DEVELOPING AN UNDERGRADUATES' LOCATIONAL INFORMATION TRACKING SYSTEM
CASE STUDY: FACULTY OF AGRICULTURE, UNIVERSITY OF RUHUNA, SRI LANKA

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ABSTRACT: Spatial and non-spatial information play different role in decision-making process. Most important thing is both spatial and non-spatial information together leads to process of decision-making easier. Spatial information can add additional value for non-spatial information and provide answer for *where is it*? University Management Information Systems (MIS) are collecting, processing and analyzing attribute data, however, there is no facility to link with spatial data. This study was basically focused on introducing a Web GIS (Geographical Information System) Application which can be used to track locational data of students in any education institute. Locational information tracking system can be a most valuable data source for a university administration for decision making process. This Web GIS Application was initiated by Faculty of Agriculture, University of Ruhuna, Sri Lanka as a case study and which can track student locations across the country. GND (Grama Niladhari Divisions) Map of Sri Lanka was used for the preparation of master data and projected it to WGS 1984 coordinate system because Google Maps which uses WGS 1984 is used for the overlay. Centroid of relevant GND was used as approximate location of a student and 3-tier client-server architecture running on LAMP stack was used with Google Maps API. Geographic locations of students were updated through MIS of the institute and then mapped on GIS Platform using Web GIS Technologies. In this Web GIS Application, students can add, view and update their home locations on high resolution satellite images available in Google Maps where they can identify their home locations clearly. Also they can easily find out the shortest path to their home locations from the institute. In other hand, academic and administrative staff can easily track locations of students. And they can find out shortest path students' locations from the institute. Further they can overlay locations of specific target group of students by Provincial, District, DSD (District Secretariat Divisions) and GND levels. Finally, they can analyze performance of target group of students by Provincial, District, DSD and GND levels based on students' locations. This helps to identify patterns of students' performances for different subjects. Based on that, the areas to be improved in order to enhance the students' performance can be suggested. And therefore the system can be used as a data source of a Decision Support System (DSS). The system was successfully integrated with the existing MIS and tested using existing students of the Faculty. Currently the system is using in the Faculty without any issues. Outcome of this application leads to take decisions of any educational institute based on locational data of students. The data source of the application can be used for future research studies as well.

1 INTRODUCTION

Faculty of Agriculture, University of Ruhuna is located (Latitude: 6.060337° N, Longitude: 80.568148° E) in Mapalana, Kamburupitiya, Sri Lanka. The Faculty is one of the premiers Agriculture Faculty in Sri Lanka which contributes to human capacity development and agricultural technology generation in the country. The Faculty is having seven (7) academic departments and offering three (3) undergraduate degree programs. Total number of courses offered by all the academic departments is more than 50. Also the Faculty is offering few postgraduate degree programs. Total student population of the Faculty is more than 800 and the academic staff population of the Faculty is more than 100 (Student Hand Book, 2015). Therefore, it was very difficult to manage the academic program without having a Management Information System (MIS). To overcome the difficulty, the Faculty introduced a web based MIS which enabled the Faculty to manage the academic program smoothly and efficiently. The MIS is having modules for Student Information Management, Course Management and Examination Management. But the MIS is managing only students' attribute data. In other words, there is no provision to manage spatial information of students in the current MIS.

Generally, students are coming from various locations of the country. Therefore, it is very important to manage spatial data such as locational data of students other than their attribute data through the current MIS. Because it will be greatly helpful for administrators, academics, students and other researchers as a tool to visualize students' locations by provincial/district/divisional levels, find shortest path to their locations from the faculty, calculate distance to their locations from the faculty and visualize academic performance of students by

provincial/district/divisional levels. Also this may be useful to compare locations vs. performance of students in different academic years and allocation of hostels among students considering distance to their locations. Therefore, this can be used as a decision support system (DSS) by analyzing spatial data of students.

There is no provision to track locational information of students in the current MIS of the faculty. This is a problem for administrators, academics, students and other researchers. If we can develop a Students' Locational Information Tracking System as a module of current MIS, this can be used as DSS by analyzing spatial data of students. Also this will be the first Undergraduates' Locational Information Tracking System that can be used to manage spatial information of students' in Sri Lankan State Universities. For the development and integration of Locational Information Tracking System with the current MIS, we can use Free and Open Source Software which will provide easy integration, low cost and improve efficiency (Anderson and Moreno-Sanchez, 2003). Also this system can be used for further research studies. Finally, this model can be applied for other educational institutes to manage spatial information of their students.

Therefore, the main objective of the study is to develop a Students' Locational Information Tracking System as a module of current MIS. This is based on four specific objectives which are; 1) Link Spatial database system with Existing MIS, 2) Provide Spatial information for accurate Decision making, 3) Visualize student information online for better understanding on their admission and 4) Provide navigation facilities. After achieving all these specific objectives, it will automatically achieve the main objective of the study.

2 STUDY AREA

For the case study, I selected Faculty of Agriculture, University of Ruhuna, Sri Lanka. University of Ruhuna is one of the recognized state university in Sri Lanka. Also I selected undergraduates of the Faculty as my target group for the development of the locational information tracking system.

3 METHODOLOGY

The purpose of the study is to introduce a Web GIS Application that can be used to track locational data of students in any educational institute. Most of the educational institutes are having MIS to manage attribute data of students. But none of the systems are having a mechanism to manage spatial data such as locations of students. This is a problem for administrators, academics and students.

This Web GIS Application has been initiated by Faculty of Agriculture, University of Ruhuna, Sri Lanka as a case study and which can track student locations across the country. Geographic locations of students updated through MIS of the institute and then mapped on GIS Platform using Web GIS Technologies. Main objective of the case study was to develop a Students' Locational Information Tracking System as a module of the existing MIS. The Locational Information Tracking System should facilitate to visualize students' locations, find shortest path to students' locations and visualize students' academic performance attached to their locations.

There are several GIS technologies available to achieve the objectives of the study. Those are Desktop GIS, Web GIS and Mobile GIS (Biyanwila, 2014). Considering the problem domain Web GIS was selected as the best GIS Technology among other GIS Technologies available in the industry. To achieve the objectives of the study, I used Web GIS Development Life Cycle (Alesheikh, 2002) as the baseline methodology. Figure 3-1 shows the Web GIS Development Life Cycle which was used throughout the project. All the data sources used for the study are secondary data sources. The data sources were existing database of the MIS and GND Survey Data (Map Scale: 1:10,000) from Survey Department of Sri Lanka. For the implementation, I used most of the free and open source platforms on top of the medium level hardware platforms. Therefore, the implementation cost of the application was very low. Since the system was web based with think client-server architecture, anybody can access the system from anywhere anytime.

Figure 3-1: Web GIS Development Life Cycle

Figure 3-2 shows the Client-Server Architecture (Alesheikh, 2002) used to implement the Web GIS Application. It shows the interaction with its different tiers.

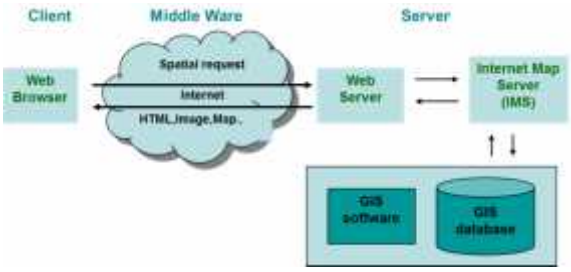


Figure 3-2: Client-Server Architecture

To implement the client-server architecture with thin model we used LAMP stack. Figure 3-3 shows the different components of the LAMP stack. Since the current MIS is also running on think client-server architecture with LAMP stack it was very easy for the integration.

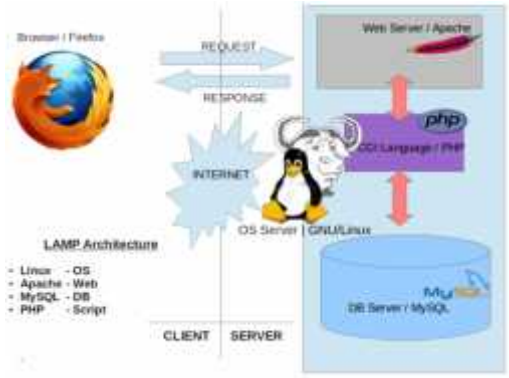


Figure 3-3: Components of LAMP Stack (https://en.wikipedia.org/wiki/LAMP_(software_bundle))

As IMS, Web Maps API was selected as the IMS Model for this project because which is fully compatible with the model of the existing MIS. Also there won't be any additional hardware requirements to implement the model. Google Maps API was selected as the Web Maps API among available API in the industry because which is free, flexible and almost all web browsers are supporting it without any plug-ins. Figure 3-4 shows the IMS Model of the proposed system.

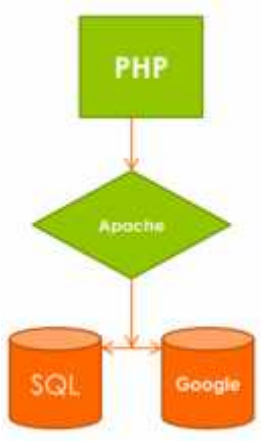


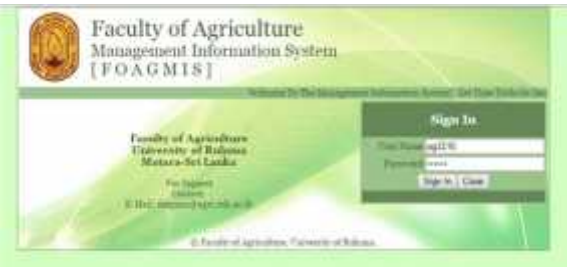
Figure 3-4: IMS Model

4 RESULT AND DISCUSIION

Table 4-1 and Table 4-2 show the results and discussions based on the Interactions of Students and Academic/Administrative Staff with the implemented locational information tracking system.

4.1 Interactions of Students

Table 4-1: Interactions of Students

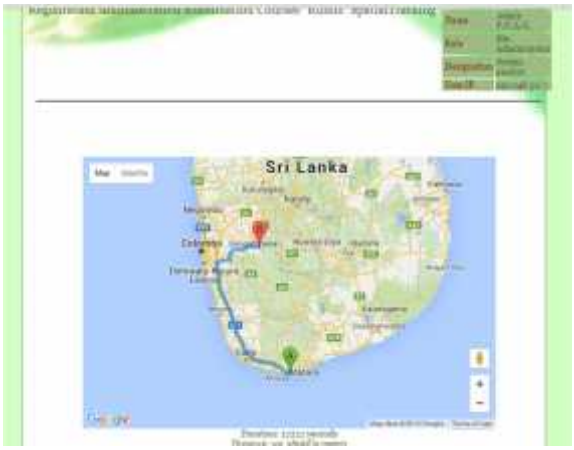
Interaction	Result	Discussion
Student Login		A student should provide his/her user name and password to login into the MIS
Menu Options		Menu options of Spatial Tracking Module those are allowed to access by a student
Add Location		A student should select his/her Province, District, DSD and GND respectively. Then the system will generate the approximate location of the student based on the centroid of his/her GND and display the location. Now the student can move the marker into his/her correct location and save the location
View/Edit My Location		A student can view his/her location. Also his/her can select a new location and submit the new location to save in the system

Reach My Location		System is generating and maps the shortest path to student location from the Faculty. Also it will display the distance and time taken to reach his/her location

4.2 Interactions of Academic and Administrative Staff

Table 4-2: Interactions of Academic and Administrative Staff

Interaction	Screen	Description
Academic/Administrative Staff Login		An Academic/Administrative Staff should provide his/her user name and password to login into the MIS
Menu Options		Menu options of Spatial Tracking Module those are allowed to access by an Academic/Administrative Staff
View Student Location		Academic/Administrative Staff can search a student to find out the location of the student

View Student Locations		Academic/Administrative Staff should select the stream, level and view by options. The output is according to View by Google Map, Province and District. View by DSD and GND are not properly displaying due to increasing number of polygons
Reach Student Location		Academic/Administrative Staff can search a student to find out the shortest path to the student home location from the Faculty
Student Results		Academic/Administrative staff should type Subject Code, select Level and View by Options. The results will display as markers attached to student locations in different colors according to the grades they achieved

5 CONCLUSION

According to the results the of the study students can add, view and update their locations on high resolution satellite images available in Google Maps where they can identify their home locations clearly. Also the students can easily find out shortest path to their locations from the institute. In other hand academic and administrative staff can easily track locations of students. Also they can find out shortest path to student locations from the institute. Further they can overlay locations of specific target group of students by Provincial, District, DSD and GND levels. Finally, they can analyze student performance (results) by Provincial, District, DSD and GND levels based on students' home locations. Finally, all these features can be accessed through a module of the existing MIS. Therefore according to the results I was able to achieve the objectives of the study.

As a result of the system, academic/administrative staff can take decisions based on the spatial data of students. Therefore, this system leads to decision supports of any educational institute based on spatial data of students.

The system can be incorporated to MIS of the other faculties of the University as well. Also this system can be introduced to other universities and educational institutes to manage locational data of students. Therefore this

system can be used as a decision support system by accessing locational data of students in national level. Further it is possible to develop a mobile application to ease of access as a further study.

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