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Short message service remotely mobile device control

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Abstract Nowadays; the use of mobile technology becomes part of the daily activity in our life. Its impossible the advantage of any mobile instruments without disadvantage. The disadvantage of unprotected mobile is creating various problems. The most popular problem is that on mobile. Once the mobile owner has stored any personal data into own mobile phone device. It might be the personal data needed at a time such as (Forgetting, lost) anywhere. Furthermore, this makes the phone owner worry about all personal data and data face real danger from someone else because of stored personal data. The mobile device might be forgotten at home, work or anywhere, and the owner of the device unable to control the phone and very hard to reach stored data such as (Photos, Videos, Document files, Contact numbers, etc.). Our proposed application solves the subject matter that mentioned the remote control of Mobile using short messaging service (SMS) instead of the use of the Internet just in case the internet facility is not always available but the SMS availability of SMS is higher than the internet facility to change some of the mobile features. The suggested mobile application was modeling to designed and implemented to control mobile through using SMS only. The application can change ringing mode or send SMS containing mobile last location or also can search for a specific name in the contact names and send it to another mobile by analysing the incoming messages if the message contains specific message format (pin code, Action, reply). The suggested application was build and tested in the android operating system and in the real mobile device.

Keywords. Mobile device control; Short message service; Broadcast receiver; Android permissions.
2010 Mathematics Subject Classification. 65L05, 34K06, 34K28.

1. Introduction

Mobile computing has caught the research communities attention for more than a decade, and has also via smart-phones and PDAs reached the commercial industry and mainstream consumers, also the mobile computing improvement in hardware such as (better processing power, larger wireless network bandwidth), enhances capabilities of mobile devices [1]. There are similarities between Mobile applications and other Software apps in several faces such as: Security: protection of different devices (smart-phones, tablets, laptops, other portable devices), Performance: load up time of applications in devices and in addition Storage limitation: the fixed size of memory [2]. While, there are some differences: Interaction with other applications: the applications in mobile are multi sources, meaning the one mobile may have a large number of apps and there is a possibility of interaction between them. Sensor handling: modern mobiles like (smart-phones) have an accelerometer which will be affected by the movement of the device and a touch screen which does many jobs especially when it includes a virtual keyboard, microphone, connect to the internet with GPS scope, and back and front camera. The flexibility of the code for different O.S versions: unlike other softwares mobile apps are code flexible, meaning it works on almost any mobile device even if the operating system of those phones are different [2]. There are several actors intervening along the value chain in mobile application industry and because of arrival of software companies with new mobile phones and platforms such as the iPhone and Android these actors has changed, Some actors lost control of the device, others got new revenue streams and some became more seamlessly integrated into the platforms [1]. Most people now use mobile and they exposed to various problems, the

most serious one is related to the phone itself and the personal data inside it needed at a time such as (Forgetting, losing). A phone might get lost and this makes the phone and its data face real danger, or it might be forgotten at home, work or anywhere, and the user will be unable to control the phone and reach its data such as (Photos, Videos, Document files, Contact numbers, etc.). There are many ways that help in this case but they are not %100 effective, one of the ways is using internet, well not always a phone is connected to internet or maybe there is not an internet source at all, and even if it was connected still there is not much to do with that phone. The mobile phone is often available by Subscriber Identification Module Card (SIM Card) as default. It can be used to solve these problems, in addition to that; it makes the user unrestrained to a particular telecommunication company in any country. This paper aims to introduce a new mobile application to dell with situations that user may be facing:

(1) Forgot a phone at home and want to get a contact number to make an important call.
   - Just send an SMS to your phone with a contact name and you will get number back as an SMS.

(2) Change the sound profile of the phone from silent to normal mode so it can be found easily.
   - ust send an SMS to your phone with a contact name and you will get number back as an SMS.

(3) Lost a phone want to know the location exactly.
   - Get current location immediately through SMS message.

2. Android Application Components

Android is a software that was founded in Palo Alto of California in 2003, And it is a Linux based operating system it is designed primarily for touch screens mobile devices such as smart phones and tablet computers. In addition, it is one of the most widely used mobile OS these days. In the last 15 years, the operating system has developed a lot starting from black and white phones to recent smart phones or mini computers [5]. Android is an open source operating system for the smart phone [5, 13]. The hardware that supports android software is based on ARM architecture platform [5], which is a family of reduced instruction set computing (RISC) architectures for computer processors [6]. However technologies and performance together plays important roles in real life developments [14]. Application components are the essential building blocks of an Android application. These components are loosely coupled by the application manifest file AndroidManifest.xml that describes each component of the application and how they interact. There are four main components in android [3, 11]:

(1) Activities: It is a platform that appears to the user, which it handles the user interaction to the smart phone screen, and holds the UI components.
(2) Services: They handle background processing associated with an application.
(3) Broadcast Receivers: They handle communication between Android OS and applications.
(4) Content Providers: They handle data and database management issues.

FIGURE 1. Adding Receiver element in Manifest [1].

```
<receiver android:name=".MyBroadcastReceiver"  android:exported="true">
    <intent-filter>
        <action android:name="android.intent.action.BOOT_COMPLETED"/>
        <action android:name="android.intent.action.INPUT_METHOD_CHANGED" />
    </intent-filter>
</receiver>
```

FIGURE 2. Submit the Intent Filter [8].

```
IntentFilter filter = new IntentFilter(ConnectivityManager.CONNECTIVITY_ACTION);
filter.addAction(Intent.ACTION_AIRPLANE_MODE_CHANGED);
this.registerReceiver(br, filter);
```

2.1. **Broadcast Receiver.** This component is responsible for events that listen for or respond to the events. Events are represented by intent class. These intents are then routed to broadcast receiver. For example: SMS message is a broadcast receiver, for sending the message there is one broadcast receiver and for receiving message there is another broadcast receiver. A broadcast receiver is implemented as a subclass of Broadcast-Receiver class and each message is broadcaster as an Intent object [3, 12]. This component is able to register receivers for any system-level or application-level event. When that event happens, android system will tell the registered receivers about the execution of events respectively. Broadcast Receivers simply answer to broadcast messages from other applications or from the system itself. These messages are sometime called events or intents [3]. Android gives three ways for apps to send broadcast: Ordered Broadcast Receiver It is a type of broadcast which is sent in a synchronous way (i.e. one by one to each listener) [10]. Second type is Normal Broadcast Receiver, which are entirely asynchronous. The send Broadcast (Intent) method posts broadcasts to all receivers in an undefined order. This is more organized, but receivers cannot read outcome from other receivers, spread data received from the broadcast, or terminate the broadcast [11].and finally Local Broadcast Receiver by use Local Broadcast Manager. Send Broadcast method sends broadcasts to receivers that are in the same app as the sender. If no need to send broadcasts over apps, using local broadcasts is the best way. The implementation is much more systematic and no need to worry about any security problems related to other apps being able to receive or send user broadcasts and no overhead of system-wide broadcast [11]. There are two ways to register broadcast receiver in mobile application [10, 12, 13]: Manifest-declared (Statically) as shown in Figure 1 that receiver can be registered through AndroidManifest.xml file. While the second way of register broadcast receiver is Context-registered (Dynamically) a receiver dynamically through the Context.registerReceiver() method this way start with create an instance of BroadcastReceiver instants and IntentFilter as shown in Figure 1. Then submit the receiver by calling registerReceiver (BroadcastReceiver, IntentFilter) [11]. The main deference

FIGURE 3. Sending-SMS-message Permission in the Manifest.

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
      package="com.example.snazzyapp">

  <uses-permission android:name="android.permission.SEND_SMS"/>

  <application ...> ... </application>
</manifest>
```

between register broadcast receiver using Manifest-declared and Context-registered is in Manifest-declared the system package manager submits the receiver when the application is installed. The receiver then becomes an individual entry point into the application, which means that the system can start the app and deliver the broadcast if the app is not currently running, while in Context-registered the system package manager submits the receiver when the application in running mode only [8].

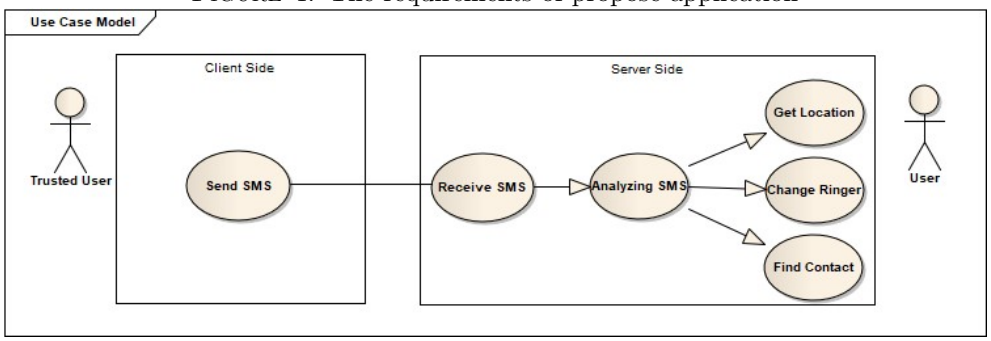
2.2. **Android permissions.** Android contains a permission system and predefined permissions for certain tasks. Every application can request required permissions. The cause of permission is to guard the privacy of an Android user. Android apps must ask permission to approach sensitive user data (such as contacts and SMS), as well as certain system features (such as camera and internet) [7, 13]. Depending on the feature, the system might give the permission automatically or might induce the user to accept the request. An application must announce the permissions it requires by containing ¡uses-permission¿ tags in the application manifest [7] as demonstrated in Figure 3. For example, an app that needs to send SMS messages would have this line in the manifest [7, 13]: There are two types of permissions (Normal, Dangerous):

(1) Normal permissions are those which are deemed harmless for the users privacy or the operation of other applications (For example the permission to set the time zone), Normal permissions are automatically granted to the application [7, 8].
(2) Dangerous permissions affect the users private information, or could potentially affect his data or the operation of other application (For example, the ability to read the users contact data or SMS messages), only dangerous permissions ask user acceptance. The way Android pose the user to grant dangerous permissions depends on the version of Android running on the user's device, and it must be granted by the user at runtime of the app [7, 8].

3. FRAMEWORK DESIGN

The idea is to control a lost phone through another phone by SMS, so another phone is needed to send the message through it. And it doesnt matter if the other phones platform is Android or not because only a message is needed from it. The application will be host on the user mobile (server side), it will read automatically all

FIGURE 4. The requirements of propose application



the incoming Message and analyzes it, after analyzing it will respond to the request which was written in the Message, coming from client side, and performs some action according to that request as explained in Figure 4 Use case diagram to demonstrated the requirements of propose application.

3.1. **The Messages Format.** The message should be written in a special format so the Application can recognize it and differentiates it from other messages. Message format should include three parts:

(1) Pin code: For security purpose a pin code should be registered to the app by user and this pin placed at the beginning of the message, so only the authorized user can remote control this mobile.
(2) User Order: in this part of a message the user should determine which action that the application perform and the action should be It must be predefined in the application as shown in Table 1 message format parts.
(3) Reply: finally, this part is optional which is getting reply SMS from the phone. Some actions the App will automatically answer the user without asking for it, like if the pin code in the received message is right, but action part does not match the operations specified in the App, then App should reply to the sender that the message not accepted.

TABLE 1. Message format parts.

Pin Code	User Request	Reply
****,	Location	
****,	Ringer: Silent	
****,	Ringer: Silent,	yes
****,	Ringer: General	
****,	Ringer: General,	yes
****,	Ringer: Vibrate	
****,	Ringer: Vibrate,	yes
****,	Contact: name	

The application checks each and every Message that comes to the Mobile in sequence steps:

(1) Step one it looks for the PIN code, if the message doesnt start with the PIN it will ignore it, and if the Message was starting with the PIN then it will accept it and starts checking the rest of the Message body.
(2) Step two it will check the body looking for similar Orders that it already has inside the system, if it didnt recognize the order it will send an Alarm message back to the sender to correct his order, and if it recognized the order it will try to perform the requested Action.
(3) Finally, it checks the Reply part, if the user wanted it to reply it will send him the result of the action which it done it, and if the user doesnt ask for reply it will not reply. These steps are explained in Figure 5 by using activity diagram.

3.2. **General Structure of the propose Application.** The propose Application contains the following parts as demonstrated in Figure 6:

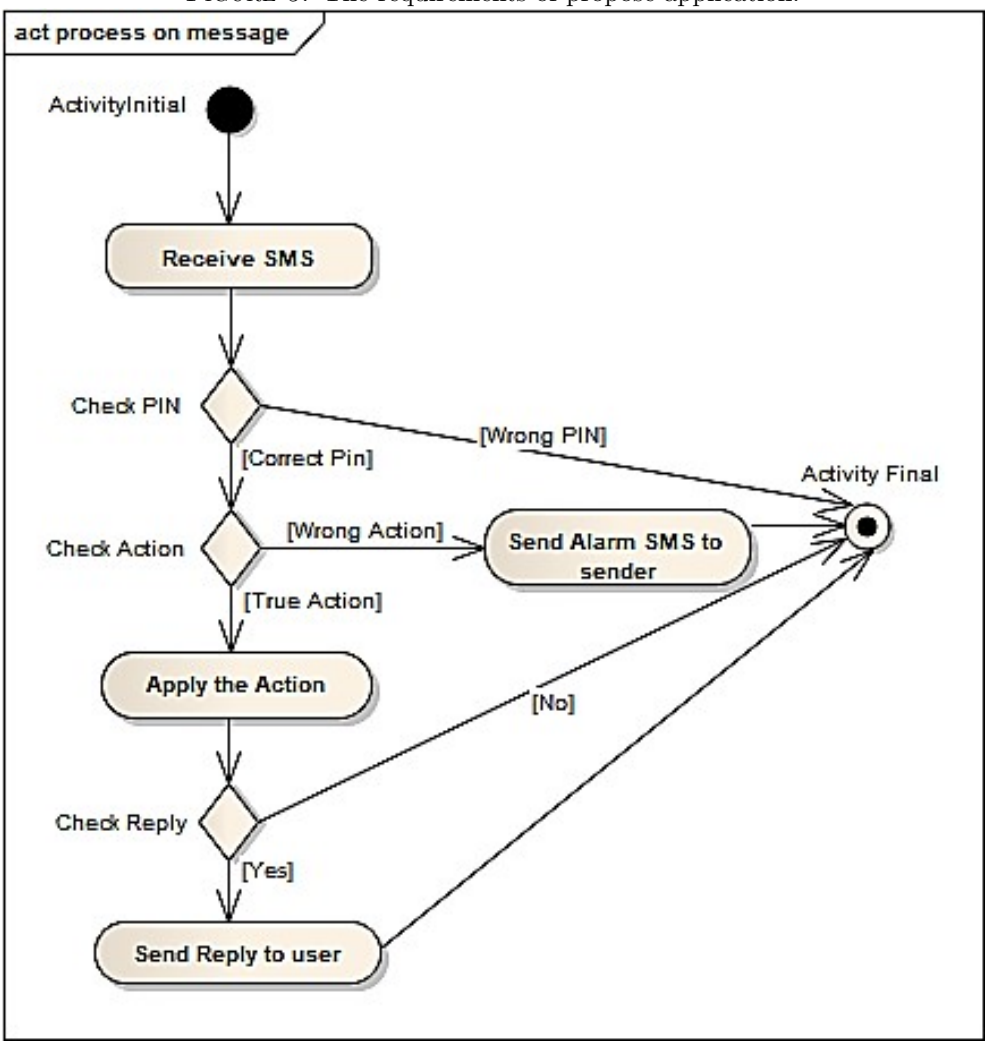
- MainActivity class and form: as form it is the first thing that appears to the user, and as class it holds the permissions that appear to user to grant or not.
- Setting class and form: it is responsible of setting the PIN code and save it inside Database.
- History class and form: it is responsible of storing Date and Time of receiving SMS, Message Body and Phone Number of the Client User inside Database each time he sends Message.
- Help class and form: it helps the user by explaining how to use the App.
- About class and form: it holds some information about the developer of the App.
- readSMS class: it is a sub class of BroadcastReceiver class which is responsible of receiving SMS messages even if the Application is turned off.
- getMyLocation class: it is a sub class of Location listener class that is responsible of getting the location of the phone.

Database class: it is a sub class of SQLiteOpenHelper class (which is a class responsible of creating database inside Android Studio). Inside this class, there are tables, which saves data that have been send to it from other activities.

3.3. **Permissions inside the propose application.** The propose application uses several features of Android and these features have permissions some of them need to be granted by the user during runtime of the application because they are related to the users personal information. These permissions identified inside application manifest and inside the onCreate function of mainActivity class by the programmer as showed in Table 2 and Figure 7. The permissions are for SMS, Accessing the mobiles Location, changing Ringer mode, and Searching through the Contact list.

The propose application works basically with SMS messages so there should be a request for receiving, reading and sending SMS message. The request will be declared inside the manifest file as in Table 2 and because SMS is dangerous permission it should be also written inside the onCreate function of mainActivity class as in Figure

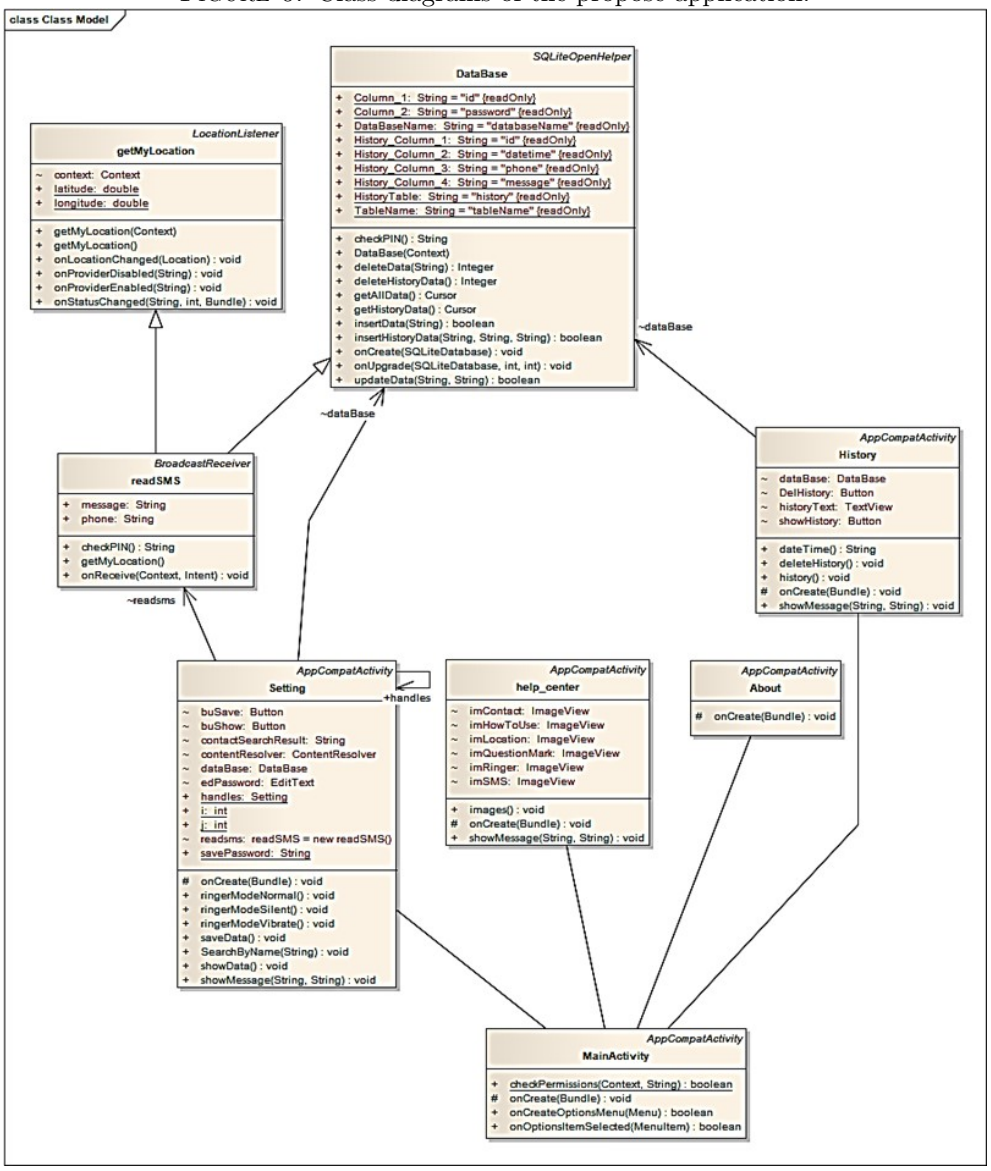
FIGURE 5. The requirements of propose application.



7 so in runtime of the application the user can grant permission to it , also, mobile location a dangerous permission it should be asked the user to grant the permission.

3.4. **High Level Design Of Propose Application.** In order to explain high-level design use sequence diagrams to demonstrate the server side on the message which sent from the client side by show sequence of operation that should do in in propose application, the main process are :getting Contact number , getting Location, and change ringing mode of the mobile phone. There are some operations similarities in application main process, for instance: Getting a Contact Phone number, start with the user in client side only has to send a Message containing the format which

FIGURE 6. Class diagrams of the propose application.



is specific for Contact Number which showed in Table 1, the System service of the Server Phone receives the message by Broadcast Receiver which receives every SMS message that comes from outside, and because application also has registered to Broadcast Receiver to receives every incoming message even if the app was turned off. The application starts analyzing the message through readSMS class which takes the

TABLE 2. Application Permissions.

Permission Name	Permission Code
Receive SMS	"android.permission.RECEIVE_SMS"
Read SMS	"android.permission.READ_SMS"
Send SMS	"android.permission.SEND_SMS"
Read Contact	"android.permission.READ_CONTACTS"
Get Contacts	"android.permission.GET_ACCOUNTS"
Ringer mode	"android.permission.MODIFY_AUDIO_SETTINGS"
Access Location	"android.permission.ACCESS_FINE_LOCATION"

FIGURE 7. Dangerous permissions inside onCreate function

```
int permissions_All =1;
String[] Permissions= {Manifest.permission.READ_SMS, Manifest.permission.ACCESS_FINE_LOCATION,
Manifest.permission.ACCESS_COARSE_LOCATION,
   Manifest.permission.READ_CONTACTS, Manifest.permission.INTERNET};
if (!checkPermissions(this, Permissions)){
ActivityCompat.requestPermissions(this, Permissions, permissions_All);}
```

Phone number of the sender and the message body, then gets the PIN code from the Apps Database by getAllData() function and compares it with the messages PIN, if the PIN was not included in the beginning of the messages body the app will ignore the message and stop, and if the PIN was true it will check the rest of the body to perform the requested Action, and if the App didnt recognize the Action it will send an alarm message back to the sender to identify his action and it will stop, otherwise it will go to Setting class and checks the contact list of the server Phone and looks for the user which requested by the client user by SearchByName() function, then readSMS class brings the result of the search and sends it back to the user and finish the process then stops as explained in detail in Figure 8.

3.5. **Low Level Design Algorithms Of Propose Application.** In this section contain the low-level design of propose application algorithms, which include four algorithms: analysis income messages algorithm, Changing Ringer mode algorithm, Getting Location algorithm, and Getting Contact algorithm

3.5.1. *Analysis income messages algorithm.* The SMS format is written in the client side and it will be analyzed in server side as demonstrate in Figure 9: Client side: The SMS format should be written in the following sequence:

(1) First the client user writes the PIN and coma symbol (****,).
(2) Then he declares the action that he wants from server side.
(3) Finally if the action was needed to be told to give result back and client user wanted to get the result he should put a coma symbol after the order then write yes (,yes)..

FIGURE 8. Sequence diagram for getting contact number by SMS.

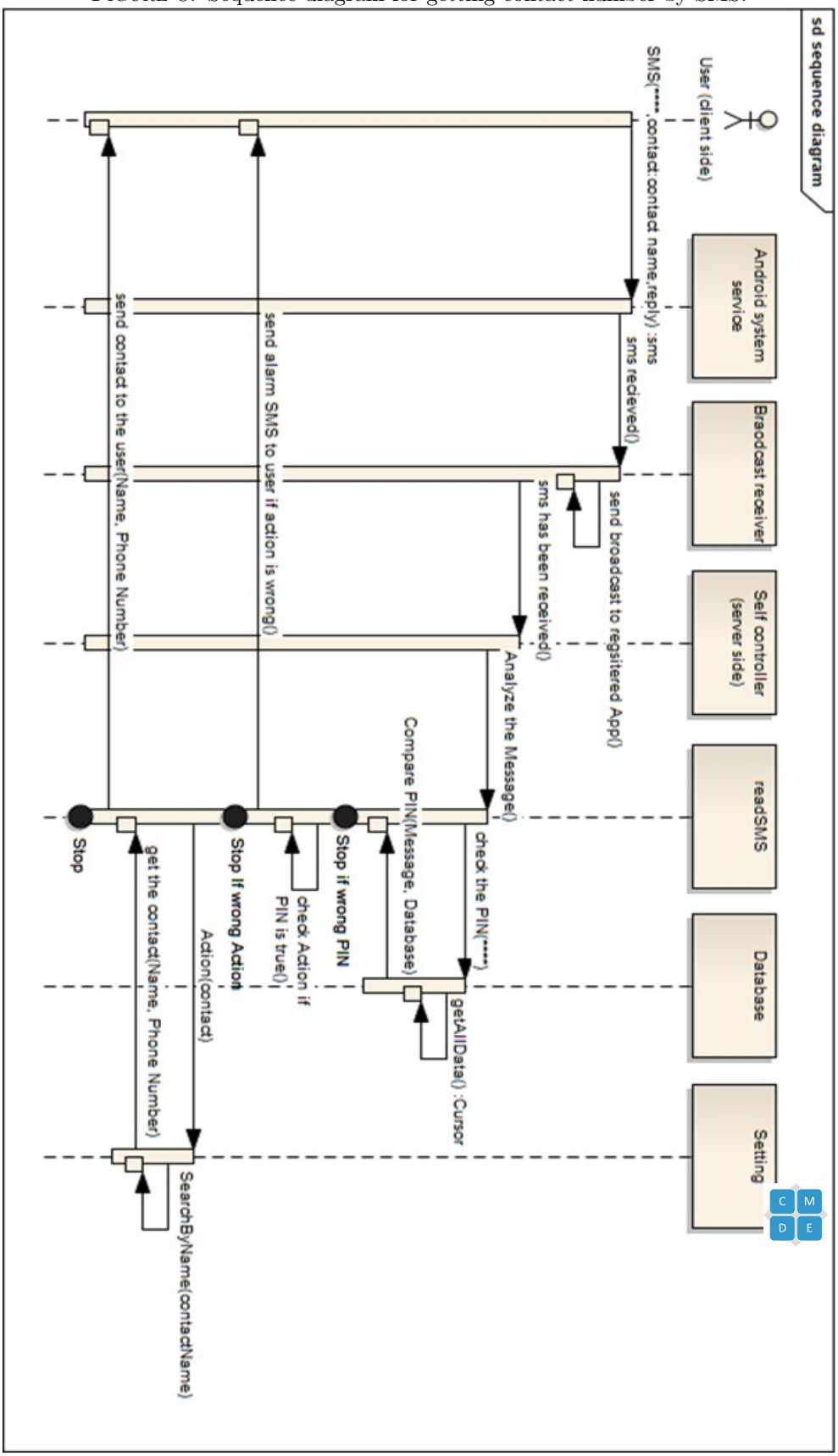
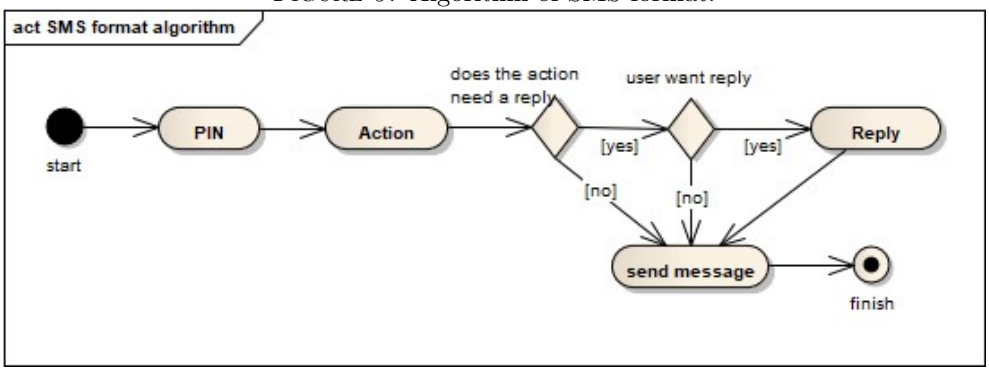


FIGURE 9. Algorithm of SMS format.



Server side:The mobiles System service receives income message and the propose application analysis the income message. First of all, checks the PIN code with the registered PIN inside the Applications database, if the PIN was wrong it will ignore, while if it was correct then it will analyze the action, if it didnt recognize the action it will send an alarm message back to the client user to identify his action, and if it recognized the action then it will answer to that action and check the message for reply, if the user wanted reply it will send him a message containing the result of the action, and if the user doesnt want reply it will stop as showed in Figure 4.

3.5.2. *Changing Ringer Mode Algorithm.* In order to change the ringer mode the following steps will happen in both client and server side:

Client side:

(1) Write PIN code and coma symbol.
(2) For ringer mode order user should write ringer:.
(3) There are three modes for ringer (General, Vibrate and Silent) so user should declare which mode he wants, he should write the mode (vibrate or silent or general).
(4) Ringer mode is one of those types of orders that do not reply the result automatically, so if the user wanted to see the result of the action he should write coma and yes.

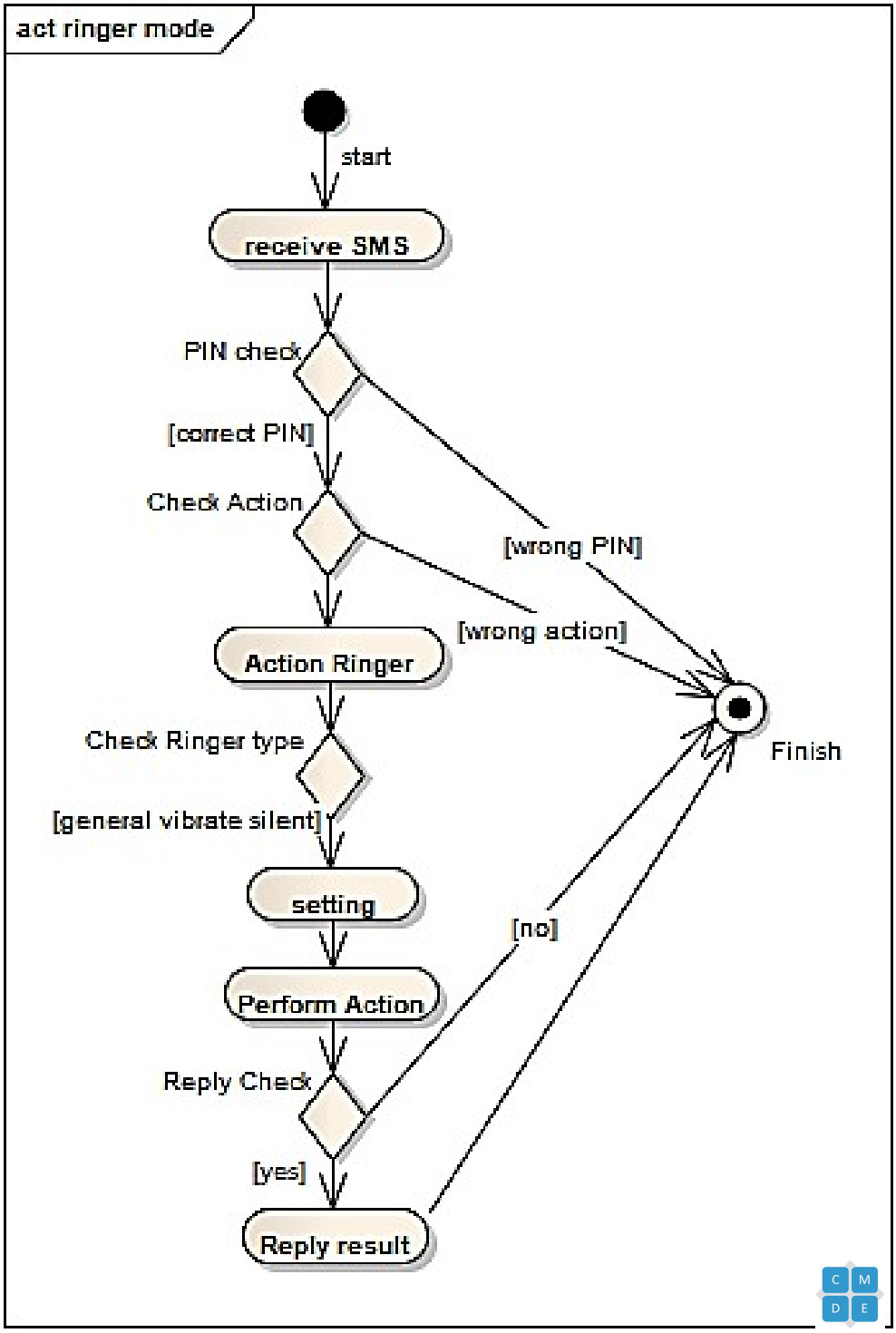
Server Side:

(1) The application checks for the PIN code.
(2) In case the PIN was correct it will check the action.
(3) For action ringer it will check the type of the requested ringer as explained in detail in Figure 10.
(4) Performs the requested action.
(5) Check for reply.

3.5.3. *Getting Location algorithm.* To get the location the following steps are happen in both client and server:

Client side:

FIGURE 10. Algorithm of Ringer mode in server side.



(1) Write PIN code and coma symbol.
(2) For location order user should write location
(3) For location order user doesnt have to write yes at the end of the message, the system will reply automatically. Server side.

Server side

(1) The application checks for the PIN code..
(2) In case the PIN was correct it will check the action.
(3) For action location it will go to getMyLocation class to get the location as shown in Figure 11.
(4) Bring the location (longitude and latitude).
(5) Send the location back to user by SMS.

3.5.4. *Getting Contact Algorithm.* In order to get a Contact number the following steps happen in both client and server side as shown in Figure 12: Client side:

(1) Write PIN code and coma symbol.
(2) For contact order user should write contact:contactName.
(3) In contact order, if the user doesnt have to write yes at the end of the message, the system will reply automatically. Server side.

Server side:

(1) The application checks for the PIN code.
(2) In case the PIN was correct it will check the action.
(3) For action contact it will go to setting class to get the requested contact as shown in Figure 12.
(4) Bring the contact (Name and Phone Number).
(5) Send the contact back to user.

4. IMPLEMENTATION AND TESTING

The propose application has a GUI which contains a number of sections such as (setting, history and help center) as shown in Figure 13, and each part is responsible of a certain job. When user downloads the Application the system will ask him to grant permission to the features (Read SMS, Access phone location and Access Contact list) as shown in Figure 14, and then the user should set the PIN code in settings so the Application can start working as shown in Figure 15. Now the user can use the applications features to control the phone, he can change ringer mode as shown in Figure 15, or he can ask for a certain contact number and get it as shown in Figure 16. To help the user get more familiar with the features and how to use the Application in a proper way there is Help section, which the features of the application are explained with examples as shown in Figure 18. And also there is History part which every accepted message by the system will be stored inside it with the Phone number of the sender and the date and time of delivering that message, as shown in Figure 19.

FIGURE 11. Algorithm of getting location in server side.

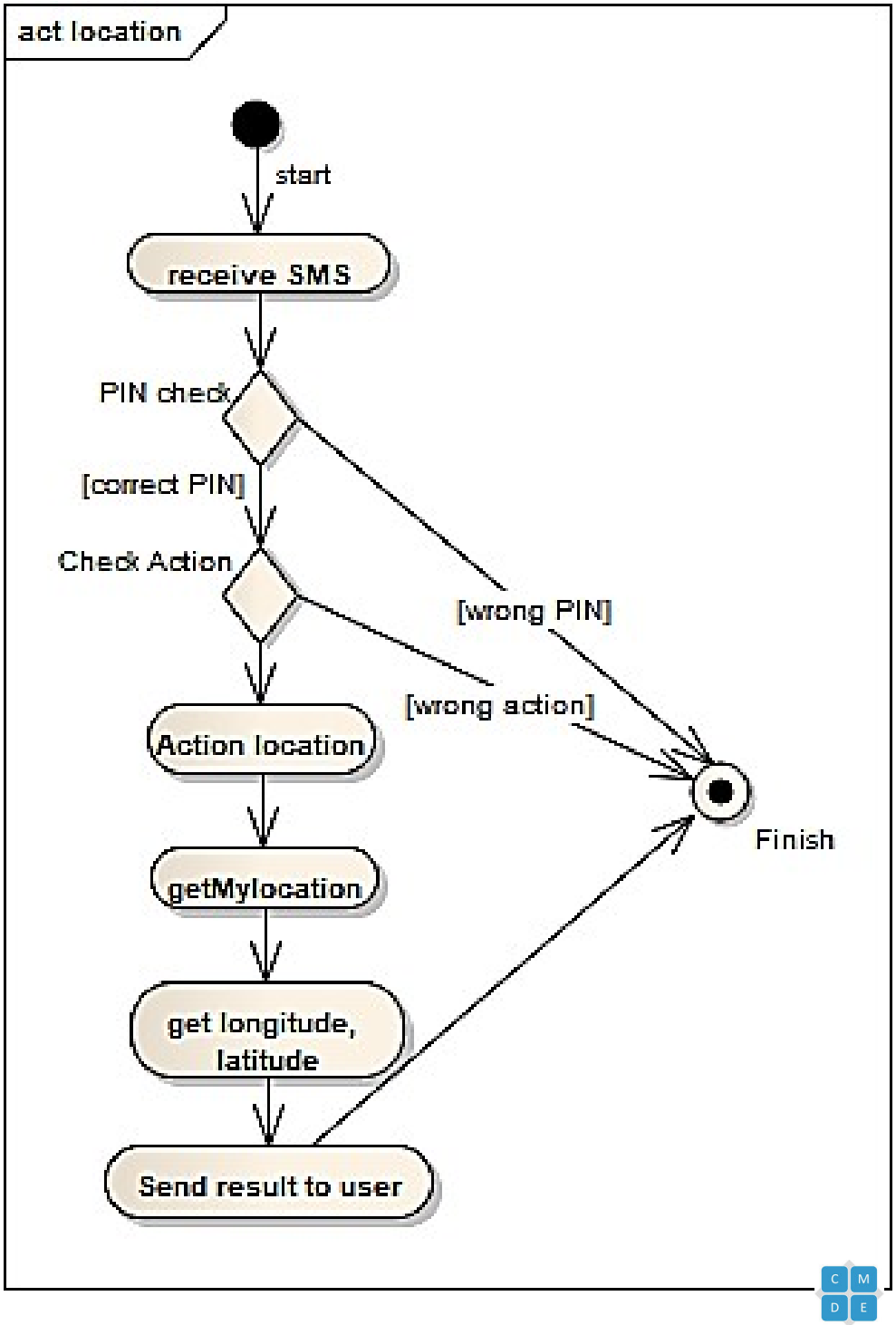


FIGURE 12. Algorithm of getting contact in server side.

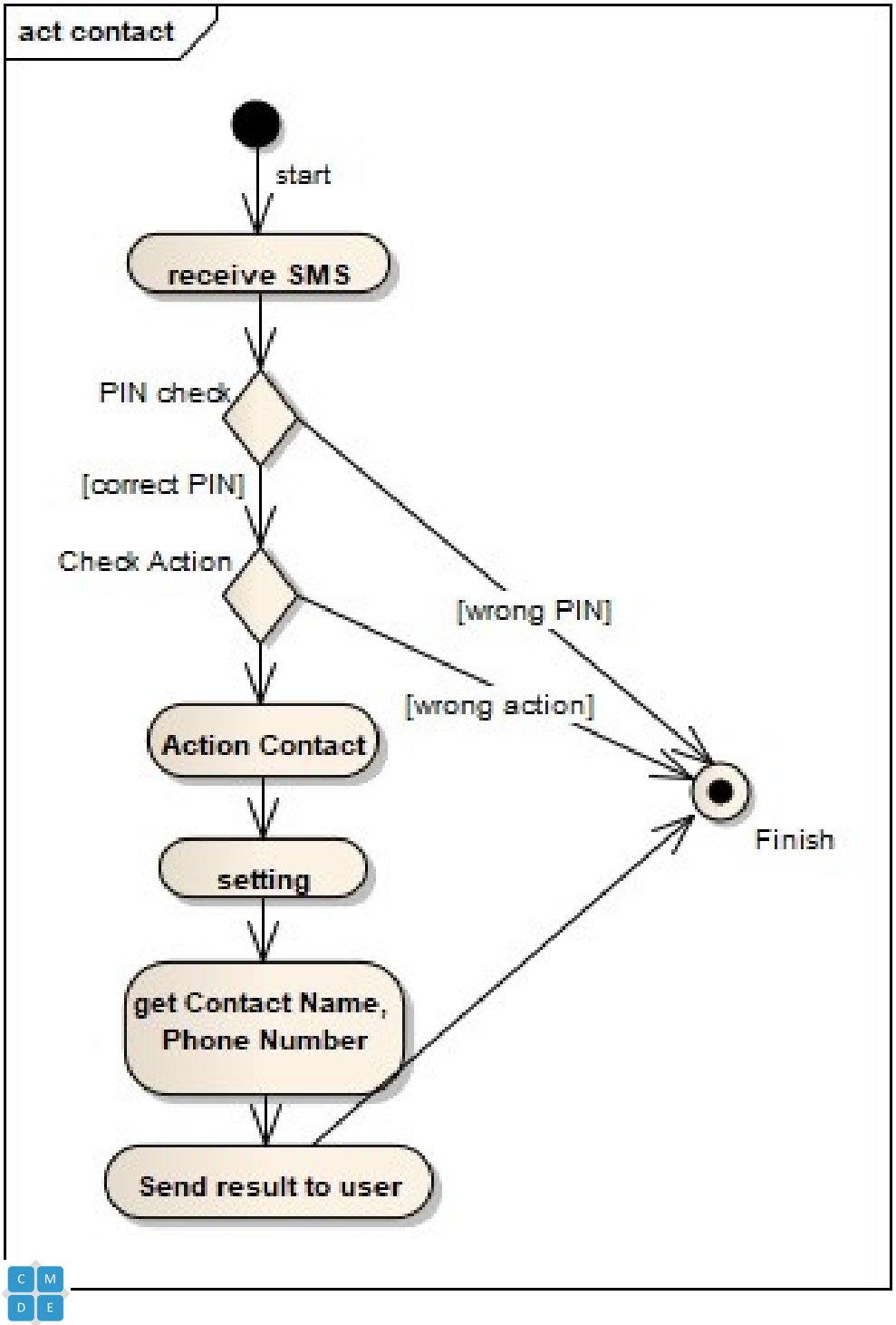


FIGURE 13. The propose Application user interface.

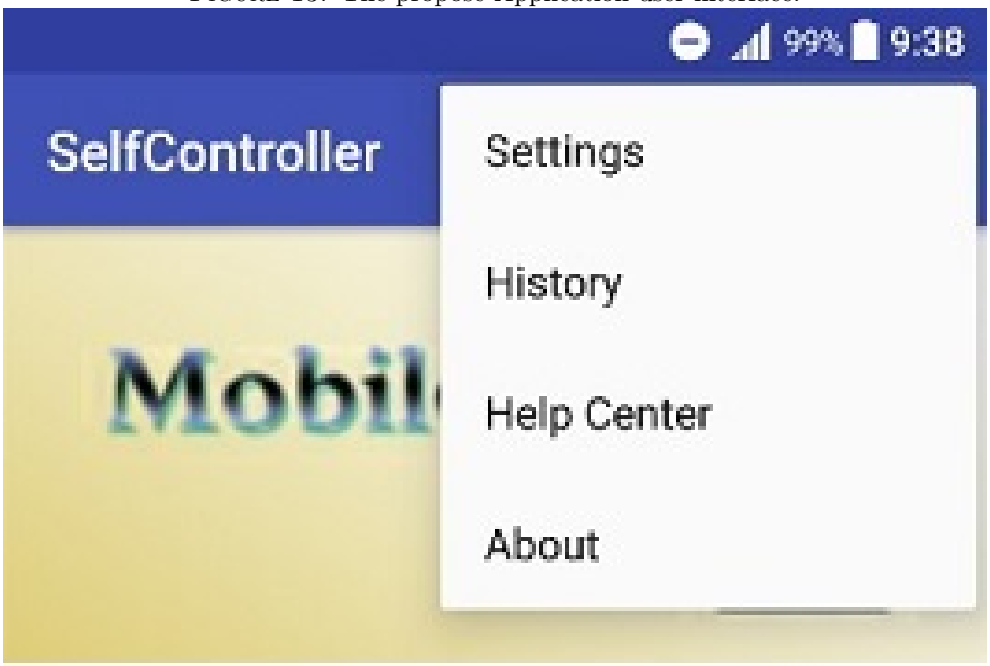


FIGURE 14. The propose application Runtime permissions.

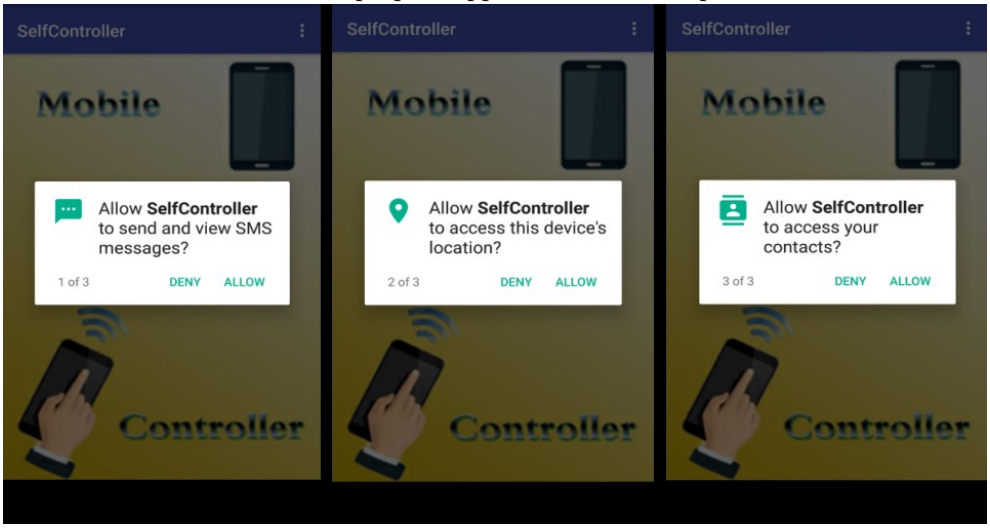
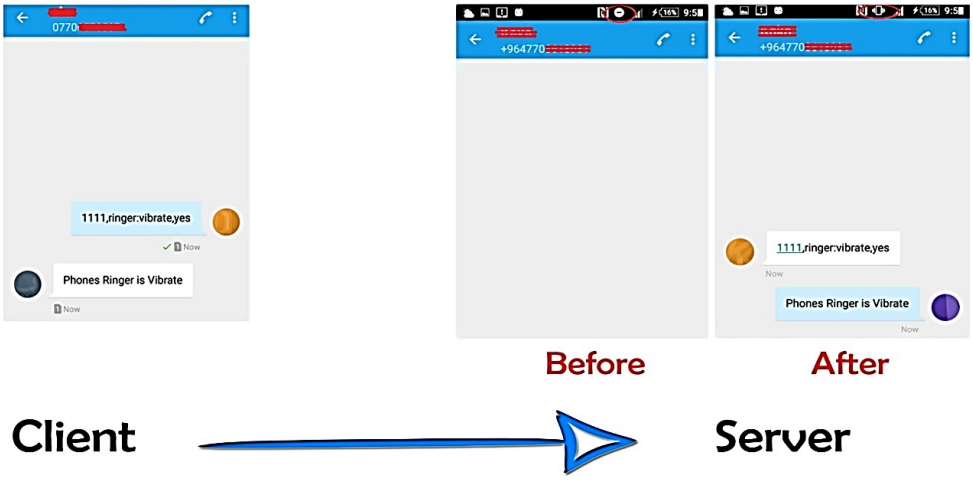


FIGURE 15. User sets PIN.

FIGURE 16. Change ringer mode from silent to vibrate.



5. CONCLUSION

The experimental result showed that controlling a mobile phone by its user can be done in an easy and safe way even if the mobile phone is far away from user and that is by using SMS messaging, this prevents presence of stressed moments and unwanted

FIGURE 17. Get contact number.

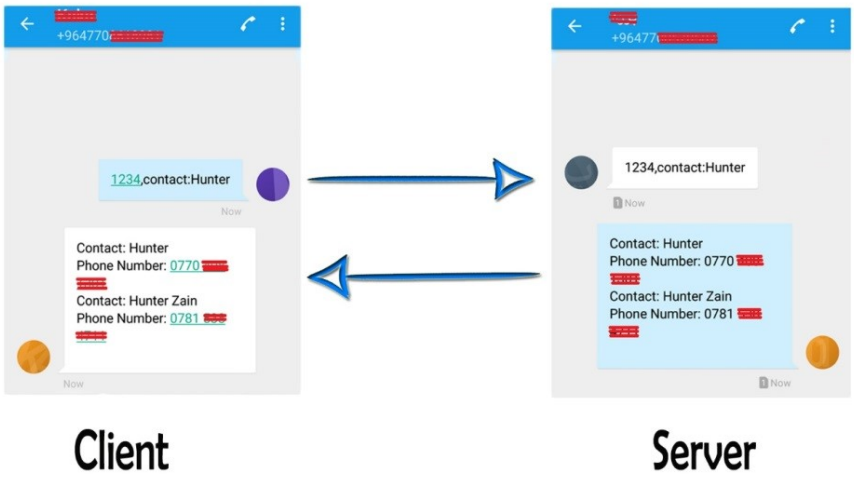
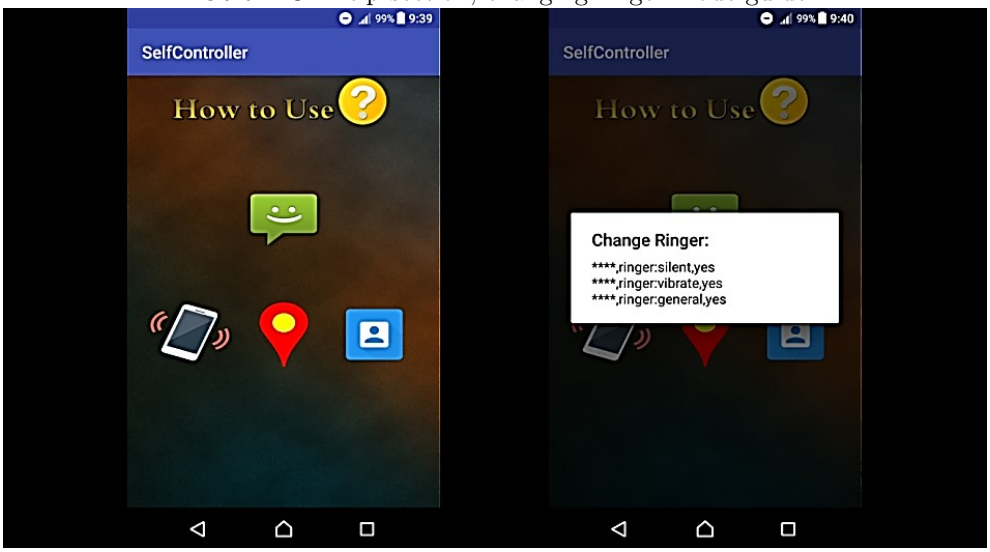
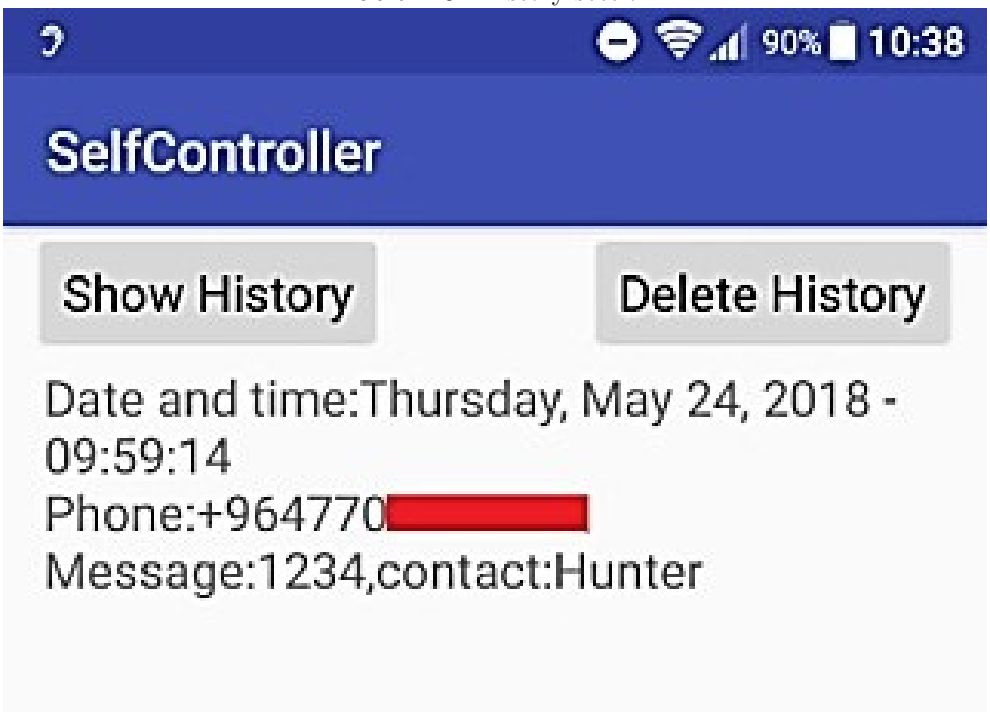


FIGURE 18. Help section, changing ringer mode guide.



situations to the user by making him more comfortable imagining his mobile in his hands. This has done by answering to a basic and general problem that faces a user with his daily routine which is losing the mobile. Losing mobile comes with many problems which this research answered them like:

FIGURE 19. History section.



- Not knowing the location of the mobile, this research solved this by getting last known location of the mobile phone and sending it to the user.
- Calling the mobile but it is in silent mode, this research solved this by controlling the ringer mode and changing it to Vibration or Normal (General) mode.
- Needing a specific contact number, this research solved this by getting the requested contact and sending it to the user.

6. Suggestions and Future Works

As a future work, the researcher has planned to add more actions to increase the abilities of the application to help user taking control of more stuff of his phone such as (control Camera, delete files, uninstall apps, change screen mode), and also to improve the quality of the app and help the user not losing money because of the SMS message cost, researcher suggests a backup way which is using other ways of messaging such as (Email, Facebook Messenger, Viber or any other messaging application).

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