SMART BABY MONITORING DEVICE

NUR SYAFIQAH BINTI SULAIMAN

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Taman Universiti, 81300 Skudai,
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(TANDATANGAN PENYELIA)

DR. NURUL AZMA BT. ZAKARIA
Nama Penyelia

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SMART BABY MONITORING DEVICE

NUR SYAFIQAH BINTI SULAIMAN

This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Networking)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2016

DECLARATION

I hereby declare that this project report entitled

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DEDICATION

I dedicate my thesis to my family, lecturers and friends who have always been the strength and support while completing the thesis. I dedicate this work and thank to my supervisor who always gave encouragement and guidance for the completion of this thesis. Finally, thanks to everyone who has always been at my side.

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ABSTRACT

Smart Baby Monitoring Device is a system that is compatible and widely used to monitor the condition of the baby at home from anywhere via a smartphones, tablets or computers from any places. This project uses a Raspberry Pi which is a multiprocessor that easy and portable to develop this project. The main objective of this project is to develop a product that has multiple functions and can be used to parents for monitoring a baby. Moreover, this Smart Baby Monitoring Device is affordable to own rather than to buy the product from a market. In addition, these products also have an availability that give an alert by sending a notification via email applications. All the data of baby will be stored in the memory of Raspberry Pi

ABSTRAK

"Smart Baby Monitoring Device" adalah satu sistem yang serasi dan digunakan secara meluas untuk memantau keadaan bayi di rumah dari mana-mana sahaja melalui telefon pintar, tablet atau komputer dari mana-mana tempat. Projek ini menggunakan *"Raspberry Pi"* yang merupakan "multiprocessor" yang mudah dan mudah alih untuk membangunkan projek ini. Objektif utama projek ini adalah untuk membangunkan satu produk yang mempunyai banyak fungsi dan boleh digunakan untuk ibu bapa untuk memantau bayi. Lebih-lebih lagi, *"Smart Baby Monitoring Device"* ini sangat berpatutan untuk dimiliki daripada membeli produk dari pasaran. Selain itu, produk ini juga mempunyai ketersediaan yang memberikan amaran dengan menghantar pemberitahuan melalui aplikasi e-mel. Semua data bayi akan disimpan dalam memori Raspberry Pi.

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LIST OF ABBREVIATIONS

I/O	- Input/Output
OS	- Operating System
NOOBS	- New Out Of Box Software
PIR	- Passive Infrared
NoIR	- No Infrared
MV	- Microwave
PNG	-Portable Network Graphic
JPG	-Joint Photographic Group
SCP	-Secure, Contain, Protect,
SSH	-Secure Shell

CHAPTER I

INTRODUCTION

1.1 Project Background

At this new era, technology is very important to make our daily life routine without fear and anxiety because parents nowadays are busy working and had to hire a maid to take care their baby at home. Although, the responsibility has been given to the maid but as parents, they must feel worry because they cannot monitor their baby at the home during work time. Therefore, with the Smart Baby Monitoring Device, all the parents does not need to worry about their baby's condition at home because they can monitor their child directly from a USB Webcam that connected to the Raspberry Pi which is through a live streaming and alert of notifications that can send to the parents via smartphones, tablets or computer.

In this project of Smart Baby Monitoring Device, it will use a Raspberry Pi which is a multiprocessor that easy and portable by plugs into any monitor. At all ages can learn and explore about computing using this device. Raspberry Pi is a single-board computer and are using at widely range of applications with processor, memory, input/output (I/O) ports and many more features.

The Raspberry Pi used is a model B and for the Operating System (OS) use a fresh install of New Out Of Box Software (NOOBS) Version 1.4.0. A USB webcam is placed in the Raspberry Pi to get a live video feed. The functionality of USB Webcam also

important, because parents can monitor their baby through a live streaming via their smartphones, tablets or computer from any places by using web browser. It communicates with the web server using sockets. To supports the Web Sockets will use a Tornado as the framework that it is written in Python. All from that Raspberry Pi that can be accessed privately or open via internet.

In this project, use a Passive Infrared (PIR) motion sensor. The PIR motion sensor detects of body heat which is infrared energy. When the sensor warm up, it can detect the surrounding area by heat and movement. The sensor is regarded as passive because it doesn't send out any signal in order to detect movement. It adjusts itself to the infrared signature of the room it's in and then watches for any changes. Like in this project it detect the motion of baby and captured the image that connected with Pi No Infrared (NoIR) Camera and sent it through the web-browser.

1.2 Problem Statement (PS)

Smart Baby Monitoring Device project is developing based on the research that a parents can monitor their baby from their workplaces through a smartphones or tablets by getting the notifications. This project is purposed to solve the following problem in Table 1.1:

Table 1.1: Summary of problem statement

PS	Problem Statement
PS1	Parents not aware the actual situation and condition of their baby in the house while they are not at home or in different room

1.3 Project Question (PQ)

Project Questions is identify from a Problem Statements. At every project questions is to identify each problem statements as described in Table ***1.2***:

Table 1.2: Summary of project question

PS	PQ	Project Question
PS1	PQ1	What is the condition of their baby in the home?
	PQ2	Can Raspberry pi baby monitor capable acts as the same baby monitor in the market?
	PQ3	Can Raspberry Pi baby monitor send a notification of their baby current situation to the parents?

1.4 Project Objective (PO)

The project objective that be analyses which are mark as below in Table ***1.3***. At the end of this project, the objective have to be achieved.

Table 1.3: Summary of project objective

PS	PQ	PO	Project Objective
PS1	PQ1	PO1	To develop a product which is function and usable to parents for baby monitoring system
	PQ2	PO2	To monitor a baby at home from anywhere
	PQ3	PO3	To send a notification of baby's condition to parents

PO1: To develop a product which is function and usable to parents for baby monitoring system

This analysis is to develop a baby monitoring system for a parents to monitor their baby condition with an audio and video stream that can access through the smartphones, tablets or desktop by using a web-browser.

PO2: To monitor a baby at home from anywhere

This analysis is widely compatible to monitor a baby at home while parents are at another places like at the work places.

PO3: To send a notifications of baby condition to parents

Parents can get an alert from a notification of their baby current situation by email.

1.5 Project Scope

The scope of this research for this project are focus on:

1. In this project, a baby monitor will use a Raspberry Pi microcomputer which is physically small and widely compatible.
2. For this project, the Raspberry Pi must be able to monitor a condition of baby with a video stream that can access from any device such as smartphones, tablets or desktop by using a web browser.
3. The PIR Motion sensor will detects the heat of energy.

1.6 Project Contribution (PC)

All parents have their responsible which is they cannot holds their baby all the time. So, the Smart Baby Monitoring Device will make it easy to monitor their baby's whether it is sleeping or crying or else. It will save the cost and to make a budget and affordable baby monitoring system that can save the costing by make an Do-It-Yourself baby monitor using a Raspberry Pi rather than to buy a product from a market.

The Smart Baby Monitoring Device is to monitor the baby sleep in the nursery room while their parents is at the other room like in the kitchen or in the dining room or at the workplace. The sensor detects of baby movement and it notify a parents by send an alert via email. It show a baby condition using a camera and USB webcam that make parents easy to monitor their baby. The Smart Baby Monitoring Device is widely compatible and can be accessed both on the tablet, smartphone or computer using a web-browser by watching a live streaming. The Smart Baby Monitoring Device can runs a web server on the Raspberry Pi. It will using a Raspberry Pi, an USB webcam and some Python. At the end of the project, this products will help parents to monitor their baby from anywhere. Table ***1.4*** below are the summary of project contribution:

Table 1.4: Summary of project contribution

PS	PQ	PO	PC	Project Contribution
PS1	PQ1	PO1	PC1	Understand functional and usable to parents for baby monitoring system
	PQ2	PO2	PC2	Monitor baby through live streaming view
	PQ3	PO3	PC3	Notify parents by email when sensor detect movement of baby

1.7 Thesis Organization

Chapter I: Introduction

In the introduction part it explained about the project background which is the project description that needed, problem statement discuss about what is the problem to produce that product, the scopes of the project and the expected result of the project. Each part in the chapter is explained briefly to make sure the project can be easily understood.

Chapter II: Literature Review

A literature review is a research project or previous paper project that point of the critical review of a current knowledge or issues in a several cases or topic. Hence, this chapter will describe about the research that had been analyzed especially about the main components that are used in this project which is a camera and the Raspberry Pi.

Chapter III: Project Methodology

This chapter discuss about project methodology which described each of the selected methodology which describe the activities that involve every stage.

Chapter IV: Analysis and Design

This chapter explained about the problem analysis for the project. All the problem statement that has been stated in chapter 1 will be discussed in detail. For the requirement analysis, it consists of two main requirement which is software and hardware requirement. The design of project and the overall project planning also will be included in this chapter.

Chapter V: Implementation

For this chapter, it will be explained about the implementation for the project. This project is will be done using Raspberry Pi microcomputer and the Pi NoIR Camera Board. Implementation phase consists of step configuration of the camera to the Raspberry Pi. Moreover, the project development environment also will be discussed in this chapter.

Chapter VI: Testing

In this chapter, it discuss about the test plan for the project. There are several test plan will be done consists of the test organization, test environment, test schedule and test strategy. For this project, the testing phase are used to test whether the Raspberry Pi can send an image and video streaming to the user through the web browser.

Chapter VII: Conclusion

In this final chapter, it will discuss the overall of the project. The summarization of the weakness and strength of the project, a contribution of the project, limitation during to complete the project and the future work that can implement in the future.

1.8 Conclusion

This chapter define in precise details of the project background, scope of the project and problem statement, this will ensure all the issue regarding the obstacle for developing the project and are being documented. This analysis and research identified the baby monitor using a raspberry pi. For the next chapter, the part that explain the literature review in details.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter discuss about a literature review of related published sources on this project. Towards a literature review it explain the details regarding the previous research and project that has been done, the critical review or justification for new improvement Raspberry Pi project and the proposed solution to the problem in previous project based on the referenced paper. This chapter also elaborate how the new improvement of the baby monitor using a Raspberry Pi and over the previous baby monitor.

2.2 Related Work or Previous Work

2.2.1 Raspberry Pi

The Raspberry Pi is multiprocessor that easy and portable by plugs into any monitor or TV. At all ages can learn and explore about computing using this device. It works as the same functionality of desktop such as can browse internet, play a video, word-processing, and play a games.

Raspberry Pi 2 which is the second generation has an upgraded Broadcom BCM2836 processor, which is a powerful ARM Cortex-A7 based quad-core processor that runs at 900MHz. The memory capacity of the board also increase to 1Gbyte. Figure 2.1 below are the details specification of Raspberry Pi 2 and Figure 2.2 is Model B.

Specifications	
Chip	Broadcom BCM2836 SoC
Core architecture	Quad-core ARM Cortex-A7
CPU	900 MHz
GPU	Dual Core VideoCore IV® Multimedia Co-Processor Provides Open GL ES 2.0, hardware-accelerated OpenVG, and 1080p30 H.264 high-profile decode Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure
Memory	1GB LPDDR2
Operating System	Boots from Micro SD card, running a version of the Linux operating system
Dimensions	85 x 56 x 17mm
Power	Micro USB socket 5V, 2A
Connectors:	
Ethernet	10/100 BaseT Ethernet socket
Video Output	HDMI (rev 1.3 & 1.4)
Audio Output	3.5mm jack, HDMI
USB	4 x USB 2.0 Connector
GPIO Connector	40-pin 2.54 mm (100 mil) expansion header: 2x20 strip Providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines
Camera Connector	15-pin MIPI Camera Serial Interface (CSI-2)
JTAG	Not populated
Display Connector	Display Serial Interface (DSI) 15 way flat flex cable connector with two data lanes and a clock lane
Memory Card Slot	Micro SDIO

Figure 2.1: Specifications of Raspberry Pi

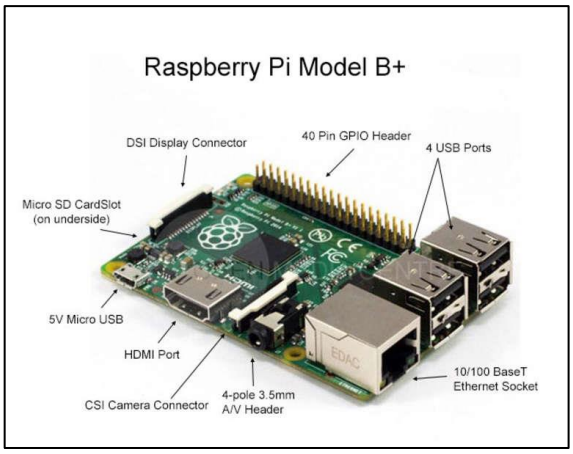

Figure 2.2: Model of Raspberry Pi 2

2.2.2 Baby Monitoring System

The Baby Monitoring System is a great baby monitor that can help a parents to make sure their baby is in a good condition. Parents nowadays are busy working and had to hire a maid to take care their baby at home. Although, the responsibility has been given to the maid but as parents, they must feel cautious and anxiety because they cannot monitor their baby at the home during work time. Therefore, with the Smart Baby Monitor Device, all the parents does not need to worry about their baby's condition at home because they can monitor their child through a live streaming and alert of notifications that can send to the parents via smartphones, tablets or computer.

Figure 2.3: Baby Monitoring System

The current of baby monitor on the market now, have a two main types. First type, which is both includes a baby camera and parent device that are linked together and only work with each other. Second is a Wi-Fi internet based cameras that can via with a smartphone or tablet. Figure 2.4 below are the top ranked baby monitor in the market with different functionalities:

Top Ranked Video Monitors — Displaying 1 - 5 of 14 — << Previous | View All | Next >>

Our Ranking	#1	#2	#3	#4	#5
Product Name	Nest Cam Read the Review	Withings Smart Baby Read the Review	Lorex Sweet Peep Read the Review	Samsung SafeVIEW Read the Review	Philips Avent Digital Video Baby Monitor Read the Review
Editors' Awards	Top Pick		Best Value		
Price	$200 List $199 from Amazon	$250 List	$120 List $195 from Amazon	$210 List	$220 List $130 from Amazon
Overall Score	87	72	61	61	61
Editors' Rating	★★★★★	★★★☆☆	★★★★☆	★★★☆☆	★★★☆☆
Pros	Allows you to monitor your baby from almost anywhere with your smartphone or tablet, long battery life, great video and sound	Great when it works, has option for wired connection for low-EMF monitoring, allows use of iOS devices to monitor anywhere	Good sound, long battery life, nice features	Large parent screen, easy to use	Good sound, easy to use, long battery
Cons	WiFi monitors are more complex to set up, requiring fast high speed Internet connections and strong WiFi signals	No Android support, reliability issues common with disconnecting signal	Disappointing video and range, manual camera adjustment	Poor video, short battery life, short range	Disappointing video, few features

Figure 2.4: Product of Baby Monitor in a market

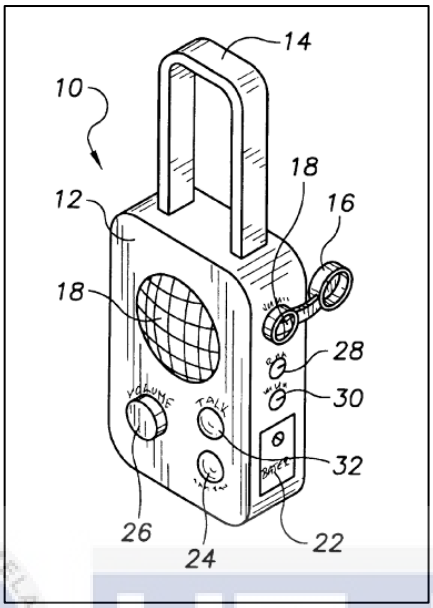

Figure 2.5: Baby Monitor System (Koczo 1997)

The Figure 2.5 above shows from the previous project of baby monitoring system, in this product using two-way communication which is a baby unit and parent unit. In the parent unit, it can store a message from parent with a waterproof switch at the parent device. After the data or message is store in a parent unit, it will digitalized the information and send to the baby unit. The output of the sound will execute on the speaker of baby unit. This project depends on the microphone only which can just hear the sound of baby and this product does not have a video and image capability. However, the project is lack of portability which is lack of storage the data or message in the cloud.

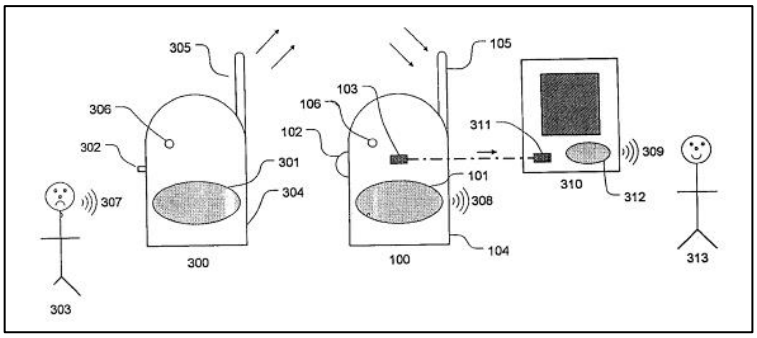

Figure 2.6: Component of Baby Monitor System (Doyle et al. 2012)

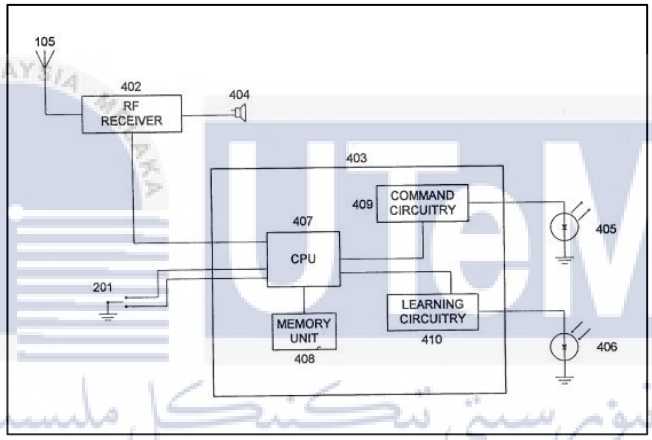

Figure 2.7: Pattern of Baby Monitor System (Doyle et al. 2012)

Based on the above, Figure ***2.7*** is a pattern or block diagram of a baby monitor device. In this project, when the output sound level of receiver reaches at reference level it link into a receiver of the baby monitor circuitry that can remotely control an electronic device. The aim of every project and this project is always want the product user friendly in term of use the product. In this project is a traditional product that have to build another device that can monitor the baby condition, it may cost the user to buy another product to monitor the baby. This project can be used by all kind of people and does not need an expertise to build this product. However, low cost also aim of this project, to develop a baby monitor system that cost lower than existing product of baby monitor system in the market.

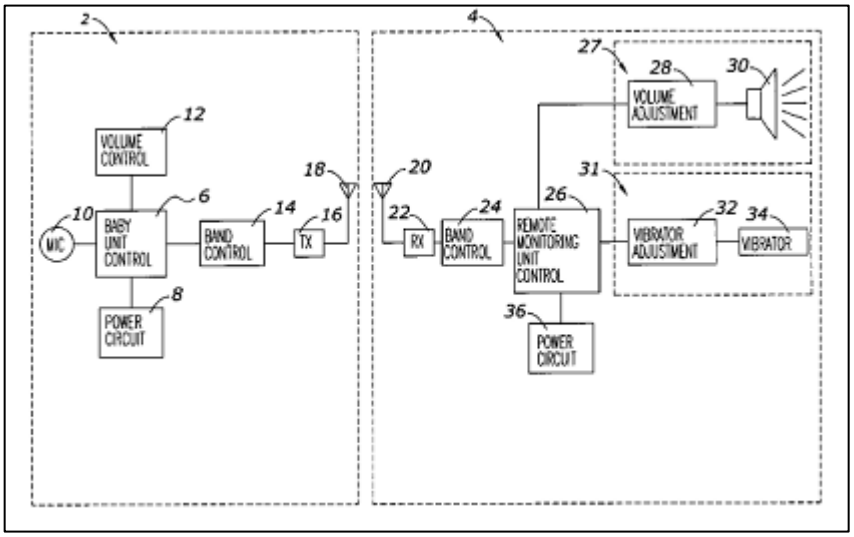

Figure 2.8: Transmitter unit in the baby monitoring system (Garza 1975)

Based on Figure 2.8, from the previous research project there is a lack of the functionality. It focus on the audio and vibration alert only which is the parents only can adjust the high and low of volume sound which is the loudest of baby cries will give the vibration. From that situation, parents only can hear the sounds of baby cries through a vibration alert, the lack of functionality here is which is does not help a parents a lot to monitoring their babies because there is not enough output or data of the baby. With a new baby monitor that power with the camera and the sensor, it's totally helps parents to monitor their baby condition after received an alert, they can checked the baby condition through a live streaming.

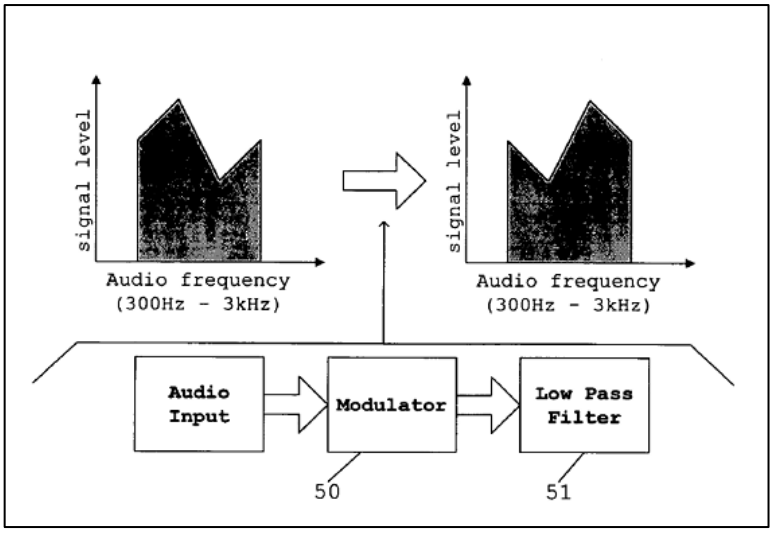

Figure 2.9: Illustration system of scrambling an audio signal (Cited et al. 2007)

Based on the previous project it focused on the pattern of the sound baby which is, it will detect the privacy code that has been register and the digital code will store in the microcontroller memory. After that, it will transmitted and detect the code of their baby sound, and if the codes is matched the registered code, the parent unit unmutes the speaker function and plays the baby sounds over the speaker. It will remain muted on the parent unit because the privacy code not matched the registered code. From Figure ***2.9***, on the right graph is the scrambler signal that lies on the same of audio frequency spectrum as the original signal on left graph and it will reflect the original signal in a graph of signal amplitude versus frequency. To reveal the original signal and make the sounds clear, have to unscramble signal back and it will reflected again. Hence, by using the modulator an a low pass filter is to get the audio signal amplitude within its frequency spectrum. If two signals are multiplied the result will sum at difference signals. As we know, when the baby is grown up, their voice or sound pattern may be changed from time to time, with this method the ability to detect a cry or sound pattern of the baby might be wrong unless the parent have to register or update and setup back the sound pattern continuously.

2.2.3 Motion Sensor

A motion sensor or motion detector are the main device that use several of technologies to notice the movement in an area, sensing a baby movement in a nursery room. If a sensor is trigger, it will send the video or image, which connects to a parents monitoring center.

Motion sensor have two main types that is a passive and active sensors. Each types of sensors use a different technology to detect motion in the assigned area. A passive sensors doesn't transmit an energy, yet it read changes of energy in the surrounding zone. In the meantime, an active sensors transmit one of three sorts of energy to recognize movement in the surrounding zone, for example, infrared light, microwave radiation, or sound waves. Below is a descriptions of different kinds of motion sensors:

2.2.3.1 PIR Motion Sensor

The PIR Motion sensor detects of body heat which is infrared energy. When the sensor warm up, it can detect the surrounding area by heat and movement. The sensor is regarded as passive because it doesn't send out any signal in order to detect movement. It adjusts itself to the infrared signature of the room it's in and then watches for any changes.

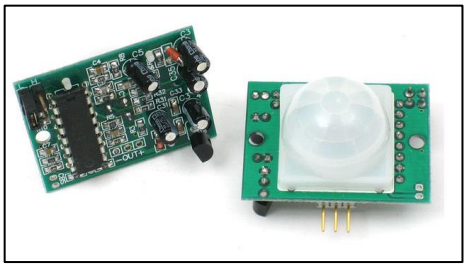

Figure 2.10: PIR Motion Sensor

2.2.3.2 Microwave (MW)

Microwave sensors send out microwave pulses and it measures the reflection off a moving item. It cover a larger area than infrared sensors, but they vulnerable to electrical interference and are more costly.

Figure 2.11: Microwave sensor (MW)

2.2.3.3 Dual Technology Motion Sensor

Motions sensors can have combined features in an attempt to reduce false alarms. For example, a PIR motion sensor could be combined with microwave sensor (MV). Since each operates in a different areas of the spectrum, and one is passive and one is active, Dual Technology motion sensors are not likely as other types to cause false alarms, because in order for the alarm to be triggered, both sensors have to be tripped. However, this does not mean that they never cause false alarms.

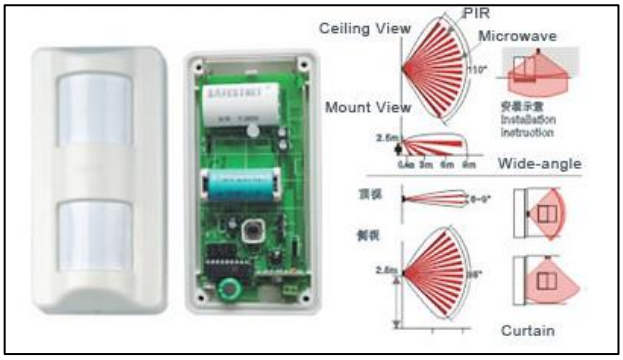

Figure 2.12: Dual Technology Motion Sensors

Every motion sensor has their ability and characteristic to detect the motion. In this project will use a PIR Motion Sensor which is suitable for baby monitor because it can placed in the small room which is nursery room. The motion sensor will detects the movements and heat energy of the baby.

2.2.3.4 Criteria for Evaluation

The important for evaluation of baby monitor system is to provide more functionality and a new features that benefits to parents and a baby. With this device will assurance parents to monitor their baby from another room or at any places, it is very important that the products work well, offer good images, and are user friendly. The parents might be frustrated of limitations on the device if the user interface is hard to navigate and does not have a two way communication.

2.3 Critical Review of current problem and justification

Based on previous research and finding of reference paper that had been discusses, the future prospect for the project is to develop a low cost of baby monitoring, low power consumption needed and able to send an alert by sending notify. A Baby Monitor System using a Raspberry Pi aim to recreate a product with a low cost and user friendly on the lack of the previous project. The proposed project also can be used on multiple different devices and cross-platform compatibility. Table 2.1 below is the summary of the previous project.

Table 2.1: Summary of Research Project

No	Author and Year	Purpose	Description	Problem
1.	Koczo 1997	This product using two-way communication which is a baby unit and parent unit. In the parent unit, it can store a message from parent with a waterproof switch at the parent device	The data or message is store in a parent unit, it will digitalized the information and send to the baby unit. The output of the sound will execute on the speaker of baby unit. This project depends on the microphone only which can just hear the sound of baby and this product does not have a video and image capability.	Lack of storage the data or message in the cloud, also does not have a video and image capability

2.	Doyle et al. 2012	The output sound level of receiver reaches at reference level it link into a receiver of the baby monitor circuitry that can remotely control an electronic device.	Incorporated into a receiver of the baby monitor circuitry that can remotely control an electric or electronic device.	A traditional product that have to build another device that can monitor the baby condition, it may cost the user to buy the another product to monitor the baby
3.	Garza 1975	This invention relates to providing additional functions to a remote baby monitor including vibration adjustment.	Includes a non-audio alert such as vibrator. In one embodiment the invention includes an intensity adjustment or a sensitivity adjustment	Lack of the functionality. It focus on the audio and vibration alert.
4.	Cited et al. 2007	It detect the privacy code that has been register and the digital code will store in the microcontroller memory.	it will transmitted and detect the code of their baby sound, and if the codes is matched the registered code, the parent unit unmutes the speaker function and plays the	The sound pattern of the baby might be wrong unless the parent have to register or update and setup back the

			baby sounds over the speaker. It will remain muted on the parent unit because the privacy code not matched the registered code.	sound pattern continuously
5.	Chicago et al. 2012	The invention relates to a baby monitor system in which different faceplates can be interchangeably connected to a baby monitor transmitter unit or to a baby monitor receiver unit.	Has a transmitter unit that has a first receiver to receive baby sounds, a transmitter to transmit a signal to the baby sounds, and a transmitter housing to house the first receiver and the transmitter.	This product does not have any storage data either in their local storage or cloud storage
6.	Cited et al. 2003	A video screen is provided on the viewing surface of the first section. The first section can be moved from the closed position to the open position such that the video screen faces upward for viewing.	A video baby monitor system has a child unit and a receiver unit. The receiver unit has a housing assembly with a first section having a viewing surface and a second section. The first and second sections are movable relative to one another between an open position	To build this product need an expertise and this product just store the data in a local storage.

			exposing the viewing surface and a closed position where the second section covers the viewing surface.	
7.	Civanlar et al. 2009	The monitor system is configured to switch from the primary power to the back-up power and to deactivate at least one video function upon detecting a loss of the primary power.	A video baby monitor system has a child unit with a back-up battery, a video camera, a microphone, and a transmitter to transmit video signals representing video images sent from camera and audio signals representing sounds sent from the microphone. The child unit is configured to operate on primary power from an external power source and to operate on back-up power from the back-up battery source.	This product only have a storage data in their local storage, so it's difficult to analyze the baby wake time for future reference because the generate data may help parents to monitor their baby.
8.	Lengsfeld & Shoureshi 2008	This baby monitor provides monitoring of a baby's activities and vital signs	Environmental conditions such as ambient temperature can also be monitored. One embodiment of	This project requires a expertise and the cost of

		from a remote location, possibly anywhere in the world. A sensor unit placed near the baby receives input from the baby, typically sound, image and vital signs such as heartbeat, respiration and temperature.	the invention is worn on, or close to, a baby's chest while sleeping and monitors heartbeats and generates an alarm if the heart rate drops unexpectedly, indicating distress such as lack of oxygen. The invention can also be used for parental reassurance by indicating the baby's heartbeat through a pulsating LED or audible sound	equipment is high

2.4 Proposed Solution or Further Project

2.4.1 Smart Baby Monitoring Device using Raspberry Pi

A Smart Baby Monitoring Device is a product that can make parents life easier by monitoring their baby. Although, there are many baby monitor system product in the market but it can work similar by using Raspberry Pi. The ability of the product is depends on the size of the room of nursery and the type of motion sensor that suitable used is PIR Motion sensor to connect with Raspberry Pi and also a camera that provides a quality images and video. The aim of this project is want the product user friendly in term of easy to use the product, the equipment with a minimum cost and alert by sending a notifications. In this project does not need an expertise to build in and it can be used by all kind of parents to monitor baby. Figure 2.13 below is the components and equipment of Smart Baby Monitoring Device by using Raspberry Pi:

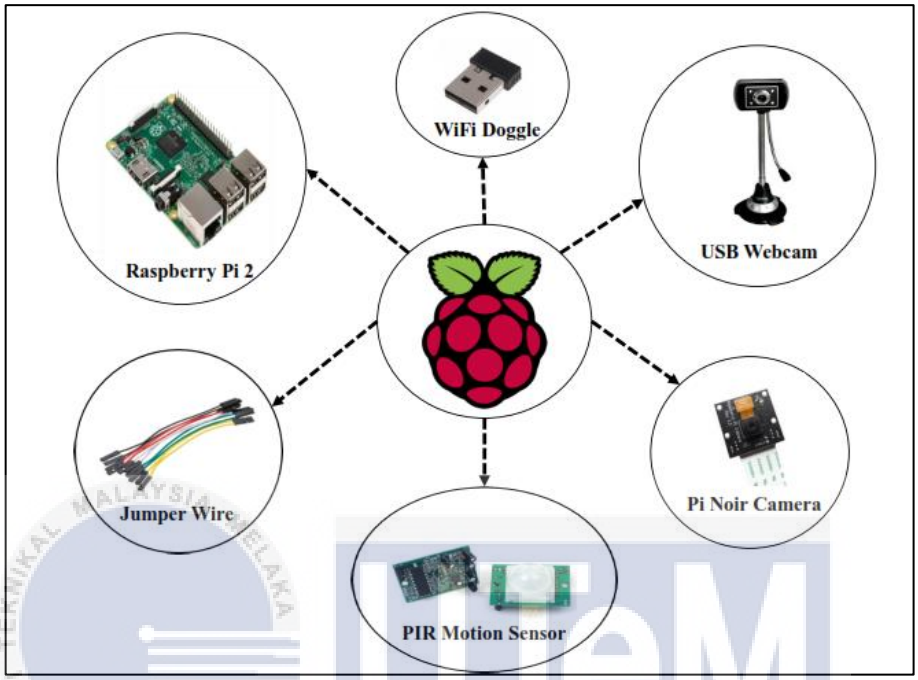

Figure 2.13: Components of Smart Baby Monitoring Device using Raspberry Pi

2.5 Conclusion

The conclusion of this Literature Review chapter is Smart Baby Monitoring Device using Raspberry Pi are designed for parents to monitor their baby and will improve from the previous project. On addition, this chapter discuss more about the component and equipment that been used and needed of differences and similarities between previous work and future project. For the next chapter, is the Project Methodology, the activities are focus on planning and executing project methodologies and conducting project milestones.

CHAPTER III

PROJECT METHODOLOGY

3.1 Introduction

This chapter discuss and explain the details of project methodologies that used in the project to develop the Smart Baby Monitoring Device using Raspberry Pi. The project methodology section is very important part because method that used contain activities for each stages and flow work of this project to make sure the project running well-managed and consistent. Methodology is the semantic, and theoretical analysis of the method that applied to a field of study. The set out of this methodology does not to provide solutions but it offers the theoretical underpinning for understanding which method, set of methods, or can be called as a best practices to be apply in order to get a specific result.

3.2 Methodology

In this project the methodologies that used is “Waterfall Model”. Activities need to be done in that stage before proceed to the next stage. Hence, using Waterfall Model which progress is seen as flowing steadily downwards (like a waterfall) through the phases of Planning, Requirement, Design, Implementation, Testing, Maintenance and Documentation. The waterfall development model originates in the manufacturing and construction industries, highly structured physical environments in which after-the-fact changes are prohibitively costly, if not impossible. Since no formal software development methodologies existed at the time, this hardware-oriented model was simply adapted for software development.

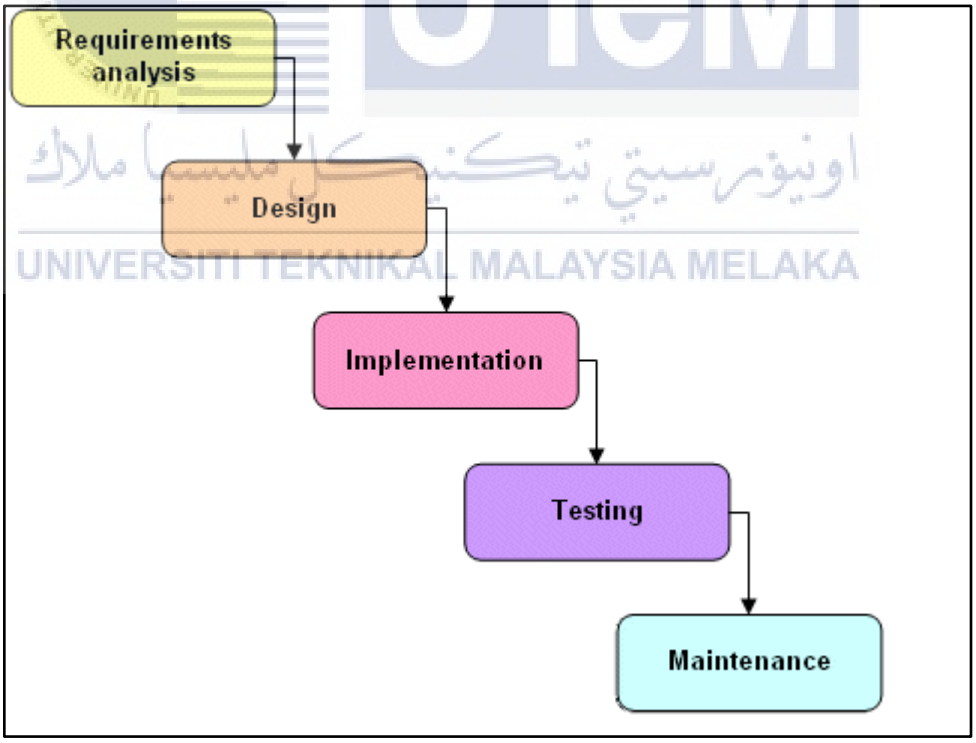

Figure 3.1: Activities all stages of the project

Phase 1: Planning

For the planning phase, the activity that need to carry out is to identify and also plan what are the tools that need to make the project. This is to make sure the entire requirement and equipment needed is complete. In order to develop the system all the requirement need to be list in term of hardware and software. Moreover, in this phase also have to study and research then gather all the information of Raspberry Pi, Pi Noir Camera and PIR Motion Sensor to understand clearly. Hence, in this phase, the development stage will be planned to make sure everything is well planned before starting the system.

Phase 2: Requirements Analysis

In this phase, the hardware and software in this project are going to analyze to make sure it is suitable to use and fulfill the requirement of the project. The information about pros and cons of Raspberry Pi, Pi NoIR Camera and PIR motion sensor are obtained. Moreover, the research of previous work and related work have to be done in this phase to overcome the weakness of the project. Also at this phase everything that has been planned are obtained so that it can be proceed to the next phase.

Phase 3: Design

This phase will describe how this project is developed. In this project the design that involve in a baby monitoring system that using a Raspberry Pi is a PIR Motion sensor and Pi Noir Camera that connected to the Raspberry Pi. Make sure that the design is approve and well design before proceed to the next phase.

Phase 4: Implementation

In Implementation phase that are development or build the product or system. In this phase, the Raspberry Pi and all the equipment and components are already installed and develop. All has been set up based on the design that has been planned. First, the raspberry pi must configured. At these part the configuration has been carried out to make

the Raspberry Pi act as a Smart Baby Monitoring Device. It monitor the baby and send the notification to the parents. Be sure that the implementation is on the right time based on the milestone so that the time will not exceed.

Phase 5: Testing

In testing phase, the early the system based on monitor a baby through web-browser using Raspberry Pi, Pi Noir Camera and PIR Motion Sensor will test whether the system can use or not without any problem.

Phase 6: Maintenance

Maintenance phase is to ensure that the system is always working to test whether the system can use or not without any problem. Also to make sure that the It is all need to be check from time to time so that there will be no error or malfunction to this system.

Phase 7: Documentation

All step involved in this project will be record in this phase. It will be documented in the report. With that everything will be documented and easy to refer. Also to keep track of what have been done and what not.

3.3 Milestone

Table 3.1: Milestone of Project

Week	Activity
1 22-26 Feb	Proposal PSM : Submission & Presentation
	Proposal assessment and verification
2 29 Feb -4 Mar	Proposal Correction/Improvement Chapter 1
3 7-11 Mar	Chapter 1 (System Development Begins)
4 14-18 Mar	Chapter 1 & Chapter 2
5 21 - 25 Mar	Chapter 2
6 28 Mar -1 April	Chapter 2 Chapter 3
7 4-8 April	Project Demo & Chapter 3 Chapter 4

8	**MID SEMESTER BREAK**
9 18-22 April	Project Demo & Chapter 4
10 25 - 29 April	Project Demo & Chapter 4
11 2 - 6 May	Project Demo
12 9 – 13 May	Project Demo & PSM Report
13 16 - 20 May	Project Demo & PSM Report Presentation Schedule
14 23 - 27 May	Project Demo & PSM Report
15 30 May -3 June	**FINAL PRESENTATION (PA)**

3.4 Gantt Chart

Gantt Chart is designed in this project to represent the activities against time in each stages. It is contains the beginning of the project is started until the end of the project time. Purpose on designing the Gantt Chart is to ensure the development of this project is running as listed in plan. The process need to be done by phases and need to finish one phase before proceed to the next phases and follow the time in the milestones.

Table 3.2: Gantt Chart of Project

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Identify Problem and Define Objective															
Study And Research															
Design The Project															
Develop The Project															
Testing															
Maintenance The Project															
Document All The Project															

3.5 Conclusion

In a conclusion, from project methodology all the phase is well planned and organizes based on the time that has been given. The milestones also help to guide for estimate time and plan to complete the task on the time. In this project, methodology that has been choose is the waterfall model and has be done with the project milestone. For next chapter, it discuss about the analysis and design of the system where the problem analysis and the specific design system are state.

CHAPTER IV

ANALYSIS AND DESIGN

4.1 Introduction

This chapter explain and discuss the requirement analysis and design of the Baby Monitoring System because it is an important phase to complete this project. In this project, all the requirements of hardware and software must be meet the requirement that need to ensure all that kind of things can work properly and smoothly during this project. The system architecture and detailed design about this project also will be included in this chapter.

4.2 Problem Analysis

All parents have their responsible which is cannot holds their baby all the time. So, the Smart Baby Monitoring Device make it easy to monitor their baby's whether it is sleeping or crying or else. Smart Baby Monitoring Device is the only way to monitor the baby condition in the nursery room while their parents is at the other room like in the kitchen or in the dining room or at the workplace.

4.2.1 Current Baby Monitoring System

Figure 4.1: Current Baby Monitoring System

Figure 4.1 shows a current baby monitoring system that have many features and ability with a good functionality but in this case it need an expertise to build in with a special needs of requirements. The special need is costly and expensive.

4.2.2 New of Smart Baby Monitoring Device

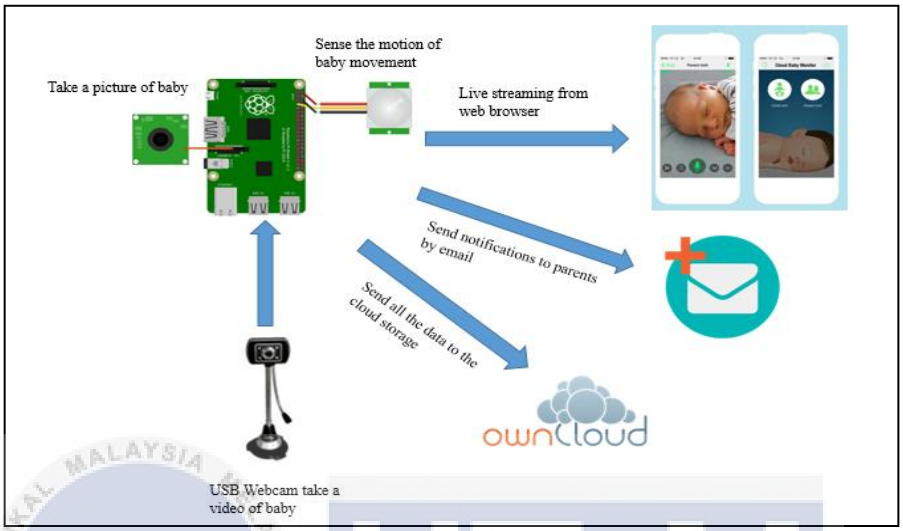

Figure 4.2: New Baby Monitoring Device

Figure ***4.2*** shows the new implement of baby monitoring device which is from the camera with a sensor and Raspberry Pi will take a picture and video of baby movement by sending the data information to the cloud storage and it will notify the parents by sending an email. All the data will be sent and store to the cloud storage. The aim of this new design of baby monitoring system is always a user friendly in term of using this product which is can notify the parents by email. Although, this project can be used by all the kind of people and does not need an expertise to build it. Moreover, it also a very low cost of product than an existing by using a Raspberry Pi.

4.3 Requirement Analysis

4.3.1 Data Requirement

The input of this product is the webcam that can view a live streaming from web-browser and Pi NoIR camera can capture the movement of baby. The data from webcam and Pi NoIR camera are sent to the cloud that has been configured in the Raspberry Pi and save as Portable Network Graphics (PNG) or Joint Photographic Group (JPG). The output of the system is the sending a notification to the parents that can detected the movements of the baby by sending a picture.

4.3.2 Functional Requirement

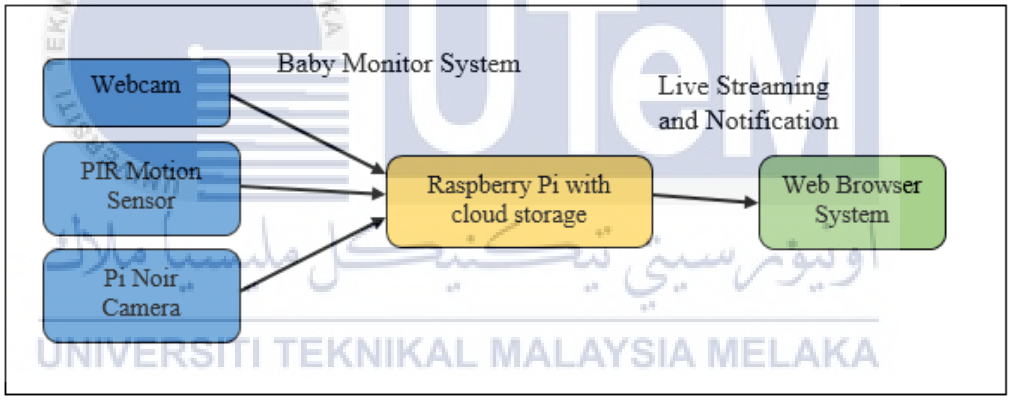

Figure 4.3: Context Diagram

In this project, the Webcam, PIR Motion sensor and Pi NoIR Camera are used to monitor a baby condition in the nursery room. This sensor will detect movement of the baby and it will sent the picture by a notifications on the web browser. A parent can monitor their baby through live streaming using a webcam by open a web browser. The Raspberry Pi is responsible to analyze the data in order to send the notification to the parents by web browser and it widely compatible and can be accessed both on the tablet, smartphone or computer.

4.3.3 Non-Functional Requirement

The output on the web cam will show in a web browser with display size about 640 X 480. The Pi noir camera has a native solution of 5 megapixel and it fixed focus lens onboard. It also have an infrared lighting in a night vision. The sensitivity range of PIR motion detector is up to 20 feet about 6 meters and 110 X 70 degree of detection range.

4.3.4 Other Requirement

Based on the system development life cycle is to make sure the entire requirement and equipment needed is complete. In order to develop the system all the requirement need to be list in term of hardware and software.

4.3.4.1 Software Requirement

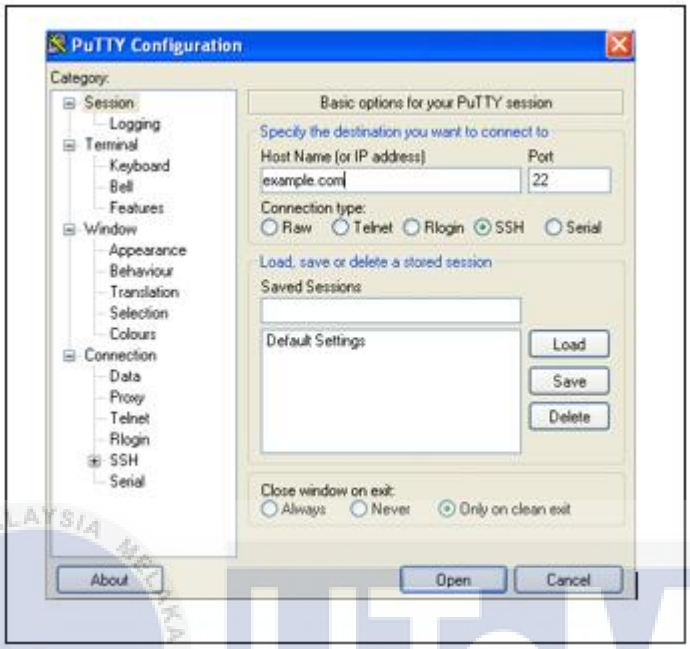

Figure 4.4: PuTTY software on Windows side

i. PuTTY

PuTTY is a free and open source terminal emulator, serial console and network file transfer application. PuTTY is a tool for remote access to another computer. It's probably used more often by people who want secure remote shell access to a UNIX or Linux system than for any other purpose, though that is only one of its many uses. It supports several network protocols, including Secure, Contain, Protect (SCP), Secure Shell (SSH), Telnet, rlogin, and raw socket connection. It can also connect to a serial port. By using this software, we can connect with Raspberry Pi using SSH without use external monitor. PuTTY is more than just an SSH client. In addition to the five protocols supported by PuTTY, it also supports features such as saved session configurations, session logging, language settings, and proxy sessions.

Figure 4.5: Python Language

ii. Python Programming Language

Python is a programming language that is easy and simple to learn syntax and also reduces the cost of maintenance. It's an interpreter, object-oriented and a high-level programming language that use in a Raspberry Pi. Python also supports modules and packages that encourages program modularity and code reuse.

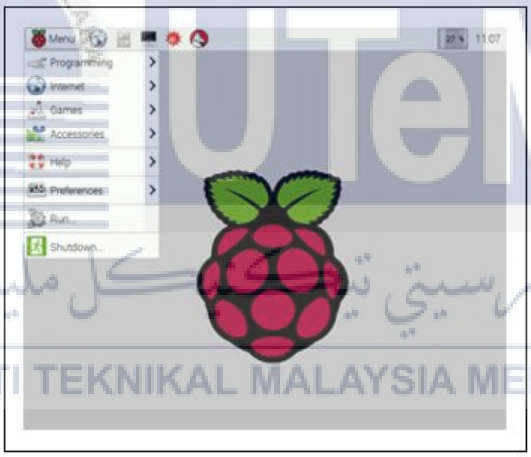

Figure 4.6: Noobs Operating System Desktop

iii. NOOBS (Raspberry Pi Operating System)

NOOBS is an easy operating system install manager for the Raspberry Pi. It also does not need network access and won't need to download any special imaging software. The installation is easy by using a SD Card to Raspberry Pi and the operating system will install and ready to use.

4.3.4.2 Hardware Requirement

Figure 4.7: Raspberry Pi 2

i. Raspberry Pi 2

The Raspberry Pi 2 has a quad-core processor that runs at 900MHz, compared to a single-core CPU that ran at 700MHz in the first generation. It's also an ARMv7 processor rather than an ARMv6 processor, which limited the software available on the original hardware. Raspbian, a version of Debian compiled for the original Pi's processor, will make another appearance on Raspberry Pi 2, but the ARMv7 processor should also allow volunteers to bring Ubuntu and other Operating System to the hardware. It have 1GB of RAM, double the previous version. Here is the full list of specs for Raspberry Pi 2 Model B:

- SoC: Broadcom BCM2836 (CPU, GPU, DSP, SDRAM)
- CPU: 900 MHz quad-core ARM Cortex A7 (ARMv7 instruction set)
- GPU: Broadcom VideoCore IV @ 250 MHz

- More GPU info: OpenGL ES 2.0 (24 GFLOPS); 1080p30 MPEG-2 and VC-1 decoder (with license); 1080p30 h.264/MPEG-4 AVC high-profile decoder and encoder
- Memory: 1 GB (shared with GPU)
- USB ports: 4
- Video input: 15-pin MIPI camera interface (CSI) connector
- Video outputs: HDMI, composite video (PAL and NTSC) via 3.5 mm jack
- Audio input: I²S
- Audio outputs: Analog via 3.5 mm jack; digital via HDMI and I²S
- Storage: MicroSD
- Network: 10/100Mbps Ethernet
- Peripherals: 17 GPIO plus specific functions, and HAT ID bus
- Power rating: 800 mA (4.0 W)
- Power source: 5 V via MicroUSB or GPIO header
- Size: 85.60mm × 56.5mm
- Weight: 45g (1.6 oz)

Figure 4.8: Monitor

ii. Monitor

Monitor is a hardware component that display a graphic information that connect through a cable using a HDMI and VGA converter from the Raspberry Pi board.

Figure 4.9: Realtek Mini Wifi module

iii. Realtek Mini Wifi module 802.11n

Wifi dongle is a wireless network interface controller that used to connect the Raspberry Pi to get an internet. Just a simple way to use it, just plugged in to the Raspberry Pi and a simple configuration is needed that can make a Raspberry Pi access to the wireless network.

Figure 4.10: USB Webcam

iv. USB Webcam

The term of webcam is a combination of ‘Web’ and ‘video camera’. It feeds or streams its image in real time or through a computer to computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and email as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera which is connects using Ethernet or Wi-Fi, a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops.

Figure 4.11: Pi NoIR Camera

v. Pi NoIR Camera

The infra-red camera module v2 (Pi NoIR) replaced the original PiNoIR camera in April 2016. The v2 camera has a Sony IMX219 8-megapixel sensor compared to the 5-megapixel OmniVision OV5647 sensor of the original camera. It gives the ability to see in the dark with infrared lighting. The Pi NoIR Camera will capture the baby picture.

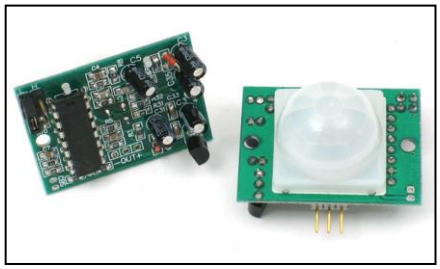

Figure 4.12: PIR Motion Sensor

vi. PIR Motion Sensor

Passive Infrared will detects the body heat. When the sensor warm up, it can detect the surrounding area by heat and movement. The sensor is regarded as passive because it doesn't send out any signal in order to detect movement. It adjusts itself to the infrared signature of the room it's in and then watches for any changes. Any object moving through the room will disturb the infrared signature, and will cause a change to be noticed by the PIR module. It also can connect those to the Raspberry Pi GPIO pins. One pin is for +5 volts, one pin is for ground and the other is the sensor pin. This sensor pin will receive power whenever motion is detected by the PIR module.

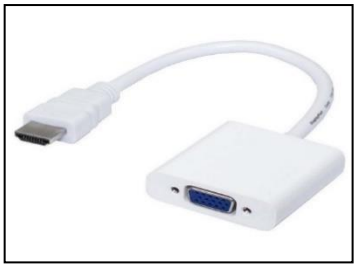

Figure 4.13: HDMI to VGA converter

vii. HDMI to VGA converter

This hardware is used to connect the HDMI cable from the monitor to the Raspberry Pi board. It is a simple device design form a small adapter with integrated with VGA Socket output, with short cable complete with HDMI plug for connection to the HDMI Socket on the Raspberry Pi.

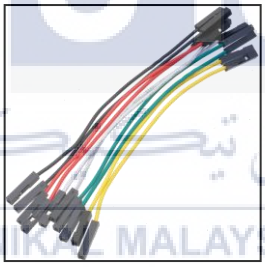

Figure 4.14: Jumper Wire

viii. Jumper Wire

Jumper wires typically vary in color and size depending on what they are being used for. In breadboards, jump wires are used to establish connections between the central micro controller and other devices such as buttons and sensors. If possible, the jumper wire should always be placed on the component side of a circuit board during assembly. The wires should also be routed in an X-Y manner, avoiding any bends. Jump wires should never be raised more than 1/8 of an inch above the surface of the circuit board.

Figure 4.15: Smartphone, Tablets, Computer

ix. Smartphone, Tablets or Computer

A parents can monitor their baby through a smartphones, tablets and PC which is they can view a live streaming of their baby from any places. It will display all the data and information of their baby by sending the picture through a web browser and it widely compatible which is can be accessed from smartphones, tablets or computer.

4.4 High-Level Design

4.4.1 System Architecture

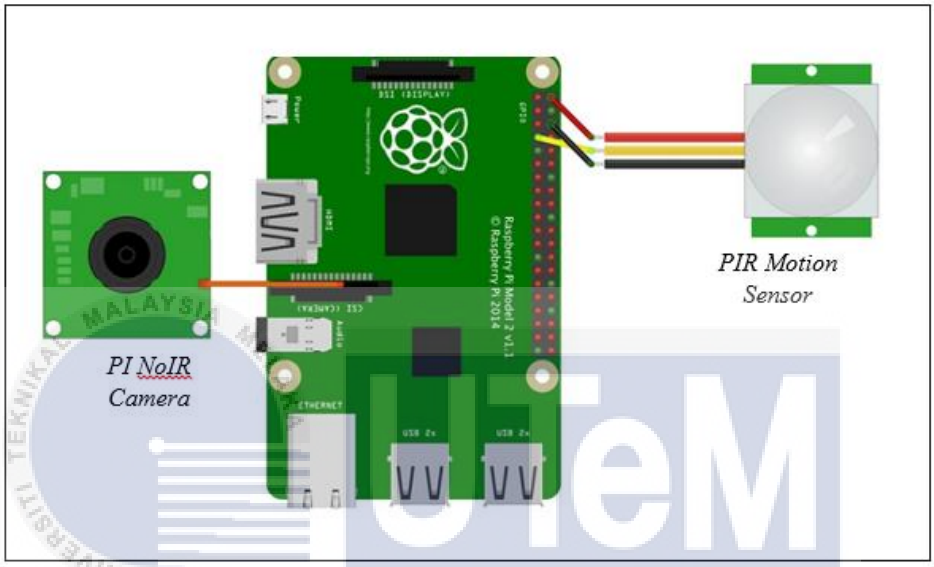

Figure 4.16: Sketch Circuit Design

Figure ***4.16*** shows the sketch circuit design for baby monitoring system using Raspberry Pi. The figures shows all the component needed and the connection between each other. The PIR Motion Sensor directly connect to the GPIO pin at Raspberry Pi.

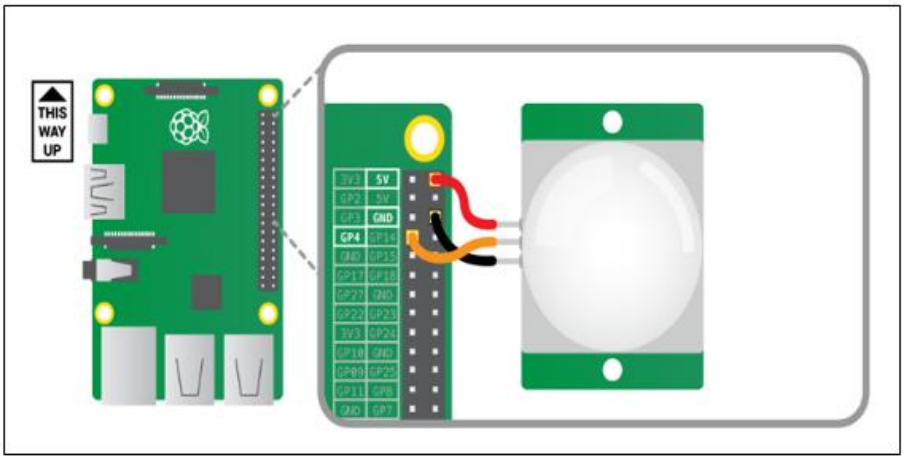

Figure 4.17: GPIO Pin

In Figure ***4.17*** shows the GPIO which is General Purpose Input/output pins of Raspberry Pi. Use a female to female jumpers (red) and connect to the VCC pin on the pin 2 of the Raspberry Pi which is to give 5 volts power to the PIR Motion Sensor. Use another female to female jumpers (black) to connect GND to pin 6 on the Raspberry Pi, this is to allow a current to flow back out of the PIR Motion Sensor into the Raspberry Pi. After that, for the sensor pin (OUT), connect a jumpers to the pin 7 (orange) on the Raspberry Pi. This pin will output the voltage when motion is detected.

4.4.2 Flowchart

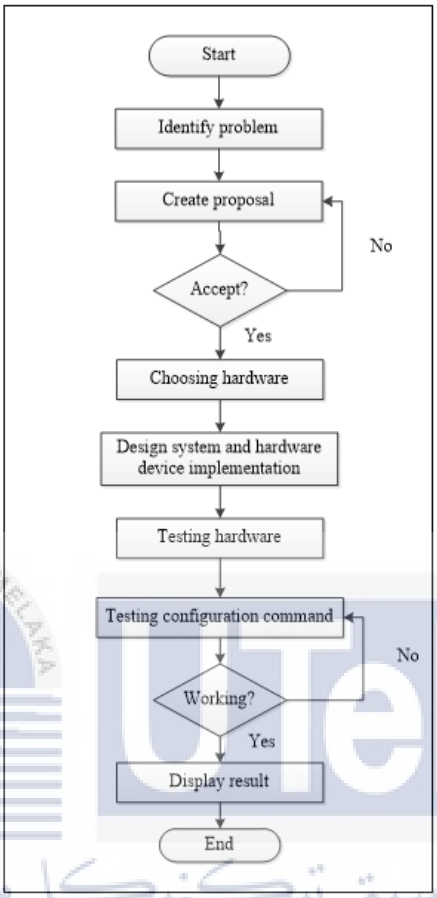

Figure 4.18: System Flowchart

The flowchart in Figure 4.18 above shows the system flowchart of this project. Firstly, is identify problem of the current state. After find the problems encountered, proposed the solution through a proposal. The problem is that the baby monitoring systems are very expensive in the market. So, to solve the problem was use the Raspberry Pi which is a low cost and a credit-card sized computer. After that, choose a hardware that use in a baby monitor system which is USB Webcam, PIR Motion sensor and Pi Noir Camera are used to monitor a baby condition in the nursery room. This sensor will detect movement of the baby and it will sent a video by a notifications on the web browser. A parent can monitor their baby through live streaming using a webcam by open a web browser. The testing of Raspberry Pi is responsible to analyze the data in order to send the

notification to the parents by web browser and it widely compatible and can be accessed both on the tablet, smartphone or computer.

4.5 Conclusion

As a conclusion, in this chapter all the problems stated have been explained in detail. All the project requirements, software and hardware needed are listed in this chapter. The design of this project is already been approve and will be proceed in the implementation phases. For further addition is adding after the testing activities. Overall, the design of this project is the best and most efficient in term of sensing system.

CHAPTER V

IMPLEMENTATION

5.1 Introduction

This chapter discuss about the implementation for the project. It will explain step by step of project setup from assembling the hardware to installation of software and it consists of step configuration of the camera to the Raspberry Pi. This project is will be done using Raspberry Pi microcomputer, webcam and the Pi NoIR Camera Board. Moreover, the project development environment also will be discussed in this chapter.

5.2 Project Development Environment Setup

This section describes the overall development environment for the project which covers a few subtopics as listed below:

1. Raspberry Pi Environment Setup

   In this Raspberry Pi Environment Setup, will discover on how Raspberry Pi being setup from the beginning until complete project and will be explained in details how the operating system has been install and configured.

2. Webcam Environment Setup

   In this setup, webcam setup will be explained and shows in details the configuration that need to be done to get a live streaming using a Webcam and Raspberry Pi.

3. Pi NoIR Camera and PIR Motion Sensor Environment Setup

   In this subtopic, the environment on how Pi NoIR Camera and motion sensor will integrated with the Raspberry Pi will be explained in details. It also include of what requirement is needed in order to make this sensor work with Raspberry Pi such as Python language library.

4. Email Alert Notification Environment Setup

   In this setup, email alert setup will be explain and show in details the configuration that need to be done for sending a notifications by email alert of a video recorded using the Raspberry Pi to the parents. The email alert will notify parents when the sensor detect a motion of baby.

5.2.1 Raspberry Pi Environment Setup

This section contains overall that are related to Raspberry Pi environment hardware and software. All hardware and software such as a device that will be used and the operating system on the raspberry pi are set up. The hardware needed to setup this project is Raspberry Pi model B+, power supply for the Pi, SD card, HDMI monitor, HDMI cable, WIFI USB dongle / Ethernet connection, USB mouse and USB Keyboard

Detailed implementation steps as listed below:

Steps 1: Setting up the raspberry pi board by inserting the SD card into the slot and then connect the HDMI cable to both monitor and Pi. Also, plug in the power supply to the Pi and then switch on the pi.

Steps 2: Install the operating system which is Raspbian. The Raspbian is an operating system that set of a basic programs and utilities that make Raspberry Pi run. It also provide more than pure operating system which is come with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation in Pi.

Step 3: Plug in the keyboard and the mouse to the USB port on the Raspberry Pi for the first time booting, it is required that mouse and keyboard to be attached to the Raspberry Pi.

Step 4: Raspbi-config screen appears for the first time booting which the setting can be changed on the screen.

Step 5: Restart the Pi in order to activate the entire configuration that has been made during an operating system installation.

Step 6: Finish Raspberry Pi environment setup

5.2.2 Webcam Environment Setup

This section describes on how webcam will be setup and integrated with Raspberry Pi. Using a USB port at a Raspberry Pi to connect the webcam. To use a webcam may have a several configuration to be done before it can be used for a live streaming.

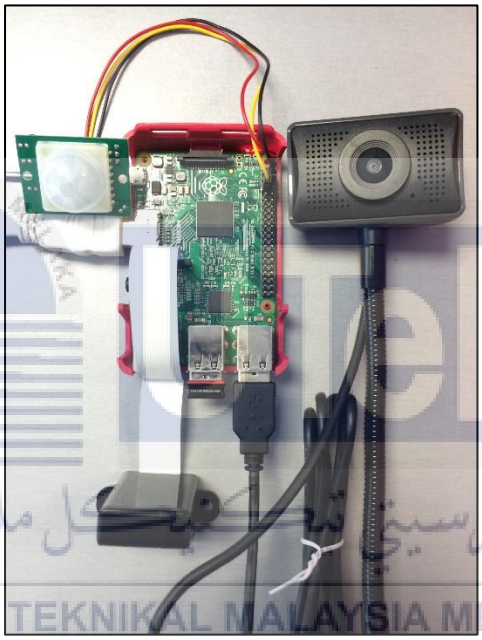

Figure 5.1: Webcam Environment Setup

5.2.3 Pi NoIR Camera and PIR Motion Sensor Environment Setup

This section describes on how Pi NoIR Camera and PIR Motion Sensor will be setup and integrated with the Raspberry Pi. First of all, have to make sure the Pi is switched off, connect the camera module to the Raspberry Pi's camera port then start up the Pi and ensure the software is enabled. To integrate or connect PIR Motion Sensor to the Pi, the sensor need to connect with the Raspberry Pi GPIO which include wiring from the sensor to the GPIO. There are extra hardware to make the sensor working well with the Raspberry Pi.

Detailed implementation steps as listed below:

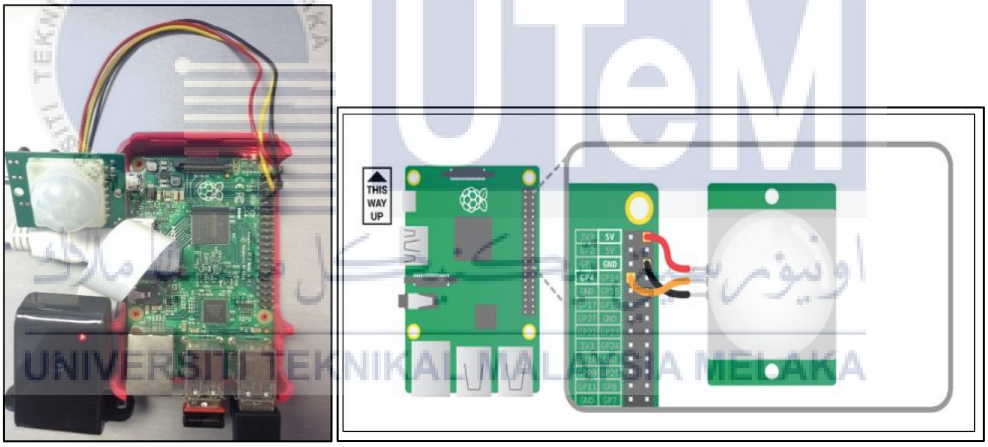

Figure 5.2: Pi NoIR Camera and PIR Motion Sensor

The Figure 5.2 shows all the component needed and the connection between each other. The PIR Motion Sensor directly connect to the GPIO pin at Raspberry Pi. GPIO pin which is General Purpose Input/output pins of Raspberry Pi.

- Use a female to female jumpers (red) and connect to the VCC pin on the pin 2 of the Raspberry Pi which is to give 5 volts power to the PIR Motion Sensor.

- Use another female to female jumpers (black) to connect GND to pin 6 on the Raspberry Pi, this is to allow a current to flow back out of the PIR Motion Sensor into the Raspberry Pi.
- After that, for the sensor pin (OUT), connect a jumpers to the pin 7 (orange) on the Raspberry Pi. This pin will output the voltage when motion is detected.

5.2.4 Email Alert Notification Environment Setup

This section will describe how it sent an alert by email notifications from the Raspberry Pi to the email address that already setup. In this project, need to create one email account and will configure in a Raspberry Pi to send to parents accounts email. A Raspberry Pi will send an attachment of video record to the parents by email.

5.3 Project Configuration Management

This section describes the overall configuration management for the project which covers a few sub-topic s as listed below:

1. Raspberry Pi Configuration

   This subtopic will explained the step from the setup of the Raspberry Pi the operating system and setup the Raspberry Pi.

2. Webcam Configuration

   This subtopic will include the script that will be used to get the live streaming in real time.

3. Pi NoIR Camera and PIR Motion Sensor Configuration

   This subtopic will include the scripting of Pi NoIR Camera and PIR Motion Sensor. The configuration of Pi NoIR Camera and PIR Motion Sensor on Raspberry Pi to show the output of the script.

4. Email Alert Notification Configuration

   This subtopic will include all the scripting that will be used to send an alert email to parents. It also will explain the step by step on how to configure the script to detect the motion from the PIR Motion Sensor.

5. USB Sound Card Configuration

   This subtopic include the configuration of the USB sound card to record and play of sound recorded.

5.3.1 Raspberry Pi Configuration

Step 1: Format SD Card to ensure the SD Card empty and have an enough space to install the Operating system.

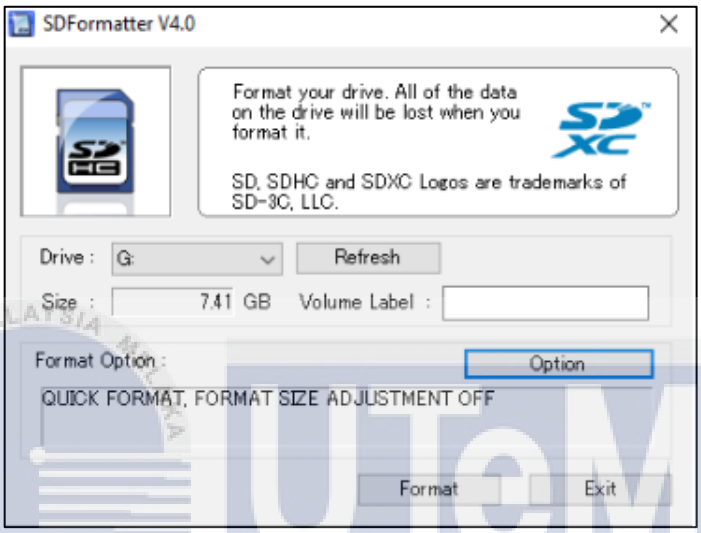

Figure 5.3: Format SD Card using SD Formatter

Step 2: SD Card format complete and ready to be used for install the Raspbian Operating system at Raspberry Pi.

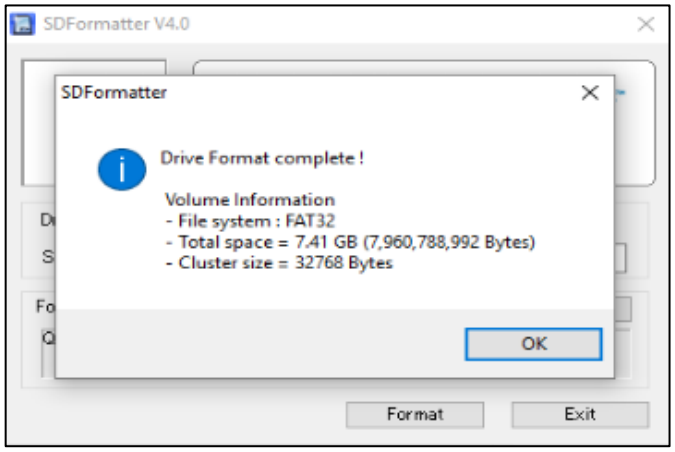

Figure 5.4: SD Card format complete

Step 3: Copy all the Operating System file to the SD Card, and insert Card into Raspberry Pi and starting the installation step.

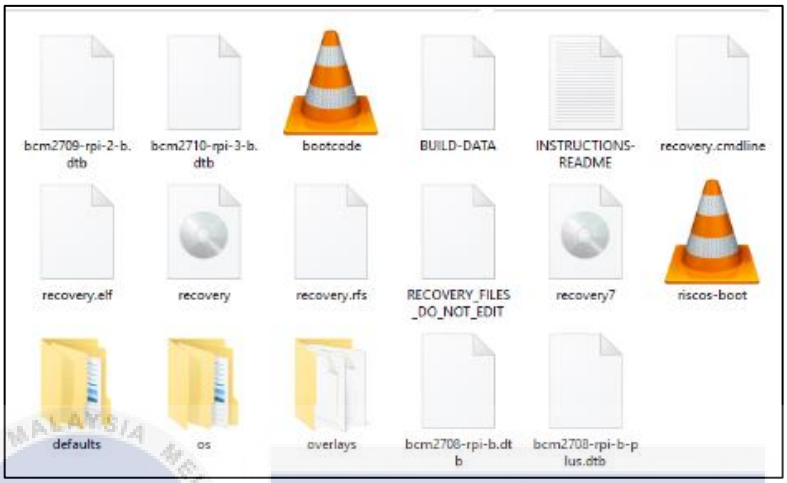

Figure 5.5: Raspbian file copy to SD Card

Step 4: Tick Raspbian and install the operating system.

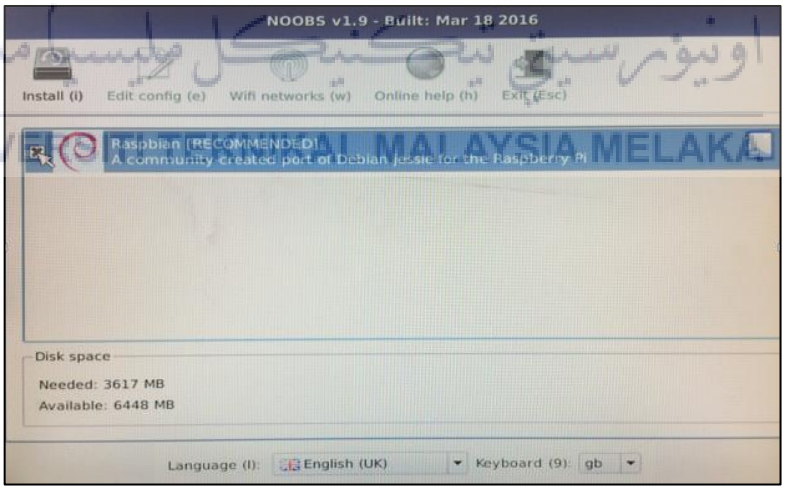

Figure 5.6: Raspbian Install wizard

Step 5: Confirmation box will appear to make sure the operating system will install and the data in the SD Card will overwritten. Click “Yes” to continue the installation.

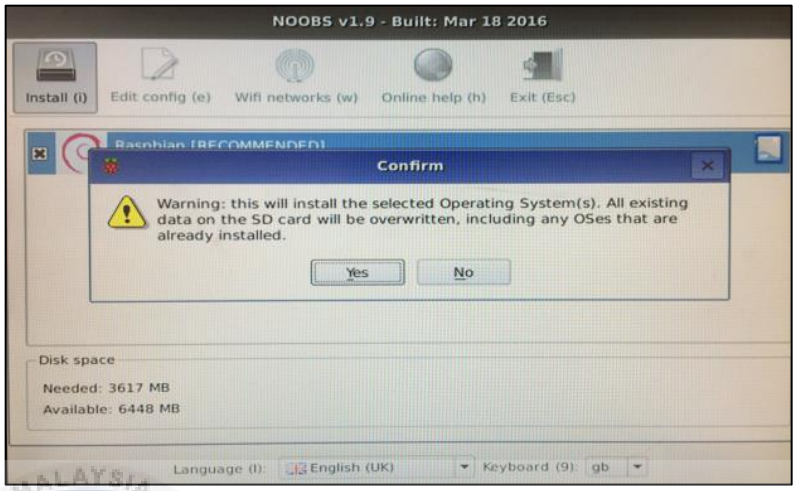

Figure 5.7: Raspbian Install Confirmation

Step 6: Waiting for the operating system install to complete. The new operating system will be install on the Raspberry Pi.

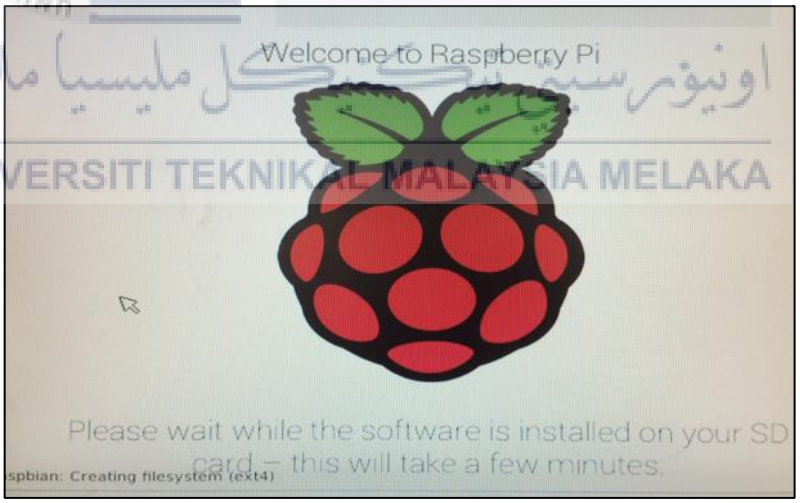

Figure 5.8: Raspbian starting install

Step 7: The Operating system done installed successfully

Figure 5.9: Successful install Raspbian

Step 8: Use a remote connection to configure Raspberry Pi using PuTTy software in Windows operating system. Open the PuTTy and insert the IP Address of Raspberry Pi. Then click “Open”.

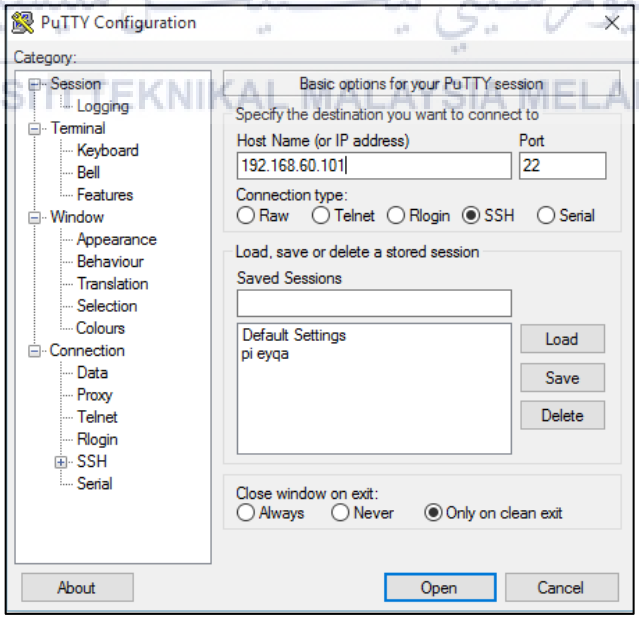

Figure 5.10: PuTTy software using SSH for remote configuration

Step 9: After that, the PuTTY Security Alert will appear for secure connection. Click “Yes” to continue the connection.

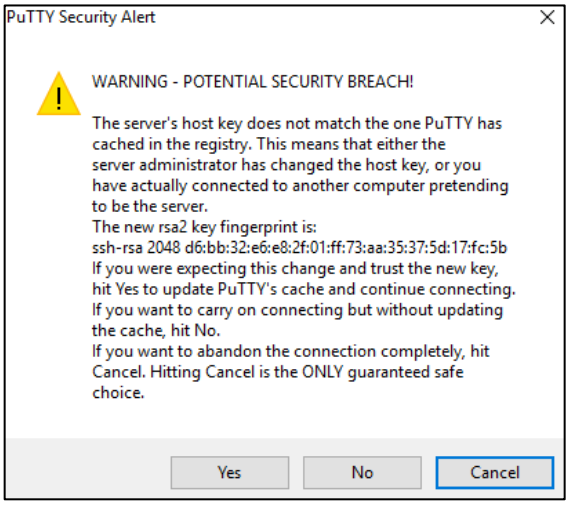

Figure 5.11: PuTTY Security Alert

Step 10: Before login to Pi, user have to set Pi by default the login and password which is login set as ‘pi’ and password ‘raspberry’ for secure connection.

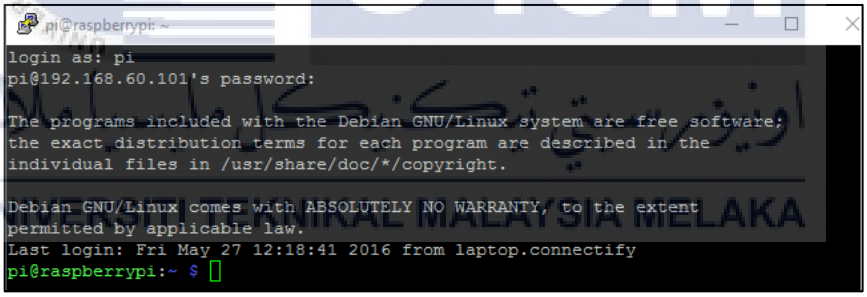

Figure 5.12: Login SSH to start the remote connection

Step 11: Get the latest update for Raspbian using command “***sudo apt-get update*** and ***sudo apt-get upgrade***”.

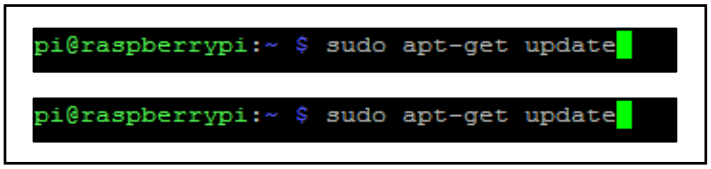

Figure 5.13: Get update for Raspberry Pi

VNC server for remote connection with GUI for Server

Step 12: Install VNC Server on Raspberry Pi by running command "***sudo apt-get install tightvncserver***".

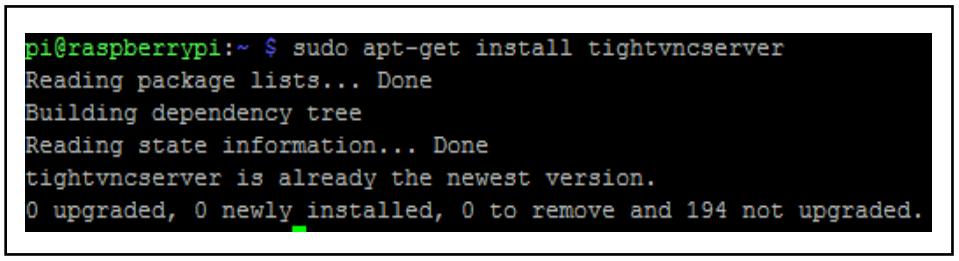

Figure 5.14: Install VNC server

Step 13: Start the VNC Server on Raspberry Pi using command "***tightvncserver***"

Figure 5.15: Start VNC Server

VNC Viewer for Client

Download VNC viewer in user side and launch the application.

Step 14: Connect VNC Server using the “localhost:5901”. Localhost is an IP address of the server and 5901 is port number for the VNC.

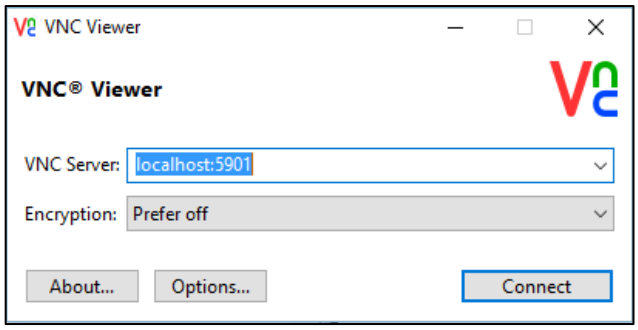

Figure 5.16: VNC Viewer for Client

Step 15: Open the PuTTY Configuration click SSH and insert IP Address of Raspberry Pi and the port number for VNC Server. After that, click “Add” button.

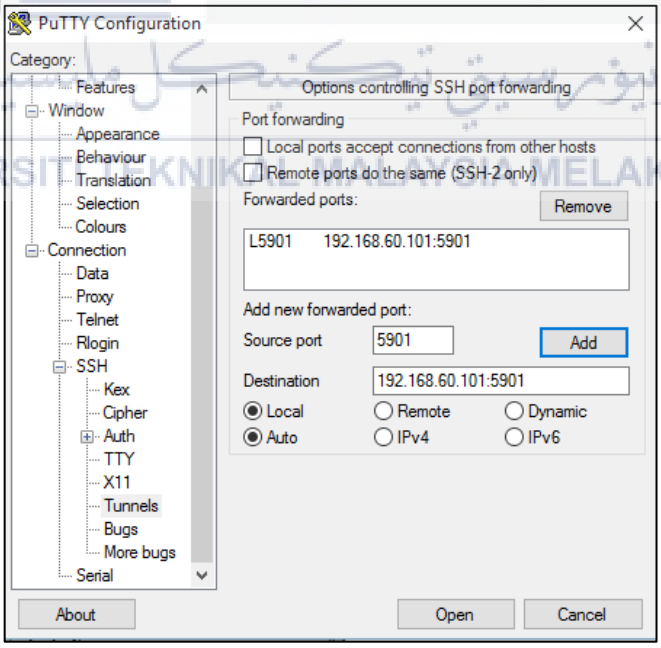

Figure 5.17: PuTTY Setup for VNC connection

Step 16: After add the IP Address and port number, click “Session” and insert again the same IP Address. Click “Open” to connect the VNC Server.

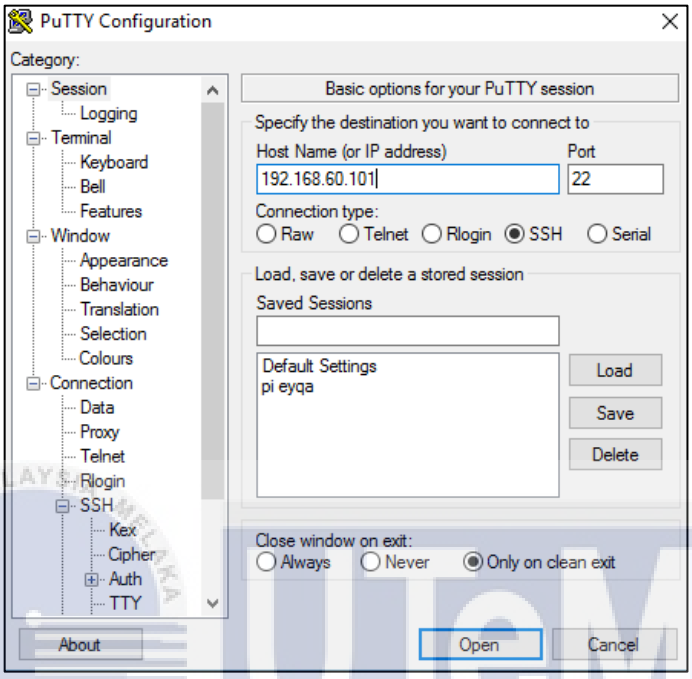

Figure 5.18: Session logging for VNC connection

Step 17: The VNC Viewer-Encryption will appear to give a warning secure connection. Then click “Continue”.

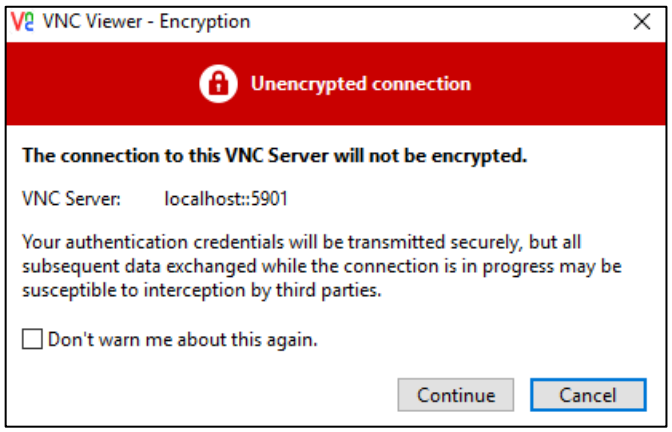

Figure 5.19 VNC Secure Connection

Step 18: VNC Viewer Authentication will appear and required password to start the connection. The password has been set during the VNC Server installation. Then click “OK”.

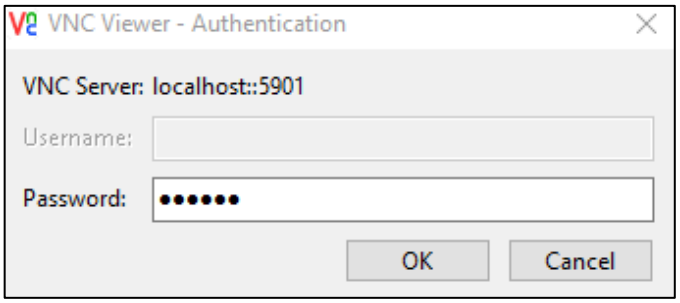

Figure 5.20: VNC Viewer Authentication

Finally, the connection of VNC Viewer is successful.

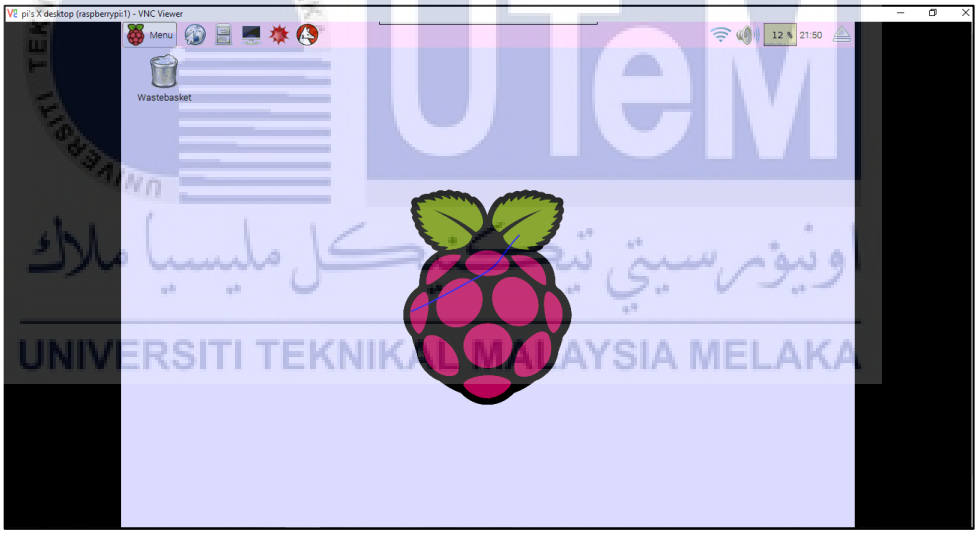

Figure 5.21: VNC Viewer successful connected

Auto running python script on boot

Step 1: Run a python script after boot by using this command "***sudo nano /etc/profile***"

```
pi@raspberrypi:~ $ sudo nano /etc/profile
```

Figure 5.22: Open file for running script on boot

Step 2: Once the editor open, edit the file by adding directory of file for example: ***sudo python /home/pi/pirCamera.py &***

```
  GNU nano 2.2.6                File: /etc/profile

# /etc/profile: system-wide .profile file for the Bourne shell (sh(1))
# and Bourne compatible shells (bash(1), ksh(1), ash(1), ...).

if [ "`id -u`" -eq 0 ]; then
  PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin"
else
  PATH="/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/local/g$
fi
export PATH

if [ "$PS1" ]; then
  if [ "$BASH" ] && [ "$BASH" != "/bin/sh" ]; then
    # The file bash.bashrc already sets the default PS1.
    # PS1='\h:\w\$ '
    if [ -f /etc/bash.bashrc ]; then
      . /etc/bash.bashrc
    fi
  else
    if [ "`id -u`" -eq 0 ]; then
      PS1='# '
    else
      PS1='$ '
    fi
  fi
fi

if [ -d /etc/profile.d ]; then
  for i in /etc/profile.d/*.sh; do
    if [ -r $i ]; then
      . $i
    fi
  done
  unset i
fi
sudo python /home/pi/pirCamera.py &
```

Figure 5.23: Adding script to the file

Step 3: Run a service after boot by using this command "***sudo crontab -e***"

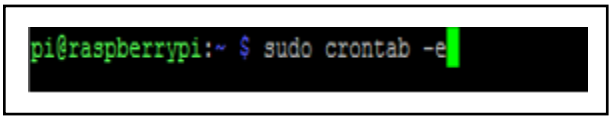

Figure 5.24: Running service after boot

Step 4: Adding motion service in the script to make a motion service running after boot

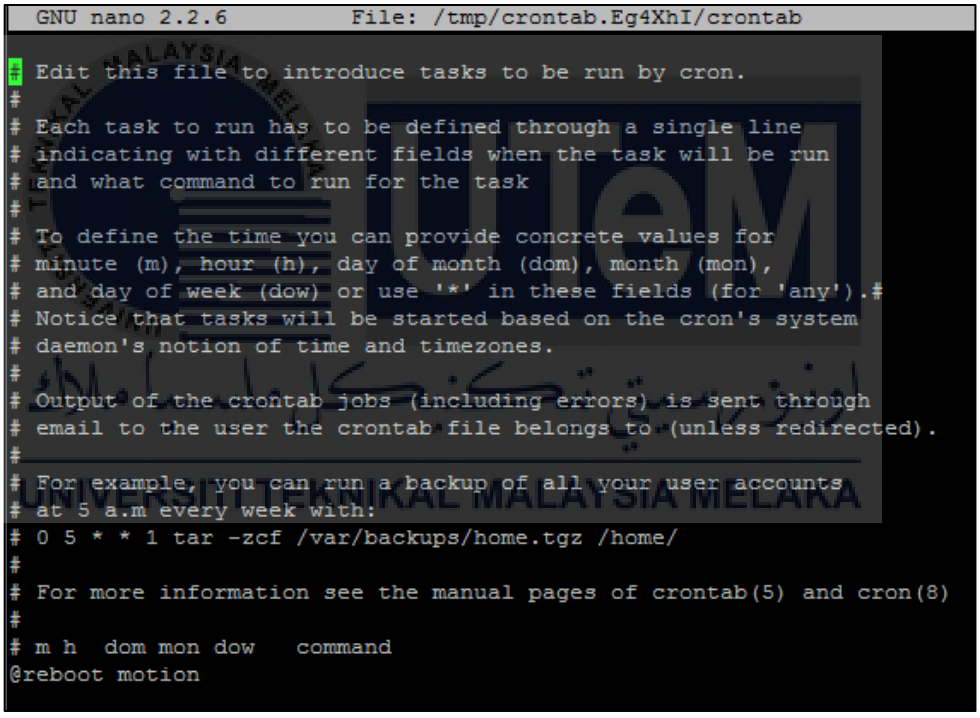

Figure 5.25: Adding script to the file

5.3.2 Webcam Configuration

This section will discuss in details on how the webcam will be setup and integrated with the Raspberry Pi to get a live streaming in a real time.

Step 1: Install motion detection software by run a command "***sudo apt-get install motion***".

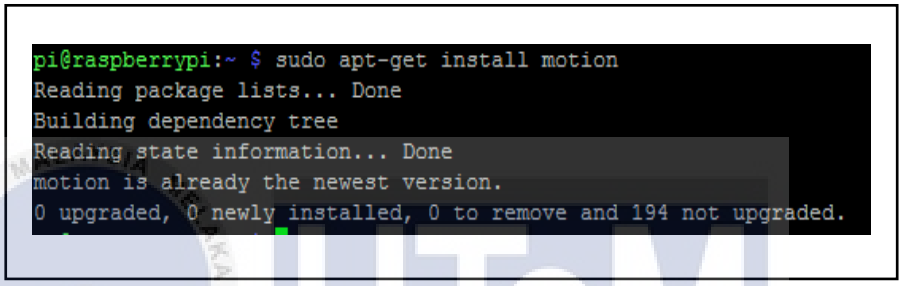

Figure 5.26: Command for installing motion

Step 2: Run a command "***sudo nano /etc/motion/motion.conf***" to edit the file that supplies it with the parameters and settings that dictate the motion detection and the corresponding output.

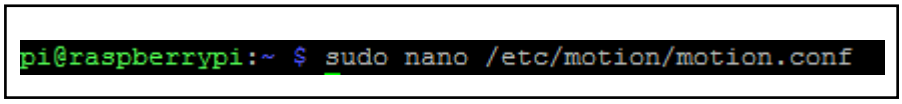

Figure 5.27: Command to edit file motion

Step 3: On motion configuration file, find the Live Stream Server section and change the stream motion from off to on by default this stream motion are off.

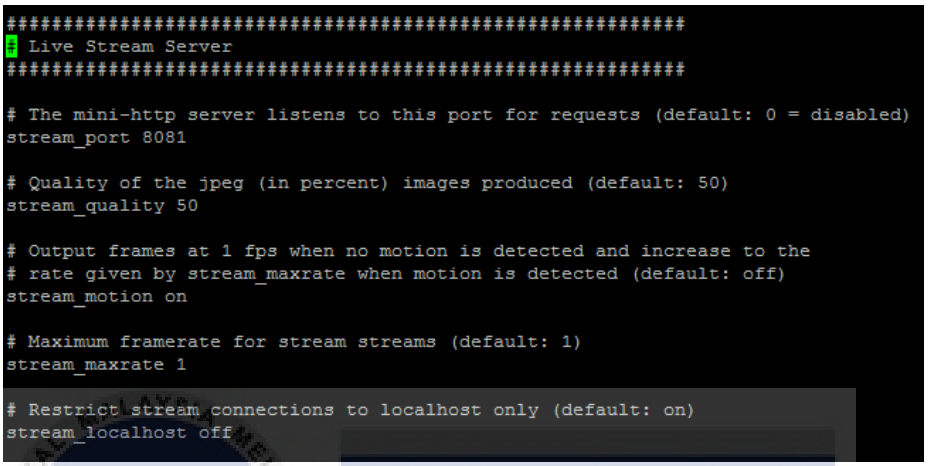

Figure 5.28: Live Stream Server Configuration

Step 4: To enable the daemon use this command "***sudo nano /etc/default/motion***"

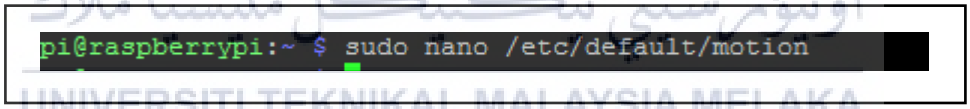

Figure 5.29: Command to enable daemon

Step 5: Once the file is opened, change "start_motion_daemon=no" to "**yes**". Enabling daemon also means that motion will start on boot by default.

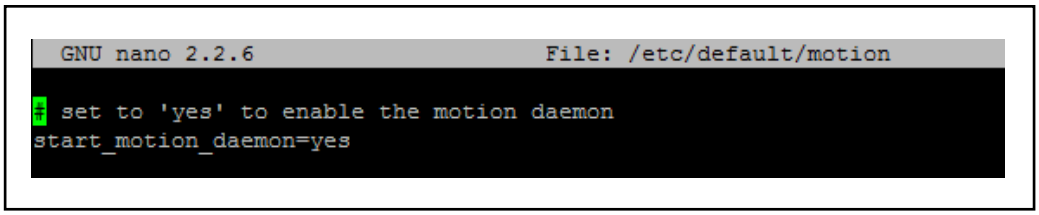

Figure 5.30: Motion daemon

Step 6: To start the motion service using by this command "***sudo service motion start***"

```
pi@raspberrypi:~ $ sudo service motion start
```

Figure 5.31 Command to start the motion service

Step 7: To test the live streaming open the browser http://192.168.60.101:8081

- 192.168.60.101 = Raspberry Pi Address
- 8081 = port number for live stream

Figure 5.32: Live streaming from browser

Step 8: To stop the motion service using by this command "***sudo service motion stop***"

```
pi@raspberrypi:~ $ sudo service motion stop
```

Figure 5.33: Stop the motion service

5.3.3 Pi NoIR Camera and PIR Motion Sensor Configuration

This section will discuss details on how the Pi NoIR Camera and PIR Motion Sensor will be configure and integrated with the Raspberry Pi.

Step 1: Create a new file by using this command "***sudo nano pirCamera.py***"

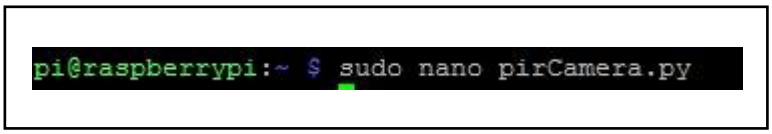

Figure 5.34: Create Pi NoIR Camera file

This is the configuration script file for PI NoIR Camera and PIR Motion Sensor to integrate with Raspberry Pi.

```
 GNU nano 2.2.6                                    File: pirCamera.py

import RPi.GPIO as GPIO
import time
import picamera
import datetime #

def get_file_name(): # new
    return datetime.datetime.now().strftime("%Y-%m-%d_%H.%M.%S.h264")

sensor = 4

GPIO.setmode(GPIO.BCM)
GPIO.setup(sensor, GPIO.IN,
GPIO.PUD_DOWN)

previous_state = False
current_state = False

cam = picamera.PiCamera()

while True:
    time.sleep(2)
    previous_state = current_state
    current_state = GPIO.input(sensor)
    if current_state != previous_state:
        new_state = "HIGH" if current_state else "LOW"
        print("GPIO pin %s is %s" % (sensor, new_state))
        if current_state:
            fileName = get_file_name() # new
            cam.start_preview()
            cam.start_recording(fileName) # new
        else:
            cam.stop_preview()
            cam.stop_recording() # new
```

Figure 5.35 Adding script to the file

Output file of the script in file format .h264 which is a video file format. This file video is store in a local memory which is in Raspberry Pi itself.

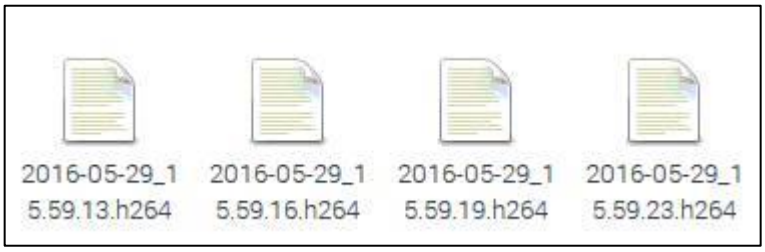

Figure 5.36: Video file

5.3.4 Email Alert Notification Configuration

Step 1: Install email package on Raspberry Pi to send an email by using this command "***sudo apt-get install ssmtp mailutils"***

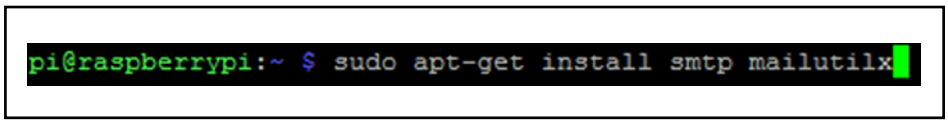

Figure 5.37: Installation email package

Step 2: Open the file configuration and edit the email configuration by using this command "***sudo nano /etc/ssmtp/ssmtp.conf"***

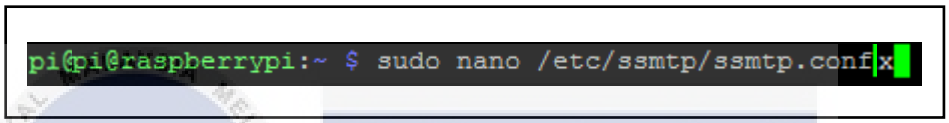

Figure 5.38: Edit configuration email file

Step 3: Configuration file launch and adding some configuration account that needed for use the email service.

AuthUser=youruserid@gmail.com

AuthPass=userpass

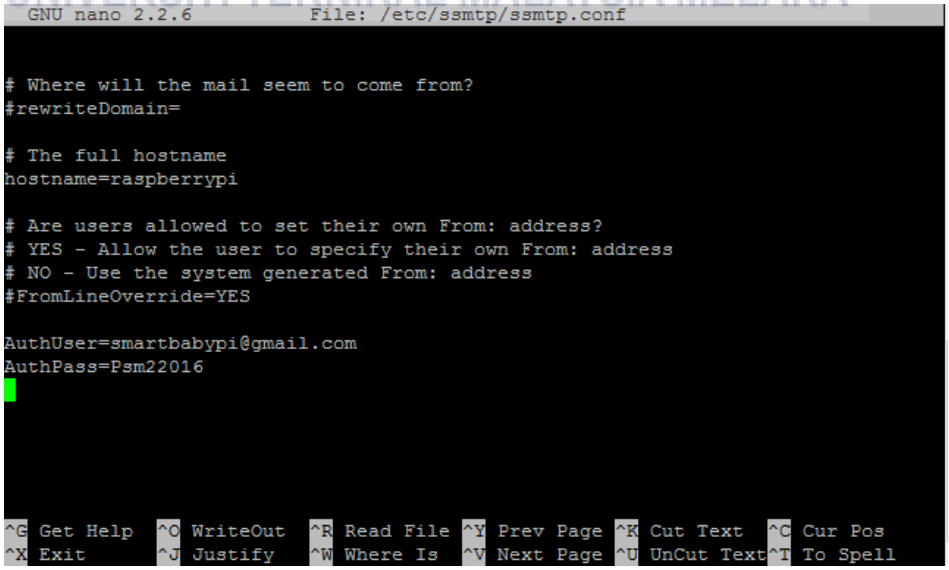

Figure 5.39: Email configuration file

Step 4: Create file to send an alert by email

```
pi@raspberrypi:~ $ sudo nano jam.py
```

Figure 5.40: Create file of scripting email configuration

Step 5: Use the script to sending an email alert when the motion is detect.

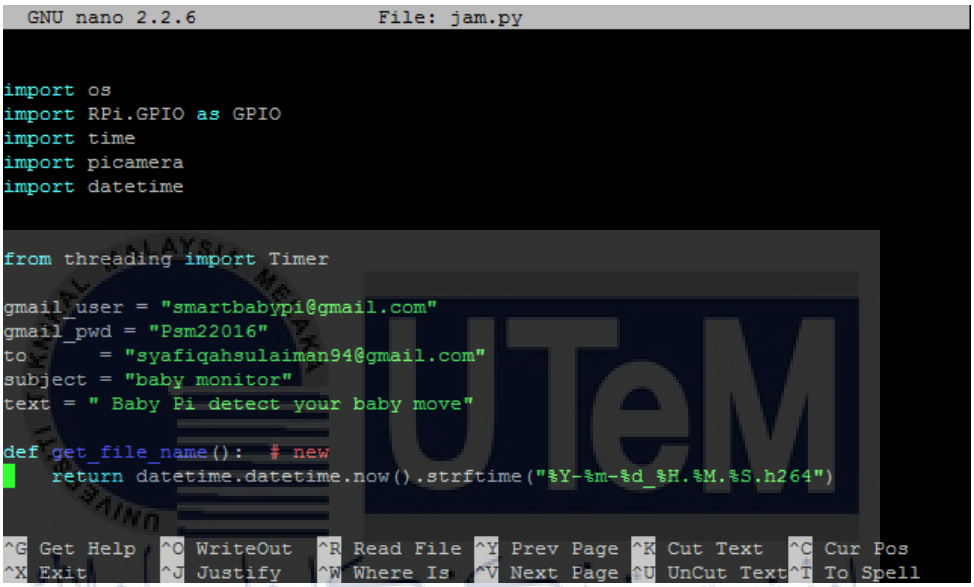

Figure 5.41: Email script to send an alert notification to user

Once the python file has been configured with the needed information, it should be able to detect a motion and send a notification to the parents by email. Figure 5.42 show on how the script detect the motion that has been configured before.

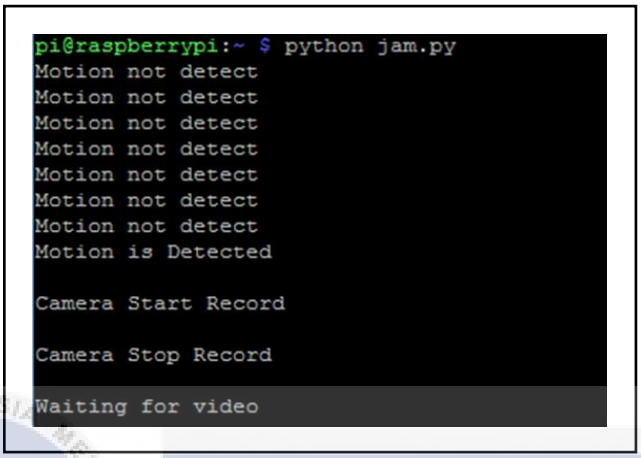

Figure 5.42: Detect a motion and send an alert

5.3.5 USB Sound Card Configuration

This section discuss in detail on how the sound card will be setup and configured with Raspberry Pi to get an audio sound.

Step 1: Click on the “Menu” then go to “Preferences” and find “Audio Device Settings”.

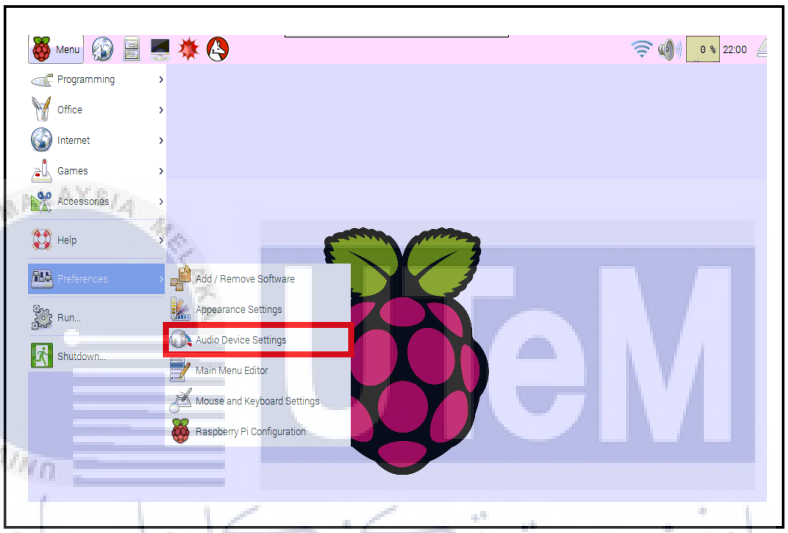

Figure 5.43: USB Sound Card setup

Step 2: Click on “USB Audio Device (Alsa Mixer)” to enable the audio setting as a default input and output for sound.

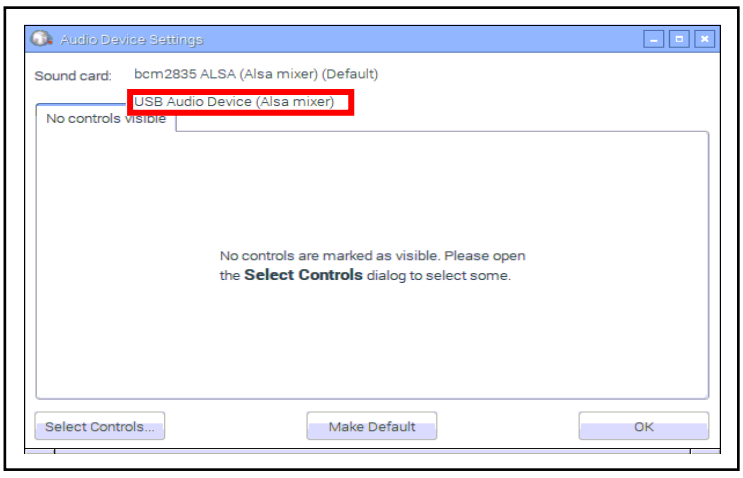

Figure 5.44: USB Sound Card Settings

Step 3: Adjust the playback setting of speaker and microphone by raise it up.

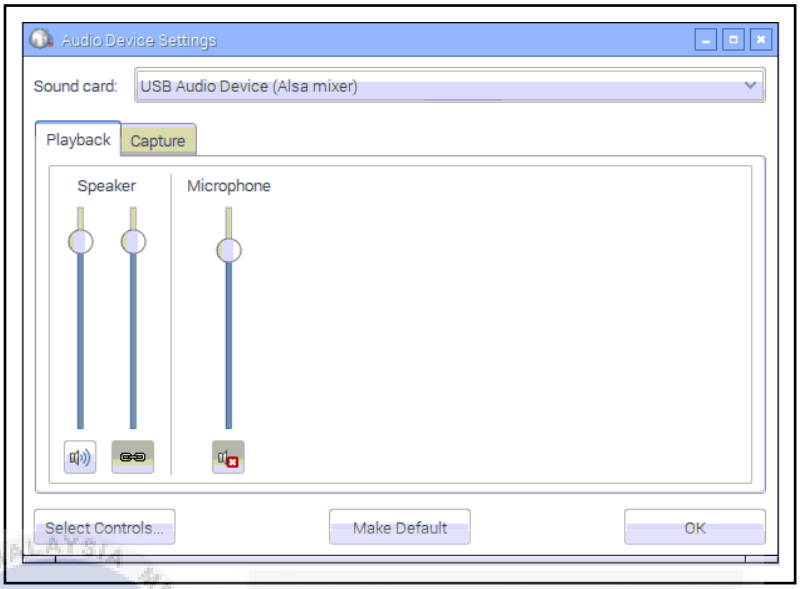

Figure 5.45: Raise volume of speaker and microphone

Step 4: To setup sound using by this command **"*alsamixer*"**

Figure 5.46: Setup sound

Step 5: Press “F6” to select a sound card option. Choose “USB Audio Device” to setup volume of speaker and microphone for USB sound card.

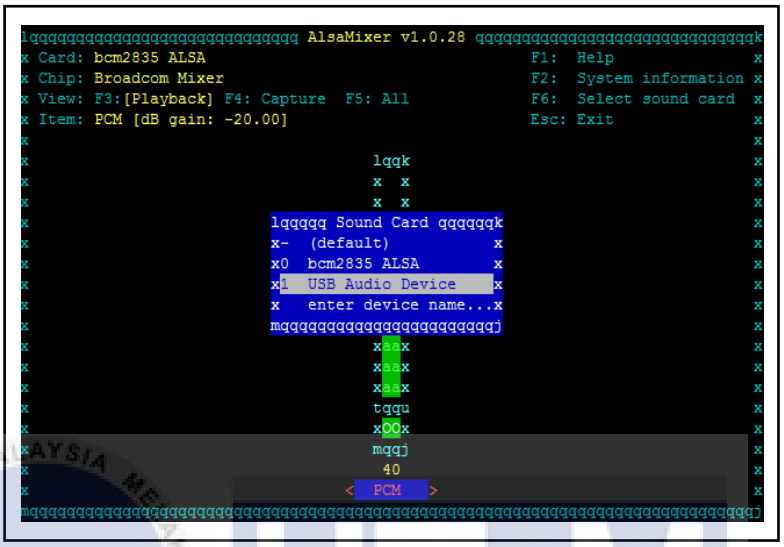

Figure 5.47: Setup USB Sound Card

Step 6: Use an arrow key up and down to change a volume sound for speaker and microphone.

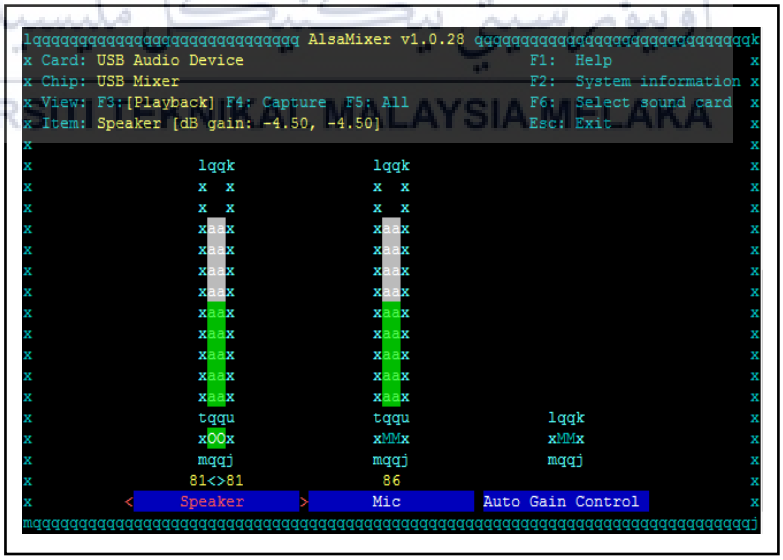

Figure 5.48: Setting a volume of speaker and microphone

Step 7: To record a sound using this command ***"arecord /home/pi/baby.wav –D sysdefault:CARD=1"***

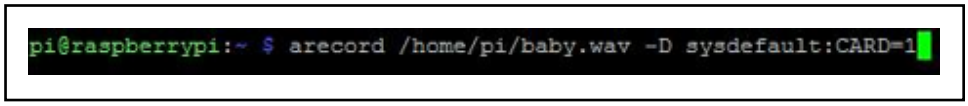

Figure 5.49: Record audio sound

Step 8: For playback a recorded sound using this command **"oxmplayer –p –o hdmi /home/pi/baby.wav"**

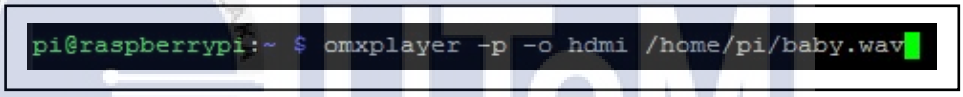

Figure 5.50: Playback the recorded sound

5.4 Conclusion

As the conclusion, in this chapter have been discussed about the step by step of installation and configuration of Raspberry Pi, Webcam, PIR Motion Sensor, Pi NoIR Camera and Email alert notification. In the next chapter, it will discuss about the test plan for the project including the test design and the test results. The analysis of the result also will be discussed in next chapter.

CHAPTER VI

TESTING

6.1 Introduction

This chapter is explained about the test plan for this project. In this test plan, it will consist of several tests which are the organization, test environment, test schedule and test strategy. In this project there are two main areas for testing which are the connection testing and configuration testing. Testing are conduct to test the connection of webcam, pi noir camera and PIR motion sensor using Raspberry Pi to monitor the baby by live streaming and get a notifications alert. This testing purpose is to monitor the baby through live streaming using webcam and to get a notifications alert by email using a PIR motion sensor.

6.2 Test Plan

6.2.1 Test Organization

Test Organization is a sub point where will be clarified and discussed about who that required in this project. For this project, there is only one person that involved which is the developer of the sensor that will be connecting with the Raspberry Pi. The individual that not just a developer the prototype, but also take a responsibility to organize the research, take care of the issue happened during implementation of the project, done all the testing, gathering the information and make an analysis from the information that have been gathered to ensure either the project has accomplished the objective.

6.2.2 Test Environment

In this project, the test environment are in the Raspberry Pi that connecting with webcam, Pi Noir Camera, and PIR Motion Sensor. There is some configuration on the Raspberry Pi that need to be done to get a live streaming using webcam in a real-time. For the Raspberry Pi, there is some GPIO connection has to be setup in order to make a PIR Motion Sensor work. This sensor will be connecting to GPIO pins on the Raspberry Pi. In addition, there have some configuration of Pi NoIR Camera and the sensor will integrated with the Raspberry Pi It also include a Python language library in order to make this sensor work with Raspberry Pi. The sensor will detect the motion of the baby and send an alert by notifications of video using email to the parents. The video will keep in the local memory which is in Raspberry Pi itself and also the video will be attach to the user to download and view the video. The testing will be done on the Raspberry Pi to test the connectivity of the sensor and the configuration test of the webcam and also the configuration testing to send an alert by notifications via video through email to the parents. The hardware and software that involved in this testing is mentioned in chapter IV.

6.2.3 Test Schedule

In the subtopic of test schedule, the testing will be carry out for the Raspberry Pi that integrated between Pi Noir Camera and PIR Motion Sensor. The testing will be done on each every movement towards the sensor to test whether the connection between the sensor and Raspberry Pi is working successfully or not. It is necessary to done this testing because the sensor should be able to detect any of movements against the sensor, so that it can send an alert by notifications via video through an email to the parents. The testing on webcam will be done to check whether the live streaming is on a real time or not. This testing need to be done in order to make sure all the connecting of the webcam, Pi Noir Camera and PIR Motion Sensor towards Raspberry Pi can integrated properly.

6.3 Test Strategy

In this project, the test strategy approach that will be used is the experimental testing. An experimental testing is a test that being directed to get an outcome from the prototype that has being produced. The outcome may include of an achievement or failure. Besides, this test is done to prove that the prototype can work properly as well as planned. For this project, the prototype is the baby monitoring system using Raspberry Pi. From the testing result accomplished, a conclusion can be made to decide whether this prototype is good in term of the performance or not.

6.3.1 Classes of Test

i. Functionality Test

The functionality test is a test to ensure that the prototype can work properly by integrated of sensor and Raspberry Pi. This testing will be done by detect any movement against the sensor and sent an alert by notifications via video through email. The testing will be done to check whether the video will keep in the local memory on Raspberry Pi itself and also it can be attach to the user to download and view the video. Moreover, the testing will be continue by getting a live streaming in a real-time using the webcam via web browser.

6.4 Test Design

6.4.1 Test Description

For this project, there are three main testing that are to be conduct which are to testing the integrated of Pi Noir Camera and PIR Motion Sensor that has been connected with Raspberry Pi, test the webcam to get a live streaming in a real-time, and also to get an alert by notifications through an email when the motion is detected. The test description is show in Table 6.1, Table 6.2, Table 6.3, Table 6.4, Table 6.5 and Table 6.6

Table 6.1: Sensor connectivity with Raspberry Pi testing

Test	Testing connectivity PIR Motion Sensor to the GPIO pin on Raspberry Pi
Test Purpose	To test the PIR Motion Sensor work with Raspberry Pi
Test Environment	Sensor connect to the GPIO pin on Raspberry Pi
Test Setup	1. Connect the sensor on the Raspberry Pi ▪ connect to the pin 2 (VCC) of the sensor to GPIO ▪ connect to pin 6 (GND) of the sensor to GPIO ▪ connect to pin 7 (OUT) of the sensor to GPIO 2. Power on the Raspberry Pi 3. Open the terminal to test the reading from the sensor 4. Run a script *python babymail.py* 5. The motion is ready to test
Expected Result	The sensor should be able detect the movement.

Table 6.2: Pi NoIR Camera connectivity with Raspberry Pi

Test	Connectivity of Pi Noir Camera on Raspberry Pi
Test Purpose	To test the connectivity Raspberry Pi with Pi Noir Camera
Test Environment	Pi Noir Camera setup with the sensor that capture the movement with camera
Test Setup	1. Locate the camera port and connect the camera 2. Start up the Pi 3. Create a new file using by this command *sudo nano pirCamera.py* 4. Adding script to the file
Expected Result	The camera should be able to have a video output

Table 6.3: Webcam connectivity with Raspberry Pi

Test	Testing connectivity Webcam on Raspberry Pi
Test Purpose	To test the connectivity Raspberry Pi with Webcam
Test Environment	Webcam connect to Raspberry Pi to get a live streaming
Test Setup	1. Connect the webcam on the usb port of Raspberry Pi 2. Start up the Pi 3. Install motion detection software by run this command *sudo apt-get install motion.* 4. Edit a configuration file by run a command *sudo nano /etc/motion/motion.conf* 5. Change the stream motion from off to on in the Live Stream Server 6. Enable the daemon to motion start on boot by run command *sudo nano /etc/default/motion* 7. Start the motion service using by this command *sudo service motion start* 8. Test the live streaming by open the browser
Expected Result	The webcam should be display a live streaming in a real-time

Table 6.4: Notification alert via Email testing

Test	Notifications to parents by email when the sensor detect movement of baby
Test Purpose	To test the email notifications is received when the sensor detect movement
Test Environment	PIR Motion Sensor, Pi Noir Camera and Raspberry Pi that has been setup
Test Setup	1. Connect the sensor on the Raspberry Pi ▪ connect to the pin 2 (VCC) of the sensor to GPIO ▪ connect to pin 6 (GND) of the sensor to GPIO ▪ connect to pin 7 (OUT) of the sensor to GPIO 2. Power on the Raspberry Pi 3. Open the terminal to test the reading from the sensor 4. Run a file on a Raspberry Pi with command *python babymail.py* 5. After run the script, the sensor will detect movement and it will record a video. 6. The video that have been recorded will attach to the email
Expected Result	The PIR Motion Sensor, Pi Noir Camera and Raspberry Pi should be able detect the movement and sent email notifications to the parents

Table 6.5: Save the recorded video of baby motion

Test	Save the recorded video in Raspberry Pi
Test Purpose	To test the script that able to store the file in the Raspberry Pi
Test Environment	PIR Motion Sensor, Pi Camera and Raspberry pi that has been setup before.
Test Setup	1. Run a script *python baby.py* 2. The sensor will detect the motion and it will record a video. 3. The recorded video will sent email notification to the parents 4. The file is stored in Raspberry Pi
Expected Result	The video file should be able store in the Raspberry Pi

Table 6.6: Record a sound using sound card

Test	Record sound from the sound card
Test Purpose	To test the Raspberry Pi get the input sound from the USB sound card
Test Environment	USB sound card plug to Raspberry Pi with Microphone and Earphone
Test Setup	1. Connect USB sound card on the Raspberry Pi 2. Set USB sound card as Default audio 3. Open terminal 4. Use command "*arecord /home/pi/Desktop/a.wav -D sysdefault:CARD=0* " to record the sound.
Expected Result	The recorded sound can be playback with the recorded voice.

6.4.2 Test Data

1. Sensor and Pi NoIR Camera connectivity test

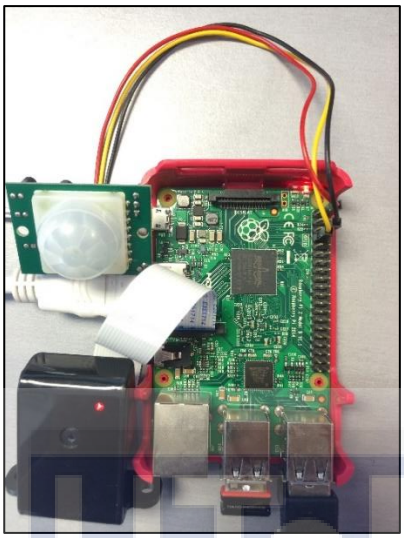

Figure 6.1: Connection of PIR Motion Sensor, Pi NoIR Camera and Raspberry Pi

Figure 6.1 shows the connection between PIR Motion Sensor, Pi NoIR Camera and Raspberry Pi. The motion sensor using GPIO pin to have the power and sensor detect motion. The LED on the Pi camera should light up to shows that the sensor is ready to record video of motion and sent alert notifications by email.


```
pi@raspberrypi:~ $ python jam.py
Motion not detect
Motion not detect
Motion not detect
Motion not detect
Motion not detect
Motion not detect
Motion not detect
Motion is Detected

Camera Start Record

Camera Stop Record

Waiting for video
```

Figure 6.2: Sensor detect a motion

Run a python script by using command *python jam.py* in a Figure 6.2. The command that should be run in order to make this sensor integrate with Pi camera. These sensor automatically detect a motion when there is a movement. From the figure, it also shows that the connection between sensor, pi camera and Raspberry Pi working.

2. Notification alert via email testing

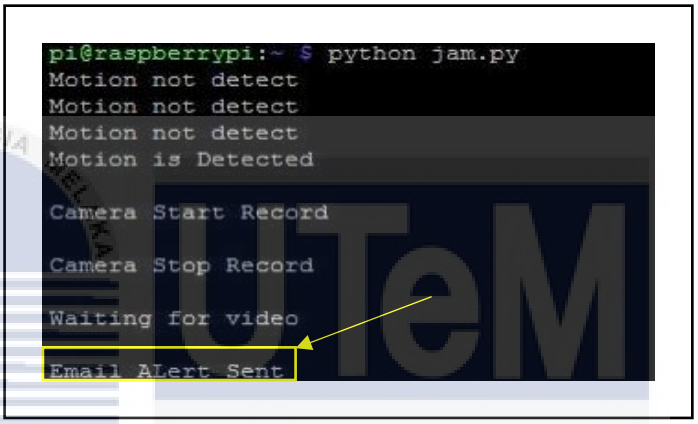

Figure 6.3 Email Alert

Figure 6.3 show the motion is detected by a sensor when there is a movement detected and pi camera will record a video in a few second and sent an alert notifications by email. With this alert, the Raspberry Pi should be able to send a notifications via email to the parents.

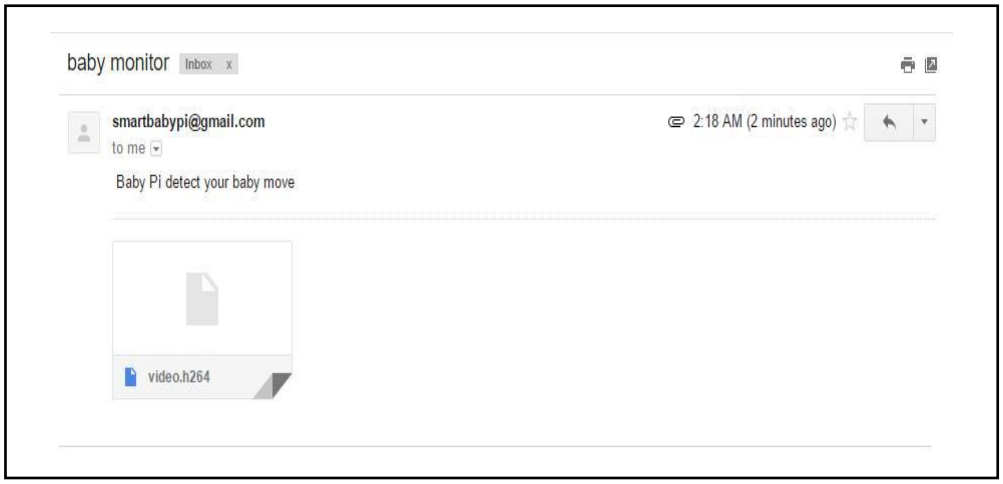

Figure 6.4: Alert Notification via email

Figure 6.4 shows the email notification that will receive by parents with an attachment of recorded video when the motion is detected. With this alert parents are aware of their baby and can stream a live streaming via web-browser to monitor the baby.

3. Webcam testing

Figure 6.5: Webcam connection with Raspberry Pi

Figure 6.5 shows a webcam connection with Raspberry Pi. The webcam view a video of the baby. Parents can watch a live streaming of the baby via web-browser after got the notification alert from email. The reason for adding a webcam is to get a different angle of the baby.

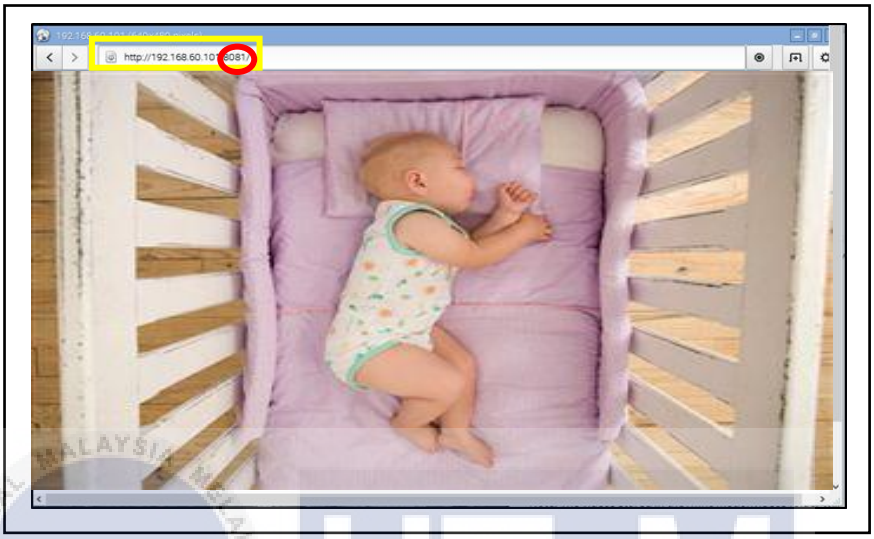

Figure 6.6: Live Streaming from the webcam

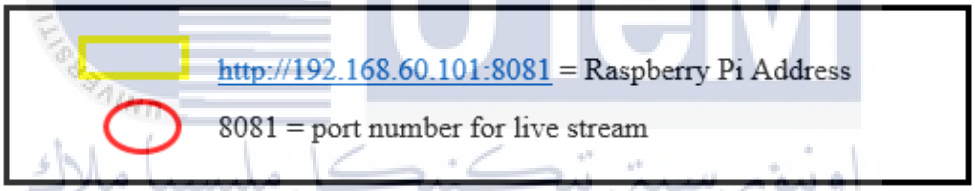

Figure 6.6 shows the live streaming from the webcam via a web-browser. Put the IP address of Raspberry Pi and port number for live stream.

4. USB Sound Card Testing

Figure 6.7: USB Sound Card connection with Raspberry Pi

Figure 6.7 shows a connection of USB Sound Card with Raspberry Pi. Plug in the earphone on the microphone port to record a sound of baby.

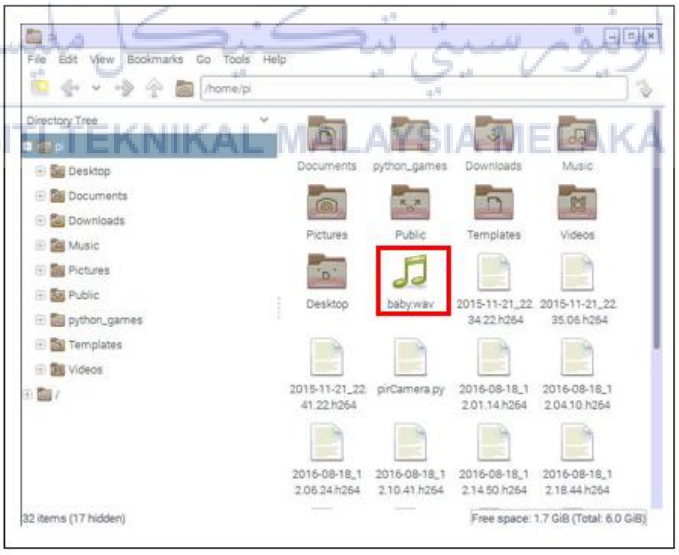

Figure 6.8: Audio file sound

Figure 6.8 shows an audio file that save in a Raspberry Pi. The file contain a recorded sound.

6.5 Test Result and Analysis

1. Sensor connectivity testing

The sensor connectivity testing has been done before, the result is shown in Table 6.7. The conclusion that can be made from this table is the range that accepted by a sensor to detect a motion. The acceptable range to detect a motion is less than 6 meter away. Above from the 6 meter, the sensor cannot detect the motion.

Table 6.7: Different range of sensor to detect

Range (meter)	Detect	No Detect
2m-4m	✓	
3m-5m	✓	
6m	✓	
6m and above		✓

Based on the Table 6.7, this project focus on 2 meter to 4 meter which is a suitable range for detect a motion of baby movement because the PIR Motion Sensor use a line of sight. Appropriate for smaller, enclosed spaces such as in a small nursery room. The sensor have to put nearest to the baby to avoid any obstacles with clear line of sight and also to avoid unnecessary detection between sensor and baby. The sensor is put at the corner of the baby cot or crib. The location as shown in the Figure 6.9.

Figure 6.9: Location of sensor

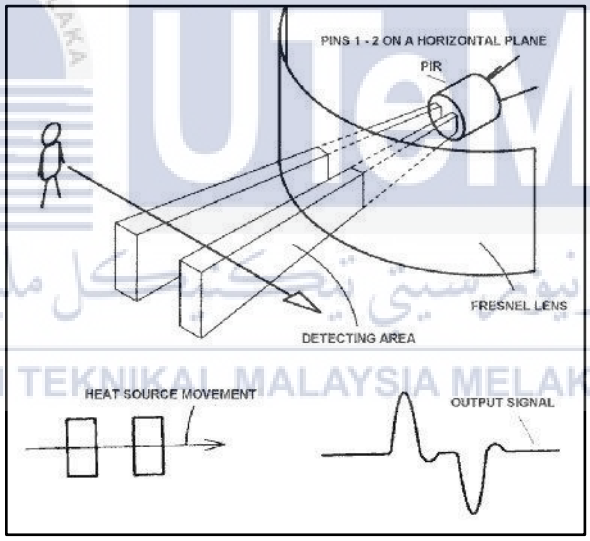

Figure 6.10: Area of range detected

In Figure 6.10 shows the area of sensor detect a motion from the heat source movement.

2. Notification alert via Email testing

The testing that has been done before, has shown that the Raspberry Pi will send a notification alert to the parents by email when the sensor detect a motion of baby that has been configured. The testing and analysis that have been done is the time taken to send a recorded video with a different record time and the size of the video file. The time taken to send a video are also influenced by a connection of the network. Table 6.8 shows the results that has been obtained from this testing.

Table 6.8: Time taken sent a recorded video via email

Record Time (seconds)	File Size (megabyte)	Time Taken to send video (minutes,seconds)
3 sec.	1.3 mb	1m 30sec
5 sec.	3.5 mb	3m 05sec
7sec.	4.5 mb	5m 36sec

Based on Table 6.8 for this project a suitable recorded time is 3 seconds of video recorded because the output file using a minimum memory, if the longest time video recorded it might use large file of memory to keep the file, so the storage will full. That enough time to recorded a video of the baby when detect a baby movement. Moreover, a large size of file take a time to send the email alert to parents. Video recording time can be change in the script by change the *sleep(3).* In the scripting also add *sleep time(5)*, which is a delay time of camera record video after 5 seconds of motion detected as an assumption the baby is delirious in 1 seconds to 4 seconds of movement. After 5 seconds of movement the baby might crying or something else. The scripting is edited as shown in Figure 6.11.

```
cam = picamera.PiCamera()

while True:
    new_state = "Detected"
    time.sleep(0.5)
    previous_state = current_state
    current_state = GPIO.input(sensor)
    if current_state != previous_state:
        print("Motion is %s" % (new_state))
        fileName = get_file_name()  # new
        print("")
                sleep(5)
        print("Camera Start Record")
        print("")
        sleep(1)
        cam.start_recording(fileName) #camera start record
        sleep(3)    # Duration video recorded
        print("Camera Stop Record")
        print("")
        cam.stop_recording()    #camera stop record
        sleep(1)
        print("Waiting for video")
        print("")
```

Figure 6.11: Time delay of recorded video

Figure 6.12 shows the notification alert that has been received by parents from the Raspberry Pi. Raspberry Pi give an alert by attached a video file via email to parents. The video can be downloaded by parents.

Figure 6.12: Notification alert received by parents

6.6 Conclusion

In a conclusion, this chapter has been explained all the detail of testing that have been done in this project. The functionality of PIR Motion Sensor, Pi Noir Camera and Webcam has been testing. The results have been analyze and all the devices can work properly as the prototype detected a motion, can get a live streaming in a real-time, the parents can get an email notifications of recorded video and all the files are stored in Raspberry Pi. In the next chapter, a project conclusion is discussed. The project summary, project contribution, project limitation and the future work of this project will be explained details in the next chapter.

CHAPTER VII

CONCLUSION

7.1 Introduction

In this chapter, is explained and discussed about the project conclusion that contains of project summarization, project contribution, project limitation and future works. Moreover, in this chapter explain whether the objective are achieved or not. For each problem of this project are explained in a project limitation section. There are several suggestion of this project that can be implemented in the future works. In the final section, it conclude all the project details.

7.2 Project Summarization

In this subtopic are explain all the summary of the project. The objective of this project is gained from the current issues which is parents are busy with their work that cannot aware the actual situation and condition of their baby when they are not at home. Fortunately, with a Smart Baby Monitoring Device the objective has been achieved which is the parents can monitor their baby all the time and anywhere. The next objective is develop a product that are functional and usable for parents and also get a notifications of baby conditions. This project are able to notify parents with an email alert by attached a video when a sensor detected a movement of baby. Moreover, parents can view a live streaming through a web-browser to monitor their baby conditions in a real time. Besides that, all the files of video are stored in a local memory which is in a Raspberry Pi itself.

There is a strength and weakness in developing this product. In this project the weakness is the size of video is limit to avoid a latency and delay and the sensitivity range of PIR Motion Sensor is limited which is up to 20 feet (6 meters). Moreover, the Raspberry Pi still need a support from external hard disk because of the internal memory is low and it cannot store all the data or files in a mean time. The strength of this project is the parents can get a notifications by email when the motion is detected.

7.3 Project Contribution

In this Smart Baby Monitoring Device, there is a lot of benefit to the parents. One of the benefit is with this device it can help parents to monitor their baby while they are in a workplaces or anywhere. The device is made up of Raspberry Pi which is cheaper than a computer and it can work exactly as a real computer. Even though the current baby monitor devices in the market have many features and ability with a good functionality, but it need an expertise to build in with a special needs of requirements and expensive. Moreover, this device can give a notify alert to a parents via email and can watch live streaming of their baby in a real time and it also widely compatible and can be accessed both on the smartphone or computer.

7.4 Project Limitation

In this project, there are various limitation that have to face during to develop and complete this Smart Baby Monitoring Device project. In the Raspberry Pi there is no input sound which does not have microphone socket, so it difficult to find a compatible and it does not support by the Raspberry Pi. Besides that, lack of time to learn more about the sound card and need more time to study how it's work with the Raspberry Pi. It also requires an additional cost to buy an extra device to record a voice of baby crying. Other than that, the video quality of USB Webcam is low because it's not the high-end specifications and it will cost more to buy that device which is the limitation of the budget. Moreover, the limitation of this project is cloud storage, there is lack of time to implement

the cloud storage. Lack of memory space to store the file and data in the Raspberry Pi, to solve this problem all the file and data storage can be store at the cloud storage. Although there are limitations in this project, but the project can be implemented successfully.

7.5 Future Works

For the future work, This Smart Baby Monitoring Device can be enhanced by adding a USB Sound Card to integrate with PIR Motion Sensor that to detects baby crying and the movement of baby in a nursery room. Other than that can enhance by using a high-end specifications of Webcam to get a better video quality without any delay. Moreover, for a notify alert, can be enhance through a media social applications such as Twitter, WhatsApp, and Telegram. All the data and video record of a baby should be able to upload and store to the cloud storage to reduce a memory space in a local memory of Raspberry Pi. Hopefully, this project can be continue in the future because there are many contribution and benefit for the future.

7.6 Conclusion

In a conclusion, the objective are achieved and has met all the requirements of this project. However, all the obstacles successfully faced even there is a several problem in this project. Hopefully, this project will give some benefits to all users or researchers that using Raspberry Pi. In a nutshell, hope that this Smart Baby Monitoring Device is widely used of the next evolution of individual and easy to use by all he user regardless of IT background or non-IT background.

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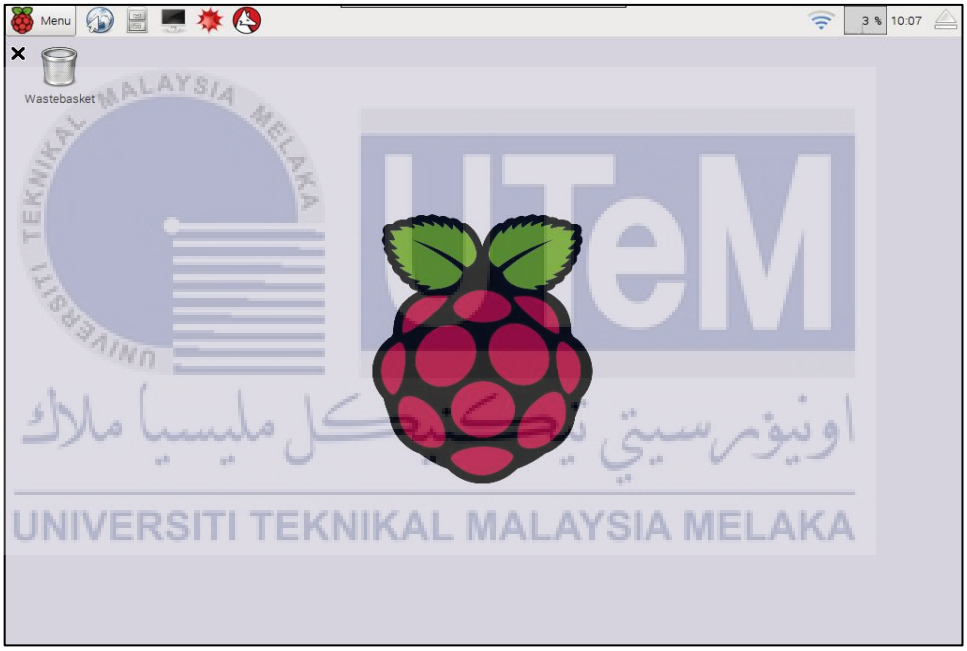
APPENDIX

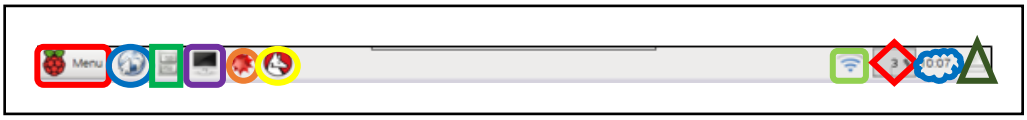
USER MANUAL FOR SMART BABY MONITOR DEVICE

Step 1: Setup the Raspberry Pi, make sure all device connect to Raspberry Pi before switch on the Raspberry Pi

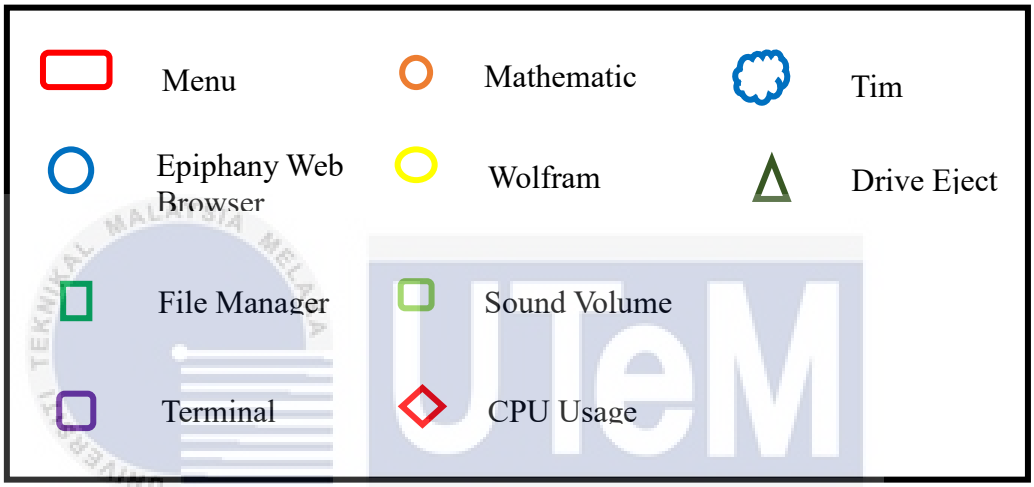
Step 2: Raspberry Pi desktop will appear after boot screen.



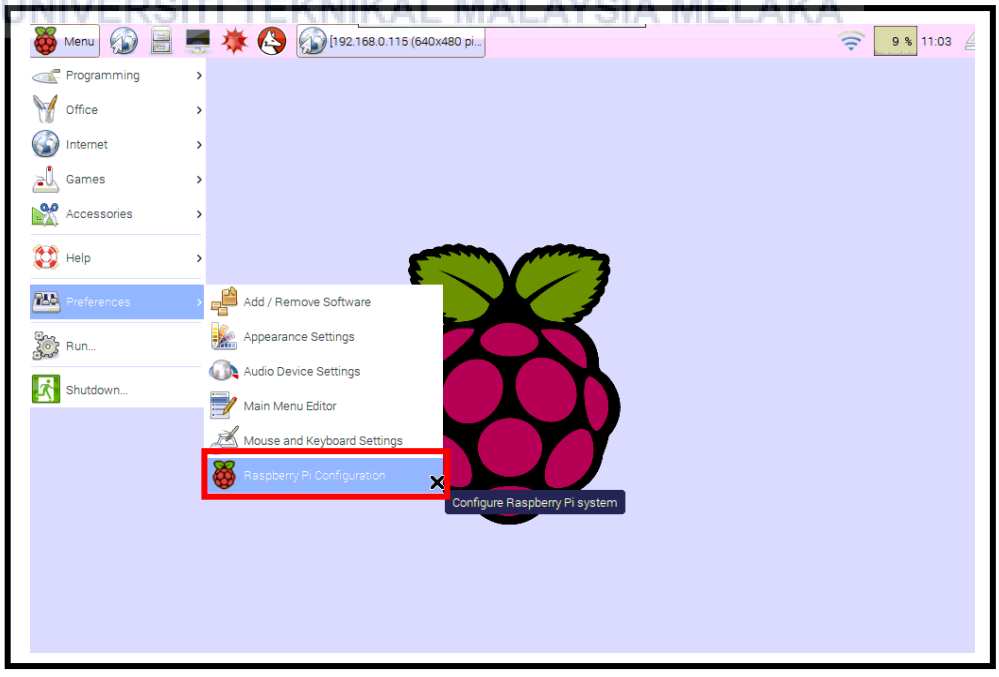
- Taskbar



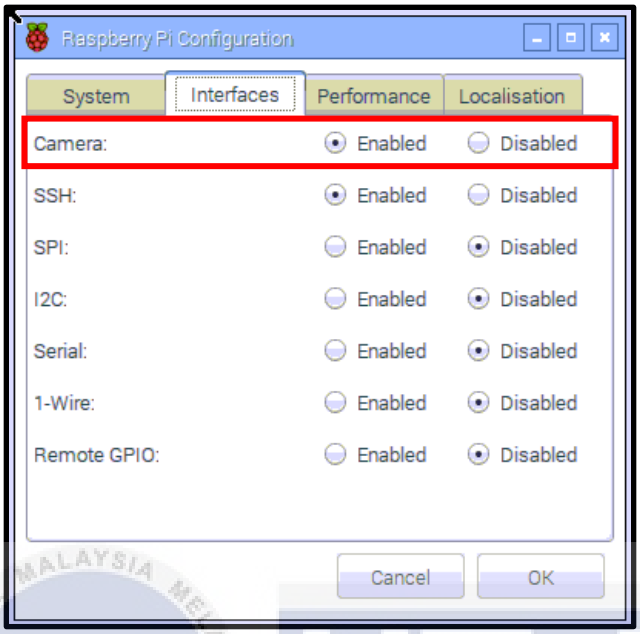
- Legend of taskbar



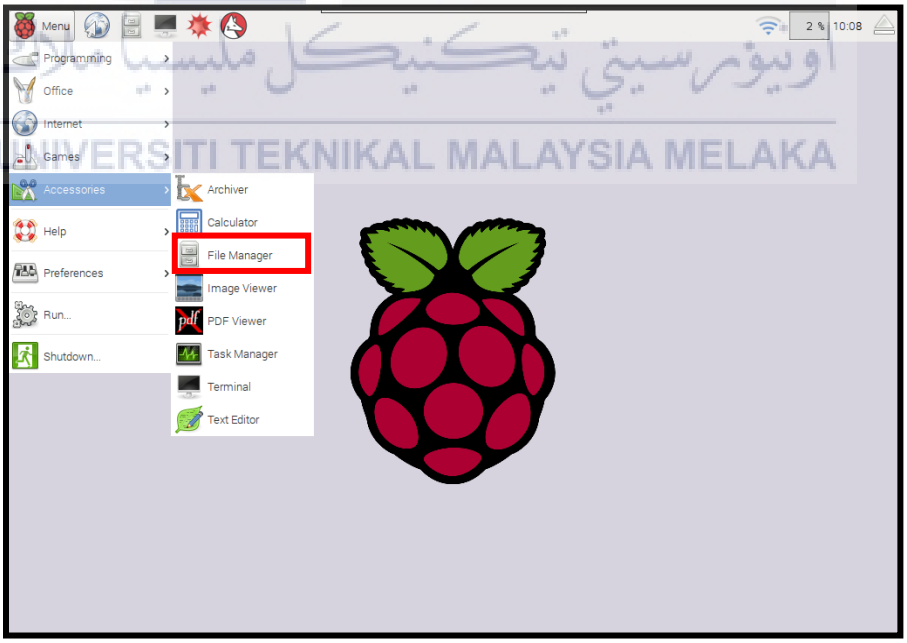
To setup Pi Camera go to Menu – Preferences – Raspberry Pi Configuration



On Raspberry Pi Configuration, Enable the camera to use the Pi Camera



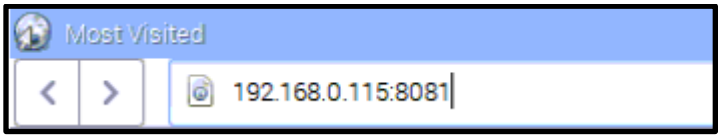
Step 3: To open the home directory Raspberry Pi, go to **Menu** – **Accessories** – **File Manager**



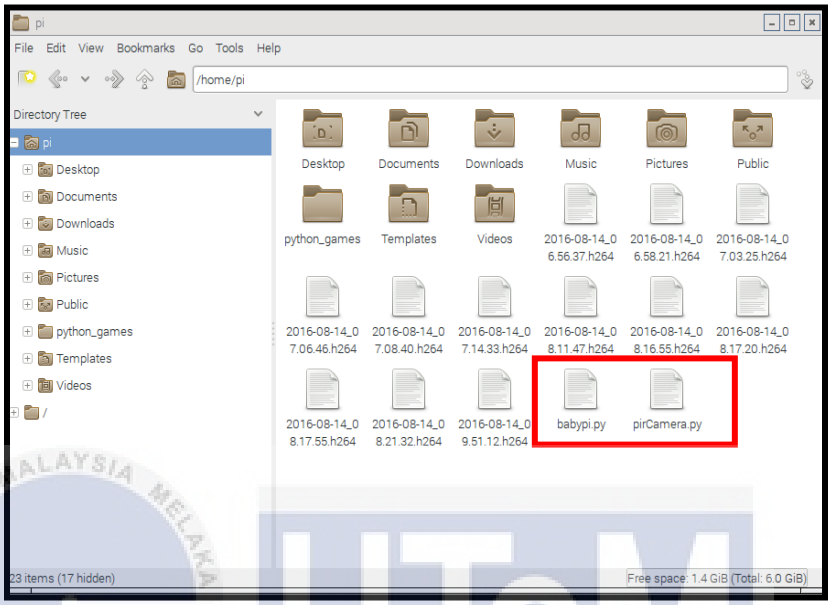
Step 4: On browser URL use IP Address of Raspberry Pi to view the webcam streaming

For example **IP Address – 192.168.0.115 and Port – 8081.**

*Make sure the motion service already start before using the webcam streaming

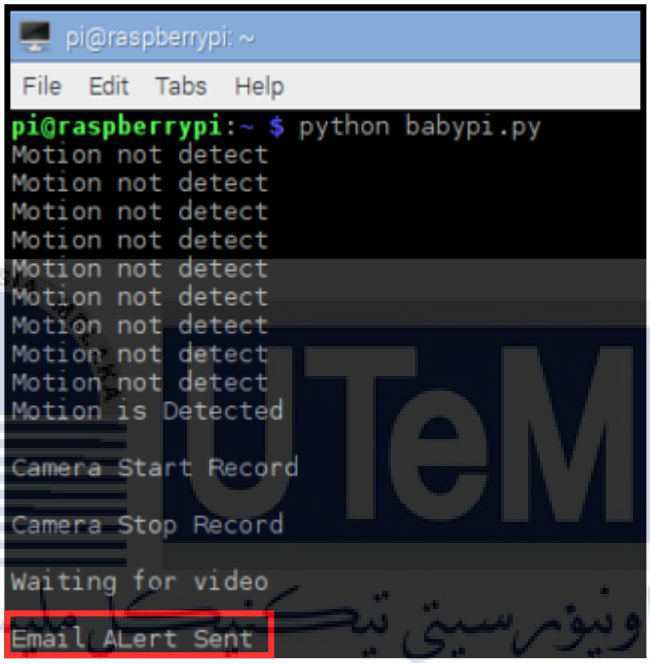


Step 5: All file in the home directory can be find here, the python file will show with .py extension



Step 6: Open terminal by click at the Taskbar menu. Use command *python babypi.py*

Step 7: The script execute and will detect the motion from the motion sensor, once the motion detected the Pi Camera will record the video. Duration of the video can be set in the file by change the value of ***sleep (). Waiting for video*** refer to the system attach the video to the user email. **Email alert Sent** notify user that the email successfully send to user email



Step 8: User can check their email after get the alert, the email will contain video attachment and can be download to watch the video.