ISSN 2320 - 2602
Volume 4 No.12, December 2015
International Journal of Advances in Computer Science and Technology
Available Online at http://www.warse.org/IJACST/static/pdf/file/ijacst014122015.pdf

An Event Notification System for Authorized and Available Organizational Members

Samuel King Opoku[1], Edna Tetteh Awisie[2]
[1]*Computer Science Department, Kumasi Polytechnic, Ghana, samuelk.opoku@kpoly.edu.gh*
[2]*Computer Science Department, Kumasi Polytechnic, Ghana, edna.sedinam@yahoo.com*

Abstract*:* Organizations conduct meetings, seminars, rallies, exhibitions and many other activities as part of their routine operations. Urgent situations usually arise which need to be addressed. Notification systems are used to inform organizational workers to attend to these situations. The common mechanisms include physical information board, radio systems, emails and short messages systems. These mechanisms pose such numerous drawbacks as broadcasting information to wrong listeners, intended recipients not readily available to read the information or attend to urgent events. This paper proposes a new mechanism for issuing notifications to available and authorized organizational members through their mobile phones with the help of Bluetooth communication technology. The paper also compares Bluetooth and infra-red communication technologies considering both their advantages and disadvantages. The system is implemented using Java.

Key words: Bluetooth, Event, InfraRed, JavaME, JavaSE, Notification.

1 INTRODUCTION

Organizations conduct meetings, seminars, rallies, exhibitions and many other activities as part of their routine operations. Urgent situations usually arise which need to be addressed. Notification systems are used to inform organizational workers to attend to these situations [1], [2]. The common mechanisms for announcing an event is through physical information board, radio systems, email and short messages (SMS) systems [3], [4]. These mechanisms have numerous drawbacks. For radio systems, not everyone is interested in the broadcast message and creates noise in their ears. An enhanced mechanism in sending an announcement to the recipient is through email or SMS. With the email announcement, not everyone will be able to read at specific times. For the SMS announcement, the person may not be around to attend to or carryout the event at a particular place in a particular time [4]. This paper proposes a new mechanism for making event announcements to available and authorized people through their mobile phones with the help of Bluetooth communication technology

The Bluetooth communication protocol has client-server architecture. The client initiates the connection and the server accepts or receives the connection. Bluetooth Specification consists of Bluetooth protocol stack and profiles [5]. The protocol stack has direct access to the Bluetooth device controlling device settings, communication parameters and power levels for the Bluetooth device. The main implemented layers in the stack are the Host Controller Interface (HCI), Logical Link Controller Adaptation Protocol (L2CAP), Service Discovery Protocol (SDP) and Object Exchange Protocol (OBEX) [5], [6]. Communication between devices depends on the type of data transferred. OBEX protocol supports exchange of such physical data as files and images. L2CAP is used for sending packets between host and client whereas Radio Frequency COMMunication (RFCOMM) supports simple data transfer [5]-[8]. The Bluetooth profiles allow different Bluetooth devices to interoperate. Although RFCOMM is easy to setup yet a one-way communication link usually shuts down before data is transferred [5].

This problem is addressed by allowing bidirectional transmission before shutting down the link. The range of coverage of Bluetooth depends on the class of the Bluetooth adaptor [8]. This could be class 1 type which covers up to 100 meters, class 2 type which covers up to 10 meters and class 3 type which usually covers up to 1 meter. Virtually all devices use class 2, with class 3 being adopted for some smaller devices such as Bluetooth telephony headsets. Bluetooth is also limited by excessive power consumption [6] and the power level of the energy source [9]. Fig 1 below provides the general overview of the Bluetooth architecture.

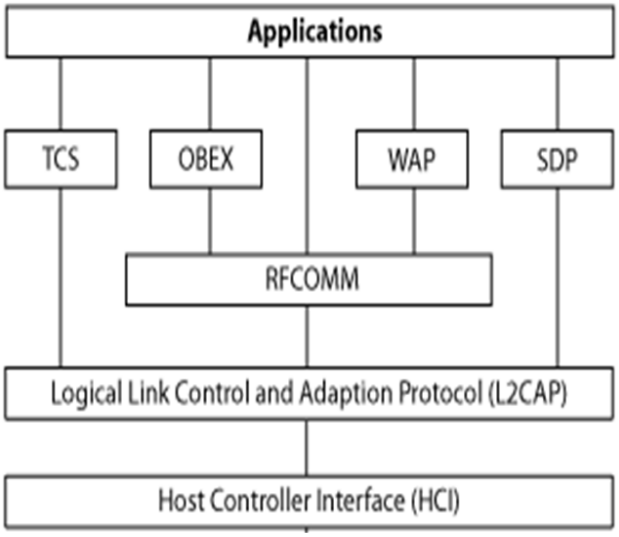

Figure 1 Overview of Bluetooth Architecture

Bluetooth is basically a wireless technology that allows a user to connect computers, mobile phones and other handheld devices to each other and/or to the Internet. Bluetooth technology eliminates the need for the cables that connect devices together [10]. For a user to use Bluetooth, a device with the wireless technology must be able to interpret certain Bluetooth profiles. Bluetooth profiles are characteristics of possible applications and the specification of the general behaviors that Bluetooth enabled devices use to communicate with other Bluetooth devices. There are various Bluetooth profiles that describe many different types of applications. At a minimum, each Bluetooth profile generally contains dependencies on other profiles, suggested user interface formats and specific parts of the Bluetooth protocol stack used by the profile. To perform its task, each profile uses particular options and parameters at each layer of the stack and this may include, if appropriate, an outline of the required service record [11].

Strengths of Bluetooth communication technology [12], [13]:

- Bluetooth does not require line of sight between communicating devices.
- It has the ability to simultaneously handle data and voice transmissions; which provides users with a variety of innovative solutions such as hands-free headsets for voice calls, printing and fax capabilities and synchronization of PCs and mobile phones
- It has an adaptive Frequency Hopping (AFH) capability which reduces interference between wireless technologies sharing the 2.4 GHz spectrum.

Some of the limitations of Bluetooth communication technology are [14], [15]:

- Excessive power consumption
- Slow transfer rate

Infrared (IR) technology allows computing devices to communicate via short-range wireless signals. IR wireless communication transfers data or information in devices or systems through IR radiation. Infrared uses electromagnetic energy at a wavelength that is longer than red light. For IR communication to work, the systems mostly operate in line-of-sight mode which means that there must be no obstruction between the transmitter (source) and receiver (destination). Infrared is used in television remote controls and security systems [16], [17].

Figure 2 Common Devices with IR capabilities (Source [16])

Some of the strengths of IR are [18], [19]:

- Low power supplies: does not require much power supply and is therefore ideal for laptops, telephones, personal digital assistants
- The range of IR is virtually unlimited, which presents the possibility of achieving extremely high data rates.
- IR light is diffusely reflected by light-coloured objects; thus it is possible to use ceiling reflections to achieve coverage of an entire room.
- IR communications can be more easily secured against spying since IR light does not penetrate walls or other opaque objects

However, Infrared has some limitations. These are [18]:

- Line of sight: the two communicating devices must be in line of sight (i.e. able to see each other) before they can communicate.
- Transmission of IR signals is normally obstructed by objects such as walls, trees, people and so forth.
- Short range: signals are transmitted best in short range distances whiles the performance of the signals drops off with longer distances.
- Weather and climatic conditions such as temperature, humidity, direct sunlight, rain, fog, dust, and pollution can affect range of transmission

Java Platform Micro Edition (Java ME) is a platform used in order to develop applications for portable devices. Java ME is made up of two configurations. These are Connected Limited Device Configuration (CLDC) and Connected Device Configuration (CDC) [20]. The application for mobile phones is developed using MIDlet with the help of CLDC configuration supported by Mobile Information Device Profile (MIDP) [20], [21]. The CDC configuration has three profiles. The first type is the Foundation Profile (FP) which is a set of Java API for devices having limited resources that do not need a graphical user interface system [22]. It is usually used in embedded devices. It is specified in Java Specification Request (JSR) 219 [23].

The second type is the Personal Basic Profile (PBP) which is a superset of the foundation profile. This profile supports devices with lightweight graphical user interface requirement [24]. Its specification is described in JSR 217 [25]. The last type is the Personal Profile (PP) which is an extension of the Personal Basic Profile with a graphical user interface toolkit [26]. It is intended for such devices as Personal Digital Assistants (PDA's), smart communications, game consoles and automobile dashboard. Its specification is described in JSR 62 [27]. The Bluetooth API (JSR 82) is integrated with the above-mentioned APIs when Bluetooth is required.

A key benefit of using JavaME is compatibility with all Java-enabled devices [27]. MIDlet is a Java class or group of classes that comprise the basic unit of execution in a Java ME MIDP application. A MIDP application, or MIDlet, is deployed as a MIDlet suite which is a combination of a Java Archive (JAR) file that collects the MIDlets and the associated files necessary to create the MIDP application,

and a Java Application Descriptor (JAD) file that identifies the application to target devices. A MIDlet suite can be built, executed, and deployed to mobile devices [28]. There are seven steps in the creation of a MIDlet. These steps are: designing, coding, compiling, preverification, packaging, testing, and deployment [29].

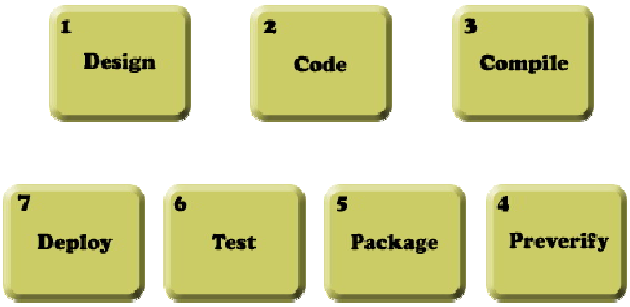

Figure 3 Steps to MIDlet creation (source [29]).

The compatibility of Java ME and Java Platform Standard Edition (Java SE) enables the development of a backend server to assist the limited processing power of mobile devices. Java SE is ideally used for GUI applications [28], [30]. The Bluecove API is integrated with Java SE for Bluetooth communication between the backend server and the mobile devices [29], [30].

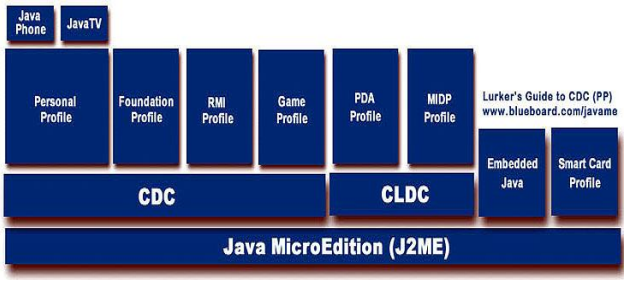

Figure 4 Architecture of JavaME

2 SYSTEM ARCHITECTURE AND DESIGN

A Personal Computer (PC) is used as a server. If the PC does not have in-built Bluetooth adapter, then Bluetooth adapter is connected. The server is implemented using Java Platform, Standard Edition (JavaSE). The Bluecove API is integrated with JavaSE. The communication between the mobile phone and the server is through Bluetooth. The figure below illustrates the architecture of the system.

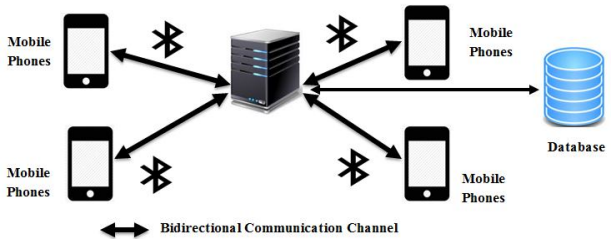

Figure 5 Architecture of the System

Information about individuals authorized to receive information and the notices to be issued are kept in a database.

The client is implemented using Java Platform, Micro Edition (JavaME). The figure below shows the simplified class diagram of the client.

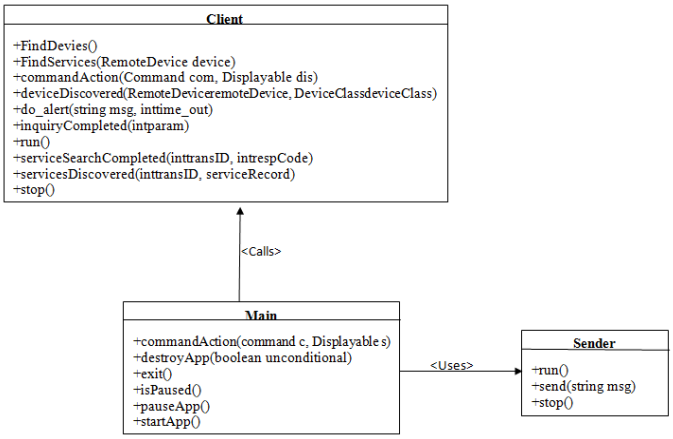

Figure 6 Architecture of the Client

The following algorithm is in the implementation of the system:

- Individuals approach network zone
- Initiate connection to the server
- Server accepts the connection and authenticate the user as a member required to receive notice from the system
- If the person is not an authorized member, the server disconnects the phone
- New threads (clone programs) are created for new connections
- For every minute, the server scans through the database, if a notice is due to be issued, check the Bluetooth addresses of the connected phones with the authorized addresses in the database.
- Send the notice to them
- Mobile phones upon receipt display the message with sound

The above algorithm is illustrated using the following flowchart:

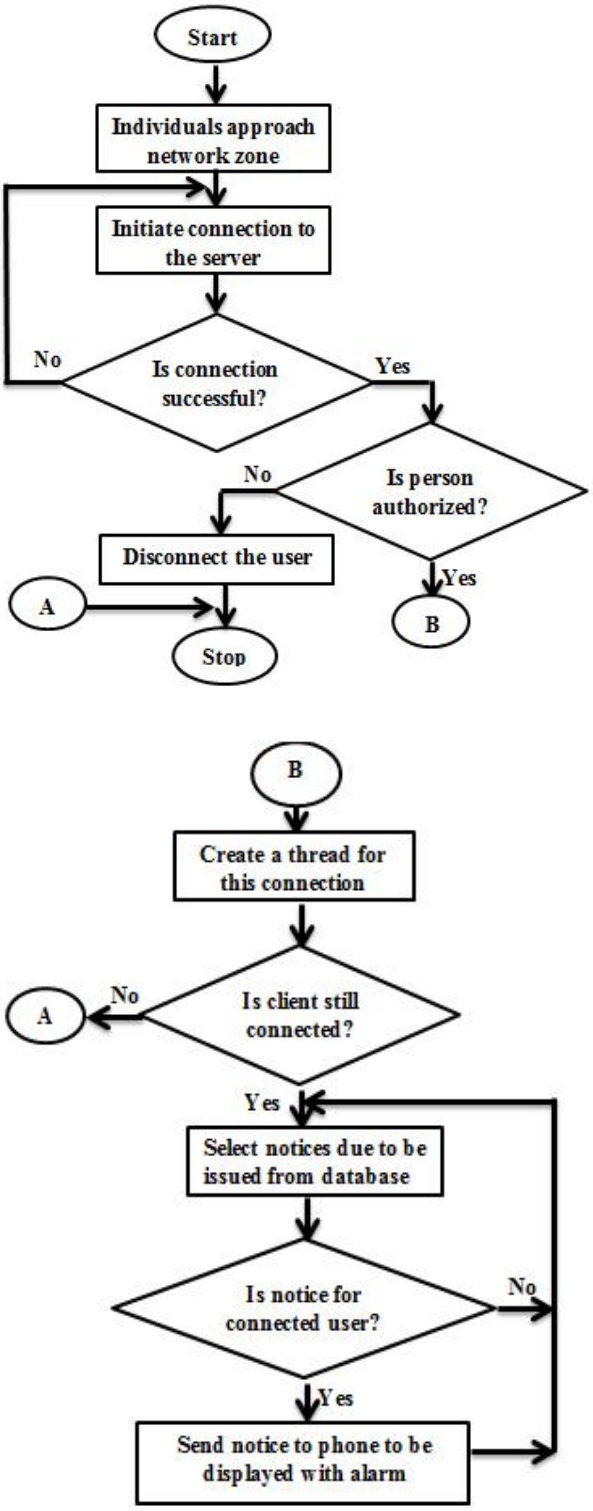

Figure 7 Interaction of Components of the System

3 SYSTEM IMPLEMENTATION AND TESTING

The system is tested in an academic field. Students in the proximity of the Bluetooth communication of the server connects to the server and their time for lectures are issued to them when due. The server is first executed before the client (mobile phone) can connect. Fig 8 shows the information displayed when the server is started and it waits for connection

Figure 8 Server waits for Connection upon Starting

The main interface that allows the administrator to set up notifications is illustrated below in Fig 9

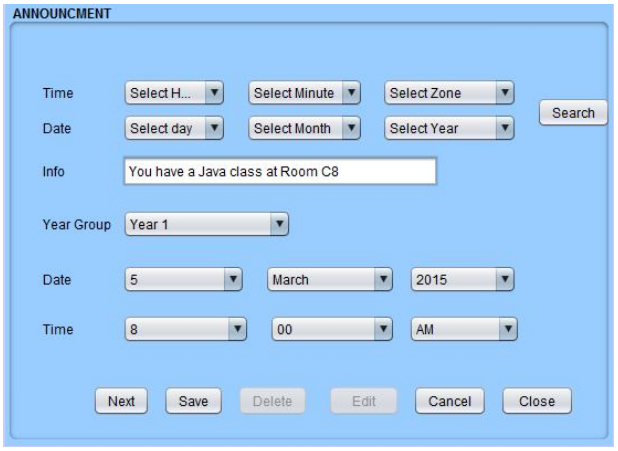

Figure 9 Notification Interface of the Server

When the client is started, it searches for the Bluetooth devices around so that the required server can be selected manually by the user. Fig 10 illustrates the interface for finding the server and the feedback obtained when the connection is successful

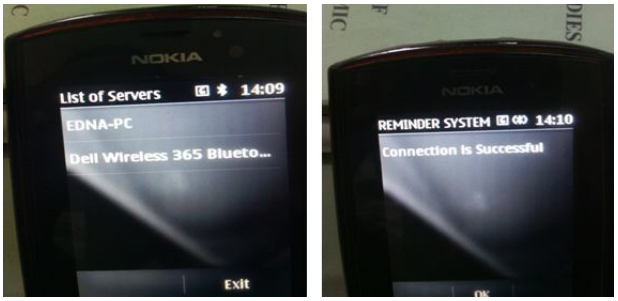

Figure 10 Searching and Finding the Server

When the connection is successful, the phone waits for notification from the server. A typical notification sent from the server is shown in Fig 11 below

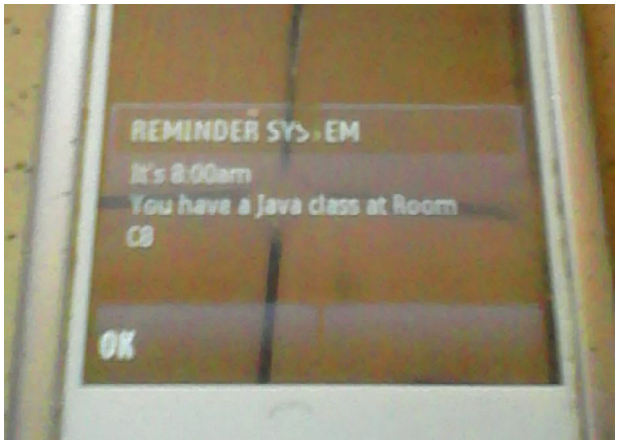

Figure 11 Notification from the Server

4 CONCLUSION

A new design for issuing notification to available and authorized persons in the proximity of an event has been implemented. The strengths of the system are:

- Bluetooth is connection-oriented communication technology. Once connection is established, smooth connection between the client and the server is ensured
- Unauthorized individuals do not receive notifications since Bluetooth address of authorized users are kept in the database

However, the system is limited by:

- Mobile phone battery runs down quickly
- If the mobile phone is in a longer range from the system, connection cannot be established
- Events are only set when administrators sit behind the server and enter the information

In view of this, future work focuses on:

- extending the connection from maximum of eight to infinity
- allowing online event set up through the internet
- automatically connecting to mobile phones so that mobile phone power can be conserved

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