

Technical Article

An Enhanced Student Enquiry Chatbot Incorporation in a University-Based System

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Abstract— University students especially the new ones experienced some problems on getting admission repeatedly over the years and the answers to these problems are provided by the institutional staff concerned. Since the number of students are increasing drastically and also some of these problems are asked several times to the staff, there is a need to developed a system that would be able to answer some of these questions in a conversational mode and provide answers when the need arise. The system can serve as University Enquiry Chatbot which can typically assist in providing information and other institutional academic activities to the new and existing students. It will also allow the students to benefit from relevant information about the institution activities such as tuition fees, course registration, admission status, hostel application, result check and so on and so forth. In this paper, an enquiry chatbot application is proposed and integrated in the prototype University web site to provide students of the institution with a simple way of talking to the staff via queries using conversational text with responses provided in a format such as text and pictures. This makes it possible for the system to provide answers related to the student query in a simpler and efficient manner. The result of the experimental evaluation conducted indicated that, the proposed system demonstrated that, most of the selected students of the university assessed the system roles as satisfactory based on the study results obtained.

Keywords— Enquiry chatbot, University-based, Query, Relevant information, Chatbot user interface, Answer

1. Introduction

A chatbot is considered as application that allows the conduct of chat conversation via text, images or speech with a good provision for interaction with a live human agent [1]. It is intelligent application software that supports communication and performing tasks in fashion similar to human [2]. The application is normally used to provide answers to the student's question or query in a University setting and it can be referred to as enquiry chatbot. It accepts user's request in form of query and processes it in order to give a desired result as answer. It solves the process of student visiting institution and queuing in order to find related information as per their needs. It will also address the problem that can arouse due to gathering the required information to existing, new and prospective students. It can be easily accessed from anywhere at any time since it is normally incorporated in the institutional website to find the required information related to the school activities. This will assist the students especially the new ones who don't have any idea about the school such as tuition fees payment, course registration, academic

calendar, timetables, academic advisers, lecture halls, hostel application and other related academic matters.

In this paper, a chatbot system is developed with a simple graphical user interface and incorporated in the prototype University web site to provide students of the institution with a simple way of asking questions on university related activities without directly going to the university staff offices for inquiry via queries using conversational text with answers provided in a form of text and images. This chatbot understands human language so as to provide human-like answers that be easily understand by students concerned. This makes it possible for the system to provide answers related to the student query by matching it with desired solution in a simpler and efficient manner. The result of the experimental evaluation conducted indicated that, the proposed system demonstrated that, most of the selected students of the university assessed the system roles as satisfactory based on study results obtained.

2. Related Work

Bayu and Ferry [3] developed a chatbot by utilising knowledge from a database to be used for human-to-machine conversation. The machine is trained with knowledge so as to identify the sentence and make informed decision itself in order to answer a question asked by the user. The response is done by matching the inputted query by the user. The input query will be computed to get the similarity relevance of sentences by using bigram computation; thereby those with higher similarity scores will have more similar of sentences to be presented. The database is served as the knowledge of the chatbot application. The application comprised of an interface that is used to access the database system that has been employed as knowledge store. The interpreter has been also employed as stored programs of functions that produced the required sets needed for performing pattern-matching processes needed by the application. The facts collected and used by the application was prepared to serve as the reference point for the chat-pattern in Indonesian language by chatbot for conversational pattern identification. However, the developed chatbot fails to understand English language. This makes it impossible to provide machine-human conversation in English.

Bani and Singh [4] developed a college Enquiry Chatbot using Artificial Linguistic Internet Computer Entity (ALICE). The chatbot utilizes Artificial Intelligence Markup Language (AIML) to form responses to user's question and inputs. The ALICE utilised a simple pattern format to served as the input for easy output presentation. It also used a simple pattern identification algorithm for matching questions and responses. However, the knowledge based used by the chatbot system is unable to keep long conversational interactions. Similarly, it cannot learn the context from which the user query is been expressed.

Nitesh *et al.* [5] presented an intelligent chatbot that utilised Natural Language Processing techniques to carry out its tasks. The chatbot is an android application based on an intelligent algorithm that analysed user's input queries and the identified the user's message intent. It then provides solutions to the queries inputted by the students by selecting the category from which it belongs to and then present the queries to the bot as questions in order to initiate the chatting process. The MYSQL is used as database where facts about questions, answers, keywords, logs and feedback messages are stored. It comprises of two types of users: Ask User and Admin User. The Ask User can only fetch information for their query from the machine as no changes are allowed but can only report for changes while the Admin User can change and update the facts stored to the text recognition. However, the system fails to recognise speech to text accent recognition.

Tiha [6] proposed a chatbot using machine learning and Google Neural Machine Translator (GNMT) module used for building dialogue generator. The Seq2Seq model was incorporated in it and also utilises GNMT with techniques embedded in it which are important for the chatbot development processes. The GNMT used neural attention

mechanism as an option for search and Vocabulary generation that utilised Google's sub-word module. The Python PYQT module is used for the Graphical User Interface where user query the system. However, the dialogue generator lies in developing coherent dialogue. The machine translation is treated as problem since the history of earlier conversation is not taken into consideration. Also the performance of the model is limited when handling long conversation.

Pawer *et al.* [7] presented a college enquiry chatbot application using knowledge in database to provide answers to student queries. The proposed application uses online enquiry chatbot system. It is developed using Microsoft Bot Builder, QnA maker, LUIS.ai and MangoDB tools. The Python programming language is used in creating application user interface that enables users to send questions and get the required answers. The application provides responses via an interface as if it is a real person that is communicating to the user. The bot will send question to the LUI-S.ai which also provide its response to the bot when processed, the bot will then retrieve the records from the database and then answer it by utilising SQL for pattern matching which is stored in a program. However, the QnA Maker that used Pattern matching approach relies heavily on the structure of the sentence which makes it difficult to retrieve the best possible answers based on the user's query.

Mabunda and Ibaijola [8] presented Pathbot for guiding visitors in order to locate venues. It is an intelligent chatbot that processes user's query by using Dialog Flow API. It is presented as a toll that assists student and visitors to navigate through the venues of the campus by utilising Finite Automaton that represents a sub-map of the campus. The tokens extracted from the Dialog Flow API are then sent to the Automaton which then used an algorithm to generate the descriptions of the venues' paths from where a user is to where the user wants to go. However, the Pathbot is unable to handle the rerouting and cases where the lost user is and also it requires strong network connectivity to function effectively.

Kadariya *et al.* [9] developed Kbot for Asthma self-management with help of A.L.I.C.E technology. The Kbot is a chatbot which served as knowledge enabled personalized that is mainly used to help Asthmatic patients through meaningful conversation. It is designed health related applications and used to help paediatric asthmatic patients aged 8 to 15 to control their health related problems. It is uses include monitoring of the patient's medication continuously and trickling of relevant health signals. However, it is unable to generate answers in a human-like fashion by expressing attitudes or emotions. It also fails to recognize some asthma symptoms and also limited to only Asthma thereby unable to treat other diseases.

Dobariya and Shah [10] presented a banking Inquiry chatbot system based on Artificial Intelligence and Natural Language Processing techniques. The chatbot is a web based system that allow user to ask queries in a plain text in English or using voice-based. It is looks like a personal assistant since

the user feels like communicating with a person. It is developed using Java programming language and MySQL as database. The system gives personal information of user's account but is unable to give general information like procedures on how to open an account; the documents required for that particular process. This makes people who do not have this type of information to go to bank and ask the employees manually thereby consuming more of their time during conversation.

3. Proposed Work

In this section, an enquiry chatbot development and incorporation in a University-based system is presented.

A. Chatbot Architecture

The general structure for the study is depicted in Figure 1.

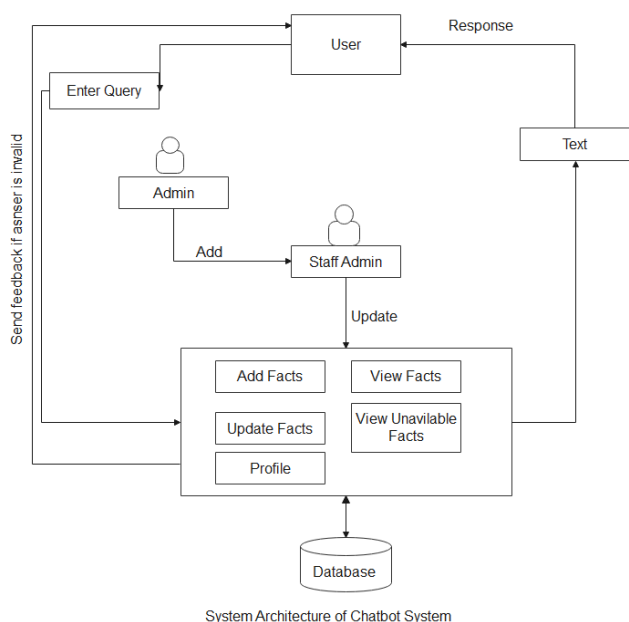


Figure 1. Architecture of the Proposed Enquiry Chatbot

B. System Input

The inputs of the proposed system are based on facts in form of questions and answers as shown in Table 1. These inputs consist of information and activities of the university. The inputted query which served as questions to be asked by the student in order to obtain feedback from the bot.

Table 1. Some Sample Facts

S/No.	Questions	Answers
1.	Hello Hey	Hi there how can I help you? Hey I'm UDUS' bot. How can I help you?
2.	What is the Tuition fee for undergraduate School fee for	For fee and Enquiry about Undergraduate please follow the link below Undergraduate Portal - Usmanu

	undergraduate	Danfodiyo University Sokoto (www.udusok.edu.ng)
3.	How can I learn online? Does udus offer online learning?	Please follow the link to know more about USMANU DANFODIYO ONLINE LEARNING MANAGEMENT SYSTEM (UDUS-LMS) Usmanu Danfodiyo University, Learning Management System (udusok.edu.ng)
4.	What is the MISSION OF UDUS? Mission of udus Udus mission	MISSION OF USMANU DANFODIYO UNIVERSITY SOKOTO To provide quality teaching, research and community service to deserving persons and communities, under the most peaceful atmosphere and in line with the national policy on education, irrespective of social class, gender, race, nationality and religion; and to ensure that at all times it serves a center for pursuit of research and academic excellence

C. System Procedure

The proposed system allows the user which can be student in the institution who wants to enquire about the school system and it related activities. The administrator is the one who manages the activities of the system; the administrator can be a teaching staff or a non-teaching staff in a University-based system. The user type in a text as query (or question) on the application interface in form of text as a chat and then the system retrieves the answers stored on the database facts by matching it with desired best possible solutions. The facts are based on questions and answers related to the institutional activities and then respond back to the user query. Similarly, the system administrator can login into the chatbot application where he/she can add staff sub-administrator for the system management and update. The staff administrator can view the facts, add facts, delete facts and also update facts.

The chatbot system is based on machine learning approach in such a way that it is capable of learning from user inputs. Since if a query (question) is asked and there is no related answer to the query on the facts database, those queries are been captured and stored into Unavailable facts. So whenever the administrator log into the system the Unavailable queries can be seen and thereby allowing the administrator to provide answer related query by adding the required facts to the application database.

The inputs of the proposed system are based on facts in form of questions and answers provided by the application administrator regarding to the information and activities of the university. This will enable the chatbot application to respond to every question ask about the institutional activities by the user to provide appropriate feedback for the query.

D. Chatbot Use Case

The use case diagram depicts the functionality of the chatbot application as per user requirements as presented in Figure 2. It models the behaviour of the chatbot system and help to capture its requirements and scope. These diagrams also

identify the interactions between the user and the actors. The system actors' description is shown in Table 2.

Table 2. System Actors Description

Actor	Description
User	Student/Staff who uses the system to engage in a conversation
Administrator	The administrator of the system. Allowed to carry out administrative tasks. On this proposed system we have two Admin 1. The Administrator: the Admin function is to add other admin called staff who can manage some part of the system 2. The Staff administrator: the staff admin is to add facts, update facts, view facts, delete facts and also add unavailable facts query by the user.

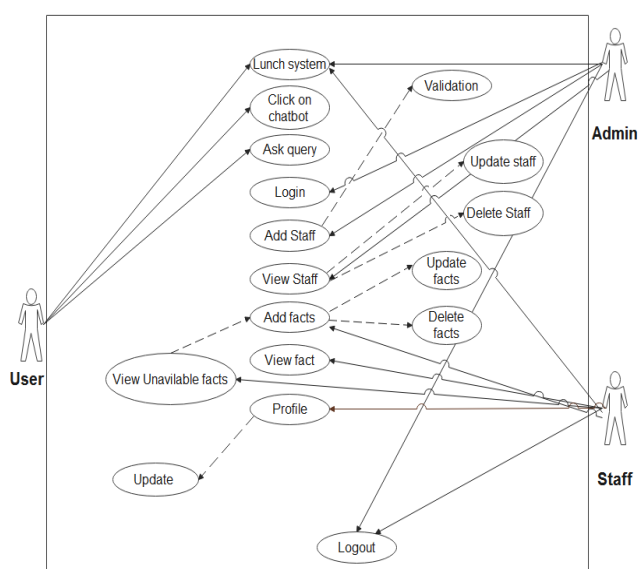


Figure 2. UDUS Chatbot Use Case Diagram

E. Chatbot Interfaces

(1) User Interface

The chatbot user interface allows the application users to communicate with the system through a Graphical User Interface (GUI), where the user of the system can ask a question or send a query while performing some tasks on the system. The user get the response to such questions that is been queried from the system via the chatbot application GUI described in Figure 3.

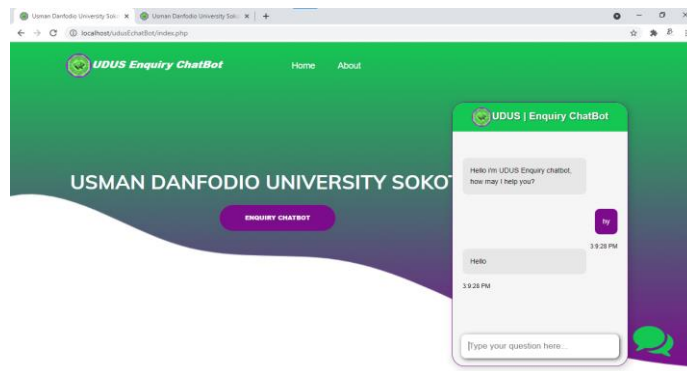


Figure 3. Enquiry Chatbot User Interface

(2) Add Facts Interface

This interface allows the administrator to add some facts to the system. These facts are based on questions and answers likely to be queried by the user as shown in Figure 4, all the added facts are stored on the application database.

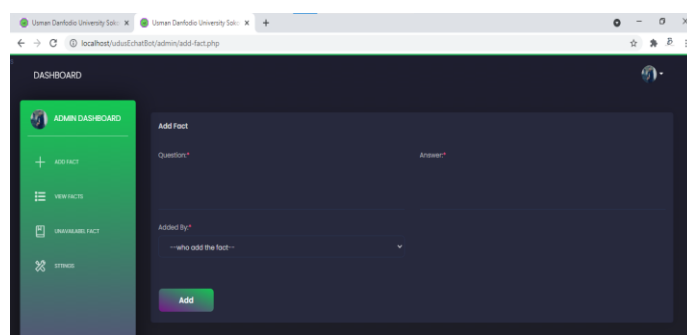


Figure 4. Facts Addition Interface

(3) Available Facts Interface

The interface allows an administrator to view available facts in form of questions and answers on the system as depicted in Figure 5. The administrator can also edit the facts, delete facts and also update facts as needed; all these are retrieved from the chatbot database.

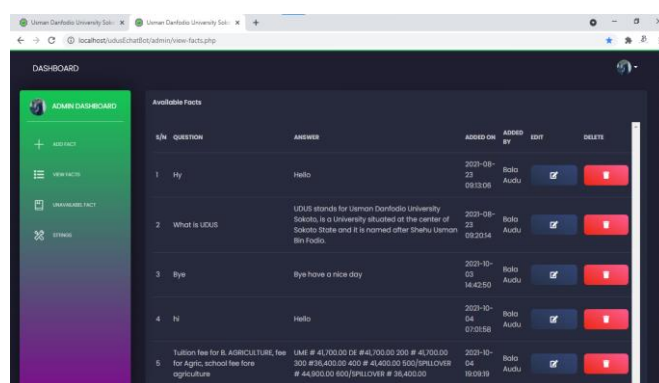


Figure 5. View Facts Available

(4) Unavailable Facts Interface

The questions been asked by the user with no available answers as identified by the enquiry chatbot application are stored on the database as unavailable facts as shown in Figure 6. This enables the administrator to view these facts and provide answers to such queries. This capability of the

application enables it to learn from user asked question, and when next such question is ask the chatbot provides answer to the asked question.

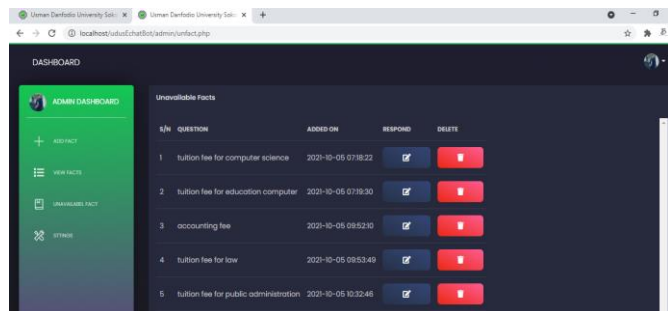


Figure 6. Unavailable Facts

(5) Response to Unavailable Facts Interface

This interface allows the chatbot administrator to respond to unavailable facts been queried by the user and provide valid answer to the question that is been asked as depicted in Figure 7.

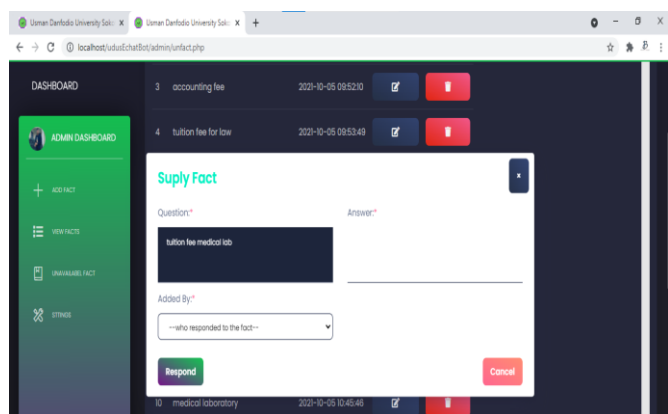


Figure 7. Unavailable Facts Response

D. Experimental Evaluation

(1) Experimental Environment

The computer system used during the experiment possesses the following requirements: Windows 8, Minimum of 1GHz Processor, Minimum of 2GB of Ram and Disk Space Minimum of 200GB. The software technologies used for the implementations and experimentations are as follows: PHP, MYSQL, Java Script are the languages used for developing chatbot. HTML and CSS are used for designing chatbot interface. The XAMPP Server is used as local server for the application. The Sublime Text editor is used for editing codes (text) of PHP, HTML, CSS, and JavaScript.

(2) System Evaluation

The performance of the developed Enquiry Chatbot is evaluated using some students of Usmanu Danfodiyo University as the domain in question, where each student is allowed to use the proposed chatbot application to ask some questions with a view to getting relevant information (answer). This will enable student to decide on the system usability with regard to its relevance to the query given to the enquiry chatbot on the target tasks. To capture the student

feedbacks, an evaluation form (questionnaire) was given to the sample 24 students (numbered from 1...24) to make justification on the chatbot functionalities. The questionnaire used during the chatbot assessment is the System Usability Scale (SUS) questionnaire [11] which contains ten questions for assessing the proposed application. The overall assessment of each of the students is captured using percentage (100).

4. Experimental Results and Discussion

The responses of the students' assessment after exploring the various functionalities of the proposed enquiry chatbot application are captured as chatbot scores (%) and presented as depicted in Table 3 and Figure 8 respectively.

Table 3. Student Assessment Results

Students	Enquiry Chatbot Scores (%)
1	76
2	70
3	72
4	70
5	80
6	84
7	75
8	65
9	70
10	75
11	67
12	79
13	77
14	84
15	65
16	64
17	74
18	69
19	66
20	84
21	82
22	69
23	66
24	76

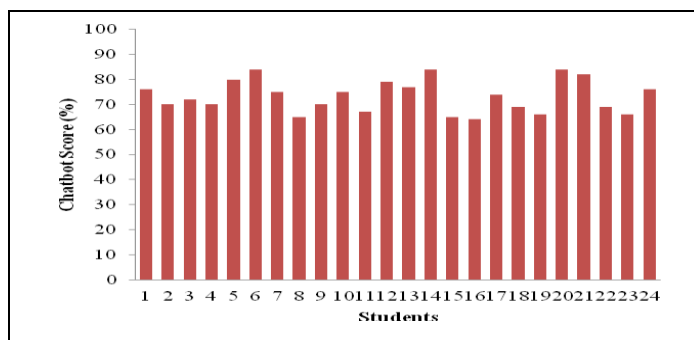


Figure 8. Enquiry Chatbot Student Assessment Scores

The evaluation responses from the students for each of the questionnaire collected after the chatbot assessment are aggregated as seen in Figure 8 and then averaged the scores obtained. The result implies that, 16 out of 24 University students rated the enquiry chatbot application with SUS scores of 70 and above. Also, the mean SUS score of the overall students' assessment calculated is 73.29. The mean score of the enquiry chatbot demonstrated the students' acceptance of the application integrated with respect to the various queries performed related to their target tasks.

5. Conclusion and Future Scope

The study developed and incorporated an enhanced student enquiry chatbot application in a University domain to assist both existing and prospective students to find interested information related to their various queries (questions) in the institution. The application enables student to query the chatbot about the institutional activities and programmes with a view to getting response in time with staff intervention via text, links, and images where necessary. It also allows the administrator to add facts, update facts and respond to unavailable facts (the questions already asked by the students without answers given by chatbot). The experimental assessment conducted on the chatbot using some students of the selected domain indicated that, the students find the application useful for institutional enquiry purposes based on the assessment scores obtained in this study.

However, the future work should focus on adding more facts to improve the chances of .proving relevant answers to the student queries. The speech to text recognition capability should also be incorporated to the proposed enquiry chatbot.

Data Availability

The data obtained from the students that participated in the experiment and used for the study are already included in the paper.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

Funding Source

None.

Authors' Contributions

Author Abba Almu designed the study, performed the literature searches, formulates the problem statement and wrote the first draft of the manuscript.

Author Bala Salim Audu managed the analyses of the study, designed the proposed work, wrote the code and interpreted the results. Both authors read and approved the final version of the manuscript.

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