



# AI-Based Career Guidance System for Engineering Students

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## Abstract

Technological advancement has resulted in numerous opportunities for engineers in terms of careers. However, choosing among available career choices is a difficult task for engineering students since they lack guidance, information, and advice from other stakeholders. To solve the problem, this paper introduces an innovative solution called the AI-Based Career Guidance System for Engineering Students. The system uses intelligent algorithms based on machine learning to analyze student input data and generate career recommendations.

Student input is captured through an assessment tool that includes questions regarding skills, knowledge, personal preferences, behaviors, and many more. Collected student data is analyzed using decision tree, random forest, and support vector machine algorithms to predict suitable career areas. After prediction, the system generates recommendations such as software development, data science, cloud computing, and cybersecurity, among others.

The system is designed using Python programming language and machine learning tools. Furthermore, it employs web technologies such as HTML and CSS to build its user interface. Experimental results show that the proposed AI system can help students make decisions in choosing appropriate career areas based on their strengths and preferences.

## Keywords:

Artificial Intelligence; Career Guidance; Machine Learning; Recommendation System; Student Analysis



## I. INTRODUCTION

Career selection is one of the critical processes engineering students go through since they can impact their careers in the future positively or negatively. There are numerous new domains emerging such as Artificial Intelligence, Data Science, Cybersecurity, Cloud Computing. The students get a lot of information and opportunities in their career selection; however, there might be some problems associated with choosing because of the large number of career options available today.

There exist a number of traditional career advising strategies that mostly involve counseling and the

advice provided by peers or online services. They tend to be quite time-consuming since the analysis cannot be done fast and may not always include students' capabilities and skills. As a result, a poor decision regarding career can be made that could have been prevented.

The proposed AI-Based Career Guidance System aims at predicting a suitable career for students basing on the analysis of machine learning models. It will use the information about students' skills and achievements, and provide intelligent predictions about possible careers. This system will allow the user to receive career guidance and make decisions concerning their future more quickly.



Figure 1: Conceptual Representation of AI-Based Career Guidance System

### 1.1 OBJECTIVES

The main objectives of the proposed system are:

1. Creation of a system based on artificial intelligence technology offering career advice to engineering students
2. Analysis of data concerning abilities and interests of the students
3. Use of machine learning technology for determining possible career options for students
4. Offering career paths based on their advantages
5. Helping students make their decisions easier by reducing confusion
6. Ensuring efficiency and convenience of the system

## II. LITERATURE REVIEW (SUMMARY)

There are several pieces of literature related to career recommendation using machine learning. Earlier methods concentrated on skill-based matching but now there is more emphasis on personality and behavioral traits

Career matching based on content-based filtering has been carried out in past research works where students' profiles are matched against possible career opportunities. Some of the other methods used were application of machine learning algorithms such as Decision Trees and Random Forest for classification purposes. Recently deep learning and intelligent recommendation systems have been considered for improving predictive power.

But most of these systems suffer from poor personalization as well as failure to consider multiple attributes together. The proposed system avoids these drawbacks by combining skill-based analysis with interest-based prediction.

## III. SYSTEM ARCHITECTURE

The AI-Based Career Guidance System follows a layered architecture consisting of user interaction, data processing, and prediction components. The system begins with a user interface where students input their details such as skills, interests, and academic performance through a structured form.



The input data is then sent to the backend, where preprocessing is performed to clean and format the data. This processed data is fed into machine learning models that analyze patterns and predict suitable career domains. The prediction results are then sent back to the system, which generates personalized career recommendations.

Finally, the output is displayed to the user in an easy-to-understand format, helping them make informed career decisions. This architecture ensures smooth data flow, efficient processing, and accurate results.

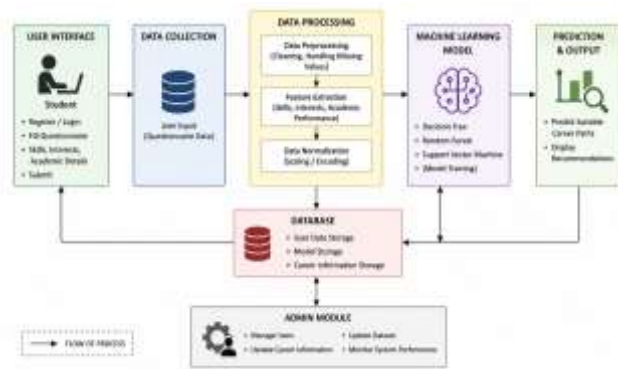


Figure 2: System Architecture of AI-Based Career Guidance System

## IV. METHODOLOGY

The proposed AI-Based Career Guidance System follows a structured machine learning workflow tailored specifically for analyzing engineering student profiles and recommending suitable career domains. The process consists of the following stages:

### 1. Data Collection

In this system, data is collected directly from engineering students through a structured questionnaire designed to evaluate their academic and professional profile. The questionnaire focuses on three major categories:

- **Technical Skills:** Includes programming languages (Python, Java, C++), web development skills, database knowledge, networking concepts, and familiarity with technologies such as AI/ML, cloud computing, and cybersecurity.
- **Academic Records:** Includes CGPA, subject-wise performance, and strengths in core

areas such as algorithms, data structures, operating systems, and mathematics.

- **Interests and Preferences:** Captures the student's inclination toward specific domains such as development, research, data analysis, security, or design-oriented roles.

The collected data forms the primary input for the system and is stored for further processing and analysis.

### 2. Data Preprocessing

The raw data collected from users is processed to make it suitable for machine learning models. This step is customized for the project as follows:

**Handling Missing Values:** Incomplete responses from students are either filled using appropriate default values or removed to maintain data quality.

**Categorical Encoding:** Non-numeric inputs such as "Interested in AI" or "Strong in Programming" are converted into numerical form using encoding techniques to make them compatible with ML models.

**Feature Scaling / Normalization:** Values such as marks, skill levels, and ratings are normalized to a standard range to ensure that no single feature dominates the prediction process.

**Feature Selection:** Relevant attributes such as programming skills, analytical ability, and domain interest are selected to improve prediction accuracy.

### 3. Model Training

The processed dataset is used to train multiple machine learning models to identify patterns between student profiles and career domains. The models used in this project include:

- **Decision Tree:** Used to create a rule-based structure that maps student attributes to career outcomes in an interpretable way.
- **Random Forest:** An ensemble model that improves prediction accuracy by combining multiple decision trees and reducing overfitting.
- **Support Vector Machine (SVM):** Used for classification by identifying optimal boundaries between different career categories based on student data.



The dataset is divided into training and testing sets to evaluate model performance and select the most accurate model for deployment.

#### 4. Prediction

Once the model is trained, it is used to predict suitable career domains for new users. When a student submits their details:

The input data is preprocessed in the same manner as the training data

The trained model analyzes the input features

The system classifies the student into one or more career domains

Examples of predicted domains include:

- Software Development
- Data Science
- Cybersecurity
- Cloud Computing
- UI/UX Design

The prediction is based on patterns learned from the dataset and reflects the student's strengths and interests.

#### 5. Output Generation

The final stage involves presenting the results to the user in a clear and meaningful format. The system generates:

- Recommended Career Paths based on prediction results
- Domain Description explaining each suggested career
- Skill Requirements needed for the recommended roles
- Guidance Insights to help students understand why a particular career suits them

The output is displayed through a user-friendly interface, enabling students to easily interpret the results and make informed career decisions.

#### IV. RESULTS AND DISCUSSION

The test has been conducted on sample data sets containing the profiles of students. It is evident from the outcome that machine learning-based algorithms can be effectively used to assign students to appropriate career clusters.

- i. Interpretable results from Decision Tree
- ii. Accurate results with Random Forest
- iii. Good performance by SVM for complex data

The system is able to generate recommendations such as Software Developer, Data Scientist, Cybersecurity Analyst and many others. The system gives faster and more accurate results compared to the existing approaches.

Table I: Model Performance Comparison

Algorithm	Accuracy (%)	Prediction Output
Decision Tree	85%	Software Developer
Random Forest	90%	Data Scientist
Support Vector Machine	88%	Cybersecurity Analyst

#### V. LIMITATIONS

However, despite the fact that the suggested AI-based Career Guidance System produces valid recommendations, there are still some limitations associated with it. The first limitation relates to the fact that it highly depends on the dataset used to train machine learning algorithms. In other words, the quality and number of entries in a dataset may affect the performance of algorithms.

The system is primarily focused on structured information such as technical skills, grades, and personal interests. In contrast, it does not include such human aspects as emotional preferences, motivations, family requirements, or financial limitations. In turn, this leads to situations when recommendations produced by the system cannot cover all aspects of users' life.



Moreover, the algorithm does not have access to up-to-date information about recent developments within various industries. This is due to the fact that it is based on the operation of pre-trained models. Consequently, the results may not correspond to recent changes in specific fields of activities.

Additionally, machine learning models are not entirely error-free and may produce less accurate results when the input data is incomplete, inconsistent, or ambiguous. The absence of human interaction in the system also limits the ability to provide emotional support and detailed counseling, which are often important in career guidance.

## VI. FUTURE SCOPE

There are ample opportunities in the future scope of the proposed AI-Based Career Guidance System. First of all, the system should consider using real-time data from various sources including job portals, industry reports, and labor market analytics. It will help to give accurate and updated career suggestions that meet the current needs of the labor market.

Moreover, the proposed application can be enhanced further by adding a skill-gap analysis tool that compares the existing skills of students with those necessary for their desired career path. On the basis of this comparison, the system can suggest appropriate courses and certificates that users need to develop their skills.

In addition, there is an opportunity for applying advanced technologies such as deep learning and NLP to further improve the prediction accuracy of the system and make the application more interactive. Specifically, one could develop a chatbot-based career guidance application that will provide real-time advice and simulate a human counselor.

Finally, there is an opportunity to develop the following functions: building career paths, internship recommendations, and even resume assistance. Finally, the system can be improved through developing its mobile application version.

In addition, the system can be expanded beyond engineering to support students from other disciplines such as management, arts, and

healthcare, making it a comprehensive career guidance platform.

Overall, these improvements can transform the system into a fully intelligent, adaptive, and scalable solution for modern career counseling.

## VII. CONCLUSION

The use of AI-Based Career Guidance System presents an effective means of providing career suggestions to engineering students that match their capabilities. The use of machine learning technology in providing solutions makes the recommendations highly accurate.

Confusion is eliminated, better decisions are made, and career planning becomes easy. Some future improvements could be incorporation into job portals, analytics, and chatbot career guidance systems.

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