Vanaja Kumari Degala, 2024, 12:4
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology
An Open Access Journal

Design and Evaluation of an Intelligent Chatbot for University Enrollment and Tuition Support

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Abstract- University students frequently encounter difficulties in accessing clear and timely information related to enrollment procedures and tuition payments, which can result in administrative delays and increased workload for academic offices. This paper presents the design and evaluation of an intelligent chatbot developed to assist students by automatically responding to inquiries related to enrollment and tuition support. The proposed system integrates machine learning (ML) and natural language processing (NLP) techniques to interpret user queries and deliver accurate, context-aware responses. The usability of the chatbot was quantitatively evaluated by measuring the time required for users to complete key tasks, including account registration, query execution, and system un-subscription, with an average completion time of approximately three minutes per task. Additionally, a user satisfaction study was conducted with sixty students to assess system performance in terms of ease of use, response speed, behavioral appropriateness, confidence in future use, and quality of responses. Results show that all evaluated criteria achieved average scores above 3 on a 5-point Likert scale. These findings indicate that the proposed chatbot is efficient, user-friendly, and well accepted by students, demonstrating its potential as a scalable digital solution for supporting university enrollment and tuition-related services.

Keywords: Chatbot, cloud server, natural language processing, neural network, machine learning.

I. INTRODUCTION

Software engineering programs aim to train highly competent professionals capable of addressing modern technological challenges. Each academic semester, universities admit a large number of new students, which significantly increases the demand for administrative information related to enrollment procedures, tuition payments, and associated fees [1]. During registration periods, students frequently seek assistance to resolve these issues, relying on administrative departments and institutional web portals as primary information sources [2]. Previous studies have reported that most student inquiries regarding enrollment and payments are repetitive, resulting in an overload of administrative staff and delays in service delivery [2]. Although digital resources are available, students often experience difficulties accessing accurate and relevant information efficiently. Furthermore, a considerable proportion of students come from cities other than where the institution is located, making in-person consultation more challenging and increasing their dependence on remote information channels [3]. Inadequate information-seeking and reading habits have also been identified as contributing factors to students' lack of understanding of enrollment and tuition-related processes [2]. The length of institutional documents and frequent updates to university websites often hinder students' ability to locate the required information, leading to confusion and unresolved doubts. As a result, students may rely on informal or unofficial sources, which can further exacerbate misinformation.

In recent decades, rapid technological advancements and the widespread adoption of digital devices and services have transformed many aspects of society [4]. Higher education institutions are increasingly required to adopt technological solutions that provide timely, accessible, and reliable information to their students. In this context, Artificial Intelligence (AI) offers promising tools for automating administrative support services. Machine Learning (ML), a subfield of AI, enables the automatic recognition of patterns within data [5], while deep learning approaches based on Artificial Neural Networks (ANNs) have demonstrated strong performance in classification

and prediction tasks [6]. Additionally, Natural Language Processing (NLP) allows systems to interpret and generate human-like responses to user queries. Chatbots, which combine ML and NLP techniques, have emerged as effective tools for supporting students by providing instant responses to frequently asked questions and personalized assistance [7]. Motivated by these capabilities, this study proposes the design and evaluation of an intelligent chatbot system that assists students by answering questions related to enrollment and tuition support in a software engineering academic context.

The main contributions of this work are summarized as follows:

- A fully open and customizable chatbot system is presented, with source code publicly available on GitHub [8], enabling adaptation and deployment across different platforms and institutions. The system uses a messaging application as the primary communication channel with end users.
- The proposed solution is evaluated from both quantitative and qualitative perspectives. Experimental results show an average completion time of approximately three minutes for key user tasks, including registration, query execution, and un-subscription. In addition, user perception results indicate a positive acceptance of the system and its potential use in future academic administrative processes.

II. RELATED WORKS

Table I summarizes chatbot-based solutions proposed over the past five years that address student inquiries related to university enrolment and registration processes. Most of the reviewed studies employ Artificial Neural Networks (ANNs) as predictive models to classify user intents and generate appropriate responses. Regarding communication mechanisms, several solutions rely on Facebook Messenger to interact with students, while others are integrated into institutional web portals or are limited to desktop-based simulations. One of the most closely related chatbot solutions was proposed in [2], where the authors utilized Dialog flow to develop a conversational agent aimed at supporting students with administrative queries. By leveraging the capabilities of this Google-based platform, the authors were able to simplify system integration within a mobile application

TABLE 1. Chatbots with AI developed over the last 5 years and whose purpose is to support university students in administrative processes.

Ref.	Authors	Goal	AI techniques/tools	Integrated with…
[9]	Hailu, G. Y., & Welay, S. (2024)	Providing, in the Amharic language, information related to higher education studies in Ethiopia.	SVM, Multinomial Naïve Bayes, and ANN through TensorFlow, Keras, NLTK	Facebook Messenger
[10]	Dewantara, A. S., & Aryanto, J. (2024)	Facilitate the processing of user input questions at the Yogyakarta University of Technology, Indonesia	Bag of Words, ANN through Sastrawi, Flask, NumPy, among others	Website of Universitas Technology Yogyakarta (UTY)
[11]	Nguyen, M. T., et.al. (2021)	Support the admission process by automatically answering questions of the admission of Hung Yen University of Technology, Vietnam	TF-IDF, NER, Rasa platform	Facebook Messenger
[12]	Windiatmoko, Y., et.al. (2021)	Answer queries asked by people to any university. Authors mention that the chatbot has not been used operationally on any university campus	ANN(LSTM), RASA framework	Facebook Messenger
[13]	Al-Madi, N. A., et.al. (2021)	Assist students from the Al-Zaytoonah University of Jordan using a Jordanian dialect	TD-IDF, Hibernate, Spring, Apache Wicket, Lingpipe, the Jazzy spelling, the Stanford NLP parser and Google search libraries	Website of the Al-Zaytoonah University of Jordan
[2]	G. A. Lindao Alfonso and R. A. Castañeda Auquilla (2020)	Facilitate access to enrollment and registration information at the University of Guayaquil, Ecuador	Diagflow	Simulation with the Dialogflow console
[14]	Le Hoanh Su, T., et.al. (2020)	Support the admissions counseling process at the University of Economics and Laws, Vietnam.	Bag of Words, SVM, ANN	Chatbot website

The results highlighted a high level of acceptance among students, indicating the feasibility of incorporating chatbot-based solutions into academic administrative services. Despite its

advantages, the approach presented in [2] presents certain limitations. Although Dialog flow facilitates rapid development and deployment, it imposes quota restrictions and limits system customizability [15]. Additionally, the proposed application was not fully integrated with popular messaging platforms such as Telegram or Facebook Messenger, as user interaction with the chatbot was primarily simulated through the Dialog flow console rather than deployed in a real-world communication environment. To overcome these limitations, the proposed chatbot solution adopts a different development approach.

Python was selected as the primary programming language, along with its extensive set of Natural Language Processing (NLP) and Machine Learning (ML) libraries, to enable greater flexibility and control over system behavior. Furthermore, a messaging platform was chosen as a free and widely accessible communication mechanism for students. Based on these technologies, the proposed system is designed as a fully open and unrestricted chatbot solution, free from quota limitations. The complete source code, along with installation and user manuals, is publicly available [8], allowing other institutions and developers to personalize, adapt, and deploy the system seamlessly across different platforms, and not solely within a single messaging environment.

III. SYSTEM DESCRIPTION

This section presents the architecture, components, and operational flow of the proposed intelligent chatbot system designed to assist students with enrolment and tuition-related inquiries. The system integrates machine learning and natural language processing techniques to interpret user queries and provide automated responses through a messaging-based interface. The overall design emphasizes modularity, scalability, and ease of deployment.

Overview of the Proposed System

The proposed chatbot is an intent-based conversational system that processes student queries and generates appropriate responses based on predefined intents and trained machine learning models. The system is designed to address a specific administrative domain-enrolment and tuition support-while excluding unrelated academic or institutional services. Interaction with users is carried out exclusively through a messaging platform, requiring only an internet connection and a registered user account. The chatbot operates continuously in a cloud environment, ensuring high availability and real-time interaction. A backend application manages user requests, performs natural language processing, invokes the trained prediction model, and retrieves corresponding responses. User activity and registration data are stored in a relational database to support system management and usage control.

Technologies and Tools

The backend of the chatbot is implemented using Python, selected for its extensive ecosystem of libraries supporting machine learning and natural language processing. NLP tasks such as tokenization, lemmatization, and text normalization are handled using dedicated Python libraries, while the predictive model is implemented using a deep learning framework. An Artificial Neural Network (ANN) is employed as the core classification model to identify the intent behind each user query. The ANN architecture consists of multiple densely connected layers with regularization techniques to prevent overfitting. The output layer uses a softmax activation function to assign probabilities to predefined intent classes. A messaging application is used as the primary communication channel between users and the chatbot. This platform enables rapid message exchange and simplifies user interaction without requiring the development of a dedicated graphical user interface.

Natural Language Processing Pipeline

To enable accurate intent recognition, user messages undergo a sequence of natural language preprocessing steps before being passed to the prediction model. These steps include:

- Tokenization, where user input is divided into individual word units.
- Lemmatization, which reduces words to their base forms to minimize vocabulary size.

- Text normalization, including the removal of stop words, punctuation, and case conversion.
- Feature representation, where processed text is converted into a Bag-of-Words (BoW) vector indicating the presence or absence of terms within the system vocabulary. This representation serves as the input to the ANN model during both training and inference phases.

System Architecture

The system architecture follows a modular client–server design. Users interact with the chatbot through the messaging platform, which forwards messages to the backend application hosted in a cloud environment. The backend application processes incoming messages, invokes the trained ANN model for intent classification, and returns the appropriate response to the user.

A relational database is integrated into the system to store user registration details, interaction logs, and usage limits. This enables session control, activity monitoring, and enforcement of interaction constraints, such as daily query limits.

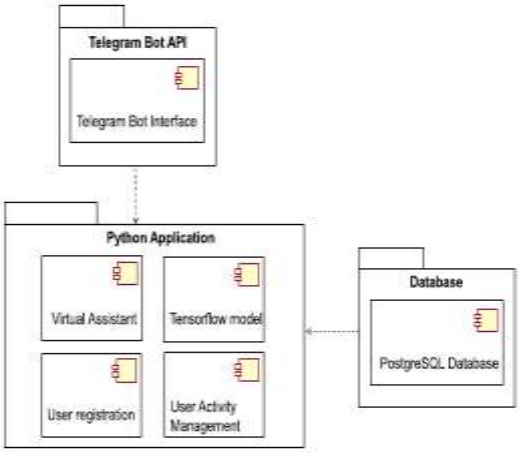

FIG 1. System component diagram.

Deployment Model

The chatbot backend is deployed on a cloud server to ensure continuous availability and scalability. The machine learning model is developed and trained locally before being integrated into the deployed application. Once deployed, the chatbot operates autonomously, responding to student queries in real time. The separation between model training and system deployment allows future improvements to be incorporated without disrupting service availability. Updated models can be retrained and redeployed as needed to improve response accuracy and system performance.

The physical deployment of the proposed chatbot system is illustrated in Fig. 2. Users interact with the chatbot through a messaging platform, which forwards requests to a cloud-hosted backend application. The backend processes user queries using the trained machine learning model and retrieves or stores relevant information in a relational database. Model training is performed on a local server, while the deployed system operates continuously in the cloud to ensure high availability.

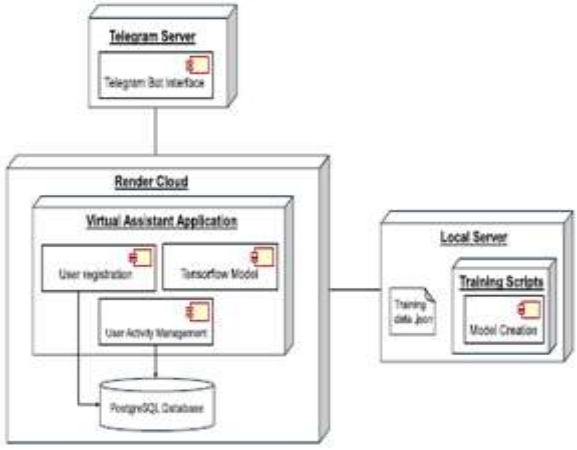

FIG 2. System deployment diagram

User Interaction Flow

Before accessing the chatbot services, users are required to complete a registration process that verifies their identity using an institutional email address. Authentication is performed using a one-time password mechanism to enhance security. Once registered, users can submit natural language queries related to enrolment and tuition processes. The system processes each query, identifies the corresponding intent, and selects an appropriate response from the predefined knowledge base. Users also have the option to unsubscribe from the service, which removes their data from the system database and revokes access to the chatbot.

IV. MODEL TRAINING AND IMPLEMENTATION

This section describes the process followed to train, evaluate, and integrate the machine learning model that enables the proposed chatbot to understand and respond to student queries related to enrolment and tuition support. The overall workflow includes data preparation, model construction, training, evaluation, and deployment within the chatbot system.

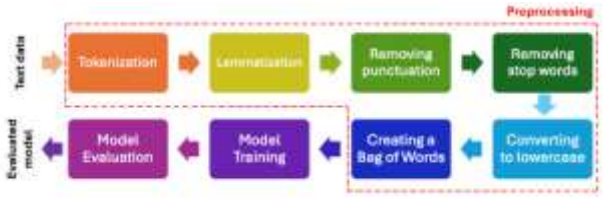

FIG 3. Pipeline followed for building the model.

Data Preparation and Preprocessing

The performance of machine learning models is highly dependent on the quality of the training data. For this reason, a structured dataset was created using a collection of frequently asked questions and representative student queries related to enrolment and payment procedures. Each query was associated with a predefined intent category, forming a labelled dataset suitable for supervised learning. Prior to training, all text data underwent a preprocessing pipeline to ensure consistency and reduce noise.

This pipeline included tokenization, lemmatization, conversion to lowercase, and the removal of stop words and punctuation. These steps helped reduce vocabulary size while preserving semantic meaning. To transform textual data into a numerical format, the Bag-of-Words (BoW) technique was employed. In this approach, each input sentence is represented as a binary vector indicating the presence or absence of words from a predefined vocabulary. This representation served as the input to the neural network during training and inference.

Artificial Neural Network Model

An Artificial Neural Network (ANN) was selected as the predictive model for intent classification due to its effectiveness in text-based classification tasks. The network follows a multilayer perceptron architecture composed of densely connected layers. Rectified Linear Unit (ReLU) activation functions were applied to hidden layers to introduce non-linearity, while a softmax activation function was used in the output layer to classify input queries into intent categories. To reduce overfitting and improve generalization, dropout layers were incorporated into the network architecture. Hyperparameters such as the number of neurons, learning rate, batch size, and number of training epochs were experimentally adjusted to achieve a balance between accuracy and robustness.

Model Training and Evaluation

The ANN model was trained using supervised learning, where input vectors derived from student queries were mapped to their corresponding intent labels. To obtain an unbiased estimation of model performance, k-fold cross-validation was applied, with the dataset divided into multiple subsets for training and validation across different iterations. Model performance was evaluated using classification accuracy and manual testing with unseen queries. Although some model configurations achieved higher accuracy values, they exhibited signs of overfitting. The final selected model demonstrated stable performance and reliable intent recognition when tested with previously unseen student questions.

Integration with the Chatbot System

Once trained and validated, the ANN model was integrated into the chatbot backend application. Incoming user messages are first processed by the NLP pipeline and transformed into BoW vectors. These vectors are then passed to the ANN model, which predicts the most likely intent associated with the query. Based on the predicted intent, the system retrieves a suitable response from a predefined response set and delivers it to the user through the messaging platform. This integration enables real-time interaction and ensures that students receive immediate and relevant responses.

Deployment and Data Management

The chatbot system was deployed on a cloud-based server to ensure continuous availability and scalability. The trained model was embedded within the deployed application, while user interaction data and registration records were stored in a relational database. This architecture allows for efficient monitoring of user activity, enforcement of usage limits, and future system enhancements. Additionally, the modular design enables the retraining and redeployment of updated models without interrupting the chatbot service.

V. CONCLUSION & FUTURE WORK

This paper presented the design and evaluation of an intelligent chatbot system aimed at supporting university students with inquiries related to enrolment procedures and tuition payments. By integrating Machine Learning (ML) and Natural Language Processing (NLP) techniques, the proposed solution provides automated, real-time responses to frequently asked administrative questions, reducing reliance on manual support services. The chatbot was implemented using Python-based ML and NLP libraries and deployed in a cloud environment to ensure continuous availability. An Artificial Neural Network (ANN) was trained to classify student queries based on intent, enabling accurate and context-aware responses.

Quantitative evaluation results demonstrated that users were able to complete key tasks such as registration, query execution, and un-subscription in an average time of approximately three minutes. In addition, qualitative feedback collected through user surveys indicated a positive perception of the system in terms of ease of use, response speed, behavioral appropriateness, and quality of answers. Overall, the results suggest that the proposed chatbot is an effective and user-friendly tool for automating academic administrative support. Its open and modular design allows for easy customization and deployment across different institutional contexts. The system shows strong potential to enhance information accessibility for students while simultaneously reducing administrative workload, making it a viable solution for future integration into university administrative processes.

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