Smart Computing Review

Developing a Framework for Determining Student Excellence and Recommending a Field of Study

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Abstract: A recommendation system is a software tool that helps in decision making. A recommendation system can save time and effort for users and can guide them in the proper direction to make the right decision. Most students in developing and underdeveloped countries choose their field of study blindly, without considering their skillfulness. The selection of their subjects is often influenced their parents, friends or different socio-economic factors. This creates a huge problem for the students during their academic studies, and in many cases, they cannot do well in their chosen field. Considering this fact, in this paper, we provide a framework for identifying student excellence and for recommending the most suitable field of study for them. We perform different experiments to show the effectiveness of our system. From the experimental results, we found that our system can guide students in efficiently selecting their field of study.

Keywords: Recommendation System, Excellence Measure, Performance Evaluation

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Introduction

Recommendation is a particular form of information filtering that exploits past behaviors and user similarities to generate a list of information items that is personally tailored to an end user's preferences. Recommendation systems are now popular, both commercially and in the research community, where many approaches have been suggested for providing recommendations.

A recommendation system will help students to make decisions about different fields of study during their student life. There are several recommendation systems for students, such job recommenders, book recommenders, and online course recommenders.

Most of the time, students are confused when choosing their field of study. They often make decisions influenced by their parents, seniors, friends or others. For this reason, in many situations, they cannot do well during their academic life. For example, after a Higher Secondary Certificate (HSC) examination in Bangladesh, students are confused about whether medical, engineering or university honors courses will be better for them. There are also many subfields under each of the above major categories. In such a scenario, students become very much confused while making their decisions.

A recommendation system that can identify student excellence can help students in proper decision making. In this paper, we propose a framework to identify the excellence in students, and based on the excellence, we recommend a field of study. More specifically, the contributions of this paper can be summarized as follows.

- At first, we collected student data with a survey of students from different classes and groups.
- We then processed the collected data to identify the fields of excellence for each student.
- We then generated the recommendation for each student using a *k*–nearest neighbor algorithm.
- We evaluated the performance of our framework using both subjective and objective measures.

The remainder of this paper is organized as follows. Section II provides a brief review of literature related to recommendation systems. In Section III, we detail the framework of our proposed approach. Section IV shows the implementation procedure and experimental evaluations of the system. Finally, we conclude and sketch future research directions in Section V.

Related Work

Chang et al. [1] proposed a method for a hotel recommendation system based on the surrounding environment. They evaluated each hotel's surrounding environment with the help of point-of-interest (POI) databases. Then, they calculated the preferences of the people using their reviews of hotels. Finally, they calculated the similarity between the environment of each hotel and the user's preferences and selected the top-k hotels to recommend. Chen et al. [2] proposed a method for place recommendation based on users' check-in histories for location-based services. They make clusters of the check-in information based on proximity. Next, for each cluster, they calculate the gravity center of each cluster. They then annotate each cluster by using a POI database. They performed semantic analysis of the users' interests and measured the similarity scores among them. Finally, they select the top-n similar users and use the top-n users' records for the recommendation.

Tiraweerakhajohn and Pinngern [3] proposed an item-based collaborative filtering method to find similar items and used the combined similarity to generate predictions. Mican and Toma [4] proposed an association rule–based recommendation system. Jiang and Yu [5] proposed a framework to analyze e-commerce data to identify customers' behaviors. Claypool et al. [6] proposed a new filtering approach to recommend interesting news. Bohm et al. [7] proposed an approach that can generate fixed-sized partitions based on a similarity threshold. It can also generate a requested number of partitions of varying sizes. The problem is that it attempts to predict ratings only considering the other users' predicted ratings.

There are several mobile applications for recommendation systems. MovieTwist is one of them, which is an artificial intelligence–powered movie search and exploration application that makes it easy to discover movies. Job Seekers is another application that helps give access to the latest job listings, as well as company reviews and salary reports, shared by those who know the company best.

In this paper, we propose a framework to recommend to students a field of study based on their own excellence measures.

System Design and Architecture

The system architecture of our framework is shown in Figure 1. In the system, users provide requested data as input to the system. We divide users into two different groups.

The first group consists of students at the undergraduate level and the second group of students is those who just passed the HSC examination and who are waiting to get admitted to university. Users in the first group need to provide their name, subject area and some feedback informing the system as whether they are satisfied with their subject of study. In addition, they need to provide information such as their HSC roll number, the name of the examination group for the HSC, their cumulative grade point average (CGPA), and individual subject marks. Moreover, they need to take an online quiz that examines their analytical skills. Quiz questions are based on the examination group. For example, if a person is a science student, questions will be from science-related subjects.

The second group of students does not need to provide the department name and feedback information when they register with the system and use it for the first time. However, after being admitted to university, they may use the system again to only add their department name and provide feedback to the system.

Based on the input information and quiz answers, we compute an excellence score for students by using following formula:

$$\text{Score} = (GS1 + GS2 + GS3 + \ldots + GS7) + (Q1 + Q2 + \ldots + Q30) + \text{Olympiad score}$$

In the above equation, GS and Q stand for grade in subject and quiz score, respectively. We consider the national grading system to determine GS values. We consider non-uniform weights for the questions of the quiz. However, the weight varies from 1 to 5 based on the difficulty of the question.

We consider one point for participation at each of the three different Olympiads for science students, because there are three different well-known Olympiads for science students in Bangladesh. However, for arts and commerce students, we consider only one point for Olympiad participation, because for them there is only one well-known Olympiad. Using the above information, we generate a score for the student.

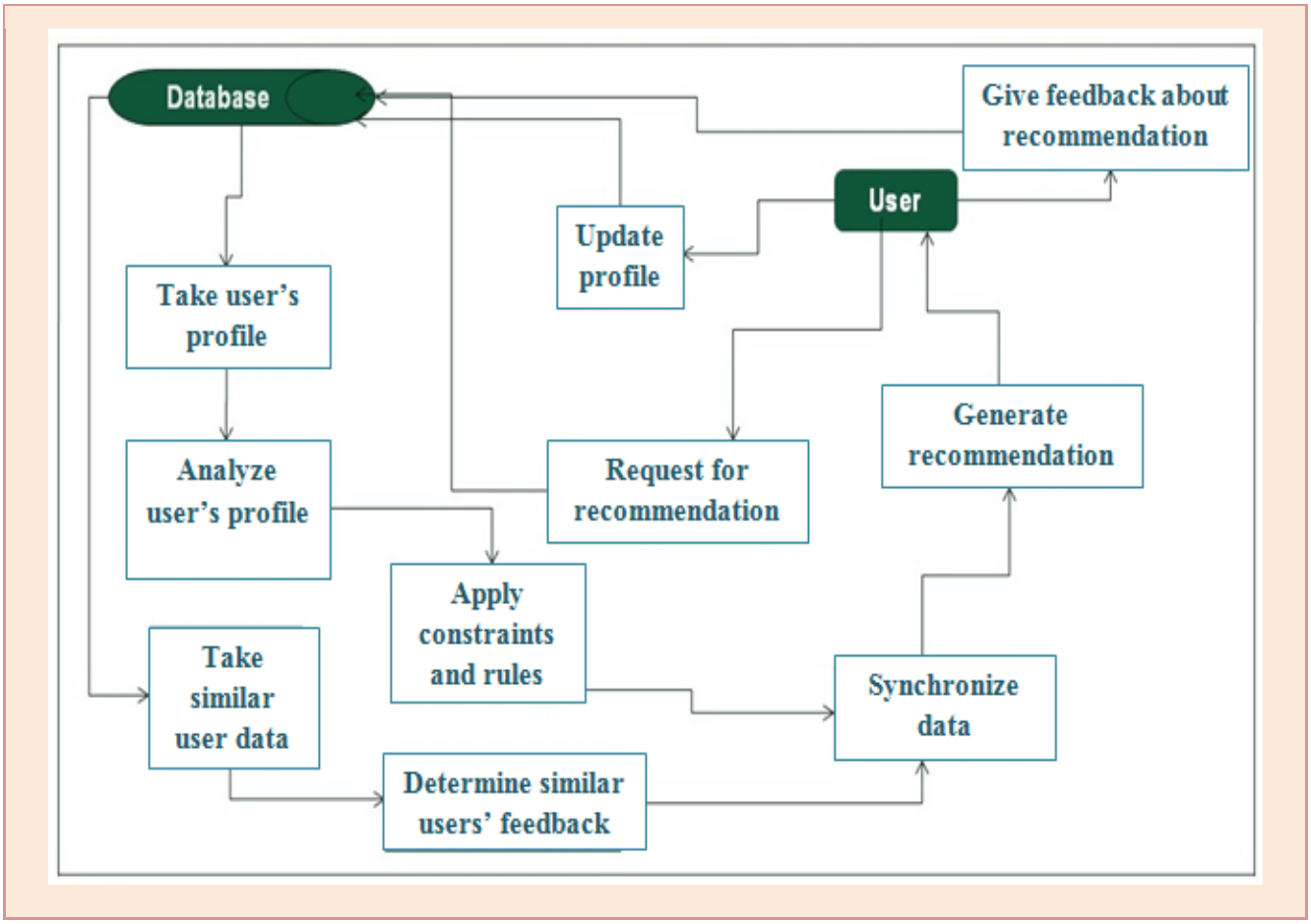

Figure 1. System architecture of the proposed framework

To generate the recommendation, we use a *k*-nearest neighbor algorithm. Here, we consider students at the university level. At first, we select the *k* most similar university students based on scores. Later, we check the feedback of these k students to identify whether they are satisfied with their subjects. Later, we filter out students who are not satisfied with their subjects. Among the remaining students, we apply a majority voting approach to select the subject to recommend. Finally, we recommend this subject to the student.

Experimental Evaluation

We implemented our developed framework on a machine with the Windows 7 OS and a 2.50 Core i3-4100 processor with 4GB RAM. The framework was developed in JAVA, with an XML Android platform as the front end and a MySQL database at the back end for storing related data.

For evaluation of performance, we considered both real data and synthetic data. To collect real data, we conducted a survey of 500 students, of which 200 are undergraduate students and the remaining are HSC-passed students. We generated 150,000 synthetic records. We considered synthetic data to check the applicability of our data over a larger data set.

Based on the survey results, as shown in Figure 2, we found that most of the undergraduate students were not satisfied with the fields they are studying.

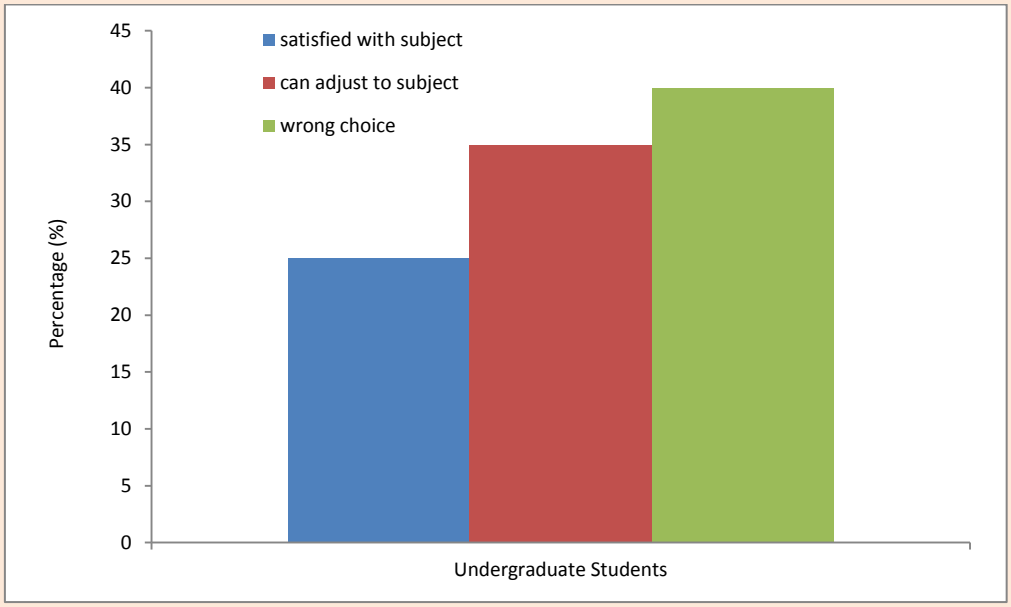

Figure 2. Student responses about their fields of study

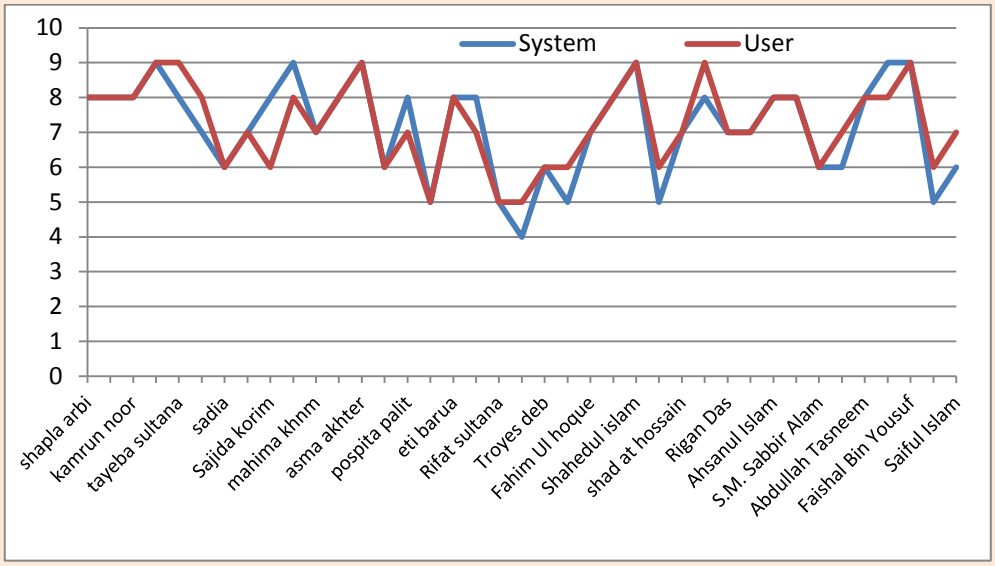

Figure 3. Comparison between the system's recommendations and the users' choices

We can see that about 25% of students are satisfied with their fields. However, the majority of students seem unsatisfied with their field of study. This is due to their making the wrong choice.

Figure 3 shows the results from the recommended fields for students as generated by our system, and the fields chosen by the HSC-passed students during the survey. Here, we consider k = 10 and separately generate a recommendation for 20 students. We considered nine different fields, as shown in Table 1. From the results, we can see that around 50% of students make the wrong choice about their field of study. This is due to the fact that, in most cases, students choose their field of study under the influence of society, friends, or families, ignoring their actual capacity.

Table 1. List of fields under consideration

Field Number	Field Name
9	Medical
8	Engineering
7	Applied Science
6	Biological Science
5	Pure Science
4	Business Studies
3	Social Science
2	Arts
1	Vocational Education

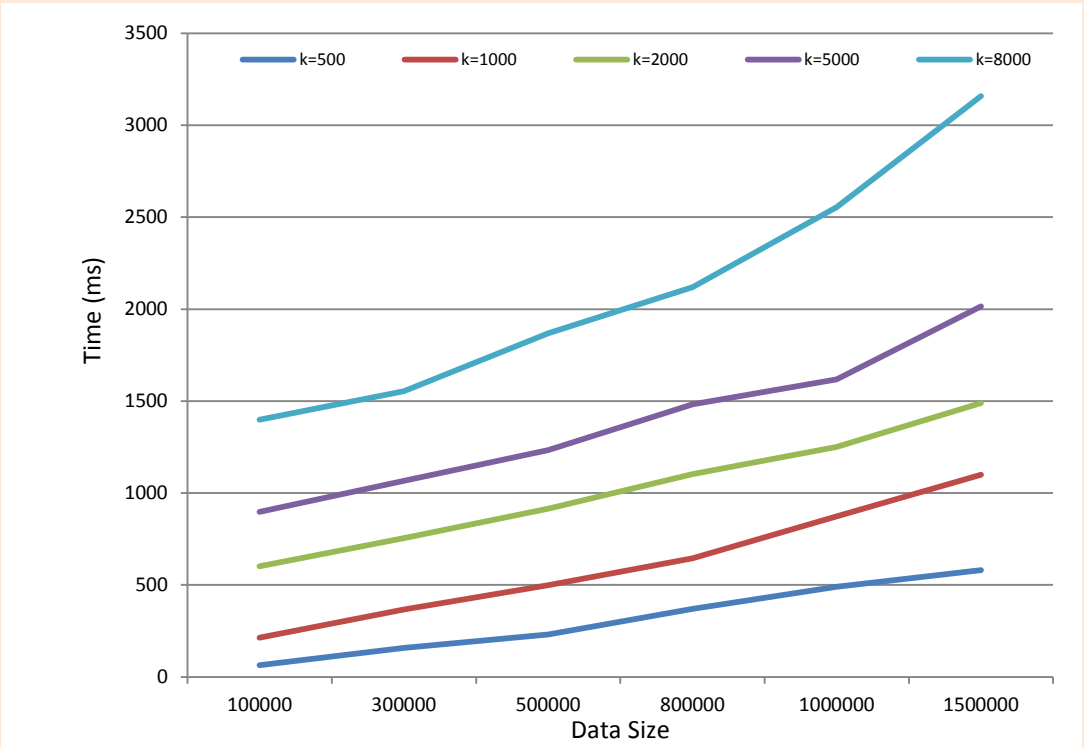

Figure 4. Performance considering response time to generate a recommendation

Our next experiment showed the efficiency of our system in handling a large data volume to generate recommendations. Here, we considered synthetic data generated by a data generation program. Figure 4 shows the performance of our system

over different data sizes and different k values. In this experiment, we generated recommendations for students considering different data sizes and k values.

From the results in Figure 4, we can see that there is not much performance degradation with an increase in data volume and k. After implementing the performance measure of our system, we conducted another survey among 20 students at a public university to test the applicability of our system. Each of these 20 students used our system and answered the following five questions by rating them between 1 and 5, where 1 mean strongly disagree and 5 means strongly agree. Other ratings are 2 for disagree, 3 for neutral, 4 for agree.

- Question 1: Do you think the system is helpful for you?
- Question 2: Do you think the system shows correct output?
- Question 3: Do you think the system provides timely response?
- Question 4: Do you think the system has a good user interface?
- Question 5: Will you recommend others to use the system?

The survey results are given in Table 2. From those results, we can see that most strongly agreed with the usefulness of the system and wanted to recommend it to others. They were satisfied with the system's performance. However, most of them were not as satisfied with the user interface.

Table 2. Survey Results

User	Question 1	Question 2	Question 3	Question 4	Question 5
User 1	5	5	4	5	5
User 2	5	4	5	4	5
User 3	5	3	4	3	5
User 4	4	5	5	4	5
User 5	5	3	4	4	5
User 6	4	5	5	4	5
User 7	5	4	3	3	2
User 8	4	4	5	4	5
User 9	4	3	4	4	4
User 10	5	4	4	3	5
User 11	5	4	5	5	5
User 12	5	3	3	3	3
User 13	5	4	5	4	5
User 14	3	4	4	4	4
User 15	4	4	5	3	4
User 16	5	4	5	3	4
User 17	5	5	4	3	5
User 18	5	4	5	4	5
User 19	5	4	5	4	4
User 20	5	5	4	3	3
AverageRating	4.65	4.05	4.40	3.70	4.45

CONCLUSION

In this paper, we have developed a framework for measuring student excellence, providing a way to help them make a proper choice as to a field of study. To measure the excellence of the students, our system generates scores for students based on their own results and other related activities. The system then recommends to students a field that is best suited to them. From the experimental evaluation, we found that the developed system can provide efficient recommendations to students and can guide them in proper decision making when selecting their field of study.

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