CHAPTER VI

DEVELOPING THE PROTOTYPE FOR MOBILE APPLICATION USING THE PROPOSED ARCHITECTURE

6.1 Overview

This chapter presents the implementation stages of the ERAA prototype, which aims to achieve the final objective of the research. The system analysis is discussed in first section, where UML is used to describe important diagrams, such as a case diagram and a sequence diagram. The second section describes the development of the ERAA system.

6.2 Analysis and Design Workflows

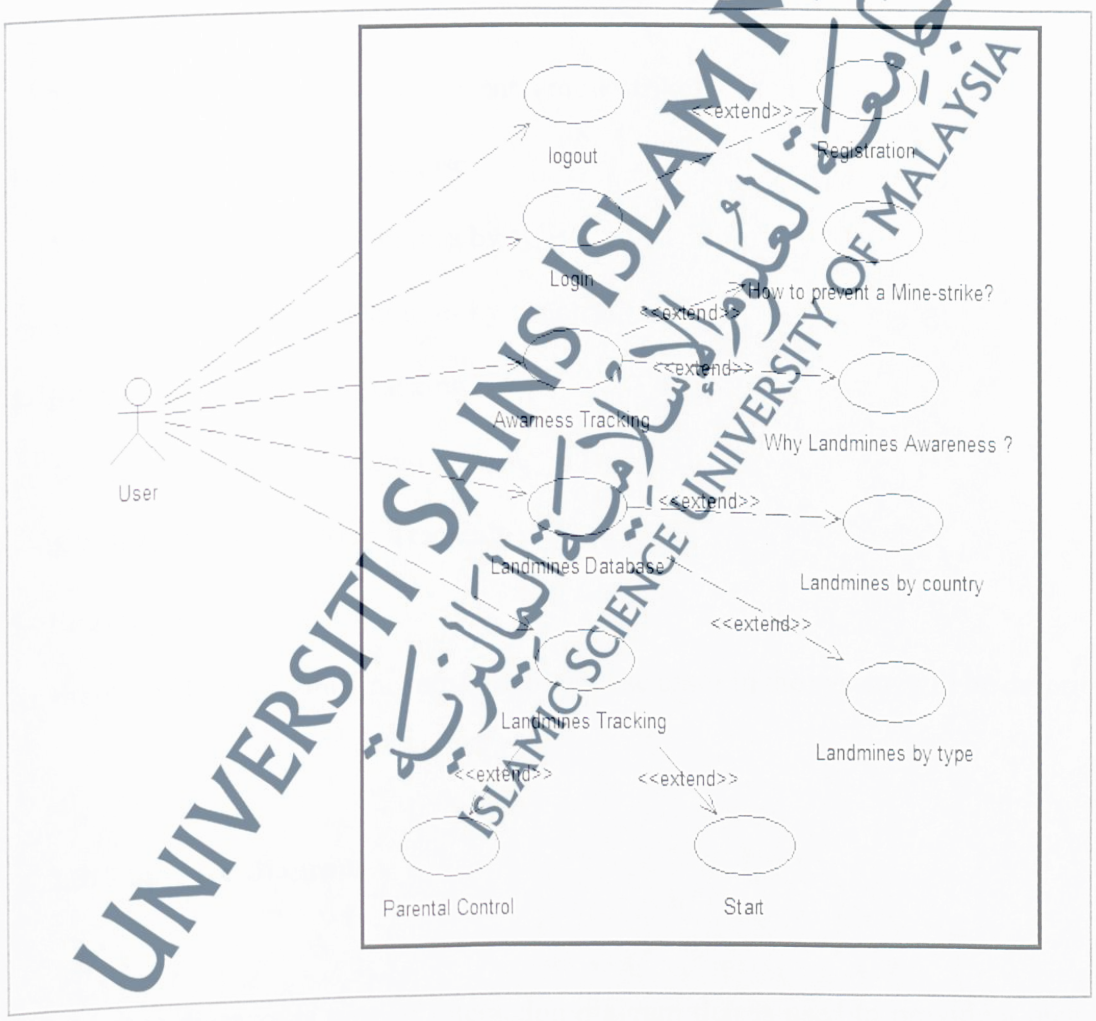
This section covers the analysis of the overall progress of the intelligent wireless landmine tracking system (i.e. ERAA). Rational Rose 2000 software tools are used to design all the required diagrams.

6.2.1 Use Case Diagram

Jacobson (2004) defined use case as follows: 'a use case specifies a sequence of actions, including a variant that the system can perform and that yields an observable result of

value to a particular actor.' The purpose of using the use case diagram is to show the functionality provided by the system and to describe the overall interaction between the user and the system. This diagram is composed of a set of components that represent communication between the user and the system. Figure 6.1 shows the use case diagram of ERAA.

Figure 6. 1: Use Case Diagram Of ERAA



6.2.2 Use Case Specification

The use case diagram of the system (ERAA) is composed of five main use cases as follows:

1- ERAA _01_01: Log in

1-1 ERAA _01_01: Registration

2- ERAA _02: Awareness Tracking.

2-1 ERAA _02_01: Why landmine awareness?

2-2 ERAA _02_02: How to prevent a mine strike?

3- ERAA _03: Landmine Database.

3-1 ERAA _03_01: Landmines by type.

3-1 ERAA _03_02: Landmines by country.

4- ERAA _04: Landmine Tracking.

4-1 ERAA _04_01: Parental control.

4-2 ERAA _04_02: Start Tracking.

5- ERAA _06 Log out.

As mentioned earlier, only the most important use cases in the system will be described.

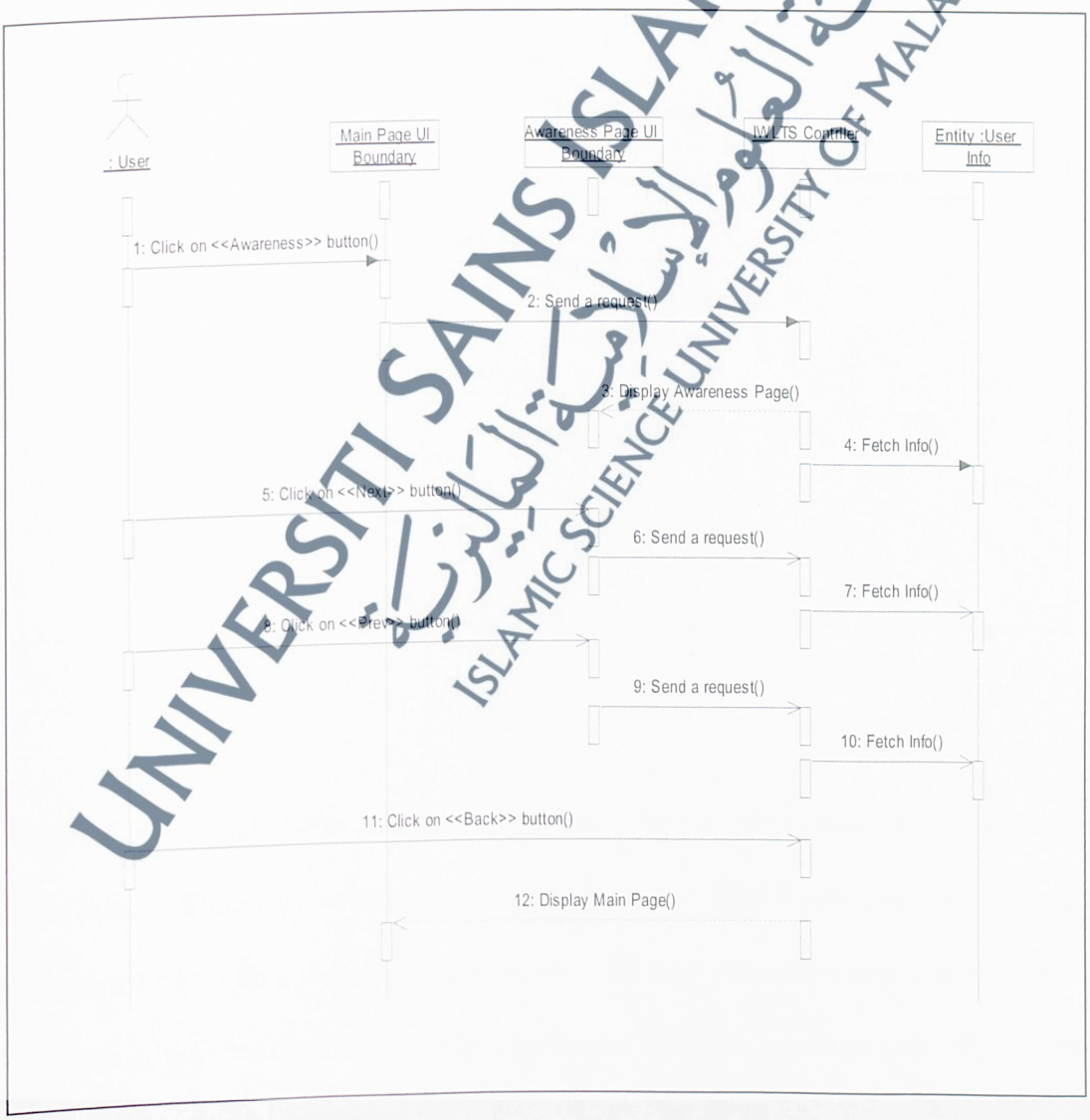
6.2.3 Sequence Diagram

A sequence diagram is type of interaction diagram that is used to provide a pictorial view of the system behaviour between two objects within that system and to represent object interaction (Johan, 2004). The following sequence diagrams present the sequence of message and the behaviour of the NATRAL system.

A. Awareness tracking sequence diagram

Figure 6.2 describes the events that will occur when a user presses the Awareness button. When a user presses the Awareness button, the system will send a request to the NATRAL control and then the Awareness page will appear. The system will open the database and fetch information to display on the Awareness page. The user can obtain additional information by pressing the next or previous buttons.

Figure 6.2: Awareness Tracking Sequence Diagram



B. Sequence Diagram of Landmines by Type

Figure 6.3: Sequence Diagram of Landmines by Type

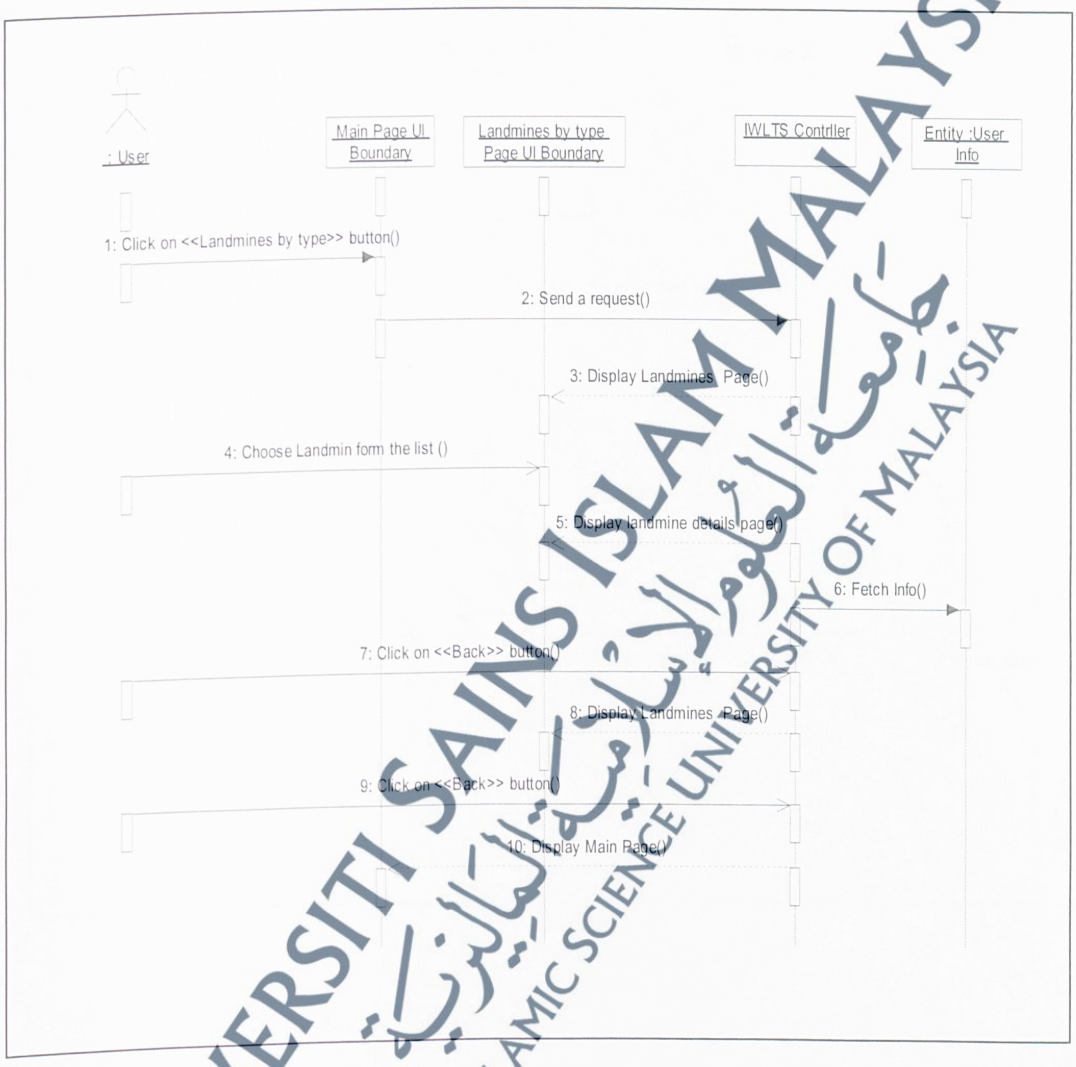


Figure 6.3 presents the events that will occur when a user presses the Landmines by type button. Once the user presses this button, the ERAA control will display the landmine page with a list of landmine icons. The user can select any icon from the list to obtain additional details related to a particular landmine, such as year of production, colour, weight and dimensions.

C. Parental Control Sequence Diagram

Figure 6.4: Parental Control Sequence Diagram

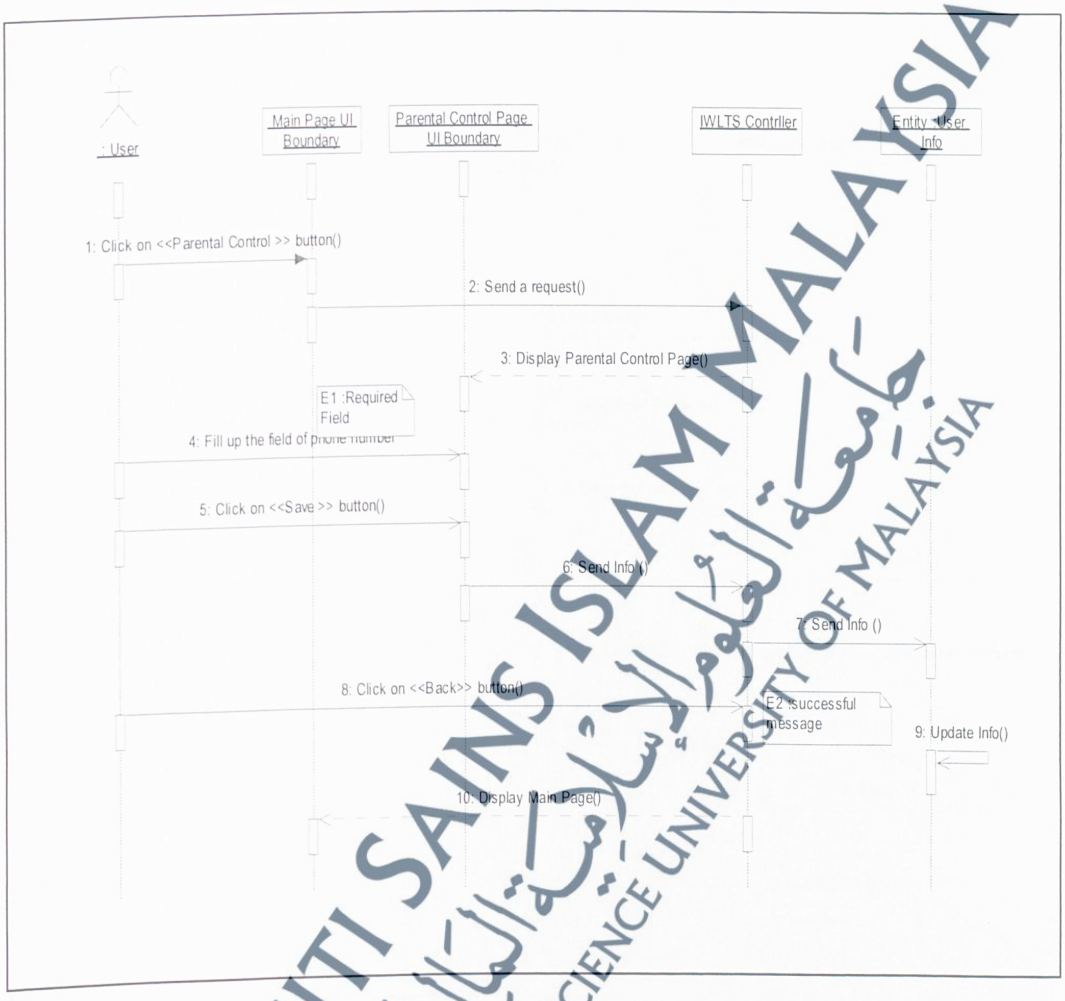
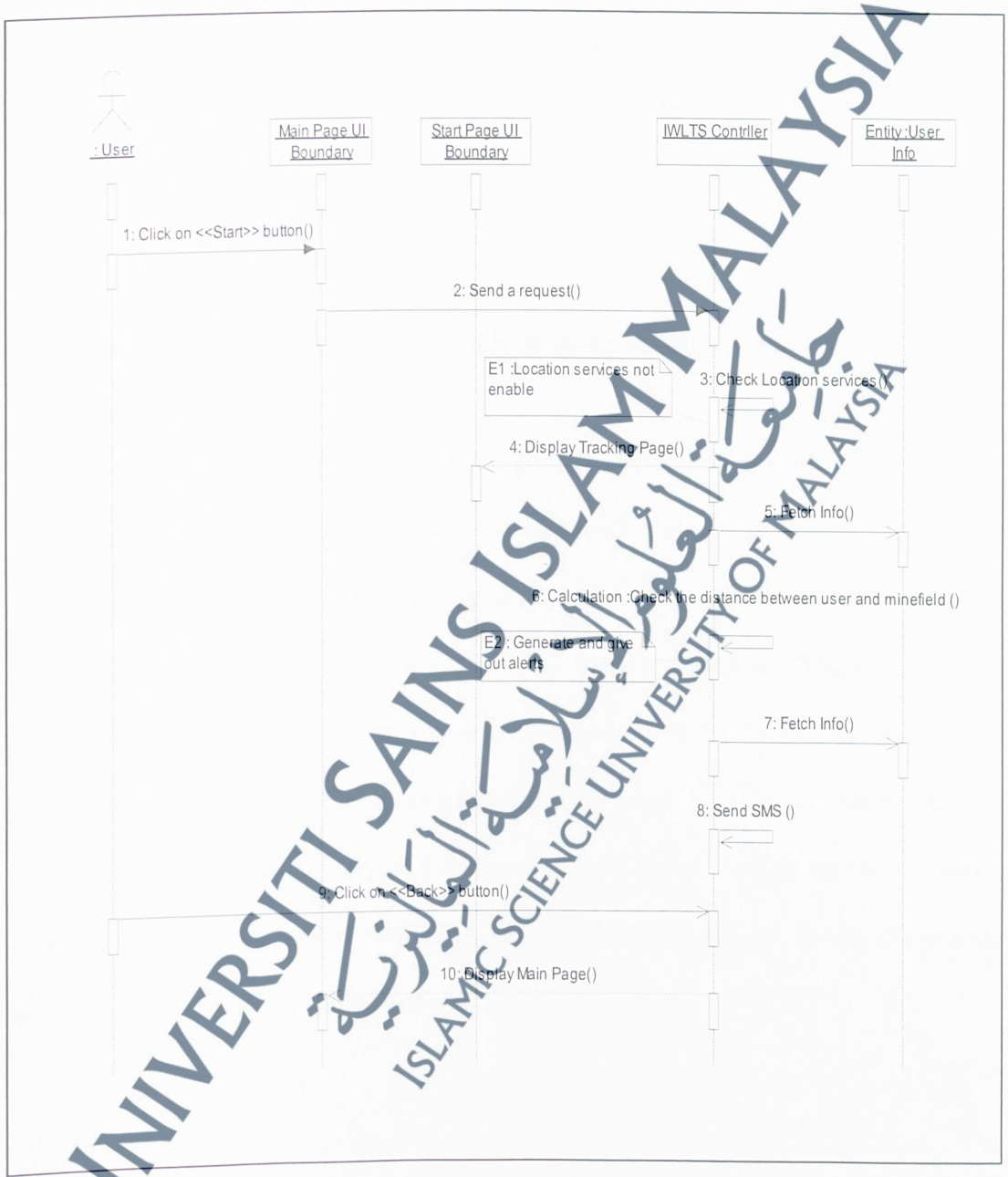


Figure 6.4 shows the parental control sequence diagram of. When a parent needs to track his/her child, he/she can press the Parental control button to save his/her phone number. The request will be sent and the Parental control page will be displayed. The parent should fill up the phone number field and then press the save button. The request will be sent and the information will be saved in the database.

D. Start Tracking Sequence Diagram

Figure 6.5: Start Tracking Sequence Diagram



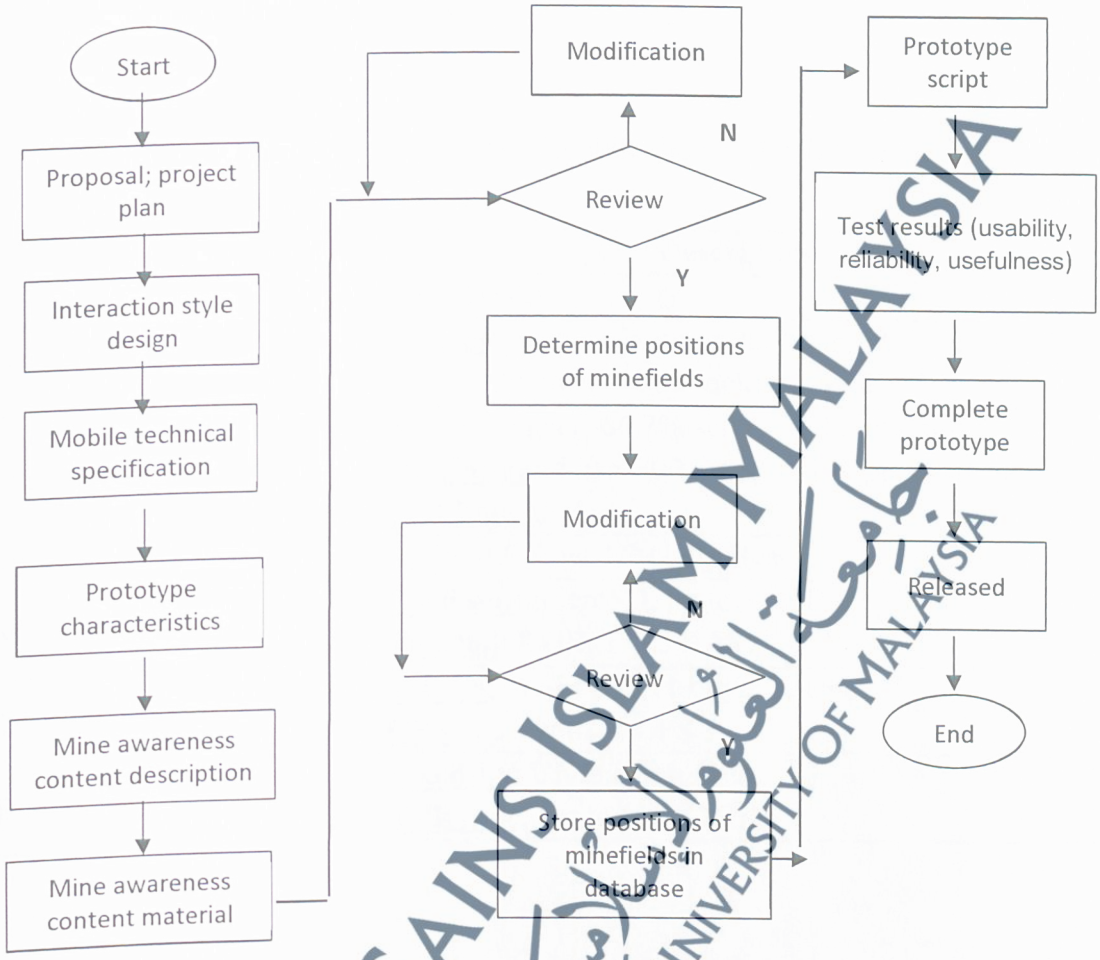
The sequence diagram of start tracking (Figure 6.5) is the most important diagram. It begins when a user presses the start button on the main page, and a request will be sent. The system will check the location service. If it is not enabled, then the system will

display the massage: 'Location services not enabled'. Otherwise, the locations of the user and minefield will be displayed and supported by Google Maps on the tracking page. Calculations will be performed to obtain the distance between the user and the minefield. If the distance is less than or equal to 20 m, then the system will generate an alert to the user. In addition, the system will send an SMS to the parents if they have saved their phone number in the database.

6.3 Implementation of Environmental Risk Assessment Architecture

In this section, we will begin by presenting a general approach to prototype design. The rapid development and successive production of mobile devices, along with the change in their models, require a harder effort to be able to keep pace. Therefore, identifying the limits and capacities of a mobile device is highly important. These limitations include a small and difficult-to-use keyboard, limited colour and font number support, small display size, limited computing power, limited bandwidth, high wireless connection cost and low memory and storage space. The subsequent sections describe the design and development of the ERAA prototype. Figure 6.6 illustrates the general flow of the development of the prototype.

Figure 6.6 General Flow of the Development of the Prototype



6.3.1 Environmental Risk Assessment Architecture Development Platforms

Potential problems may occur when developing applications for mobile devices. One of these problems is platform compatibility, which may vary depending on mobile phone model. These problems should be considered during mobile application development. Table 6.1 lists most features that should be available in mobile devices that will be used to operate ERAA. As mentioned earlier, knowing the environment and considering the limitations and capacities of the application hardware are the first step in designing and

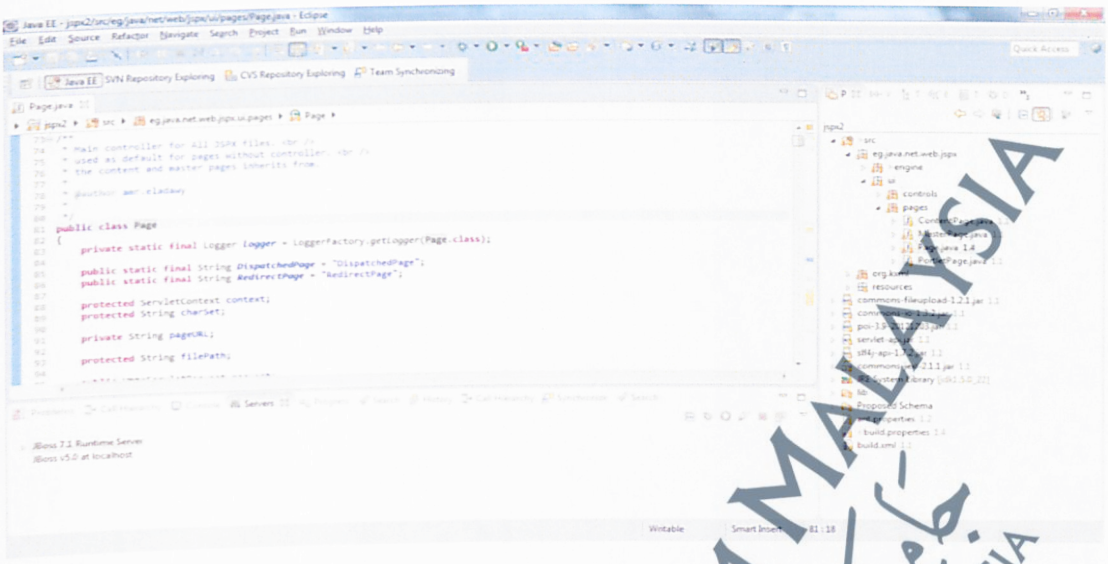
developing a mobile application. On this basis, the Samsung GT-18552 phone will be used to develop the ERAA prototype

Table 6. 1: Technical specifications of mobile devices for ERAA application

Features	Description
Network	GSM/HSPA
Body	**Dimensions:** 133.3 mm × 70.7 mm × 9.7 mm (5.25 inch × 2.78 inch × 0.38 inch) or more
Display	**Size:** 4.7 inch (~66.7% screen-to-body ratio) **Resolution:** 480 × 800 pixels (~199 ppi pixel density) **Multitouch: Yes**
Platform	Android OS, v4.1.2 (Jelly Bean)
Memory	**Card slot:** microSD, up to 32 GB **Internal:** 8 GB, 1 GB RAM
Communication	**WLAN:** Wi-Fi 802.11 b/g/n, hotspot **GPS:** Yes, with A-GPS
Battery	**Stand-by:** Up to 210 h (3G) **Talk time:** Up to 11 h (3G)

Eclipse is an integrated development environment (IDE), as shown in Figure 6.6. It provides a Rich Client Platform (RCP) for developing general purpose applications. It comprises a base workspace and an extensible plug-in system for customising the environment. Written mostly in Java, Eclipse (which is integrated into the Samsung emulator) is used for ERAA development. Eclipse is selected as the development platform primarily because it is free and open source software.

Figure 6.7: Screenshot of Eclipse 4.4



6.3.2 Environmental Risk Assessment Architecture User Interface Design

In this section, the logical design is converted into a more technical specification of system development. To gain an extensive idea and additional details about the ERAA system, all the screenshots are presented. Defining a user interface depends on the underlying platform and it can be achieved using different technologies. For example, the platform used to develop the ERAA prototype (Android) is the XML resource file.

The system begins by displaying a log-in page (Figure 6.8), which allows a user to access the functions of the system by entering his/her username and password and then clicking the Sign in button. If the user input is invalid, then the system will display a warning message. If the user does not have an account, then he/she must make one by clicking the Sign-up button. The system will display a registration page, as shown in Figure 6.9. The user should fill up the fields and then press the Create Account button.

Figure 6.8: Log-in page

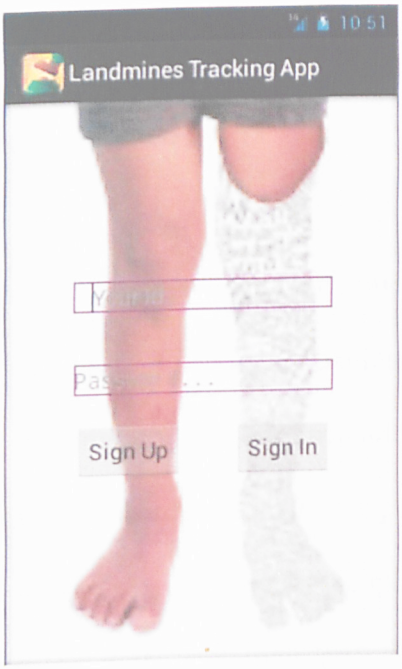


Figure 6.9 : Registration page

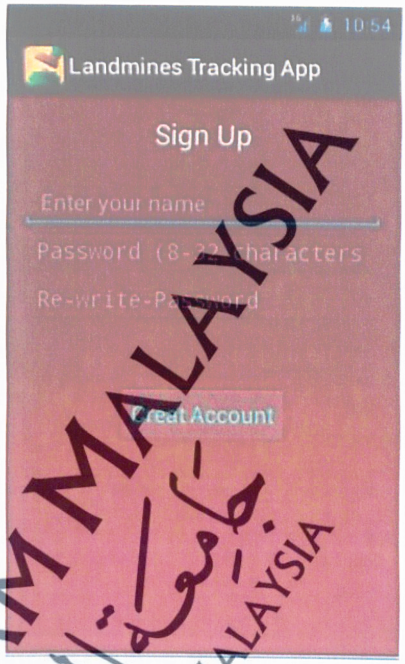
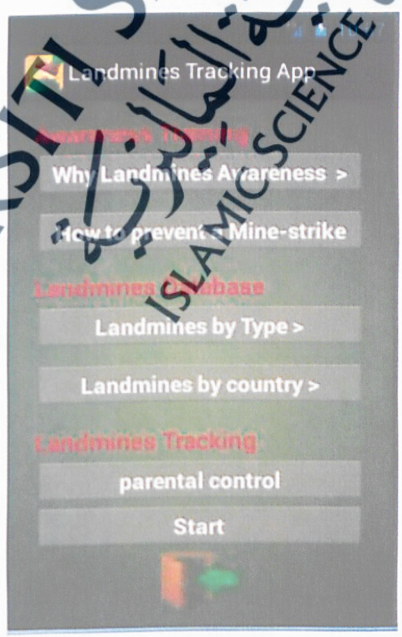


Figure 6.10 shows the main page, which consists of a vertical box that contains six options.

Figure 6.10: Main screen



The main screen is divided into three categories: Awareness training, Landmine database and Landmine tracking.

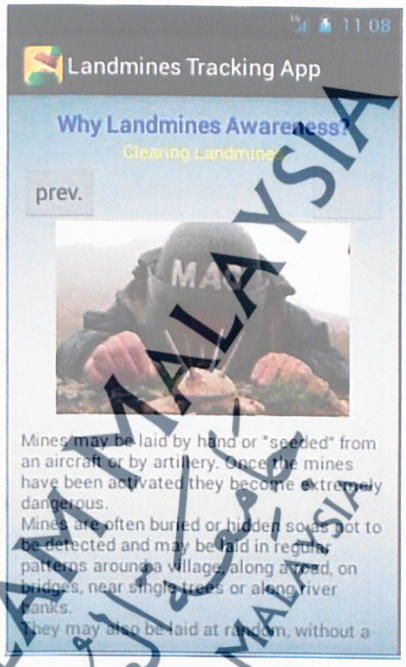
1) Awareness Training

Mine risk education is one of the important preventive educational activities to mitigate the risk of landmines and other explosive remnants of war. Collecting or handling scrap metals, moving UXOs from farmlands and dismantling UXOs are the most common ways in which people voluntarily expose themselves to UXO risk. Mine risk education aims to minimize dangers for people living, working and travelling through areas contaminated with landmines and UXOs. Furthermore, it helps reduce the risk of casualties from landmines, cluster bomb remnants and other explosive remnants of war. This application aims to create awareness of where these weapons are found in a community through a variety of tactics. The main page offers the following four options.

i. Why Landmine Awareness?

One of the factors that exacerbate the problem of landmines is the lack of awareness and knowledge about their risks. Creating awareness at the community level has been proven beyond any reasonable doubt to be an effective strategy for mitigating the risk of explosive devices. This option covers many topics related to landmines such as the impact on children, the economic costs of landmines, the human cost of landmines, landmine production and trade and clearing landmines. Users can explore these topics, which are supported by pictures, as shown in Figures 6.11a and 6.11b, by clicking on the next or previous buttons.

Figure 6.11: Landmine Awareness (a), (b)



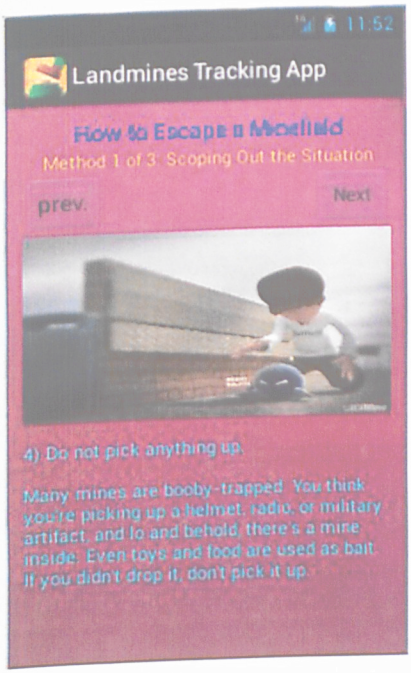
ii. How to Prevent a Mine Strike?

Any armed conflict in the world typically leaves behind problems of explosive remnants of war that continue to kill and maim people for years or even decades after the conflict has ended. Children are particularly vulnerable to the risk of landmines, especially with their increased mobility after a conflict. Thus, advising users on what he/she should do in case of an emergency and how to keep himself/herself safe is extremely important.

This option presents three methods on how to escape a minefield, as shown in Figures 6.12a and 6.12b:

A. Scoping out the situation
B. Getting out safely
C. Avoiding minefields

Figure 6.12: How to Prevent a Mine Strike (a), (b)



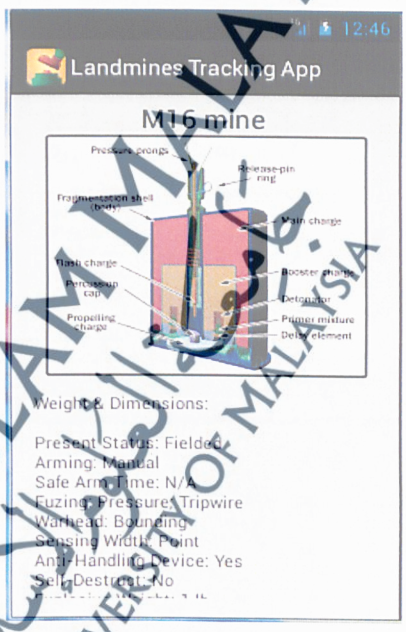
2) Landmines Database

i. Landmines by type

Most accidents are caused by lack of knowledge. Nearly all victims of UXOs did not know that the object they were moving is a type of UXO. Mines/UXO come in different shapes, sizes and colours. Sometimes, they are even designed to look like children's toys. Children tend to pick up interesting and strange objects. Therefore, children may find a landmine and play with it until it explodes. The blast may cause the loss of a leg or an arm, or even death. People should understand that the only way to avoid landmines is to know where they are found and what they look like. The next screens, as shown in Figures 6.13a and 6.13b, present a list of different types of landmines. The list is

supported with a picture for each mine and relevant information, such as dimensions, height and colour.

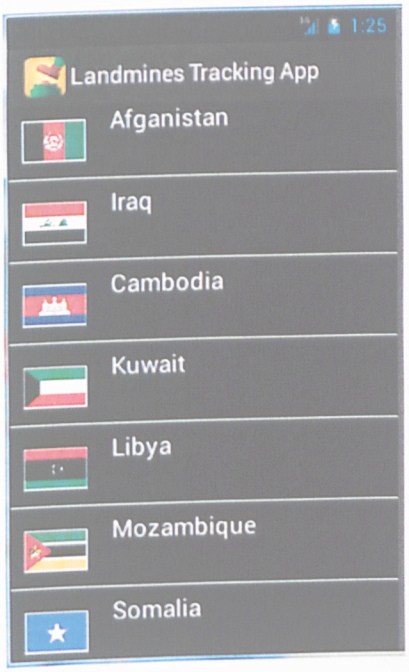
Figure 6.13: List of Landmines With Their Characteristics (a), (b)

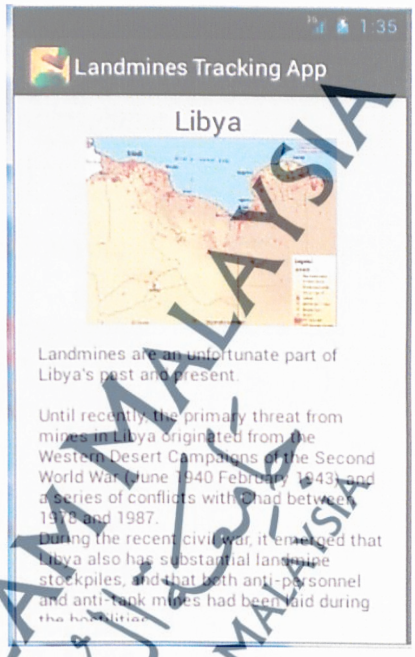


ii. Landmines by country

Millions of landmines remain lying in the ground worldwide. Over 50 countries are facing the problems of anti-personnel mines and UXOs. A user should constantly be on the lookout that the countries that he/she is travelling to are safe from landmines and UXOs. Figure 6.14a shows that the most heavily landmined countries include Egypt, Iran, Angola, Afghanistan, Iraq, Cambodia, Kuwait, Libya, Mozambique and Somalia. Figure 6.14b provides an overview of these countries supported with their maps.

Figure 6.14: 10 countries with the highest numbers of landmines (a), (b)





3) Landmines Tracking

i. Parental Control

The increasing prevalence of children wandering is a concern of many parents. At present, GPS technology is sufficiently sophisticated that parent will know if their children are safe by simply using this app. Parental control is a feature in our developed app, which can be used by parents to track their children in real time. This feature enables parents to restrict their children's access to a minefield. To use this feature, parents are required to add their phones numbers to their children's phones through the next screen shown in Figure 6.15. Parents will receive an alert or an SMS in their cellphone if their children approach a minefield. Furthermore, parents can use web-

based maps with this app to monitor the movement of their children in real time. With this app, parents can ensure that their children are not wandering near minefields after school instead of going home. This app is easy to use, and parents can access location data from a web-based user interface or from their smartphone.

Figure 6.15: Parental Control

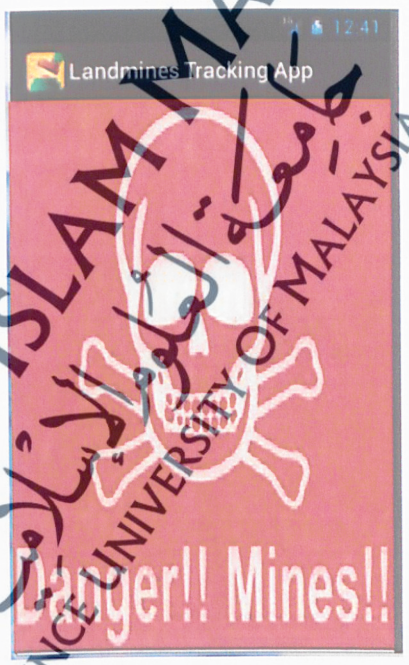
ii. Start

This feature is the most important component of the application. It allows a user to track himself/herself with the touch of a button on the main screen. The operation of this system is simple and does not require assistance from other people. The system turns a cell phone into a GPS tracking device by simply holding down the start button on the main screen, as shown in Figure 6.17. The system starts to capture position (longitude, latitude) from satellites once a user successfully logs in. Then, the system automatically opens the database and fetches the borders of the land where mines buried based on the

landmine intensity in these areas. These variables will be used as input variables by the neuro-fuzzy model to calculate the degree of danger that the user is facing as he/she navigates places near areas affected by landmines. The application provides a viable solution in the form of maps and alerts to the user through his/her mobile phone in case of exposure to landmine risk.

Figure 6.17: Start tracking

Figure 6.16: Warning massage



Once the neuro-fuzzy model determined that the user has gotten inside approved geographical zones (i.e. minefields), the user will be warned by the system about the risk by generating alerts, as shown in Figure 6.16. A new screen will also appear (Figure 6.18) to show the location of the user on Google Maps in real time, The borders of the minefields will also be displayed. This screen will appear with two options: 'Show Me the Safe Route' and 'Call emergency'.

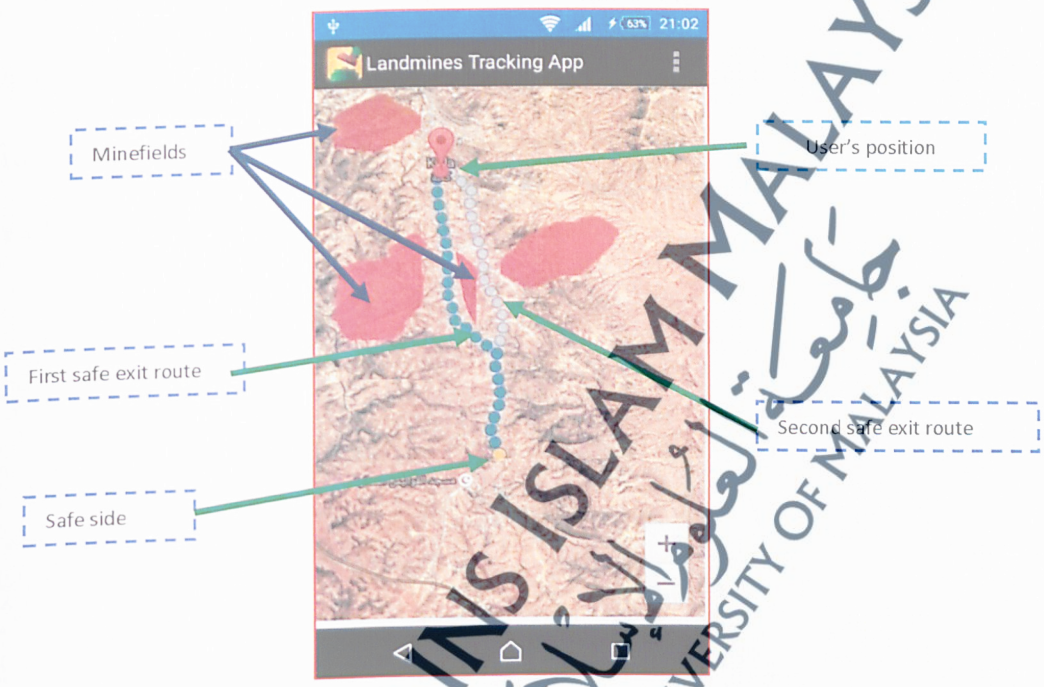
When the user click on the Call emergency button, the system will connect him/her to emergency services. The user can use the keypad that appears to dial an emergency number. The system will also send the real-time location of the user (longitude, latitude) via SMS. The location will appear on the website of emergency services using Google Maps. In such case, the user should stay in his/her location and wait until the emergency team arrives.

Figure 6.18: Satellite View

If an alert message times out due to no response or a team member indicates their inability to respond, then the user can click the Show Me the Safe Route! button. In such case, the safe path selection model, which uses GAs to determine the most optimum route based on safety, starts working. Readers can refer to Section 5.3.3.2 for further details regading this model. The model provides directions from the current location of the user to outside the mined area by updating the location of the user and

generating a new direction once the previous one has been completed, as shown in Figure 6.19.

Figure 6.19: Map Shows the Safe Routes and the Locations of the Major Minefields



6.3.3 Environmental Risk Assessment Architecture Installation

Java Archive (JAR) is a package file format that is typically used to aggregate Java class files and associated metadata and resources (e.g. text and images) into a single file to distribute application software or libraries on the Java platform. A .jar file can be automatically generated in Eclipse. The .jar file typically consists of numerous classes and interfaces. The main application class in ERAA is called the Main Tracking Activity class. Eclipse generates ERAA classes in a .jar file called ERAA.jar, which will be downloaded to the mobile device with the Java application descriptor (JAD) file.

6.4 Summary

This chapter presents the development, analysis and design of the ERAA prototype. The analysis and design of the prototype are provided in Section 6.2, whereas Section 6.3 describes the three steps that must be followed to develop the ERAA system, namely, ERAA development platforms, ERAA user interface design and ERAA installation. In addition to the details described in the previous sections, Figure 6.6 shows the general flow of prototype development.