

**ARTIFICIAL INTELLIGENCE CHATBOT  
SYSTEM FOR STUDENT INQUIRIES IN THE  
LKC\_FES WEBSITE**

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**ARTIFICIAL INTELLIGENCE CHATBOT SYSTEM FOR STUDENT  
INQUIRIES IN THE LKC\_FES WEBSITE**

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**A project report submitted in partial fulfilment of the  
requirements for the award of Bachelor of Science  
(Hons.) Software Engineering**

**Lee Kong Chian Faculty of Engineering and Science  
Universiti Tunku Abdul Rahman**

**April 2020**

**DECLARATION**

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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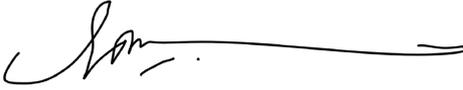
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**APPROVAL FOR SUBMISSION**

I certify that this project report entitled “**ARTIFICIAL INTELLIGENCE CHATBOT SYSTEM FOR STUDENTS’ INQUIRIES IN THE LKC\_FES**” was prepared by **SIEW YONG JUN** has met the required standard for submission in partial fulfilment of the requirements for the award of Bachelor of Science (Honours) Software Engineering at Universiti Tunku Abdul Rahman.

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## **ABSTRACT**

The usual way of finding information on a university's website is done by navigating through the website. It takes huge effort to find an answer to a user query as websites contains a vast amount of information. Statistics shows that LKCFES students find it hard to search for information on the website. It is a big learning curve for a user to use the website; such learning curve is an added disadvantage to new users when searching for information. Understanding the issues, this project utilizes the revolution of Artificial Intelligence to provide an easy solution at a much lower cost, one such technology that stands upon a huge wave of progress is Chatbot. The use of chatbot offers a new opportunity for an organization at providing personalized user experience at scale and encourages more interactions. Students are able to access information containing in LKCFES website with natural language eliminating the needs of traditional browsing. The implemented Chatbot System to support the LKCFES website had proven to help optimize students' experience by encouraging more interaction between users and organization. Likewise, it also reduces the learning curves for new users in using the website.

## TABLE OF CONTENTS

<b>DECLARATION</b>		<b>i</b>
<b>APPROVAL FOR SUBMISSION</b>		<b>ii</b>
<b>ACKNOWLEDGEMENTS</b>		<b>iv</b>
<b>ABSTRACT</b>		<b>v</b>
<b>TABLE OF CONTENTS</b>		<b>vi</b>
<b>LIST OF TABLES</b>		<b>x</b>
<b>LIST OF FIGURES</b>		<b>xi</b>
<b>LIST OF SYMBOLS / ABBREVIATIONS</b>		<b>xiv</b>
<b>LIST OF APPENDICES</b>		<b>xv</b>
<b>CHAPTER</b>		
<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	Introduction	1
1.2	Background	1
1.3	Problem Statement	2
1.3.1	Limitation of HCI Design	2
1.3.2	Big Learning Curves for users	3
1.4	Project Objectives	3
1.5	Project Solution	4
1.6	Project Approach	6
1.7	Scope of the Project	7
1.7.1	Project Scope Covered	7
1.7.2	Project Scope Not Covered	7
1.8	Conclusion	8
<b>2</b>	<b>LITERATURE REVIEW</b>	<b>9</b>
2.1	Introduction	9
2.2	Review on Chatbot for HCI design	9
2.3	Review on Existing Chatbot System	10
2.3.1	Rule-based Chatbot	10

	2.3.2	AIML Chatbot	12
	2.3.3	Word Embedding Chatbot	14
	2.3.4	Evaluation	15
2.4		Comparison of System development methodologies	16
	2.4.1	Waterfall development model	17
	2.4.2	Agile Development Model	18
	2.4.3	Prototype Development Model	19
	2.4.4	Evaluation	20
2.5		Summary	21
<b>3</b>		<b>METHODOLOGY AND WORK PLAN</b>	<b>22</b>
3.1		Introduction	22
3.2		Phases of Prototyping Methodology	22
	3.2.1	Prototype Development Phase	22
	3.2.2	Iterative Development Phase	23
3.3		Requirement Gathering Technique	24
	3.3.1	Questionnaire Survey	24
	3.3.2	Summary of the Survey	24
3.4		Project Plan	25
	3.4.1	Gantt chart	25
3.5		Development Tools	26
	3.5.1	Tools and IDEs	26
	3.5.2	Languages	27
	3.5.3	Software Frameworks	27
	3.5.4	Database	28
	3.5.5	Deployment Services	28
<b>4</b>		<b>PROJECT SPECIFICATION</b>	<b>29</b>
4.1		Introduction	29
4.2		System Flow	29
4.3		Use Case	30
	4.3.1	Use Case Diagram	30
	4.3.2	Use Case Description	31
4.4		Sequence Diagram	36
4.5		System Specification	39
	4.5.1	Functional requirements	39

	4.5.2	Non-functional requirements	40
	4.6	Requirement Analysis	40
<b>5</b>		<b>SYSTEM DESIGN</b>	<b>45</b>
	5.1	Introduction	45
	5.2	User Interface	45
	5.2.1	User Interface for student	45
	5.2.2	User Interface for administrator	47
	5.3	Database design	54
	5.3.1	MongoDB Schema	54
	5.3.2	Database Logical Design	54
	5.3.3	Entity Relationship Diagram	55
	5.4	System Architecture Design	55
	5.5	System Deployment Design	56
	5.5.1	Presentation Tier Components	57
	5.5.2	Application Tier Components	57
	5.5.3	Data Tier Components	58
<b>6</b>		<b>SYSTEM IMPLEMENTATION</b>	<b>59</b>
	6.1	Introduction	59
	6.2	Web Application	59
	6.3	Web API endpoint	59
	6.4	Chatbot's Model	61
	6.5	Implementation of cloud services	62
	6.5.1	Docker	62
	6.5.2	Amazon Elastic Container Registry	62
	6.5.3	Amazon Fargate	62
	6.5.4	Amazon S3	63
	6.5.5	MongoDB Atlas Dashboard Overview	63
<b>7</b>		<b>SYSTEM TESTING</b>	<b>64</b>
	7.1	Introduction	64
	7.2	Functional Testing	64
	7.2.1	Integration Testing	64
	7.3	Non-Functional Testing	69
	7.3.1	Static Code Analysis	69
	7.3.2	Performance Test	69

	7.3.3 Usability Test	71
	7.3.4 User Acceptance Test	74
<b>8</b>	<b>CONCLUSION AND DISCUSSION</b>	<b>79</b>
	8.1 Introduction	79
	8.2 Conclusion	79
	8.3 Limitations and Recommendations for future work	79
	<b>REFERENCES</b>	<b>81</b>
	<b>APPENDICES</b>	<b>86</b>

## LIST OF TABLES

Table 2-1: Comparison of Chatbot development approaches	16
Table 2-2: Comparison matrix of various methodologies	20
Table 3-1: Description of Steps for Prototype Development Phase	22
Table 3-2: Summary of Survey Question	25
Table 4-1: Ask Question use case	31
Table 4-2: Select Question use case	32
Table 4-3: Login as administrator use case	32
Table 4-4: View admin dashboard use case	33
Table 4-5: Create, Read, Update, Delete chatbot abbreviation use case	33
Table 4-6: Create, Read, Update, Delete chatbot database use case	34
Table 6-1: List of web and chatbot API endpoints	59
Table 7-1: Integration Test Case 1	64
Table 7-2: Integration Test Case 2	65
Table 7-3: Integration Test Case 3	66
Table 7-4: Integration Test Case 4	66
Table 7-5: Integration Test Case 5	67
Table 7-6: Usability Test Form Template	71
Table 7-7: Usability Test Result	73

## LIST OF FIGURES

Figure 1.1: Challenges of UTAR LKCFES website	2
Figure 1.2: High-Level Architectural Diagram of project	5
Figure 1.3: Prototyping methodology (Pal, 2018)	6
Figure 2.1: Preview of APU Admin bot (Singh, Joesph and Jabbar, 2019)	11
Figure 2.2: A Sample Conversation with Eliza	11
Figure 2.3: A Specimen Conversation with Eliza (Case 1)	12
Figure 2.4: A Specimen Conversation with Eliza (Case 2)	12
Figure 2.5: Snapshot of chatbot AIML responses (Ranoliya, Raghuwanshi and Singh, 2017)	13
Figure 2.6: A Sample Conversation with Alice (Shawar and Atwell, 2015)	13
Figure 2.7: Example of AIML knowledge unit	14
Figure 2.8: Example of word embeddings	15
Figure 2.9: Waterfall development model	17
Figure 2.10: Prototyping methodology (Pal, 2018)	19
Figure 3.2: Gantt Chart Diagram for Prototype Development Phase	26
Figure 4.1: IPO Diagram on Overall Chatbot Function	29
Figure 4.2: IPO Diagram on Chatbot Recommendation Function	30
Figure 4.3: Use Case Diagram	31
Figure 4.4: Sequence Diagram of Ask Question Use Case	36
Figure 4.5: Sequence Diagram of Select Question Use Case	37
Figure 4.6: Sequence Diagram of Login as Administrator Use Case	37
Figure 4.7: Sequence Diagram of View Admin Dashboard Use Case	38
Figure 4.8: Sequence Diagram of CRUD chatbot abbreviation use case	38

Figure 4.9: Sequence Diagram of CRUD chatbot database use case	39
Figure 4.10: Objective of student's when accessing the LKCFES website	41
Figure 4.11: LKCFES website usage frequency	41
Figure 4.12: Student's acknowledgement of challenges in using LKCFES website	42
Figure 4.13: Challenges and limitations faced by students, when using the website	42
Figure 4.14: Student's opinion on AI Chatbot	43
Figure 4.15 Student's expectations from the chatbot	44
Figure 5.1: Home page of the chatbot system	45
Figure 5.2: Chatbot replying students with high confidence level	46
Figure 5.3: Chatbot retrieving similar question for students to select when having an average confidence level	46
Figure 5.4: Chatbot asking for simplify input when the confidence level is low	47
Figure 5.5: UI design for admin login page	47
Figure 5.6: Sidebar menu for admin	48
Figure 5.7: Overview section of admin dashboard	48
Figure 5.8: UI to create question and answer record	49
Figure 5.9: UI to read question and answer record in table format	49
Figure 5.10: UI to edit and update question and answer record	50
Figure 5.11: UI to delete question and answer record	50
Figure 5.12: UI of database search result by entering keyword	51
Figure 5.13: UI to create abbreviation record	51
Figure 5.14: UI to read abbreviation and meaning in table format	52
Figure 5.15: UI to edit and update abbreviation record	52
Figure 5.16: UI to delete abbreviation record	53

Figure 5.17: UI of abbreviation search result by entering keyword	53
Figure 5.18: MongoDB scheme design	54
Figure 5.19: Database logical design	54
Figure 5.20: Database ERD	55
Figure 5.21: Overview of three-tier architecture design of the chatbot system	56
Figure 5.22: System Architecture Design	56
Figure 6.1 Routes hierarchy for the chatbot system	59
Figure 6.2: Chatbot's model design	61
Figure 6.3: Dockerfile content to dockerize chatbot model API	62
Figure 6.4: Chatbot model API image in ECR repository	62
Figure 6.5: Running services and task in Amazon Fargate	62
Figure 6.6: Static Web Hosting of Vue.js in S3	63
Figure 6.7: Overview of activities in MongoDB Atlas	63
Figure 7.1: Prospector Static Code Analysis of Chatbot Model	69
Figure 7.2: Google PageSpeed Insights report for the chatbot web application	70
Figure 7.3: Pingdom Website Speed Test report for the chatbot web application	70
Figure 7.4: User Acceptance Test Case	75

**LIST OF SYMBOLS / ABBREVIATIONS**

<i>UTAR</i>	Universiti Tunku Abdul Rahman
<i>LKCFES</i>	Lee Kong Chian Faculty of Engineering and Science
<i>HCI</i>	Human-Computer Interaction
<i>AIML</i>	Artificial Intelligence Modelling Language
<i>FAQ</i>	Frequently Asked Question
<i>SDLC</i>	Software Development Life Cycle
<i>IPO</i>	Input Process Output
<i>CRUD</i>	Create, Read, Update and Delete
<i>UI</i>	User Interface
<i>PaaS</i>	Platform as a Service

**LIST OF APPENDICES**

APPENDIX A: Questionnaires	86
APPENDIX B: Gantt Chart for Iterative Development Phase	91
APPENDIX C: Google PageSpeed Insight Full Report	92
APPENDIX D: Usability Test Result	94
APPENDIX E: User Acceptance Test Agreement Form	105
APPENDIX F: Feedback for Project I	106

## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

This chapter presents the background of integrating chatbot system with the university's website. Other than that, a problem statement is constructed based on the survey carried out. Then, the solution and approach to the problem are developed to achieve the project's objective as well as covering the project scope.

#### 1.2 Background

The usual way of finding information on a university's website is usually done by navigating through the website. It takes a huge effort just to find an answer to a user query as websites contain vast amounts of information. The Faculty of Engineering & Science website of UTAR serves an example of this challenge. In a survey conducted at UTAR Sungai Long campus to the students of LKCFES faculty, 88% out of 50 LKCFES students find it hard to search for information on the official website. It is a big learning curve for users to use the website; such a learning curve is an added disadvantage to new users when searching for information.

However, in this era of the fourth industrial revolution, Artificial Intelligence is revolutionizing the structure of many organizations by providing an easy solution at much lower cost. One such technology that stands on a huge wave of progress is chatbots. Chatbots are conversation machine system that interacts with users using human communication language'' (Atwell & Shawar, 2005, p. 489 cited in Hill, Randolph Ford and Farreras, 2015, p. 246).

Research by Singh, Joesph and Jabbar (2019) at Asia Pacific University Malaysia determine that chatbots are able to provide students with a quicker solution to resolve their queries. The use of chatbots offers a new opportunity for organizations at providing personalized user experience at scale and encourages more interactions between user and organization. In the context of education, there will be more interaction between students and the university. Such a benefit will enhance the university's performance at a much lower cost.

Thus, this project of Chatbot system to support the LKCFES website can help optimize student's experience by encouraging more interaction between users and organization. Likewise, it also aims to reduce the learning curve for new users.

### 1.3 Problem Statement

The challenges that UTAR Lee Kong Chian Faculty of Engineering & Science website faces are shown in Figure 1.1 below. Problem is investigated through survey to identify the challenges faced by the LKCFES website.

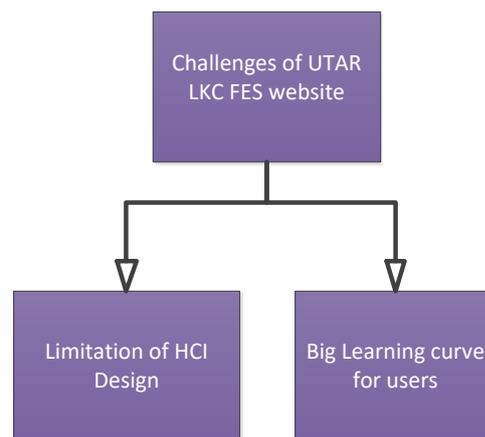


Figure 1.1: Challenges of UTAR LKCFES website

#### 1.3.1 Limitation of HCI Design

A good and efficient user interface will be controllable plus comprehensible, allowing users to do their intended work effectively and yet felt satisfied. Efficient user interfaces are developed on top of principles of human interface design.

Referring to the Six Principles of User Interface Design by Constantine and Lockwood (2004) one of the principles that the LKCFES website has a limitation on is the Simplicity Principle. The simplicity principle indicates that the design should make simple, and provide shortcuts on long procedures. For example, a search bar to the related queries would be a good shortcut to long procedures when navigating through the website.

However, the LKCFES website is an information-based website where students can visit to obtain information regarding their faculty. To provide a search bar will not improve the website simplicity as users are required to know the search

keyword to their objectives. Thus, the survey carried out that asks the opinion of students on the usability of UTAR LKCFES website shows that 41% of the respondents find the website hard to navigate through.

Nevertheless, the limitation of Simplicity Principle on the website can be overcome with the implementation of a chatbot. The chatbot is able to serve certain needs of users that are limited to search bars such as providing context and suggestions for users to recognize “What to Search”. Resulting, the task is made simple and the usability of the website will improve.

### 1.3.2 Big Learning Curves for users

A well-designed user interface ought to minimize users’ memory load. It should be made so that users can easily scan through and know where to navigate rather than remember. This impression is supported on the 10 usability heuristic by Nielsen (2005) which one of it advises recognition over recall.

The LKCFES website is tailored to recognize over recall. Then again, the survey result shows that the website has big learning curves when students are using it. 88% of respondents are struggling to use the website to achieve their goals easily when they are new to the website. As a result, it is making students dissatisfied and uncomfortable to use the website

It has something to do with the fact that the website contains a huge amount of information. The faculty website is home to 10 department’s information with many programmes; it is unavoidable that such a huge amount of information on the website causes content to be difficult to scan. Occasionally, increasing the learning curve and also consumes user time to resolve answers to their queries.

Once again, the solution of chatbot can help reduce the learning curve of the LKCFES website. Chatbot promotes recognition over recall by suggesting questions for users based on the user’s input. Thus, it reduces the time needed for users to complete their respective task.

## 1.4 Project Objectives

The main achieved objective is **to develop a chatbot system that answers any user inquiry related to LKCFES website**. This chatbot web application acts as a proof of concept in increasing usability and reduces learning curves for users of LKCFES website. It answers any inquiry of users given that it is related to LKCFES website.

Meanwhile, it comes with an administrator dashboard that provides a full overview of the chatbot system.

In achieving the main objective, the following are the achieved sub-objectives:

**i. Perform and gather data for chatbot system requirements by conducting a survey**

This Chatbot web application acts as a proof of concept in increasing usability and reduces learning curves for users of LKCFES website. It answers any inquiry of users given that it is related to LKCFES website. Meanwhile, it comes with an administrator dashboard that provides a full overview of the chatbot system.

**ii. Conduct literature review on opinion of Chatbot for HCI design, existing similar chatbot system and comparing types of system development methodologies.**

The review on the opinion of Chatbot for HCI design is to gain insights and justification for the implementation of the chatbot. Likewise, the evaluation of existing similar chatbot systems extracts the most suitable chatbot development approach for the project. Meanwhile, the comparison of different methodologies helps in selecting the most suitable approach for this project system development.

**iii. Perform numerous testing**

A variety of testing is carried out to test the robustness and usability of the chatbot system. It also appraises the acceptance of the users to incrementally improve the quality of the chatbot system.

## **1.5 Project Solution**

To solve the limitation of LKCFES website, a web chatbot system is developed. The chatbot system has the following features to address LKCFES website's limitations:

**a. Allows users to ask the chatbot for relevant information or answers relating to LKCFES**

With the existing LKCFES website, students are required to navigate through the website to find relevant information about their question. This feature allows a student to query chatbot for any information regarding LKCFES faculty using natural language. If the chatbot does not understand user query, an "unsure"

message will be displayed. If the chatbot has a confidence level of below 50%, it would display relevant questions and answers to the user. This function increases the efficiency of students in finding it's their intended answers.

**b. Allows admins to view the overall information of the chatbot system.**

Another feature is an admin dashboard that shows all the relevant information regarding the system. For example, the system will show information like chatbot accuracy, number of users and average user usage.

**c. Allows admins to create, read, update and delete chatbot database**

Admins of the chatbot system are able to CRUD (Create, Read, Update and Delete) the chatbot database. Chatbot database is considered the knowledge-based of the system that helps to support decision-making. For example, adding a question and answer would allow the chatbot to understand more user queries. Then, the chatbot is able to retrieve and show user pre-defined response based on the user query. A pre-defined response is professional and is the more suitable in a business use case compared to a generated response.

**d. Allows admins to create, read, update and delete abbreviations**

“An abbreviation is a short form of a word” (Oxford English Dictionary, 2017). For example, a common abbreviation for students is FYP which means Final Year Project. Then, the chatbot would convert FYP to Final Year Project which increases chatbot understanding and accuracy.

Next, Figure 1.2 shows the technology and tools used to develop the chatbot system.

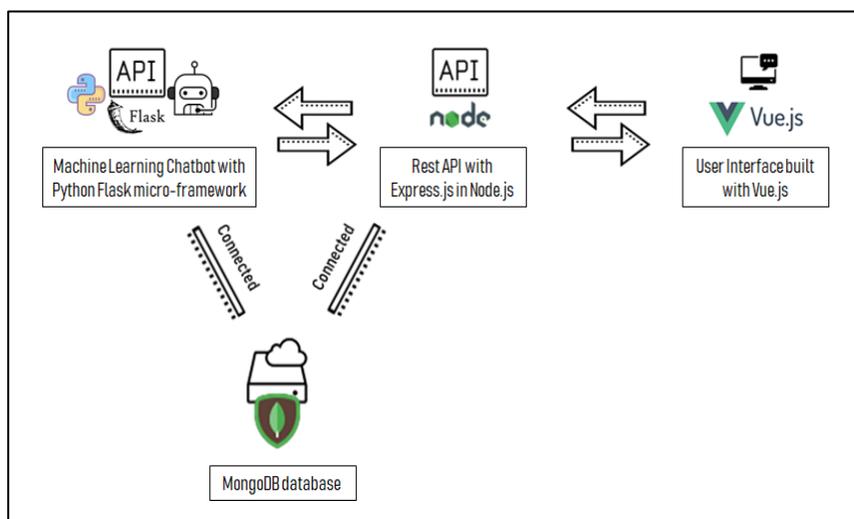


Figure 1.2: High-Level Architectural Diagram of project<sup>1</sup>

<sup>1</sup> Icons in the diagram are retrieved from <https://icons8.com/>

## 1.6 Project Approach

Prototyping methodology is the approach for this project. Prototyping is a process of developing a crude implementation of a system. The key function of a prototype model is to clarify requirements and determine critical consideration of the project.

A prototype model has 2 phases, prototype development and iterative development. The first phase of prototype development begins with initial requirements and rapid design to implement a prototype. Next, the prototype will be reviewed by customers and the requirements are refined. Likewise, the prototype is adapted to fit the new requirement suggested by the customers. This cycle of getting customer feedback and modified prototype carries on until the prototype is approved by customers.

The second phase of iterative development starts after the customer approves of the prototype. In this phase, the actual software is built with an iterative approach. The prototype model on the first phase could be reused or removed/thrown away. However, the experience collected from building the prototype has greatly reduced technical risk.

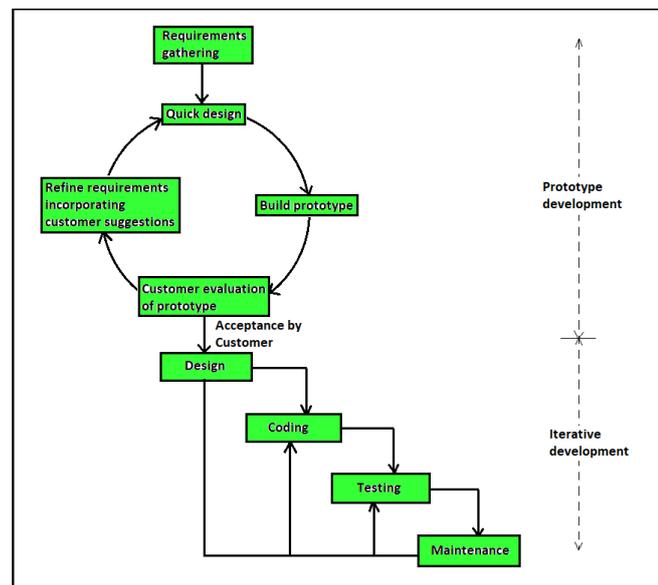


Figure 1.3: Prototyping methodology (Pal, 2018)

Additionally, requirement elicitation technique of survey questionnaires is another project approach. The survey is intended to target UTAR LKCFES students to gather data and opinion regarding the current LKCFES website and the implementation of a chatbot system. The intended audiences are specifically LKCFES students as the chatbot system is implemented to assist student at the website.

## **1.7 Scope of the Project**

### **1.7.1 Project Scope Covered**

To solve the challenges encountered by the LKCFES website, a chatbot system is developed as the solution. This system is a proof of concept where the LKCFES website is integrated with a chatbot. The intended target users of this chatbot system are UTAR LKCFES students.

#### **User scope coverage:**

- i. UTAR LKCFES students
  - Students are able to ask the chatbot for relevant information or answers relating to LKCFES website.
  - Students can also select a question to ask whenever the chatbot confidence level is in the range of 50% to 80%.
- ii. Administrator
  - Administrators are able to view the admin dashboard that shows the overall chatbot system.
  - Administrators are able to manage the chatbot's database with Create, Read, Update, and Delete operations.
  - Administrators are able to manage the chatbot's abbreviation with Create, Read, Update, and Delete operations.

#### **System scope coverage:**

Ratu Chatbot is a retrieval-based chatbot which understands user's queries and give appropriate responses based on it. This chatbot system is available to be used through the UTAR LKCFES website. The target users for this project will be targeting specifically UTAR LKCFES students. Students are able to search for their intended answers easily by using the chatbot. Besides that, the system will include a recommendation function. Queries are suggested based on the user's question.

### **1.7.2 Project Scope Not Covered**

#### **Target User**

Although anyone can have access to the LKCFES website; UTAR lecturers and Non-UTAR LKCFES students are not considered as the intended user of this system.

### **Platform**

This chatbot system is not designed to fit perfectly with mobile.

### **Tutorial**

There is no tutorial included on how to use the chatbot system.

## **1.8 Conclusion**

To summarise, the current UTAR LKCFES website faces unavoidable challenges such as limitation of HCI design and big learning curve. Thus, a chatbot system is developed to integrate with the website; it helps to solve the limitation and improve the learning curve to solve UTAR LKCFES students' dissatisfaction when using the website.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter highlights the review of Chatbot for HCI design, review on existing chatbot systems and comparison of system development

#### 2.2 Review on Chatbot for HCI design

Følstad, et al. (2018) state that chatbots are becoming an important driving force to the face of HCI community. Chatbots are effective tools to engage customers which make them an innovative means for users to interact with digital services. It is also believed that chatbots technologies hold great potential to be a technology for social good

Similarly, Brandtzaeg and Folstad (2017) highlights that natural language is the preferred interface as interaction with digital services replacing swiping, scrolling or button clicks. This change is particularly visible with the recent developments of chatbots. World's leading companies like Facebook are setting the trends to help chatbot grow as the CEO of Facebook. For instance, CEO of Facebook Mark Zuckerberg proclaimed that the solution to app overload are chatbots (McMillan, 2017).

Furthermore, Thakkar, et al. (2019) point out that the demands for chatbot on colleges website or education institutes are rapidly increasing. They specify that the educational institutes' website is typically unmaintained and filled with redundant info. Hence, searching for intended information becomes a troublesome work for teacher and students. The system to solve the problem is chatbot as chatbot are able to help users in finding their intended information in a few questions and clicks.

Last but not least, a study by Brandtzaeg and Følstad (2017) are able to evaluate why people are getting so involved in chatbots. The paper studies user behaviour and experience when using the chatbot. It checks the motivation behind the interest in it. Based on the study, the most frequent motivation can be broken down into one word, "productivity". Studies found that the chatbots are able to

provide efficient assistance and information in a short amount of time (Brandtzaeg and Følstad, 2017).

In a nutshell, it can be concluded that AI conversational interfaces and chatbots represent a new world to be explored and conquered. The system developed in this project of implementing chatbots on UTAR LKCFES website is a great improvement on the HCI of the website. As natural language interface is a new paradigm in how users interact with data and services; implementation of chatbot on LKCFES website will help increase students productivity and efficiency at locating information.

### 2.3 Review on Existing Chatbot System

In this section, two related University's Chatbot Enquiries System are studied, analysed and evaluated for the chatbot development technique. At the same time, each of the development concepts is further elaborated using the first chatbot ELIZA (Weizenbaum, 1966) and award-winning ALICE chatbot system architecture (Shawar and Atwell, 2015). By the same token, a new chatbot approach of using Word Embedding will be accessed as Mikolov, et al. (2013) perceive that the word embedding vectors algorithm has many advantages in comparison to earlier algorithms.

Two chatbot developments namely the APU Admin bot which uses **rule-based approach** and Manipal University chatbot which uses **AIML approach** and **Word Embedding chatbot** are evaluated to gain insights and view on this project development.

#### 2.3.1 Rule-based Chatbot

The APU Admin bot by Asia Pacific University Malaysia aims to provide students with fast response resolving frequent queries to the administrative offices (Singh, Joesph and Jabbar, 2019). The chatbot is developed with chatfuel using a **rule-based approach** of pattern recognition, phrases, certain words and action triggers on a sets of responses. Users may interact with the chatbot on APU's Facebook Messenger and submit enquiries via chat prompts.

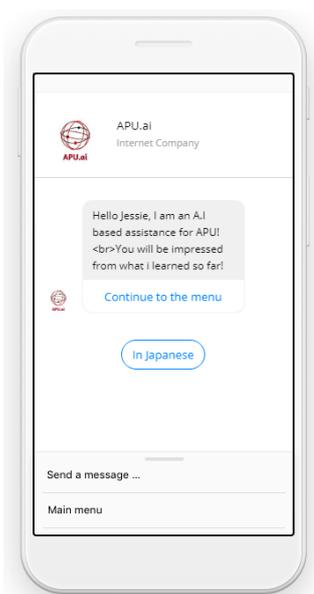


Figure 2.1: Preview of APU Admin bot (Singh, Joesph and Jabbar, 2019)

Implementation of ELIZA is similar to APU Admin Bot rule-based approach. ELIZA is the first chatbot created by Joseph Weizenbaum at MIT Artificial Intelligence Laboratory in January 1966 (Weizenbaum, 1966). Eliza uses a rule-based approach in identifying keywords and matches the specific keywords on a collection of predefined rules in order to generate appropriate responses. According to Yuan (2016) the benefit of this approach is that they are accurate, giving developers the flexibility to create and remove rules in handling new situations and address bugs with certainty.

```

Welcome to
      EEEEE LL   IIII ZZZZZZ  AAAA
      EE   LL   II    ZZ   AA  AA
      EEEEE LL   II   ZZZ  AAAAAA
      EE   LL   II   ZZ   AA  AA
      EEEEE LLLLL IIII ZZZZZZ  AA  AA

Eliza is a mock Rogerian psychotherapist.
The original program was described by Joseph Weizenbaum in 1966.
This implementation by Norbert Landsteiner 2005.

ELIZA: How do you do. Please tell me your problem.
YOU:   Men are all alike.
ELIZA: In what way ?
YOU:   In every single way
ELIZA: That is interesting. Please continue.
YOU:   I don't want to continue
ELIZA: Do you wish to be able to want to continue ?
YOU:   █

```

Figure 2.2: A Sample Conversation with Eliza

Considering the case below to understand the implication of how rule-based chatbot works. The conversation below is generated when tested on the sample of ELIZA library elizabot.js described by Joseph Weizenbaum. (Weizenbaum, 1966)

<p>YOU: Why don't you argue with me.          ELIZA: You like to think I argue with you -- don't you ?</p>
--

Figure 2.3: A Specimen Conversation with Eliza (Case 1)

At every point of conversation, the chatbot would recognize the keyword(s) of the user's input. In the case given, the chatbot recognizes the keyword **“argue”** and is able to generate an appropriate response from the collection of predefined rules. However, in the context of keywords not present on its set of rules. ELIZA would proceed to get more information from the user to keep the discussion going as indicated from another case below.

<p>YOU: How would I be able to get good result          ELIZA: Can you elaborate on that ?</p>
--

Figure 2.4: A Specimen Conversation with Eliza (Case 2)

The chatbot does not recognize the keywords of **“good result”** indicated by the user. Thus, it needs to create an answer to persuade the user in presenting another question in chances of finding a keyword that it understands or recognizes.

### 2.3.2 AIML Chatbot

Manipal University of India developed a chatbot for university's related FAQ (Ranoliya, Raghuwanshi and Singh, 2017) . The aim of this chatbot is to achieve the academic needs of visitors. The chatbot is developed mainly on Artificial Intelligence Mark-up Language (AIML) to provide accurate and efficient answers for student queries based on FAQs dataset. It is tailored to help student in fetching information such as updates of recent activities, university surrounding, availability of services and other academic information. Figure 2.5 below illustrates the snapshot of the chatbot responses.

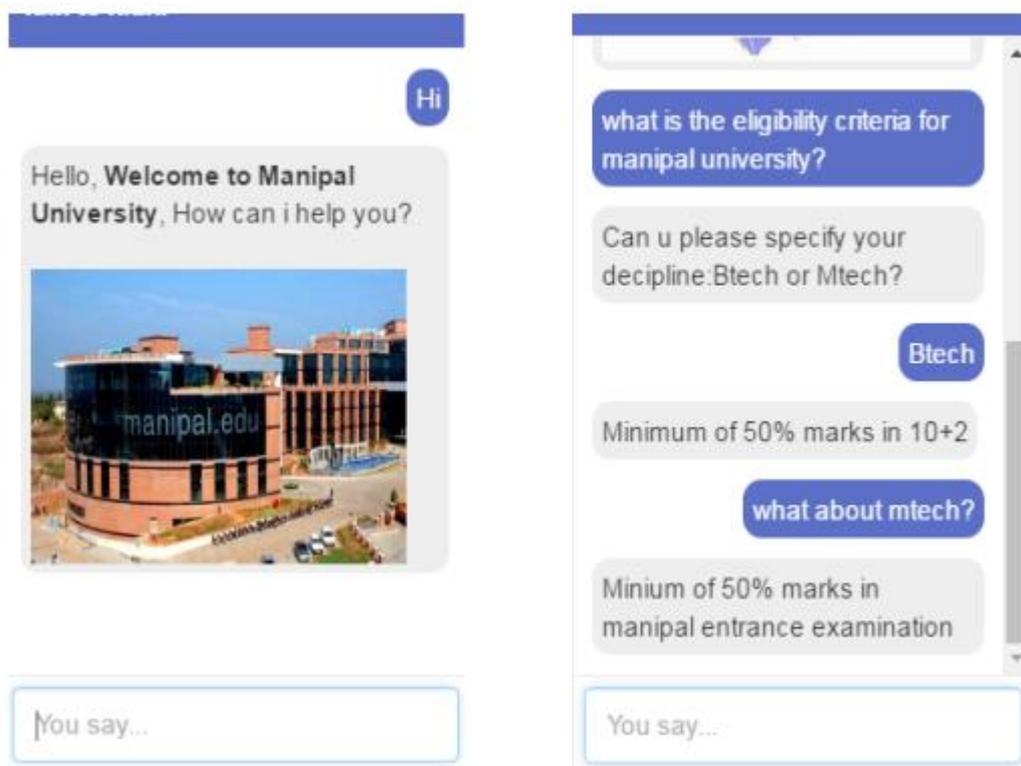


Figure 2.5: Snapshot of chatbot AIML responses (Ranoliya, Raghuwanshi and Singh, 2017)

The concept of AIML is widely similar to ALICE. ALICE was created by Richard Wallace in 1995. The ALICE system architecture stores its knowledge in AIML files. AIML is a derivative of Extensible Mark-up Language (XML) (Atwell and Shawar, 2007)



Figure 2.6: A Sample Conversation with Alice (Shawar and Atwell, 2015)

To put it simply, AIML consists of a basic unit of knowledge known as category. Individual categories contains input, output and option context. The input question is known as pattern and the answer is termed template. According to a

review by Arsovski, et al. (2017), The benefit of AIML knowledge is that they are easy to be implemented with user-friendliness as its core system of dialogue. Likewise, as we can see from the AIML knowledge unit, it uses XML for the computer-readable representation of knowledge. Figure 2.7 illustrates the example of AIML knowledge unit.

```
<category>
  <pattern>HELLO </pattern>
  <template>Hi there </template>
</category>
```

Figure 2.7: Example of AIML knowledge unit

Referring to Figure 2.7, if the user inputs “**HELLO**”, then ALICE replies “**HI THERE**”. From this idea of category, the chatbot is able to response to users based on their input. Currently, there are more than 50,000 categories in the public-domain of ALICE knowledge-based. ALICE would be able to answer in a higher variety of options with more numbers of categories in its knowledge base. However, all these categories are manually “hand-coded”, which is time-consuming and confines its adaptation to new languages and new discourse-domains. This limitation causes AIML to have relatively poor matching patterns and difficult to maintain.

### 2.3.3 Word Embedding Chatbot

Word Embeddings is a type of representation for models to learn by mapping words to vectors of numeric values. Representing the word/data as lower dimensional vectors are referred to as word embeddings (Levy and Goldberg, 2015). According to Turian, Ratinov and Bengio (2010), these representations of word embeddings have been shown to perform well across a variety of tasks. Figure 2.8 below shows an example of word embeddings

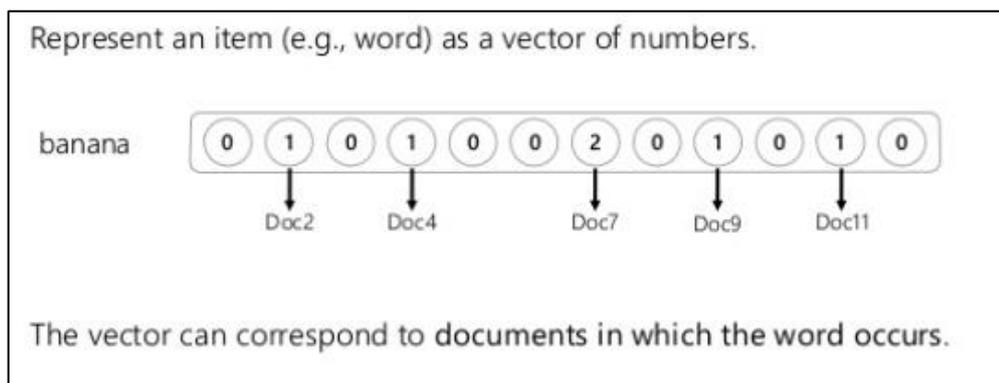


Figure 2.8: Example of word embeddings

The benefit of word embeddings is its ability to outperform retrieval based systems on both human judgments and automatic evaluation metric. (Xu et al., 2017) On the same page, Mikolov, et al. (2013) indicate that the use of word embeddings needs little pre-processing, thus requiring little memory that allows it to be used on computing much larger data sets. However, one limitation of word embeddings is the possibility of conflating words into a single representation. (Camacho-Collados and Pilehvar, 2018)

#### 2.3.4 Evaluation

From all the systems studied and analysed, it is clear that every chatbot development approach has its own properties, advantages and limitations. Different development approaches should be tailored accordingly to their desired project as suggested by no free lunch theorem found in Machine Learning Context. The **No Free Lunch** theorem put forward that “no one model that works best for every problem” (Wolpert and Macready, 1997). Thus, selecting the right approach is critical in defining the success of this project. Table 2.1 below summarizes and compares all the advantages and limitations of every development approach.

Table 2-1: Comparison of Chatbot development approaches

<b>Chatbot Development Approach</b>	<b>Rule-Based Approach</b>	<b>AIML Approach</b>	<b>Word Embedding Approach</b>
<b>Advantages</b>	<ul style="list-style-type: none"> <li>• Highly accurate and secure</li> <li>• Generally faster to train making it less expensive</li> <li>• Flexibility to add or remove rules to handle new situations</li> </ul>	<ul style="list-style-type: none"> <li>• Easy to implement with simple language</li> <li>• User friendliness</li> <li>• Easy to learn with XML as representation of knowledge</li> </ul>	<ul style="list-style-type: none"> <li>• Broader range of decision-making skills</li> <li>• Lower computational power</li> <li>• Generalization power to generalize features (words)</li> </ul>
<b>Limitation</b>	<ul style="list-style-type: none"> <li>• Time consuming</li> <li>• Less learning capacity</li> <li>• Unable to handle complex queries</li> </ul>	<ul style="list-style-type: none"> <li>• Time consuming</li> <li>• Difficult to maintain as we need to create a lot of categories</li> </ul>	<ul style="list-style-type: none"> <li>• Possibility of conflating words into a single representation</li> </ul>

Based on the above mentioned comparison, Word Embedding Approach will be chosen as the system's chatbot development approach. This is because the idea of word embedding approach is very intuitive, which transforms unlabelled raw corpus into labelled data, and learns the representation of words in a classification task. For example, the word embedding algorithm "**Word2Vec**" can precisely depict a word's meaning based on previous appearances. Relationship like "man" is to "boy", "woman" is to "girl" can be generalized and inferred by word vectors. (Goldberg, 2018)

Besides, the goal of this project is to build a chatbot on the UTAR LKCFES website to be used online. Thus, the lower computational power benefit by Word Embedding algorithms increases the efficiency of the chatbot.

#### **2.4 Comparison of System development methodologies**

There are different types of development methodologies; each different methodology has an individual implication of use in the system development approach. In this section, five different development models will be analysed and discussed; they are waterfall development model

### 2.4.1 Waterfall development model

Balaji and Murugaiyan (2012) claim that the waterfall development model is Sequential development. It is a most traditional and widely known model; divided by sequence of stages as the output of each stage becomes the input for the next. To simplify Balaji and Murugaiyan ideas, Figure 2.9 shows the stages of the waterfall development model.

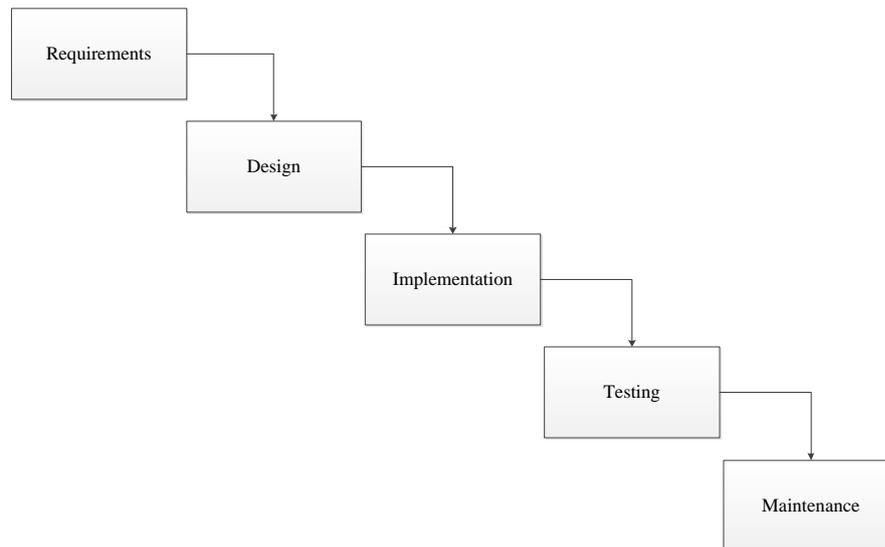


Figure 2.9: Waterfall development model

As the oldest and most used model in the software industry, there are some advantages to waterfall development models which presume its popularity. Raccoon (1997) is convinced that the waterfall model will stick around for a much longer period of time. Therefore, here are some advantages of using the waterfall development model.

#### Advantages

- **Simple and easy to implement**

Waterfall development is a linear model, the rigidity of it makes it easy to implement.

- **Lower risk**

The incremental stages of waterfall development enable changes to be easily monitored. In respect to this, issues are isolated and resolve which diminish risks. (Ruparelia, 2010)

- **Easy to be managed**

The distinct advantage of a waterfall is that it allows managerial control. Each phase has a review process and specific deliverables; As a result, this process leads to on time deliverable. (Association of Modern Technologies Professionals, 2019)

But atlas, every rose has its thorns. The drawbacks of the waterfall model are:

### **Drawbacks**

- **Not ideal for project with moderate requirement**

Moderate and unclear requirement are undesirable for waterfall development model. It leads to redesign, redevelopment and increased cost. (Parnas and Clements, 1985)

- **It is not iterative**

The major limitation of the waterfall model is its inability to be iterative. If changes are required on the 3<sup>rd</sup> or 4<sup>th</sup> phase; the entire methodology needs to be performed again. As a consequence, stakeholders are unable to make any change request after the development phase and the changes will not be implemented. (Pal, 2018a)

## **2.4.2 Agile Development Model**

Agile Software Development is an approach based on interactive and incremental development, where the process allows frequent or constant alteration in the development project and evolves through collaboration between teams (Cohen, Lindvall and Costa, 2004). These are some advantages and drawbacks of Agile Development Model:

### **Advantages**

- **Ability to change requirements easily of project**

Agile has the ability to regulate the change of circumstances, due to its continuous attention to technical excellence and good design.

- **Able to achieve high client's satisfaction**

Agile has a high degree of teamwork, high stakeholder engagement and continuous association between client and project team. Thus, allowing clients to regulate and control the highest priority of each features making them satisfied with the end result (Segue Technologies, 2015).

## Drawback

- **Lack of documentation**

Agile method requires little to none planning to get started, with so little to go on, the project can easily side-track if the representative stakeholders are not completely clear of the outcome (TRYQA, 2019).

- **More time and commitment needed**

The constant communication and interaction between the client and project team are time consuming. Although, the high degree of teamwork might ensure product to meet users experience, yet this demands more time and energy of stakeholders involved (Fridman, 2016).

### 2.4.3 Prototype Development Model

Prototyping is a process of well-defined phases within the SDLC (Floyd, 2011). The process encourages efficient development of an application by breaking down a system to individual comprehensive parts (Kraushaar and Shirland, 2006). Furthermore, prototype model in SDLC can help to consequently refine a product to meet end-user demand and market expectations (Gomaa, 2004).

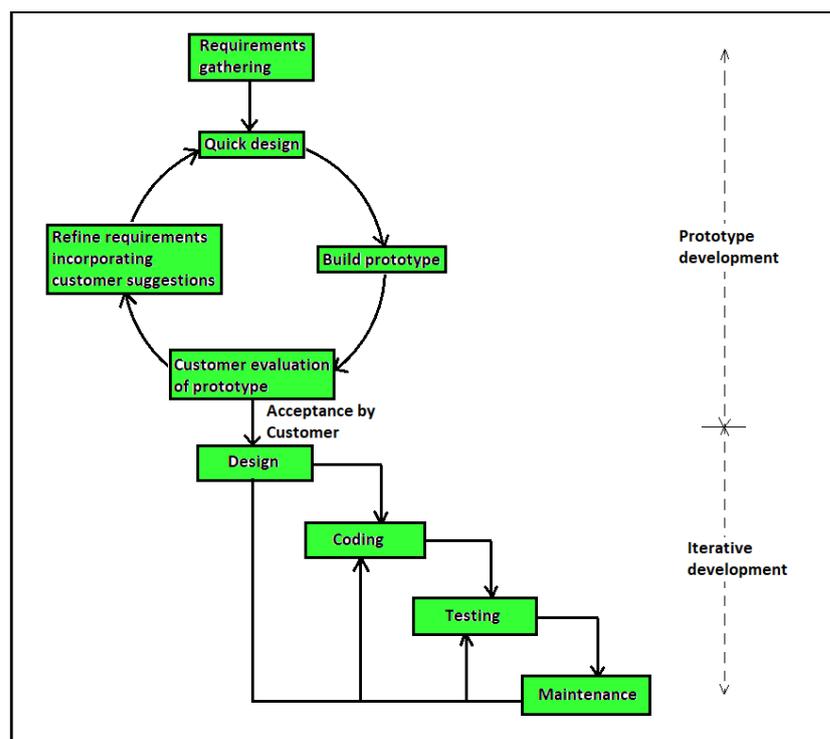


Figure 2.10: Prototyping methodology (Pal, 2018)

Thus, the advantages and drawback of prototyping models are:

### **Advantages**

- **Clarification of unclear user requirements**

Prototyping models help developers to find out missing requirements in the system. This helps to reduce the risk of failure of a project. As a result, prototyping models further encourages innovation and flexible designing.

- **Errors can be detected in the early stage of development**

Using prototyping approach allows detection of errors early in the software development life cycle. Saving cost and effort; likewise improving the quality of the system in the same manner.

### **Disadvantages**

- **Unsuitable for big projects**

Every phase of development requires the cooperation of stakeholders. It is only suitable for small projects that have full stakeholder's contribution.

- **Impractical use of time and cost**

The additional cost and time to refine and develop prototypes could be used for building and implementing a real system. Hence, some stakeholders might find it impractical to use the prototyping approach.

## **2.4.4 Evaluation**

From all the methodologies studied and analysed, a comparison matrix could be drawn out to show their differences.

Table 2-2: Comparison matrix of various methodologies

<b>Methodology</b>	<b>Waterfall</b>	<b>Agile</b>	<b>Prototyping</b>
<b>Requirement gathering</b>	Very detailed and In the beginning	Undetailed and Often Change	Detailed and Often Change
<b>Cost</b>	Low	Very High	High
<b>Changes Control</b>	Difficult	Easy	Easy
<b>User Involvement</b>	Low	Highly involved	Highly involved

To conclude, it shows that every methodology has its own advantages and drawbacks. However, prototyping methodology is the most suitable approach for this project system development. It is because there are fewer requirements at the beginning of the project. Prototyping methodology allows frequent changes of requirements to fit the user's need. In addition, this chatbot project scale is small; making it appropriate and seamlessly fit this chatbot development needs.

## **2.5 Summary**

To summarise, it is reviewed that chatbot represents a new world in HCI to be conquered. The system developed in this project will be a great improvement of HCI on the LKCFES website.

Word Embedding Approach will be chosen as the system's chatbot development approach due to its properties which fits perfectly on the chatbot of this project.

Last but not least, the development methodology chosen is Prototyping model approach. It is because of the advantages that are suitable for the project development.

## CHAPTER 3

### METHODOLOGY AND WORK PLAN

#### 3.1 Introduction

The methodology approach applied in this project is prototyping model. This prototyping methodology is adopted from Pal (2018) that with phases, i.e.- the Prototype Development and Iterative development. In this chapter, the detail of each phase will be discussed.

#### 3.2 Phases of Prototyping Methodology

##### 3.2.1 Prototype Development Phase

In this prototype development phase, there are a total of five steps to be carried out. These five steps are in a cycle to obtain customer feedback and modify the prototype accordingly until the prototype is approved as shown in Table 3-1.

Table 3-1: Description of Steps for Prototype Development Phase

Steps	Description
1. Gathering requirements	Gather requirement by using various requirement elicitation technique such as questionnaire.
2. Quick design	Quick design of low fidelity prototype is developed after requirements gathered from users.
3. Build a prototype	After a quick design is carried out, build the prototype accordingly.
4. Evaluation of prototype	User evaluates the submitted prototype
5. Refine requirements	Requirements are refined and the prototype is modified accordingly to the refined requirement based on user feedback

### **3.2.2 Iterative Development Phase**

Once the client agrees and approves the prototype, the second phases of the methodology, i.e. the iterative development will be executed. In this phase, the actual implementation of the system or software is developed using iterative approach. The code for the prototype could be reused or removed/thrown away. Regardless, the experiences gathered from building the prototype have greatly reduced the technical risk.

#### **3.2.2.1 First Iteration**

The first iteration activities include the following:

- i. Build the chatbot model;
- ii. Integrate the chatbot model with Python Flask into an API;
- iii. Design and build the front-end user interface of chat with Vue.js;
- iv. Source Control and backup using GIT

#### **3.2.2.2 Second Iteration**

Additional activities relating to Admin are added.

- i. Refine the chatbot model based on feedback from the first iteration
- ii. Create backend API as a service for Admin related functionality (This is to ensure separation of concern)
- iii. Design and build the front-end user interface of Admin Login Page and Admin Dashboard with Vue.js

#### **3.2.2.3 Third Iteration**

In the third and final iteration, the activities include:

- i. Restructure chatbot model again based on feedback from the second iteration
- ii. Complete full administrator login page with JWT token security
- iii. Complete full admin dashboard that allows visualization of system performance
- iv. Complete full CRUD function that allows administrators to add data to train the chatbot
- v. Complete full CRUD function that allows administrators to add common abbreviation which increases the accuracy of the chatbot

### **3.3 Requirement Gathering Technique**

The requirement gathering technique used to gather requirements and problems from stakeholders is the questionnaire.

#### **3.3.1 Questionnaire Survey**

A total of 50 students have been distributed with a questionnaire to understand the user's opinion and requirement. The survey targeted 50 UTAR LKCFES students and consisted of respondents from Year 1 to Year 4. The respondents from each year are fairly equally distributed with Year 1 to Year 4. The respondents from each year are fairly equally distributed with Year 3 students as the highest contributors. Furthermore, it is found that forty-eight of the respondents used the LKCFES official website to search for information regarding FYP, internship and respective departments as intended.

There are a total of nine questions divided into two sections; Section 1 is to gather user's opinion while Section 2 is to gather requirement of the system. Additionally, the structure of the question is closed-ended questions, four dichotomous questions and five multichotomous questions.

#### **3.3.2 Summary of the Survey**

Based on Appendix A, 88% out of fifty respondents find it difficult to use the LKCFES website. This is due to the limitation of HCI that LKCFES faces as an information-based website. From the survey, the biggest limitation stated was that "the official website requires much navigation to the answer the respondents are looking for."

Furthermore, a large majority of 88% respondents think that chatbot is a viable and productive solution for students to search for an answer; whereas, 10% are unsure with and 2% disagree with the implementation of the chatbot. Likewise, the result shows that 96% of the respondents will use the chatbot when it is implemented and wanted the following functions on the chatbot:

- Forty (80%) respondents wanted the chatbot to give a few answers with recommendations for easier searching. For example, the chatbot may ask "Did you mean Scholarships?" when user type queries related to scholars.

- Thirty-one (62%) respondents agreed with the functions of showing a few questions for users to select to solve the limitation **needing to know what to search when searching** that is encountered by the search bar.
- Nine (18%) of the respondents required an option to report, if unable to find their intended queries.

Table 3-2: Summary of Survey Question

Survey Question	Number of respondents (50 total)		
	Agree	Neutral	Disagree
The LKCFES website is difficult to use	44	0	6
Chatbot is a viable and productive solution for students to search for an answer	44	5	1
I will use the chatbot system if it is implemented	48	0	2
	<b>Functions requested by majority respondents</b>		
What functions do you want to be implemented in the chatbot system?	<ul style="list-style-type: none"> <li>• Chatbot reply with a few answers for user to select if unsure</li> <li>• Show a few questions for user to select</li> </ul>		

### 3.4 Project Plan

This section shows the project planning Gantt charts which are used to ensure the application is developed within schedule and unswerving scope.

#### 3.4.1 Gantt chart

- i. Prototype Development Phase

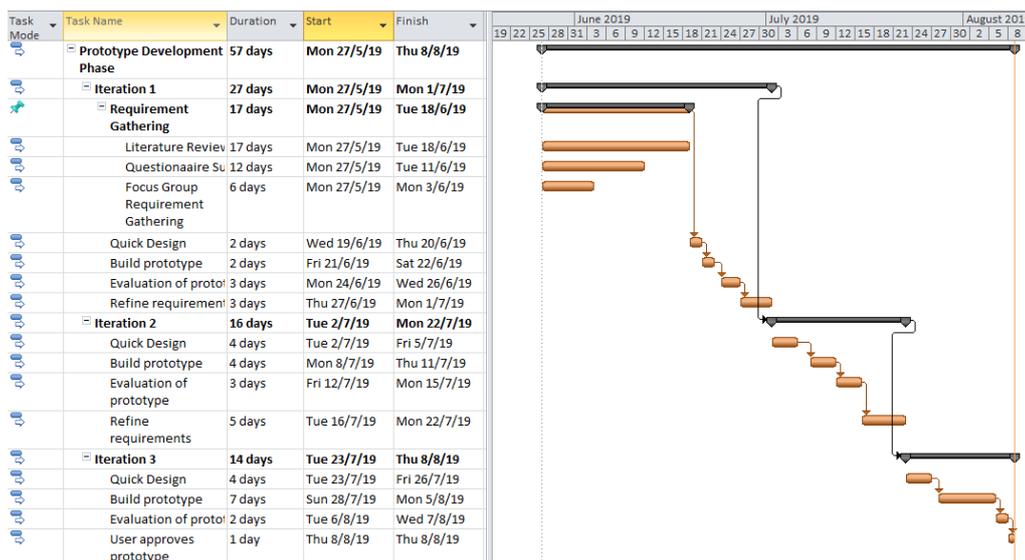


Figure 3.1: Gantt Chart Diagram for Prototype Development Phase

ii. Iterative Development Phase and Deployment

Gantt Chart for Iterative Development Phase is attached as appendix B

### 3.5 Development Tools

#### 3.5.1 Tools and IDEs

i. Jupyter Notebook

Jupyter notebook is a flexible tool which lets developers put code, shows the output of the code and any kind of visualization or plot etc. in the same document. It would be used to develop prototypes of chatbot approaches such as using word embedding.

ii. Visual Studio Code IDE

Visual studio code is created by Microsoft as source-code editor software. Visual Studio codes have much functionality which includes debugging, syntax highlighting, snippets, code refactoring and many more.

iii. GIT

Git is used as a version control system. According to Blischak et al (2016), Git is a good and useful tool that helps improve code development and documentation. Likewise, it encourages and allows collaboration of code on a massive scale.

**iv. MongoDB Compass**

MongoDB is a GUI that provides easy visualization of data, easy execution of queries and full CRUD functionality. The use of MongoDB compass as part of the development allows a better and more efficient insight on the system.

**v. Postman**

Postman is a platform for API development. The features provided by postman simplify each step of building an API, thus allowing developers to create API faster (Postman, 2019).

### **3.5.2 Languages**

**i. Python**

Python is a high-level, interpreter and general-purpose programming language. The versatility is extremely beneficial allowing beginners to pick up with its consistent syntax and language that mirrors humans. Furthermore, the prebuilt libraries made available in python are an added advantage to building AI projects.

**ii. HTML, CSS, JavaScript**

Traditional Web Application is built with HTML, CSS and JavaScript. It is a mixture of static markup language, presentation description language and client-side scripting.

### **3.5.3 Software Frameworks**

**i. Flask**

Flask is a web service framework written in Python. Flask is very minimal coming with an inbuilt light-weighted web server that requires minimal configuration. Likewise, it is easy to be controlled from Python code making it versatile and popular to developers.

**ii. Vue.js**

Vue.js is a JavaScript framework that is widely known for being progressive (bin Uzayr et al., 2019). It shipped with a template model that is bound to a data model and is reactive whenever the models update. Furthermore, the simplicity and ease of use that Vue.js provides a small learning curve in developing small projects like single-page web application.

**iii. Express.js**

Express.js is a Node.js web application server framework (Express.js, 2017). It helps to organize web applications into MVC architecture on the server side. In this project, Express.js is used to develop a robust API service for the chatbot system.

**3.5.4 Database****i. MongoDB**

The database used in this project is MongoDB. It is an open-source document-stored that is scalable and flexible. Likewise, it is also popular among many important projects and products such as Disney, The New York Times and Forbes. (Boicea, Radulescu and Agapin, 2012)

**3.5.5 Deployment Services****i. Docker**

Docker is an open-source platform as a service tailored to make it easier for developers to pack ship and run any application virtually anywhere. The ease of use, fast scaling of the system and good software delivery made Docker the most loved platform. (Docker Website, 2016)

**ii. Amazon Web Services (AWS)**

Amazon Web Services provide scalable, inexpensive and reliable cloud computing services. It is available worldwide in various regions that provide the functionality to help a business scale and grow. (AWS, 2020)

**iii. MongoDB Atlas**

MongoDB Atlas provides global cloud database service. It could be deployed across AWS, Azure or Google Cloud Platform.

**iv. Heroku**

Heroku is a cloud PaaS which supports several programming languages. Their service is beneficial for developer to easily run and operate applications provided by their cloud service.

## CHAPTER 4

### PROJECT SPECIFICATION

#### 4.1 Introduction

This chapter is to discuss the requirements gathered from questionnaires. Likewise, it also shows the system flow, use case and project specification.

#### 4.2 System Flow

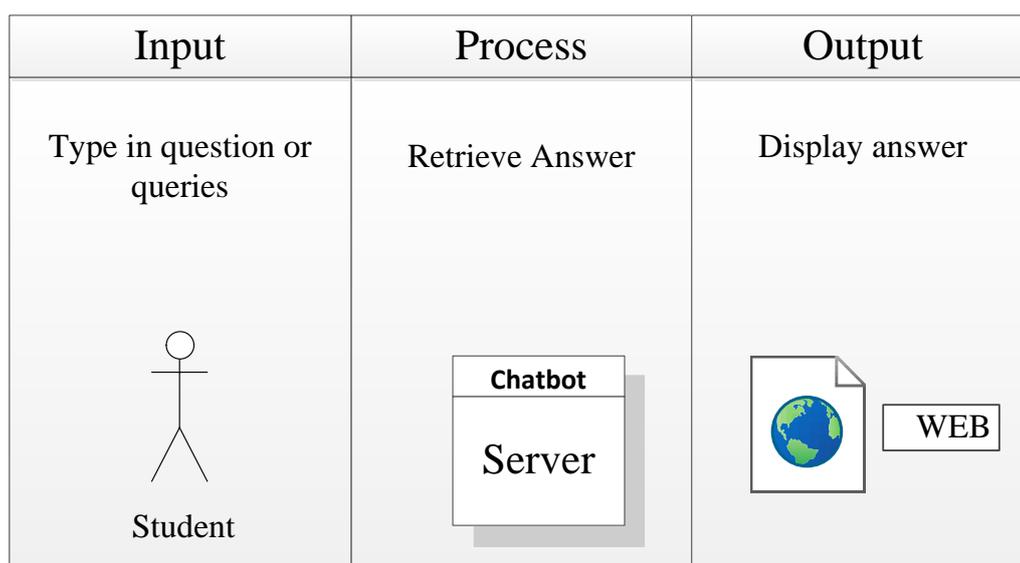


Figure 4.1: IPO Diagram on Overall Chatbot Function

Figure 4.1 describes the input process output on the overall chatbot function.

- **Input** - The student type into the user interface to ask the chatbot system on LKCFES related queries.
- **Process** – The chatbot system uses Natural Language Processing to recognize the text input and retrieve the most confident answer.
- **Output** – The chatbot system passes the answer onto the user interface to be displayed.

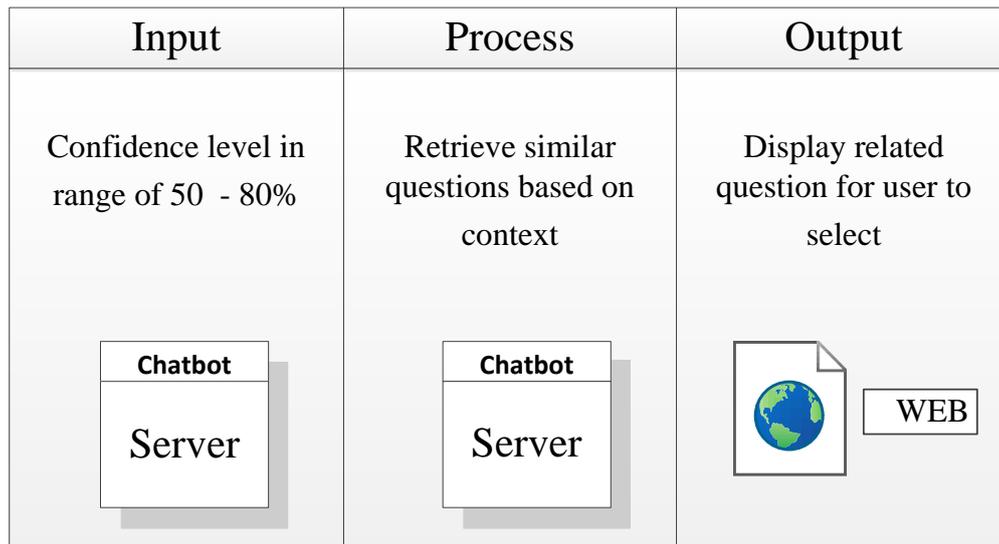


Figure 4.2: IPO Diagram on Chatbot Recommendation Function

Figure 4.2 describes the input process output on the Chatbot Recommendation Function.

- **Input** - The chatbot confidence level of its accuracy is 50% to 80%.
- **Process** – The chatbot system understands the situation and retrieves related questions based on the context of the query.
- **Output** – The chatbot system displays the list of related questions to the user interface for the student to select.

### 4.3 Use Case

This section illustrates and discusses the use cases of the system

#### 4.3.1 Use Case Diagram

Figure 4.3 of the use case diagram is created to show the high level tasks of both student and chatbot on the system.

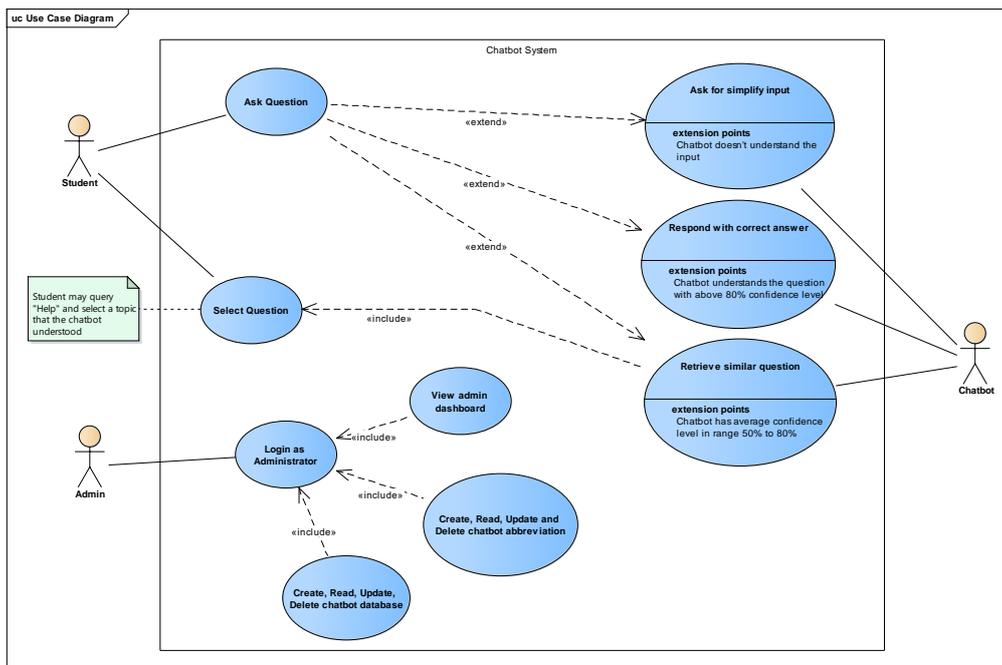


Figure 4.3: Use Case Diagram

### 4.3.2 Use Case Description

Table: 4-1: Ask Question use case

Use Case Name: Ask Question	ID: 1
Primary Actor: Student	
Stakeholders and Interests: Student – uses the system to ask questions regarding LKCFES	
Description: This use case designates the flow of event of a student asking the chatbot system question	
Relationships: Association: Student Extend: Ask for simplify input, Ask for more information, Respond with the correct answer	
Flow of events: <ol style="list-style-type: none"> <li>1. Student submit enquiry via chat prompts to the chatbot system</li> <li>2. If chatbot doesn't understand input, Perform 1.1 "Ask for simplify input"</li> <li>3. If chatbot has an average confidence level in the range of 50% to 80%, Perform 1.2 "Retrieve similar question"</li> <li>4. If chatbot understand the input, Perform 1.3 "Respond with correct answer"</li> <li>5. The System displays the most suitable response.</li> </ol>	

Alternate/Exceptional Flows:
1.1: Ask for more information - The chatbot responds by asking the user to query with simplify input
1.2: Retrieve similar questions - The chatbot responds by passing a list of related question to the user
1.3: Respond with correct answer - The chatbot understand the queries and respond with the correct answer

Table 4-2: Select Question use case

Use Case Name: Select Question	ID: 2
Primary Actor: Student	
Stakeholders and Interests: Student – select question suggested by the system	
Description: This use case designates the flow of event of student selecting question suggested by chatbot system	
Relationships: Association: Student	
Flow of events: <ol style="list-style-type: none"> <li>1. The system has a confidence level in the range of 50% to 70%</li> <li>2. The system recommends a list of question for the student to select</li> <li>3. The student selects the question recommended</li> <li>4. The system displays the answer based on the question selected</li> </ol>	

Table 4-3: Login as administrator use case

Use Case Name: Login As Administrator	ID: 3
Primary Actor: Admin	
Stakeholders and Interests: Admin – log in to account	

Description: This use case designates the flow of event of an authorized admin logging into the chatbot system.
Relationships: Association: Admin Include: View admin dashboard, CRUD chatbot abbreviation, CRUD chatbot database
Flow of events: <ol style="list-style-type: none"> <li>1. Administrator logs in by entering email and password.</li> <li>2. If email or password are not found, the system display a message indicating incorrect email and password</li> <li>3. The system logs in admin to the admin dashboard.</li> </ol>

Table 4-4: View admin dashboard use case

Use Case Name: View admin dashboard	ID: 4
Primary Actor: Admin	
Stakeholders and Interests: Admin – view dashboard	
Description: This use case designates the flow of event of an authorized admin viewing admin dashboard about the system performance	
Relationships: Association: Admin	
Flow of events: <ol style="list-style-type: none"> <li>1. Perform login as administrator use case</li> <li>2. Administrator clicks onto dashboard option at the sidebar menu</li> </ol>	

Table 4-5: Create, Read, Update, Delete chatbot abbreviation use case

Use Case Name: Create, Read, Update, Delete chatbot abbreviation	ID: 5
Primary Actor: Admin	
Stakeholders and Interests: Admin – Create, Read, Update and Delete chatbot abbreviation	

Description: This use case designates the flow of event of an authorized admin executing CRUD (Create, Read, Update, Delete) operation on chatbot abbreviation	
Relationships: Association: Admin	
Flow of events: <ol style="list-style-type: none"> <li>1. Perform login as administrator use case</li> <li>2. Administrator clicks onto abbreviation option at the sidebar menu</li> <li>3. The system shows a table of abbreviation and meaning to admin.</li> <li>4. If the Administrator chooses to add an abbreviation. Perform 4.1</li> <li>5. If the Administrator chooses to read an abbreviation. Perform 5.1</li> <li>6. If the Administrator chooses to edit the abbreviation. Perform 6.1</li> <li>7. If the Administrator chooses to delete the abbreviation. Perform 7.1</li> </ol>	
Alternate/Exceptional Flows:	
4.1: Create abbreviation <ul style="list-style-type: none"> <li>- Administrator chooses to create a new abbreviation</li> <li>- Administrator enters new abbreviation and meaning.</li> <li>- The system creates new abbreviation information and updates the table</li> </ul>	
5.1: Read abbreviation <ul style="list-style-type: none"> <li>- Administrator chooses to read the detailed abbreviation</li> <li>- Administrator clicks onto a row of a specific abbreviation</li> <li>- The system pops up a “View modal” with detailed information about the abbreviation and its meaning</li> </ul>	
6.1: Update abbreviation <ul style="list-style-type: none"> <li>- Administrator chooses to edit abbreviation</li> <li>- Administrator edit the abbreviation and meaning</li> <li>- The system updates the abbreviation information and updates the table</li> </ul>	
7.1: Delete abbreviation <ul style="list-style-type: none"> <li>- Administrator chooses to delete abbreviation</li> <li>- The system pops up a prompt to confirm the deletion</li> <li>- Administrator select “confirm” for deletion</li> <li>- The system deletes the abbreviation information and updates the table</li> </ul>	

Table 4-6: Create, Read, Update, Delete chatbot database use case

Use Case Name: Create, Read, Update, Delete chatbot database	ID: 6
--	-------

Primary Actor: Admin
Stakeholders and Interests: Admin – Create, Read, Update and Delete chatbot database
Description: This use case designates the flow of event of an authorized admin executing CRUD (Create, Read, Update, Delete) operation on the chatbot database
Relationships: Association: Admin
Flow of events: <ol style="list-style-type: none"> <li>1. Perform login as administrator use case</li> <li>2. Administrator clicks onto database option at the sidebar menu</li> <li>3. The system shows a table of question and answers to admin</li> <li>4. If the Administrator chooses to add a question and answer. Perform 4.1</li> <li>5. If the Administrator chooses to read a question and answer. Perform 5.1</li> <li>6. If the Administrator chooses to edit a question and answer. Perform 6.1</li> <li>7. If the Administrator chooses to delete a question and answer. Perform 7.1</li> </ol>
Alternate/Exceptional Flows: <p>4.1: Create question and answer</p> <ul style="list-style-type: none"> <li>- Administrator chooses to create new question and answer</li> <li>- Administrator enters new question and answer</li> <li>- The system add and create a new question and answer information and updates the table</li> </ul> <p>5.1: Read question and answer</p> <ul style="list-style-type: none"> <li>- Administrator chooses to read detailed question and answer</li> <li>- Administrator clicks onto the row of a specific question and answer</li> <li>- The system pops up a new modal with detailed information about the question and answer</li> </ul> <p>6.1: Update question and answer</p> <ul style="list-style-type: none"> <li>- Administrator chooses to edit question and answer</li> <li>- Administrator edit the question and answer</li> <li>- The system updates the question and answer information and updates the table</li> </ul> <p>7.1: Delete question and answer</p> <ul style="list-style-type: none"> <li>- Administrator chooses to delete question and answer</li> <li>- The system pops up a prompt to confirm the deletion</li> <li>- Administrator select “confirm” for deletion</li> </ul>

- The system deletes the question and answer information and updates the table

#### 4.4 Sequence Diagram

The sequence diagram of Figure 4.4 and Figure 4.5 illustrates the detail of how the chatbot operations are carried out, while Figure 4.6, 4.7, 4.8 and 4.9 shows flows of functions in the admin dashboard.

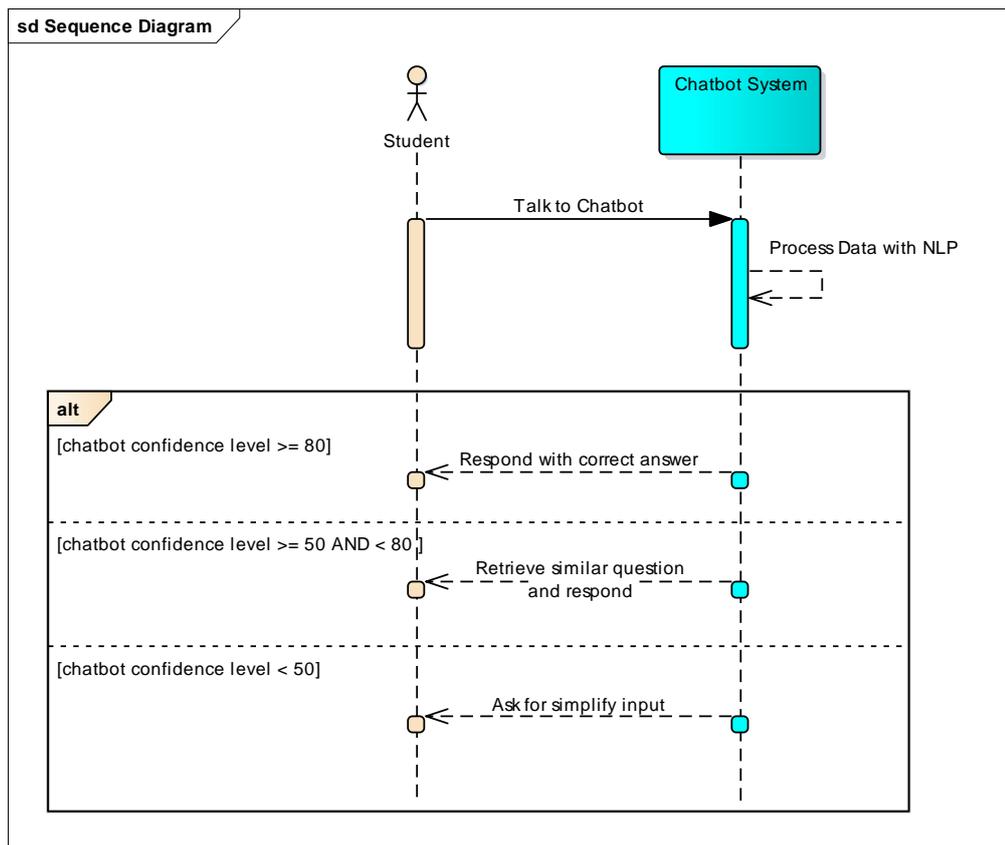


Figure 4.4: Sequence Diagram of Ask Question Use Case

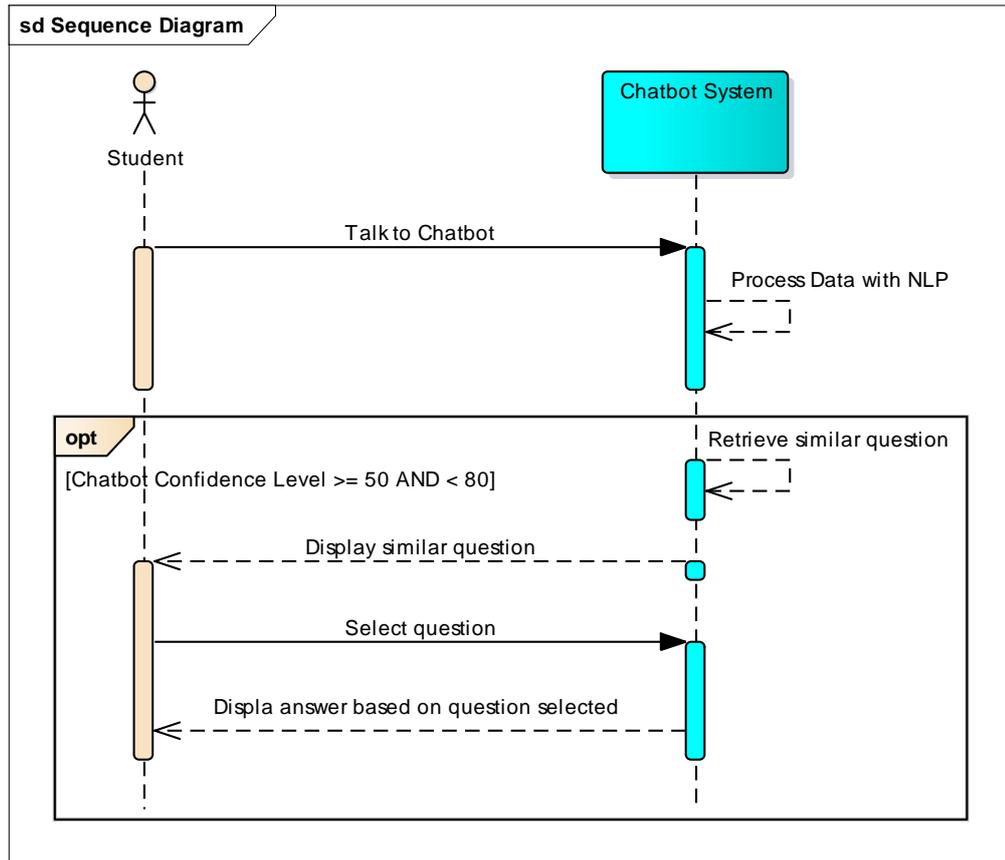


Figure 4.5: Sequence Diagram of Select Question Use Case

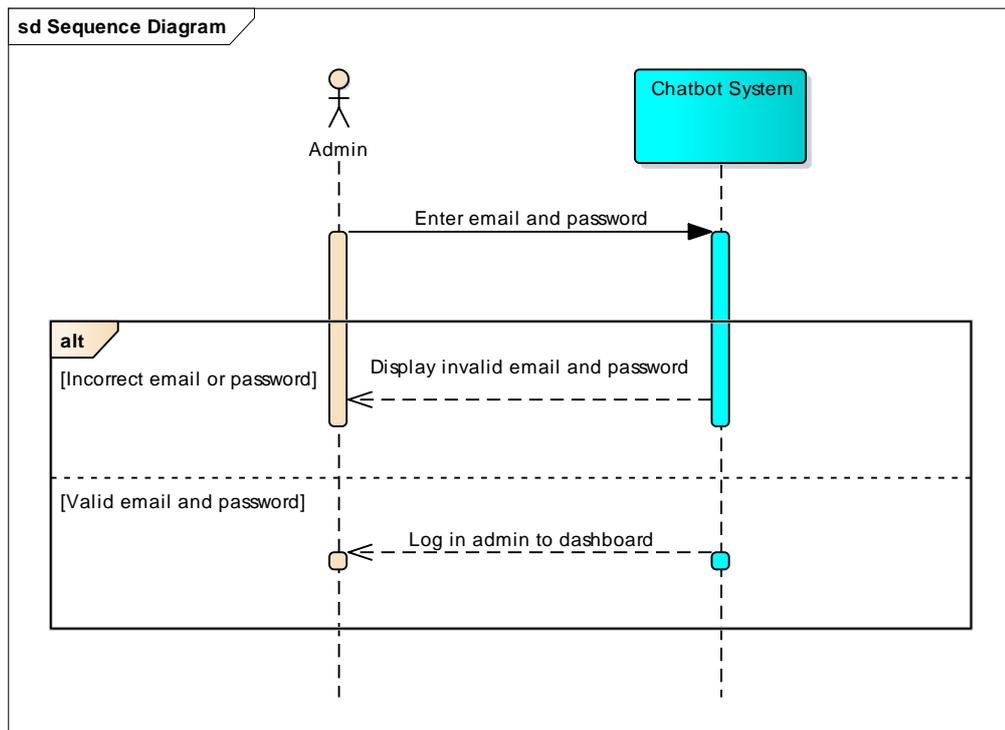


Figure 4.6: Sequence Diagram of Login as Administrator Use Case

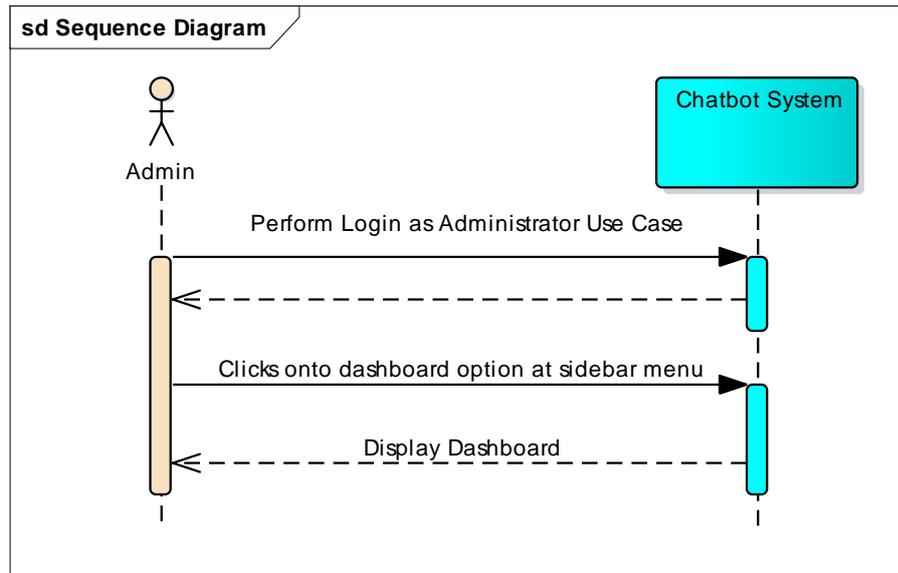


Figure 4.7: Sequence Diagram of View Admin Dashboard Use Case

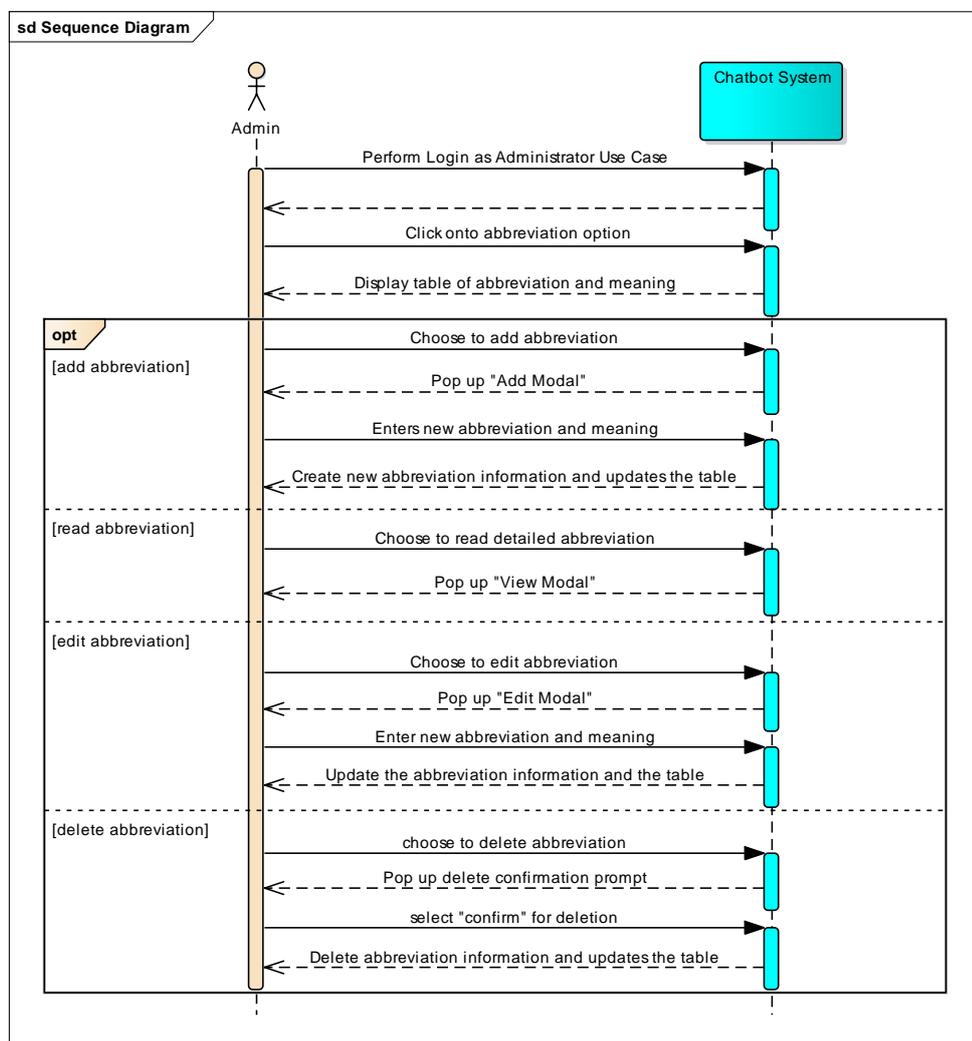


Figure 4.8: Sequence Diagram of CRUD chatbot abbreviation use case

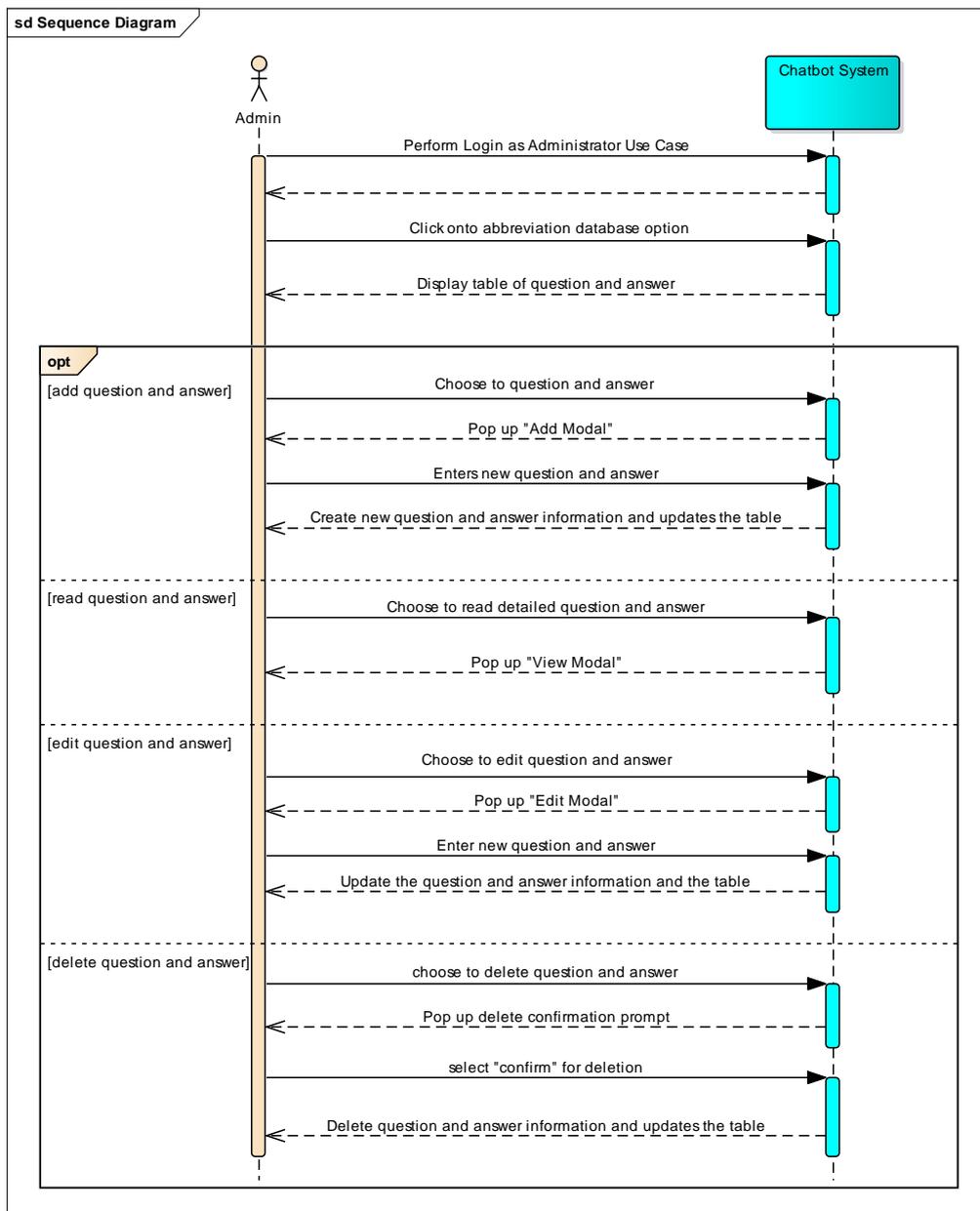


Figure 4.9: Sequence Diagram of CRUD chatbot database use case

## 4.5 System Specification

### 4.5.1 Functional requirements

The functional requirements of the chatbot system are listed below:

1. The system shall respond and reply to any text input it be given
  - i. The system shall ask for simplified text input if the inputs are not understood by the system with a confidence level of less than 50%.

- ii. The system shall retrieve a list of similar question for the user to select if the inputs are fairly understood by the system with a confidence level in the range 50% to 80%
  - iii. The system shall respond and reply with factual information if the inputs are understood by the system with a confidence level of more than 80%
2. The system shall use Natural Language Processing to recognize text input.
  3. The system shall allow admins to be able to login to their account
  4. The system shall allow admins to view admin dashboard
  5. The system shall allow admins to Create, Read, Update and Delete (CRUD) chatbot abbreviations
  6. The system shall allow admin to search for an abbreviation by entering the keyword
  7. The system shall allow admins to Create, Read, Update and Delete (CRUD) chatbot database
  8. The system shall allow admin to search for a question and answer in the chatbot database by entering the keyword

#### **4.5.2 Non-functional requirements**

The non-functional requirements of the chatbot system are listed below:

1. The system shall be robust and error-tolerant
2. The system shall be quick and responsive when generating an answer.
3. The system shall be consistent with next to zero bugs or faults,
4. The system shall be usable and interactable with user
5. The system shall provide accurate responses to input.

#### **4.6 Requirement Analysis**

A survey is conducted on students from UTAR LKCFES to gather data and opinion regarding the current LKCFES website and the implementation of a chatbot system. Fifty sets of questionnaires have been distributed to fifty students and all the students have promptly provided their responses. The feedbacks are analysed and summarised as follows:

1. Intended object of student’s when accessing the LKCFES website

Q1. What do you use the LKC FES website for?

50 responses

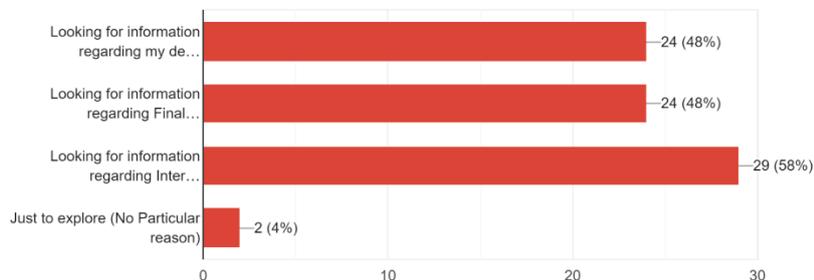


Figure 4.10: Objective of student’s when accessing the LKCFES website

Based on Figure 4.6, the three main reason students uses the LKCFES website is to:

- i. Look for information regarding their department
- ii. Look for information regarding Final Year Project
- iii. Look for information regarding internship

The result shows that the majority of the students use the website to look for information regarding internships followed by respective departments and Final Year Project. In contrast, only two out of fifty students used the website for no particular reason. In my opinion, LKCFES website is an important gateway for students to gain information regarding their academics with over 96% of students uses the website for academic purposes.

2. Frequency of student usage of LKCFES website

Q2. How often do you use the LKC FES website?

50 responses

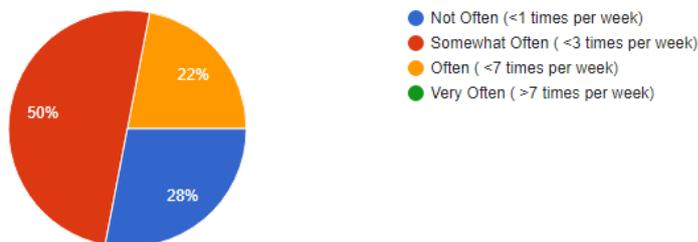


Figure 4.11: LKCFES website usage frequency

According to Figure 4.7, students do not use the LKCFES website often with most of the students accessing the website less than 3 times per week. Likewise, none of the students uses the LKCFES website more than 7 times per week. This shows that the workload of the LKCFES website is average with no constant visitor. Furthermore, the majority of the students that don't use the website often are from Year 1 as they do not require getting information regarding Internship or Final Year Project.

### 3. Student's acknowledgement of challenges in using LKCFES website

Q3. Do you find it difficult to use the LKCFES website?

50 responses

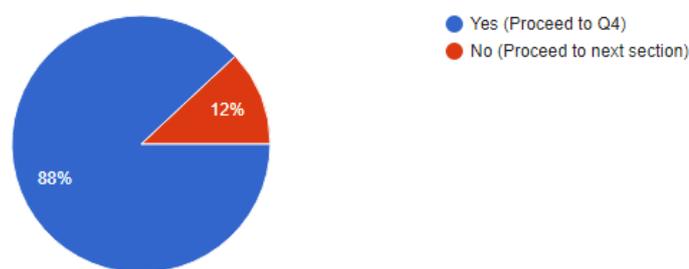


Figure 4.12: Student's acknowledgement of challenges in using LKCFES website

### 4. Challenges and limitation faced by students

Q4. What do you find difficult when using the LKCFES website?

44 responses

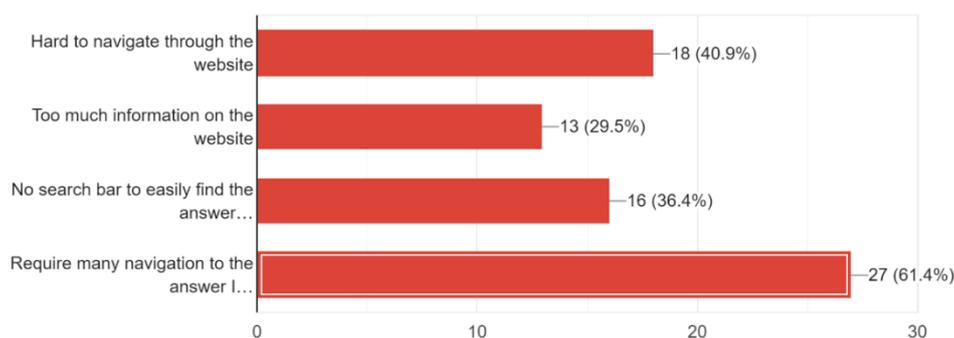


Figure 4.13: Challenges and limitations faced by students, when using the website

Based on the Pie Chart in Figure 4.8, a large majority of 88% of students acknowledge that they face difficulty in using the LKCFES website. The difficulty that students face can be broken down into four aspects as shown in Figure 4.9:

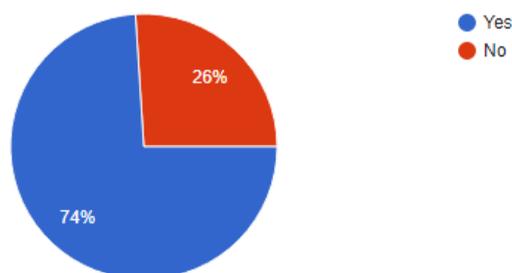
- i. Hard to navigate through the website
- ii. Too much information on the website
- iii. No search bar to easily find the intended answer
- iv. Require many navigation to the answer

This shows that the limitation of an information-based website HCI has caused difficulty to students. Although, LKCFES website is tailored to be built under the principles of good design, yet the limitations faced by any information based website remain unavoidable. For example, the problem that the majority of the students face “websites require much navigation to their intended answer” is unavoidable.

## 5. Student’s opinion on AI Chatbot

Q1. Do you use any AI-chatbot?

50 responses



Q2. Do you think that the chatbot will help student to search for answer faster?

50 responses

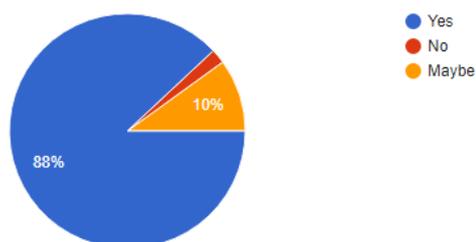


Figure 4.14: Student’s opinion on AI Chatbot

As shown in Figure 4.10, nearly  $\frac{3}{4}$  of the respondent’s use AI-chatbot like Siri, Alexa, Google AI Assistant. A huge majority of the students believe that the chatbot

solution on this project will help students to search for the intended answer quicker. It clearly shows that chatbot shows potential in helping to improve the LKCFES website HCI; equally, increasing student's productivity.

## 6. Student's expectations from the chatbot

### Q5. What are the feature that you would like to see in the chatbot system?

50 responses

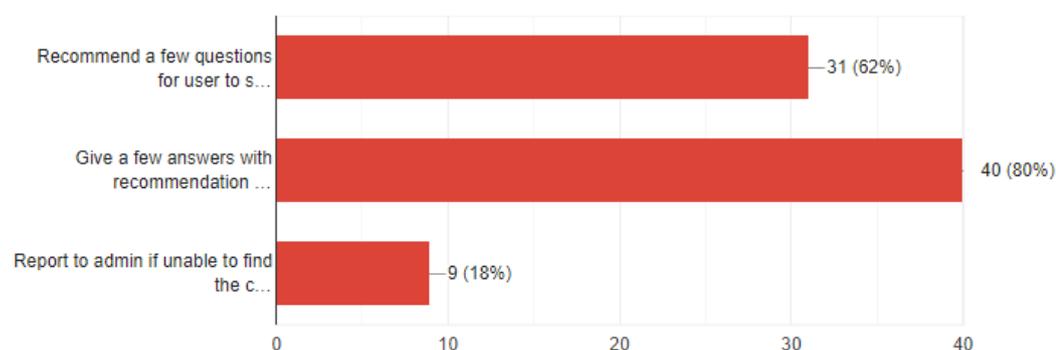


Figure 4.15 Student's expectations from the chatbot

Based on Figure 4.11, the functionality that students expect the most from the chatbot is to give a few answers with recommendation with over 80% voted for it. This is followed by the expectation of "Recommend a few questions for user to select" as students might not know the word to type in when searching. In my opinion, the recommendation function is a basic necessity of a chatbot as it gives user's a sense of control and choice when using the system. In awe, it increases the user's productivity when using the system.

Lastly, the lowest voted functionality is to report to the admin if unable to find the correct answer function. From my perspective, this is because the student might find it tedious to report the incorrect answer to the admin whenever there is a suspected problem. Thus, the student does not consider the function as efficient and does not require the function.

## CHAPTER 5

### SYSTEM DESIGN

#### 5.1 Introduction

This chapter shows the system design involved in the project namely User Interface Design, Database design, System Architecture Design and System Deployment Design.

#### 5.2 User Interface

This system mainly targets two users which are the admin and student from LKCFES faculty. However, any user that visits the LKCFES website may use the chatbot system. Non-administrator users may only use the chatbot interface while administrators have access to the admin dashboard to view the overall system.

##### 5.2.1 User Interface for student

Students only interact with the chatbot page as seen on the images below.

##### 5.2.1.1 Home Chatbot page

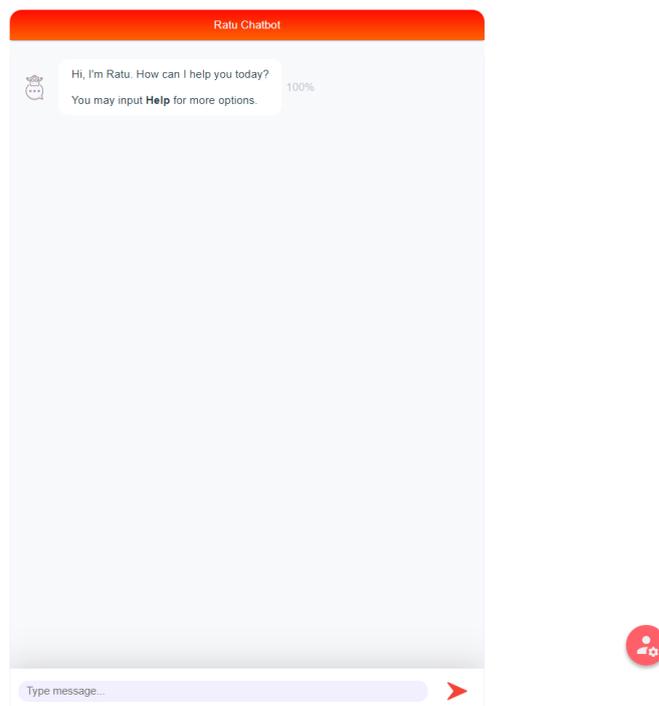


Figure 5.1: Home page of the chatbot system

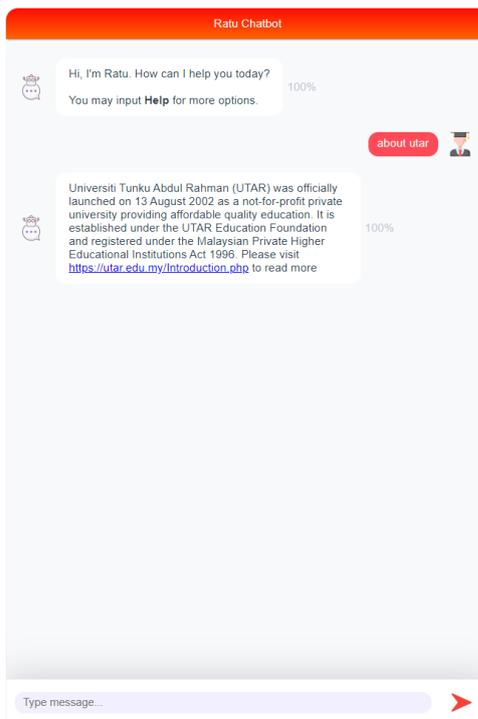


Figure 5.2: Chatbot replying students with high confidence level

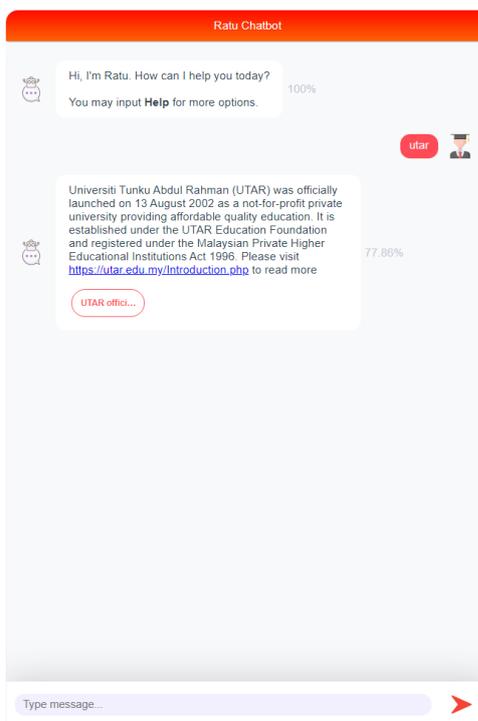


Figure 5.3: Chatbot retrieving similar question for students to select when having an average confidence level

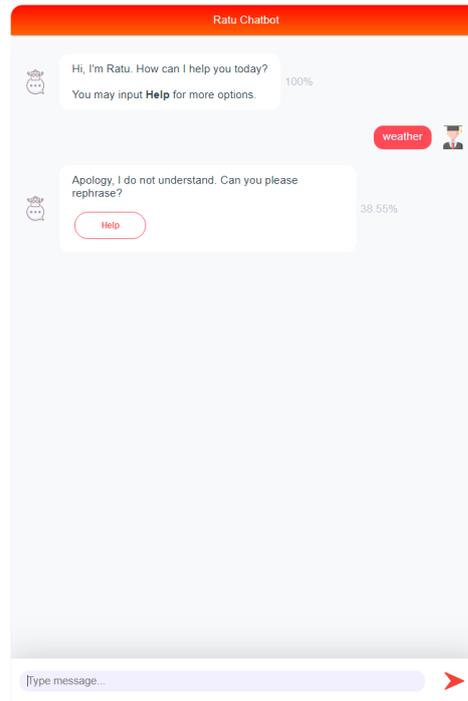


Figure 5.4: Chatbot asking for simplify input when the confidence level is low

## 5.2.2 User Interface for administrator

### 5.2.2.1 Admin Login page

This page is a login page that allows administrators to view admin dashboard

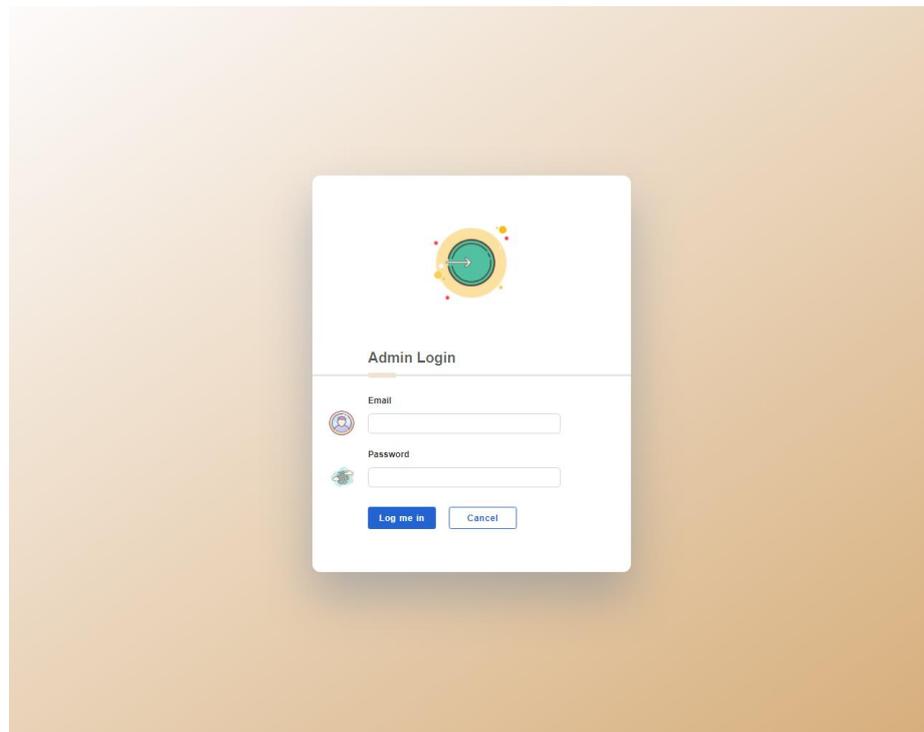


Figure 5.5: UI design for admin login page

### 5.2.2.2 Sidebar menu for admin

The sidebar menu provide a list of menus that allows administrator to view and carry out different functionalities in the dashboard

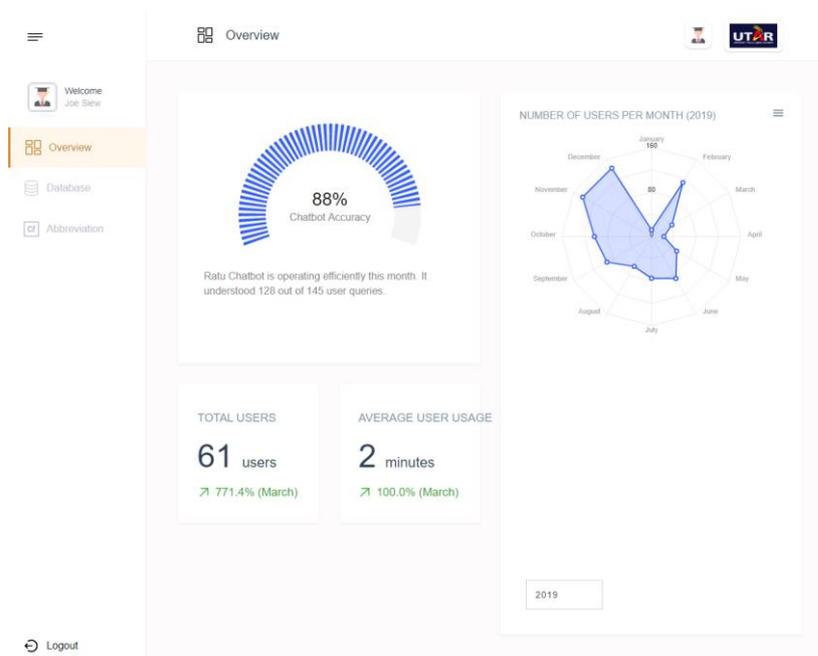


Figure 5.6: Sidebar menu for admin

### 5.2.2.3 Admin dashboard overview section

The overview section of the admin dashboard shows the high level overview of how the chatbot is performing.

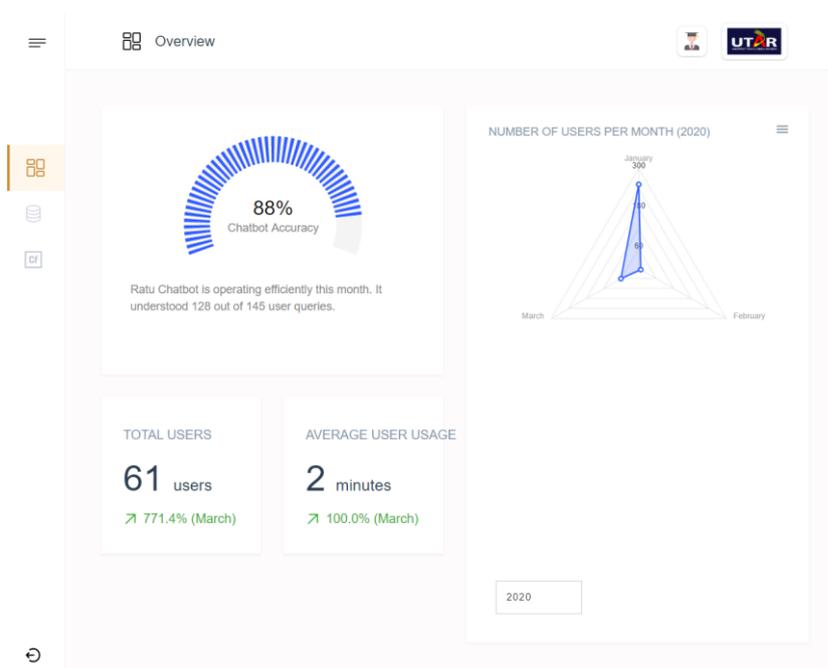


Figure 5.7: Overview section of admin dashboard

#### 5.2.2.4 Admin dashboard database section

The database section of the admin dashboard allows CRUD operation on chatbot's database. These UI below allows admin to perform Create, Read, Update, Delete and Search.

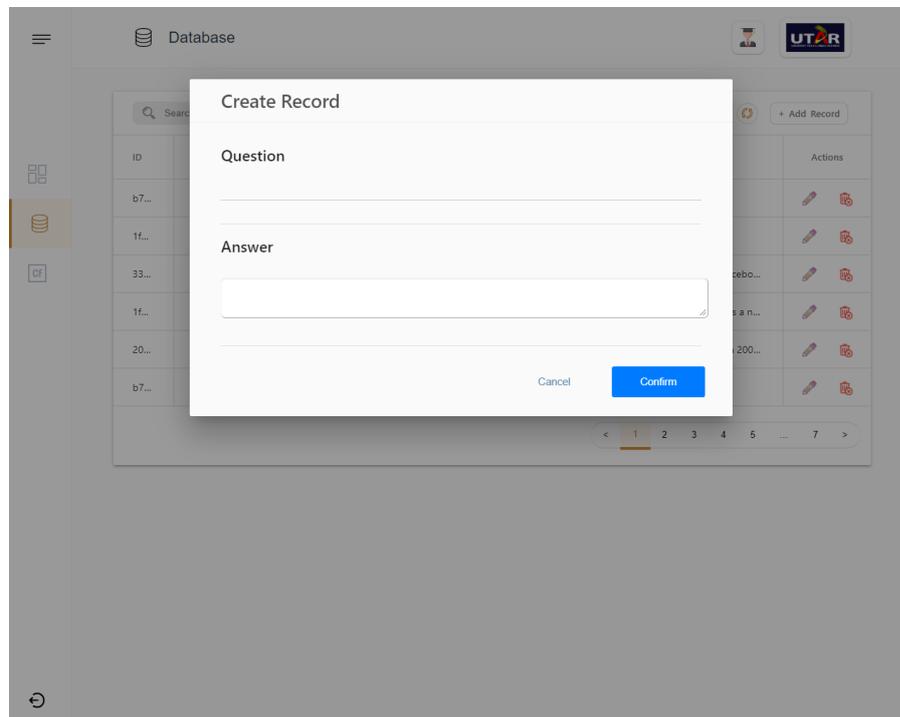


Figure 5.8: UI to create question and answer record

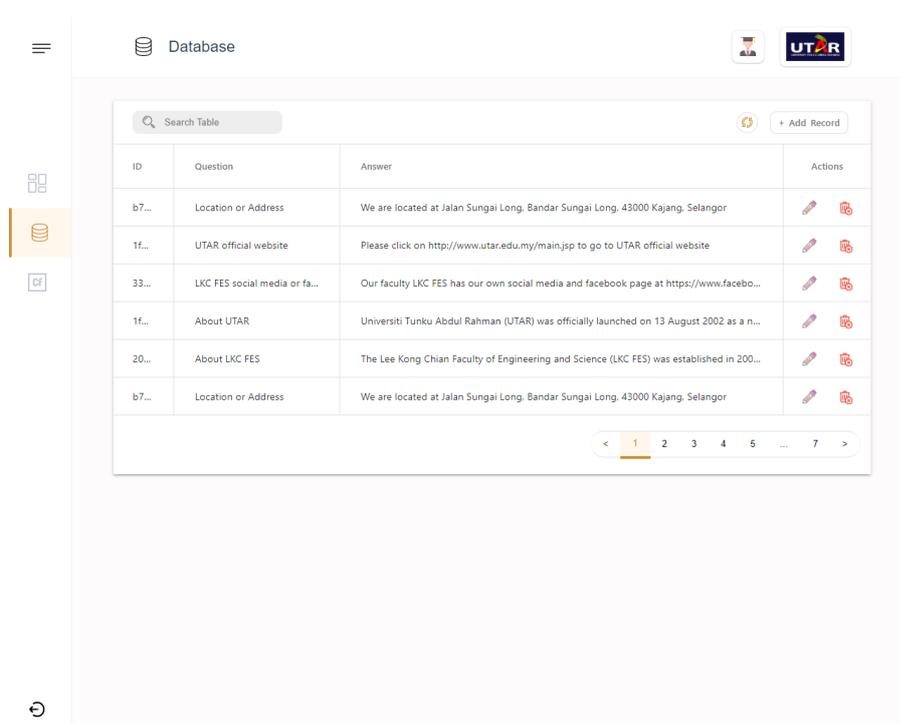


Figure 5.9: UI to read question and answer record in table format

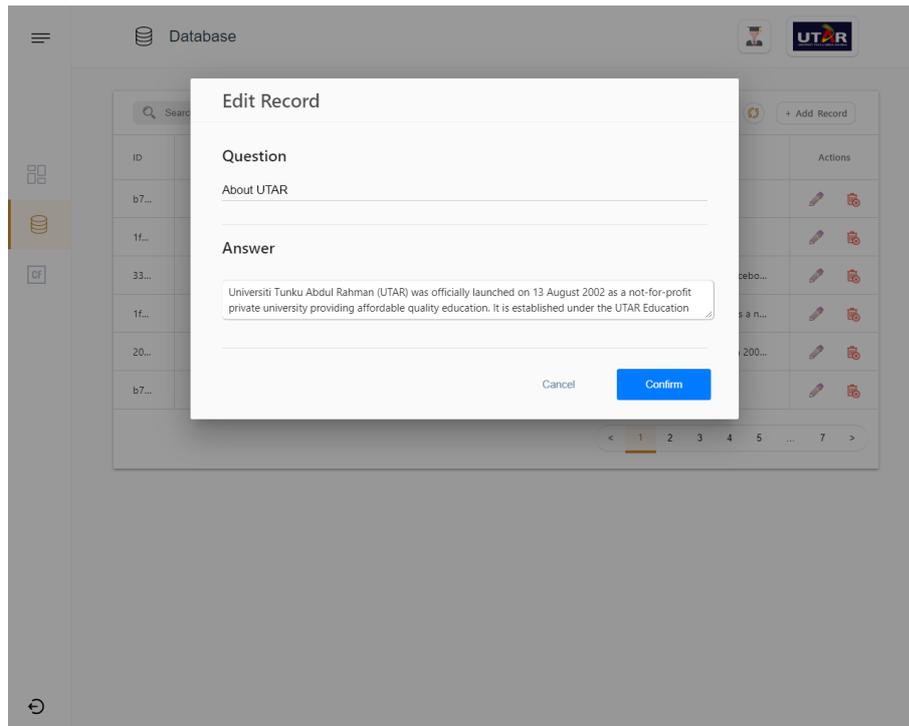


Figure 5.10: UI to edit and update question and answer record

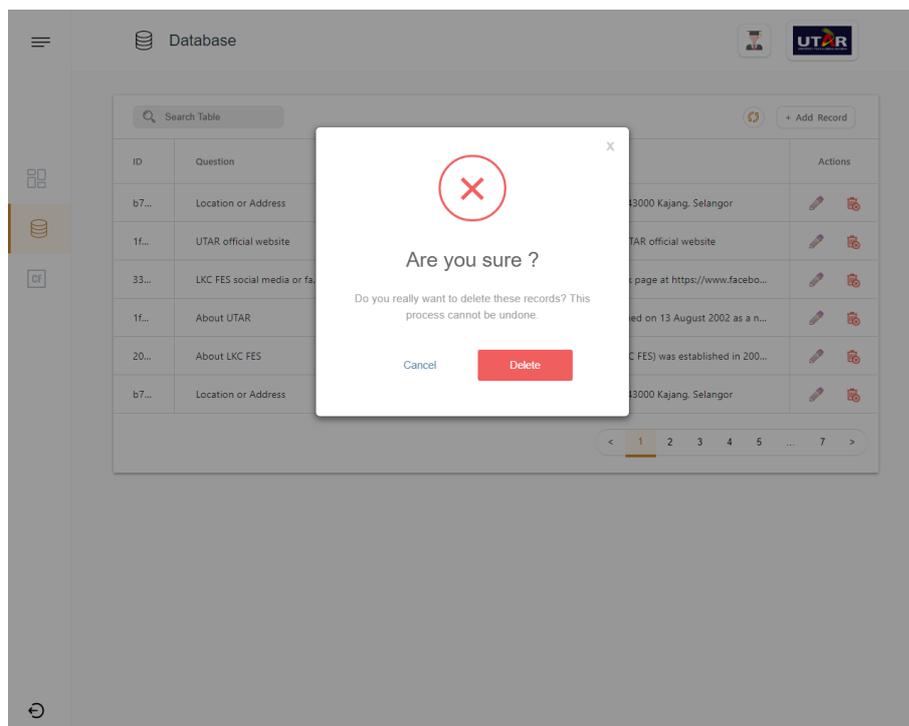


Figure 5.11: UI to delete question and answer record

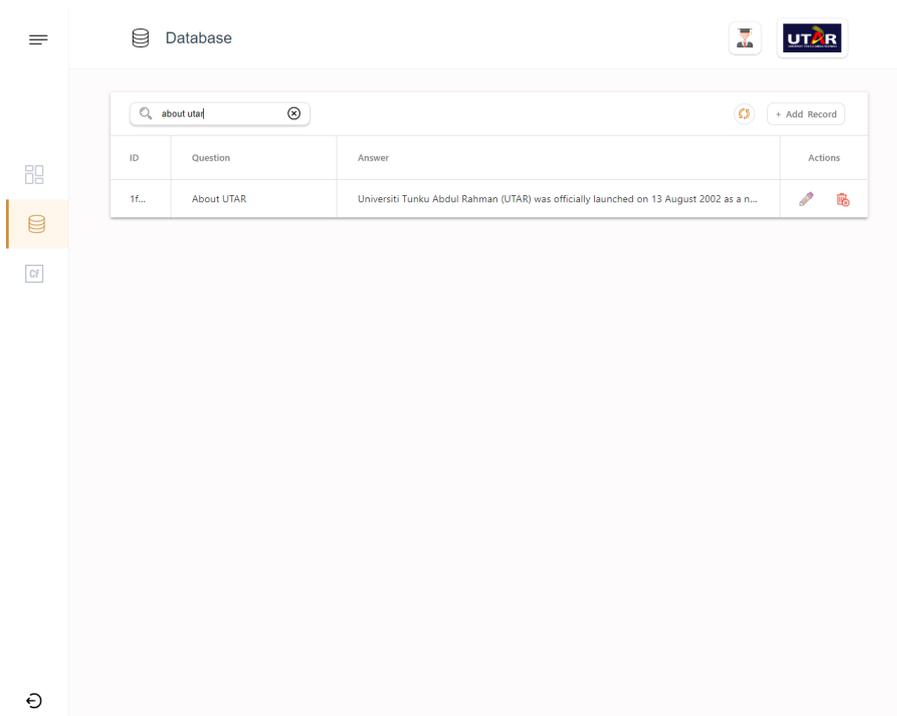


Figure 5.12: UI of database search result by entering keyword

### 5.2.2.5 Admin dashboard abbreviation section

The abbreviation section of the admin dashboard allows CRUD operation on chatbot's abbreviation. These UI below allows admin to perform Create, Read, Update, Delete and Search.

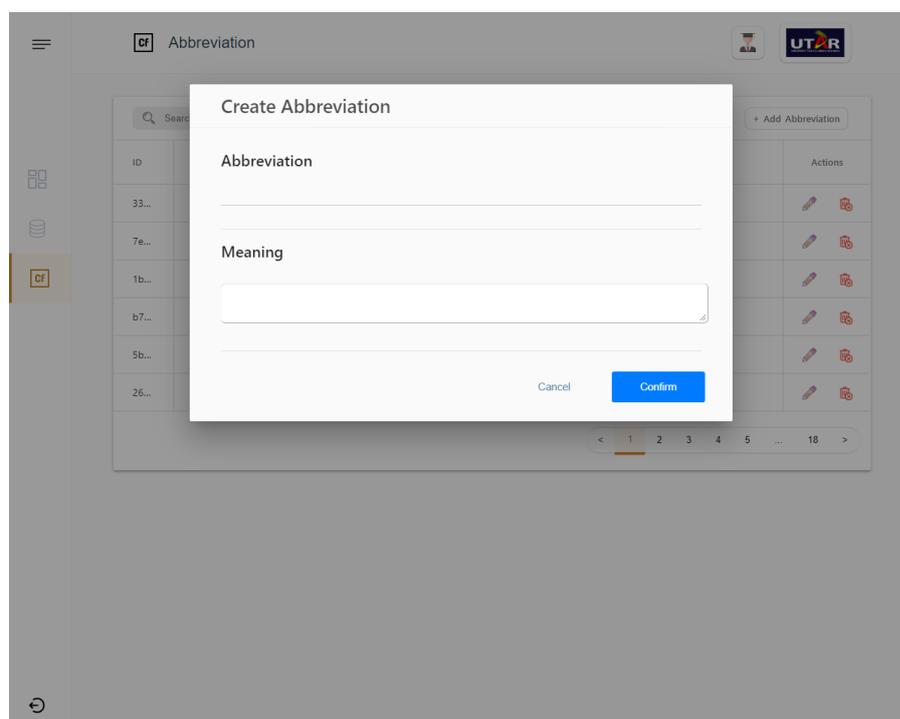


Figure 5.13: UI to create abbreviation record

cf Abbreviation

Search Table + Add Abbreviation

ID	Abbreviation	Meaning	Actions
33...	ASAP	As Soon As Possible	
7e...	ASL	Age Sex Location	
1b...	ATK	At The Keyboard	
b7...	ATM	At The Moment	
5b...	B	Be	
26...	B4	Before	

< 1 2 3 4 5 ... 18 >

Figure 5.14: UI to read abbreviation and meaning in table format

cf Abbreviation

Search Table + Add Abbreviation

**Edit Abbreviation**

**Abbreviation**

FYP

**Meaning**

Final Year Project

Cancel Confirm

< 1 ... 3 4 5 6 7 ... 18 >

Figure 5.15: UI to edit and update abbreviation record

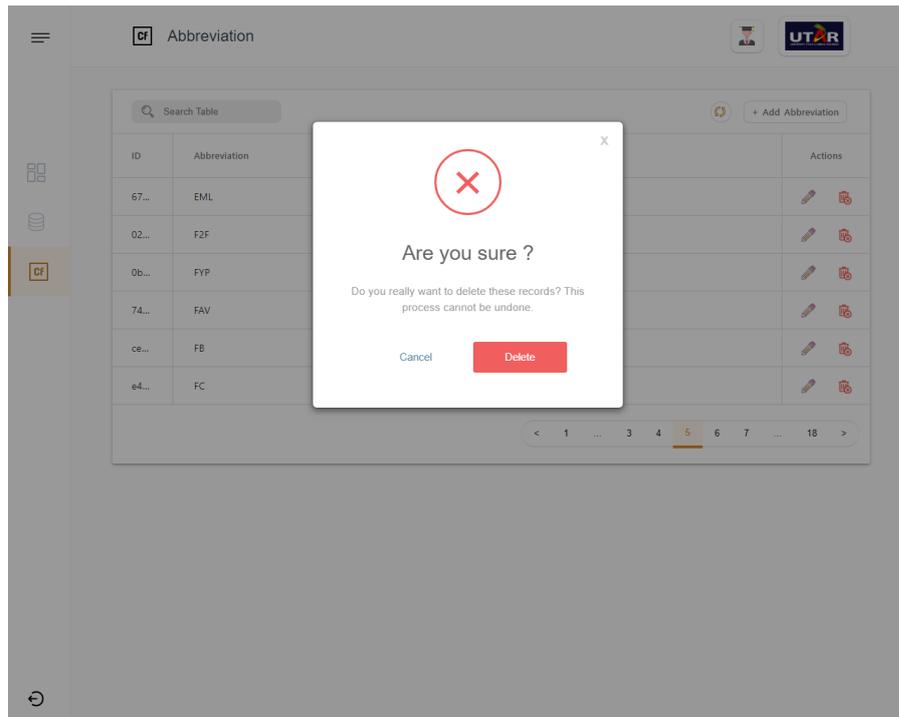


Figure 5.16: UI to delete abbreviation record

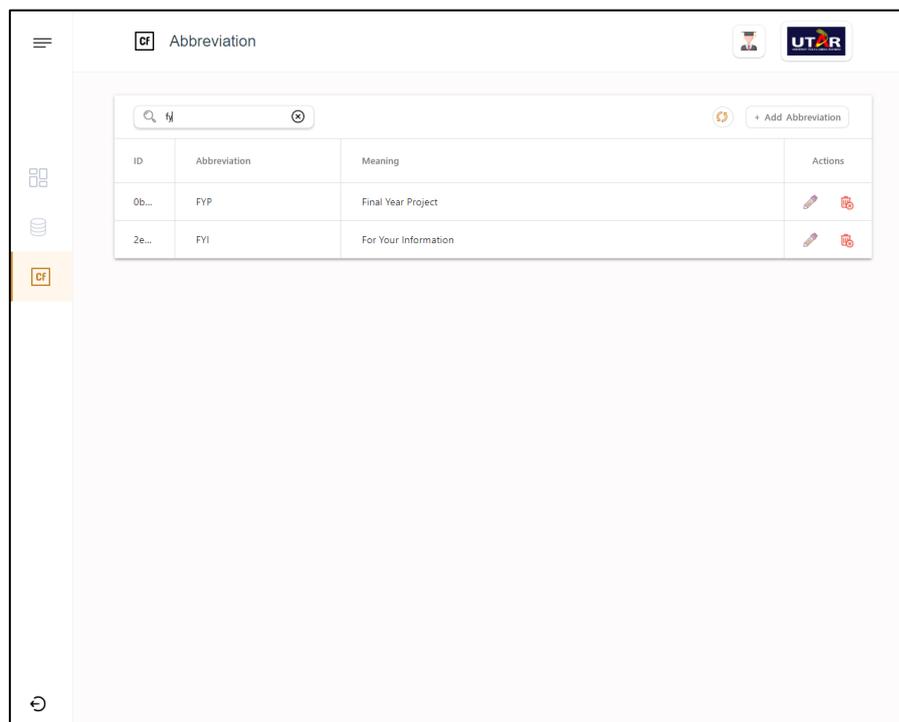


Figure 5.17: UI of abbreviation search result by entering keyword

### 5.3 Database design

#### 5.3.1 MongoDB Schema

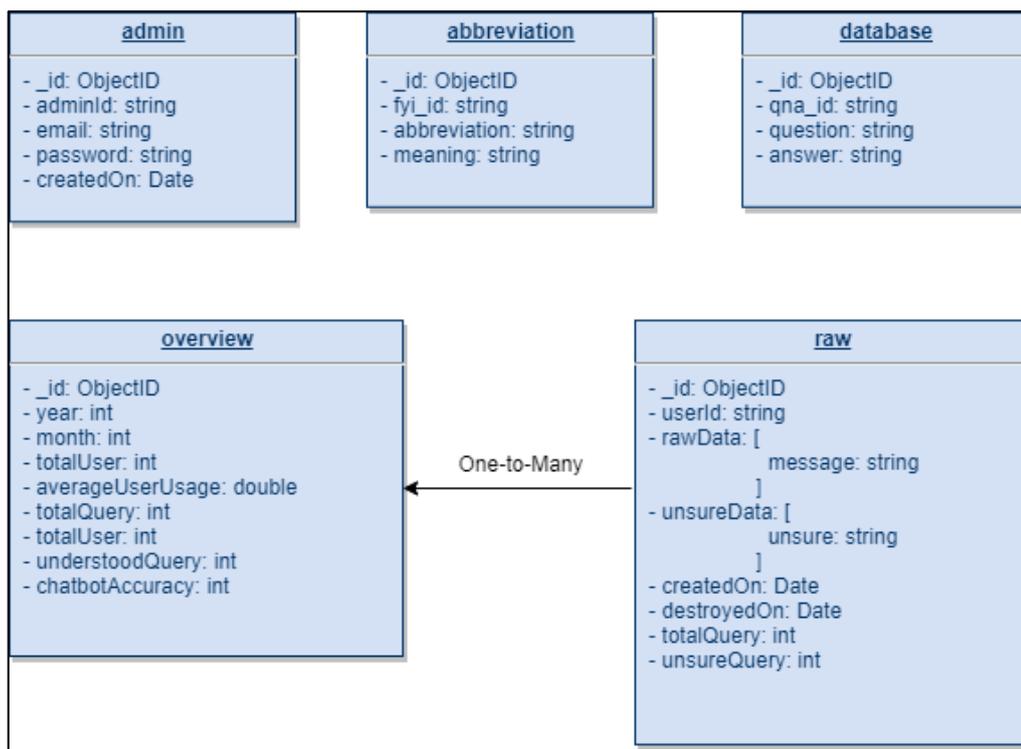


Figure 5.18: MongoDB scheme design

#### 5.3.2 Database Logical Design

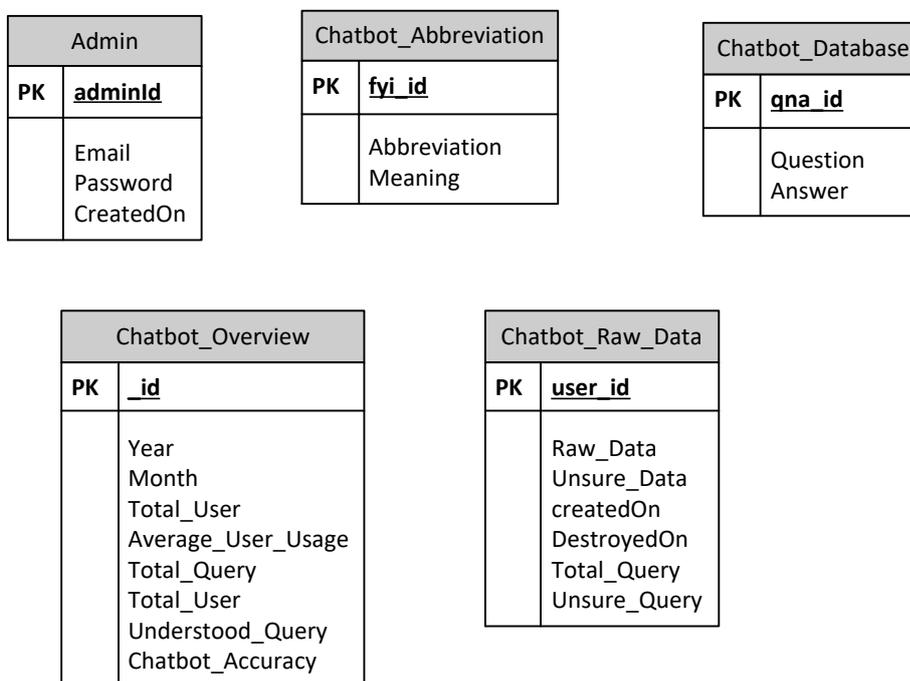


Figure 5.19: Database logical design

### 5.3.3 Entity Relationship Diagram

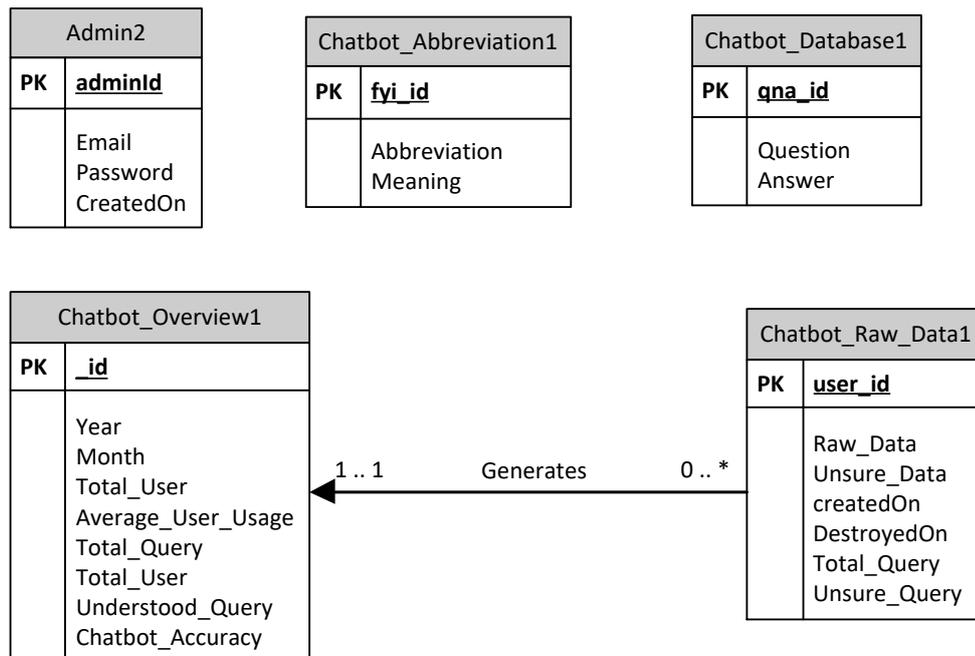


Figure 5.20: Database ERD

## 5.4 System Architecture Design

The system architecture design used in this project is the three-tier architecture. Three-tier architecture divides the entire application into three different layers mainly Presentation Tier, Application Tier and Data Tier (JReport, 2020). The overview of the three-tier architecture is shown in Figure 5.21 below.

- i. **Presentation Tier** – Front-end of the application that consists of graphical user interface.
- ii. **Application Tier** – Contains business logic and is the core functionality of the system.
- iii. **Data Tier** – Data tier consist of database or data storage.

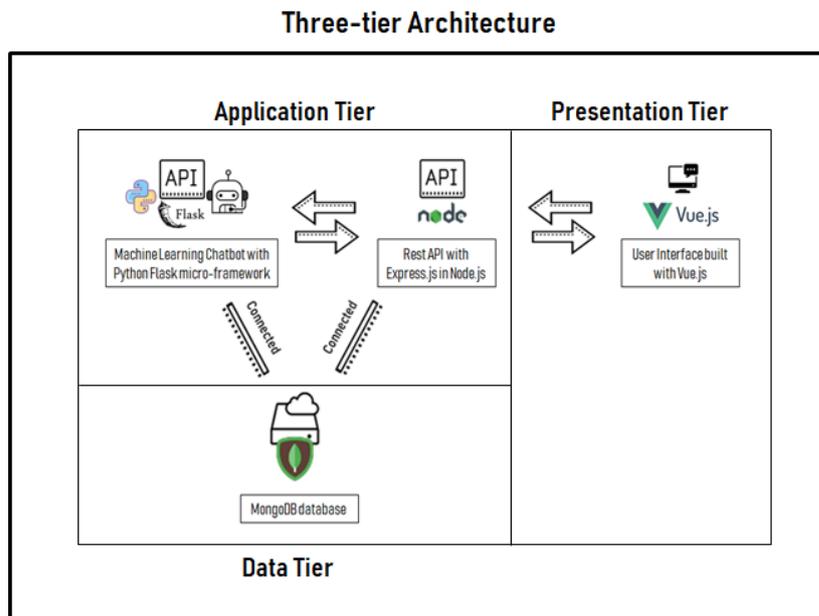


Figure 5.21: Overview of three-tier architecture design of the chatbot system<sup>1</sup>

### 5.5 System Deployment Design

As discussed in section 5.4, there are 3 tiers or layers in the software architecture of this system. Figure 5.22 is constructed to illustrate the components in each tier.

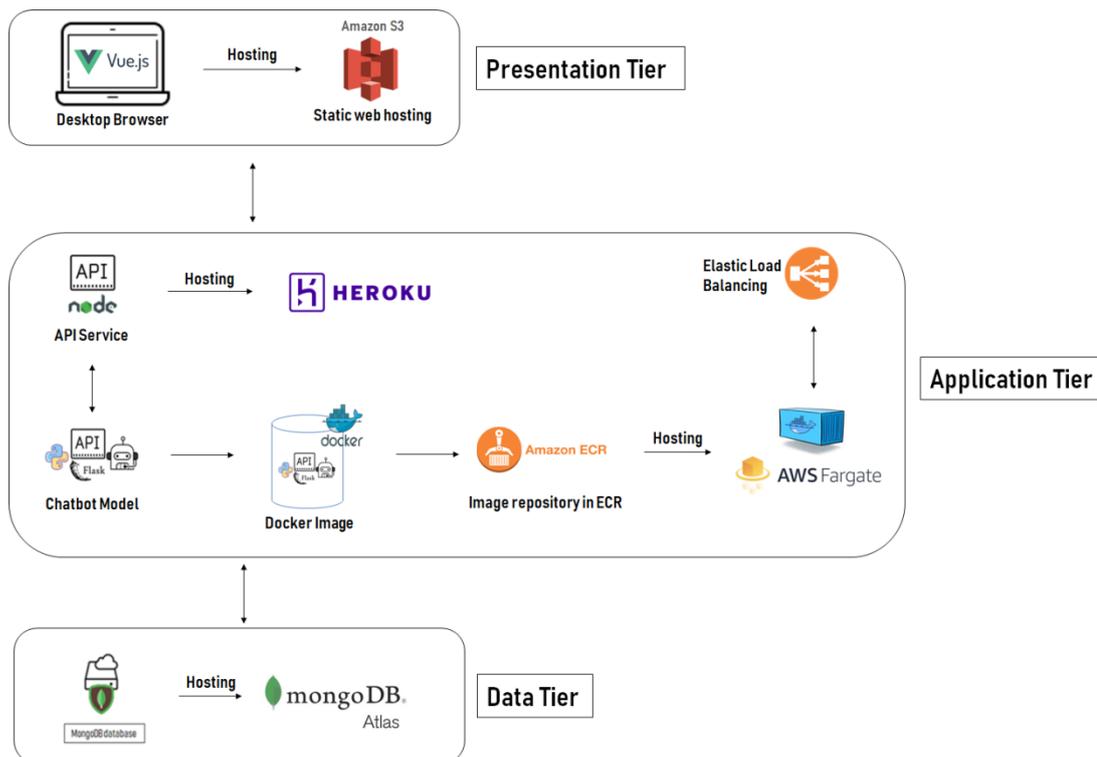


Figure 5.22: System Deployment Architecture Design<sup>1</sup>

### **5.5.1 Presentation Tier Components**

The presentation tier consists of Vue.js and Amazon S3. The web hosting for the Vue.js UI of this system is separated as a standalone service with Amazon S3. Amazon S3 is an excellent service to host static websites due to its high availability and accessibility.

### **5.5.2 Application Tier Components**

#### **5.5.2.1 Node.js API Service**

Majority of the services such as UI and Chatbot Model run on Amazon Web Service, while only the API service runs on Heroku. The reason load balancing is not implemented on the API service is due to the fact that its workload would not be high. The Node.js API service's main focus is on administrator related functionalities which have substantially lower usage compared to the Chatbot API.

#### **5.5.2.2 Chatbot Model Service**

The deployment of the chatbot model is more sophisticated as it is the core of this system. It consists of 4 major parts to ensure its capability to support high traffic.

- The first part is to dockerize the chatbot model into a docker image. Docker makes deployment easy, fast scaling of system and also good system delivery (Docker Website, 2016)
- Next, we save the docker image into an Amazon Elastic Container Registry repository. The benefit of ECR is that it helps developers store, manage and deploy container images. Thus, it greatly simplifies the workflow of deployment. (AWS, 2020)
- Following, the docker image is pulled from Amazon ECR and is hosted in Amazon Fargate. Amazon Fargate is a serverless computer for containers. It works together with Amazon ECR to build container images, define memory and computer resources required then lastly run and deploy applications.
- Lastly, the AWS Fargate is assisted by Amazon Elastic Load Balancing to distribute network automatically. In this project it is well suited for balancing HTTP load and provides advance request routing for containers.

### **5.5.3 Data Tier Components**

The data tier components only consist of MongoDB Atlas. It deployed a fully managed MongoDB across AWS service. It provides a robust ecosystem in managing the system's database.

## CHAPTER 6

### SYSTEM IMPLEMENTATION

#### 6.1 Introduction

This chapter describes system implementation on the front-end routes hierarchy, web API endpoints, chatbot's model and the implementation of cloud services.

#### 6.2 Web Application

The web application consists of many routes that allow users to switch pages without refreshing the page. The routes that are marked with cache have an added functionality of client-side storage. Client-side storage is a brilliant method to increase application performance; by caching data on the browser itself, the application can skip fetching information from the server every time the user needs it. (Vue.js, 2020)

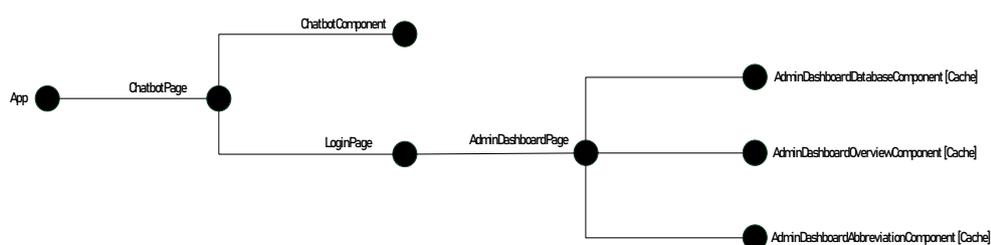


Figure 6.1 Routes hierarchy for the chatbot system

#### 6.3 Web API endpoint

There are a total of 2 API with 18 endpoints. Each endpoint serves its purposes.

Table 6-1: List of web and chatbot API endpoints

Type: Chatbot API. Methods: GET, POST	
Description: Chatbot API is incorporated with the chatbot model. It is an API for the chatbot machine learning model.	
Route	Description
POST /api/chatbot/chat	Send query to the chatbot and returns an answer
GET /api/chatbot/train	Retrain chatbot based on changes in the chatbot's database.
GET /api/chatbot/abbreviation	Recalibrate chatbot based on changes in the

	chatbot's abbreviation.
<b>Type: Admin. Method: POST</b>	
<b>Description:</b> This endpoint is for creating and login admin	
Route	Description
POST /api/admin/signup	Create new admin based on email and password
POST /api/admin/login	Login admin and return JWT token
<b>Type: Admin Dashboard Overview. Method: POST , GET</b>	
<b>Description:</b> These endpoint is for the admin dashboard overview section that gives a high level overview of the chatbot system	
Route	Description
POST /api/admin/dashboard/overview/raw	Create unprocessed raw user data based on every user session
GET /api/admin/dashboard/overview/month	Retrieve overview data of the chatbot system at a specific month and year
GET /api/admin/dashboard/overview/year	Retrieve overview data of the chatbot system at a specific year
<b>Type: Admin Dashboard Database, Method: POST , GET, PATCH, DELETE</b>	
<b>Description:</b> These endpoints are for the admin dashboard to execute CRUD and search operation on chatbot's database.	
Route	Description
POST /api/admin/dashboard/database	Add new question and answer record into chatbot's database
GET /api/admin/dashboard/database	Get a list of question and answer records according to the page and limit
GET /api/admin/dashboard/database/search	Search for a question and answer records based on keyword
PATCH /api/admin/dashboard/database/{id}	Update a question and answer based on the id
DELETE /api/admin/dashboard/database/{id}	Delete a question and answer based on id
<b>Type: Admin Dashboard Abbreviation, Method: POST , GET, PATCH, DELETE</b>	
<b>Description:</b> These endpoints are for the admin dashboard to execute CRUD and search operation on chatbot's abbreviation.	
Route	Description
POST /api/admin/dashboard/database	Add new abbreviation record into chatbot's abbreviation
GET /api/admin/dashboard/database	Get a list of abbreviation records according to the page and limit
GET /api/admin/dashboard/database/search	Search for an abbreviation records based on keyword
PATCH /api/admin/dashboard/database/{id}	Update an abbreviation based on the id
DELETE /api/admin/dashboard/database/{id}	Delete an abbreviation based on id

## 6.4 Chatbot's Model

The chatbot's model uses spaCy similarity which compares word embedding, multi-dimensional meaning representations of a word. SpaCy is able to compare between two objects and make a prediction of **how similar they are**. (spaCy, 2020) For example, the similarity between dog and cat is higher than the similarity between dog and apple. Hence, using this approach; the system could map and analyse the similarity between user questions to the database predefined questions and find out the most accurate answer.

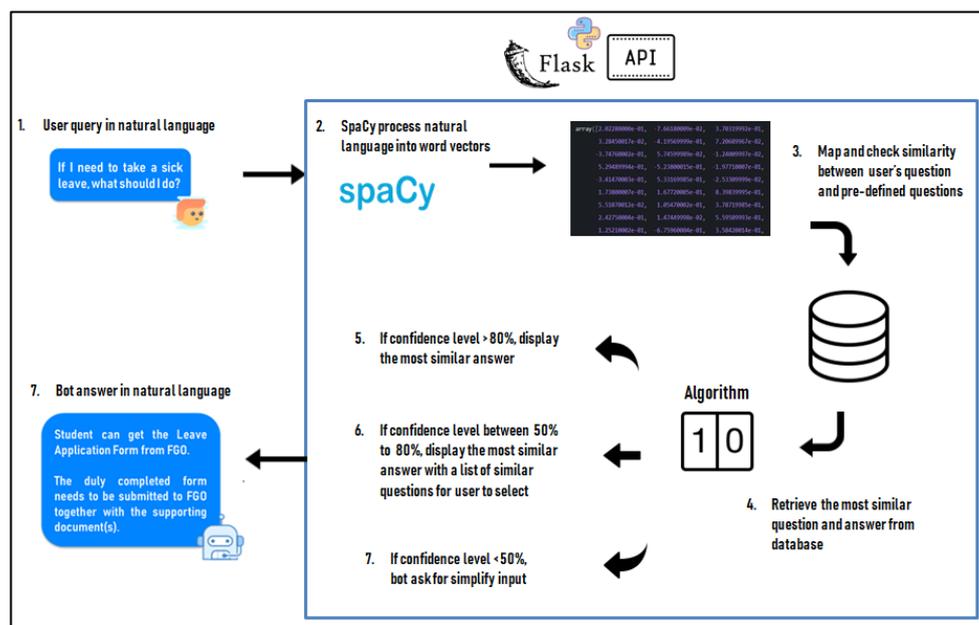


Figure 6.2: Chatbot's model design<sup>2</sup>

### Description

1. User send question as natural language to the chatbot's API
2. SpaCy processes the user's question into word vectors.
3. Map and check similarity between the user's question and lists of predefined questions in the chatbot's database.
4. Retrieve the most similar question and answer from the database
5. If confidence level or similarity above 80%, display the most similar answer
6. If the confidence level or similarity in range of 50% to 80%, display the most similar answer with a list of similar question for the user to select
7. If confidence level is less than 50%, ask for simplify input.

<sup>2</sup> Icons in the diagram and retrieved from <https://www.flaticon.com/> and <https://icons8.com/>

## 6.5 Implementation of cloud services

### 6.5.1 Docker

Create a **Dockerfile** to dockerize chatbot model API and push to Amazon ECR

```

Dockerfile x
Dockerfile > FROM
1 FROM python:3.7.5-slim
2
3 LABEL maintainer "Joe Siew joesiew98@gmail.com"
4
5 COPY ./requirements.txt /app/requirements.txt
6
7 WORKDIR /app
8
9 RUN pip install -r requirements.txt
10
11 COPY . /app
12
13 EXPOSE 80
14
15 ENV MONGODB_URL="mongodb://[REDACTED]:[REDACTED]@shard-00-00-z2bin.mongodb.net:27017,utar-chatbot-shard-00-01-z2bin.mongodb.net:27017,utar-c
16
17 CMD ["python", "model.py"]

```

Figure 6.3: Dockerfile content to dockerize chatbot model API

### 6.5.2 Amazon Elastic Container Registry

Dockerized chatbot model API image is stored in Amazon ECR for easier management and deployment.

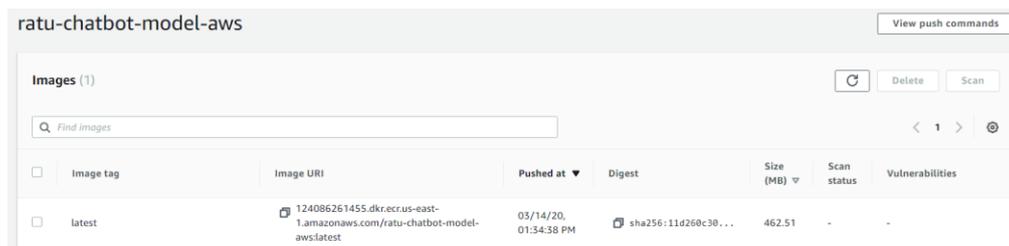
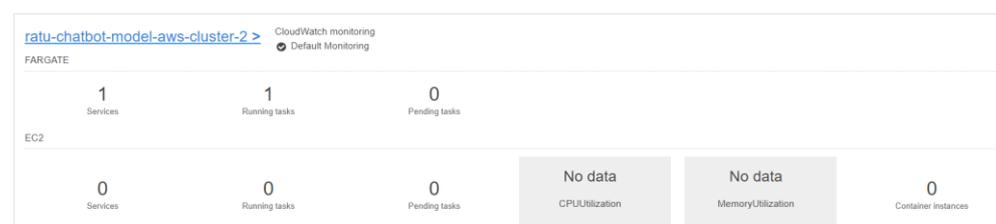


Image tag	Image URI	Pushed at	Digest	Size (MB)	Scan status	Vulnerabilities
latest	124086261455.dkr.ecr.us-east-1.amazonaws.com/ratu-chatbot-model-aws:latest	03/14/20, 01:34:38 PM	sha256:11d260c30...	462.51	-	-

Figure 6.4: Chatbot model API image in ECR repository

### 6.5.3 Amazon Fargate

Amazon Fargate host the dockerized chatbot model API image by pulling the image from Amazon ECR. It will build the container images and allocate resources to deploy the chatbot model API application.



Category	Services	Running tasks	Pending tasks	Other Metrics
FARGATE	1	1	0	-
EC2	0	0	0	No data (CPUUtilization, MemoryUtilization, Container Instances)

Figure 6.5: Running services and task in Amazon Fargate

### 6.5.4 Amazon S3

Amazon S3 hosts the front-end Vue.js UI of this chatbot system as a standalone service.

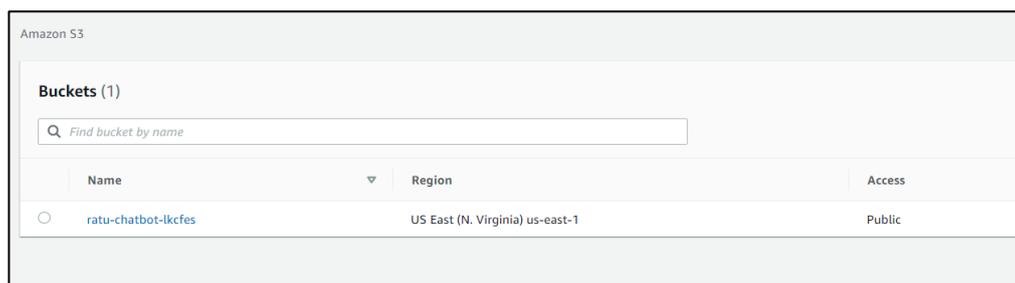


Figure 6.6: Static Web Hosting of Vue.js in S3

### 6.5.5 MongoDB Atlas Dashboard Overview

MongoDB Atlas dashboard overview shows information regarding the chatbot's database.



Figure 6.7: Overview of activities in MongoDB Atlas

## CHAPTER 7

### SYSTEM TESTING

#### 7.1 Introduction

This section ensures the application is compliant to the requirement and is within scope requirement. Thus, a few tests are conducted which includes integration test, usability test, performance test and user acceptance test.

#### 7.2 Functional Testing

Functional test is executed to ensure the requirement of a system is met by evaluating a correct output when given input. It is to ensure that the system is compliant to the functional requirements of the system.

##### 7.2.1 Integration Testing

The integration testing is executed to test when all 3 modules are integrated together as 1 system. It includes the UI, API and chatbot model. Test cases are produced for the integration test as shown below.

Table 7-1: Integration Test Case 1

<b>Test Case ID:</b> TC001	<b>Test Status (choose one)</b> Pass, Fail, Retest	<b>Follow-up Actions (if fail)</b>	
<b>Summary Description of This Test Case</b> TC001: The system shall respond and reply to any text input it be given			
<b>Test Creator</b> Siew Yong Jun	<b>Creation Date</b> 12-March-2020	<b>Text Executor Name</b> Siew Yong Jun	<b>Execution Date</b> 22-March-2020
<b>#</b>	<b>Expected Outcome</b>	<b>Met?</b>	<b>The Actual Results Observed, if Not Met</b>
01	Attempt to click send of user input without errors	Pass	
02	Attempt to click "enter" to send user input without errors	Pass	
03	User input shall be displayed on the chat with complete accuracy	Pass	
04	The chatbot respond and reply to	Pass	

	every input by the user		
05	The chatbot respond and reply with factual information when the confidence level is above 80%	Pass	
06	The chatbot asks for simplify text input when the confidence level is below 50%	Pass	
07	The chatbot retrieve a list of question for the user to select when the confidence level is in range of 50% to 80%	Pass	
08	The chatbot reply shall be displayed on the chat in the correct order	Pass	

Table 7-2: Integration Test Case 2

<b>Test Case ID:</b> TC002	<b>Test Status (choose one)</b> Pass, Fail, Retest	<b>Follow-up Actions (if fail)</b>	
<b>Summary Description of This Test Case</b> TC002: The system shall allow admins to be able to login to their account			
<b>Test Creator</b> Siew Yong Jun	<b>Creation Date</b> 12-March-2020	<b>Text Executor Name</b>	<b>Execution Date</b>
<b>#</b>	<b>Expected Outcome</b>	<b>Met?</b>	<b>The Actual Results Observed, if Not Met</b>
01	Enter valid email and valid password shall login admin to the admin dashboard	Pass	
02	Enter invalid email shall display error message "Incorrect email or password"	Pass	
03	Enter invalid password shall display error message "Incorrect email or password"	Pass	
04	Attempt to login with invalid email format shall display validation message "Invalid email"	Pass	
05	Attempt to login without input shall display validation message "required"	Pass	

Table 7-3: Integration Test Case 3

<b>Test Case ID:</b> TC003	<b>Test Status (choose one)</b> Pass, Fail, Retest	<b>Follow-up Actions (if fail)</b>	
<b>Summary Description of This Test Case</b> TC003: The system shall allow admins to be able to view admin dashboard			
<b>Test Creator</b> Siew Yong Jun	<b>Creation Date</b> 12-March-2020	<b>Text Executor Name</b>	<b>Execution Date</b>
<b>Prerequisite</b> <ul style="list-style-type: none"> <li>- User should be an authorized administrator</li> <li>- User needs to login to the admin dashboard</li> </ul>			
<b>#</b>	<b>Expected Outcome</b>	<b>Met?</b>	<b>The Actual Results Observed, if Not Met</b>
01	Able to view dashboard upon login without errors	Pass	
02	User is able to view the admin dashboard overview section upon login	Pass	
03	Admin dashboard overview section shall show chatbot accuracy, total users, average user usage per minute and number of users per month without error	Pass	
03	Attempt to open and close sidebar menu without errors	Pass	
04	Admin dashboard shall show 3 sections namely Overview, Database and Abbreviation	Pass	
05	Attempt to click on logout button shall navigate admin to login page	Pass	

Table 7-4: Integration Test Case 4

<b>Test Case ID:</b> TC004	<b>Test Status (choose one)</b> Pass, Fail, Retest	<b>Follow-up Actions (if fail)</b>	
<b>Summary Description of This Test Case</b> TC004: The system shall allow admins Create, Read, Update and Delete (CRUD) chatbot abbreviations TC004: The system shall allow admin to search for an abbreviation by entering the keyword			
<b>Test Creator</b>	<b>Creation Date</b>	<b>Text Executor Name</b>	<b>Execution Date</b>

Siew Yong Jun	12-March-2020		
<b>Prerequisite</b>			
<ul style="list-style-type: none"> <li>- User should be an authorized administrator</li> <li>- User needs to login to the admin dashboard</li> </ul>			
#	Expected Outcome	Met?	The Actual Results Observed, if Not Met
01	Admin is able to view abbreviation table without error	Pass	
02	Attempt to click refresh button shall refresh the table	Pass	
03	Attempt to click on a row of the table shall show full abbreviation detail in a pop-up view modal	Pass	
04	Attempt to click on “Add Abbreviation” shall pop-up input modal	Pass	
05	Admin is able to create new abbreviation and is updated on abbreviation table without error	Pass	
06	Attempt to click on edit icon shall pop-up edit modal	Pass	
07	Admin is able to edit a specific abbreviation and is updated on abbreviation table without error	Pass	
08	Attempt to click on delete icon shall pop-up delete confirmation	Pass	
09	Admin is able to delete a specific abbreviation and is removed from the abbreviation table without error	Pass	
10	Admin shall be able to search for an abbreviation by entering a keyword	Pass	

Table 7-5: Integration Test Case 5

<b>Test Case ID:</b> TC005	<b>Test Status (choose one)</b> Pass, Fail, Retest	<b>Follow-up Actions (if fail)</b>
<b>Summary Description of This Test Case</b>		
TC005: The system shall allow admins Create, Read, Update and Delete (CRUD) chatbot database		
TC005: The system shall allow admin to search for a question and answer by entering the		

keyword			
<b>Test Creator</b> Siew Yong Jun	<b>Creation Date</b> 12-March-2020	<b>Text Executor Name</b>	<b>Execution Date</b>
<b>Prerequisite</b>			
<ul style="list-style-type: none"> <li>- User should be an authorized administrator</li> <li>- User needs to login to the admin dashboard</li> </ul>			
<b>#</b>	<b>Expected Outcome</b>	<b>Met?</b>	<b>The Actual Results Observed, if Not Met</b>
01	Admin is able to view chatbot's database table without error	Pass	
02	Attempt to click refresh button shall refresh the table	Pass	
03	Attempt to click on a row of the table shall show full question and answer detail in a pop-up view modal	Pass	
04	Attempt to click on "Add Record" shall pop-up input modal to enter new question and answer	Pass	
05	Admin is able to create a new question and answer then the record is added onto the database table without error	Pass	
06	Attempt to click on edit icon shall pop-up edit modal to edit the existing question and answer record	Pass	
07	Admin is able to edit a specific question and answer then the record is updated onto the database table without error	Pass	
08	Attempt to click on delete icon shall pop-up delete confirmation	Pass	
09	Admin is able to delete a specific question and answer then the record is removed from the database table without error	Pass	
10	Admin shall be able to search for question and answer by entering a keyword	Pass	

## 7.3 Non-Functional Testing

Non-functional testing is to test those non-functional requirements of the system is compliant. The non-functional testing tested for this system is maintainability, usability and performance.

### 7.3.1 Static Code Analysis

Static code analysis is applied throughout the entire development process. Vue.js front-end development uses Vetur as its static code analysis tool. Vetur is hugely popular among Vue.js developers as it provides syntax highlighting, code snippets and emmet to ease the development process.

Next, ESLint is also applied as ESLint statically analyse codes to find problems. ESLint could be applied to JavaScript development to ensure clear consistent coding conventions and automated enforcement.

Furthermore, python prospector is used to analyse Python code for potential problems, convention violations, complexity and error. Figure 7.1 below shows an example of the prospector output on the Chatbot Model.

```
D:\FYP\Ratu_Chatbot_Model>prospector
Check Information
=====
Started: 2020-03-19 14:40:02.575843
Finished: 2020-03-19 14:40:15.983843
Time Taken: 13.41 seconds
Formatter: grouped
Profiles: default, no_doc_warnings, no_test_warnings, strictness_medium, strictness_high, strictness_veryhigh, no_member_warnings
Strictness: None
Libraries Used: flask
Tools Run: dodgy, mccabe, pep8, profile-validator, pyflakes, pylint
Messages Found: 0
```

Figure 7.1: Prospector Static Code Analysis of Chatbot Model

### 7.3.2 Performance Test

#### 7.3.2.1 Google PageSpeed Insights

Google PageSpeed Insights or PSI, in short, helps to monitor and report performance on desktop devices. Likewise, it provides suggestions on how that page may improve. PageSpeed Insights provide a performance score that summarizes the page's performance, A score of 90 or above is considered fast while 50 to 90 is moderate and below 50 is considered to be slow (Google Developers, 2019) . The chatbot web application achieved the result of 77 which is considered moderate.

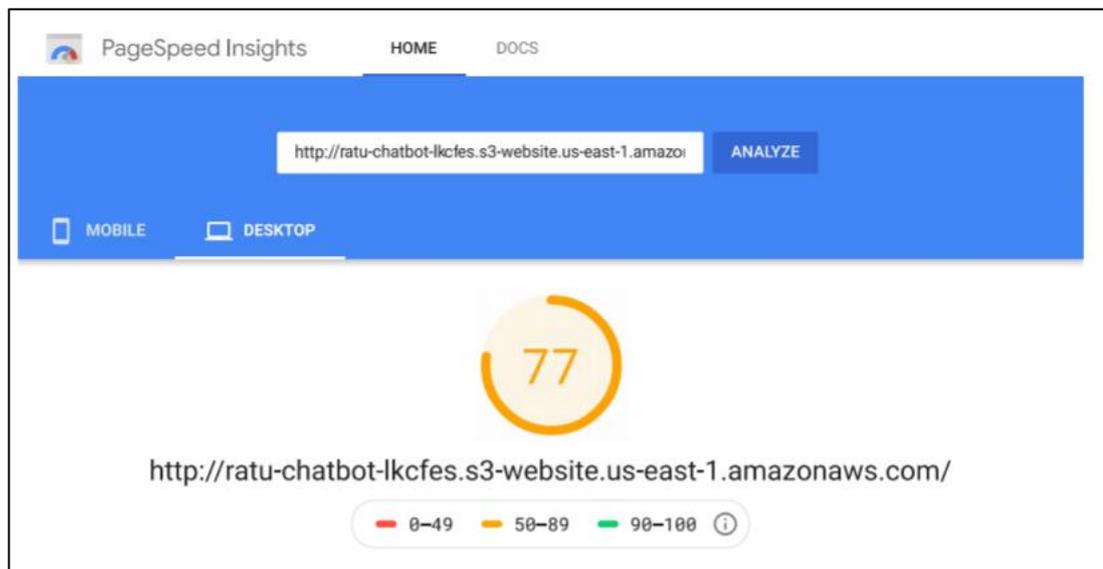


Figure 7.2: Google PageSpeed Insights report for the chatbot web application

Full Google PageSpeed Insights report is attached on Appendix C

### 7.3.2.2 Pingdom

Pingdom Website Speed Test is another tool used to evaluate the web application. Pingdom Website Speed Test evaluates and identifies website load speed. The chatbot web application achieves an excellent result at 98 out of 100 for its load speed.

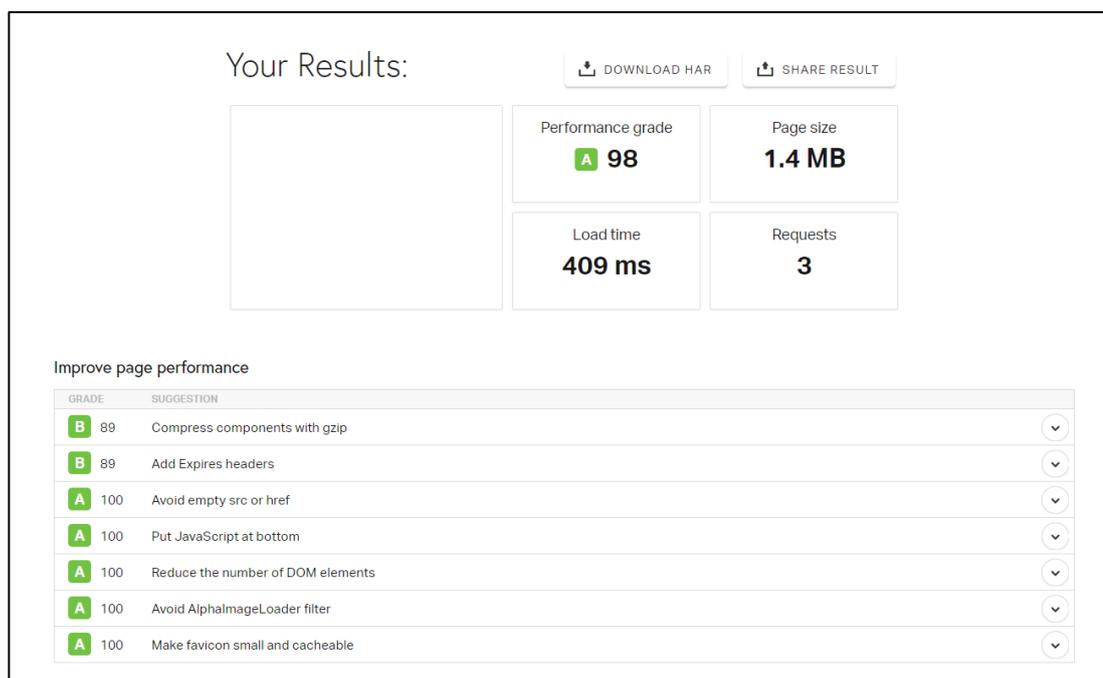


Figure 7.3: Pingdom Website Speed Test report for the chatbot web application

### 7.3.3 Usability Test

The purpose of this usability test is to learn how well a representative sample of target users can interpret and use the “Artificial Intelligence Chatbot System for Students’ inquiries in the LKCFES”. Areas of the system that will be evaluated for is the usability of the chatbot system in comparison to the LKCFES website by comparing the user success rate, time taken and the number of errors based on a scenario.

#### 7.3.3.1 Usability Test Form Template

Table 7-6: Usability Test Form Template

<b>Notetaker:</b>				
<b>Date:</b>				
<b>Participant:</b>				
<b>Time:</b>				
<b><u>Scenarios for user</u></b>				
1. Your student id just recently expired; therefore you would like to find out how to renew your student id.				
2. You would like to find out UTAR Sungai Long Campus complete address.				
3. You would like to find out the credit hours allowed to register for the long and short trimester.				
4. You are going for your internship soon; you would like to find out more information regarding the internship.				
5. Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.				
6. You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.				
<b>Scenario 1 - Your student id just recently expired; therefore you would like to find out how to renew your student id.</b>				
	<b>Success / Fail</b>	<b>Time to complete the task</b>	<b>Number of error</b>	<b>Error Made</b>
<b>Using the LKCFES Website</b>				
<b>Using the Chatbot System</b>				

**Scenario 2 - You would like to find out UTAR Sungai Long Campus complete address.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website				
Using the Chatbot System				

**Scenario 3 - You would like to find out the credit hours allowed to register for long and short trimester.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website				
Using the Chatbot System				

**Scenario 4 - You are going for your internship soon; you would like to find out more information regarding the internship.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website				
Using the Chatbot System				

**Scenario 5 - Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website				
Using the				

Chatbot System				
<p><b>Scenario 6 - You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.</b></p>				
	<b>Success / Fail</b>	<b>Time to complete the task</b>	<b>Number of error</b>	<b>Error Made</b>
<b>Using the LKCFES Website</b>				
<b>Using the Chatbot System</b>				

### 7.3.3.2 Usability Test Result

Table 7-7: Usability Test Result

	<b>Usability</b>	<b>LKCFES Website</b>	<b>Chatbot System</b>
<b>Participant 1</b>	<b>Success Rate:</b>	6 out of 6	6 out of 6
	<b>Total time to complete all task</b>	2 minute 43 second	46 second
	<b>Total number of error</b>	0	0
<b>Participant 2</b>	<b>Success Rate:</b>	6 out of 6	6 out of 6
	<b>Total time to complete all task</b>	4 minute 25 second	47 second
	<b>Total number of error</b>	2	0
<b>Participant 3</b>	<b>Success Rate:</b>	6 out of 6	6 out of 6
	<b>Total time to complete all task</b>	4 minute	29 second
	<b>Total number of error</b>	0	0
<b>Participant 4</b>	<b>Success Rate:</b>	6 out of 6	6 out of 6
	<b>Total time to complete all task</b>	4 minute 11 second	1 minute 11 second
	<b>Total number of error</b>	2	0
<b>Participant 5</b>	<b>Success Rate:</b>	6 out of 6	6 out of 6

	<b>Total time to complete all task</b>	3 minute 46 second	34 second
	<b>Total number of error</b>	0	0
<b>Participant 6</b>	<b>Success Rate:</b>	6 out of 6	6 out of 6
	<b>Total time to complete all task</b>	1 minute 47 second	29 second
	<b>Total number of error</b>	0	0
<b>Participant 7</b>	<b>Success Rate:</b>	6 out of 6	6 out of 6
	<b>Total time to complete all task</b>	1 minute 56 second	32 second
	<b>Total number of error</b>	0	0
<b>Total time to complete all task of all participants:</b>		22 minute 47 second	4 minutes 47 second
<b>Total number of error of all participants</b>		4	0
<b>Success rate:</b>		100%	100%

The usability test result of table 7-7 shows that the AI chatbot system is indeed a solution to the limitation of HCI faced by the LKCFES website. It simplifies the search of information while reducing the learning curve significantly. Nevertheless, the chatbot is not a replacement of the LKCFES website but a symbiosis to enhance the usability. The chatbot system is not suitable to store a mass amount of information like the LKCFES website which plays a vital role in much detailed information.

#### 7.3.4 User Acceptance Test

The scope of this UAT is to test the chatbot system functionality for compliance to the functional requirement and user test scenarios.

### 7.3.4.1 User Acceptance Test Case

Figure 7.4: User Acceptance Test Case

Testing Date				
Testing start time				
Testing end time				
Name of tester				
No	Functionality	Test Scenario	Pass / Fail	Comments
01	The chatbot system respond to any text input given	<ol style="list-style-type: none"> <li>1. User enter any text input to chatbot system</li> <li>2. Chatbot reply with natural language</li> </ol>		
02	<p>If the confidence level is less than 50%,</p> <p>The chatbot system ask for simplify text input</p>	<ol style="list-style-type: none"> <li>1. User input “what is the weather?”</li> <li>2. Chatbot reply by asking for simplified text input</li> </ol>		
03	<p>If the confidence level in the range of 50% to 80%,</p> <p>The chatbot system retrieve a list of similar question for the user to select</p>	<ol style="list-style-type: none"> <li>1. User input “LKCFES”.</li> <li>2. Chatbot replies while show a list of 2 questions for user to select</li> </ol>		
04	<p>If the confidence level more than 80%,</p> <p>The chatbot system reply with factual information</p>	<ol style="list-style-type: none"> <li>1. User input “what to do during intern”</li> <li>2. Chatbot reply with factual and correct information at 100% accuracy</li> </ol>		
05	Login	<ol style="list-style-type: none"> <li>1. Admin can login to their own account</li> <li>2. Enter the credential as below               <ol style="list-style-type: none"> <li>a. email: <a href="mailto:admintest@gmail.com">admintest@gmail.com</a></li> <li>b. password: password123</li> </ol> </li> </ol>		
06	View Admin dashboard overview	<ol style="list-style-type: none"> <li>1. Admin clicks on “overview” at sidebar menu</li> <li>2. UI show overview section</li> </ol>		
07	CRUD and search on admin dashboard database	<p><u>Create a Question and Answer</u></p> <ol style="list-style-type: none"> <li>1. Admin clicks on “Add Record”</li> </ol>		

		<ul style="list-style-type: none"> <li>button</li> <li>2. UI pops up “Create Record” modal</li> <li>3. Admin Input Question and Answer as per below <ul style="list-style-type: none"> <li>a. Question: How are you?</li> <li>b. Answer: I am fine.</li> </ul> </li> <li>4. Clicks “Confirm”</li> <li>5. Table show correct information as input</li> </ul>		
		<p><u>Read a Question and Answer</u></p> <ul style="list-style-type: none"> <li>1. Admin clicks onto the “How are you” question row of the table</li> <li>2. UI pop up modal that show the detail question and answer</li> </ul>		
		<p><u>Update a Question and Answer</u></p> <ul style="list-style-type: none"> <li>1. Admin clicks on the edit icon at the “Actions” column of “How are you?” question</li> <li>2. UI pops up “Edit Record” modal</li> <li>3. Update the question and answer as per below <ul style="list-style-type: none"> <li>a. Question: “What is chatbot?”</li> <li>b. Answer: “Chatbot is an AI”</li> </ul> </li> <li>4. Clicks “Confirm”</li> <li>5. Table show correct updated information</li> </ul>		
		<p><u>Delete a Question and Answer</u></p> <ul style="list-style-type: none"> <li>1. Admin clicks on the delete icon at the “Actions” column of “What is chatbot?” question</li> <li>2. UI pops up “Are you sure?” modal</li> <li>3. Clicks “Delete”</li> <li>4. Table shows that the “What is chatbot” question is removed</li> </ul>		
		<p><u>Search Question and Answer</u></p> <ul style="list-style-type: none"> <li>1. Admin click onto the “search table” search bar</li> <li>2. Input keyword “location”</li> <li>3. Table show row with question “Location and Address”</li> </ul>		
08	CRUD and search on admin dashboard abbreviation	<p><u>Create Abbreviation</u></p> <ul style="list-style-type: none"> <li>1. Admin clicks on “Add Abbreviation” button</li> </ul>		

		<ol style="list-style-type: none"> <li>2. UI pops up “Create Abbreviation” modal</li> <li>3. Admin Input Abbreviation and Meaning as per below <ol style="list-style-type: none"> <li>a. Abbreviation: MCO?</li> <li>b. Meaning: Movement Control Order.</li> </ol> </li> <li>4. Clicks “Confirm”</li> <li>5. Table show correct information as input</li> </ol>		
		<p><u>Read Abbreviation</u></p> <ol style="list-style-type: none"> <li>1. Admin clicks onto the “MCO” abbreviation row of the table</li> <li>2. UI pop up modal that show the detail abbreviation and meaning</li> </ol>		
		<p><u>Update Abbreviation</u></p> <ol style="list-style-type: none"> <li>1. Admin clicks on the edit icon at the “Actions” column of “MCO” abbreviation</li> <li>2. UI pops up “Edit Abbreviation” modal</li> <li>3. Update the abbreviation and meaning as per below <ol style="list-style-type: none"> <li>a. Abbreviation: “UNI”</li> <li>b. Meaning: “university”</li> </ol> </li> <li>4. Clicks “Confirm”</li> <li>5. Table show correct updated information</li> </ol>		
		<p><u>Delete Abbreviation</u></p> <ol style="list-style-type: none"> <li>1. Admin clicks on the delete icon at the “Actions” column of “UNI” abbreviation</li> <li>2. UI pops up “Are you sure?” modal</li> <li>3. Clicks “Delete”</li> <li>4. Table shows that the “UNI” abbreviation is removed</li> </ol>		
		<p><u>Search Abbreviation</u></p> <ol style="list-style-type: none"> <li>1. Admin click onto the “Search Table” search bar</li> <li>2. Input keyword “FYP”</li> <li>3. Table show row with abbreviation “FYP” and meaning “Final Year Project”</li> </ol>		

### 7.3.4.2 User Acceptance Test Result

The test results are collected from 7 participants in the UAT.

Functionality No	No. of test conducted	No. of test passed	Comments
01	7	7	
02	7	7	
03	7	7	
04	7	7	
05	7	7	
06	7	7	Sidebar should expand on default as user does not know what is the section by icon only
07	7	7	
08	7	7	
<p>Overall comments:</p> <ul style="list-style-type: none"> <li>• Very nice and functional system</li> <li>• The UI is simple, beautiful and intuitive</li> <li>• Everything is great with no issue</li> <li>• Intuitive system, the chatbot system is able to search information quicker a lot comparing to the LKCFES website</li> <li>• Easy to use without much learning</li> <li>• I like the feedback shows by the system at admin dashboard</li> </ul>			

## CHAPTER 8

### CONCLUSION AND DISCUSSION

#### 8.1 Introduction

This chapter concludes the project by discussing the limitations of the system, future improvement and challenges.

#### 8.2 Conclusion

This system has achieved its objectives after undergoing 6 months of Software Development Life Cycle. The system had proven effective in solving HCI limitation of the LKCFES website and reducing learning curves for students. With this chatbot system, UTAR LKCFES student could easily retrieve information that they need using the chatbot system with natural language. This idea is intuitive and simple with close to zero learning curve. Besides, the admin dashboard provided ensures that the information is up to date. The most relevant result is ensured to be displayed with ease using the chatbot system. Nevertheless, the chatbot is not a replacement of the LKCFES website but a symbiosis to enhance the usability of LKCFES website.

#### 8.3 Limitations and Recommendations for future work

The system is developed successfully and compliant to all specifications stated in the scope. Yet, there are a few improvements that could be implemented in future development. The table below suggest future enhancement that could improve the chatbot system

No.	Limitation	Suggestions of improvement
1.	No HTTPS connection for both the web application and web service	Set up HTTPS connection on website. Procedures include getting a dedicated IP address and buy, install, activate the certificate.
2.	Admin dashboard does not provide analytics that suggest	Implement a data-driven approach to chatbot system. This means that the system

	data to be added into the chatbot system	should utilize the raw data made available and provide analytic to understand students better
3	System does not have function that allows administrator to change the password from the UI	Add a change password functionality which allow administrator to change password by sending validation to their respective email.
4	This chatbot system does not fit perfectly with mobile.	Future development could involve developing a system on mobile application

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## APPENDICES

### APPENDIX A: Questionnaires

#### Survey on UTAR Student Information Chat Bot System (LKC FES)

Thank you for agreeing to participate in this survey

I am Siew Yong Jun, a software engineering student that is conducting a survey for my final year project titled "Chat bot system to learn Artificial Intelligence algorithms".

This questionnaire will contain a few questions for me to understand and analyse user's opinion and requirement when using a similar system. It is intended to target students from Lee Kong Chian Faculty of Engineering & Science.

Your response are voluntary and anonymous, it would be used solely for academic purposes.

This questionnaire will only take 4-5 minutes to complete.

Once again, thank you for your cooperation, your response will contribute to this academic research

Conducted by:  
Siew Yong Jun (1604184)  
Department of Internet Engineering and Computer Science  
Lee Kong Chian Faculty of Engineering & Science (LKC FES)  
Universiti Tunku Abdul Rahman

\* Required

#### Section 1: Demographic profile

1. Gender \*

Mark only one oval.

Male

Female

2. Year & Trimester \*

Eg: Y1T1

---

#### Section 2: LKC FES Website

This section ask about user opinion on the LKC FES website (<http://fes.utar.edu.my/>)

Latest Timetable | Common SOPs | FAQ | Academic Advisor | Final Year Project | Industrial Training Programme | Outcome-Based Education (OBE)

**UTAR** Lee Kong Chian Faculty of Engineering & Science  
Sungai Long Campus

Home | UTA.edu.my | LKCRS Facebook | About Us | Departments | Academic | Student Affairs | Research | Facilities | News

## Lee Kong Chian Faculty of Engineering & Science

The Lee Kong Chian Faculty of Engineering & Science (LKC FES) was established in 2004 at the then Kuala Lumpur Campus in Setapak with four programmes. In June 2015, the faculty relocated to the Sungai Long Campus and is now offering a total of 24 programmes ranging from Bachelor to Doctoral levels in the areas of engineering, science, mathematics and information & communication technology.

News



Events



Our Programmes



Research Activities



Final Year Project



Industrial Training



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**3. Q1. What do you use the LKC FES website for? \***

(You may select more than one answer)

Check all that apply.

- Looking for information regarding my department
- Looking for information regarding Final Year Project (FYP)
- Looking for information regarding Internship
- Just to explore (No Particular reason)
- Other: \_\_\_\_\_

**4. Q2. How often do you use the LKC FES website? \***

Mark only one oval.

- Not Often (<1 times per week)
- Somewhat Often (<3 times per week)
- Often (<7 times per week)
- Very Often (>7 times per week)

**5. Q3. Do you find it difficult to use the LKC FES website? \***

*Mark only one oval.*

- Yes (Proceed to Q4)
- No (Proceed to next section)

**6. Q4. What do you find difficult when using the LKC FES website?**

*(You may select more than one answer)*

*Check all that apply.*

- Hard to navigate through the website
- Too much information on the website
- No search bar to easily find the answer I want
- Require many navigation to the answer I am looking for
- Other: \_\_\_\_\_

**Section 3: Chatbot system on LKC FES website**

This section ask about users opinion of having a chatbot on LKC FES website.  
Next, it would ask the user of their recommendation & requirement for the chatbot

Figure below shows a conceptual design of the chatbot.

The screenshot shows the website for the Lee Kong Chian Faculty of Engineering & Science (LKC FES) at the Sungai Long Campus. The page features a navigation menu with links like Home, UTAR.edu.my, LKCFES Facebook, About Us, Departments, Academic, Student Affairs, Research, Facilities, and News. The main content area includes sections for News, Events, Research Activities, and Final Year Project. A 'Chat With Us' chatbot window is overlaid on the right side of the page. The chatbot interface shows a conversation between 'Ratu' (the chatbot) and 'User'. Ratu's messages include a welcome message and a response to a user query about sick leave. The user's message asks for advice on taking sick leave. Ratu's response states that a Leave Application Form from FGO is required, along with supporting documents. The chatbot window has a 'send' button at the bottom.

7. Q1. Do you use any AI-chatbot? \*

Eg: Siri, Google Assistant, Alexa  
Mark only one oval.

- Yes  
 No

8. Q2. Do you think that the chatbot will help student to search for answer faster? \*

Mark only one oval.

- Yes  
 No  
 Maybe

9. Q3. If the chatbot system is implemented. Will you consider to use it? \*

Mark only one oval.

- Yes (Proceed to Q5)  
 No (Proceed to Q4)

**10. Q4. If No, what are the reasons?**

(You may select more than one reason or specify your answer)

*Check all that apply.*

- I do not think that a chat bot is needed
- I am used to navigating through the website
- It is disturbing to have an extra feature
- It will be difficult to learn new things
- Other: \_\_\_\_\_

**11. Q5. What are the feature that you would like to see in the chatbot system?**

(You may select more than one function, you may give multiple answer at the "other" option)

*Check all that apply.*

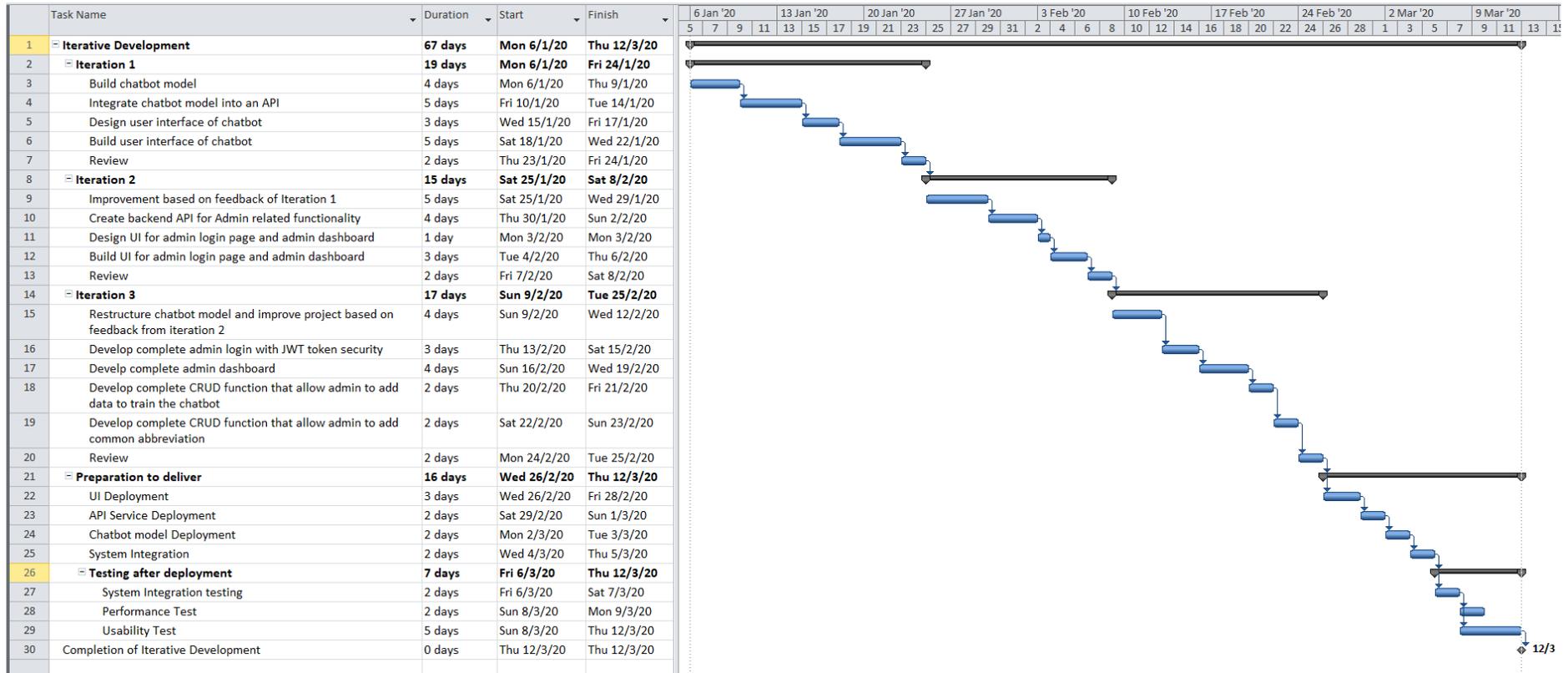
- Recommend a few questions for user to select
- Give a few answers with recommendation (Eg. "Did you mean Scholarships?" )
- Report to admin if unable to find the correct answer
- Other: \_\_\_\_\_

---

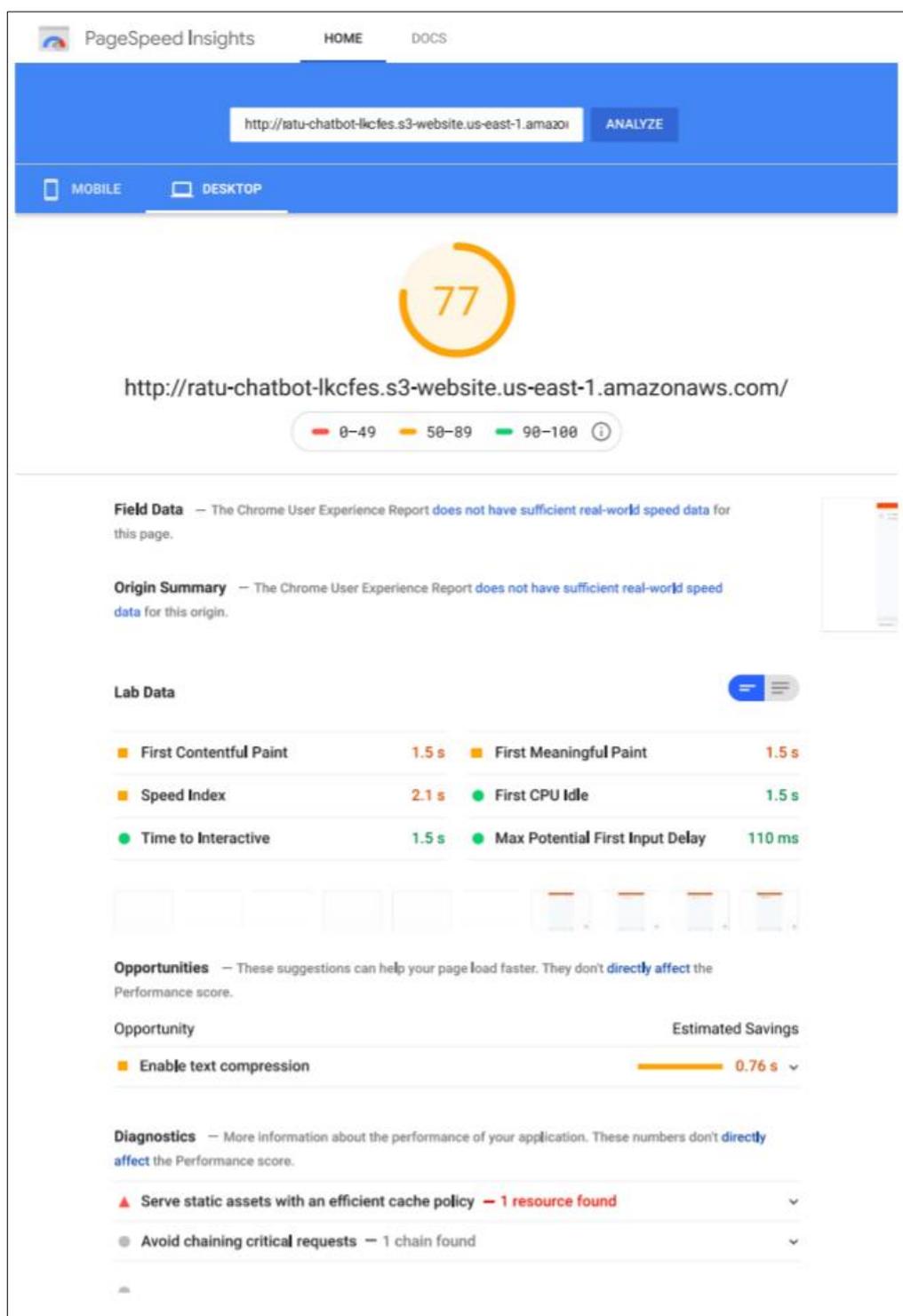
Powered by

 Google Forms

### APPENDIX B: Gantt Chart for Iterative Development Phase



## APPENDIX C: Google PageSpeed Insight Full Report



 PageSpeed Insights
 HOME
DOCS

**Passed audits (20)**

- Eliminate render-blocking resources
- Properly size images
- Defer offscreen images
- Minify CSS
- Minify JavaScript
- Remove unused CSS
- Efficiently encode images
- Serve images in next-gen formats
- Preconnect to required origins
- Server response times are low (TTFB) — Root document took 390 ms
- Avoid multiple page redirects
- Preload key requests
- Use video formats for animated content
- Avoids enormous network payloads — Total size was 1,369 KB
- Avoids an excessive DOM size — 32 elements
- User Timing marks and measures
- JavaScript execution time — 0.2 s
- Minimizes main-thread work — 0.3 s
- All text remains visible during webfont loads
- Minimize third-party usage — Third-party code blocked the main thread for 90 ms


The speed score is based on the lab data analyzed by Lighthouse.  
Analysis time: 3/20/2020, 5:00:31 AM

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**Give Feedback**

Have specific, answerable questions about

**About PageSpeed Insights**

## APPENDIX D: Usability Test Result

**Notetaker: Siew Yong Jun**

**Date: 24 March 2020**

**Participant: 1**

**Time: 12:10pm – 12:25pm**

**Scenarios for user**

1. Your student id just recently expired; therefore you would like to find out how to renew your student id.
2. You would like to find out UTAR Sungai Long Campus complete address.
3. You would like to find out the credit hours allowed to register for the long and short trimester.
4. You are going for your internship soon; you would like to find out more information regarding the internship.
5. Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.
6. You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.

**Scenario 1 - You would like to renew student id, you would like to find out what you are required to do**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	24s	0	
Using the Chatbot System	Success	18s	0	

**Scenario 2 - You would like to find out UTAR Sungai Long Campus complete address.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	21s	0	
Using the Chatbot System	Success	5s	0	

**Scenario 3 - You would like to find out the credit hours allowed to register for long and short trimester.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	24s	0	
Using the Chatbot System	Success	12s	0	

**Scenario 4 - You are going for your internship soon; you would like to find out more information regarding the internship.**

	Success / Fail	Time to complete the task	Number of error	Error Made

Using the LKCFES Website	Success	10s	0	
Using the Chatbot System	Success	4s	0	

**Scenario 5 - Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	10s	0	
Using the Chatbot System	Success	3s	0	

**Scenario 6 - You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	11s	0	
Using the Chatbot System	Success	4s	0	

**Notetaker: Siew Yong Jun**

**Date: 24 March 2020**

**Participant: 2**

**Time: 12:50pm – 01:15pm**

**Scenarios for user**

1. Your student id just recently expired; therefore you would like to find out how to renew your student id.
2. You would like to find out UTAR Sungai Long Campus complete address.
3. You would like to find out the credit hours allowed to register for the long and short trimester.
4. You are going for your internship soon; you would like to find out more information regarding the internship.
5. Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.
6. You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.

**Scenario 1 - You would like to renew student id, you would like to find out what you are required to do**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	132s	1	Not sure where to find the information
Using the	Success	15s	0	

Chatbot System				
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**Scenario 2 - You would like to find out UTAR Sungai Long Campus complete address.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	23s	0	
Using the Chatbot System	Success	3s	0	

**Scenario 3 - You would like to find out the credit hours allowed to register for long and short trimester.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	93	1	Not sure where is the information
Using the Chatbot System	Success	10s	0	

**Scenario 4 - You are going for your internship soon; you would like to find out more information regarding the internship.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	5s	0	
Using the Chatbot System	Success	5s	0	

**Scenario 5 - Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	13s	0	
Using the Chatbot System	Success	10s	0	

**Scenario 6 - You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	9s	0	

Using the Chatbot System	Success	4s	0	
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**Notetaker: Siew Yong Jun**

**Date: 24 March 2020**

**Participant: 3**

**Time: 01:30pm – 01:45pm**

**Scenarios for user**

1. Your student id just recently expired; therefore you would like to find out how to renew your student id.
2. You would like to find out UTAR Sungai Long Campus complete address.
3. You would like to find out the credit hours allowed to register for the long and short trimester.
4. You are going for your internship soon; you would like to find out more information regarding the internship.
5. Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.
6. You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.

**Scenario 1 - You would like to renew student id, you would like to find out what you are required to do**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	56s	0	
Using the Chatbot System	Success	5s	0	

**Scenario 2 - You would like to find out UTAR Sungai Long Campus complete address.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	11s	0	
Using the Chatbot System	Success	5s	0	

**Scenario 3 - You would like to find out the credit hours allowed to register for long and short trimester.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	73s	0	
Using the Chatbot System	Success	6s	0	

**Scenario 4 - You are going for your internship soon; you would like to find out more information**

regarding the internship.

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	7s	0	
Using the Chatbot System	Success	5s	0	

**Scenario 5 - Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	53s	0	
Using the Chatbot System	Success	3s	0	

**Scenario 6 - You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	40s	0	
Using the Chatbot System	Success	5s	0	

**Notetaker: Siew Yong Jun**

**Date: 24 March 2020**

**Participant: 4**

**Time: 01:50pm – 02:07pm**

**Scenarios for user**

1. Your student id just recently expired; therefore you would like to find out how to renew your student id.
2. You would like to find out UTAR Sungai Long Campus complete address.
3. You would like to find out the credit hours allowed to register for the long and short trimester.
4. You are going for your internship soon; you would like to find out more information regarding the internship.
5. Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.
6. You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.

**Scenario 1 - You would like to renew student id, you would like to find out what you are required to do**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the	Success	70s	1	Unsure where to

<b>LKCFES Website</b>				find the information
<b>Using the Chatbot System</b>	Success	12s	0	

**Scenario 2 - You would like to find out UTAR Sungai Long Campus complete address.**

	Success / Fail	Time to complete the task	Number of error	Error Made
<b>Using the LKCFES Website</b>	Success	17s	0	
<b>Using the Chatbot System</b>	Success	14s	0	

**Scenario 3 - You would like to find out the credit hours allowed to register for long and short trimester.**

	Success / Fail	Time to complete the task	Number of error	Error Made
<b>Using the LKCFES Website</b>	Success	80s	1	Unsure where to find the information
<b>Using the Chatbot System</b>	Success	15s	0	

**Scenario 4 - You are going for your internship soon; you would like to find out more information regarding the internship.**

	Success / Fail	Time to complete the task	Number of error	Error Made
<b>Using the LKCFES Website</b>	Success	8s	0	
<b>Using the Chatbot System</b>	Success	8s	0	

**Scenario 5 - Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.**

	Success / Fail	Time to complete the task	Number of error	Error Made
<b>Using the LKCFES Website</b>	Success	55s	0	
<b>Using the Chatbot System</b>	Success	11s	0	

**Scenario 6 - You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.**

	Success / Fail	Time to complete the task	Number of error	Error Made

Using the LKCFES Website	Success	21s	0	
Using the Chatbot System	Success	11s	0	

**Notetaker: Siew Yong Jun**

**Date: 24 March 2020**

**Participant: 5**

**Time: 02:20pm – 02:32pm**

**Scenarios for user**

1. Your student id just recently expired; therefore you would like to find out how to renew your student id.
2. You would like to find out UTAR Sungai Long Campus complete address.
3. You would like to find out the credit hours allowed to register for the long and short trimester.
4. You are going for your internship soon; you would like to find out more information regarding the internship.
5. Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.
6. You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.

**Scenario 1 - You would like to renew student id, you would like to find out what you are required to do**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	110s	0	
Using the Chatbot System	Success	4s	0	

**Scenario 2 - You would like to find out UTAR Sungai Long Campus complete address.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	20s	0	
Using the Chatbot System	Success	6s	0	

**Scenario 3 - You would like to find out the credit hours allowed to register for long and short trimester.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	30s	0	
Using the Chatbot System	Success	6s	0	

**Scenario 4 - You are going for your internship soon; you would like to find out more information regarding the internship.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	20s	0	
Using the Chatbot System	Success	9s	0	

**Scenario 5 - Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	25s	0	
Using the Chatbot System	Success	4s	0	

**Scenario 6 - You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	21s	0	
Using the Chatbot System	Success	5s	0	

**Notetaker: Siew Yong Jun**

**Date: 24 March 2020**

**Participant: 6**

**Time: 03:00pm – 03:12pm**

**Scenarios for user**

1. Your student id just recently expired; therefore you would like to find out how to renew your student id.
2. You would like to find out UTAR Sungai Long Campus complete address.
3. You would like to find out the credit hours allowed to register for the long and short trimester.
4. You are going for your internship soon; you would like to find out more information regarding the internship.
5. Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.
6. You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.

**Scenario 1 - You would like to renew student id, you would like to find out what you are required to do**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	13s	0	
Using the Chatbot System	Success	4s	0	

**Scenario 2 - You would like to find out UTAR Sungai Long Campus complete address.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	25s	0	
Using the Chatbot System	Success	5s	0	

**Scenario 3 - You would like to find out the credit hours allowed to register for long and short trimester.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	11s	0	
Using the Chatbot System	Success	7s	0	

**Scenario 4 - You are going for your internship soon; you would like to find out more information regarding the internship.**

	Success / Fail	Time to complete the task	Number of error	Error Made

Using the LKCFES Website	Success	20s	0	
Using the Chatbot System	Success	3s	0	

**Scenario 5 - Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	22s	0	
Using the Chatbot System	Success	4s	0	

**Scenario 6 - You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	16s	0	
Using the Chatbot System	Success	6s	0	

**Notetaker: Siew Yong Jun**

**Date: 24 March 2020**

**Participant: 7**

**Time: 03:30pm – 03:41pm**

**Scenarios for user**

- Your student id just recently expired; therefore you would like to find out how to renew your student id.
- You would like to find out UTAR Sungai Long Campus complete address.
- You would like to find out the credit hours allowed to register for the long and short trimester.
- You are going for your internship soon; you would like to find out more information regarding the internship.
- Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.
- You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.

**Scenario 1 - You would like to renew student id, you would like to find out what you are required to do**

	Success / Fail	Time to complete the task	Number of error	Error Made
Using the LKCFES Website	Success	30s	0	
Using the Chatbot System	Success	5s	0	

**Scenario 2 - You would like to find out UTAR Sungai Long Campus complete address.**

	Success / Fail	Time to complete	Number of error	Error Made
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		<b>the task</b>		
<b>Using the LKCFES Website</b>	Success	20s	0	
<b>Using the Chatbot System</b>	Success	4s	0	

**Scenario 3 - You would like to find out the credit hours allowed to register for long and short trimester.**

	Success / Fail	Time to complete the task	Number of error	Error Made
<b>Using the LKCFES Website</b>	Success	9s	0	
<b>Using the Chatbot System</b>	Success	3s	0	

**Scenario 4 - You are going for your internship soon; you would like to find out more information regarding the internship.**

	Success / Fail	Time to complete the task	Number of error	Error Made
<b>Using the LKCFES Website</b>	Success	20s	0	
<b>Using the Chatbot System</b>	Success	4s	0	

**Scenario 5 - Final Year Project Poster Competition is closing in; you would like to find out more about final year project poster competition.**

	Success / Fail	Time to complete the task	Number of error	Error Made
<b>Using the LKCFES Website</b>	Success	27s	0	
<b>Using the Chatbot System</b>	Success	10s	0	

**Scenario 6 - You would like to apply for a medical leave. Therefore, you want to find out what is the procedure to do so.**

	Success / Fail	Time to complete the task	Number of error	Error Made
<b>Using the LKCFES Website</b>	Success	10s	0	
<b>Using the Chatbot System</b>	Success	6s	0	

## APPENDIX E: User Acceptance Test Agreement Form

**User Acceptance Test Agreement Form****Please read this form before you sign it**

I agree to participate in this user acceptance test and I understand that the participation in this user acceptance test is voluntary.

I know that in this user acceptance test:

- U will be asked to perform certain tasks on the web application
- I will be given the opportunity to ask questions and will have my questions answered to my satisfaction
- My suggestion may be used to help improve the usability of the web application
- I have the right to withdraw my consent on this user acceptance testing and to discontinue participation at any time, without prejudice to my future treatment.

I have read and understood the information on this form and any questions that I have about this user acceptance testing have been answered. My signature below may be taken as an affirmation of all the above statements; it was given prior to my participation in this user acceptance test.

Name : \_\_\_\_\_

Signature : \_\_\_\_\_

Date : \_\_\_\_\_

## APPENDIX F: Feedback for Project I

<b>Project title:</b>	Chat bot system to learn Artificial Intelligence algorithms
<b>Student Name</b>	SIEW YONG JUN
<b>Supervisor</b>	Ts Dr Simon Lau Boung Yew
<b>Moderator</b>	Dr Hoo Meei Hao

Key Assessment for Project Proposal	Supervisor Comments/Remarks	Moderator Comments/Remarks
<b>Project Description</b> - Is the problem or need to be addressed clearly presented? - Is the proposed approach or solution clearly presented and justified?	Clearly described	Each problem are described and supported by the result of the data collected or literature review.  Solution presented is basic. Need to include the explanation of training process in the adopted approach - word embedding. - to include the expansion of the dataset after the implementation for future needs. How the dataset include new contents (after the chatbot implementation) posted in the website?  Title doesn't reflect work done. Propose to relate title to students' enquiries in the faculty.
<b>Project Scope and Objectives</b> - Is the scope of the project clearly defined? - Are the objectives of the project clearly specified? - Are the project scope and objectives appropriate for a final year project?	Suggest to list the features and tasks to be performed for this project	Objectives: To rewrite the 1st objective which is about the implementation and evaluation of the implemented chatbot solution.
<b>Literature Review / Fact Finding for Benchmarking / Verification of Project</b> - Are sources for literature review / fact finding appropriate? - Is information from literature review / fact finding relevant and adequate? - Is information from literature review / fact finding clearly presented and discussed?	Check grammar. Good analytical analysis on Table 2.1 The flow is satisfactory	ok
<b>Research/Development Methodology and Development Tools</b> - Is the methodology for the project clearly described and discussed? - Are the required development tools clearly described and discussed? - Are the stated methodology and development tools appropriate?	Check grammar.	There are 2 development methodologies (prototype and iterative) presented. Determine a development methodology for this development or combined these 2 methodologies to adapt to the development needs.
<b>Project Plan</b> - Are the phases and tasks of the project properly defined and planned? - Are the phases and tasks consistent with the methodology of the project?	Highlight key activities on Figure 3.1	the plan doesn't include gathering requirements. How many iteration to go? This is not obviously show in the plan.
<b>Initial Deliverables</b> - Are deliverables (e.g. use case diagrams and descriptions) of initial phases of the project plan included in the report?	Satisfactory	ok
<b>Report Structure and References</b> - Is the report organised in a logical structure? - Are references listed in accordance to Harvard format?	The report organization is satisfactory	
<b>Language and Clarity of Writing</b> - Are the sentences concise and understandable? - Are there spelling and grammar issues?	Check grammar.	