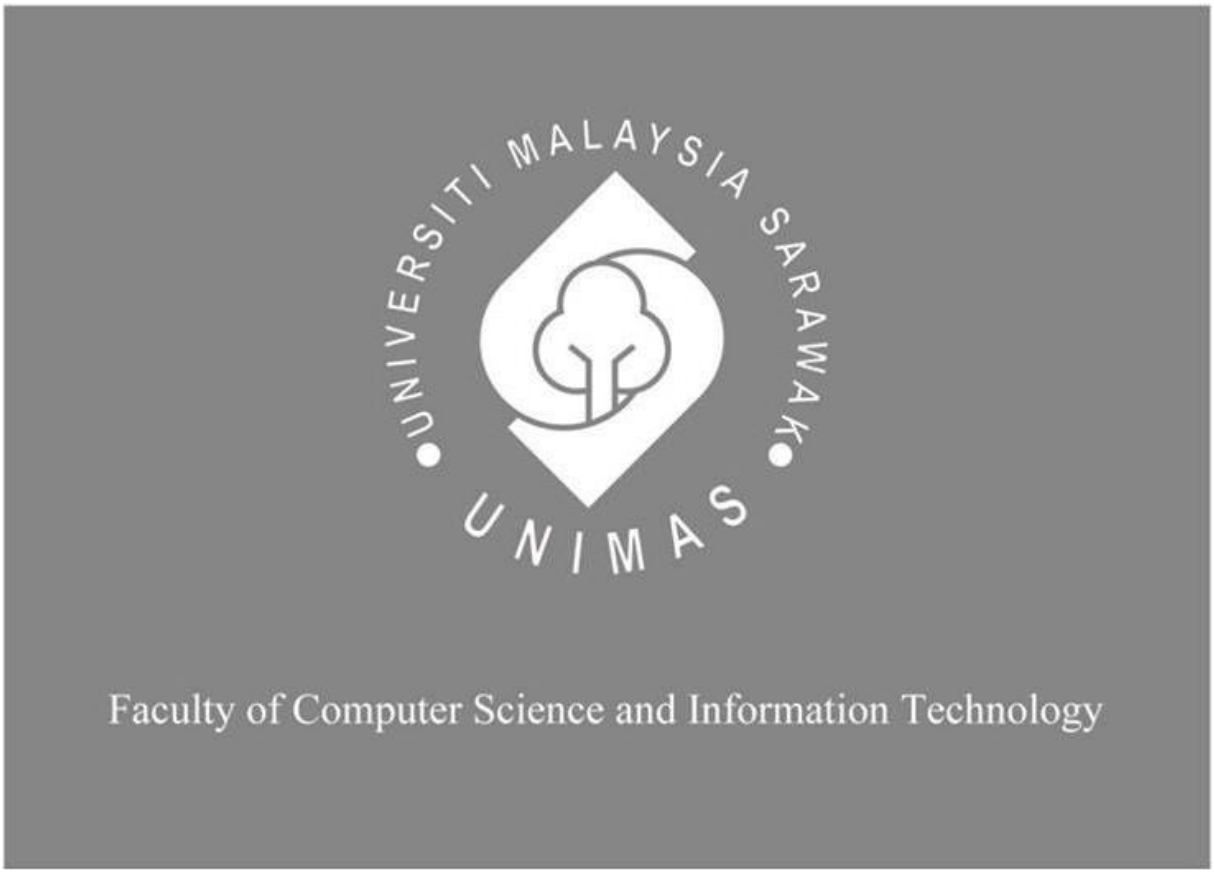

FLASH FLOOD MONITORING AND WARNING SYSTEM

Ho Wan Yu

Bachelor of Computer Science with Honours

(Network Computing)

2022

FLASH FLOOD MONITORING AND WARNING SYSTEM

HO WAN YU

This project is submitted in partial fulfilment of the

requirements for the degree of

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(HO WAN YU) 22 JULY 2023

ACKNOWLEDGMENT

In this project, I would like to acknowledge and give my warmest thanks to my supervisor Dr. Lau Sei Ping who make this Final Year Project on the topic Flash Flood Monitoring and Warning System possible. I feel myself very fortunate to have such a thoughtful and professional supervisor like him. I was able to complete all my project stages thanks to his direction and counsel.

Besides, I would like to thank my Final Year Project partner, Christopher Sii How Chiong, who handled the configuration of the Flash Flood Observer and developed the mobile application for admin's features. Christopher consistently engaged in discusses and collaborated closely with me to sort out the issues we had throughout our project. Last but not least, I would also like to deliver my thankfulness to my family and friends for their continuous support through the journey to complete my Final Year Project within the time given.

ABSTRACT

Flood is natural disaster that will cause a significant damage to the environment and both living and non-living things. Kota Samarahan repeatedly experienced flooding due to few reasons such as low-lying area, gradual urbanisation, and no masterplan to construct the drainage system. These issues become a big problem when the flash flood is happened and will interrupt society's activities. Therefore, the real-time flash flood monitoring and warning system is proposed in this project. The concept of this proposed system is to share the water level reading from the hardware. The hardware, Flash Flood Observer is under other FYP project to collect the data to the same sharing database server. The proposed system able to share the real-time water level and show the flood prone area based on the sea level using the GIS map. When the water level reaches a critical level, it will broadcast the warning to the end-user. This project is developed based on Rapid Application Development (RAD). The methodology used as the methodology offers a rapid prototype and iterative delivery as software development.

ABSTRAK

Banjir adalah bencana semula jadi yang akan menyebabkan kerusakan yang besar kepada persekitaran dan benda-benda hidup dan bukan hidup. Kota Samarahan kerap mengalami banjir disebabkan oleh beberapa sebab seperti kawasan rendah, urbanisasi beransur-ansur, dan tiada pelan induk untuk membina sistem saliran. Isu-isu ini menjadi masalah besar apabila banjir kilat berlaku dan akan menganggu aktiviti masyarakat. Oleh itu, sistem pemantauan dan amaran banjir kilat masa nyata diusulkan dalam projek ini. Konsep sistem yang diusulkan adalah untuk berkongsi bacaan aras air dari perkakasan. Perkakasan, Flash Flood Observer adalah di bawah projek FYP yang lain untuk mengumpul data kepada pangkalan data yang sama. Sistem yang diusulkan boleh berkongsi aras air masa nyata dan menunjukkan kawasan berisiko banjir berdasarkan aras laut menggunakan peta GIS. Apabila aras air mencapai tahap kritikal, ia akan menyiarkan amaran kepada pengguna akhir. Projek ini dibangunkan berdasarkan Pembangunan Aplikasi Pantas (RAD). Metodologi yang digunakan sebagai metodologi menawarkan prototaip pantas dan penghantaran iteratif sebagai pembangunan perisian.

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CHAPTER 1: INTRODUCTION

1.1 Introduction/Background

Floods are mostly caused by geographical conditions, metrological conditions, hydrological conditions, flaws with planning, and environmental conditions brought on by human activities etc. (Priyadarshinee et al., 2015). Floods can have disastrous repercussions on people, the environment, and the economy. It became a trouble when the homes, bridges, roads, and automobiles are all ruined by flooding, especially flash floods. When floods strike, the ecology also suffers (Almawgani, 2020). There are many flood detection systems still using the traditional method of disaster forecasting in rural areas in Malaysia. The traditional method which locals keep an eye on water rises that occur close to rivers. This action is too dangerous since the region close to the river has become unsafe for their safety, which restrict current water level data from being gathered causing delay in broadcast the notification to the locals (Priyadarshinee et al., 2015). The current flood detection system only keeps track of the water level, but it does not offer a reliable warning system to the local community.

This work focuses on designing and developing of a Flash Flood Monitoring and Warning System by applying IoT device, “Flash Flood Observer”. The "Flash Flood Observer" created by one of the FYP students (SEM 1 2022/2023), Christopher Sii How Chiong (69385), which will collect all the data of water level then transmitted and stored on a same sharing database server. The Flash Flood Monitoring and Warning System will retrieve and process the water level data into information from the database server for forecasting and issuing push notification to local community or driver that installed the application on the smartphone. The GIS map also be implemented in the system where the map will be updated by overlaying flood prone area on the map of the possible affected area with reference to the threshold water level.

1.2 Problem Statement

Flood is a natural disaster that affects both living and non-living things in the environment. According to the Senior Minister of Works (MoW) Dato Sri Fadillah Yusuf, Kota Samarahan frequently experienced flooding because of low-lying area, gradual urbanisation, and no masterplan to construct or upgrade the drainage system (Nur Ashikin Louis, 2021). These natural calamities become a big problem when safe zones, and other critical information cannot be noticed by local community and the drivers to assist in disaster preparedness and response. Hence, this problem interrupts society's activities such as local community or the drivers not aware of the flash flood happening in far distance. In these conditions, real time flood warning system is important because flood can happen when everyone is resting thus may not be aware of the rising water until it is too late.

1.3 Objectives

The following are the project objectives:

- To design an online system for storing water level information relayed from the "Flash Flood Observer".
- To provide real-time water level conditions in normal, alert, warning, and danger.
- To broadcast a location-aware flood warning to the local community through the mobile application.

1.4 Project Scope

The scope of the project are focusing on allowing the passing of the water level reading from the hardware. The hardware development, Flash Flood Observer is under other FYP project which is handled by Christopher Sii How Chiong. The Flash Flood Observer will post the water level data collected to the same sharing database server. With all the water level readings, the

flash flood monitoring and warning system can predict when the water level reaches a critical level. Besides, the warning system able to show the affected area based on the sea level. With this information, the system will broadcast the warning to the end-user. This system is designed and developed for Android-based smartphone users using the Flutter with Visual Studio Code. The target user of this Flash Flood Monitoring and Warning System app are the local community and the driver.

1.5 Brief Methodology

The selected methodology for the Flash Flood Monitoring and Warning System is Rapid Application Development (RAD). This is because RAD life cycle provides higher efficiency for rapid development. RAD is a reduction in planning and requirement analysis but more focus on rapid prototyping. Besides, RAD uses a shorter time to complete and able to produce more quality project with limited manpower.

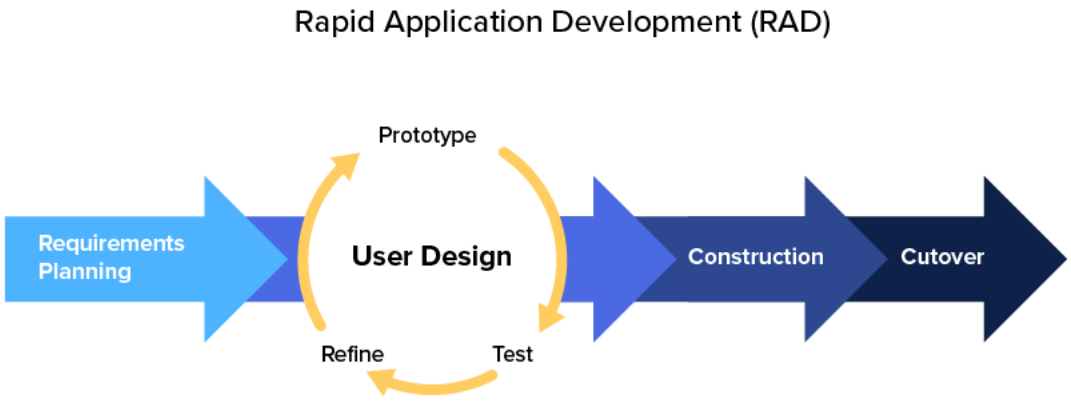

Figure 1.1. Software Life Cycle of Rapid Application Development (Kissflow, 2022)

Phase 1: Requirement Planning

During this phase, gathering the requirements that are faced by the user which are related to the flash flood happening. Developer needs to consider the requirements of the user and the problem statement. Once the requirement is figured out, the estimated project timeline will be outlined.

Phase 2: User Design

Once the project has been scoped, the user interface will begin to design and build out the initial prototypes. The goal in this phase is to rapidly produce a working design and at the same time can meet the user experience. The prototype design is implemented and able to share the water level information and broadcast the location aware alert to the user. After demonstration to the user, the prototype will be tested and improved in turn based on the requirements until all the requirements have been met.

Phase 3: Construction

In this phase, all the requirement, design and feature of the application will be converting into source code. Since most of the user problems and changes during the iterative prototyping phase, this phase able to construct a final working model faster. The warning system is thoroughly tested during this phase to ensure the result satisfies user expectations and objectives. At the same time, the working prototype of the warning system will be built and improved.

Phase 4: Cutover

The final phase is ready to implementation the completed and refined warning system after approval by the user and the final product is ready to release.

1.6 Significance of Project

The propose of this system is help the local community to acknowledge the current flood water level of the user location and able to help the driver aware the flash flood happening in far distance. The system with the GIS map able to display and provide real-time water level conditions in normal, alert, warning, danger level. Besides, this proposed system able to help the local community or the driver to face or avoid the disaster as the system will broadcast alert to the end-user in real-time regarding the water level danger where the flood is occurring. In this project, the proposed system uses the water level data collected from "Flash Flood Observer", and based on the water level data to determine whether there is a potential flood.

1.7 Project Schedule

Project schedule is used as progression guidance for the project. Figure 1.2 shows the project schedule and Gantt Chart as a timeline progress of the Final Year Project 1 and 2.

ID	Task Name	Duration	Start	Finish
1	**Final Year Project 1**	**287 days**	**Mon 17/10/22**	**Sun 30/7/23**
2	**Brief Proposal**	**12 days**	**Mon 17/10/22**	**Fri 28/10/22**
3	Prepare Brief Proposal	10 days	Mon 17/10/22	Thu 20/10/22
4	Milestone: Submit Brief Proposa	0 days	Fri 28/10/22	Fri 28/10/22
5	**Project Proposal**	**8 days**	**Mon 7/11/22**	**Mon 14/11/22**
6	Full Proposal Briefing	1 day	Mon 7/11/22	Mon 7/11/22
7	Prepare Full Proposal	7 days	Tue 8/11/22	Mon 14/11/22
8	Milestone: Submit Full Proposal	0 days	Mon 14/11/22	Mon 14/11/22
9	**Chapter 1: Introduction**	**7 days**	**Tue 15/11/22**	**Mon 21/11/22**
10	Finalize Project Proposal	7 days	Tue 15/11/22	Mon 21/11/22
11	Milestone: Submit Chapter 1 Report	0 days	Mon 21/11/22	Mon 21/11/22
12	**Chapter 2: Literature Review**	**19 days**	**Mon 21/11/22**	**Fri 9/12/22**
13	Research and review on existing problem	8 days	Mon 21/11/22	Mon 28/11/22
14	Documentation	12 days	Mon 28/11/22	Fri 9/12/22
15	Milestone: Submit Chapter 2 Report	0 days	Fri 9/12/22	Fri 9/12/22
16	**Chapter 3: Methodology**	**22 days**	**Fri 9/12/22**	**Fri 30/12/22**
17	Define Requirement Analysis and Design	22 days	Fri 9/12/22	Fri 30/12/22
18	Milestone: Submit Chapter 3 Report	0 days	Fri 30/12/22	Fri 30/12/22
19	**Final Report**	**47 days**	**Sat 31/12/22**	**Wed 15/2/23**
20	Finalize and submit final report and paper	26 days	Sat 31/12/22	Wed 25/1/23
21	Prepare FYP presentation video	2 days	Wed 25/1/23	Thu 26/1/23
22	Submit presentation video	1 day	Thu 26/1/23	Thu 26/1/23
23	Modify FYP	21 days	Thu 26/1/23	Wed 15/2/23
24	Milestone: Submit Final Report	0 days	Wed 15/2/23	Wed 15/2/23
25	**Chapter 4: Implementation**	**89 days**	**Thu 16/2/23**	**Mon 15/5/23**
26	Preperation for Implementation and Testing	89 days	Thu 16/2/23	Mon 15/5/23
27	Revised Structure of FYP Report and Gantt Chart	10 days	Wed 29/3/23	Fri 7/4/23
28	Milestone: Revised Structure Submission	0 days	Fri 7/4/23	Fri 7/4/23
29	Milestone: Submit Chapter 4	0 days	Mon 15/5/23	Mon 15/5/23
30	**Chapter 5, 6: Testing, Conclusion and Futrue Work**	**14 days**	**Tue 16/5/23**	**Mon 29/5/23**
31	Milestone: Submit Chapter 5, 6	0 days	Mon 29/5/23	Mon 29/5/23
32	**FYP 2 Report and Symposium**	**62 days**	**Tue 30/5/23**	**Sun 30/7/23**
33	Draft for FYP2 Full Report and Paper	12 days	Tue 30/5/23	Sat 10/6/23
34	Milestone: Submit FYP2 Final Report and Paper	0 days	Sat 10/6/23	Sat 10/6/23
35	Preparation for FYP2 Final Report, Source Code, Installation Kits, User Manual	22 days	Sat 10/6/23	Sat 1/7/23
36	Milestone: Submit FYP2 Final Report, Source Code, Installation Kits, User Manual	0 days	Sat 1/7/23	Sat 1/7/23
37	Preparation pre-recorded video and presentation slides	3 days	Sat 1/7/23	Mon 3/7/23
38	Milestone: Submit pre-recorded video and	0 days	Mon 3/7/23	Mon 3/7/23
39	Amendment and Modification (if any)	22 days	Mon 3/7/23	Mon 24/7/23
40	Submission of Final Report	7 days	Mon 24/7/23	Sun 30/7/23
41	Milestone: Submit Final Report	0 days	Sun 30/7/23	Sun 30/7/23

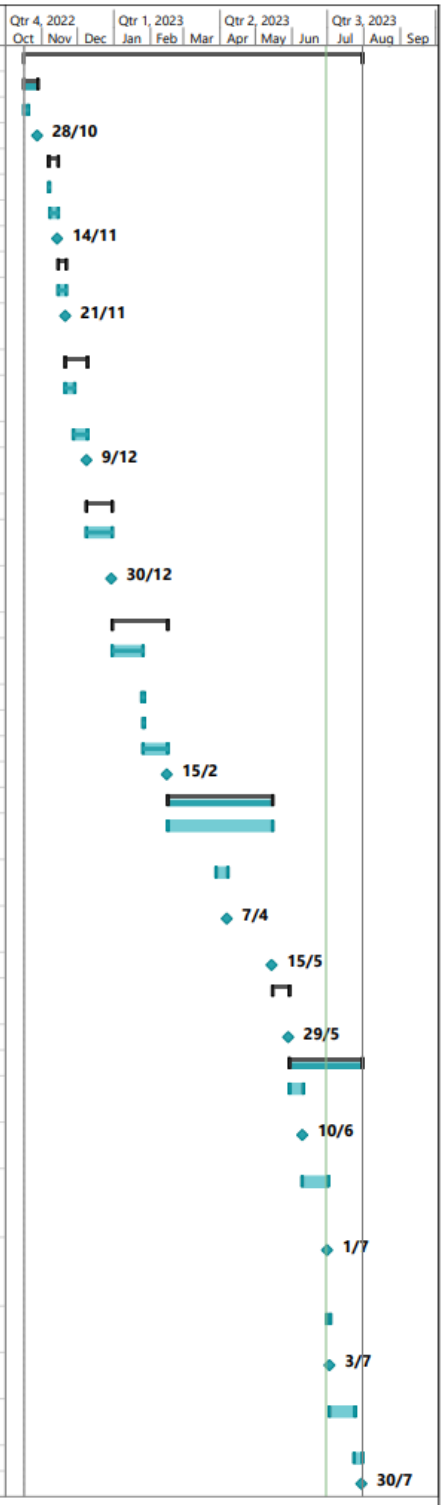

Figure 1.2. Project Schedule and Gantt Chart

1.8 Expected Outcome

At the end of the project, the real-time flash flood monitoring and warning system by applying IoT device will be designed and developed. The expected outcome of this projects is the system

able to accept and store the water level information for the observer to monitor and share the information of forecasting flood events in real time. The system will be able to monitor the current flood water level, able to show the flood prone area and enable broadcast location aware flood warning regarding the water danger level settings.

1.9 Project Outline

The project report consists of five chapters as described below:

1.9.1 Introduction

Chapter 1 describes about the general introduction of the proposed system. This chapter consists of the background, problem statements, objectives, project scope, brief methodology used, significance of project, project schedule and the expected outcome of the project.

1.9.2 Literature Review

In this chapter, literature review of reviewed systems will be selected through the existing systems and related paper. The reviewed systems will be discussed and compared, as well as describing the proposed system. The technology and software development tools utilised to create the proposed system are also reviewed in this chapter.

1.9.3 Requirement Analysis and Design

Chapter 3 discusses the system architecture and the methodology used in this proposed system. Rapid Application Development (RAD) is chosen due to its efficiency. It has four phases in RAD which is requirement planning, user design, construction, and cutover. In RAD, it more focuses on the prototype over planning. These four phases of RAD methodology will be discussed in detail in this chapter.

1.9.4 Implementation and Testing

Chapter 4 discusses the implementation phase and the testing phase done in this project. The system prototype is developed according to the system design and conduct the testing. Besides,