# A STUDY OF INFRARED TECHNOLOGY, AND A DEVELOPMENT OF (PROTOTYPE) NOTIFICATION SYSTEM FOR WASTE MANAGEMENT USING INFRARED TECHNOLOGY

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**THESIS SUBMITTED IN PARTIAL FULFILLMENT FOR THE BACHELOR OF SCIENCE (Hons) IN**

**DATA COMMUNICATION AND NETWORKING**

**FACULTY OF INFORMATION TECHNOLOGY**
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**SHAH ALAM**

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Approved by the Examining Committee:

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## DECLARATION

I hereby declare that the work in this project paper is my own except for quotation and summaries, which have been duly acknowledged.

……

27th April 2006

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# ABSTRACT

Nowadays, the infrared technology is used widely in various applications including the wireless communication, environment control system, computer hardware, sensor devices and many more. Through this research project, researcher wants to study about the infrared technology in detail and to find out people understanding towards infrared technology. Infrared has a few advantages that make it been chosen over others wireless technology. Infrared require low power, simple circuitry, energy efficiency, precise control, low cost and maintenance. Due to these features, the researcher has come out with idea to create notification system which can assist people in waste management. The researcher used the infrared technology combined with sensor application, to develop a prototype of notification system which can alert people whenever the large bins become full or over limits. This system will warn people about the waste situation so they know it need to be cleared if it is full. Consequently, people can make a report to waste management company as soon as possible. The researcher has chosen infrared technology to be used for this notification system because of the features it has. The researcher has made a survey through questionnaires in order to achieve the first objective of this research project, while the second objective through product development. All findings were presented together with the discussions. Finally, conclusions and recommendations were proposed at the end of the research project.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

This chapter briefly describes the introduction and purposes of this research project. The researcher will explain in detail the background of this research project, the problem statements which encourage the researcher to make this research project, the objectives researcher wants to achieve through this research project, the scope of this research project and the significance this research project will contributes.

## 1.2 Background of Research Project

The infrared technology increasingly present applications and holds great potential for enabling people with a variety to access a growing list of information resources. Already commonly used in remote control of televisions and CD players, infrared technology also is being used and developed for remote control of environment systems, personal computers peripherals and talking signs.

Wireless communication allows information to be exchange between two devices without the use of wire cable. For example, a wireless keyboard sends information to the computer without the use of keyboard cable, a cellular phone sends information to another telephone without the use of telephone cable,

transferring information from one computer to another computer without using a cable, changing television channel using remote control and many more. In recent years, these applications are widely use by users.

As the infrared technology is been widely used for variety applications, the researcher has come out with idea to create a notification system which related to the waste management.

As we know, the waste collection and management is important in order to keep the environment clean. Nowadays, there are many companies which handled the collection of waste such as Alam Flora Sdn Bhd, Majlis Bandaraya Shah Alam, Dewan Bandaraya Kuala Lumpur and many more.

Every waste management company has their own manual schedule in collecting the waste. This is depending to the areas involved. Overall, the current schedule is they collect the waste everyday, three times per week or once per week. The schedule for waste collection at one place is difference with other places.

## 1.3 Problem Statement

The infrared applications have been used for a variety purposes. But not all people know or realize about the uses of infrared technology. Beside, every people have difference perception and difference understanding towards infrared technology. Behind the advantages using the infrared technology, there are also some limitations occur due to the infrared features.

Infrared technology has been used widely in sensor applications. Based on that situation, the researcher get in idea to suggest and create a notification system which can assist waste management in daily life using the infrared technology.

Everyday we are producing a lot of waste. This is a major factor which leads to environment pollution. In order to maintain the cleanliness, there are companies which are responsible to manage and dispose the waste. The companies play their task in collecting the waste before it can be disposed off at the disposal sites. They have their own manual schedule in collecting the waste which is everyday, three times per week, twice per week, once per week and so on.

In certain places, the producing of waste sometimes over limits the large bin or full before the next collection. Consequently, the over limit of the waste will causing a bad impacts to the environment. Beside, it will also produce a bad smell and unhealthy air which is not good for our breathing. This situation will disturb people who are living around that area. Furthermore, the place might become the place where it can spread disease such as dengue, cholera and so on. This is very dangerous to people especially for the children.

In the other hand, the workers might not follow their working schedule very well in collecting the waste. Due to this situation, people need to make a report in order to inform the company about the over limits of the waste. For example, people need to go to the service counter or call the waste management company to make the report.

Sometimes people do not realize when the large bins become full or the waste is over limits. Because of this, it is better if there is a notification system which can alert people about the full of waste in the large bins so that they can make a report in short time.

## 1.4 Objectives

The researcher has two objectives for this research project. The first objective of this research project is the researcher wants to make a study of infrared technology and the infrared applications available uses by people.

In addition, the researcher wants to find out what are people perceptions and their understanding towards infrared technology.

The second objective is the researcher wants to develop a prototype of notification system for waste collection. This notification system will alert people whenever the large bins become full or over limits.

The purpose of this notification system is to make people realize the situation so that they can make a report as soon as possible.

## 1.5 Scope of Research

For the first objective, the researcher wants to make a study of the infrared technology in detail. Here the researcher will focuses on the history of infrared, the applications using infrared technology, the advantages of infrared technology and the limitations of infrared features.

Beside, the researcher wants to find out user perception towards infrared technology, the type of infrared applications people familiar with and the frequency people uses those applications.

For this objective also, the researcher wants to make a survey of waste management to determine how often the waste collection is done at respondents living area. The researcher also wants to observe respondents opinion about the suggestion to use notification system which can assist waste management.

For the second objective, the prototype of this project will be using an integrated infrared circuit. The main devices consists of a sensor circuit which is a modification from automatic door chiming bell, the infrared sender circuit, the infrared receiver circuit and a light bulb.

The prototype can only detect when the large bin become full. The circuit will be connected to the light bulb which can display a signal to warn the user that the waste is over limits and the large bin need to be cleared. The integrated infrared circuit will be placed at the wall in the area of large bin. The prototype is planned to be used for large bin which is located under a building.

## 1.6 Significance of the Research

There are a few significance can be contributed through this research project. The first significance is to the society, they will know information about the infrared technology and the applications of infrared technology in detail.

The second significance, if the prototype of the notification system successfully built it can assist people to manage the domestic waste by alerting people when the large bins become full. For the areas involved, this notification system will help to avoid a bad environment and prevent the environment pollution.

For the researcher, this research project will help the researcher to learn more detail about the infrared technology by doing detail study. Beside, the researcher also will gain an experience in system development through the prototype development.

## 1.7 Summary

In this chapter, the researcher discusses the purposes for this research project which are to study the infrared technology and develop a prototype of notification system to assist waste management. The researcher also intends to propose the prototype so that in can be enhanced and implement in future.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

This chapter is dedicated on reviewing various related literatures and briefly describes the study done by the researchers. In completing this research project, the researcher needs to gather information from many sources such as books, newspapers, journals, articles and internet browsing. The researcher also has to understand deeply about the infrared technology, the sensors applications and the waste management scenarios that are related to the development of this research project.

## 2.2 Introduction to Infrared

Infrared radiation is an electromagnetic radiation of a wavelength longer than visible light, but shorter than microwave radiation. The name “infra” means “below” (from the Latin) and “red” is being the color of visible light of longest wavelength. According to Hopper, A. (2003), the infrared cannot be seen by human eyes.

*“The infrared wavelength range between 700nm to 1 mm. An infrared beam cannot be seen by the eye but can cause changes in certain electronic component”.*

(Hopper, A. 2003)

### 2.2.1 The History of Infrared

The infrared was discovered by Sir William Herschel, an astronomer in 1800. Knowing that sunlight was made up of all the colors in spectrum and also a source of heat, Herschel wanted to find out which colors were responsible for heating objects. He made an experiment using a prism, paperboard and thermometers with blackened bulb.

Through the experiments, he measured the temperatures of the different colors. Herschel observed an increased in temperature as he moved the thermometer from violet color to red color, from the spectrum created by sunlight passing through the prism. At first, Herschel termed this invisible radiation with "calorific rays", which today is known as infrared.

*"The hottest temperature was actually beyond the red light. The radiation causing this heating is not visible by human eyes"*

(Sir William Herschel, 1800)

### 2.2.2 The Applications using Infrared Technology

**i. Wireless Communications:**

Infrared data transmission is also employed in short-range communication among communication devices such as hand phone, personal digital assistance and computers. These devices are usually conforming to standards published by the Infrared Data Association (IrDA). Cremer, Mike. (Nov-Dec 1994).

Infrared communications are useful for indoor use in areas of high population density. Infrared does not penetrate walls and so does not interfere with other devices in adjoining rooms. With the development of next generation mobile communications, IrDA technology has emerged in mobile phones, PDAs digital cameras, along with traditional portable personal computers.

*"Infrared technology is highlighted because of its increasing presence in mainstream applications, its current and potential usage in disability-related applications and its advantages over other forms of wireless communication"*

(M, K-Krolak., Mark E.Novak, 1995)

**ii. Computer Devices:**

Infrared technology also has been built up in computer hardware and peripherals such as mouse, keyboards, floppy disk drives, printers and so on. All these devices are connecting to computer without using any wire or cable. The data transmission between these devices is in wireless form.

**iii. Environmental Control System:**

For the environmental control system, the infrared technology is being used together with a sensor. This including the tools which can control things in certain environments such as the automatic door chiming bell, the automatic sliding door, devices to control lights, devices to control level of the temperature and many more.

**iv. Home Security System :**

The infrared technology also is used in purpose for home security system. This is usually used accompanied with alert system. Since the infrared cannot be seen by human eyes, it is useful to detect intruders during night.

For certain security system, the infrared beam is transmitted in a straight line. Once there is an object blocking the signal, the signal is interrupted and consequently alerts the security system.

**v. Remote Control Devices:**

Remote controls devices use infrared light-emitting diodes (LEDs) to emit infrared radiation which is focused by a plastic lens into a narrow beam. The beam then is modulated, switched on and off to encode the data. According to Weeder, Terry, J. (August 1995), the receiver uses a silicon photodiode to convert the infrared radiation into an electric current. It responds only to the rapidly pulsing signal created by the transmitter and filters out slowly changing infrared radiation from ambient light.

**vi. Toys:**

Some of the toys also are using the infrared technology. Infrared detection is a common thing to add to a robot. It allows the robot to determine when it has come in close proximity to an object without coming into physical contact.

**vii. Night Vision:**

Infrared is used in night vision equipment when there is insufficient visible light to see an object. The radiation is detected and turned into an image on the screen. The hotter objects showing up in different shades compare to the cooler objects.

**viii. Thermography:**

Infrared radiation can be used to remotely determine the temperature of objects if the emissivity is known. Thermography is mainly used in military and industrial applications but the technology is reaching the public market in the form of infrared cameras on cars due to the massively reduce the production cost. Infrared radiation also is used in infrared saunas to heat the sauna's occupants and to remove ice from the wings of aircraft.

**ix. Spectroscopy:**

Infrared radiation spectroscopy is the study of the composition of organic compounds. The structure and composition of the organic compounds are based on the percentage transmittance of infrared radiation through a sample.

### 2.2.3 The Advantages of Infrared

There are numerous advantages when we are using infrared technology. A few advantages are listed below.

**i. Low Power Requirements:**

Infrared applications normally require a low power to be used. It is also portable and can be used in devices such as personal computer, laptop, telephones, personal assistance and so on.

**ii. Simple Circuitry:**

No special or proprietary hardware is required. Usually infrared circuit can be incorporated into the integrated circuit of a product.

**iii. Energy Efficiency:**

Most of the energy in properly designed system is directed to the surface and acting directly on the coating. This will resulting in faster product curing or drying and lower energy costs. The processing time can be 50 to 85 percent faster than convection ovens which are using microwave.

**iv. Time and Space Saving:**

Infrared equipment occupies less floor space compare to equipments which are using microwave. For example, infrared ovens can be added to improve existing convection ovens.

**v. Precise Control:**

Electric infrared emitter responds very quickly and can be controlled by microprocessors that quickly follow process changes. This is very important where the coating characteristics change from product to product.

**vi. Low Initial Cost and Maintenance:**

Electric infrared equipment usually cost less than other equipments for the same function. The infrared emitters can be designed for long life, easy periodic cleaning and minimal cost maintenance.

**vii. Infrared More Secure:**

Infrared has high noise immunity and not as likely to have interference from signals by other devices. Since the infrared signal cannot penetrate walls, there is less likelihood of eavesdropping compare to ordinary radio waves.

### 2.2.4 The Limitations of Infrared

Behind the advantages listed above, infrared applications also have certain limitations. Several limitations are listed as follow:

**i. Line of Sight:**

The infrared beam is transmitted in straight line. Because of that, transmitters and receivers must be almost directly aligned so they are able to see each other to communicate.

**ii. Blocked by Common Materials:**

The transmission of infrared beam can be blocked by the object such as walls, people, plants and so on.

**iii. Short Range:**

Infrared performance drops off with longer distance. The infrared range is not long compare to other signal.

**iv. Sensitive:**

Infrared is sensitive to light and weather. Infrared transmission can be affected by direct sunlight, rain, fog, dust and other pollution.

**v. Speed:**

The data rate transmission of infrared is lower than typical wired transmission.

### 2.2.5 Infrared Data Association (IrDA)

#### i. Introduction to IrDA:

Infrared Data Association (IrDA) was established in 1993 as collaboration between major industrial organizations in order to establish an open standard for infrared data communications. Since the foundation of IrDA, the organization's standard has been adopted by leading component manufactures, hardware and software companies worldwide. With the announcement of IrDA support in the Microsoft Windows 95 operating system in 1995, IrDA gained a foothold as a standard for low cost wireless communications between computers and peripheral devices.

#### ii. Infrared Implementations in IrDA:

Infrared data transfer is implemented according to the Infrared Data Association (IrDA) standards and protocols. These standards are designed to allow low-cost components and low power requirements to simply enable connections with pointing infrared devices at each other. Infrared transceivers are now installed in nearly all new portable computers. For a computer that does not have built-in infrared transceiver, it can be installed with an external infrared transceiver.

IrDA is a half-duplex and short range data transfer technology. The IrDA protocols specify the procedures that support link initialization, devices address discovery, connection startup and data rate negotiation, information exchange, link disconnection, link shutdown and device address conflict resolution.

### iii. The Objectives of IrDA:

When IrDA was established, its main objective was to create an interoperable, low-cost infrared data interconnection standard supporting a walk-up, point-to-point user model. The standard should be adaptable to a broad range of mobile appliances that need to connect to peripheral devices and hosts. To target such a broad range of devices, the following set of requirements was placed on IrDA:

1. Low cost.
2. Industry standard.
3. Compact, lightweight and low power.
4. Intuitive and easy to use.
5. Non-interfering.

Using these requirements, the IrDA committee developed a series of standards aimed at providing common, low-cost and directed infrared communications for all classes of mobile computing devices. Cremer, Mike. (Nov-Dec 1994).

## 2.3 Introduction to Sensor

Generally, a sensor is a type of transducer. Most sensors are electrical or electronic and consist of several components. Sensors are either direct indicating such as a mercury thermometer, or are paired with an indicator such as connected to an analog digital converter, a computer and a display.

First, there needs to be some interface which is not directly contact to the object, so that observable fact being quantified can be measured. Next, the physical signal captured must be translated into the signal that can be observed recorded in some way. Finally, the transducer signal must be conditioned to remove noise and calibrated into a scale so that the final quantified values have readily in interpretable meaning. This is to make the value sensed by human can be measured and readable.

While sensors are typically placed near the object being measured, there can also be important benefits to sensing objects from some distance. The whole fields of remote sensing have developed out of an interest in making the measurements of the earth's surface from airborne, space-based, observing platforms and so on.

Aside of using sensor for physical properties, there is also great interest in identifying and quantifying the presence of materials either for biological material or chemical material. In this situation, sensor needs to be very sensitive to small quantities because we are looking for very small objects, said Li, W., & Ching Yue, O. (2005).

### 2.3.1 Classification of Sensor Types

Over the years, many type of sensors have been developed. Beside, the technology nowadays allows more and more sensors to be manufactured. Since a significance change involves an exchange of energy, sensors can be classified according to the type of energy transfer they detect. The classification of sensor types is illustrated as follow:

**i. Thermographic Sensors:**

Thermographic sensor is used in the field related to the heat. Examples of thermographic sensor are thermometers and thermostats.

**ii. Electromagnetic Sensors:**

An electromagnetic sensor is used in the device which related to the magnetic field. Examples of electromagnetic sensor are magnetic compass, electrical resistance sensor, electrical current sensor and electrical voltage sensor.

**iii. Mechanical Sensors:**

Mechanical sensors is used to measure materials which are related to mechanical things such as pressure, air speed, gas' liquid. Examples of mechanical sensors are pressure sensor, gas and liquid flow sensor.

**iv. Chemical Sensors:**

Chemical sensors detect the presence of specific chemicals or classes of chemicals. Example of chemical sensor is oxygen sensor (lambda sensor)

**v. Optical and Radiation Sensors:**

Electromagnetic time-of-flight, which generates an electromagnetic impulse, broadcast it then measure the time a reflected pulse takes to return. For example the radio detection and ranging (RADAR).

Light time-of-flight, which is used in modern surveying equipment. A short pulse of light is emitted and returned by a reflector. The return time of the pulse is proportional to the distance and is related to atmospheric density in a predictable way.

**vi. Light Sensors:**

Light sensors also known as photo detectors which including the semiconductor devices. Examples of light sensors are photodiodes, phototransistors and photocells.

**vii. Proximity Sensors:**

Proximity sensor is a type of distance but less sophisticated. It only detects a specific. It may be optical, combination of a photocell and LED

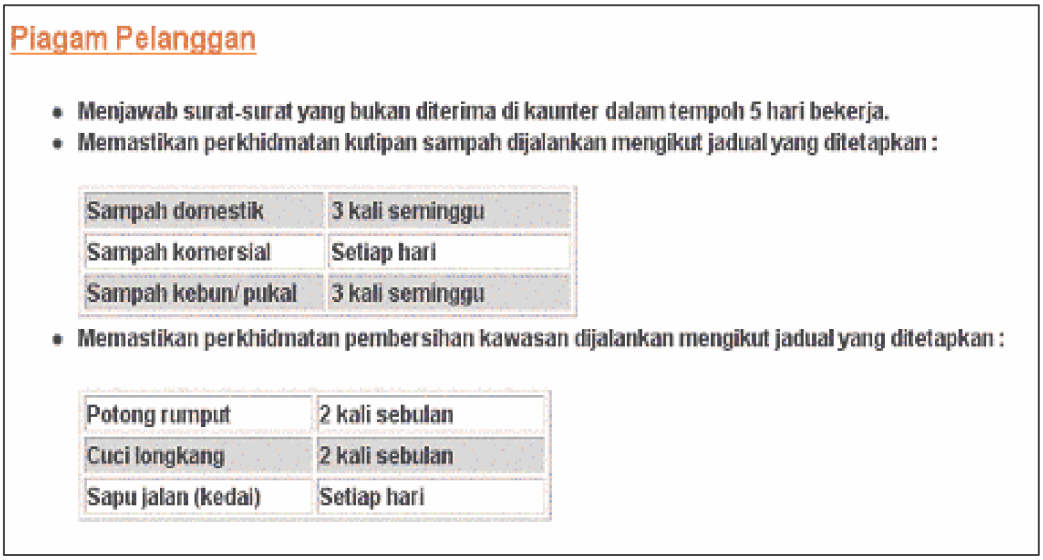
or laser. Example of proximity sensors are application in cell phone, paper detector in photocopiers, auto power standby or shutdown.

**viii. Acoustic Sensors:**

The acoustic sensors use ultrasound time-of-flight. Examples of acoustic sensors are microphones, hydrophones and seismometers.

## 2.4 Waste Management

Every company which handles the waste management has their own schedule. Here the researcher has browsed the "Majlis Bandaraya Shah Alam" (MBSA) to observe the schedule for the waste collection. Figure below shows the waste management schedule for MBSA.



Piagam Pelanggan

- Menjawab surat-surat yang bukan diterima di kaunter dalam tempoh 5 hari bekerja.
- Memastikan perkhidmatan kutipan sampah dijalankan mengikut jadual yang ditetapkan :

| | |
|---|---|
| Sampah domestik | 3 kali seminggu |
| Sampah komersial | Setiap hari |
| Sampah kebun/ pukal | 3 kali seminggu |

- Memastikan perkhidmatan pembersihan kawasan dijalankan mengikut jadual yang ditetapkan :

| | |
|---|---|
| Potong rumput | 2 kali sebulan |
| Cuci longkang | 2 kali sebulan |
| Sapu jalan (kedai) | Setiap hari |

*Source: http://www.mbsa.com.my/V2/swm_recources.htm*

Figure 1: The waste management schedule of "Majlis Bandaraya Shah Alam"

Figure above shows the waste management for "Majlis Bandaraya Shah Alam". From the figure above, the waste is collected based on the waste categories, which are domestic waste, commercial waste and garden or bulk waste. The wastes are collected everyday and every three days.

This means, the waste at certain places are not collected everyday. Because of that, the waste might over limits the large bin before the next collection time.

## 2.5 Related Research

**Title : A Comparative Study on Infrared (IrDA) and Bluetooth Technology**
**Author: Jamaluddin Bin Yusof**
**Year : 2003**

Through this research, the author found that both infrared (IrDA) and Bluetooth technology offers wireless connectivity services. Infrared is used for high speed, short range, line-of-sight and point-to-point data transfer. The range of infrared can be longer than one meter. It requires a narrow angle (30 degree) point-and-should operation. According to the author, the maximum data transfer speed is 4 Mbps and 16 Mbps is under development. It does not interfere with other wireless communication and also is immune to interfere from others.

As the researcher will be using an infrared technology for project development, it is important for the researcher to know more detail about the infrared technology. The research above helps the researcher to gain more information as guidelines.

## 2.6 Summary

In this chapter, descriptions for infrared technology and infrared applications are explained in detail. Beside, the researcher also presents the information about sensor and the types of sensor available. In addition, the schedule for waste management also been observed based to the “Majlis Bandaraya Shah Alam” schedule.

# CHAPTER 3

# METHODOLOGY

## 3.1 Introduction

Methodology plays an important part of the project development. This chapter present about the methodology that has being used as guidance towards the development of this project. A methodology is a physical implementation of the logical lifecycle including the activities, roles, techniques, requirements and tools to be used in performing each task.

In this research project, the researcher used the System Development Lifecycle (SDLC) for the project development. The methodology is broken down into four distinct phases which consists of Discovery (Phase 1), Designing (Phase 2), Development and Construction (Phase 3) and Implementation and Testing (Phase 4).

At phase 1, the pre-project discovery is performed. It is here where the high-level requirements are defined including the project plan and success metrics. The preliminary studies and information gathering is done during this phase.
The researcher also makes a survey at this phase by distributing questionnaires and continues with analyzing findings and discussions.

Phase 2 is the beginning of the technical process and the initial designs where the architecture begins to take place. Here the detailed design and specification of the development effort are defined. The system designs are presented in detail at this phase. The requirements for the project development also are determine.

Phase 3 is the phase where the development and construction of the technical solution is performed. This is the most important stage of the project development process. At this phase, the researcher develops and constructs the prototype model, the sensor circuit, the infrared sender circuit, the infrared receiver circuit and also deals with connecting all the devices. The formal quality assurance takes place at this phase.

Finally, phase 4 is the implementation and testing of the resultant development. Here the function of the prototype will be tested step by step to determine any problems occur and finding solution to fix the problems. The overview of the project methodology is illustrated in the next figure.

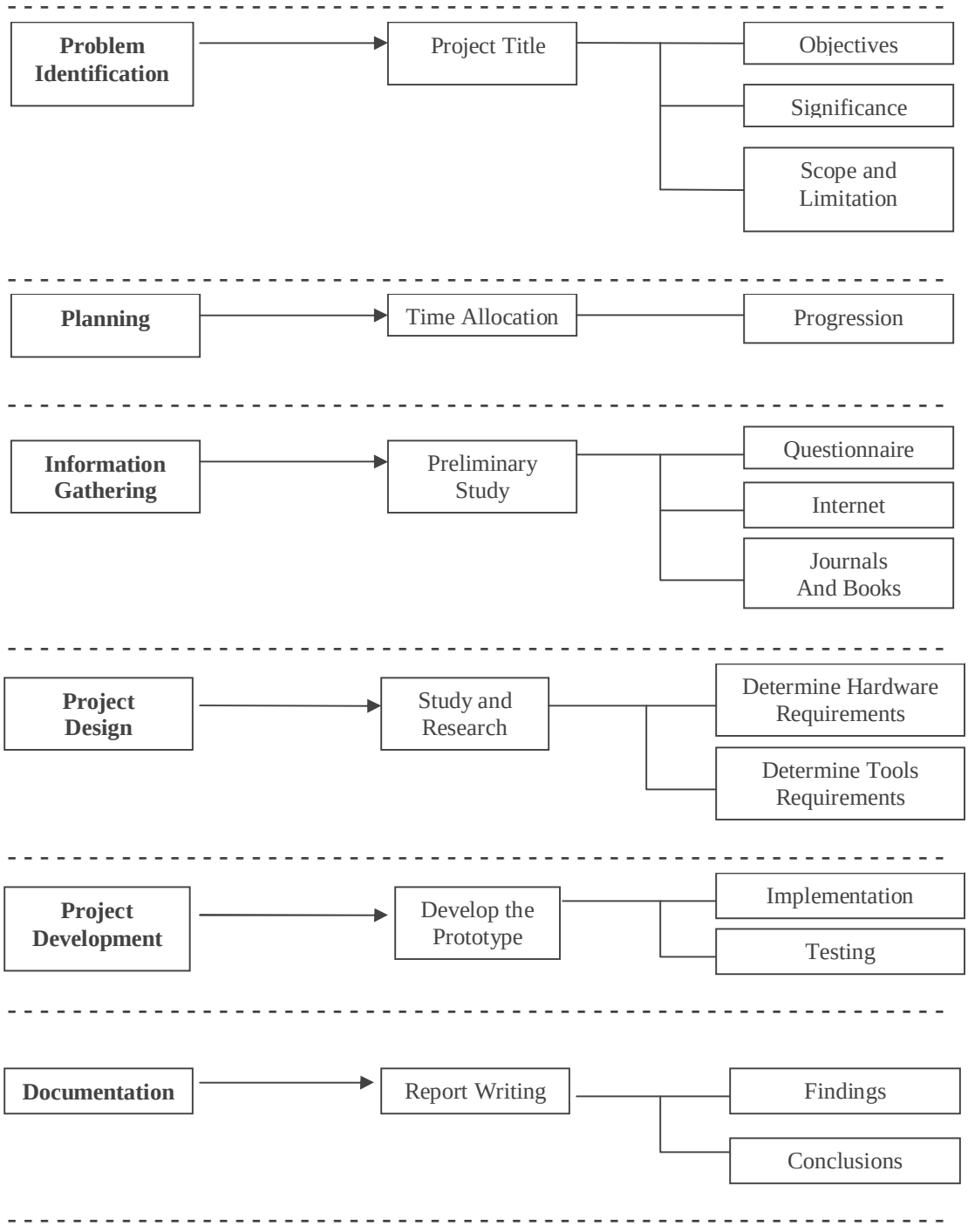



Figure 2 : The methodology overview

## 3.2 Phase 1: Discovery

For phase 1, the researcher will make a review for detail study about the infrared technology and the waste management. At this phase, the researcher tries to collect as much information as possible.

### 3.2.1 A Study about Infrared Technology and Waste Management

At this phase, the pre-project discovery is performed. A preliminary study from related literature review is done in order to get a clear overview of the project. All information gathered from the preliminary study will be used as guidelines to conduct this project in future.

The researcher has made a study through several sources including browsing related website, reading related articles, journals, books and also review the related previous research. By doing this information gathering, the researcher gets enough information as guidance.

### 3.2.2 Distribution of Questionnaires

At this phase also, the researcher has distributed a questionnaires in order to observe and get all the information related to the infrared applications use by respondents and the information about the waste management. The researcher randomly distributes a total of fifty questionnaires. The targets for the respondents of this research are UiTM students and those who have been

working. The total of respondents that occupied in this questionnaire is 50 respondents regardless of sex.

The questionnaire is done to be appropriated to the first objective of the research project. The questionnaires are offered to the respondents with reasonable range of answers to be chosen.

### 3.2.3 Analyzing Findings

After distributed all the questionnaires, the data will be analyzed and calculated based on the questions and number of the respondents. Then the findings from the questionnaires will be presented in a bar chart and pie chart using Microsoft Excel.

### 3.2.4 Discussions

The researcher will make a discussion based on the findings from the questionnaires. This is the important step because the researcher needs to relate the findings with the objectives of this study. Beside, discussions must be done in order to make a conclusion and propose some recommendations. Finally, the researcher will go through the report writing process.

## 3.3 Phase 2: System Designing

This is the beginning of the technical process and the initial designs. It is here where hardware requirements and tools are determined. Beside, the detailed design and specification of the development effort also been defined.

### 3.3.1 Hardware Requirements

Beside the detail study and the distribution of the questionnaires, all the requirements for hardware are determine at this phase. The hardware requirements that will be used in this project are illustrated as follow:

**i. Materials for the Prototype**

| No | Materials | Requirements |
|---|---|---|
| 1 | Polystyrene | To make the base for the prototype |
| 2 | Cardboard | To make the large bin model, light bulb stand, roof and walls |
| 3 | Light bulb | To display the signal from infrared receiver circuit |
| 4 | Wires | To connect the infrared integrated circuit with the light bulb |
| 5 | Paper box | To make the box for infrared integrated circuit |

Table 1: Materials for the prototype

### ii. The Automatic Door Chiming Bell

The chiming bell consists of sensor which is using infrared application. The sensor can detect an object if there are something has blocked the signal produce by the sensor. The researcher will modify the automatic door chiming bell circuit to be used in the prototype.


Figure 3: The automatic door chiming bell.

The features of the automatic door chiming bell are illustrated as below:

1. Automatically sound with a melody when someone passes through the sensing area.
2. The chiming door will produced three different melodies.
3. The chiming door functions in one unit and wiring required.
4. The sensing area up to 5 meters.
5. Used low power consumption.
6. Operated by two pieces 1.5V battery.
7. Ideal for placing near the door of shop, house to announce the entry or exit of the visitors.

### iii. Infrared Sender Circuit

| No | Electronic Component | Quantity |
|---|---|---|
| 1 | IC-1 555 (8 PIN) | 1 |
| 2 | Resistor 1, 1.2K (Brown-Red-Red) | 1 |
| 3 | Resistor 2, 39K (Orange-White-Orange) | 1 |
| 4 | Resistor 3, 100R (Brown-Black-Brown) | 1 |
| 5 | Capacitor 1, 470pF (471) | 1 |
| 6 | Capacitor 2, 0.1 (104) | 1 |
| 7 | Capacitor 3, 0.1 (104) | 1 |
| 8 | Switch (Push on button) | 1 |
| 9 | Light emitting diode | 1 |
| 10 | Infrared diode | 1 |
| 11 | Battery (9V) | 1 |

Table 2: Electronic components for infrared sender circuit

### iv. Infrared Receiver Circuit

| No | Electronic Component | Quantity |
|---|---|---|
| 1 | IC-1 4069 (14 PIN) | 1 |
| 2 | Resistor 1, 510R (Green-Brown-Brown) | 1 |
| 3 | Resistor 2, 3.3K (Orange-Orange-Red) | 1 |
| 4 | Capacitor 1, 10µF (Electrolytic) | 1 |
| 5 | Capacitor 2, 47µF (Electrolytic) | 1 |
| 6 | Q1 9013 (NPN) | 1 |
| 7 | Rectifier (IN4001/4002) | 1 |
| 8 | Light emitting diode | 1 |
| 9 | Relay 6VDC (SPDT) | 1 |
| 10 | Battery (9V) | 1 |

Table 3: Electronic components for infrared receiver circuit

### v. Tools to Construct the Circuit

| No | Tools Name | Quantity | Usage |
|---|---|---|---|
| 1 | Strip board | 2 units | To be used for electronic components placement |
| 2 | Soldering iron | 1 unit | For soldering the electronic components on the strip board |
| 3 | Soldering paste | 1 unit | |
| 4 | Soldering lead | 1 roll | |
| 5 | Sucker/ desoldering pump | 1 unit | To replace a faulty component or fix a joint |
| 6 | Magnifier helper | 1 unit | Assisting in soldering process |
| 7 | Wire stripper/wire cutter | 2 units | To split between wire copper and its cover |
| 8 | Small diameter wires | 2 meters | To make jumpers on the strip board |

Table 4: Tools to construct and develop the circuits

### 3.3.2 General Overview of the System:

Figure below show the general overview for the system. From the diagram, there are three parts of the system which consists of the large bin, the integrated infrared circuit and the output signal.

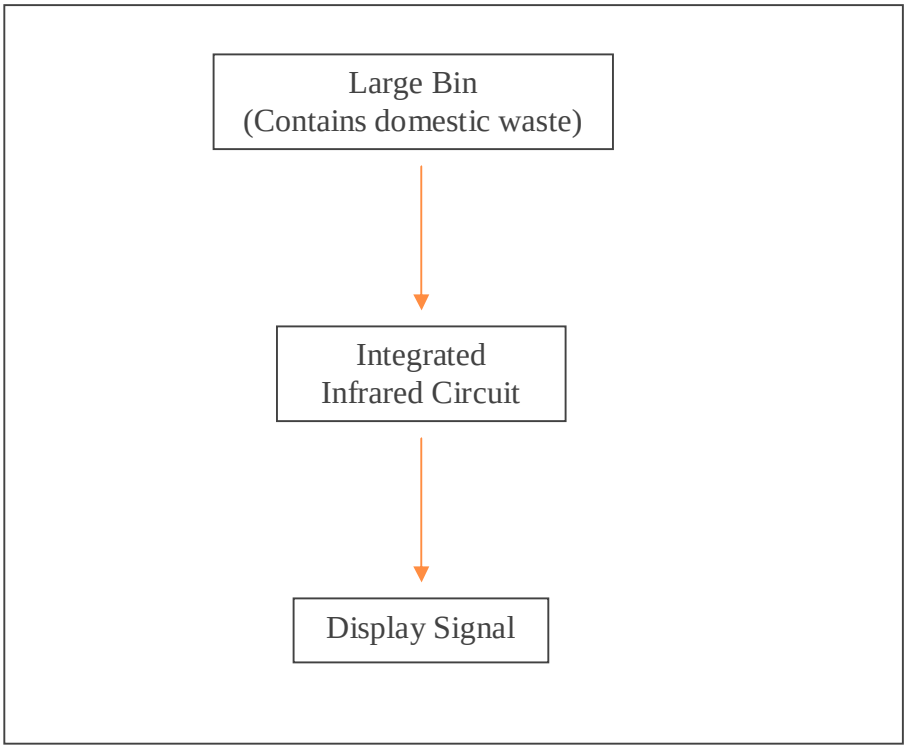



Figure 4: General overview of the system

### 3.3.3 Detail Overview of the System:

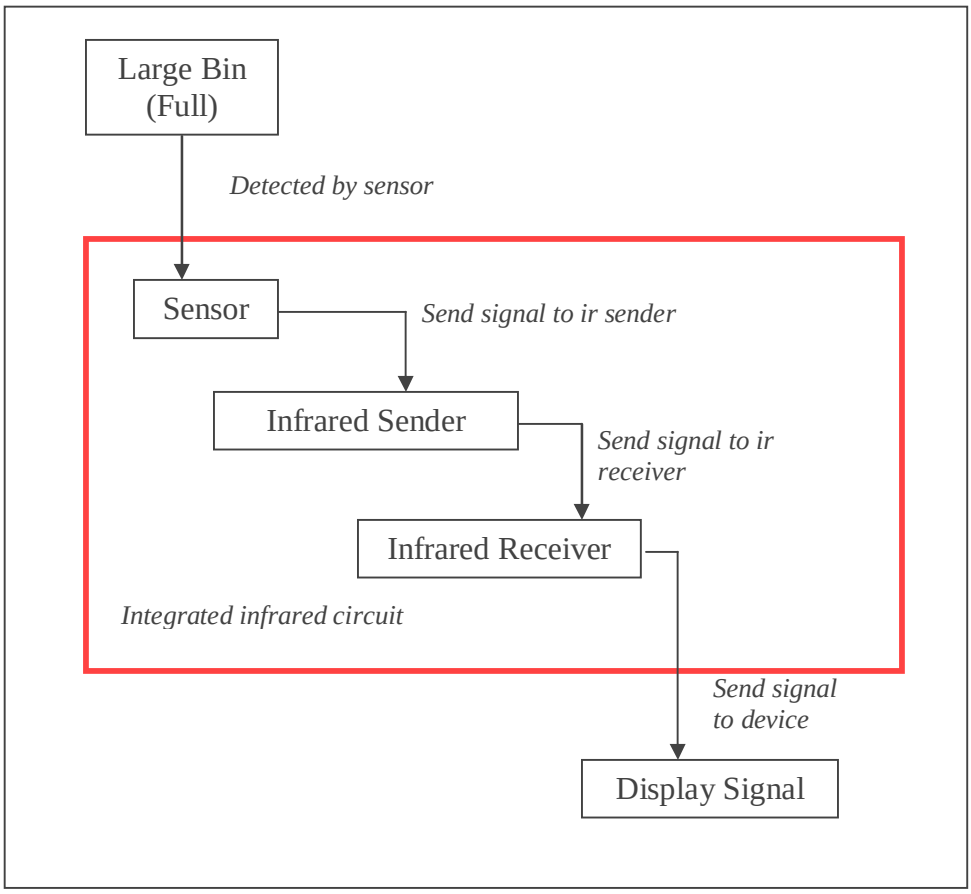



Figure 5: Detail Overview of the System

Figure above show the overview of the system in detail and the connection design between all devices. The integrated infrared circuit consists of the sensor circuit, the infrared sender circuit and the infrared receiver circuit.

For the operation, when the large bin becomes full it will be detected by the sensor. The sensor will transmit a signal to the infrared sender circuit. The infrared sender then will transmit signal to the infrared receiver circuit. Finally, the infrared receiver is connected to the light bulb and the light will be emitting to display the output.

### 3.3.4 The Physical Layout of the Prototype

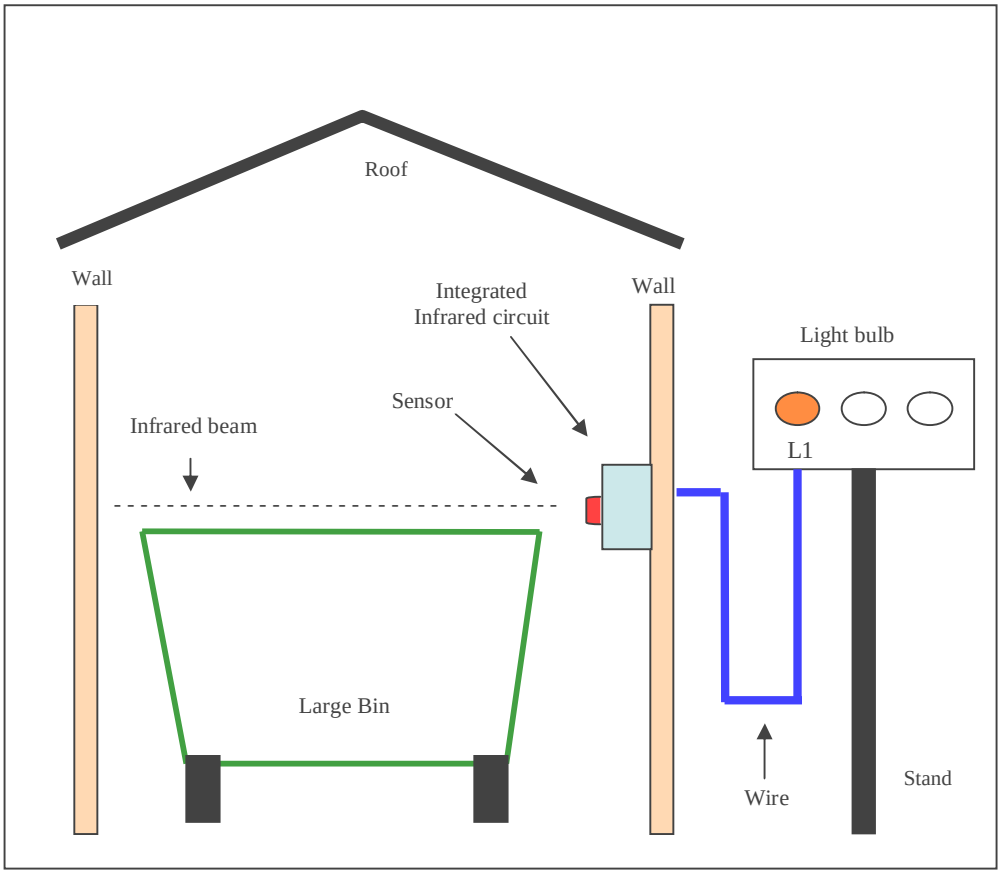



Figure 6: The physical layout for the prototype

Figure above illustrate the physical layout for the prototype. The prototype is design to be used for a large bin which is located in a building. The position for the integrated infrared circuit will be placed at the wall, beside the large bin. The light bulb will be connected to the circuit using a wire. There is a stand which will be holding the light bulb.

From the picture, each bulb will represents for one large bin. But for this prototype, there only one light bulb will be used, which present the large bin for the prototype.

## 3.4 Phase 3: Development and Constructions

The development and construction of the technical solution is performed. Here it is important to take note that the formal quality assurance takes place at this phase. The process and steps that will be performed are illustrated below.

### 3.4.1 Development of the Prototype Model

The model for the prototype will be developed according to the physical layout which has been showed in figure 6.

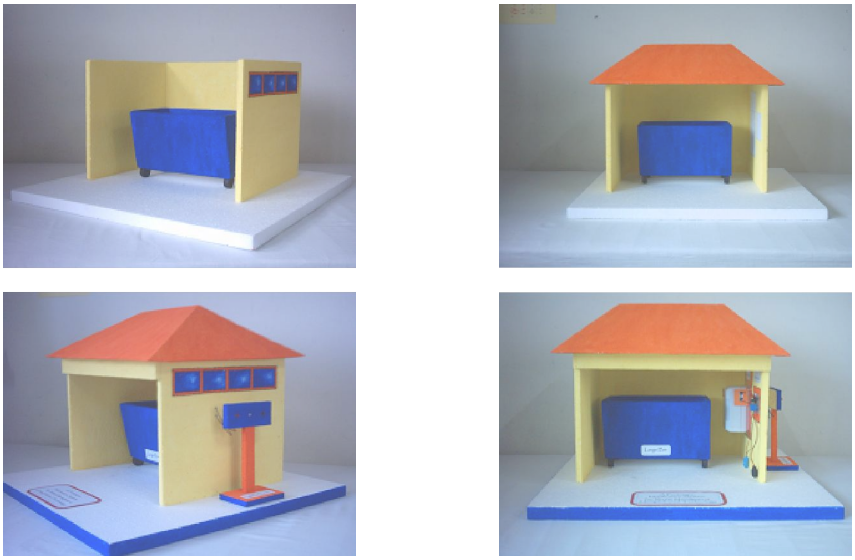


Figure 7: Prototype model development

### 3.4.2 The Door Chiming Bell Circuit

The door chiming bell circuit is used to act as the sensor circuit. The sensor circuit will be modified in order to connect it with infrared sender circuit.

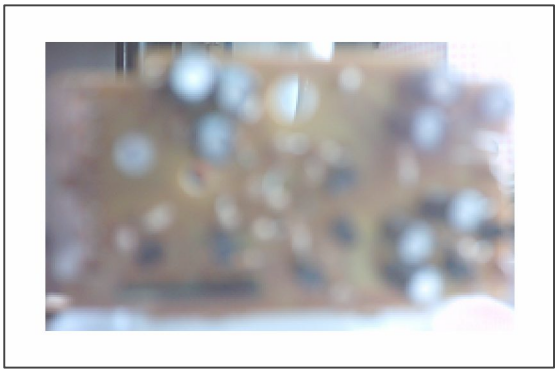


Figure 8: The chiming bell circuit

Figure 9: The picture of the sensor

### 3.4.3 Development of the Infrared Sender Circuit

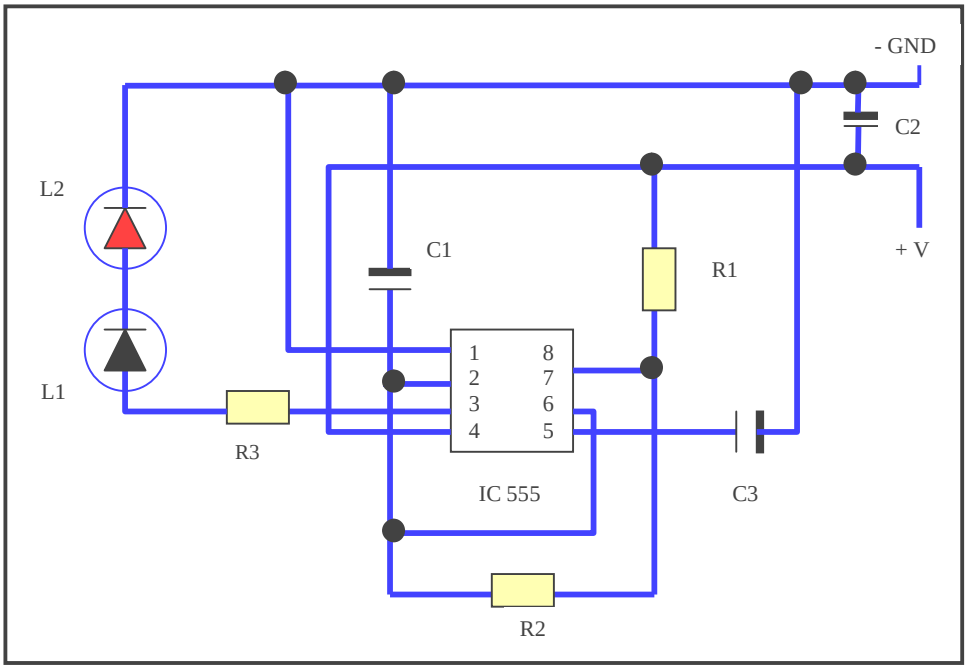



Figure 10 : The diagram for the infrared sender circuit.

Figure 11: The infrared sender circuit

### 3.4.4 Development of Infrared Receiver Circuit

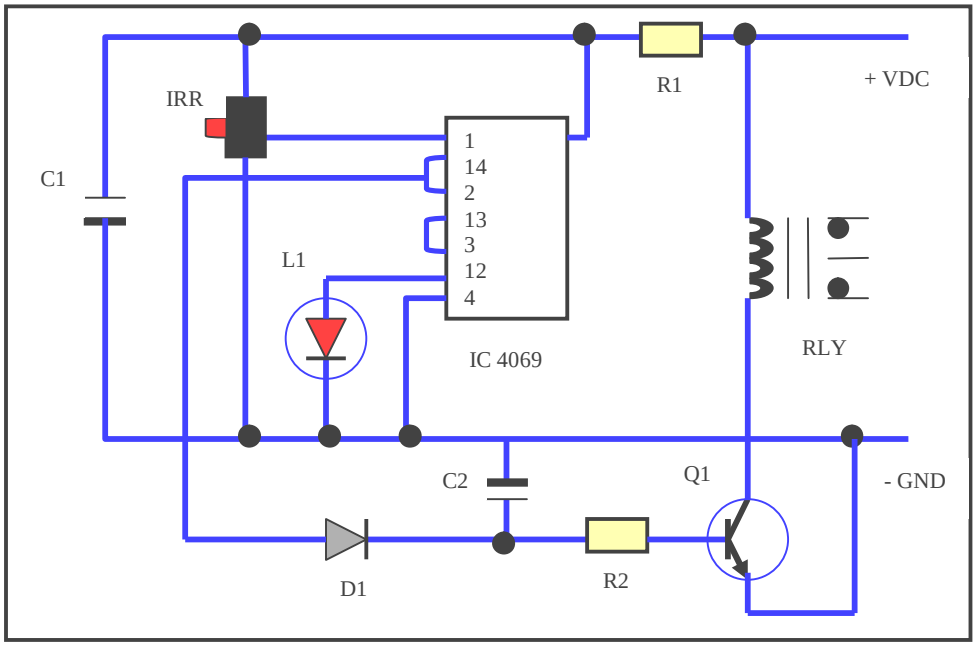



Figure 12: The diagram for infrared receiver circuit.

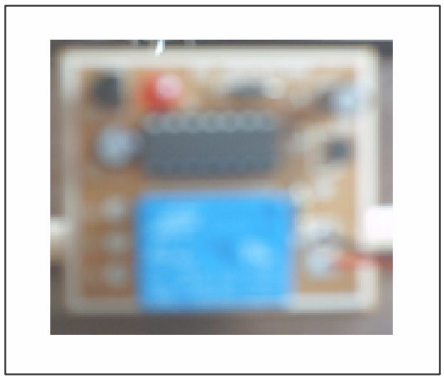


Figure 13: The infrared receiver circuit

## 3.5 Phase 4: Implementation and Testing

After all the three phases for development is finished, phase 4 will be performed. The prototype of this project will be implemented to test whether the functions is work successfully or not. If the function of the prototype is success as required, the result will be recorded to make the documentation.

Otherwise, if the function is not work as required an adjustment will be made as needed until the goal is achieve. The next figure shows the steps researcher goes through this phase.

Figure below shows the flowchart for implementation and testing. The steps involved at this process are done one by one. All the devices will be tested to ensure it will work as expected.

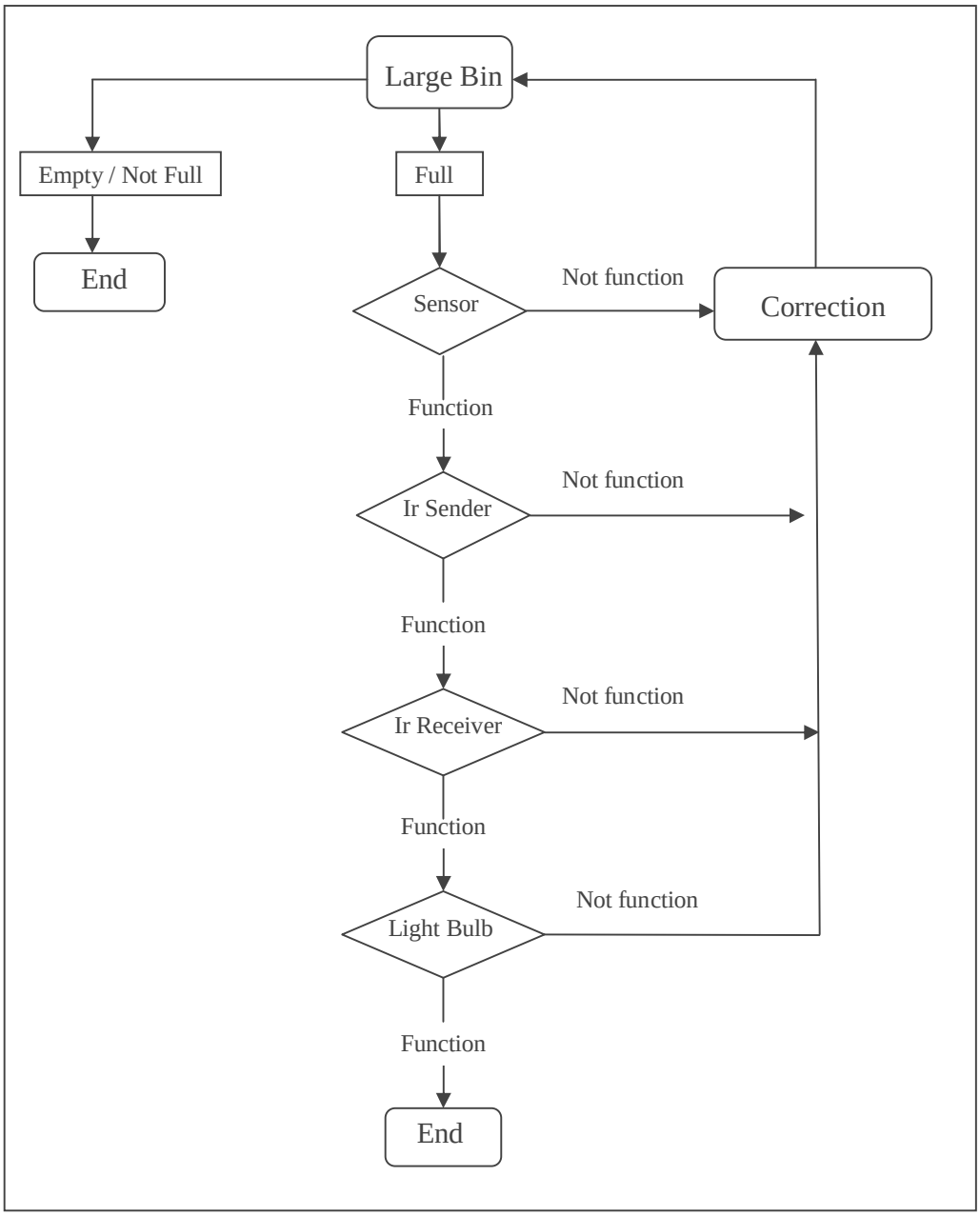



Figure 14: Flow chart for implementation and testing.

## 3.6 Summary

This chapter briefly described the methodology used by the researcher in completing this research project. All the requirements, materials and tools are listed in particular figures and tables. The steps for the project development are constructed in sequential order.

# CHAPTER 4

# FINDINGS AND DISCUSSIONS

## 4.1 Introduction

This chapter will present the findings for this research based to the questionnaires and the development of the prototype. The discussions for each finding also will be stated after the findings.

## 4.2 Findings and Discussions

### 4.2.1 Findings and Discussions from the Questionnaires

**i. Demographic Questions:**

Question 1: "Gender : Male or Female"
Question 2: "Age : 18-21, 22-25, 26-29, or 30 and above"
Question 3: "Status : Single or Married"
Question 4: "Occupation : Student, Working or others"

The purposes of these questions are to determine the identification of the respondents consists of gender, age, status and occupation.

For this part, 15 respondents are male while 35 respondents are female. There are 15 respondents age between 18-21 years old, 21 respondents age between 22-25 years old, 10 respondents age between 26-29 years old while 4 respondents at the age of 30 years old and above.

**ii. Research Questions (Section A: The Infrared Technology)**

**Question 5**:

"Do you know about the infrared technology?"

The purpose of this question is to determine respondent's knowledge towards infrared technology and whether they are exposing to the infrared technology or not.

For this question, all of the respondents know about the infrared technology.

**Question 6**:

"What is your perception about the infrared?"

The purpose of this question, the researcher wants to find out what is respondent's expectation towards infrared technology, whether they know or not what the real definition for infrared is.

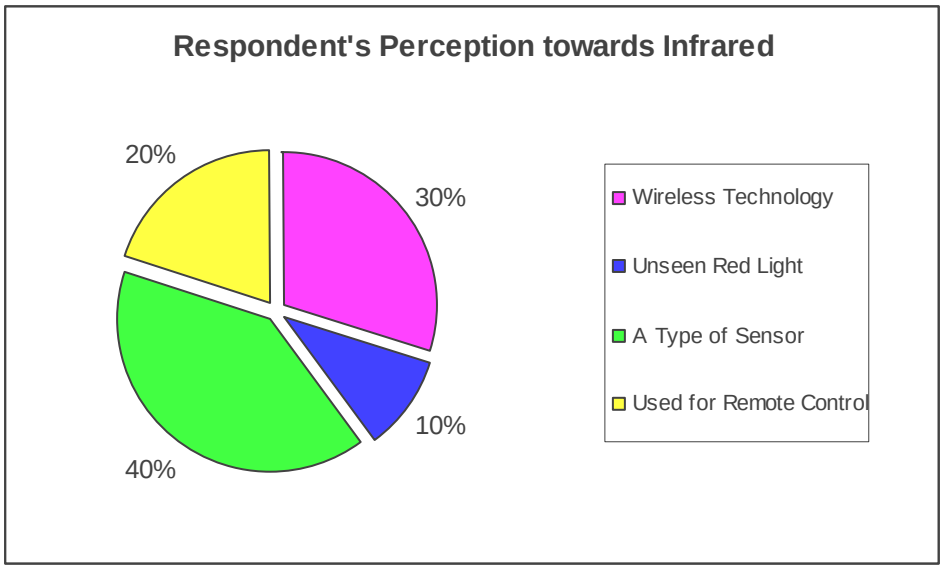



Figure 15: The respondent's perception towards infrared.

The pie chart above shows the percentage of respondents and their perception towards infrared. There are 40 % of respondents said that infrared is a type of sensor, 30 % of respondents said infrared is a wireless technology, 20 % of respondents said infrared is used for remote control while only 10 % of respondents said that infrared is an unseen red light.

Most of the respondents accept that infrared is a type of sensor. This might be because of infrared is widely used in sensor devices, so they accept the infrared is the sensor.

**Question 7**:

"Do you know the applications using infrared technology in our life?"

The purpose of this question is the researcher wants to find out whether respondents know and familiar with the applications using infrared or not.

For this question, all respondents state that they know about the applications using infrared technology. This means all of the respondents exposed to the applications using infrared technology.

**Question 8:**

"If yes, please choose from answers below in which applications that you know."

The purpose of this question, the researcher wants to know what the types of application are respondents know using infrared technology.

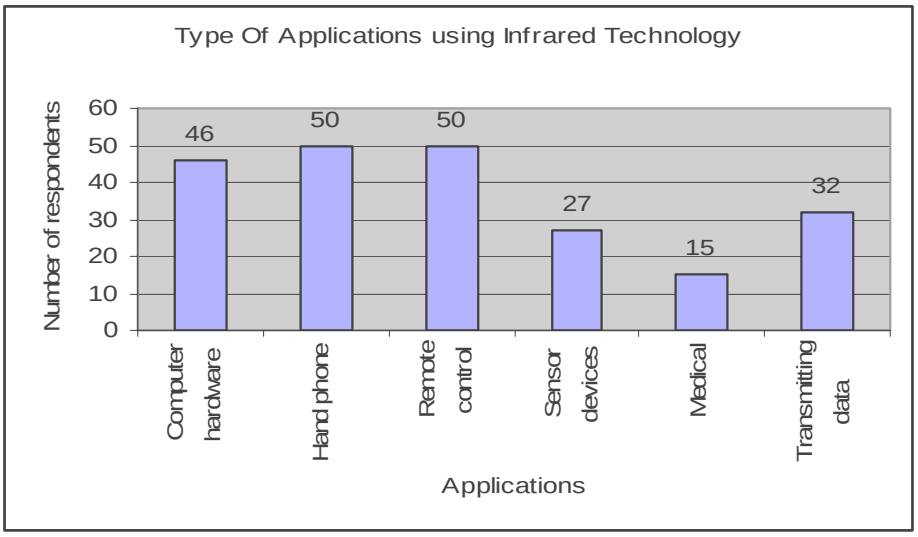



Figure 16: Type of infrared applications uses by respondents

The graph above shows the type of applications using infrared technology which are known by the respondents. There are six type of applications provided in the answers. 46 respondents out of 50 knew that infrared technology is used for computer hardware. There are 50 respondents knew that infrared technology is used in hand phone and remote control devices. Other than that, 27 respondents knew infrared is used for sensor devices, 15 respondents knew infrared is used in medical and 32 respondents knew that infrared is used in transmitting data from different devices. Most of the respondents know that infrared is used in remote control devices, hand phone and computer hardware.

**Question 9:**

"Do you ever use the applications listed in question 8?"

The purpose of this question is the researcher wants to find out whether respondents ever used the infrared applications or not.

For this question, all respondents said that they have used the applications listed in question 8.

**Question 10:**

"If yes, how often do you use the applications?"

The purpose of this question is the researcher wants to find out the frequency for each applications used by respondents.

| **Type of Applications** | Very Often | Often | Sometimes | Rarely | Never | Total Respondents |
|---|---|---|---|---|---|---|
| Computer Hardware | 22 | 10 | 5 | 13 | 0 | = 50 |
| Hand Phone | 6 | 12 | 2 | 2 | 10 | = 50 |
| Remote Control | 11 | 26 | 9 | 4 | 0 | = 50 |
| Sensor Devices | 7 | 23 | 15 | 4 | 1 | = 50 |
| Medical | 0 | 0 | 0 | 0 | 50 | = 50 |
| Transmitting Data | 3 | 10 | 12 | 7 | 18 | = 50 |

Table 5: Frequency the respondents uses infrared applications

Table above shows the frequency for infrared applications uses among respondents. Most of the respondents very often use the infrared technology in computer hardware. In contrast, there are no respondent uses the infrared technology for medical purposes.

**Question 11:**

"Do you own any infrared devices?"

The purpose of this question is the researcher wants to know whether respondents own any infrared devices. This is to determine respondents can afford to buy the infrared devices or not.

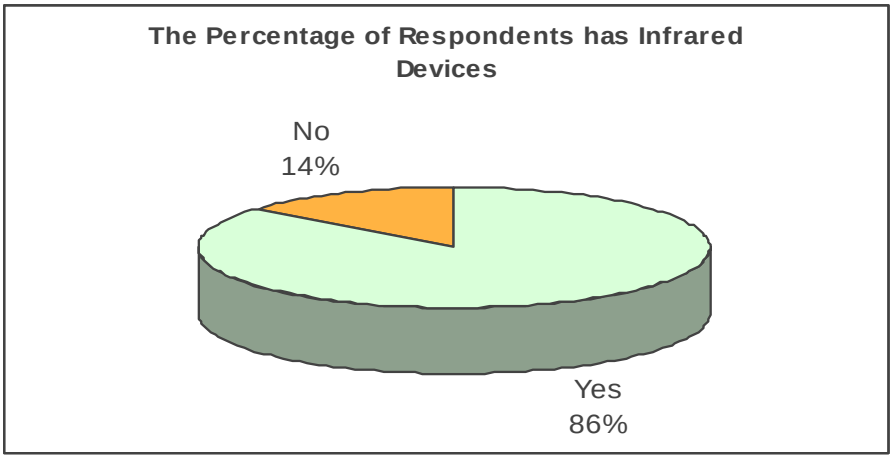



Figure 17: Percentage of respondents has infrared devices

The pie chart above shows the percentage of respondents who have and do not have any infrared devices. There 86 % which means 43 respondents owning an infrared devices, while 14 % which means 7 respondents do not have any infrared devices.

From the finding, most of the respondents are able to own infrared devices. This means they are affordable to buy infrared devices.

**Question 12:**

"If yes, what are the types of infrared devices do you have?"

The purpose of this question is the researcher wants to find out what are the type of applications are affordable to be owned by respondents.

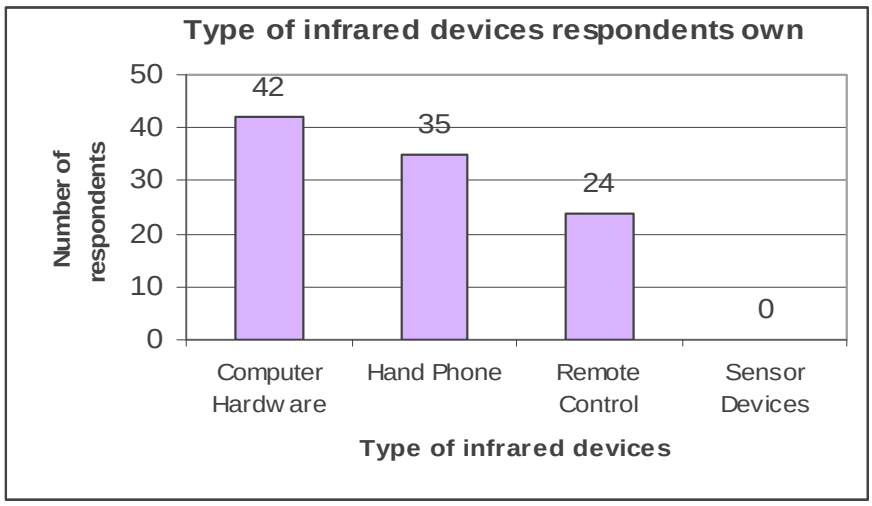



Figure 18: Types of infrared devices respondents own

The graph shows the type of infrared devices own by the respondents. There are four types of devices provided in the answer. Most of the respondents which are 42 respondents have the infrared computer hardware, 35 respondents have the infrared application in their hand phone, and 38 respondents have a remote control while there is no respondents have sensor devices.

### iii. Research Questions (Section B: Waste Collection)

**Question 13:**

"Does the collection of waste done at your living area?"

The purpose of this question is the researcher wants to find out whether the service for waste collection is done or not at respondents living area.

For this question, all respondents said that the waste collection is done at their living area.

**Question 14:**

"How many times the waste collection is made at your place?"

The purpose of this question is the researcher wants to find out the frequency of the time for waste collection at respondents living area.

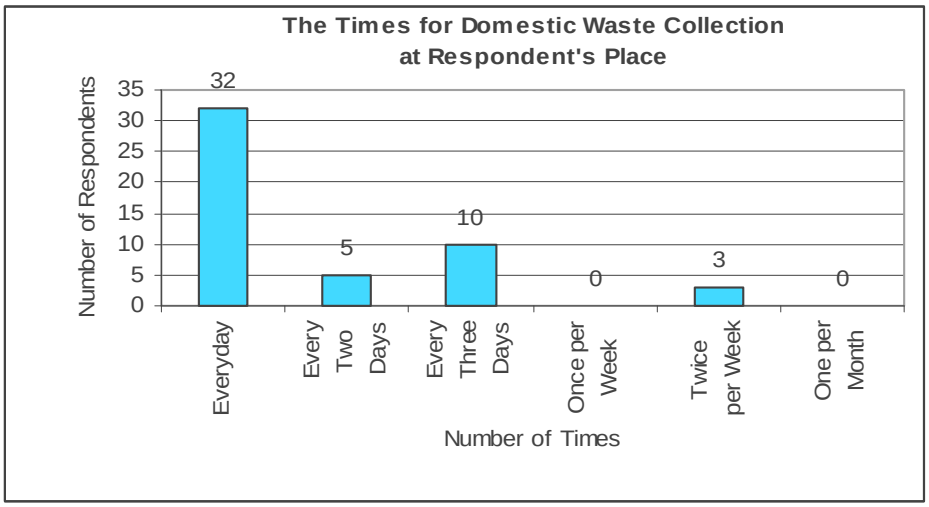



Figure 19: Time for waste collection at respondents place

The graph above shows the number of times for waste collection at the respondents place. There are 32 respondents said that the waste collection is done everyday at their place, 5 respondents said every two days, 10 respondents said every three days, 3 respondents said twice per week, while there is no respondents for both once per week and once per month.

This means that there are certain places where the service for waste collection is not done everyday.

**Question 15:**

"Do you satisfy with the waste collection service at your place?"

The purpose of this question is the researcher wants to find out whether respondents satisfy of not with the service for waste collection at their place.

For this question, most of the respondents satisfy with the services which consist of 37 respondents. Only a few respondents do not satisfy which are 13 respondents.

**Question 16:**

"Have you ever seen (at your place or other places) the uncollected waste?"

The purpose of this question is researcher wants to know whether respondents ever seen the uncollected waste or not.

For this question, 43 respondents said they have seen the uncollected waste, while 7 respondents said they have not ever seen the situation.

**Question 17:**

"In your opinion, what are the causes of this situation to happen?"

The purpose of this question is the researcher wants to determine the causes which contribute to the uncollected waste situation.

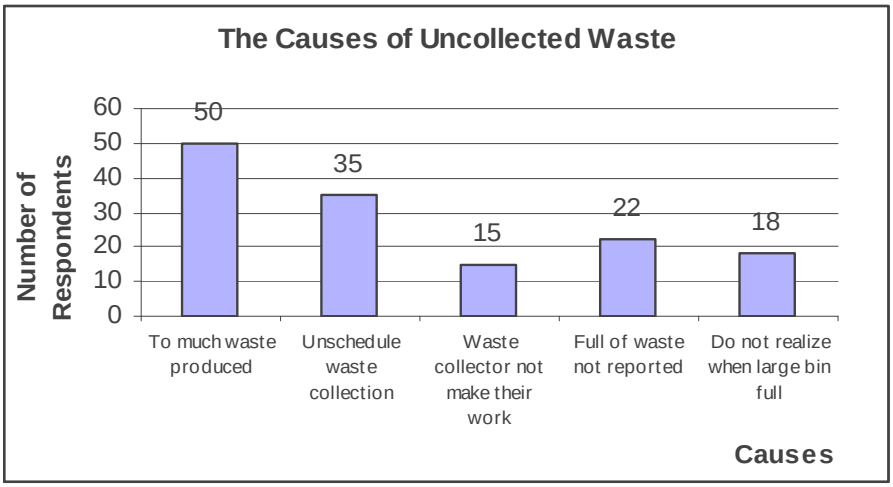



Figure 20: The causes of uncollected waste

From the chart, 50 respondents said that the cause of the uncollected waste is because there are too much domestic waste produced everyday. 35 respondents said it is because the unscheduled collection, 15 respondents said the waste collector did not make their work properly, 22 respondents said the full of domestic waste was not reported and 18 respondents said they do not realize when the large bin become full.

**Question 18:**

"Due to uncollected waste situation, what are the impacts might arise?"

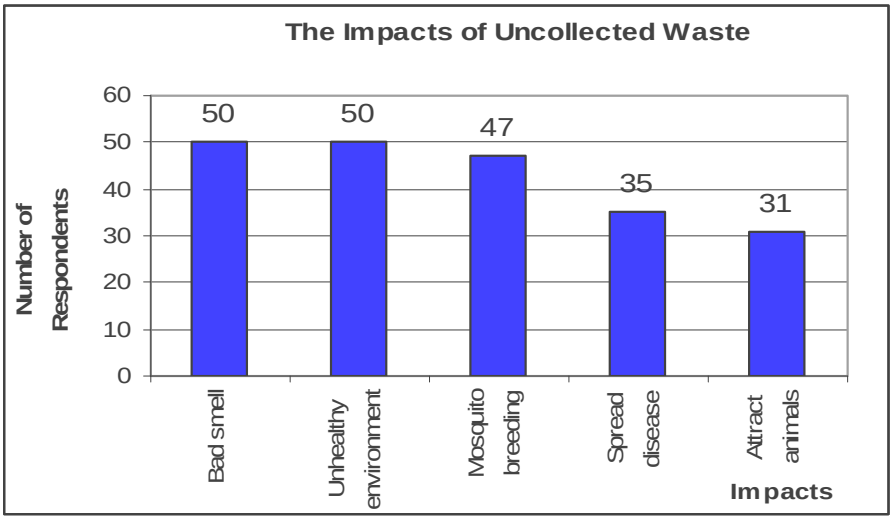



Figure 21: The impacts of uncollected waste

The pie chart above shows the number of respondents and their view towards the impacts of uncollected waste. 50 respondents said the situation will cause a bad smell, 50 respondents said it cause an unhealthy environment, 47 respondents said the situation will encourage mosquito breeding, 35 respondents said it will cause a disease to spread and 31 respondents said it will attract animals to gather at that place.

**Question 19:**

"In order to ensure the clearance of waste is done properly, do you agree if there is a notification system which can notify people about the full or uncollected waste so that a report can be made?"

The purpose of this question is researcher wants to know whether respondents agree or not with the suggestion to use a notification system to alert people when the large bin become full.

For this question, most of the respondents agree if there is a notification system to alert people. The numbers of respondents who agree are 37 respondents, while there are 13 respondents who did not agree with the suggestion.

**Question 20:**

"If the answer is yes, at which places do you suggest the notification system should be used?"

The purpose of this question is researcher wants to determine the places where the notification system can be used.

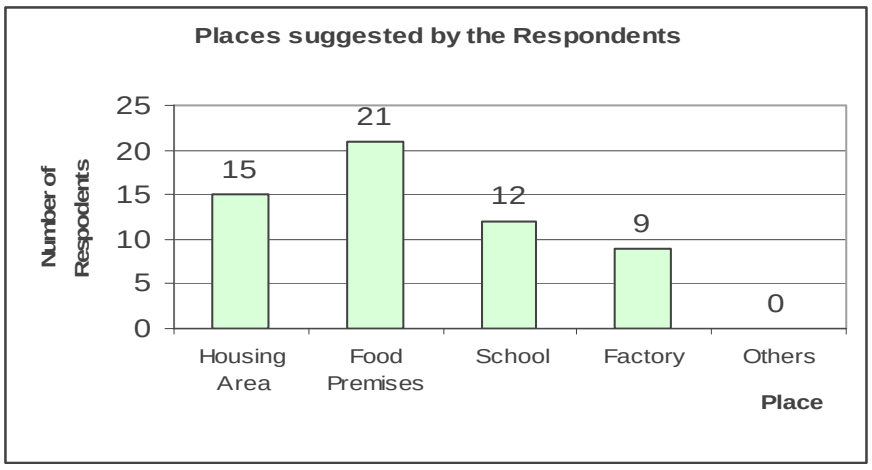



Figure 22: Places suggested by respondents to be used notification System

The graph above shows the number of respondents and the areas they suggest can be used the notification system. The highest is suggested to use at food premises which are 21 respondents. There are 15 respondents suggest to be used at housing area, 12 respondents suggest at school, 9 respondents suggest at factory and no respondents suggest to other places.

### 4.2.2 Findings and Discussions from the Prototype Development

**i. Development of Infrared Sender Circuit and Infrared Receiver Circuit**

After the development of infrared sender circuit, it was tested to find out whether it is function or not. If the LED emits a light it means the circuit is function.

There are a few problems researcher faced during the process to build the both circuit. The first problem, it is difficult to solder the electronic components properly. If there is a mistake during the soldering, researcher need reconstruct the circuit and solder the components again.

This might cause the electronic components damaged and not function properly. Because of this, researcher needs to buy new electronic components and build the circuit again until it is function.

**ii. Connecting Sensor Circuit with Infrared Sender Circuit**

The sensor circuit is taken from the automatic chiming bell. The output from the sensor circuit is connected to the infrared sender circuit.

The problem for this process is the researcher needs to modify the sensor circuit and the infrared sender circuit so that both circuits can be linked.

### iii. Displaying Output from Infrared Receiver using Light Bulb

When the infrared receiver circuit received signal from infrared sender circuit, the signal from infrared receiver circuit will be displayed through a light bulb.

Actually, the researcher wants to display the output of the prototype through a personal computer. The problem is the researcher does not found suitable programming software to use for the circuit.

Most of the programming software for infrared circuit is available to be used to control other devices from personal computer, such as to control television or VCD player.

Beside, the researcher does not have much experience with the circuit development and the time to finish the prototype is very limited since the researcher has to study all aspects in detail.

Because of that, the researcher needs to find another alternative to be used for displaying the output. The researcher chooses to use a light bulb.

## 4.3 Summary

This chapter presents the findings from the questionnaires and the prototype development. From the questionnaires, the findings are presented in graph and chart form. The findings are then continuing with discussions done by the researcher. Beside, there are also findings from the prototype development and discussions of the problems researcher faced during the process.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Introduction

This chapter will presents the conclusions for this research project. Beside, the researcher has suggested several recommendations for future researcher in order to enhance product development from this research project.

## 5.2 Conclusions

As a conclusion, the growth in mobile and portable computing devices has led to an increase in demand for wireless data connectivity. Even though the infrared technology is widely used in various applications, not all people know about that scenario.

Beside, people have different perception towards infrared because they actually do not really know what infrared is. This is true because from the survey done by the researcher, almost respondents said that infrared is a sensor. Actually, the real definition of infrared it is an electromagnetic radiation and unseen red light which can be used for various purposes.

Infrared technology offers advantages of low cost, low power consumption, no regulatory restrictions, scalability and very high data rates. Consumer electronic components have used infrared technology as a transmission medium for remote control and computer hardware. Beside, it is also been used in sensor devices.

There are a few limitations faced in infrared technology which are the infrared is transmitted in line of sight and in short range. In addition, the signal also can be blocked by common materials and very sensitive.

The waste management is important in order to maintain a good and healthy environment. Unhealthy environment might happen if people do not have civic awareness. Because of that, the waste management company should play their role very well. Beside, people also should be responsible to make a report if they see the waste is over limits and might cause bad impacts to the environment.

With the application of infrared technology, the researcher tries to develop a notification system which can be used to alert people when the large bin is full. This prototype development hopefully will assist the waste management.

## 5.3 Recommendations

There are several recommendations proposed by the researcher in order to enhance this notification system. The recommendations can be used by future researchers as guidelines.

For the study towards infrared technology, future researcher can used this research to compare the infrared technology with other wireless technology such as Bluetooth technology.

Besides, future researcher can improve the prototype by using a personal computer to display output from the integrated infrared devices. This can be done through deep study of electronic components and programming software available.

In addition, future researcher can develop a notification system which can be online connected to the waste management company. This will assist the company to monitor if there are large bins become full before the next collection. Beside, waste collector can be monitored either they have done their work or not.

Future researcher also can create new notification system which would be suitable to implement for large bin in order to alert people about the full of the dustbin.

## 5.4 Summary

In this chapter, the researcher makes conclusions based on the findings from this research project. There two parts of the findings concluded by the researcher. The first part is based to the findings from the questionnaires while the second part is based to the prototype development.

In addition, the researcher has proposed a few suggestions for future researcher as guidelines. Hopefully, with the recommendations suggested, a better notification system can be made in future.

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# APPENDIXES

Name : Siti Noor Arnie Binti Bustamam -Survey Form-
I/D : 2003470979
Program : Bsc (Hons) Data Communication and Networking

## Introduction

This questionnaire is a part of the completion for my final semester "Research Project" (ITT 580). Generally, this research project is about a study of infrared technology and product development using an infrared technology for waste collection. The purposes of this questionnaire are to observe the uses of the infrared technology applications in daily life and the waste management at respondent's living area.

Your participation for this questionnaire is entirely anonymous. Please read all the questions and tick the answer that most accurately reflects your view. There is also an opportunity to provide more detailed comments. Your comments will be taken very seriously. Thank you for your participation.

Demographic questions:

1. Gender: [ ] Male [ ] Female

2. Age: [ ] 18-21 [ ] 22-25 [ ] 26-29 [ ] 30 and above

3. Status: [ ] Single [ ] Married [ ] Others: _____ *(Please specify)*

4. Occupation: [ ] Student [ ] Working [ ] Others: _____ *(Please specify)*

Research Questions:

Section A: (The Infrared Technology)

5. Do you know about the infrared technology?

[ ] Yes [ ] No

6. What is your perception about the infrared?

*(Please choose only one answer)*

[ ] Infrared is a wireless technology.

[ ] Infrared is an unseen red light.

[ ] Infrared is a type of sensor.

[ ] Infrared is used for remote control devices *(ex; television remote).*

[ ] Others: _____ *(Please specify)*

7. Do you know the applications using infrared technology in our life?

[ ] Yes [ ] No

8. If yes, please choose from answers below in which applications that you know.
*(You can choose more than one answer).*

[ ] Use for computer hardware *(ex; mouse, keyboard, printer etc)*

[ ] Use in hand phone *(ex; to transmit picture, ring tones etc)*

[ ] Use in remote control devices *(ex; television, VCD player etc)*

[ ] Use in sensor devices *(ex; automatic sliding door, automatic door chiming bell)*

[ ] Use in medical *(ex; laser)*

[ ] Use for transmitting data from different devices *(ex; from pc to hand phone)*

[ ] Others: _____ *(Please specify)*

9. Do you ever use the applications listed in question 8?

[ ] Yes [ ] No

10. If yes, how often do you use the applications?

i. Computer hardware:

[ ] Very often [ ] Often [ ] Sometimes [ ] Rarely [ ] Never

ii. Hand phone:

[ ] Very often [ ] Often [ ] Sometimes [ ] Rarely [ ] Never

iii. Remote control:

[ ] Very often [ ] Often [ ] Sometimes [ ] Rarely [ ] Never

iv. Sensor devices:

[ ] Very often [ ] Often [ ] Sometimes [ ] Rarely [ ] Never

v. Medical purposes:

[ ] Very often [ ] Often [ ] Sometimes [ ] Rarely [ ] Never

vi. Transmit data between different types of device:

[ ] Very often [ ] Often [ ] Sometimes [ ] Rarely [ ] Never

11. Do you own any infrared devices?

[ ] Yes [ ] No

12. If yes, what are the types of infrared devices you have?

*(You can choose more than one answer).*

[ ] Computer hardware

[ ] Hand phone

[ ] Remote control

[ ] Sensor devices

[ ] Others: _____ (*Please specify)*

## Section B: (Waste Collection)

13. Does the waste collection is done at your living area?

[ ] Yes [ ] No

14. How often the waste collection is made at your place?

[ ] Everyday

[ ] Every two days

[ ] Every three days

[ ] Once per week

[ ] Twice per week

[ ] Once per month

[ ] Others: _____ *(Please specify)*

15. Do you satisfied with the waste collection service at your place?

[ ] Yes [ ] No

If no, please state the reason:

_____

_____

16. Have you ever seen *(at your place or other places)* the uncollected waste?

[ ] Yes [ ] No

17. In your opinion, what are the causes of this situation to happen?

*(You can choose more than one answer).*

[ ] Too much waste produced everyday

[ ] Unscheduled waste collection

[ ] The waste collector does not make their work properly

[ ] The full of the waste is not reported

[ ] Do not realize when the large bins become full

[ ] Others: _____ *(Please specify)*

18. Due to the uncollected waste situation, what are the impacts might arise?

*(You can choose more than one answer).*

[ ] Causing a bad smell

[ ] Causing unhealthy environment

[ ] Become the place for mosquito breeding

[ ] Causing a disease to spread

[ ] Encourage animals *(like dogs, cats etc)* gather at the place

[ ] Others: _____ *(Please specify)*

19. In order to ensure the clearance of waste is done properly, do you agree if there is a notification system which can notify people about the full or uncollected waste so that a report can be made?

    [ ] Yes [ ] No

120. If the answer is yes, at which places do you suggest to use the notification system? *(You can choose more than one answer).*

    [ ] Housing area

    [ ] Food premises

    [ ] School

    [ ] Factory and manufacturing area

    [ ] Others: _____ *(Please specify)*

*–Thank You-*