain organizations will have agreements on their date schedules, requiring the system development team to execute the project on time to minimize miscommunication among stakeholders.

6.3 Test Result and Analysis

Once the system has been integrated entirely, the test cases and expected outcomes for the entire system will be recorded. The following table summarizes the results of each component's testing.

6.3.1 Hardware Test

Table 6-1 Raspberry Pi 3 Model B

Testing device	Raspberry Pi 3 Model B
Functionality testing	To test the Raspberry Pi functionality
Summary test case	To upload coding in Raspberry Pi
Executing steps	1. Run Thonny Python 2. Upload the code in Raspberry Pi
Expected result	The code is successfully uploaded
Error message	No error message
Result	Success

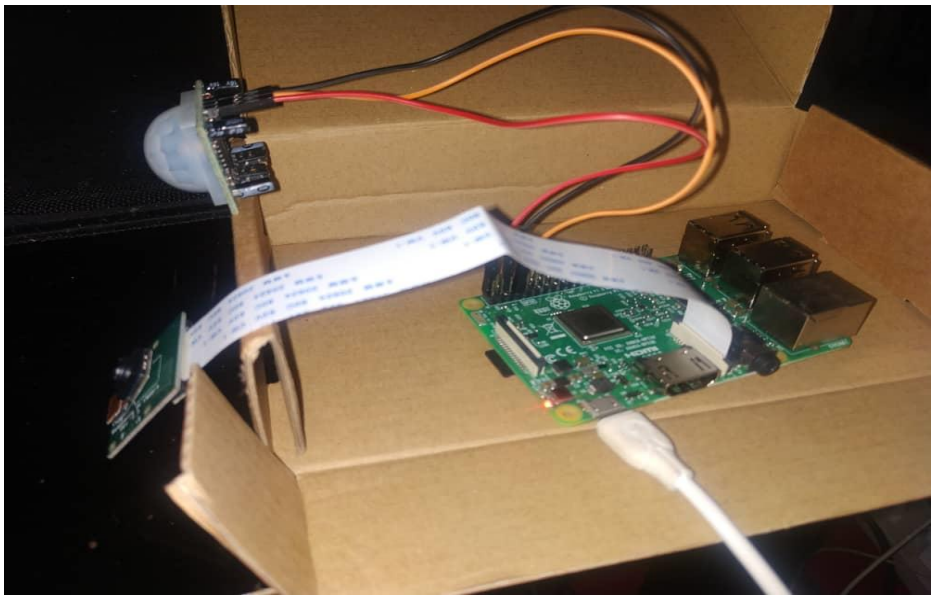


Figure 6-1 Successful wired Home Security devices

Table 6-2 PIR sensor Test

Testing device	PIR sensor
Functionality testing	To test the PIR sensor functionality and range
Summary test case	To detect the motion
Executing steps	1. Run Thonny Python 2. Upload the code in Raspberry Pi
Expected result	The PIR sensor can detect the motion and sent to the Raspberry Pi to capture the picture/video
Error message	No error message
Result	Success

Figure 6-2 Successful wired PIR sensor

Table 6-3 PI camera Test

Testing device	Pi Camera
Functionality testing	To test the Pi Camera functionality
Summary test case	To capture the motion
Executing steps	1. Run Thonny Python 2. Upload the code in Raspberry Pi
Expected result	The PI camera successfully capture/recorded the motion that trigger the sensor.
Error message	No error message
Result	Success

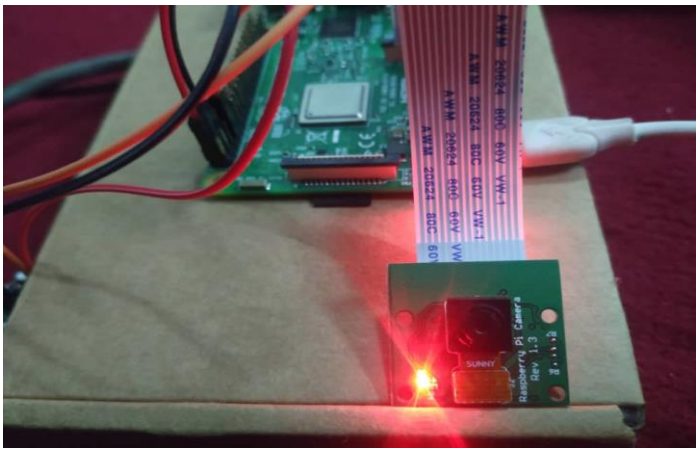


Figure 6-3 Successful function Pi Camera

Table 6-4 SD card test

Testing device	16GB SD card
Functionality testing	To test the SD card functionality
Summary test case	To upload Raspbian OS
Executing steps	1. Download Raspbian OS in Raspberry website 2. Insert into SD card and put into Raspberry Pi
Expected result	The Raspbian OS successfully install and running
Error message	No error message
Result	Success

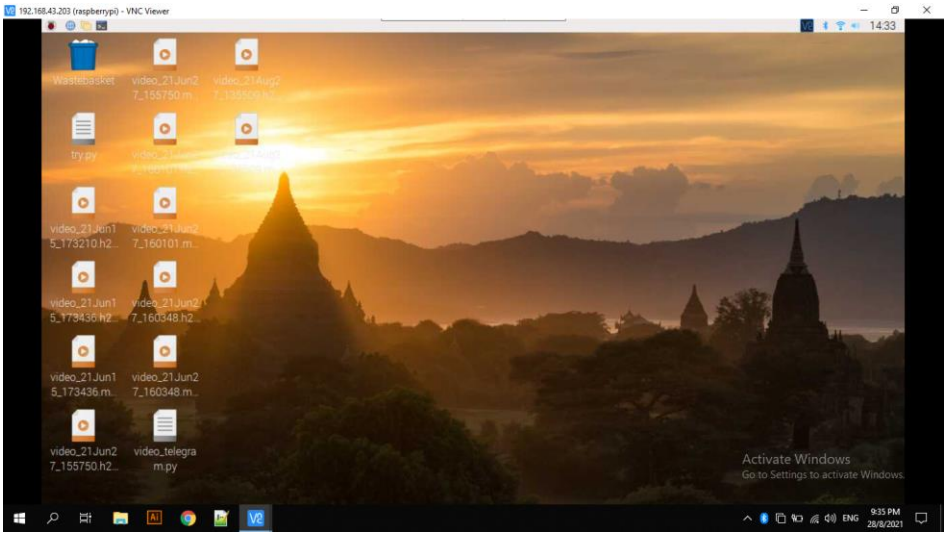


Figure 6-4 Successful running Raspbian OS

6.3.2 Software Test

Software test is to more focus on code part. Below show the coding between Raspberry Pi and Telegram application


```
"""
Home Security Android Application Alert System
"""
import time



from source.camera import Camera
from source.telegram import Telebot
```

```
from source.sensor import Motion

from setup import TOKEN_ID, REGISTRATION_FOLDER, VIDEO_TIME, CHAT_ID



camera = Camera(REGISTRATION_FOLDER)

bot = Telebot(TOKEN_ID, CHAT_ID)

pir = Motion()




@bot.handler("/start")

def on_start():

    bot.is_listen = True

    return bot.send_message("Home Security System started")


@bot.handler("/stop")

def on_stop():

    bot.is_listen = False

    return bot.send_message("Home Security System stop")




@bot.handler("/status")
```

```
def on_status():
    return bot.send_message("Home Security is now running") \
        if bot.is_listen else bot.send_message("Home Security doesn't run")



@bot.handler("/photo")
def on_photo():

    return bot.send_photo(camera.take_photo(), "photo")


@bot.handler("/video")
def on_video(*args):
    delay = args[0] if args else VIDEO_TIME
    bot.send_message("Video Recording start")
    return bot.send_video(camera.start_recording(delay), "video")


print('I am listening ...')
try:
    while True:
        if bot.is_listen and pir.movement_detected():
```

```
                bot.send_video(camera.start_recording(VIDEO_TIME), 'motion sensor have been trigger')

            else:

                time.sleep(1)

        except KeyboardInterrupt:

    del camera
```

Connection between Raspberry Pi and Telegram code

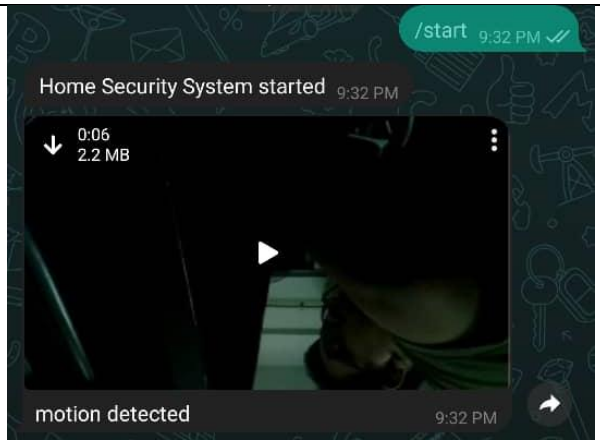
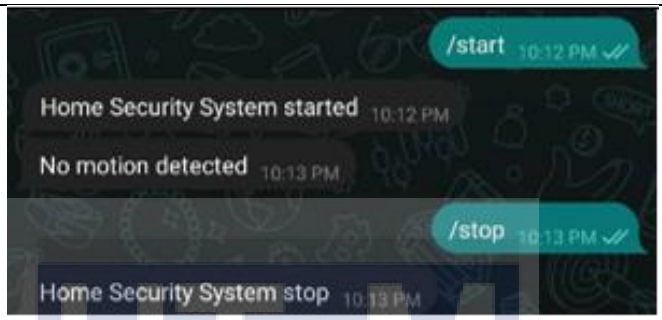
```
        TOKEN_ID = '1801887840:AAF7i9qjyZHlg1Hufs7m2ZNoGfVPXe0ilmc'

        CHAT_ID = '247888293'

        VIDEO_TIME = 5

REGISTRATION_FOLDER = 'tmp/video'
```


Figure 6-5 Raspberry Pi and Telegram code

6.3.3 PIR sensor testing

Table 6-5 PIR sensor testing table

PIR sensor testing	Output

Home Security output if PIR sensor detecting the motion	
Home Security output if PIR sensor no detect the motion in 15 second.	

6.4 Conclusion

To recap, testing can only reveal the presence of program flaws. Development testing entails a variety of levels of testing to ensure that the system meets all applicable client requirements and specifications. Additionally, with the testing organization's teamwork, the issue might be corrected on time. This testing should occur after the implementation phase to minimize misunderstandings among stakeholders. We should write automated tests whenever possible. The tests are included in a program that may be executed whenever a system is modified. Test first development is a methodology for developing software in which tests are written

before the code to be tested. Tests will be run on the refactored code until it executes successfully. Finally, all modifications must be well recorded.

CHAPTER 7: CONCLUSION

7.1 Introduction

This chapter is, in fact, the end section. This chapter is the final component of this project Home Security Android Application Alert System. This part can outline the general conclusion of the project, bringing to a closure all of the understanding that has been established, beginning with the matter's proclamation and ending with the accomplishment of the aim.

7.2 Project Summarization

Using a Raspberry Pi and a PIR sensor, to create a home security application alert system. This system works by sending an alert notification to the user via a simple Android application that is connected to the Home Security System if the PIR sensor detects any motion or movement while the user is away from home. The purpose of this project is to develop a low-cost security device that sent alert notification to the users if the sensor senses the motion and will capture video or image of the subject that cause the sensor trigger.

This home security device system involved hardware and software application to perform Raspberry Pi function of the system such as Thonny Python application. PI Camera, SD card and Telegram mobile application. This home security system devices is developed for private property, server rooms, home, office or place that user want to secure from the intruders.

7.3 Project Contribution

Home Security Android Application Alert System can be a greater contribution in private property security industry where in this project, the Home Security Android Alert System use high technology appliance at the lower cost in each of the Home Security devices. This system can be useful to secure any room from intruder and alert the user immediately if the system sensor trigger. The suitable location to place the Home Security System is place the user want to secure from intruder such as house, office, server room and many more. As advance enhancement, this system use Android phone application to control the Home Security system and the application come with many useful and simple features that user can understand immediately after they use

it. Furthermore, seems the system will be monitoring from user mobile phone, this will be great advantages to approach the users to use Home Security system because only with mobile phone they can secure their property. Finally, the system need a stable and strong internet connection, thus Internet will be a huge contributing to this system.

7.4 Project Limitation

In this situation, project constraint will be able to accommodate an unexpected cost increase at any stage. The scope of the project may be reduced while maintaining a high level of quality. If the scope of the project expands as a result of scope creep, we should have the time and resources necessary to complete the project with the promised quality. The changes will be reviewed and corrected prior to the system being delivered.

7.4.1 Internet Connection

The Home Security system must connected to a stable and strong network connection to ensure the video or picture can be sent immediately without delay after the sensor has been trigger and the home security system can received user instruction without any error from android application. The signal transfer, reception moment and speed are critical components in preventing the system's operation from being harmed.

7.4.2 Length of Female to Female Jumper Cable

While the female to female jumper cable is critical hardware in this system, the length of the female to female jumper also plays a part in achieving the optimal result. This is because a shorter jumper cable length results in a more sensitive PIR sensor. The reason for the increased sensitivity of the PIR sensor is that when the jumper connection is shortened, the 15 cm PIR sensor can sense the temperature coming from the Raspberry PI, resulting in the false alarm output.

7.5 Future Works

In future the system can be add some additional devices like fire sensor, smoke sensor and any other devices which suits the system to secure the user property voice the intruder and threat that can harm and destroyed the user property. Besides, the system use Telegram application to control and monitor the system, it be great and useful to create more feature for user to make the system feel more user friendly. For example, home security status message come in different colors so that user can differentiate the notification whether the system is on (green) or off (red). Finally, using a newest version of Raspberry Pi for Home Security system can be improved the home security system performance because it come with better ram and better processors.

7.6 Conclusion

In conclusion, the Home Security Android Application Alert System is mainly focus to help people to secure their property from threat and intruder. This system is fully focused on customer satisfaction and also occupied customer requirements. As it appears that this project already exists on the market, we added numerous features to the system in order to assist consumers and make their lives easier. This Home Security System is completely controllable via a mobile application on an Android device. Additionally, it will safeguard personal property, and if the sensor is triggered, the system will notify the user via the Telegram application.

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