Career Recommendation System

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***Abstract*- Picking an appropriate career after the 12th grade is a daunting problem for the student whose career selection process is plagued by inadequate counselling and organized information resources.**
This paper offers an intelligent and interactive Career Consultation System that aids students of the 12th grade to figure out career choices that best suit their interests, academic background, and their own individuality.
The system uses machine learning algorithms to process user input and then recommends careers based on personalization.
The back end is coded in Python and Flask, whereas the front end is deployed with ReactJS, HTML, and CSS, which assures a smooth, user-friendly interface.
Thus, the system bridges the existing gap between student" scepticism and professional" guidance by providing recommendations generated through data in an economical and scalable format.
Focused recommendations seek to empower students to make informed decisions about their future profession.

I. INTRODUCTION

The transitionary phase following class 12 is a make-or-break moment for a student as career decisions are made for select professional fields in later life. Sadly, for an array of considerations such as the plenty of professional streams to choose from with limited information about future areas, lack of expert counsel, there exists a good number of confused and stressed-out students in India and other parts of the world. Many of them land in the career category out of peer pressure, family expectations, and through ignorance, only to realize later that they do not enjoy the career, with the subsequent switch in their career to alternate fields.

A technology-driven solution is envisaged to cater to the needs of students and recommend in accordance with their interests, academic streams, and aptitude. In this regard, we propose a Career Recommendation System for the needs of 12th-grade students. The system takes input from the user detailing subjects of interest, stream (Science, Commerce, Arts), hobbies, and personality. The system then uses these inputs to recommend potential future career options that would best fit into the user's profile using Machine Learning algorithms. It has been designed using Python for logic and ML, Flask as a web application framework to integrate machine learning models into the backend, and ReactJS for the development of an interactive and responsive frontend. The idea is to open-up career guidance to the public in a more accessible, economical, and evidence-based approach, especially for those students who cannot afford costly career counselling fees.

II. LITERATURE REVIEW

The apply of Artificial Intelligence and Machine Learning in career guidance systems has grown a lot recently. This is because both schools and students want more personalized, data-based career advice. The way career guidance is provided is being changed by these technologies, offering advice that is specific to each student's skills, academic results, and interests. This portion deals with current research on the conventional methods of career guidance, the recommender systems based on machine learning, and their limitations. It also discusses how web technologies like Flask and ReactJS are making these systems easier to use.

Traditional Career Guidance Methods

The traditional career guidance methods usually employ tests for personality, skills, and abilities-based analysis combined with professional advisement on career suggestions. Some well-known models would include Holland's Theory of Vocational Choice (1997), which divides people into six types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. These types are typically attached to certain career paths.

For example, those with a Realistic personality might be counselled toward careers in engineering or mechanics, whereas those with an Artistic personality might be steered toward careers in art or design.

Although these models have been used by researchers for a long time, these researchers have pointed out some flaws-

They don't accommodate new-age careers in the world of technology, like digital marketing, UI/UX design, and data science.

- These methods are fixed and based on set categories, so they can't easily adjust to new career options or fields that combine different skills.
- They don't offer much interaction or instant feedback, so they may not be as helpful in meeting individual needs in different learning environments.

Machine Learning-Based Career Recommender Systems

- Collaborative Filtering: Patel et al. (2019) employed a collaborative filtering strategy grounded in user similarity to recommend careers.
  Limitation: Cold-start issue, particularly for new users or students with sparse profiles.
- Content-Based Filtering: Singh et al. (2020) employed keyword matching among user skills and job descriptions.
  Limitation: Restricted to predefined positions; does not flexibly manage new job titles or interdisciplinary positions.
- Hybrid Model: To fix the problems of using only collaborative or content-based filtering, hybrid models combine both methods to make better recommendations. Ahmed et al. (2021) created a hybrid system that mixes collaborative filtering and content-based techniques. These models can improve the quality of recommendations, but they are expensive to run and need careful adjustments to work well.
- Decision Tree Models: Decision Trees are a most known machine learning method used for classifying data. Rajeswari et al. (2018) used decision trees to help classify students into different career streams based on their academic scores and interests. Decision Trees are simple to understand and are useful for creating clear models. However, because they often fail to identify complex patterns in user behaviour, their usefulness in detailed career recommendations can be limited.

Strengths:

- Easy to understand and use.
- Clear decision-making process.

Limitations:

- Can't handle complex, nonlinear relationships in data.
- K-Nearest Neighbours (KNN): KNN is used in career recommendation systems to find profiles that are same to a user's profile. It works by comparing a user's information with others and recommending careers based on the same profiles. However, KNN doesn't perform well when the data is too large or noisy.

Limitations:

- Performance drops with large datasets or noisy data

Deep Learning and Neural Networks

- Kumar et al. (2022) demonstrated ANN-based models perform good than SVM and Naive Bayes classifiers in career suggestions based on academic and behavioural information. Strength: Can capture sophisticated, nonlinear associations.
  Weakness: Needs high computation and huge datasets.
- Recurrent Neural Networks (RNN) and LSTM have been applied to dynamic recommendation scenarios where temporal student data (growth, improvement) come into play.

Application of Natural Language Processing

- Certain systems incorporate NLP to analyse student responses, essays, and feedback.
  For instance, Sharma et al. (2021) created an NLP-based recommendation system that processed open-ended input to identify career orientation.
  Shortcoming: NLP models need fine-tuning for regional languages and student writing patterns.
  Gaps in Existing Literature

There is nothing real-time web-based application based on new tech stacks such as Flask, React, and REST APIs.

Fewer systems are developed especially for 12th-grade students in India.

Few models blend frontend interaction and backend smarts seamlessly.

Lack of explainable AI to demonstrate to students why a career is suggested

Role of Flask and Web Technologies in Career Recommendation Systems

Flask is greatly applied as a machine learning backend framework because it is scalable and easy to use. Sharma et al. (2021) note the ability of Flask to incorporate web-based applications with machine

learning models, while Bootstrap maximizes responsiveness and provides an easy-to-use interface for improved accessibility.

Research Objective:
This research paper aims to build a Career Recommendation System by using machine learning, which can help personalized career suggestions based on a education, skills, and interests of the user. The system will:

- Uses ML based algorithms for example Decision Trees, Random Forest, K-Nearest Neighbours, and Support Vector Machines to analyse user information and recommend the best career paths.
- Build a web application using Flask and Bootstrap, which will be simple and easy for students and job seekers to use.
- Help users make better career decisions using data instead of relying on advice from experts.
- Provide real-time career suggestions that adapt to changing job trends and user preferences.
- Create a smart ML based that use machine learning to analyse user data and suggest the most suitable career options.

III. METHODOLOGY

The approach to creating the Career Recommendation System consists of various major stages, from collecting data and preprocessing to training the model, developing the web interface, and ultimately deployment. The system is created to accept the inputs from the users, process it using Machine Learning models, and return tailored career recommendations in the form of an interactive web interface. The process is segregated into the following stages:

1. Data Collection
Suitable dataset inputs were collected from publicly ready sources and educational websites that correlate academic streams, interests, and personality with possible careers. The dataset was also filtered based on the views of expert career counsellors. The dataset contains the following features:

- Academic stream (Science, Commerce, Arts)
- Like-minded subjects
- Interests/hobbies
- Skill levels
- Personality (introvert/extrovert/analytical/creative)

2. Data Preprocessing
Prior to training the machine learning model, the data was pre-processed and cleaned:

- Missing values were handled.
- Categorical variables (such as stream and interest) were represented by Label Encoding or One-Hot Encoding.
- Features were normalized to improve model performance.

3. Model Selection and Training
For career forecasting, multiple ML based models like Decision Tree, K-Nearest Neighbours (KNN), and Random Forest were experimented with. Based on accuracy and relevance, the top-performing model was chosen. The model was skilled on the pre-processed dataset and validated on a test set to provide authentic recommendations.

4. Web Application Development
The system was developed as a web application for ease of access and usability. The tech stack includes:

- Python for backend logic and ML integration
- Flask as the backend web framework
- ReactJS for creating a responsive frontend
- HTML/CSS for styling and UI components

The frontend gathers the user inputs from interactive forms and transfers them to the backend through API calls. The backend processes the inputs, feeds them to the trained ML model, and sends back the list of appropriate career choices.

5.System Deployment and Testing

- Host the Flask-based application on a local server (localhost) for testing. Perform usability testing to verify accuracy, reliability, and efficiency of user experience. Collect feedback and improve the system based on actual user inputs.

6. Testing and Hosting

- We tested our system on a local server (localhost). We asked some students and teachers to try it and give feedback.
  We checked:
  - Is it giving correct suggestions?
  - Is the website-based system easy to use?
  - Is the speed good?
  - Based on feedback, we made small improvements.

7. Future Enhancements plans

- Use Natural Language Processing to read and understand the user's written feedback in normal language. This will help the system understand what is being said by students in their own words.
- Add real job market trends by connecting the system to websites like LinkedIn or job portals. It helps students know which careers have more jobs, better pay, and future growth.
- Use Explainable AI (XAI) to clearly show why a particular career was suggested. It will explain the reason behind the suggestion based on the user's answers and choices.

IV. RESULTS AND DISCUSSION

The Career Recommendation System was built with fundamental machine learning algorithms and hosted as a web-based application using Flask and React. To analyse its efficiency, we trained a Decision Tree Classifier on a small but diverse sample of student profiles. They contained information such as stream choice (Science, Commerce, Arts), favourite subjects, hobbies, working style preference, and other interests. Every student profile was matched to a career of choice, considering expert knowledge and labelled data. The model had nice accuracy between 80 and 85 percent on test data, good enough for an early version. However, since the set was small and built through sampling, such accuracy will increase when more real data is being fed for training. Based on submitted student inputs, the system was sorting them into broad career categories such as Engineering, Medicine, Business, Law, Design, Teaching, and others.

Few students tested the system to validate how straightforward or helpful it really was. Most of them had a positive impression regarding ease during the usage of the interface because it was constructed using HTML, CSS, and React in the simplest, clearest manner. Once students entered their preferences, the system promptly offered suggestions about potential careers with some short descriptions about them and required skills for these careers.

Students liked the personalized suggestions, including those who were confused by an abundance of options. But we did realize that in certain cases of unclear or mixed interests feedback, the system gave generalized suggestions or repeated some career titles. This shows that the model needs more detailed data and better logic to handle complicated or unclear profiles.

Overall, it is shown by the project that machine learning can help students to select their career. While the model is still in the early stages, it works well and offers a platform that can be improved in the future with more data, better algorithms, and more career options. It is shown by the positive feedback from early users shows that this system has the power to be a helpful tool for schools and career counsellors

V. CONCLUSION

The Career Recommendation System designed in this research work is intended to help 12th-grade students determine appropriate careers based on their academic interests, personal interests, and skill set. The system utilizes a mix of machine learning, specifically the Decision Tree algorithm, and web technologies such as Python (Flask), React, HTML, and CSS to design an interactive and user-friendly platform The system uses computer programs to work. The system has been designed using Machine Learning, with the Decision Tree algorithm being the most pertinent. This method allows the system to learn from historical data and then provide responses to new questions. The usual software tools such as Python (with Flask) and React are employed in the system. HTML and CSS are used in giving the proper look and feel to the website. All these attributes contribute to a system that is easy to use and understand.

A student entering the system for the first time finds a form. The form asks various questions about their marks with which the student may have scored in the intermediate standard, and the subjects they like. Once constituents answer, the system goes through the entire set of answers and displays the recommended career for that student. Such careers are engineering, law, medicine, business to far as teaching, and all the remaining.

Sometimes, the system will produce inconsistent suggestions, which is a good thing. The system is a good result, despite having been trained on a relatively smaller database. Among the students who tried it, many liked the system, as it serves careers for students who cannot make it to an actual counsellor. It is free, and anyone with a phone or computer can access it. They save time and can clear confusion in the minds of many students who have no one to guide them.

The system is not, however, without flaws. If a student gives a wrong answer or cannot comprehend a question fully, the system might suggest the wrong

career. Also, the system only knows about common careers and will not suggest any new or peculiar ones because the data used to train it is limited.

Despite everything, this project illustrates the considerable usefulness even a simple machine-learning-model-based system can offer. The system will become more intelligent with better data and more training. The system can also identify careers likely to grow in near-term future, for example, Data Science or Robotics.

Future versions can add functionality to include colleges, skills required, salary info, and videos that explain each career. If the system is deployed in many schools and by students from different locations, it can help masses to take better career choices.

Now this Career Recommendation System becomes a great start. It proposes the relief of issues from career selection using the available technology. A good tool for students in planning their career.

VI. FUTURE SCOPE

At present, the Career Recommendation System serves as the foundational system for putting forth suggestions for students with regards to making career choices based on simple machine learning algorithms. Further enhancement is very much possible so that the system can attain a greater degree of accuracy and reliability and be of help to more people.

Using a bigger and more flexible size of data would be one way to make it better. At present, it is using a very small amount of data for training, which makes the system suggest only a few careers. The system could suggest a much wider range of careers, including newer and unusual ones, if fed with real-world occurrences drawn from schools, websites, educational databases, etc.

Other newer machine learning technologies could also be introduced to improve this career recommendation system, such as Random Forest, Neural Networks, etc., helping the system to make better decisions when handling more complex profiles, especially when students express multiple interests or skills.

The system could also serve to allow students to just answer in their own words and not limit them to given answers. This, though, offers more flexibility and helps the system interpret things like students' desires, goals, and opinions better.

So far, the system idea has focused on a one-size-fits-all approach, but it would be interesting to build in accommodations for how each student behaves over time. Ultimately, it could take into things like school performance, where they want to work, their background, and the job market, to generate a customized career path for each student.

Furthermore, such a system can offer gains such as suggesting colleges, presenting crucial exams to consider, recommending courses for skills, internships, and offering mentorship. Being interconnected with other relevant websites/apps will make the system genuinely beneficial for real-life decisions.

Finally, this system kept as a mobile app would greatly enhance its accessibility by students living in rural and underserved areas. It could also work with multiple languages and offline, thereby levelling the playing field even further.

In conclusion, the present project is a first step toward building a smart, personalized system to assist students in selecting careers. With further research and development, it can become an important tool students use to chart their education and career path.

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