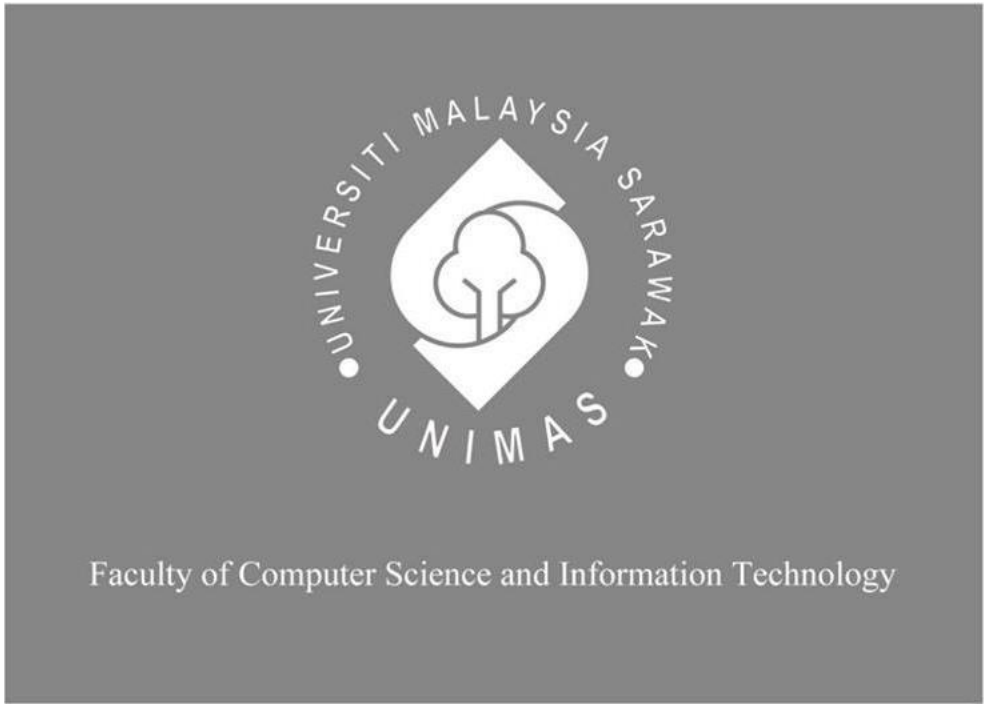


# *CASH FROM TRASH (CAFTRA) –*

# *INNOVATIVE WAY OF RECYCLING SYSTEM*

Imaan Aisyah Binti Kassim

**Bachelor of Computer Science with Honors (Software Engineering)**
**2020**

# CASH FROM TRASH (CAFTRA) –

# INNOVATIVE WAY OF RECYCLING SYSTEM

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Imaan Aisyah Binti Kassim

Faculty of Computer Science and Information Technology

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# ABSTRACT

*CAFTRA is an IoT project that is integrated with hardware devices that collects recyclable items from users and rewards them with cash based on the current market price. It will measure trash volume in the recycle bin. It can help the garbage collector management staff to monitor and optimally utilised resource. This report describes a study on creating an IoT prototype that consists of Arduino and some sensors that are connected to the Blynk App. A comparison study of three existing or similar system with the proposed system had been conducted. Each of the compared system components and the overall workflow is explained. Features of between systems are highlighted in the comparison table which are the important elements for designing the proposed system. The requirement for the user and the system was analysed. User requirement consists of identifying target user, meanwhile, system requirement consists of software and hardware requirement. After the requirements are identified, the proposed system is designed which including system framework with all the hardware and software design approaches. CAFTRA is developed to enhance public practise in recycling activities as well as to support the Government in Separation at Source initiatives (SSI).*

# ABSTRAK

CAFTRA adalah projek IoT yang diintegrasikan dengan peranti perkakasan yang menjadi tempat pengumpulan barang-barang kitar semula dari pengguna dan memberi mereka ganjaran dengan wang tunai berdasarkan harga pasaran semasa. Ia akan mengukur muatan sampah dalam tong kitar semula agar dapat membantu kakitangan pengurusan pengumpul sampah untuk memantau dan menggunakan sumber secara optimum. Laporan ini menerangkan satu kajian mengenai mewujudkan prototaip IoT yang terdiri daripada Arduino dan beberapa sensor yang disambungkan ke App Blynk. Kajian perbandingan tiga sistem yang sudah ada atau serupa dengan sistem yang dicadangkan telah dijalankan. Setiap komponen sistem yang dibandingkan dan keseluruhan aliran kerja dijelaskan. Ciri-ciri antara sistem dibandingkan di dalam sebuah jadual perbandingan yang merupakan elemen penting untuk mereka bentuk sistem yang dicadangkan. Keperluan untuk pengguna juga akan dianalisis. Keperluan pengguna terdiri daripada mengenal pasti pengguna sasaran, sementara itu, keperluan sistem terdiri daripada keperluan perisian dan perkakasan. Selepas keperluan dikenalpasti, sistem yang dicadangkan dirancang dengan membuat beberapa rangka kerja sistem dengan semua pendekatan perkakasan dan perisian. CAFTRA dibangunkan untuk tujuan meningkatkan amalan awam dalam aktiviti kitar semula serta untuk menyokong Kerajaan dalam Inisiatif Pengasingan Sisa (SSI).

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# CHAPTER 1: INTRODUCTION

## 1.1 Introduction

SWCorp deputy chief executive officer (technical) Dr. Mohd Pauze Mohamad Taha said that the recycling rate in Malaysia last year is only 17.5% despite introducing the waste segregation programme (The Star Online, 2017). This also means that Malaysia is very much behind compared with several developed countries. A European Environment Agency 2013 report revealed that recycling rates are highest in Austria at 63%, followed by Germany (62%), Belgium (58%), the Netherlands (51%), and Switzerland (51%) (The Star Online, 2017).

Generally, the benefits of recycling seem straightforward. The practice reduces waste sent to landfills, conserves natural resources, reduces pollution, and creates jobs. Sometimes, the majority of the communities do recycle and aware of it but only a few of them do it consistently. The reward for recycling (saving the earth) and the impact of infrequently recycling (damaging the environment) aren't necessarily immediate. While different communities have different barriers to recycling, thus unique recycling solutions are required to overcome them.

'Cash from Trash - Innovative Way of Recycling System' (CAFTRA) project is a recycling system that collects recyclable items from users and rewards them with cash based on the current market price. This will be a good recycling practise for communities as well as to support the government in Separation at Source initiatives. For this project, an IoT prototype will be developed to show and demonstrate the features of CAFTRA. This prototype will accept aluminium cans thrown by users and then exchange with cash accordingly as their rewards. Meanwhile, CAFTRA can be monitored as it can display real-time storage and cash information, and also will notify the authorities (admin) for full storage.

## 1.2 Problem Statement

The problem with Malaysia's current recycles system is within the aspect of making it a daily practise or habit among communities. This is due to the lack of stimulants to infuse the spirit of recycling into their daily life. To be specific, the consumption of canned drinks among university students is very high because canned drinks are cheap, convenient, and easy to get especially when vending machines are scattered around the university area. However, they usually just throw their used aluminium cans away without appropriately recycling them. Moreover, there is lack of innovative recycling system or programme that utilizes the use of Internet of Things (IoT) technology in Malaysia. Hence, a unique and innovative strategy using technologies that need to be produced to support the current recycling system. On the other hand, there is a lack of proper technological platform to notify the authorities involved regarding the recycle bin storage status and cash available. A proper and more systematic system is needed to make sure the recycle bins are managed properly.

## 1.3 Objectives

The objectives of this project are:

- To identify system requirements and design of CAFTRA.
- To develop a prototype of CAFTRA.
- To evaluate the functionality and features of CAFTRA.

## 1.4 Methodology

The CAFTRA prototype will be developed based on the Rapid Application Development (RAD) methodology which falls under the parental category of agile development techniques. James Martin stated in his book Rapid Application Development, RAD is a development lifecycle design to give faster development with higher quality results. RAD worked parallel as a prototype

integrated for the express product delivery (Powell-Morse, 2015). The advantages of this method are reducing development time and productivity with fewer people in a short time. There are 4 main phases in this procedure:

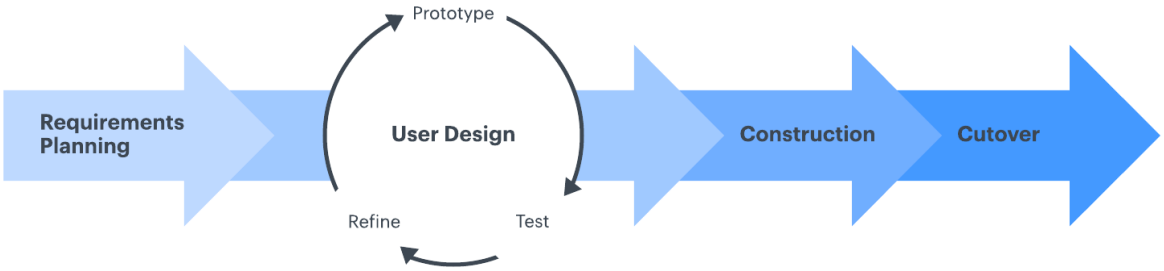


Figure 1.1: RAD Methodology[1]

1. Phase 1: Planning Phase
    - Completing the project proposal about the CAFTRA project. Some sensors that will be used are also planned such as nodeMCU, Ultrasonic sensor, IR obstacle, and Arduino Uno as its microcontroller. The requirements are obtained from users with the help of their feedbacks.
2. Phase 2: User Design Phase
    - Sketch the prototype of the project and study the suitable sensors that will be used in the prototype. Some sensors that will be used are also planned such as nodeMCU, Ultrasonic sensor, IR obstacle, and Arduino Uno as its microcontroller. The workflows and requirements of the system will be stated and designed.
3. Phase 3: Construction Phase
    - Develop the prototype of CAFTRA.

[1] https://www.lucidchart.com/blog/rapid-application-development-methodology

- Write coding to the sensor used in this project.
- Test prototype.

4. Phase 4: Cutover Phase
    - All the documentation has been completed. The CAFTRA prototyping had been done and the mobile application for monitoring also completed.
    - Do testing and changeover to the prototype.

Since the entire project is divided into modules and each module is treated as a separate prototype the time spent in delivering is reduced. This rapid pace is made possible as RAD focus on minimizing the planning stage and maximizing prototype development. By reducing planning time and emphasizing prototype iterations, RAD allows project managers and stakeholders to accurately measure progress and communicate in real-time on evolving issues or changes. This results in greater efficiency, faster development, and effective communication.

**1.5 Scope**

The target users for CAFTRA will be university students. For this case study, the area would be Faculty of Computer Science and Information Technology (FCSIT), UNIMAS. This project will focus on only one type of recyclable item which is aluminium cans. Aluminium cans are chosen because it is one of the most recyclable items could be collected from students. In addition to that, aluminium cans will give a discrete amount that can be counted and later exchanged with cash accordingly. Other than that, the status of CAFTRA can be monitored from the Blynk App that will only be accessed by the admin in charge so that any further action will be taken by them.

## 1.6 Significance of Project

This spotlight for this project is currently directed to the IoT development project. It develops to enhance public practise in recycling activities as well as to support the Government in Separation at Source initiatives. The consumption of canned drinks among university students is very high as canned drinks are cheap, convenient, and available around the university area. Thus, CAFTRA might be fully utilized by them to recycle their empty canned drinks. With daily and continuous practise, this project will increase interest among students to keep. To attract students willingness to do recycling, CAFTRA is also a good platform for them to earn extra pocket money. Besides, by creating a designated place to put the CAFTRA such as faculties or residential colleges, it will help the authorities to increase the number of aluminium cans collected, and at the same time allowing them to collect and sort them easily.

## 1.7 Project Schedule

The duration to complete this Final Year Project (FYP) is about 8 months. This project is expected to be done on 25th May 2020, the last day for final submission. Figure 1.2 and Figure 1.3 shows the duration of each task that will be done in this FYP 1 and FYP 2 respectively. These schedules below must be followed to keep this project on track.

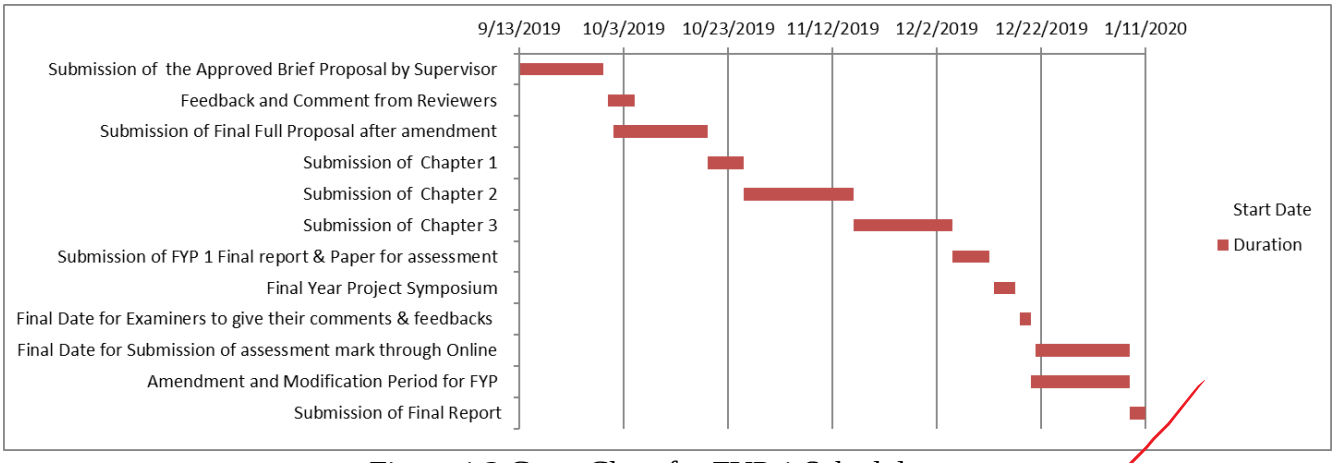


Figure 1.2 Gantt Chart for FYP 1 Schedule

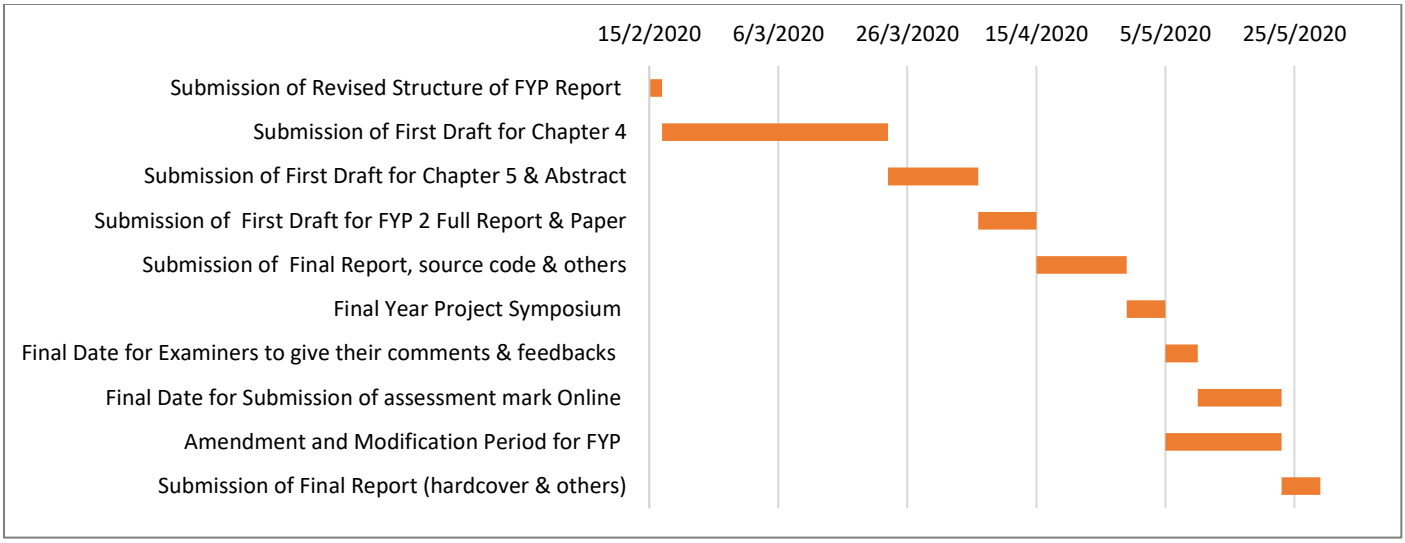


Figure 1.3 Gantt Chart for FYP 2 Schedule

## 1.8 Expected Outcome

At the end of this project, a functional simulation of CAFTRA is designed. University students will get an instant reward for recycling but at the same time, by practicing recycling the students able to conserve the environment. In the long term, recycling will be their daily habit and the number of aluminium cans recycled will be increased. This project will be a good incentive for the future of recycling by using the IoT technology approach. Besides, the authorities' work in managing and collecting recycled papers will be more manageable with this CAFTRA project.

## 1.9 Project Outline

Chapter 1: Introduction

Chapter 1 depicts the introduction of the proposed framework. This chapter is comprehensive of the problem statement, objectives of the study, the methodology used, project scope, the significance of the project, project schedule, and the expected outcome of the project. The problem statement describes the challenges faced by the present system and justifies the development of

this project. The objectives clarify the project's goal that is expected to be achieved by the end of development. Besides, the methodology section explains the method that will be used to complete the project. The scope clears up the limitations of the project to be developed. The project schedule is illustrated in a Gantt Chart to get a clear visual representation of time frames to keep the project development always on track.

Chapter 2: Literature Review

Chapter 2 discusses the review done on existing techniques and systems similar to the proposed project. The discussion will be based on three (3) different existing systems, including their features, limitation, and improvement. The overall study will be involving articles, journals, and conference papers. Limitations of existing systems and methods of improvement are analyzed by presenting a side by side comparison of the features. At the end of the chapter, a brief description of the software and the technology tools utilized for the execution of this project.

Chapter 3: Requirement Analysis and Design

This chapter portrays the methodology utilized for the development of this entire project. This chapter also incorporates the method of acquiring requirements from the stakeholders of the system. The last segment of this chapter comprises of Overall System Architecture, Flow Charts, Use Case Diagram, and Statechart Diagram to express the system's requirement and design. In addition to that, the sketches of interfaces will be included.

Chapter 4: Development and Implementation

This chapter discusses about the implementation of the proposed system. The interface design of the proposed system will be shown so that the structure of the proposed system can be easier to understand. The tools use for the implementation and overall function of the system will be explained so that a clear view of the system can be shown.

Chapter 5: Testing

This chapter discusses the testing used to test the proposed system. The function of the proposed system will be tested as a completed system to ensure that the system requirements have been met. User testing is conducted, and the feedback has been analyzed and discussed.

Chapter 6: Conclusion and Future Work

In this chapter, a conclusion and summary of the entire project will be made by explaining the work that has been obtained and achieved. This chapter also includes the discussion of the future works that can be done for this project soon.

## 1.10 Summary

To increase the collection of recyclable items and encouraging communities to make recycling as their habits, CAFTRA will be a good opportunity to achieve that. Communities have different barriers and problems to recycle, hence unique recycling solutions are required to overcome them. Thus, the CAFTRA prototype will be designed to shows and demonstrate the system features. To complete this project, a project schedule is made to keep me in track and Rapid Application Development (RAD) Methodology is used as my project management approach. The scope of this project will be focusing on university students in the university area. Therefore, in the end, students can have a designated place to throw away their used canned drink to gain cash rewards and at the same time, this will be a good practice for them to recycle.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Introduction

This chapter attempts to review the relevant literature and make research on existing techniques and systems similar to the proposed project. The discussion will be based on three (3) different existing systems with the proposed objects. The overall study is done based on articles, papers, and websites. The chapter first discusses the Recycle for Life by Cenviro. The second existing system that will be discussed is the Germany Bottle Recycling Machine. The third related system is the ecoATM Gazelle Kiosks. Limitations and methods of systems are analysed by presenting a side by side comparison of functionalities. At the end of this chapter, there will be a brief overview of the proposed system.

## 2.2 Recycle for Life by Cenviro


Figure 2.1: 'Recycle For Life' Smart Card[2]

[2] http://www.mykasih.com.my/

Recycle For Life by Cenviro (RFL) is a recycling programme that rewards cash through a smart card. The concept was initiated by Cenviro Sdn Bhd together with MyKasih Foundation to enhance the public's practice in recycling activities as well as to support the Malaysian Government's Separation at Source initiatives ("Recycle For Life," 2018). Through RFL recyclables collection, the cash value will be credited into the Recycle For Life smart card (RFL Card) based on the current market price. The RFL Card is powered by Whalet; an electronic wallet approved by Bank Negara Malaysia ("Recycle For Life," 2018). The smart card can be used for purchases of goods at participating school's canteen, bookshop, hypermarkets, and merchant partner outlets. The RFL program will be introduced in all schools nationwide to create awareness and understanding towards recycling practises for our future and the younger generation. They are also willing to share their RFL concept with any interested parties.

### 2.2.1 Features


Figure 2.2: Recycle For Life Process Flow[3]

[3] http://www.rfl.com.my/

Recycle For Life programme includes a buyback system where people can collect selected recyclables such as steel, paper, plastic, aluminium, and electronic waste and weigh them and get a cash value. The cash value of the recyclables will be credited into their RFL smart card based on the current market prices of the items. The smart card can be used for the purchase of goods at selected hypermarkets, partner outlets, and bookshops. The buyback system is also a self-sustaining activity for any organisation, where the funds raised from the sale of recyclables can be used to fund their activities. Furthermore, RFL also provides a mobile application platform for its users to check their account balance, view their transaction history, and also view the upcoming and past collection events.

### 2.2.2 Advantages and Disadvantages of Recycle for Life

The advantage of this system is the use of a smart card. The recyclable cash value will be credited into the Real For Life smart card (RFL Card). Thus, it serves for a variety of purposes, allowing the management to streamline their processes in an efficient and cost-effective method. For instance, the RFL Card can be used for purchases of goods at participating school's canteen, bookshop, hypermarkets, and merchant partner outlets. This can consequently get more users as it is faster and increased operational efficiency. Meanwhile, the authorities' side will have a lower total cost of provisioning the service and decrease the operating costs.

However, the smart card reader is needed when using the smart card. According to the terms and conditions of this programme, an RFL Cardholder must present the RFL Card before any recycling activity to ensure that the recycling activity cash earnings are accumulated in the RFL Card ("Recycle For Life," 2018). RFL recyclables collection activity will not be carried out should the RFL Card be faulty. The problem will also arise when smart card readers often can't