# HELPER SYSTEM FOR MANAGING ALZHEIMER'S PEOPLE USING MOBILE APPLICATION

LIM SAY CHOON

A thesis submitted in fulfilment of the requirements for the award of the degree of Degree of Computer Science

Faculty of Computer Systems & Software Engineering
Universiti Malaysia Pahang

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# ABSTRACT

Alzheimer's disease is one of the common types of chronic disease and makes the patients easier to lose memory. The effects of this disease will decrease the ability and quality of Alzheimer's people daily life and increase the dependent or needed others or technology to assist them. Thus this study was focusing on developing helper system for managing Alzheimer's people using mobile application. This mobile application was developed using Android based platform. It includes the audio reminder that can help to remind the Alzheimer's people to do their daily life activities on time. While the caregivers can directly remote control and setting the smart phone that taking by Alzheimer's people and check back the history of the done activities by using computer. Evaluation and validation was performed based on the functionality, user-friendly and acceptability. Result shown that almost 90% of the user agreed and accept that this application is useful for managing Alzheimer's people and 85% from them agreed that this application had enough functionality, while 10% of the user disagreed and dissatisfied with this application. The recommendation had been made by user on user interface such as with different theme styles to let it more attractive and embedding server application inside the system in order to improve this helper system for future research.

# ABSTRAK

Penyakit Alzheimer merupakan salah satu jenis penyakit kronik yang menyebabkan pesakit lebih mudah hilangan ingatan. Penyakit ini mengurangkan keupayaan dan kualiti kehidup harian pesakit Alzheimer yang mengakibatkan pesakit memerlukan orang lain atau teknologi untuk membantu menguruskan kehidupan harian mereka. Oleh yang demikian, kajian ini dijalankan untuk membangunkan satu sistem bagi membantu menguruskan pesakit Alzheimer dengan menggunakan aplikasi mudah alih. Aplikasi mudah alih ini, mengandungi modul peringatan audio yang boleh membantu untuk mengingatkan pesakit Alzheimer melakukan aktiviti kehidupan harian mereka pada waktu yang ditetapkan. Selain itu, aplikasi ini juga membenarkan penjaga membuat kawalan jauh secara langsung terhadap telefon pintar pesakit Alzheimer dengan menetapkan aktiviti baru dan menyemak semula aktiviti yang telah dilakukan dengan menggunakan komputer. Penilaian dan pengesahan terhadap aplikasi ini telah dilaksanakan berdasarkan kepada faktor kebolehfungsian, mesra pengguna dan penerimaan pengguna terhadap aplikasi ini. Hasil penilaian menunjukkan 90% daripada pengguna bersetuju aplikasi ini amat berguna untuk menguruskan pesakit Alzheimer dan 85% daripada mereka bersetuju aplikasi ini mencukupi kebolehfungsian, manakala 10% daripada pengguna tidak bersetuju. Pengguna mencadangkan penambahbaikan terhadap reka bentuk antara muka dan juga menerapkan penggunaan pelayan di dalam “helper system”.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# CHAPTER 1

# INTRODUCTION

## 1.0 Introduction

From year to year, the population of older people increases gradually. In 2014 the World Health Organization (WHO) reported that the population over 60 years is expected to reach 2 billion from 605 million living worldwide over the same period between 2000 and 2050 [1]. The increasing number of older people will influence the increasing the risk of chronic disease [2]. This disease will affect the quality of life of the older people over the time due the progressive of chronic disease. Undeniable older people is the person who lead us to this world and teach us many things when we still younger. Therefore, it is our responsibility to take care the older people like how they take care us when we are young. We need to managing older people from their daily life activities and some that might have health problem. For the daily life activities, we need to take care of their meals, bathing, dressing, taking medicine and many more. These are the basic activities that we should do every day even the older people have health problem. Sons and daughters often face difficult decisions as their parents enter their golden years. Particularly if one parent has passed away, deciding how to best provide for an aging parent once it's clears they can no longer live independently is difficult [3].

However, managing older people is not easier because it take time. This make their family need take time for them to take care the older people, but some of them be forced to send the older people to the nursing home reluctantly due their busy work. So it is needed some help from technology or other peoples to help us take

care of their older people. One of the suitable technologies that can help older people is the mobile application. Nowadays, most of the people having at least one mobile phone no matter are having by child or older people. This is convenient for the people who want to manage older people or older people themselves by using the mobile application for managing.

The mobile application may be can like an audio reminder application that can remind older people doing their daily activities on time, especially for the Alzheimer's people that easier to lose memory even for their daily life activities. In addition, the remote control of mobile phone also can let the caregivers or their family easier to control the mobile phone of Alzheimer's people. Therefore the society can let them stay safely at home without any further worry during their working hour for the office guys or office ladies. The older people also will feel comfortable to stay at home without sending them to another place such as nursing home which is fully new environment to them and need they take some times to adopt the environment. Some of them, may be still cannot adopt it for stay a long time at there.

## 1.1 Problem Statement

From the knowledge as we know, the Alzheimer's disease is not a disease like high blood pressure or diabetes that can recover or maintain by just taking medicine on time without specific help from others to take care or managing them. Alzheimer's disease let the patient easier to lose memory of what they had done even a minute ago. So they need some specific applications to take care and remind them of what they should do. Therefore some parties had developed some applications to help and managing them.

The computer-aided telephone system that developed by other parties to help and enable Alzheimer's people to make phone calls to their family members or friends independently. They no need to memorize the telephone number that they want to make phone call, they just need to select the name or photo which show in

the computer-aided telephone system. Another example application that can help managing Alzheimer's people is the environment-aware system. It is a remote monitoring system that has a device that able to monitor the humidity and temperature of the environment, patient's location and even the patient's movement by using the sensors and GPS. Then the device will sends this information to the caregivers through SMS. Besides that, the iWander system that developed by other parties is a mobile application that can navigate the Alzheimer's people to a safe location or back home via the help of GPS when they are wandering outside. Then it also will notify the caregivers about the current location of the patient and let the caregivers can to do the further step of how to manage the situation of the Alzheimer's people.

All of this solution to help Alzheimer's people not just give the advantage for us to managing Alzheimer's people, but it also has the limitation too. For example, the computer-aided telephone system just has the solution for the patient make phone call independently, but it can't let the patient do their daily activities independently. Make phone call is just the small thing that involve in our life and sometimes the Alzheimer's people will forget who they should to make phone call due to memory lose. Whereas the environment-aware system need to purchase the sensors and locate at home just can help to monitor the patient. The purchase fee for some family might be a burden to them and they may not be able to afford it. Sometimes, the sensors also will lose functioning accidently and it will break the function of monitor the patient as well. In addition, the iWander system needs GPS to guide the patient and the GPS need the internet connection just can function. If the Alzheimer's people walk to an area that can't access to the internet, the caregivers also can't know the exactly location of the patient.

Nevertheless still had other parties developed the smart phone application nowadays which has the function of daily living reminder, picture-dialing and one hour reminder to help and managing the Alzheimer's people in their daily life. However there is still no has any party developed the mobile phone controlling for managing the older people with Alzheimer's disease. It influence the caregiver can't fully control and view the smart phone which taking by the Alzheimer's people directly when they are not around with Alzheimer's people.

Therefore, by considering the convenient of mobile phone, which using and had by most of the people in this world in their hands, so propose a mobile application that can help to manage the Alzheimer's people with the function of mobile phone controlling by remote personal computer in their daily life is one of the good ways. The mobile phone application also has the function of audio reminder that can help to remind the Alzheimer's people to do their daily life activities on time and the caregiver can directly remote control and setting the reminder too by just using their own personal computer.

## 1.2 Objective

- To identify alternative suitable approaches in managing Alzheimer's people.
- To develop helper system for managing Alzheimer's people on mobile application.
- To validate the functionality and acceptability of helper system on mobile application by user.

## 1.3 Scope

The user for using this helper system can be any people that they need it to help them managing the Alzheimer's people and the Alzheimer's people himself. The stage of Alzheimer's disease that covers is until the stage four which is moderate cognitive decline stage. While the platform for this helper system is mobile application with Android based. This is because most of us having the smart phone in this modern century in our hand and Android based smart phone is the highest purchase among others platform from the analysis of worldwide smart phone OS market share [4]. However, the module in this helper system include the audio reminder to remind older people to do their daily life activities such as taking

medicine, time to take bath and have meals. Besides that, people can directly control and set the daily life activities that should be done by Alzheimer's people on the smart phone of the Alzheimer's people and also check back what activities that the Alzheimer's people had done by using their own computer.

## 1.4 Thesis Organization

This thesis consists of five chapters. Chapter 1 discuss about the introduction of the helper system. It includes the related issues about the helper system and the goal to be achieved in the end of the project. Chapter 2 discuss about the existing solution for managing Alzheimer's people done by other parties and which of the techniques or method can be adapt into the project. Chapter 3 discuss about the method, technique or approach to be used in the project. While Chapter 4 in this thesis discuss about the implementation of the helper system and testing that had been taken. Lastly, Chapter 5 discuss about the result discussion, future research, contribution of this research and making conclusion for the overall process and research that had been done.

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

As mention in previous chapter, the population of older people gradually increases and the older people with Alzheimer's disease also increase too. According to the record of Alzheimer's resource, the older people with Alzheimer's disease were nearly 36 million in the world [5]. Therefore, taking care or managing those older people with Alzheimer's disease is needed. It is our responsibilities as citizens in this world to manage them to let them have a good quality of life. Nevertheless, many applications had developed to manage those older people with Alzheimer's disease which are convenient to us. In this chapter will discuss about the existing applications that help to manage older people with Alzheimer's disease and the comparisons of the existing mobile applications.

## 2.1 Alzheimer's Disease

The nerve cells in the brain die until influence it difficult for the brain's signals to be transmitted properly is the condition of Alzheimer's disease. Among the older people, the Alzheimer's disease is the most common form of dementia [6].

Normally, this condition of Alzheimer's disease affects the ability of thinking and memory. In 1906, Dr. Alois Alzheimer was the first person to identify the Alzheimer's disease [7]. The person with Alzheimer's disease, their brain will shrinks in some region when the brain cells die and it will affect the functionality of the brain.

The person with Alzheimer's disease, their ability to remember the new information was gradually decreased. This is due to the malfunction or die of neurons which is function in forming the new memories [8]. One of the characteristics that we familiar with or know well is the memory loss. The memory loss will affect the daily life of person with Alzheimer's disease disrupts. They may difficult to complete the daily life activities which are familiar task at home such as take medicine, meals, bathing and grooming. They easily to forget what he or she done a minute ago and misplacing the things that used every day. Besides that, they will confuse with where they are and even the time. The person with Alzheimer's disease wills also changes in personality or behavior which is unusually angry or quiet. Furthermore, the advanced of Alzheimer's disease will affect them in the problems of words in speaking or writing and communication due to them can't recall the words or understand the common word's meaning. From all of the symptoms above, it is necessary to take care and managing the older people with Alzheimer's disease to improve their quality of daily life. The summary of the stage of Alzheimer's disease and its symptoms characteristics may refer to Appendix A.

## 2.2 Using VNC for Remote Control of Mobile Phone

Virtual Network Computing (VNC) is a graphical desktop sharing system for remotely control computer or mobile phone [9]. It allows the user can quickly and easily to access the graphical displays. Besides that, VNC is an independent platform which has the VNC server, VNC client and the communication protocol. The VNC share the screen of mobile phone to the computer by using the Remote Frame Buffer (RFB) protocol as shown in the Figure 2.1.

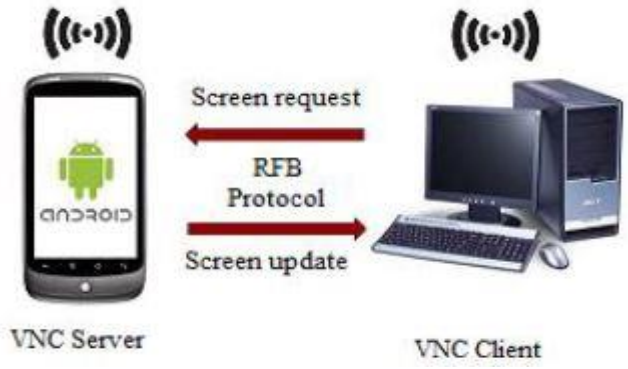


Figure 2.1 VNC System [9]

The VNC system should be done within Wi-Fi range and it can used to transfer file between the both server and client besides screen sharing. It means that it can be remotely control another device by using the RFB protocol which is about the screen update and capturing events like mouse or keystrokes for the function of controlling [10]. The VNC server will responds in the term of update about what has request by the VNC client. Therefore the VNC client can manage and control the updated of the VNC server such as add files, remove files, update files and any require operations.

The RFB protocol is a simple protocol for remote access to Graphical User Interface and it works by responding to the request from the client about the specific onscreen rectangle and the server responds in the form of the update which consists of an encoding or difference between the last time clients requested data and the moment of the request [11]. The RFB protocol divided into 3 phases such as handshaking, initialization and normal protocol interaction as shown in Figure 1.2 below.

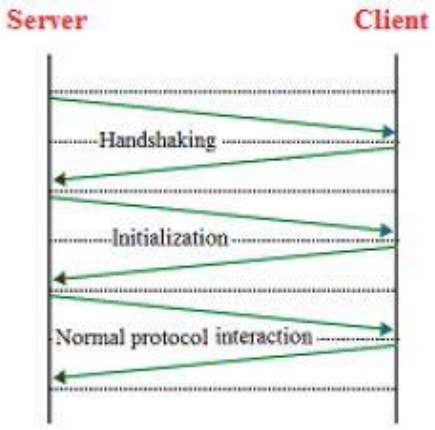


Figure 2.2 The RFB protocol procedures [11]

During the handshaking phase, the server and client will be connected to each other and the server will sends the protocol version messages to the client and both will exchange the security message. At the next phase of initialization phase, the server will sends the serverInit message which includes the width and height of frame buffer, pixel format and device name to the client after it receives the clientInit message from the client [9]. While during the normal protocol interaction phase which is the last phase, the client will sends FramebufferUpdateRequest message to the server once both are agree upon about the encoding methods which consists of RAW, RRE, Hextile, Zlib and Tight. Lastly the server will send its screen to the client after it receives the update message from client [9].

## 2.3 Using AirMirror on AirDroid for Remote Control of Mobile Phone

AirDroid is a favorite tool especially for Android users to transfer files, links and access contacts and messages from their Web browsers to their mobile devices [25]. It also consists of the AirMirror inside of it to remote control by using your pc.

Besides that, AirDroid has the function of standard web browser connects the computer to the mobile phone [26]. It just need to point the browser at web.airdroid.com and the device are connected. Once it connected, the computer browser will shows a desktop-like interface to the mobile phone.

The AirMirror feature inside the AirDroid lets you see and control your mobile device right on your desktop, using mouse to tap on buttons and fields and your keyboard to type [25]. This means that you can respond to any messages or call even from WhatsApp, Line or WeChat from pc without having to pick up mobile device.

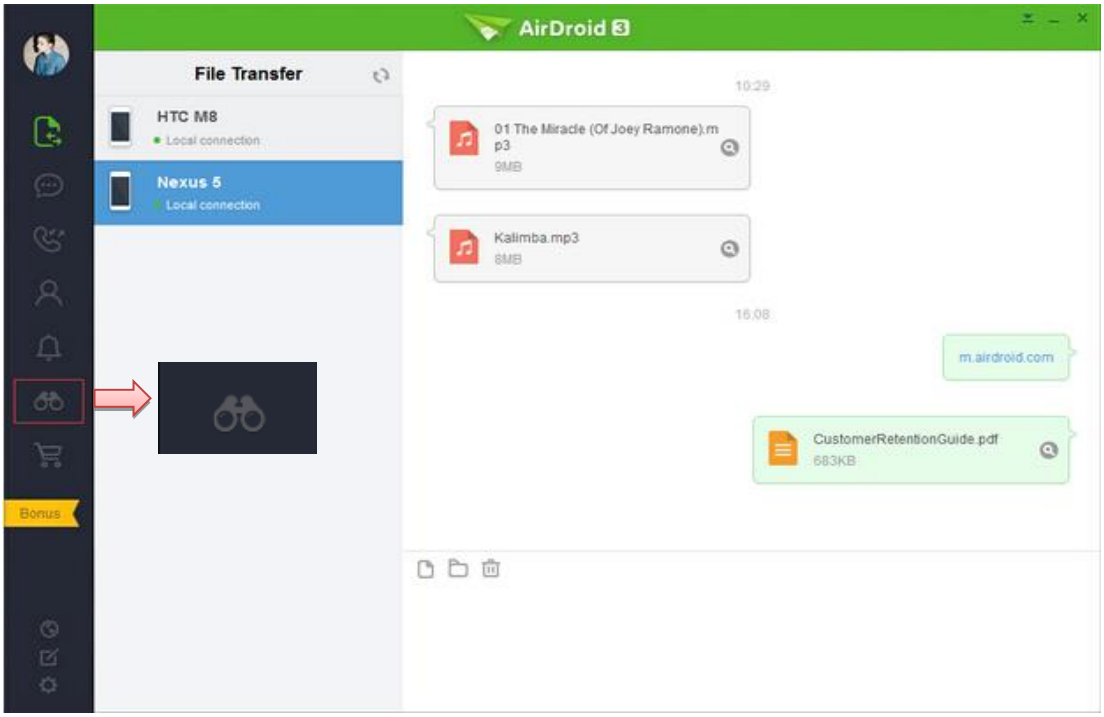


Figure 2.3 AirMirror Icon [27]

Figure 1.3 as shown above shows the AirMirror icon which place at the left hand side which in red square shape. While the Figure 1.4 as shown below shows the AirMirror which show the screen of mobile phone to let user see and control the mobile phone. The five icons at the bottom are screenshot, back, home, recent tasks and AirMirror keyboard.


Figure 2.4 AirMirror [28]

## 2.4 Application for managing Alzheimer's disease

There has some application for managing Alzheimer's disease that developed by other parties. It includes the mobile robotic guide and computer-aided telephone system. Below are the description and how these applications can help to manage Alzheimer's disease.

### 2.4.1 Mobile Robotic Guide

The mobile robotic guide provides guidance for older people to do the physical activity. One of the tasks of the robotic which can help to manage the older people with Alzheimer's disease is the task of reminding people of events. It can move to the older people's room, alert and inform them about the upcoming event or appointment through the speech and visual display. Furthermore, it also will assist them to the environment.

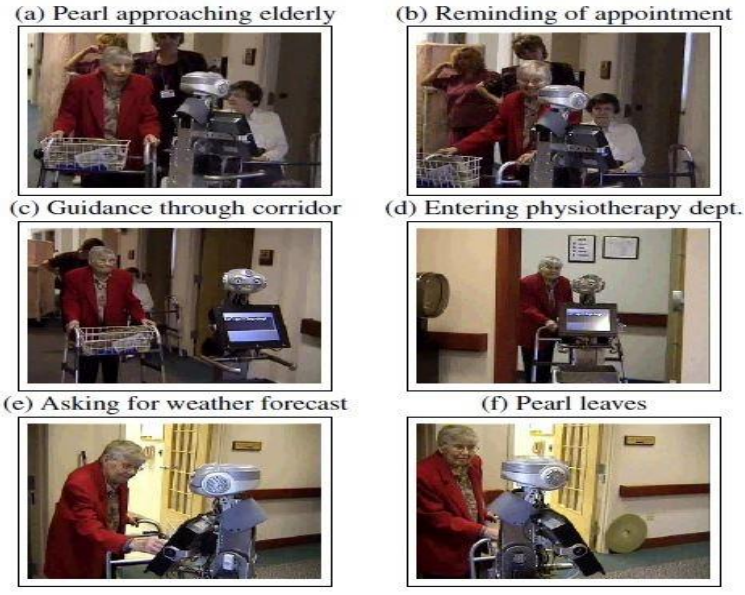


Figure 2.5 Guidance experiment by mobile robotic [12]

Figure 2.5 above shows the example of a successful guidance experiment. The robot detects people using map differencing. It will learn the map first and then

detects the people by significant deviation from the map. So that, it can detects people correctly and guiding them. The robot also has the sensor to detect the people reliably. It can give a safe navigation to the older people.

This mobile robotic guidance is still in the research phase, so that, it can't founded or consider as appropriate way for managing the older people and also older people with Alzheimer's disease by this robot. It just can be a guideline for improve and develop a similar or more advanced technology like the robot.

### 2.4.2 Computer-aided Telephone System

The computer-aided telephone system which developed by other party is for helping older people with Alzheimer's disease make phone calls to their family members or friends independently. This system consisted of a net-book computer, a global system for mobile communication modem (GSM), a micro switch device, a headset with microphone and a specifically developed software program [13][14].

In the initial, the micro switch will activate and trigger to the computer to present the list that the Alzheimer's person should call. The computer will present the specific name or other relevant expression for each member in the list with showing the member's photo on the screen. Then, the Alzheimer's person just need push the yellow pad which is the micro switch to call the member in the list that he or she wants to call. After that, the computer will select the telephone number of the member and activate the phone call direct to the member. The photo of the member will show on the screen to let the Alzheimer's person may maintain some form of the visual contact.

## 2.5 Mobile Applications for Managing Alzheimer's disease

Besides the application for managing Alzheimer's disease, some of the mobile application for managing Alzheimer's disease also had developed by other parties. The mobile applications include the daily life activity tracking application for smart homes, iWander, environment-aware system and smartphone application for people with Alzheimer's disease. Undeniable these mobile applications help to improve the quality of daily life of the people with Alzheimer's disease. Below are the description and how these mobile applications can help to manage people with Alzheimer's disease.

### 2.5.1 Daily Life Activity Tracking Application for Smart Homes

Smart home is the independent healthy living for older people and older people with Alzheimer's disease. The daily life activity tracking application helps the older people with Alzheimer's disease to complete the activities independently in their own homes and facilitates family members and care givers to track inhabitants at the same time [15]. The architecture of activity tracking application divided into three layers which are smart home, cloud computing and application layer. Figure 2.6 below show the architecture of activity tracking application.

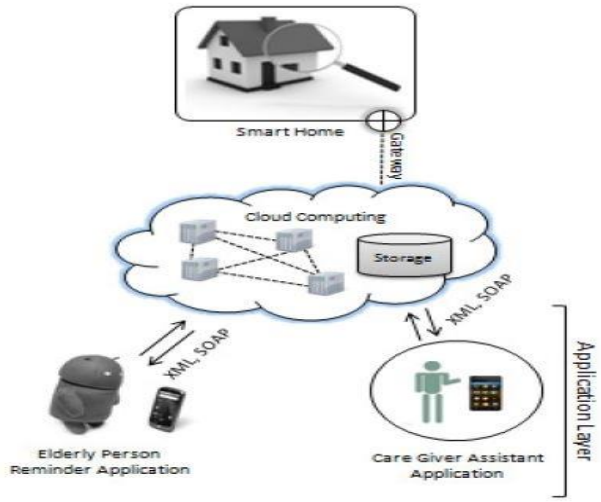


Figure 2.6 System Architecture of Activity Tracking Application [15]

Smart home is a sensing and intelligent technology to recognize and track the daily life activities of inhabitants. Sensors are deployed on different objects and locations to sense the environment in the home. It periodically sends the collected data to the server [15]. The sensor which deployed on different objects and locations to track the daily routines are RFID Tags, Biosensors, Micaz and Masol. However, the Cloud Computing provides the dynamically scalable and virtualized resources as a service with pay-as-you-go manner. The smart home sensed the environment in the home and sends the data to cloud which is stored in a database as a sensor log [15]. In the cloud, the activity recognition algorithms will process the sensor logs to recognize the daily life activities. The algorithm of recognize activities include the laundry, cooking, restroom, watching TV, cleaning and many more. For the application layer, it consists of the Elderly Person Reminder Application and Care Giver Assistant Application. The elderly person reminder application is an attention capturing application for the older people with Alzheimer's disease and it activated when a critical running activity needs to be complete first for avoiding any sort of accident [15]. The application will notify older people with Alzheimer's disease about the incomplete activity and to do some certain activity such as take medicine. If the attention is ignored more than three times, then the application will send the notification to the care giver for assistance. The care giver assistant application is for the care giver keep track the activity of older people when they are at outside. They can make sure the older people with Alzheimer's disease had take medicine according to the schedule and query the current status that older people with Alzheimer's disease done through the application interface via the picture and current atmosphere.

### 2.5.2 iWander

iWander is a mobile application specially develop for dementia or Alzheimer's patient. It runs on several Android devices with the function of GPS and communication capabilities. This application run in the background of the mobile and collects data through the sensor of device such as GPS, time, weather, stage of

Alzheimer's patient and user feedback. Then the data will be evaluated by the Bayesian network techniques to determine the possibility of the person wandering. Depending on the probability, iWander automatically takes actions that help navigate the patient to a safe location, notify caregivers, provides the current location of the patient and call 911 [16].

The application consists of the wander detection, alert actions and automotive travel. It creates the safe zones which are identified by monitoring the GPS locations for the areas where the phone is charged for extended periods of time. If the Alzheimer's patient is inside a safe zone, the application remain transparent, but if the Alzheimer's patient is outside the safe zone, the probability of patient wandering is determined by using the Bayesian network techniques.

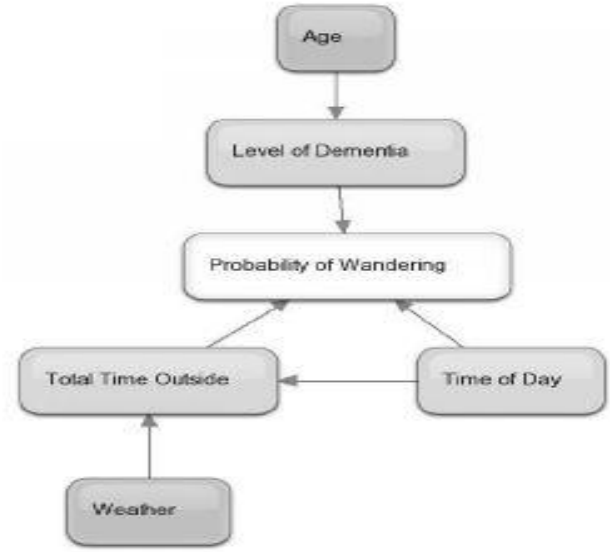


Figure 2.7 Bayesian Network [16]

The Figure 2.7 above is the Bayesian network displays the relations between the variables and how they affect the probability of wandering. If the probability stated that the patient is likely wandering, the action will be taken. Firstly, the notification will pop out to let the Alzheimer's patient give their feedback if they are safe and okay. If the patient does not respond, the GPS coordinates will give them direction to the safe zone. If there is still no respond made by Alzheimer's patient after a period of time, an alert will sent to the caregivers. The alert is used to notify the caregivers and establish bidirectional communication with the patient. The Google Voice will ring several different caregiver numbers simultaneously when the

alert is issued. If one of the caregiver answer then it will connect to patient's device and it will show the street address of the patient by using the Google Map APIs via SMS, email or web interface. In urgent case, the caregiver can give command to the patient's device to make a call to 911.

### 2.5.3 Environment-Aware System

Environment-aware system is similar like remote monitoring system for older people with Alzheimer's disease. This system consists of a device that able to monitor the humidity and temperature of the environment, patient's location and even the patient's movements. It provides the assistance to the caregivers by providing the patient's location and environment condition.

The environment-aware system consists of a wearable electronic device which able to monitor the physical activity of the older people with Alzheimer's disease, monitor their location using a GPS receiver. Then the wearable electronic device will sends the alarm messages and the information of it to caregiver's cell phone through SMS and a server. The communication of this device is through the Global System Mobile (GSM) and General Packet Radio Services (GPRS). Whereas the data that sent to the server are stored in database and can be access through a smart phone with Android application which developed in this project. The record contains the patient's personal data, emergency contacts, and the data collected with a time-stamp [17].

In this system, the wearable electronic device was developed by using an Arduino Uno board to collect the data from the sensors and GPS receiver and control the data transmission through the GSM/GPRS link. Figure 2.8 shows the structure of the program that runs in the Arduino.