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Behaviour Analysis of Student in Education System using FLS & KMC

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Abstract

An undergrad's life can be fundamentally arranged into spaces, for example, instruction, wellbeing, social and different exercises which may incorporate day by day errands and voyaging time. Time administration is critical for each graduate. A self-acknowledgment of one's time spent in different sectors is very fundamental to boost one's powerful yield. This paper describes two approaches a) Fuzzy Logic System (FLS) b) K-Means Clustering (KMC) to determine the ones behaviour, determine whether he/she as qualities of becoming an successful student, recommend student every week so that they invest the time in those field that provide positive impact on growth of the student. Student success plays important role in University. As from factor of truth a student success depends on various factors such as domain of interest, ease of learning environment in institute, guidance from professors, friends & family but as these all things are un measurable to measure the success of student here this paper concentrates on study conducted by collecting data of M.Tech CSE students that belongs to Visvesvaraya Technological University Center for PG Studies, Kalaburagi for a period of 1 Month. Aim here is to build an Mobile app that collect student information through Google Maps API, GPS that represent student way of living & to provide an Web based interface so that university can track how student are utilizing there time in day, & recommend them weekly the way they live.

***Keywords**:* FLS, KMC, GPS

1. Introduction

Students play very important role for much of organizations as their success measures can also increase the success rate of university, education institutes etc. Due to today's fact as there is heavy competition between various institutes/university regarding number of admission (NoA) respective to branches available universities now are engaged in applying various measures that would increase the outcome of the student. Universities started by providing well-furniture, well-equipped, highly experience staff, by providing these features also universities/organization failed to increase NoA. Universities then found that NoA have effect from various factors such as Tuition Fee, Hostel facilities available, Transportation facility, existing student experience within university environment, placements etc. from the above listed effects it was found that existent student experience & their success played very important role in increasing NoA in future. So these institutions also expect admitted students have highest success ratio when compared to other colleges in order to increase NoA. Thus paper concentrates on increasing the success of a student by building Mobile App that help student & university to track student success. Mobile App (that includes both FLS & KMC) provides recommendation to student so that they can cross verify the way of living & alter their time usage in those fields that would result in achieving success rate when compared to before. Student attributes that represents student way of living may lie in labels as listed in **Table 1**. Patel et al. [1] have assessed students' scholastic execution considering different factors, for example, participation, inner exam, lab assignments, and

cooperation assessment. Chrysafiadi et al. [2] have built up a FLS which comprehends the overlooking procedure of a student. Ingoley et al. [3] have disposed of the customary approach of appraisal of a student's execution by additionally considering individual factors, for example, stretch and tolerating the way that the assessing framework can be non-straightforward. Gokmen et al. [4] have made a FLS assessment framework which assesses students based on their execution and the sort of examinations by setting up evaluation criteria before an examination. Hameed et al [5] have built up a dependable and powerful framework utilizing Gaussian participation capacities for a student's assessment. Xu et al. [6] have customized the electronic instructive framework as for learning materials, test and so on accomplishing adequacy in learning. Huapaya [7] has built up a FLS student conclusion model to enable instructors to assess students by giving a high level of adaptability. From the collection, it has been seen that relatively few references address the student way of life issues. This paper concentrates on those attributes of student that help to measure the success of student. Student life is multitasking; they visit many places during the day to carry their day to day activities and this entire day information in form of time spent at each location can help in assessing whether student have qualities of becoming a successful student or not. As one carries his/her phone while visiting various types of places listed in **Table 1**, useful information of the student is collected through the help of Mobile App through GPS. Data collected here is in the format a) Type of the place being visited and b) Time spent at each type of Location. One more important factor that is considered with respect to student is Usage of Phone (UoP). As there is adverse effect of usage of phone/phone apps during the class hours or heavy usage of phone at home, this is considered here because increase of phone usage will gradually decrease the study time of a student. In case of UoP, here this paper concentrates only on those apps such as chatting app, video calling app that take enough amount of a student that would decrease the rate of one's success. Time spent at each place matters lot in analyzing student as For Ex: - During the college hours if he/she is not present at college and spending time in another location (i.e. restaurant) then student can have inverse effect on their success rate. So, day to day activities of student are tracked with the help of Mobile App built.

Scope of this current paper is to describe two approaches i.e. **1] FLS 2] KMC** in order to represent how to a) Examine the students time spent at each location, b) Collect the times spent using phone/phone apps & then recommend the way they live. Both Methods are applied to same data set collected from features available from Mobile App generated and then use this information to recommend student way of living so that they can focus on their success and have self balanced life. Schools, universities, and scholastic foundations, personal institution can make use of this Mobile App built using to monitor how well students are performing - whether they are overemphasized, failing to meet expectations and so forth. The outcome of these systems heavily depends on the data collected through Mobile application.

Table 1: Sample Place and Reason of Visit

Type of the Place	**Reason of Visit**
College	Enquiry, To meet friends, For Admission etc.
College Canteen	To have healthy snacks, Lunch, Meeting friends etc.
Tutorials	Extra classes for acquiring placement skills
Temple	Festival, For peace of mind
Mall, Cinema Hall, Beauty services	Hang out with friends & family, To Relax, To have a new look etc.
Restaurant	Fresher's/Friends Birthday Party etc.

Supermarket	To buy required material
Banks	To carry out financial tasks
Private Company	Internship at Company
Gym	Exercise, To increase immunity
Hospital	Regular Check Up, Treatment
Friend Home	To study, attend function, gossip etc.

2. RELATED WORK

Fuzzy set theory was formalized by Professor Lofty A et al. [10, 11] and, since then, it is applied to solve situations in a lot of disciplines.FLS System is found of fields in education described by Kinshuk et al. [12-15]. In 2014, Prateek Agarwal et al. [16] proposed fuzzy rule based expert system which evaluates the overall performance of the students using fuzzy logic. They have considered the five major factors that affect the performance. These are teaching factor, university system, university environment, personal factor, and family issues.

On the basis of that a fuzzy expert system is designed that realizes the purpose of education but this system not fully efficient to generate the results. Its capabilities are not much enhanced using fuzzy approach. H. Xu et al. [6], concentrated on increasing the performance or to motivate the student by providing personalized learning material based upon collected data in the form of learning activities, time spend on each quiz/chapter/section, where as data collected in Maria Samarakou [17] to increase performance is in the form of two semester exam marks conducted on 4 classes of 20 students.

Ayesha et al. [11] describe the use of KMC algorithm to predict student's learning activities. The information generated after the implementation of data mining technique may be helpful for instructor as well as for students. Dr. Sanskruti Patel et al [1] it can be found that every institute has its own way of representing the attributes of student & has their own types of data structure, author was successful in building a model that would incorporate all the types of data structure & various different attributes describing student with ease of work without much modification to existing structure (Data Grid Environment).

From this it can be concluded that FLS system exist long ago in the year 1965 & is widely applied to variety of domains, variety of structure format, different fields that help one to understand the problem definition i.e. that depend on many-valued logic very clearly just by representing factors by using simple IF-THEN rules & membership function.

3. METHODOLOGY

As listed above there are two methods i.e. **1**.FLS **2**.KMC to evaluate or to analyze student behaviour based on data being collected through the Mobile App which is described as below.

3.1. FLS

Fuzzy logic System(FLS) discards the theory of "Absolute Truth" and proposed a new theory of "Partial Truth" i, e degree of membership function. Fuzzy set [8-10] theory an element's belongingness to a particular set is decided using membership function which gives a membership value between 0 and 1.FLS system is widely accepted by variety of domains due to its easy representation of problem domain & which helps one to

have clear picture of how data is collected, analyzed & how data collected helps in producing the output. This paper takes advantage of this easy approach to define how student success rate is measured. As Success rate of the student can't be represented accurately by using several attributes. With the help of simple IF-THEN Rules problem formulation can be well formed and easily understood by any person that belongs from any discipline. IF-THEN rules play very important rule as this provides well-defined framework for defining relationship among various attributes describing student. As new rule may come into picture as an when there are changes into existing structure of student database, FLS provides an easiest approach toward alteration/ deletion/ appending rule, this new rule may help to analyze & direct toward achieving highest degree of accuracy in analyzing the student.

3.2 KMC

KMC is one form of Data Mining that classifies the data in the form of cluster(s), provides pictorial representation of data being collected.KMC is used to group similar data Cluster analysis is used to segment a large set of data into subsets called clusters. Each cluster is a collection of data objects that are similar to one another are placed within the same cluster but are dissimilar to objects in other clusters as shown in below **Figure 1**.

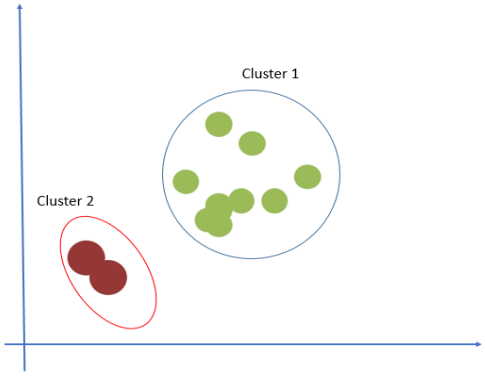

Figure 1: K- Means Clustering (KMC) with k=2

4. IMPLEMENTATION

Work Flow of each method is precisely described in this section. Each method has its own workflow

4.1 FLS (Fuzzy) Based System

This paper displays how a versatile application utilizing FLS investigate a student's way of life and gives proposals and recommendations in view of the outcomes. The novel commitment of this paper is to make a self-check framework for students to carry on with an adjusted way of life. Schools, universities, and scholarly organizations can utilize this FLS to keep eye on how the students are performing, reasons for increase or decrease- whether they are overemphasized, failing to meet expectations and so on & its architecture is shown in Figure 2.

FLS is implemented by following 3 steps:

4.1.1 ***Collection*****: -** In order to collect student data in terms of App Usage & Time spent at each location Mobile App is created that collects this data. This step is conducted so that enough amounts of data are available to analyze student way of living.

4.1.2 ***Computation (Calculating Membership Functions):*** **-** To analyze student data FLS system is used, that works on the principle of rules. Rules are specified here using IF-THEN construct. Rules specified using IF-THEN helps to clearly understand workflow of FLS system without any ambiguity. It involves computation of time spent at spots listed in **Table 1**. For ex: -As student carries his/her phone throughout the day, Mobile App is generated and installed on each of the student mobile in order to collect the time spent at each place throughout the day. In particular when student visits any spot from the set S, let S be set of all the labels that students can visit spots S = {s|s is spot} & UoP from Apps set A throughout the day by is tracked & calculated by the app generated using check-in and check-out time feature available in app and stores this useful information in the database in the form <<location name/App Name>><<start time>><End time>>.Analyzing one person can differ from domain to domain. In Education domain student can be easily characterized into time spent at each spot during the day. Spot Set S & Phone App Set A defined as :
S={"Home","Restaurant","Mall","Temple","College","PlayGround","Hospital","Tutorials","Gym","FriendHome"} and A={"Whatsapp", "Facebook","Instagram","SanpChat"} respectively.

Now let R, L, I , J, E, O be subset of S defined as follows:

R={s|s $\in$ S , s=Recess and s$\neq$ home, job}

L={s|s $\in$ S , s=Health and s$\neq$ home, job}

I={s|s $\in$ S , s=Tutorials and s$\neq$ home, job}

E={s|s $\in$ S , s=Social event/entertainment and s$\neq$ home, job}

O={s|s $\in$ S , s= Other and $\notin$ R $\cup$ H $\cup$ T $\cup$ E $\cup$ J}

J={s|s $\in$ S, s=Job Place and s$\neq$ home}

In the above sets home & job spots or locations are different for each of the student and is considered to be manually entered by each student.

Home Label: Home label is represented by H and when student is present in home, he/she spend ones time for doing work then adding this to Job label then total time spent in home doing tasks that can alter membership function of health, recess, tutorials, social events, other tasks is represented as t_L,t_R,t_I,t_E to respectively.

4.1.2.1 ***Time Computation***

One can find the successful student compulsory in the labels from **Table 2**, as per the time range specified. If he/she has decrease in these ranges than there is possibility that student is spending much of time in other spots that's represented in **Table 3** & their possible range that leads to negative effect. Once database is collected, using IF-THEN Rules can be defined to check if student is obeying the sample time distribution or not if not then it results to reduce in membership function of that & spot. Then together the membership function is calculated. Lastly we denote overall time spent in recess, tutorials, job work, health, social events, UoP.

$$D_R = \sum_{y_i \in R} T(y_i) + t_R \qquad \textbf{(1)}$$

For ex- If student s visits labels $y_1, y_2 \ldots y_n$, then time spent at these spot is represented as $T(y_1), T(y_2) \ldots T(y_n)$ respectively, let D_R, D_L, D_I, D_J overall time spent in Recess,Health,Tutorials,job/work respectively where D_R defined as follows,

Spot/Location Name	Time in Hours/Day
Home	12 Hours – 18 Hours
College/School	6 Hours -- 8 Hours
Tutorials	1 Hour – 3 Hours

Table 2: Sample Time Distribution That Has Positive Effect

Time Spent in	Time in Hours/Day
Tutorials	>5 Hours
College	>10 Hours
Apps	>5 Hours
Restaurant\ Supermarket\Mall	>5 Hours

Table 3: Sample Time Distribution That Has Negative Effect

One can find the successful student compulsory in the above labels as per the time range specified. If he/she has decrease in these ranges than student is spending much of time in other spot that's represented in the set S. Once database is collected, using IF-THEN Rules ,member function being calculated can be used to check if student is obeying the sample time distribution or not if not then it results to reduce in membership function of that & spot.

Fuzzy sets of the attributes describing student is defined as follows:

R={hectic, ideal, lazy}
L={unfit, fit, proactive}
I ={restless, ideal, inactive}
E={private, social, over-social}
J={dull, hard-working, steady}
A={low, avg, high}
O={useful, Not useful}

Membership Function Of Label	**Low <0.4**	**Avg [0.4-0.5]**	**High [0.6 – 1.0]**
Recess(R)	<1 Hour	3-5 Hour	>5 Hour
Health(L)	<1 Hour	1-2 Hour	>3Hour
Tutorial(I)	<1 Hour	3-5 Hour	>6 Hour
Social Event/Activity(E)	<1 Hour	3-5 Hour	>6 Hour
Job/Work(J)	<1 Hour	3-6 Hour	>6 Hour
UoP(A)	<1 Hour	1-3 Hour	>5 Hour

Table 4: Membership Function Assigned Using Above Table

4.1.2.2 Qualitative Time of student is denoted by M_R,M_L,M_I,M_E,M_J,,M_A,M_O for respective labels. The rate for M_L for health category is calculated as follows: -

$$M_L = \sum_{x \in L} Y(x) + t_L \quad \textbf{(2)}$$

Similarly others are defined.

4.1.2.3 ***Deffuzification (Classification)***: This step takes in database as input and using the membership values computed in previous step are used to recommend the student. To recommend student important attributes & its corresponding membership function of the linguistic variable defined in **Table 1** are considered to recommend student from the list specified in **Table 5** so that they can come to know the way of living and the output produced here is the highest recommendation scored i.e. R1 in this case.

Calculate Membership Values for following linguistic variables

R1={K_R="hectic" && M_R="Less Score" && K_J="Hard Working" && M_J="High Score"}

R2={K_E="over-social",M_E="High Score"}

R3={K_A="Avg", M_A="High Score",K_J="dull",M_J="Less Score"}

R4={K_L="unfit",M_L="Low Score"}

Recommend	Values	(Mean)
R1	{1.0,0.7,1.0,1.0}	0.925
R2	{0.0,0.2}	0.05
R3	{0.6,0.8,0.6,0.5}	0.625
R4	{0.6,0.9}	0.75

Table 5: Membership function of attributes calculation

Recommendation considered here are:

R1="Spend some leisure time with friends and family"
R2="Family need your care and attention"}
R3="Success comes to those who do Hard Work"
R4="Turn Fat into Fit"

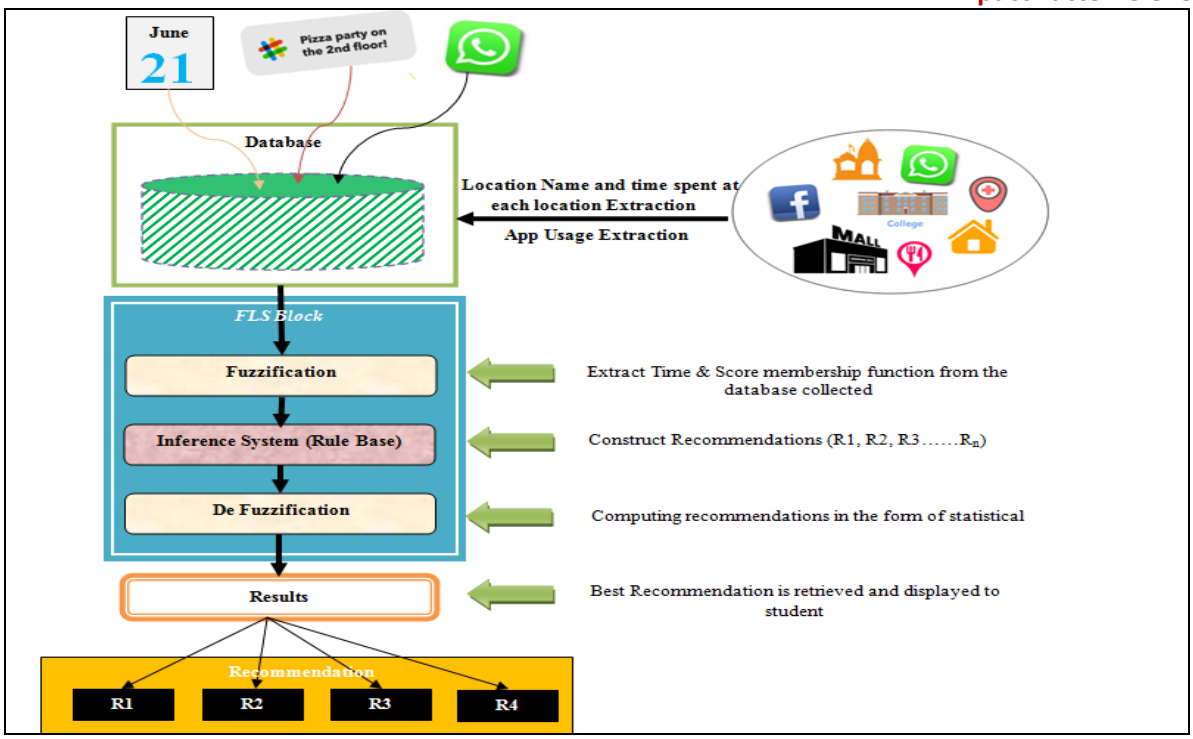

Figure 2: Architecture for Student Analysis using FLS

4.2 KMC Algorithm

KMC clustering is a technique for vector quantization, initially from flag preparing that is well known for bunch examination in information mining. KMC clustering plans to segment *n* perceptions into k bunches in which every perception has a place with the group with the closest mean, filling in as a model of the bunch. These outcomes in a partitioning of the information space into Voronoi cells. The issue is computationally troublesome (NP-hard), there are productive heuristic calculations that are usually utilized and meet quickly to a nearby ideal. These are typically like the desire boost calculation for blends of Gaussian dispersions by means of an iterative refinement approach utilized by both KMC and Gaussian Mixture Modeling. Moreover, they both utilize group focuses to display the information; in any case, KMC clustering tends to discover bunches of practically identical spatial degree, while the desire augmentation instrument enables groups to have distinctive shapes. The calculation has a free relationship to the k-closest neighbour classifier, a well-known machine learning method for characterization that is regularly mistaken for KMC on account of the k in the name. One can apply the 1-closest neighbour classifier on the bunch focuses got by KMC to order new information into the current groups. This is known as closest centroid classifier or Rocchio algorithm.

Given a set of observations ($\mathbf{x}_1, \mathbf{x}_2, \ldots, \mathbf{x}_n$), where each observation is a *d*-dimensional real vector, *KMC* clustering targets to partition the *n* observations into *k* ($\leq n$) sets $\mathbf{S} = \{S_1, S_2, \ldots, S_k\}$ so as to minimize the within-cluster sum of squares (WCSS) (i.e. variance). Formally, the objective is to find:

$$\arg\min \sum_{i=1}^{k} \sum_{x \in S_i} \|x - \mu_i\|^2 = \arg\min \sum_{i=1}^{k} |S_i| Var\ S_i \quad \textbf{(3)}$$

Where $\boldsymbol{\mu}_i$ is the mean of points in S_i. This is equivalent to minimizing the pair wise squared deviations of points in the same cluster:

$$\arg\min_{S} \sum_{i=1}^{k} \frac{1}{2|S_i|} \sum_{x,y \in S_i} \| x - y_i \|^2 \quad \textbf{(4)}$$

The Equivalence can be deduced from identity

$$\sum_{x \in S_i} \|x - \mu_i\|^2 = \sum_{x \neq y \in S_i} (x - \mu_i)(\mu_i - y) \quad \textbf{(5)}$$

Because the total variance is constant, this is also equivalent to maximizing the squared deviations between points in different clusters (between-cluster sum of squares, BCSS).

KMC clustering algorithm

Input: k (the number of clusters),
D (a set of lift ratios)
Output: a set of k clusters
Method:
Arbitrarily choose k objects from D as the initial cluster centers;
Repeat:

1. (re)assign each object to the cluster to which the object is most similar, based on the mean value of the objects in the cluster
2. Update the cluster means, i.e., calculate the mean value of the objects for each cluster

Until no change;

5. RESULTS & DISCUSSION

This section provides overview of the system being implemented using KMC & FLS and some of screenshots as final outcome. In order to analyze the data and understand the outcome of the two systems being implemented, let us consider the data that was collected by conducting experiment on M.Tech CSE Department of 50 students as described before for a period of month. Every student is asked to install the built app & register using the registration facility available in **Figure 4**. E-mail Id entered during registration is used as unique identifier to uniquely identify student. When applied these two methods on initial data being collected; it was found that KMS is faster when compared to FLS. The average run time of methods being implemented is shown as below in the **Figure 3**, it is representation of comparison between two methods in terms of run-time and found that KMC is faster when compared to FLS.

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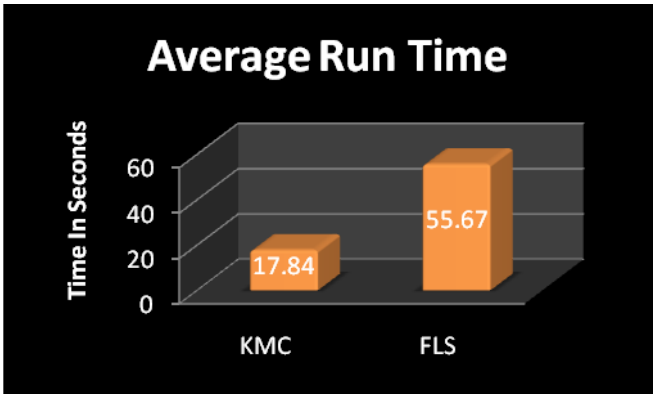

Figure 3: Comparison of two methods being implemented

Data Collection is carried with the help of Mobile App, in order to verify student credentials login page as shown in the below **Figure 4.** Data collected helps to analysis student behaviour in relationship with the location details extracted with the help of feature available in Mobile App such as GPS.

Figure 4: - Verifying Student Credentials

Student carries his/her phone wherever they go Mobile App built act here as data source. Student visits different locations during the day to differentiate the place being visited student select the place from the list available in Mobile App as shown in below **figure 5.**

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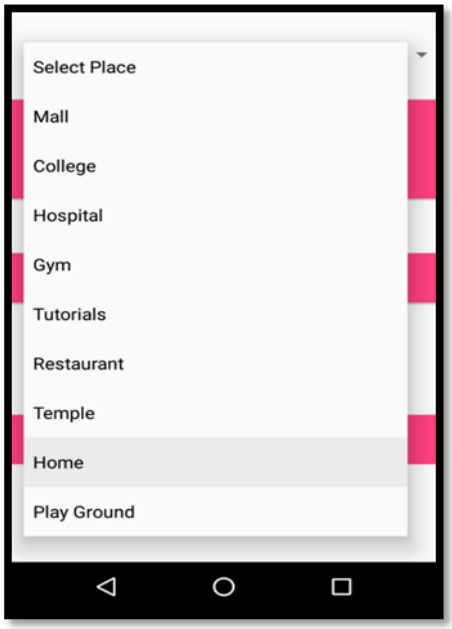

Figure 5: Select Current Place being visited

In order to keep records of time being spent at each location student uses the facility available in Mobile App as shown in below **Figure 6.** Student clicks on check-in as soon as he/she enters the selected place & then clicks on check-out to mark the exit of student from that place.

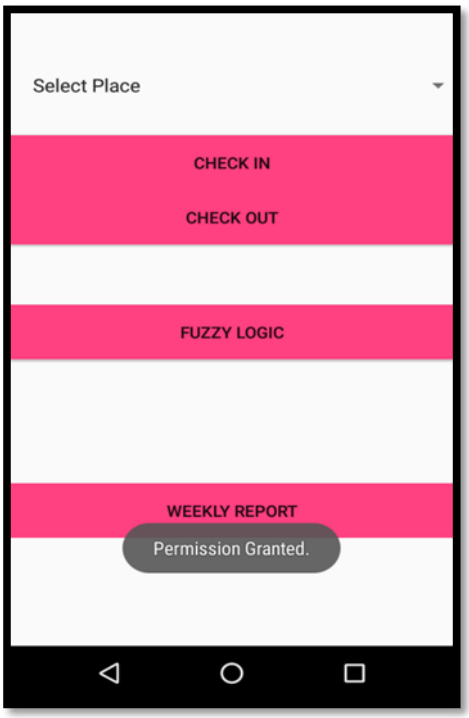

Figure 6: Check-in & Check-out option available to collect time being spent at each place

After data being collected, to analyze student behaviour let us consider the specific date say from May 10th 2018 to May 16th 2018 as shown in below **figure 7**. After selecting the date FLS analyze the data in back end & display the results.

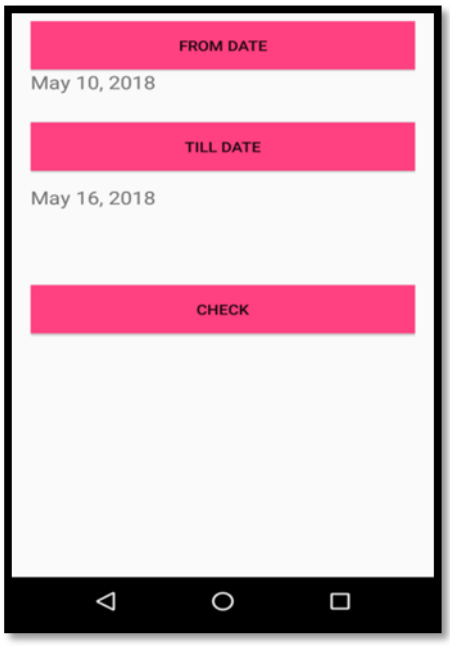

Figure 7: Extract Student Data as per date to analysis student

Weekly, report generation facility is available in mobile app as shown in below figure **figure 8,** in order to have a self track on where student have spend more time. By viewing the result one can alter or modify the way of leaving so that they can have positive effect on ones education, wealth & health. If student is having health issues then he/she can be found at the hospital location for high amount of time when compared to other students that belong to same class. Pie chart generated helps one to have overlook of the time being spent & help them to analysis their way of living and adjust their lifestyle in order to produce useful outcome from which one can get benefit of.

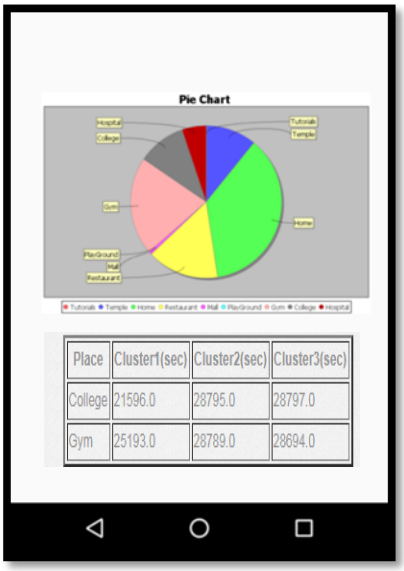

Figure 8: Report & Clusters are generated as Per Date Being Specified

As specified earlier goal of the university was to increase the outcome of the student so that NoA should increase in the future as shown in below **figure 9.**In order to happen this, to the university persons/Head of the department or any person related to department responsible for tracking student behavior & regularly/weekly encourage student by sending SMS to those student who were found to have positive outcome & recommend those students those who were found to have negative impact in the field of education.

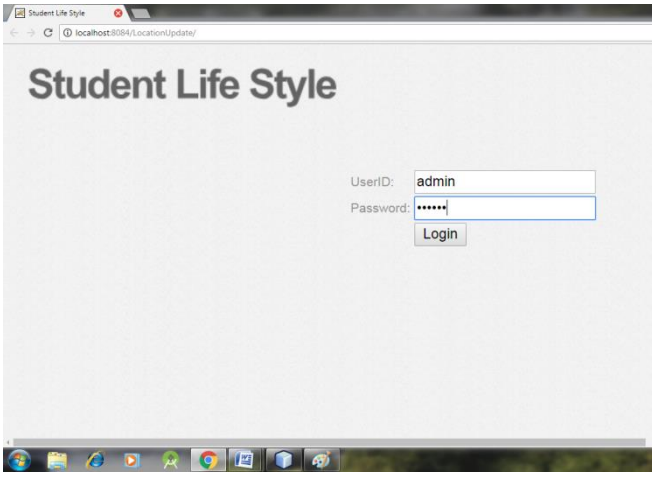

Figure 9: Web based interface for university professor /H.O.D to track student behavior

With the help of system being developed, when student data is tracked and analyzed last step here is to recommend student. From the database it was found the in the period of May 10th 2018 - May 16th 2018 student named X was found that he/she has work for much of the time & data collected for X student represent the fact that student needs some leisure time. So the following **figure 10** shows the best recommendation (that has highest membership value) being sent to the registered number.

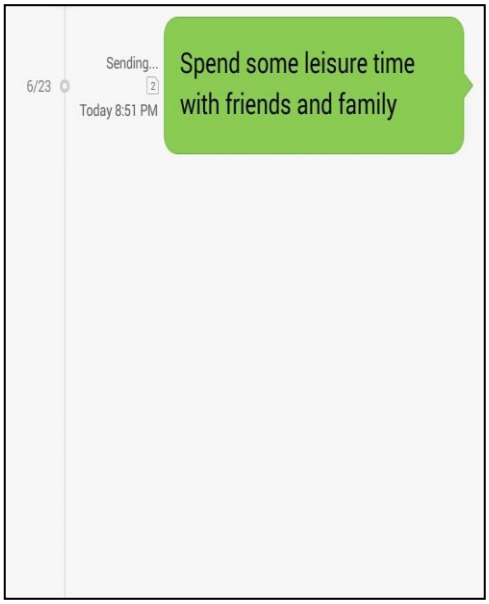

Figure 10: Best Recommendation is sent to student as SMS

6. CONCLUSION

Proposed systems presented here perform well when compared to earlier studied strategies, this may due to some of the factors such as including those features or attributes in computation that were not considered earlier, structure of the database representing student, source of data collection ,method used to evaluate the problem etc. Features that were considered earlier to analyze student was just based upon the internal factors such as marks scored in exams, lab assessment marks. Student behaviour not only lies in these area but also rely on external factors such as Usage of Phone (UoP), location & time being spent at each location. Features used in this system resulted in analyzing the student more efficiently when compared to existing systems. Student spend their time unknowingly into those categories which lead to performance degradation, decrease in success rate. With the help of Mobile App one can track their own time expenditure of their day to day activities with the help of report generation that is generated every week. Outcome of these system provide a best recommendation that describes how a student can manage their time expenditure in order to increase the success rate.

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