Design and implementation of framework for higher education enrolment through ICT enabled application using JEE

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Abstract. Education is a vital tool for a country's economic growth. The growing competence in the world has increased the demand in the tertiary education sector. As a result, the higher education enrollment process becomes tedious and time-consuming. A lot of educational institutions face issues in the enrollment process. For instance, analysing the huge data of various student demographics, grouping similarities, finding loopholes, determining the categories etc. Therefore, an analytical framework serves as a tool for a reliable and efficient enrollment process. The design and implementation of the framework for higher education enrollment through ICT enabled applications using JEE stands as a vanguard technology. The framework contains an academic dashboard with statistical representations of various categories of the enrolled student's data, generating daily matrix reports, Google API visualizations for quicker understanding and also a counselor ranking which depicts the success rate of each counselor etc. By harnessing accurate parameters like the number of walk-ins, the number of walk-ins but not purchased applications, applications purchased but not submitted, submitted but not enrolled etc. in institutions can enroll the optimal number of students. In addition, tracking enrollment trends over time provide institutions with a better glimpse of the huge data and helps them in better and effective decision making resulting in an increased reputation of the institutions. This paper focuses on data capturing through the ICT enabled application that is developed. Based on the data captured, analysis and decisions are made.

1. Introduction
The importance for education is being realized in a wider aspect from every nook and corner of the society which naturally expands the education system and the urge for effective enrollment across the globe. Nowadays the desire to pursue higher education among the people under various categories is drastically increasing therefore in the recent decade a lot of educational institutions are being set up. The higher education enrollment process deals with many issues because the higher education institutions should analyse various parameters of the applicants along with the constraints set by the institutions in order to make the enrollment process effective and reliable. This becomes difficult if the enrollment process is conventional. It becomes time-consuming, involves too much manual work and also is imprecise and inaccurate.

It is possible to discover the key characteristics from the enrollment data of the students by the help of data mining techniques, such as clustering, association analysis or decision tree. This can possibly be used for future prediction. [1] Another issue in higher education enrollment is equity. It is nothing but expanding the access to higher education for underprivileged communities in the society like minorities, low income etc. The enrollment models seeking to attain equity in higher education should be more outcomes-based (e.g., increase success) rather than process based (e.g., increase participation). [2] In the 21st century, there are two major trends affecting higher education. First one is the widening participation in higher education and the second one is the growing mobility of students and scholars internationally. Such a diverse and huge number of applicants need high-quality
admission process that supports the selection of the students, whose probability of completing the program successfully over the desired time period is high. [3] The various locations students come from is also one of the important factors to consider in the enrollment process. Students from different locations put an effort into getting enrolled in reputed institutions. Data mining techniques along with visualizations can be used to uncover and extricate knowledge to progress in the right direction. A single data contains a lot of information. Visualization using graph is one of the most useful methods to analyse the data. The prediction of a student’s interest with the location is more beneficial for identifying academic achievements. [4,11], Fishbein and Ajzen delineate that a student’s previous behavior, attitude and intentions impact their decision to drop out. Therefore, attrition is observed as an upshot of weakened intentions. They use certain psychological models to understand the behaviors of students [5] Understanding student behaviour is essential in order to understand the student intentions which directly impact the enrollment process.

Above mentioned are certain instances of the possible issues of an effective enrollment in higher education. To eradicate these discrepancies analytical software is much needed. This project aims to solve all the lacking features in the existing software, add new features like the daily matrix, graphical representations, provide all the background details of the student, statistical information etc. Separate login for the principal, counselor, convener, and an admin will be provided where they can get access to only the required interfaces of their concern. The existing system carries basic functionalities which require to be enhanced and be made more user-friendly. The goal is to develop a system which minimizes human interventions and facilitates quicker decision making. The software will provide detailed information about all students and their background. For example, details of all students from a particular district, a list of students who have a percentage between 70%-80.

This can be carried out using simple Data mining techniques. Data analysis can be defined as a process of assessing the data through a logical and analytical approach in order to scrutinize each element of the given data. In today’s progressive and ambitious world, students are vying for a place in their respective professional careers. This will have a prodigious influence on educational institutions. Naturally, this will demand an effective enrollment process in the higher education sector as it is the building block for a professional career Eventually, this will grant them an advantage over their competitors to recognize which areas in their services they need to upgrade upon, where enrollment rate might have fluctuations and various other loopholes in the enrollment process. One of the significant benefits is that the use of data analytics helps institutions save a lot of money, evolve better marketing strategies, increase the efficiency in enrollment, enhance the growth of institutions and thereby standing out from the crowd by differentiating themselves from the competitors in the field. Students performance can be identified using Educational Data mining. [12]. The objective of introducing a more systematic and substantial way to the daily use of quantitative information in educational institutions require a decisive shift in the paradigm of the enrollment process that should be accompanied by the introduction of statistical analysis and data visualizations.

2. Literature Review
A Research paper by Heena Sabnani, Mayur More, Prashant Kudale, Prof. Surekha Janrao proposed that conducting an entrance examination for all the students would help the student to analyse which course/branch to join. For an institution, this would help them to analyse enrollment, an increase in the number of students joining and reduce the number of dropouts. [6]

A Research paper by Karsten Albæk’s objective is that students who take subjects which they have already studied in their higher education help them to fare well in the graduate level. By having common subjects, there is a smooth transition into college from school. [7]

A Research paper by Stephen J. Aguilar proposed that there are several ways in which students can be catered to be trained in a better way. One of the methods is having small classrooms with a smaller number of students in each, and another way is to teach the student skills of learning. In this manner, no student will remain an average student and the possibility of getting better grades increases using their methods. [8]
The methodology used in the paper by E. Fernandes, M. Holanda, M. Victorino, V. Borges, R. Carvalho, and G. Van Erven is CRISP-DM. It is used for predicting student performance and the failure rate. Two datasets say DS1 and DS2 are maintained in order to collect the quantitative information. The first DS1 is collected prior to the admission and the DS2 is collected after around two months since the classes began. [9]

The Research paper by J. Juszkiewicz proposed the pattern in decline of enrollment in community colleges since 2010. There has been a steady decline since 2010 and the age group of students who enroll is before the age of 24. One of the main reasons for the decline is the change in economic conditions. [10]

3. Methodology

3.1. Data collection and classification

Student enrollment data is collected and classified under various categories based on student demographics. The major part of data about the students is obtained during the student walk-in.

3.2. Statistical Analysis and Data representations

The enrollment data captured under various interfaces like a walk-in, call recording, prospectus purchase is analysed, and various patterns are formed. For instance, students below 60% of marks, students from a specific geographical location, students from a computer science background or non-computer science background etc. The data is represented in the dashboard for a better glimpse of a bigger picture.

3.3. Modules and operations

The tool developed comprises several modules based on the type of user. The privilege is given keeping security constraints in mind to provide a hassle-free environment.

3.3.1 Admin module

The admin has the provision to add university, departments, new courses/programs, counselor, staff etc. The admin module is the superior most and permission for any change can be granted only by the admin which makes it secure and robust.

3.3.2 Counselor module

The counselor has access to add information on walk-in’s, phone calls, number of prospectuses purchased/sold, number of applications submitted and finally the number of enrollments.

3.3.3 Convener module

The convener gets the list of the number of walk-in’s, but application not purchased, the number of applications purchased but not submitted, the number of applications submitted but not enrolled. Google map visualization is also available in this module. The convener gets a report of the daily matrix, program-wise dashboard, gets to view the year wise comparison.

4. Design of Framework

4.1. Architecture Diagram

Figure 1. Admin Module Architecture
5. Proposed System
The main intention of this entire framework is to make the higher education enrollment process easier but effective and reliable. Data mining is a powerful tool that is used to achieve this purpose. Conversion of walk-in into enrollment or a call enquiry into enrollment is the success parameter (effective enrollment). Achieving this is the main objective of the paper which requires capturing of data and analysing the data to identify the trends and understand the loopholes to make the student enroll to their desired course. In order to capture the data and identify the patterns or classify and derive useful information from the enrollment data, a systematic tool is essential.
6. Implementation and Results

Figure 5. Admin Module Interface

Figure 5 represents the Admin Module. The admin module helps in maintaining security in the entire system. Only the admin can add, alter and delete new universities, department, academic terms, faculty, programs/courses. Even in the data that has been entered in the convener module, for any changes to be made only the admin has authority. By doing so the system is made reliable and has integrity.

Figure 6. Summary Dashboard

The Summary Dashboard gives an overall view of the entire enrollment that has taken place in an academic year. It classifies the students into three categories based on their 12th-grade marks, i.e., below 60%, between 60% and 80% and above 90%. This will help the institution to provide additional classes or bridge courses for the students below average. This will help the student to perform better in his course, increase his comfort in the subjects and also provide a better name for the institution. Figure 6 shows the interface of the summary dashboard. Also, the total number of admissions enquires for that year can be viewed.
The daily matrix provides information about walk-in’s, call recordings, applications submitted online, prospectus sold, successful enrollments that have taken place on a daily basis course wise. It also provides overall tracking of all the enquires and enrollments that have taken place from all modes. Figure 7 shows the interface of the daily matrix.

Figure 8 represents the pie chart of course wise analysis. The course wise graph depicts the number of enrolments that have taken place for each course. Visualizing it as a graph helps quicker analysis of the demand for each of the courses.

Figure 9 depicts the percentage of students from each state. This will help the institution to focus on which areas to advertise and monitor the regions from where they can expect major enrolments.

The successful number of enrollments made by each counselor is considered and depicted. This is a process of gamification which encourages the counsellors to get a better ranking and hence resulting in a higher enrolment rate. Figure 10 depicts the rankings.
7. **Future Work**

Further, this work can be extended and enhanced in a more advanced level to make predictions of the enrollment process (increase/decrease), student performances etc. using machine learning tools.

Machine learning is a budding technology with a wide scope. This could potentially be used to hunt for patterns on a broader level. Machine learning can assess data for each student and determine the likelihood that the student will enroll. After a student enrolls, even more, data set about the student can be captured, such as the initial grades, grades after a certain period of time, the number of backlogs etc. which helps in predictions. Using machine learning, institutions can then focus on student retention and endurance and identify the key factors that influence student success or failure.

One increasingly popular ML model that could be used for this task is the artificial neural network, which is known for its versatility and general predictive ability when dealing with large amounts of data. ML is capable of leveraging patterns that it finds in large quantities of data in order to improve its predictive power.

8. **Conclusion**

In general, the enrollment process is out of kilter. To make the enrollment process more accurate, efficient and exemplary, it becomes essential to adopt statistical analytics, descriptive analytics, and perceptive analytics through a tool to follow and trace individual student details from walk-in to enrollment. This reduces the error rate as human interventions are less when compared to conventional methods. This paper provides more transparency in generating daily matrix, ranking, and visualizations.

Therefore, the scope of Data Analytics & EDM (Educational Data Mining) in the optimal analysis of enrollment data serves as vanguard technology to ameliorate the performance of the enrollment process in higher education.

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