

FCSIT WhatsApp Chatbot

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ABSTRACT

WhatsApp is currently one of the most widely used communication mediums among students in tertiary education in the form of both personal messages and group messaging chats. Currently, the practice in most Malaysian Universities is that students need to consult the faculty staff or search through the faculty's website to obtain information related to their academic studies. However, the process of obtaining needed information can take some time ranging from minutes to hours and at times are not consistent as the queries are answered by different staff members. There are WhatsApp chat groups for students to interact with faculty staff, but the chat group can be overwhelmed by questions due to the huge number of group members hence causing important messages to be overlooked. In an attempt to overcome these challenges, we developed a FCSIT (Faculty of Computer Science and Information Technology) WhatsApp chatbot to solve these problems by offering a centralized platform of communication for both faculty staff and students to carry out information sharing through WhatsApp messages. Communication is in the form of personalized messages between the chatbot and the user thus solving the problem of overwhelming messages posed by group chats. Agile Kanban methodology was used to develop the system which promotes the use of a Kanban board to visualize the development stages. A questionnaire was distributed to lecturers, faculty staff and students to test the system and to gather opinions and suggestions from targeted users, which is the FCSIT community, in order to assess whether the system fulfils its objectives.

Keywords: Chatbot, Kanban Methodology, Natural Language Processing, WhatsApp

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INTRODUCTION

WhatsApp is an instant messaging application which serves the purpose of replacing SMS (short message service) with a cross-platform mobile messenger application that works whenever devices are connected to the internet (Yeboah & Ewur, 2014). In the university setting, WhatsApp is widely used as an informal communication between students for discussions about various projects or assignments, as well as information sharing among lecturers, faculty staff and students (Joicy & Sornam, 2018). In order to further improve the efficiency of the current workflow being employed in the faculty, we leveraged the use of new technology such as the chatbot application. A chatbot is used to simulate human conversation in the form of text and sound to reply to a user query. Companies nowadays such as Spotify and Sephora utilize the chatbot as their virtual assistant to answer customers' queries and learn the behaviour of every customer based on conversations from time to time (Kim, 2018). The presence of a chatbot supports the automation of replies for similar queries, allowing human resources to focus on more important and qualitative tasks while improving the business with the least effort. Reply to queries can be received within seconds and is no longer restricted to office hours.

This project integrates both the use of WhatsApp which is a popular communication tool among staff members and student and a chatbot by creating a FCSIT (Faculty of Computer Science and Information Technology) WhatsApp chatbot application to support the teaching and learning ecosystem. The chatbot serves the purpose of providing a centralized communication platform to answer queries and delivering messages to users via the FCSIT WhatsApp chatbot. This project also includes the development of a website that provides a medium for the faculty administrative staff and lecturers to create the knowledge base for the chatbot, such as

changing query's answer, delivering messages to related users and modify the chatbot's reply upon receiving new input.

Problem Statement

In today's world, technology has enabled us to communicate faster and more efficiently. Repetitive tasks can be done by machines that are no longer constrained by working hours; thus it is essential that we adopt new technology to remain relevant in today's fast changing world and to maximize productivity. Students as stakeholders of the university would want to obtain the latest and relevant information from the faculty or university with the least amount of time. However, in terms of providing services to student, the time taken to reply to student queries can be long and inconsistent replies could be given by different staff members. Apart from that, replies to queries are constrained by working hours. Also, faculty staff had to give the same reply to the same questions posed by different students, and at times queries were made after office hours. Efforts have been made to improve communication between faculty staffs and student by using WhatsApp chat group but due to information overload in chat groups, most users have trouble keeping track of the latest information shared in the group chat, and there exists a huge number of unimportant messages which causes important information to be overlooked. Currently WhatsApp is one of the most widely used communication platform among the FCSIT community. We attempted to leverage on one of the most common communication tools used by FCSIT community and integrate it with an online chatbot technology to create a personalized WhatsApp chatbot. The chatbot will simulate the actions and response of faculty staff to deliver accurate information in the form of WhatsApp personal messages in order to solve the problem of missing out on important messages caused by overwhelming messages in a chat group. It also allows students who are not keen to participate in group chat to communicate via personal messages.

A Google Form questionnaire was distributed to FCSIT students to determine the most used messaging application that is used by students for academic purposes and the result is shown in Figure 1. Based on Figure 1, WhatsApp was found out to be the most used messaging application by FCSIT students. In Figure 2, most students that participate in WhatsApp group messages agreed that one of the problems with group WhatsApp messages is that important messages tend to be overlooked when there are too many messages from members in the group chat. Based on the feedback received from the respondents in Figure 2, we further refine the question as in Figure 3. A total of 94.2 percent of FCSIT students agree with having a chatbot that they can interact with and have messages directly sent to them from the chatbot.

Objectives

In this paper, we proposed a WhatsApp chatbot that can reply to a student query automatically in real time. We also developed a website that allows authorized users to create the knowledge base for the chatbot. The requirements of the system were obtained through interview sessions conducted with students and faculty members. Students can pose questions to the Whatsapp chatbot and the system shall reply based on the information that is available in the knowledge base. In the event that the Whatsapp chatbot produces a wrong answer, the system provides a feedback page where students can make a report to the system administrator. The administrator would then be able to view the report and make changes to the knowledge base of the system in order to further improve the system.

MATERIALS & METHODS

The software methodology used to develop the system was the Agile Kanban methodology. Agile Kanban methodology is an evolutionary and non-disruptive method that promotes gradual improvements to the project development process. Through the use of Kanban methodology, the system respects several important principles. The entire workflow is visualized in a Kanban Board, and the Kanban board can be in the form of physical or virtual board. The board is filled with processes in different states such as requirements, design, development, testing done and product backlog. Work in Progress (WIP) will be limited to ensure that new tasks are started after the previous tasks are fully completed. Limiting WIP can help in analysing the work progress, thus improving the workflow and reduce the time taken to complete each task. Workflow of the project can also be improved as

Kanban board provides good management of projects by highlighting various stages of workflow and work status in each stage.

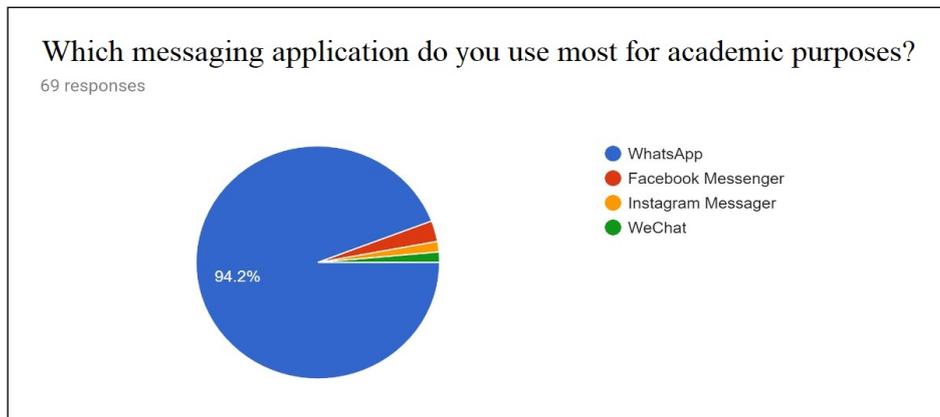


Figure 1. Messaging application used by students for academic purposes.

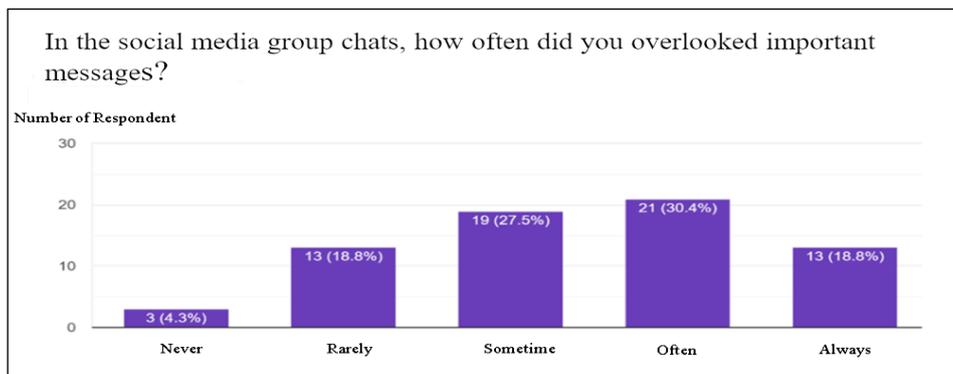


Figure 2. Frequency of overlooked messages in social media group chats.

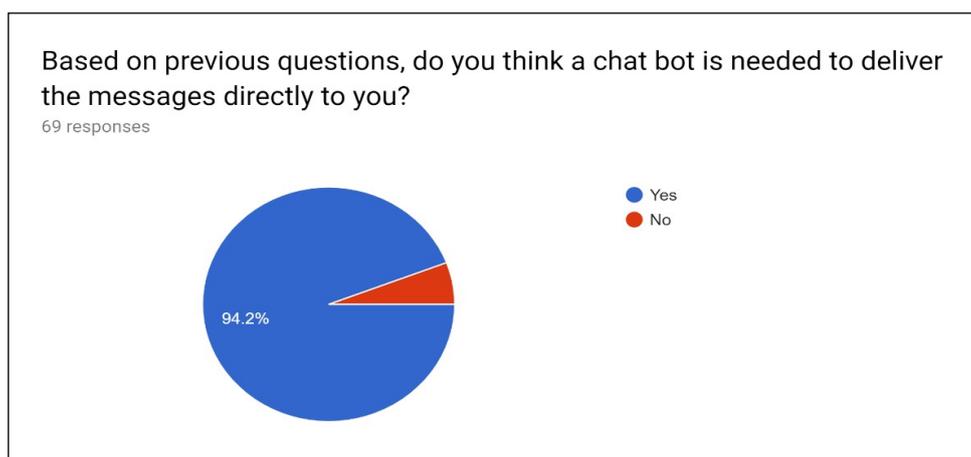


Figure 3. Percentage of students that agree the need for a chatbot as a means of communication.

Explicit process policies can be made visible in the Kanban board as it can help to guide the system to be developed in a correct manner. The Kanban methodology enables developers to predict the deliverables date of features to clients based on the amount of work on the Kanban board. Limiting the work in progress helps a lot in reducing partially done work, extra features, lost knowledge, handoffs, task switching, delays and defect which are considered as seven wastes of lean software development (Straube, 2017).

Due to the nature of chatbot development where the project might undergo significant amount of requirement change, we have selected the Agile Kanban methodology (Table 1). To establish the viability of the system to be constructed, functional requirements are gathered. The logical design is represented as a use case, conversation flow, sequence, activity and class diagram. Physical design is represented by a wireframe design. A high-level design is represented as an architectural design that describes the design structure and the relationship between various modules in the system development.

Table 1. Phases and Activities in Agile Kanban methodology.

Phases	Activities
Requirements	Questionnaire Functional Requirements
Design	Logical Design Physical Design
Development	Front-End Development Back-End Development
Testing	Prepare Test Case Collect Feedbacks From Testers
Done	Work done
Product Backlog	To-Do list

Requirement Analysis

Requirements are needed to determine the feasibility of the system. Several steps were carried out to determine the complete requirements, including questionnaire and listing out functional requirements. Questionnaire will be distributed to the target users which are the students in FCSIT, UNIMAS to collect opinions towards the existence of chatbots around the faculty. Furthermore, functional requirements are created to provide an overview of requirements to every stakeholder involved in this project. In total there are four targeted users for the system. They are the super admin, faculty staffs/admins, lecturers and students. The functional requirements include requirements for the WhatsApp interface and the web template to program the chatbot (Table 2).

System Architecture

Figure 4 represents the system architecture of the FCSIT WhatsApp chatbot that shows the structure of the system and its relation between the various modules. In the scenario where the chatbot has been triggered by students typing the specific trigger string to the chatbot followed by sending of a message to the chatbot, the message will be captured by the WhatsApp API and the interpreted message will be sent to the DialogFlow agent using an API which connects the WhatsApp API and the DialogFlow agent. The message will then be matched against intents available in DialogFlow which has already been defined by FCSIT authorized administrator through the web template. When an intent is matched, the webhook executes external APIs to query the database for the corresponding response(s). Otherwise, a fallback message will be sent to the student, indicating the chatbot does not understand the input inserted by the student. To create the knowledge base of the chatbot, the super administrator, lecturers and faculty staffs will use a dedicated website to insert knowledge information into the database which in turn is processed by the chatbot when there is a query from a user. The chatbot will act as a medium to aid faculty personnel to deliver messages, as well as answer different queries made.

Use Case Design

Figure 5 represents the use case diagram for our FCSIT WhatsApp chatbot application. There are four actors that will be using the system which are the students, super administrator, lecturers and faculty staffs or administrators. Each use case has a use case description that describes the way the task is performed through the system. Each actor can carry out different operations based on the respective identities. Table 3 shows the breakdowns of the use case diagram.

Table 1. Example of Functional Requirements obtained from requirement analysis process.

Requirement ID	Requirement Description	Priority
User: Super Admin		
FR.SA01	Login to the proposed system as super admin	High
FR.SA02	Register web template's user such as faculty staffs and set their respective rights	High
FR.SA03	Set frequently asked question by providing keywords and answer	Medium
FR.SA04	Manage faculty events	Medium
User: Admin		
FR.AD01	Login to the proposed system as admin	High
FR.AD02	Set frequently asked question by providing keywords and answers	High
FR.AD03	Edit and delete the Frequently Asked Question (FAQ)	Medium
FR.AD04	Set and configure details of events happening around the faculty	High
FR.AD05	Edit and delete events through the website	Medium
User: Lecturers		
FR.LC01	Login to the proposed system as lecturer	High
FR.LC02	Modify class status and add announcements	High
FR.LC03	Add and modify class and enrolled students	Medium
User: Students		
FR.ST01	Able to carry out conversation with the chatbot through WhatsApp	High

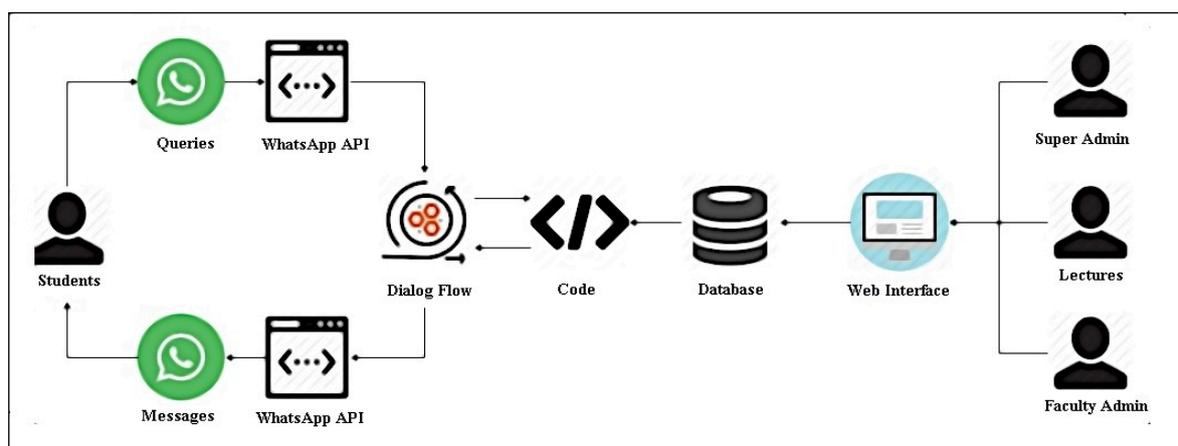


Figure 4. System Architecture Design for FCSIT Whatsapp Chatbot.

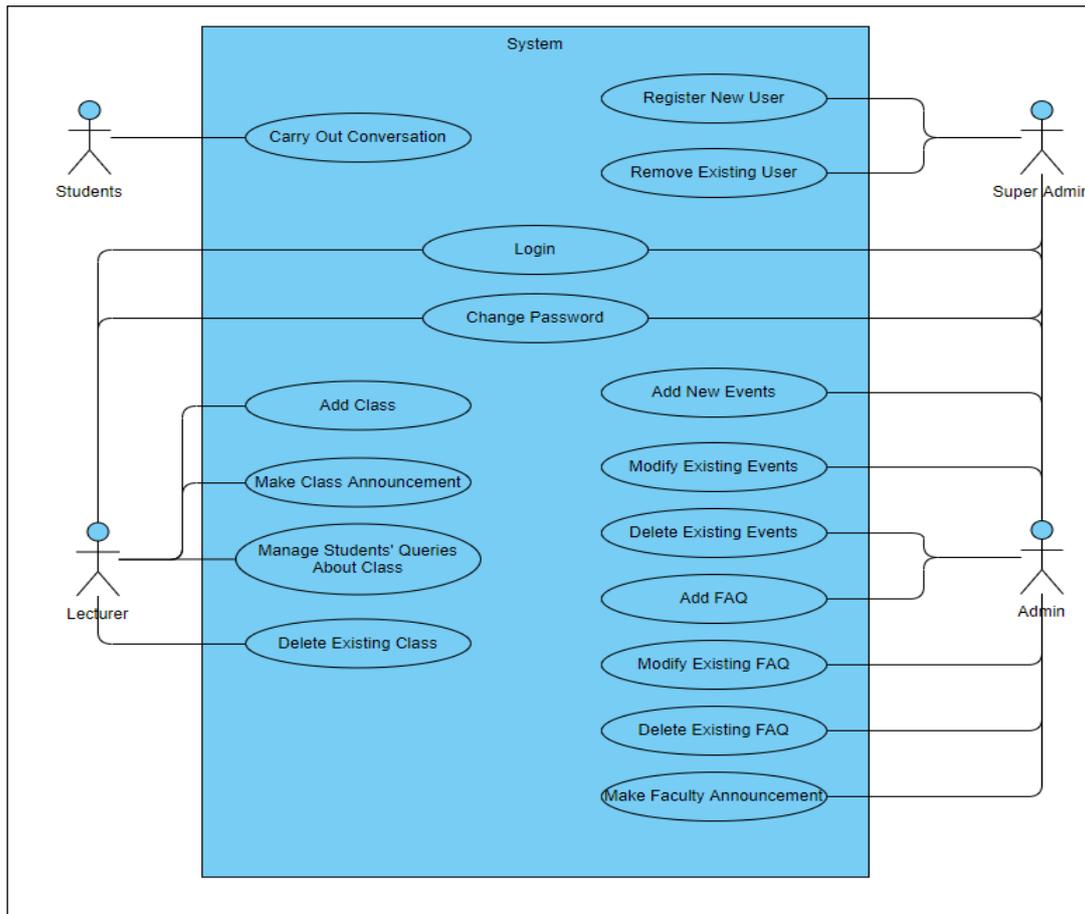


Figure 5. Actors and Use Cases for FCSIT Whatsapp Chatbot.

Table 3. Use Case Design Description.

Actors	Activities
Students	Able to carry out a conversation with the chatbot through WhatsApp Messenger.
Super Admin	Able to register new user such as lecturers and faculty staffs to manage the chatbot.
Lecturers	Able to manage class status by inserting announcements and deliver messages.
Faculty Admin	Able to manage events by adding new events with description and put up new FAQs to the system so that students can view them through the chatbot.

IMPLEMENTATION & DISCUSSION

This project has a web template that allows authorized users to create the knowledge base for the application. The tools that were used in the development of this application are as follows:-

A. Environment Setup

I. Visual Studio Code

Visual Studio Code was used as the main IDE of the project. VS code was chosen as it is more light weight and suitable for web development as it has a rich marketplace of extension.

II. AngularJS 9

Angular 9 was chosen as the framework for developing the web template. AngularJS is supported in most of the modern browser and have a wide variety of support in online forums.

B. NODEJS

NodeJS is one of the most popular JavaScript application runtimes. Node Package Manager makes use of free online libraries to simplify the system development. NodeJS also has the advantage of providing great command line interface to create web applications.

C. Google Firebase

Firebase was chosen as the server to host the website, host back-end functions and database. Firebase was chosen for the project as it provides a wide variety of services that suits the needs of this project such as authentication, real-time database, functions, storage and hosting.

D. DialogFlow

DialogFlow is used as an NLP tools for the faculty administrator to create Frequently Asked Questions (FAQ). A dedicated server-side code was designed for the administrator to create the intent, setting keywords in DialogFlow by using communication between the interface and the server-side codes.

E. ChatAPI

Chat-API (<https://chat-api.com/en/?lang=EN>) was used for connecting the project to a WhatsApp Messenger. As the official WhatsApp Business API is not available, Chat-API will be used as an alternative until the official WhatsApp API is available for use. Chat-API handles receiving message, sending message and broadcasting messages.

Interface

The system comprises of two categories of interfaces which are: 1) Web interface that allows a user to create the knowledge base and 2) Interface of the FCSIT WhatsApp Chatbot where the user interacts with the chatbot.

A. Web knowledge base home page

Figure 6 is the home page from the super administrator perspective which can either be the lecturer or staff member. The top navigation bar indicates the tasks that can be performed such as managing events, FAQ, and announcements.

B. Web form to add content into knowledge base

Figure 7 is the form where content for the knowledge based is created by the faculty staff member or the lecturer. Content that is created are 1) categorized 2) labelled 3) tagged with relevant keywords and 4) given content. The content created is then used as a knowledge source to deduce answers based on user queries.

C. Web View Content of Knowledge Base

Figure 8 is the faculty administrator view form for FAQ. After clicking “FAQ”, there will be a FAQ table containing FAQs available in the system.



Figure 6. Home page of chatbot knowledge base.

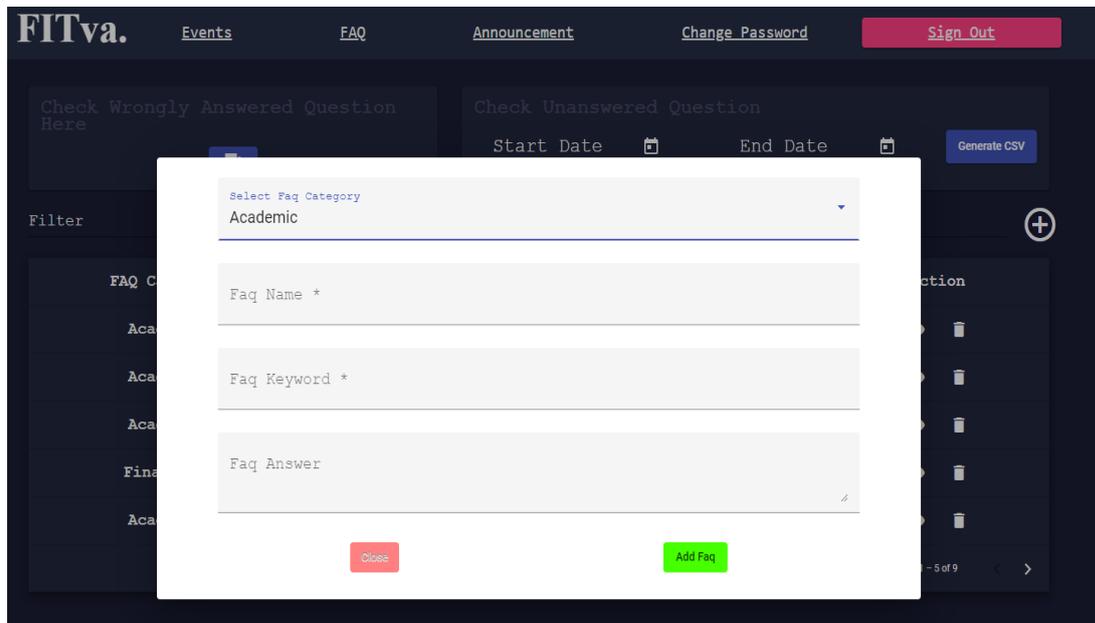


Figure 7. Knowledge base content creation.

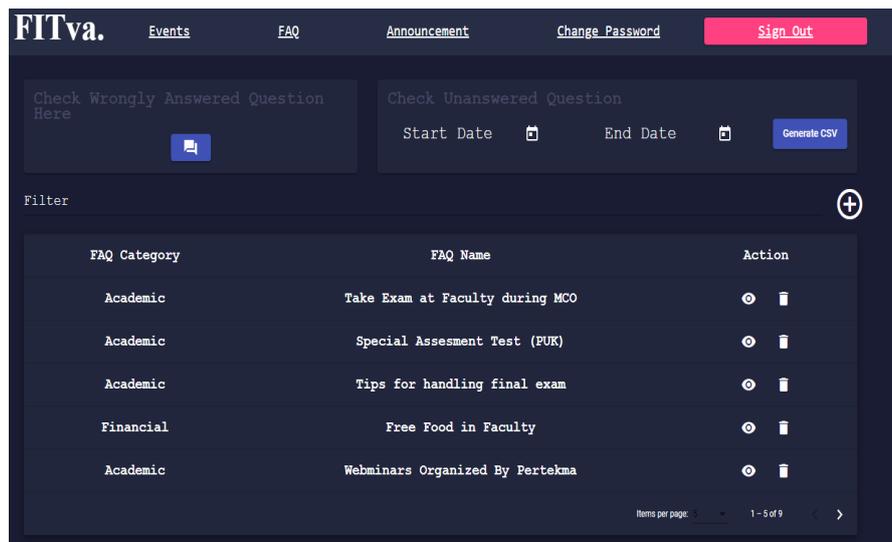


Figure 8. View page of frequently asked question knowledge base page.

D. Whatsapp Chatbot Student Query

Figure 9 is a student query for FAQ. If the chatbot receives the FAQ from the students and a match is found in the database, it will reply to the FAQ answer based on the information that was created by the faculty administrator on the website.

E. Whatsapp Chatbot Failed Query (Unavailable FAQ)

Figure 10 is a scenario of a failed student query for FAQ where the knowledge data is unavailable in the FAQ knowledge base. Since there is no match in the database, the chatbot will reply to a fall-back message, and the query will be stored in the database so that faculty administrator can monitor unanswered questions and make the necessary changes.

F. Web View Unanswered Question

In Figure 11, the user may select to view unanswered questions by selecting the date range. After selecting a range of dates and by clicking the “Generate CSV” button, a CSV file will be downloaded to the user’s device and the user will be able to view the unanswered questions. User may then create a new FAQ based on the data in the generated CSV file. Figure 12 is an example of CSV file with unanswered questions.

Testing

Testing is an important process of this project because testing gathers users’ feedback and changes for developers before the final release of the product. In this section, various testing such as unit testing, functional testing and user testing were carried out.

A. Unit testing

Unit testing is to make sure that each unit of the project is working as intended. Main units such as input, buttons and validations were tested during unit testing.

B. Functional testing

Functionality testing is carried out to make sure all the functions that are required are developed into the system. Functionality testing is done by the developer using test case to manually verify that the functions are working as intended and to detect bugs or error in the system.

C. User testing

User testing evaluates the system with the user. The purpose of the testing is to collect the feedback and suggestion from the users after using the system. User testing is done by the targeted user which is the faculty administrator, lecturers and students. Testing results are collected through survey question via Google Form which is divided into three parts which are system functionality, user interface design and user recommendation.

User testing was done with three different users namely lecturers, faculty staff and students. The system was tested by two lecturers from the FCSIT and both lecturers agreed that the system has the potential to enhance interaction between the faculty and the students. Testing done with the faculty staff revealed there is potential improvement to the system where it was found out that some processes could be further automated such as the manual work of importing student data to the system, a trigger mechanism that allows a message to be sent to all students and a more detailed categorization of students (into current intake, final year and industrial training students). Testing with ten faculty students was done and we found out that the average time it took to reply/broadcast a message may take 3 to 5 seconds while an announcement with file attachment may take a longer time depending on the size of the file. The result of the testing was on average satisfactory and no bugs or errors were detected at the time of the test. Most users found that the interface was easy to understand and all functionalities met the required objectives.

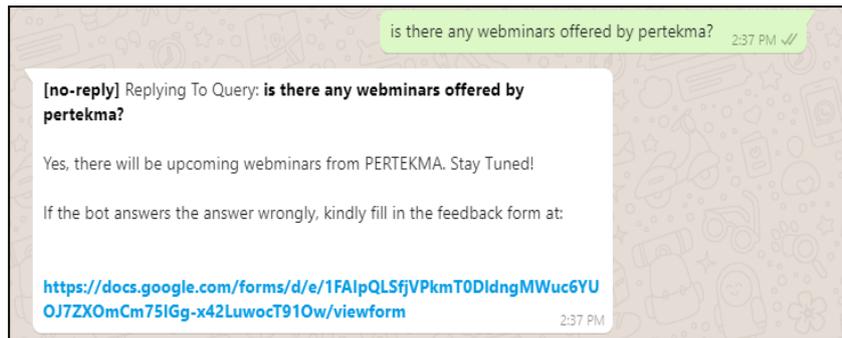


Figure 9. Chatbot responding to Student Query.

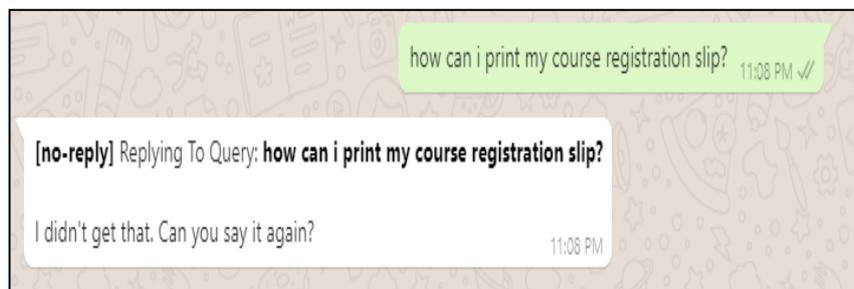


Figure 10. Chatbot responding to a Failed Query.



Figure 11. Unanswered Question Form Page.

7/7/2020	Where is faulty counseling service?			
7/7/2020	counsel			
7/7/2020	Where is the school counselling counter			
7/7/2020	Where is the counselling service counter?			

Figure 12. Unanswered Question from user in comma-separated values file format.

CONCLUSION

In conclusion, the project has met its objectives where the chatbot was able to personally reply to queries made by the user in real time. Queries which were not recognized by the chatbot were able to be captured and stored in the database to be reviewed by the faculty administrator. Response from the chatbot was between 3 to 5 seconds; however, any messages with larger file attachments may require a longer reply time.

Future Work

In order to further improve our system, some of the following improvements could be made:-

- a. Accepts queries made by the user in other languages other than English.
- b. An analytical tool extension that has features that can analyse the most used keywords, most searched topics, incorrect bot replies, etc.
- c. Development of a mobile application as an alternative to the web template implementation.
- d. Extend the broadcast function of the chatbot where video and/or message recording can be sent by the chatbot to the users, for example video recording that is released by the chatbot based on predetermined time and date.

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