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# Developing an Android Mobile Bluetooth Chat Messenger as an Interactive and Collaborative Learning Aid

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**Abstract.** With the development of digital technologies in recent decades, there has been drastic change in the mode of communication and usages of digital accessories in our today lives. It is sure that invention of mobile phone/smart phone has enhanced our life standard and made life easier. The main aim of this research paper is to analyze, design, build and test Bluetooth chat software. The software has been developed as an Interactive and collaborative learning aid. That tool could benefit students in general specially students with disability. Using the developed system, disable students can connect with their peer students, who are within Bluetooth range, without having access to Wi-Fi or Internet. The application does not require any Internet connection, the application works just with Bluetooth connectivity, users can send free message to their friends sitting over classroom, school playgrounds and festivals, when nearby, without a cellular connection or Wi-Fi. Moreover, the application is very easy to use. Bluetooth messaging is also great for making new friends in a library or chatting up someone in crowded places, because one can hook up with anyone who has a Bluetooth-enabled phone. There were previous attempts to create a similar product with little success. Short Messaging Service (SMS) offers the same services as Bluetooth Chat for a fee; but the developed Bluetooth Chat Messenger is free. The research will elaborate on the details.

**Keywords:** Bluetooth Chat Messenger · Android operating system · Information technology · Short Messaging Service (SMS)

## 1 Introduction

The Bluetooth Chat Messenger application proposed by this paper is a two-way, sending and receiving, text chat program for any device, i.e. phones, tablets, computers, e-book readers…etc., powered by Google's Android operating system with Bluetooth transceiver's capabilities. These devices are largely used in open and closed spaces; and everywhere as streets, squares, hotels and other places. The Bluetooth Chat Messenger does not require a GSM or Wi-Fi connection, all it needs is two Bluetooth compatible Android devices in range of about 50 feet of each other.


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There were previous attempts to make a similar application. As far as it shows on market.android.com [1] the official Google's Android market, there are some attempts to do applications with the same type and idea as the proposed application with little success. For example application "feeble"; as Google's Android market [2, 3] shows, user's reviews shows dissatisfaction with the application (i.e. reviews of the users said: "Couldn't connect to a friend's phone.", "Crashes constantly on Android").

The proposed Bluetooth Chat Messenger application has advantages over existing applications. It works as a client and a server at the same time speaking from network wise or perspective of view. The application creates a server then waits for another client to connect to it (i.e. Server situation); or ask another device to chat with it (i.e. Client situation). It has a friendly graphical user interface (GUI) using well-proportioned and harmonious color within its interface. It is easy to use. It cans also, beside exchanges text messages, sends smiley and exchange files and allows more than two users to chat among each other. It can save the chat devices names in order to save time searching for them. It can save chat's conversations history in database to make users able to browse through their past conversations. It also offers a social users' profiles option; it enables users to fill in their profile with their personal information and offer them to enable or disable exchanging these information with other users as a way of implementing and adding a "social" networking experience touch.

## 2 Aims and Objectives

The main aim of the research is to analyze and design Bluetooth Chat Messenger application software by the name of Blue chat in order to be used as an interactive and collaborative learning aid. In this section will describe and illustrate the paper's scope and objectives.

The scope of the paper will establish constrains that should be followed while executing the project. These constraints are:

1. The blue chat application should allow a user to fill in his/her profile including his location using Google's maps API and save that user's profile.
2. The application should allow a user to search for other available blue chat users; weather they chat before (prepared) or not.
3. The application should allow users to chat with each other if they are in range of the user's device's Bluetooth adapter.
4. The users should be able to share their profiles among each other.
5. The application should allow the users to share and send files among each other.

The objectives of the paper are to deliver an Android application that should be easy to use, enjoyable and could be applied to learning purposes:

1. Imagine a scenario in a school playgrounds or crowded places where the wireless or wired local area network (LAN) failed for any reason. How would users communicate among each other or exchange files of great importance?

2. Think of a presentation going on and two or more students maybe not sitting beside each other. How they can communicate or exchange information silently without interrupting the presentation?
3. Picture a scene of a person sitting alone and bored with nothing to do, in a club or in a plane. He needs some company or someone to talk to or have an "on the go" social conversation.
4. Can children with disabilities be integrated in their society? Can we decrease the isolation of disable children from the digital age? Can technology facilitate communication for children with intellectual disabilities? Can technology help disabilities students to learn effectively?

To achieve the previously mentioned scenarios; a clear, well-organized development plan should be followed. The development plan will be as follow:

1. Analysis phase: It is where our project lifecycle begins. Gather market and user requirements. Understand users' expectations. Analyse Market and application's criteria.
2. Design phase: Develop a specification for our system that will meet market and users' needs and take into account time, resources, and eventually cost. Using the analysis, a design of the application will be followed.
3. Implementation phase: In this phase, the construction of the actual project result will begin where encoding of the application will take place.
4. Testing phase: Testing the application functionality through various conditions and use cases to ensure the software quality.

## 3 Literature Review

The Android project which is owned by Google was first unveiled to the world from New York City by T-Mobile, a leading mobile phone communication network in the United States of America, and HTC, a leading mobile phone manufacturer; as an operating system for the T-Mobile G1 phone.

The first Android powered smart handset mobile phone appeared on the 23rd ofSeptember 2008 [4]. Since 22$^{nd}$ of October 2008; when the T-Mobile G1 phone was first released for sale in the United States of America; the Android is rising in its market share and distribution as an operating system for various and many devices types including mobile phones, tablets among others. Android is growing 30 times faster than the US population [5].

The Bluetooth technology is a wide spread technology since it was first invented by Ericson's, which was a leading mobile phone manufacturer now named Sony Ericson–Dutch-born, senior scientist JaapHaartsen and air interface expert Sven Mattis back at 1994. In March 2001 Bluetooth was first introduced [6]. Nowadays it is difficult to find a device with no Bluetooth transceiver.

### 3.1 Google's Android

Google offers both search and advertising services, which mutually target to manage and analyze the world's information. It also offers a lot of online tools and platforms including: Gmail, YouTube (according to [7] , two billion videos watched per day and thirty five hours of video uploaded every minute at 2010), and Maps. Most of its products are free, supported by its highly integrated online advertising platforms AdWords and AdSense as provided by [6]. Google also got the first place among 100 companies to work for; two consecutive years, 2007 and 2008 [9].

Google got the Android project in 2005 to guarantee that a mobile operating system could be produced and retained as an open source platform. Google continues to provide time and resources into the Android project, which has proved to be valuable. As of July 2010, 160,000 Android handsets have been activated daily, which is great considering that Android mobiles have been available only since October 2008. That is less than three years, and the Android has already made a huge impression and influence. On the 10$^{th}$ of May 2011, Google announced that there were at that time 100million activated Android devices with 400,000 new Android devices activated everyday and 4.5 billion applications installed from Android Market till that time as written in the official [12].

The following sections are a description of the Android operating system, which is available from the Android software development kit (SDK) or online through (http://developer.android.com/index.html).

### 3.2 The Android's Architecture

The Android operating system is an open source and free platform; it is not bound to one hardware provider or manufacturer. This openness of Android is allowing a quick gain of the market share; but this would be covered later in market analysis. Android also can run on many devices with various screen resolutions and sizes. For an Android device to be certified as compatible; it have to follow certain hardware rules including but not limited to: a compass, a Global Positioning System (GPS) trait, a camera and a Bluetooth transceiver which is needed for the Blue Chat application.

### 3.3 Android Linux Kernel

The Linux kernel is basically used in core system services as memory management, network stack, security, process management, and driver model. The kernel works as an abstraction layer between the hardware of an android device and the remainder of the software stack.

Android was made on top of the open-source Linux 2.6 kernel. The developing team chose this kernel because it delivered confirmed core features to develop the Android operating system on which includes:

1. Process management: as the kernel allocates resources to processes as they need managing processes well.
2. Memory management: where the kernel handles memory management by itself.
3. Network stack: the kernel handles network communication.
4. Driver model: ensuring that anything or everything works and enabling hardware manufacturers to build their drivers into the Linux build.
5. Security model: where the kernel handles security among the system and the applications.

### 3.4 Libraries

Android's features were made up from a number of open-source projects and built over the Linux kernel and written mostly in C/C++ programming language which includes, but not limited to:

1. SQLite: an open-source relational database engine designed to be embedded in devices.
2. Media frameworks: which are libraries to play and record audio and video, as well as static images. It supports MP3, AMR, AAC, H.264, MPEG4, PNG, and JPG extensions.
3. Open Graphics Library (Open GL): that is a cross-language and cross-platform application program interface (API), which is used to produce 2D and 3D computer graphics.
4. WebKit: an open-source web browser engine to display web content and ease page loading.
5. Secure Sockets Layer (SSL): basically libraries in charge for Internet security.

### 3.5 Dalvik Virtual Machine (DALVIK VM)

The Dalvik virtual machine is the Android virtual machine. The Dalvik Virtual machine acts only as an interpreter virtual machine. It executes files in a certain format; this format is adjusted for memory map able execution and efficient storage. It can run classes compiled by a Java language compiler that have been transformed into its native format using an included "dx" tool.

The reason for choosing this virtual machine is that this virtual machine core class library provides a common development base for those used for programming with Java Standard Edition programming language, but it is customized specially to the needs of embedded use or in this case small mobile devices.

### 3.6 Android Software Development Kit (SDK)

The android software development kit offers the libraries and tools needed for starting developing Android applications that run on Android-powered devices. This

development kit may be used with mane Integrated Development Environment (IDE). Nowadays, Android Studio (based on IntelliJ IDEA) is the official IDE recommended by Google. Even though, the authors prefer to use Eclipse integrated development environment, because it is the integrated development environment that was greatly used with the Android software development kit, it is officially supported.

### 3.7 Bluetooth Technology

Bluetooth is a wide spread wireless technology paradigm low power consumption characteristics for exchanging data over short distances via short wavelength radio transmissions from immobile or mobile Bluetooth powered devices to create a Personal Area Network (PAN) with high security level [8]. William Stallings [9] says Bluetooth offers wide range of protocols that are helpful in variety of fields.

Some of these protocols would be used in the Blue Chat application. Bluetooth has the ability to work in network or communications either as half-duplex (in one direction at a time) with transmitting rate up to 721 kilobits per second (Kbps) in one direction and 57.6 Kbps in the other and If the use calls for the same speed in both directions, Bluetooth can establish a link with 432.6-Kbps in each direction or full-duplex (in both directions concurrently) with data rate more than 64 kilobits per second (Kbps) as discussed by Curt Franklin and Julia Layton [13]. Besides, it is rare nowadays to find a device with no Bluetooth adapter in it.

### 3.8 Market and Market Share Analysis

Basically, this section includes facts to judge upon them about the Android operating system and its market. First of all the Android was first released to people for sale in 2008. Android phones hit 33.3 million handsets sale in the last quarter of the year 2010, more than any other Smart phone operating system including the previous leader, Nokia's Symbian, which sold 31 million units [10]. In the United States of America, Android is now in the first place of Smartphone usage; it became the number one mobile operating system. Android, a platform which didn't exist just 25 months ago, is now the most-used operating system on Smart phones in the United States, having just surpassed BlackBerry. According to David Goldman; a staff writer in the CNN Money [11] about 31.2% of the United States of Americas' smart phones were operated by Google's Android operating system in January 2011 and 30.4% of the United States' smart phones use BlackBerry operated devices. Putting in mind, the Android passed Apple's operating system (iOS) which runs on the iPhone, iPod Touch and iPad November 2010. After these facets answering the question of why especially developing the Blue Chat application for the Android operating system became more than easy. Simply the Android operating system is the future in the mobile phones; it is a technology revolution, it is just number one.

Unfortunately, developing for application that uses Bluetooth technology as Blue Chat application must be developed using Android 2.0 minimum because needed

services for Bluetooth was not introduced before. But thankfully Blue Chat will only skip 4.3% of current Android operating system devices (1.9% using Android version 1.5 + 2.5% using Android version 1.6), which means after doing the calculation, that Blue Chat will target 95.7% of the current Android operating system users which far away from being few. It is 95.7% of 100 million current Android operating system users.

But, if the Blue Chat would have been developed using newer Android application programming interface framework without any important needed technical reasons, it have been skipped 64% of current Android operating system users and a lot of current operating devices. That is why it is extremely important to know and analyze the market the application would be compete in and the users of this market; and in later section, user characteristics would be discussed for more deep analyses.

# 4 Project Specification

The Blue Chat application's specifications are not complex. First the software must be installable on any device operated by the Android Operating System and support all screen sizes and resolutions to cover a wide range of users and devices. The application then must meet its main purpose or role of exchanging text messages and files among more than one user; this must be achieved or else the software would be useless or unusable. Then the most important criteria is to satisfy the customers' needing by making the software easy to use, the extra features to be entertaining and usable for them and to implement the application with no errors and out of bugs to avoid continuous crashing with a satisfying performance whether speed or quality.

## 4.1 Purpose of the System

The main purpose of this project is to deliver a useful Bluetooth chatting application that targets the wide spread Android operating system powered devices. The most important feature to be fulfilled is that application should share or exchange text messages among the Blue chat application users and to present or offer this feature in an entertaining way to pull android's users likeness to the application through using the profile feature for every user showing his/her personal information. Adding that, the application should be compatible with different Android operating system powered devices that comes in many different shapes, sizes and capabilities.

## 4.2 Assumptions and Dependencies

1. The android operating system is the operating system of the device which the Blue Chat application would be installed in. An Internet connection is needed in order to load extra functionality.
2. The android operating system is of version 2.0 or more
3. The android operating system has to have a built-in Bluetooth adapter in order to connect to other Blue Chat application users and exchange text messages and files.

4. The profile of each Blue Chat application user should be filled and saved by the application's user

### 4.3 Constraints

1. The application should be installed on more than one device in order to operate or function with each other.
2. The android operating system has to be within the range of Bluetooth adapter of the device in order to scan, discover, exchange or send text messages or files.
3. The android operating system has to enable Bluetooth adapter (turn it on) to start the application.
4. The android operating has to enable Bluetooth adapter to be discoverable to be visible by other application's users.

### 4.4 Functional Requirements

1. An application to show profile to be filled by the application's users which includes image view, buttons, text views, edit text views.
2. An application to show available users which will be made of a list of pre-paired Bluetooth Android devices and not paired ones, if the devices are within the range of the Bluetooth device's adapter.
3. An application to show current chat session with other users which will be made of buttons, text view and edit text view.
4. An application to show available directories and files on the device that Blue Chat application would be installed on.

## 5 Development Phases

To achieve the previously mentioned goals; a clear, well-organized development plan must be followed. The development plan that that the development will build upon will be as follow:

1. Analysis phase: Where researching the market will take place and put the application's implementation and functionality criteria will be found and analyzed. The first part of the project is the analysis process. Analysis processes is where research is done to start building the application based on firm, reasonable and logic basis. Analysis includes specifying and concluding the features of the software after knowing that these features are reachable. Also look back if there are past attempts trying to achieve the same idea of the application and get advantage of them. The Blue Chat application would mainly be available through the Android market. Blue Chat application can be used by any user having a device powered by Android operating system version 2.0 or more, in particularly for users who love to be social

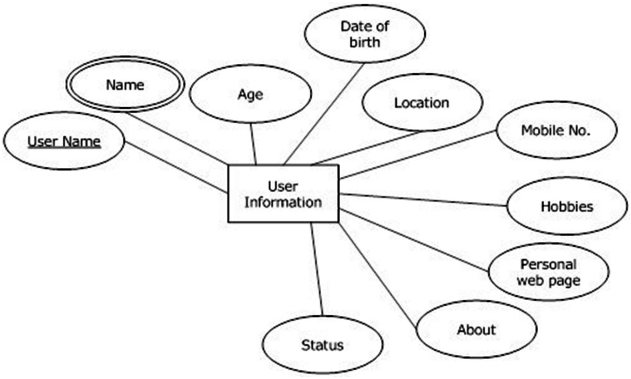


**Fig. 1.** Entity-relationship diagram of the profile database (ERD)

and like using social networks as Facebook.com or Twitter.com. Also Blue Chat must be available for serious companies or factories that need to connect their employees with each other and exchange text messages for communication and share or exchange files for business purpose. The Blue Chat application can be used by any one unless user cannot or do not know how to interact with Android operating system device itself. Users must have Android powered devices running Android version 2.0 or more. Users could be either males or females. Users' age might begin from 10 years old, as long as the users can or know how to interact with Android operating system device itself. Analysis means to get everything just ready for the next step even if it might get a little advance; as designing the software's database, see Fig. 1.

2. Design phase: the interface design is a milestone in this application development. Starting by simple, fabricating simple buttons, text boxes and warning messages. Next, preparing the protocols needed for the application to use Bluetooth and Client/Server codes.

- User Case One Scenario, Fig. 2:

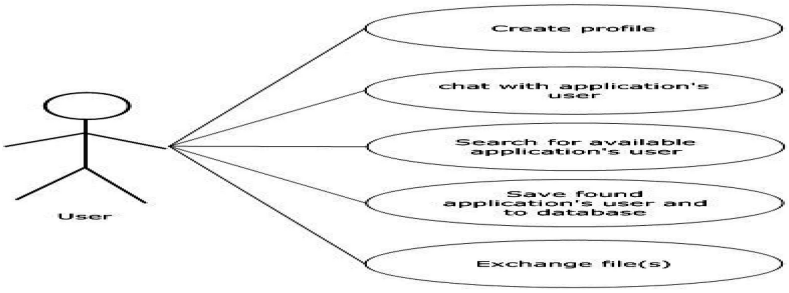


**Fig. 2.** Use Case One

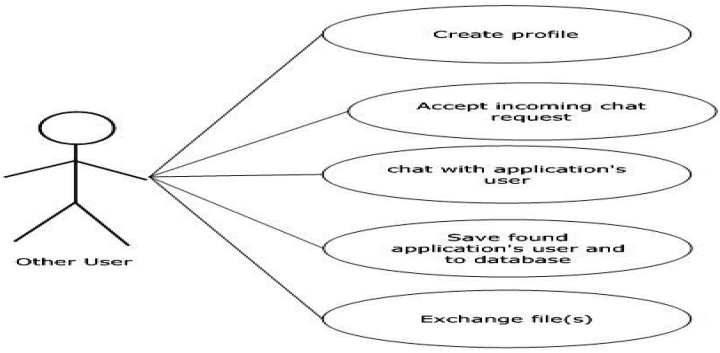


**Fig. 3.** Use Case Two

- Fill profile: The user (still new user) opens the application for the first time and fills in his/her personal information.
- Search for available users: The user will search for another user using the application that is within his/her device's Bluetooth adapter range.
- Start chatting with available users: The user will start chatting and exchanging text messages with other users using the application that within in his/her device's Bluetooth adapter range.
- Exchange files: The user can share or exchange files with other users using the application that within in his/her device's Bluetooth adapter range.
- Save other users' profiles: Other users' profiles will be saved on the user's device.

- User Case Two Scenario, Fig. 3:
  - Fill profile: The user (still new user) opens the application for the first time and fills in his/her personal information.
  - Accept chatting request: The other user may or may not accept a chatting request from another user using the application that is within his/her device's Bluetooth adapter range.
  - Chat with available users: The user will start chatting and exchanging text messages with other users using the application that within in his/her device's Bluetooth adapter range.
  - Exchange files: The user can share or exchange files with other users using the application that within in his/her device's Bluetooth adapter range.
  - Save other users' profiles: Other users' profiles will be saved on the user's device.

The Prototype screenshots of the Blue Chat application shows how simple and usable is the application's interface while and connecting and exchanging messages with other devices. These buttons and layouts are prebuilt within the Android operating system libraries. See Fig. 4.


**Fig. 4.** Prototype screenshots of the Blue Chat application

3. Implementation phase: the coding of the application would be worked upon to reach the needed functionalities needed to be implemented in the software.
   Choosing the appropriate programming language is not difficult. Java is the best suited programming language for developing Android applications. Java is a well spread language with a lot of support and help documentation and resources. All the needed tools are free and easily installed. These tools are recommended by Google and are free. They include:

   - Java Development Kit (JDK): it is the foundation of the Android software development kit (SDK).
   - Android software development kit (SDK): Provides access to the Android's libraries and allowing developing for Android platforms.
   - Android Development Tools (ADT): Do all background work for developer, such as creating the files and structure required for an Android application.
   - Eclipse integrated development environment (IDE): provides tools or environment for writing Android programs and joins Java, the Android software development kit and the Android Development Tools (ADT) together.

4. Testing phase: Testing the application through various conditions and use cases would take place to ensure the software quality.

The Android software development kit contains cohesive testing framework that facilitates testing all components of an application and its functionalities using DDMS, AVD Emulator and the real physical device.

The authors installed the Blue Chat application and test it using HTC Desire HD mobile device running Android 2.3 (Gingerbread). See Table 1.

**Table 1.** Testing phase

| Test case | Functionality | Working |
|---|---|---|
| Fill in profile | Adds a social touch to the application | Yes |
| Save profile | Save the user's profile to be then exchanged with other users | Yes |
| Scan for users | Determines if there are available Blue Chat application users available for chatting | Yes |
| Accept chatting request | Accepts incoming chat request and start exchanging text messages | Yes |
| Exchange text messages | Send and exchange text messages among application's users | Yes |
| Exchange files | Send and exchange files among application's users | Yes |

## 6 Conclusion and Further Work

The goal of this paper is to create an Android application Blue Chat. This application would take the advantage of the wide spread of the Android operating system via varieties of devices. It is concerned with solving some problems of communicating freely, securely, silently and within small range. It is great for making new friends in a library or chatting up someone in crowded places. The paper application paves the ground for more Bluetooth applications.

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