

AI-Driven Career Recommendation and Personalized Learning System

P. Rajapandian¹, V. Hemasree²

¹ (Associate Professor, Department of Master of Computer Applications, Sri Manakula Vinayagar Engineering College, Puducherry - 605107, India

Email: rajapandian.mca@smvec.ac.in)

² (PG Student, Department of Master of Computer Applications, Sri Manakula Vinayagar Engineering College, Puducherry - 605107, India

Email: hemavenkatesan2003@gmail.com)

Abstract:

For many students, selecting a career in the Information Technology (IT) field can be very challenging considering the variety of career paths available. The proposed project will create an AI-Driven Career Recommendation and Personalized Learning System that will allow students to discover appropriate career options in IT based on their assessment results, interest and capability levels. Students will be evaluated on Theory, Practical, Aptitude and Communication assessments to determine their proficiency level as either Beginner, Intermediate, Advanced or Expert. A XGBoost based machine learning model will provide recommendations for careers within various areas of IT including; Python Programming, Java Programming, Web Development, Artificial Intelligence, Cybersecurity, Cloud Computing, Database Management Systems and UI/UX Designer. In addition to providing a career recommendation, the AI-Driven Career Recommendation and Personalized Learning System will provide students with materials that will enable them to advance within their chosen career path by providing a basic career roadmap, links to online resources, resume keywords, interview preparation materials, and potential project ideas. In addition, there will be a chatbot powered by AI to provide guidance for students on careers and training needs related to careers in IT. Overall, the proposed AI-Driven Career Recommendation and Personalized Learning System will provide students with the resources necessary to make educated decisions about their future careers in IT.

Keywords — Career Recommendation, Personalized Learning, XGBoost, Machine Learning, Educational Technology, Career Guidance.

I. INTRODUCTION

There are multiple career options available in the information technology sector, including, but not limited to, computer programming, artificial intelligence, information security, cloud computing and user interface/user experience design. Many students have difficulty making appropriate career choices, as they do not receive adequate direction or

have enough information on what is necessary to pursue specific careers.

Many of the more traditional methods of providing career-directed guidance do not take into consideration individual student’s abilities, interests and capabilities. Thus making it challenging for the student to make appropriate selecting of respective careers and to develop learning paths.

The Artificial Intelligence Driven Career Recommendation and Personalized Learning System provides a solution to this issue by analyzing student performance, predicting grade levels with proficiency and providing recommendations for classifying student interest in information technology, utilizing the XGBoost algorithm.

Additionally, this system provides students with personalized learning assistance in form of career pathway design; learning resources and completions of resume keywords; preparation for job interview; suggestions for projects; and a chatbot-style artificial intelligence career counseling system to support students' pursuit of their chosen career.

The objectives of the program are as follows:

- a) Validate student skill sets and recommend relevant careers in information technology;
- b) Provide personalized learning paths and provide resources for preparing resumes and job interviews;
- c) Provide assistance with project ideas and provide AI Based Career Counseling.

II. LITERATURE SURVEY

1. *A Method for Recommending Careers to Students Using Machine Learning - R. Kumar and S. Mehta (2020) :*

The goal of this research project was to create a machine learning program that can match students with potential job careers based on their school transcript (GPA) and selected area of interest. The program uses multiple classification techniques to match students' GPA scores with one or more pre-defined job positions, including but not limited to: Software Developer, Data Analyst, Database Administrator, etc. The program will yield more accurate results than most standard classification systems (rules) because it only uses the student's GPA to create an association between the job and the job title; therefore, it does not account for other relevant factors such as communication skills, potential for success in the role, or prior work history. The program does not provide any recommendations

for further training or support (e.g., tutoring) related to a student's career progression.

2. *Using Data Mining to evaluate students - P. Singh & A. Verma (2021):*

In this study we developed a system to evaluate student's academic performance, using their test marks, in order to make predictions about their future success. However, the evaluations produced by our method cannot help someone evaluate their potential career or decide how to best assist them with planning for their future career. For this reason there is an urgent need for an assessment, prediction and recommendation system which will provide that type of support to each student, as well as provide their results.

3. *AI-Based Career Guidance Chatbots - N. Sharma, L. Jain (2023):*

Currently, there exist numerous AI based chatbots that assist students in answering their queries regarding careers. The current AI-based Chatbot systems are static and respond based upon previously defined static data or through how they were trained on previous conversations. Current systems do not have the capability to analyze student performance and provide personalized recommendations for career paths. Current systems do not utilize integrated systems for the purpose of skill assessments and Do If-Then Statements predictive modelling through the use of machine learning or other intelligent agents technologies. This has led to the development of a more sophisticated system that integrates several sources of information into one endpoint that includes predictive analytics and personalized learning recommendations for students.

III. PROPOSED SYSTEM

The overall workflow of the proposed system is shown in Figure 1.

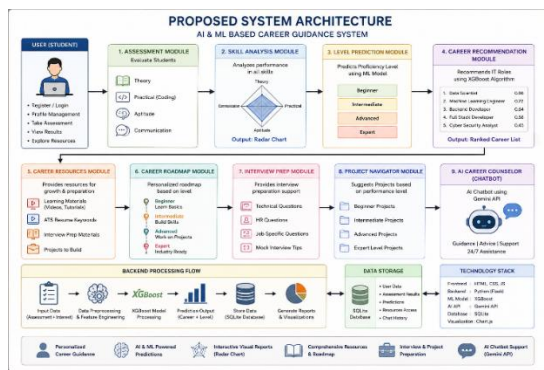


Figure 1 : Workflow of Proposed Career Recommendation and Learning System

This was developed to address the deficiencies of traditional methods for guiding users through their careers by creating a smart (AI and ML-based) and inclusive (matching user's interests and skills) platform enabling them to find suitable IT-based careers. By taking into account student performance, interest, and skill level; we're able to provide accurate career suggestions along with resources to support their exploration through learning, either by independent research or working with a coach/mentor.

The system will have an Assessment Module for evaluating students by Theory, Practical, Aptitude, and Communication. Using the results of the Assessment Module, Skill Analysis will identify each student's areas in need of development or areas where they excel. The output for Skill Analysis will be presented graphically (eg. Radar Chart – similar to a spider web chart).

The level determined from Level Prediction (ie. beginner, intermediate, advanced, and expert) will be used by the Career Recommendation Module to recommend the correct IT role(s) based on a numerical ranking of probability using the XGBoost Algorithm.

The Career Resources Module will contain learning materials (may include video tutorials), ATS resume keywords, interview prep material (examples of standard interviewing formats), and

projects to consider if they pursue that recommended path.

The examples provided by the Career Roadmap Module will describe steps (ie. behaviours) to follow at each of the identified levels of service to assist students in achieving their career objectives.

The Interview Prep Module will provide the user with technical, HR, and job-specific interview question examples to assist them in their preparation. The Project Navigator Module will generate project suggestions for the user based on their previous level of performance. Finally, students will have access to AI Career Counselor chatbot using Gemini API for guidance and advice as they prepare for successful careers in the IT industry.

IV. SYSTEM ARCHITECTURE

The system architecture of the AI-Driven Career Recommendation and Personal Learning System depicts the overall flow from student input to final career outputs, that is, how all modules are integrated and work together to give accurate predictions and personalized coaching.

The process starts when the student registers and logs in to the system. The student selects a subject and takes a test on theory, practical knowledge, aptitude, and communication. This input is used for performance assessment purposes.

Based on the assessment results, the AI Skill Analysis module creates a radar chart showing the strengths and weaknesses of the student. After that, the Level Prediction module classifies the student level as Beginner, Intermediate, Advanced, or Expert based on the performance reported.

Next, he will choose interests with the XGBoost model recommending appropriate IT careers based on subject, skills, interests, and predicted level.

Finally, more guidance such as career roadmaps, learning resources, keywords for the resume, interview preparation, project suggestions, and the

AI career counselor chatbot can help the student choose a career. The architecture of the proposed system is illustrated in Figure 2.



Figure 2 : System Architecture

V. DATASET DESCRIPTION

The dataset used for this project was produced specifically for the use of an AI-Based Career Recommendation System – as well as student level prediction. Data collected from a student's performance was collected from roughly 10 different fields of Information Technology, such as (but not limited to) the following: Python, Java, C Programming, Web Technology, DBMS, DSA, AI/ML, Cybersecurity, Cloud Computing and UI/UX Design.

For each record in the dataset there are several input features; theory score, practical score, aptitude score, communication score and subject interests; however these values are transformed into their respective percentages in order to allow for a universal comparison amongst all students. With this data, each student is assigned to one of four possible

Proficiency Levels, with the possible levels being: Beginner, Intermediate, Advanced or Expert.

In addition to the proficiency levels, every student also possesses a set of career labels that correlate back to each of the 10 fields indicated above. Each career label corresponds to appropriate IT roles in that respective field; for instance; software developer, data scientist, cloud engineering, cyber security analyst, and UI/UX designer. This dataset will provide the necessary support for training the XGBoost model to provide an accurate student performance level prediction and career recommendations for each student based on their performance and interest level.

VI. METHODOLOGY

The methodology of the proposed AI-Driven Career Recommendation and Personalized Learning System has been developed in a step-by-step fashion that clearly defines how to handle the collection of data, analysis of that data, and prediction of career and skill level based on the collected data.

A. Data Collection

The system collects student performance data from various assessments. Key parameters include Theory Score, Practical Score, Aptitude Score, Communication Score, Subject selected, and Interest Area selected to use as input to analyze each student's skill set. Through the input of these parameters, the system can evaluate the student's skill level; recommend appropriate careers for each individual student.

B. Data Pre-processing

The collected data undergoes cleaning and transformation into a machine-readable format. Missing values have been addressed, and categorical variables (Subject and Interest) have been encoded through the use of label encoders so that the resulting dataset can be used for training the model.

C. Feature Selection

The selected important features for prediction include Subject, Theory Score, Practical Score,

Aptitude Score, Communication Score, and Interest Area. This provides sufficient input for level prediction and career recommendation.

D. Level Prediction

Once the system has predicted a student's skill level from assessments, the student's level is identified as Beginning, Intermediate, Advanced, or Expert based on score distributions and associated subject types.

E. Career Recommendation

XGBoost can be used to identify job recommendations for the user by using the levels that were previously predicted (i.e., a score from level prediction). The XGBoost algorithm will also produce a probability score for each job recommendation so that it can determine which jobs to recommend based on the highest probability scores.

F. Personalized Learning Module

Based on the job recommendation provided by the XGBoost Job Recommendation model (i.e. first provide the recommended job) and the predicted user level (using only the 'degree' level from level prediction), the system also provides resources and support to assist with the user's career, including career roadmaps, learning resources, resume keywords, interview preparation, and project suggestions.

G. Outputs

The system will combine the data from the earlier processes, and present them to the user, including their predicted level, the recommended job list, the user's career roadmap, learning resources, interview preparation resources, and project ideas or suggestions.

VII. WORKING OF XGBOOST ALGORITHM

The main machine-learning algorithm of this project is the XGBoost algorithm, which will be used for both level prediction and recommending careers. The algorithm requires input features from a student's performance (subject knowledge, theory performance, practical performance, aptitude,

degree of communication and interests) to make predictions.

For level prediction, each student will be assessed in four areas—by theory marks, practical marks, aptitude marks, and communication marks—then calculate the percentage scores for each of these four areas (as a percentage). These four score percentages will be the inputs to the XGBoost model to determine each student's predicted level of Beginner, Intermediate, Advanced, or Expert. This prediction puts a larger weight on the practical performance and aptitude for the coding-related subjects and theory performance and aptitude for all other (non-coding) subjects.

For recommending careers, the system will use four different inputs: subject, level, interest area, and performance scores. The XGBoost model will use these four inputs to calculate probabilities for the various IT career roles. The system will rank career options based on these probabilities; the number of recommended options is dependent on the level of the student (4 recommended options for Beginner, 5 recommended options for Intermediate, 6 recommended options for Advanced, and 7 recommended options for Expert).

The other area of focus that is very relevant in making the recommendations is the area of interest of the student. For example, should the student express an interest in Machine Learning, then the examples of occupations that would be recommended to the student would include: Data Scientist, ML Engineer, AI Engineer. In such a way, the areas of interest assist in guiding the model to provide more relevant career paths related to the IT industry.

To summarize, there's a comprehensive set of algorithms that provide an ability for students to predict the overall level of performance based upon academic data, assessment of their skills, and mapping of their areas of interest to the career they ultimately want to pursue.

VIII. MODULES DESCRIPTION

1. *User Authentication Module*

This module enables students to securely register and log into the System. The user credential is stored in the database and the management of the session belongs to this module, which provides secure access to every feature of the platform.

2. *Assessment Module*

This module assesses students on the basis of the Theory, Practical, Aptitude, Communications, and Speed for the purpose of collecting data to conduct skill analysis and provide referral to identify level of prediction and referral to career.

3. *AI Skill Analysis Module*

This module analyses student performance and displays results in a radar chart format as visual representation of strengths/weaknesses within the different skill areas of students, which assists students in understanding their performance better.

4. *Level Prediction Module*

This module allows users to categorize students into four rank levels: Beginner, Intermediate, Advanced, and Expert, based on assessment scores and subject matter achievement.

5. *Interest Selection Module*

This module collects student interests related to the subject or subjects selected by the student. The student interest data collated from the student will assist the system in refining career referral recommendations and assist the student in generating more specific recommendations.

6. *Career Recommendation Module*

Career recommendations is the main module of this system. The XGBoost algorithm is used to recommend suitable IT career roles based on student performance/interest/predicted level. Based on the probabilities of each career option relative to the student's level, the top recommendations will be provided.

7. *Roadmap to a Career*

The Roadmap to a Career module creates a step by step learning plan (roadmap) based on your recommended career. Within this roadmap, it will lay out topics of study (to be studied) in sequential order; thereby giving each individual a structured method (learning path) to follow throughout their academic journey.

There are several additional functions integrated into the Roadmap to a Career module. Individuals can create a schedule (at the outset of each modular topic) using a calendar function (through integration with Google Calendar); at the time of their designated study date/time a reminder will be sent to the individual so that they can maintain a high level of consistent adherence to their original learning plan (as they complete each modular topic). With the completion of each topic of study, updating of the learning roadmap will occur.

8. *Career Resources Module*

This module offers learning resources such as web-based links to instructional videos, tzt resume keywords for all recommended careers, and skill enhancement materials for specific skill sets.

9. *Interview Preparation Module*

This module provides users with the following features:

Technical interview questions, human resource (HR) interview questions, role-specific inquiries, and free video tutorials regarding the interview process.

10. *Navigation for Projects*

This module lists projects generated based on an individual's predicted career; as well as the individual's student level. These projects can be of four categories: Beginner, Intermediate, Advanced and Expert. Each project consists of the following: the technologies used in the completion of the project, implementation ideas

for the project, and links to videos to aid in understanding the project implementation.

11. AI Career Counselor Module

The AI career counselor module utilizes the Gemini API and functions as a virtual assistant to answer career-related queries, identify skill-related guidance, recommend coursework, and help define your path towards your educational or occupational goals.

12. My Progress

The My Progress module is a tracking system for assessing the fine-tuning of an individual's performance (on a student-level) and overall career growth (over time). This tracking system allows for graphical comparisons (via SVG charts) of performance and improvement (with regard to marks) across multiple types of assessments.

The My Progress module allows individuals to:

- Identify what they have done in the past
- Compare how they have performed in the past with their current performance
- Average change over time (an increase or decrease) in their scores
- Visually represent how they are performing each subject

All of these tracking capabilities will allow the individual to assess where they are at in their learning journey.

13. Report Generation Module

The report generation module creates pdf reports through the use of the `html2pdf.js` library. Reports are available in downloadable formats and provide users with an overview of their assessment results, career prediction, roadmap description, and skill gap analysis.

IX. RESULTS AND DISCUSSION

The assessment of the systems was made using Career Recommendation and Level Prediction, which has been measured using two types of

Machine Learning Approaches. Below are the summarises of each systems performance.

TABLE 1 : Model Performance

MODULE	ACCURACY
Career Recommendation	82%
Level Prediction	86%

The Career Recommendation Model achieved 82% accuracy, which means that the student will receive professional recommendations of appropriate IT careers based off their individual performance, interests and skills data. A career recommendation typically uses multiple disciplines with a significant amount of possible outputs making the emphasis of this classification model to provide the most appropriate ranked recommendations rather than just one predetermined output.

The Level Prediction model achieved 86% meaning that based on students skill level, students are classified into one of four categories (Beginner, Intermediate, Advanced or Expert), enabling the understanding of the students current ability and providing the framework to generate an appropriate learning path for the student.

In summary the prediction and classification will therefore provide a successful and substantive tool for providing customized career direction and learning paths to support each individual student.

X. FUTURE SCOPE

Enhancements to both functionality and usability will be a focus moving forward with respect to the system. To enhance usability, the addition of voice recognition technology (Web Speech API) for interview practice could be included. An additional enhancement will be resume parsing using NLP to extract and identify skills contained in the resume as well as those that may be missing from those resumes; both forms of information would be valuable in guiding the candidate's application process. Integration with real-time job posting data from data sources, such as LinkedIn, will assist in providing information regarding the current job market. Additionally, improving the AI chatbot to provide individualized information based on the

user's activity could enhance the user's ability to receive personalized support. Lastly, a mobile version of the system will allow for increased access and usability for candidates.

XI. CONCLUSION

The AI-Powered Recommendation Engine is a good solution for informing students of career paths that are appropriate and related to their skills, interest, and performance concerning career opportunities in the domain of IT. Using machine learning techniques to analyze assessment results and estimates of specific levels of proficiency, the system provides accurate and meaningful career recommendations. Moreover, with its personalized learning features such as career roadmaps, interview preparations, project suggestions, and resume keywords, the students will be equipped to improve their knowledge and be competent for any job opportunities when they finish their courses. Though weak by itself, this ultimately helps guide the students into better decision-making towards their career in the IT domain.

REFERENCES

- [1] T. Chen and C. Guestrin, "XGBoost: A Scalable Tree Boosting System," *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, pp. 785–794, 2016.
- [2] F. Pedregosa et al., "Scikit-learn: Machine Learning in Python," *Journal of Machine Learning Research*, vol. 12, pp. 2825–2830, 2011.
- [3] J. Han, M. Kamber, and J. Pei, *Data Mining: Concepts and Techniques*, 3rd ed., Morgan Kaufmann, 2012.
- [4] A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 3rd ed., O'Reilly Media, 2022.
- [5] M. Lutz, *Learning Python*, 5th ed., O'Reilly Media, 2013.

[6] M. Grinberg, *Flask Web Development: Developing Web Applications with Python*, 2nd ed., O'Reilly Media, 2018.

[7] A. Kapoor and S. Sharma, "Career Recommendation Systems Using Machine Learning Techniques: A Review," *International Journal of Computer Applications*, vol. 182, no. 45, pp. 1–6, 2019.

[8] S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed., Pearson Education, 2021.