Improving University Education in Nigeria Through Mobile Academic Directory

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Abstract *Improving the economy of third-world countries and revamping the falling standard of university education are among the challenges of the current political administration in West African and Nigeria in particular. These are captured in the vision 2020 agenda for Nigeria. Mobile devices have gradually become part of our daily life and most Nigerians cannot live without them. Devices that are compliant with Mobile Information Device Profile (MIDP) will enable software engineers to develop applications that can run on multiple platforms and improve on the system's functionality. The functionality of mobile devices can be improved to deliver any type of data to any user, anywhere in world and with the use of different programming languages. This paper models a MIDlet application that adds additional functionalities in the use of our mobile devices. It designs an academic directory that runs on any java-enabled mobile device, and provides increased access to academic information for research purposes by presenting an ideal combination of two of the fastest growing technologies in the world today: the mobile technology, and the computer network technology to build a J2ME-based mobile application. It will encourage effective university administration and interaction among lecturers for research purposes. Consequently, the standard of educational can be improved upon.*

Keywords: MIDP, Mobile device, MIDlet, J2ME, Academic directory.

Introduction

Mobile devices have become part of our everyday life and most of us can no more live without them. Devices that are compliant with Mobile Information Device Profile (MIDP) will enable software engineers develop applications that can run on multiple wireless platforms and improve on the system's functionality. That is, the functionality of mobile devices can be developed to deliver any type of data to any user, anywhere in world and with the use of different programming languages. Using the generic framework provided by J2ME platform, it has become possible to develop various MIDlet applications, and thus, the power of these mobile devices can become endless. Software programs that once needed large, expensive computer systems can now be run on a single processor chip. For example, the average mobile phone handset now contains computing capabilities comparable to those of a standard desktop PC of just five years ago. No doubt, a mobile phone will lack the computational power, memory, etc of a computer and cannot perform the same functions as high-end servers or client workstations. The J2ME is Sun Microsystems's attempt to port the Java programming language to devices with such resource limitations. In this paper, emphasis is focused on proffering a solution to the problem of a complete absence of an integrated database of university lecturers and selected principal officers of Nigerian universities and the need to bridge the communication gap between the NUC officials and university authorities. This unique directory is also geared towards enhancing effective communication among lecturers in the same field of specialization. Currently, the mobile phone is being used as a tool for communication. It has helped people and organizations achieve a lot by connecting people together, via calls and sms, for purposes ranging from education, business, pleasure, etc. But its potential has not been fully exploited. This project apart from bridging the communication divide among NUC officials and the entire university community, also provides a value added service in the form of software that gives NUC, her staff, and the entire university community, more value for their money via mobile devices they already posses. The findings in this paper if fully applied will increase our access to information and information is the major tool for good decision-making and proper management and administration, especially in the university educational system. Lecturers in the same area of specialization in different universities and research centers can now engage in a more profitable interaction.

Theoritical Framework for This Study

This study used the generic framework provided by J2ME platform, which contains a subset of several specialized classes. We will focus on two of such classes: the CLDC (Connected Limited Device Configuration) and MIDP (Mobile Information Device Profile). These sets of classes make up a *profile* in the J2ME terminology and are based on the extremely limited device memory, processor speed, battery, and network connectivity bandwidth. The CLDC is the base platform on which the MIDP APIs are stacked. The CLDC classes consist of a standardized set of functionality that all vendors who offer J2ME-certified phones will support. Generally, you won't have to interact directly with those classes, but certain devices require that you access those lower-level classes to perform certain functionality. The MIDP profile has been developed to support the vertical niche of cell phones or similar devices constrained by screen and keypad limitations, in addition to the obvious battery, processor, and bandwidth constraints.

Mobile Device Programming

There are many programming languages (technologies) available today for developing mobile applications. Some of these technologies include: Java 2 Micro Edition (J2ME), Python, C/C++, Easy Mobile Programming (EMP), etc. Of all these languages, the J2ME stands out as the technology (programming language) of choice because it is platform independent and has a rich set of APIs appropriate for mobile devices. Consequently, the Mobile Academic Directory of university lecturers (MOBIACAD) developed in this work made use of the Java 2 Micro Edition (J2ME).

What is J2ME?

The J2ME is Sun Microsystems's attempt to port the Java programming language to devices with resource limitations. A mobile phone, which lacks certain computational power, workstation power, large memory, etc, cannot perform the same functionality as high-end servers or client workstations. The J2ME platform is built upon the Java programming language to provide the maximum functionality available on the resource-limited device. A subset of the base functionality is provided along with some specialized classes. In this work, I will focus on the CLDC (Connected Limited Device Configuration) and MIDP classes of the J2ME. These sets of classes make up a "profile" in the J2ME terminology which is based on the extremely limited device memory, processor speed, battery, and network connectivity bandwidth. J2ME is meant for small devices such as mobile phones, TV set top boxes, Vehicle telemetric, pagers, PDAs, etc. Since applications (including their data) that will run in such devices cannot be larger than 1 MB or so, J2ME combines a resource constrained Java Virtual Machine (JVM) and a set of Java Application Program interface (API) for developing applications for mobile devices. J2ME runs atop a Virtual Machine (called the KVM) which allows reasonable, but not complete, access to the functionality of the underlying phone. J2ME was designed for devices with:
- ➢ Limited processing power
- ➢ Limited system memory
- ➢ Limited storage capacity
- ➢ Small display
- ➢ Less Battery power
- ➢ Limited connectivity to internet.

All J2ME-compliant device manufacturers include the miniature version of the JVM in their devices, which is very light weight and suitable for such small devices. This JVM enables the execution of small Java programs which are called *MIDI*ets. J2ME can be divided into three parts, as shown in Figure 1.2 below: a configuration, a profile, and optional packages. A configuration contains the JVM (not the traditional JVM, but the cut-down version) and some class libraries; a profile builds on top of these base class libraries by

providing a useful set of APIs; and optional packages, as well, an optional set of APIs that you may or may not use when creating your applications. Optional packages are traditionally not packaged by the device manufacturers, and programmers can package and distribute them with your application. The configuration and profile are supplied by the device manufacturers and are embedded in the devices.
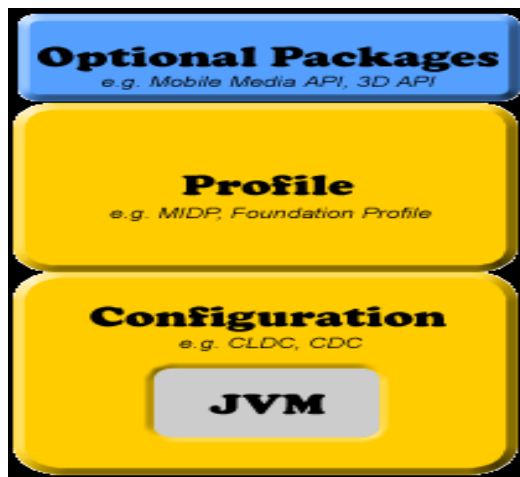

Figure 1.2. The J2ME stack

The MIDlet Lifecycle and Application Management Software (AMS).

Mobile devices interact with a MIDlet using their own software, which is called Application Management Software (AMS), whether by emulators or real contact. The AMS is responsible for initializing, starting, pausing, resuming, and destroying a MIDlet, (AMS may also be responsible for installing and removing a MIDlet.) To facilitate this management, a MIDlet can be in one of three states which are controlled through the MIDlet class methods, which every MIDlet extends and overrides. These states are active, paused and destroyed.
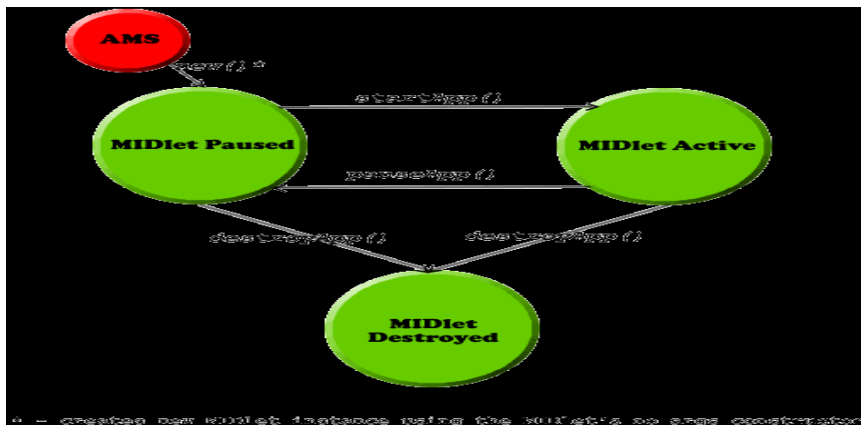

Figure 1.3. The possible states of a MIDlet and the transition between them

Materials and Methods for the Study

Information was obtained using the various tools of Object-Oriented Analysis and Design Methodology (OOADM) to capture all user requirements for the system and use the analysis and design tools of UML (Unified Modeling Language) to model the basic classes and interacting objects. Our focus was to make use of the user-requirements to model the basic classes and collaborations between them, and to give a detailed

and insightful investigation and analysis of the existing system, its working procedures, and its mode of operation. The reason for our choice of the design tools of UML (Unified Modeling Language) is because it contains a set of tools for specifying, constructing and documenting software systems. Unified Modeling Language (UML) is a standardized general-purpose modeling language in the field of software engineering. This standard was created, and is being managed by the Object Management Group (OMG). It includes a set of graphical notation techniques to create visual models of software-intensive systems and for the modeling of all phases of software development: requirements, analysis, design, programming, and testing, especially for java software of embedded systems. It defines a set of structural diagrams that are used to show relationships between objects in a system. The special tools and notations of the UML were extended to model the mobile application for this study. The following factors were put into consideration: sources of data, data analysis techniques, model specifications, etc. When choosing a methodology, it is important to consider not only the features of the methodology, but also the cost of using it, the type of problems to which it is best suited, and its limitations In modeling the actual system, each object represents some entity of interest in the system being modeled, and is characterized by its class, its state (data elements), and its behavior. According to Khlaif M (2009), in developing any MIDlet using MIDP, we must be aware that a completely object-oriented design will not represent the best solution. Each created object requires some memory. Because of the fact that the device's available memory is very limited, your application should be economic when creating objects. Various models can be created to show the static structure, dynamic behavior, and run-time deployment of these collaborating objects. Coding platform is the Java 2 Micro Edition. The database was developed first in Microsoft Access and then converted into Extensible Markup language (XML) in readiness for use with J2ME. At the end of the day, the "jar" file format of the software was distributed via Bluetooth for installation into the mobile device used for this project, which is a mobile phone that supports Java Technology (that is, CLDC 1.1 and MIDP 2.0) named 3250.

Class Relationship in UML modeling for MIDlets
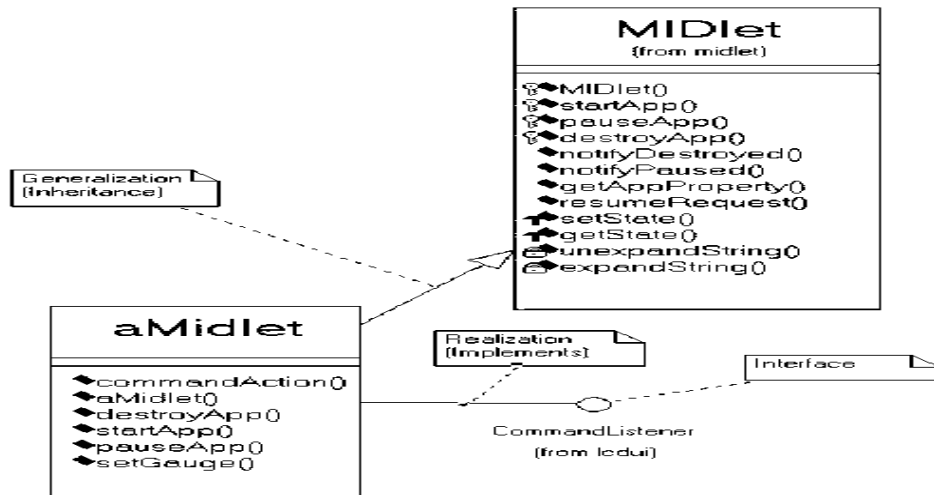
Fig. 1.4 Class relationship in UML
Source: Khlaif M (2009), Pg. 88.

Hardware and Software Requirements

Computers with at least 256MB RAM, 20GB Hard disk, a Bluetooth device & its associated drivers. The receiving phone should be MIDP 2.0 and CLDC 1.1 compatible with Bluetooth capability. The minimum hardware and software requirements that are required for the development of the MIDP application are summarized in the table 1.1 and table 1.2 below:

Table 1.1: Hardware requirements.

HARDWARE	REQUIREMENT
Processor speed	Pentium II with at a speed of 100MHz and **above**.
RAM size	256MB and above.
Display	1024x768 or higher with 65536 and more colours.
Hard Disk size	550 Megabytes of memory and above.
Handset model	Any model that is java-enabled (CLDC 1.0 and MIDP 1.0 or CLDC 1.1. and MIDP 2.0 support), with a screen resolution of 128x128 or higher.

Table 1.2: Software requirements

SOFTWARE	REQUIREMENT
Operating system	Microsoft windows.
Java Development Kit	JDK 1.5 and above.
Wireless Toolkit	Sun Java Wireless ToolKit for CLDC.
Integrated Development Environment (IDE)	J2ME Polish, Apache Ant, Eclipse.

Results and Discusions

Data Flow Diagram of the proposed solution The Data Flow Diagram of our MOBIACAD is displayed in the figure 1.5 below:
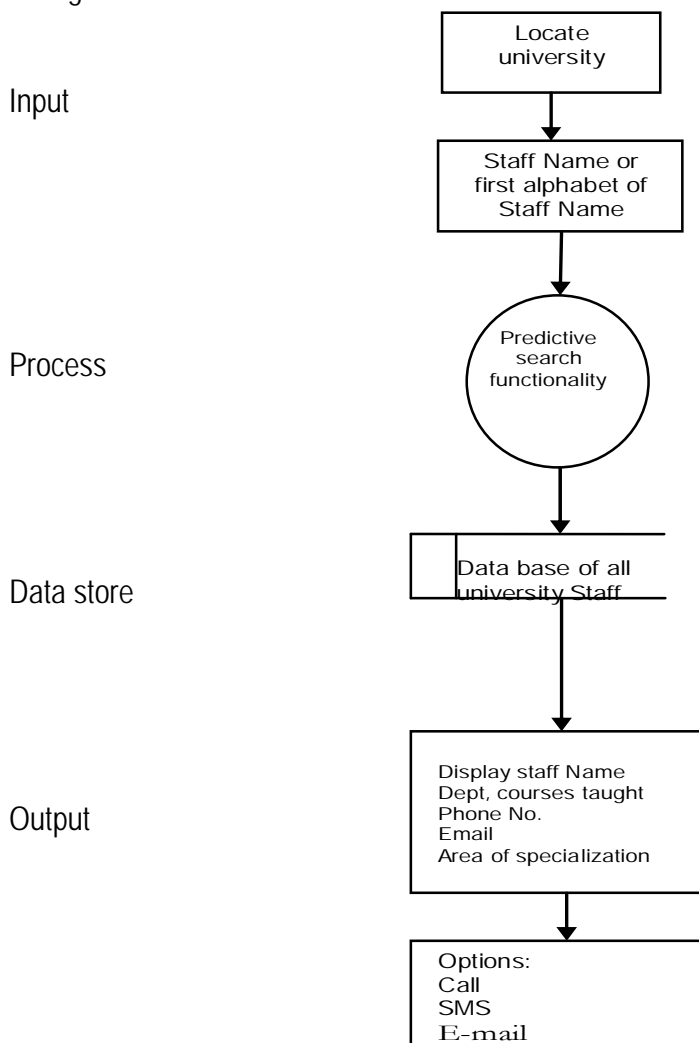
Overall Architecture of the Application

The architecture of the entire information flow in MOBIACAD MIDlet application is displayed in the figure 1.6 below:
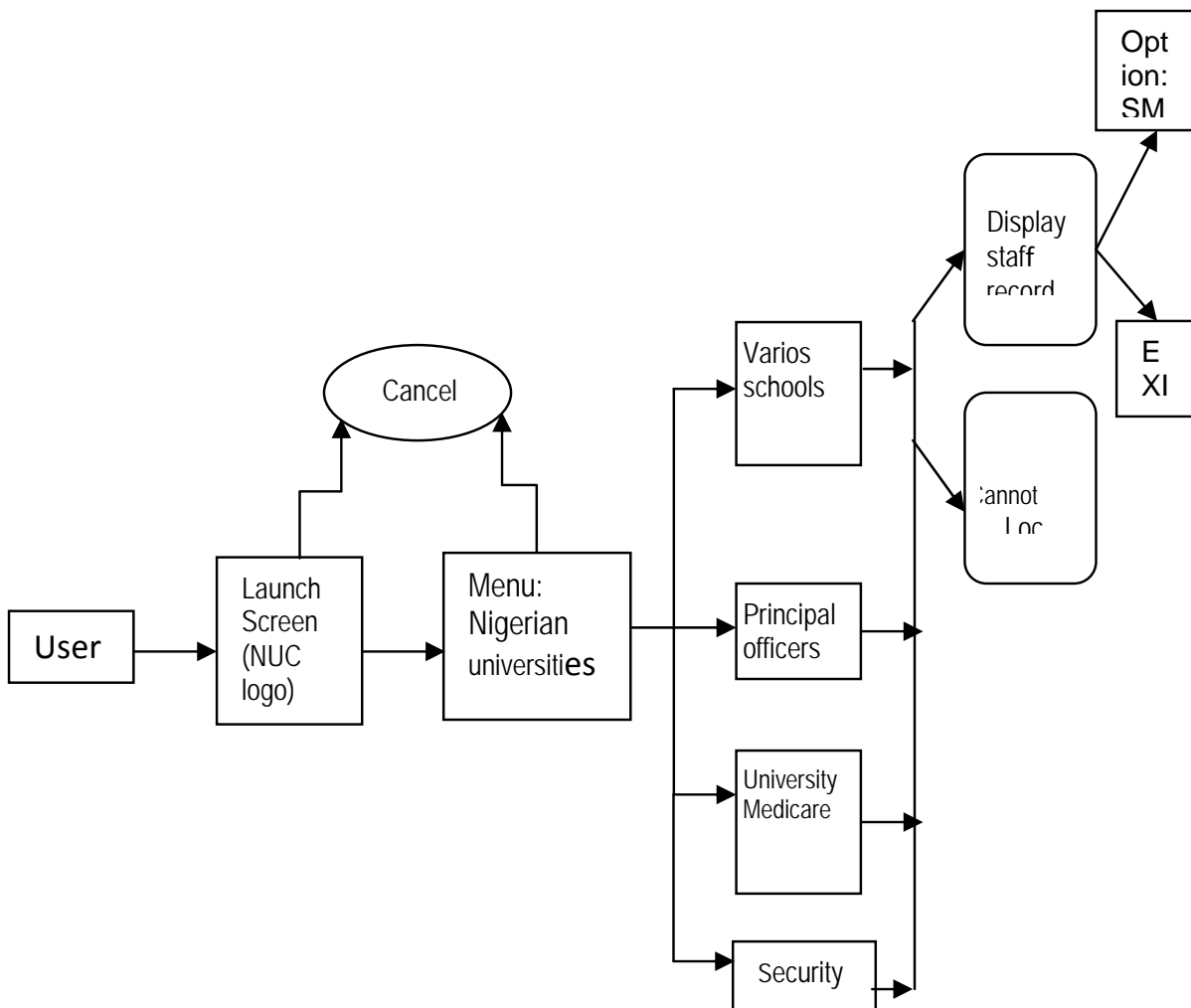

Fig. 1.6 Overall Architecture of MOBIACAD MIDlet Application.

Database Design

As stated earlier, the database was developed first in Microsoft Access and then converted into Extensible Markup language (XML) in readiness for use with J2ME. In developing any MIDlet application using the Mobile Information Device Profile (MIDP), full relational databases has always proved to be very expensive. In fact, the standard MIDP 2.0 does not even support the basic SQL data types such as the Float data type. Again, the standard persistent storage facility (the Record Management Store (RMS) on the MIDP is very much inadequate for enterprise applications. RMS are both very slow and not index-able and poor search functionality. In fact, RMS's linear structure makes it a pain to handle relational or object data. To address this problem, database vendors have developed simple database solutions on top of the known RMS. Some of these databases include: the Oracle J2ME, Extensible Markup Language (XML), Simple Object Database Access (SODA), and the Standard Development KIT (SDK). These databases are extremely lightweight and fits appropriately to MIDlet applications for mobile devices. Each vendor provides its own lightweight proprietary access API. In this work, XML was used to support Persistent Storage. Persistent Storage in

MIDP is centered on record stores.

Record Stores

A record store is a small database that contains pieces of data called "records". A record is simply an array of bytes. Each record in the record store has an integer identification number. Record stores are represented by instances of javax.microedition.rms.RecordStore. They are identified by a name.
Within a MIDlet suite's record store, the names must be unique. The diagram of a record store with two records is shown in fig. 1.7.

RecordStore

Int RecID	byte[ ] data
Int RecID	byte [ ] data

Fig. 1.7 Inside a RecordStore

To create a record store, MIDlets use the following static RocordStore method: *Public static RecordStore openRecordStore(String recordStoreName, Boolean Create)*. The class diagram of the record store in our MOBIACAD MIDlet is displayed in fig. 1.8 below:

DirectoryMidletStore
Search: TextField. ANY Call: TextField. ANY Send As SMS.TextField. ANY
phoneNum.getString() name.getString() msg.getString() clear.getString() back.getString() exit.getString()

Fig. 1.7 RecordStore class diagram

Data Dictionary for MOBIACAD

S/N	Field Name	Type	Description
1	Schools /Faculties	Text	All schools in university
2	SAAT	Text	School of Agriculture
3	SEET	Text	School of Engineering
4	SMAT	Text	School of Management Technology
5	SOSC	Text	School of Science
6	SOHT	Text	School of Health Technology
7	Search	Text	To retrieve desired information quickly
8	Exit	Text	A functionality for exiting from the software
9	Back	Text	A link for returning to a previous menu
10	Clear	Text	A link for deleting a character
11	Lecturers on campus	Text	Names of lecturers on campus
12	Call	Text	A link to call a selected phone number
13	Send as SMS	Text	To send a staff details to a chosen phone number
14	Medicare,Enquiries, Emergency	Text	A link to the phone number of medical personnel

Site Preparation, Installation, AND Test Run

A space should be created in each department for a table and a computer (desktop or laptop), with a Bluetooth device installed on the computer.

Air-Conditioners should be installed in the room containing the computer before bringing in the computer. A staff is enough to man the system. This staff will be trained before implementation.

The software can be installed on any Java-enabled mobile phone with Bluetooth device. Examples of such mobile phones include: symbian phones, series 60 phones, series 40 phones, etc. Installation steps are as follows:

1. Locate the jar file on your computer.
2. Activate the Bluetooth facility on the mobile phone and transfer the jar file to the selected phone.
3. For series 60/40 phones (e.g. Nokia 2700), the application installs directly into your phones internal memory or memory card; while for other phones, it comes as a text message and prompts the user for installation upon opening the message.
4. Once installed, the application can easily be accessed.
5. The user can navigate through MOBIACAD using the user-friendly graphic interface (GUI).

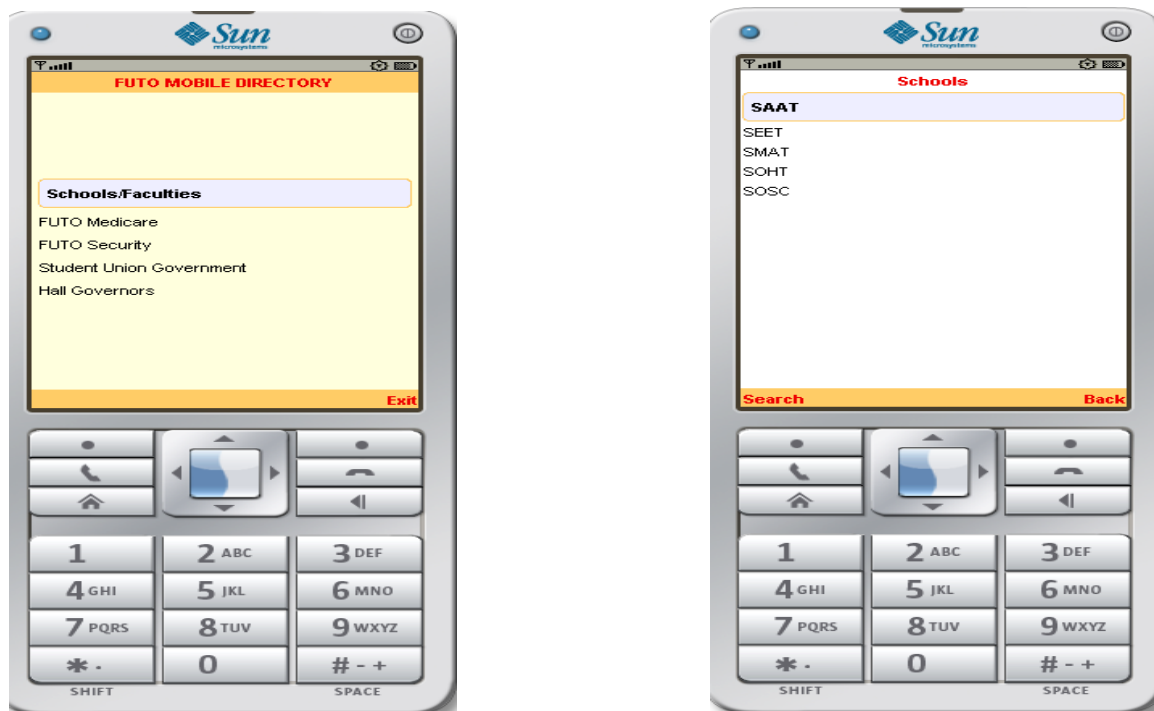Some of the results obtained are displayed in figure 1.8.

Fig. 1.8. Application screens with menus

Conclusion

From the results so far obtained and illustrations made, it is evidently clear that, using the generic framework provided by J2ME platform, it has become possible to develop various MIDlet applications. Consequently, the power of these mobile devices can become endless. The mobile technology is now an integral part of our everyday lives. This is the technology of the 21st century with its inherent and incredible opportunities.

In this paper, we have proffered a solution to the problem of a complete absence of an integrated database of university lecturers and selected principal officers of Nigerian universities and have bridged the communication gap between the National University Commission (NUC) officials and university authorities. This unique directory will definitely enhance effective communication among lecturers in the same field of specialization in different universities, and they can now engage in more profitable interaction. Besides providing an integrated database, we have been able to make it mobile (i.e. making it available for use on mobile phones) to suit the fast-paced lifestyle of today and to make it available and accessible to more people. This system has contributed immensely to the ICT body of knowledge because it has opened the door to a new era of software engineering especially in Nigeria. It has also included additional features in the use of our mobile devices. This will bring about accelerated development in the field of technology. It will also build capacity in embedded system technology at our institutions and Research Centers.

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