Location Detection of Dementia Using GPS Coordinate Finder

by

NurSyakilatul Aina Binti Saini

Dissertation submitted in partial fulfillment of

The requirement for the

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(Information and Communication Technology)

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CERTIFICATION OF APPROVAL

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Approved by,

_____

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UNIVESITI TEKNOLOGI PETRONAS

Tronoh, Perak

May 2013

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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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NURSYAKILATUL AINA SAINI

ABSTRACT

Gerontology problems affect many old citizens at the age of 67 years old and above. Many people become forgetful as they become older and one of the problems is dementia. Memory impairments are the most common among people with dementia. Dementia can happen to anybody, but it is more common after the age of 65 years. It causes a loss of mental ability, and other symptoms. Dementia can be caused by various disorders which affect parts of the brain involved with thought processes. People with dementia do not remember how to get back home and there is no specialized device to assist family members to take care of their elders in Malaysia. Thus, this project aims to identify tracking system that is suitable for dementia and to develop an application to help relatives to track dementia's location. This scope is to find the location of dementia and to help relatives to track dementia's location using GPS tracker and coordinate finder application. This paper discussed about the location detection of the GPS in order to track for dementia's location for the wide range of network with the accessibility of the Internet network. This system will help relatives to track the location of the people with dementia and to reduce the burden of family member to take care of dementia people. Additionally, the GPS will detect the location and send the message to receiver to inform the current coordinate location. MIT AppInventor is used in developing the Android Application and tested with a smart phone. This paper describes the system designed of GPS and application, and discussed the implementation of the system to the dementia people. Positive results are received from the conducted user perception study and shows that users (family members) are satisfied with the application in identifying dementia's location effectively.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

The study from Polikar, Topalis, Green, Kounios, & Clark (2008) found that there were 135 million people that had been diagnosed diabetes in 1995. The total of 11.2 million people is from gerontology problem. There were many health issues related senior citizen. With age, come complications in individual's health conditions that can be caused due years of neglect, years of poverty or just age. Apart from many issues faced by senior citizens health is a serious problem. More common sicknesses are diabetes which the killer disease which attacks most of the organs. Heart disease, cancer, overweight and dementia also attacked senior citizens due to ageing. However, dementia is not due to aging but caused due to diseases, medications, nutritional imbalances, diabetes and also renal failure (Bruunsgaard, 1997). Dementia is a condition of the brain which causes a gradual loss of mental ability, including problems with memory, understanding, judgment, thinking and language (Kenny & Knot, 2012). Early signs of dementia commonly develop, such as changes in personality and changes in the way a person interacts with others in social situations. As dementia progresses, a person's ability to look after them from day to day may also become affected. The most crucial symptom of dementia is short-term memory loss, it required for people to look after them. It is because dementia people can perform tasks, but they forget how to do it. The rapid growth of ICT technology helps people who suffered from dementia syndrome.

1.2 Problem Statement

People with dementia have loss of memory, always end up somewhere else and not remember how to get back home. Other than that, there is no device specialize for dementia to assist family member to take care of their elders in Malaysia. Dementia problem may result of confusion caused by changes in the brain and memory loss or

perhaps due to difficulties recognizing people and objects. Study from (Neil, 2012) found that approximately, about 17 to 25 million people are affected with dementia globally. It primarily affects the elderly people. The onset of dementia usually occurs during the middle adult life. In some people, the symptoms are seen earlier, but may not be recognized. The frequency of people suffering from Alzheimer's disease found by (Alzheimer's Association, 2011) increases with age and it is estimated that the occurrences is:

- 0.5% per year in people aged from 65 to 69 years
- 1% per year from 70 to 74 years
- 2% per year from 75 to 79 years
- 3% per year from 80 to 84 years
- 8% per year in people over 85 years

Studies estimated that 26% of women and 21% of men over the age of 85 years are affected with some form of dementia. Of them, approximately 50% have Alzheimer's disease.

Other than that, (Susan,C. R, Barbara, G, Nirvana H.P.,& Ann, B, 2008) found that family members and other informal caregivers heavily burdened by the need to support and often monitor the person with dementia in everyday life. Often requires additional efforts of home care and relief housing. Informal family and relatives does not get information where the dementia people located when they are lost. It is because dementia people suffered from short- term memory lost which they did not realize where the current location is and makes everyone worried about them.

1.3 Objectives

- ❖ To identify tracking system that suitable for people with dementia

- ❖ To develop an application to help relatives to track dementia's location

❖ To conduct user acceptance test (UAT) in order to test the developed product.

Research will be conducted to identify the best solution to be used GPS and wireless technology to integrate with the mobile phone. After that, testing will be conducted to test the functionality of the device to make sure it well-developed and shows the effectiveness of the device to identify the location of dementia people when they are lost.

Finally, user acceptance test will be conducted to the target users. The test will be done to determine whether the application can be used in the exact real world. With this, the project is expected to be completed within eight months, from initial requirements findings, development, testing until final delivery of the prototype.

1.4 Scope of Study

The scope of study of this project is to find the location of dementia while enhancing the efficiency and reliability of the application system for tracking location device and also to develop an application to help relatives to track dementia's location. This scope need to be implemented for dementia and to conduct research on GPS system and wireless technology to identify their limitation. This part of work also involves finding out how to configure the system so that it generates a field capable of covering the appropriate area. Create subsystem prototypes and conduct testing. This is done to ensure that all the features of the system can be built and operate as expected.

1.5 Project Feasibility

The benefit from this project is location detection for dementia people will help relative to identify dementia's location effectively. Wireless technology is essential in this system. It is because GPS Coordinate Finder required Wi-Fi in order to develop the system through this system, dementia people do not have to worry if not able to find way home because by using this system, GPS device will help relative to locate the location by the message from the mobile phone.

Other than benefiting the dementia people, the system also help to the family members or relatives who are responsible to take care of their parents who are suffered from dementia symptom.

Within eight months, this project can be completed at least to the minimum requirements, it is also depends on the amount of scope creep that would be encountered which is inevitable. Due to the scope creep and testing difficulties, it is also difficult to gauge how perfect the system can be within the time frame.

CHAPTER 2

LITERATURE REVIEW

This chapter mainly discusses on the general ideas of the project. Several keywords are discussed along with problems addressed in the previous chapter until the idea of the proposed solution.

2.1 Gerontology problems

According to (Sim, 2001) in Malaysia during 1990, 9% or almost half a billion of world population were over 60 years old. The figure will increase to 1.4 billion in 2030 as mentioned by (World Bank, 1994). It is because of the declining fertility, developing countries are ageing much faster than the developed nations. By 2020, 9.5% expected of population will be at the age of 60 years and above. The society need to continuous improvement in medical field, the availability and accessibility of health care, longer life expectancy as well as declining birth rate.

Figure 1 shows gerontology problems in UK from year 1997 until 2001. They suffered from many types of diseases such as infection parasitic, metabolic diseases, mental disorders, nervous system and many more. It shows that, at the age of 65 and above, the chance of old citizens to get infected with diseases is higher.
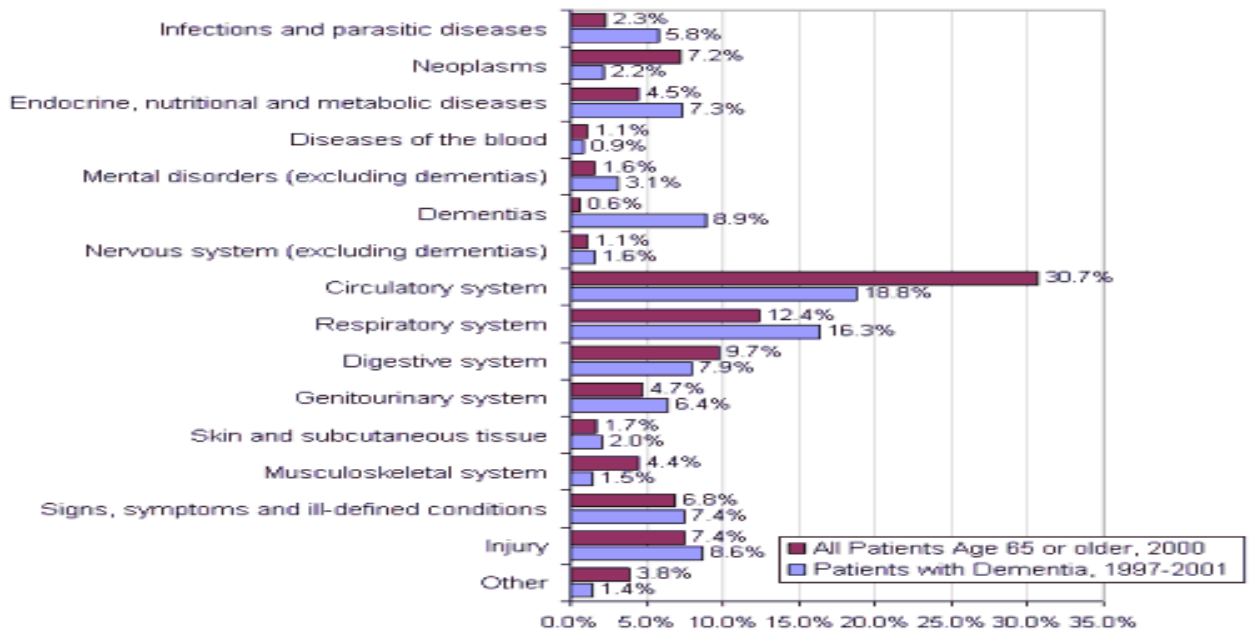
Figure 1 Gerontology diseases in 1997 until 2001 in New York

Source: Parnetti, L., Amici, S., Lanari, A., & Gallai, V. (2004). *Dementias Reported in Hospitalizations Among New York State Residents.* Department of Health Information for a Healthy New York.

2.2 Dementia problem

Garcia (2010) stated that dementia refers to a syndrome of acquired cognitive deterioration that can be associated with various potential stages of the disease. The two most common variations of this disease are Alzheimer type dementia and vascular type dementia. There are other forms known as mixed dementia. All of these forms can be associated with different patterns of anatomical affectation, different risk factors, multiple diagnostic characteristics and multiple profiles of neuropsychological tests, making the differential diagnosis of dementias (DDD) very complex. New diagnostic tools had been proposed based on a data fusion scheme using artificial neural networks and ensemble systems, which offer important advantages referring to other computational solutions.

Figure 2 shows the people with dementia symptom when suffered dementia illness in Britain. There are 77% of people that having depressed when suffered dementia illness. However, only 44% of them felt lost friends after being diagnosed by doctor.
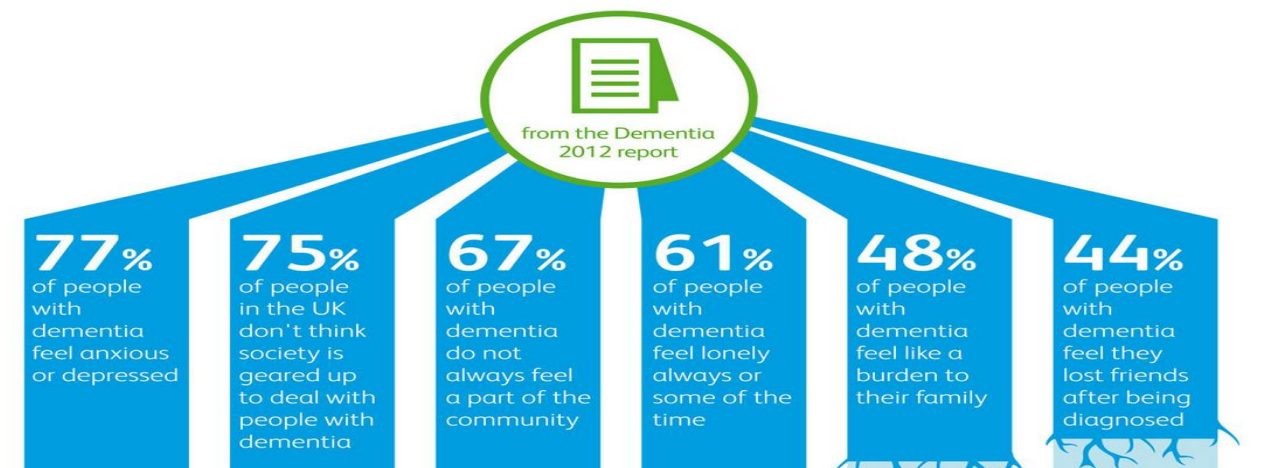
Figure 2 Symptom of Dementia

Source: http://www.theguardian.com/news/datablog/2012/mar/26/dementia-britain-visualised

The study from (Kadir, Hassan, & Razak, 2011) shows that the increment of life expectancy observed for conditions such as cognitive decline and dementia. The study determined the prevalence of cognitive impairment and dementia and to identify its associated factors among 399 elderly patients in Hospital Universiti Sains Malaysia. This was conducted in 2 phases. In the first phase, subjects were screened using either validated Malay version of Mini Mental State Examination (MMSE) or Elderly Cognitive Assessment Questionnaire (ECAQ). All subjects suspected to have dementia were selected for further evaluation in phase 2 of this study. The second phase involved full clinical examination to establish the diagnosis of dementia. The prevalence of cognitive impairment and dementia in this study was 11.8% and 2.5% respectively.

The early signs of dementia can be identified by several factors (Hof, et al., 1992) such as:

- ❖ Progressive and frequent memory loss

- ❖ Confusion

- ❖ Personality change

- ❖ Apathy and withdrawal

- ❖ Loss of ability to perform everyday tasks

2.2.1 Causes of Dementia

There are several causes of dementia. It is difficult to determine the exact cause that had been mentioned by Fitzpatrick AL (2012). Hence, a clear diagnosis is very important for treating this condition.

Some of the causes are as follows.

- Degenerative diseases like Alzheimer's disease, Parkinson's disease, Huntington's disease and Creutzfeldt-Jakob disease. It makes people to have difficulties in remembering name and recent events.

- Vascular dementia caused due to atherosclerosis, which is a condition that harms the blood vessels supplying the brain. It is occurring because of the brain injuries and blood vessel blockage. It affected individual's thinking and physical functioning.

- Medicines like tranquilizers, sleeping pills, antidepressants can cause dementia like symptoms.

2.2.2 Risk factors for Dementia

The incidence of dementia among the elderly population is rising rapidly worldwide. In the United States, Alzheimer's disease (AD) is the leading type of dementia and was the fifth and eighth leading cause of death in women and men aged more than 65 years, respectively, in 2003. In Taiwan and many other counties, dementia is a hidden health issue because of its underestimation in the elderly population. In Western countries, the prevalence of AD increases from 1–3% among people aged 60–64 years to 35% among those aged more than 85 years. In Taiwan, the prevalence of dementia for people aged more than 65 years was 2–4% by 2000. Therefore, it is important to identify protective and risk factors for dementia to prevent this disease at an early stage mentioned by (Chen Y. C., 2009).

The following are some of the risk factors contributing to this condition.

- Age advances, possible chances of getting affected with dementia is more serious.

Figure 2.1 shows the demographic ageing is a worldwide process that shows the successes of improved health care over the last century. Many are now living longer and healthier lives and so the world population has a greater proportion of older people. Dementia mainly affects older people, although there is a growing awareness of cases that start before the age of 65. By 2050, people aged 60 and over will account for 22% of the world's population, with four-fifths living in Asia, Latin America or Africa.
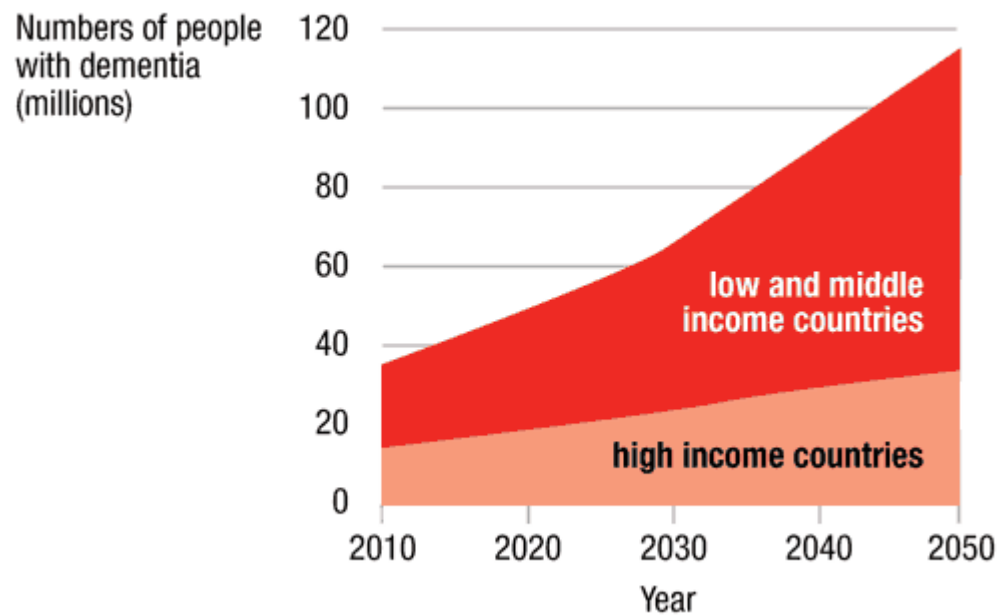
Figure 3 The growth in number of people with dementia VS income

Source: Alzheimer's Association. (2011). *2011 Alzheimer's Disease Facts and Figures, Alzheimer's & Dementia.* United State.

- Genes play an important role in passing the disorder to the offspring.

- People who smoke and consume alcohol are at the highest risk for atherosclerosis, which is an underlying cause for dementia.

- Higher levels of cholesterol increase the risk of vascular dementia.

- Presence of higher levels of homocysteine in the blood increases the risk of vascular dementia and Alzheimer's disease.

- People with this condition develop plaques and neurofibrillary tangles increasing the risk.

Table 1 shows the sample consist of 2980 community older Malaysians that involved 1503 women and 1477 men with average of 70.5 years. The overall prevalence of dementia was 14.3%. It shows a clearly increasing trend by age groups, doubling every 10 years from 9.5% in the 60-69 age groups, to 26.3% in those aged 80 and above.

Variable/category	Total n	Cases n	Preva-lence, %	95% CI
Age				
60–69	1,519	145	9.5	8.2–11.1
70–79	1,049	179	17.1	14.9–19.5
80+	350	92	26.3	21.9–31.1
Sex				
Male	1,456	128	8.8	7.4–10.4
Female	1,469	290	19.7	17.8–21.8
Education				
No formal education	1,309	316	24.1	21.9–26.5
Primary	1,291	88	6.8	5.6–8.3
Secondary/tertiary	281	7	2.5	1.2–5.1
Ethnicity				
Malay	1,725	256	14.8	13.2–16.6
Bumiputera	320	103	32.2	27.3–37.5
Chinese	700	44	6.3	4.7–8.3
Indian	139	8	5.8	2.9–10.9
Other	41	7	17.1	8.5–31.3
Place of residence				
Rural	1,290	240	18.6	16.6–20.8
Urban	1,635	178	10.9	9.4–12.5
Marital status				
Married	1,630	167	10.2	8.9–11.8
Unmarried	1,290	250	19.4	17.3–21.6
Employment				
Employed	1,639	73	4.5	3.6–5.6
Unemployed	951	298	31.3	28.5–34.3
Hypertension				
Yes	892	126	14.1	12.0–16.6
No	1,887	284	15.1	13.5–16.7
Stroke				
Yes	49	13	26.5	16.2–40.3
No	2,729	397	14.5	13.3–15.9
Self-rated health				
Very poor	108	36	33.3	25.2–42.7
Poor	948	182	19.2	16.8–21.8
Good	1,481	178	12.0	10.5–13.8
Very good	239	12	5.0	2.9–8.6

Table 1 Prevalence of dementia by health and socio-demographic factors

Source: Hamid, T., Krishnaswamy, S., Abdullah, S., & Momtaz, Y. (2010). Sociodemographic Risk Factors and Correlates of Dementia in Older Malaysians. *Dementia and Geriatric Cognitive Disorders* , Vol. 30.

Women showed a higher prevalence rate (24%) compared to men (8.8%). Among dementia cases, women (69%) outnumbered (2:1) men (30.6%; table 2). Unmarried respondents (19.4%) had almost twice the prevalence rate of dementia as married respondents (10.2%), and among dementia cases, unmarried (widowed, divorced, single) persons (60%) outnumbered married respondents (40%). The prevalence rate of dementia was almost 2 times higher in rural populations (18.6%) than in urban populations (10.9%), with slightly more rural residents than urban residents among dementia cases.

2.3 Network Technology

2.3.1 Client Server Model

Figure 4 shows the client server model as the basic network that to be implemented in this project. According to (Guimaraes & Igbaria, 2007), "client/server systems (CSS) are emerging as the new paradigm for systems development, replacing or integrating legacy applications with systems that provide higher quality user interfaces on the client component and substantial user-transparent data processing capability on one or more servers".
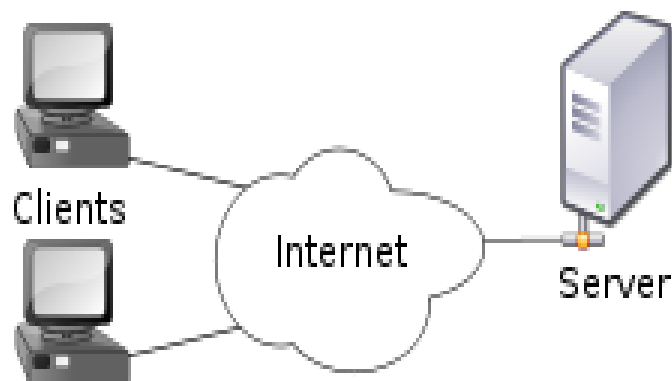
Figure 4 Client Server Model

The partition of tasks or workloads between the providers of a resource is called servers, and service requesters, called clients. It is implemented as the one node become server node and the rest are clients. Client is a human which having GPS device. There will be

the data server or master node which is wireless technology that support ad-hoc network. Client server will be chosen automatically that have dedicated IP which can route any node. After particular range, the server will generate alarm to the end user through mobile phone.

2.3.2 Role of server client

As mentioned by (Kim & Han, 2001) the role of the server client as per below:

• Functions for client/server applications are provided by a combination of resources using client workstation processor and the server processor.

• Client server also functioned as a database server provides data in response to an SQL request issued by the client application.

• Other than that, it is also function as mixture of personal activity products blended for client workstation with custom application. The client workstation can use or uses local operating system to

• Server is acting a service provider responding to the client's request while client is solely a consumer services provided by one or more servers.

• Client which provides presentation services. It is because the user input and final output are presentation at the client workstation. Furthermore, current technology provides full support for GUI's. The functions such as field edits, context sensitive help, navigation, training, personal data storage and manipulation frequently executed on the client workstation. All of them use the GUI and Windowing functionality.

2.3.3 VANET

Study from (Singh, Hasbullah, & Nayan, 2013) shows that VANETs provided facility for vehicles to instinctively and wirelessly network with new vehicles close by for the purposes of as long as travelers with new features and applications. Other than that, traffic incident is turning into serious for traffic management authority as well as vehicle user.

Early detection of Incident using VANETs to be able to provide with maintain of incident detection node (IDN) located at the side of the roads, such that route change before their point of entrance to the traffic maintaining with ongoing communications while they move. This work dispenses and prospers a framework for early detection of incident using vehicular ad-hoc networks (VANETs).

This work proposed incident detection techniques where Incident Detections Node (IDN) collect On-Board Unit (OBU) data directly from passing vehicles and perform some analysis to detect possible incidents and to be integrate with the Internet. The proposed technique is good for traffic management can take a proactive role in managing substitute routes to avoid the accident. Therefore, early detection of incident would provide better management of traffic flow as the figure 5 shows the incident node detection for the effective transmission. VANETs would also head towards the so-called "4G" approach where there is opportunistic utilization of the best network, (Chandrasekaran, 2008).
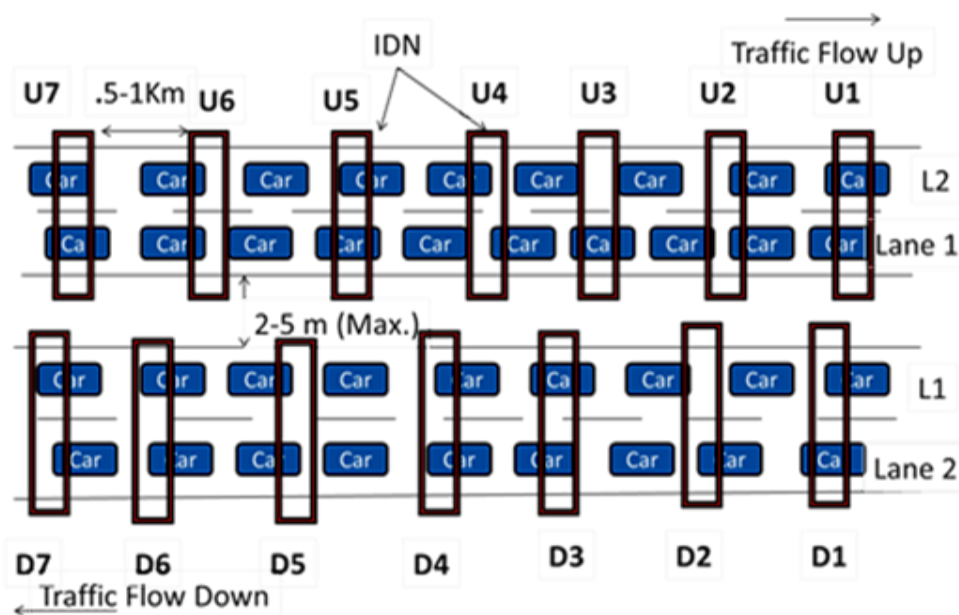
Figure 5 Incident node detection

2.3.4 Wireless technology

Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor as stated by (Rose, 2006). Figure 6 shows the example of wireless communication

Figure 6 Wireless communication

Wireless system concept can provide isolated pockets of high bandwidth connectivity to the internet for mobile terminals as mentioned by (Chandrasekaran, 2008). By choosing wireless technology, it will help the project to support ad hoc network. It is proven by the study from (Doan, Berradia, & Mouzna, 2009) which wireless communication devices helps to detect their geographical location and to provide ad-hoc network connectivity with the roadside equipment respectively.

The example of wireless technology as shown in figure 7 include GPS units, garage door openers, wireless computer mice, keyboards and headsets, headphones, radio receivers, satellite television, broadcast television and cordless telephones.

Figure 7 Wireless technologies

2.3.5 GPS

A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites high above the Earth. It helps people to track the current location when people are lost. According to (Adomatis, 2013) GPS also helps people to know about how to keep up with the whereabouts of family, friends and employees. It also helps to find cell phone, to track children, teen tracking, tracking Alzheimer and tracking stuff.

Figure 8 Artist's conception of GPS Block II-F satellite in Earth orbit

Wi-Fi is complements in order to provide cellular gridding, providing additional conduits for location information to pass through to the net. Mobile phone has a unique electronic identifier and can pass the information which locates people within the geographic area covered by the hotspot.

2.3.6 RFID

Radio Frequency Identification (RFID) is one of the grouped under Automatic Identification such as bar code, optical character recognition, magnetic inks, biometrics and many more. This is the new way of controlling information for the large production networks. The important feature of RFID is tracking object which capable to provide unique ID.

There are several types of tags and readers of RFID such as passive, semi-passive, active, read-only and read-write. There are methods of wireless signal used for communication between the tag and reader for example by induction and also propagation.

Figure 9 Example of active GPS

2.4 Comparison Study

2.4.1 The DIANA system

The DIANA system reduces the risks associated with community living for older people suffering from dementia. The Dementia Information and Needs Analyzer system is drawn in Figure 4 and consists of distributed sensors, artificial intelligence in the form of dedicated software running on a local PC.
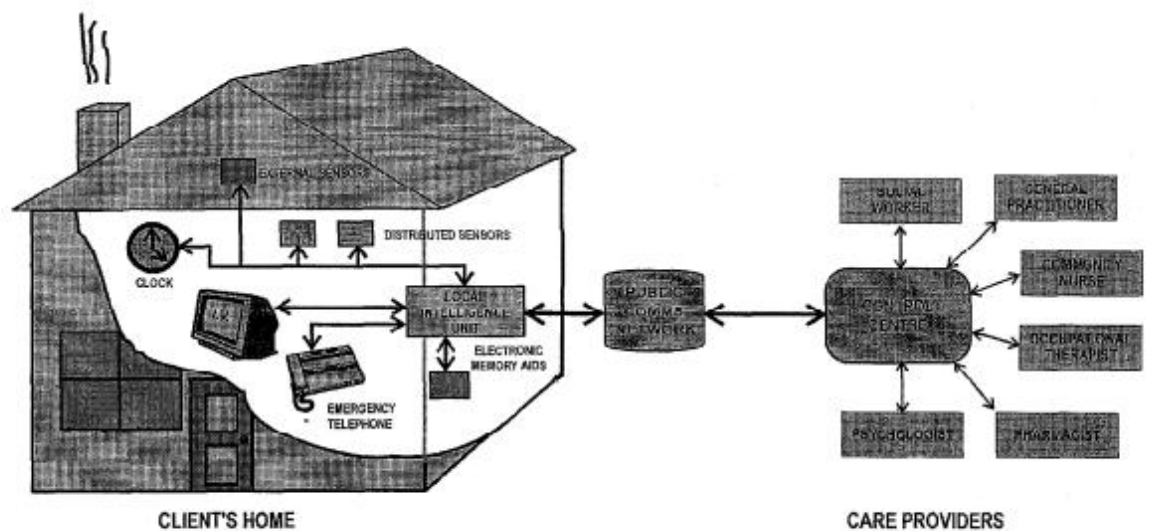
Fig. 2. Elements of DIANA.

Figure 10 Elements of DIANA

Study from Dought, Williamst, King, & Woods (1998) mentioned that external environmental sensors are added to the internal thermostat in order to provide the system with information on the weather. The outputs of all the activity and event sensors are coded and are transmitted on a short burst basis each time that they are activated. These signals are received and decoded by the PC which counts events such as the opening and closing of doors and drawers, transfers from a chair, toilet or bed, and movements across and into rooms whilst also managing clock and data collection functions. In a conventional telecare system, the data are integrated in order to provide a measure of total activity. In DIANA, the system applies a particular weighting to the data in order to distinguish between normal and abnormal behavior. Any action that is repeated within a period of five minutes produces a double count on the second occasion. Thus, if a person gets up to look in a drawer and then returns to the chair to sit down, they will score a 6 on a conventional activity scale - one for the act of getting up (piezo sensor), one for moving across the room (PIR), one for opening a drawer (inductive coupling sensor), one for closing the drawer, one for moving back to the chair and one for sitting down. If they repeat this act within 5 minutes then the second score is 12 which are achieved by doubling the previous scores. In the same way, activities detected by the sensors during the also attract a double score.

2.4.2 COGKNOW Day Navigator

COGKNOW Day Navigator is an assistive system for persons with dementia using cognitive support. Figure 5 shows the device of COGKNOW. It helps dementia people to do their daily routine to increase independence while relieving their relatives from always having to be around to support them.

Figure 11 COGKNOW Day Navigator

The main functionalities are:

- ❖ Time Indication
- ❖ Remotely configurable reminders
- ❖ Music
- ❖ Radio
- ❖ Picture Dialing
- ❖ Activity Assistance
- ❖ House Alerts for safety

Unfortunately, this device only applicable for activities within the house and do not have application to track people when they are going out from the house. It is also not wearable where dementia people always forget things.

2.4.3 The AETREX GPS Shoes

The AETREX GPS Shoes contained GPS tracking technology to help protect individuals afflicted with Alzheimer's and other forms of dementia who have a tendency to wander and become lost. It is very beneficial to dementia people.

Figure 12 The AETREX GPS Shoes

These innovative shoes feature the latest GPS tracking technology embedded in the base of the heel with location coordinates sent to a central monitoring station. When dementia people are wearing the AETREX GPS Shoes, they will have the ability to quickly track and locate them at any hour of the day using the interactive tracking website service which only works within the United States and excludes Alaska & Hawaii).

Finally, this extraordinary footwear will provide the comfort and security for dementia people. The drawbacks of the shoes are the tracking service is not quite global. It only works in the continental United States and not applicable in Malaysia.

2.4.4 GPS Device

Figure 14 Real GPS Tracking Device

Figure 13 GPS Watch

Both devices in Figure 13 and Figure 12 are GPS tracking that use to track the location of people that might useful for people with dementia. However, both devices need to press the button in order to know the current location to send messages to the relatives. People with dementia is having difficulties to press any button because they having cognitive problem. Therefore, device that tracks the location automatically is highly recommended.

2.4.5 The BUDDI Personal Alarm

Figure 15 The BUDDI Personal Alarm

Figure 14 shows the BUDDI personal alarm that embedded with the system that have the several alarm for several activities such as fall alert, emergency alarm, locate and many more. However, the drawback for this device is, it is not suitable for people with dementia because button need to press in order to know the current location. Therefore, dementia need a specially design if the device needs to be implemented for them.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter will cover the details explanation of methodology that is being used to make this project complete and working well. In order to evaluate this project, the methodology based on System Development Life Cycle (SDLC) as shown in Figure 15 will be used.

3.1 Choosing System Development Methodology

In order to evaluate this project, the methodology based on System Development Life Cycle (SDLC) as shown in Figure 15 will be used.
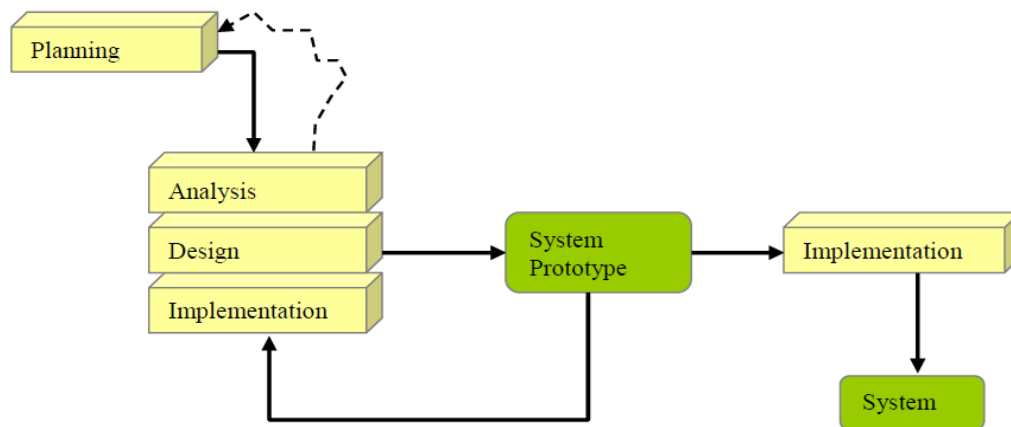
Figure 16 SDLC Phase

This methodology is usually used when the process is likely to be changed as the project proceeds or when the stakeholder has little idea of what system to be built. All the Analysis, Design, and Implementation phases performed at the same time and on each

cycle in producing a system prototype. Figure 15 shows the cycle repeated continually based on the comments until the system prototype successfully meets the requirements. The last prototype will then be called the system. Prototyping development needs only initial basic analysis and design. Thus there is a possibility to revise the initial design decision and start all over again from the beginning. As for the advantage of using this model is that it can deliver system quickly to users, though it not exactly meeting the requirements.

Figure 16 shows steps in each phase of the development cycle.
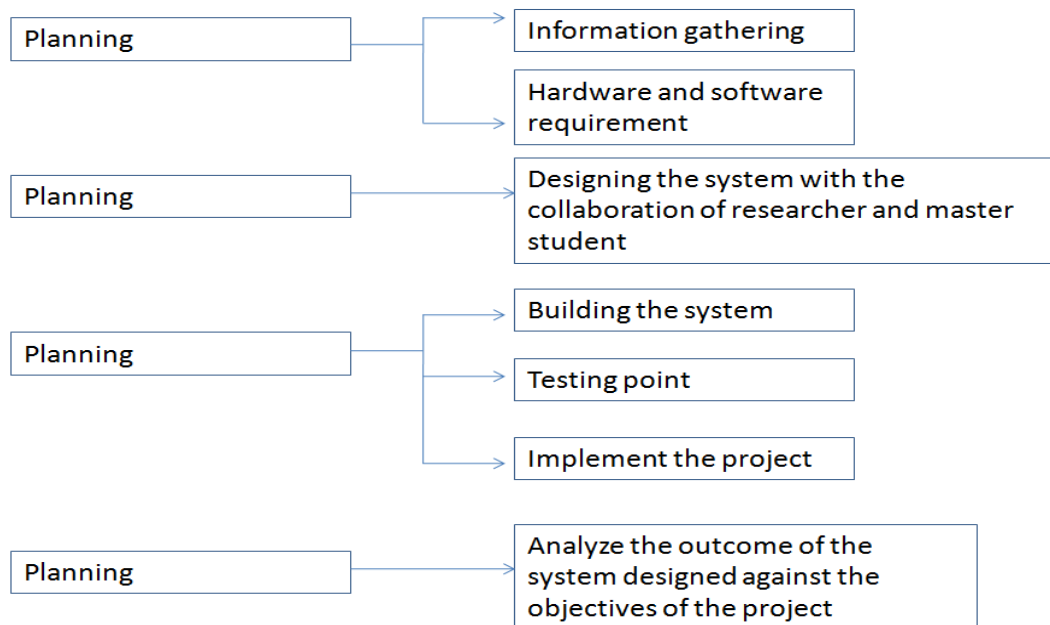
Figure 17 Steps in SDLC phase

3.2 Planning

In order to obtain all the information requires fulfilling the project's objectives, project planning must be done in the proper manner.

3.2.1 Information Data Gathering

In this stage, information on how the project can be carried out is done. Extensive literature studies and meeting is carried out to get a thorough data to design and build the system. The literature studies come from the materials collected from journal and research paper gathered from Internet. Furthermore, meetings with experts also can be done to get more information and suggestions for designing and building the system.

3.2.2 Hardware and Software requirement

Hardware and software requirements need to be derived to make sure that a suitable hardware can be gathered and suitable software can be developed. However, time and cost constraint must be put as considerations in choosing the hardware and software implementations.

In this project, in addition to extensive literature studies, several meetings and consultations with experts; Dr. Low Tan Jung (UTP lecturer), Dr. Wan Fatimah Wan Ahmad (UTP lecturer), A/P Dr. Ahmad Kamil Mahmood (UTP lecturer), Jun Okitsu (Hitachi researcher) and Thariq Ali (master student) has been conducted for better system development.

3.3 Designing

In this stage, the overall system design needs to be selected. As there are many system design can be implemented in temperature monitoring, one particular design that is most effective and efficient must be chosen. Hardware, software, and time limitations also need to be considered in choosing the system design.

3.4 Implementation

3.4.1 Building the system

There are two main activities this stage, which are collecting sensor data and asset management.

a. Collecting sensing data.

This stage focuses on the hardware implementation, which includes:

i. Sensor configuration

The configuration of sensor will include the configuration of the overall wireless network system which includes the server, concentrator, sensor board and the firmware.

ii. Windows Application

A standalone application is built in order to give user friendly environment for analyzing the data gathered from the sensor. This standalone application will come in handy for further implementation of the experiment. The application will be built under the agile development methodology, where it's being developed in incremental, repetitious means. This cycle of development is repetitive as all sections developed will be review continuously to identify element of enhancement and refinement that comply with project's objectives. Figure 17 below shows the general agile development cycle:
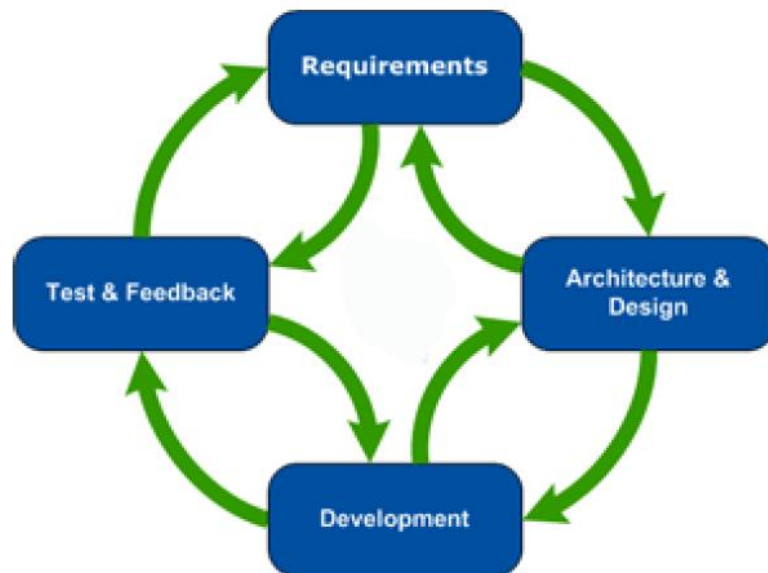
Figure 18 Agile Development

3.4.2 Testing point

In order to ensure correctness of the result, the project will do several testing, verification, validation and evaluation. In this stage, the project will be tested. The testing of this project consists of verifying and validating the system.

In this step, all the rules will be rechecked to make sure that the conditions is match with the conditions from information obtained. Otherwise, validation involves testing the system to ensure it is the right system- that it meets the expert's expectation. In this project, the activity involve is to test the overall system in order to make sure the system is working properly for optimum data collection. Some data samples can be derived from the testing experiment for evaluation.

3.4.3 Implementation of the project

After the system is tested, verified, validated, and evaluated then the system ready to be implemented and used by the users. The design phase determines how the system will works in the system environment. In this case, the system help dementia patients through persuasive technologies will be developed. On this stage, the illustration of the interface is done based on the findings received. Implementing the project is the main stage in the development cycle. In this stage, real-time data will be gathered to be analyzed.

3.5 Data Analysis

The activities such as problem identifying and predicting the potential problem of   the project in the future are arising during this stage. The information gathered during planning stage are being analyzed therefore the literature review are done. During this stage, the system should able identify the opportunity of helping patients of dementia through the device system.

3.6 Project Activities

3.6.1 Requirement Planning

This is where the research to develop location detection for dementia using ad-hoc network framework will be done. The research will be conducted in three phase. In phase 1, the research is done to determine the need of location detection for people with dementia. Phase 2 is focusing on identifying the essential requirement of the system design that will be developed. Finally, phase 3 involves derivation and validation of the proposed system design of location detection using ad-hoc network.

3.6.2 User Design

During this time, rapid prototype needs to be developed. At the end of user design, the outcome should be as below:

- ❖ Diagram defining the interaction between process and data
- ❖ Preliminary draft of the interface

3.6.3 Construction

During this phase, writing coding is needed for prototype development. When developing the system, construction and user design are combined together. The outcomes from the activity are:

- ❖ Finalized the framework of location detection using ad-hoc technology design
- ❖ Finalized the design of prototyping

3.6.4 Cutover

Cutover is the delivery of the application to its end users. Planning for cutover must begin early in the SDLC process. Cutover involved many of the traditional activities of implementation, including testing the system, user acceptance testing and training users. The outcome from this activity is the enhancement system will be implemented.

3.7 Key Milestone

Task	Start Date	End Date
Project initiation	May 2013	May 2013
Planning phase	June 2013	July 2013
Construction phase	July 2013	November 2013
Final review	November 2013	December 2013
Release	December 2013	December 2013

Table 2 Project Milestone

3.8 Gantt Chart

No	Activities	Final Year Project 1														Final Year Project 2													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**Selection of Project Title**																												
	Search for Project Title																												
2	**Planning & Research Analysis**																												
	Literature review research																												
	Define system scope																												
	Determine system outline																												
	Conduct interview																												
3	**Architecture Design**																												
	Develop system topology																												
4	**System Development**																												
	Write coding																												
	Demonstrate																												
	Run simple test to show the workability																												
	Ensure all components																												

#	Task																																	
	interrelated and working																		▓	▓	▓	▓	▓	▓	▓									
	Refine																		▓	▓	▓	▓	▓	▓	▓									
	Debug																		▓	▓	▓	▓	▓	▓	▓									
	Reconstruct the system																		▓	▓	▓	▓	▓	▓	▓									
5	System Cutover																												▓	▓	▓	■		
	Testing system functionality and usability																												▓	▓				
	Check system specification aligned with requirements																												▓	▓				
	System implementation																												▓	▓	▓	▓		

▓ = Process ■ = Suggested milestone

Table 3 Gantt chart

3.9 Tools

There are a number of essential tools needed in developing this project. Below are the minimum requirement and tools that are required.

- ❖ Personal computers with Windows platform, 1 GB RAM (minimum), 80 GB hard-disc space, including 115 MB of available space on the hard disk that contains the operating system.
- ❖ GPS device
- ❖ Eclipse
- ❖ Android mobile phone
- ❖ MIT Appinventor

CHAPTER 4

RESULTS AND DISCUSSIONS

This chapter discusses on all of the results collected from most of the phases in the system development process. The result helps to support the evidence towards achieving the objectives together with the discussion. This chapter will describe on several main aspects mentioned below.

4.1 Literature Review Findings

From the literature review, the findings are as below:

- ❖ Old citizens suffered from various types of diseases which may harm their health and daily life routine ("Living independently with Dementia", 2013)
- ❖ Dementia illness usually happened to people age 65 years old and above (Parnetti, Amici, Lanari, & Gallai, 2004).
- ❖ People with dementia have significant memory problems as well as cognitive difficulties that are severe enough to get in the way of daily life (Kenny & Knot, 2012).
- ❖ Family members and other informal caregivers heavily burdened by the need to support and often monitor the person with dementia in everyday life (Susan,C. R, Barbara, G, Nirvana H.P.,& Ann, B, 2008).
- ❖ VANET network provided location optimization which having GPS and wireless technology that needed to locate current location of dementia people (Singh, Hasbullah, & Nayan, 2013).
- ❖ Malaysia during 1990, 9% or almost half a billion of world population were over 60 years old. The figure will increase to 1.4 billion in 2030 as mentioned by (World Bank, 1994). It is because of the declining fertility, developing countries are ageing much faster than the developed nations. By 2020, 9.5% expected of population will be at the age of 60 years and above (Sim, 2001).

❖ Gerontology problems in UK from year 1997 until 2001. They suffered from many types of diseases such as infection parasitic, metabolic diseases, mental disorders, nervous system and many more. It shows that, at the age of 65 and above, the chance of old citizens to get infected with diseases is higher (Parnetti, Amici, Lanari, & Gallai, 2004) .

❖ Dementia refers to a syndrome of acquired cognitive deterioration that can be associated with various potential stages of the diseases (Garcia, 2010).

❖ There are 77% of people that having depressed when suffered dementia illness. However, only 44% of them felt lost friends after being diagnosed by doctor ("The Guardian", 2012).

❖ The increment of life expectancy observed for conditions such as cognitive decline and dementia. The study determined the prevalence of cognitive impairment and dementia and to identify its associated factors among 399 elderly patients in Hospital Universiti Sains Malaysia. (Kadir, Hassan, & Razak, 2011).

❖ The early signs of dementia can be identified by several factors such as, Progressive and frequent memory loss, Confusion, Personality change, Apathy and withdrawal and Loss of ability to perform everyday tasks (Hof, et al., 1992).

❖ The incidence of dementia among the elderly population is rising rapidly worldwide. In the United States, Alzheimer's disease (AD) is the leading type of dementia and was the fifth and eighth leading cause of death in women and men aged more than 65 years, respectively, in 2003. (Chen Y. C., 2009).

❖ Dementia mainly affects older people, although there is a growing awareness of cases that start before the age of 65. By 2050, people aged 60 and over will account for 22% of the world's population, with four-fifths living in Asia, Latin America or Africa. 2980 community older Malaysians that involved 1503 women and 1477 men with average of 70.5 years. The overall prevalence of dementia was 14.3%. It shows a clearly increasing trend by age groups, doubling every 10 years from 9.5% in the 60-69 age groups, to 26.3% in those aged 80 and above. (Hamid T. A., Krishnaswamy, Abdullah, & Momtaz, 2011).

❖ Client/server systems (CSS) are emerging as the new paradigm for systems development, replacing or integrating legacy applications with systems that provide higher quality user interfaces on the client component and substantial user-transparent data processing capability on one or more servers" (Guimaraes & Igbaria, 2007).

❖ Client/server applications are provided by a combination of resources using client workstation processor and the server processor. Other than that, Client server also functioned as a database server provides data in response to an SQL request issued by the client application (Kim & Han, 2001).

❖ VANETs provided facility for vehicles to instinctively and wirelessly network with new vehicles close by for the purposes of as long as travelers with new features and applications. Other than that, traffic incident is turning into serious for traffic management authority as well as vehicle user (Singh, Hasbullah, & Nayan, 2013).

❖ VANETs would also head towards the so-called "4G" approach where there is opportunistic utilization of the best network, (Chandrasekaran, 2008).

❖ Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor as stated by (Rose, 2006)

❖ Wireless system concept can provide isolated pockets of high bandwidth connectivity to the internet for mobile terminals as mentioned by (Chandrasekaran, 2008).

❖ By choosing wireless technology, it will help the project to support ad hoc network. It is proven by the study from (Doan, Berradia, & Mouzna, 2009) which wireless communication devices helps to detect their geographical location and to provide ad-hoc network connectivity with the roadside equipment respectively.

❖ GPS also helps people to know about how to keep up with the whereabouts of family, friends and employees. It also helps to find cell phone, to track children, teen tracking, tracking Alzheimer and tracking stuff (Adomatis, 2013).

4.2 Interview Findings

Most of the findings through interview are the same with literature findings. Additional findings from interview are gathered as below:

- ❖ GPS is applicable to be implemented for location detection for dementia people.
- ❖ Wi-Fi or internet is needed in order to support GPS Coordinate Finder in order to develop the system.

4.3 System Architecture

Figure 16 shows the system architecture for Location Detection of dementia using GPS Coordinate Finder. Internet network is required to support the data server of the GPS.
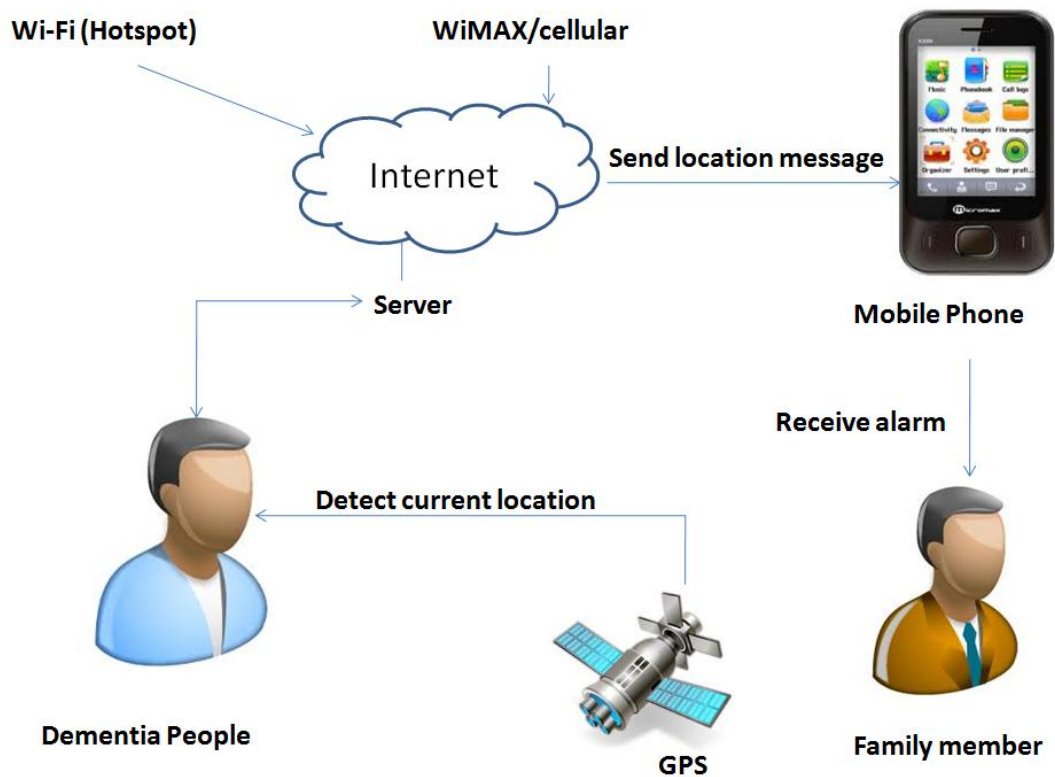

Figure 19 High Level Architecture of Location Detection for Dementia

Client server model in be implemented in this architecture. It utilizes Client-Server architecture as its architecture with the wireless technology acts as the middleware. Dementia people is a client which having small device. When the relative make a phone call, the GPS device will send the coordinate message and open the coordinate finder to find the exact location.

4.4 System Flow

Figure 19 shows the system flow diagram for the location detection using ad-hoc network.
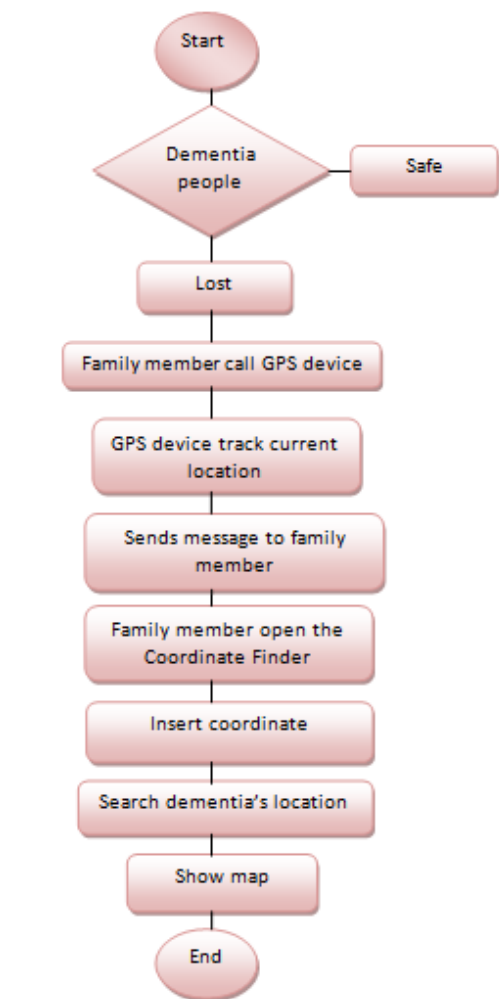

Figure 20 System Flow Diagram

The system flow diagram shows the system being implemented to user. A GPS device will attach to the user. GPS satellite will automatically track the location of the user. Family member will get notification through their mobile phone by calling the GPS device. Family member will be notified by the coordinate message sent by the device. It will help them to track user if the user is not able to find way home because of the dementia illness.

4.5 Prototype of mobile application

Figure 20 shows the prototype of GPS device and also view screen for the Location Detection of Dementia using GPS Coordinate Finder. The application will automatically detect the current location and need to be inserted coordinate such as latitude and longitude in order to find the location effectively.

Figure 20 GPS Device

Figure 21 shows the message from GPS device that helps family member to locate their parent who are not able to find their way home or lost. The message is consist of latitude and longitude of the dementia's location.

Figure 21 SMS from the GPS device

Figure 22 shows android application for mobile phone to identify the exact location of the dementia. The application is specializing design for the dementia and it is used to find the dementia location. The application is automatically get the current location of the family member. In order to identify dementia's location, user needs to insert latitude and longitude coordinates which they got from the SMS after calling the GPS device. Show me the map's button will show the direction of the dementia's location. With the help of GPS satellite, it helps GPS coordinate finder to track the dementia location

effectively. Button of save current location is current location of the user will be saved in the database for the future purposes.
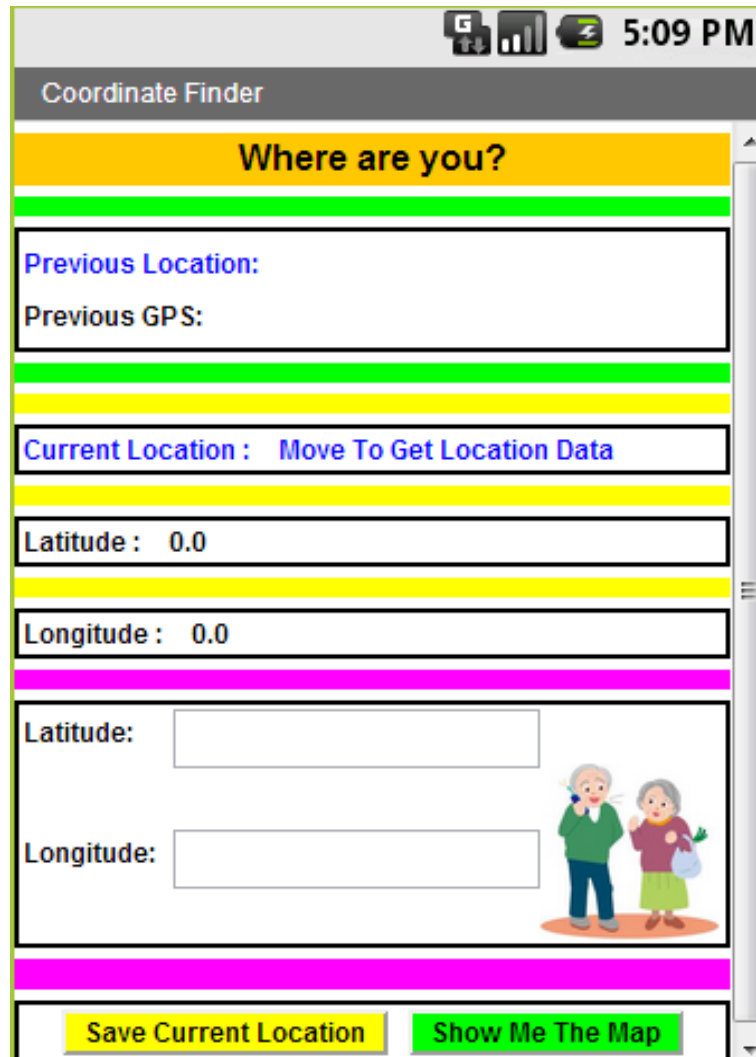

Figure 21 GPS Coordinate Finder Application

Figure 22 shows the map after user is clicking the button of show me the map. The map will be enlarged at the screen to direct user where is the location of dementia who is holding the GPS device. GPS satellite will help user to identify the location by showing the direction of the current location to the end location where the dementia is located.
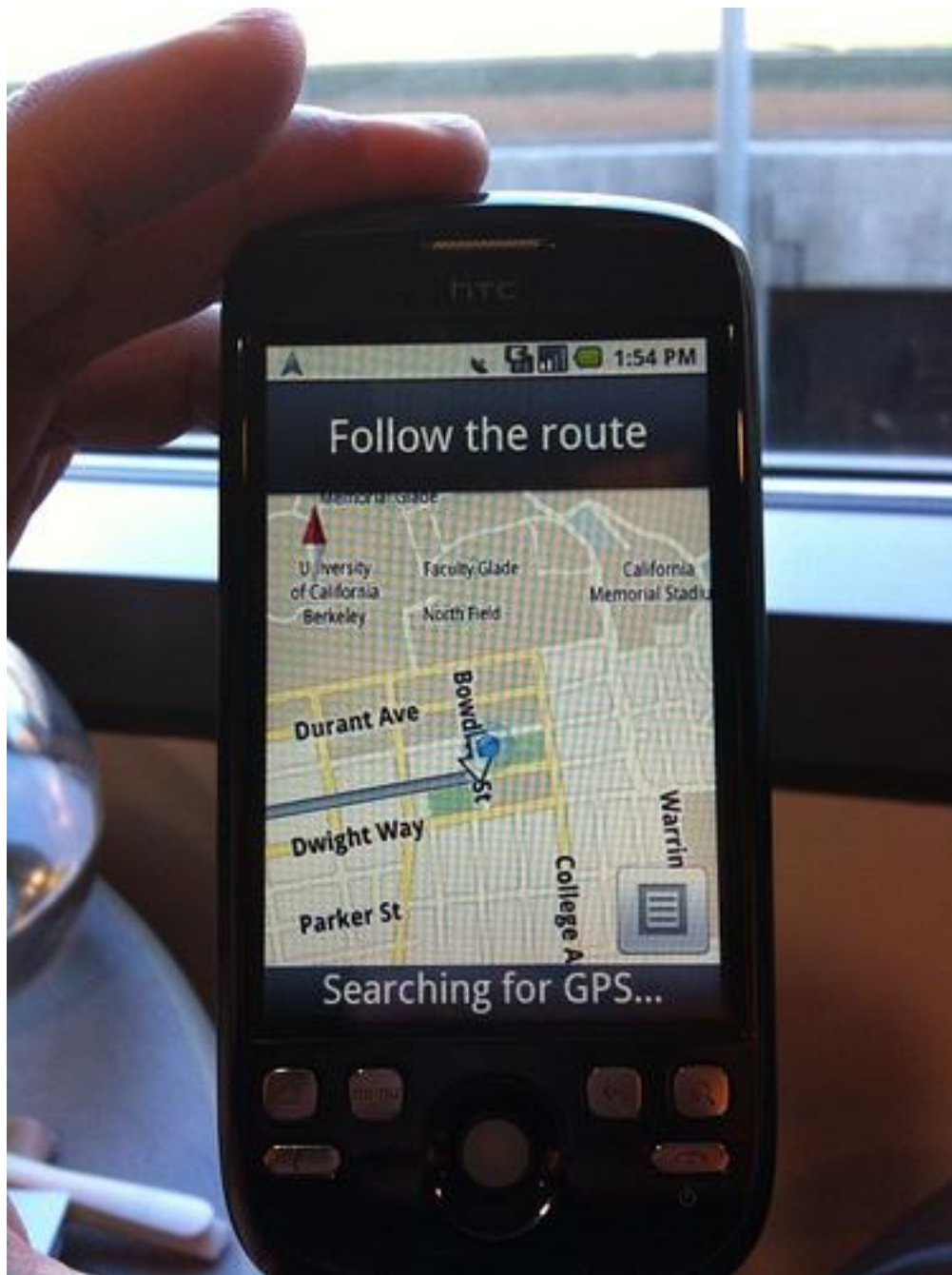
Figure 22 Map to show the location of dementia

4.6 Requirement analysis

In requirement analysis, users that involved in the system are the people with dementia and also the relatives, which is the family member. The system is used to track dementia's location in order to help family member to identify where the elder is.

It is essential to check for relevant information about users' need which is family members and dementia people, and to exploit this information. Dementia Home Care Center and people who have relatives who suffered from dementia illness may provide information about real users which can be used to recruit people for user requirements analysis and for user validation later in the development process.

Dementia people will carry the GPS device as a node for GPS to locate the current location and to transmit the data as an alarm to family member by using wireless technology. Family member will get the notification from the SMS through the mobile phone.

The limitation of the system is, there must be stable internet connection in order to make the system succeed. It is because the application required internet to track the location by GPS satellite and send message to the family member. The accuracy of the dementia's location is also one of the limitations because GPS satellite cannot detect the location of the level in a building. It only can detect the building location not the exact point where dementia people is. However, Wi-Fi is chosen because the wide range it offers and its availability.

4.7 User Perception Survey

A user perception survey is carried out starting from 28th November 2013 to 30st November 2013. The target respondents are family members who are having elderly potential for dementia. The survey is carried out mainly through online while some was filled in on-the-spot by the users located in Perak, Muar and also Kuala Lumpur.

Respondents	Number
Perak	3
Muar	4
Kuala Lumpur	3
Total	10

Table 4 Number of respondents found from different areas
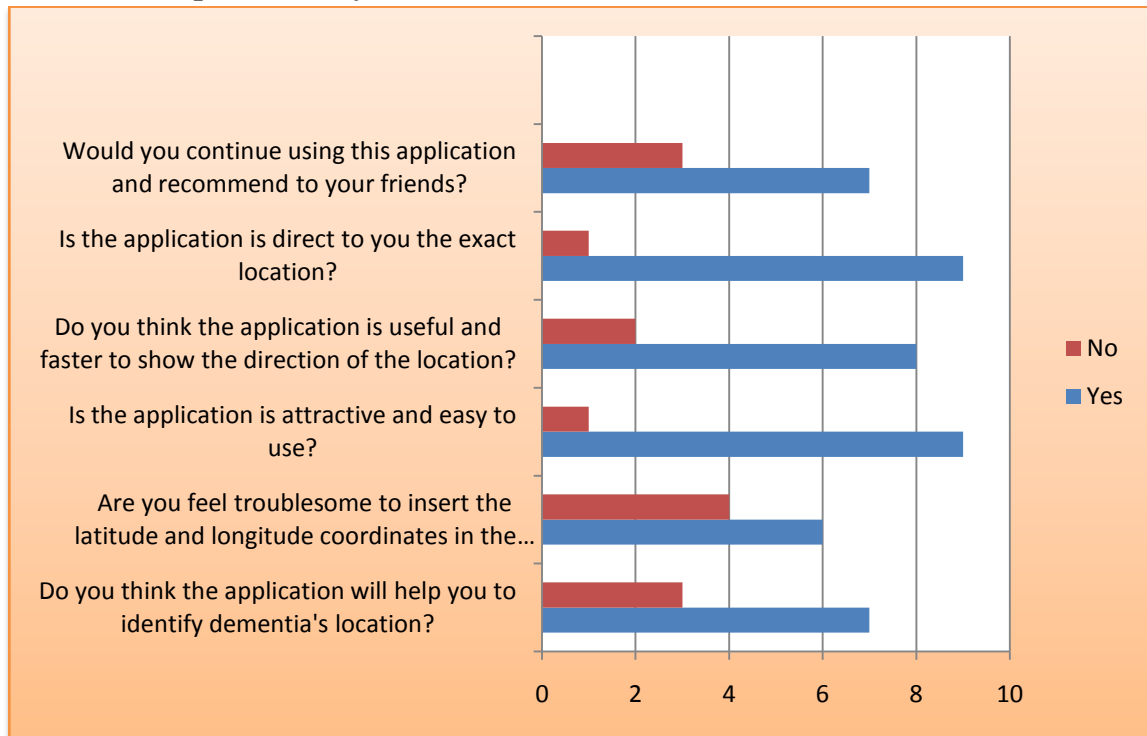
4.8 User Perception Survey Result

Table 5 User Perception Survey Results

From the chart above, it is shown that users strongly agree that the application will help to identify dementia's location, mainly because they can see that GPS device will automatically triggered the location with the help of GPS satellite and the coordinate finder to support the application. Besides, users agree that the application appears to be very attractive and it is easy to use.

Furthermore, most users agree that this application is useful to find the exact location of dementia. However, users are strongly believed that, it is troublesome to insert latitude and longitude coordinates in the application.

At the end of the user perception survey, 70% of users strongly agree that this application will help them to identify dementia's location easily, 60% believe that improvement is needed for the application as it is troublesome to insert the coordinates of the latitude and longitude and 70% responded that they might continue to use this application and recommend to other new parents, to promote family titles learning.

As the user testing time is recorded, it is found that the users spent about seven minutes (in average) exploring and repeating the application.

CHAPTER 5
FUTURE PLAN AND CONCLUSION

5.1 Relevancy to the objectives

From the results of user perception study, the targeted users show positive response that the application is helpful in tracking the location in effective way. However, more specific location is requested from the user such as at which level is dementia located in the building.

Results from the User Perception Survey which is 64.25% also indicates that user are quite satisfied with the prototype application and would like to continue using it in the future as well as recommend it to other friends.

Besides, they do not have to worry anymore about where to find the dementia and could give dementia full support to move freely wherever they wanted to go without any hesitation.

5.2 Suggested future work for Expansion and Continuation

There are several recommendations that can be made to this prototype in this future. The recommendations are not meant to change this project for the whole, however it is to allow improvements in certain aspects and make this system for betterment.

5.2.1 Develop mobile application

In order to continue development of the system, the extraction of the SMS need to be done. User does not have to insert latitude and longitude coordinates anymore. The application is automatically extract the information and be able to find the location efficiently and faster.

5.2.2 GPS device configuration

GPS device is able to identify the exact location in every level in a building not only the place.

5.3 Conclusion

In this research, the performance of Wi-Fi and GPS as medium for dementia people to communicate with the relatives in a simple network was evaluated. Wi-Fi was found to provide reliable and high throughput, while connected (Singh, Hasbullah, & Nayan, 2013). The Wi-Fi connection was unaffected by speed and the only distinguishable factor seems to be separation which determined whether the connection is made. It is suitable to use internet network to track the dementia people as they suffered from cognitive difficulties. GPS and wireless technology are being discovered in order to make the system become more reliable and more efficient for tacking people. The system will be developed to help the family members and relatives to reduce the burden to take care of people with dementia. By the end of the stage, the system will be able to be tested for User Acceptance Test to test the developed product.

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