Faculty of Computer Science and Information Technology

IOT-based Mobile Trash-Can for Tourist Attraction

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Bachelor of Computer Science with Honors

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IOT-BASED MOBILE TRASH-CAN FOR TOURIST ATTRACTION

Tay Lee Chee

This project is submitted in partial fulfillment of the

requirements for the degree of

Bachelor of Computer Science with Honors

Faculty of Computer Science and Information Technology

UNIVERSITI MALAYSIA SARAWAK
2020

TONG SAMPAH MUDAH ALIH BERASAKAN IOT UNTUK TARIKAN PELANCONGAN

TAY LEE CHEE

Projek ini merupakan salah satu keperluan untuk Ijazah Sarjana Muda Sains Komputer dan Teknologi Maklumat

Fakulti Sains Komputer dan Teknologi Maklumat

UNIVERSITI MALAYSIA SARAWAK

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Abstract

This study will design mobile trash-can that will be capable of following a designed path in a tourist attraction that are indoor. The project has two part, moving part and notification part. The main microcontroller for moving part is Raspberry Pi 3 Model B+, it will be connected to the infrared sensor and ultrasonic sensor. This trash-can will move on the black surface and stop on white surface, this is achieved by using infrared sensor. The trash-can will stop when encounter an obstacle by using the ultrasonic sensor. There are two motors on two-side of trash-can to control the movement of the trash-can. The microcontroller for notification part is Arduino UNO, it will be connected to the infrared sensor and ultrasonic sensor. While the infrared sensor detected the trash inside reached the limit height, then a notification will send to the cleaner’s smartphone. There is an ultrasonic sensor on top of the cap to create an automation cap. When the ultrasonic sensor detected the obstacle in front of it, then the cap will open.

Abstrak

Kajian ini akan merancang tong sampah mudah alih yang akan dapat mengikuti jalan yang direka dalam tarikan pelancong yang berada dalam bangunan. Projeck ini ada dua bahagian, pergerakan dan pemberitahuan bahagian. Raspberry Pi 3 Model B+ diguna untuk bahagian pergerakan dan bersambung dengan sensor inframerah dan sensor ultrasonik. Tong sampah mudah alih ini akan bergerak di atas permukaan hitam dan berhenti di atas permukaan putih. Fungsi ini dicapai dengen kegunaan sensor inframerah. Apabila terdapat halangan di depan tong sampah mudah alih, tong sampah mudah alih akan berhenti. Fungsi ini dicapai dengan menggunakan sensor ultrasonik. Dua motor dekat dua sisi sampah mudah alih adalah untuk mengawal pergerakan. Untuk bahagian pemberitahuan, Arduino UNO diguna dan disambung dengan sensor inframerah dan sensor ultrasonik. Apabila sensor inframerah mengesan sampah sudah melebihi had tinggi, pemberitahuan akan dihantar kepada pembersih punya telephone bimbit. Sensor ultrasonik yang diletak atas topi tong sampah mudah alih adalah untuk kegunaan automasi topi. Apabila sensor ultrasonik mengesan halangan, topi tong sampah mudah alih akan buka.

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CHAPTER 1: Introduction

1.1 Introduction

Trash-can is a container which made up of metal or plastic to serve the purpose of temporarily storing waste. Nowadays, one of the worldwide economic activities is tourism. Tourism industry in Malaysia are important as it act as main contributor to the country's economy. Since the tourism industry have become source of Malaysia's economic, there also have been increase in tourism activities and tourism attraction. Based on the statistic of Ministry of Tourism & Culture, there were 25.8 million of tourists visited Malaysia during 2018. Tourism brings the economic moving and yet it also bringing impact to our country. It results in creation of additional wastes that have either direct or indirect impact to the environment. Cleaning tourist attraction becomes time consuming and required more manpower.

The evolution of robotic are happened really fast this day and have led to development of more compact robots. Robots are doing common and daily human tasks with improved efficiency and perfection. To make sure the robots performed perfectly, they have been programmed to perform a wide range of activities, from simple and easy daily task to complex task that requires precision and perfection. Robotics becoming a field which is brings extreme changes into people's life. Manpower can be saved by using robots in various field that required a lot of manpower. By using robots, all those time consumed jobs can become more efficiency and convenience. Years over years, robots are becoming part of the people's life.

1.2 Problem Statement

Many of visitor have faced problem in finding trash bin when they are visiting a new tourist attraction. Some tourist attraction only provided limit quantity of trash-can and the trash-can only situated at the entrances. When visitors wished to throw the rubbish, he or she needed to find the exactly place for the trash-can. So, they cannot fully enjoy the attraction while still concern to finding a trash-can. It could be troublesome for visitors to dispose their trash.

1.3 Scope

The targeted group of this automated mobile trash-can is visitors around the indoor tourist attraction. The mobile trash-can will move in specific places and on a specific routes. The trash-can will stop when there is an obstacles in front of the ultrasonic sensor. When the trash inside the trash-can reach a maximum level, then the cleaner will receive the notification. The length of black line used for line follow algorithm expected around 2-3 metres.

1.4 Limitation

Due to hardware limitation, the trash-can cannot support too heavy waste. Thus, only paper, and plastic bags are allowed. Anything with the water is not allowed because the water can destroy the sensors. The black line can also be destroyed due to many human factors. This can cause the trash-can to stop moving. The length of black line used is around -32 metres due to power supply.

1.5 Objectives

The objectives of this project are:

1. To design prototype for automated mobile trash-can

2. To implement my propose technique in real prototype

1.6 Methodology

Methodology can be defined as a method that use to develop a system or conduct research in a particular area of study. Waterfall modal is used in this project. It is divided into four stages, which are requirement analysis, design, development, and testing. The activities for each stage will be further explained as below.

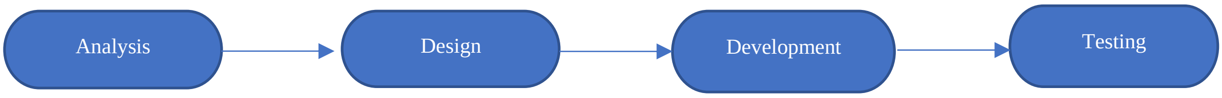


Figure 1. 1: Waterfall Modal

Stage 1 –Analysis

Analysis is the first stage and the most important stage in SDLC. In this stage, information and requirement are gathering to plan the basic project approach. End of this analysis stage, we will have a clearer picture about the scope of the entire project.

A set of questionnaires also designed to collect the data from a group of people. Questionnaires contains all closed-ended question. Closed-ended questions are chosen because it is easier and quicker for the visitor to answer. Through all these answers, data will be collected and analysed to gain the requirement for this project.

Stage 2 – Design

In this stage, overall project architectures are defined through the requirement gained in stage one. The simple prototype of the project is formed. The needed materials are listing down and borrowing from the faculty. Raspberry Pi and Arduino UNO is the main materials that needed and a few of sensors to make the prototype more perfect. The suitable motors and the power supply also are taking into consideration for the prototype to work out. The diagrams are also drawn in this stage to have a clearer picture about the project design.

Stage 3 – Development

In this stage, actual development start and product is built. The programming code is generated during this stage. The main language used to implement this project is Python and C/C++ for Arduino. Python is one of the primary programming languages hosted on Raspberry Pi. The python is responsible for the specific route for the automated mobile trash-can and algorithm for all the sensors. C/C++ is the primary programming language for the Arduino UNO. The C/C++ is responsible for the detect the condition of trash and open the lid of the trash-can. All the hardware will assembly in this stage.

Stage 4 – Testing

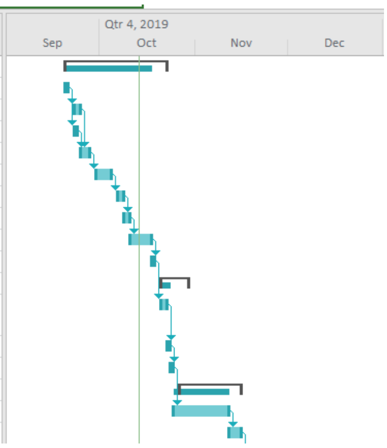
Once the project is complete, it is deployed in the testing environment. Whole functionality of the project will be testing and evaluates. Testing will be done on a selected target group and collect the feedback from them. Feedback from the users are important to see whether the project fulfil the requirement or not.

1.7 Significant of Project

The significant of this project is to design and develop an automated mobile trash-can. The target group for this project is visitor. The automated mobile trash-can will move in specific places and on a specific routes.

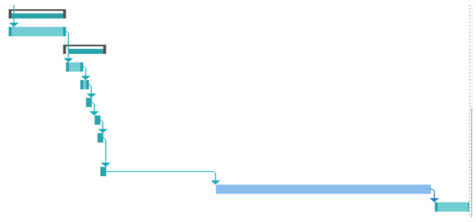
1.8 Project Schedule

All progress will be made during the first and second semesters of the academic year 2019/2020 to complete this final year mission. The following figures show the Gantt diagram for both semesters of the project.



	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	**Project Preparation**	**23 days**	**Fri 9/20/19**	**Tue 10/22/19**		
2	Identify problem	1 day	Fri 9/20/19	Fri 9/20/19		
3	Define objective of project	2 days	Mon 9/23/19	Tue 9/24/19	2	
4	Define project outcome	1 day	Mon 9/23/19	Mon 9/23/19	2	
5	Prepare brief proposal	3 days	Wed 9/25/19	Fri 9/27/19	3,4	
6	Feedback and comment from reviewer	5 days	Mon 9/30/19	Fri 10/4/19	5	
7	Define scope and significant of the project	2 days	Mon 10/7/19	Tue 10/8/19	6	
8	Define the methodology	2 days	Wed 10/9/19	Thu 10/10/19	7	
9	Prepare full proposal	5 days	Fri 10/11/19	Thu 10/17/19	8	
10	Milestone: Submission of full proposal	1 day	Fri 10/18/19	Fri 10/18/19	9	
11	**Chapter 1 Introduction**	**7 days?**	**Mon 10/21/1**	**Tue 10/29/19**		
12	Modification of full proposal into Chapter 1	2 days	Mon 10/21/19	Tue 10/22/19	10	
13	Define the methodology	1 day	Wed 10/23/1	Wed 10/23/1	12	
14	Milestone: Submission of Chapter 1	1 day	Thu 10/24/19	Thu 10/24/19	13	
15	**Chapter 2 Literature Review**	**16 days**	**Sun 10/27/19**	**Fri 11/15/19**		
16	Prepare Literature Review	12 days	Fri 10/25/19	Mon 11/11/1	14	
17	Milestone: Submission of Chapter 2	4 days	Tue 11/12/19	Fri 11/15/19	16	

Figure 1. 2: Gantt Chart



18	**Chapter 3 Methodology**	**14 days**	**Sat 11/16/19**	**Wed 12/4/19**		
19	Milestone: Chapter 3 completed	14 days	Sat 11/16/19	Wed 12/4/19	17	
20	**FYP 1 Report and Symposium**	**10 days?**	**Thu 12/5/19**	**Wed 12/18/1**		
21	Prepare FYP 1 presentation slide	3 days	Fri 12/6/19	Tue 12/10/19	19	
22	FYP 1 Symposium	2 days	Wed 12/11/1	Thu 12/12/19	21	
23	Finalize FYP 1 final report	1 day	Fri 12/13/19	Fri 12/13/19	22	
24	Submit FYP 1 report	1 day	Mon 12/16/1	Mon 12/16/1	23	
25	Milestone: FYP 1 report and symposium completed	1 day	Tue 12/17/19	Tue 12/17/19	24	
26	Milestone: FYP 1 completed	1 day	Wed 12/18/1	Wed 12/18/1	25	
27	**Chapter 4 Implementation and testing**	55 days	Mon 1/27/20	Fri 4/10/20	26	
28	**Chapter 5 Conclusion and future works**	10 days	Mon 4/13/20	Fri 4/24/20	27	

Figure 1. 3: Gantt Chart

1.9 Expected Outcome

The main outcome of the project is the automated mobile trash-can. The automated mobile trash-can will move in specific places and on a specific routes.

1.10 Project Outline

There will be five chapter included in this report, details are explained as below:

(i) Chapter 1: Introduction

This chapter provides general view to the project. This chapter included problem statement, objectives of the project, methodology used in the project. Furthermore, project scope, project significance, project schedule and expected outcome are clearly outline in this chapter. This chapter provided us with the general understanding and view toward this project.

(ii) Chapter 2: Literature Review

This chapter will look deeply into existing projects which similarly to the proposed project. The existing will be review and compare to proposed project. Limitations of the existing projects were analysed and method of the existing project is study. In addition, materials needed and all details to implement the existing project are study. In the end, this chapter provides us with a clear picture of proposed project. The knowledge from study the existing project will act as foundation to complete this proposed project.

(iii) Chapter 3: Requirement Analysis and Design

In this chapter, methodology uses to develop the proposed project will be discussed. Methodology can be defined as a method that use to develop a system or conduct research in a particular area of study. Waterfall modal will be used in this project. All the requirement analysis will be record in this chapter. All project design and implementation details will be further explained in this chapter.

(iv) Chapter 4: Implementation

In this chapter, all the details of implementation are discussed and testing in real environment. Project prototype are build based on the requirement collected in Chapter One. Algorithm for the project to work will be further explained in this chapter. In the end, the finished prototype will be test in real environment to access its function and achievement.

(v) Chapter 5: Testing

The develop prototype will be testing in real environment to test whether it fulfil the requirement from Chapter one or not. Functional, unit, non-functional testing all will be carried out to test the prototype.

(v) Chapter 6: Conclusion and Future Work

This chapter includes the summary for the entire project. This chapter included the lesson learnt from this proposal project and future improvement to it.

CHAPTER 2: Literature Review

2.1 Introduction

Literature review is to in depth reviews and discussed any study that relating to the mobile trash-can. This chapter focus on the relevant literature reviews that related or similarly to the proposed project. The journal articles, published reports, conference papers and other can be the references. The first project reviewed is Autonomous Trash Collecting Robot. The second project reviewed is Object Detection Based Garbage Collection Robot (E-Swachh). The third project reviewed is Moeder Cleaning Robot.

2.2 Review of Related Existing Project

For this portion of the chapter, it will review and discuss about the related existing project. There are three exiting projects which related to proposed project to be review later in this section. Each of the project has their own functionality, purpose and even the drawbacks.

2.2.1 Autonomous Trash Collecting Robot

Autonomous Trash Collecting Robot is created by G. Sivasankar, B. Durgalakshmi, and K. Seyatha. Autonomous Trash Collecting Robot is an autonomous robot that can collect waste from an environment. The robot can perform the task while still avoiding static or dynamic obstacles. The block diagram of the system is as shown in Figure 2.1 below:

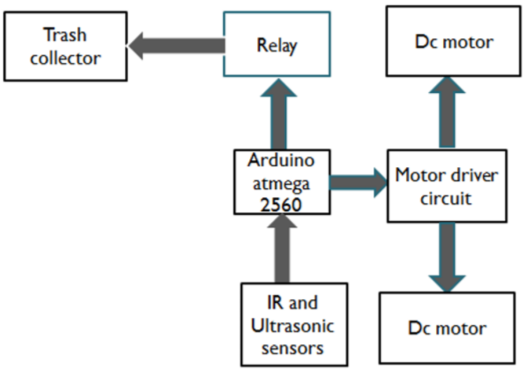


Figure 2. 1: *Block Diagram of Autonomous Trash Collecting Robot*

(adapted from Sivasankar, Durgalakshmi, & Seyatha, 2017)

In order to avoid obstacles for the robot, ultrasonic sensors and IR sensors are used for this purpose. Through transmitting the sound waves at a specific frequency, ultrasonic sensor can measure the distance and listen to the sound waves to bounce back (Sivasankar et al., 2017). An IR sensor's basic concept is to emit an infrared signal, then infrared signal bounds from anywhere on the object's surface and eventually the infrared receiver detects the signal. The trash collector part is attached to a fan. If there is electric flow, the fan will start rotating. Consequently, there is suction created inside the vacuum cleaner and causing the waste to suck into the trash collector part.

Figure 2. 2: *Prototype of Autonomous Trash Collecting Robot*

(adapted from Sivasankar et al., 2017)