



Faculty of Computer Science and Information Technology

***HEALTH INFORMATION SYSTEM WEB APPLICATION WITH
INTELLIGENT SEARCH***

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Bachelor of Computer Science with Honours (Software Engineering)

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FREDDY WONG JING ZONG

This project is submitted in partial fulfilment of the requirements for the degree of Bachelor
of Computer Science with Honours (Software Engineering)

Faculty of Computer Science and Information Technology

UNIVERSITI MALAYSIA SARAWAK

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CARIAN PINTAR**

FREDDY WONG JING ZONG

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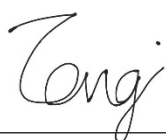
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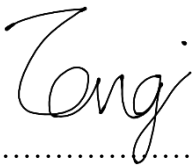
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ABSTRACT

The Health Information System (HIS) is used to access the health information easier compared to saving the information in physical documents. However, the health information systems used by hospitals and clinics are not centralised, so patient data is not synchronised, making it difficult to retrieve patients' updated health information. The inspiration of doing this project is to provide the platform where the users can view their health information anytime and anywhere. Also, by integrating a third-party intelligent search engine which has more advanced searching query and functions than a normal search function does, the users are able to get their more preferred search results in a more efficient way. The methodology used in this project is Rapid Application Development (RAD) and there are four phases in this project. In order to develop the proposed system, the requirements and suggestions are gathered by using questionnaires and interviewing sessions with health professionals. Three third-party intelligent search engines are being reviewed to decide the most suitable intelligent search engines. In addition, three existing health information systems are being reviewed and compared as well for the reference of the proposed system. The system is developed using the web programming languages such as HTML, CSS, PHP, and Azure Cognitive Service is used as the intelligent search engine. Due to Azure Cognitive Service is used, Microsoft SQL Server or MSSQL is being selected as database of the web application. The system is developed based on the requirements gathered and reviews. In addition, the system is tested using functionality testing and unit testing. Usability testing is also conducted by 15 testers and 2 professionals. All of them are able to operate the system with minimum supervision, and most of them are satisfied with the system. Though, further enhancements are required to improve the Health Information System (HIS) in the future. It is recommended to incorporate a feature that enables medical professionals to store medical records by attaching documents in formats such as PDF or images for future reference. Furthermore, when the system is being commercialized, consideration should be given to upgrading the Azure Cognitive Search service to a higher pricing tier.

ABSTRAK

Health Information System (HIS) digunakan untuk mengakses maklumat kesihatan dengan lebih mudah berbanding dengan menyimpan maklumat dalam dokumen fizikal. Namun, sistem maklumat kesihatan yang digunakan oleh hospital dan klinik tidak dikendalikan secara sentral menyebabkan data pesakit tidak diselaraskan. Hal ini menyebabkan maklumat kesihatan pesakit yang dikemas kini sukar untuk didapati. Oleh itu, inspirasi untuk memulakan projek ini adalah untuk menyediakan sesuatu platform di mana pengguna boleh melihat maklumat kesihatannya pada bila-bila masa dan di mana sahaja. Selain itu, dengan mengintegrasikan enjin carian pintar pihak ketiga yang mempunyai pertanyaan dan fungsi carian yang lebih canggih daripada fungsi carian normal, pengguna boleh mendapatkan hasil carian yang lebih disukai dalam cara yang lebih efisien. Metodologi yang digunakan dalam projek ini adalah *Rapid Application Development (RAD)* dan terdapat empat fasa dalam projek ini. Dalam usaha untuk mengembangkan sistem yang dicadangkan, keperluan dan cadangan dikumpulkan dengan menggunakan kaji selidik dan sesi temubual dengan profesional kesihatan. Tiga enjin carian pintar pihak ketiga ditinjau untuk membuat keputusan untuk memilih enjin carian pintar yang paling sesuai. Selain itu, tiga sistem maklumat kesihatan yang terdapat di pasaran juga ditinjau dan dibandingkan untuk rujukan sistem yang dicadangkan. Sistem ini dibangunkan menggunakan bahasa pengaturcaraan web seperti *HTML*, *CSS*, *PHP*, dan *Azure Cognitive Search* digunakan sebagai enjin carian pintar. Oleh kerana *Azure Cognitive Search* digunakan, *Microsoft SQL Server* atau *MSSQL* dipilih sebagai pangkalan data aplikasi web. Sistem ini dibangunkan berdasarkan keperluan yang dikumpulkan dan ulasan. Selain itu, sistem diuji menggunakan ujian kefungisian dan ujian unit. Ujian kebolegunaan juga dijalankan oleh 15 penguji dan 2 profesional. Kesemua mereka dapat mengendalikan sistem dengan pengawasan minimum, dan kebanyakan mereka berpuas hati dengan sistem tersebut. Namun, penambahbaikan selanjutnya diperlukan untuk menambah baik *Health Information System (HIS)* pada masa hadapan. Adalah disyorkan untuk memasukkan ciri yang membolehkan profesional perubatan menyimpan rekod perubatan dengan melampirkan dokumen dalam format seperti *PDF* atau imej untuk rujukan masa hadapan. Tambahan pula, apabila sistem sedang dikomersialkan, pertimbangan harus diberikan untuk menaik taraf perkhidmatan *Azure Cognitive Search* kepada peringkat harga yang lebih tinggi.

CHAPTER 1: INTRODUCTION

1.1 Background

Health information consists of medical record, diagnosis, medications, and medical history. It is an important data needed by the medical personnel to treat patients. Therefore, the Health Information System (HIS) is meant to integrate data collection, processing, reporting, and use of the information necessary for improving health service effectiveness and efficiency (Health information systems, n.d.). In hospitals and clinics with HIS, the medical personnel can retrieve the information without obtaining the physical record from patients if their existing record are storing inside the database. However, the systems used by hospitals and clinics are not centralized which causes the patients' data are not synchronized in every hospital.

In addition, for some hospitals and clinics that are less likely to use HIS, the medical personnel could only store the patients' medical record in the form of physical document. This will affect their work efficiency during treatment and diagnosis because they have to find the record one by one in the cabinet or folders. It takes time for the medical personnel to find the patients' document to update their record.

Therefore, a solution regarding this issue needs to be provided. The development of a web application of health information system with intelligent search feature is one of the ways to improve the operation of the clinics or hospital. The system is used to save the patients' record digitally and the search feature will be integrated into the web application. However, it is not normal search function. The intelligent search engine can understand the intent and meaning of queries and respond to them in a way that feels more natural than standard search (Higbie, 2022). The patients' medical record stored inside the database can be searched easily compared to normal search and the search results are more intuitive.

1.2 Problem Statement

The HIS used by hospitals or clinics are decentralized and it is troublesome for medical personnel to update manually every time. The patient still can get the up-to-date medical record if they only go to public hospitals because the database is usually interconnected between public hospitals. However, when patients transferred from public to private hospitals, they have to acquire the previous medical record as printed document in order to add or update patients' medical record into their respective database. This condition also applies when they transferred from private hospital to public hospital.

In some hospitals or clinics, the medical personnel could only store the health information physically in folders and it is hard to search for specific record by looking one by one at the file cabinet. In addition, during the diagnosis or treatment process, most of the people are illiterate they cannot describe their problem clearly (Md. Saniat Rahman Zishan et al., 2019). Therefore, without the help of updated medical record and an effective method of searching medical record, the work performance and efficiency of medical personnel will be affected.

In other scenarios, some existing systems that use normal search feature always have latencies of searching specific items. With the assistance of AI throughout the searching process, faster and more relevant search results will be shown with minimum keywords input. Therefore, with the integration of intelligent search engine into Health Information Systems, the stated issues can be solved once the system is deployed out.

1.3 Scope

The scopes of the project are listed below:

- The target users for this system are the registered patients under the hospital or clinic, medical personnel such as doctor, nurse, and admin who handles medical record.
- The system is designed and deployed as a web application.
- The main purpose of this system is to store the medical record digitally and search for data efficiently.

1.4 Objectives

- To design a health information system web application.
- To integrate intelligent search function into health information system web application.
- To develop the web application that is accessible by medical personnel and patients.

1.5 Methodology

In this project, the methodology chosen is Rapid Application Development (RAD), which is based on the agile methodology. This methodology is always applied in the quick application development cycle and provides good quality software compared to traditional software engineering approaches (Sasmito et al., 2020). Therefore, it is suitable in this project to complete the development in this limited time period. RAD methodology consists of four phases and each phase is described below.

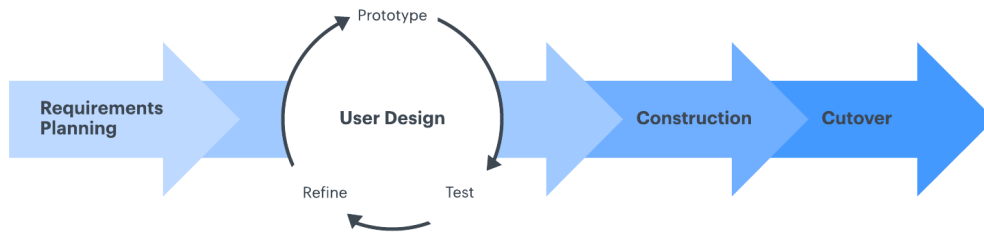


Figure 1.1: Rapid Application Development Model (Lucid Content Team, n.d.)

1.5.1 Phase 1: Requirements Planning

This is the first phase before the project starts where the developer analyzes and determines the problems and objectives. The requirements will be gathered from the users, in this project the users are individuals and medical practitioners by using questionnaire and interview session. In addition, few existing health information system and existing third-party intelligent search engines will be reviewed and compared, and the most suitable intelligent search engine will be decided to be integrated into this web application.

1.5.2 Phase 2: User Design

In this phase, the prototype such as paper prototype will be built and demonstrated to the users. The reason of demonstrating to them is to get feedback and to enhance the prototype if there is problem. The feedback will be gathered from normal users by using questionnaire, while the interview session will be held to get better feedback from experienced person such as medical personnel in this project. The process will iterate again from prototype, test, and refine until the prototype satisfies user needs.

1.5.3 Phase 3: Construction

After the second phase, the development process starts, and a working system will be built based on the requirements and prototype. The main web application will be developed using HTML, CSS, JavaScript, and PHP as well as other frontend and backend frameworks. After that, the selected third-party intelligent search engine will be integrated into the web

application and connected to the database. Testing will also be done in this phase to check for bugs, errors, or any malfunctioned component. At this phase, user feedback is still required before the project finalized.

1.5.4 Phase 4: Cutover

This is the last phase where the working system will be deployed into server and be prepared to launch into live environment after testing.

1.6 Significance of Project

The aim of this project is to develop and provide a centralized system for medical personnel to save, view, edit or delete medical record anywhere, anytime using any computer and mobile devices with web browser software. The patients will be able to view their own medical record as well. The system is also made sure that only owner and medical personnel can access to the medical record. The intelligent search engine will be integrating into the web application to increase the efficiency of the medical personnel when searching for any specific record.

1.7 Project Schedule

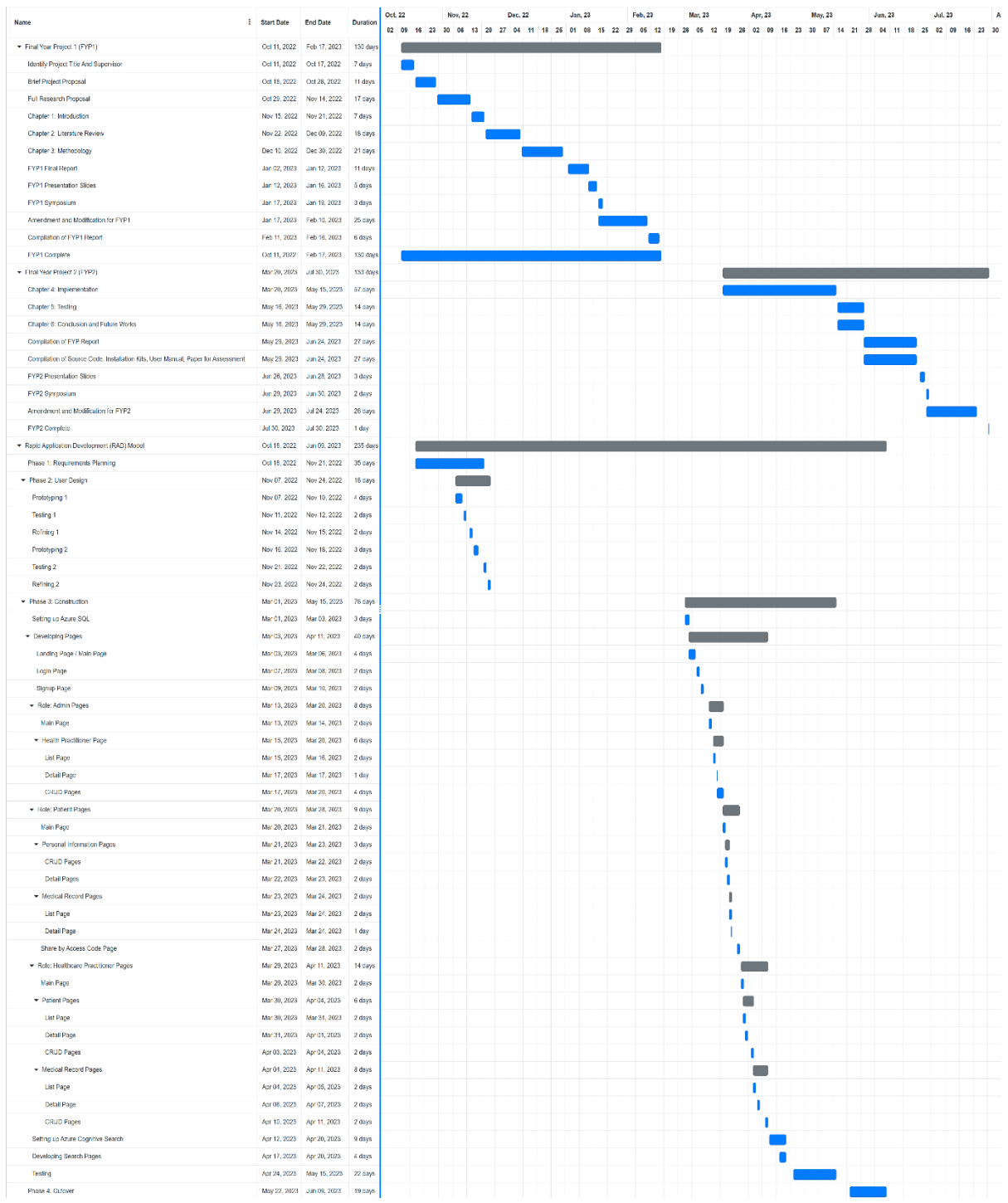


Figure 1.2: Gantt Chart for Final Year Project

1.8 Expected Outcome

At the end of this project, a web application for health information system is expected to be designed and developed. Medical personnel will be able to store the patients' medical record inside the database and do any updates or amendments to the record. The patients as well can view their own medical record. The third-party intelligent search function is expected to be integrated to the web application for the medical personnel to search for the specific record in shorter time.

1.9 Project Report Outline

1.9.1 Chapter 1: Introduction

This is the first chapter where the concept of this proposed system is discussed. The chapter begins with the background of the project and the current problems regarding the project background are identified. The objectives, scope, significance of the project and expected outcome are stated as well to describe the goals and general achievements in this project. In addition, the methodology chosen are briefly described along with project schedule throughout the whole project.

1.9.2 Chapter 2: Literature Review

This chapter focuses on comparing the existing system or function related to this project. On first part, few existing intelligent search engines are reviewed and compared based on the features, strength, and weakness to decide the most suitable intelligent search engine to be integrated into the Hospital Management System. The next part discusses the tools that used in this project development.

1.9.3 Chapter 3: Requirement Analysis and Design

Chapter 3 discusses the methodology used during the project development, which is Rapid Application Development (RAD). This chapter describes the method used to collect related information, analysis of the collected data, logical design of the system such as database and logical diagram, and physical design which is the prototype of the system.

1.9.4 Chapter 4: Implementation

This chapter discusses the implementation and development of the proposed system in this project based on the design in Chapter 3.

1.9.5 Chapter 5: Testing

This chapter describes the testing specifications during the testing phase of the RAD methodology.

1.9.6 Chapter 6: Conclusion and Future Work

Chapter 5 shows the conclusion of the whole project. This chapter is also discussing the suggestions or ideas to further improve the developed system.

1.10 Chapter Summary

Chapter 1 introduces the proposed system, which is Health Information System (HIS) web application with third-party intelligent search engine integrated into it. The main purpose of this web application is to provide a centralized platform for patients and medical personnel to store the medical record. With the intelligent search function, the medical personnel are able to search for the record with ease and more efficient.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter discusses the reviews of the existing health information systems with intelligent search function embedded, intelligent search algorithms, and existing third-party intelligent search engines to be integrated into the proposed system. The technologies and tools that are needed to build the proposed system are stated as well.

The first part of this chapter is about the analysis of three existing health information systems. The features and search functions of three existing health information systems are being reviewed. After that, a comparison between these systems and proposed system is made as well.

In the next part, few intelligent search algorithms are being discussed as well. After that, three existing third-party intelligent search engines are being analyzed. A comparison between three of them is made as well. This comparison is used to decide the most suitable intelligent search engine that is used to integrate into the proposed system.

Whereas in the second part, the technologies and tools such as the programming language, database type are specified and listed for the development of the proposed system.

2.2 Brief Overview

The standard feature and functions of the proposed system which is Health Information System (HIS) are shown below:

- Account login/ logout/ register functions for all roles.
- The user can view patients/ medical records/ accounts as list and show in detail based on different account roles.

- Search function based on account role. The search items availability is based on different account roles.
- Filterable search results.
- Ability to share medical record by using access code.
- Create / Edit / Delete medical record.

2.3 Reviews of Similar Health Information Systems

In this part, three similar Health Information Systems are being reviewed and compared. The reviewed systems are Mayo Clinic Health System (2022), Cleveland Clinic Health Essentials (2022), and Johns Hopkins Medicine (2022). The details of each system are discussed, and the comparison between three systems and proposed systems is made in sections below.

2.3.1 Mayo Clinic Health System

Mayo Clinic Health System is a centralize health information system that connects between hospitals, clinics, and other health care facilities that serve communities in Minnesota, Wisconsin, Iowa, and Georgia. This is an online platform that not only open for patients only, but it also provides a lot of healthcare news and info for visitors. In addition, Mayo Clinic has a department of Artificial Intelligence and Informatics which includes clinical and research faculty, as well as operational staff who engage in the use of informatics and digital technology to improve human health (Mayo Clinic, n.d.)