

**Context-Awareness:**

**Assistive android mobile application for Alzheimer Patient**

**With Location-Awareness element**

by

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11217

Dissertation submitted in partial fulfilment of  
the requirements for the  
Bachelor of Technology (Hons)  
(Information & Communication Technology)

September 2011

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## **CERTIFICATION OF ORIGINALITY**

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



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AMIRUL HAKIM BIN MD ISKANDAR

# CERTIFICATION OF APPROVAL

Context-Awareness:

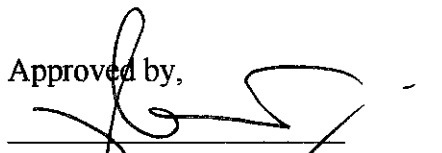
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A project dissertation submitted to the  
Information Communication Technology  
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Approved by,  
  
\_\_\_\_\_  
(Ms. Nazleeni Samiha Binti Haron)

UNIVERSITI TEKNOLOGI PETRONAS  
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September 2011

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## **Abstract**

This project presents a new approach that uses the context aware standards to provide a location awareness support for early stage of Alzheimer patient. The proposed context model enables the development of a mobile application to assists the Alzheimer patient when they cannot remember where there are and on how the assistive device would be able to guide their way home by integrated some technology that is already out there. In particular, we describe in this paper the nature of the Alzheimer disease, about the framework and the definition of the context aware especially on location awareness and on how the application will assists the Alzheimer Disease patient in their daily life.

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# **Chapter 1**

## **1. Introduction**

### **1.1 Background**

As a human being, to be able to do certain daily routine tasks are a must as time passed by. An adult human being will be able to do routine daily tasks that have a degree of complication for example making a tea or coffee, driving and any other daily routine tasks. As age goes by, the old generation tend to get a disease that will cause cognitive disability such as dementia, Alzheimer and Parkinson disease. After the improvement of the computer technologies in the medical field, there are many aiding and monitoring tools that the computer societies try to invent. As time goes by, more and more types of aiding tools and monitoring program are out there and the tools have become more and more efficient. One of the main reasons for the spread of the medical-based computer tools is because the generation now are more towards to the technology-savvy and thus they will be able to use the computer-based tool more easily. Other than that, with the development of this kind of aiding tools for the cognitive disabled person, it might help lessen the burden of the person itself. Instead of relying to their families or guardian, they can rely on this kind of aiding tools to help with their daily routine tasks. These types of application really give great impact to the human life especially to the medical world.



## **1.2 Problem Statement**

In this digital age, computer is one of the main choices by the doctor in order to assist or monitoring a patient eating habit, level of health and many other things that are relevant to the health of their patient. As for the current context-aware computer application, usually traditional approach in the development of computerized systems has been the concept of using the black box approach (traditional approach) for example a set of functions, predicates, subroutines, I/O systems, and networks, which process input and provide output with the user not playing a significant role in these processes. Something goes in for the input and something comes out of the output, and the output is completely determined by the input. This situation is sometime very dangerous for the Alzheimer type dementia disease. What will happen if the person already takes their medication 5 or 10 minutes earlier? The notification to take medicine will make the patient overdose on drug. So, as time goes by, context are being taken into as an implicit input and output to the application. This new view allows the application to decide what to do, base not only on the explicitly presented input, but also on the context in which the system is being used, including time, place, weather, user preferences, or the history of interaction.

## **1.3 Project Objective**

The implementation of this project is to overcome the stated situation in the problem statement which is the black-box type of application. The project objective is about studying the nature of the Alzheimer Disease (AD), the concept of context-awareness on how to add the context-aware feature to the mobile application and followed by the development of the mobile application. The main objective of this project is to apply the concept of context-aware to a mobile application to aid the patient that have Alzheimer Disease (AD) and to develop a mobile application to assist on the Alzheimer's daily routine task i.e. - How to travel to the shop alone. To

create a To-Do list so that they do not have to be afraid if they forgot on what to do.

#### **1.4 Significance of the project**

When we discuss about the significance of this project, we will be looking and asking about the purpose or the reason on why the study is important.

The main reason on why this study is important is because:

- 1) This study will somehow be able to help other researchers that are interested this area, which is to develop an assistive device for Alzheimer patients.
- 2) This research and the study would absolutely save other researcher time by referring to other people research material.
- 3) As for this project, it is very important because this is one of the assistive device projects that will lessen the burden of the guardian of the Alzheimer's patient. Based on the name assistive device, the patient will be able to be independent when they want to go out to do something or to buy something from the shop without relying too much on the guardian guiding them to their destination.
- 4) Enhancing the efficiency of the current mobile technology to assists early state Alzheimer patient.
- 5) As for the research and project, this project is very important and will benefit the guardian of the Alzheimer's patient, their guardian, and this project will also benefit the medical world when they are able to assists their patient using latest technology.

Lastly, if this study and the project are complete, millions of Alzheimer patient will be able to at least be independent when going out from their house. They will be able to have a bit of their freedom back and that freedom is the freedom to go out without any worries of lost.

## **1.5 Project Scope**

This project aims to research about the nature of the Alzheimer disease, the context-aware concept to improve the traditional black-box design and then come out with one prototype to implement the concept. The context-aware concept that will be implemented in the early stage of Alzheimer disease mobile application is the location-aware function, which will be able to assists the early stage patient diagnosed with Alzheimer-type dementia in case of sudden memory lost to where the patient leave or to the nearest police station. The scopes of the research that will be covered are as the following:

- i) Models and architecture of context-aware applications
- ii) The nature of the Alzheimer Disease (AD)
- iii) Human considerations in context-aware systems
- iv) Analysis of the context-aware functions and combine the concept with the aiding tool concept.
- v) Choosing of suitable platform (desktop or mobile computing) to implement the specified context-aware function (Cognitive Assistive Device).
- vi) Monitoring tools by healthcare practitioner
- vii) User Interface that will be easier for the patient to learn

## **1.6 Feasibility of the Project within the Scope and Time frame**

The duration to develop the project is three months. The project is feasible to be developed because some of the component for specific function such as the 3D navigation from Google and the Google Latitude will be integrated in the android mobile application using the powerful Intent function for android. The main idea for the application is it needs to be as simple as it can get so that the Alzheimer Patient will have the capability to learn about the device and how to use the mobile application easily.

The application was developed based on the target objective which is to provide the navigation power to the application by integrating Google

navigation and the tracking capabilities by integrating Google Latitude technology in the application. Other than that, the function that keeps the profile of the patient and the easy speed dial button will make it easier for anyone who found the patient that is lost after wandering without any goal.

From this, we can conclude that the project is indeed within the scope and match the objectives of the final year project that has been approved by the supervisor.

## **Chapter 2**

### **2. Literature Review**

#### **2.1 Dementia**

Dementia is characterized by the loss of or decline in memory and other cognitive abilities. It is caused by various diseases and conditions that result in damaged brain cells. The criteria for a person to be classified as a dementia patient is it must include decline in memory and in at least one of the following cognitive ability whether it be the ability to generate coherent speech or understand spoken or written language, the ability to recognized or identify objects by assuming intact sensory function, the ability to execute motor activities, assuming intact motor abilities, sensory function and comprehension of the required task, and lastly the ability to think abstractly, make sound judgments and plan and carry out complex tasks [1].

Dementia also is known as a common clinical syndrome in the older-adult population and is characterized by a sustained decline in cognitive function and memory. Eventually the dementia becomes so severe that it impairs a person's ability to work and perform common tasks in the home [2].

It is estimated that there are nearly 5.3 million people with dementia in the United Stated alone, it is the 7<sup>th</sup> leading cause of death, USD 172 billion dollars in annual costs and there is about 10.9 million unpaid caregivers as of the year 2010 [1].

## 2.2 Alzheimer's Disease (AD)

When we are discussing about dementia, Alzheimer is the most common form of dementia; accounts for an estimated 60–80 percent of cases. The difficulty remembering names and recent events is often an early clinical symptom; apathy and depression are also often early symptoms. Later symptoms include impaired judgment, disorientation, confusion, behaviour changes and difficulty speaking, swallowing and walking. Hallmark abnormalities are deposits of the protein fragment beta-amyloid (plaques) and twisted strands of the protein tau (tangles) [1].

Alzheimer disease also can be said as an adult disorder whose prevalence increase with age, affecting 10 to 20% of the population aged over 80 years. It is a slowly progressive, neurodegenerative disease [3]. As AD progresses through each stage (mild, moderate, and severe) of the disease, gradually patient symptoms become more apparent. These symptoms range from the decline in cognitive abilities and mild memory loss in the early stages of the disease, to needing help carrying out everyday activities in the moderate stages of the disease, to support in almost all aspects of daily functioning in the later and severe stages [22].

As AD is a progressive illness, gradually over time, more parts of the brain become damaged. As this happens, the symptoms of AD become more severe, and eventually, patients require full-time help and assistance with all their daily activities. This in turn impacts on patient quality of life and loss of independence, the patient become a burden on their family and friends and often, in the later stage of the disease [23].

After understanding the nature of the Alzheimer Disease (AD) that will give an impact to the human cognitive ability, it will be easier to find out the ways or computer method that will be able to assist the patient that have the Alzheimer Disease by applying the context-aware concept and also in order to choose the suitable target user for the mobile application that will be develop later.

In the past, there are many devices have been invented. It was used to assist people with cognitive disabilities to complete various tasks for almost 20 years [8, 10].

### **2.3 Importance of assistive device in the healthcare environment.**

Previous research by Russell et al. found 75% of disabled older persons used some form of assistive technology [23,26]. Assistive device can be used as an alternative way of carrying out tasks and can be used independently or alongside personal care [23,27]

### **2.4 Context-Aware Concept**

As for the definition of context, there are many different definitions that have been defined by different people or dictionaries. Although the previous definition of context are by enumeration of example or by choosing synonyms for context [4] which are not truly precise as people find it hard to define, there are still some definition of context that we could say that it is very near to the 'context aware' scope.

According to the dictionaries, dictionaries generally define "context" as related circumstances or background and "awareness" as knowledge, self-consciousness, recognition, conscious, consideration and etcetera [5]. As for Schilit et al, Schilit et al claimed that the important aspects of context are: where you are, who you are with, and what resources are nearby [5]. Other than that, in the work that first introduces the term 'context-aware,' Schilit and Theimer refer to context as location, identities of nearby people and objects, and changes to those objects [4]. In other part, because many researchers are not satisfied by the general definition, many researchers have attempted to define context by enumerating examples of contexts. Schilit divides context into three categories [5]:

- 1) Computing context, such as network connectivity, communication costs, and communication bandwidth, and nearby resources such as printers, displays, and workstations.
- 2) User context, such as the user's profile, location, people nearby, even the current social situation.

- 3) Physical context, such as lighting, noise levels, traffic conditions, and temperature.
- 4) Time context, such as time of a day, week, month, and season of the year.

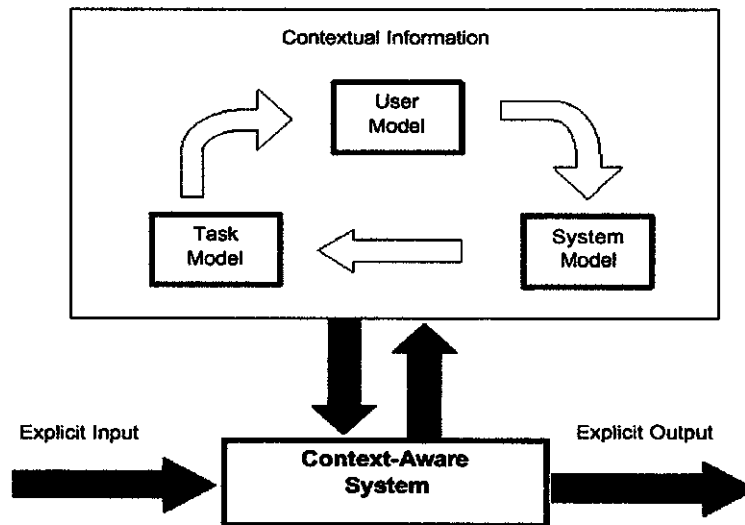


Figure 1: Context Aware System

Figure 1: Explicit input from the environment is explained through the use of contextual information that is stored by the system according to the task, the user, and the system. The three elements are updated as necessary by the system in order to maintain up-to-date information as the environment and user change. In addition, the three elements must interact with each other in order to ensure that changes that may occur in one model do not negatively impact information stored in another, such as making other information out of date or redundant. [10]

Then to summarize the definition given by Schilit et al and all the definition that we have discussed and to fit in the concept in the project is to say that context-aware involved what is around the individual, while taking into consideration the location of the individual and what is around the individual. As for the awareness terminology, we can say that the definition will be more towards the knowledge or the self-learning or consciousness of the device own by the individual.

For this project, there are many issues need to be highlighted especially selecting the target group of Alzheimer patient. As Alzheimer's disease progresses, individuals move through several stages: from the decline in cognitive abilities characteristic of



normal aging to mild cognitive impairment (MCI) without dementia, through to the mild, moderate, and severe stages of AD [6]. Age related memory impairment is subjective in nature; individuals may forget words or names but can generally remember them at a later point in time. Individuals with MCI have an objective memory impairment accompanied by normal general cognitive functioning and no decline in functional abilities that would impact activities of daily living. Individuals with MCI have a high risk of progressing to dementia or AD with rates found to be between 6 and 25% per year [7]. So, by choosing the right group of target user, the tools will be able to function as per desired. We will be choosing the early stage of Alzheimer patient that have difficulty to remember their way back home and difficulty remembering name of places.

In the past, there are many devices have been invented. These devices have been used to assist people with cognitive disabilities to complete various tasks for almost 20 years [8, 10]. The traditional approach in the development of computerized systems has been the concept of using a black box—i.e. functions, predicates, subroutines, I/O systems, and networks, which process input and provide output with the user not playing a significant role in these processes. Something goes in one side and something comes out the other side, and the output is completely determined by the input [9]. So, in order to overcome the traditional approach of the black box, we can implement the context-aware concept in our project.

According to the past approach, there are many flaws in the system because it solely depends on the input of the user, which sometime might never be accurate. For example, there is a device that provides unnecessary reminders. Several past devices were programmed to give a reminder for every step in a task that a user needed to complete whether the reminder was needed or not. If a user had already successfully completed the step, the device still prompted the user to complete it. This may result in the user becoming annoyed and frustrated. [10]

## **2.5 Advance Smartphones technology**

For the application, we will use the mobile technology for our project. It is because in desktop computing most parameters in the environment are relatively stable, constituting a rather constant context. Likewise, mobile notebook computers are designed for stationary use so that there is usually little variation in the situation

surrounding notebook usage. In contrast, the environment of ultra-mobile computing is characterized by change. Interaction with applications on ultra-mobile computers is usually spontaneous and short; applications are revisited with varying frequency and in different places, without being closed; and ultra-mobile computers can be operational and used while on the move [11]. Now, we already have the ultra-mobile technology that consists of mobile phone such as HTC, iPhone, iPad, blackberry and etc that have the capabilities and the processing power near to a small notebook.

In the beginning, first-generation wireless cell phones were, large in size, placed in a briefcase-sized cover and permanently installed within a vehicle. [23, 24] As time passed-by, the technology of the mobile phone was improved in terms of its size, mobility, connectivity, friendly-user interface and offer many functions. According to Ballagas et al, these functions can include motion sensing, voice recognition, and the ability to see, hear, and interact with the surrounding environment [25] through WiFi, infrared, 3G, 4G, and Bluetooth technology to name a few. With all the new 3G and WiFi connection services with mobile phone, mobile phone can now have limitless potential and opportunities to grow. So, there will also be many opportunities and potential that could be taken by the medical-area people in order to increase improve the lifestyle of the Alzheimer Patient.

Just what likeBurstein et al write, according to him, as the mobile computing paradigm proliferates rapidly into the medical field alongside the existing legacy systems, it is important to realise the changes in the landscape of the computing devices it brings. Unlike stationary desktop oriented machines (PC's), mobile devices (such as phones, PDA's) are constrained by their shape, size and weight [12].

So, according to all to the ideas of the boundless potential of the mobile phone technology, mobile phone latest technology may offer a better solution compared to the recent technologies in terms of the assistive device mechanism for the Alzheimer patients.

## 2.6 Context aware with mobile technology

Due to their limited size, it is easy to carry this device anywhere and everywhere where the patient is going. So, the assisting devices will be able to fulfil its role when the Alzheimer patient went out to the city and lost its way back home. The application will be a mobile application so it will be easy to be carried around. Then, the other main reason we would like to implement the context aware concept to the mobile technology is because according to Keith Cheverst et al, one area of research that is concerned with exploring the ways in which mobile devices can be used to provide more sophisticated services is that of context-aware computing [13].

Other than that, the role of context for better decision-making has been a topic of significant research effort over the years [12, 14, and 15]. The more ambiguous decision situation, the bigger advantage is there to provide the decision-maker with support in modelling and learning the context for better understanding of decision parameters and implications of selecting particular decision alternatives. Most of real-time decisions are mainly based on access to real-time data or information that can support the decision-making process. So, the decision making process in our Alzheimer assisting tool application will play a very important role because the decision making process of indicating the patient already far away from their home will not be depending on the patient input.

As for the human factor related context, Schmidt, Beigl&Gellersen define human factors and physical environment as two important aspects relating to computer science. Human factors related context is structured into three categories: information on the user (knowledge of habits, emotional state, bio physiological conditions, etc), the user's social environment (co-location of others, social interaction, group dynamics, etc), and the user's tasks (spontaneous activity, engaged tasks, general goals.). Likewise, context related to physical environment is structured into three categories: location (absolute position, relative position, co-location.), infrastructure (surrounding resources for computation, communication, task performance.), and physical conditions (noise, light, pressure,) [11]. So, when we

decided to develop a tool that is related to the user's social environment, we have considered applying the location-awareness concept.

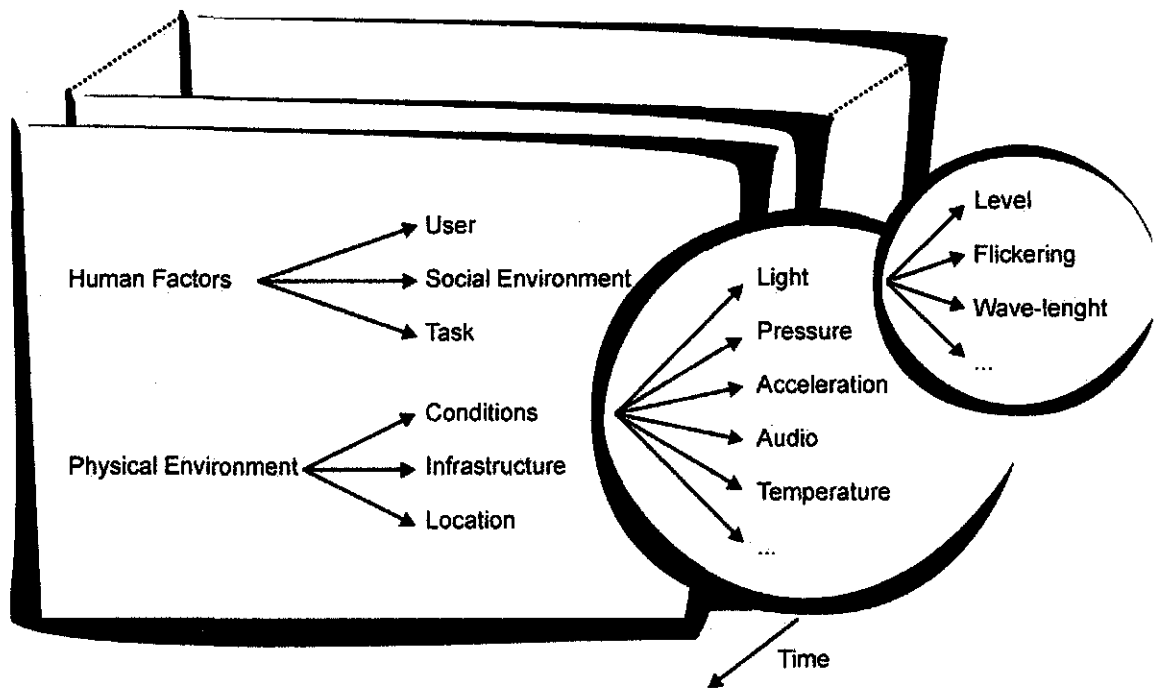


Figure 2: Context feature space [12].

This model, according to Burstein et al, the described model provides some structure for consideration of context. For pragmatic use of context, the general challenge is to identify the set of relevant features in terms of which a situation or environment can be captured sufficiently. Situations and environments are generally characterized by a large degree of continuity over time, so that context history itself becomes an important feature for approximation of a given situation or environment [12].

## 2.7 Location Awareness, the comparison of technology and current issues.

As for the location awareness, there are many ways to track the location of the users; the simplest method of locating the user is to let him/her tell the location, for example, the foursquare 'check-in' mobile application. From the point of view of the user, this method requires extra effort because the user needs to define his/her location and input it to the system as a part of the search. According to EijaKaasinen, the user can be located with different positioning systems. If the user device includes a GPS (Global Positioning System) module, the user's location can be defined very

accurately (2–20 meters). A GPS cannot be used indoors and it may not work in ‘urban canyons’ either. The location is calculated in the user device and it has to be sent to the service provider in order to get location-aware services. The range of commercial products currently available include mobile phones with integrated GPS modules, separate GPS modules for PDAs (Personal Digital Assistant), and GPS devices with integrated mobile phone and data features to know the latitude and the longitude of the coordinate [16]. Other than that, we can also use reverse Yahoo Geocoding to determine the coordinate of the user by converting street addresses or place names into geographic coordinates [17].

As for the issue for location awareness application, it is essential to design location-aware applications to take into account the accuracy and reliability of available location. Not only is GPS data not very accurate, but it is also not always available. GPS signal is lost when entering most buildings and the so-called concrete canyons in urban areas make reception difficult. The fact that most buildings are GPS opaque was exploited advantageously, permitting a simple learning mechanism for the locations of buildings [18]. As for the new technology, there is 3G connection in the new smart phones. In order to access the Yahoo Geocoding for example, one must have a 3G connection. But in certain areas, there is no 3G or 4G coverage. This is also the issue that we need to take into consideration in case of the patient lost in an area where there is no 3G or 4G coverage.

The project will be utilizing the android functions which are provided by using the LBS or Location Based Services using android. It is a platform that provides information services based on the current or a known location, supported by the electronic map platform. The location information (latitude and longitude coordinates) of mobile end user can be obtained through the mobile communication network or the Global Navigation Satellite System (GNSS) [28, 29].

In the emergency, safety and medical/health services, many governments are moving to require cellular operators to develop the capability to automatically identify subscribers’ location in the event of an emergency [28]. As for this project, the concept of tracking the Alzheimer patient that is lost on a journey to their destination could be applied using LBS.

## 2.8 Battery Issues

As for the battery management issue, this is also one of the main issues that we need to consider thorough out this project. We need to consider whether the battery will be able to last long enough until the patient arrives at his/her home and not only last half way through. This is a very important factor because it involves the safety of the patient itself. What will happen if the battery was dead while the patient cannot remember where they are or while they are returning to their home? This will be a very dangerous situation unless we assume that there is a good person to help the patient to charge back the device. According to Nishkam Ravi et al, Mobile devices such as smart phones are riding the wave of Moore's Law, providing increasing functionality due to rapid improvements in processing power, storage capacities, graphics, high-speed connectivity, etc. However, the main problem faced by these devices is battery management, since battery capacities are not experiencing the same exponential growth curve as other technologies such as processing power and storage. While there is ongoing research in discovering and exploiting ambient energy sources, it is highly likely that energy will remain the key bottleneck for mobile devices in the near future [19].

## 2.9 Mobile Agent

As for the framework of this project, this project as a whole is a mobile agent and not just a program because the term agent is used to represent two orthogonal concepts. The first is the agent's ability for autonomous execution. The second is the agent's ability to perform domain oriented reasoning."P> This pointer at definitions come from an online white paper by Sankar Virdhagriswaran of Crystaliz, Inc., defining mobile agent technology. Autonomous execution is clearly central to agency [20]. Other than that, according to The Maes Agent [Maes 1995, page 108], it defines that "Autonomous agents are computational systems that inhabit some complex dynamic environment, sense and act autonomously in this environment, and by doing so realize a set of goals or tasks for which they are designed [20]. As for the other definition, an agent can be define as referring to a component of software and/or hardware which is capable of acting exactly in order to accomplish tasks on

behalf of its user. [21] As for another definition, according to the Software Agent course by Dr. Alan Oxley in Universiti Teknologi Petronas, an agent is a computer system capable of autonomous action in some environment, in order to achieve its delegated goals. So, in other word, we could agree that after comparing the definition stated that an agent should be capable of autonomous action, an agent must have the capability of acting autonomously and also goal-oriented. As for this project, the mobile device will advice by using sound output to the patient if the patient are 100m away from his/her house.

In the review of published works, we could agree some of the main idea of what an agent means and the comparison between an agent and a program, which agent are autonomous, the context-aware concept which is the current and future trend of ubiquitous computing because of the booming of the smart phone market and lastly, regarding to the concern of the nature of the Alzheimer Disease and it's differences between the dementia disease.

## **Chapter 3**

### **3. Methodology**

#### **3.1 Research Methodology**

As for the methodology, the purpose or the goals for this research is for us to understand more about the Alzheimer disease in term of the definition of the disease, the cause of the disease, and the main part is the trend of the disease in this world statistically before coming out with a project title and scope. Then, the research purpose also is to ensure that we had chosen suitable application to develop for example we have to choose whether it be an assistive device or a monitoring device. Other than that, we have done the research to have a better picture of the context-aware concept which is their definition, overview, its framework and lastly how to apply the location-aware concept for mobile devices.

The technique that we had use in order to gather all the information that is related to the project is by using the method of qualitative research which is accessing the public record. Most of the fact in this proposal facts and figures were obtained from and external source. The records are all part of the public domain information and created with the purpose to record their own research findings, to share with other people to help with other people research through journals, articles and books.

Other than that, some facts are found based on Personal Records such as from previous experience in real-life involving real smart phone in term of the battery power issue (running an application will cause a lot amount of power) and the events where we interacted with other family members that have the Alzheimer Disease in the past. So, by interacting with them, we have learnt one or two facts regarding the Alzheimer Disease.



By using Qualitative Research method; we have been able to determined and decided on choosing which mobile application that is suitable for this project. At first there are two choices of application that we would make. After the amount of research that we have undergoes this past few weeks (reading journal, article, and website), taking into consideration in term of feasibility aspect and the relevancy of the project, we have chosen to develop assistive device for Alzheimer Patient powered by mobile technology.

For the future plan, we will be planning to perform interview with a doctor to learn more about the dementia patient. The set of question have yet to be determined but it will base on the Alzheimer's disease (AD), the nature of the disease, and a couple of question regarding to the Alzheimer's patients in order to support the points that we have found during the research. Other than that, we also could create a set of questionnaire for the guardian of the Alzheimer's patient to answer in order to get their feedback on whether the assistive device that will be develop later will be able to help them ease their daily burden.

### 3.2 Project Methodology



Figure 3: Project Methodology

Software development model:

Software development methodology is a framework in software engineering that is used to structure, plan, and control the process of developing a system or software. There are many types of software development methodology approach such as waterfall methodology which is a linear framework, prototyping which is an iterative framework, Incremental which is a combination of linear-iterative framework, and lastly, rapid application development or RAD which is also one of the iterative framework.

For this project, the software prototyping framework will be used, which is the development approach of activities during software development by creating prototypes of the software. A prototype is the incomplete version of the software that is currently being developed. During the project timeline, a prototype will be developed to measure whether the goals for the development activities could be achieved.

### **3.3 Project Orientation**

#### **3.3.1 The planning phase:**

The planning phase is the phase where the studies of the feasibility of the project were done. During this phase, it is a must to establish a high-level or the bird-eye view of this software that is intended to be developed to ensure sufficient understanding of the software itself. Other than that, the Gantt chart and the project activities and key milestone for the project are defined in this phase. To come out with a good plan during this phase, researches needs to be done thoroughly to understand and identify the context that will be use and the most suitable platform that this software will be developed.

NO	TASK NAME	WEEK													
		1	2	3	4	5	6	7	8	9	10	11	12	13	
1	Selection of FYP topic							M							
2	Preliminary research work							I							
3	Submission of Extended Proposal							D							
4	Literature review							S							
5	Seminar							E							
6	Proposal Defense							M							
7	Report preparation							B							
8	Interim Report Submission							R							
9	Technical Report Submission							E							
								A							
								K							

Table 1: Gantt chart for project

This is the Gantt chart for the final year project that we designed (the activities) throughout the whole final year project 1. For the first six weeks, all the effort are concentrated more onto gathering the general information or ideas for the title of the project, the target user for the software which that will be developed, which is the Alzheimer Disease patients, and the technologies that will be involved (for example mobile technology, GPS technology and etc). The weeks after the mid-semester break, the research is conducted to understand more about the technical specs of the project.

There are also proposal defence on week 9 which is the presentation of the idea of the project and about the purpose of the project. The presentation was done in front of the supervisor and another lecturer.

As for the key milestone of the project, the key milestones were determined and wereset to ensure that the project is on track and the key activities were completed on time.

Key milestone:

Activities	FYP 1				FYP 2			
	W2	W3	W8	W11	W2	W3	W8	W11
	W4	W6	W10	W13	W4	W6	W10	W13
Study on how distributed agent works	■							
Study on available algorithm to develop the system (mobile app sample)	■	■						
Identify suitable algorithm (GPS, Google API, android)		■	■					
Gathering information on how to develop the system			■	■				
Plan system requirement & design				■	■			
System development					■	■		
Conduct testing							■	
Analysis and discussion of results								■
Research documentation								■
<b>Milestone</b>			◆					
Identify suitable algorithm to be used					◆			
Finalized system requirement & design							◆	
Completion of system development							◆	
Completion of system testing								◆
Completion of analysis of results								◆
Project completion								◆

Table 2: Milestone for Final Year Project

### 3.3.2 Analysis

In the analysis phase, the platform, the language and the type of context that will be used for the project are discussed in a detail manner. The architecture or any sources that are near and related to the assistive mobile application are reviewed and are taken into consideration (for example the ComMotion architecture). During this phase also, the suitable development kit or SDK are determined (in this case, Eclipse with android plug-in, droiddraw for interface and the emulator to run the android program).

#### Analysis of a suitable platform to be used:

According to the literature review section, it is justified that the most suitable platform for this kind of assistive device application to be developed is on a mobile device or to be precise, on smart phones. During this time, the two most popular smart phones will be the android based phone and the iPhone by Apple.

Based on the fact that android could be developed on any computer (which is not limited to any type of computer), and it is open-source language of java,

it is easier to developed an application on android based smart phones. Other than that, android platform is also a new generation of smart mobile platform that provides support for mobile map and location service (which is closely related to the location-aware element in this assistive mobile application software) for free.

### 3.3.3 Design

In the design phase, the architecture of the system, the input and the output of the system were being determined. The mobile application is basically connecting to the GPS satellite system for its capability to indicate the location of the Alzheimer patient. For this system, the input will be set by the patient's guardian in term of the destination that the patient wants to reach. After that, the patient only needs to follow the GPS guide (the output will be voice output for guidance) to reach the destination.

As for the user interface or UI, the user interface prototype will be design by using sketch and the droiddraw to allocate the necessary buttons.



Fig 3: Android Supports Satellite and Map View

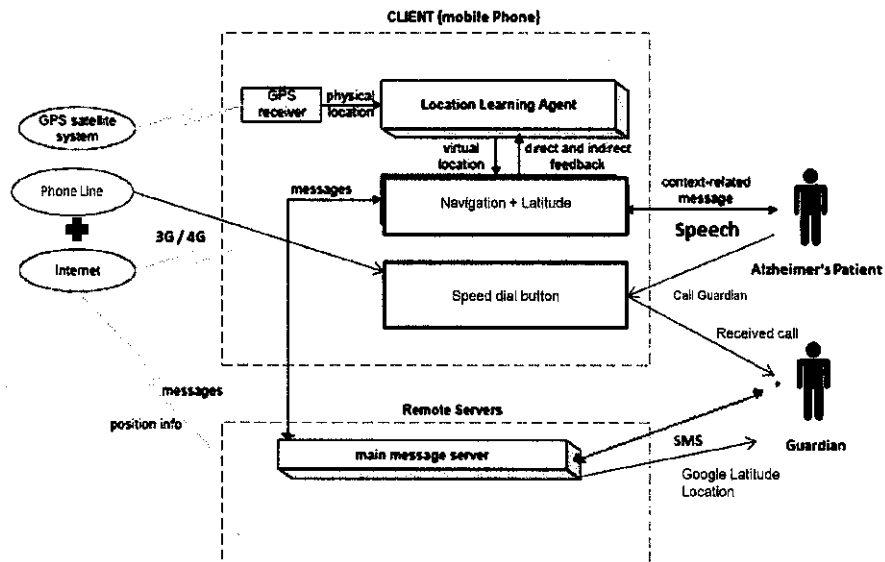


Figure 4: System Software Architecture

This is the sample of the LBSOID interface that is supported in the android programming that will be used in this project. There are many functions that are supported in the LBS.

### 3.3.4 Implementation

During this phase, the java code will be written and a small prototype will be design to test the basic functionality for example, testing whether the map will run as desired.

### 3.3.5 Testing

The testing phase will be throughout the implementation phase, to check whether all the function that is included will worked as desired. However, after all the hard coding tasks are completed, the alpha testing will take place by the developer will try all the functionalities of the application and to find whether there are major bugs on the system.

### **3.3.6 Maintenance**

After the development task is completed, any new bug that is discovered during user usage will try to be fixed by the developer.

### **3.4 Summary of the software to be develop**

For this project, a mobile assistive application will be develop in order to assist the Alzheimer patient to go to a destination without any help from peers or guardian. The context aware concept that will be used in this project is the location-aware concept that the android based phone supports. The current location of the patient will be determined by GPS receiver (by connecting with the GPS service). As for the input, if the first case the patient wants to go to the grocery shop to buy something, the guardian him/herself will input the destination for the patient. By doing this, at least the guardian was aware that the patient is going out. For the output, the output to guide the patient to their destination is by using voice output (the order to turn right and left).

As for the second case, assuming that the application is on and the guardian had already set their home in the application, if suddenly the patient is wandering around aimlessly or suddenly does not remember the way back home, the application will automatically give a warning by using voice output if let say, it is already 100m from house and the application will guide the patient back to their own house. The guardian also will receive the current location of the patient in a form of SMS.

The way that this application determined the location of the patient is byusing the LBSOIDor the Location Based Services using Android. Android is the first open source mobile application that has powerful APIs, excellent documentation, a thriving developer community and no development or distribution cost [28]. The android provides access to the following components to facilitate the implementation of the LBS services which are the location manager, location provider, Geocoding, and Google-map [28].

There are also some assumptions that the developer need to be consider throughout the whole project which is the battery power. For power saving, after 15 minute of idle (no button is pressed) the smart phone screen will automatically in power saving mode.



## Chapter 4

### 4. Results and Discussions

For this project, there are many types of method that will be used to obtain the data related to the android mobile application especially related to the practicality of the android app, the feasibility to develop and the accuracy of the android application to the target user, which is in this case, to the patient itself and to their guardian. The method that will be used in this case will be questionnaire to a number of 50 samples that are being questioned randomly.

#### 4.1 Data Gathering

##### 4.1.1 Questionnaire Result

Question No.	Question category	Yes	No	Percentage (%)
1	Do you know about Alzheimer Disease?	45	5	90% - Yes 10% - No
2	Do you have any experience with Alzheimer patient? Directly or indirectly? (Example: Family Members, relatives, friends)	30	13	69.77% - Yes 30.23% - No
Question No.	Type of problem that the patient might be facing because of the disease	Total Number		Percentage (%)
3	Are they forgetting identity? (their own name, family members)	7		23.33%
4	Are they losing the ability to read?	4		13.33%

5	Are the patients wandering and forgetting what they are doing?	9	30%
6	Have the patients lost their ability to remember on how to reach a certain destination desired by them?	10	33.33%

## 4.2 Data Analysis

### 4.2.1 Data analysis based on question categories

#### Question 1: Do you know about Alzheimer Disease?

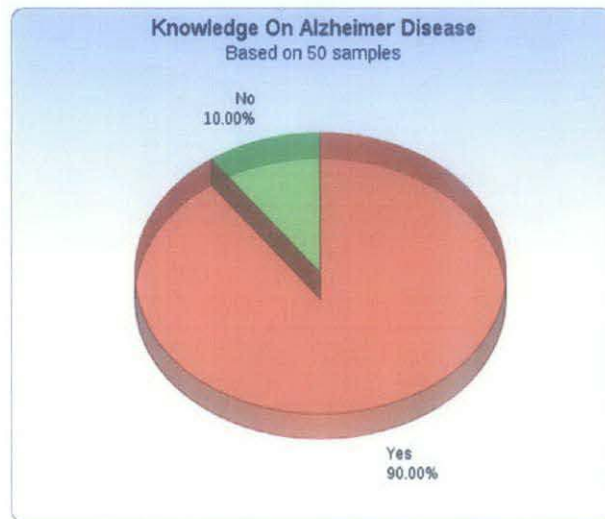


Figure 5 – Knowledge on Alzheimer Disease

Based on the survey first question, out of 50 samples that answer the questionnaire that contained six questions, there are 45 samples out of 50 samples or 90% of the participants are aware of the Alzheimer Disease. There are many reasons why 90% of the samples are aware of Alzheimer disease and one of the main factors is because the disease is one of the rapidly growing diseases in this time. Other than that, with the internet and mass media to boost the awareness on the Alzheimer Disease, the awareness and the exposure on this disease are increasing every day to the people.

Other than that, some of them have direct and indirect experience with the patients. For example, some of the people have family members that have Alzheimer disease (father, mother or even relatives) and some of them are being the guardian of the patient itself. Then, as for indirect experience with Alzheimer patients, some of the samples have the experience of meeting Alzheimer patients in the hospital, or from their friends' family or relatives.

As for the samples that did not know and did not aware about Alzheimer Disease, which are 10% of the samples from the questionnaire, it is found out that the sample does not have any direct or indirect interaction or experience with Alzheimer patient in their life.

**Question 2: Do you have any experience with Alzheimer patient?  
Directly or indirectly? (Example: Family Members, relatives, friends)**

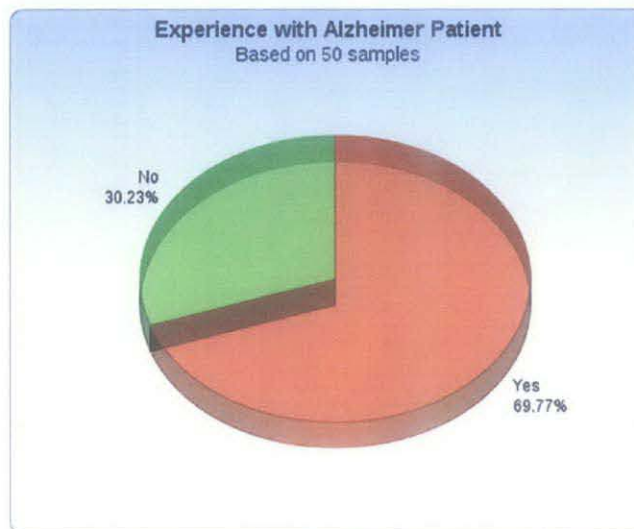


Figure 6 – Experience with Alzheimer Patient

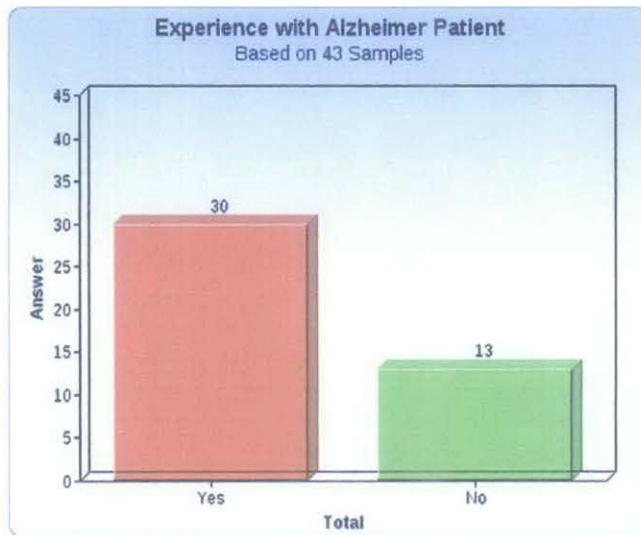


Figure 7 – Experience with Alzheimer Patient

The second question is only for the samples that only answer yes for the first question. There are about 45 people or 90% of the samples says 'yes' on the first question. Two people withdraw from the survey. From the samples, it is found out that 30 samples out of 43 samples or 69.77% have indirect or direct experience with Alzheimer Patients. Most of the samples that answer 'yes', have a direct experience with the Alzheimer patient because they have close family member (grandfather, grandmother) that have the disease and some of them have interacted with relatives that have Alzheimer Disease. As for the samples that answers 'no' for the second question, there are 13 samples out of 43 or 30.23% are answering 'no' for the question. This is because the samples are the one that are aware and get all the Alzheimer Disease information through mass media such as newspapers, internet (social network or search results), from television (documentary on the disease) or from event organized by NGO or government body to educate people on the Alzheimer Disease. They did not have any direct or indirect experience with the Alzheimer Patient themselves.

Notes: Start question 3-6 the samples that answered the second question with 'yes' only will answer the rest of the questionnaire, which are 30 samples out of 43 samples.

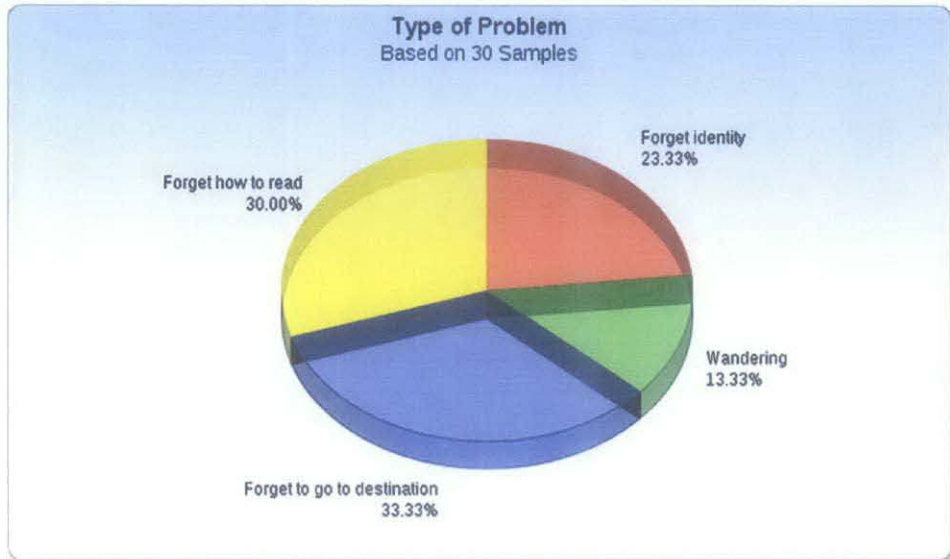


Figure 8 – Type of Problems

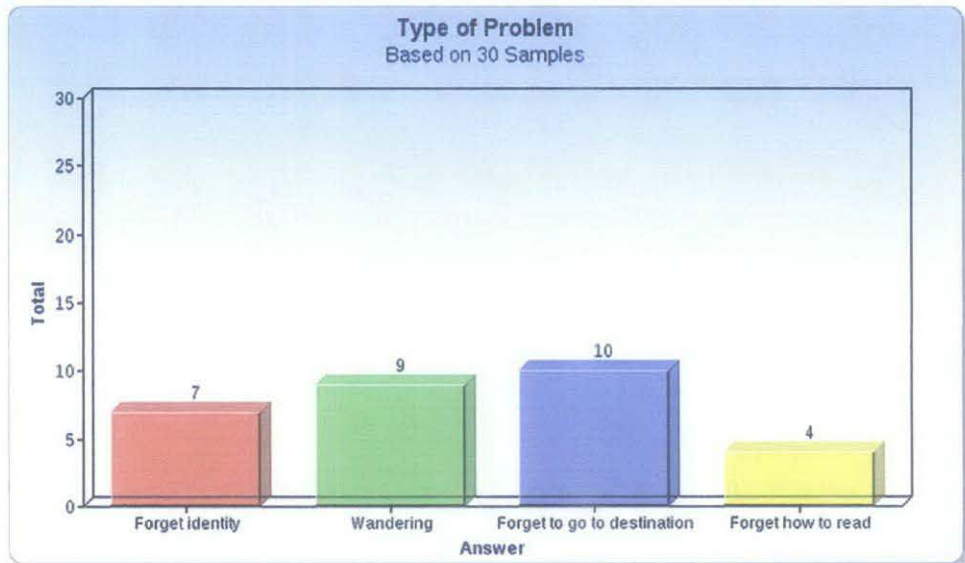


Figure 9 – Type of Problems (bar chart)

**Question 3: Are the patient forgetting their own identity? (Their own name, family members)**

According to the questionnaire, there are 7 samples out of 30 samples that have experienced with the Alzheimer patient that have lost the ability to remember their own identity. Majority of the samples indicate that the Alzheimer patient that they have direct or indirect experience with lost the ability not all the time, but only some of the time. Meaning, sometimes they tend to forget but they still can remember after a deep thinking on whom the patient are.

**Question 4: Are the patient forgetting their own identity? (Their own name, family members)**

According to the questionnaire, there are 4 samples that have experienced with the Alzheimer patient already lost the capability to read. Their cognitive ability is declining. Other than the help from the guardian, any help using any assistive device will be rendered useless unless the assistive device is using sound as output to assist the Alzheimer patient of this kind.

**Question 5: Are the patients wandering and forgetting what they are doing?**

According to the questionnaire, there are 10 samples out of 30 samples that have experienced with the Alzheimer patient have done at least once wandering around or forgetting what should they be doing. For example according to the feedback from the samples, there are some who experience with the patient that forget the destination and the purpose halfway after they go out to buy something or to go somewhere.

Some of the patient just wandering away from home without any objective. This situation also often occurs based on the feedback from the questionnaire. The patient's guardian has some problem in order to know the whereabouts of the patient when they wander outside of the house compound.

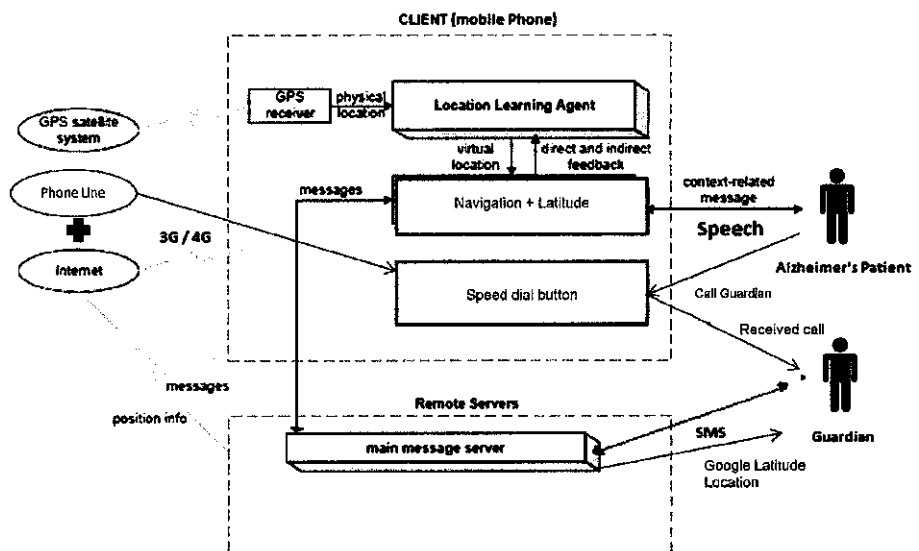
**Question 6: Have the patients lost their ability to remember on how to reach a certain destination desired by them?**

According to the questionnaire, there are 9 samples that have experience with the Alzheimer patient have starting to lost their ability to remember on how to go to a certain place for example to go to the marketplace to buy something. According to the remarks obtained from the samples, it can be said that most of the patient that they encounter or have experience with are still in the early stage of the Alzheimer disease.

Because of this symptom, the patient that usually goes out to do routine work such as to do some shopping to buy some grocery will find out it is very difficult for them to do their routine work without the help of the someone especially the guardian to guide them, in this case, the marketplace.

**4.3 Experimentation/Modelling / Prototype/Project Deliverables**

As for the project progress, the prototype that contains certain functions is already functioning.



According to this software architecture this software will utilize the GPS function, which is to navigate using Google Navigation, and also to retrieve the longitude and the latitude of the current location of the patient.



Figure 10: Prototype Menu Screen (left) + added feature on android phone(right)

As far as we are concern with the project, there are 2 more function that needs to be completed before the final presentation for this final year project. This is the main menu for the application. The application name is Alzheimer Helper android app and in short, it will be called AlzHelper.

### Navigation

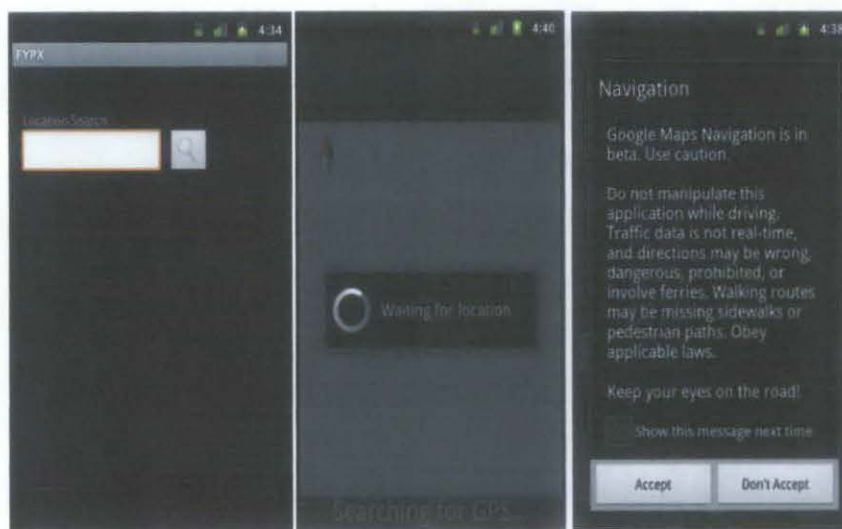


Figure 11: Navigation menu screen



After clicking the navigation button, the leftmost screen will appear to capture the address or location that the patient desired to go. Google navigation was called using programming method called intent to invoke the navigation activity of the Google navigation. The Google Navigation will only operate if there are 3G signals and GPS activated at the same time.

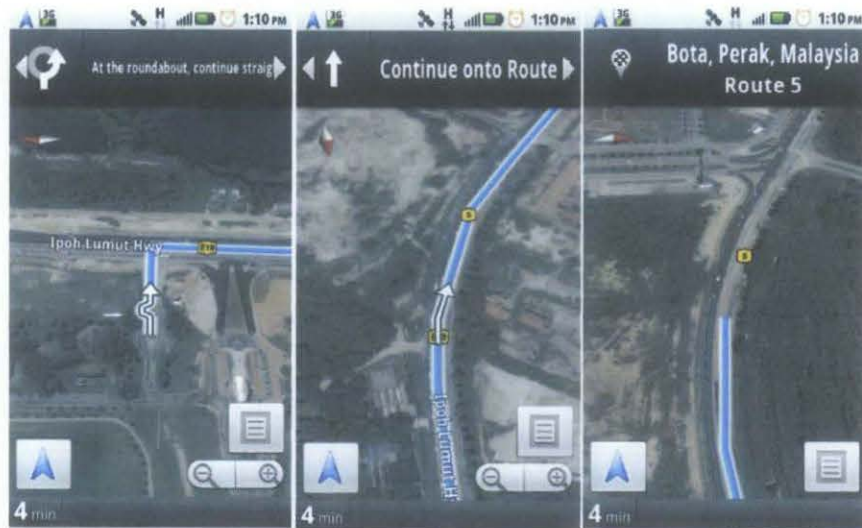


Figure 12: Navigation Screen

After searching for location, the screen for navigation will come out and will guide the patient to desired location. For the screenshot, this is the example for a guide to route 5 to Bota, Perak.

### Profile

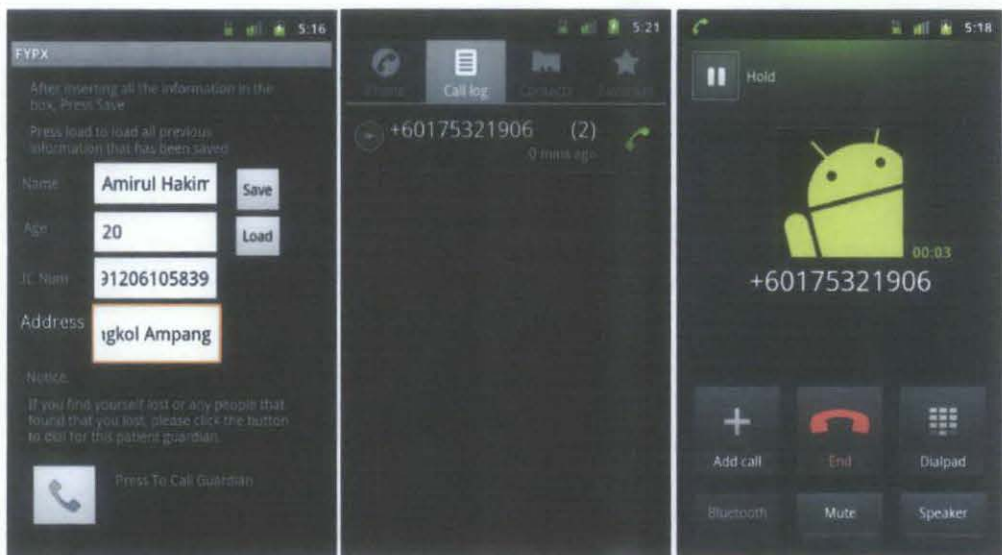


Figure 13: Profile Screen

When the profile button is clicked at the main menu, the profile screen will pop-out and the guardian can save all the patient info inside the criteria box, such as name, age, the Identity Card of the Alzheimer patient and also the address where the patient or where the guardian lives. This situation is very convenient for example when the patient is lost, if someone found the patient, they can just refer to the patient identity and help to bring them home.

Other than that, the speed dial button that connects directly to the guardian will allow the patient to directly call the guardian if they cannot remember where or what they are doing. If also the patient is lost somewhere and the police tend to find the patient, the police would not have to check the phone number of the guardian from their record. Instead they can just dial the number by pressing the call button at the profile menu.

### Tracking

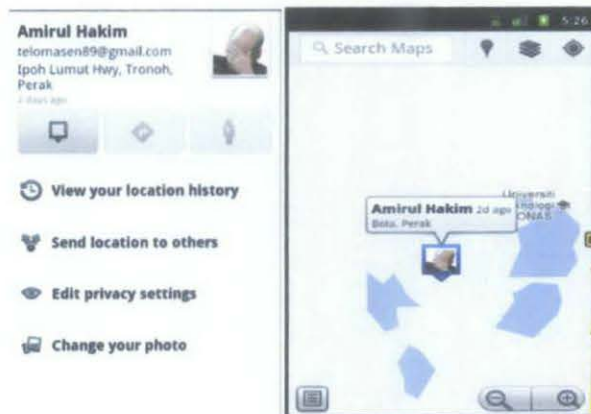


Figure 14: Tracking screen

The tracking capability will be obtained by integrating Google Latitude with the mobile application. This is also very important especially for the guardian to track down wandering patients. If the tracker is on, the guardian can check using PC or other mobile phone to detect on the whereabouts of the patient.

## Tracking

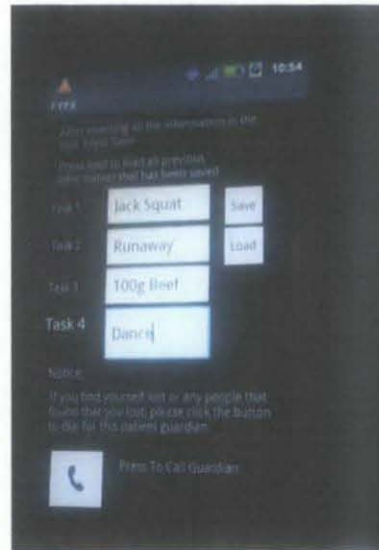
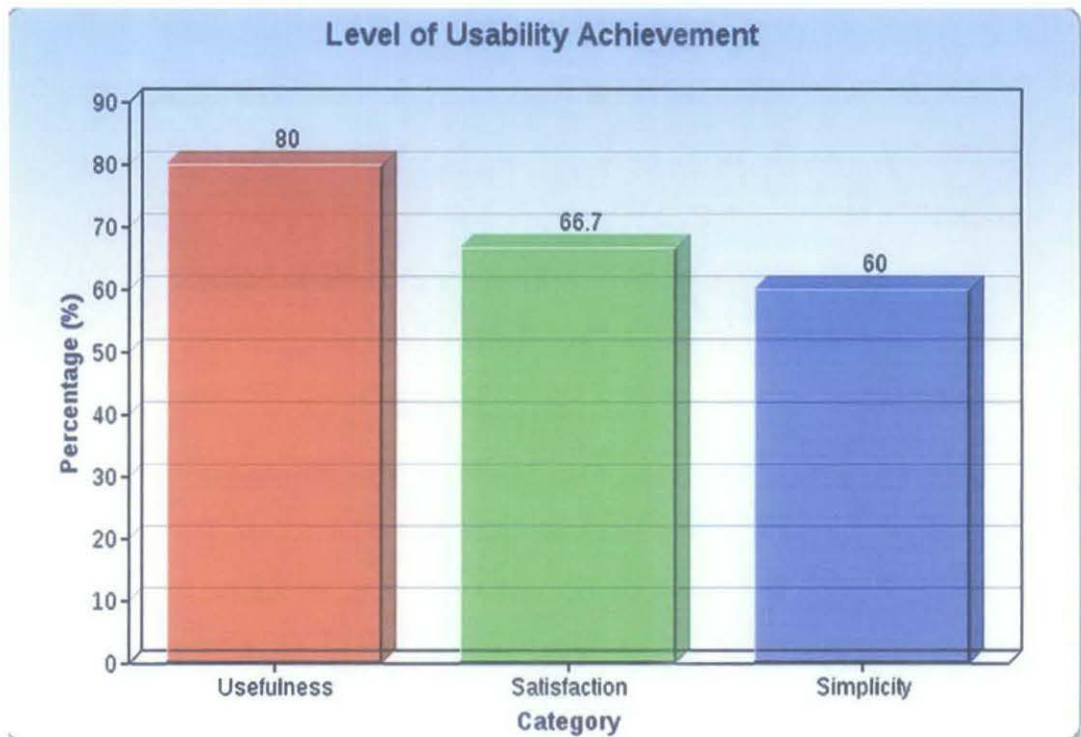


Figure 15: To-Do list screen

When the To-do list button was click at the main menu, the task list screen shot will popped-out and the guardian can save all the patient activities info inside the task box. This situation is very convenient for example when the patient is lost on what to do, for example what to buy at the supermarket, patient can just refer to the list to see what should buy. The speed dial button is also included so that if they need further help, they can just call the guardian.

#### 4.4 User Acceptance test



Based on the current prototype, we have conducted the User Acceptance Test with user. Based on the bar chart obtained, it is found out that some of the found out that the usefulness of the software is especially at the profile page where all the important detail for the patient can be stored. As for the Google Navigation, there are about 20% that say the system is not quite useful for the patient because Google Navigation might be complicated to the patient to understand or to use without the help of someone to guide them.

As for the satisfaction level for the application, it is found that 66.7% are satisfied with the prototype while 33.3% is not satisfied with the application. Most of the feedback received, it is too complicated for Alzheimer patient, some feedback also indicate that the because of every Alzheimer patient is different varying the level of severity of the disease and the nature of disease, this application might only help certain Alzheimer individual.

As for the simplicity of the application, it is found that only 60% of the sample that answer the 'yes' for the simplicity. However most of the remarks and feedbacks from the simplicity section are about the user interface and about the functionality that the application has. Some of the feedback indicates that it will be better if there is a to-do list completed in the prototype because that is one of the main parts that people wanted to see.

## **Chapter 5**

### **5. Conclusions and Recommendations**

#### **5.1 Suggested Future Work for Expansion and Continuation**

For this project, there are many things that can be improved in the future for the android assistive application. The part that can be improved is first to build the whole 3D GPS navigation system (not depending on Google Navigation) from the scratch (from the map until finish the whole 3D GPS navigation). Currently, the technology being used in this mobile android application is the Google Navigation technology. Although there are some limitations for Google Navigation (it only works in certain country, Malaysia not working) there are some alternatives to counter the problem which is by using a Brut map package.

As for the map capability itself, there are new technologies that can improve the android mobile application a lot. For example, by utilizing the Augmented Reality, one can make full real time navigation based on real situation and thus, this will be easier for the user to understand the navigation to guide them to their destination.

Other than that, the main objective is to create the assistive application as simple as possible so that it will be very easy to make the patient to understand on how the application works. The user interface element for the application is very important so that the application will not look too complicated to be understood by either the guardian or the Alzheimer patients themselves.

## 5.2 Conclusion

Mobile contexts of use vary a lot and will be always changing because the usage by the user varies. Not only will the context aware technology with mobile be far more advance every time a new smart phone or other mobile gadgets are out at the market and it will be more convenience and easier to develop an assistive devices especially for the Alzheimer Patients.

At first, by understanding the nature of the Alzheimer Disease (AD), we will be able to understand the impact of the disease itself and we will be able to come out with a solution regarding to what had happened to the patient for example memory loss. After that, we will also managed to categorized and choose a suitable target user before developing the suitable assistive device for them. If we choose the wrong target user by not defining and understanding the nature of the disease itself (generalizing Alzheimer Patient as one), what will happen to the mild Alzheimer patients? If we develop the location awareness mobile application for those patients, there will be no use because, they would not even remember either about the assistive devices that they have or how to exactly use the device. Other than that, we also need to consider the cognitive ability to learn of the Alzheimer Patient because the learning ability for every Alzheimer patient might vary.

So, one of the key issue for this project is to ensure the simplicity of the assistive device so that it will act as desired. As for the context-aware concept, we can agree that it is the latest trend in ubiquitous computing. Instead of having a mobile device that is not intelligent enough (to learn more about the user by itself), we could apply the context-aware concept to our mobile device so that, it will be able to have a bit of consciousness and thus, learn some info regarding to the behaviour of the user.

Lastly, there are some other key issues that need to be address in later stage of the development such as the location verification issues and some mobile device battery limitation issues.

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## Appendices

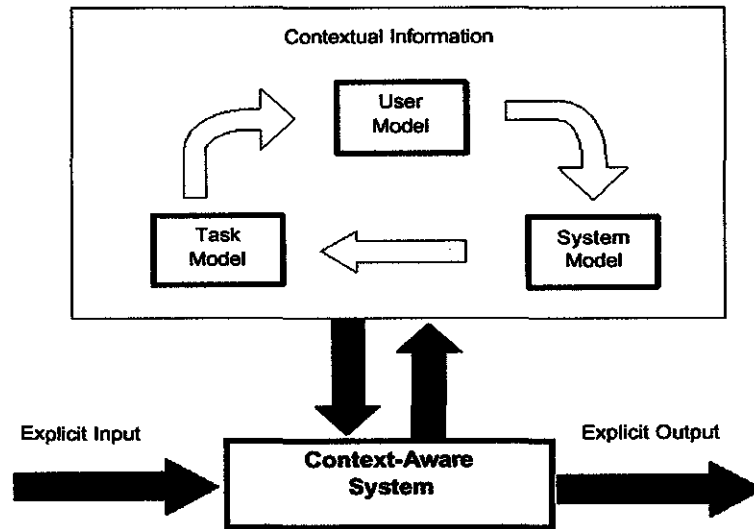


Figure 1: Context Aware System

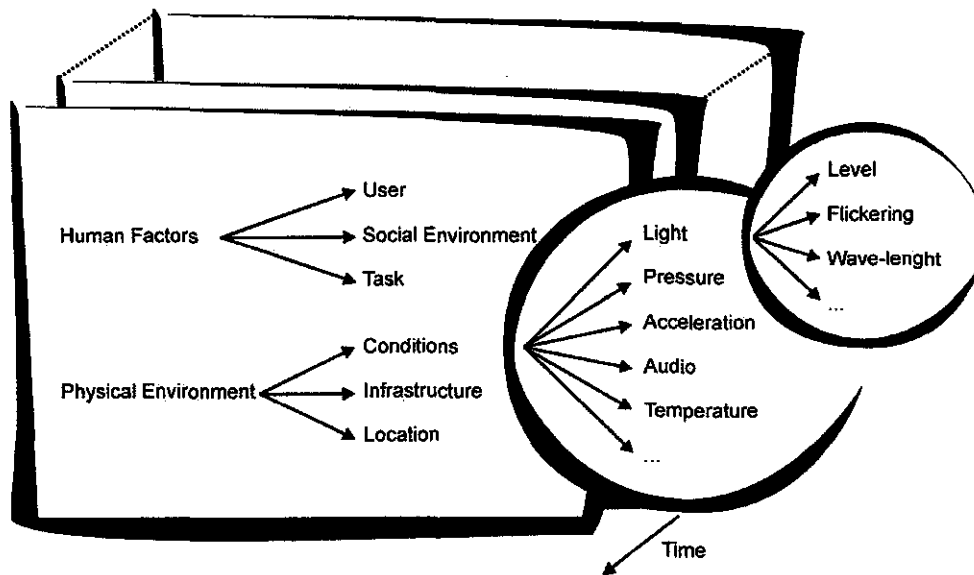


Figure 2: Context feature space [12].

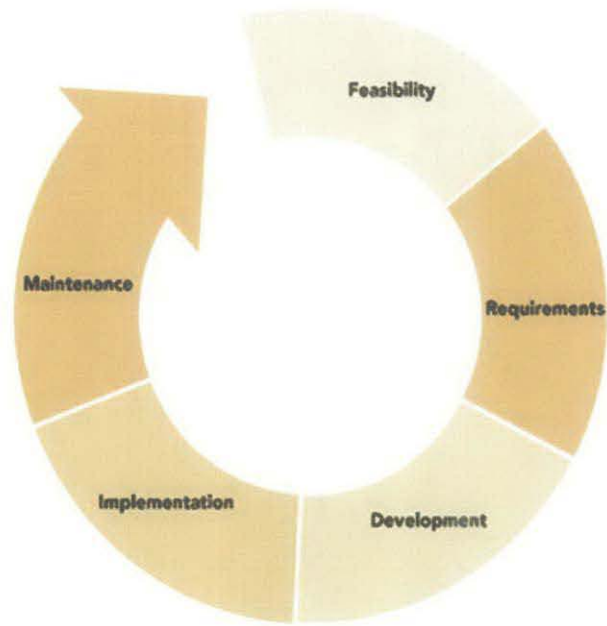


Figure 3: Project Methodology

NO	TASK NAME	WEEK													
		1	2	3	4	5	6	7	8	9	10	11	12	13	
1	Selection of FYP topic		■	■				M							
2	Preliminary research work				■	■	■	I							
3	Submission of Extended Proposal						■	D							
4	Literature review				■	■	■	S	■	■	■	■			
5	Seminar				■		■	E							
6	Proposal Defense							M							
7	Report preparation							B		■					
8	Interim Report Submission							R		■	■	■	■	■	■
9	Technical Report Submission							E					■		
								A							
								K							■

Table 1: Gantt chart for project

Activities	FYP 1				FYP 2			
	W2	W3	W8	W11	W2	W3	W8	W11
	W4	W6	W10	W13	W4	W6	W10	W13
Study on how distributed agent works	■							
Study on available algorithm to develop the system (mobile app sample)	■	■						
Identify suitable algorithm (GPS, Google API, android)		■	■					
Gathering information on how to develop the system			■	■				
Plan system requirement & design				■	■			
System development					■	■		
Conduct testing							■	
Analysis and discussion of results								■
Research documentation								■
<b>Milestone</b>			◆					
Identify suitable algorithm to be used					◆			
Finalized system requirement & design							◆	
Completion of system development							◆	
Completion of system testing								◆
Completion of analysis of results								◆
Project completion								◆

Table 2: Milestone for Final Year Project

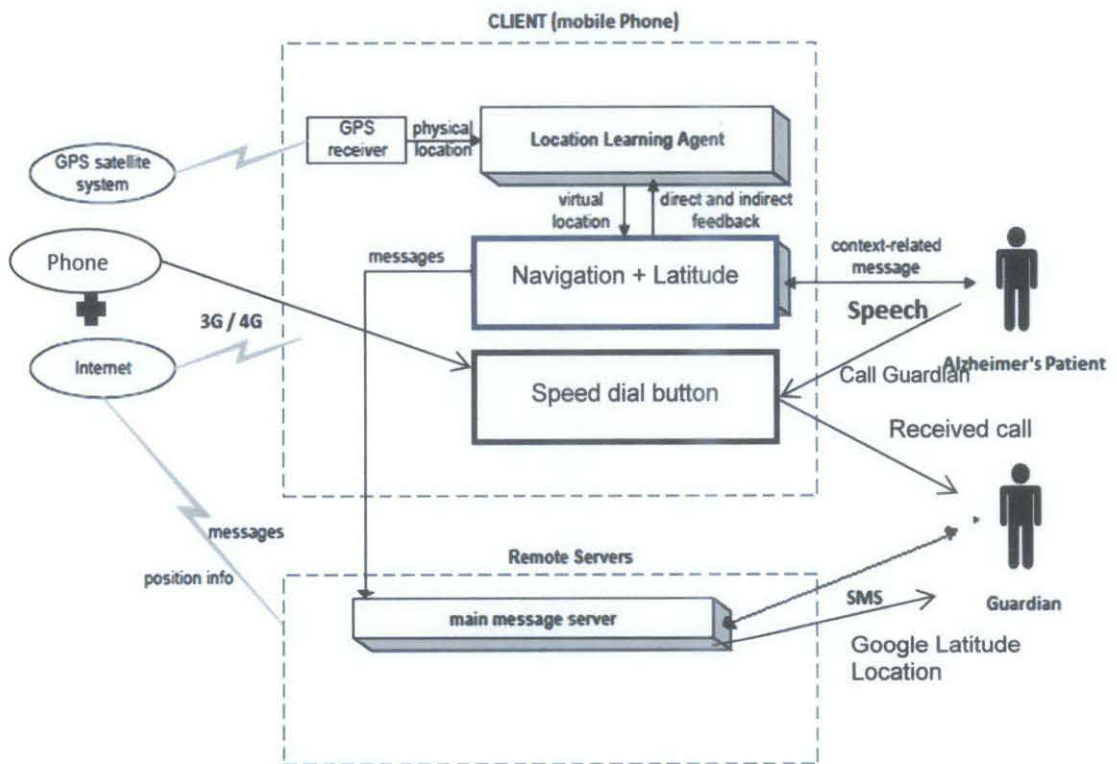


Figure 4: System Software Architecture

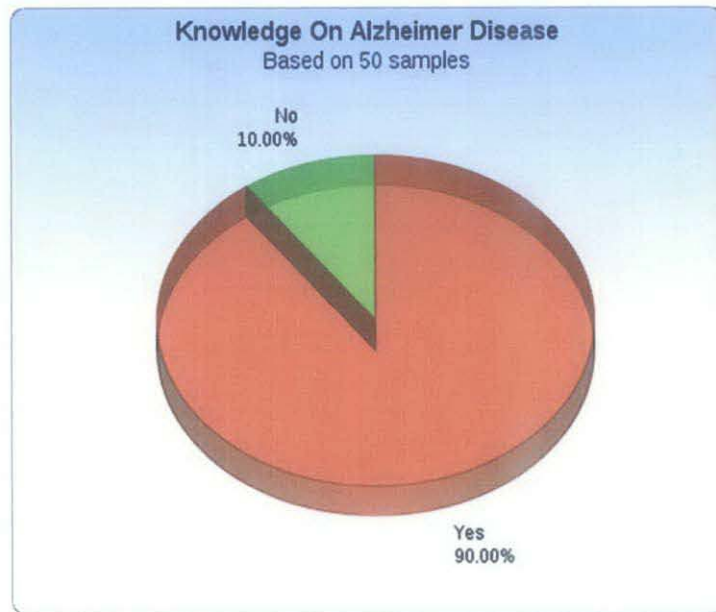


Figure 5 – Knowledge on Alzheimer Disease

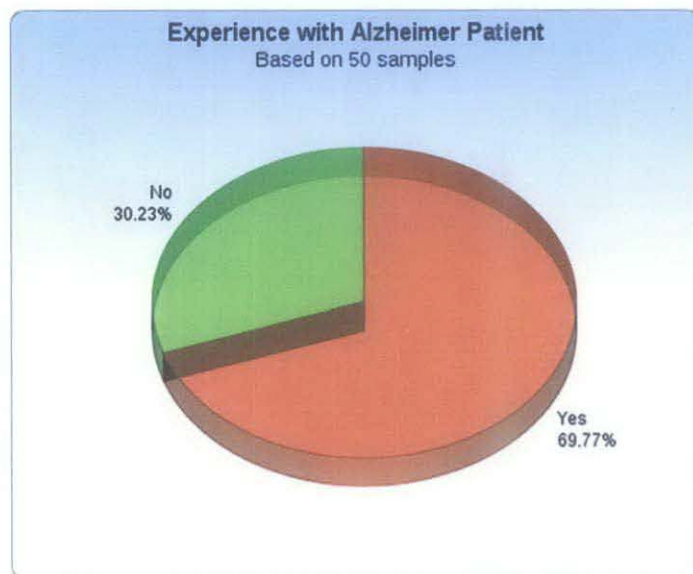


Figure 6 – Experience with Alzheimer Patient

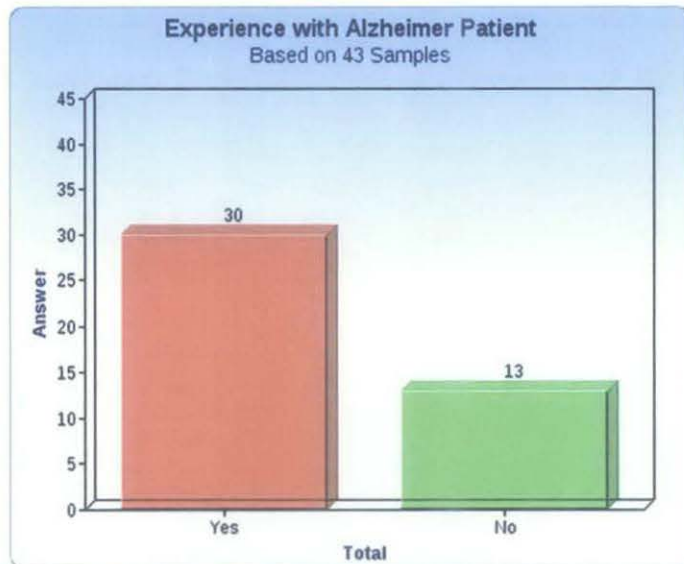


Figure 7 – Experience with Alzheimer Patient

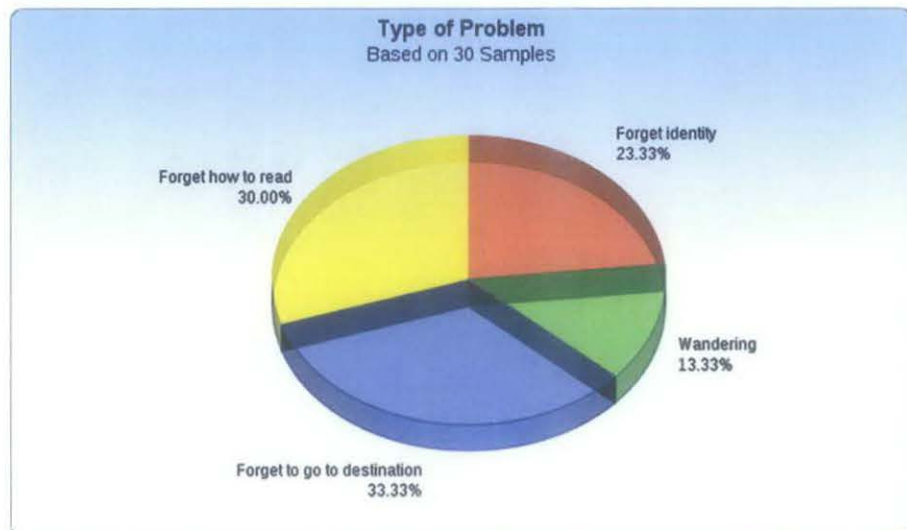


Figure 8 – Type of Problems

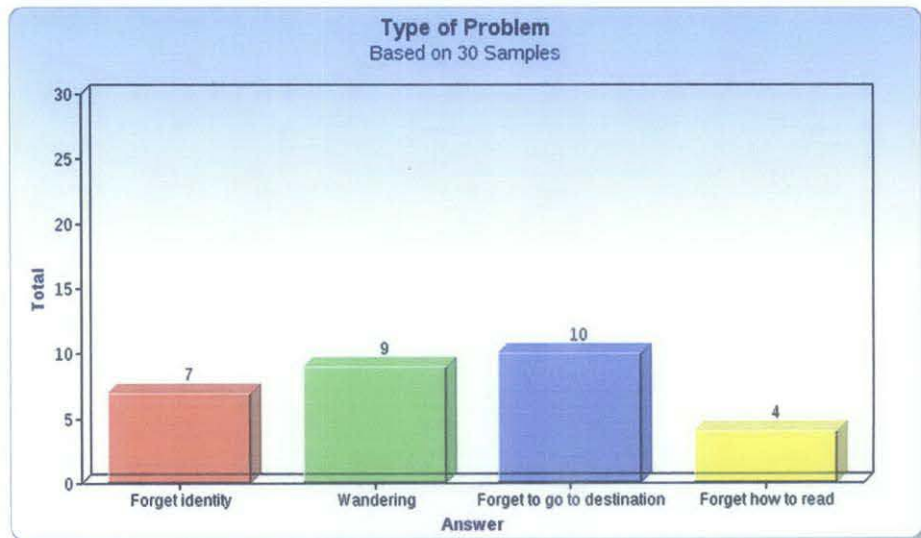
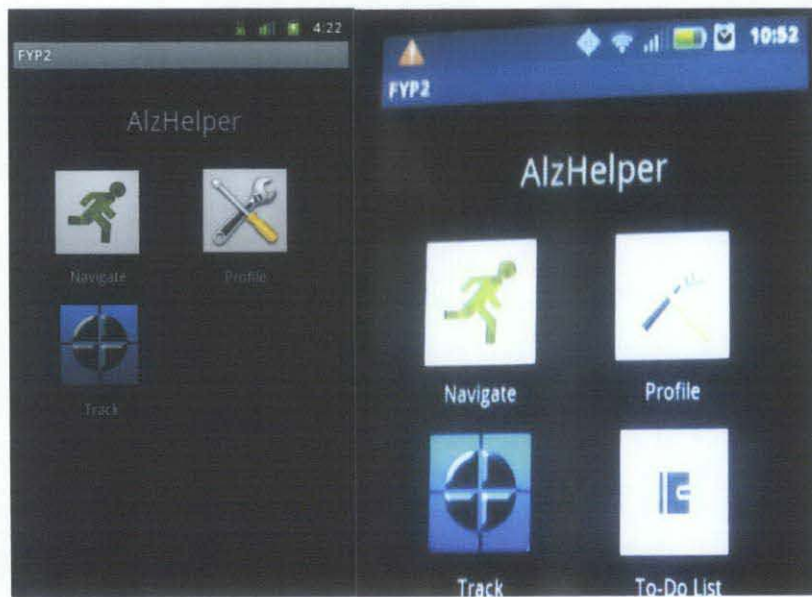


Figure 9 – Type of Problems (bar chart)

## Phone





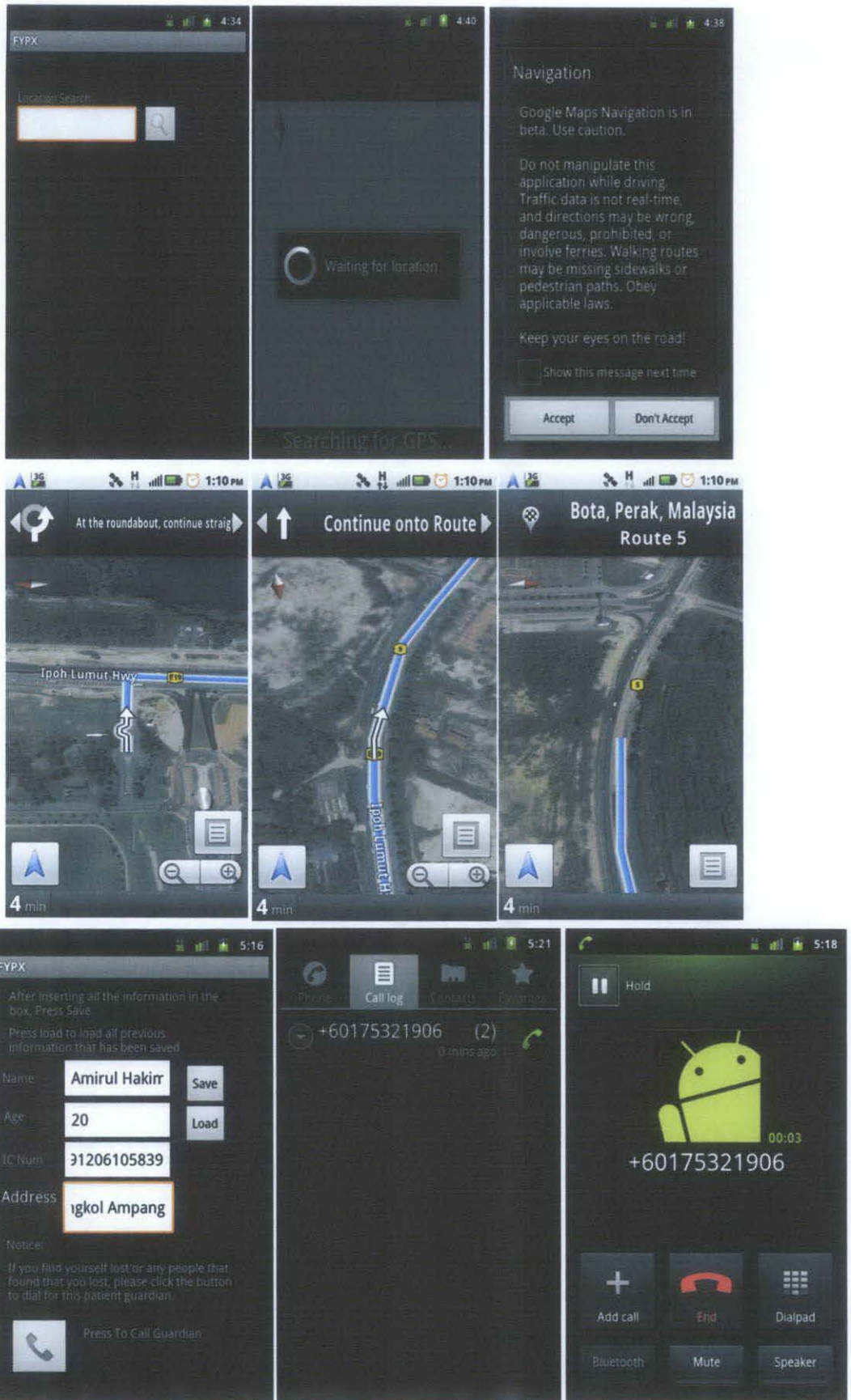


Figure 13: Profile Screen

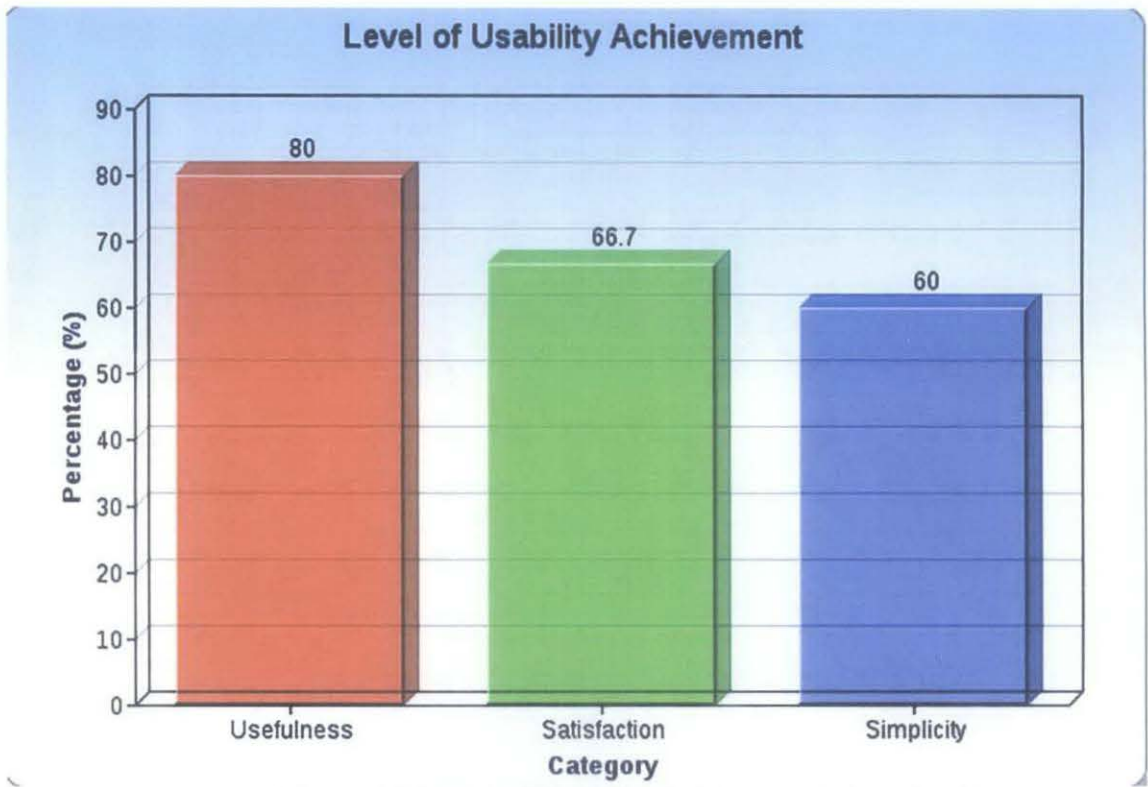


Figure 16: Level of Usability Achievement (bar chart)

# **Questionnaire – Data Gathering**

**Topic: Alzheimer Assistive Android Application**

**Intro:-**

This questionnaire is intended in providing the researcher valuable information with regards to the topic mentioned. This questionnaire will be evaluating respondent opinion with regards to:-

1. The question on Alzheimer Disease and the problem faced by the Alzheimer Patient based on the sample experience.

## **Section 1: Background**

1. Do you have any knowledge on Alzheimer Disease? (Yes / No) :-  
\_\_\_\_\_
2. Do you have any experience with Alzheimer patient? Directly or indirectly? (Example: Family Members, relatives, friends) (Yes / No) :-  
\_\_\_\_\_

**\*Type of problem that the patient might be facing because of the disease\***

## **Section 2: problem**

1. Are they forgetting identity? (their own name, family members) (Yes / No) :-  
\_\_\_\_\_
2. Are they losing the ability to read?:- (Yes / No):-  
\_\_\_\_\_
3. Are the patients wandering and forgetting what they are doing? (Yes / No):-  
\_\_\_\_\_
4. Have the patients lost their ability to remember on how to reach a certain destination desired by them? (Yes / No):-  
\_\_\_\_\_

## **Questionnaire – User Acceptance Test (UAT)**

### **Topic: Alzheimer Assistive Android Application**

#### **Intro:-**

This questionnaire is intended in providing the researcher valuable information with regards to the topic mentioned. This questionnaire will be evaluating respondent opinion with regards to:-

1. The usability of the Alzheimer Assistive App developed which will be divided into three main categories, which are usefulness, simplicity and satisfaction.

#### **Section 1: Background**

1. Do you have any knowledge on Alzheimer Disease? (Yes / No) :-

\_\_\_\_\_

2. Do you have any experience with Alzheimer patients? (Yes / No) :-

\_\_\_\_\_

#### **Section 2: Evaluation on Usefulness**

1. Based on your experience with Alzheimer Patient and with your knowledge about Alzheimer Disease, is it easy for you to be able to navigate by using the navigation function in the app? (Yes / No) :-

\_\_\_\_\_

2. Is it easy for you to get the concept of the app when you first try it:- (Yes / No) :-

\_\_\_\_\_

Remark / feedback on the usefulness of the application:-

\_\_\_\_\_

**Section 3: Evaluation on Simplicity**

1. Is it easy for you to grab the concept of the application, Example: to use the function, or to understand on every function that work? (Yes / No)

\_\_\_\_\_

2. Is it simple for you to navigate through the application and to learn its User Interface about the function that the whole app can do? (Yes / No)

\_\_\_\_\_

3. Remark or feedback on simplicity? (Answer Yes / No if you approve the simplicity of the app and give remarks)

\_\_\_\_\_

**Section 4: Evaluation on Satisfaction**

1. Are you satisfied with the User Interface of the application?

\_\_\_\_\_

2. Are you satisfied with the functions that the application can give? :-

\_\_\_\_\_

3. Remark or feedback on satisfaction? (Answer Yes / No if you approve / disapprove the simplicity of the app and give remarks)

\_\_\_\_\_