A Mobile App Architecture for Student Information System

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ABSTRACT: *This paper proposes a mobile app architecture that reuses the resources of the existing student information system of educational institutions. The educational institutions have an existing website that interacts with a data store to disseminate information to its stakeholders. The data store and the web resources have been reused for the mobile app. Web services are developed to fetch information from the data store. The data fetched via web services is presented via appropriate screens. Design of a complete new application requires a lot of effort during development and testing, to come up with a stable product. Reuse of existing infrastructure and software simplifies the task by focusing mainly on the new features and saves cost, time and effort. A prototype developed for University of Delhi using the proposed architecture is discussed in detail. The architecture enables delivery of individualized information to students on their mobile devices which is accessible anywhere and anytime. This keeps students informed and satisfied. The architecture can be replicated to design mobile app for any organization having a data store.*

Keywords: Educational Institution, Mobile App, Reusability, SOA, Student Information System, Web Services, 3-Tier Architecture

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1. Introduction

Students require a great deal of information from colleges such as admission notices, timetables, events details, assessments etc. Currently, this information is provided to students through college website. The information present on website is generic, pertaining to large group of students and other stakeholders. For instance, the notices displayed on websites are not only specific to students, but, notices for teachers, staff members and general public are also provided through the website. Moreover, the attendance and assessment records displayed on websites are consolidated lists containing information of all the students of a particular course/class. Timetables are also provided for all courses. This approach lacks personal touch. Students have to extract their own information from website by navigating through various links or applying many filters/ search criteria. Many students face difficulty in doing so, which results in delivering incomplete or inaccurate information and thus lead to student dissatisfaction. Students are the key stakeholders for any educational institution. In today s competitive environment those educational institutions flourish which develop significant relationship with their students. An information system which can provide individualized services to students by use of latest technology can increase popularity of institution [1].

Nowadays, students expect to satisfy their information needs immediately. Rather than “going to get” needed information, undergraduate students are accustomed to instant information access [3]. In recent years, mobile devices have become

very popular among student community [2].Using mobile technology; the information can travel to the student in a fast, personalized, accurate and convenient way. The dependency of students on mobiles has resulted in availability of different kinds of mobile apps that provide information which is custom tailored to student s needs. Major International universities provide their apps to students for catering to their information requirements [4].The apps have a student-centric focus which improves the students satisfaction with college services [8].In this paper; we propose architecture for development of such mobile apps by reusing the existing infrastructure of Institution. As a proof of concept of our proposed design we hereby present an android based app- DUIT (Delhi University Information Tool) developed for the students of Dyal Singh College university of Delhi [5]. DUIT empowers student by providing them with relevant personalized information anywhere anytime. It also provides analysis to the students related to their attendance and assessment.

Rest of the paper is organized as follows. Section 2 describes the current information dissemination process of colleges and requirement of mobile apps to facilitate the process. Section 3 describes architecture for „Student Information System mobile applications. Section 4 demonstrates the application of proposed architecture in development of DUIT and discusses its various components. Section 4 presents result. Section 5 discusses the future scope of Student Information system apps.

2. Why Mobile App for Student Information System?

Students require lot of information from colleges such as admission notices, timetables, events details etc. Currently information is distributed to students in two ways. In traditional approach, notices are displayed on physical notice boards of college which students check on regular basis. It leads to over-crowded notice board areas. Students cannot receive the information if they are not physically present in college. Moreover, it wastes lot of paper.

Second approach is to provide information on college websites. Students may access website from anywhere. It does away with crowded notice boards and promotes paperless information dissemination. But, the major challenge in obtaining information from website is that it provides collective information pertaining to large groups of students. The onus of filtering the personalized information and performing calculations to do analysis is on the students. For instance, when the monthly attendance of students is uploaded on the website, several issues may arise in identifying individualized information. To find their attendance, students have to look for all the lists submitted by different teachers. Students then search their own attendance from these lists and perform mathematical calculations to obtain their consolidated attendance. This task is performed for all the papers for different subjects. This is a tedious job and is error prone too.

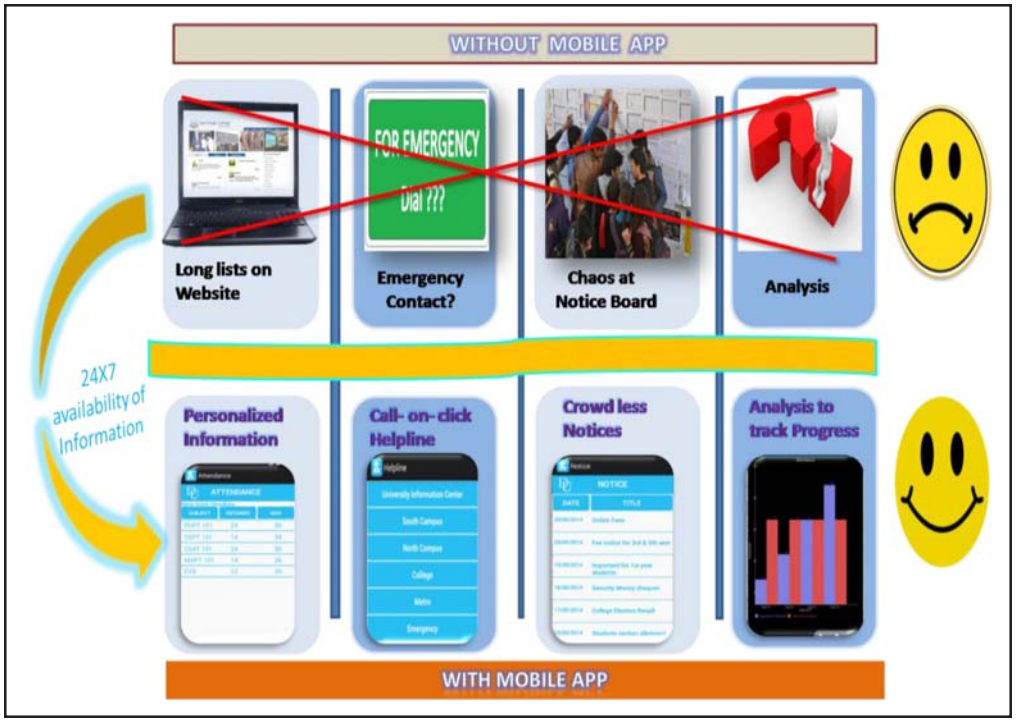

Figure 1. Benefits of Mobile Apps to students

Moreover, in the current scenario, analysis of assessment results or attendance uploaded on website is very difficult. The student themselves have to calculate their shortage of attendance etc. There is no mechanism present which can help him to do such analysis. Figure 1 demonstrates how mobile app can help students by delivering all the relevant information to their pockets in a gracious manner.

The personalized nature of this information eliminates the hassle of searching long list for finding individual information. Many student centric features can be provided through apps such as student helpline which gives information about the important campus contacts like admin istrative office, examination cell and emergency contacts like nearby hospitals, buses and metro helpline. So, at the time of need just a click is required to call any important contact. Unlike physical notice boards and websites notices which include notices for teachers, government, staff and general public also; Student information apps provide only student related notices which can be saved on student's device for future reference. In order to analyze one's attendance and assessment information student has to put in lot of effort by gathering information of whole class and then performing calculations to figure out his performance as compared to class or his deviations from class average , minimum and maximum etc. Such analysis can be provided by apps in comprehensible pictorial graphs. Thus Student Information apps satisfy the information needs of students and make their student-life easier, happier and enriched.

3. Architecture of a 'Student Information System' Mobile App

When a completely new application is designed, a lot of effort goes into its development and testing to come up with a stable product. Reuse of existing resources offers various benefits in terms of reducing time, cost and effort involved in developing an application. Reuse is the practice of incorporating an asset in more than one system [9]. Most educational institutions already have their web based information systems in place which means they have web server/application server on which the web site is hosted and a database containing all college-related data (including student Data).If we reuse existing infrastructure and software, existing processes do not get much impacted and we mainly focus on stabilizing the new features. Also, by using service oriented architecture, if we built self-contained web services for different components of required information system, they can be reused by different consumer applications across multiple platforms by putting in very little extra effort.

Keeping in mind the benefits of 'Service Oriented Architecture, and 'Reusability', this paper proposes extensible3-tier architecture to develop mobile applications for student information system. Figure 2 represents the proposed architecture. We describe the components of the architecture in detail.

Database Tier

Database tier is composed of two data stores. One is the existing database of educational institution from which student related information is fetched. Since we perform only retrieval of data from this database and do not modify it, it can be used by web based information system or in any other way as it was previously being used.

A small separate database component is created to add some app-specific data such as list of registered users of the app, records of external links to web pages etc. Create, Read, Update and Delete(CRUD) operations are performed on this database as this is specific to the mobile app.

Web/Application Tier

We develop web services and admin web pages for mobile app in this tier. Web services are broadly categorized into two groups. First group includes the services that fetch the personalized information of student from database based on student s unique id such as enrollment number. These services do not perform any create/update /delete operation and perform only read operation on existing database of institution. These services send individualized data to presentation layer in XML/ JSON format. Second group of web services performs CRUD operations on app specific data store. They transfer data to and fro from mobile app to data store using XML/JSON.

Additionally, admin web pages are created in this layer, which are accessed by College admin Department. Using these pages, college admin department manages the configuration of various component of app.

Presentation Tier

At the Presentation tier, we have cross platform mobile devices, on which app is to be deployed. The presentation layer logic

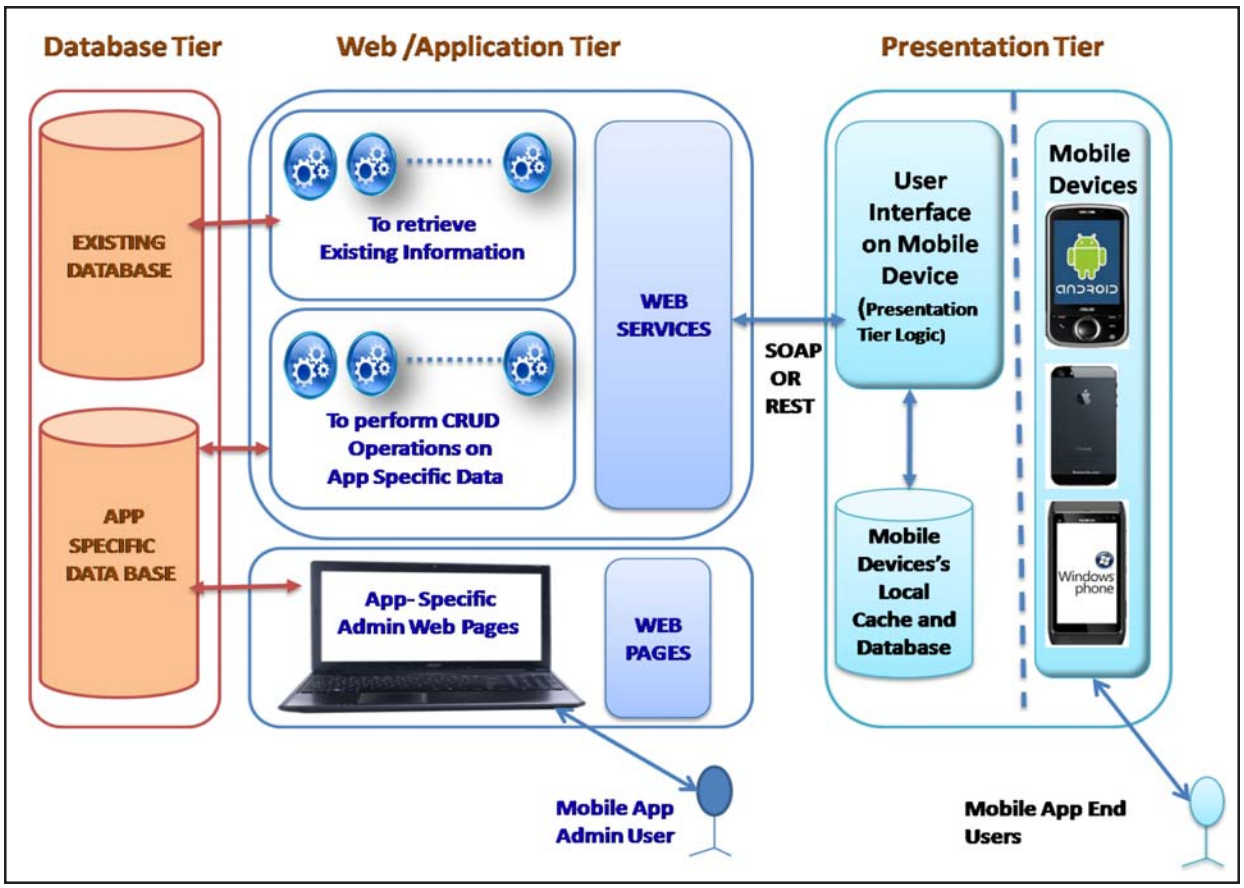

Figure 2. Three tier architecture of student information mobile app

is platform dependent and is written uniquely for devices of different platforms. This logic creates the appropriate user interface screens on the device. Moreover, this layer acts as a consumer of web services created at middle tier. It registers new users and requests student s information by calling web services. Web services in turn interact with database and deliver data to this layer in XML/JSON format. The response is parsed to fetch the desired information which is finally presented to the users. Cache and local database of mobile is used to store application data.

4. Case Study: DUIT (Design and Development)

Delhi University Information Tool (DUIT) is an android based mobile app developed using the proposed architecture discussed in this paper. DUIT app is divided into six components – attendance, assessment, notice, timetable, helpline and analysis. There is also a login and registration component which enables registration of new user and access to app by registered users. The student gets information about their time tables, attendance and the assessment marks. The students have access to the student-centric notices and helpline. Moreover, DUIT app also performs an analysis of their attendance records, assessments etc. and displays in form of self-explanatory pictorial charts.

The app delivers specific and personalized information on student s device. Information is made available to students without necessitating a deliberate effort from their side to search for that information.The Delhi University Information Tool is designed by using participatory design methodology [6]. This methodology focuses on active involvement of all the stakeholders in iterative design process. As per Spinuzzi [6], participatory design has three stages, namely, Initial exploration, discovery and prototyping. The stages of DUIT are as follows:

Initial Exploration of Work

In initial exploration, to determine the platform for which the app shall be developed, DUIT team conducted a survey of target group (students of Dyal Singh College).Secondly the team performed extensive study of websites of various colleges to

understand the kind of information circulated by them. Then, Demand/Expectation Survey of students was conducted to know their most preferred features. Through survey results, following was discovered:

- Android phones were the most common device among students of Dyal Singh College.
- Notices, attendance, assessment and timetables were the most sought after features for which students used to visit the college website.
- Students wished to have a customized helpline feature.
- Students had no way of analyzing their attendance /assessment status.

Discovery Processes

The DUIT team identified that students (potential users of DUIT) were the most important stakeholders of this app; others were teachers who submit attendance/ assessment reports, admin staff who upload notices, reports on college website. So a group of students (from different courses and different academic backgrounds) were selected. Similarly, prominent teachers from various departments were identified. Experienced admin staff was chosen. Lastly, the third party vendor who manages the database of college was also invited. As users of a product must take part in the innovation process[7], these people were brought together to form a focus group for discussions. Many brainstorming sessions were held to finalize the features of DUIT. It was decided to functionally break down the app into 6 different components. Storyboard was created to illustrate the interaction between user interfaces and components. Existing Database and Web server of college was reused and web services were implemented for app specific components. Architecture of DUIT is illustrated in Figure 3.

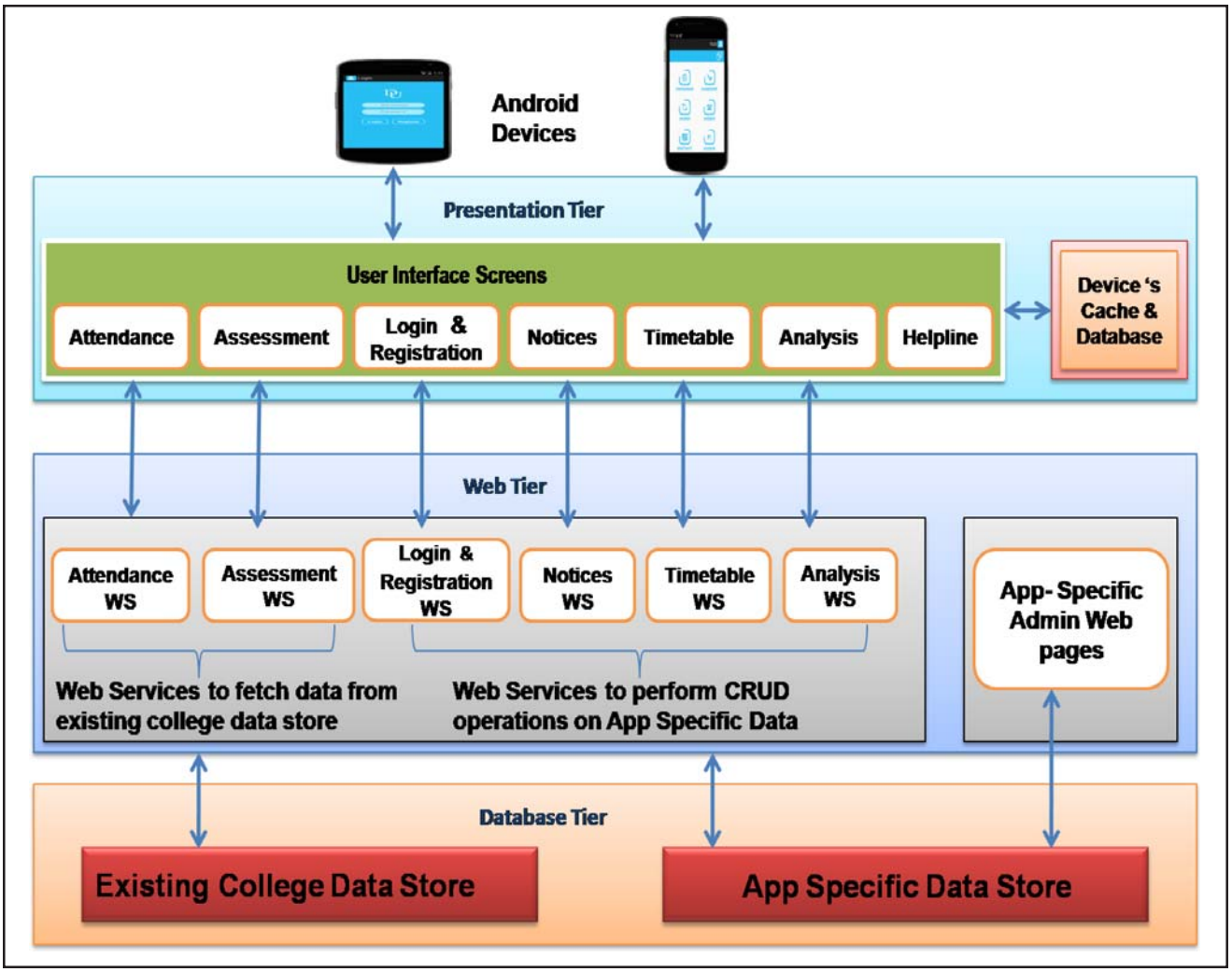

Figure 3. Architecture Design of DUIT

For each component there are distinctive user interface screens which interact with web services to retrieve data from the college database. A brief description of each component is as follows:

Login and Registration- New user registers first by entering the roll number, email id and password. Subsequently, the student logs in to access DUIT.

Attendance- Student clicks on Attendance icon on main screen to view classes attended and classes held for each subject.

Assessment-Personalized Assessment is made available on a single click.

Helpline-Helpline provides a call-on-click feature to connect to University Information Center which provides information services to the students and resolves their queries. Call-on-click option is provided for offices of University of Delhi, Delhi Metro Helpline, Hospital, Fire brigade and women helpline.

Notices-A list of notices is displayed. By tapping on the particular notice, detailed information can be viewed/ downloaded as pdf file.

Analysis- It acts as a self-analysis tool which illustrates the attendance/assessment status of students as compared to whole class in form of comprehensive graphs. It enables students and college authorities to proactively work on improving student s performance.

Time Table-This component brings student s class timetable to his device.

Figure 4 shows some screens of various components of DUIT.

Figure 4. Screens of DUIT

Prototyping

Several prototypes were created by iteratively incorporating ideas of all stakeholders. Students expected a sophisticated mobile app that has usable features as well as elegant design. They preferred a minimalistic design with expandable menus, lists views rather than whole information cluttered on main screen. The logo, icons, color scheme and look and feel of the app were decided and screens were created in first prototype. Along with screens, Login and Registration module and Helpline were also delivered in first prototype. Focus groups discussions were held and various improvements in User Interface (UI) design and helpline were put up. They were integrated in second prototype which included notices and timetable modules as well. Final prototype included attendance and assessment. Continuous feedback was taken from all stakeholders and applied iteratively to come up with deliverable product. Usability testing was also performed side by side to ensure proper functioning of app.

The DUIT app is working and is uploaded on Google Play Store for use by the students of the college at https://play.google.com/store/apps/details?id=com.duit&hl=en

Future Work

The extensible Service Oriented Architecture of Student Information System Mobile Apps makes it possible for any department of the college to provide personalized information to the students by creating a new a module in the app. To do so, a web service need to be built to fetch the information from database and presentation layer logic need to be written to call that web service and present results on UI. Hence, Student Information system apps can be integrated with Library information systems, M-learning platforms and Location based features such as locating nearest computer center, locating nearest restaurantetc. Figure 5 shows the integration of the app with other information systems.

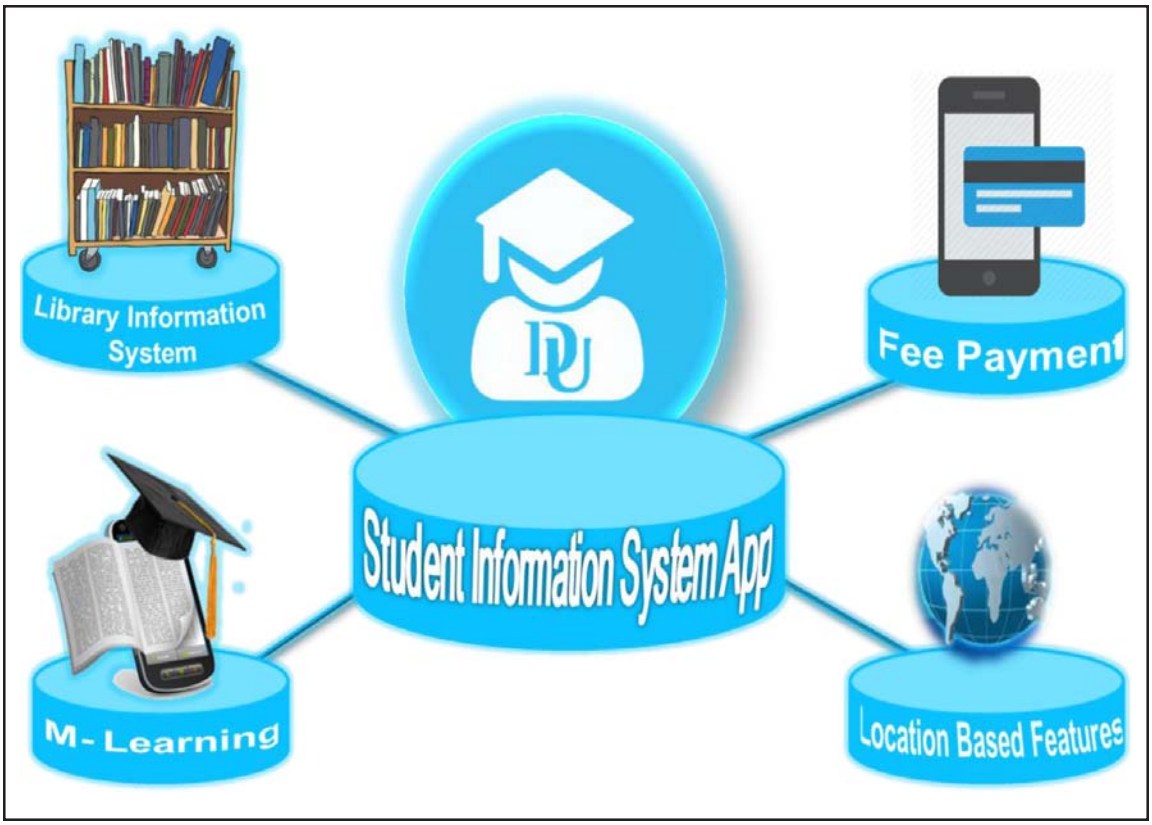

Figure 5. Future Scope of Student Information System Apps

These apps can also include Fee Payment feature which shows their fee payment schedule. Students are able to pay fee and receive confirmations using the app. Students who have loans or get grants/scholarships can track their detailed financial details using the app.

Large universities provide transport options for students to commute within and outside the campus. Information related to availability of such transport options can be linked and provided through the app. Moreover, Sports Updates Feature can be added to deliver scores of college teams to the students in real time. Similarly, Drama/other clubs can send personalized updates to students who sign up with them etc.

Conclusion

Today s student community and their expectations with regards to instant and personalized availability of information on their mobile devices is pushing more and more educational institutes to have a mobile/app presence. As the educational institutes embark on this journey they will need to decide whether to build a completely new technical architecture to support the app-based delivery of information, or, to re-use their existing infrastructure (database, web-servers) using SOA (service oriented architecture) to enable the same. We propose an architecture that reuses existing infrastructure using SOA for app based delivery of information to the students. The architecture is stable, resilient and scalable to incorporate the diverse needs of students and various university departments.

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