

# Campus Push, Location, Context, Policy Driven Push Notification Application for Mobile Devices

Roopkala Ravindran, Nitika Qazi, Vinita Atre, Jayesh Rohira, Sagar Narkar

**Abstract**— This paper aims to capture the need for Context aware services and policy driven methods in a College campus. With an attempt to replace the traditional methods being followed for attendance, notifications etc., this paper gives a view of the application that would facilitate attendance tracking, update about library books status, automatic download of lab plans, timetable, results through push notifications based on user location and time. Thus, we propose a mobile application for College Campus smart space named as Campus Push.

**Index Terms**— service provisioning, smart phones, tablets, ubiquitous computing, context aware, policy driven architecture, push notifications.

## I. INTRODUCTION

With the widespread use of mobile computing devices on educational campus, we intend to provide a location based and context based information exchange system to improve, organize and automate the otherwise tedious task of information delivery management in an educational organization.

Ubiquitous computing (ubicomp) also known as Pervasive computing is a concept in software engineering and computer science where computing is made to appear everywhere and anywhere. Ubiquitous computing includes many concepts like distributed computing, mobile computing, location computing, mobile networking, context-aware computing, sensor networks, human-computer interaction, and artificial intelligence.

It can occur using any device like a laptop, tablet, computer or a terminal in household devices like microwave, refrigerator etc.

Contemporary human-computer interaction models, whether command-line, menu-driven, or GUI-based, are inappropriate and inadequate to the ubiquitous case. Partially we are in ubicomp world but a lot is yet to emerge that supports ubiquitous computing and makes it more secure and robust in itself.

One of the fields of ubiquitous computing is context-aware systems that capture the context sensitive information from the immediate environment and provide services following a policy driven architecture. This project uses the same for sending push notifications to all those people registered with the application. The notifications differ for different types of users, this data being obtained from the user via his/her personal information. Using the service provisioning system, this application supports its users by providing the services it has chosen using the appropriate presentation mechanisms<sup>[1]</sup>.

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## II. LITERATURE SURVEY

### A. Service Provisioning Architecture:

The three basic components of the architecture are:

#### a) Services

It includes the various services that the system is capable to provide. It further handles the availability and segmentation of the services that it provides.

#### b) User

It stores user related information including its personal details, priorities and preferences for the services it needs. The personal details of the user help to categorise the user and provide the services or suggestions accordingly. The preferences that a user gives may include time when the service is needed or the location where it is needed.

#### c) Service Management

It makes use of the context aware system. It receives the context sensitive information from the user's device and provides the services depending on the policy being followed as a part of the policy driven mechanism and the preferences that the user had provided<sup>[2]</sup>.



Figure 1: Generic View of the Framework Components  
Source: <sup>[2]</sup>H. Harroud, A. Berrado, M. Boulmalf and A. Karmouch

### B. Context aware Architecture:

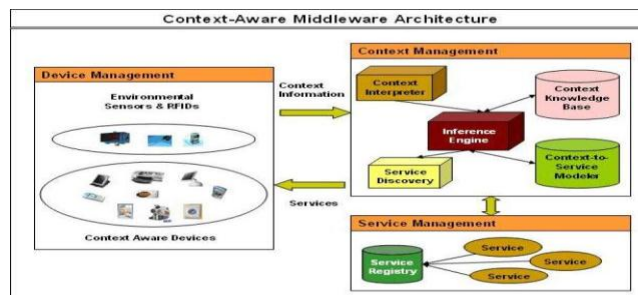


Figure 2: Context aware Middleware Architecture  
Source: John Keeney, Vinny Cahill

Context awareness is a property of mobile systems that is defined complementarily to location awareness. Context-aware computing is a style of computing related to a general class of mobile systems that can sense their physical environment, and adapt their behaviour accordingly.

Context-aware systems are a component of a ubiquitous computing or pervasive computing environment. In context-aware computing, we use the term context to refer to the circumstances in which a specific computational program is being executed (such as the current occupation of the user) or the current state of the environment. Context implies the following: where you are; who you are with; and what resources are nearby.

Context aware systems have to remember past events and generate reminders for future events. Context-aware is used more generally to include nearby people, devices, lighting, noise level, network availability, and even the social situation, e.g. whether you are with your family or a friend from school [3].

Attributes of a context aware system:

1. *Context type*: The context type refers to the category of context such temperature, time, speed, etc. This type of information may be used as a parameter for a context query or a subscription.

2. *Context value*: Context value means the raw data gathered by a sensor. The unit depends on the context type and the applied sensor, e.g. degrees Celsius, miles per hour, etc.

*C. Policy Driven architecture:*

A policy rule is defined as a rule governing the choices in behaviour of a managed system. Management action policies are defined as persistent, positive or negative, imperatives or authorities for a set of policy subjects to achieve goals or actions on a set of target objects [3]. A policy can be seen as a conditional statement. Enabling conditions result in the enforcement of actions, which dynamically adapt the behaviour of corresponding services.

The policy driven architecture facilitates end-users services context awareness by dynamically creating new context policies and by triggering actions of predefined policies in response to satisfied context sensitive conditions [4]. By enforcing policies on services the behaviour of the system is automatically adapted to context changes when the condition of the policy is satisfied.

The policy driven approach facilitates development of context aware services, enhances their context effectiveness and reduces the development costs. Furthermore, each service has the ability to limit context usage to its specific needs by enabling a context negotiation for establishing a context level agreement (CLA). CLAs guide the interaction and information dissemination among different services as they receive the agreed context either in the form of context values or context policies and make decisions accordingly on users' behalf.

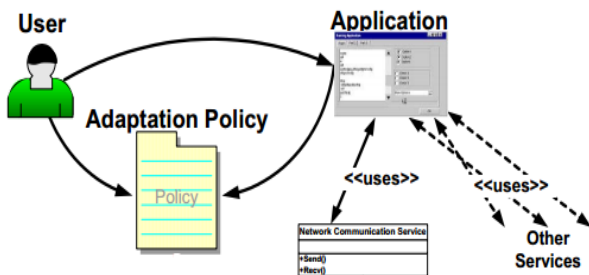


Figure 3. Policy Driven architecture Source [5]: Yong Lu, 2009. Towards an open ubiquitous computing

*D. Google Cloud Messenger*

Google Cloud Messaging for Android (GCM) is a free service that helps developers send data from servers to their Android applications on Android devices, and upstream messages from the user's device back to the cloud. [6] This could be a lightweight message telling the Android application that there is new data to be fetched from the server (for instance, a "new email" notification informing the application that it is out of sync with the back end), or it could be a message containing up to 4kb of payload data (so apps like instant messaging can consume the message directly). The GCM service handles all aspects of queuing of messages and delivery to the target Android application running on the target device.

Characteristics of Google Cloud Messaging (GCM):

- a. It allows 3rd-party application servers to send messages to their Android applications.
- b. Using the GCM Cloud connection, you can receive upstream messages from the user's device.
- c. An Android application on an Android device doesn't need to be running to receive messages. The system will wake up the Android application via Intent broadcast when the message arrives, as long as the application is set up with the proper broadcast receiver and permissions.
- d. It does not provide any built-in user interface or other handling for message data. GCM simply passes raw message data received straight to the Android application, which has full control of how to handle it. For example, the application might post a notification, display a custom user interface, or silently sync data.

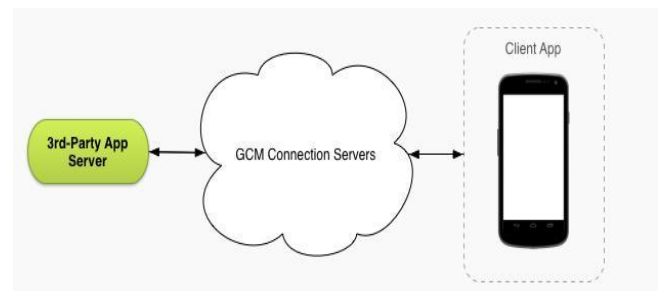


Figure 4: architectural overview Source: developer.android.com

*E. Comparison With other applications:*

Applications using location based, context aware architecture are scarce in the educational field. The time constraint on the broadcast messages is used to notify the users at the most appropriate time of the day [7].

Other Apps		Campus Push
Name	Limitations	
Jabong, Flipkart, Yatra,, MakeMyTrip	Broadcasts notifications to all users. Not policy driven.	Broadcasts different messages to staff and students.
M-Indicator	Client side requests are not entertained. Hence one way.	Two ways XMPP based messaging system.
Attendance Tracker	No record with the faculty. Only used for keeping a record with the student.	Record is maintained at the central server, hence available to all.
Bookmyshow. Zomato, M-Indicator	Does not send notifications based on the users location, e.g. when near a movie theatre or a restaurant.	Location based, e.g. Send the lab plan when near a certain lab.
Zomato	Does not provide download options ,e.g. download of menu etc.	Auto download based on location and time.
M-Indicator, BookMyShow	Doesn't send time specific notifications.	Time based push notifications.

Figure 5: Comparison with other applications

### III. SURVEY AND APPLICATION

#### 3.1 Survey of Smart Spaces

While many ingenious applications related to smart spaces are discussed in the paper titled "Automatic Service Provision in Network Smart Space"<sup>[8]</sup>, some other areas where service facilitation has proven helpful are mobile health care, disaster management, shopping malls and lastly travel and tourism. Furthermore, smart spaces can be created in educational campuses to provide interactive real time services as mentioned in the motivation.

##### 1. Mobile Health Care

On the go health care services are provided using Personal Health Records (PHRs) which created a remarkable upsurge in the field of Medical Science. They contain global patient information from trusted sources. Thus this information is readily and easily available to patients and practitioners at real time. The Emergency Medical System are one of the most crucial system because they are involved in a variety of activities which are performed from the time of a call to an ambulance service till the time of patients discharge from the emergency department of a hospital. The Emergency Medical System is closely knit so that collaboration and coordination becomes a crucial issue for patients and for emergency health care services' performance. Cloud computing, Ubiquitous technology, Middleware services integrated with PHR's would transform the entire process on a small mobile device<sup>[9].e</sup>

The main services provided by the Healthcare applications are

- i. A mobile user (patient) being registered with the system. PHR stores the medical record of the user.
- ii. Updates provided to the user to handle critical situations.
- iii. On-click integrated collaboration to help in critical situations like call ambulance or family or personal doctor.

Added benefits include dealing with scenarios in which if the practitioner is physically not present to provide help but being connected through the mobile device. A patient health record could be moved around on various machines and a healthcare practitioner would be able to collaborate with colleagues from other locations and make informed decisions anytime by sharing resources. The vital signals that are measured and transmitted to a software broker could be transmitted in real time and adequately analysed using the discovered grid resources. Thus, enabling remote management of patient conditions and quick detection of health anomalies.

##### 2. Disaster Management

Disasters are generally unpredictable and provide a short window of opportunity to mitigate its dire consequences. Thus Disaster Management, the process of being ready to tackle any unnatural and manmade disaster, involves being aversion, prepared, quick response and fool proof recovery mechanisms, probably leading to mitigate the impact of disasters. A variety of events are covered by disaster management which utilize context aware services at real time<sup>[10]</sup>. A holistic and integrated approach will be evolved towards disaster management with emphasis on building strategic partnerships at various levels. The themes underpinning the policy are:

- i. Community based Disaster Management, including last mile integration of the policy, plans and execution.
- ii. Capacity development in all spheres.
- iii. Consolidation of past initiatives and best practices.
- iv. Cooperation with agencies at national and international levels.
- v. Multi-sectorial synergy.

##### 3. Shopping Malls

Malls in today's lifestyle have huge number of products on display, various offers, and promotional advertisement to acquire customer interest. But, does every customer gets or knows about this information. The customer interested in the particular product needs to be notified with the provisional updates. This could be done by automatic content-provision services. This can be done by location detection, performed by network. The system uses users' smart phones to display advertising content based on the users preferences already stored in the mobile application. The context in the nearby where the customer moves around in the mall checks the context provided by the users profile and provide appropriate notification about products to the customer requirements.<sup>[11]</sup><sup>[12]</sup>

##### 4. Travel and Tourism

Application integrated with context sensitive services helps to create user preferences and profiles. Thus their location information with the current time can be used for formulation of suggestions on the users mobile device with nearby area of interests like ATMs, hotels, restaurants, parks, malls, etc.<sup>[2]</sup>.The study of these applications has led to the utilization of three main technologies, which creates the smart space. The first is context-aware technology that is able to adapt its operations to the current context without explicit user intervention and thus aim at increasing usability and effectiveness by taking environmental context into account. The second is middleware technology, provides an infrastructure platform to build your own ubiquitous applications. The third is sensing and wireless network technologies provide various protocols for perceiving and transporting environment context information.

##### 3.2 College Campus Smart Space Survey

Following is a survey done in "Vivekanand Education Society's Institute of Technology's Department of Information Technology". The students targeted were from final and pre-final year under graduation. Valuable inputs were also gathered from the faculty.

The three mentioned technologies are available in any college campus. College campus can be considered as a smart space, where students can use the network technologies on their mobile devices and be connected to the college environment to receive information about the recent news, events and ongoing activities in their campus. This leads us to the development of "CampusPush" application  
CampusPush Survey: To understand the basic service requirement in a ubiquitous college environment, we conducted a survey with the pre-final year, final year students and staff.

Conclusions based on Survey: The bar graph compares the users who have given information about their usage of smart phones, whether they use Internet throughout the day, awareness of location based service detail is gathered.

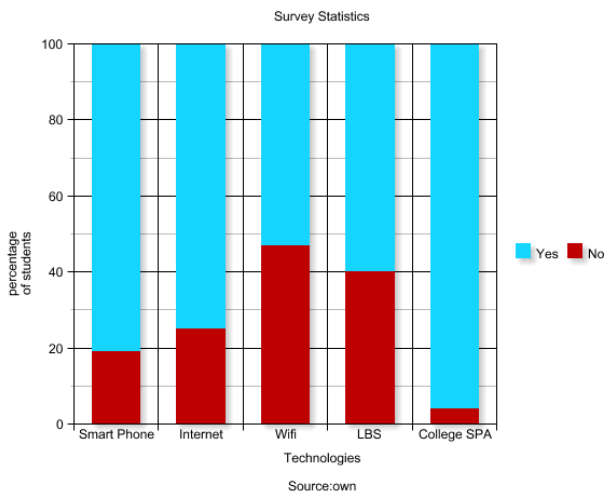


Figure 6: Smart Space Survey

The results of the survey can be summarised as:

- i. Firstly, almost 80% users have a smart phone.
- ii. Secondly members around 85% have used mobile Internet, whether possess a smart phone.
- iii. Also almost 50 – 55% members use the Wi-Fi facility provided in the college premises.
- iv. Furthermore there are 75% members who have at least once used or are frequent users of Location based services that could range from Emergency/ Safety/ Healthcare, Information.
- v. Finally, the highlight, 99% of members feel that college campus should have services, Navigation/ Routing, Transaction & Billing, Entertainment, proximity or any other service<sup>[13]</sup>.

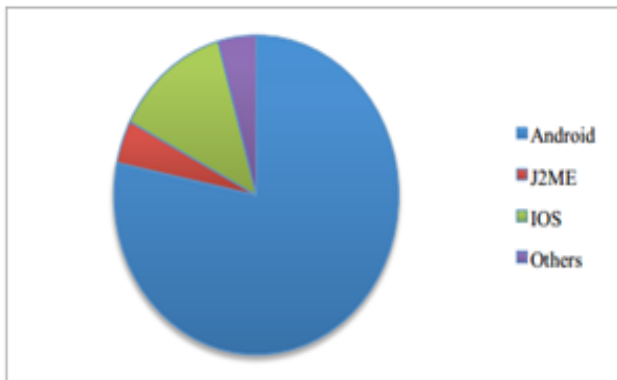


Figure 6: Software selection

The survey also captures technical details about the underlying software platform which should be used to develop the mobile application. Android was the trending mobile development platform. Also found that the tendency of mobile users have changed as survey found that 40% are ready to even use the application if it would be charged. The study reveals that users are interested in an application, which would have a very fast response time, provide security, should be fault tolerant with the availability of personalization.

#### IV. PROPOSED SYSTEM

Campus Push is an application that can be used in a College by the faculty as well as the students.

The architecture explains the working between the Client Application, GCM and the Application Server. The application consists of the attendance manager, Push notification manager, GPS locator and the library manager that handle the attendance, sending of push notifications, gathering the location related information and information from the library database respectively. The application server is responsible for identifying the policy corresponding to a particular location and performing the necessary action. This information along with the device id of the target device goes to the GCM Server that sends push notifications to the client application on the user’s phone.

Thus, when a student enters the lab, the lab plan gets automatically downloaded on his/her smart phone based on the location. It also helps the faculty with taking the attendance of students in a lab by automatically notifying the teacher about the presence of a person in the lab. Apart from this, it notifies the user if he comes near the library or the seminar hall. The end users in this smart space are people present in the college campus such as students, faculty, and technical/ non-technical staff equipped with smart phones.

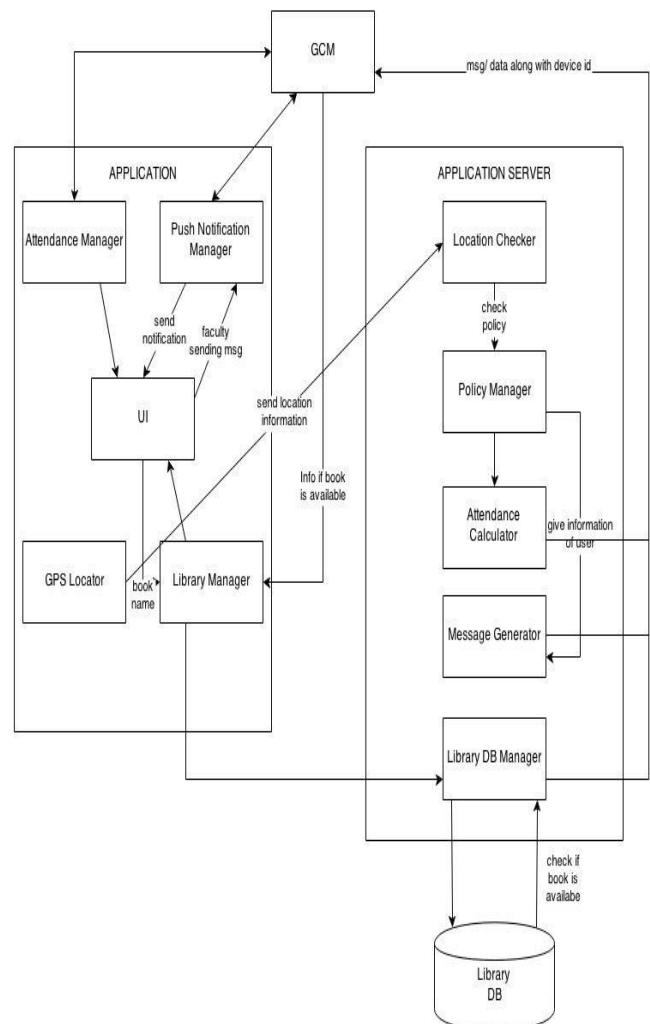


Figure 8: Architecture of proposed system

#### V. CONCLUSION

Campus Push is a user friendly mobile android application which facilitates intelligent location based and time based notification system in the educational campus using a policy driven and context aware architecture.

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