

ESCORT - NATURAL LANGUAGE PROCESSING BASED UNIVERSITY STUDENTS' GUIDANCE SYSTEM

2022-179

Final Report – Group

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DECLARATION


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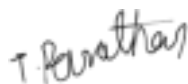
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ABSTRACT

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 the 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.

ACKNOWLEDGEMENT

This research was supported by our supervisor Ms. Hansi De Silva and our co-supervisor Mr. Dharshana Kasthurirathna and our external supervisor M.s Archchana Kugathan, we thank them for their support and guidance. We express our gratitude to the Students Affairs of Sri Lanka Institute of Information Technology, Dr. Gadambanathan Thanabalasingam (District Consultant Psychiatrist, Batticaloa) for providing information to conduct this research. Also, we thank our colleagues for participating in the survey.

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LIST OF ABBREVIATIONS

NLP	Natural Language Processing
SLIIT	Sri Lanka Institute of Information Technology
PSS	Perceive Stress Scale
API	Application Programming Interface
PKL	Pickle file
NLTK	Natural Language Took Kit
ReLU	Rectified Linear Unit
QA	Question Answering

1. INTRODUCTION

Education is one of the fundamental needs and a right of all human beings. Even though universities play a key 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 (a file that has been trained to recognize certain types of patterns) to function as a helpdesk for university students.

I. 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 payment, sports, exams, parking, etc. But most of the students don't get reply from administration on time. The main reasons for these are, as the number of students in a university is high and institutions do not have enough time to clarify all the questions in a limited time range [2]. There are many reasons for a student to get incorrect information and late replies such as if the 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. According to the reference, more than 80% of university students face stress because of several factors [3]. A chatbot system is developed to provide solutions to administration-related issues. The model for the chatbot is developed with NLTK. 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.

II. Recommending solutions for psychological issues

Many university students are having psychological issues, nowadays. It is evidenced that mental issues start at the beginning of university life and decrease throughout the studies [4], [5]. The increment and reach of common psychological issues including stress, hostility, depression, and anxiety peak around age 25 [6]. The students are affected mentally because of the disability to manage both studies and work simultaneously. Issues in universities such as academic and non-academic issues, bullying, and misunderstandings with family, friends, lecturers, and other students impact the mental state of students.

Further, quite a lot of students are feeling nervous to explain their issues in person to psychiatrists, counsellors, family, and friends. Numerous students have difficulties in communication because of a lack of language skills. Also, some prefer their native languages to discuss the issues. This research is to provide effective solutions for the psychological issues of university students without any communication and language issues. Also, the detection of stress levels using the Perceived Stress Scale (PSS) feature is implemented. Students can predict their stress levels by answering the given question.

III. Career Guidance

Career guidance for university students is one of the important aspects of academic studies. There is a need for students to clear their doubts and questions on their career-guidance. A career is one of the most important parts of a student's life as well as for a person who is trying to get another job as well. To shape up their skills and to enhance their knowledge in a specific field of study is important. The career –guidance units in the universities and educational institutes are not much known by the students until half of their life in universities. The steps taken by the career-guidance units are mostly not acknowledged by the students. The notices, workshops and training provided by the career-guidance unit should reach each student. Not only, the programs conducted by the career-guidance unit, but also with a QA system that can answer questions of students regarding the career-guidance would be more beneficial for students. Therefore, a system that can answer questions of students on career-guidance is implemented on this research paper.

IV. Performance prediction and learning materials recommendation

Much research is being conducted on the academic performance of students in higher education in order to address academic underperformance, rising university dropout rates, and later graduation [32]. The early prediction of performance is essential for maintaining students on a progressive path. It can help to maintain or improve the quality of teaching and performance of students 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 [33]. Timely predicting student performance makes it possible to detect underperforming students. To achieve this goal, a recommendation system is implemented with a high accuracy rate to improve the weak areas of a student using the recommended study materials. The proposed system will predict student performance by conducting an

online quiz per subject and also it recommends e-learning resources based on the performance.

1.1 Background Literature

1.1.1 Background

I. Chatbots for University Administration and Students.

Unable to get a proper solution or answer to a question is one of the common problems university students are facing. One of the reasons for this is, as the number of students in a university is high and institutions do not have enough time to clarify all the questions [7]. So, some students never get replies for the questions they have asked. As shown in Figure 1 more than 85% of the students do not get replies to their questions all the time. The other 14% of the students who got reply from the administration also does not get a confident solution.

According to the reference university students are facing more than 80% of stress because of several factors [3]. If university administration does not send reply on time, students will get some more stress because of not finding a solution. As show in in Figure 1, even if the students get a reply with a solution/ answer it is not clear enough or it in not helping to solve the question/ issue they are having. Only approximately 26% of the students are satisfied with the provided solution.

These are many reasons that a student gets wrong information. If the student does not as the question clearly and the administrator do not understand the question well or the answer provided by the administrator is not clear enough to the student. One of the main reasons for the above problem is communication. Sri Lankan students faces difficulties in English communication because it is taught as second language. This communication issue can lead to wrong information transfer. According to Figure 1.3, in the COVID-19 pandemic time students faced a lot of challenges to contact the university administration.

To provide a solution to this developing a chatbot system to clear students administrative related issues will be a time saver and effective for students to get accurate reply on time. Having a chat-bot with multiple language support will help the students and administration to manage the need of students. They can ask the questions they have with their preferred language, so that the clearness of the question will be easily passed among the student and the chat-bot. And students

can ask multiple questions until they find a solution.

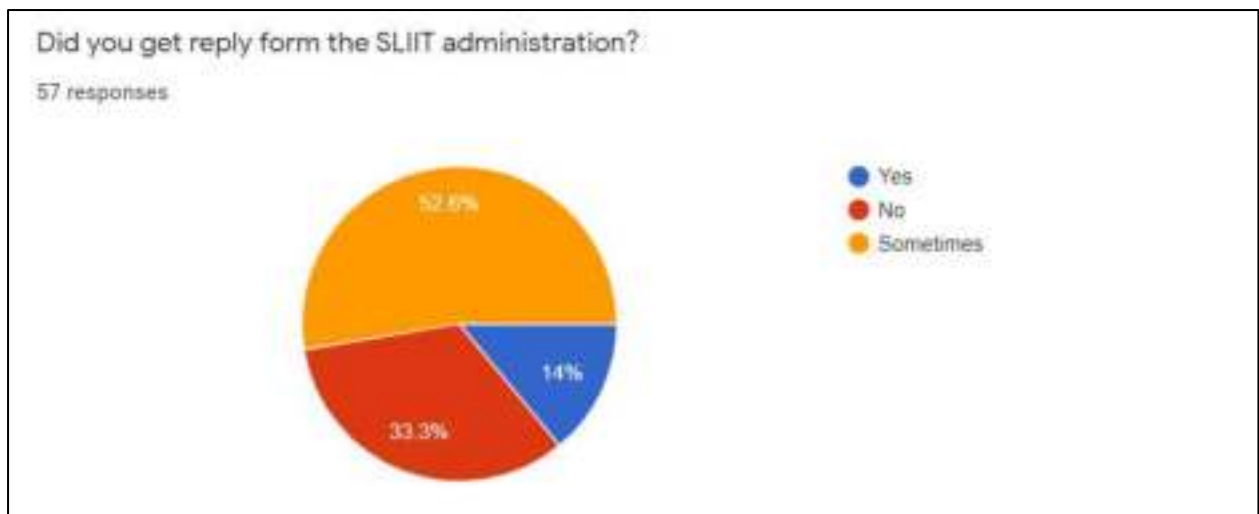


Figure 2: Summary of responses to know did students receive reply form university administration

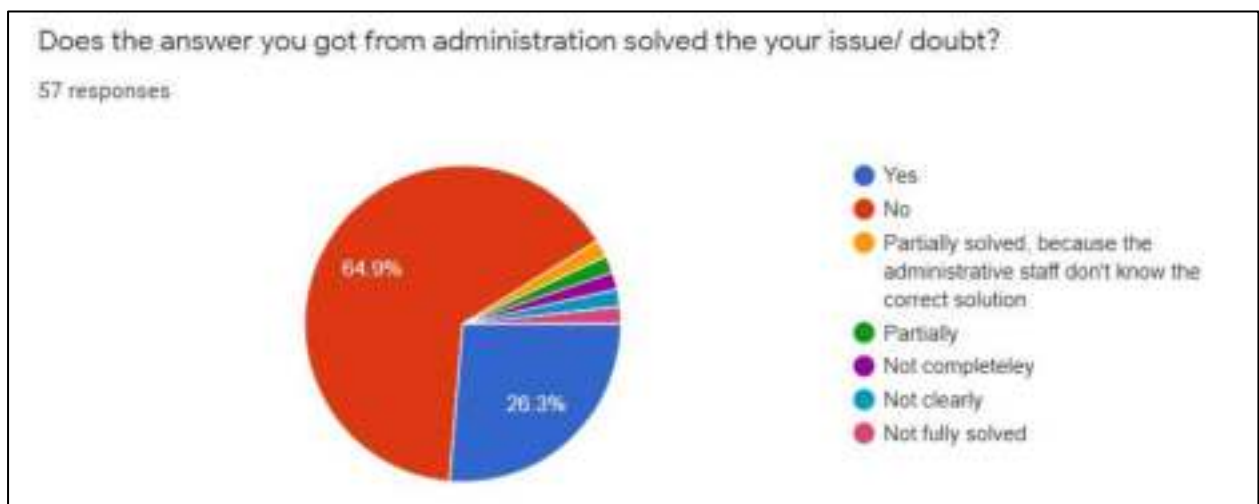


Figure 1: Summary of how the answer from university administration solved student's issues

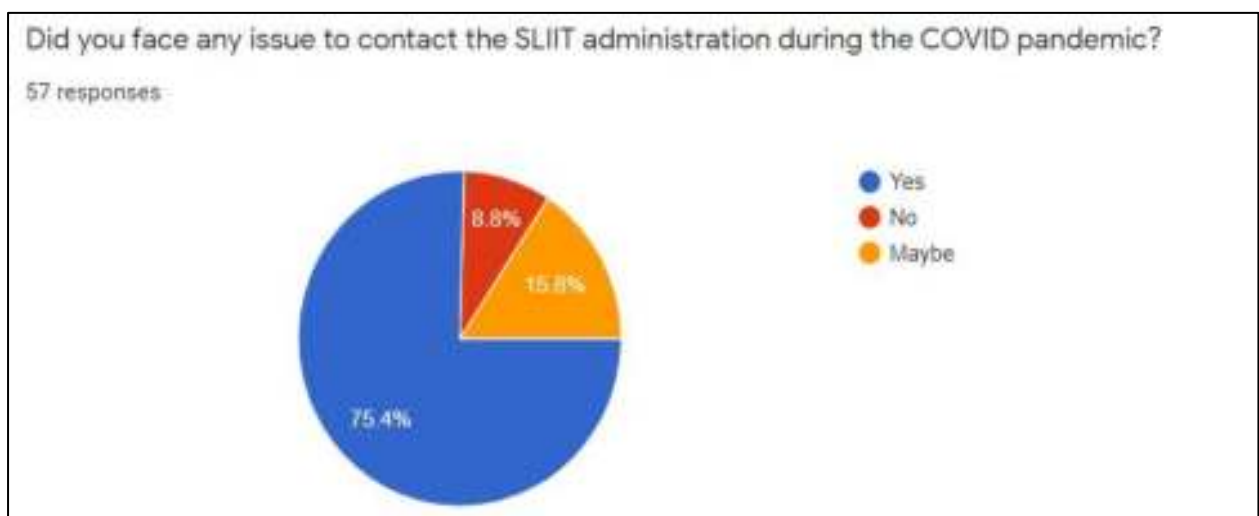


Figure 3: Summary of responses to know if students faced difficulties to contact administration during the COVID pandemic

II. Recommending Solution for Psychological Issues.

The additional evaluation has known varied socio-demographic, situational and educational aspects as possible bases for mental problems of students. Unquestionably, the uneasiness of the university way characteristically affects mental health [8]. University students had additional negative feelings, psychological symptoms, and economic/social issues than the general population due to educational delays, the economic effects of the pandemic, and its effects on their standard of living [9]. The scholars also practiced serious mental issues like depression, anxiety, alexithymia, stress, and posttraumatic stress disorder [10], [11]. Lack of communication is one of the main issues that university students face. Also, students do have not enough time to consult psychiatrists and counsellors physically. The main reason for conducting this research is to provide better solutions for the psychological issues of university students without

III. Career Guidance QA System:

The Question-Answering system has been built for many closed and open domain use cases. A chatbot that answers questions from any domain is an open domain, whereas a chatbot that answers in a specific domain (E.g. healthcare-related things) is known as a closed domain. Building an open domain QA system needs more data and has many training hours, whereas building a domain-specific QA system is much more valuable and timesaving than an open domain QA system. A QA system can be built by using different methods. For example, rule-based, context-based, using the knowledge base, and database approach. The most useful approach that can provide the best solution for a QA system is integrating NLP techniques and usages. Applying NLP in the QA system has boosted the research area prominently.

IV. Performance prediction and learning materials recommendation.

There is a significant amount of research conducted on student academic performance in higher education to address difficult issues such as academic underachievement, rising university dropout rates, and late graduation [34]. Simply put, student achievement refers to the extent to which students meet short- and long-term educational objectives. The academic performance of students must be assessed in order to promote growth and improve the quality of higher education.

Student's academic achievement can be assessed through examinations, assignments, and etc. It is essential for maintaining students on a progressive path. If a student's performance can be predicted well in advance, it can help to maintain or improve the quality of teaching by predicting students' interests in subjects, student-level activities, and contributing to their performance in universities.

The analysis of student performance and the availability of e-learning resources can be well planned during their institutional study period [35]. Timely forecasting of student performance makes it possible to detect underperforming students and recommend appropriate learning materials. Students could also improve their learning activities on their own.

1.1.2 Literature Review

I. Chatbots for University Administration and Students

Many kinds of research have been conducted to create a better chatbot for university students. According to many authors having a chatbot will make students' life easier because chatbots can save a lot of time [1]. According to 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 [1], [2]. The teachers also found it challenging to answer all the questions asked by each student. Therefore, the authors have implemented the system based on voice and text. Having multiple options to ask questions will make the user input easier [1]. In research, study authors implemented a chatbot that allows both audio and text user input [7].

Usually, a student will be unable to contact the administration all the time. There can be holidays and working days issues. But having a chatbot will help to make the university administration 24/7 [7]. 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 [12]. The tokenization, preprocessing and pattern match they have used is similar to the one used by Hiremath et al. [13]. Developing a chatbot and providing accurate answers for the educational system is important because students need to get a proper solution for their doubts without wasting their time. Research related to educational domain chatbots collected around 1500 questions and responsive answers from an educational organization [14]. Having a large amount of data set will help to maintain the accuracy of the answer provided by the chatbot. In the research made by [7] the same query is asked in a different form by changing the wordings and adding special characters to increase the accuracy of the chatbot.

As per the readings mentioned above, the idea of chatbot with multiple language support will be helpful to university students and university administration. Although many researches are conducted related to an educational chatbot, most of them do not have enough accuracy and enough functionality. Also, there are no researches prevailing that have multiple language support for users to communicate with the chatbot.

II. Recommending solutions for psychological issues

The expertise of important stages of mental health problems is the biggest issue for several university students. However, it is combined by its association with alternative food habits, behaviors and weaknesses in studies, and an analysis representing the associations among these issues and mental health issues are given [8]. [5]. In addition to students' retrospective self-ratings of impairment, the impacts of psychological issues on university outcomes have conjointly been incontestable lengthwise [15]. For instance, students' levels of psychological issues at mid-course have foreseen decreases in test performance from the first to the second year, even when dominant for previous performance [16].

The demand and the need for recommendation systems are increasing nowadays. People prefer recommendation systems in almost every situation [17]. It is established that psychological issues affecting university students worldwide from the literature review of the past 30 years [8]. The trend of greater numbers of students with psychological issues continues to be true as reported by 93.7% of directors [18]. Even though there are many psychiatrists available, students face some difficulties in contact physically. 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 [8].

Lack of communication is one of the critical issues for university students. Some students are not fluent in English, and some are unable to describe the issues clearly in English [19]. 19.1% of students experience more than two mental issues. It was revealed by the Logistic regression models that female students over 21 years, non-heterosexual students, and students from lower socioeconomic backgrounds were more probable to have psychological and behavioral problems. Even though 10% of students received treatment for psychological issues, 22.3% of students did not seek solutions for their issues [20].

III. Career Guidance

A simple closed-domain question answering system was built for the baseball game during the 1960s. This was the first attempt at a question-answering system [31]. A system for Question Answering called "YodaQA" was built based on unstructured answers' sources. The primary source for the system is DBpedia ontology and the Freebase RDF dump, and it uses multiple searching techniques such as full-text search, structured search, and document search [29].

SQL databases are prevalent for their usage. It has been one of the most used databases in the world. As these are widely used, using SQL as a database and querying answers for a question will provide more possibility of getting the answers. However, natural language needs to be converted to SQL queries to query the DB. In this approach [30], SQL and NoSQL databases can be used to query.

Answerbag is a question-answering website where users can ask their questions and get answers. The questions can include fact-checking, entertainment, or any other open-domain questions. Professional researchers and site members can also answer the questions on the website. This site can be considered an expert community system as well.

IV. Performance prediction and learning materials recommendation

Many studies have already been carried out in this field. Academicians evaluate students' progress from a variety of different perspectives, such as their final grades, grade point averages, and potential future jobs [34]. According to a recent comprehensive survey, nearly 70% of the examined work looked into predicting student performance using grades and GPAs, whereas only 10% of the studies looked into predicting student achievement using learning outcomes [35]. A basic study was carried out to examine comparable systems which were already in use to evaluate student performance.

(a) Faculty Support System (FSS)

It helps to track student performance in a course. It is an open-source software [33]. Data mining techniques like the classification technique are used in this search. The classification technique is used for forecasting student performance.

(b) Student Performance Analyzer (SPA)

The SPA is a web-based software. It allows teachers and staff to view student performance and track school information. SPA is designed to analyze, display, store, and collect feedback on student assessment data [36]. Apart from that, it enables the generation of various types of student performance reports, such as progress reports and achievement reports.

(c) Intelligent Mining and Decision Support System (InMinds)

University of Malaysia Sarawak (UNIMAS) is used InMinds to monitor the effectiveness of several fields within each UNIMA department [37]. The features, usability, and flexibility of the system, make it ideal for analyzing the performance of UNIMAS. This system provides charts to aid in the interpretation of student achievement.

Kovacic analyzed the early prediction of success through some machine learning techniques. The review examined socio-demographic characteristics, i.e., education, work, gender, and characteristics of courses in order to obtain effective forecasting [38]. In order to forecast student performance on the exam, a comprehensive analysis of supervised learning and machine learning approaches was conducted. They considered different factors, including demographics and social interest, to predict students' expected scores in the final term as well as students at risk [39].

1.2 Research Gap

I. Chatbots for University Administration and Students.

Having questions to university administration is common in every universities. Students at a university, lecturers and parents also have many questions that they would like to clarify with the university administration. A university administration is tried to contact by phone, email, and in person. But the administration cannot answer all the questions on time and accurate. Also, there are a lot of miscommunications happening because of the language issue. In that respect there is a need for a system to answer all administrative related questions in the language user prefers. For that purpose, Natural Language Processing techniques are used as an approach to create a chatbot with multiple language support.

There are a lot of research conducted related to chat-bot for education system where students can get benefit by resolving their issues and save time. But most of those are developed between students and lecturers to ask doubts in a specific subject [1], [2], [14]. But having a platform to ask questions other than modules or subjects is not much researched.

In the research conducted by Sangeeta Kumari, Zaid Naikwadi, Akshay Akole and Purushottam Darshankar, they have implemented a chat-bot for both students and parents to clear the doubts they have related to the university administration [7]. And another research also designed to solve administrative issues using chat-bot [13].

But these researches are focusing on one language. Mostly all the researches are using English as their communication language or one other specific language. The research conducted by Bayu Setiaji and Ferry Wahu Wibowo is developed for Indonesian language only [12]. When it comes to a university, there can be a lot of different students who speak different languages. Having only one specific language for communication is a drawback in these researches.

Only one product is released for real users to test the application to identify the success or failure among them. Other products have not been tested with users.

Table 1: Comparison of former researches

Products	Designed for university students	Designed to resolve administrative issues	Multiple language selection	Released for real users
Research A [1]	✓	×	×	×
Research B [2]	✓	×	×	✓
Research C [4]	✓	✓	×	×
Research D [21]	✓	✓	×	×
Research E [12]	✓	×	×	×
Escort	✓	✓	✓	✓

The proposed system Escort is designed to overcome the above limitations other researches have. Escort is focusing on the issues university students are having related to university administration. Also, the multi-language selection is also provided where students can choose their preferred language form the provided options. By releasing the final product to real users, we can identify how well the system is useful and what are the improvements or enhancements can be done in the future.

II. Recommending Solution for Psychological Issues.

Psychology-related problems are common nowadays. Thus, there is a demand for solutions for psychological issues. Even though there are some other applications available, people face some difficulties because everyone is not familiar with English to express what exactly they feel. Also, those available applications are not specific to university students as designed for common users [22].

Further, unlike directly providing the exact problem and finding solutions, this application gives chance to find out the solution simply by describing how they feel if the university students are unable to diagnose the psychological issues they have [16]. Also, this recommendation system recommends solutions such as simple activities and exercises which can be manageable with students' studies and work. This recommendation system is an easily accessible and user-friendly web

application which is available 24/7 in English, Tamil, Sinhala and Thanglish for university students.

Features	Champions mind	Sintelly	Positvt	Escort
Designed for university students	✗	✗	✗	✓
Language selection	✗	✗	✗	✓
Solution for known issues	✗	✓	✓	✓
Solution for unknown issues	✗	✗	✗	✓
Simple solution	✓	✗	✓	✓

Figure 4: Comparison table of physiological recommendation system

III. Career Guidance.

The different research that was conducted up to now are based on combining NLP techniques such as entity recognition, pos tagging, creating knowledge bases, and querying them with machine-understandable queries by constructing queries using NLP mapping methods. There is a lack of a system for education-based QA. Especially in the career-guidance system for university students.

Research related to career guidance using an expert system approach [6] was about analyzing the student's personal skills and helping them to choose the right vocational course for their college studies. But this doesn't help the students to get to know about their industry, culture, and latest trends followed in that field. Therefore, a system should be there to assist students to do the following things and prepare students themselves for the job.

IV. Performance prediction and learning materials recommendation

Predicting students' performance eventually became a difficult endeavor. Prediction algorithms now in use are insufficient to forecast students' performance in higher education institutions. As a result, there was a clear need for more advanced approaches for predicting at-risk students and determining what factors influence their outcomes, which inspired us to conduct this research. This study contributes to the existing knowledge base by predicting student academic performance and assisting in the identification of students with poor grades who can then be reviewed and given new learning materials and strategies to help them improve their marks.

When we compare our research ideas to existing ones. Most of them are designed to predict school students' performance, but we will design for university students. Most of these systems predict performance using GPA, CGPA, 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. In particular, we recommend 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 academic achievement in a specific module by evaluating the students' performance using data mining 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 [32]. As a result, the system will predict students' performance and based on it, recommend learning resources. It helps the students to overcome their weak subjects.

Features	Faculty Support System (FSS) [7]	Student Performance Analyzer (SPA) [8]	Intelligent Mining and Decision Support System(InMinds) [9]	Student Performance Analysis System (SPAS) [10]	Escort
Designed for University Students	✗	✗	✓	✓	✓
Based on transcript	✗	✗	✗	✓	✓
Accurate performance prediction	✓	✓	✗	✗	✓
Categorizing before posting	✗	✗	✗	✗	✓
Recommending E-Learning Resources	✗	✗	✗	✗	✓

Figure 5: Comparison table of performance prediction

1.3 Research Problem

I. Chatbots for University Administration and Students.

Students and university administration need to manage their time to be productive. Also, students need to be clarified if they have any doubts related to university administration. From the conducted survey we can identify that most of the students are facing a lot of issues while clarifying the doubts from university administration.

According to Figure 6 we can see that approximately 60% of the students think that the university administration misunderstood their question because of language issue. Understanding the question incorrectly will lead to wrong information sharing and it will be very harmful to both students and administration.

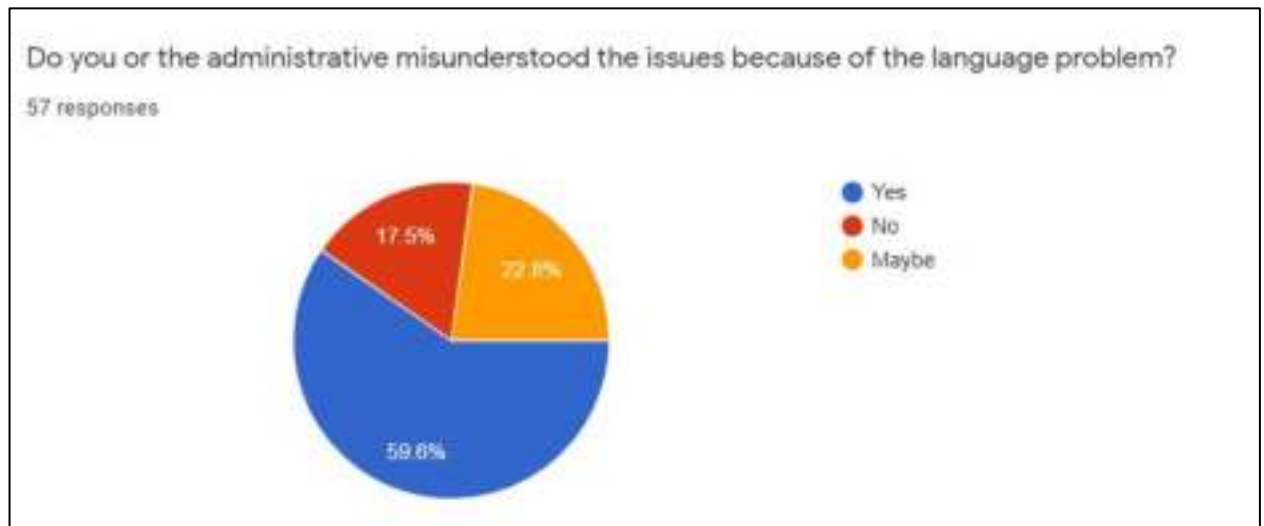


Figure 6: Summary of response to identify language issue

According to Figure 7, most of the students use email and phone as communication media to contact university administration. Because of a lot of emails and calls, university administration is also unable to response to all of them. This leads to having unresolved doubts or questions among university students.

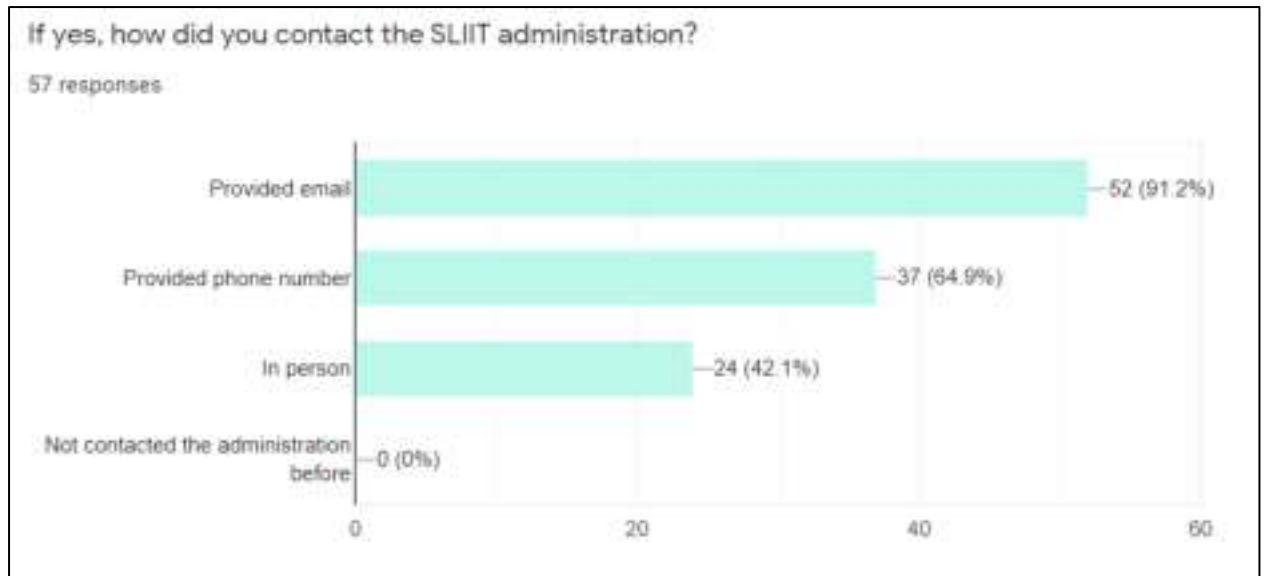


Figure 8: Summary of response to know communication platform

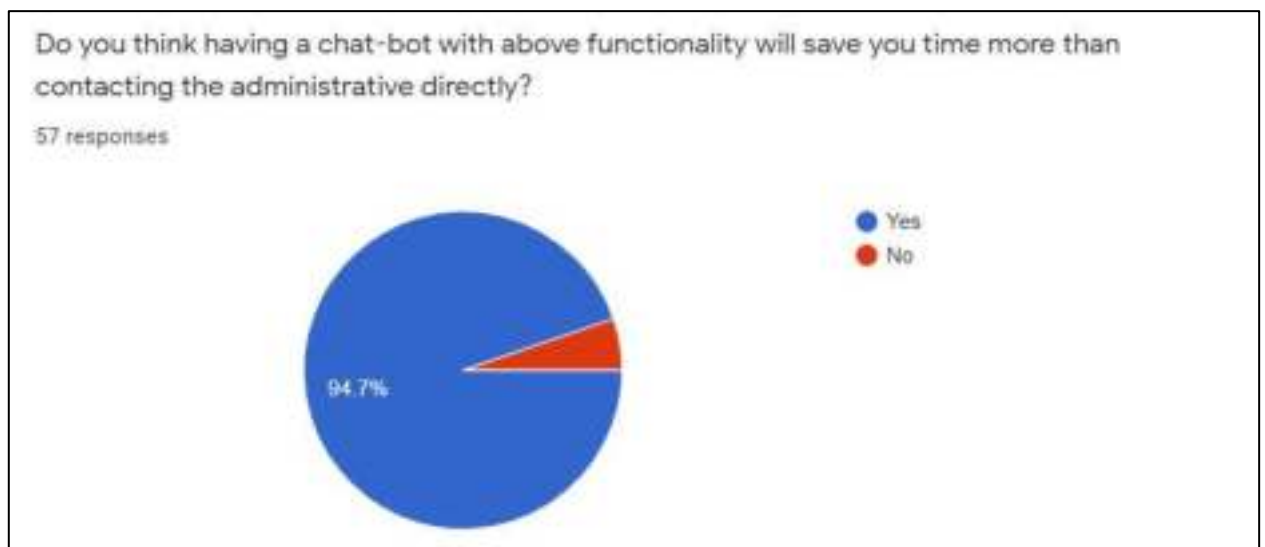


Figure 7: Summary of response to know if chat-bot is useful among students

Also, using a chatbot will reduce the waiting time for asking simple doubts [7]. During the survey, students also expressed that having a chat-bot will help them to reduce time and get accurate response (Figure 8).

Electronic devices and trending technologies had become the sensation of young generation, and most of them prefer to have online platform to solve every issue. This research proposes 'Escort' as a solution to support young generation university students.

II. Recommending Solution for Psychological Issues.

Psychological issues are the most common problem for everyone, especially university students. These issues are very dangerous if they are not treated at an early stage as it affects mental health. Many people do not aware of psychological issues. Even though the students identify the development of mental issues, the students do not have enough time to consult psychiatrists or counsellors for treatment because of the heavy schedule of studies, assignments, and exams. Some students do not consider these psychological issues a serious problem.

Some students use their own methods to get rid of the psychological issues temporary. Even though these methods reduce mental disorders in some students, those methods might not be effective for numerous students because of behaviors, habits, and daily routines of the students. This recommendation system would support the users to recognize the psychological issues and the stress level of the students and recommend solutions which are effective and manageable.

III. Career Guidance.

Career guidance system in university and education institutions: The career guidance in the universities and education institutions should be aware of what students are expected about their careers in the future as well as their internship opportunities. According to that, the career guidance unit needs to consider the needs of students and act according to them. Need for an expert system to be available for students anywhere at any time: In the university system, career guidance is mostly a one-way communication where instructions and notices are published through the learning management system. Even though workshops and guidance are organized physically or online, most students are not aware of it and are hesitant to participate in the programs. Therefore, an online platform that would solve the student's doubts about career guidance will be beneficial.

IV. Performance prediction and learning materials recommendation

Universities make it possible to improve knowledge, skills, and a way of life. However, nowadays, university students face many challenges [35]. They have difficulty contacting the university administration to address their educational needs. As a result, students are having difficulty obtaining administration-related information, such as payment problems, course details, IC status, and more.

More than that, students have difficulties in communicating language while sending emails and also when to raise their problems about academic needs. Students who face psychological problems are increasing daily and also many students are facing problems in choosing an appropriate career path [33].

2. RESEARCH OBJECTIVES

2.1 Main Objective

- This research recommends a proper system for university students where they can communicate using chatbot, related to administrative and personal issues and get an accurate solution.
- Also, from this system students can get a better career guidance and suitable solution for students' weakness according to their grades.

2.2 Sub Objective

- Give solutions for the doubts/ issues or clarifications related to university administration.
- Recommend exercises and activities in preferred language for psychological issues.
- Recommending answers for university students regarding their questions on career-guidance
- Predicts student performance and recommends suitable learning materials

3. METHODOLOGY

This research work presents 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. The Figure.1 represents the whole functionality of the system.

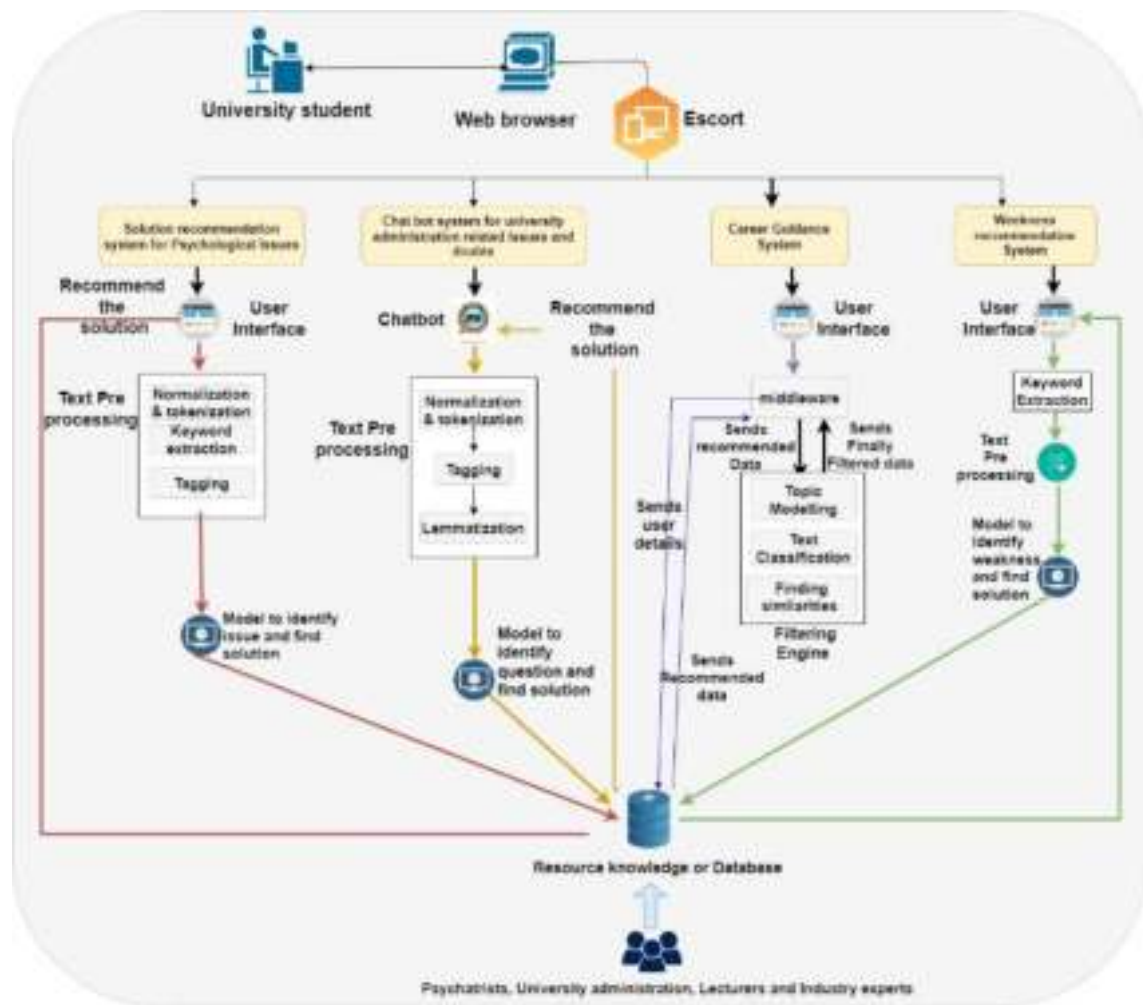


Figure 9: System Overview Diagram

3.1 Chatbots for University Administration and Students

The proposed “Escort” administration related chat-bot has the capability of,

- Allow students to choose their preferred language to ask questions.
- Identify the issue student asked in their preferred language.
- Give an accurate solution for the asked question.

The system will identify the question asked by the student in the given language choice and it will preprocess the sentence and identify the proper solution. Students can access the system via a web application and there they can access the cat-bot. They can choose their preferred language mode (English, Tamil, and Thanglish) and start asking questions related to administration.

The system will identify the input and prepare the text data by commencing preprocessing, [23] which will use various steps like removing punctuations, tokenization and removing URLs according to our dataset.

A. Data Collection

The primary goal of collecting requirement is to identify the administration related questions students are having. The questions for the data set are collected for SLIIT students via google questionnaire. The questionnaire had 9 sections, where students can add their questions according to the category. Later the questionnaire was shared among common users, so they can ask their common questions about SLIIT. The total questions received was around seven hundred and the data set has around three thousand questions with answers. The answers for each question are written with the help of SLIIT administration hundred and the data set has around three thousand questions with answers.

have related to university administration

We are final year students from faculty of computing at Sri Lanka Institute of Information Technology(SLITT). This is a survey to gather the questions students have related to university administration related to payment, examination, registration, university shuttle and more.

The questions can be anything related to administration which you already asked or want to ask the university administration. We are gathering information only for statistical purpose and you are not be identified individually. Your contribution is highly appreciated. Thank-you for your support.

Each question have samples in bracket to identify the category. You can type multiple answers for each question [Expected time to fill the survey - 5 to 10 minuts]

deepass1405@gmail.com (not shared) [Switch accounts](#)

***Required**

What are the questions you have related to **the courses available in your university?** (Available courses, fee, duration, qualifications to join, job opportunities for that course, bachelors or masters course, etc.) [Ex. What kind of Masters degrees are available related to Computer Science?]

Your answer

What are the questions you have related to **the registrations, payments and examinations in you university?** (Semester registration, IC, prorata, exam excuse, etc.)[Ex. What is the penalty for late semester registration?]

Your answer

What are the questions you have related to **the events happen in your**

Figure 10: The google form of data collection

Question No	Question	Response
1	What are the questions you have related to the courses available in your university?	
2	What are the questions you have related to the registrations, payments and examinations in you university?	
3	What are the questions you have related to the events happen in your	
4	What are the questions you have related to the courses available in your university?	
5	What are the questions you have related to the registrations, payments and examinations in you university?	
6	What are the questions you have related to the events happen in your	
7	What are the questions you have related to the courses available in your university?	
8	What are the questions you have related to the registrations, payments and examinations in you university?	
9	What are the questions you have related to the events happen in your	
10	What are the questions you have related to the courses available in your university?	
11	What are the questions you have related to the registrations, payments and examinations in you university?	
12	What are the questions you have related to the events happen in your	
13	What are the questions you have related to the courses available in your university?	
14	What are the questions you have related to the registrations, payments and examinations in you university?	
15	What are the questions you have related to the events happen in your	
16	What are the questions you have related to the courses available in your university?	
17	What are the questions you have related to the registrations, payments and examinations in you university?	
18	What are the questions you have related to the events happen in your	
19	What are the questions you have related to the courses available in your university?	
20	What are the questions you have related to the registrations, payments and examinations in you university?	
21	What are the questions you have related to the events happen in your	
22	What are the questions you have related to the courses available in your university?	
23	What are the questions you have related to the registrations, payments and examinations in you university?	
24	What are the questions you have related to the events happen in your	
25	What are the questions you have related to the courses available in your university?	
26	What are the questions you have related to the registrations, payments and examinations in you university?	
27	What are the questions you have related to the events happen in your	
28	What are the questions you have related to the courses available in your university?	
29	What are the questions you have related to the registrations, payments and examinations in you university?	
30	What are the questions you have related to the events happen in your	

Figure 11: Categories and dataset of each category

B. Natural Language Processing techniques and Model Build

1. Text preprocessing

In NLP, text preprocessing is the first step of implementing a model. To achieve an accurate chatbot the techniques tokenization, lower casing, stop words removal and lemmatization are being used. Tokenization is a text preprocessing technique which split the sentence into smaller units. Sentence tokenization is used to split the sentences into words. Then lemmatization is used to switch each words into its base root mode. Then the words are converted to lowercase and the stop words have been removed.

```
for intent in intents['intents']:
    for pattern in intent['patterns']:
        stop_words = set(stopwords.words('english'))
        word = nltk.word_tokenize(pattern)
        words.extend(word)
        documents.append((word, intent['tag']))

        if intent['tag'] not in classes:
            classes.append(intent['tag'])

words = [wordlemmatizer.lemmatize(word.lower())
          for word in words if word not in ignore_patterns and stop_words]
```

Figure 12: Implementation of text preprocessing techniques

2. Modal Build

The model is built using the above text preprocessing techniques. The model is developed by using Natural Language Toolkit (NLTK) and Keras library for artificial neural networks. The data set is created as a json file which have the university administrative related questions and responsive answers for them. The data set is called and put into tokenization, ignore patterns, lemmatization, and lowercasing techniques. Once the text preprocessing part is completed the words and their responsive labels are stored in PKL files, which is a file created by pickle that enables object to be serialized to files on disk and deserialized back into the program at run time. The model type being used is Keras sequential which allows to build a model layer by layer. 'Dense' layer type is used to create the layers and for activation function ReLU (Rectified Linear Activation) is being used. For the last layer 'Softmax' activation is used. The model is trained for two hundred epoch, which means the entire dataset is passed forward and

backward through the neural network two hundred times. Once the training is completed the model can be used to ask questions and get response.

```
model = Sequential()
model.add(Dense(128, input_shape=(len(train_x[0]),), activation='relu'))
model.add(Dropout(0.3))
model.add(Dense(64, activation='relu'))
model.add(Dense(32, activation='relu'))
model.add(Dense(16, activation='relu'))
model.add(Dense(len(train_y[0]), activation='softmax'))

model.compile(loss='categorical_crossentropy',
              optimizer='rmsprop', metrics=['accuracy'])
history = model.fit(np.array(train_x), np.array(train_y),
                  epochs=200, batch_size=5, verbose=1, validation_split=0.33, validation_data=(x_val, y_val))
model.save('model/english_administrative_chatbot.h5', history)
```

Figure 13: Implementation of layers and activations

3.1.1 System Architecture of administrative chatbot

The system architecture is shown in the Figure 14

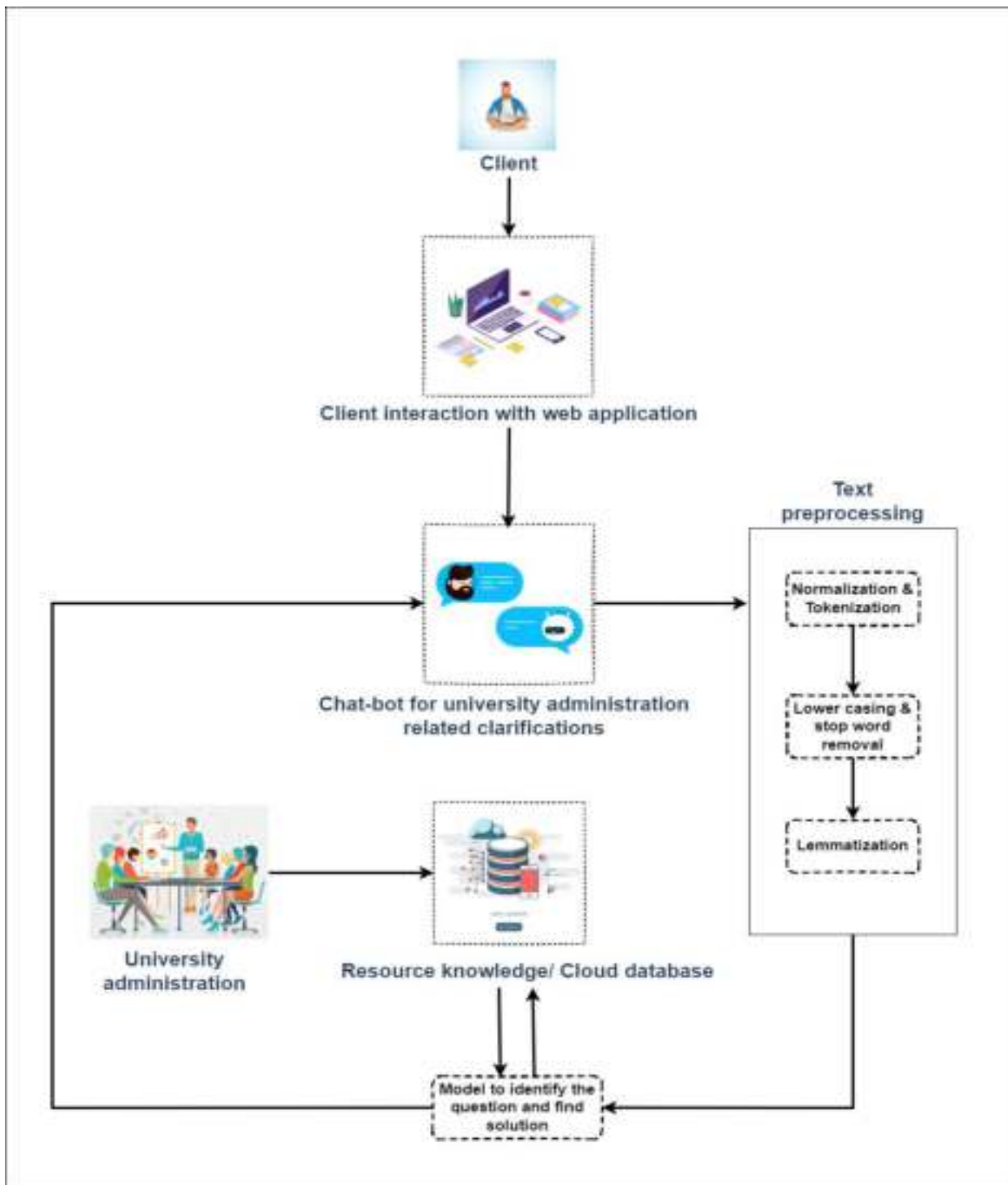


Figure 14: High Level Architectural Diagram of administrative chatbot

3.2 Recommending solutions for psychological issues

- Dataset collection

A questionnaire was prepared and distributed among the students at the Sri Lanka Institute of Information Technology (SLIIT). The questionnaire contained multiple choice questions and short answer questions to identify the mental issues, reasons, behaviors, and mental stages of the students. The responses were collected and analyzed to identify the psychological issues and the causes of those issues.

- Data Preprocessing

First, the university students are instructed to select the language among English, Tamil, Sinhala and Thanglish. Students' issues 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 [24]. There is a function called tokenize in NLTK which classifies the words and sentences.

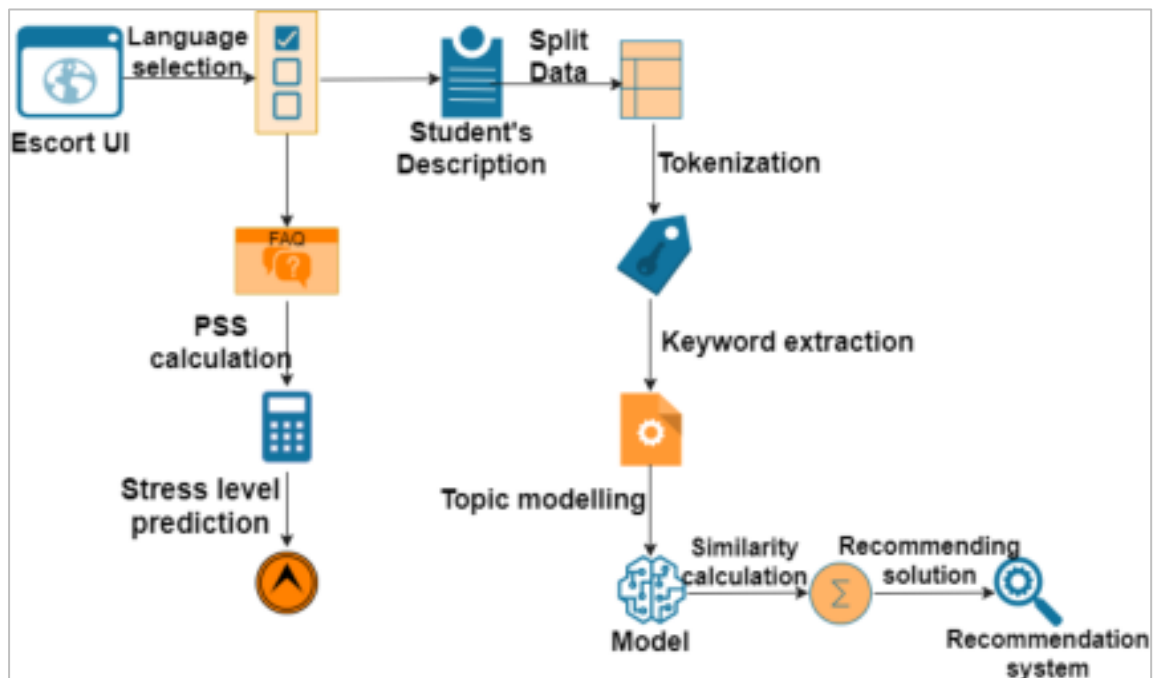


Figure 15: System overview diagram of psychological system

- Algorithm development

Once the data has been preprocessed, an algorithmic program is developed to process it [25]. There are many alternative Natural Language Process algorithms. However, 2 main varieties are usually used:

- a. Model

The models which contain the dataset for English, Tamil, Sinhala and Thanglish are trained using Gensim [26]. Gensim is a fast, data streaming and open-source python library to train models.

- b. Keyword Extraction

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 [27].

- Similarity Calculation and solution recommendation

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. The recommendation systems for English, Tamil and Sinhala are developed and Thanglish is in the process of development.

- Perceived Stress Scale

Another feature, Perceived Stress Scale (PSS) is implemented to predict the stress level of the students. There are 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.

3.3 Career Guidance

The Figure illustrates the overall system architecture diagram of the career-guidance QA system.

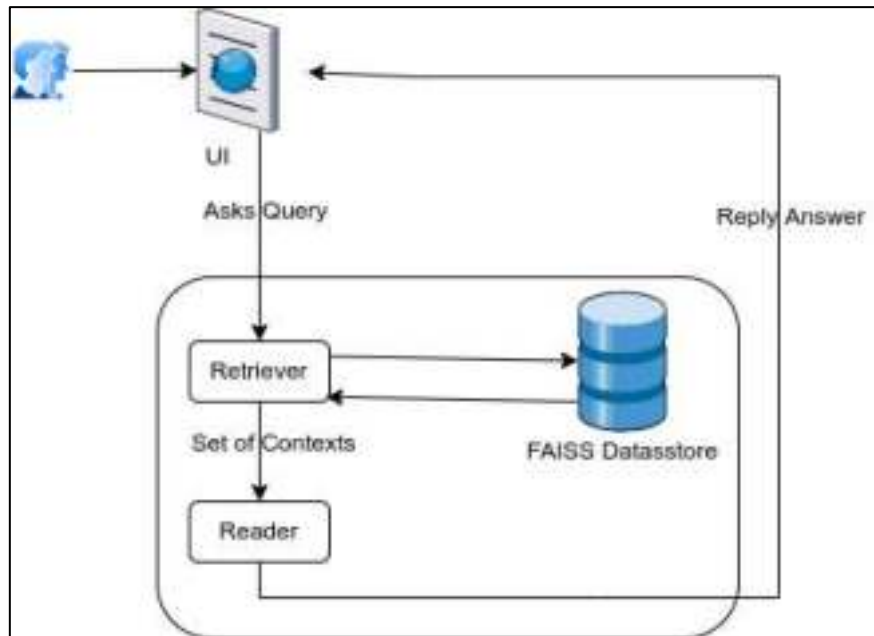


Figure 16: System diagram of career guidance

The system consists of a front-end created by React and with the backend written in python. In the backend, the haystack library is used to build the question-answering component. This library consists of the necessary components needed to build the whole system itself. The haystack library contains the following pipeline nodes for the processing of the input text. These nodes can perform the steps like preprocessing, retrieving, or summarization of text along with routing to different pipeline nodes as well. Nodes can be considered as the building blocks that are able to switch from one to another node where one node's output will be fed as input to the other node. In this research, the following pipelines are used from this library.

1. **Reader:** The reader pipeline node takes a question and a set of documents as input to the pipeline and returns the answer by selecting a suitable phrase within the documents. The reader can also be known as an open-domain QA system in Machine learning terminology.
2. **Retriever:** The retriever pipeline node performs Document Retrieval by sweeping through a document store and returns a set of candidate documents that are relevant to the query.

I. Document Passage Retriever and Model Build

A. Annotating the document

The collected data were annotated with questions and with the respective answers. The content of the dataset was preprocessed and removed special characters.

B. Train & Test dataset

Two datasets were prepared for the testing purpose separately. Both test and train datasets were annotated with a question and its respective answer.

Documents						
id	Text	Status	Label	Created	Updated	Actions
77136 0	The concept of graph database traces back to Leonhard Euler. Euler was an 18th century Swiss mathematician.	new	2648	14/07/2022	14/07/2022	+ -
77136 9	Javascript is a popular web development philosophy that aims to speed up both web development and the	new	2648	14/07/2022	14/07/2022	+ -
77137 0	abstract. Something that exists as an idea or thought but not in concrete or tangible (touchable) form.	new	2648	14/07/2022	14/07/2022	+ -
77137 1	NLTK (Natural language Toolkit) is used for such tasks as tokenization, lemmatization, stemming, pos-	new	2648	14/07/2022	14/07/2022	+ -
77137 2	Open-source software is software with code that anyone can view, modify or extend. Why prefer Open	new	2648	14/07/2022	14/07/2022	+ -
77137 4	Artificial intelligence: A type of knowledge-based decision-making exhibited by machines or computer-	new	2648	14/07/2022	14/07/2022	+ -

Figure 17: Annotated Documents List

Questions

11

What are the institutions providing degrees in IT in Sri Lanka?

What are the main IT business solutions?

What are the IT companies that pay more than 50000 per month?

What are the IT companies that pay more than 100000?

ADD CUSTOM QUESTION

Annotation Document

Search

To become a software engineer in Sri Lanka, the education (degree) from coursework and degree. The course type that you would have for such a degree includes math, computer history, engineering, and a variety of other areas relevant to computer work, programming languages, and software.

Computing and Information Technology courses offered by SLTE, NISM, NISM-Greek Campus, AICT, Information, ISM, ESCTT and many other Private Institutes. Bachelor of Information Technology (BIT) External degree from UCSC, BIT External Degree from University of Moratuwa.

Online Courses that are available for students in software engineering: [Udemy online courses](#), [Coursera](#), [FreeCodeCamp](#), [Codecademy](#).

Companies in Sri Lanka that pay more than 10k and above: Surge Global, Seival Group, H2O.ai, Atlas Labs, PMSquare (Sri Lanka, America).

IT Companies in Sri Lanka that pay 25k - 10k: Codestation, CreativeSoftware, Speco LABS, MyBudget, Appexin, WSC, Fortale, Vistara's Innovations Lab, Revocode Labs, CARE Technologies, Rensum Software Ltd, ADA, MoudheCode, Adage Digital, Sana Commerce Sri Lanka, VIZIWARE, Vistara's, Spexix, Diffusion Sri Lanka, Zeta Custom Exports Pty Ltd, Kalinovation Technologies, NVRIG, JRC Software, Sasa Colombo, Mau Labs Sri Lanka, Galaxy Technologies, TWC Innovations, Piyoon Care, CodeKee International.

Figure 18: Annotated Single Document with question and answers

II. Data Collection

The data for the research project was gathered from social media posts, medium articles, and different IT experts' interviews and talks in a text format.

3.4 Performance prediction and learning materials recommendation

The proposed system helps to predict the student's performance for a particular subject by providing online quiz and recommend suitable e-learning resources based on the performance. When a student enters our system, it provides the opportunity to select modules that they have in their semester. After selecting the module, the quiz will be conducted.

A. Dataset

The dataset was created according to the marks, and the time was taken for a quiz. We divide e-learning resources into five categories, so this dataset also has an attribute named tutorial group. It has more than 100 data points.

	A	B	C	D	E
1	Marks	Duration	Tutorial group		
2	65	1600	B		
3	45	650	C		
4	65	1500	B		
5	35	887	D		
6	75	800	A		
7	85	1800	B		
8	35	631	C		
9	65	2556	C		
10	25	1328	D		
11	60	1545	C		
12	25	898	D		
13	85	1936	B		
14	75	1945	C		
15	35	1768	E		
16	20	825	E		
17	75	1865	B		
18	95	2650	B		
19	90	2458	B		
20	25	945	D		
21	55	1714	C		
22	35	1685	D		
23	80	2590	B		
24	90	2565	B		
25	100	1990	A		
26	45	1000	C		
27	55	1765	C		
28	75	2214	B		

Figure 19: Dataset of performance prediction system

B. Model Development

First, import the dataset and visualize it. After that, check the null values and categorical columns and pre-processed the dataset. Plotted the graphs based on the pre-processed 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 to get the best accuracy. Finally, visualize the confusion matrix.

According to these processes, the system first displays the marks and the time based on quiz performance. Then the system will predict the tutorial group based on the model that is created. Finally, it displays the e-learning resources link. Students can view the resources by clicking the links. This system helps students to improve their academic achievement.

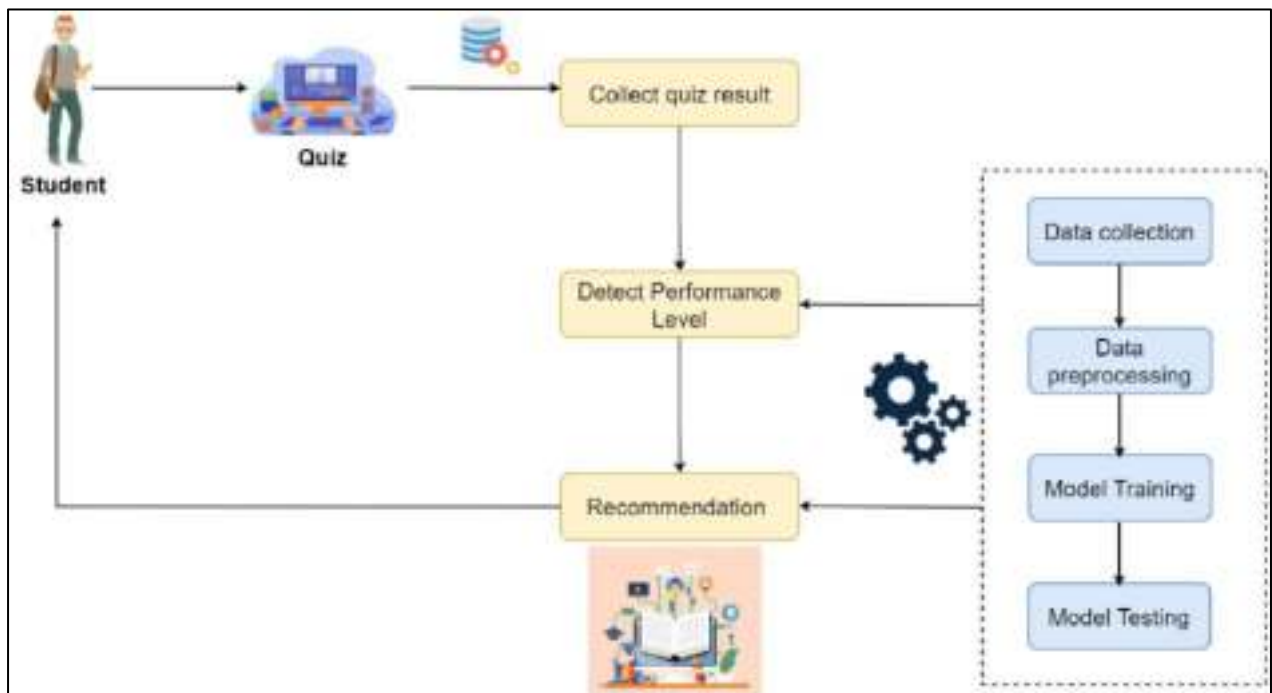


Figure 20: System overview diagram of performance prediction

3.5 Commercialization aspects of the product

Escort, which provides a perfect solution for university students in different ways. Students can ask administration related questions, get solutions for psychological issues, get career guidance, and predict the performance and get resources recommend. People don't like to wait to get a solution or lose time because of searching. We, Escort provide a full university guidance system for students, which will save a lot of time.

The system will help students to get on the spot solutions for administrative related questions and psychological issues. Multi language option is a biggest benefit for everyone. Students also can get career guidance mentors and identify their weakness module and get resources recommended on the spot. The system is implemented with multiple language option, which will help to overcome the communication issues. As the system will operate 24/7 users do not have to waste their time on waiting for a solution.

4. IMPLEMENTATION & TESTING

4.1 Implementation

I. Chatbots for University Administration and Students

All three language models (English, Tamil, and Thanglish) were implemented in this stage. Each model was trained using more than 2500 data set. As the first procedure, the chatbot model was implemented and trained in python language. NLTK is used to implement the text preprocessing part and Keras sequential method was used to create and train the model. Once the model was created an API as implemented to communicate with frontend.

Frontend was developed using Java Script (React JS framework). Once the user enters the web site, they can choose their preferred language and start asking their questions. All the interfaces were implemented with user-friendliness and responsiveness which user can access the website via any smart device (computer, laptop, mobile phone, and smart television).

The following are some of the interfaces which were implemented for administrative chatbot.

- A. Administrative home page
- B. English chatbot
- C. Tamil chatbot
- D. Thanglish chatbot

A. Administrative home page

Administration home page will help students to know what the system does, and it allow users to choose the language they preferred.



Figure 21: Administration chatbot home page

B. English Chatbot

English chatbot page is to ask questions only in English. It has the instructions about the questions users can ask. A chat option is provided in the page where users can easily type their questions and the get response immediately.

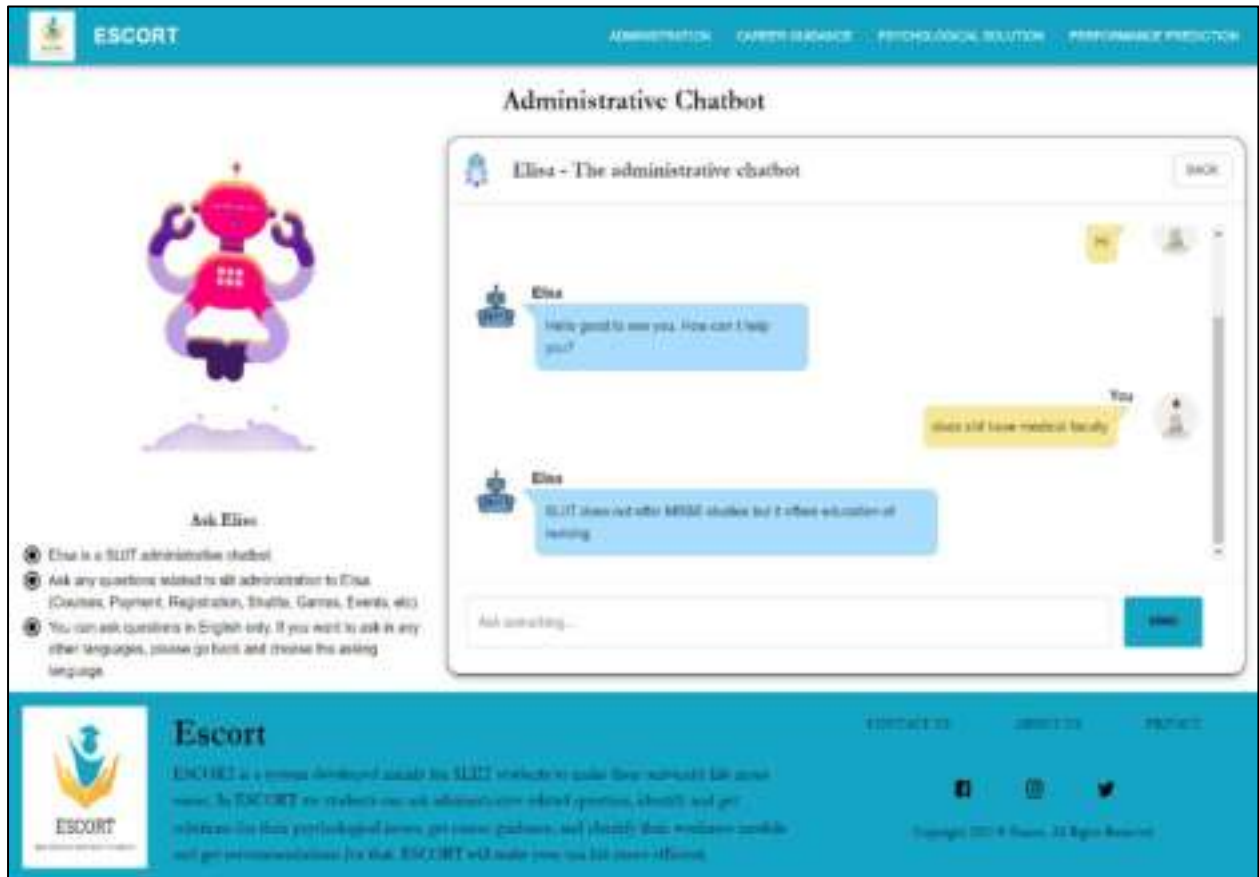


Figure 22: English chatbot

C. Tamil Chatbot

Tamil chatbot page is to ask questions only in Tamil. It has the instructions about the questions users can ask. A chat option is provided in the page where users can easily type their questions and the get response immediately



Figure 23: Tamil chatbot

D. Thanglish Chatbot

Thanglish chatbot page is to ask questions only in Thanglish. It has the instructions about the questions users can ask. A chat option is provided in the page where users can easily type their questions and get response immediately

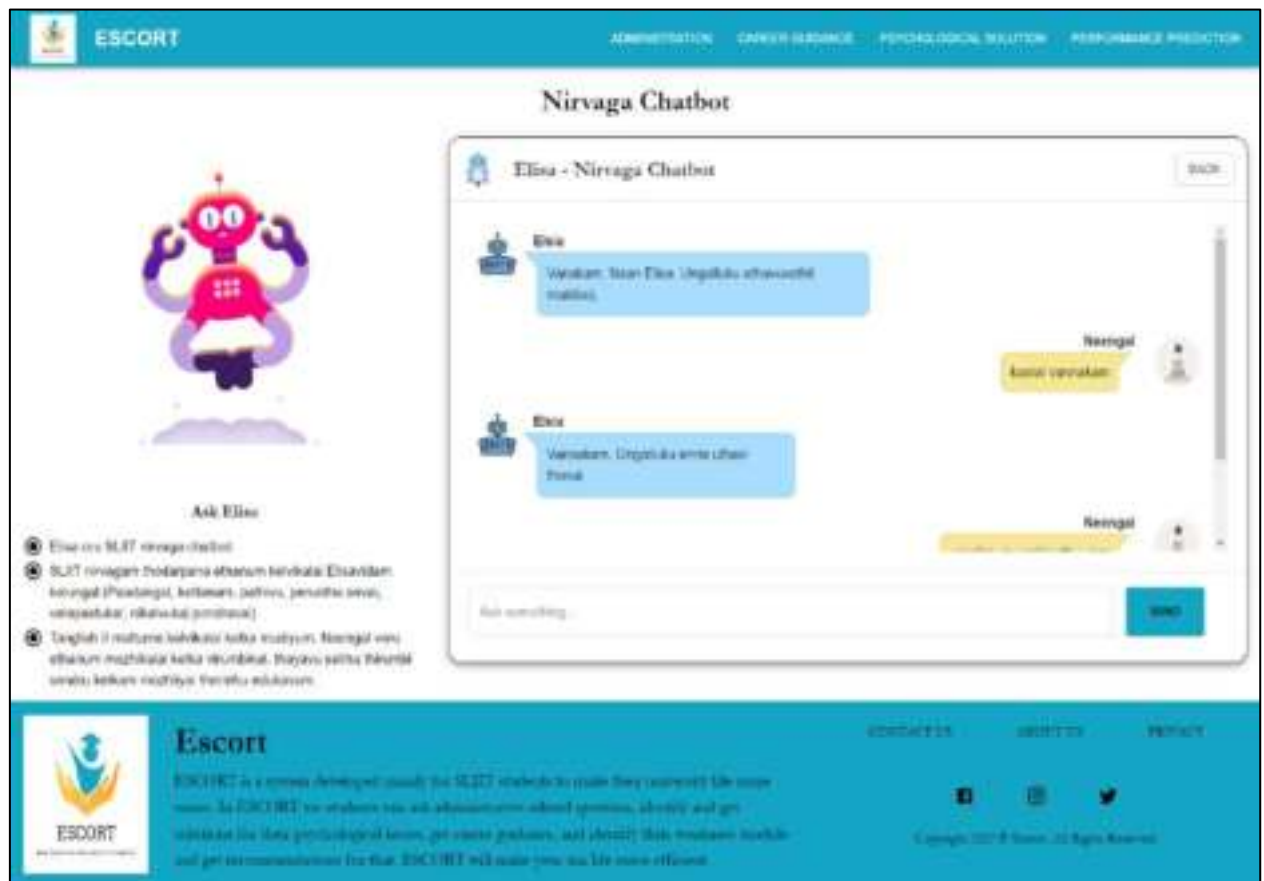


Figure 24: Thanglish chatbot

E. Mobile responsive view

The system is mobile responsive, so users can easily access via any smart devices.



Figure 25: Mobile responsive

II. Recommending solutions for psychological issues

All the processes to develop the recommendation system to recommend solutions to the psychological issues of university students are implemented in this phase. Gensim is used to train the model in English, Tamil, Sinhala and Thanglish. The frontend of this web application is developed using React and the backend is implemented using Python. In addition, Open CV and Matplotlib are used to develop the Word Embedding Graph of psychological issues.

This screen will be displayed when the student selects Psychological Solution in the navigation bar. This is the home screen for the Psychological Solution Recommendation System.

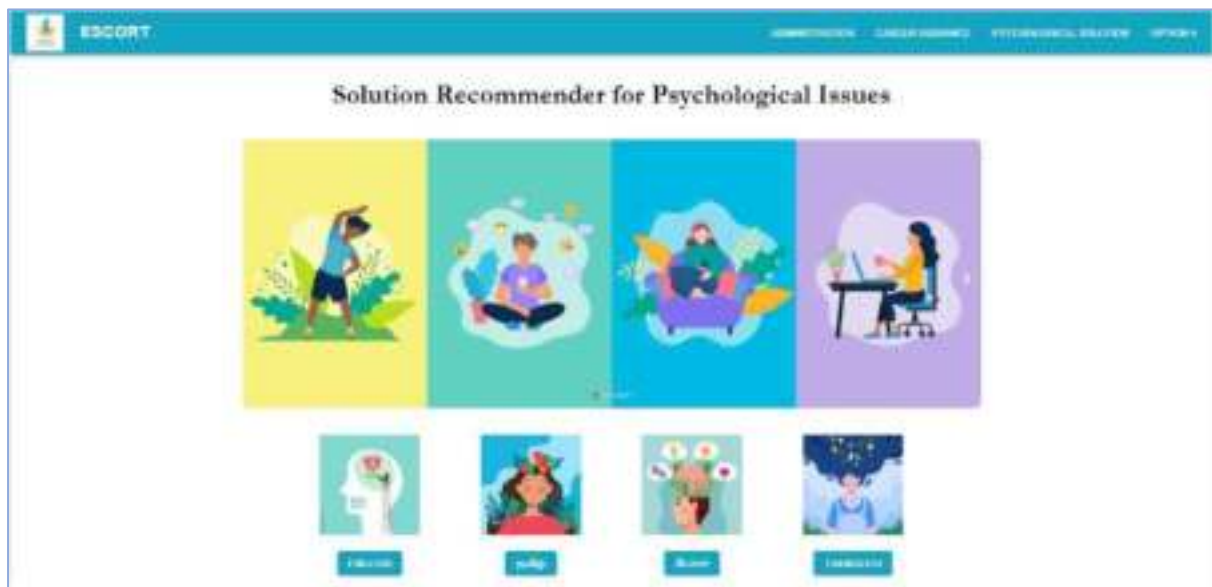


Figure 26: Psychological Recommender Home

This screen will be displayed when the student selects the ‘English’ button in the Psychological Recommender Home. Students can type their issues in this text box in English and click the ‘Search’ button. The solution will be recommended in English.

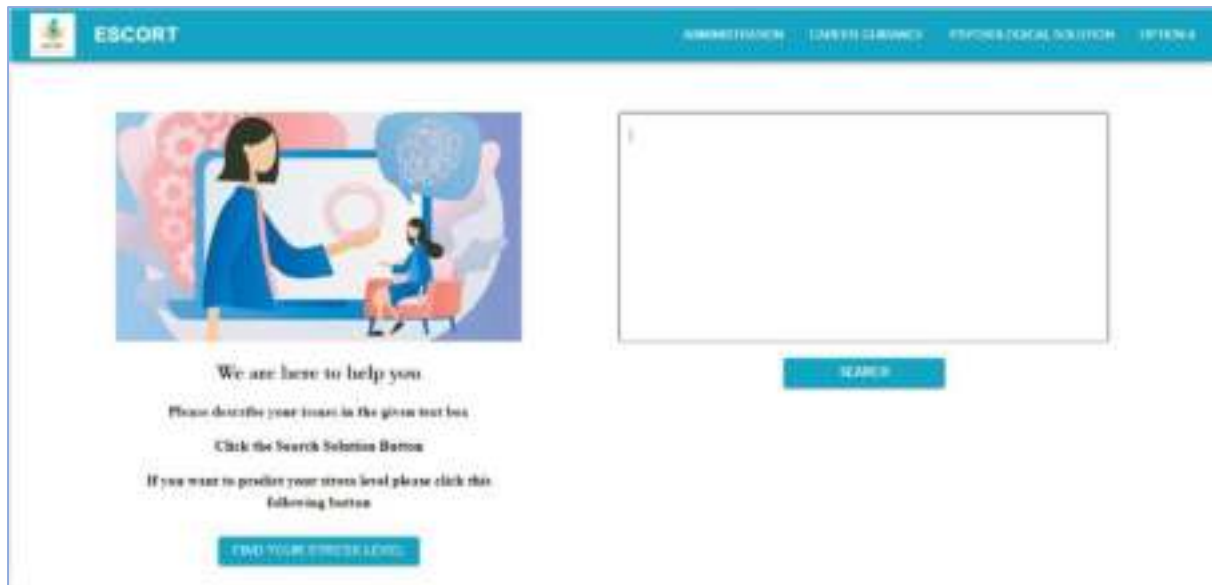



Figure 27: Psychological Recommender Home in English


If the student clicks the FIND YOUR STRESS LEVEL button screen for predicting stress level will be displayed. Here, students can find their stress level by answers to the 10 multiple-choice questions.



Figure 28: Stress Level screen


[HOME](#)
[ABOUT US](#)
[CONTACT US](#)

[ADMINISTRATION](#)
[CAREER GROWTH](#)
[PSYCHOLOGICAL SOLUTION](#)
[OPTION 1](#)




உங்களுக்கு உதவு நாங்கள் இருக்கிறோம்

அறுவெள்ளை உரை போட்டியில் உங்கள் பிரச்சனைகளை விபரிக்கவும்

மேடல் பொத்தானை அடைதல்

உங்கள் மன அழுத்தத்தை கணிப்ப விதம் பிளாட் பிளவுகள் பொத்தானை அடைதல்

100% நம்பக தகவலை வழங்கும்



Start

This screen will be displayed when the student selects the ‘සිංහල’ button in the Psychological Recommender Home. Students can type their issues in this text box in Sinhala and click the ‘සෙවීම’ button. The solution will be recommended in Sinhala.



43

This screen will be displayed when the student selects the ‘Thanglish’ button in the Psychological Recommender Home. Students can type their issues in this text box in Thanglish and click the ‘Theadu’ button. The solution will be recommended in Thanglish.



Figure 31: Psychological Recommender Home in Thanglish

III. Career Guidance

- Front-end user interaction for query question

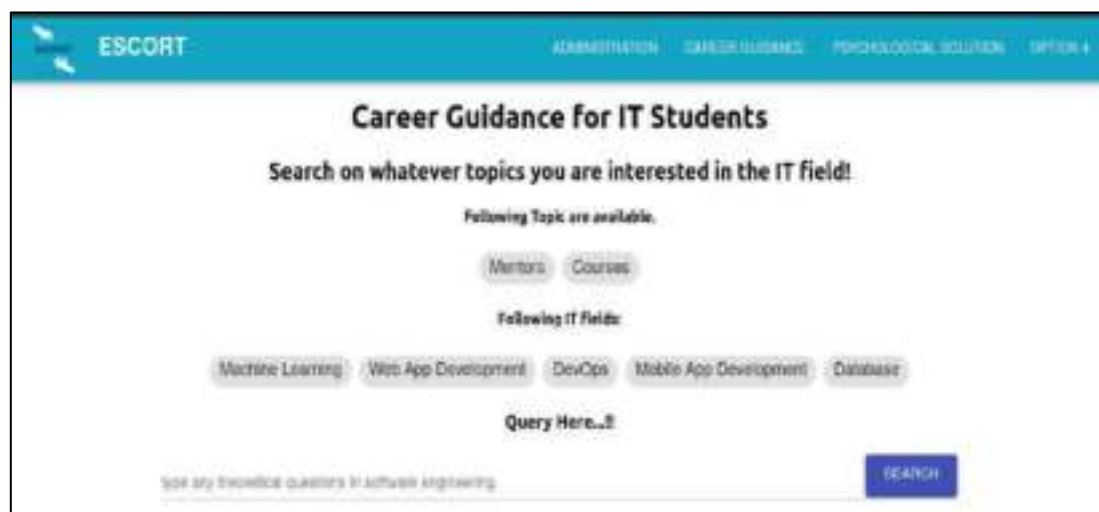


Figure 32: Front-end of career guidance QA page

- Dockerizing the backend

For ease of deployment, a docker image was built. Docker is a platform as a service (PaaS) that uses virtualization technology to provide software as containers. This docker image eases the method of deployment of the backend service in a short period of time. The only thing we need to do is pull the latest code from the version control to the server, build the docker image and start the docker container service.

When building the docker image, the DPR model will be rebuilt, and the latest dataset will be fed to the FAISS data store as vector embeddings.

IV. Performance prediction and learning materials recommendation

This system is implemented to predict each student's performance and recommend suitable learning resources. This proposed system is a web application, react Js was selected to proceed with the frontend. The entire backend was done using Python in Jupyter Notebook. These components are later merged into the frontend developed in the VsCode IDE. Below are some sample interfaces design for the web application.


Using this interface user can be able to select the subject which they wanted to analyze their performance.



Figure 33: Performance analysis home page

Using this interface user can be able to perform the quiz which is conducted by the system.

Database Systems



Quiz Instructions.

Quiz Instructions Time

Quiz Instructions Time remaining

Quiz Instructions Available Marks

Instructions

START QUIZ

1. Which of the following are applications of Topological Sort of a graph?

- ☐ Resource Scheduling
- ☒ Course Scheduling
- ☐ Oil Drilling Drilling
- ☐ All of the above

NEXT **FINISH**

Figure 34: Quiz page

This interface will be displayed marks and time when the student finished the quiz and also this interface suggest the user with e-learning resources link.



Figure 35: Results page

4.2 Testing

A. Unit Testing

Unit test is a method where testing the smallest piece of code that can be logically isolated in a system. Normally unit test is implemented by the software developer who developed the system. This will help to detect the early flaws in code. In the administrative chatbot system unit test played a main part which helped to identify the minor bugs.

B. Module Testing

Used to check the individual components of the system which helps to early detection of errors. Module testing helps to break the system in to smaller parts and test, which reduces the complexity of testing the whole system.

C. Integration Testing

Integration testing is the phase in software testing in which individual software modules are combined and tested as a group. It occurs after unit testing and before system testing

D. System Testing

System testing is the testing of a complete and fully integrated software product. System testing is actually a series of different tests whose sole purpose is to exercise the full computer-based system

E. Test Cases


Table 2: Test case 1

Test Case	Test Case 001
Test case description	Recommending solutions for psychological issues in Thanglish.
Pre-condition	Browse Escort website
Test procedure	<ol style="list-style-type: none"> 1. Open the Escort website 2. Click “Psychological Solution” from Navigation Bar. 3. Click the “Thanglish” Button 4. Type issues in the text box 5. Click the “Theadu” button
Test input	Enaku mihavum panichchumaiyaka ullathu.
Expected Result	Thodarnthu velai seiyavo padikkavo vendaam. Ovvoru 40 nimidangalukkum siriya idaivelaikalai eduththukkollungal. Nalla isaiyai kelungal
Actual result	Thodarnthu velai seiyavo padikkavo vendaam. Ovvoru 40 nimidangalukkum siriya idaivelaikalai eduththukkollungal. Nalla isaiyai kelungal
Test Result	Pass

Table 3: Test case 2

Test Case	Test Case 002
Test case description	The student's description does not contain issues in English
Pre-condition	Browse Escort website
Test procedure	<ol style="list-style-type: none"> 1. Open the Escort website 2. Click "Psychological Solution" from Navigation Bar. 3. Click the "English" Button 4. Type issues in the text box 5. Click the "Search" button
Test input	I am very happy nowadays.
Expected Result	No Result Found
Actual result	No Result Found
Test Result	Pass

Table 4: Test case 3

Test case	Test case 003
Description	User interact with the Tamil chatbot system for the first time.
Summary	User try to interact with the Tamil chatbot for the first time by saying 'எனக்கு உதவி தேவை.' The system replies with the correct response.
Pre-condition	Choose 'தமிழ்' button to navigate to Tamil chatbot
Post-condition	User got the correct response
Test procedure	<ol style="list-style-type: none"> 1. Go to Escort website 2. Choose Administrative from the top navigation bar 3. Choose 'தமிழ்' button 4. Type the question 5. Click 'Send' Button
Test input	<p>எனக்கு உதவி தேவை</p> 
Expected result	வணக்கம். உங்களுக்கு என்ன உதவி தேவை / உங்களை சந்திப்பதில் மகிழ்ச்சி. உங்களுக்கு என்ன உதவி தேவை

Actual result	<p>உங்களை சந்திப்பதில் மகிழ்ச்சி. உங்களுக்கு என்ன உதவி தேவை</p>  <p>NSCORP</p> <p>நிர்வாக சாட்போட்</p> <p>என்ன - நிர்வாக சாட்போட்</p> <p>எனினு</p> <p>நான் என்ன செய்ய வேண்டும்?</p> <p>உங்களுக்கு என்ன உதவி தேவை?</p> <p>NSCORP</p> <p>NSCORP is a project of the Government of Tamil Nadu, aimed at providing a platform for citizens to interact with the government and seek assistance. The chatbot is designed to assist citizens in various ways, including providing information about government services, helping with document uploads, and providing guidance on how to use the platform.</p>
Test result	Pass

Table 5: Test case 4

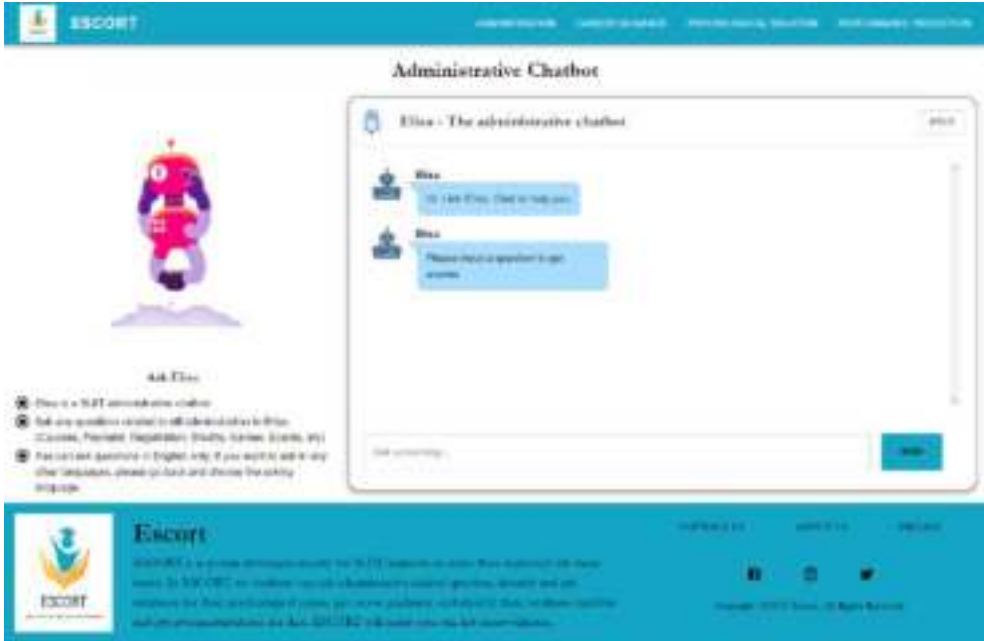
Test case	Test case 004
Description	User try to pass empty value as a question
Summary	User try to pass empty value as question and the system reply by asking to enter a question
Pre-condition	Choose any language button to navigate to responsive language chatbot
Post-condition	User got the response as to enter a question
Test procedure	<ol style="list-style-type: none"> 1. Go to Escort website 2. Choose Administrative from the top navigation bar 3. Choose any language button 4. Click 'Send' Button without typing any question.
Test input	Empty
Expected result	Please input a question to get answer / தயவு செய்து வினா ஒன்றைக் கேட்கவும் / Thayavu seithu vinaa ondrai kerkavum
Actual result	<p>Please input a question to get answer / தயவு செய்து வினா ஒன்றைக் கேட்கவும் / Thayavu seithu vinaa ondrai kerkavum</p> 

Table 6: Test case 5

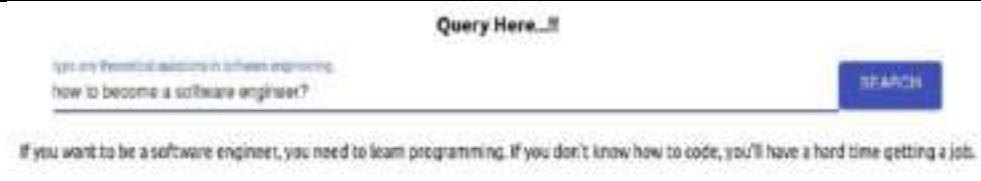
Test case	Test case 005
Description	User asks a question on “How to become a software engineer?”
Summary	When user asks a question on career-guidance related question on “How to become a software engineer?” The system replies with the correct answer
Pre-condition	-
Post-condition	User got the correct response
Test procedure	<ol style="list-style-type: none"> 1. Go to Escort website 2. Choose Career Guidance from the top navigation bar 3. Type the question 4. Click ‘Search’ Button
Test input	“How to become a software engineer?”
Expected result	Any answer that is relevant to becoming a software engineer
Actual result	
Test result	Pass

Table 7: Test case 6

Test Case	Test Case 006
Test case description	User have to select the subject from the give options.
Pre-condition	Browse Escort website
Test procedure	<ol style="list-style-type: none">1. Open the Escort website2. Click “Performance Analysis” from Navigation Bar.3. Display home page with subject options.
Test input	Click the particular subject
Expected Result	System to navigate the quiz page.
Actual result	User can be able to navigate the quiz page
Test Result	Pass

Table 8: Test case 7

Test Case	Test Case 007
Test case description	User get the suggestions after finishing the quiz.
Pre-condition	Browse Escort website
Test procedure	<ol style="list-style-type: none">1. Open the Escort website2. Click “Performance Analysis” from Navigation Bar.3. Display home page with subject options.4. Click the subject5. Redirect to quiz page6. Start the quiz
Test input	Complete the quiz
Expected Result	System to navigate the result page and display marks, time, and suggestion links.
Actual result	User can view the marks and time but unable to view the suggestions.
Test Result	Fail

5. RESULTS AND DISCUSSIONS

5.1 Results

I. Chatbots for University Administration and Students

The implemented system can successfully answer the questions user ask in their preferred language (English, Tamil, Thanglish) with the accuracy above 90%. After the user select a language and insert the question, the system will sand the answer as a reply.

```
454/454 [=====] - 1s 2ms/step - loss: 0.0253 - accuracy: 0.9978 - val_loss: 0.8604 - val_accuracy: 0.9633
Epoch 196/200
454/454 [=====] - 1s 2ms/step - loss: 0.0175 - accuracy: 0.9978 - val_loss: 0.7617 - val_accuracy: 0.9625
Epoch 197/200
454/454 [=====] - 1s 2ms/step - loss: 0.0137 - accuracy: 0.9987 - val_loss: 0.8291 - val_accuracy: 0.9606
Epoch 198/200
454/454 [=====] - 1s 2ms/step - loss: 0.0176 - accuracy: 0.9987 - val_loss: 0.7703 - val_accuracy: 0.9606
Epoch 199/200
454/454 [=====] - 1s 2ms/step - loss: 0.0028 - accuracy: 0.9996 - val_loss: 0.7876 - val_accuracy: 0.9578
Epoch 200/200
454/454 [=====] - 1s 3ms/step - loss: 0.0108 - accuracy: 0.9974 - val_loss: 0.9056 - val_accuracy: 0.9579
English administrative model created successfully!!
accuracy: 98.63%
```

Figure 36: Accuracy of English model training

If a user, ask English language questions to the chatbot the following will be the answer.

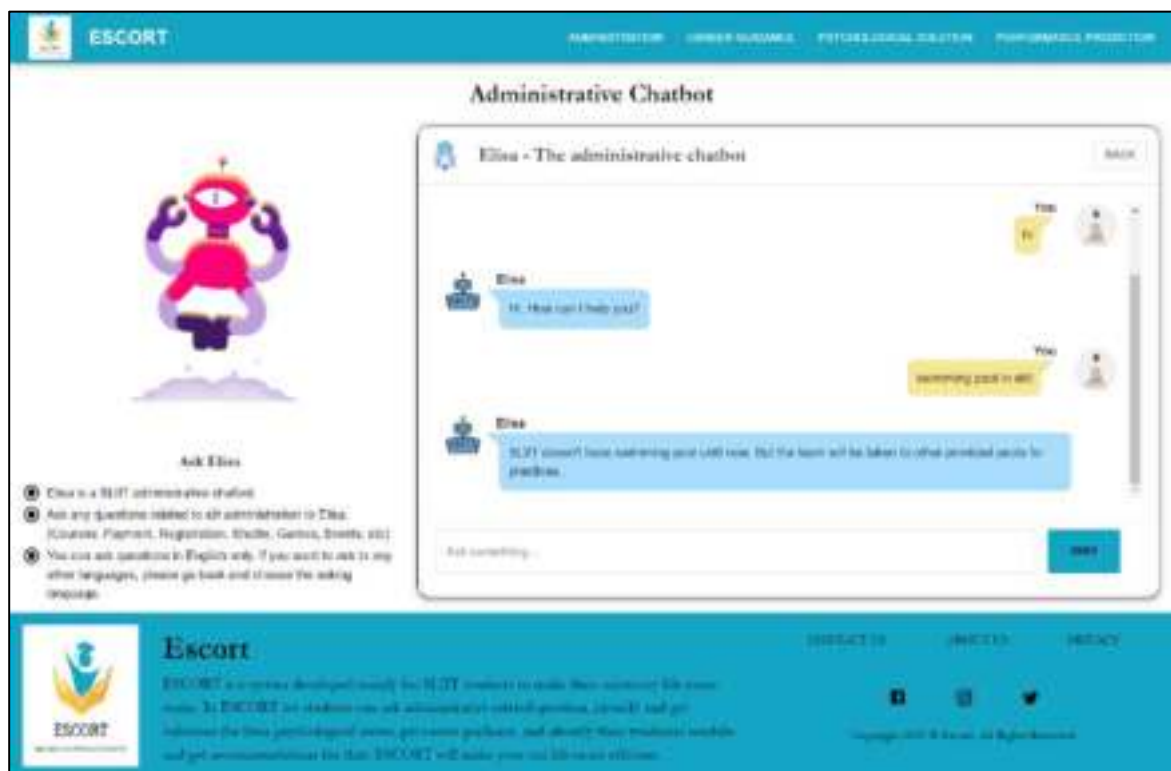


Figure 37: English chatbot

II. 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. 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 92.37% 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

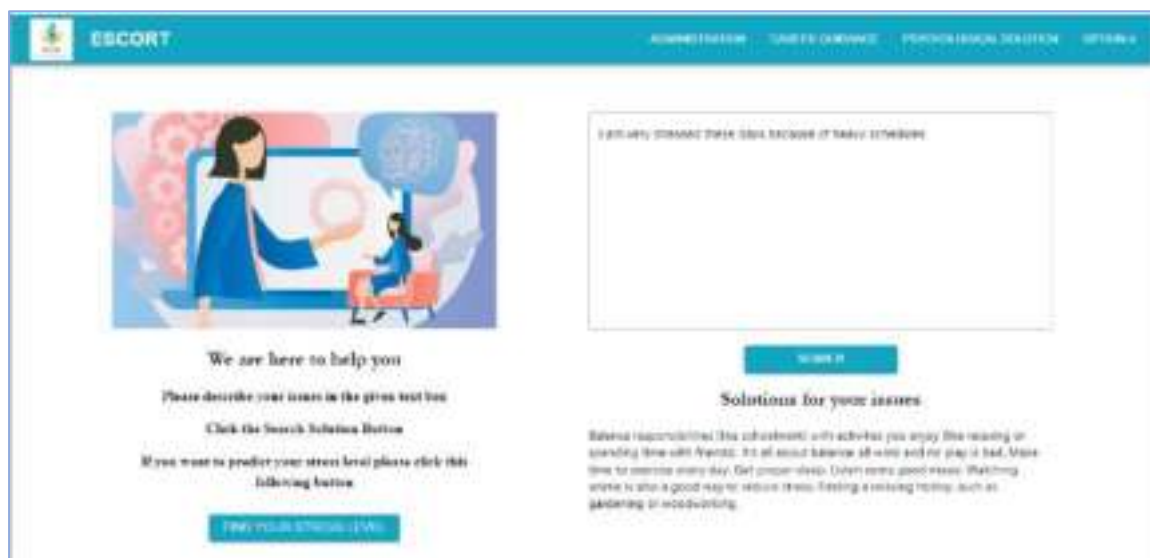


Figure 38: Recommending Solution in English

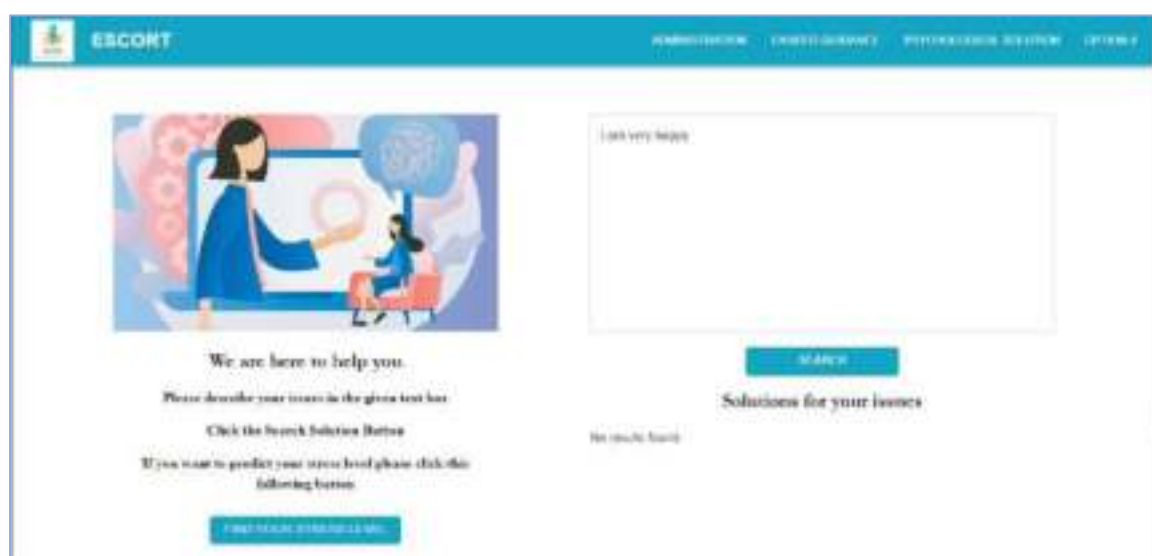


Figure 39: If the student has no issues in English



Figure 41: Recommending solution - Tamil



Figure 40: If the student has no issues - Tamil



Figure 42: Recommending solution in Sinhala

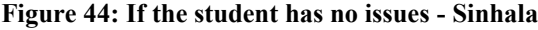
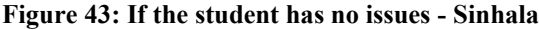




Figure 46: Finding stress level

III. Career Guidance

Career guidance for students during their undergraduate studies is an inevitable step that both university and students must take care of. Unfortunately, neither the education institutions nor students take those steps carefully. Career guidance should need to be made public for each one. The students should be able to get access to the system and be able to clear their doubts. A manual system like mentors or representatives chatting over the internet will not be going to work anymore. Each person has got busy and has filled within a time frame. Therefore, considering these things in mind, a QA system for a career guidance system is very important. The retriever model was tested with the test data and the text similarity accuracy of 0.94% was obtained.

```
INFO - haystack.modeling.evaluation.eval -
      text similarity
INFO - haystack.modeling.evaluation.eval - loss: 0.27022711890884405
INFO - haystack.modeling.evaluation.eval - task_name: text similarity
INFO - haystack.modeling.evaluation.eval - acc: 0.946257197696737
INFO - haystack.modeling.evaluation.eval - f1: 0.20000000000000004
INFO - haystack.modeling.evaluation.eval - acc and f1: 0.5711285988483685
INFO - haystack.modeling.evaluation.eval - average rank: 4.771428571428571
INFO - haystack.modeling.evaluation.eval - report:
      precision    recall  f1-score   support

hard negative      0.9722      0.9722      0.9722      1987
positive          0.2000      0.2000      0.2000        35

accuracy
macro avg      0.5861      0.5861      0.5861      1042
weighted avg   0.9463      0.9463      0.9463      1042

INFO - haystack.modeling.model.bladaptive_model - prediction_head saving
```

Figure 47: Accuracy rate of build DPR model

IV. Performance prediction and learning materials recommendation

The proposed system is implemented with four subjects for third year second-semester software engineering students at the Sri Lanka Institute of Information Technology, such as database systems, case studies in software engineering, software project management, and user experience engineering. The data set contains above 100 samples, which contain attributes such as marks, time, and tutorial groups. A model is created to recommend the tutorial according to the marks and time taken for the quiz in one subject. We train the model using four algorithms.

Models and their accuracy rate:

- a. SVM Model: 0.39
- b. Decision-Tree-Classifer Model: 0.86
- c. Random-Forest-Classifier Model: 0.87
- d. Gaussian-Naive-Bayes Model: 0.79

Finally, we select the random forest classifier algorithm which gives a higher accuracy rate than others. Therefore, we trained models using this algorithm. for all the subjects.

5.2 Research Findings

I. Chatbots for University Administration and Students

Considering the questions university students have related to university administration and the issues of getting proper answer for those, I decided to develop a chatbot system which is a part of Escort. The goal of the system is to have multiple language option for users to ask and receive administrative related questions in nine categories and provide answers or solutions with high accuracy. From collecting the dataset to finish the implementation I faced some issues and some of them were resolved during the testing and for some I have used an alternative way.

A. Collecting dataset for the model

As mentioned in the methodology I have used google form to get the questions SLIIT students have related to SLIIT administration. As I need more dataset it was not success to collect the data set only from students. So, I have shared the questionnaire with some of the parents and other A/L finished students who would like to join SLIIT. As they also had a lot of questions, I was able to collect enough dataset for the model.

B. Technology requirement for system development

NLP is an advance technology which need more ram to run without issues. In the beginning I was using a laptop which had 8GB RAM. In the beginning I was able to train the model using that. But as the dataset increases the time for processing and training increased and because of that the API call took long time. After that I increases the RAM to 16GB and then the model worked without any issue and the model build time decreased more than 40%.

II. 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 [28]. 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.

Table 9: Comparing other recommendation systems

Error	Movie Recommendation systems	Job Recommending systems	Escort
MAE	0.4	0.7	0.5
RMSE	0.8	0.2	0.3

Word embedding is an approach used to represent words and sentences. It is a dense vector representation for text where words have the same meaning or similar representation. Here, some psychological issues in English are graphed using Word embedding, Gensim, python, Open CV and Matplotlib.

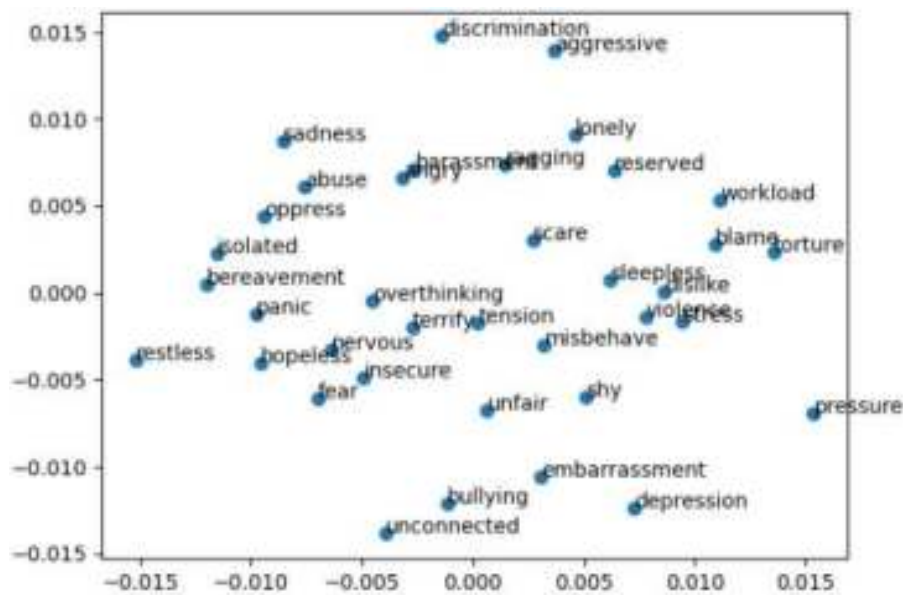


Figure 48: Word embedded graph

III. Career Guidance

Considering the need for a career-guidance QA system among university students to prepare for their industrial experience and professional life, we decided to develop a QA system for university students related to career guidance. As a first step, we decided to provide for IT students. The goal is to provide an informative, useful and concise platform for university students to build up their professional life by querying their doubts regarding career guidance.

The data required to build up this system was collected from different websites, blogs, YouTube interviews, and podcasts as a text file. NLP techniques and the latest libraries in

NLP such as FAISS are used in this research project to provide efficient and reliable answers to students.

IV. Performance prediction and learning materials recommendation

This system conducts online quizzes and, based on the results and the time taken for the quiz, predicts performance. According to the performance, it recommends online videos, tutorials, and links. Using our system, students will get the motivation to improve on their own, and they can test themselves and easily find what tutorials they need to focus on. This model achieved a 0.87 accuracy rate. 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.

5.3 Discussion

I. Chatbots for University Administration and Students

Managing time for implementing the project and managing the documentations while studying is one of the major issues we have faced. Submitting the documents and other submission on time was a challenging part. To avoid last minute timing issues, we have maintained the teams task deliverables to manage my tasks.

We faced some issues while collecting the dataset. We have shared the questionnaire only with the SLIIT students and we were unable to collect enough dataset. To get more dataset we shared the questionnaire with some parents of SLIIT students and to some people who would like to join SLIIT in future. From that we were able to get enough dataset.

Once the dataset was collected, we started arranging the questions according to the category. Then we contacted the SLIIT administration and got the answers for each question. Once the answers were collected, we wrote other forms for the same question (Ex: What is the fee for Software Engineering can be asked as Fee of Software Engineering). One all the questions have be added to other forms, we have translated the whole question and answer set to the Tamil language. In Tamil also we have identified other forms of asking the same question by arranging the words and change with synonymous a word. Then we translated to Tamil dataset to Thanglish.

Once the dataset was created, we started working on the model. First, we implemented the model for the English language, and we used NLTK and Keras sequence model to train the model. Once the model has trained the accuracy of the English model was around 82%. To increase the model, we added some more datasets and then the accuracy was 96%. Once we have completed the English model we started working on the Tamil and Thanglish models simultaneously. we got 89% and 83% accuracy for them.

After completing building all the models, we implemented the API in Python. Then we started working on the front end. For the front end, we have used React JS. We have developed the front end with a chatbot option and then we have connected the Python API of the chatbot. Then we asked some questions and checked the system

in all three languages. Once all the implementation is completed, we have tested all of the functions. Finally, the administration chatbot component of Escort was designed and implemented as expected.

II. Recommending solutions for psychological issues

The recommendation system for recommending solutions to psychological issues to university students, component of Escort - Natural Language Processing Based University Students' Guidance System is designed and implemented as expected. In this research, functions to identify the psychological issues and recommend solutions were proposed as a main component of Escort - Natural Language Processing Based University Students' Guidance System.

The result gained shows that this recommendation system provides satisfactory accuracy, compared to most of the research that has previously been done. In summary, this recommendation system offers proper solutions for university students to overcome mental health problems.

III. Career Guidance

As a part of Escort - Natural Language Processing Based University Students Guidance system, the career guidance QA system was implemented as expected. The system which can be able to access anywhere from any devices is a good sign of aa user experience for the end user. As a future improvement, adding knowledge base into the system and querying them would encourage more users to get interacted with the system.

The accuracy and the result got from the QA system is satisfiable. Most of the questions that were asked in this QA system were answered with related answers by the system. Overall, the system performs well than other systems that were implemented till now.

IV. Performance prediction and learning materials recommendation

Escort, a Natural Language Processing-Based University Students' Guidance System, includes this performance prediction and recommendation system for assisting students in determining their performance in a specific subject and

recommending suitable e-learning resources, is implemented as we expected. The project began with the implementation of the backend using a few sample datasets. Jupyter Notebook was used to carry out the backend using Python. Following the backend, the frontend was separately designed using React JS in VS Code. The typical part of the project was the integration, as the means of integrating were not very clear, and the majority of the time was spent identifying how the integration should be carried out. The proposed system gives 87% accuracy, to predict students' performance. It can be able to give better solution for the 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.

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, Escort system will be extended by increasing the 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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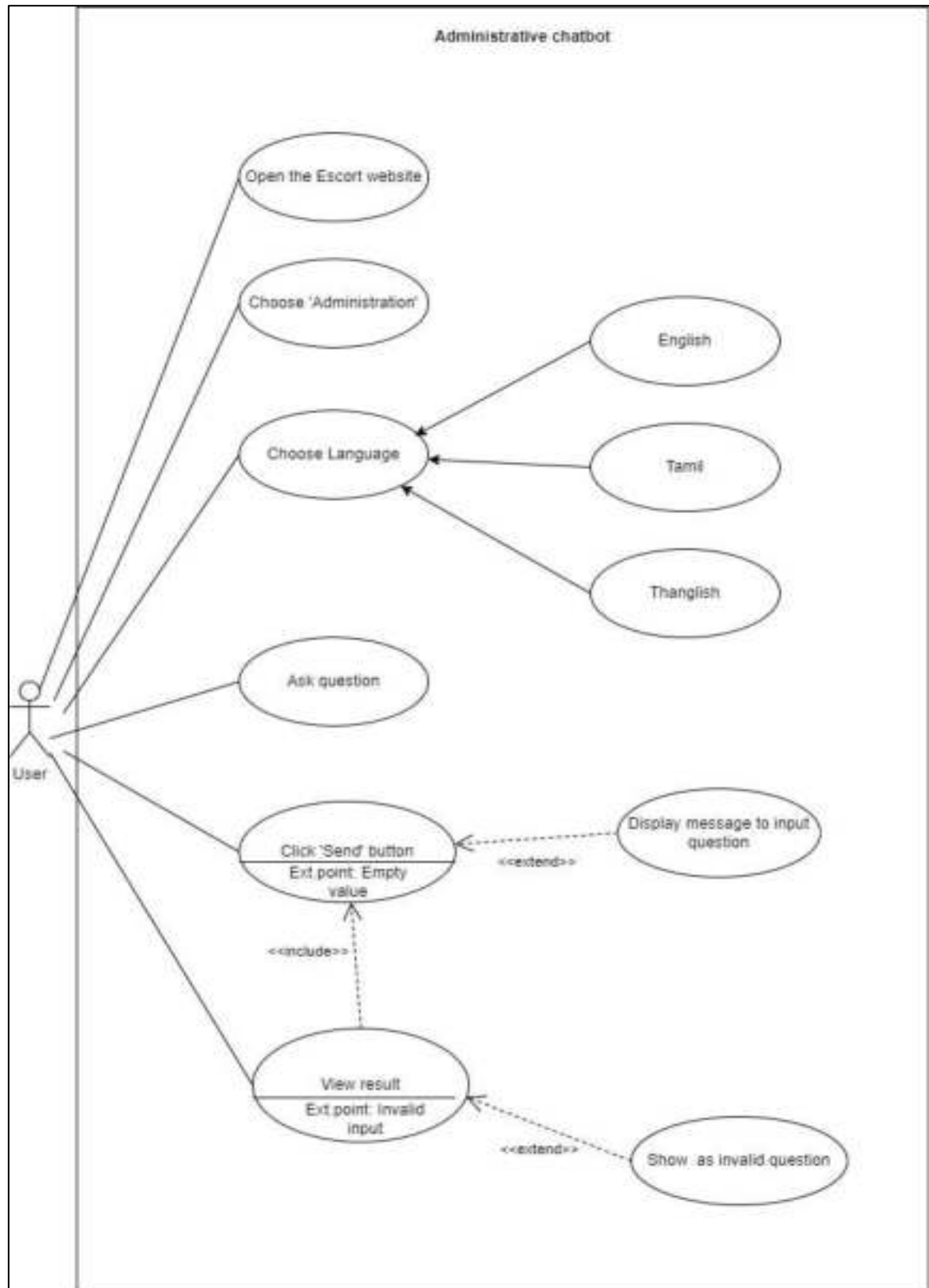
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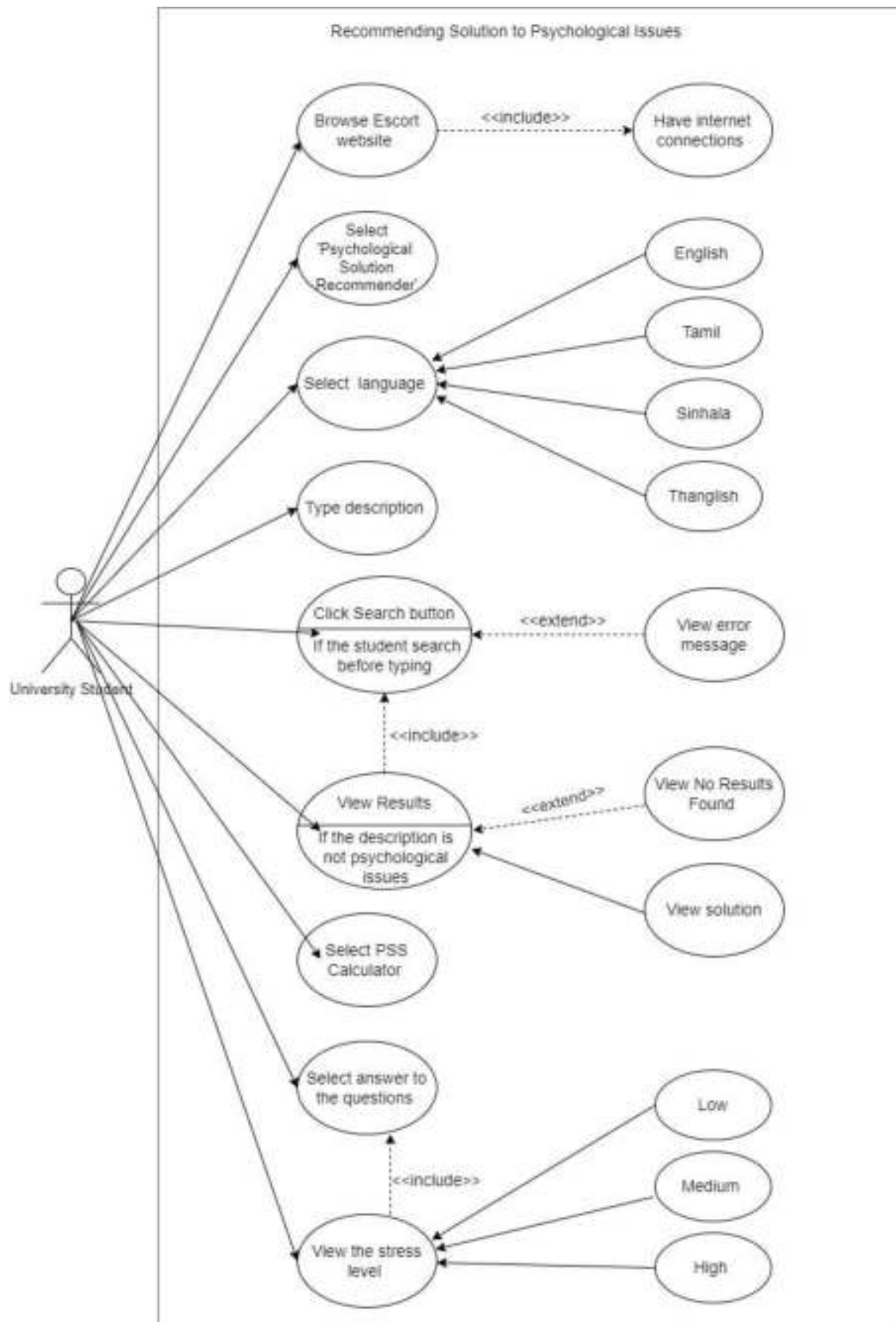
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APPENDICES

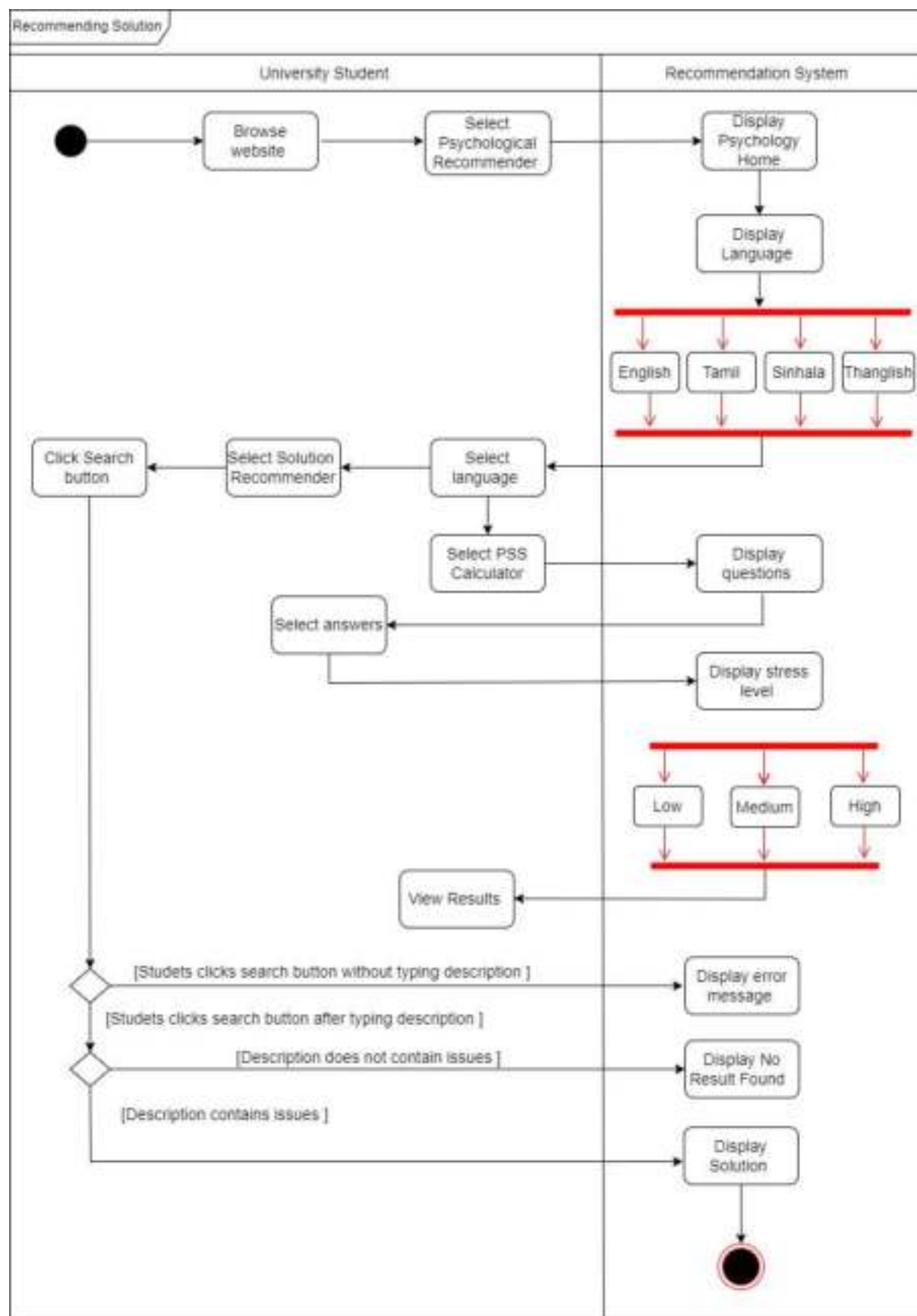
Appendix A: Use case diagram of Administrative chatbot



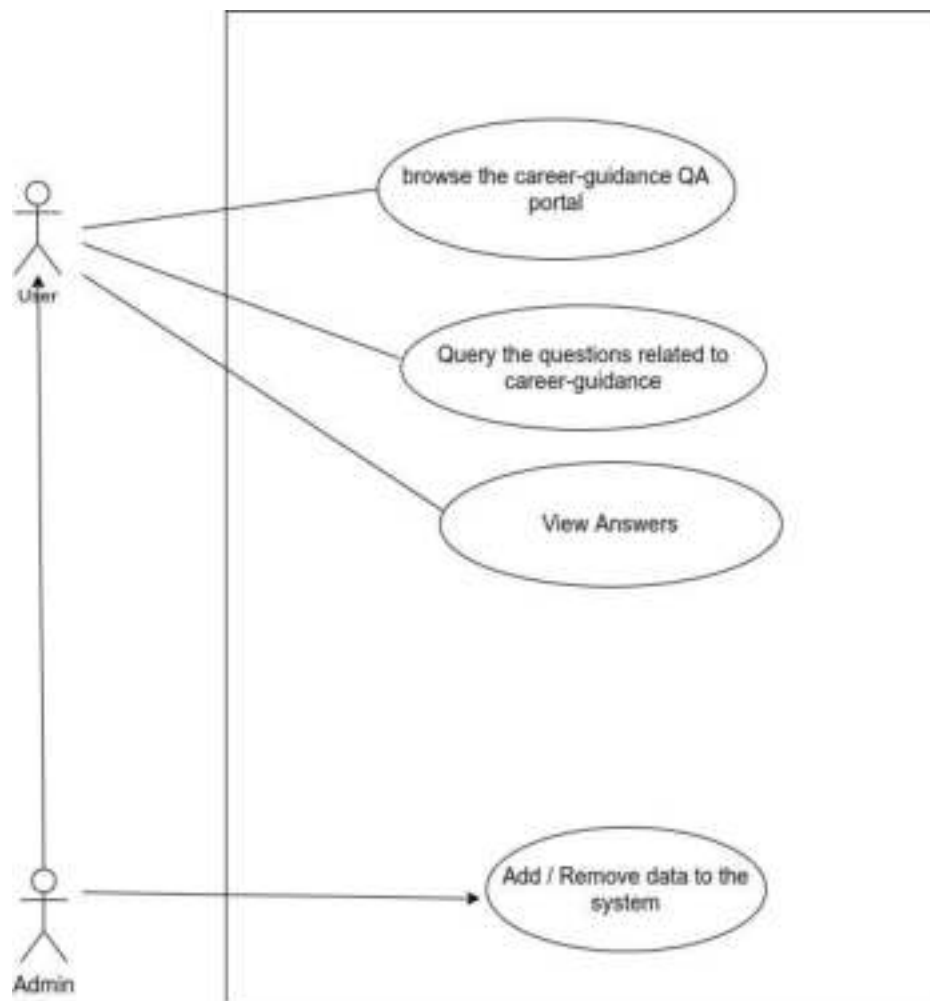
Appendix B: Use case Diagram for recommending solutions for psychological issues



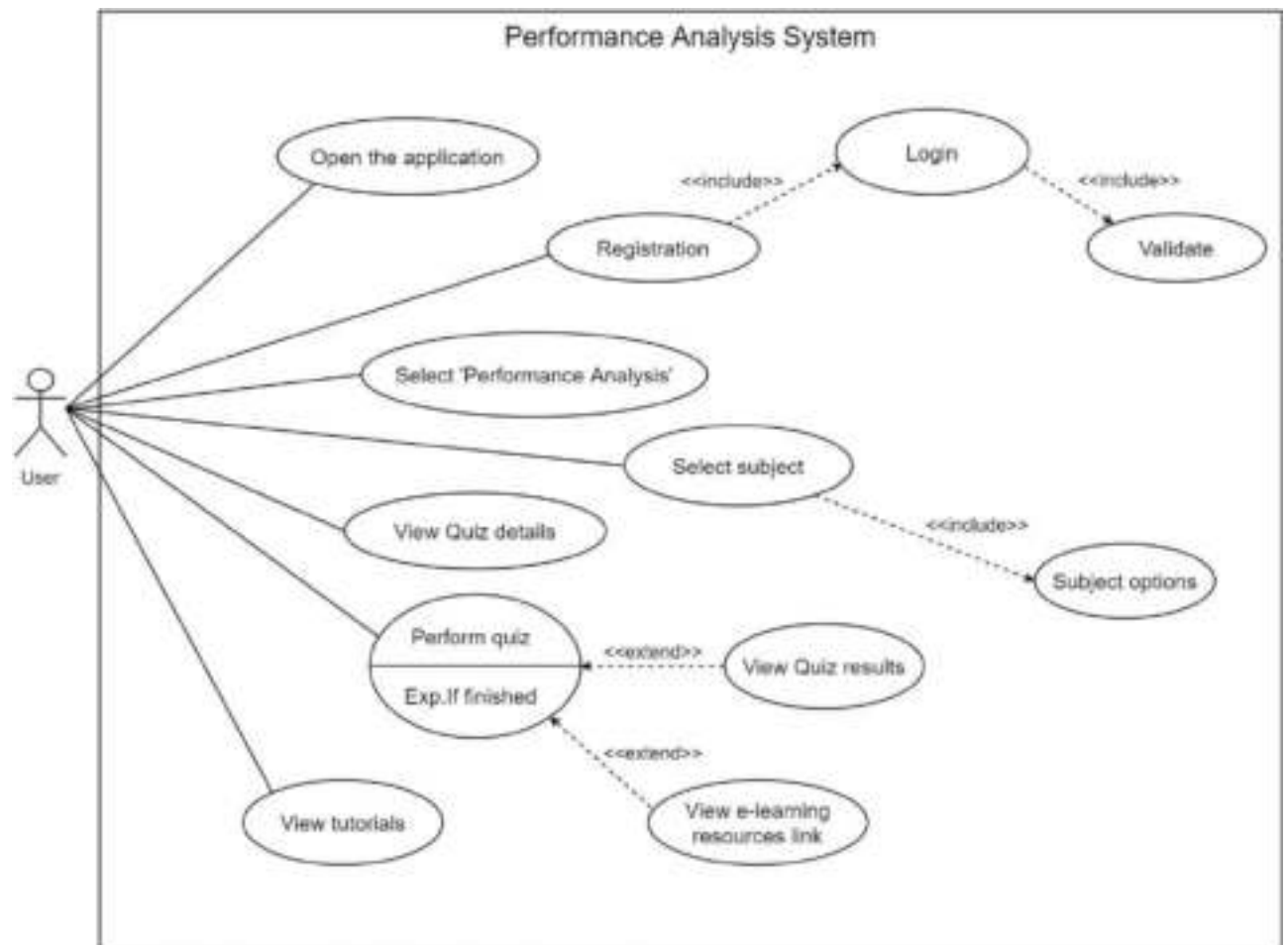
Appendix C: Activity Diagram for recommending solutions for psychological issues



Appendix D: Use case diagram for Career Guidance QA system



Appendix E: Use case Diagram for Performance prediction and recommendation



Appendix F: Activity Diagram for Performance prediction and recommendation

