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An Automated Project Recommendation System Using Machine Learning Techniques

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Abstract: Choosing a right project is always a difficult for students as well as for professionals due to lack of right guidance, a mismatch between one's skills, experience, interests and project required. Hence it causes low performance and ineffective results. To overcome this problem, we have designed an innovative concept for project recommendation system which recommends projects to users based on their skills, interests and experience. The objective of this paper is to highlight the current trend in project recommendation systems which addresses the problems faced by users and recommends best possible results by applying Machine Learning algorithms like content, based filtering, Cosine Similarity and TF- IDF Vectorisation in order to match interests of users with project requirements. The System resulted in achieving an overall average accuracy of 72.4 % match.

Keywords: Machine Learning, Project recommendation, Content-based filtering, TF-IDF, Cosine similarity.

I. INTRODUCTION

Students and specialists have facing difficulty in selecting a project because of lack of guidance with the old trends of technology. This is a very difficult part in selecting a project. Selection of a wrong project can change the whole project. This gives the worst performance and results due to a disinterest in the subject. Hence, the recommendation system is an important part of guiding the user.

Recommender systems, also called as recommendation systems are a filtering-based system that provides suggestion to personalized items with machine learning techniques. Recommender systems are very popular with the rapidly increasing amount of information on the internet and for use in many contexts including education, e-commerce, and social media. They are used in e-commerce sites to provide personalized recommendations but also in social media sites, education and entertainment, and news sites.

To overcome these problems, a recommender system has been devised that would help the users to find the pretty projects by providing them the needed guidance as per their interests and skills. This idea will help the users in choosing a apt project and can also lead to better performance and it was suitable skills. This project would aim at building an intelligent system that would be capable of understanding the interests and skills of users and would then recommend as per the user profiles with a detailed description. This idea would help to develop a smart system which would be capable of understanding user's problems and would provide the apt solution with a detailed description. This system would make user's life easier by helping to find projects as per the user profile and will also save lot of time spent in searching it out.

II. REVIEW OF LITERATURE

Recommendation systems can also be described as a tool that helps users to find what they are looking for; they recommend items based on the preferences of the user and the items available. Ricci et al 2015. mentioned that different recommendation systems exist, but content-based filtering is very useful when knowing user preferences and characterizing items. In our project, we know the student skills and project description clearly. So, content-based filtering was suitable in our case.

The approach to match users to projects presents us to the problem of efficiently process texts. Salton and Buckley have introduced the TF-IDF, which is an effective way to measure the value of words in documents. While normal words frequency normalizes the document word counts, the TF-IDF considers the specificity of each word. This is very useful for analyzing the importance of skills for the projects.

Singhal has pointed out that a recommendation system should be capable of ranking its results. Finding similar projects is not enough: they should be ordered by the application's relevance to the user. Our design takes this into account an introduces match scores for each recommended project.

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Pazzani and Billsus have shown that content-based filtering performs best when the profiles of users and descriptions of items are both well specified. Their research demonstrated that, when a system has a detailed profile of the user, as well as a thorough description of items, then recommendations will be accurate. Our system is enhanced by this, as we have well defined user skills, as well as the full specification of project requirements.

Mooney and Roy manage to perform content-based filter of book recommendations based on text descriptions and preferences of user. This proves that our idea of merging project description and skill requirements for project recommendation is a right way of doing.

III. SYSTEM ARCHITECTURE

A. User interface

The first user will put his/her details such as skills, interests and experience level in the webpage whereas experience is in a drop, down menu, whereas skills and interests are in selection. To create the webpage, HTML, CSS, Bootstrap and Select2 technologies have been used which makes the interface look better and gives a better experience to the user. The user interface is the first step in this proposed system. The proposed system becomes more accessible and comprehensible to the user.

B. Backend processing

For the backend processing, flask technology is used, which is used for processing the request from user and search engine. The dataset is in csv file format with project name, description, difficulty, rating and levels. The dataset gives you a detailed description of each project, which makes the recommended project easier.

C. Machine Learning Engine

Match tool: Combines user inputs (provided in a webpage including skills, interests and experience level) and turns into numbers using TF-IDF vectorisation for finding vectors between them. Also finds the matching required projects. Finds the similarity between them using Cosine Similarity function. Puts use sorting algorithm and gives the top 5 recommended projects with high, rated on it.
The TF-IDF formula is:
TF, IDF(t, d) = TF(t, d) x IDF(t)
where:
TF(t, d) = how often term t in document d.
(tf): log(N/df(t) where N = total number of documents. Df(t) = number of documents in which term occurred. IDF is a measure of how much information the word provides.
Number of projects (i.e., total projects n = total projects)
df(t)=the number of projects that has t in it
Specialized terms have more emphasis.

D. Results Display

This page recommended the 5 best projects. The brief on the project, the level of difficulty, rating, skills necessary will be shown for each project. The project cards are used to exhibit 5 different project displays in the result display. The badges are used to highlight the characterize in the result display. Result display page is easy to be understood by each individual.

IV. METHODOLOGY

The system is developed based on client, server architecture which is more user friendly, easy to search for the information like input skills, interest, level of experience etc. The Flask back end takes care of request from users while the machine learning here is based on cosine similarity which does the calculation of how much two projects are similar. It highlights the top recommended projects with the difficulty and rating by sorting algorithm. A lot of researchers have spoken about the significance of recommendation system and how it helps each individual in taking a wise decision by suggesting the best appropriate option for them based on their requirements. It plays a vital role in education sector where a project recommendation system guides the users to choose a better project which is more suitable for them. The preceding system is an only project recommendation system which is on the skill and content based that is good for beginners. Python is used for this system as it is easy and popular. Flask is used here to developed user, friendly interfaces. A few current systems have inaccurate and unclear recommendations as it does not give any difficulty level.

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V. RESULT

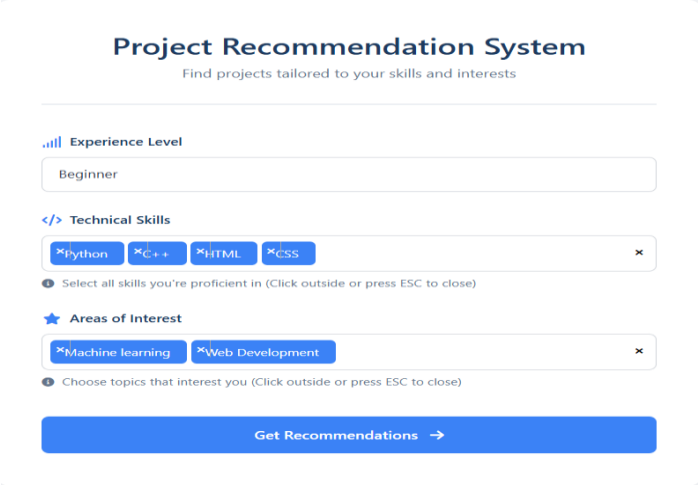

Fig 1. Input collection from user

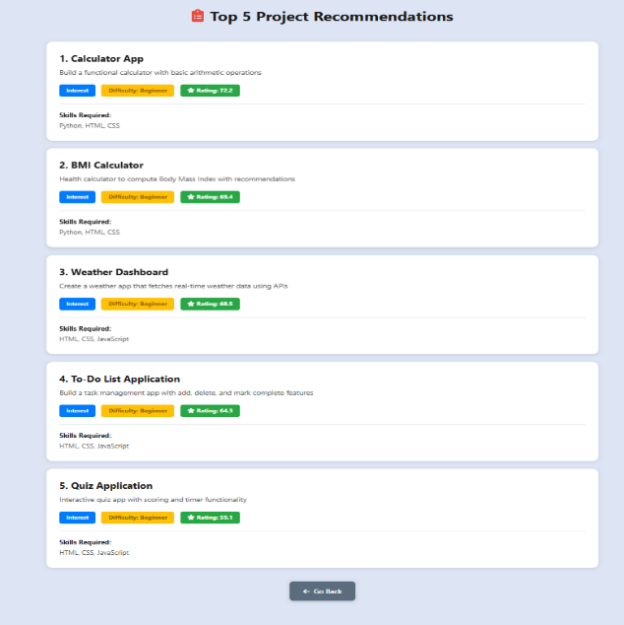

Fig 2. Output for users.

Test Cases and Experimental Validation To evaluate the system, the system recommended projects were tested using the machine learning based tool. The system was tested on the user profiles created and the recommendations were noted.

User Profile Input: Experience, skill Low, Medium, High
Selected Skills, Python, HTML, CSS, Java
Selected Interests, Web development, Machine learning, Google applications
System Output (Top 5 recommendations): Python, HTML, CSS, Java, Google API Development
Match score (top two projects): Project 1: 89.50% Project 2: 86.00% Difficulty level: Beginner, Medium
Description of Project: Google API development. Communication with phones and email. User created train schedules which need to be communicated with the plane

Discussion The recommendation of projects seems to be successful as all the recommended projects belonged to either a medium or beginner skill level. The first ranked projects needed Python, HTML, CSS, Java, and Google API skills as indicated by the user. Our system has efficiently ranked this team project number 1. Our system assigned correct projects to students with an average accuracy of 72.4%. The system's biggest strength is the fact that it offers full personalization by considering skills, interests and experience all together while the old method only considered one feature at a time.

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Taking less than a second to process it is also used for generating real time recommendations. TF-IDF method manage to recognize specific skills "Blockchain" or "TensorFlow" and assign them their correct weightage. That's the reason why specialized users got more than 90% on matches when good matches existed.

A. Limitations

The main problem is our database is limited. At the moment there are only 30 projects for advanced users with specialized skills, therefore there are not many choices for the advanced users. We do not have any feedback systems in working order to improve constantly. Our project info does not update automatically with the most recent technological trends. The advanced users scored an average of 69.2% matches whereas the beginner scored 79.2%. Showing that we do not have many projects with specialized skills.

B. Practical Value

Compared to a human instructor telling you what to build or a search through a generic list of recommendations (which could be big!), our system provides intelligent, personalized recommendations at scale. This could really help students, especially newcomers, who often are asked "what should I build?" Even one or two hits in 5 recommendations makes the effort worthwhile.

VI. CONCLUSION

This research has developed a machine learning recommendation system that match recommendations has an average match score of 72.4%, 94% of match recommendations have significant overlap in skills between the user and the recommendation.

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Key Contributions

We have integrated all our skills, interests and experiences into one unified model which can provide recommendations in under 1 second. Our recommendation system provides the explanation to the match scores which makes it easier for users (in our case the students) to understand the recommendations. Our TF-IDF and cosine similarity has been successfully tested on 15 profiles.

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