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A Campus-based Chatbot System using Natural Language Processing and Neural Network

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Abstract - A chatbot is designed to simulate human conversation and provide instant responses to users. Chatbots have gained popularity in providing automated customer support and information retrieval among organisations. Besides, it also acts as a virtual assistant to communicate with users by delivering updated answers based on users' input. Most chatbots still use the traditional rule-based chatbot, which can only respond to pre-defined sentences, making the users unlikely to use the chatbot. This paper aims to design and build a campus chatbot for the Faculty of Information Science & Technology (FIST) of Multimedia University that facilitates the study life of FIST students. Before the FIST chatbot can be used, natural language processing techniques such as tokenisation, lemmatisation and bag of word model are used to generate the input that can be used to train the neural network model (multilayer perceptron model). It makes the FIST chatbot comprehends user intent by analysing their questions, enabling it to address a broader range of inquiries and cater to the student's need with accurate answers or information related to the Faculty of Information Science & Technology. Besides, we also developed the backend interface allowing the admin to add and edit the dataset in the proposed chatbot and enable it continuously responds to the student with the latest and updated information.

Keywords – Artificial intelligence, FIST chatbot, neural network, natural language processing, backend interface

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I. INTRODUCTION

Chatbots have gained popularity in providing automated customer support, information retrieval, and personalised interactions. Therefore, chatbots have garnered global attention, leading numerous organisations to incorporate them into their systems. The ability of a chatbot is that it offers 24-hours customer service every day. This enables users to seek and obtain information beyond regular working hours. Chatbot also helps simultaneously handle the user's query, freeing human resources to focus on more complex and specialised tasks.

Traditional rule-based chatbots typically rely on predefined responses or pattern matching, limiting conversational abilities. The rule-based chatbots only provide a set of options for users to choose from, and users are not allowed to type questions. Hence, this approach lacks user convenience, as it solely operates within pre-existing structures and



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answers. This situation makes the users unable to ask the question in their sentences and causes the user to be reluctant to use the chatbot service.

The prevailing trend in organisations is the utilisation of traditional rule-based chatbots due to their ease of setup and cost-effectiveness. Although these chatbots are widely adopted, they pose certain inconveniences to users as they are limited to pre-defined structures and responses. Additionally, the Artificial Intelligence (AI) technology employed in modern chatbots for educational purposes remains relatively basic, making them incapable of handling complex queries or unexpected questions. Another limitation is that chatbots heavily rely on the quality of the data they are trained on; thus, incomplete or outdated information may result in inaccurate responses. Besides, the chatbots may fail to update their knowledge base, leading them to rely on obsolete data within the system.

This paper integrates AI techniques into an educate-related chatbot to enhance its feedback capabilities. Hence, we developed a FIST (Faculty of Information Science & Technology) chatbot that serves as an intelligent virtual assistant to assist users with their queries related to the faculty. The emergence of AI inspires the inception of the FIST chatbot. Unlike traditional rule-based chatbots that can only respond using predetermined answers and structures, the FIST chatbot leverages AI to overcome this limitation [1]. Through machine learning algorithms, the chatbot is trained to comprehend user intent by analysing their questions, enabling it to address a broader range of inquiries and cater to the specific needs of users.

Additionally, the primary goal of the FIST chatbot is to enhance user convenience and facilitate users in adapting to university life. For instance, if users require information about the location of the computer lab, they can inquire with the chatbot, eliminating the need to contact the faculty and waste their time for a simple query. Moreover, the FIST chatbot strives to enhance student satisfaction by promptly and accurately addressing their questions.

II. LITERATURE REVIEW

A. Artificial Intelligence in Education

Artificial Intelligence (AI) significantly influences almost every aspect of life. Still, education is particularly affected since teaching and learning are essential elements of life, and the existing educational system leaves much to be desired [2][3]. Older schooling needed to be more flexible than what the future of AI in education would provide. The most crucial instructors to the educational system need to be more scalable and pricier. Besides, instructors are given much paperwork and are underappreciated in certain nations [4]. The presence of instructors is essential in the educational sector, and the introduction of artificial intelligence changes educators' work. As AI solutions continue to advance, they make it easier to see where there are gaps in teaching and learning and raise the quality of education [5]. AI can promote efficiency and personalisation and simplify management tasks, enabling instructors to provide understanding and adaptation. These are distinctively human talents, and robots would struggle to replicate them.

Artificial Intelligence has seen widespread use in education practices, also known as Artificial Intelligence in Education (AIED), since the development of computing and data processing technologies. These practices include teaching robots, intelligent tutoring systems, human-computer interactions, adaptive learning systems, and many more [6]. Since introducing AIED about 30 years ago, AI has been seen as a potent instrument supporting new instructional design paradigms, technology advancement, and educational research. Researchers are attempting to use cutting-edge AI approaches, such as deep learning and data mining, to cope with complex problems and tailor teaching methods for each student as schooling progresses.

B. Natural Language Processing

Natural Language Processing (NLP) is a technique that controls how the chatbot comprehends and analyses the input text [7]. It is an algorithm that makes the chatbot learn the complexity of human language through a wealth of conversational data and machine learning [8]. The bot changes this knowledge of language to rule-based machine learning algorithms to solve particular issues and carry out specific jobs. One example of NLP is Gmail keyword extraction, which is the task of NLP to make the email automatically classified as Social, Advertising, Spam, and Primary. Bots learn which category to allocate emails to by understanding terms in subject lines and correlating them with specified tags.

Before performing NLP, some preprocessing processes are necessary to enable NLP to comprehend human language. The preprocessing allows for the cleaning and transforming of unstructured text data into a clean and consistent form

that can be processed in the feature extraction. Bag of words (BoW) is a statistical language model used to analyse text and documents based on word count. It is a common feature extraction approach used in NLP, where textual data is converted into numerical vectors, in which features are unique words and feature values are word counts. In this method, the data is represented by calculating the frequency of words appearing in the sentences. Each element in the vector corresponds to the count of a specific word used in the vocabulary. The feature is then used in machine learning or deep learning algorithms.

C. Machine Learning

Machine learning is one of the branches of AI that enables the system to "self-learn" from training data through the algorithms, enhancing the system's accuracy. The learning process is automated. The primary goal is to allow the system to be trained by the data and experiences to predict the output. The machine learning algorithms detect hidden patterns in the training data, learn the patterns, form the model, and make predictions to resolve the challenging issues. Examples of machine learning algorithms include support vector machine and naïve Bayes algorithms.

Support vector machine (SVM) is a supervised machine learning algorithm for classification tasks. In SVM, it typically finds the optimal hyperplane, which means best classified into all the classes in the database. The SVM model can work effectively in high-dimensional spaces and handle linear and non-linear separation. Naïve Bayes is a probabilistic algorithm which also used for classification tasks. In naïve Bayes, it calculates the probability of each input class and assigns the highest probability classes to the input. naïve Bayes can work in high-dimensional data and is easy to implement.

D. Deep Learning

Deep learning is the subfield of machine learning that focuses on artificial neural networks that imitate how the brain processes information. The artificial neural network (ANN) model includes using computing and mathematics to replicate the activities that occur in the human brain. The ANN models follow the same architectural structure, conceptualised after the nervous system of living organisms. The ANN models, much like the structure of the actual brain, are made up of neurons organised in a complex and nonlinear form. In ANN, weighted linkages are used to connect the individual neurons. Figure 1 shows the architecture of ANN.

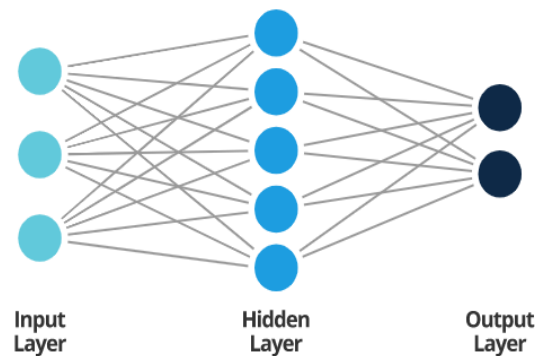


Figure 1. Architecture of artificial neural network.

As shown in Figure 1, ANN consists of several layers, including the input layer, the output layer, and the hidden layer. An input layer includes neurons responsible for receiving information and transmitting it to subsequent layers. There should be an exact match between the number of features in the dataset and the number of neurons in the input layer. The output layer represents the predicted feature, and its composition is determined by the model type. Hidden layers consist of many neurons, each of which makes a different change to the input before passing it on. The weights are improved during training so that the network can make more accurate predictions. There are several types of neural networks, such as feedforward neural networks, recurrent neural networks, convolutional neural networks, and modular neural networks [9].

E. Related Works of Chatbot System

Lee et al. [10] introduced a question-generation model in the chatbot system. This approach produces questions based on specific features through Stanford tools. Logistic Regression is used as a classifier to create the ranking model that accesses the questions to enhance the system performance. However, the paper does not elaborate on the specific natural language processing method used in the chatbot system.

Wu et al. [11] created a chatbot that performs the task of babysitting to tell stories to the users. Since the input is a Chinese story, the text has to be segmented and tagged using part-of-speech (POS) tags. Information extraction is performed by Term Frequency-Inverse Document Frequency (TF-IDF) approach to retrieve the essential portions of the story. Artificial Intelligence Markup Language (AIML) is used to produce dialogue scripts in AIML form. The AIML engine in the chatbot converts the AIML scripts into a natural language format.

Su et al. [12] designed a chatbot system that emphasises the daily conversation of older people to offer companionship and provides recommendations based on their everyday conversation. The MHMC chitchat dataset, which consists of older people's conversations, is used. Preprocessing splits the daily conversation into sentences and words to produce the message pattern. The Long Short-Term Memory-based (LSTM) model converts the sentence content into semantic features. The Euclidean distance is utilised to select the most appropriate question pattern along with its corresponding response, determined by the semantic feature distance.

Gupta et al. [13] created a chatbot as an experimental tool to explore the potential of utilising chatbots for promoting inclusive learning. A user study using a chatbot-led interview is conducted with 215 undergraduate students. Thematic analysis is undertaken from the chat responses of the students. The study reveals that chatbot supports an inclusive learning environment, especially for disadvantaged students.

III. THE EXISTING SYSTEMS

A. Course Enrolment Bot

Course Enrolment Bot [14] is a chatbot that aims to help users who want to apply for a course at the university. Course Enrollment chatbot allows users to type the inquiry in their words. It tries to understand the users' intent and reply with suitable answers. For example, the user inputs the request to enroll course, and the bot guides users to register. The limitations of this chatbot are that chatbot only handles enroll course operation, and the user cannot enroll in another course once a course is success registered.

B. Undergraduate Admissions Chatbot

In Undergraduate Admissions Chatbot [15], users need to select the button given by the chatbot to ask questions. This chatbot can provide specific control to users, such as applying for the course, getting more information about the undergraduate program, requirements to apply, steps to apply, and information about the scholarship. When users select the button given, the chatbot can guide users to get the answer to the question. This chatbot's limitation is that the user can only choose the option given; otherwise, the chatbot cannot understand what users want to express.

C. MMU Messenger Chatbot

Multimedia University (MMU) uses Messenger to help handle students who want to inquire and find a solution. MMU messenger chatbot [16] allows users to find the solution and answers within a few seconds. MMU messenger has reduced work pressure on the staff by communicating with the users and solving their problems. The limitation of this chatbot is users feel robotic when interacting with the MMU messenger chatbot. Table 1 displays the comparison between existing systems and the proposed system.

Table 1. Comparison between The Existing Chatbot System and The Proposed System

	Course Enrollment Chatbot	Undergraduate Admissions Chatbot	MMU Messenger Chatbot	FIST Chatbot (The Proposed System)
Input type of the chatbot	Input text	Select button	Select button	Input text
Unsolved question forward to admin	No	No	No	Yes

Chatbot provides the inquiry form for a user to fill in when the user is unsatisfied with the answer provided by the chatbot	No	No	No	Yes
Chatbot records the query if it cannot provide the answer to the query	No	No	No	Yes
Chatbot records the information of the user	Yes	Yes	No	Yes
Target user of the chatbot	Public user	Public user	Public user	University students

From Table 1, it can be seen that the FIST chatbot has excellent capabilities in handling unresolved questions compared to other chatbots. When the FIST chatbot cannot solve a question, it records it to allow for future updates and improvements. Moreover, users who are not satisfied with the chatbot's answer can fill out an inquiry form to get further assistance. Users can view the status of the inquiry form in the inquiry record. It is important to mention that the FIST is available exclusively for students at FIST, as it is currently in Beta. Therefore, this system is designed to answer questions from FIST students for internal use only.

IV. THE PROPOSED SOLUTION

A. Data Collection

Data collection is important for the FIST chatbot because the data is used to build the original data set in the system. The integrity of the data determines the performance of the FIST chatbot. A Google form is prepared to collect student responses from FIST. The main purpose of this Google form is to collect the questions that students want to know from the FIST chatbot. The Google form was sent to over 500 students who are currently studying on FIST, and the duration of data collection is about one month. The Google form successfully collected over 92 responses from the FIST students. Examples of questions that students would like to ask the FIST chatbot are shown in Figure 2.

How to apply dean list?

What are the elective subjects we should choose?

i think that maybe question about the course or subject. Then some junior that have face problem about their course maybe the senior can teach them. I think this is more batter as a question. Coz junior always confuse about What will they learn in this course or subject and also for the senior they will also face some problem like the fyp. This all my opinion about this chatbox, good luck.

How and where to find the past year exam paper of each subject.

i answered the Q above since there's no option like 'I have nothing to ask'

Where is lab venue?

programming tips, advises

Figure 2. Example of questions that students want to know.

Once the data is collected, the dataset for the FIST chatbot is curated to include only the questions about FIST that students want to know. In contrast, all queries unrelated to the topic are excluded. Within the FIST chatbot dataset, each question is accompanied by a corresponding label indicating its category, and the answer given serves as the response for that question. The dataset is stored in JSON format, a file that stores data types in a way that humans can understand, and the data is stored in key-value pairs; the key is the name, and the value is the data associated with the keys. Figure 3 shows the dataset of the chatbot in JSON format. Each element of the dataset has four keys: type, question, answer, and image. The type key consists of the category of the question, the question key stores the content of the corresponding question, the answer key stores the answer of the chatbot, and the image key stores the image to display. If the question key contains multiple related questions, it is added to the value part of the question key in an array format.

```

{
  "type": "Apply Dean List",
  "question": [
    "Can i apply dean list?",
    "Dean List"
  ],
  "answer": "The faculty initiated the award to celebrate the exceptional scholarly achievements of the students who score 3.67",
  "image": null
},

```

Figure 3. Dataset in JSON format.

B. Methodology

FIST chatbot is divided into two parts: front-end and back-end, as shown in Figure 4. The front-end part includes the system interface developed with HTML, CSS, and JavaScript. In the front-end part, the FIST student submits a query to the FIST chatbot through the system interface. The chatbot system sends the student's question to the back-end for processing. In the back-end part, the NLP preprocesses the query to convert the data into a numeric vector. This numerical vector serves as input to the pre-trained neural network model (multilayer perceptron model) for prediction to generate the correct answer for the student. When the administrator updates the information, the chatbot automatically re-trains the neural network model with the latest information.

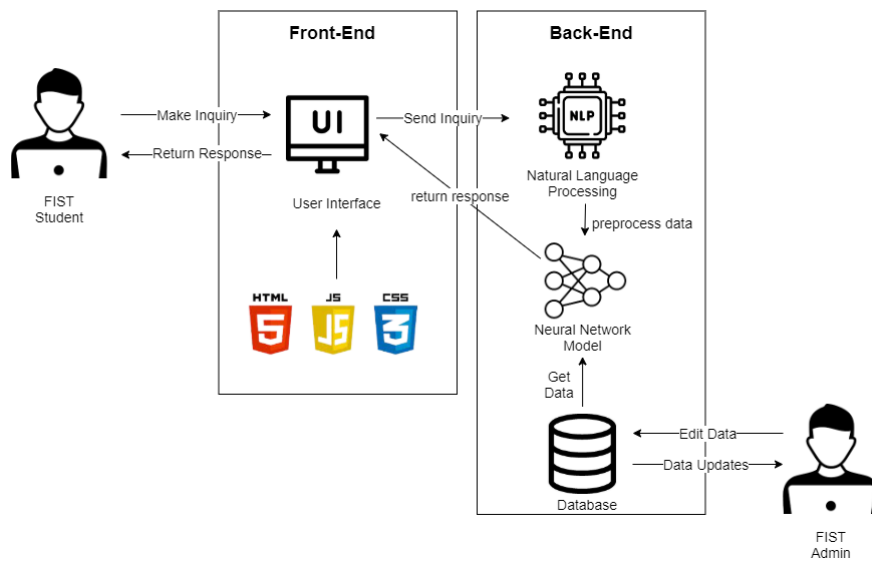


Figure 4. System architecture of FIST chatbot.

When the user inquires about the chatbot, the system performs NLP and a neural network algorithm to predict the possible response to the user. If the response cannot solve the user’s query, the proposed system suggests the user fill out the inquiry form. The data of the inquiry form is recorded, and the admin will provide feedback to solve the user’s doubt. Figure 5 shows the flowchart of the proposed FIST chatbot system.

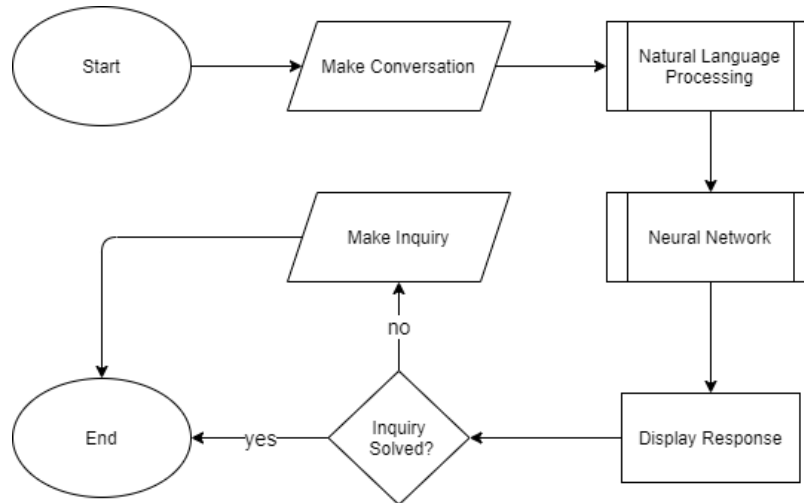


Figure 5. Flowchart of the proposed system.

The NLP component takes the user's query as input data. Preprocessing includes tokenisation and lemmatisation. First, the text is decomposed into smaller single sentences and semantic units by tokenization. Then, words are reduced to their root forms by lemmatisation to standardise them. This is followed by the removal of stop words, i.e., prepositions and articles such as “the”, “at” and “to”, as they do not contain unique information. Once preprocessing is complete, NLP converts the text into a language that a bot can understand. The NLP process uses the BoW technique to extract features from the input sentence by computing the frequency of each word in the input text, which are later used by the neural network. Figure 6 illustrates the NLP process in the proposed system.

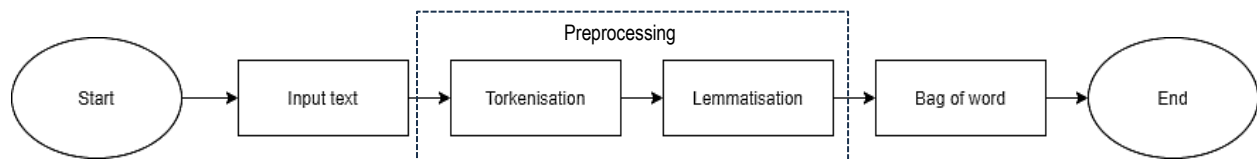


Figure 6. Flowchart of NLP.

Figure 7 shows the pseudocode of tokenisation. In tokenisation, three variables are first initialised with zero or an empty value, including two variables that store the first and last words of the text, and a token list that stores a list of words. Then all the words in a text are looped through. If the word in the loop is not empty or does not contain a punctuation mark, it is appended to the token list. When the loop reaches the end of the word in the text, the last word is captured and stored in the token list. After the loop ends, the token list is returned, which consists of a list of individual words.

```

START
  SET start_of_word = 0, end_of_word = 0, tokens = []
  FOR character IN text:
    end_of_word += 1

    IF character IS whitespace OR character IS punctuation:
      EXTRACT the substring from text, starting from start_of_word and ending at end_of_word - 1
      IF current_word IS NOT empty:
        ADD the value of current_word to the end of the tokens list
      ENDIF
      SET start_of_word = end_of_word
    ENDIF

  IF end_of_word == length of text:
    SET last_word = text[start_of_word:end_of_word]
    IF last_word IS NOT empty:
      ADD the value of last_word to the end of the tokens list
    ENDIF
  ENDIF

  ENDFOR
  RETURN tokens
END

```

Figure 7. Pseudocode for tokenisation process

Figure 8 displays the pseudocode of lemmatisation after tokenisation. In lemmatisation, words are converted to lowercase and stop words (i.e., words that have no meaning) are removed. Once word filtering is complete, the words are converted to their base form (original format) using the lemmatisation library.

```

START
  SET document = []
  SET remove_stopwords = stopwords.words('english')
  SET ignore_letters = ['?', '!', ',', '.'] + remove_stopwords
  FOR each word IN token:
    SET lowercase_word = word.lower()

    IF lowercase_word NOT IN ignore_letters:
      LEMMATIZE the lowercase word using the lemmatizer function from the lemmatizer_library
      ADD lemmatized_word to document
    ENDIF
  ENDFOR
END

```

Figure 8. Pseudocode for lemmatisation process

The pseudocode of the BoW process is shown in Figure 9. BoW computes the frequency of words in the sentence extracted by the process of lemmatisation. It goes through each word in the whole sentences. If the word occurs in the predefined record, the number one is appended to the variable bag, which represents the frequency of the word in the sentence. After a sentence is reviewed, the value of bag from the corresponding class is added to form the training dataset.


```

START
  FOR each sentence IN dataset:
    SET bag = [], training = []
    SET word_patterns = document[0]

    FOR each word IN dataset:
      IF word IN word_patterns:
        then append (1) to bag
      ELSE
        then append (0) to bag
      ENDIF
    ENDFOR

    SET output-row = [class size]
    APPEND bag and output-row to training
  ENDFOR
END
    
```

Figure 9. Pseudocode for BoW process

BoW converts the preprocessed word into numerical features that the neural network model can work with. The output generated by BoW serves as training data for the neural network model. The first step of a neural network model is to use training data to train the model for predictions. Then, weights and biases are incorporated into the input features to improve the neural network model's capabilities. Then, the neural network model uses the training data to determine optimal values for all weights and biases based on the labels provided. Once the neural network model completes its training, it receives input data from the user to make predictions for appropriate output values. The neural network process in the proposed system is shown in Figure 10.

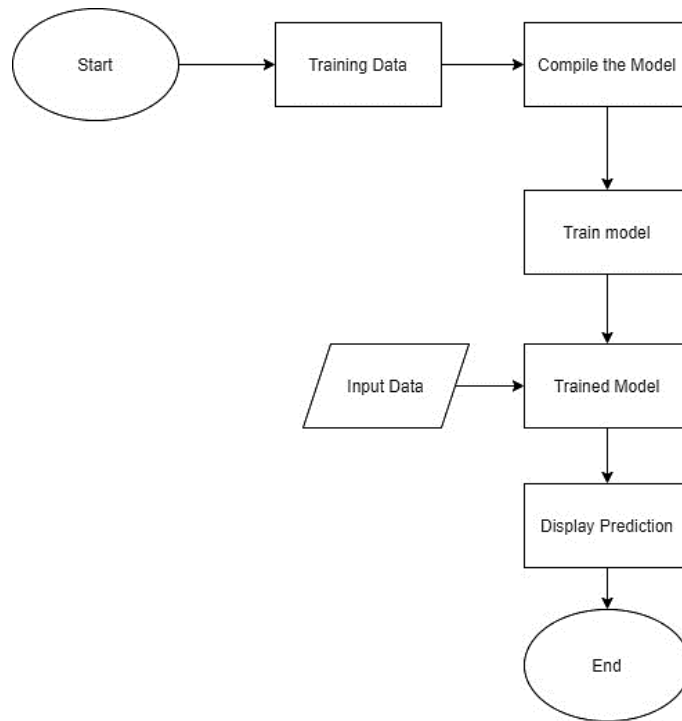


Figure 10. Flowchart of neural network model.

C. System Interface of User

The main page of the Faculty of Information Science and Technology (FIST) is shown in Figure 11. Students can click on the buttons in the navigation bar on the top left to access other details of FIST. In addition, students can communicate with the chatbot by clicking the “Chat Now!” button at the bottom right of the main page.

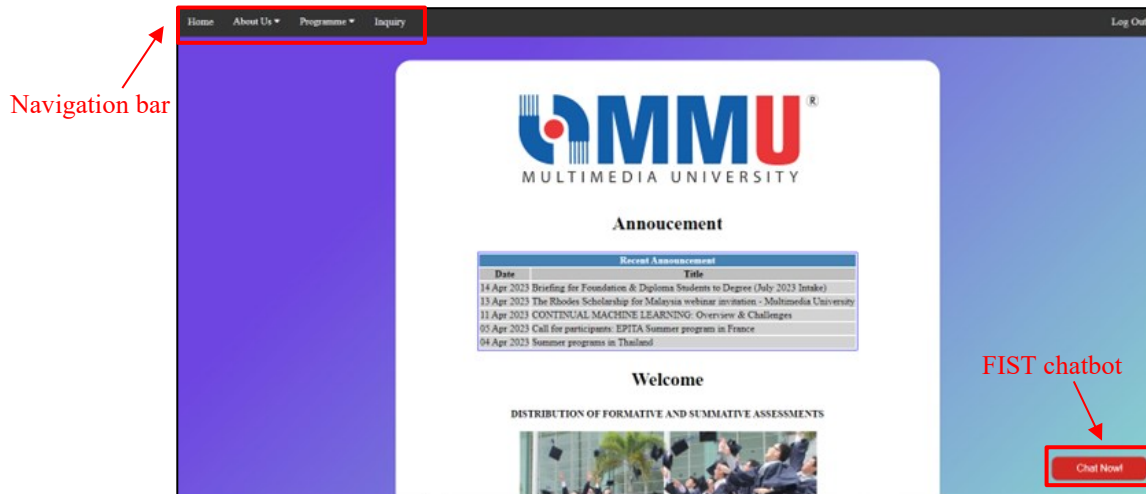


Figure 11. Student main page.

FIST chatbot, as shown in Figure 12, appears when the user clicks the “Chat Now!” button on the main page. Students can begin the query by typing the question into the chatbot and clicking the “Send” button. FIST chatbot will reply the correct answer to the students as soon as it receives the question.

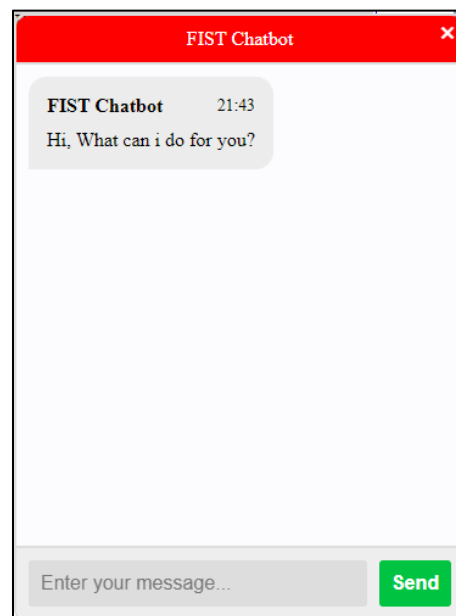


Figure 12. The interface of the proposed FIST chatbot.

Suppose the student has done the query before. In this case, he can click the “Inquiry” option in the navigation bar on the main page shown in the Figure 11. On the inquiry history page shown in Figure 13, the student can view his previous queries and check the status of each query. If the query remains unresolved, students can contact the admin or send a new query form as a reminder to the admin.

Inquiry Record

No	Question	Date Inquiry	Status
1	can you provide the phone number of DR. CHONG LEE YING?	2023-05-26	solved
2	subject enrollment	2023-05-26	solved
3	subject enrollment	2023-05-26	unsolved
4	mmu melaka available course	2023-06-03	unsolved

Figure 13. Inquiry history page.

D. Admin Dashboard

There are three question types (chatbot question, unanswered question, and inquiry) that are managed by admin in the admin dashboard, as shown in Figure 14. Chatbot questions refer to questions explicitly designed for the chatbot, while unanswered questions are those that the chatbot could not solve. In addition, the inquiry includes the data from the inquiry forms submitted by the students.

Three question types (chatbot question, unanswered question, and inquiry)

Figure 14. Admin dashboard page.

In Figure 14, when the admin selects “Chatbot Question” from the menu on the left, a table of different categories of chatbot questions is displayed. These details include the category, the associated question, the associated answer, and the creation date. When the admin clicks the “View Content” button, they can access the information about the questions and answers based on their chatbot category. The “Insert Category” and “Delete” buttons help the admin insert or delete category data in the table. Also, the admin can click the “Update Chatbot” button to update the data of a category. Figure 15 shows the chatbot question table, which displays the category, the question, and the corresponding answer.

Chatbot Question Table

Insert Category Update Chatbot

Show 10 entries Search:

No	Category of chatbot question	Question	Answer	Created date
1	Apply Dean List	View Content	View Content	2023-04-11 Delete
2	Choose elective subjects	View Content	View Content	2023-04-11 Delete
3	Find past year exam paper	View Content	View Content	2023-04-11 Delete
4	Credit transfer	View Content	View Content	2023-04-11 Delete
5	Availability of FIST staff	View Content	View Content	2023-04-11 Delete

Figure 15. Chatbot question page.

The admin can view the question details in the same category by clicking the “View Content” button under the "Question" column, as shown in Figure 15. Assuming the “Apply Dean List” category is selected, admin can view the question for that category by clicking the “View Content” button, and the question details are shown in Figure 16. A category can consist of many question details. In Figure 16, the admin can insert new question details by clicking the “Insert Question” button. At the same time, the admin can remove the question details by clicking the “Delete” button.

Question Tables

Insert Question

Category: Apply Dean List

Show 10 entries Search:

No	Question	Delete
1	Can i apply dean list?	Delete
2	Dean List	Delete

Showing 1 to 2 of 2 entries Previous 1 Next

Figure 16. Question table from the same category.

The admin can view the associated answer in the “Apply Dean List” category after clicking the “View Content” button under the “Answer” column (refer to Figure 15). If the admin has the latest information, he can update the answer by clicking the "Edit answer" button, as shown in Figure 17.

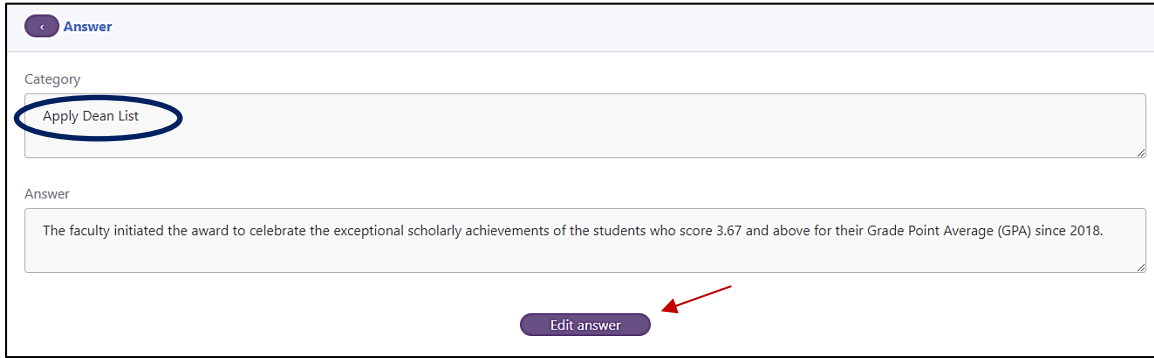


Figure 17. Answer table from the same category.

By clicking the “Inquiry” option in the left menu of the admin dashboard in Figure 14, the admin can view the student's details (phone number and email), question, inquiry date, and status in the inquiry table. Once the admin has answered the question via email or contacted the student, they can update the inquiry status or delete the data by clicking the appropriate button. Figure 18 shows the inquiry details retrieved from the inquiry form submitted by the students.

No	Phone number	Email	Question	Inquiry Date	Status	
1	1189051110	1191201052@gmail.com	can you provide the phone number of DR. CHONG LEE YING?	2023-05-26	Solved	Delete
2	0113941231	1191201296@student.mmu.edu.my	how do i apply ptptn	2023-05-26	Solved	Delete
3	0113941231	1191201296@student.mmu.edu.my	Credit transfer	2023-05-26	Unsolved	Delete
4	0113941231	1191201296@student.mmu.edu.my	how to connect mmu wifi	2023-05-26	Unsolved	Delete

Figure 18. Inquiry table.

If the chatbot cannot answer certain questions, it is usually because there is not enough data in the database. These unanswered questions are recorded and stored in the "Unanswered Question" table in the database. Once logged into the admin dashboard shown in Figure 14, the admin can access these questions by selecting the “Unanswered Question” option from the left menu. Figure 19 shows the table of unanswered questions, which displays the question itself, the date it was asked, and the total number of responses.

No	Unanswered question	Date asked	Total number of question being asked	
1	can you provide the phone number of DR. CHONG LEE YING?	2023-05-29	7	Delete
2	where can i find the website of the multimedia university	2023-05-25	3	Delete
3	campus maps	2023-05-25	1	Delete
4	CGPA	2023-05-25	1	Delete

Figure 19. Unanswered question table.

V. IMPLEMENTATION RESULTS

A. FIST Chatbot

FIST chatbot uses a multilayer perceptron to predict the answer to students' queries. It achieves a 98% accuracy rate, which means that the chatbot can understand and respond to the correct information for the students based on the given dataset. When the students make a query to the chatbot, the FIST chatbot can solve the query by providing the appropriate answer. Figure 20 shows the output of the FIST chatbot when the user makes a request to the chatbot.

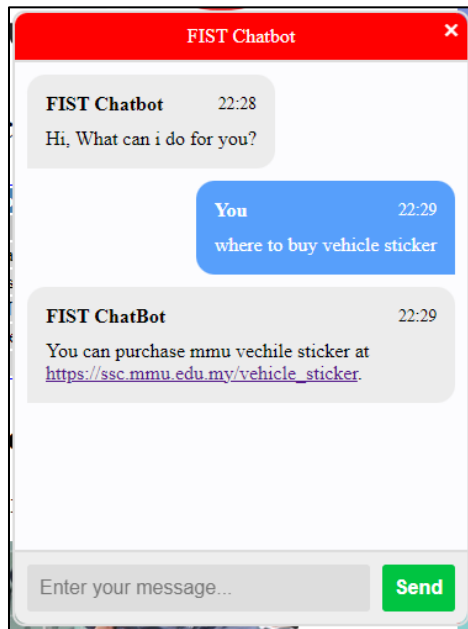


Figure 20. FIST Chatbot.

B. Comparison of Suitable Model for the Chatbot

To effectively implement the FIST chatbot, a critical step involves comparing different models to identify the most suitable one for constructing the proposed system, ensuring optimal performance and user satisfaction. For this purpose, three models were utilized for comparison: support vector machine, naïve Bayes, and multilayer perceptron. The incorporation of support vector machine, naïve Bayes, and multilayer perceptron (MLP) in chatbot systems is attributed to their frequent application and remarkable performance within the chatbot framework [7], [17] and [18]. All three models were trained using the same dataset. It is worth noting that the MLP model underwent NLP before training. The accuracy results for each model are presented in Table 2.

Table 2. Comparison between Different Models.

Models	Accuracy
Support Vector Machine	0.92
Naïve Bayes	0.54
Multilayer Perceptron	0.98

The MLP model has the highest accuracy rate among the three models, which is 98% of accuracy rate. The SVM model shows a 92% accuracy rate, displaying excellent performance but slightly worse than the MLP model. The naïve Bayes model gets the lowest accuracy rate, which only gets 0.54 accuracy, which determines that it is unsuitable for this dataset. Hence, MLP is used as a model of the FIST chatbot as it has obtained the highest accuracy.

C. Updatable Chatbot System and Chatbot Maintenance Notification

After the admin clicks the "Update Chabot" button, as exhibited in Figure 15, the FIST chatbot system collects the latest chatbot knowledge from the database and retrains the MLP model. Once the MLP model has been trained, the chatbot can respond to new questions that have not been answered. Figure 21 shows the process of retraining the MLP model.

```

Epoch 196/200
7/7 [=====] - 0s 2ms/step - loss: 0.139
0 - accuracy: 0.9697
Epoch 197/200
7/7 [=====] - 0s 2ms/step - loss: 0.196
3 - accuracy: 0.9394
Epoch 198/200
7/7 [=====] - 0s 2ms/step - loss: 0.064
4 - accuracy: 1.0000
Epoch 199/200
7/7 [=====] - 0s 2ms/step - loss: 0.436
8 - accuracy: 0.8788
Epoch 200/200
7/7 [=====] - 0s 2ms/step - loss: 0.124
1 - accuracy: 0.9697
Done
    
```

Figure 21. Process of retrain MLP model.

Additionally, the chatbot will be auto-updated at 10 pm once the admin changes the chatbot knowledge in the database. When the admin updates, deletes and inserts the data in the table exhibited in Figure 15, it enables the automatic update of the FIST chatbot. Figure 22 shows "FIST chatbot will be updated at 10 pm tonight" at the top navigation bar of the page to notify the admin about the update time.

The screenshot shows a web interface for chatbot maintenance. At the top, a notification bar states "FIST chatbot will be updated at 10 pm tonight". Below this is a section titled "Chatbot Question Table" containing two buttons: "Insert Category" (green) and "Update Chatbot" (red). Underneath are controls for "Show 10 entries" and a search box. The table below has columns for No., Category of chatbot question, Question, Answer, Created date, and a Delete button. The table contains three rows of data.

No.	Category of chatbot question	Question	Answer	Created date	
1	Apply Dean List	View Content	View Content	2023-04-11	Delete
2	Choose elective subjects	View Content	View Content	2023-04-11	Delete
3	Find past year exam paper	View Content	View Content	2023-04-11	Delete

Figure 22. Chatbot maintenance notification to the admin.

It is essential to let the users know the chatbot is under maintenance. Users are aware that the chatbot may not be functioning during maintenance and will use the chatbot in the available time. The FIST chatbot maintenance time takes 10 min, from 10:00 pm to 10:10 pm, which means the FIST chatbot is unavailable during this time. Figure 23 shows the maintenance notification to the users, and the FIST chatbot functions well after the maintenance time.

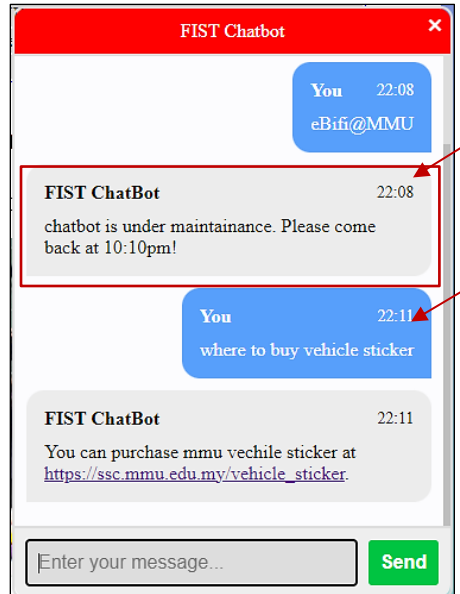


Figure 23. Chatbot maintenance notification to the user.

D. Inquiry Form

When the FIST chatbot cannot answer a student's inquiry, it offers an inquiry form for the student to fill out. The inquiry form only requires the student to provide their question, as the FIST chatbot retrieves their email and phone number from their login account information. Figure 24 shows the inquiry form provided by the chatbot.

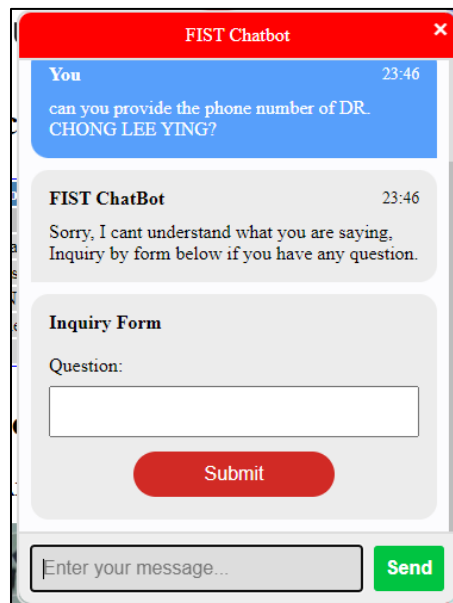


Figure 24. Inquiry form displaying in FIST chatbot.

E. Information Collected When User Perform the Inquiries

FIST chatbot collects the information of the user when performing the inquiries. The previous result mentioned that the FIST chatbot collects the inquiry from FIST students by providing an inquiry form to fill in the question. Sometimes, FIST students might not be willing to fill out the inquiry form, which makes the inquiry form lose function when the students do not submit the question from the inquiry form. In order to address this issue, the FIST chatbot gathered the queries posed by FIST students that had not been answered during the conversation. It allows the unsolved question can be collected even though FIST students did not submit the inquiry form. FIST chatbot records the question unanswered, frequently asked of unanswered questions and the date asked. Figure 25 shows the unanswered question table that can be viewed by the admin.

No	Unanswered question	Date asked	Record count of asked	
1	can you provide the phone number of DR. CHONG LEE YING?	2023-05-29	7	Delete
2	where can i find the website of the multimedia university	2023-05-25	3	Delete
3	campus maps	2023-05-25	1	Delete
4	CGPA	2023-05-25	1	Delete
5	PTPTN	2023-05-25	2	Delete

Figure 25. Unanswered question table.

VI. FUNCTIONAL TEST

A functional test evaluates the individual functions of the FIST chatbot to ensure that they work as intended. It examines the student login function, chatbot text entry, inquiry form entry, chatbot question table, unanswered question table, inquiry table, and admin dashboard to determine whether they align with the expected behavior, as exhibited in Table 3.

Table 3. FIST Chatbot Functionality Testing

No.	Test Scenario	Expected Result	Actual Result	Pass/Fail
1	FIST Student Login Account: Login account with invalid credentials.	FIST student should not able to login account.	FIST student not able to login account and the system displays the error message to FIST students.	Pass
2	FIST Student Login Account: Login account with valid credentials.	FIST student should be able to login account.	FIST student is able to login account and the system direct FIST students to main page.	Pass
3	FIST Chatbot: FIST student ask question to FIST chatbot.	FIST student should be able to get the answer.	FIST student is able to get the answer from the FIST chatbot after ask the question.	Pass
4	FIST Chatbot: Enter the question that FIST chatbot could not answer.	FIST chatbot should be able to collect the question that could not answer.	FIST chatbot able to collect the question that could not answer.	Pass
5	FIST Chatbot Inquiry Form: Enter the question that FIST chatbot	FIST chatbot should be able to provide inquiry form.	FIST chatbot able to provide the inquiry form to FIST students when it could not answer the question.	Pass

	could not answer.			
6	FIST Chatbot Inquiry Form: Leave blank to the inquiry form.	FIST student should not be able to submit the inquiry form	FIST student not able to submit the inquiry form and FIST chatbot display alert message to remind the student fill in the form.	Pass
7	FIST Chatbot Inquiry Form: Enter the question into the inquiry form	FIST student should be able to submit the inquiry form.	FIST student able to submit the inquiry form and FIST chatbot direct the student to the inquiry form page.	Pass
8	View Chabot Question Table: Admin view the chatbot question table	Admin should be able to view the chatbot question table.	Admin able to view the chatbot question table.	Pass
9	View Unanswered Question Table: Admin view the unanswered question table	Admin should be able to view the unanswered question table.	Admin able to view the unanswered question table.	Pass
10	View Inquiry Table: Admin view the Inquiry table	Admin should be able to view the inquiry table.	Admin able to view the inquiry table.	Pass
11	Insert New Chabot Question: Leave blank for all text field.	Admin should not be able to insert new chatbot question.	Admin not able to insert new chatbot question and the system display alert message to remind the admin fill in all the text field.	Pass
12	Insert New Chabot Question: Enter all the text field	Admin should be able to insert new chatbot question.	Admin able to insert new chatbot question.	Pass
13	Delete Chatbot Question: Delete the specific chatbot question	Admin should be able to delete the specific chatbot question.	Admin able to delete the specific chatbot question.	Pass
14	Edit Chatbot Answer: Enter the text field	Admin should be able to edit the chatbot answer.	Admin able to edit the chatbot answer.	Pass
15	Update Chatbot: Click the update chatbot button	Admin should be able to update the chatbot.	Admin able to update the chatbot.	Pass

There are 15 test cases to verify the functionality of the system. Table 3 contains the test scenario, the expected result, the actual result and the status (Pass or Fail). The actual result is compared with the expected result. If the actual result matches the expected result, the test is considered passed; otherwise, it is considered failed.

VII. USABILITY TESTING

Usability testing is conducted to assess the user experience and identify any usability issues or areas for improvement. 50 FIST students were invited to participate in the usability test to evaluate the FIST chatbot. The students tested using the FIST chatbot and filled in the feedback survey form after doing the test on the chatbot. Figure 26 shows the distribution of the students that participate in the test.

- Delta (third year of degree)
- Gamma (second year of degree)
- Beta (first year of degree)
- Foundation
- Diploma

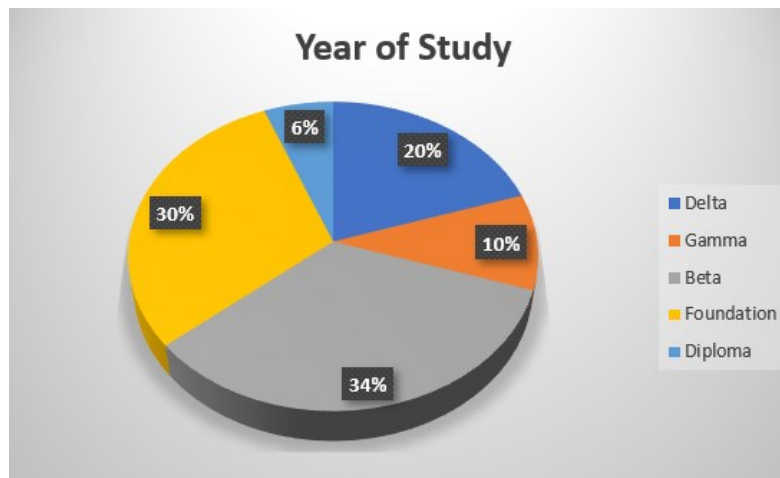


Figure 26. Distribution based on year of study.

Figure 27 shows that 42 of the students were interested in using the FIST chatbot but another 8 of the students did not interest in using the FIST chatbot. After investigation, the reasons why the students did not prefer the FIST chatbot are because:

- They think that chatbot is difficult to use
- Although chatbot can provide the response immediately, they still prefer human-to-human interaction.

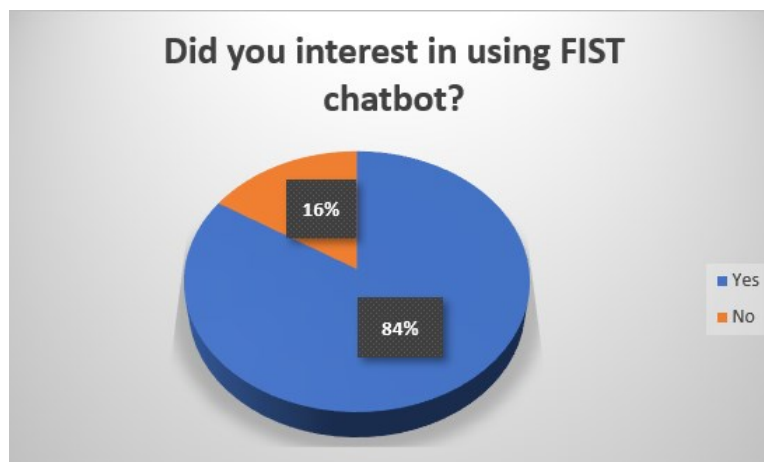


Figure 27. Percentage of student interest in FIST chatbot.

The testing process started with a simple demo to guide the students to open the FIST chatbot and ask the FIST chatbot by typing questions. Each student was required to test the FIST chatbot with 10 questions related to the FIST. Figure 28 shows the students' feedback, where 35 think that the FIST chatbot can solve their query, and 15 still feel that the chatbot could not solve their question.

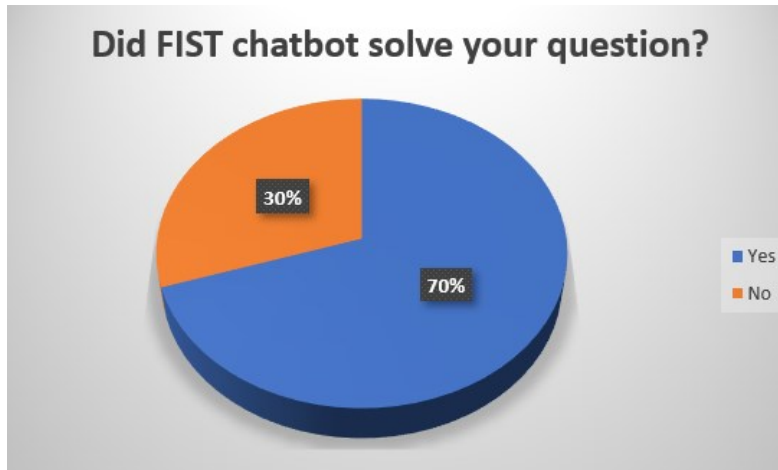


Figure 28. Majority students think FIST chatbot can solve their question.

After the students had used the FIST chatbot, 45 of the FIST students recommend to embedded the FIST chatbot into the FIST website, and only 5 of the FIST students did not recommend it, as shown in Figure 29. The result concluded that most students wish to embed the FIST chatbot into the FIST website as the FIST chatbot could solve most students' questions and is user-friendly. After obtaining their feedback, the reason why the students did not recommend to embedded the FIST chatbot in the FIST website are:

- They think human interaction is more simple
- Chatbot cannot solved the question when it is too complex.

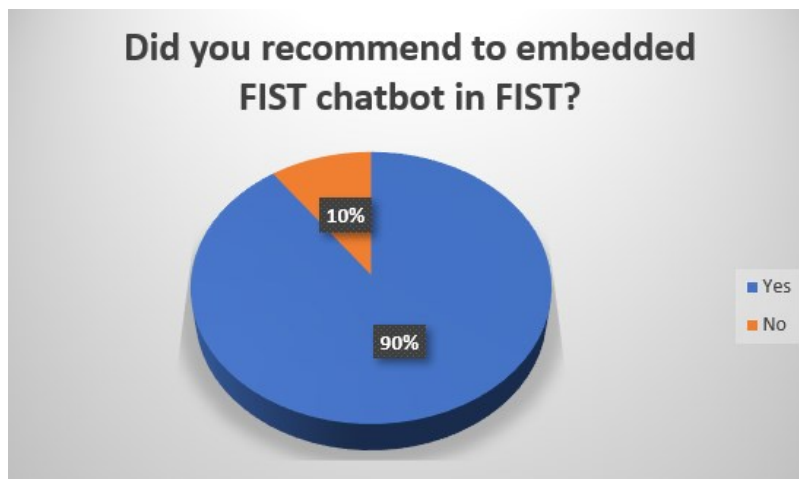


Figure 29. Most students recommend embedding the FIST chatbot in the FIST website.

VIII. CONCLUSION

This paper presents a FIST chatbot that aims to assist students in obtaining information easily and quickly by involving machine learning and deep learning algorithms. The FIST chatbot system provides a smooth conversational experience for FIST students by implementing natural language processing and neural network techniques. Both natural language processing and neural network technique allow the chatbot to comprehend user inquiries and respond with accuracy and relevance. With the evolution of the FIST chatbot, the quality of education has increased from time to time. It attracts people to pay more attention to education, particularly the chatbot system. In addition, this proposed system shows that chatbots cater to the need of users to get instant feedback to solve their queries and the potential of AI-powered conversational agents in transforming customer engagements and service provision.

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