**Personal Security Smartphone Application**

# Final Year Project Report



**TrackMe**



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Statement Of Originality

I declare that this project is my original work except where stated.

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Table Of Contents

Abstract 5

Acknowledgements 6

1. Introduction 7

1.1 Background 7

1.2 Project Objectives 8

1.3 Context 9

1.3.1 Mobile Application Development 9

1.3.2 Learn Server-Side Scripting Language 9

1.3.3 Database Administration 9

1.3.4 Application Use 10

2. Technology Overview & Selection 11

2.1 Technology Overview 11

2.1.1 Mobile Application Platform 11

Android 11

Advantages of Android Development 12

Disadvantages of Android Development 12

iOS 13

Advantages of iOS Development 13

Disadvantages of iOS Development 13

Platform Selection 13

2.1.2 Application Technologies 14

Location Tracking 14

Considerations 14

Selection 14

Fall Detection 15

Considerations 15

Selection 15

Messaging Service 16

Considerations 16

Selection 16

2.1.3 Database 16

Considerations 16

Selection 16

2.1.4 Server Side Scripting 17

2.1.5 Web Server 17

2.2 Similar Applications 17

2.2.1 BSafe [3] 17

2.2.2 Emergensee 18

3. Implementation Details 19

3.1 Mobile Application 19

3.1.1 Application Module 20

3.1.2 Activity Module 20

3.1.3 Services Module 20

3.1.4 Helper Module 20

3.1.5 UI 20

3.2 Database 20

3.3 Server-Side Scripting 20

4. Evaluation 20

4.1 Testing During Development 21

4.2 User Feedback 21

5. Conclusion 21

References 22

Appendices 23

Screenshots 23

Abstract

The aim of this project is to create a smartphone application that utilizes the unique capabilities of smartphones in order to aid the personal security for vulnerable adults and children.

The application was designed to utilise a smartphones inbuilt GPS and accelerometer to track the users location and detect scenarios in which the user may be in a vulnerable situation. This involved detection of scenarios such as a user physically falling, or veering outside a particular boundary when such behavior is unexpected. When possible (i.e. User device has Internet connectivity) a users location data is uploaded to a backend server where other users of the application can query their most recent location and time. The application also has the ability to send an emergency text message in the case of an emergency such as a fall being detected or a user travelling outside of a pre-defined boundary from their starting position.

The application was designed, developed and deployed on the Android platform using the Android Studio IDE.

The project also incorporates the use of both PHP and MySQL to develop the supporting backend remote database server.

The project meets the primary aims allowing periodic check-ins from a users smartphone, remote monitoring of device location, detection of lack of user movement and movement outside certain boundaries.

Acknowledgements

I would like to express sincere gratitude to all that helped me throughout the course of completing this project as without the continued support I would not have made nearly as much progress.

Firstly I would like to thank Dr. Desmond Chambers, my project supervisor, for keeping the project on track as well as providing helpful advice, suggestions & guidance, particularly regarding how the application should function, throughout the year.

I would also like to thank my friends and colleagues who participated in the testing process of the application throughout the development process.

And finally I would like the College of Engineering & Informatics, specifically the Discipline of Information Technology.

1. Introduction

# 1.1 Background

Personal security has always been a very important issue and no matter how adequate the personal security measures in place are it is always something that can be enhanced. Security is especially an issue for more vulnerable people such as younger children and the elderly. This is because of hazards such as getting lost, going missing or suffering a fall.

Over the last number of years there has been a staggering amount of missing people reported in Ireland alone. For example in 2013 there were approximately 7700 people reported missing and in 2014 there were approximately 9100 people reported missing. [4]

Injuries due to falls are commonplace especially among the elderly in our population. It is estimated the 1/3 of the population over 65 years old have a fall causing injury each year. [5]

According to statistics gathered by IrishHealth there are approximately 7000 people over 65 are admitted to hospital with injuries relating to a fall each year. [6]

Due to the advancements in smartphone capabilities gives rise to the possibility of enhancing personal security. These advancements allow things such as location tracking, fall detection, emergency text sending without user interaction & boundary detection.

According to figures accumulated in 2015 2.37m people in Ireland own a smartphone with 55% of that 70% owning an android smartphone. [7][8]

Because of these statistics

The issues with personal security and the advancement in capabilities of smartphones are what inspired the idea behind TrackMe.

TrackMe is an application that provides the functionality of user location tracking, boundary tracking & fall detection. Location information is uploaded to the backend server where it can be analysed and other TrackMe users can track a users latest location. If a fall is detected or if a user passes outside a specified boundary a text will be sent to a user defined emergency contact.

# 1.2 Project Objectives

This project involved the creation of a fully functional smartphone application and the application was designed to provide the end user with the following core features:

* Application tracks user location at a user-specified time interval.
* User can query another users latest location update from server.
* User can enable fall detection algorithm.
* User can enable boundary detection from tracking start point.

These core features required the following to also be implemented in the project:

* Allowing application to upload location data to backend server (when possible i.e. Internet connection available on user device).
* Allowing application permission to access devices system services and hardware such as Internet, accelerometer & GPS location hardware.

The goal is to implement these features with a user-friendly interface.

The main purpose of the application is to enhance the personal security of the user by providing means by which to alert others of possible danger to them & also be able to track the user if they are for some reason unreachable.

# 1.3 Context

Additional objectives and motivations that I had for undertaking this project are as follows:

## 1.3.1 Mobile Application Development

I have always been interested in developing smartphones applications but prior to undertaking this project I was always under too many time constraints to afford me the opportunity to attempt some mobile app development. I saw this project as a great opportunity to develop an application of my own and gain some knowledge about mobile application development.

## 1.3.2 Learn Server-Side Scripting Language

Throughout the completion of my degree I was never afforded the opportunity to undertake any great amount of development using a server side scripting language such as PHP or Ruby. I used this project as an opportunity to develop my knowledge of PHP by using it to complete server-side scripting.

## 1.3.3 Database Administration

During the completion of my degree I have already gained some experience in the setup and administration of databases, such as MySQL and Microsoft SQL Server, but I wanted to improve on my current level of proficiency by setting up a more complex backend server than I have used in previous projects.

## 1.3.4 Application Use

Having previously been in situations where I would have found an application such as TrackMe useful I believed that this project was interesting to see how I would be able people in scenarios where their personal security was compromised.

2. Technology Overview & Selection

This chapter is a state of the art review of the technologies that are relevant to this project. It includes a brief overview of current technologies available that I have investigated during the completion of this project. This chapter also includes a review of products & services available that offer similar features to this project.

# 2.1 Technology Overview

## 2.1.1 Mobile Application Platform

In this section I will discuss the possible different platform that I could have used to develop TrackMe and the advantages and disadvantages of these platforms.

The platforms that I investigated during as part of the project were Android and iOS as the project specification gave the freedom to utilize a platform if my choice and I felt that these. For the year ending December 2016 there were approximately 1,270.000 Android smartphones whereas in the same timeframe there were 216,000 iOS Devices sold. [9]

### Android

Android is a mobile device operating system built primarily for use with smartphones and tablets. Androids UI is based on emulating real world direct manipulations such as tapping, swiping & dragging on-screen objects in order to manipulate them.

#### Advantages of Android Development

* Significantly larger user base than any other smartphone operating system meaning that applications developed for Android devices have a much larger potential reach.
* Online documentation for Android development is largely accessible and very thorough.
* Predominantly coded in Java which is the programming language that I am most familiar with.
* Deployment to Android application store, i.e. Google Play Store, is a much simpler & less costly process than deployment of an iOS application to the App Store.
* Android development platform allows the use of third-party tools and libraries so allows a very broad range of functionality within applications.
* Broad range of possible development environments can be used to develop applications such as Eclipse & Android Studio.

#### Disadvantages of Android Development

* Application development can be more difficult due to the lenient implementation constraints applied thus leading to the potential for an increased number of bugs.
* Potential for an increased development process when compared to other application platforms due to the lenient constraints applied on development.
* There is a large fragmentation of operating system versions meaning that development of new features need to be carefully considered as they could potentially prevent a significant portion of the potential market from being application to run an application.

### iOS

iOS is a mobile device operating system built exclusively for Apple devices such as the iPhone & the iPad. Similarly to Android the UI is based on the emulations of real world gestures.

#### Advantages of iOS Development

* iOS development features more rigourous development guidelines which leads to an application which can often be to a higher standard in comparison to other operating systems’ application.
* Smaller array of possible devices to develop for meaning that it is easier to develop application that is compatible with the UI of all devices.
* More likely to be compatible with most devices as there is less fragmentation of operating system releases.

#### Disadvantages of iOS Development

* Much smaller potential user base in comparison to the Android platform.
* Development on the iOS platform requires XCode IDE that is only available on Apple branded computers through the iOS App Store.
* The process of deploying an application to the App Store is costly, time consuming and has a high level of auditing.

### Platform Selection

For the development of this application I decided to use the Android platform as it allowed me to access the largest user base and gave more freedom when developing as it allowed for the use of some 3rd party application.

## 2.1.2 Application Technologies

In this section I will discuss the possible methods of implementing the key features of the application, at a high level. I will also give an insight into my rationale for my technology selection decisions.

### Location Tracking

#### Considerations

Implementation could be achieved using GPS location sensors on phone when location services are activated.

The smartphone devices could user it’s network provider to detect a users location when GPS is turned inactive.

A user could be tracked by either sending their location through a network socket to another user or by uploading their location information to a backend server where another user can query it.

Throughout my research it became clear that a users address is only available when they have Internet connection as there is no alternative way to access a geocoder without an Internet connection. I did not consider this to be a major problem as a user can still obtain their latitude and longitude values without needing a connection.

#### Selection

For the development of this application I decided to implement the following:

* A method that would receive the most accurate location data at all times depending on the network and Internet connectivity states of the device. (I.e. Use best available to device at the time)
* Location data would be pushed to the backend server, using an Internet connection. I considered the fact needing an internet connection may be a problem but in recent times having always on Internet connections on smartphone devices has become a lot more common so I decided that this would be the most secure and robust way to make user location data available to the necessary individuals.

### Fall Detection

#### Considerations

Fall detection could be implemented in several ways using a smartphone devices accelerometer. Fall detection can be programmed to be either very sensitive or very ignorant to possible falls. Generally speaking a fall is portrayed on a device by a change in gravitational direction either over 25m/s (downward fall) or below 1m/s (trip). Another consideration that needed to be made was that the phone accelerometer would pick up natural gravitational pull of approximately 9.8m/s at idle.

#### Selection

For the development of a fall detection algorithm I decided that the best approach would be to create an algorithm that was quite sensitive as for the purpose of personal safety I felt that a false positive was a better outcome than a false negative when detecting a fall.

### Messaging Service

#### Considerations

There is a range of possible social media platforms that can be used for messaging such as Viber, Whatsapp and Facebook Messenger applications as well as standard SMS services. For this application the fundamental characteristic I wanted for my messaging platform was that a message could be sent without any user input or interaction. I felt this was a fundamental requirement as the messaging feature of the application would only be used in case of emergency.

#### Selection

I decided to use SMS as a messaging service for this application as it was the only viable option that could send an emergency message without the need for any user interaction. I felt that this was the best option considering that this functionality would only be used in cases where a possible danger or an emergency has been detected

## 2.1.3 Web Hosting Service

### Considerations

For Implementation of a web server there were many viable options such as Amazon Web Services, Google Web Server and NUI Galways’ Danu6 Linux server.

### Selection

I decided to use NUI Galway’s DANU6 Linux web server as it already had all the technologies I would possibly need to complete my project.

Danu6 is a Gentoo Linux cluster that runs:

* Apache 2.4 and MySQL 5.5
* PHP 5.5
* Java 1.7
* Python 2.7 & 3.3,
* PhpMyAdmin PHP 5.5

## 2.1.4 Server Side Scripting

### Considerations

For this part of the project I considered server-side scripting language such as Ruby and PHP. Both of these languages very easily be able to accomplish what I needed from my server interaction.

### Selection

I decided to use PHP as it would easily accomplish what I needed and it looked like Ruby had a much steeper learning curve. PHP also had an abundance of online information and tutorials that would be very useful if I was to run into problems.

## 2.1.5 Database

# 2.2 Similar Applications

## 2.2.1 BSafe [3]

Social Personal Safety Network

Location Sharing

Location Tracking

Location Check-In

Check-In Timer

Fake Call Triggers

Guardian Alert Button



Figure 2‑1 BSafe Application

## 2.2.2 Emergensee

Live streaming of video & audio

GPS location data

Preset timer for check-in

Text & email distress notifications

Incident recording capability

24/7 monitoring

Real-time precautionary escort

Pre-set safety contacts



Figure 2‑2 Emergensee UI

3. Implementation Details

# 3.1 Mobile Application

Modularized application split into several modules

## 3.1.1 Application Module

## 3.1.2 Activity Module

## 3.1.3 Services Module

## 3.1.4 Helper Module

## 3.1.5 UI

# 3.2 Database

# 3.3 Server-Side Scripting

PHP

4. Evaluation

# 4.1 Testing During Development

# 4.2 User Feedback

5. Conclusion

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Appendices

Screenshots