CHAPTER I INTRODUCTION

I.1 Background

Telkom University boasts a number of 28.789 students as of 2020. As one of the oldest faculty in Telkom University, School of Industrial Engineering governs three bachelorette majors, namely Industrial Engineering, Information System, and Logistics Engineering, currently with 3812 active students registered (Telkom University, 2020). With quite a lot of students, the facility provided to support the education system is also highly advanced as can be seen in their Manufacturing Building.

However, the public facilities provided in the hall of faculty building is still lacking. One of the public facilities that is crucial but often overlooked is the existence of drinking water refilling station, which is pretty much non-existent in the hall of faculty building, it can be found neither at the main central halls or the corners of the building interiors as can be seen on Figure I.1. Sure, it existed in some room like the lecturer rooms and laboratories, but the entry to those rooms are limited to authorized personnel only, meaning common students taking class or strolling in the faculty building won't have access to it. The nearest, drinking water feasible is located at the canteen, which is located quite far outside of the building.

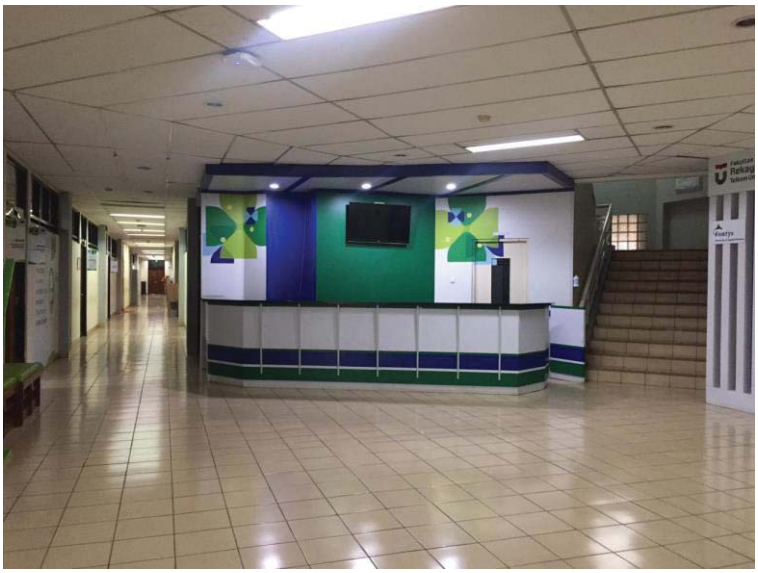

Figure I.1 Observed School of Industrial Engineering Central Hall Reference (Ahnaf, 2021)

According to the interview conducted with 5 students that generally stays at the faculty building, the interviewees agreed that the faculty indeed lacks the facility to provide drinking water for public access. The facility exists however in laboratories, as agreed by 1 student who have access to the privileged drinking water refilling station in their laboratory, namely the Technical Drawing Laboratory. For public access, however, the interviewees note that they could get drinking water at refilling station located in the B building, but somehow the station haven't fully operating yet, or they can get it from the nearest canteen past the business center, outside of the building. Students will need to go to the canteen just to buy a bottle of drinking water, which takes lot of time and effort, when in turn could discourages them to drink some water even if they're thirsty enough because of the effort needed. As observed, the trip to the canteen from the faculty building first floor could take about ten minutes judging by average people's walking pace. A round trip could easily take about 20 minutes, this however, excluding the time one would need to queue at the cashier and doing the payment. As a comparison, in a crowded lecture schedule, a two-credits lecture subject give exactly 20 minutes of break time, with 100 minutes lecture. This made people more reluctant to get some hydration and just continue to go through classes in their current condition, which could lead to a condition of dehydration, which become the main problem in this occasion. A research has shown that 1 in 4 college students were dehydrated, with an additional 37,5% shows signs of dehydration (Zemek & Johnston, 2016).

Prolonged dehydration can prove a serious threat to human health had it been overlooked and could affect physical and cognitive performance of those affected (Popkin et al., 2010). This could be a problem since attending classes requires concentration. The students could use regular bottled water to solve this issue, if they had already carried it. However, regular bottled water containers are made from plastic and is not recommended for reusing. This bring to another important matter in Indonesia that need as much attention in this occasion, which is the plastic waste problem. By year 2015, Indonesia is believed to be the world second highest plastic waste producing country with about 1,29 million metric tons of plastic debris entering the world oceans, projected to increase even more in the near future (Jambeck et al., 2015). The problem become worse especially when it comes to

plastic bottle. In 2018 alone, Indonesia had used about 8,6 billion of plastic bottles, ranked fourth as the world leading countries in bottled water consumption (Dini, 2019).

To tackle this problem, the Indonesian government through the Ministry of Communication and Informatics launched the "1 Million Tumbler Movement" beginning in 2019, as a part of Clean Indonesia National Campaign. The movement is targeted to increase people awareness regarding the use of tumbler to decrease the use of plastic straw and bottles, which ultimately will lead to less plastic waste produced (Kominfo, 2019). Although people responses for this movement was relatively good, it faces obstacles to sustain the movement itself, such as the lack of public facilities like dispenser or vending machine that provides drinking water refilling services. This brought the problem back to square one.

Unfortunately, research has shown that dehydration in school is closely affected by availability and accessibility to the said facility (Kenney et al., 2020). A smart and simple water dispenser that act based on reading of sensors can be built with help of microcontrollers to process the input (Yendri et al., 2020). Better yet, to provide wireless user monitoring utilizing internet connection, a microcontroller board with internet connection capabilities can be used, enabling the use of Internet of Things technology (Gunasinghe & Tharmaseelan, 2019). Internet of Things or abbreviated as IoT, is an advanced communication paradigm, in which the objects of everyday life will be equipped with devices able to do digital communication, and suitable protocol stacks that will enable them to communicate with each other and with the users, becoming an integral part of the Internet, that nowadays has occupied many things in everyday live, such as the implementation of smart cities and smart homes (Zanella et al., 2014). By this definition, IoT could also be used in controlling the process of the water refilling dispenser that can be built, based on user request.

The idea of controlling process using IoT is not new as this was shown in previous researches. A water flow monitoring system using android smartphone can be built based on its NFC function, with user-control made in form of an android application using AIA MIT platform built using the waterfall method (Jamaluddin et al., 2017). Another research shows a development of an IoT-based smart monitoring and reliable controlling system for sub-station equipment to replace the more expensive

PLC and SCADA systems (Hossain et al., 2019). A user control and monitoring application is also developed for a similar project of a farmbot system based on IoT, built using sequential method (Murdyantoro et al., 2019). Therefore, developing an automated dispenser system with a reliable user control utilizing IoT is a feasible feat in fulfilling the need of a public facilities providing water fulfilling services.

However, the constraint to provide a drinking water refilling station might be economical, as it would need not only its own area but also an employee working as a cashier to settle the payments. Therefore, a more significantly practical system could solve this problem, especially when it comes to the purchasing and payment process. Several vending machines have already implemented simplistic payment process by using cards as a payment method to simplify the process (Caporusso et al., 2020). A more advanced payment system for vending machine, utilizing electronic payment and M2M communication between a device and the vending machine have also been developed (Koike et al., 2011). This system used the developed financial technology called electronic payment, supporting a cashless transaction method in a form of electronic money (Naeem et al., 2020). Incorporating the e-payment technology into the automated might be able to solve the economical constraint in implementing it.

Therefore, to solve the scarcity of automated water refilling station, which in turn will also provide supports in decreasing plastic bottle waste, an automated water refilling dispenser integrated with cashless and simple payment method will be developed. Thereupon, the methodology used for building the proposed IoT system is the waterfall method of approach, which offers a free flowing, sequential development process. This method considered to offer a well-defined set of criteria and requirement indications before actually starting the design phase and implementation of the project, thus, offering a basis plan of the project before starting and continuing in an orderly sequence of phases (Dima & Maassen, 2018). The waterfall method, although used by many renowned software developers, is a good method for personal projects in which the requirements are defined at the start of the project, allowing the study to continue through its developing stages without the interference of an ever-changing requirements, making it a good consideration for this type of study (Balaji, 2012). The end product of this research will be an automated dispenser prototype integrated with android user control based on IoT

that will serve as one system and its performance in acquiring data from the database.

I.2 Problem Definition

According to the problem stated in the background, the problem definition will be as stated below.

1. How to develop integrated automated dispenser prototype based on IoT?
2. How much is the system delay in responding to user request?

I.3 Research Objectives

This research objectives to be achieved is as follows:

1. The development of integrated automated dispenser prototype based on IoT.
2. The system delay in responding to user request.

I.4 Scope of Research

The problems in this research were limited into these aspects:

1. This study is focused only on developing integrated automated dispenser prototype based on internet of things using waterfall approach in school of industrial engineering in Telkom University.

This research was intended only into these aspects:

1. Development of integrated automated dispenser prototype based on IoT.
2. The waterfall approach in this research doesn't conduct the maintenance process.
3. The water flow rate is controlled by the water pump itself, with a maximum flow rate of 240L/H
4. The price of the product may not reflect the real market as it was only intended for simulation, and is controlled by using the application and database
5. The payment currency and balance are simulated in the application, without the use of real money balance and in respect, no linkages with any available e-payment instruments and/or corporations
6. The software used to program in this research are Android Studio and Arduino IDE
7. No feasibility study conducted in this research

8. The developed system only uses the normal waterway and therefore will only be able to provide normal water with room temperature
9. There is a voucher feature in the application but no voucher implemented yet
10. The gallon refilling process is still done manually

I.5 Research Benefits

This research is expected to give these benefits.

1. Provides design of an automated dispenser system
2. Encourages development and research of technologies that when implemented will improve public services
3. Increases public awareness regarding the Internet of Things development especially in the field of financial technology
4. Provide social empowerment means as it can empower the university staffs to support the implementation of the automated dispenser
5. Offers empirical thoughts regarding the development of Internet of Things in automation field of study from a view of an industrial engineering student
6. As a solution to help decrease plastic waste by reducing the use of plastic bottles

I.6 Writing Systematics

This research is described using writing systematics such as follows:

Chapter I Introduction

The first chapter which consists of descriptions about the research's background, problem formulations, objective, scopes, benefits, and systematics.

Chapter II Literature Review

This chapter contains relevant literatures which support this research in solving underlying problems.

Chapter III Research Method

This chapter provides detailed explanation regarding the steps taken in the research including the problem definitions followed by problem solving systematic.

Chapter IV System Development

This chapter explains the requirements needed in developing the automated dispenser system both in hardware and software.

Chapter V Testing and Analysis

This chapter describe the testing and analysis process of the developed system.

Chapter VI Summary

This chapter generally concludes the research by providing conclusion of current research and suggestions for next researches to come.