**“AITor” EDUCATION PLATFORM – A PERSONALIZED STUDENT PERFORMANCE ANALYZER AND RECOMMENDATION SYSTEM**

2022-017

Final Report

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B.Sc. (Hons) Degree in Information Technology Specializing in Software Engineering

Department of Computer Science and Software Engineering

Sri Lanka Institute of Information Technology

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# Declaration

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

Signature:

|  |  |  |
| --- | --- | --- |
| IT19188546 | Liyanage N.L.T.N. | A close-up of a logo  Description automatically generated with low confidence |

The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor Date

................................... ...................................

# Abstract

Career orientation is a crucial topic in the development of youths since it has been linked to both good and negative psychological, physical, and social economic differences that remain well beyond the teenage years into adulthood [1]. Refer to [2], to get an ideal career orientation, one would consider various methods of finding characteristics that would lead to an accurate personality classification. This study aims to conduct a complete analysis on the performance of the student throughout the process of their assessments. In this context, career orientation is defined as the extent to the school leavers as well as the freshly graduates are tempting into discover a career which is more suitable for them.

Before continuing with the main objective that career orientation based on student performance, an online survey was distributed to the selected student portion as the initial stride of the work phase for determine the factors that should be considered in the process of recommending the best suited career orientation. After analyzing the responses of the online survey, some considerable number of factors was gathered. This research carried out intentions to develop a model based on machine learning to analyze the student performance and the recommending process.

Since the performance of the student will be analyzed in the process of recommending the best suited career orientation, as a sub objective an overall learner classification will be presented. For that, the concept of Microsoft Power BI and SAS Viya comes into the play along with the ARIMA algorithms. The main skill factors which are identified by the developed model and the domains that the student should work-on in terms of increasing their performance will be presented in detailed manner in the Power BI dashboard. Furthermore, by considering all the characteristics and trends among of all students and a report will be generated and presented the dashboard.

**Keywords:** Career orientation, performance analysis, machine learning, overall learner classification, Microsoft Power BI, skill factors

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# Table of content

[Declaration iii](#_Toc120828692)

[Abstract iv](#_Toc120828693)

[Acknowledgement v](#_Toc120828694)

[Table of content vi](#_Toc120828695)

[List of figures viii](#_Toc120828696)

[List of tables ix](#_Toc120828697)

[1. INTRODUCTION 1](#_Toc120828698)

[1.1 Background & Literature Survey 1](#_Toc120828699)

[1.1.1 Background Review 1](#_Toc120828700)

[1.1.2 Literature Review 5](#_Toc120828701)

[1.2 Research Gap 8](#_Toc120828702)

[1.3 Research Problem 11](#_Toc120828703)

[2 OBJECTIVES 12](#_Toc120828704)

[2.1 Main Objective 12](#_Toc120828705)

[2.2 Specific Objective 12](#_Toc120828706)

[2.2.1 Identification and prediction of best learning strategy 12](#_Toc120828707)

[2.2.2 Identification and recommendation of learning materials 13](#_Toc120828708)

[2.2.3 Performance analysis and personal skills identification 13](#_Toc120828709)

[2.2.4 Progress analysis forecasting and career recommendation 13](#_Toc120828710)

[3 METHODOLOGY 15](#_Toc120828711)

[3.1 Introduction and basic user flow 15](#_Toc120828712)

[3.2 System Architecture 17](#_Toc120828713)

[3.3 Data Gathering and Requirements 18](#_Toc120828714)

[3.3.1 Data gathering 18](#_Toc120828715)

[3.3.2 Requirements 19](#_Toc120828716)

[3.4 Feasibility Study 20](#_Toc120828717)

[3.5 Methods and Technologies 21](#_Toc120828718)

[4 IMPLEMENTATION AND TESTING 22](#_Toc120828719)

[4.1 Implementation of the Model 22](#_Toc120828720)

[4.2 Testing 22](#_Toc120828721)

[4.2.1 Test Cases 22](#_Toc120828722)

[5 PERSONAL AND FACILITIES 29](#_Toc120828723)

[5.1 Usage of cloud infrastructure 29](#_Toc120828724)

[5.2 Other Usages 29](#_Toc120828725)

[6 BUDGET AND BUDGET JUSTIFICATION 30](#_Toc120828726)

[7 GANTT CHART 31](#_Toc120828727)

[REFERENCE LIST 32](#_Toc120828728)

# List of figures

[Figure 1‑1: Status Of Struggling Without Progress Tracking Of Students 2](file:///C:\Users\it19188546\Downloads\IT19188546_TEMP-22-206_Proposal_Document.docx#_Toc95471692)

[Figure 1‑2: Response For The Help Of Career Orientation Recommendation 3](#_Toc95471693)

[Figure 1‑3: Comparing The Percentage Match Accuracies Of S & P 6](file:///C:\Users\it19188546\Downloads\IT19188546_TEMP-22-206_Proposal_Document.docx#_Toc95471694)

[Figure 1‑4 : Accuracy Comparison Of Datamining Algorithms. 7](file:///C:\Users\it19188546\Downloads\IT19188546_TEMP-22-206_Proposal_Document.docx#_Toc95471695)

[Figure 3‑1: Phases And The Modules Of The Proposed Solution 16](file:///C:\Users\it19188546\Downloads\IT19188546_TEMP-22-206_Proposal_Document.docx#_Toc95471696)

[Figure 3‑2: System Architecture 17](#_Toc95471697)

[Figure 6‑1: Gantt Chart 24](file:///C:\Users\it19188546\Downloads\IT19188546_TEMP-22-206_Proposal_Document.docx#_Toc95471698)

# List of tables

[Table 1‑1: Comparison between research A, research B and proposed solution 9](#_Toc95505860)

[Table 1‑2: Comparison between existing applications and proposed solution 10](#_Toc95505861)

[Table 5‑1: Cloud cost estimation 23](#_Toc95505862)

# INTRODUCTION

## Background & Literature Survey

### Background Review

With the impact of Sars-Cov-2, over 160 countries enacted nationwide shutdown, affecting over 87 percent of the world's student population and several other countries have implemented limited school closures, according to UNESCO's monitoring [3]. In this scenario, a considerable number of schools, universities and other higher educational institutes have transformed to the online education techniques. For the online deliveries, such institutions have motivated to apply software solutions like Learning Management Systems (LMS) in their courses.

When the deliveries of the course modules conducted through the online platforms rather than delivering them in the physical manner, the institutions and the lecturers/teachers would like to have a personal analyze for each student who are they teaching. In physical lectures or the teachers can go to each student and get a rough idea about the student. But in the online lectures they are unable to continue the same procedure. Most educators were unable to assess their students' progress due to their incapacity to evaluate and monitor their actions in a virtual environment [4]. In addition, students are also facing some issues such as lack of focus.

In refer to [5], student achievement in an online course is linked to their previous session performance as well as their level of interest. Literature has paid little attention to determining whether student performance and participation in previous tests may influence student accomplishment in subsequent examinations. So that, considering the above scenario, the requirement for the relevant solution is more confirmed.

In the high demand of this collective progress analysis of the students, a closed online survey was conducted among nearly 50 tutors of schools as well as higher education institutes, who will be highly benefitted with a solution for the above gap.

Chart, pie chart

Description automatically generated

Figure 1‑1: Status of struggling without progress tracking of students

According to the above shown figure 1-1, more than 90% of the tutors are confirmed that they are struggling for conducting the online courses without following the student progress. Therefore, the importance of the progress analyzing for the online course content delivering is proven.

Furthermore, with the pandemic in the world the students who were willing to take the first step in their professional career were affected in a considerable manner. On the other hand, the companies who were willing to hire the employees were affected as well. For that the companies made an immediate transition for normal in-person interviews to the hiring interview processes through the online video conferencing platforms like Zoom, Microsoft Temas, Google Meet. However, the hiring companies could face the problems with the employees that they hire through this online interview processes. As per an example, a developer cannot be hired only based on their facial interview. According to [6], Technical interviews (a type of interview in which candidates create code to solve a problem) are prevalent in the software development industry, and are employed by organizations such as Facebook, Google, and Microsoft. These interviews are used to objectively analyze candidates and determine whether they are a good fit for the firm.

An undergraduate or a student who is willing to step into the industry, or who is about make his/her decision regarding the career orientation, are grappling even a bit at that instant. Making the correct profession choices has grown increasingly complex and difficult due to advancements in technology and rapid changes in marketplace conditions, as influenced by globalization and the ever-increasing interdependence of national economies [7].

In further refer to [7], changing career orientation later in life is frequently a waste of time and resources for the people who concerned. It is desirable that career choices are made with attention. That is because it should made as appropriate as possible in the first time around. Therefore, selecting the career orientation had not been the easiest decision to construct.

Considering the fact that selecting career orientation is not easy, a recommendation for the career orientation would help the school leavers and the undergraduates. In order to collect the idea about the recommendation, a closed online questionnaire was conducted among the school leavers as well as undergraduates. More than 60 individuals were contributed to the survey.

Chart, pie chart

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Figure 1‑2: Response for the help of career orientation recommendation

When referring the above shown figure 1-2, around 39% of the participant were not sure about a recommendation would help for that much a sensitive topic. Another 25% of the participants of the survey did not think the career orientation recommendation would help them. However, only about 37% of participants believe the recommendation will help foe selecting he career orientation. Therefore, when developing that kind of a algorithm, the accuracy should be considered in forehand.

### Literature Review

In the formation of a more efficient generation of corporate personnel, career orientation is a critical issue that should not be underestimated. Thus, we are supposed to analyze the performance of a student and predict a future recommended path for the student. Hence, in the consideration of performance of a student, we must rely on every possible data of a student. On the other hand, for analyzing and the determination of the prediction, we must exercise more powerful and more accurate techniques and algorithms. Thus, in thus literature review we will review some already existing performing analyzing approaches and algorithms and the existing approaches that can be found to execute the career recommendation. Furthermore, for generate the report of the overall learner classification of the system was supposed to utilize a third-party application. Thus, in this literature review the possible third-party applications will be discussed.

In the consideration of the performance of the students, since we have the gathered data through the previous phases of the system, we have the advantage of using data mining techniques as well as the supervised and unsupervised learning techniques. Using data mining techniques, we could gain the advantage of determining the relevant information from the data set. Moreover, these techniques obtain the knowledge from the given data. When considering the supervised and unsupervised learning techniques and from their subcategory’s classification, prediction, association, clustering we have the ability of applying the classification technique for analyzing the performance of the student. Furthermore, we can apply the data mining technique for the conduct the student performance [8].

According to the Lim Pek Choo and Jane Labadin in their study on student performance and forecasting [9], accuracy of the projected baseline grading is considerably higher when considering accuracy of the both standard grading and the projected baseline grading.

Chart, line chart

Description automatically generated Source: [9]

Figure 1‑3: Comparing the percentage match accuracies of S & P

Refer to [10], a recommender system algorithm is created to help both client and companies in the many ways. Methods used are Content based filtering dependent on a correlation be-tween the content of the jobs and a client profile. The content of every job is presented as a lot of descriptors or terms, ideally the words that are present in a report Collaborative filtering: It is an algorithm that helps make automatic predictions depending on the preferences of the client which are gathered from their likes and dislikes and client information or taste data from numerous clients Hybrid filtering. Hybrid filtering is the mix of the possibility of both collaborative filtering and content-based filtering to give viable proposals of related. The principal advantage of utilizing Hybrid Recommendation framework is that the precision is very high.

The desired features of a Research Paper Recommender System are accuracy - information needs differ among users due to different backgrounds and knowledge, inclinations and objectives, and settings consequently the framework needs to fulfill the client’s individual information need. The content must also be relevant to the user. This is exactly same as a career recommendation system where the profiles of the users are extremely diverse, and the content needs to match each user’s profile. User satisfaction - The recommendations made to users based on the research paper must be optimal. Recommender systems must also vary on demographics of the user i.e., the age group and qualifications of the user to provide optimum user satisfaction [10].

Chart, bar chart

Description automatically generatedAccording to [11], When it concerns to Open Educational Resource (OER) systems, there is a scarcity of material on high-quality OER recommender systems. To use semantic content, various studies have developed recommendation algorithms based on ontologies, linked data, and open-source RDF data in recent years. Created an ontology for learners, learning objects, and their settings, for example, to provide adaptive suggestions based on object features that are similar. By developing rules based on recommended sequences of learning objects using current ontologies, researchers investigated the Cold Start problem in the context of new micro OERs. In addition, learners can use an OER recommendation system to help them meet their skill-based learning goals.

Figure 1‑4 : Accuracy comparison of datamining algorithms.

Source: [12]

In refer to [12] and the above figure 1-4, The accuracy of C4.5 algorithm is 86% for the career dataset. Other algorithm accuracies are 84%, 82%, 80% for Naïve Bayes, K Star and Simple Cart respectively. In Figure 3, shows how C4.5 algorithm gives choices to the students for choosing career based on their skills.

## Research Gap

Researchers have done many case studies on the mentioned main objective performance progress analysis and forecasting as well as on career recommendation. Considering the conclusions and the methodologies of the [5], [8] and [9], they have followed some basic methods such as,

* Student’s exam marks analysis
* Graph theory to check relationship between student and subject

And referring to the [7], [10] and [11] which were conducted based on career orientation recommendation, most of them have followed some old school methods such as,

* Text filtering based on resumes
* Questionnaires

None of the above mentioned researches have considerably focused on the personal skills of the students when it is comes to the students career orientation recommendation. Personal skills are the main factor that we can depend on since they are the factors that ensuring the student’s performance throughout his/her academics.

In the [5] (will be known as Research A) and the [8] (will be known as Research B) will be compared with the solution that this paper is about to create regarding the matter of the solution the researchers concluded for the progress of the performance analysis and the forecasting.

In the following table, the methodologies as well as the conclusions of the above case studies will be discussed.

Table 1‑1: Comparison between research A, research B and propdosed solution

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Case study | Does it have time-based learner analysis mechanism? | | Does it have a forecasting result dashboard? | | Main output |
| Result analysis | Progress analysis | Individual Student | Overall (Group/batch vise) |
| Research A | yes | no | no | no | Students will be analyzed based on the assessment results analysis. |
| Research B | no | yes | no | yes | Students will be analyzed based on the progress analysis. |
| AITor | yes | yes | yes | yes | A dashboard in both individual and overall manner for time series forecasting based on results and progress analysis of the students. |

Moreover, considering the existing real-world applications such as Blackboard, Jotform are also have some features like result analysis as well as progress analysis. But they are more focusing on the content delivering to the students. The following table contains the comparison between those existing application with the proposed solution.

Table 1‑2: Comparison between existing applications and proposed solution

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Platform / Tool | Time-based learner analyzer | | Forecast Dashboard | |
| Result Analysis | Progress Analysis | Individual | Overall |
| Blackboard | Available | Not Available | Not Available | Available |
| Jotform | Not Available | Available | Not Available | Not Available |
| AiTor | Available | Available | Available | Available |

## Research Problem

Further referring into the research gap that concluded in the above chapter, two main research problems has been identified.

1. How to obtain more productivity by analyzing and forecasting the progress of the students? (Individual/Overall)
2. What are the possible steps to reduce the struggle of the students when they are about to select their career orientation?

Considering the first problem that obtain more productivity of the students, first there should be a method to identified that the productivity levels of the students in both individual and overall group manner. That would help the tutors as well as lecturers to reach out each student and help them to improve their productivity in each subject module. For achieve this scenario, the proposed solution of this paper comes up with overall and individual forecasting result dashboards. When having a forecasting dashboard, not only the teachers or lecturers, but also the students/undergraduates will be highly benefitted. They could refer the forecasting dashboard and level up their abilities and the skills. And they could recognize the level that they are in the batch or group.

In the above-mentioned dashboard, the identified weaknesses, personal skill levels, result progress will be visually presented. For the matter of displaying them, the individual analyze report for the student and the overall student group/batch analyzed report will be using many kinds of charts to make the result is more visualized. The identified second problem is what are the possible steps to reduce the struggle of the students when they are about to select their career orientation. As the first step of this, the student’s results for assessments, progress of the assessments throughout the term or a semester will be considered. And the identified personal skills of the students will be highly considered as well. After consideration both of those two major factors, a recommendation for the student’s career orientation. And in the process of identifying the recommended career for the student, current trend of the world as well as the number of opportunities for the relevant career in the job market will be examined.

# OBJECTIVES

## Main Objective

The major purpose of this case study is to provide both students and tutors with a highly engaging technology-enhanced online education experience, in which students may receive more individualized education and tutors can get an upfront detailed analysis of their students.

Given that the majority of educational institutes now give their course content online and based on the analysis performed in the preceding sections of this document, students have found it difficult to absorb the whole knowledge from the content delivered via the instructor.

According to the online questionnaire that conducted among the students, the main goal of this study is to develop a better platform that is tailored to each individual and has a proper course material recommendation method, from the student's perspective.

On the other hand, from the tutor’s perspective, the main objective is to provide a platform that provides a detailed analysis of students. The analysis could be helpful for the institution purposes as well.

## Specific Objective

### Identification and prediction of best learning strategy

This objective is to design the process by which the application will detect, predict, and analyze the student's best learning strategy(s). Authors must conduct research and determine the most popular and widely used learning tactics among pupils. This entails developing and testing a hypothesis about how to determine the best learning technique for each learner. In most circumstances, a single learner may employ a variety of learning techniques (video, audio, text). These prerequisites should also be addressed by this goal.

### Identification and recommendation of learning materials

Once the best learning strategies have been determined, a method for appropriately identifying and recommending subject materials to the learner should be developed. The goal of this goal is to reduce the amount of time students spend browsing the internet for appropriate course content. It has been discovered that students occasionally struggle to select the most appropriate supporting learning environment. Students will be able to have a seamless experience in accessing the best filtered content in one platform if this goal is achieved.

### Performance analysis and personal skills identification

The involvement of students with the teacher was limited as the transition from traditional classroom teaching to online teaching occurred. In a traditional classroom setting, where both the student and the teacher are physically present, the teacher can keep a close eye on the student. As a result, the teacher is able to make valid assumptions and analyses about that specific pupil. However, with the transformation to online education, an increase in the number of students in a single session, and a lack of technology, it has become more difficult to identify each student individually and give extensive analysis of their productivity. The goal of this objective is to deliver a valid and accurate analysis based on proof-of-work and statistical analysis for each student as well as the entire classroom.

### Progress analysis forecasting and career recommendation

In refer to [9], a modified and adjusted grading system is required since the current standard grading system does not provide a realistic projection of the students' performance in the actual public examination. As a result, schools now decide on a set of minimal (baseline) marks, also known as baseline data, that will be used to calculate each grade for school-based examinations. Therefore, the students, lectures as well as the institution will be highly benefitted through a proper progress analysis forecasting.

According to [7], Statistics show that many young people alter their job paths, sometimes involuntarily and sometimes on their own volition. For example, 40% of STEM (science, technology, engineering, and mathematics) students and 60% of pre-medical students fail to complete their degrees or switch to other subjects.

The realm of cooperation is a broad and ever-changing domain. Keeping up with industry trends is essential if you want to advance your career in a specific field. Students, particularly recent graduates, or undergraduates are having difficulty determining the best path to advance their careers. If they haven't recognized their purpose, they may choose the wrong path and make poor career decisions. The goal of this purpose is to discover and deliver individualized career suggestions to each student, as the suggested system closely monitors the students' educational trends and has enough data to make justifiable assumptions.

# METHODOLOGY

## Introduction and basic user flow

A fully functional web application is proposed by this paper. The web application is more capable of four main functional components which are achieving the sub objectives that mentioned above.

1. Identifying the best learning strategies of the student
2. Recommending course related materials according to the identified learning strategies
3. Conducting the performance analysis and identify the personal skills of the student
4. Conduct the time-series forecasting for the progress of the student, presenting the detailed report and recommend the career orientations.

The fourth main functional component that conducting the time series forecasting for the progress of the student will be more extracted in this part of the paper.

As per discussed before in the background and literature review, it could identify that most of the case studies were considered only some of the features that we discussed on the research gap section. Most of the cases, for the time-series forecasting they did consider only in the result analysis. But to get more accurate results regarding the student’s performance, the progress analysis should also be considered in the forecasting.

In the proposed application, both the result and the progress analysis will be considered. There would be three main phases in the proposed solution to continue the process of conducting the time-series forecasting for the progress of the student, presenting the detailed report.

1. Assessment phase
2. Forecasting phase
3. Presenting phase

Along with these three phases of the forecasting and presenting section, there will be another sub-module called ‘Career Recommendation Module’ which recommends the Diagram

Description automatically generatedcareer orientation of each student.

Figure 3‑1: Phases and the modules of the proposed solution

The above figure 3-1 includes the diagram which displays the 3 phases and the career recommendation module.

Besides, considering the ‘Career recommendation module’, it is responsible for consider all the possible data that is related to the career orientation selecting. In the module, there will two components which is personal skill analyzer and trends and job market analyzer. The personal skill analyzer will consider the student assessment marks as well as the identifies personal skill factors while the trends and job market identifier consider the current world trends as well as the job opportunities in the job market.

## System Architecture

Graphical user interface, application

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Figure 3‑2: System Architecture

The figure 3-2 is briefing how the system architecture works. The architecture contains three main components in the forecasting and the career recommendation.

* Time-based leaner analyzer
* Career Recommendation module
* Intelligent Forecasting module

Both time-based leaner analyzer and the career recommendation modules will be connected with the previous components from the other objectives of the proposed system.

## Data Gathering and Requirements

### Data gathering

There are many ways that we could utilize for data gathering processes when it comes to educational purpose-based platform developing. But, considering the facts that the accuracy of the data as well as the validity and the usability, the gathered data should be more specific in those factors. However, the process of data gathering could be divided in to three main parts based on the components we have divided the sub-objective.

* Time-based learner progress analyzer

First, according to the system architecture which is presented under the figure 3-2, as inputs of the time-based learner progress analyzer output of the assessment modules will be considered. Thus, all the results of the previously concluded assessments and the term assessments will be the data that will be gathered on behalf of this component.

* Career recommendation module

According to the figure 3-2, there are two main inputs for the career recommendation module. First, the output of the personal skills identification module. There could be one or more outputs from that module. As the second input the current trends from the world regarding that subject area as well as the job opportunities in the job market will be considered. For the identification of current trends, the annual survey of the stack overflow as well as the data sources provided by the google will be used. To identify the job market, the LinkedIn sources as well as the api provided by the Glassdoor online platform will be considered.

* Intelligent forecasting module

As the inputs of this module, the outputs of the above two modules will be used. And this module will provide the main output for the proposed solution.

### Requirements

When dealing with the students and the lecturers there should not be any issues or delays. Therefore, the requirements for proper policies and procedures when providing the services is a must. Moreover, to achieve the completion of the objective the conducting the time-series forecasting for the progress of the student, presenting the detailed report and recommend the career orientations, identification of the requirements is more important. In the requirements there are two main parts which is functional and non-functional requirements.

* Functional Requirements

Considering the all the requirements in the proposed solution, there are four functional components that we can identified. They are,

* Identify the progressed points of the students.
* Conduct a time series forecasting for the student performance.
* Generate a fully functional dashboard for present the analyzed data.
* Recommend a career orientation based on the performance and other factors.
* Non-functional Requirements

Looking into the proposed system architecture of the system and the data gathering phases, we could see there are more inputs and outputs from the third-party applications we are based on. Therefore, proper data handling protocols must use in the implementations. And since there is a proposed recommendation system the accuracy is also a noticeable factor. Thus, we could identify,

* Accuracy
* Availability
* Usability

as the non-functional requirements of the proposed solution.

## Feasibility Study

When discussing about the feasibility of the proposed solution, we have to discuss about the three main feasibilities.

* Schedule feasibility

The proposed project should be completed within the specified time frame of one year, with each phase producing credible outputs while staying on schedule. Also, submit the final output product by the scheduled deadline.

* Economy feasibility

Even if the proposed project's end outcome, the proposed project works flawlessly as planned, producing preferred correct outputs without any faults or misses, it cannot be identified as a success if it costs a lot of money. The services which will be used should be less expensive and more reliable. So, the resources and needed services cornered into a limitation of cost.

* Technical feasibility

The project members should have some expert level understanding of fundamental cloud services, current laws and equations, and hands-on experience with basic cloud architectures such as microservices in order to properly accomplish the proposed project.

## Methods and Technologies

When considering the methods that could be used in the implementation and the designing processes, there are some factors that should be highly considerable when choosing the methods and the technologies. As we discussed under the requirements the accuracy of the final output should be highly considered since this proposed application supposed to use in the educational sector.

Furthermore, talking about the availability of the solution that this paper is proposing, the dashboard that contains the student’s performance and the progress analysis results should be accessed by various people at the same time. And also, the security of the data is somewhat sensitive. For that reason, the security factor also should be considered when it comes to resulted data handling. In case of these considerable factors, an existing visualized dashboard technologies such as the Microsoft Power Bi, Sas Via dashboards will be considered.

However, since a software solution also will be developed with this applied research, the software developing life cycle will be followed throughout the implementations.

# IMPLEMENTATION AND TESTING

## Design Phase

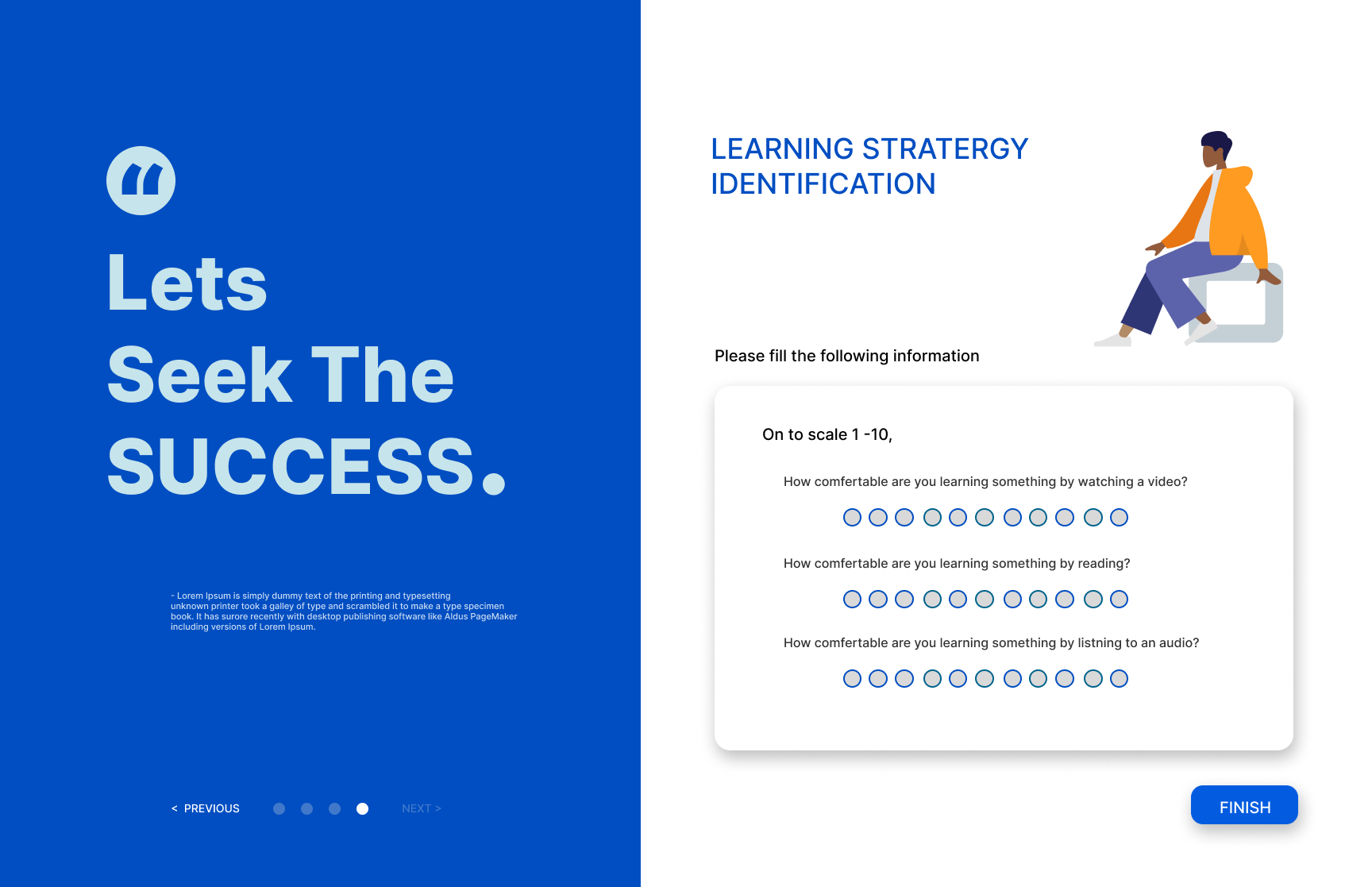


Figure 4‑1: User Interface 01

Graphical user interface, application

Description automatically generated

Figure 4-2: User Interface 02

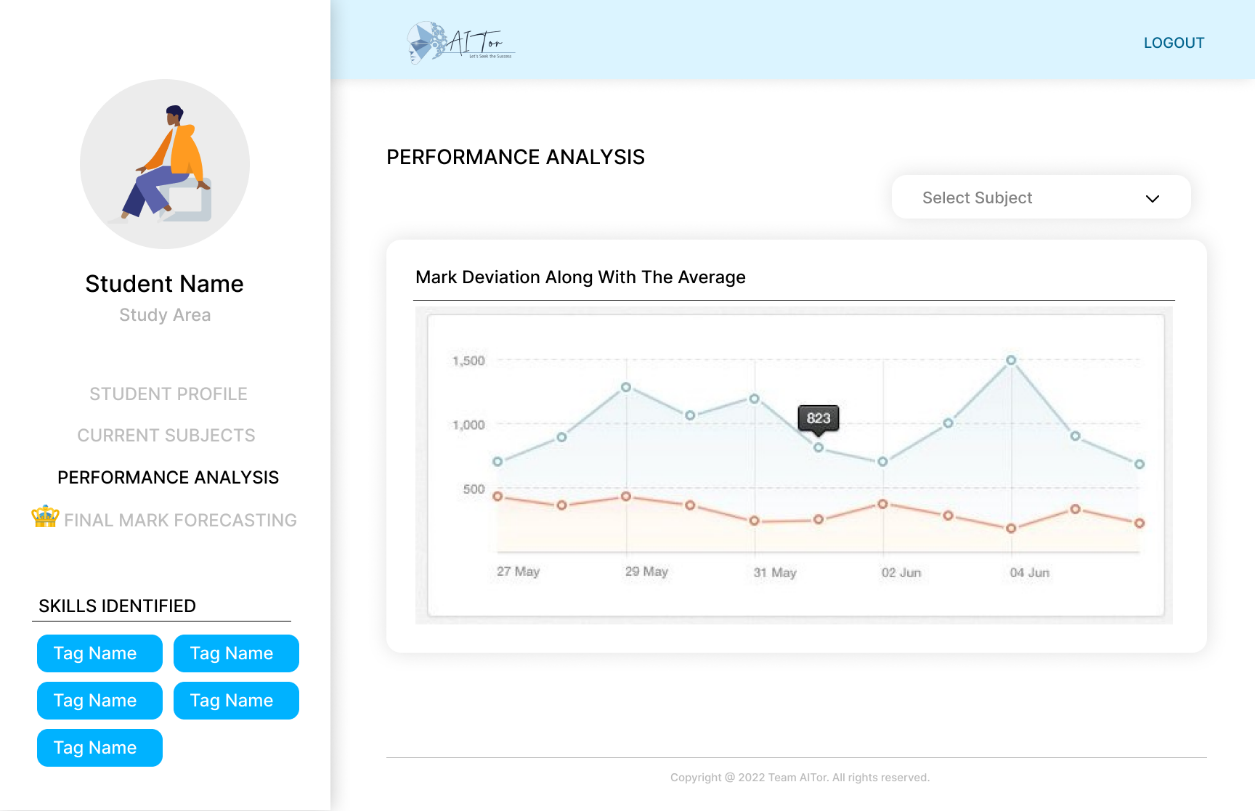


Figure 4-2: User Interface 02

## Implementation of the Model

## Testing

As the final stage of entire development of the “AITor” platform set of testes were carried out in order to uncover hidden bugs, to ensure the quality of the product which enables to achieve high customer satisfaction on live operation. By following standered software development methods, following set of categories of tests were carried out.

* Unit Testing
* Integration Testing
* System Testing
* Regression Testing

Also, it was taken necessary steps to fix the identified bugs throughout the testing process and was able to ensure that the final product is working as per the requirements.

### Test Cases

Followings are set of test cases which were conducted for learning material recommendation and learning content identification component, under the system testing step of the testing process.

Table 4.1 Test Case - Add new module

|  |  |
| --- | --- |
| **ID** | **001** |
| Test Case Name | Add new module |
| Test Scenario | Add new module to the LMS by the Teacher |
| Primary Actor/s | Teacher/Tutor |
| Preconditions | Tutor must be logged in to the teacher dashboard of the AITor |
| Input Data | * Module basic information * Module outline of the module |
| Test Steps | 1. Navigate to the “Add Module” page of the teacher dashboard. 2. Fill all the required fields of the add module form. 3. Upload the module outline of the module using “Upload Module Outline” Button on the form. 4. Click submit button. |
| Expected Output | * New module should be appeared on the modules section of the teacher dashboard. * New module should be appeared on the modules section of the student dashboard. |
| Actual Output | * Shows added module on the teacher dashboard. * Shows added module on the student dashboard. |
| Status (Pass/Fail) | Pass |

Table 4.2 : Test Case - Identify learning content using module outline.

|  |  |
| --- | --- |
| **ID** | **002** |
| Test Case Name | Identify learning content using module outline. |
| Test Scenario | System should be able to identify the learning areas of the module by module outline document. |
| Primary Actor/s | Teacher/Tutor |
| Preconditions | * Tutor must be logged in to the teacher dashboard of the AITor * Module outline document should be in “pdf” format. * Module outline document should be in written in given format of the AITor user manual. |
| Input Data | Module Outline Document |
| Test Steps | 1. Navigate to the “Add Module” page of the teacher dashboard. 2. Fill all the required fields of the add module form. 3. Upload the module outline of the module using “Upload Module Outline” Button on the form. 4. Wait for upload progress bar to complete. 5. Click on “View Identified Content” Button. 6. Compare with main learning areas of the module outline document with the identified learning areas. |
| Expected Output | Identified learning areas should be same as in the main learning areas of the module outline document. |
| Actual Output | Identified learning areas are same as in the main learning areas of the module outline document. |
| Status (Pass/Fail) | Pass |

Table 4.3 Test Case - Populate module page.

|  |  |
| --- | --- |
| **ID** | **003** |
| Test Case Name | Populate module page. |
| Test Scenario | Module page should be populated according to the learning content identified by the module outline. |
| Primary Actor/s | Teacher |
| Preconditions | Tutor must be logged in to the teacher dashboard of the AITor. |
| Input Data | * Module Outline Document |
| Test Steps | 1. Navigate to the “Add Module” page of the teacher dashboard. 2. Fill all the required fields of the add module form. 3. Upload the module outline of the module using “Upload Module Outline” Button on the form. 4. Wait for upload progress bar to complete. 5. Press Submit button. 6. Navigate to the module page of the newly added module. 7. Compare the sections of module page with the mail learning areas of the module outline document. |
| Expected Output | Sections of the respective module page should be same as in the main learning areas of the module outline document. |
| Actual Output | Sections of the module page is same as in the main learning areas of the module outline document. |
| Status (Pass/Fail) | Pass |

Table 4.4 : Test Case - Recommend learning materials according to identified learning content.

|  |  |
| --- | --- |
| **ID** | **004** |
| Test Case Name | Recommend learning materials according to identified learning content. |
| Test Scenario | System should be able to recommend learning materials according to identified learning content. |
| Primary Actor/s | Student |
| Preconditions | * Student should be logged in to the system. * Student should be enrolled into the respective module |
| Input Data | N/A |
| Test Steps | * Navigate to a module page in enrolled module list. * Click “View Recommendations” link at the bottom of any section on the module page. * User will navigates to the recommendations page. * Ensure Audio, Video and Text based recommendations are appear in the recommendations list. * Compare the topic of selected section of the module page and similarity of the materials recommended for that section. |
| Expected Output | Recommended learning materials should be match with the expected learning content of the selected section of the module page. |
| Actual Output | Recommended learning materials match with the expected learning content of the selected section of the module page. |
| Status (Pass/Fail) | Pass |

Table 4.5 : Test Case - Recommend learning materials for new users.

|  |  |
| --- | --- |
| **ID** | **005** |
| Test Case Name | Recommend learning materials for new users. |
| Test Scenario | New user will be enrolled to existing module.  System should be able to recommend best rated learning materials to new users. |
| Primary Actor/s | Student |
| Preconditions | * Student should be logged in to the system. |
| Input Data | N/A |
| Test Steps | * Enroll to an existing module in the modules page. * Select a section and click on “View Recommendations” link. * Check the AITor ratings section of the recommendations. |
| Expected Output | System should recommend best rated items in the AITor system for the selected learning content. |
| Actual Output | System recommends best rated items for existing modules in the AITor system for new users for the selected learning content. |
| Status (Pass/Fail) | Pass |

Table 4.6 : Test Case - Recommend learning materials for existing(Trained) users.

|  |  |
| --- | --- |
| **ID** | **006** |
| Test Case Name | Recommend learning materials for existing(Trained) users. |
| Test Scenario | Trained user will be enrolled to existing module.  System should be able to recommend learning materials recommended using collaborative filtering. |
| Primary Actor/s | Student |
| Preconditions | * Student should be logged in to the system. * Student should previously enrolled at lease one module of the system of the system and should have provided ratings. |
| Input Data | N/A |
| Test Steps | * Enroll to an existing module in the modules page. * Select a section and click on “View Recommendations” link. * Compare the recommendations with the recommendations for a new user. |
| Expected Output | System should able to produce fine-tuned and more personalized recommendations for existing and trained users. |
| Actual Output | Recommendations for the existing user is different than the recommendations for the new user. |
| Status (Pass/Fail) | Pass |

# PERSONAL AND FACILITIES

## Usage of cloud infrastructure

* AWS ECS for manage the deployments of Docker container
* AWS ECR for manage the Docker images. This will be the primary version control point of the application versions.
* AWS EC2 for handling the 3rd party integrations which will help with the deployment process. (Jenkins installations, sonar cube)
* AWS load balancer
* AWS SQS for decouple the requests between the components
* AWS S3 for store static content such as images, raw files, logs

AWS key space as the primary database database and AWS RDS for optional data handling

## Other Usages

* Power BI dashboard
* SAS Viya dashboard
* Glassdoor API
* Stackoverflow services
* LinkedIn API

# BUDGET AND BUDGET JUSTIFICATION

The budgets that are needed for the entire AITor platform, can be classified into two categories. These categories will represent the cloud-based cost that needed for development ad deployment and the other category represent the marketing cost for commercialize and market the AITor product **Cloud Based Cost**

Table 6‑1: Cloud cost estimation

|  |  |  |  |
| --- | --- | --- | --- |
| Service | Monthly | First 12 months total | Currency |
| AWS Fargate | 36.04 | 432.48 | USD |
| S3 Standard | 1.16 | 13.92 | USD |
| Data Transfer | 0 | 0 | USD |
| Amazon Simple Queue Service (SQS) | 0 | 0 | USD |
| Amazon Elastic Container Registry | 0.5 | 6 | USD |
| Amazon EC2 | 43.87 | 526.44 | USD |
| Amazon Keyspace | 2 | 64 | USD |
| Other | 20 | 240 | USD |
|  |  |  |  |
| Cost | **103.57** | **1282.84** | **USD** |

In the cost calculation, it is assumed that 100 users are using the system. Since the entire system will be fully hosted in AWS cloud and will uses different cloud features, the considerable portion of the cost will allocate acquiring cloud services. The “Other” category mentioned in the above table includes the costs for third party APIs that are used in getting learning materials into the system.

# RESULTS AND DISCUSSION

At the end of the implementation, the system was able to function as it was expected and was able to predict learning styles, recommend learning materials according to the predicted learning styles, identify best suited career paths and to provide accurate forecasts of students in different levels. Individually the learning style identification component was able to record 86.67% of accuracy while learning material recommendation module and skill Identifier and career path recommendation modules respectively preserving 83.58% and 83.35% average values.

In measuring the accuracy values for the material recommendation component, it had to use survey-based approach since this component has been used unsupervised learning for the model implementation. In this process, separate survey was created to get feedbacks od users who was got learning material recommendations via the material recommendation component. By comparing recommended ratings for learning materials and actual ratings which was gathered through the survey, the accuracy values were calculated.

Another factor that was highly affected towards the accuracy of the material recommendation model was the sparsity of the learning materials of some of the types. Compared to the video and text-based learning materials, the sparsity of audio learning materials was very high, and this effect resulted in introducing difficulties in recommending learning materials as per the predicted weights of different learning styles.

As it was introduced in aforementioned, having a rich pool of learning materials always empowers the learning material recommendation systems more accurate and the current accuracy values will be further increased through exposing to high number of learning materials.

# GANTT CHART

Chart, timeline, bar chart

Description automatically generated

Figure 7‑1: Gantt Chart

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