Thesis for the Degree of Master of Computer Engineering

Design and Implementation of SMS Application based on Android

by

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Design and Implementation of SMS Application based on Android

안드로이드 기반 SMS 애플리케이션 설계 및 구현

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by

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Table of Contents

List of Figures

List of Tables

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Abstract

In modern world, mobile technology allows consumers to connect any location they need to stay; mobile devices are swiftly becoming the primary mean of mass communication for the people connected to the Internet. SMS (short-message-service) is a personal medium since it is similar to spoken communication, and is very efficient due to the fact that it can be deployed anywhere and cell phone service is available at any time. [4]

The android based SMS application design system is under the premise of smart phones, based on the characteristics of the Google android platform, the Eclipse development tools by means of Smartphone general SMS management system. In different circumstances, such as the mobile network / non-mobile network case to obtain the group chat feature. The group chat feature can flexibly transform which solve the problem of users in a particular case group chat problem, mobile phone text messages function is more perfect, and provide more convenient services for users.

1. Introduction

Mobile phone SMS having the features of easy-to-use, inexpensive, reliable, and fast accessible is becoming a way of communicating in popularity.

The mobile phone giant Motorola launched A6188 mobile phone in early 1999; it has been considered to be the ancestor of the smart phone and the world's first mobile phone with a touch screen. When it was released, it became the first choice for high-end business people. The Scandinavian Ericsson launched R380SC, the world's first Symbian OS cell phone in 2000. Google acquired android in 2005, and form the Open Handset Alliance to develop an improvement. Later years, android gradually extended to the platform computers and other fields. IOS, android's main competitor was first published on January 9, 2007 by Apple Inc. and designed for iPhone. Its appearance has the historic significance of the development of smart phones. And in 2011, android exceeded Symbian in the global market share for the first time. The data shows that in November 2011, android had accounted for 52.5% of the global smart phone operating system market share, in the main mobile phone brand like HTC / MOTO / Samsung.

In the area of mobile communications, with the improvement of the mobile network, mobile phone becomes smarter. The mobile application devoted the programming and software development to an emerging industry, covering all aspects of consumers' lives.

For SMS management messaging software, android itself only has the general function of sending and receiving. But the android open source enables programmer to develop software which can satisfy more users' needs. Among SMS management tools, there are some quite unique management tools.[9] In the Google app store, some SMS management software have particular functions. Anti SMS Spam & Private Box mainly focuses on spam SMS filtering, the character is that through setting a blacklist keyword to intercept the location of the sender. The Auto SMS it can set up a schedule, you automatically send text messages in the future of the family. GOSMS is a popular SMS application, which has the ability to filter spam messages, and IM features through using the mobile network.

This thesis designed for a SMS management software which is based on an android original system SMS software management tools to do the enhancements. The characteristics of the software tools are sending and receiving text messages and filtering SMS. Especially, it provides a group-chat function.

2. Related Work

2.1Principles of SMS

SMS stands for **S**hort **M**essage **S**ervice, which is a communications business between mobile phones to send messages. A mobile phone can communicate with the cell tower via the control channel, which makes the phone to get its signal area. The phone can switch to another area by means of roaming, every once in a while, the phone exchanges data packets with the tower to guarantee all working properly. When user sends text message, the message will be sent to the SMSC in the form of small packets through the control channel, and then through the mobile phone towers, the message will be sent to the target phone. SMS is a Store-and-forward service, which means the message will not be sent to the target phone directly. The advantage of this approach is that the target phone should not power on or in the service area. The messages are stored in the short message center, when the target phone power on or get into the service area, it will receive the messages automatically.

SMS can be divided into two types, **Point to Point** and **Point to Multipoint**. Point to point is currently the most widely used type, which can be divided into MO (Mobile Originated) and MT (Mobile Terminated).A complete short message transmission process is made up of a MO and MT to complete together. Figure 1 shows the principle of SMS

Point to multipoint is also known as cell broadcast. In a specific geographic area, SMSC(Short Message Service Center) sends the short messages with versatility, such as weather, traffic and other information broadcast regularly to the user who is currently in that region. Point to multipoint short messages does not provide the confirmation message that indicates that the client has received the message.

With the development of mobile technology, SMS usage becomes more frequent. With the popularity of smart phones, the use of SMS-based and integrated more functionality app software, smart phones will play more advantages, and bring users more convenience. In 2011, an U.S. survey pointed out that SMS is a useful medium, which provides more relevant services to users, its make more popular in the younger age groups.

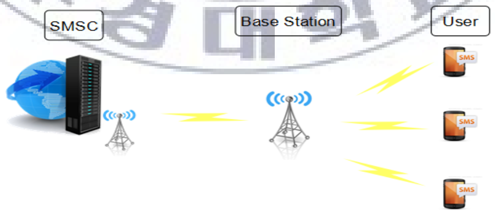


Figure 1. Principle of SMS

2.2 Researches on SMS apps based Android smart phones

In the research area, there are some advanced researches on the SMS apps development. For example, the paper [5] “Luxus SMS

Controller for Android based Smart Phones" proposed a SMS application which focused on the SMS manager and included some previous features like Group chat. The key features of the proposed application includes: Auto-Reply Modes, Auto-Messaging Modes, Group Chat, SMS Spam, Auto-Message Report. Its group chat function adopted a unique chat code generated by the designed app to identify the incoming messages that which chat the message belonged to. This group chat function totally adopted SMS to realize group chat. Obviously the design can make users to do group chat without the mobile internet condition. It only used the traditional Mass-SMS way. In this paper, it only proposed SMS way group chat. It will cost a large number of SMS if there are many group chat participators. And it needs to optimize the unique chat code to plug in the SMS content.

In the paper [1] "A Research and Design of Android Based Application", it proposed an instant messaging app to replace the original SMS function. And it adopted client / server socket function to carry out instant messaging function. And its problem is that it only realized one to one communication. And its server side lack visual interface, the server is just a message transmitter, users can't monitor the details of the chat message.

So this thesis refers the above research papers and solves the problems. The design not only optimizes the unique chat code, but also combines socket function, and uses two ways to do carry group chat. The features of the design in this thesis include:

1. Basic SMS : Provide the basic send and receive SMS function

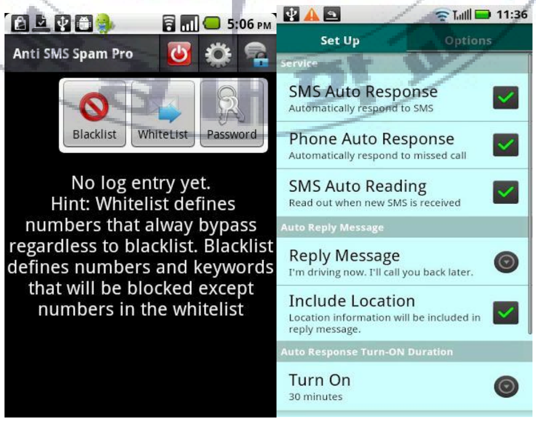
2. Spam: Adopt the designed database to restore spam messages

3. Group chat: In the internet condition, use socket communication function; in the non-internet condition, use mass-SMS function.

2.3 Current SMS apps & IM apps on Google Store

In the Google app market, there is some popular SMS management software currently: Anti SMS Spam & Private Box, Auto SMS, and GoSMS. These apps have their own characteristics.

Anti SMS SpamPrivate Box: Block number in blocked list, Block sender as name, i.e message received from your bank HSBC, Block unknown senders, Private Box with Password protected, Restore to Inbox, Import number from call log, SMSthreads and phone book, and compose/reply private SMS. Figure 2 shows the SpamPrivate Box.



No log entry yet.
Hint: Whitelist defines numbers that alway bypass regardless to blacklist. Blacklist defines numbers and keywords that will be blocked except numbers in the whitelist

Service

SMS Auto Response ☑
Automatically respond to SMS

Phone Auto Response ☑
Automatically respond to missed call

SMS Auto Reading ☑
Read out when new SMS is received

Auto Reply Message

Reply Message
I'm driving now. I'll call you back later.

Include Location ☑
Location information will be included in reply message.

Auto Response Turn-ON Duration

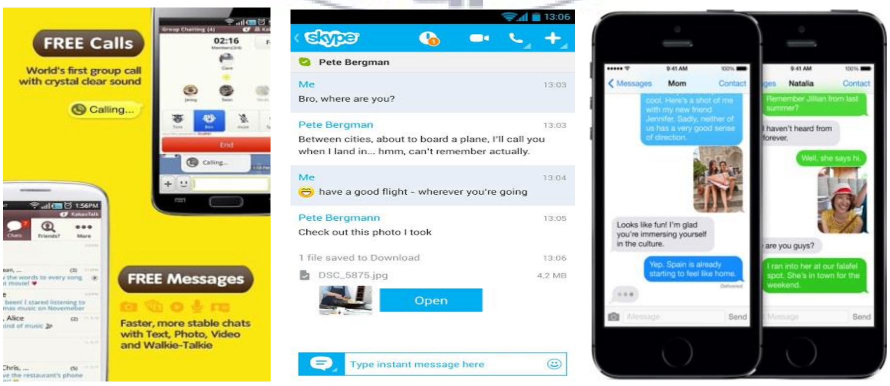
Turn On
30 minutes

Figure2. AntiSMS SpamPrivate Box

Auto SMS: SMS Auto responder, SMS scheduler, SMS Reader, Instant SMS, SMS Forwarder. This app responds to incoming SMS and missed call automatically and is able to set a schedule to send SMS in future time. And it also can read out SMS in some supported languages.SMS forwarding and many more features are also available.

GoSMS: Custom theme, integrated IM chat, private mail, regular SMS, SMS intercept, cloud backup and other functions. GoSMS is a relatively successful and popular commercial app.

Instant messaging (IM) is a type of online chat which offers real-time text transmission over the Internet.[3][10]And mobile technology has also facilitated the development of mobile instant messaging, which is the technology that allows instant messaging services to be accessed from a portable device, ranging from standard mobile phones to smart phones. These apps use some popular protocols, such as XMPP, SIMPLE, XML-RPC, SOAP, etc. [2] [6] There are some representative apps, like What's App, Kakao Talk, Skype, QQ etc. Figure 3 shows the popular IM based communication applications on smart phone.


FREE Calls
World's first group call with crystal clear sound
Calling...
02:16
End
Chats
Friends
More
FREE Messages
Faster, more stable chats with Text, Photo, Video and Walkie-Talkie
13:06
skype
Open
Type instant message here
9:41 AM
Messages
Mom
Contact
Natalia
iMessage
Send
Delivered

Pete Bergman

Me 13:03
Bro, where are you?

Pete Bergman 13:03
Between cities, about to board a plane, I'll call you when I land in... hmm, can't remember actually.

Me 13:04
have a good flight - wherever you're going

Pete Bergmann 13:05
Check out this photo I took

1 file saved to Download 13:06
DSC_5875.jpg 4.2 MB

cool. Here's a shot of me with my new friend Jennifer. Sadly, neither of us has a very good sense of direction.

Looks like fun! I'm glad you're immersing yourself in the culture.

Yep. Spain is already starting to feel like home.

Remember Jillian from last summer?

I haven't heard from forever.

Well, she says hi.

are you guys?

I ran into her at our falafel spot. She's in town for the weekend.

Figure3. Current IM Applications

In the iOS field, there is also a popular SMS app called iMessage.

This app is designed by Apple Inc. and combines many functions. It lets users send messages back and forth with anyone on iPad, iPhone, iPod touch, or a Mac running Mountain Lion or later. Send photos, videos, locations, and contacts, too. And users can text and send photos and videos via MMS to other mobile phones over cellular networks. And the outstanding point of the app is that it combines the internet function to the traditional SMS service. It uses green and blue messages to identify internet message and SMS message.

2.4 Bulk SMS

Bulk SMS is the mean of the dissemination of large numbers of SMS messages for delivery to mobile phone terminals. When users edit a text message or forward relevant messages, they can edit multiple phone numbers for SMS blasts. Figure 4 shows the course of Bulk SMS. It is often used by media companies, enterprises, banks (for marketing and fraud control) and consumer brands for a variety of purposes including entertainment, enterprise and mobile marketing. Using the feature of bulk SMS, we can realize the group chat feature. The principle is that, group chat members can use each other's phone number as the destination address, to send a message, which can be sent to multiple objects. [5]

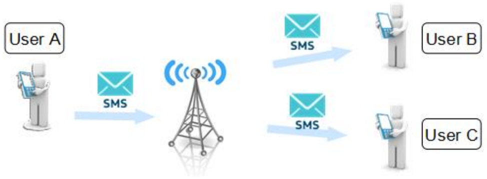


Figure4. Bulk SMS

2.5 Socket Communication

There are two ways of communication between android client and server: http communication and socket Communication. The difference is that, http connection uses "request - response" approach, that is, when client requests, it will establish a connection channel, when the client send a request to the server, the server can return data to the client. But the socket communication is directly doing data transmission after established connection , the connection can be achieved taking initiative to push information, without sending a request to the server every time.

Socket is an abstraction layer, through which an application can send and receive data. Using the socket, applications can be added to the network to communicate with other applications in the same network, there are some android chatting-room apps based on that principle. [8] Socket provides the port of the program internal and the external communication, and provides the transmission channel for the communication parties. Figure 5 shows the link process of socket communication.

The principle of TCP Socket:

On the server side, the server declares Server Socket object and specifies a port number, and then call ServerSocket's function accept() method to accept data from the client, accept() method is in the blocking state if no data received in. Once the data is received, then read the receive data via inputstream.

On the client side, the client creates a Socket object that specifies the server's ip address and port number, and reads the data through inputstreams, accesses to data sent by the server, and then writes the data which is to be transmitted into outputstreams, realizing TCP protocol based socket data transmission [1].

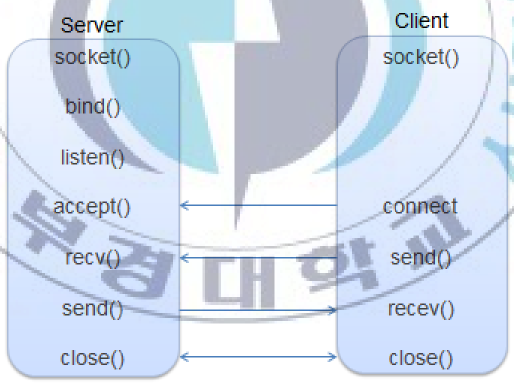


Figure5. Connection-oriented sockets

2.6 Analysis of Android Platform

Android, the name of open source Linux-based mobile operating system, is developed by Google Inc. in 2007.It mainly used in mobile devices such as smart phone and tablet PC as well as other areas, such as TVs, digital camera, etc. Till 2011, android beats Symbian in the global market share. In November 2012, survey data showed that android had accounted for a 76% market share of the global smart phone operating system [7].

2.6.1 Android Components

There are four major components. Activity: performance features. Service: running in the background and non-interface rendering. Broadcast Receiver: receive broadcast. Content providers: support multiple applications to store and retrieve data, play a role of database.

- Activities: in android, Activity is the essential for all programs; all programs' processes are running on the Activity. Activity represents a screen of the phone. An android application contains a number of Activities. They can jump to each other. When you open a new Activity, the previous one will be paused, and be pushed into the History Stack, user can rollback to returns to the previous screen
- Service: it has the similar run level with Activity, but it can only run in the background and interact with other components
- BroadcastReceiver: in android, Broadcast is a mechanism which is widely used to transmit information between applications. And BroadcastReceiver is a component of

filtering to accept and respond to the sending Broadcast. BroadcastReceiver does not generate UI so that user could not see it. And it notifies user via NotificationManager what has happened. BroadcastReceiver can register in the AndroidManifest.xml file, and use the method Context.registerReceiver() in the running code to register.

- Content Provider: Content Provider is the Third-party application data access scenarios provided by android. In android, the data is closely guarded, an application's databases, files, etc. do not allow other programs to directly access to. Android provides Content Provider, and applications can derive Content Provider to provide data.

2.6.2 SQLite

SQLite is a popular embedded database which supports SQL language, using limited memory to achieve a good performance. In addition, it is open source, anyone can use it. SQLite contains several components: Core, Backend, SQLCompiler, Accessories. Through using VM (Virtual Machine) and VDBE (Virtual Database Engine), SQLite makes it easy to debug, modify and extend SQLite kernel. Android uses integrated SQLite at run-time. Every android application can use SQLite. Android provides SQLiteOpenHelper class to create a database, which means you just need to inherit the class SQLiteOpenHelper, and then you can create your database.

3. SMS Management System Design

This chapter mainly introduces the SMS management system development environment, development tools, system architecture and implementation of each function modules.

3.1 Development Environment Requirement

The system design needs Eclipse development tools, operating system windows XP 32bit (or above), Java Developer Kit (JDK 6 and above) and Java Runtime Environment configuration. Eclipse is an IDE (Integrated Development Environment), which can provide developers with a more flexible development. Eclipse is an open source Java software development tool using “platform + plug-in” architecture, and takes platform as a vessel, all the functions are packaged in the plugins, and through plugin components to build the development environment. This feature enables Java developers realize desired functions through different plugins.

ADT (Android Development Kit) is a necessary eclipse plug-in for android software developing; Android SDK (Software Development Kit) provides developers with library files and other development tools. The AVD (Android Virtual Device) provides platform for software simulation and testing.

3.2 System Architecture

The SMS management tool not only has general messaging management tool capabilities, such as send and receive text messages on spam messages are filtered, but also the most important is that it has a group-chat feature. The difference of Group chat with other messaging management tools in different circumstances is that; adopt different ways to achieve a group chat function. Using socket communications to realize group chat when online network environment and using Bulk Message feature for group chat during offline. This feature has the advantage that in the poor network signal or no network environments and it can also provide users group chat services.Figure6 shows the system structure of android based SMS management application tool.

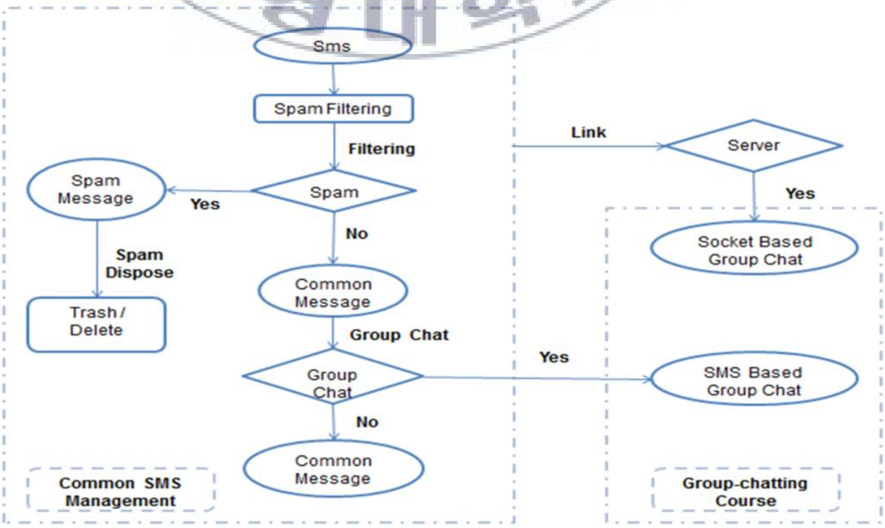


Figure6. System structure

3.3 System Module Introduction

This section mainly describes android based SMS management system's modules. The application's client contains these packets: **com.lurely.chat**,**com.lurely.conversation_adapter**, **com.lurely.database**, **com.lurely.service**, **com.lurely.SMS_v1**. In details, **com.lurely.chat** packet contains the classes which achieve the funtion of group-chat, such as the SMS Group and Internet Group. **com. lurely. conversation_adapter** packet contains the classes of adaptering of group-chat interface. **com.lurely.database** packet contains the classes of creating and using database. This thesis designs the system that contains a custom database to store the blacklist and spams. **com.lurely.service** packet contains the classes of SMS monitoring services. And **com.lurely.SMS_v1** packet mainly contains the main Activity classes of this application, such as Inbox, Outbox, New message, SMS blacklist, spam message. Server-side contains the packet **cn.lurely.socketserver**, being used as the Internet-Group chat server. It mainly adopts socket communication technology.

Figure7 shows the framework when the SMS management system is running. When the application starts, the class **SMSService** is started and running in the background, monitoring incoming SMS text messages and doing the corresponding operation. **MainActivity** is the default launched Activity, other Activities can be switched with each other like a tab. **SendList** shows the Outbox list, **ReceiveList** shows the Inbox list, **BlackList** shows the blacklist and **GroupList** shows the group-chat interface respectively.

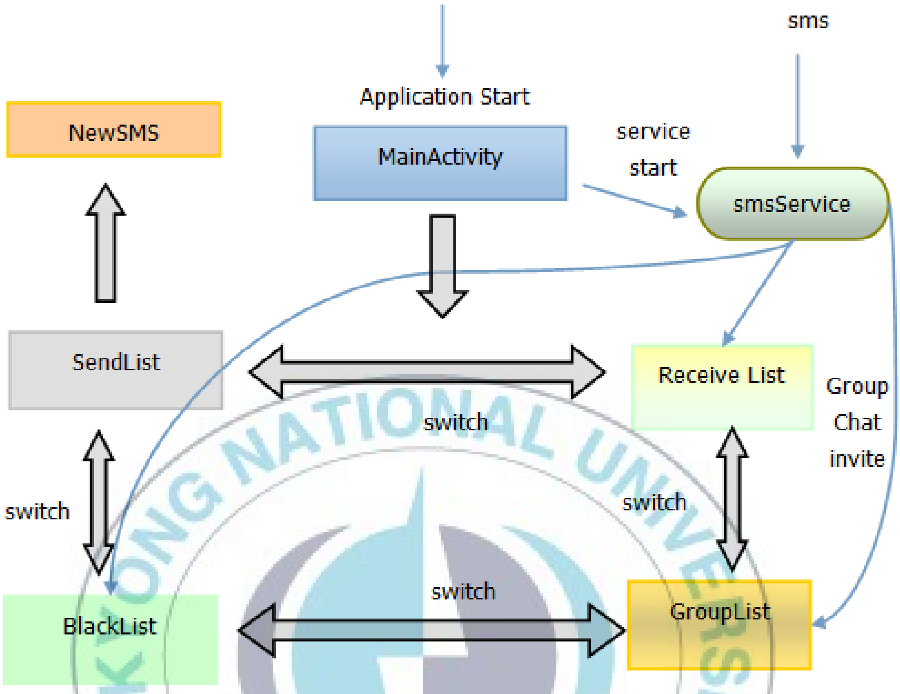


Figure7. Running mechanism of main Activities

3.3.1 System Database

The packet**com.lurely.database** contains the classes of creating the SMS management system database. **ChattingAdapter** is a subclass which inherits the class **SQLiteDatabase**. This class takes care of opening the database if it exists, creating it if it does not have, and upgrading it as necessary. Transactions are used to make sure the database is always in a sensible state. And the class makes it easy for ContentProvider implementations to defer opening and upgrading the database until first use, to avoid blocking application startup with long-running database upgrades. And class **DatabaseUse** refactors the methods to operate the self-built database. Table 1 shows the content of the packet **com.lurely.database**.

Table 1. Packet com.lurely.database

Class	Main Function
DatabaseHelper	Inheriting from the class SQLiteDatabase
DatabaseUse	Contains methos to operate on database

The class **DatabaseHelper** creates five tables to store the data. Table “Name” is used for storing the blacklist phone numbers. Table “Record” is used for storing the spam messages. And the other three tables are used for further extensions.

The method to create the database is as follows:

```
create table Name(...);

create table Word(...);

create table Record(...);

create table Key(...);

create table Password(...);
```

The class **DatabaseUse** defines some methods to do the operations on the database. Table 2 shows the main methods of class

DatabaseUse.

Table 2. Main methods of class DatabaseUse

DatabaseUse	
Method	**Main function**
Insert	Insert data into different tables
Update	Update the database
Delete	Delete the data from the database
Query	Query data from the database

3.3.2 Service Method

The packet **com.lurely.service** contains the class of SMSmonitoring service. Class **SMSService** and class **LurelyIntentReceiver** declare some custom broadcast identification constants, these contants can identify the SMS types (common SMS, group chat SMS or spam SMS), with different types to different operations. Table 2 shows the classes in packet **com.lurely.service.**

Table 3. Packet com.lurely.service

Class	Main Function
SMSService	Monitoring the system incoming SMS
LurelyIntentReceiver	Mass SMS based group chat monitoring

The table 4 shows the group-chatting keyword variables used in the SMSService class, first defines the group chat keyword variables. These string variables will be added into the original SMS to be used as the group-chat key words. When the designed application detects these key words, the system will do the corresponding operations.

Table 4. Group chat keyword variables

Variable	Main Function
strInviteWord	Group chat invitation code
strPlusWord	Agree to add to the group chat invitation
strGTWord	Indicate that the SMS message is a group chat content
strInWord	Be used for group chat invite operation
strQTWord	Quit the group chat

Example source code of the keyword:

```
private static String strInviteWord = "<invite>" ;
private static String strPlusWord = "<plus>";
private static String strGTWord = "<gt>";
private static String strInWord = "<in>";
private static String strQTWord = "<qt>";
```

The table 5 shows the custom broadcast variables. The service receives the incoming SMS message and sends the corresponding broadcast to the application. BroadcastReceivers receive them and implement the corresponding intents.

Table 5. Group chat broadcast variables

Variable	Main Function
LURELY_SERVICE_IDENTIFIER	Group chat invitation broadcast
GT_IDENTIFIER	Group chat content broadcast
PLUS_IDENTIFIER	Agree to add into group chat broadcast
QT_IDENTIFIER	Quit group chat broadcast
LURELY_SMS_ACTION	SMS receive broadcast

```
    public static final String LURELY_SERVICE_IDENTIFIER =
"LURELY_ON_SERVICE_001";
    public static final String GT_IDENTIFIER = "GT_MESSAGE";
    public static final String PLUS_IDENTIFIER = "PLUS_MESSAGE";
    public static final String QT_IDENTIFIER = "QT_MESSAGE";
   private static final String LURELY_SMS_ACTION =
   "android.provider.Telephony.SMS_RECEIVED";
```

The followings are the methods defined in the class **SMSService**. The method **isCommandSMS()** compares two variables to detect whether or not the SMS contains the specific key word code. If the message contains the code, the method will send the corresponding broadcast. The example source code is as follows

```
   if(isCommandSMS(strInviteWord,content)) //To monitor the key words in
SMS
            {
                if(isCommandSMS(strInWord,content))
                {
                    Intent i= new Intent(LURELY_SERVICE_IDENTIFIER);
                }
            }
    if(isCommandSMS(strGTWord,content))
            {
                Intent gtintent = new Intent(GT_IDENTIFIER);
            }
   if(isCommandSMS(strQTWord,content))
            {
                Intent qtintent = new Intent(QT_IDENTIFIER);
            }
   if(isCommandSMS(strPlusWord,content))
            {
                Intent plusintent = new Intent(PLUS_IDENTIFIER);
            }
```

3.3.2 Main Interface

The table 6 shows the packet **com.lurely.SMS_v1 content**, which contains the class of the main Activities. **MainActivity** is the first Activity when the application starts, the other Activities can switch with each other. **ReceiveList** and **SendList** use listview to display the Inbox and Outbox list respectively through accessing the SMS database. **NewSMS** is the Activity of creating new SMS. **SMSDetails** shows the detail information of the Inbox and Outbox. **BlackList** use listview to display the added blacklist phone number. Record displays the spam SMS.

Table 6. Packet com.lurely.SMS_v1

Class	Main Function
MainActivity	The main screen when application starts
ReceiveList	Show the Inbox message list
SendList	Show the OutBox message list
NewSMS	Create the new message
BlackList	Show the blacklist phone number
Record	Show the spam message list
SMSDetails	Show the detail information of SMS

3.3.3 Group Chat Module

The **SMSGroup** uses the bulk SMS feature. User A sends group chat invitation SMS to user B. And user B receives the invitation and then to do the response. If user B accepts the invitation, he will send a responsive SMS to user A. And user A and B enters the group chat interface. If user B refuses the invitation, the application will neglect the message. All the invitations and group chat message information use the uniform codes generated by the application. And the codes are sent in the SMS type. Through this method, the number of participants can be more than three users.Figure8 shows the SMS based group chat scheme.

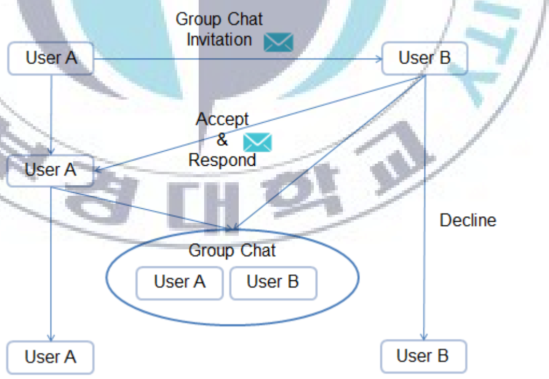


Figure8.SMS Group chat Scheme

The packets **com.lurely.chat** and **com.lurely.conversation_adapter** realize the function of group-chat. Besides, packet **com.lurely.chat** contains the mass-SMS based and internet based group chat classes. And packet **com.lurely.conversation_adapter** contains the method of inheriting class BaseAdapter to make group chat interface more colorful. Tables 7 and 8 show the two packets.

Table 7. Packet com.lurely.chat

Class	Main Function
GroupList	Main screen for user to select the group-chat type
SMSGroup	Group-chat base on mass-SMS
InviteActivity	Send invitation to other users to join the group chat
InviteDialogActivity	Response the invitation of the group chat
SocketGroup	Group-chat base on internet

Table 8. Packet com.lurely.conversation_adapter

Class	Main Function
ChatMessage	Inheriting from the class BaseAdapter to adapt the group chat
ChattingAdapter	Make the group chat interface obtain the bubble effect

The **SMSGroup** class defines a class **GTReceiver** that inherits BroadcastReceiver. The receiver can accept custom broadcasts: **GT_MESSAGE**, **PLUS_MESSAGE**, and **QT_MESSAGE** to realize the mass SMS based group chat function. The example source code is as follows:

```
public class GTReceiver extends BroadcastReceiver
 {
     public void onReceive(Context context , Intent intent)
     {
         if(intent.getAction().equals(GT_IDENTIFIER))
         {
                 //send group chat message to other users.
                 //Display the message on the screen
         }
         if(intent.getAction().equals(PLUS_IDENTIFIER))
         {
             //plus the group chat user's number
         }
         if(intent.getAction().equals(QT_IDENTIFIER))
         {
             //quit the group chat, and send quit code to
             //other group chat users.
         }
     }}
```

In the client-side, the **SocketGroup** class implements socket communication. It declares Socket object and datastream object to send and receive messages with the server. Table 9 shows the declared objects in SocketGroup activity.

Table 9. Declared objects in SocketGroup

object	Main Function
socket	Declare Socket object socket
thread	Declare Thread object thread
dataInputStream	Declare DataInputStream object
dataOutputStream	Declare DataOutputStream object

The example source code is as follows:

```
    public class SocketGroup extends Activity implements Runnable {
    Socket socket; Thread thread;
    DataInputStream dataInputStream;
    DataOutputStream dataOutputStream;
    boolean flag = false;
    try{socket = new Socket(ip,PORT);
    dataInputStream = new DataInputStream(socket.getInputStream());
    dataOutputStream = new DataOutputStream
(socket.getOutputStream());
        dataOutputStream.writeUTF();
        }catch(IOException e1){
              System.out.println("Sorry,  connection failure! ! !");
        }thread = new Thread(SocketGroup.this);
           thread.start();}
```

On the server side, it contains four classes: BroadCast, ClientThread, Server, and ServerThread. The class Server is the main class. It displays an interface for user to start the application. The other clients can connect to the server to communicate with each other. The ServerThread class is server monitoring port thread. It can monitor the new client's connections and record client connections and messages need to be sent. BroadCast can send messages to clients. ClientThread keeps connections between sever and each client, receiving messages sent from clients. Table 10 shows the main classes in server-side.

Table 10. Main classes in Server-side

Class	Main Function
BroadCast	send messages to clients
ClientThread	keep connections between sever and each client, receiving messages sent from clients
Server	The main interface, start ServerThread
ServerThread	Monitor new connections and record connections and messages need to be sent

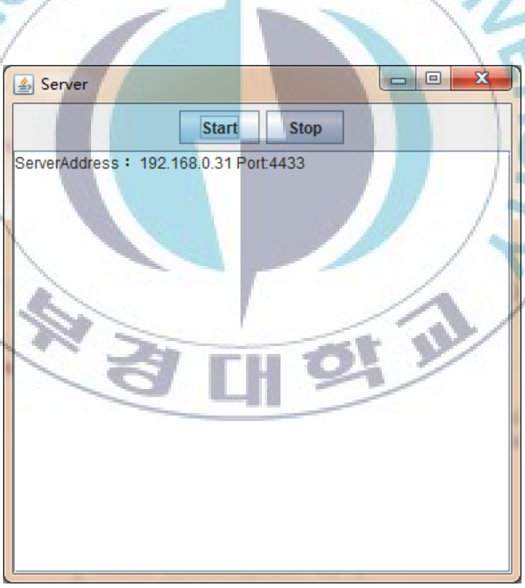
The designed android based SMS management tool can not only send and receive messages, read and write messages, but also has functions of group chat and message blacklist. To realize these functions, we must declare the corresponding Activities and permissions. The example code is as follows:

```
    <service
    android:name="com.lurely.service.SMSService"
    android:exported="true"
    android:process=":remote"
    ></service>
    <uses-permissionandroid:name="android.permission.SEND_SMS"/>
    <uses-permissionandroid:name="android.permission.RECEIVE_SMS
"/>
    <uses-permissionandroid:name="android.permission.WRITE_SMS"/
>
    <uses-permissionandroid:name="android.permission.READ_SMS"/>
    <uses-permission
    android:name="android.permission.READ_CONTACTS"/>
    <uses-permission
    android:name="android.permission.RECEIVE_BOOT_COMPLETED"/
>
    <uses-permissionandroid:name="android.permission.INTERNET"/>
    <uses-permission
    android:name="android.permission.WRITE_EXTERNAL_STORAGE"/
>
```

4. Deployment and System Test

4.1 Server

Server-side application is running on the computer as a stand-alone Java application, and set the port number 4433, as well as the computer's IP address 192.168.0.31. The client will take this ip as the default connection address. This server application will record the internet based group chat messages.Figure9 shows the initial interface of Server-side.

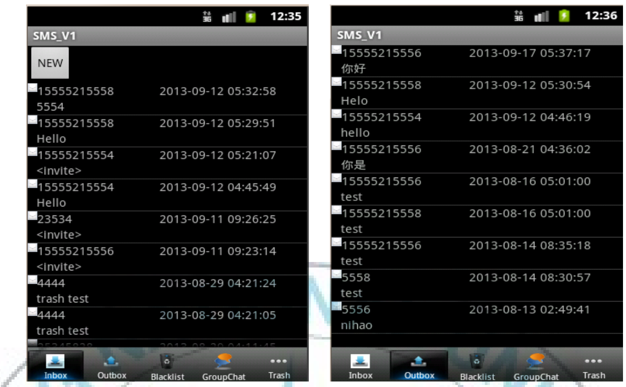


ServerAddress： 192.168.0.31 Port:4433

Figure9. Server-side Interface

4.2 Client

The Inbox and Outbox access the system SMS database and display the in/out messages in the list. User can click the list to get into the detail message to see the full content of the message and reply the message to the sender. The following shows the test result.Figure10 shows the Inbox and Outbox interface.

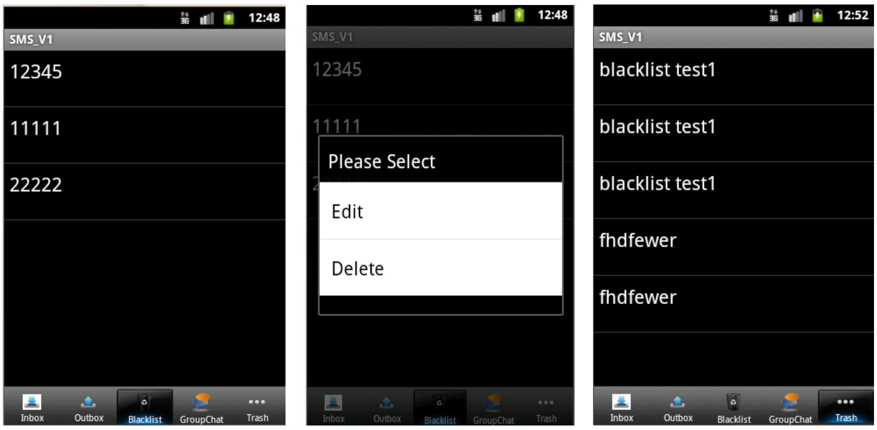


15555215558 2013-09-12 05:32:58
5554
15555215558 2013-09-12 05:29:51
Hello
15555215554 2013-09-12 05:21:07
<invite>
15555215554 2013-09-12 04:45:49
Hello
23534 2013-09-11 09:26:25
<invite>
15555215556 2013-09-11 09:23:14
<invite>
4444 2013-08-29 04:21:24
trash test
4444 2013-08-29 04:21:05
trash test

15555215556 2013-09-17 05:37:17
你好
15555215558 2013-09-12 05:30:54
Helo
15555215554 2013-09-12 04:46:19
hello
15555215556 2013-08-21 04:36:02
你是
15555215556 2013-08-16 05:01:00
test
15555215558 2013-08-16 05:01:00
test
15555215556 2013-08-14 08:35:18
test
5558 2013-08-14 08:30:57
test
5556 2013-08-13 02:49:41
nihao

Figure10. Inbox & Outbox

The blacklist can filter the spam message number. User can edit the blacklist to add or delete the blacklist number. The incoming spam message will be removed to the trash. User can edit the trash to delete or restore the spam message to Inbox. Figure11 shows the blacklist interface.

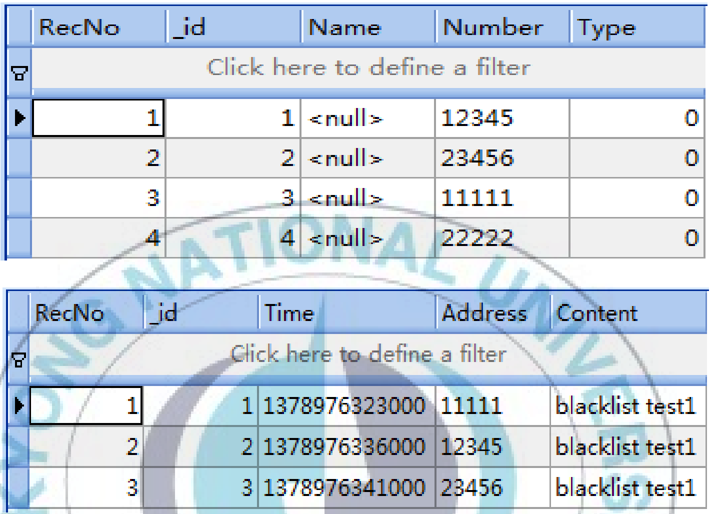


12345
11111
22222

blacklist test1
blacklist test1
blacklist test1
fhdfewer
fhdfewer

Figure11. Blacklist & edit

The blasklist and trash data are stored in the self-built database.The file's name is SMSLurely.db. Use PC software "SQLite Expert" to open the database file. Figure12 shows the stored information of database.

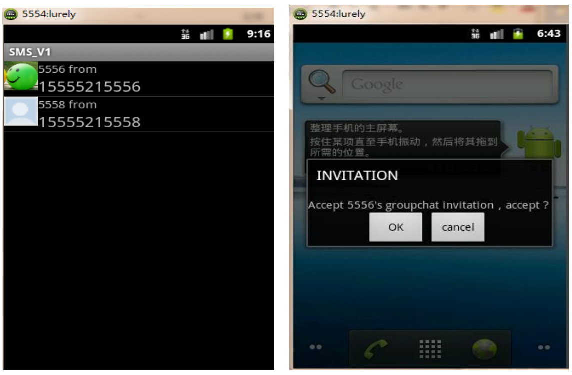


RecNo	_id	Name	Number	Type
Click here to define a filter				
1	1	<null>	12345	0
2	2	<null>	23456	0
3	3	<null>	11111	0
4	4	<null>	22222	0

RecNo	_id	Time	Address	Content
Click here to define a filter				
1	1	1378976323000	11111	blacklist test1
2	2	1378976336000	12345	blacklist test1
3	3	1378976341000	23456	blacklist test1

Figure12. Blacklist Database &Trash Database

Figures 13, 14, 15 show the course of mass-SMS group chat. User A send an ivitation to User B. And User B receives the invitation, he can accept or deline the invitation. If he receives the inviation, he will enter the group chat interface. The group chat user's number will be showed in the title bar. User A and user B can start group chatting. And the number of group chattting user can be more than three persons. The test result is as follows:



5554:lurely

9:16

SMS_V1

5556 from
15555215556

5558 from
15555215558

5554:lurely

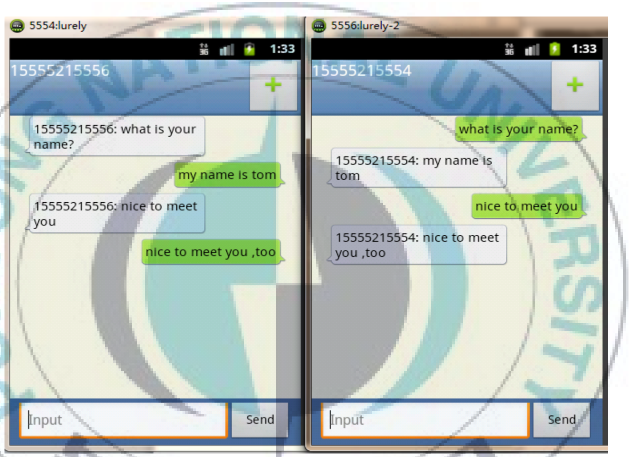
6:43

整理手机的主屏幕。
按住某项直至手机振动，然后将其拖到所需的位置。

INVITATION

Accept 5556's groupchat invitation，accept ?

Figure13. Send Invitation &Receive Invatation



5554:lurely

1:33

15555215556

15555215556: what is your name?

my name is tom

15555215556: nice to meet you

nice to meet you ,too

5556:lurely-2

1:33

15555215554

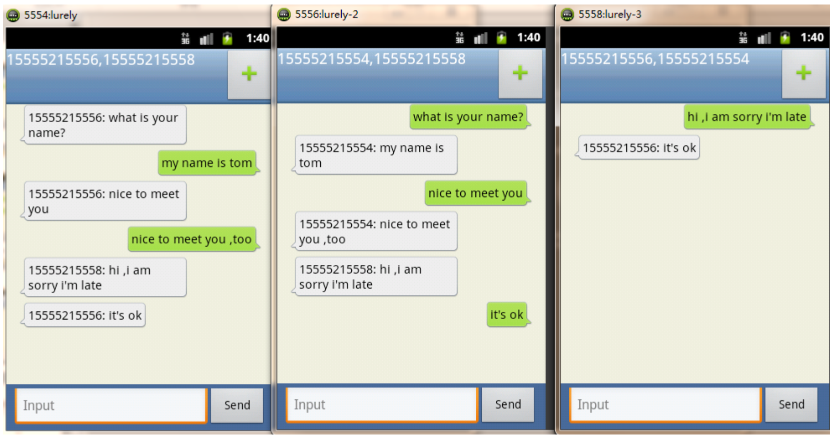
what is your name?

15555215554: my name is tom

nice to meet you

15555215554: nice to meet you ,too

Figure14. User A & user B Communication



5554:lurely

1:40

15555215556,15555215558

15555215556: what is your name?

my name is tom

15555215556: nice to meet you

nice to meet you ,too

15555215558: hi ,i am sorry i'm late

15555215556: it's ok

5556:lurely-2

1:40

15555215554,15555215558

what is your name?

15555215554: my name is tom

nice to meet you

15555215554: nice to meet you ,too

15555215558: hi ,i am sorry i'm late

it's ok

5558:lurely-3

1:40

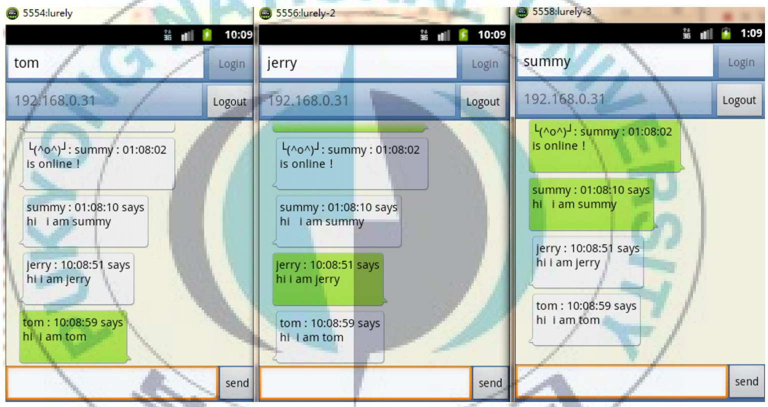
15555215556,15555215554

hi ,i am sorry i'm late

15555215556: it's ok

Figure15. Three Users Communication

The internet-based group chat function considers the situation that when the user can connect their smart phones to the internet. They can use wifi/3G network to create internet-based group chatting room. The test is on the android virtual devices. The PC is the server. Clients connect to the server to realize group chat. The communication log will be recorded in the server-side application's list. Figures 16,17 show the course of Socket based group-chatting.

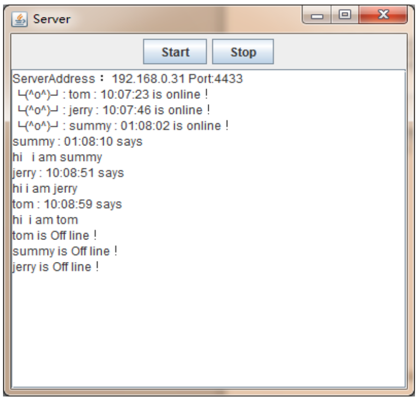


```
tom
192.168.0.31
└(^o^)┘: summy : 01:08:02
is online !
summy : 01:08:10 says
hi   i am summy
jerry : 10:08:51 says
hi i am jerry
tom : 10:08:59 says
hi  i am tom
```

```
jerry
192.168.0.31
└(^o^)┘: summy : 01:08:02
is online !
summy : 01:08:10 says
hi   i am summy
jerry : 10:08:51 says
hi i am jerry
tom : 10:08:59 says
hi  i am tom
```

```
summy
192.168.0.31
└(^o^)┘: summy : 01:08:02
is online !
summy : 01:08:10 says
hi   i am summy
jerry : 10:08:51 says
hi i am jerry
tom : 10:08:59 says
hi  i am tom
```

Figure16. Socket-based Group Chat



```
ServerAddress：  192.168.0.31 Port:4433
 └(^o^)┘ : tom : 10:07:23 is online !
 └(^o^)┘ : jerry : 10:07:46 is online !
 └(^o^)┘ : summy : 01:08:02 is online !
summy : 01:08:10 says
hi   i am summy
jerry : 10:08:51 says
hi i am jerry
tom : 10:08:59 says
hi  i am tom
tom is Off line !
summy is Off line !
jerry is Off line !
```

Figure17. Communication Log

4.3 Test Result Analysis

In summary, the test result shows that the designed android based SMS management tool in this thesis extends the system SMS functions.

Table 11 shows the comparison between the proposed application and the other applications. The related papers [1] [2] [6] designed the group chat applications that are mainly based on internet. The communication capacity can accommodate hundreds of users, but limited to the network environment. Paper [5] showed the mass SMS based SMS management application. It used the similar way to realize group chat communication function. Obviously, it will take a large cost of SMS charges.

The designed application in this thesis can solve the above problems. First, the blacklist can be edited and user can edit the spam messages, restore the messages that are not spam messages. Second, the group chat function provides different situations for users. The mass SMS based group chat function is used in the poor internet situation. The system uses mass SMS to realize group chat. The internet based group chat function is in the internet situation. The communication type provides users more convenience and more selectivity.

In the future research, there will be more functions, such as Bluetooth based group chat, SMS message encryption, etc. These functions will make the designed application more useful and popular.

Table 11. Comparison to Other SMS Applications

Application / Comparison	Proposed Application	Paper[5] Application	Paper[1] Application
Communication form	1 : N	1 : N	1 : 1
Server service	YES	NO	YES
SMS monitoring	YES	YES	NO
Spam & Blacklist manage	YES	NO	NO
Internet requirement	Socket based group chat	NO	YES
Group chat function	YES	YES	NO

5. Conclusion

Today, mobile applications especially in the communication area are increasing. But with different characteristics, not all of them can grasp users' choices. The key to grasp the user's choice is that, there should be user-friendly interface and convenient functions. In this thesis, the designed application has the function to hold users 'favorites.

Firstly, this thesis chose android platform as the development platform. Then, we studied the SMS history, researched the android platform features and android application framework. Finally, the thesis took advantage of the characteristics of group chat and instant messaging communication software features, designed the group chat function to meet the needs of group chat in different conditions.

In comparison with other SMS apps, the group chat function is outstanding. The test result shows that the designed SMS management application obtains not only the basic SMS system function but also the group chat function. In the future research, we will add and make improvement for more functions into the application, like Bluetooth based group chat, message content encryption, SMS GPS function, etc. We hope these extensions would make the application more efficient and convenient in order to capture the consumers' choices.

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