



Faculty of Computer Science and Information Technology

IOT-BASED INTELLIGENT BIN FOR SMART CITY

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Bachelor of Computer Science with Honours
(Multimedia Computing)
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IOT-BASED INTELLIGENT BIN FOR SMART CITY

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This project is submitted in partial fulfilment of the requirements for the degree of
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ABSTRACT

Intelligent Bin for Smart city is a project that consists of two systems which are a web application and a mobile application as well as a prototype of the Intelligent Bin. Garbage overload is always an issue, especially during festival seasons. Therefore, Intelligent Bin has been proposed to overcome this issue. The purpose of this project is to build a waste management system by using the Internet of Things (IoT). This system will notify waste management staff that the bin is already full. Apart from that, public users also can use this intelligent bin and gain points every time they used it. Having this system in daily life makes it easier for both users when it comes to waste management.

ABSTRAK

Intelligent Bin for Smart City ialah projek yang terdiri daripada dua sistem iaitu aplikasi sesawang dan aplikasi mudah alih. Sistem ini juga mempunyai prototaipnya yang tersendiri. Sampah yang melimpah ruah merupakan satu masalah yang selalu terjadi terutamanya pada musim perayaan. Oleh itu, sistem *Intelligent Bin* telah dicadangkan untuk menangani masalah tersebut. Tujuan utama sistem ini adalah untuk mencipta sistem pengurusan sisa menggunakan *Internet of Thing (IoT)*. Sistem ini akan memaklumkan kepada kakitangan pengurusan sisa setiap kali *Intelligent Bin* penuh. Selain itu, pengguna awam juga boleh menggunakan sistem ini dan mereka juga dapat mengumpul mata ganjaran setiap kali mereka menggunakan sistem ini. Dengan adanya *Intelligent Bin for Smart City*, ia dapat memudahkan aktiviti harian semua pengguna terutamanya berkaitan pengurusan sisa.

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CHAPTER 1: INTRODUCTION

1.0 Introduction

Malaysia's solid waste is estimated to be 38,427 metric tons per day in 2021 (1.17 kg/capita/day). Of which, 82.5 per cent is disposed in landfills. By 2022, the amount of Municipal Solid Waste, (MSW) collected would be 14 million metric tons per annum, enough to fill the Petronas Twin Towers every seven days. Therefore, there is an urgent need to respond to these mounting issues and provide new facilities as Malaysia's rate has exceeded the Japan International Cooperation Agency (JICA) study's proposed rate of 30,000 metric tons per day in 2020 for Malaysia. Meanwhile, the Solid Waste Corporation (SW Corp) reported that the recycling rate achieved in 2020 is 30.67 per cent and is lower than other developed countries such as Singapore (59 per cent), Korea (49 per cent), and Taiwan (60 per cent) (Waste to Energy for a Sustainable Future, 2021).

This statistic demonstrates that recycling waste is not as common in Malaysia as it is in other ASEAN countries such as South Korea, Taiwan, and Singapore. As a result, one way to encourage Malaysians to recycle waste is to provide a fun, proper, and simple way to recycle waste. Placing several recycling bins in a residential area can boost recycling activity.

However, if the recycle bin is not properly maintained, it will pollute the environment by attracting mice and pests and causing garbage overload. As a result, the management team, such as the cleaning company and the city council, must devise a schedule to collect all waste at a specific time. This situation will cause problems for both the management team and the environment. Thus, a intelligent bin has been proposed to make it easier for both users and management teams to keep the environment pollution-free.

This smart bin has a few features added such as monitoring garbage levels, auto lid

opening, a compressor for space saving in the bin, a locator for the trash bin, and notifying users when the trash bins are full. Aside from that, this smart bin also has a redemption system where users can redeem points every time, they used the bin.

1.1 Problem Statement

Every housing area will have a specific dustbin for residents to throw their garbage into, and this dustbin is usually not for recycling. As a result, all garbage will be thrown into one large dumpster, resulting in excess of solid waste in Malaysia (Sreenivasan et al., 2012)

Aside from that, waste collection in Malaysia usually has a specific time and schedule for each housing area. This predetermined schedule will pollute the environment due to garbage overflow, especially during the festival season. This garbage accumulation will not only attract pests, stray dogs, and mice, but it also can attract scavengers such as homeless people, drug addicts and refugees.

Furthermore, Malaysians believe that recycling waste takes a lot of time because they must go to the recycling facility whenever they want to use it. They also discover that recycling waste is not enjoyable because they must divide each waste into its component parts, and some people believe that dividing waste by themselves will expose them to bacteria due to the unsanitary dustbin.

These issues can be solved with the help of the Internet of Things (IoT) by having a smart dustbin with sensors to monitor garbage levels, an automatic lid opening, a compressor to provide more space, and the location of the dustbin. Having IoT in daily life is extremely beneficial because it has made everyone's life easier.

1.2 Project Scope

The following are the main priorities of this project development:

1. The target location for this project will be at Kota Samarahan and data collection will be within Universiti Malaysia Sarawak (UNIMAS).
2. The project includes an intelligent bin prototype, a web-based administration application, and a mobile citizen application.
3. The project is intended for use by the cleaning company administration, and citizens.
4. The web-based application monitors garbage levels, locates trash cans, and notifies users when the trash cans are full.
5. The mobile application contains the trash can's location and a reward system for users who use the trash can.
6. The prototype includes a tracker to locate the trash can, a sensor to detect garbage levels, a compressor to increase bin space, and a sensor to open the bin lid.

1.3 Aim and Objective

This project's aim is to create a waste management system using the Internet of Things (IoT).

Based on the previous problem statements, the following are the project's objectives:

1. To design an intelligent prototype, as well as a web application for administration and a mobile application for users.
2. To develop an intelligent bin that can notify the administration when it is full, can be tracked, and has an automatic lid opener using a sensor.
3. To assess the usability and functionality of the intelligent bin for the intended users.

1.4 Methodology

The chosen method for this is the Agile method due to the project involves three types of systems which are the prototype, web application and mobile application.

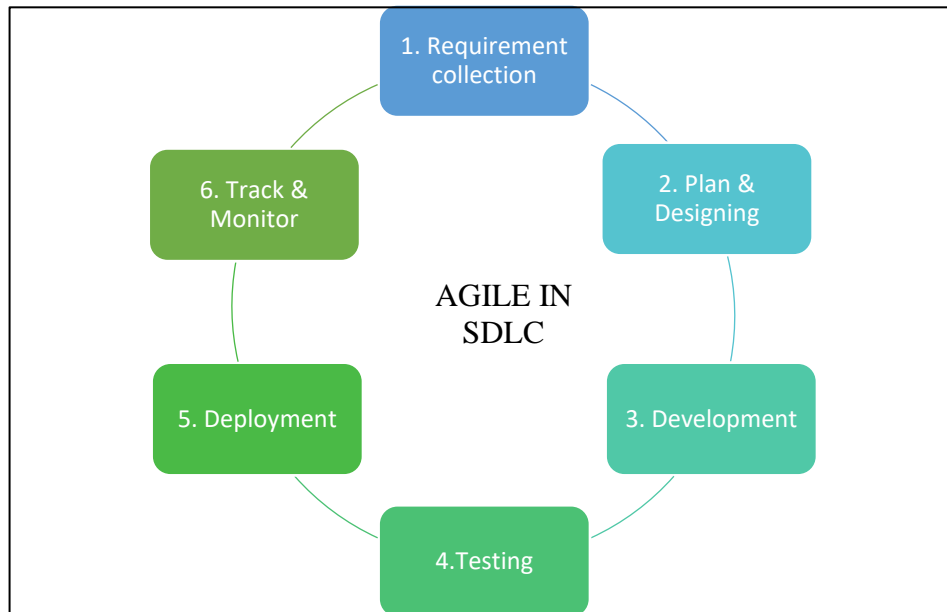


Figure 1.1: A flow chart of Agile methodology (Trivedi, 2021)

The Agile method consists of 6 steps. The first step is requirement collection, where all of the project's requirements will be collected. During this phase, information such as who will use the product and how they will use it must be gathered. These requirements must be quantifiable, pertinent, and specific. The next phase is planning and designing the system.

The previous phase's requirements are used to design and create the system. During planning and design phase, a Unified Modelling Language (UML Diagram) including activity diagram, use case diagram, sequence diagram and class diagram is design. The project's look and plan of action will be considered during this phase. After that, the system will be developed after the designing phase is completed. This phase involves implementation from the design feature and coding. In development phase, two applications will be develop which is web-based application and mobile application. The prototype of the system also will be developed in this phase.

Once the system is completed and developed, it will be tested. This phase is essential for ensuring that the system meets the requirements established in the first phase of the project. After the testing phase is done, the application will be released, and the proposed project will be put into operation. The user will be able to use it with real-world data. This process of implementation will end when the users agree with it. When the application is released to the public, a planned improvement will also be taken into account.

The method's final step is the track and monitor or called maintenance phase for the developer to keep updated on the system. After the system is released to users, a new problem may arise; therefore, this phase is critical to keep the system valuable and meet the user's requirements. However, the maintenance for this proposed project will not be carried on because the project is to fulfil the Final Year Project requirement. Thus, no maintenance will be carried out thereafter.

1.5 Significance Project

This project will consist of three types of systems: prototype, web-based application, and mobile application. The purpose of having a prototype in this project is to see and monitor how each compartment's sensor and tracker work. Meanwhile, the web-based application will be used by the administration to monitor the garbage level in each dustbin for cleaning purposes, and the mobile application will be used by citizens to locate the nearest dustbin and redeem rewards after using it.

The significance of developing a web-based application for administration users is that it will make it easier for staff to navigate the website and check and monitor the garbage level. Aside from that, when using a web-based application, the collected data is easier to record and save in the database.

The significance of developing a mobile application for citizens stems from the fact that