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Research Article

University Activity Management System

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ABSTRACT

The University Activity Management System project centers on the college network so it can organize the activities in the university in an efficient manner. To execute an activity, it is needed to assess and boost it. In hierarchical investigations, successful and proficient improvement is the administration of activities when authoritative activities are required. This university tasks the executive's framework project covers all exercises going to the university. This framework is created utilizing Machine Learning (ML) techniques. There is an automated scheduling framework, automated change schedule framework, predict understudy grades dependent on making and evolving participation, staff requirement prediction, student enrollment prediction and checking student's attendance by utilizing image recognition techniques.

Keywords: Machine learning; Automated timetable; Automated change schedule; Human resource management; Genetic algorithm; Random forest regression algorithm; Linear regression algorithm

INTRODUCTION

The university activity management system project will focus on the university activities which enables universities to coordinate the activities they need or have and make appropriate decisions about these activities. Management of activities requires assessment and maximization of those activities. In organizational research, the efficient and effective development of an organization's activities when they are needed is activities management. In this university activity management system project, all activities coming to a university will be covered. This system will use Machine Learning (ML) techniques to develop it. It will have an automated scheduling system for generating timetables and change timetables upon the requests by lecturers, analyze the students' marks prediction based on the attendance, lecturers, and students' resources analysis, and the last one is this system enables the ability to get student attendance by using image recognition. The effectiveness of university activities depends on an effective activity management system [1]. Most of the current works relating to activity management systems are still primarily conducted paper-based. This approach is a high-risk problem that can overcome the integration of technologies in the form of activity management systems, such as accelerating and managing the workflow of the university's activities and each proposal, and minimizing tracking errors in office processing, reduction of processing time, reduction of duplication, support for quality improvement of data collection, quality improvement projects and reporting, etc. Current inter-university activities overlap and are often constrained by university activities that can be undertaken because they consume a significant portion of the overall budget. Since these activities usually have economic impacts, an appropriate assessment of the proposed activities should be carried out. The order of the day is to do something useful while always maintaining a budget and avoiding duplicate activities at the university. Better planning and management are needed for other activities, depending on the instructor, student, and student evaluation and reasons for participation. Training statistics improve reliability by generating relevant, reliable, and timely data. The goal of this project is to act to proactively plan, schedule, and allocate organizational activities efficiently and effectively. Additionally, this is mainly focused on Human Resource Management (lecturers and Students) and infrastructure management of academic environments to overcome conflict. The system provides efficient scheduling of personnel and infrastructure management. It is made according to the needs of the college. When coming to schedule, most research has only focused on implementing an automated timetable scheduling for universities but in our system, proposed

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an effective automated scheduling system with optimizing the total distance that each lecturer needs to travel from one lecture to another. Not only that it checks all the constraints and is free of conflicts in each slot. And the other thing is past research mainly focused on generating timetable, but researchers had not focused on the change scheduling part of the generated timetable some research has just only implemented change or rescheduling part without integrating or checking constraints relevant to changing slots, but in our proposed system it enables the feature of automated changing schedule by considering all the constraints and affected parties as well. When it comes to Human Resource Management (HRM), it plays a main role in university activities such as staff recruitment, student enrollment, student attendance, student performance, and so on. Through that, many linear and non-linear approaches have been proposed for predicting future requirements [2,3]. According to Garg and Swati, ML applications increase employee experience and facilitate organizational success in addition to enhancing the efficiency and effectiveness of HRM activities [4]. Although there is much research regarding the student enrollment and lecturer requirement predictions, there is not any relationship between academic activities and HRM. Through our proposed system it creates a relationship between human resource analysis and timetable scheduling by selecting subjects from the timetable. When considering the lecturer requirement analysis, is based on many factors like the number of lecturers, future student enrollment, number of subjects, number of students per batch, and number of batches. Students' attendance and students' marks prediction are also integrated with this activity management system. According to major research in this area, there was no tool to examine this and see in real-time, especially the relationship between student attendance and student achievements. They perform the results based on manually programmed procedures. Through our project propose real-time attendance updates via the internet, decision proposals, attendance-based future prediction, and the development of report generation systems. This will mainly help to motivate the student for increasing their academic performance by analyzing their attendance data.

LITERATURE REVIEW

Hundreds of papers on activity management have been published. Over the last 60 years, many papers have been published in academic journals related to the management of university activities. When coming up to the activities in universities, each activity is getting more and more complex day today. Therefore, it can be referred to a lot of published research projects on the internet. Each research project had introduced new concepts to help the management of activities in universities. Automated timetables, lecturer management and student management are somewhat complex scenarios in the university but most of the research has not introduced a system to resolve all the complex problems that each university faced. They have only focused on specific areas in the university academic environment. Therefore, it has been evaluated different research papers with specific areas of automated timetable, lecturer management and student management. Automated scheduling can be defined in the most general terms as the limited allocation of resources to objects placed in time and space to reduce the total cost of collecting resources used in the university. Hambali, et al. proposed Genetic Algorithm (GA) and Simulated Annealing (SA) algorithms to solve the problem of the university course schedule [5].They used Charles Darwin's Survival of the Fittest (GA) theory, which is simulated annealing along the graph coloring heuristic to generate a multi-dimensional array as a space to reference the entire course of a given semester. However, Hayat, et al. have proposed a system to solve timetabling schedule problems by reviewing algorithms that consider the demands of institutional constraints for course timetable management by using Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) [6-9].They have devised solutions to the problem resulting in plans that allow all students to participate in meetings of interest at a given place and time. However, there are limitations in allocating resources including time, space, and the availability of both faculty and students. In research they have used data mining methods which can be used to predict possible areas on student enrollment [10]. The prediction of this research usually Advantageous to study current and historical data relationships for certain situations with the correct prediction methods. This provided a high level of precision with less costs, the amount of historical data in which the relevance of the information can be measured for a reliable decision-making and finally, the period of formulation of the forecasts. Moreover, in HRM, machine learning acts as a lead role. According to the usage of decision trees and text-mining algorithms for classification dominates all HRM operations, with ML applications being greatest in the areas of recruiting and performance management. Kausar worked on research regarding the prediction of teacher enrollment for Pakistani schools and pointed out that at all levels, schoolteachers must be further enrolled [3,4]. By using the Support Vector Machine (SVM) model, this study examines the number of schoolteachers and forecasts future yearly teacher enrolment. Research in Aalto University School of Business in Finland, investigating the relationship between school attendance and performance by Finland University, was based on a manual data collection procedure. In this research attendance data was collected by circulating an attendance sheet at every class and every teaching event. Every student who a sign the attendance sheet needs to ensure the accuracy of the signatures indicates in the list was cross-checked by counting the number of students present at that moment. All the data analysis and decision-making regarding the findings were based on manual procedures [7]. Another study of Melaka Manipal University attempts to identify the relationship between attendance and performance by changing the attendance policy from 75% to 90%. They have found out increment of attendance positively affects performance. This research was performed by using statistical analysis [8]. The research of Yenepoya Institute of Technology India has proposed face recognition techniques for marking the attendance of the students. In that system which detects the faces from live streaming video of classroom and attendance will be marked when detected face is matched with the database. After the recognition, the marking of attendance will be recorded in database [10]. However, in the automated scheduling, research they have not answered few key points yet [5,6]. They are

optimizing the distance that needs to travel from one lecture to another, and automated changed request handling for the schedules. In research student enrollment prediction, they have not focused on how to get student enrollment prediction based on departments and not considered the rate of students which is failed on each year [10]. When considering human resource management, Kausar only focused on predicting staff requirements just only based on historical data of staff count [3]. They did not address the other aspects that were affected in future staff requirements, such as student count, number of batches, etc. In researches of predicting student marks based on attendance not focused on how to get attendance smartly and how visualized for the students and staff. In research predicting student marks based on attendance is not focused on how to get attendance smartly and how visualized for the students and staff [7,8].

METHODOLOGY

In this research work, to achieve the optimal output design, the researchers used optimization algorithms to generate timetable and change schedule, linear regression and random forest regression for predictions, and image recognition technology to get students' attendance. The detailed methods of the above components are described below.

Generate timetable

To obtain an optimal output design, it is used Charles Darwin's idea of survival of the fittest (Genetic Algorithm) in our generating schedule. This method works with many solutions, each of which is referred to as a chromosome. The chromosome is made up of many genes, each of which has a value that corresponds to a property in the solution. The genes can then be utilized to regulate the chromosome's fitness. Crossing creates a new off-string based on the fitness of the chromosomes. These offspring are then altered at random to expand the search space. When an offspring satisfies a given fitness requirement, the algorithm stops because an acceptable solution has been identified. The genetic algorithm is divided into two stages: Selection and crossover.

Population: A set of selected parent members makes up the population.

Chromosome: A chromosome is made up of a single lecture hall's timetable.

Gene/slot ID: A gene was used to symbolize a time. Lecturer and Student Group are stated inside that time slot ID for the course.

Crossover: Crossover is the method that is used in GA to reproduce. The selected members were taken two by two and mated to create a new member

Mutation: Mutation is a genetic operator that changes the gene sequence by altering one or more gene values in a chromosome from its initial state to reproduction state and may be able to arrive at a better solution.

For example, the 1st gene/0 slot ID of the chromosome represents the course and the lecture hall which is relevant for Monday 8.30 a.m. to 9.30 am time slot. [Course, Lecturer, Student Group] Altogether it has the following concepts: 50 genes/50 slot ids in one chromosome, 10 chromosomes for the 10 lecture halls in one member and there can be any number of members in a population.

Algorithm

First, generate the initial population. Evaluate the fitness of all the members in the initial population and select the better members to carry on the generation. If the selected parents have a higher fitness value above a decided value, then they are passed to the secondary population without crossover or mutation. The rest of the members (selected parents) are going through cross-over. In the crossover process, it selects chromosomes two by two and selects a random crossover point, and does the crossover. Create a new population with a certain percentage of mutations. If the solution is the best solution that satisfies all the hard constraints, and the soft constraints finish the algorithm

Hard constraints

Lecturer-based priorities scheduling the top of the scheduling section is the most critical component in organizing Lecturer-based scheduling. First of all, as it considers concentrating on the available position of lecturers and designing the most appropriate location, time slots, and student groups for them.

Student group-based scheduling

The other significant component of timetabling is student group-based scheduling. In this chapter, concentrate on the student assigning the lectures and finding the ability of the student to establish the timetable and the appropriate location for the student groups.

Location-based scheduling

In this scheduling case, the most significant aspect is location-based scheduling. When the most convenient place for arranging lectures, laboratories, and tutorials is considered. If the next tutorial or a laboratory is scheduled for a single lecture in the time slot, find the same venue. This is the main value of our research.

Resources cannot overlap time wise

In this case, the common hard constraints are considered. All content included in the timetable is considered to prevent any conflicts. They are: Teachers cannot have two lessons at the same time, Some groups cannot listen to two lessons at the same time and the classroom cannot take two lessons at the same time.

Note: the term "same time" is not meant only at the beginning of the class, it should be considered the duration of the class. If the resource is busy now `T1` and the class lasts `t1`, then the resource can only be re-occupied now `T2=T1 + t1`.

Soft constraints

If the subject has several forms of teaching, the preferred order for each group is the lectures, Tutorials, and laboratory and Labs with Tutorials.

Change schedule upon the request

After generating a timetable, lecturers might request for changing or swapping time slots they got. In this component, it is used to process change requests, and the lecturer only needs to drag and drop the activity from the existing plan to the new desired weekday. The system will display the available locations, and the use of the optimization algorithm system will suggest possible solutions, such as exchanges with other activities (considering the availability of all parties involved). The possible suggested solutions will not cause any conflicts. Change requests will be processed completely automatically through this component. The following evolutionary algorithm approaches have been taken for this change schedule component. They are highlighted as follows:

Chromosome: it is used to represents the schedule,

Fitness function: it is used for checking how good a particular schedule is for swapping,

Mutation: it is used to recombination the schedule.

This component suggests 2 feasible solutions for the user. They are the best free slot to change and the best-reserved slot to change. In order to achieve these solutions, this component performs several tasks. Initially, get all the existing schedules (chromosomes) that match for request slot by considering all the constraints (desired weekday. capacity, location type, and duration).

Algorithm

Get the fitness value for each slot that has been filtered in the above method until it reaches the minimum value. After iterating all the chromosomes or after getting fitness value 0, select that chromosome/schedule for the best existing schedule to change/swap. To get the best free location to change, the algorithm checks the best slot id that suits a requested slot on the given desired weekday. After getting the best suitable slot ID to change, the algorithm will iterate all free locations until getting fitness value 0 or the minimum value. After performing all the steps algorithm will shows console output like the below image (it is in JSON format). If there is not any best free location to change or an existing slot to change, the algorithm will provide empty values for that (Figure 1).

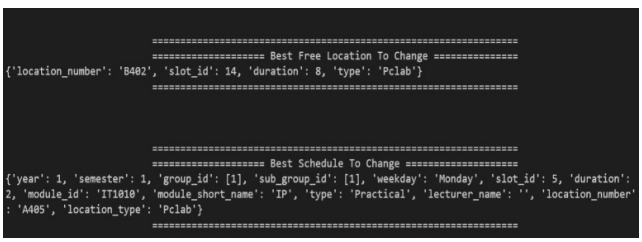

Figure 1: Change schedule output results.

Students' enrollment prediction

For certain scenarios, it is typically helpful to conduct research on the present, historical and ongoing data connections. The knowledge gained through prediction methods might be useful in determining the potential of historical data in an organization and in making management decisions in the current scenario. When considering the enrollment prediction, it can be divided into three methods [9]. Quantitative methods based on historical data, Contribution models that use historical data and rely on a link between enrollments and other factors, or approaches that involve subjective evaluation rather than quantitative metrics, Modifications or comparisons to previously existing prediction techniques.

In this study, statistical linear regression is applied in this system to predict future student enrollment in universities. In regression, variance is a measurement of how much observed values deviate from the average of predicted values. As the dataset is small, it is used a linear regression model having a variance score of 1. The data dimension is represented by 4 columns and 37 rows because there are normally 4 academic years in a particular university. In this function, the user must input the year and the academic year, and because of that, the user will get the predicted student count as the output. This output has been taken as an input in staff requirement prediction.

Lecturers' requirement predictions

Staff requirement prediction is critical for both strategic and tactical decision-making in universities, and it is seen as a necessary component of efficient and effective management. This function mainly focuses on predicting staff enrollment at each level (senior lecturer, lecturer, associate lecturer and instructor).

Algorithm

As the data size is small so it is used multivariate linear regression, K-nearest neighbors' regression, and random forest regression algorithms to predict future staff requirements in universities. By testing the model, it is identified the accuracy rate of the algorithms as follows: Multivariate linear regression–49%, K-nearest neighbors' algorithm–54%, Random forest regressio –98%.

The data set contains the count of four levels of staff (senior lecturer, lecturer, associate lecturer, instructor) in the last 10 years at a particular university. Moreover, academic year, student count, the number of students per batch and the number of subjects are also included in the data dimension. According to these factors (academic year, student count, number of batches, and number of subjects), users will be able to predict staff requirements at each level.

Input fields

To predict teacher requirements, users must enter the following fields:

Year, Academic year, Student count (This will be the output of student enrollment prediction function), Number of students per batch, Number of subjects

Students' marks prediction

Here the future data can be predicted by studying past data. Mark's prediction has done based on the same concept. The past data is the early semester's attendance and marks for the subject.

Algorithm

As algorithms, it is used linear regression for future prediction. By assuming attendances and marks act as a linear relationship (Y=mx+c) it can be used linear regression. By testing the model by using test data (20% of the data set) and identify the accuracy is 98% for the linear regression.

Students' attendance

Attendance is one of the most valuable facts to the lecture as a university. Lecturers should know how many students participate in a particular session for the lecturer's known and academic activities of the university. Normally, getting attendance is conducted as manual activity. In this system, the attendance was collected in a digital way using a face recognition system and update in an excel sheet. And this research is expecting to provide a mobile app for the student to get attendance by reading QR codes to identify the relevant session generated by the lecturer. For avoiding cheats through the mobile app, it can be tracked the location by the app. Student's faces can be uniquely identified in the app (face recognition). The student's image will be stored and the registration number on the firebase database location, and it checks that faces with the current face (app user's image through the mobile camera).

RESULTS AND DISCUSSIONS

Generate timetable

Existing systems have limitations. Because there are just a few courses and, more significantly, they are all fixed, assigning a timetable for a primary school may appear to be a simple process. As a result, manually scheduling a timetable is not a tough process. When it comes to organizing a timetable at the university level, however, there are numerous factors to consider. There are several subjects and modules. There are many optional topics to choose from, as well as a lack of lecture halls and other facilities. As a result, there are several restrictions. When faced with these kinds of limitations, even automated systems struggle. As a result, it's critical to think about the limits of existing systems and technology. In university, it has a completely automated method for scheduling timetables. Some similar limitations have been found in existing systems. However, our suggested approach anticipates a few more major limitations. Although it utilizes a Genetic Algorithm, in this case, it goes above and beyond the previous system, making it more efficient and with a better schedule.

Change schedule upon the request

When it comes to changing the timetable, no existing system allows it and our research will take that into consideration. The system is also intended as a lens to alter the timetable based on the requests of all university lecturers. The system selects the most appropriate time and location for checking through the admin panel as well as the pleasant transfer of the lecturers themselves at the request of the university lecturers.

Student enrollments and staff requirement predictions

Student enrollment prediction and staff requirement prediction functions are interrelated with each other. The output of the student enrollment prediction can be used as an input field of the staff requirement prediction. Furthermore, it could be able to create a relationship between timetable scheduling and human resource analysis by getting the subjects from the timetable schedule. The accuracy graph of the selected algorithms (multivariate linear regression, K-nearest neighbors' algorithm, random forest regression) in staff requirement prediction is showing below (Figure 2).

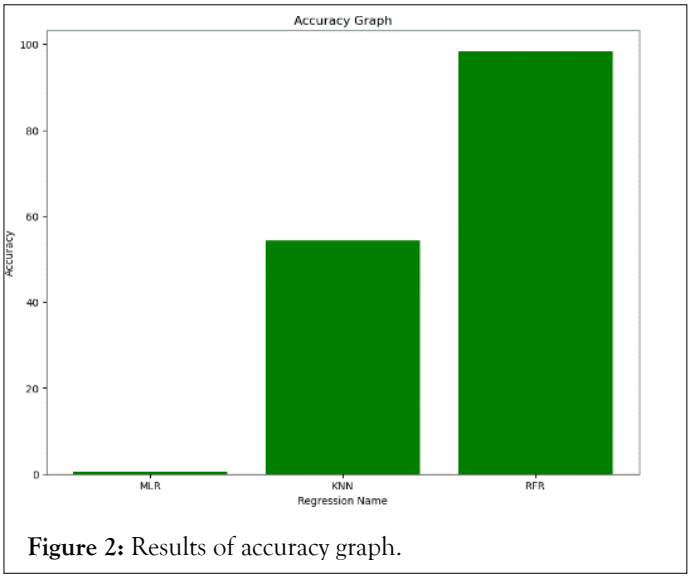

Figure 2: Results of accuracy graph.

Student attendance marking

This system was developed using advanced technology of facial recognition and location tracking, so there will be no chance of deceiving help. This method is more advanced and accurate than manual attendance dialing, for example, students sign attendance sheets. This attendance grading system will help improve student attendance. It takes time to manually check and mark attendance, but the system will automatically generate attendance reports in a short time. The world is changing with technology, why keeping these simple things in the manual and waste time and energy. This method is much easier than other attendance methods.

Student marks prediction

Here there is a high probability of obtaining the attendance rate of all students and predicting student performance. This prediction will be high because it can get the most accurate

attendance scores. Predicting the results is somewhat difficult, but this advanced technology makes this task simple and automated. This will help lecturers and teachers pay attention to who the lowest-scoring student is. On the other hand, this will be a great support for students to achieve higher grades.

CONCLUSION

Our study investigates a variety of areas of the university's activity management system. That is, scheduling, adjusting timetables to meet the demands of university lecturers and a few other aspects of human resource management are factored in. Creating a schedule, in addition to all the systems designed so far, has added special limitations. In the end, it creates a very well-crafted schedule. Another aspect of our research is that it can be specified a schedule modification feature that is not included in any system that has ever created a schedule. Here the lecturers can change the schedule as required. Also, in our system, it is considering the admission of university so that it has a better understanding of the admission of students in the coming years. Our system also includes the study of the attendance of university students by them. In addition to the university lecturers, it also allows students to understand their own attendance and their own score levels. In the future, it is hoped to automatically assign teacher/lecturers to modules when creating a schedule, without having to manually enter teacher/lecturer details.

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