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Course Project in Mobile Computing – AnExperiential Learning

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Abstract: AbstractAs a predominant technology among our student bodies (with smart phones and tablets), along with the growing market for Android or iPhone developers, students are yearning for understanding the computations that happen at the back-end. In this paper, a case study of a project in "Mobile computing" course is presented. Students were encouraged to develop new applications to retrieve the back end data such as SIM information, Nearest Tower Information and Protocol stack employed during Internet browsing. The main objective the course project is to strengthen the theoretical concepts in the class by experimenting with real-time mobile system. Assessment of student's "understanding level" prior to and after the course project is recorded.

Analysis of the assessment data showed that the students developed a good level of understanding of the underlying wireless and mobile communication networks and their technical features, and were able to map the theoretical concepts learnt in class with practical applications. The project objectives of improving programming skills and developing mobile apps are found to complement the course outcomes.

Keywords: Mobile computing, experiential learning, course project.

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1. Introduction

In mobile computing, a set of distributed computing systems or service provider servers participate, connect, and synchronise through mobile communication protocols [1]. Mobile computing as a generic term describes the ability to use the technology to wirelessly connect to and use centrally located information and/or application software through the application of small, portable, and wireless computing and communication devices.

Mobile computing provides decentralized (distributed) computations on diversified devices, systems, and networks, which are mobile, synchronized, and interconnected via mobile communication standards and protocols [2]. Mobile device does not restrict itself to just one application, such as, voice communication. It offers mobility with computing power. It facilitates a large number of applications on a single device.

The course "Mobile computing" (ISE438) is perceived by the students as confusing, complex, but very interesting world of wireless and mobile technologies.

Table 1: Course Articulation Matrix

PO / CO		a	b	c
1.	Describe the basic concepts, principles and standards in mobile computing.	H	M	
2.	Explain functionalities of network and transport layer in mobile computing.	H	M	
3.	Explain application languages, database and application frameworks in context to mobile computing.	H	M	
4.	**Develop interactive/ innovative mobile applications, to realize theoretical concepts of mobile computing.**		H	H
CO: Course Outcomes, PO: Program Outcomes				

There are various complex concepts which do require experimental learning in order to understand. In this paper, three concepts - i) SIM information, ii) Nearest Tower Information and iii) Protocol stack, are presented, which students learn through experiment mode of learning. The course outcomes and their mapping to program outcomes are presented in Table 1.

Three concepts which are presented in this paper are correlated with the fourth course outcome, the one with bold letters. Corresponding performance indicators are presented in Table 2.

Table 2. Performance Indicators

2.1.2*	- Identifies processes/modules/algorithms of a computer based system and parameters to solve a problem.
2.2.4	- Compare and contrast alternative solution / methods to select the best methods
3.4.2	- Ability to implement and integrate the modules.

*2.1.2: Program outcome 2, Competency 1, Performance Indicator 2.

The details of proposed methodology are presented in the next section.

2. Proposed Methodology

Many institutions offer a course on Mobile Computing and the pedagogy varies from one institution to other. In Amity University, Advanced Mobile Computing is offered with conventional teaching using lecture and practical based method [5]. In addition to giving the assignments and tutorials, the course instructor spends considerable time in linking theoretical concepts to practical oriented approach [5]. Another institute, RMIT of Australia offers this course with development of useful mobile app as one of learning objectives [6]. NPTEL offers a mobile computing course with focus on Android Programming to create applications for smart-phones [7]. However the main learning objective of mobile computing course is to understand network structure and background architecture of mobile communication with minimal focus on mobile app development.

2.1 SIM Information

In the process of learning mobile computing, the concept of SIM (Subscribers Identity Module) is important. The following concepts are of importance during the study of SIM.

- Uniquely identifies the user to the service.
- Enables the Mobile Station (MS) to connect to the GSM network.
- When the MS connects to the Global System for mobile communications (GSM) subsystems, the SIM saves a temporary mobile (dynamic) cipher key for encryption, temporary mobile subscriber identity (TMSI), and location area identification (LAI)
- Information which does not change when the MS moves into another location: (i) international mobile subscriber identity (IMSI) and (ii) card serial number and type.

To realize these concepts, students are encouraged to develop or redesign the existing mobile apps on android

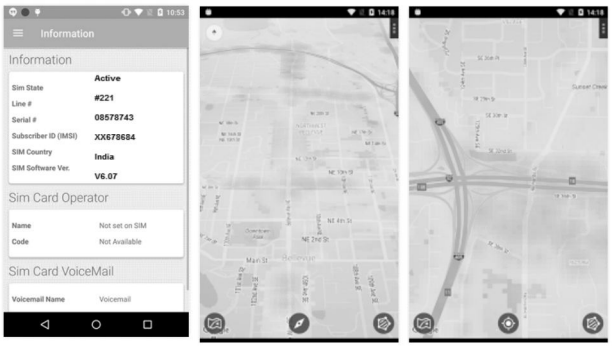

Figure 1: SIM Information

platform, first to to gather this information and then check whether IMSI does not change when MS moves into other location. Via publicly available mobile apps, students were able to access code snippets that show how to extract all SIM information including TMSI and IMSI. To name few, SIM Manager, SIM Tool Manager, SIM card manager etc. from Google playstorewere explored by students.

The following figure 1 presents some of the snapshots of GUI depicting SIM information

2.2 Nearest Tower Information

GSM network architecture has three main modules:

- Radio subsystem (RSS)
- Network subsystem (NSS)
- Operation subsystem (OSS)

RSS consists of a number of base station controllers (BSC). Each BSC connects to a number of base transceiver stations (BTS) which, in turn, provide radio interfaces for mobile devices. Figure 2 presents the connectivity between BS, BSC and BTS [3].

There is no easy solution for collecting information of nearby BTS. The existing mobile apps need to be re-coded in order to extract this information. Apps like Tower Collectorfrom Google play storeis explored by students to collect this information.

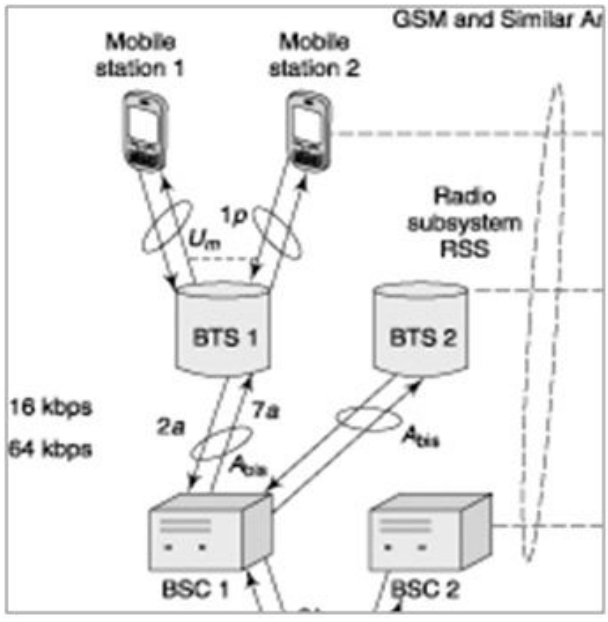

Figure 2. Connection interfaces in the RSS subsystem between BSC and the BTSs [1]

The following figure 3 presents some of the snapshots of GUI depicting Nearest BTS information

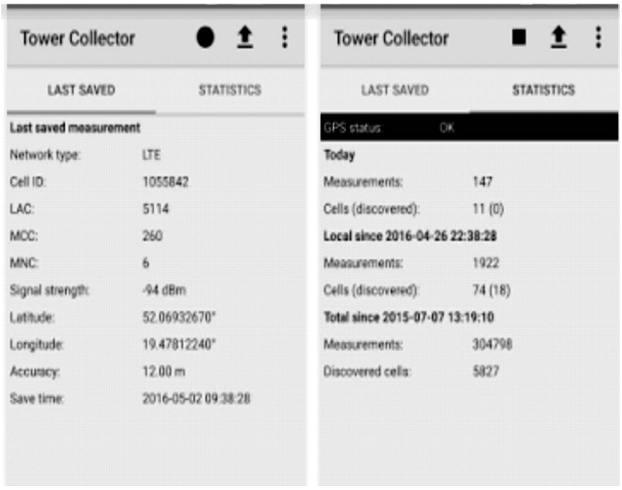

Figure 3: Nearest BTS information

2.3 Protocol stack information

Conventionally, communication is based on Open System Interconnections (OSI) reference model, which has seven layers and corresponding protocols. However GSM architecture differs from OSI model. Following concepts are highlighted during lecture class.

- TCP/IP or GSM, a transceiver need not define protocols for all 7 layers, Some layers perform the functions of neighbouring layer(s).
- The MS, BTS, BSC, and MSC, for example, have just 3 layers—physical, data link, and network.
- Transport and session layer functions taken care of by network layer protocols.
- The tasks of the presentation layer are performed by other layers.
- TE (user) application at either end (caller and connected ends) controls the application layer protocols.

To collect this information, students explored “Packet Analyzer” tool. A packet analyser is a computer program that can intercept and log traffic that passes over a digital network or part of a network. The packet sniffer enables us to capture all uplink and a downlink packet associated with a network interface, and stores the packet timestamp and header information corresponding to IP, UDP, TCP, and ICMP protocols, in a log.text file.Figure 4. presents protocol stack in GSM architecture [4].

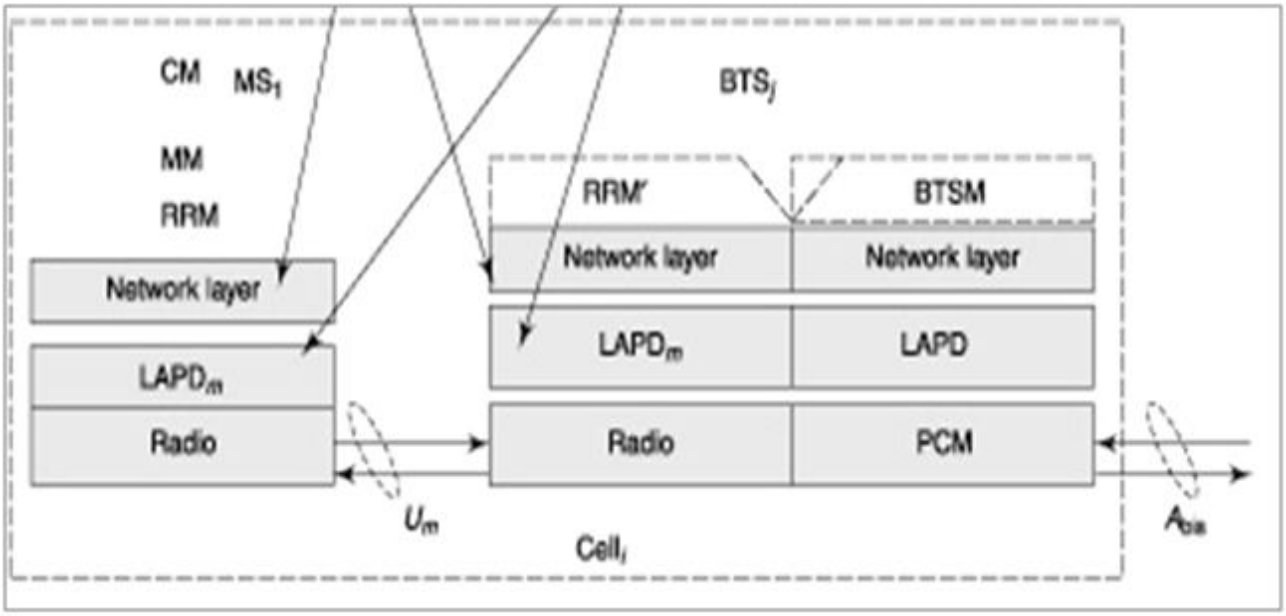

Figure 4. Protocol stack in GSM architecture

The following figure 5, presents some of the snapshots of GUI depicting Protocol Stack

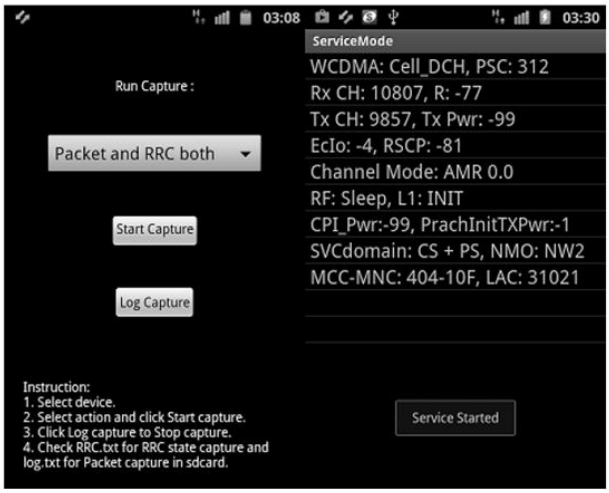

Figure 5: Protocol stack information

3. Results and Discussions

With experimental learning, definitely understanding level is better compared to tradition classroom teaching. This is observed by two assessments. First one is minor exam and continuous internal evaluation(CIE) results. Second one is assessment of PO.

Following figure 6, presents performance in Minor as well as CIE.

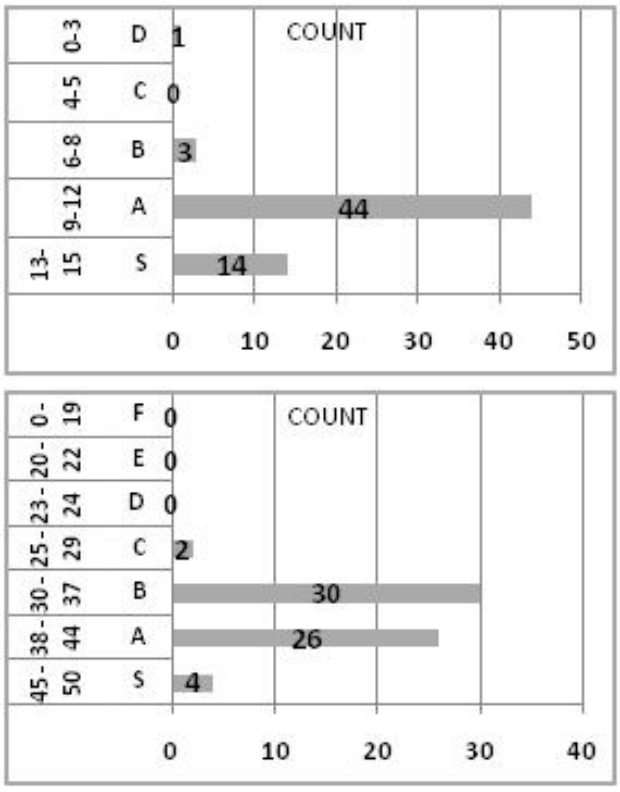

Figure 6: a) Performance in Minor exam
b) CIE performance

Following Figure 7, presents the attainment of PI in the scale of 1 to 10.

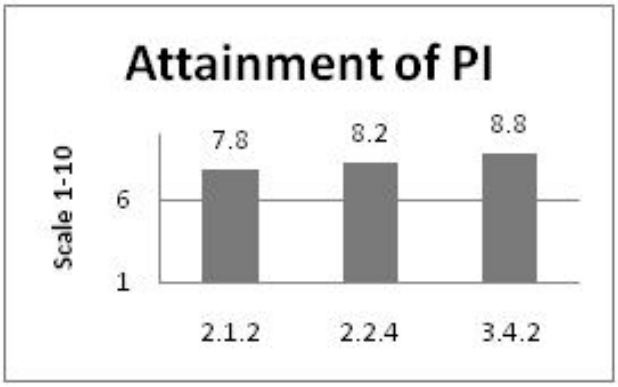

Figure 7: Attainment of Performance Indicators

From both the assessment methods it is observed that experimental learning has complemented the better attainment of program outcomes.

4. Concluding Remarks

The proposed method of experimenting with mobile apps to collect information about theoretical concepts learnt in the class strengthens the understanding level. Concepts of SIM information, nearest tower information and protocol stack are visualized by using/re-coding existing apps. Other concepts like SMS, MMS features and e-mail are also explored by students and practically demonstrated by them. It is observed that student actively participated and showed interest in the course.

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