Explainable Career Recommendation System

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Abstract

Too many people are not satisfied with what they do for a living. Why is that? Most people make mistakes while choosing their career and end up with a job that isn't suited for them. Currently, there are a plethora of websites that provide heaps of information regarding employment opportunities, but this task is extremely tedious for students as they need to go through large amounts of information to find the ideal job/career. Simultaneously, existing job and career recommendation systems only take into consideration the domain in which the user is interested while ignoring their profile and skillset, which can help recommend jobs and careers which are tailor-made for the user. The Explainable career recommendation system aims at helping the user make the perfect educational and occupational choices based on their interests and abilities. This system is primarily being developed for class 12^{th} students for choosing the right engineering career path. A perfect career choice will not only provide fruitful employment opportunities, but will also enable students to lead a satisfactory and respectful lifestyle.

Keywords: Recommendation system, content-based filtering, collaborative filtering, Hybrid model, Explainability

Statements and declarations

Competing interests

The authors have no relevant or non-financial interests to disclose.

1 Introduction

Choosing the right professional path is very important in our lives becausethe fate of our entire career depends on the choice we make. Career goals will also guide you to do what you want with your life instead of just landing into a job. As the education system is diversifying day by day which is leading to the creation of new jobs and opportunities, the way of people to make their career choices is also changing. These have made career planning more complex and confusing. The formal resources of career guidance are not easily accessible, and people tend to rely on family and friends and make their choices. Gradually people are falling into a profession where they are not happy and satisfied. Pursuing a career with your abilities and preferences, you will find greater satisfaction. So that choosing a career is very important for every individual at right time, as only the right decision can bring happiness in your life, otherwise you could be very unhappy in the future. The Explainable Career Recommendation System helps the user i.e. students to choose the rightcareer path and also helps them to sort their confusions. If we choose the career that we are interested in, we will always try to learn more and eventually lead a better lifestyle. So your career choices should be your mirror image and hence it is important to understand yourself while choosing a career which is what this proposal aims to achieve.

2 Related works

Engineering is an extensive field of science and choosing the right engineering stream from so many fields is very difficult. A recommender system can solve this problem as they predict what the user wants by analysing their behaviour. Our recommendation system predicts which engineering stream the user will probably excel in based on the user's skillset and interest.

There are three main types of recommendation systems which are content-based filtering, collaborative filtering and a hybrid of both.

Content-based filtering [6, 7, 10, 15] recommendation systems use user's or item's characteristics to create the specific recommendations. The result is based on users past purchase history. In this method, the algorithms try to find out some keywords to identify the context of the content and find similarities in other contents to recommend those contents to a specific user. Figure 1 discusses about content based filtering. The similarities between the contents are determined using any method like cosine similarity[2, 7].

In collaborative filtering [7, 10, 11, 18, 19], recommendations are based on user-item communication. This recommendation systems utilize the user-item interactions to find similar users and the information gained from them are recommended to similar users. The existence of grey sheep users [3] can reduce the value of the system. Figure 2 discusses about collaborative filtering.

Hybrid recommendation systems [2, 6, 10, 15–17] combines more than one recommendation strategies. This combination leads to better recommendations. Figure 3 discusses hybrid filtering.

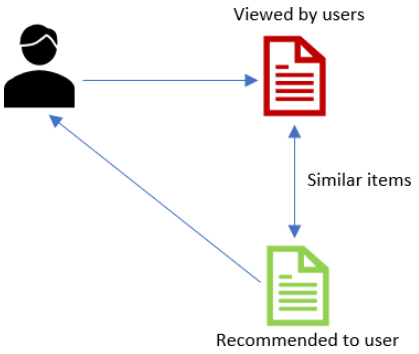

Fig. 1 Content-based filtering

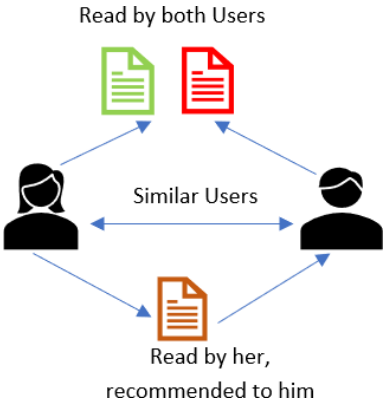

Fig. 2 Content-based filtering

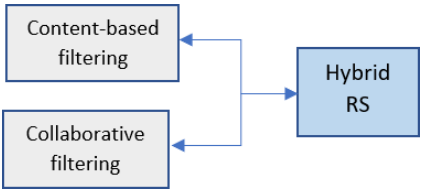

Fig. 3 Hybrid filtering

Recommendation systems work well when there is lots of data for effective recommendations. Every recommendation system will face a problem called cold-start problem [8, 9, 20] when the system lacks the information about the user-item interactions. Recommendation systems based on current student academic performance [4, 13] for predicting most suitable courses have been developed in the past years, but the user couldn't interpret the reason for the recommendation. Explainable recommendation systems [1, 5, 11, 14] help the user to know why the particular item is recommended. Revealing why the item is recommended can also help the user to make better decisions.
The input parameters and the final class of output are more, normal machine learning algorithms cannot give fruitful outcome for the recommendation result[12].In order to choose the best model, the dataset is passed to different machine learning algorithms. The highest accuracy value is given by SVM.
Support vector machine is a popular supervised machine learning algorithm. It can be used for both classification and regression problems, though more often used for classification. The goal of this algorithm is to find the best data seperation hyperplane. In real-world problems, the datasets of the two classes are almost linearly inseperable. Using kernel trick, SVM can be extended to solve nonlinear classification problems. Hence, due to these features SVM is used in this recommendation system.

3 Proposed system

The main limitation of existing recommendation systems is that they do not guarantee interpretability of the recommendation results. So the users are not able to understand the reason for the recommendation. This limitation of RS is solved in our proposal. The architecture of the proposed system is shown in Figure 6. The primary objective of the proposed system is to discover potential engineering career that could be good fit for one's personality. The objectives of this proposal includes:

- Recommending 12^{th}passed students to choose the best engineering course for their higher studies based on their skills and interest.

- Explaining the reason for recommendations.

4 Experimental setup

As the required kind of data was not readily available in the web resources it was required to be created. So we manually collected the required data from current and former engineering students by sharing a google form for accurate engineering career recommendation. User skills and interests are identified indirectly in the form of questionnaire. This form contains questions to identify the skills, interest and preferences of students. In addition to this it also identifies their level of satisfaction regarding selected engineering course. Student feedback analysis is shown in Figure 5.

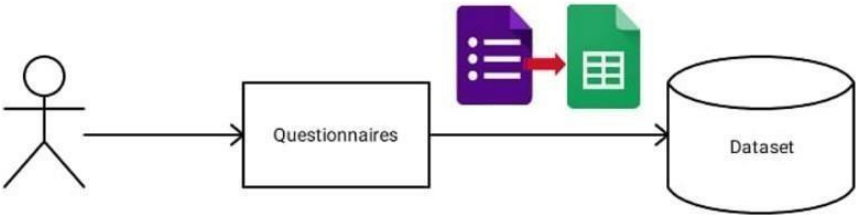

Fig. 4 Data collection

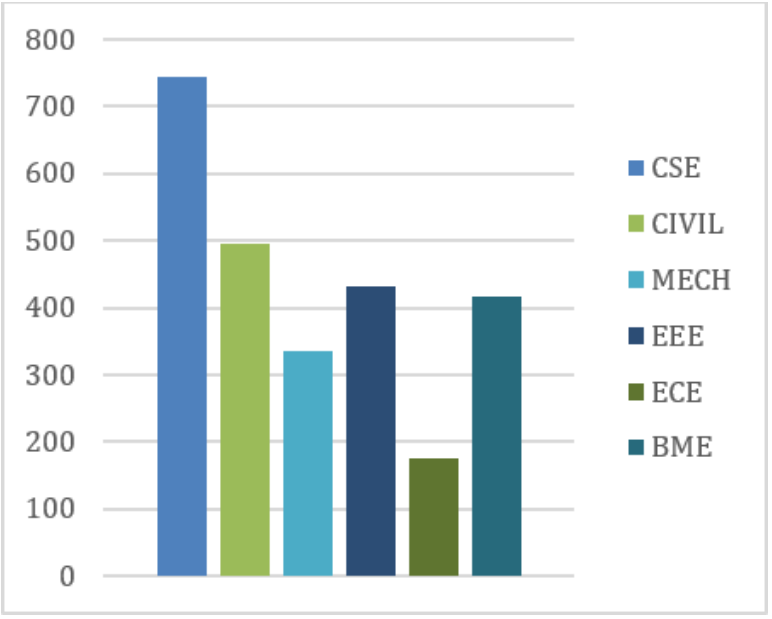

Fig. 5 Student feedback analysis

Questions used to identify creative skills of students were found primarily. From this questions, we selected relevant questions based on basic engineering skills and shared the same to current and former engineering students via google form. Student's feedbacks are stored, these feedbacks are the responses of various engineering students across different fields. We have collected 2800 responses. Data collection is shown in Figure 4.

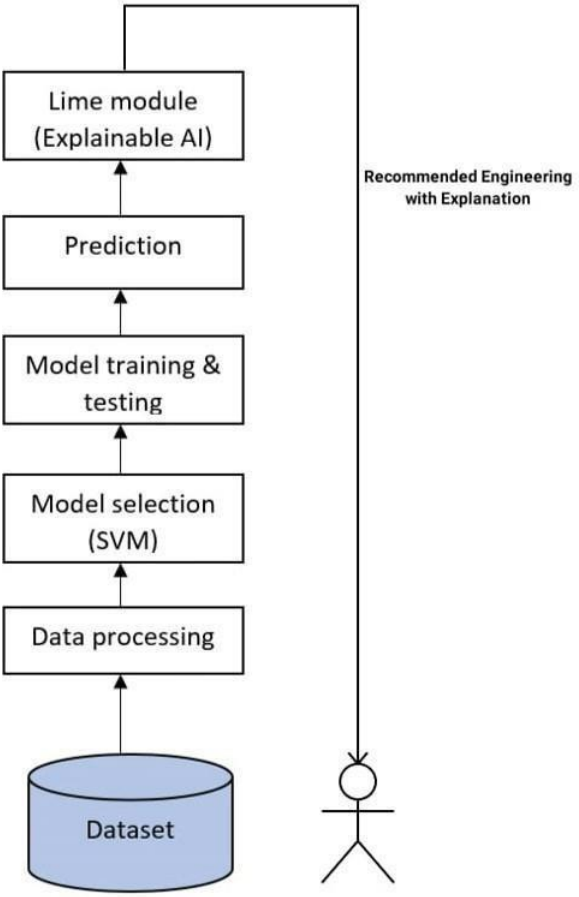

Fig. 6 Architecture

Only satisfied users data are taken to make the predictions, others are ignored. The remaining informative data is stored and organized as the dataset, which contains 2599 data points. The Dataset is converted to required form, then divided into two training and test sets in the ratio 70:30 and passed to the SVM model for training and testing. The output of training and testing module is passed to the prediction module. Based on the inputs suitable engineering is recommended to the user with the interpretation of the output. Explanations to the recommendation are given by the LIME module. LIME is an explainable AI method which tries to find explanations for the given test sample. The output of LIME is a list of descriptions like a graph. These list of descriptions shows the contribution of each feature to the prediction output and also helps to determine which all features can change the predictions in the system .

5 Results

In the pre-processing stage all the descriptive answers given by each user were changed to numerical values and it is shown in Figure 7. The pre-processed data was then divided into training set and test set in the ratio 60:40 respectively. The SVM model was developed and the model was fit on the training set, to perform prediction on test set. Explainability feature generated by the LIME module is shown in Figure 8. Accuracy of prediction was computed, and found to be about 97.5. Accuracy, zero one loss and precision values are shown in Figure 9.

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Fig. 7 Pre-processed dataset

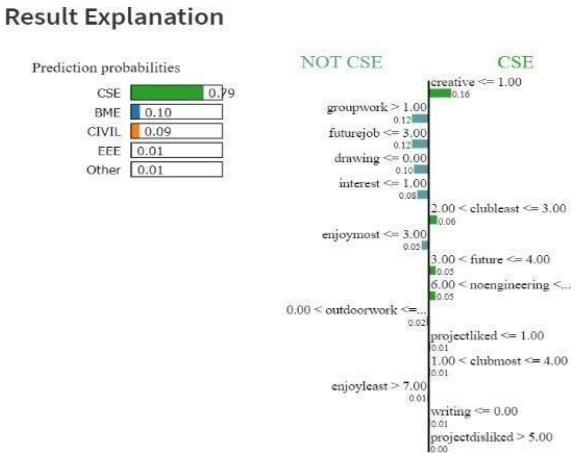

Fig. 8 Explainability feature

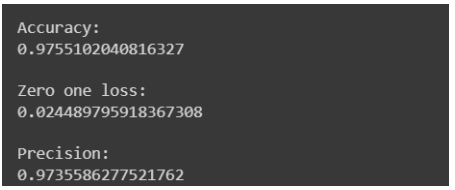

Fig. 9 Evaluation scores

6 Conclusion

Nowadays many people are ending up regretting their career choices. This is because of a large number of career options being available in the world. Manually sorting out huge information on various engineering fields with one's skills and interest is very tedious and time consuming. In this paper, we have presented an Explainable career recommendation system which solves this problem efficiently and recommends suitable engineering stream. The main limitation of this work is that the dataset is limited to engineering courses only. So the next step is to deliver the explainability of the predictions for more courses.

Compliance with Ethical Standards and Declarations

Conflict of interest: On behalf of all authors, the corresponding auther states that there is no conflict of interest.
Consent to participate: Informed consent was obtained from all individual participants included in the study.

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