



Career Crafter: Career-Based Project Recommendation System

¹Smitha Vas P, ²Sneha S Nair, ³Malavika J.M, ⁴Malavika S Nair, ⁵Fathima Babu Abbas

¹Associate Professor, ²Student, ³Student, ⁴Student, ⁵Student

¹Department of Computer Science & Engineering,

¹LBS Institute of Technology for Women, Poojapura, Thiruvananthapuram

Abstract: The Career-Based Project Recommendation System integrates project-based learning and career counseling using LLMs and ML. Designed to support long-term career planning, it links jobs and project ideas through personal skills and interests to align academic work with career aspirations. The system interacts via a simple questionnaire that gathers technical skills, interests, certifications, and job role preferences. A machine learning model then predicts the most suitable job roles. These predictions help users understand which roles align with their strengths. Based on the result, a Large Language Model suggests custom project ideas. Each idea includes a description and abstract, enabling users to evaluate its career relevance. This system empowers students to pursue academic projects that match their aspirations, offering personalization and accuracy.

Index Terms – Machine Learning (ML), Large Language Models (LLMs), Project-Based Learning, Job Role Prediction, Skill Advancement.

I. INTRODUCTION

The Career-Based Project Recommendation System aims to provide personalized project recommendations based on the user's responses to a series of questions about their skills, interests, and career aspirations. This system leverages machine learning techniques to predict the most suitable career paths and suggests relevant projects that align with those predicted roles. With the increasing demand for skilled professionals in various industries, this tool will assist users in selecting projects that will enhance their skills and improve their career prospects.

1.1 Motivation

The rapid advancements in technology and the evolving job market demand individuals to stay updated with the most relevant skills. Students and professionals often struggle to identify projects that will help them build expertise in their desired field. This system addresses the gap by guiding users to projects that align with their predicted job roles, thus providing a streamlined approach to career development. The target audience includes students, recent graduates, and professionals looking to enhance their career prospects by selecting projects that align with their future job roles.

1.2 Objectives

This project's primary goal is to create an intelligent recommendation system that predicts the best job opportunities by analysing user data, including talents, educational background, and career interests. The choice Tree model, which powers this prediction method, was selected because to its capacity to precisely forecast roles based on user-provided data and clearly lay out choice paths. The algorithm goes one step further by recommending project ideas that are specifically related to the ideal employment roles after it has identified

them. The purpose of these project suggestions is to assist users in expanding their knowledge in fields related to their professional objectives and gaining real-world experience.

An intuitive user interface is offered to guarantee that users can engage with the system and utilize its capabilities with ease. Entering data, seeing job position forecasts, and looking into project ideas are all made easier by this interface. In addition to enhancing user experience, the platform's seamless design promotes easy navigation throughout its various areas, which helps users find their career pathways and engage on projects that expand their skill sets.

II. METHODOLOGY

The Career-Based Project Recommendation System is developed using a structured approach that integrates machine learning techniques for job role prediction and a web-based platform for user interaction. The process includes gathering data, designing the system, creating a model, and deploying the system.

2.1 Objectives

There are two primary parts to the system: the frontend and the backend. A decision tree model on the backend uses the input data to determine the user's ideal employment role. The frontend is a web interface where users answer questions related to their skills, interests, and career goals, which are then processed by the backend.

2.2 Data Collection

User inputs are collected through a series of questions. These inputs include information about the user's educational skills, interests, and desired job roles. A dataset is also curated from existing job profiles to map the user responses to relevant job roles. Additionally, data is collected from industry reports and job portals to ensure the dataset is comprehensive and up-to-date.

2.3 Machine Learning Model

The core of the recommendation system is a Decision Tree machine learning model. A labelled dataset that links different career interests and skill sets to certain employment roles is used to train the model. The decision tree algorithm helps in predicting the most appropriate career role based on the user's answers.

2.4 Training and Testing

There are training and testing subsets of the dataset. Training data is used to construct the decision tree, while testing data is used to assess the accuracy of the model. A range of performance indicators are employed to evaluate the efficacy of the model, including accuracy, precision, recall, and F1-score. The model is cross-validated to make sure it performs effectively when applied to fresh data.

2.5 Web Interface

A user-friendly web interface is developed using HTML, CSS, and JavaScript. The interface allows users to easily input their responses to the questionnaire, and the results are displayed in real-time based on the predictions made by the model. JavaScript is used to ensure smooth interactions and dynamic content updates. The design focuses on providing a seamless and intuitive user experience.

2.6 Integration of Project Suggestions

Once the job role is predicted, the system uses a curated list of project ideas that match the job role. The system suggests these projects to the user, providing brief descriptions and abstract details of each project. The project suggestions are regularly updated based on trends in the industry, ensuring that they remain relevant and aligned with current job market demands.

III. SYSTEM DESIGN

Using a structured workflow as shown fig 1, that combines user input, machine learning (ML) models, and a large language model (LLM), the Career-Based Project Recommendation System generates customized project recommendations based on anticipated job positions. In order to provide pertinent recommendations,

the system is organized into three main sections: User Interaction, Machine Learning Model Building, and LLM Integration.

The User Interaction phase is when the procedure starts. Through an interactive interface, users begin by entering their academic background, abilities, and preferred career path. After being gathered, this input data is sent for additional processing. After receiving the user data, the system uses a trained machine learning model to forecast an appropriate employment role. The algorithm then creates project recommendations based on the expected work role and presents them to the user for review on the user interface. A solid job role prediction model is developed through a series of processes in the Machine Learning Model Building phase. The first step is Data Collection, which involves gathering pertinent datasets with characteristics connected to careers. The Data Pre-processing step subsequently prepares and cleans the data to eliminate errors and guarantee high-quality input.

The next step is Feature Engineering, which involves extracting key features to improve model performance. Following feature definition, Model Selection occurs, during which an appropriate machine learning algorithm is selected to categorize user input into a job role. The Model Evaluation phase assesses the performance of the chosen model after it has undergone Model Training with the processed dataset. The model is incorporated into the system for job role prediction if it satisfies the required accuracy and efficiency. The LLM Integration phase is the final and crucial step in the Career-Based Project Recommendation System, where a Large Language Model (LLM) is incorporated to generate customized project recommendations. This phase starts with LLM Model Building, where the model is configured and fine-tuned to align with the system's objectives. The goal is to ensure that the LLM can effectively process user inputs, understand career trends, and generate meaningful project suggestions. By leveraging a pre-trained LLM, the system enhances its recommendation capabilities, utilizing the model's vast knowledge base to provide accurate, innovative, and well-structured project ideas based on the user's predicted job role.

In the final stage, LLM Model Integration ensures seamless communication between the ML-based job role predictor and the LLM-powered recommendation generator. This connection enables the system to combine structured machine learning predictions with dynamic language model insights, resulting in personalized and context-aware project recommendations. The integration not only enhances the adaptability of the system but also refines the accuracy of suggestions over time, creating a more intelligent and responsive recommendation process. By aligning machine learning forecasts with advanced language model capabilities, the system provides an intuitive and effective way for users to explore career pathways and discover relevant project ideas tailored to their interests and aspirations.

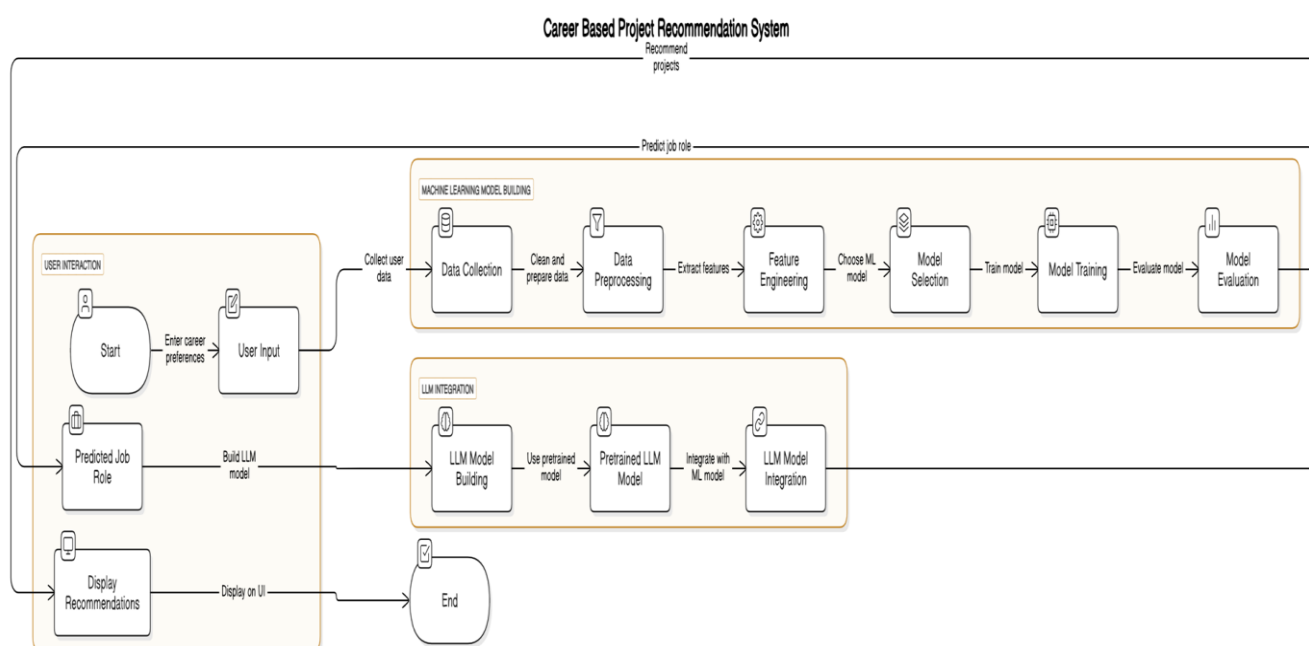


Figure 1. System Design

IV. IMPLEMENTATION

The Career-Based Project Recommendation System will be a personalized career guidance tool and project recommendation system leveraging machine learning algorithms that will provide recommendation to students. The system is a web-based solution with the frontend uses HTML, CSS, and JavaScript, while the backend uses Flask with Python. The main functionality is oriented around making predictions about suitable job roles for students and is also aimed at finding projects in the academic area that are relevant to their skills, interests, and aspirations. The system gets intelligent job role predictions from a machine learning model. For that we trained four different ML models which are Decision Tree, SVM, Random Forest and XGBoost. After training these ML models we found that Decision Tree Classifier has the highest accuracy of 87.61%, set up on a 6901x20 dataset (mldata.csv).

Before training, the dataset undergoes pre-processing:

- 1) Handling missing values: The conversion of the dataset is the process in which the missing values are filled using statistical imputation technique.
- 2) Feature encoding: The categorical variable can be converted into a numeral and the category can be filled with one-hot encoding.
- 3) Data splitting: The dataset is utilized for validation after being divided into 80% training and 20% testing data.

As part of our model development, employing feature selection, we found Tree-based methods to be more accurate, such as Decision Tree, for instance. The other models are Support Vector Machines (SVM), Random Forest, and XGBoost, and after relative comparison, the Decision Tree model has the highest accuracy. The model is retrieved with Scikit-learn's Decision Tree Classifier, and subsequently, the accuracy score, the confusion matrix, and classification report is used to measure the performance of the model.

Table 1. Performance Metrics

Model	Accuracy (%)	Precision	Recall	F1-Score
Decision Tree	87.61	0.8859	0.8762	0.8794
SVM	83.27	0.8426	0.8327	0.6697
Random Forest	87.61	0.8768	0.8762	0.8670
XGBoost	85.45	0.8567	0.8354	0.8432

V. RESULTS

The Career-Based Project Recommendation System delivers a structured and AI-powered approach to career and project selection, ensuring that users receive personalized job role predictions and relevant project recommendations. The system's final output consists of two key components:

- Job Role Prediction
- Project Recommendations

Once the user interacts with the web interface, they provide responses related to skills, technical expertise, academic background, interests, and career preferences. These inputs are processed by the Flask backend, which passes them to the trained Decision Tree model. The model then analyzes the data and predicts the most suitable job role for the user. This job role classification helps students gain clarity on their career paths, ensuring that their skills and interests align with industry requirements.

After the Decision Tree model determines the job role, the system forwards this prediction to the LLM-based recommendation module. The Large Language Model (LLM) creates project ideas that are relevant to the business and align with the anticipated career path through the use of natural language processing (NLP). The LLM considers various factors, including emerging trends, technological advancements, skill requirements, and real-world applications, to suggest meaningful projects. Each project recommendation is presented with a brief description and an abstract, giving the user a clear understanding of the project's scope, objectives, and implementation process. This ensures that students not only receive guidance on their career paths but also have practical projects that they can work on to develop relevant technical and problem-solving skills.

The final system seamlessly integrates machine learning and AI-driven project recommendations, making it a comprehensive career guidance tool. The approach enables students to make well-informed judgments, obtain real-world experience, and advance their professional development by bridging the gap between project selection and career goals. The combination of real-time job role prediction, personalized project recommendations, and an interactive web interface makes this system an efficient, scalable, and user-friendly solution for students and professionals exploring career-oriented projects.

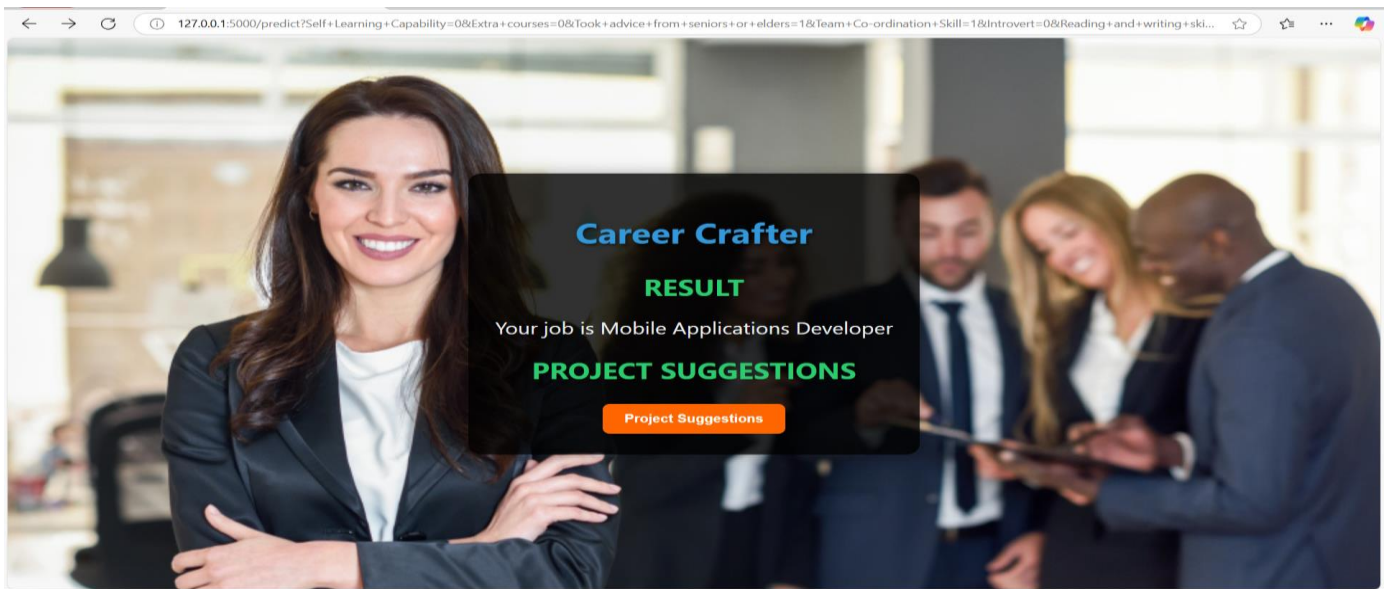


Figure 2. Prediction Page

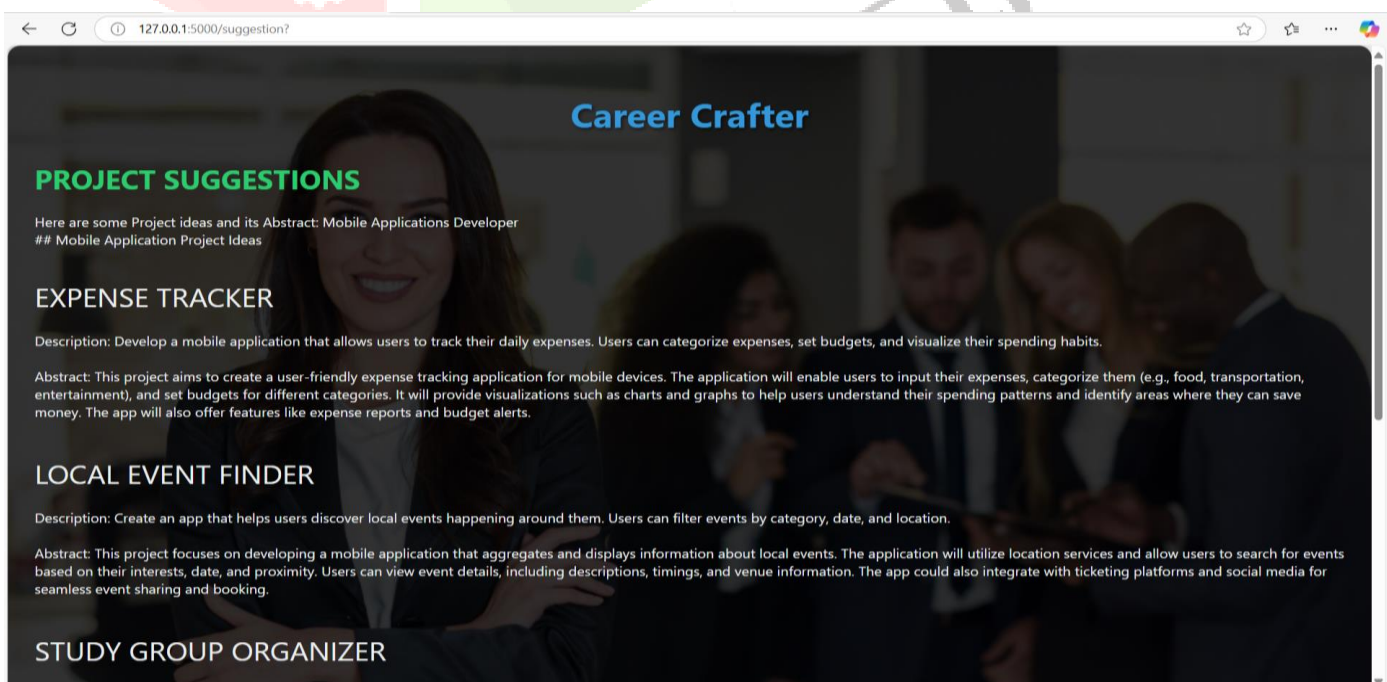


Figure 3. Project Recommendation Page

VI. CONCLUSION

The Career-Based Project Recommendation System integrates project-based learning and career counseling through LLMs and ML. In supporting long-term career planning, the proposed system aligns jobs and project ideas with abilities and interests to help users align their academic work with their career ambitions. The first option indicates the need to provide advice of an individual who requires specific and appropriate guidance towards making decisions relating to professional development and education and, hence setting a good background for a professional career. The system works by simply interacting with the user using simple and straightforward questions and then collecting responses. These questions focus on assessing the user profile, which may include technical skills, interests, certifications, and job roles. A machine learning model applies this information to its vast algorithmic computation and processes the data to predict the most suitable job roles which a user matches to. It makes the correct roles identification for that user by analyzing their strength and aspirations and so makes sure recommendations are right, but above all meaningful.

VII. ACKNOWLEDGMENT

We would like to sincerely thank our guide for her important advice and unwavering support during this project's development. We also want to express our gratitude to our peers for their insightful criticism and recommendations, which enabled us to improve the project. Our profound gratitude is extended to LBS Institute of Technology for Women, Trivandrum, for supplying the facilities and resources required to successfully complete this study. Additionally, we would want to express our gratitude to IJCRT Journal for providing us with the chance to submit our journal. Lastly, we want to express our sincere gratitude to our family and friends for their unwavering support and faith in us during this journey.

REFERENCES

- [1] Dhananjaya, G. M., et al. "A Digital Recommendation System for Personalized Learning to Enhance Online Education: A Review." IEEE Access (2024).
- [2] Siswipraptini, Puji Catur, et al. "Personalized Career-Path Recommendation Model for Information Technology Students in Indonesia." IEEE Access (2024).
- [3] Kamal, Nabila, et al. "Recommender System in Academic Choices of Higher Education: A Systematic Review." IEEE Access (2024).
- [4] Masciari, Elio, Areeba Umair, and Muhammad Habib Ullah. "A Systematic Literature Review on AI based Recommendation Systems and their Ethical Considerations." IEEE Access (2024).
- [5] Venkatesan, Vinoth Kumar, et al. "High-Performance Artificial Intelligence Recommendation of Quality Research Papers Using Effective Collaborative Approach." Systems 11.2 (2023): 81.
- [6] Amin, Samina, et al. "Developing a personalized E-learning and MOOC recommender system in IoT-enabled smart education." IEEE Access 11 (2023): 136437-136455.
- [7] Salam, Abdus, and Fathurrahmad Fathurrahmad. "Student final project recommendation system model using Case-Based reasoning (CBR) method." Jurnal Mantik 5.3 (2021): 1535- 1542.
- [8] Li, Lianhuan, Zheng Zhang, and Shaoda Zhang. "Hybrid algorithm based on content and collaborative filtering in recommendation system optimization and simulation." Scientific Programming 2021.1 (2021): 7427409.
- [9] Qamhie, Manar, Haya Sammaneh, and Mona Nabil Demaidi. "PCRS: personalized career- path recommender system for engineering students." IEEE Access 8 (2020): 214039-214049. 30
- [10] Zhang, Pengcheng, et al. "FunkR-pDAE: Personalized project recommendation using deep learning." IEEE Transactions on Emerging Topics in Computing 9.2 (2018): 886-900.