ESCORT - NATURAL LANGUAGE PROCESSING BASED UNIVERSITY STUDENTS' GUIDANCE SYSTEM

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The dissertation was submitted in partial fulfilment of the requirements for the BSc (Hons) in Information Technology Specialized in Software Engineering

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute higher learning and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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Name	Student ID	Signature
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The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

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    Signature of the Supervisor   Date

ACKNOWLEDGEMENT

ABSTRACT

Every university's main goal is to offer its students with the best learning experiences and achievable knowledge. Identifying the students who require extra support and suggesting the best possible solution to enhance their performance are key steps in achieving that goal. By producing graduates, students' performance has a significant impact on educational institutions and social and economic growth [1].

It is very important to predict the performance of students in higher education [2]. Early identification of at-risk students and preventative actions can greatly enhance their success. This is crucial to helping at-risk students and ensuring their preservation while providing excellent resources and educational experience and enhancing the university's grading and reputation [3]. Assignments, lab tests, mid-exams, and Final examinations, all have an impact on the academic success or failure of a student.

Predicting academic performance and recommending e-learning resources are critical considerations for students who want to enhance their grades. The student's performance prediction has the advantage of reducing official warning signs and student expulsions due to inefficiencies. Effective performance prediction approaches help to recommend solutions and resources more accurately. The existing literature is primarily focused on predicting academic results and how effectively a teacher might design a specific course to help students improve their academic performance.

This research will assist students to identify learning gaps and determine ways to resolve such gaps. This system will effectively help university students using Machine Learning techniques. Our study's main goal is to use random forest classification approaches to uncover students' performance and help recommend e-learning resources. The proposed system will predict student performance by conducting an online quiz per subject.

Keywords – Student, Performance, Machine learning technique, E-learning resources,

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ML – Machine Learning

UI – User Interface

VS – Visual Studio

1. INTRODUCTION

1.1 Background

Education is one of the basic needs. It is also a right of all human beings. Universities are considered excellent places to receive an education, but for a variety of reasons, some students are unable to take full advantage of what they have to offer [4]. There are many common factors that make university students in distress and under perform or drop out without completing their courses [4]. They face a lot of pressures and challenges that cause various physical, social, and emotional challenges. It is important to provide better service to university students to address their concerns. We provide a solution for students with communication problems with the administration, who struggle with psychological problems, who struggle to choose the right career path, and who are unable to identify the problems and weaknesses in their education.

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 [5]. 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.

Academic achievement is the level of achievement of the student's academic goal that can be measured and assessed through examinations, assignments, and other forms of measurement. The early prediction of performance 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 [3]. 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.

1.2 Literature Survey

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 [5]. 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 [3]. A basic study was carried out to examine comparable systems which were already in use to evaluate student performance.

(a) Faculty Support System (FSS)

Shana and Venkatachalam have presented a framework called Faculty Support System (FSS) to track student performance in a course. It is minimal in cost as it utilizes cost-effective open-source analysis software, WEKA [7]. Data mining techniques like the classification technique are used in this search. The classification technique is used for forecasting student performance. In order to contribute the student performance in a specific course, FSS has its focus.

(b) Student Performance Analyzer (SPA)

The SPA is an online web-based secure 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 [8]. The analysis is used to monitor the student or class to determine the overall performance of the student or class. 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) used InMinds to monitor the effectiveness of several fields within each UNIMA department [9]. 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 [6].

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 [10].

1.3 Research Gap

Predicting students' performance eventually became a difficult endeavor. Prediction algorithms now in use are insufficient to forecast students' performance in higher education institutions. Many studies have been published to address the challenge of predicting student performance; however, those did not provide enough solutions for the students who received low grades.

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.

According to the below table, 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 by conducting the online quizzes in every subjects, so it helps the students to improve their final exam marks in each subjects. In particular, we recommend appropriate online learning materials based on their 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 random forest classification algorithm. The purpose of this research is to forecast student performance, with a particular focus on identifying students who may fail to satisfy course requirements [11]. As a result, the system will predict students' performance and, based on it, recommend learning resources. It is designed to help the students for doing the quiz, viewing their marks and time taken for the quiz and recommend learning materials to help them 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	✗	✗	✗	✗	✓

Table 1 Comparision table

1.4 Research Problem

Universities make it possible to improve knowledge, skills and a way of life. However, nowadays, university students face many challenges [12]. Many students are not able to identify issues and weaknesses in their studies. They have a problem in referring to appropriate tutorials, videos and documentation [14]. Most problems experienced by undergraduate students are due to a lack of knowledge about the content of lectures, unable to communicate with others regarding academic matters, and not having the appropriate time management for each topic. On the other hand, the continued failure of examinations by university students is the main issue for both teachers and students.

The lack of motivation with regard to academic career can also lead to a lower grade of undergraduate students. A good study design is an essential requirement for students to improve their academic performance. Students still have difficulty finding a suitable solution for their study plan. Even if they can develop a plan, it may not be efficient enough to improve their academic performance. Sometimes they do not give equal weight to all subjects. A good study plan and learning materials will give them the motivation to be responsible for their study and eventually will help them improve their academic performance.

1.5 Research Objectives

1.4.1 Main Objective

This proposed system is specially designed for university students who are having difficulty with their grades and performance. It helps those who are struggling to find learning materials that meet their needs. Furthermore, most students find it difficult to recognize their weak subjects, so our system assists in identifying those subjects as well as providing solutions for how to overcome those.

The main objective of this study is to identify and analyze students' academic performance based on online quizzes and recommended appropriate learning resources. This study is more valuable for identifying weak students, and helping these students individually so that their performance improves in the future. Overall, this study met its goals of improving student performance, predicting at-risk and dropout students, and helping to enhance their final grades.

1.4.2 Sub Objectives

In order to reach the main objective, the specific objectives that need to be attained are as follows.

1. Conduct online quiz

   The proposed system provides an online quiz for each subject. Students have the option of choosing the preferred subject in which to analyze their performance.

2. Predicting performance level in a subject.

   After completing the quiz, based on the student's performance, the system displayed the marks and time taken for the quiz.

3. Recommend Learning materials.

   Depending on the quiz results and time, the system will recommend links to learning resources such as tutorials, videos and articles.

4. Help to improve knowledge

   Students have the opportunity to develop their knowledge and grades through this system.

2. METHODOLOGY

2.1 Methodology

This part of the report specifies the flow of functionalities, the processes done, technologies used and how the testing has been done. The result of the entire procedure is a web application that is specially constructed for university students to enhance their academaic performance. The overall project uses Machine learning for the efficient development of the product.

Feasibility Study

Before initiating the product development, a feasibility study was conducted to measure the viability of the product. The pros and cons of the product were analyzed during the early stages to avoid any technical, social, or economic issues in the future. Technical feasibility paved the way for the identification of the necessary technologies for the product. As no hardware needs are associated with the product, the cost and hardware knowledge were lower than expected. As the system covers only university students and the application uses data for the model created for each subject, necessary alterations were made according to the regulations.

Requirement Gathering

Next to the feasibility study is the Requirement gathering phase, where all software, hardware, social needs of the system were analyzed. Requirements are gathered from various stakeholders of the system. The key that helped in the process was the literature reviews. Through the reviews from previous papers, the necessary technologies and equipment were analyzed, and necessary actions were made to get the requirements. Functional and non-functional specifications are satisfied at the end of this phase.

Functional and non-functional requirements related to this part of the project are mentioned below.

Functional Requirements:

- The system allow the user to select the subjects which they preferred.

Non-Functional Requirements:

- User friendly
- Secured
- Reliable
- Timely
- Capacity
- Compatibility

Resources Used

1. VsCode

   VScode is an Integrated Development Environment which also supports the development process through debugging, version control and task management.

2. Jupyter Notebook

   Jupyter Notebook is an open-source web application that allows users to create and use the code along with the explanatory in the single interface. Jupyter Notebook was accessed using the Anaconda Navigator interface which is also open source. This interface is now used for the cleaning and preprocessing of the data and for the entire initiation of the product implementation.

3. Gitlab

   GitLab is a web-based DevOps lifecycle platform that includes a Git repository manager and continuous integration and deployment pipeline capabilities. It is licensed under an open-source license developed by GitLab Inc.

Along with these software aspects, usual hardware aspects like the PC with internet and server for backend are necessary.

Process

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.

- **Dataset Collection**

  The dataset was created manually 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 500 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 1 Dataset

- **Modal 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.

System Overview

The entire flow of functionalities that is followed in this process is diagrammatically represented through a system overview diagram below.
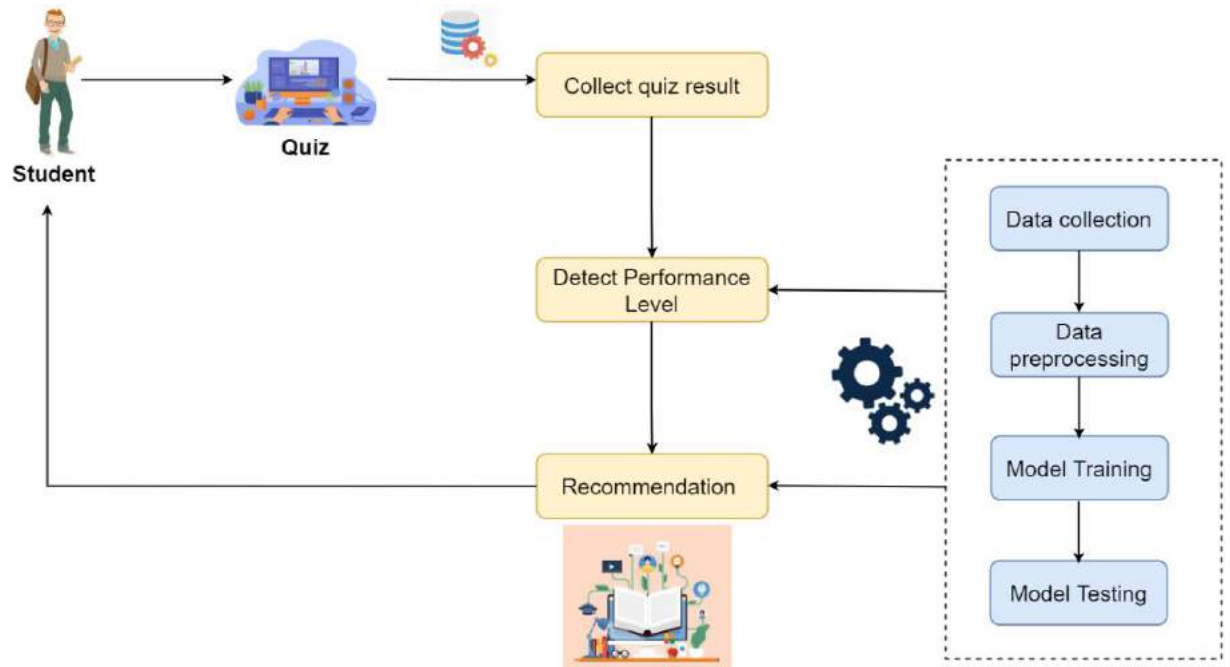

Figure 2 System Overview Diagram

2.2 Commercialization Aspects

This is a novel application generated in the educational world. There are some minor issues with existing educational platforms that are either under-addressed or cannot be avoided. These aspects are taken into consideration. Also, this application underwent a series of research, surveys, and testing that confirmed it satisfied the needs of a university student. This not only predicts the performance of a student but also provides e-learning resource links. This is a space for students who need to analyze their own performance. Overall commercialization factors that can be considered are as follows:

- Students can use this free online space to evaluate their performance.
- We have implemented a successful and accurate system to predict performance and recommend suitable e-learning resources.
- Students can select the subjects in which they want to analyze their performance, which will help them improve their weak subjects.
- Security and privacy.

.

2.3 Testing and Implementation

2.3.1 Implementation

All the performance analysis processes were implemented in this stage.

This system is implemented to predict each student's performance and recommend suitable learning resources. This proposed system is a web application. In the beginning, the prediction model was trained and implemented using the Python language in Jupyter Notebook. This model was trained using the Random Forest Algorithm.For suggesting the e-learning resources, the trained model was used in the web application. Next react Js was selected to proceed with the frontend. These components are later merged into the backend developed in the VsCode IDE.

All the interfaces and the functions were implemented with user-friendliness, so the people who have less knowledge of technology can use this web application. Below are some sample interfaces design for the web application.

A. Home Screen

B. Quiz Screen

C. Results Screen

A. Home Page

This is the home page of the performance analysis system. In here There are four subjects are there.Using this interface user can able to select the subject which they wanted to analyze their performance.
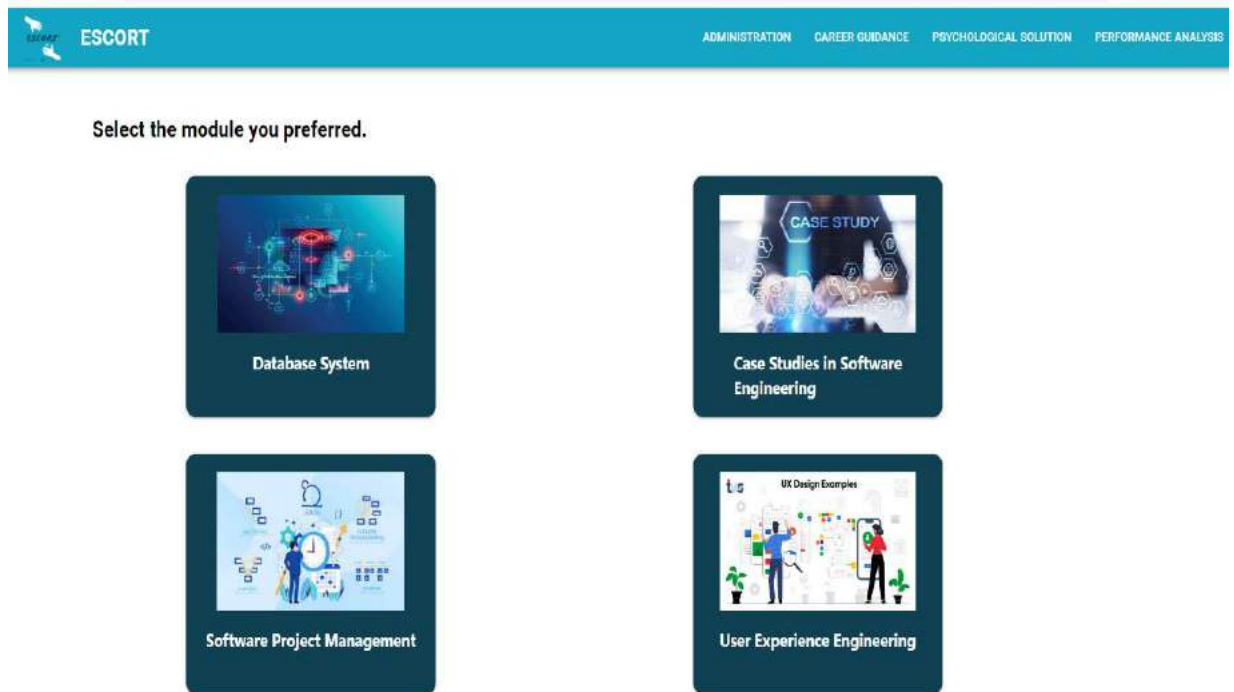

Figure 3 Home page

B. Quiz Page

When users choose their preferred subject to review their performance, they are redirected to this page. Here users can able to see the quiz instructions and questions. When users click to start the quiz, the quiz and the timer will also be started. By clicking the next button, users can go to the next question, and users can finish the quiz using the finish button.

Figure 4 Quiz page

B. Results Page

After finishing the quiz, the system will display the marks and time taken for the quiz in this interface. This interface also displayed the suggested e-learning resources link based on the quiz performance.
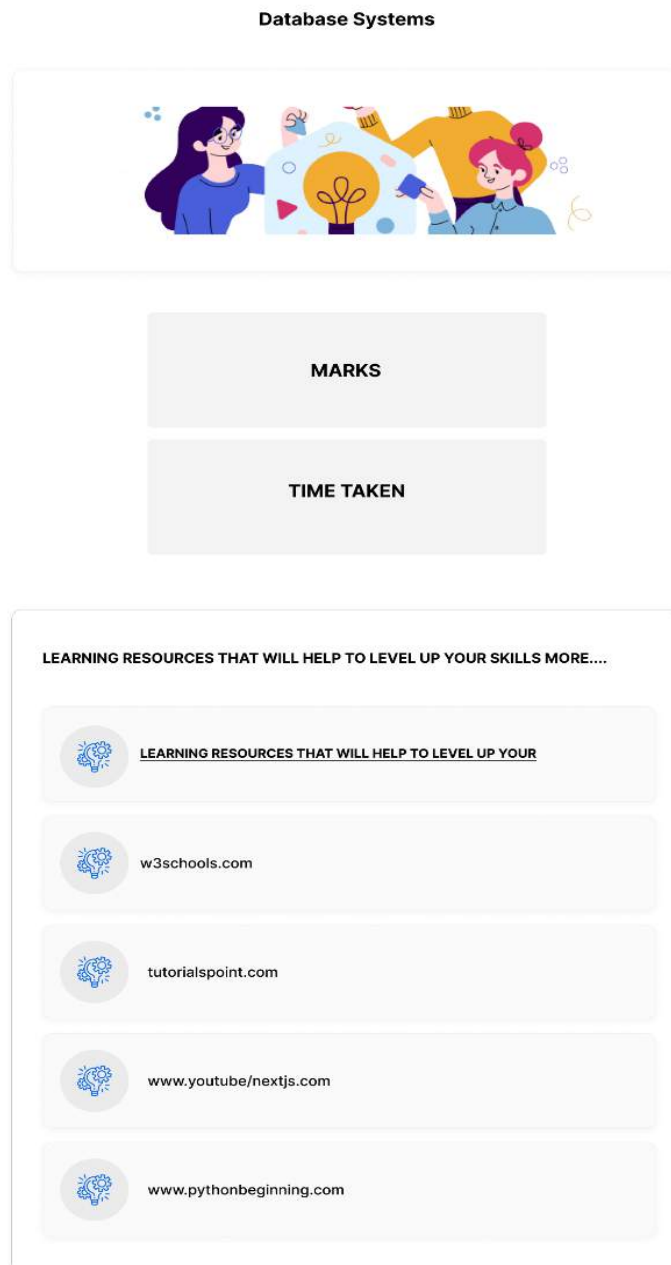

Figure 5 Result page

2.3.2 Testing

Testing is carried out as part of the project to guarantee that the system fulfills functional and non-functional criteria. Testing is carried out at various stages of the project. Testing has been made essential from the beginning stages of product development through the final integrated system in order to reduce risks. Types of tests performed during each stage of the project are as follow.

a. Unit Testing

Each unit of the system is tested at the end of each unit creation. For this type of test, each unit is added to one cell of the Jupyter notebook and then run individually. If a set of alterations are made, then the kernel is restarted and run to test for any new vulnerabilities in each unit.

b. Component Testing

After the units are tested individually the entire component should be tested. In this product development, this type of testing is used only a few times. In order to assure the success of the entire component, the entire product is backed up to reduce risks, and then the outputs were deleted in the duplicate and tested entirely as the component.

c. UI Testing

This is to test the Graphical user interfaces of the systems. This was done after the creation of the frontend of the mobile application. The backend was not integrated or tested during this stage. Only the visual aspects of the system were thoroughly checked after each update.

d. Integration testing

This is done after each integration. As more than two members are associated with this product development, there is a need for integration of work. The system is tested for functional aspects after each person's integration.

e. System testing

This is done after the system is completely developed. This is to test whether the system is ready to be deployed. Application is tested end to end to confirm that the system works perfectly.

Finally, the web application is put to the test. Both functional and non-functional aspects of the application were tested to ensure the requirements of the system. Because testing was made essential from the outset of the product development process, there were fewer mistakes discovered. And the mistakes were resolved with the utmost ease.

Test Cases

Test Case	Test Case 001
Test case description	User have to select the subject from the give options.
Pre-condition	Browse Escort website
Test procedure	1. Open the Escort website 2. 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 able to navigate the quiz page
Test Result	Pass

Table 2 Test case 1

Test Case	Test Case 002
Test case description	User get the suggestions after finishing the quiz.
Pre-condition	Browse Escort website
Test procedure	1. Open the Escort website 2. Click "Performance Analysis" from Navigation Bar. 3. Display home page with subject options. 4. Click the subject 5. Redirect to quiz page 6. 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

Table 3 Test case 2

Test Case	Test Case 003
Test case description	User get the correct marks after finishing the quiz.
Pre-condition	Browse Escort website
Test procedure	1. Open the Escort website 2. Click "Performance Analysis" from Navigation Bar. 3. Display home page with subject options. 4. Click the subject 5. Redirect to quiz page 6. Start the quiz
Test input	Complete the quiz
Expected Result	System to navigate the result page and display the accurate marks.
Actual result	User didn't get the accurate marks.
Test Result	Fail

Table 4 Test case 3

Test Case	Test Case 004
Test case description	System display the time which is taken for the quiz after finishing the quiz.
Pre-condition	Browse Escort website
Test procedure	1. Open the Escort website 2. Click "Performance Analysis" from Navigation Bar. 3. Display home page with subject options. 4. Click the subject 5. Redirect to quiz page 6. Start the quiz
Test input	Complete the quiz
Expected Result	System display the correct time taken for the quiz.
Actual result	System display the correct time.
Test Result	Pass

Table 5 Test case 4

Test Case	Test Case 005
Test case description	User get the suggestions after finishing the quiz.
Pre-condition	Browse Escort website
Test procedure	1. Open the Escort website 2. Click "Performance Analysis" from Navigation Bar. 3. Display home page with subject options. 4. Click the subject 5. Redirect to quiz page 6. 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 and the suggestions.
Test Result	Pass

Table 6 Test case 5

Test Case	Test Case 006
Test case description	User get the correct marks after finishing the quiz
Pre-condition	Browse Escort website
Test procedure	1. Open the Escort website 2. Click "Performance Analysis" from Navigation Bar. 3. Display home page with subject options. 4. Click the subject 5. Redirect to quiz page 6. Start the quiz
Test input	Complete the quiz
Expected Result	System display the accurate marks.
Actual result	System display the accurate marks.
Test Result	Pass

Table 7 Test case 6

3. RESULTS AND DISCUSSION

3.1 Results

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 500 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 :

SVM Model: 0.39

Decision-Tree-Classifier Model: 0.86

Random-Forest-Classifier Model: 0.87

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.

3.2 Research Findings

The goal of this research is to develop an application that allows students to analyze and improve their performance. As a result of the research Escort is developed and its able to satisfy the goals of the research.

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.

The application further satisfies the below need.

- User-Friendly design – The application is designed like the usual platforms in order to make the users feel much more comfortable.
- Timely – The system is working at a good speed.
- Cost-Effective – The application can be used free of charge. There will be not any additional charges.

3.3 Discussion

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. Juypter 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.

Later tests were carried out in order to intentionally cause the system to make errors. This is to ensure the correct functioning of the system. Acceptable outputs were generated and the system functions perfectly well in all sorts of scenarios.

The proposed system give 87% accuracy, to predict students' performance. It can 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.

3.4 Future Work

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. As mentioned in the initial part, we only consider four subjects and recommend some learning resources.In future work, we can suggest more e-learning resources and consider more subjects.

4. CONCLUSION

 Many researches conducted in this field bt they only focus on performamce prediction.The proposed system helps university students identify their weaknesses in each subject and recommends e-learning material links to improve their education. This will benefit students who require additional assistance and received lower grades in their final exams.

The purpose of this research is to identify the challenges and opportunities for quality education in higher education institutions, as well as to provide a model for improving the quality of education.By using this system students able to enhance their academic performance , can evaluate their performance own, can find the study meterials which help to increase their grades with out searching in the browser.

In the future, this system will be extended by increasing the accuracy and also contacting the university lecturers to add study materials for each subject to improve the students' knowledge.

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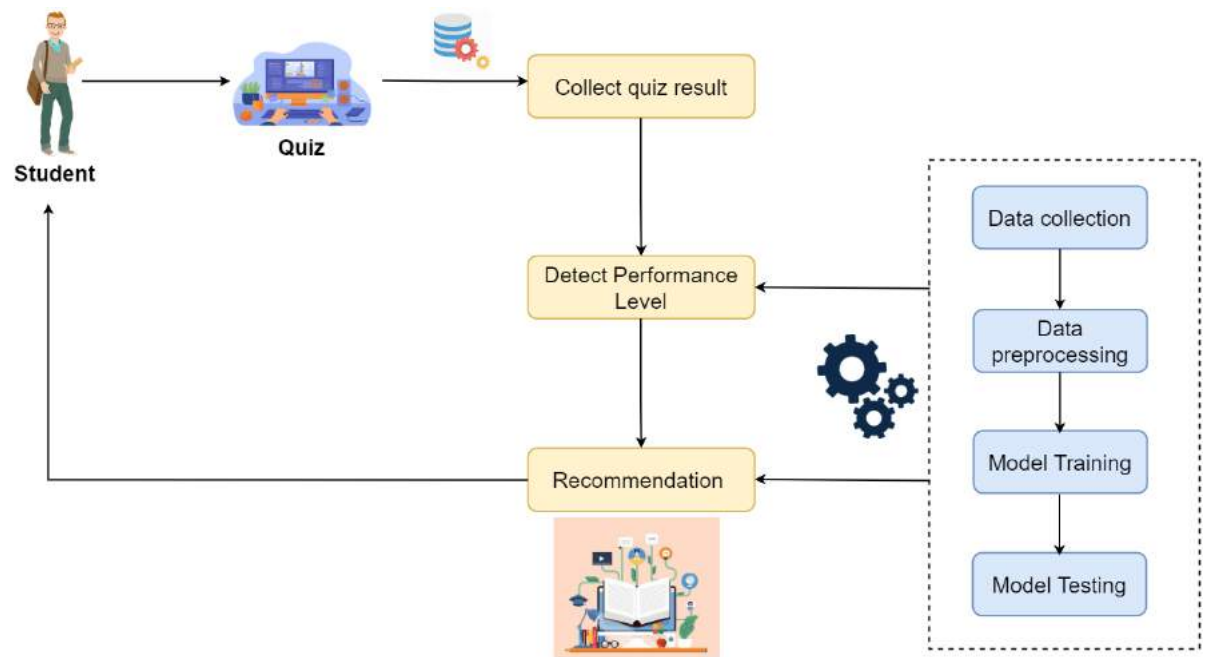
6. APPENDICES

Appendix A : Use case Diagram
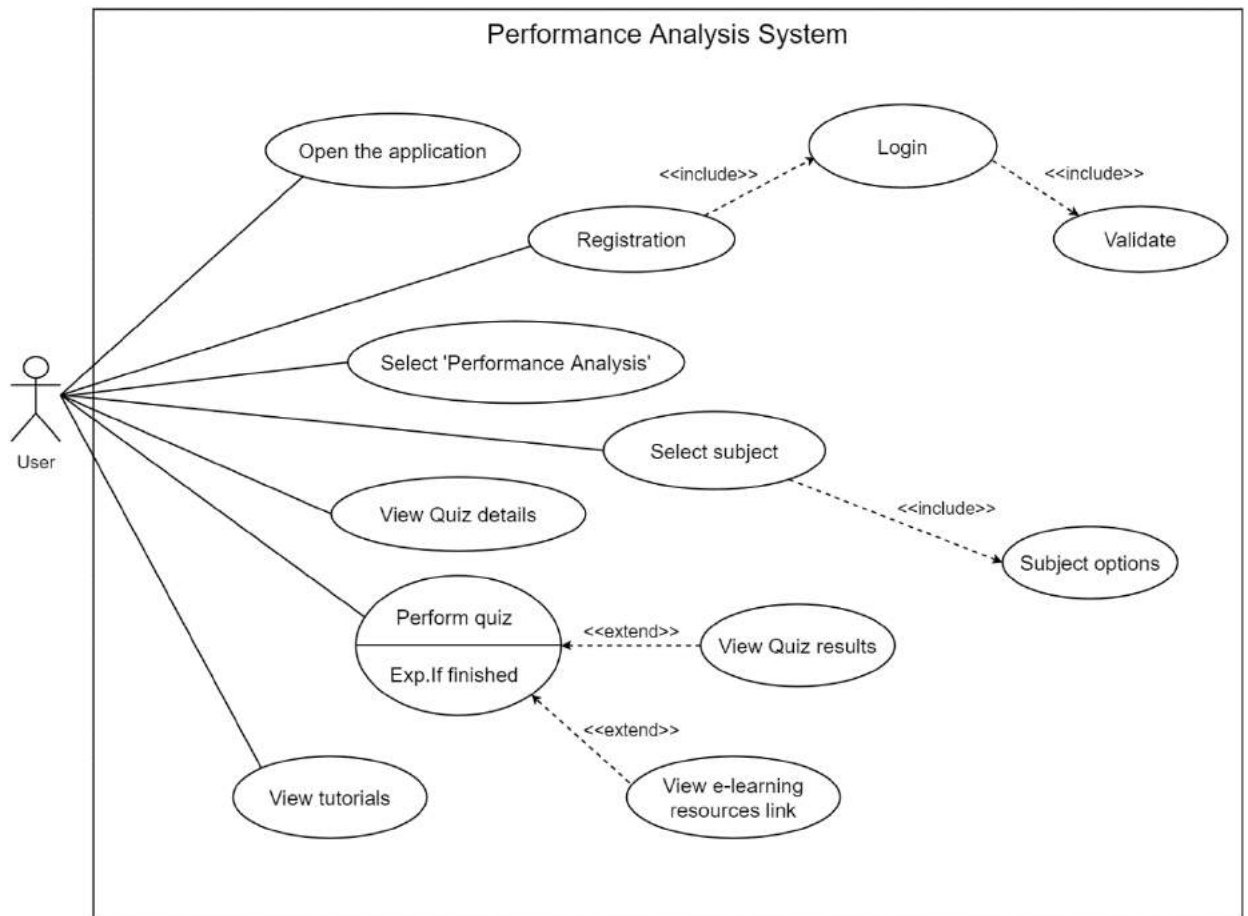
Appendix B : Activity Diagram
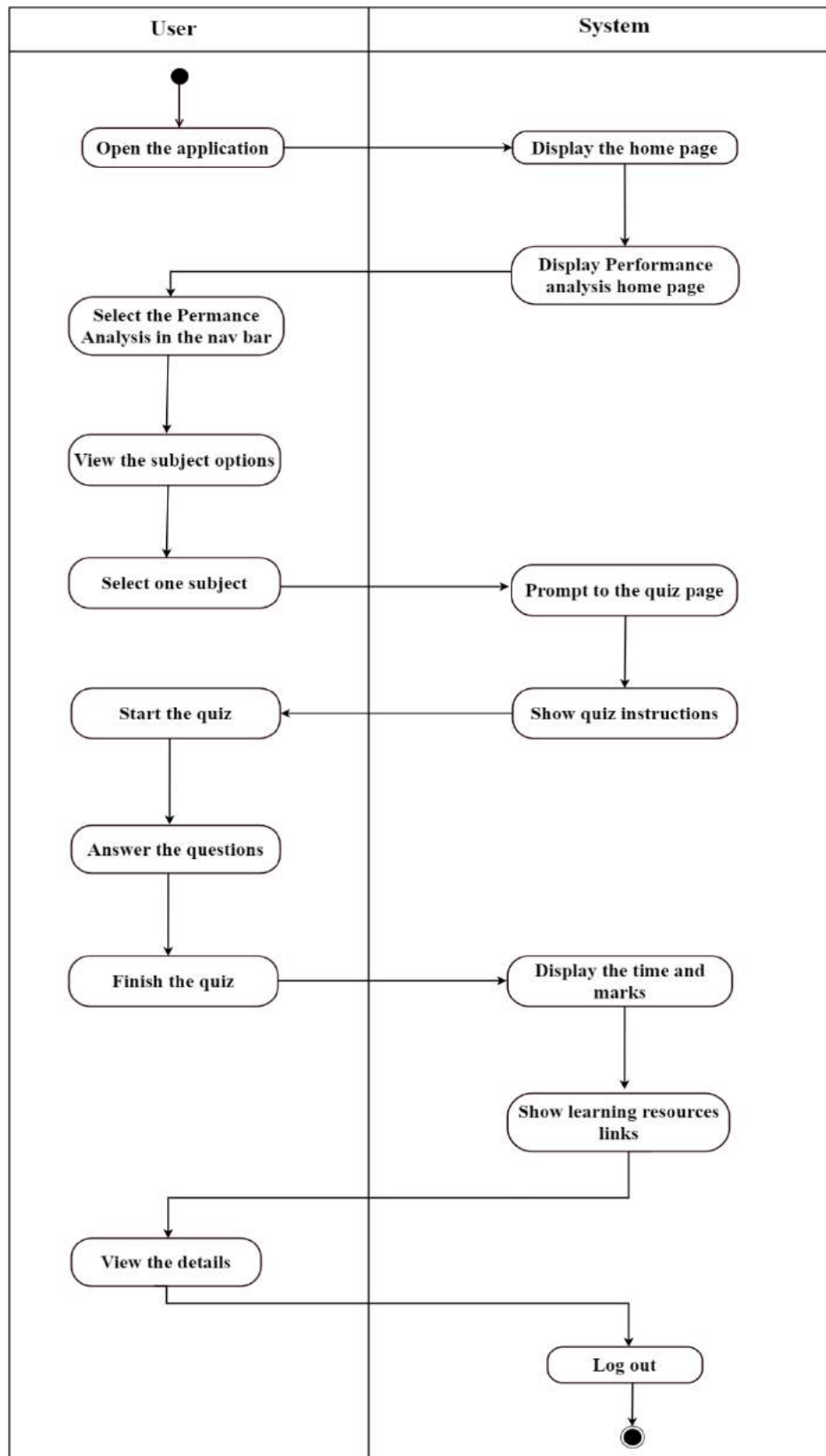
Appendix C : System Diagram

Appendix D : Gitlab Link

Please refer the link to find the full project:

http://gitlab.sliit.lk/2022-179/2022-179_escort/-/tree/feature/performance-prediction