Escort - Natural Language Processing Based University Students Guidance System

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Abstract - **Universities play a significant role in students' lives and aim to provide the best education, knowledge, and experience. However, university students face many difficulties during their university life including language, communication issues, and the inability to get proper guidance for education and career improvement. This paper proposes an approach to overcome these issues. With the help of Natural Language Processing (NLP), several solutions are implemented for the mentioned issues. First, a chatbot helps to communicate with the university administration, where students can ask relevant administrative-related questions. A recommendation system is developed to provide solutions for their psychological issues. Another recommendation system is built for career guidance which will help students to identify the future career of their interest, and the provided mentors will be able to guide them. Another recommendation system identifies the performance of students in each module according to their performance level. The system recommends learning materials to improve their level. With these components, ESCORT – A university students' guidance system, will make students' life easier and more efficient.**

Keywords—Natural Language Processing, administration, psychology, career guidance, performance level, pre-processing

I. INTRODUCTION

Education is one of the fundamental needs and a right of all human beings. Even though universities play a significant role in the life and career of students, various students cannot gain the full benefits of the universities for several reasons [1]. It is imperative to provide good service to university students because students face many challenges during the university period. This paper describes a web application with four main models (files that have trained to recognize certain types of patterns) to function as a helpdesk for university students.

A. Chatbots for University Administration and Students

Most university students are facing difficulties to get solutions to administration-related issues. Students have numerous doubts and questions regarding university administration but institutions do not have enough time to clarify all the questions in a limited time range [2]. If a student does not ask the question clearly and the administrator does not understand the question correctly or the answer provided by the administrator is not clear enough for the student, the information is being passed wrongly. According to the reference, more than 80% of university students face stress because of several factors [3]. To provide solutions to administration-related issues a chatbot is developed with NLTK and tokenization and lemmatization are used under text-preprocessing. This will be an effective time-saver for students to come to an accurate reply at any time. Having a chatbot with multiple languages will support the students and administration in managing the needs of students. From this, the students will be delivered the correct and accurate answers in the selected language until finding a solution.

B. Recommending solutions for psychological issues

Many university students are having psychological issues, nowadays. Evidence has given that mental health issues start at the beginning of university life and decrease throughout the studies [3], [4]. The increment and reach of common psychological problems including stress, depression, hostility, and anxiety peak around age 25 [5]. The students are affected mentally because of the disability to manage both studies and work simultaneously. Further, many students have difficulties explaining the issues in-person to psychiatrists and counsellors because of a lack of language skills. Also, some prefer their native languages to talk about their problems comfortably. In this research, a recommendation system has been implemented in English, Tamil, Sinhala, and Thanglish to provide solutions for psychological issues without delay and communication issues. Also, there is another feature called the Perceived Stress Scale (PSS). Students can predict their stress levels by answering the questions without consulting psychiatrists.

C. Career Guidance

Career Guidance for university students is an essential factor. Each student should know how their career path needs to be taken. For that, students must get the career guidance information handy.

D. Performance prediction and learning materials recommendation

Student academic performance in higher education is extensively researched to tackle academic underachievement, increased university dropout rates, and graduation delays [6]. The academic achievement of the students can be measured

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and assessed through examinations, assignments, and other forms of study measurements. Early prediction of performance and level in a particular module is essential for maintaining students on a progressive path in universities. The analysis of student performance and the availability of e-learning resources can be well-planned during the university days of the students [7]. To achieve timely prediction of student performance, a recommendation system is implemented to improve the student's weak areas by recommending study materials.

II. Literature Review

A. Chatbots for University Administration and Students

According to many authors having a chatbot will make students' life easier because chatbots can save a lot of time [8]. In a research, conducted during the pandemic, the authors mentioned the interaction between the student and teacher became low and the students find it difficult to get solutions for their doubts [8], [9]. Therefore, the authors have implemented the system based on voice and text. Having multiple options to ask questions will make the user input easier [8]. In a research, study authors implemented a chatbot that allows both audio and text user input [2].

Having a chatbot will help to make the university administration 24/7 [2]. To check the bot's accuracy many authors have asked the same queries in different ways by changing the working, sentence order and irrelevant orders [2]. An author developed a text-based chatbot for the Indonesian language [11]. The tokenization, preprocessing and pattern match they have used is similar to the one used by Hiremath [12]. Developing a chatbot and providing accurate answers for the educational system is important. Research related to educational domain chatbots collected around 1500 questions and responsive answers from an educational organization [13]. Having a large amount of data set will help to maintain the accuracy of the answer provided by the chatbot. In a research, the same query is asked in a different form by changing the wordings and adding special characters to increase the accuracy of the chatbot. [2] As per the readings mentioned above, the idea of a chatbot with multiple language support will be helpful to university students and university administration. Although many researches are conducted related to educational chatbots, most of them do not have enough accuracy and enough functionality.

B. Recommending solutions for psychological issues

People prefer recommendation systems in every situation [14]. It has been established that psychological issues affect university students worldwide from the literature review of the past 30 years [15]. The trend of higher numbers of students with psychological issues continues to be accurate as reported by 93.7% of directors [16]. Even though many psychiatrists are available, students have no time to consult psychiatrists or go to counselling for treatments because students are far away from home and continue university academic activities [15].

Lack of communication is one of the critical issues for university students. Some students are not fluent in English, and some can not describe the issues clearly in English [17]. 19.1% of students experience more than two mental issues. It had revealed by the Logistic regression models that female students over 21 years old, non-heterosexual students, and students from lower socioeconomic backgrounds were more probable to have psychological and behavioural problems. Even though 10% of students received treatment for psychological issues, 22.3% of students did not seek solutions for their problems [18].

C. Career Guidance

A question-Answering system using Natural Language Processing (NLP) is an exciting research component. The system will be asked a question from the user, and then the question will be processed and answered based on the context or relevant data found in the database. Converting a natural language query to SQL and retrieving answers from the database is an approach where it needs a mapping of natural language to SQL queries [36]. Another approach of extracting the keywords in the query and, based on the query providing the answers from the datastore is another approach followed in the question answering (QA) implementation [37].

D. Performance prediction and learning materials recommendation

Academicians measure student success from a variety of perspectives [6]. A basic study was carried out to examine similar existing systems used to analyze student performance. Faculty Support System (FSS): Shana and Venkatachalam have proposed a framework named FSS.FSS uses cost-effective open-source analysis software, WEKA, to analyze student performance. The classification technique is used here. The framework identifies factors that contribute to student performance in a specific course [24]. Student Performance Analyzer (SPA) is an online web-based software that allows teachers to view student performance, and track school data and is designed to analyze, display, store, and collect feedback on student assessment data [25]. It also enables the generation of student performance reports, such as progress reports and achievement reports. Intelligent Mining and Decision Support System (InMinds) helps the University Malaysia Sarawak (UNIMAS) to monitor the performance of various fields in each department of UNIMA [26].

Kovacic analyzed the early prediction of success through machine learning techniques. The review examined socio-demographic characteristics and characteristics of courses to obtain effective forecasting [27]. A comprehensive analysis of supervised machine learning techniques was conducted and applied to predict students' performance in the examination. They considered different factors, including demographics and social interest, to predict students' expected scores in the final term as well as students at risk [28].

III. METHODOLOGY

This research work presents a guidance system for university students using four main functionalities. These individual functionalities act as the solutions for some of the problems faced by university students during their university life. Fig.1 represents the whole functionality of the system.

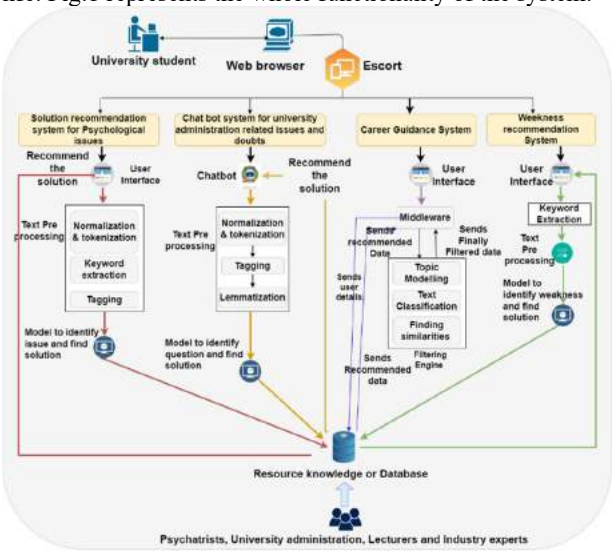

Fig 1: System overview diagram

A. Chatbots for University Administration and Students

The proposed administration-related chatbot has the capability of, allowing students to choose their preferred language to ask questions, identify the issue student asked in their preferred language and give an accurate solution for the asked question in the same language. The system identifies the question asked by the student in the given language choice and pre-processes the sentence and identifies the proper solution. Students can access the system via a web application and there they can access the chatbot. Students can choose their preferred language mode (English, Tamil, and Thanglish) and start asking questions related to administration. The system identifies the input and prepares the text data by commencing pre-processing, [19] which uses various steps like removing punctuations, tokenization, and removing URLs according to our dataset. Text pre-processing includes tokenization and lemmatization.

Four thousand questions and relevant answers for them were the datasets collected from Sri Lanka Institute of Information Technology (SLIIT) students using a questionnaire. The dataset is saved as a JSON file and the model gets the question from a user and compares it with the dataset and gives an accurate answer. Once the preferred language is chosen and the question is asked by the user, the tokenization method is used to divide each sentence into words/ tokens. The tokenized words are gone under the lemmatization process which removes inflections and maps the word to its root form. Then all the words are changed as lowercase letters and saved to their tag, which is given in the dataset. Once the texts are prepared the prebuilt model which was developed with NLTK and text pre-processing techniques, identifies them and analysis those with the dataset the system has. Then the system can reply with a suitable answer. Students can continue this process until receiving a proper solution to the questions, they have.

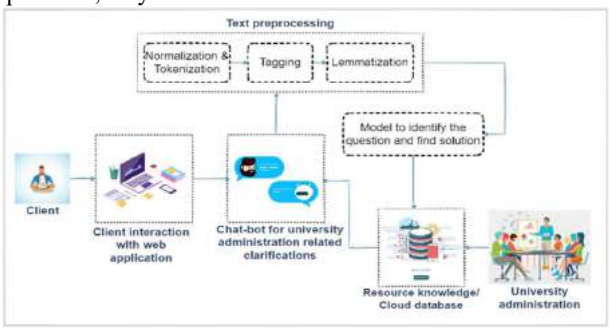

Fig 2: System Diagram of Administrative Chatbot

B. Recommending solutions for psychological issues

The datasets were collected among the students at the Sri Lanka Institute of Information Technology (SLIIT) through a questionnaire. The language is selected, and the issues and feelings are typed by the students in the given text box. The description of students is split and listed down the words and sentences. Then it is tokenized using the Natural Language Tool Kit (NLTK). NLTK was developed in conjunction with a computational linguistics course at the University of Pennsylvania in 2001 [20].

The models which contain the dataset for English, Tamil, Sinhala and Thanglish are trained using Gensim [21]. Gensim is a fast, data streaming and open-source python library to train models. Here, the important word(s) that are psychological issues and the reasons for those issues are extracted. Keyword extraction is a technique that automatically identifies a set of terms that best describe the subject [22]. The extracted keywords are compared with the trained models and calculated the similarity. The solutions which have the top 5 accuracy rates will be identified and stored in an array. The solution which has the highest accuracy rate is recommended as a solution to students. The number of activities in the solutions will be changed based on the psychological issues. This recommendation system is developed in English, Tamil, Sinhala and Thanglish with 95.68% accuracy. Another feature, Perceived Stress Scale (PSS) is implemented to predict the stress level of the students. There were 10 multiple-choice questions and 5 choices with different points. Each point range has different stress levels Low, Medium, and High. Students have to select the answers and the system calculates the stress level according to the response to the given questions

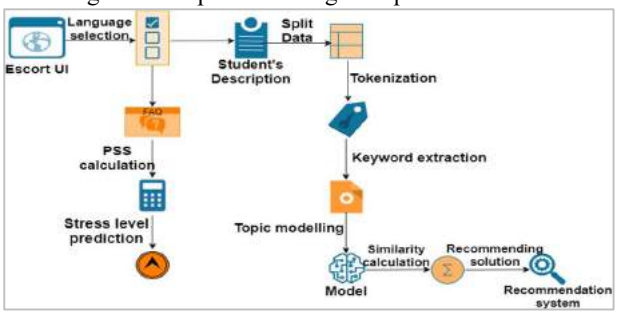

Fig 3: System Diagram of Recommending solutions for psychological issues

C. Career Guidance Recommendation

Career guidance-related information was scrapped through websites and from field-related experts' blogs. Then the information was fed into a datastore FAISS (Facebook AI Similarity Search). The questions and answers were annotated using the annotation tool. After the annotated dataset was split into train and test. The retriever model was trained by an annotated question and respective answers. The retriever model was built using Dense Passage Retrieval (DPR) to choose the suitable context from the datastore for the query. Along with that, a graph database which includes mentors and course details for the IT students was also implemented.

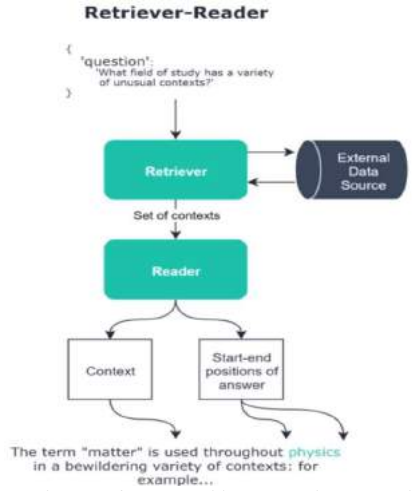

Fig 4: System Diagram of Career Guidance Question Answering System

D. Performance prediction and learning materials recommendation

Predicting students' performance in undergraduate studies is crucial for any university. Understanding students' performance in each module ahead of time is essential for supporting at-risk students in reducing the challenges they confront in their learning journeys and assisting them in excelling in the learning process. The data collection of this proposed system is based on attributes such as marks and duration. Academic performance will be predicted based on the online quiz provided by the system. When a student enters our system, it will provide the opportunity to select subjects that they will have in their semester. After the selection of the subject, the quiz will be started by the system with the instructions.

Development of a model for performance prediction and recommendation. For this first import the dataset. The next step is to visualize that dataset. After that, check the null values and categorical columns. Then the data set is preprocessed. Plotted the graphs based on the preprocessed dataset and visualized the correlation. Next, split the dataset into two parts for training and testing the model. Train the model by applying different algorithms.

Algorithms and their accuracy rate:
Support Vector Machines Algorithm - 39%
Decision-Tree-Classifier Algorithm - 86%
Random-Forest-Classifier Algorithm - 87%
Gaussian-Naive-Bayes Algorithm - 79%

Finally, Random Forest Classifier Algorithm was selected which was given high accuracy. After that, testing was done using Random Forest Classifier model, and lastly, visualize the confusion matrix. According to those steps, the system will classify student performance into three categories (high, average, and low) based on their quiz scores and duration. Then the system will analyze the student's performance and provide recommendations like e-learning materials or resource links to help them improve their academic achievement.

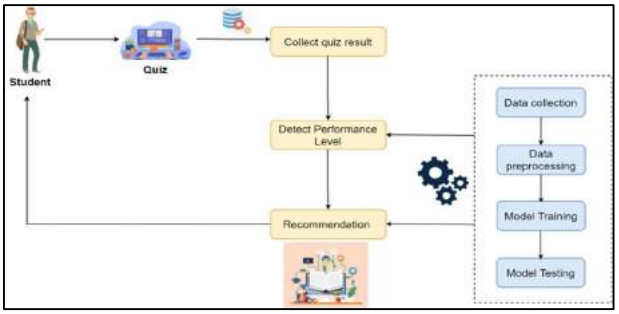

Fig 5: System Diagram of Performance Prediction and Learning Materials Recommendation System

IV. Result

A. Chatbots for University Administration and Students

The administrative chatbot developed to overcome the communication and time issue which support English, Tamil, and Thanglish is helping students to ask any questions related to administration and get accurate solutions for that. As the website is developed as responsive, users can easily access it via any portable electronic device such as a phone, laptop, smart TV, and tab. The recommended system is giving answers with an accuracy of 94% for the English language and 87% and 85% of accuracy for Tamil and Thanglish. In the future, the dataset will be increased to improve the accuracy of each language.

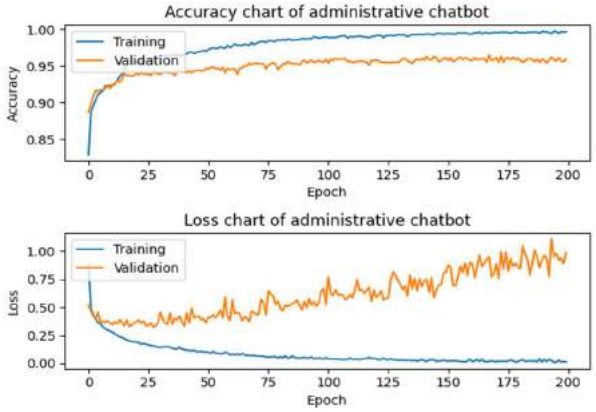

Fig 6: Accuracy chat of model training

B. Recommending solutions for psychological issues

This recommendation system is developed in English, Tamil, and Sinhala for university students to get solutions for psychological issues without communication issues. Thanglish recommendation system development is in progress. The students are recommended solutions including activities and exercises which saves students time and money. Students can access these recommendation systems at a

convenient time. These systems recommend simple, effective, and reliable solutions. The accuracy of the system is 95.68% Also, there is a feature called the Perceived Stress Scale (PSS) which is used to predict the stress level of the students implemented. Apart from the access of students, a word embedding graph is implemented to identify the probability of psychological issues.

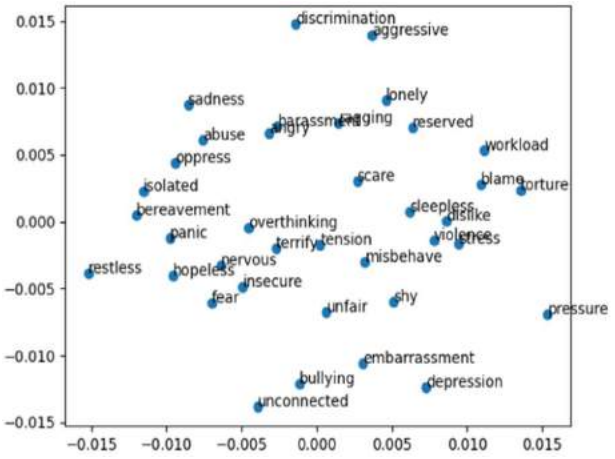

Fig 7: Word embedding graph for the probability of psychological issues

TABLE I. EVALUATION TABLE FOR RECOMMENDING SOLUTIONS FOR PSYCHOLOGICAL ISSUES

Error	Value
MAE	0.5
RMSE	0.3

C. Career Guidance Recommendation

From the collected information on career guidance, a DPR model was built and tested. The answers that were provided by the system were acceptable to a certain extent. It needs a lot of career guidance-related information to provide more relevant and detailed answers to the queries.

	precision	recall	f1-score	support
hard_negative	0.9722	0.9722	0.9722	1007
positive	0.2000	0.2000	0.2000	35
accuracy			0.9463	1042
macro avg	0.5861	0.5861	0.5861	1042
weighted avg	0.9463	0.9463	0.9463	1042

Fig 8: Evaluation of QA System

D. Performance prediction and learning materials recommendation

This system conducts online quizzes and is based on the results, predicts performance, and recommends appropriate learning materials. This proposed model is designed to predict performance and recommend online videos, and tutorials link based on that performance. This system achieved 87.15% model accuracy. Using our system, students will get the motivation to improve on their own. This system meets its goals of improving student performance and helping to enhance their final grades. In the future, our system aims to get more accurate results.

V. EVALUATION

A. Chatbots for University Administration and Students

Three models have been developed for three languages (English, Tamil, and Thanglish). The English language has a dataset with around 3700 questions and relevant answers. It has an accuracy of 98.61%. The Tamil model has the accuracy of 93.33%, which gave accurate answers for nine out of 10 questions. The Thanglish model with around three thousand data set has an accuracy of 88.84%. Overall, the answers provided for each language are satisfiable. However, adding more datasets will improve the solution provided by the chatbot.

B. Recommending solutions for psychological issues

The datasets for each model were evaluated through offline evaluation, user study and online evaluation. 48% of issues were evaluated using offline evaluation, 16% of issues were evaluated through a user study and 36% were evaluated with online evaluation [23]. The probability of some psychological issues is graphed using Word embedding and matplotlib. Mean Absolute Error (MAE) and Root Mean Square Error (RMSE) are the statistical accuracy metrics that are used typically. MAE measures the deviation of recommendation from the value of the user. RMSE excessively corrects large errors as the residual is squared.

C. Career Guidance

From the DPR model the following evaluation metrics were obtained. Precision & recall are the traditional measures that have been long used in information retrieval. While the F-measure is the harmonic mean of the precision and recall; these three metrics are given by:

Precision= number of correct answers / number of questions answered

Recall= number of correct answers / number of questions to be answered

F Measure = 2 Precision * recall / Precision + Recall

Overall, career guidance related questions and the answers provided by the system were satisfiable to the end user. However, providing more information and storing it in the datastore will improve the quality of the answers given by the system.

D. Performance prediction and learning materials recommendation

When comparing our research ideas to existing ones most of them are designed to predict school students' performance, but Escort is designed for university students. Most of these systems predict performance using Grade Point Average, Cumulative Grade Point Average, grades, student demographics, and psychological attributes. Our system predicts students' performance based on transcripts, which include assignment marks, lab test marks, and mid-exam marks, so it helps the students improve their final exam marks. Escort recommends appropriate online learning materials based on performance. This will help them concentrate on each subject and improve their performance.

The goal of this project is to create a system that can predict student performance in a specific module by conducting online quizzes using classification algorithms. The purpose of this research is to forecast student performance, with a particular focus on identifying students who may fail to satisfy course requirements. It was created to help students by allowing them to view their performance in a certain module and get the recommended learning materials to help them overcome their weak subjects.

VI. Conclusion

In this paper, Escort proposed a system which helps university students in many ways. The administrative chatbot will help students and administration to save time and get proper answers to their questions. The psychological recommendation model will identify students' psychological issues and propose solutions. The system will identify students' weaknesses in modules and recommend resources to improve their education. And the career guidance system will help students to select the best career path with the help of mentors.

In the future, the Escort system will be extended by increasing accuracy and giving live conversations with psychiatrists and career mentors. Also, Escort will contact the university lecturers to add study materials to each module to improve the students' knowledge.

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