
Global Positioning System as a Safety Monitor for Alzheimer's Patients

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Abstract: A huge number of peoples who are suffering from Alzheimer disease or mental and developmental retardation were reported missing every year. Thus, in order to enhance the quality of life for these particular individuals, a high quality people tracking system with low price is needed. The purpose of this project is to integrate the Global Positioning System and Global System for Mobile Communication technology for real time people tracking using Google Maps. This embedded system was divided into two parts, which are the tracking part and the displaying part. For tracking part, the embedded system is equipped with GPS, GSM modem and LPC 2138 (ARM) microcontroller for navigation purpose. The GPS provide information about the real time location of the people and sends the coordinate to the GSM modem through the microcontroller. Microcontroller used as the interface between GPS receiver and GSM modem. After receiving the location data, the data is sent to GSM modem through Short Message Service. In this project, GSM modems with SIM card used. The modem located in the tracking part serves as the transmitter and display part serves as the receiver for the GPS location coordinate. The receiving data will be sent to the control unit through the serial port. After the data processing, the location of the user can be viewed on Google Maps. The coordinate of the user is stored in a text file as well. A prototype of a real time people tracking system that will update the user coordinate every 2 minute.

Keywords: Alzheimer's, healthcare. GPS tracking, safety monitoring.

1. INTRODUCTION

Healthcare for the elderly is an important issue in the world today. Approximately 75% of the elderly suffer from one or more kinds of chronic diseases, and alzheimer is one of the most common chronic conditions affecting older people alzheimer patients gradually lose many of the skills needed in everyday life, causing themselves and their caregivers great hardship. Alzheimer is often seen as part of the normal aging process, but this thinking unfortunately causes people to miss the best time for treatment. Since the family members of elderly alzheimer patients cannot keep constant monitoring of the patients' activity around the clock, it is quite possible for the patients to go outside alone without notifying the family members, and thus, get lost afterwards. It will increase high risk and the burden on patient's family members.

The IT technologies, such as GPS, global system for mobile communications (GSM), and geographic information system (GIS) are currently being applied to safety monitoring. These technologies have been used in mechanisms and systems for locating elderly alzheimer patients outdoors, with the ultimate goal being to locate all lost patients within the golden first 24 h. In addition, high-tech systems can use visual or auditory signals to provide the elder with many types of daily reminders enabling them to live independently and safely. Mobile phone technology to develop a dual indoor safety care and outdoor mobile care system able to prevent Alzheimer patients from entering hazardous areas or getting lost. This paper contains four sections. Section I consists of an introduction. In Sections II and III, we describe theoretical model and explanation of system design considerations and applica- tion method; system construction results and data analysis and discussion. Finally, in Section IV, conclusions are presented.

2. THE SYSTEM ARCHITECTURE

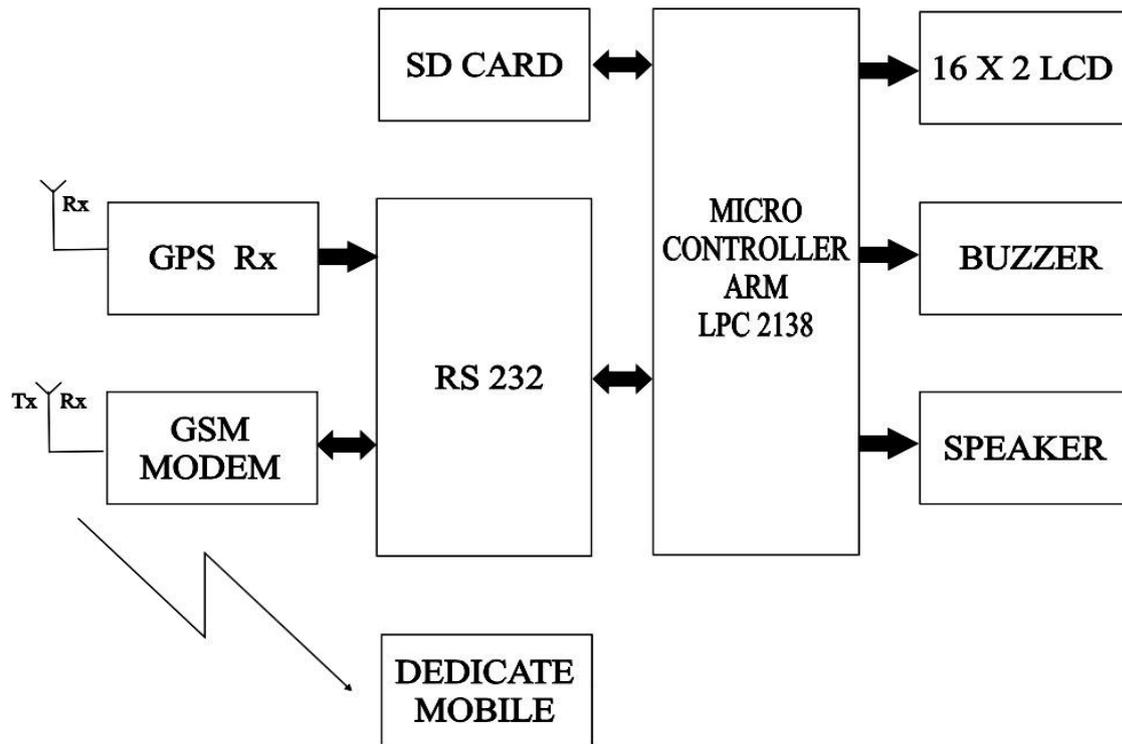


Fig2.1. Block Diagram of System

In this system work the GPS based wireless Shoes with path guidance is used. The coordinates coming from the GPS and the locations will be stored in to the SD card via the matrix KB. Also location will be stored in the form of voice. The caretaker or family member which records the name and other information about the place which can guide the person wearing the shoes (patient).

The patient wears the shoes and goes out, The Microcontroller continuously compares the coordinates coming from the GPS receiver every second with the coordinates stored in the SD card memory.

If at any place the coordinates match then for that particular place he can see the name and other details of that place on the LCD and also can hear the info about the place from the earpiece.

The system sending these coordinates to the base unit via the GSM modem .The PC receives these co-ordinates via GSM and redirects these latitude and longitude co-ordinates to the visual basic software. The VB software then shows these co-ordinates on the GOOGLE map so that we can exactly locate the location of the patient.

3. SYSTEM DESCRIPTION

3.1. LPC 2138 Microcontroller

The LPC2138 microcontrollers are based on a 16/32-bit ARM7 TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with 32 kB, 64 kB, 128 kB, 256 kB and 512 kB of embedded high-speed flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, these microcontrollers are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. With a wide range of serial communications interfaces and on-chip SRAM options of 8 kB, 16 kB, and 32 kB, they are very well suited for communication gateways and protocol converters, soft modems, voice recognition and low-end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit 8-channel ADC(s), 10-bit DAC, PWM channels and 47 GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for industrial control and medical systems.

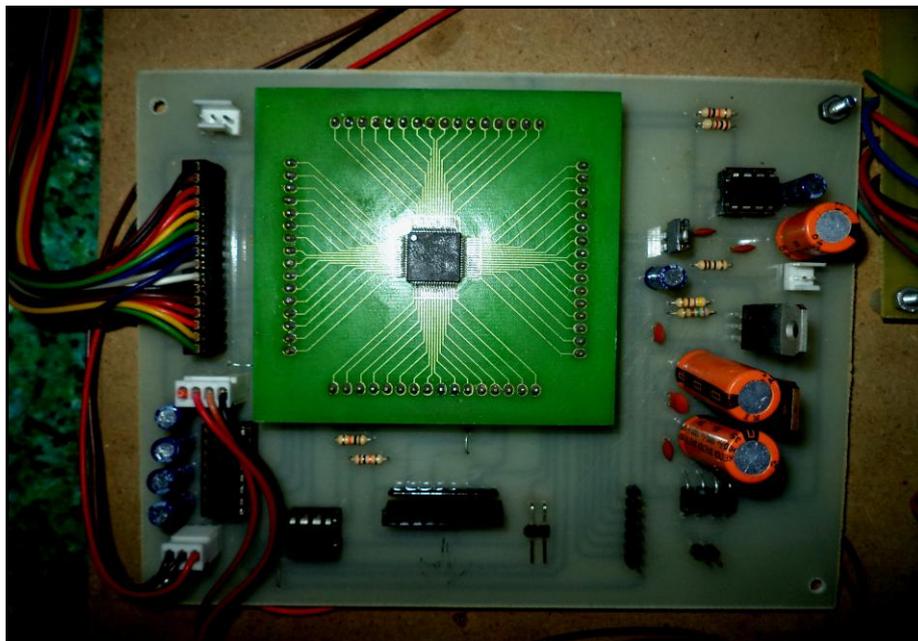


Fig3.1. LPC 2138 Microcontroller

3.2. GSM Module (SIM 300)

Design for global market, SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz. SIM300 provides GPRS multi-slot class 10 capabilities and support the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. The physical interface to the mobile application is made through a 60 pins board-to-board connector, which provides all hardware interfaces between the module and boards except the RF antenna interface. GSM Module SIM 300 is compatible with an LPC 2138 microcontroller board. Since this shield can support both of the GPS and GSM technology, it is suitable to use for tracking purpose at anywhere and anytime with signal coverage.



Fig3.2. GSM Module SIM 300

3.3. GPRS Modem (SR 87)

The ProGin SR-87 series GPS modules is ideal for any application of mobile communication where it needs to integrate with GSM/GPRS communication. It provides the wireless communication link for application such as remote data monitoring and acquisition. It is also fully supported by the ActiveXperts SMS and MMS Toolkit software[23]. The ProGin SR-87 series GPS modules incorporates high sensitivity, high performance SiRF StarIII chipset solution in a compact design. The module tracks up to 20 satellites at a time while offering fast time-to-first-fix and 1Hz navigation update. The unit is very suitable for broad applications such as Handheld, PDA, PPC or other battery operated navigation system.

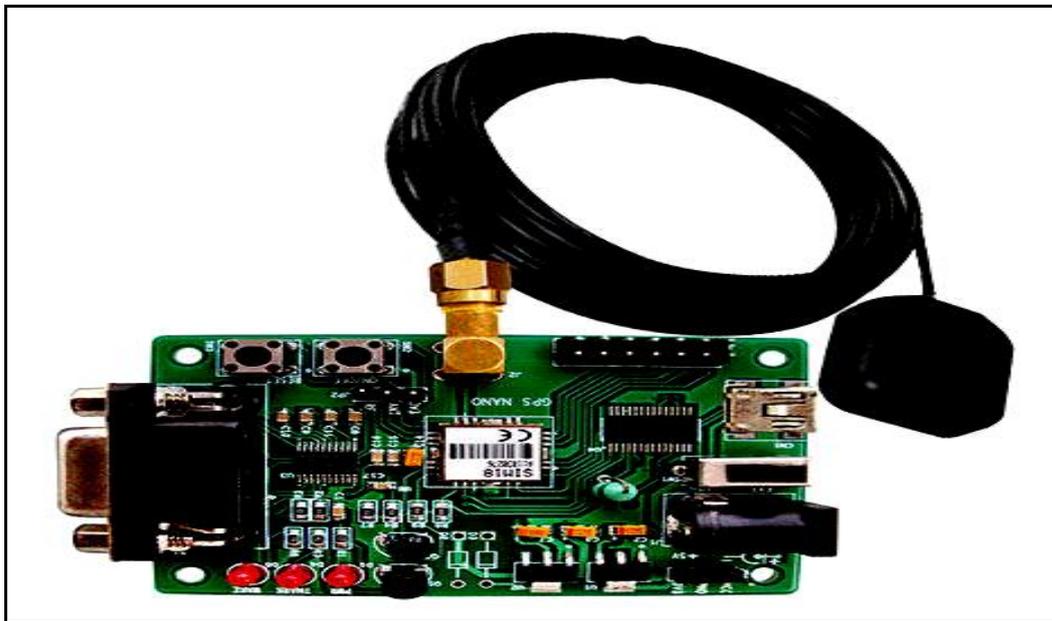


Fig3.3. ProGin SR-87 GPS Modem

4. SOFTWARE DESIGN

4.1. Embedded C

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular function. The software is installed on the controller, the brains of the electronic device. Each embedded system is used for one specific function. The C language can also use very simple commands to control the device, freeing up the limited memory of the device to hold many commands or parameters. C can be written for both microcontrollers and digital signal processors. Code is written in C on a programmer's PC. Code is run through a compiler on the programmer's PC to create a software program. The embedded system software may be run through a simulator on the programmer's computer. The software program is copied onto the controller using a "programmer." The controller is then tested on a "test bed" to ensure that it works properly.

4.2. Embedded C programming Language

In the early days, embedded software was written exclusively in the assembly language of the target processor. This gave programmers complete control of the processor and other hardware, but at a price. Assembly languages have many disadvantages, not the least of which are higher software development costs and a lack of code portability. In addition, finding skilled assembly programmers has become much more difficult in recent years. Assembly is now used primarily as an adjunct to the high-level language, usually only for those small pieces of code that must be extremely efficient or ultra-compact, or cannot be written in any other way.

C++ is an object-oriented superset of C that is increasingly popular among embedded programmers. All of the core language features are the same as C, but C++ adds new functionality for better data abstraction and a more object-oriented style of programming. These new features are very helpful to software developers, but some of them do reduce the efficiency of the executable program. So C++ tends to be most popular with large development teams, where the benefits to developers outweigh the loss of program efficiency.

4.3. Flow Chart

The design process is started by writing the source code for the tracking module and displaying module. After that, the coding for tracking part is downloaded into the microcontroller. Both of the coding for tracking and displaying parts is then tested to make sure that they meet the specification. When both of the coding fulfill the specification, the whole system is being tested to ensure it works properly.

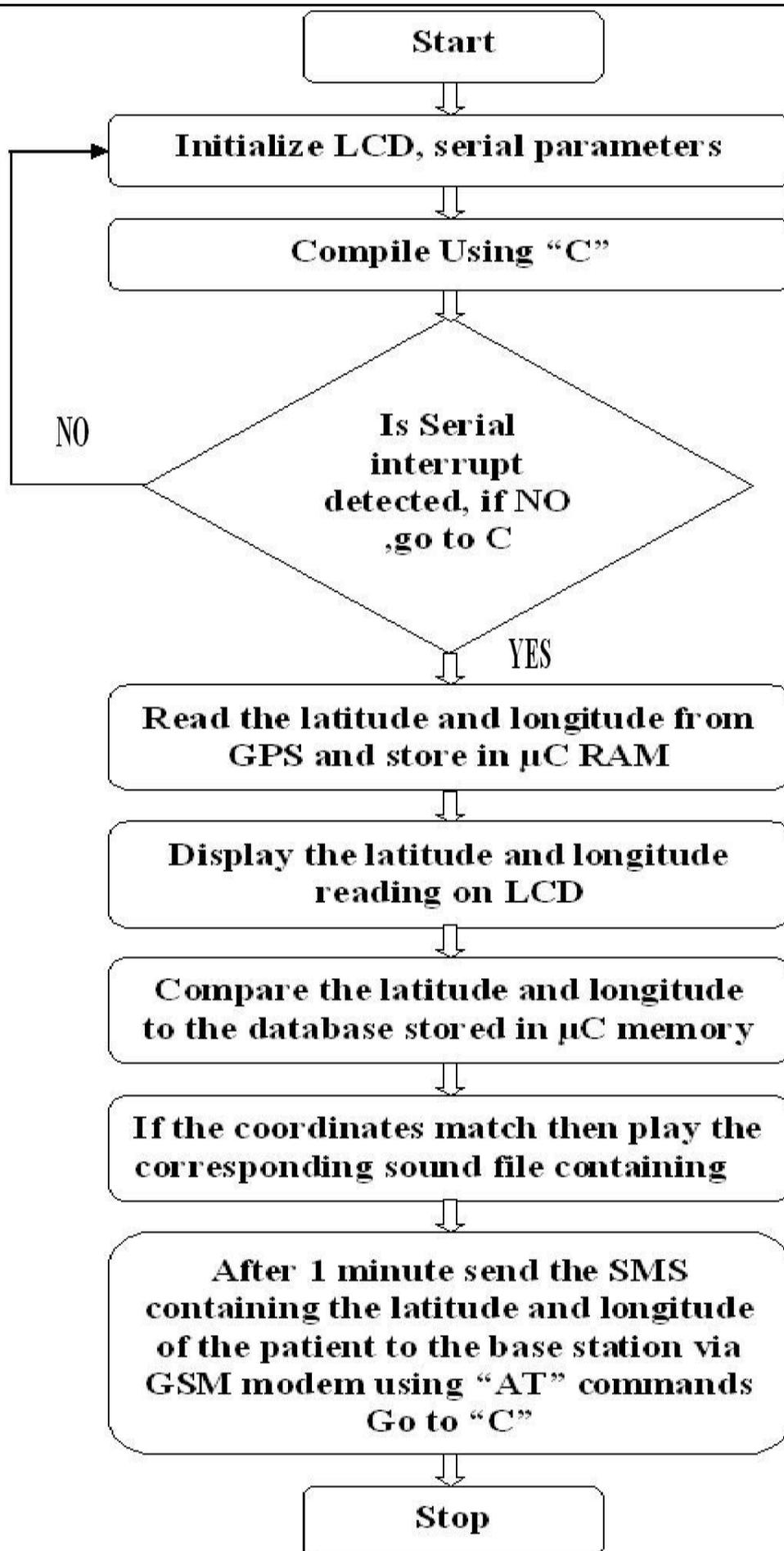


Fig4.3.1. Code Generation Flow For Assembly And 'C'

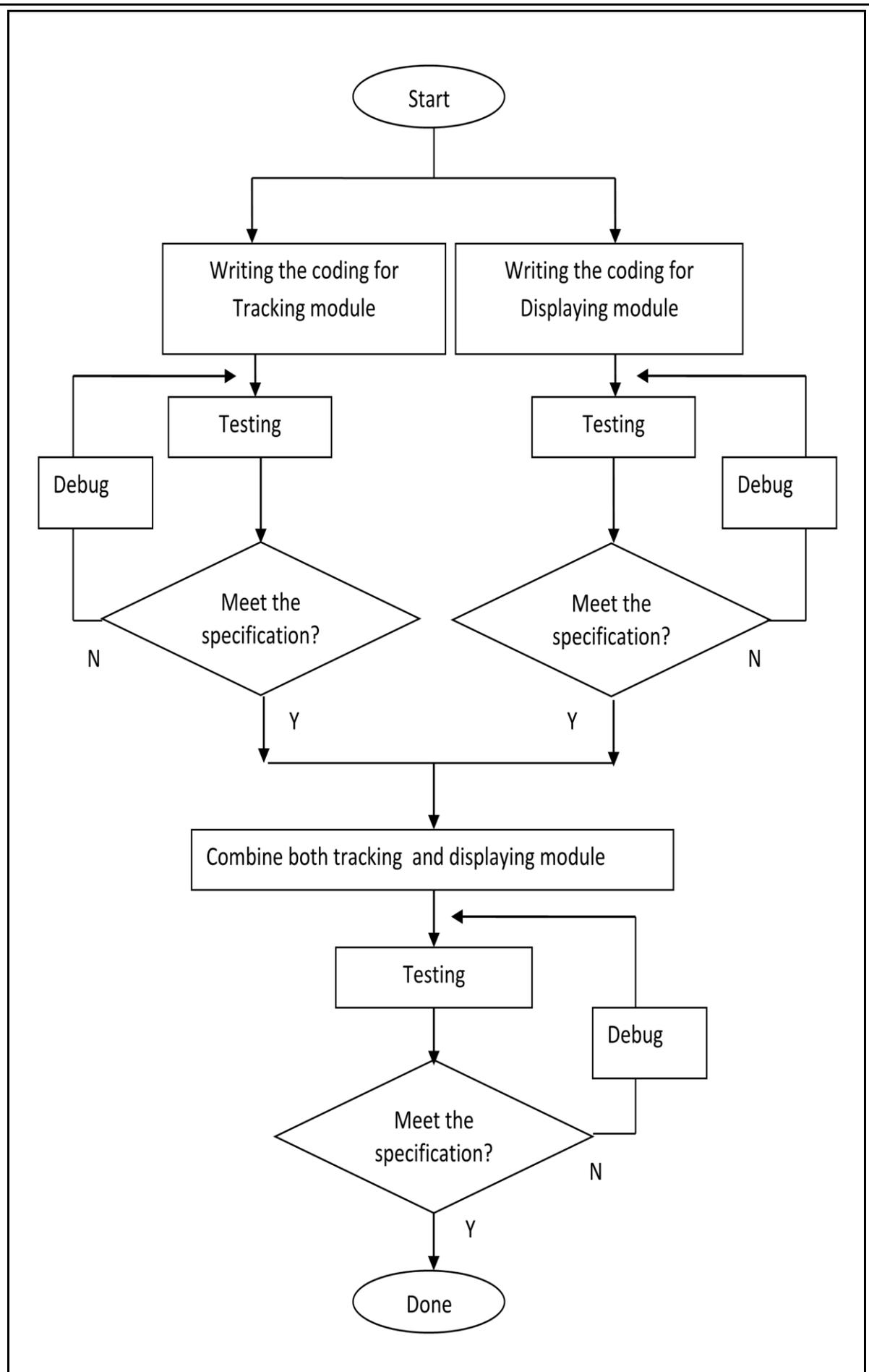


Fig4.3.2. Design flow of People Tracking System

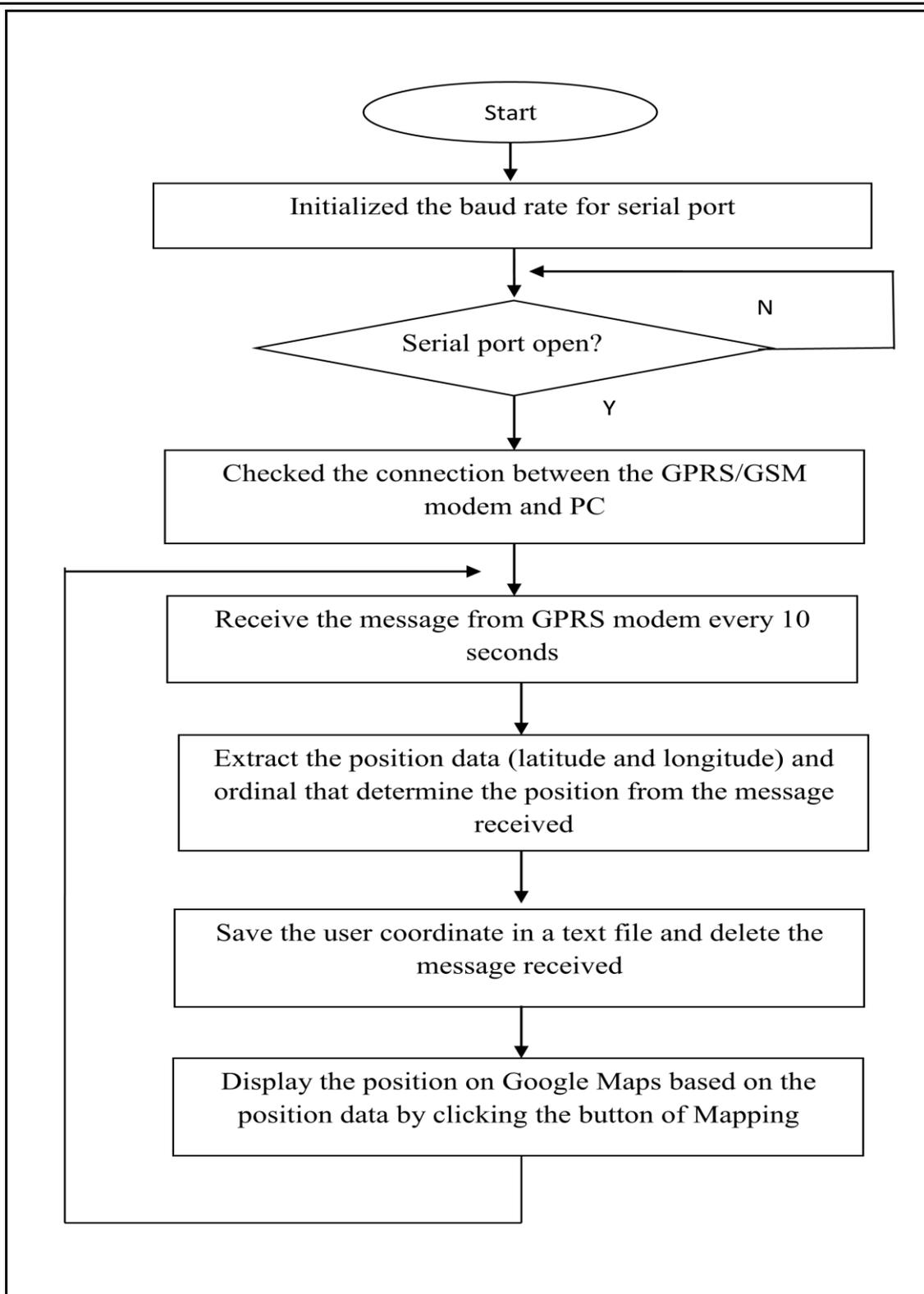


Fig4.3.3. Flow Chart for Controlling Module of People Tracking System

Fig 4.3.3 shows the flows at the displaying part for people tracking system. A user interface is creating by using a C# Windows Form.

The main form has a single serial port control that is used to communicate with the GPRS modem, two text boxes that are used to display the current position as latitude and longitude, two buttons, one of which is used to turn on and off the automatic updating of present position and the other is used to map the current position on Google Maps. Besides that, this form also contains a timer control which is used to automatically update the coordinate information that is received from GPRS modem.

First of all, there is a need to initialize the port settings of serial port. For MR 87 GPS modem, the

baud rate was set to 115200 bits per seconds, data bits was 8 bits and the stop bits was 1 bit.

Every 120 seconds, AT command is sent to GPRS/GSM modem in order to test the connection and read the message received by GPRS/GSM modem. To perform such operation, the following AT commands are used.

- (i) "AT" : To test the connection of GSM modem.
- (ii) "AT+CMGF=1\r" : To conFig the GSM modem to use the text mode.
- (iii) "AT+CMGL=\ "ALL\r": To read all the messages inside the inbox.

If the serial port does not open, a message box with the message of "Error Opening Port" will be displayed at the output. The update timer and mapping button also will be disabled, the text of the button will be altered from "Stop Update" to "Update" and "COM Port Closed" will be displayed in the text box of latitude and longitude. If the serial port is open successfully, the latitude and longitude data will be extracted from the \$GPGGA sentences which is receive from the GPRS/GSM modem every 60 seconds. The latitude and longitude information that is contained in the \$GPGGA sentence is in degrees and minutes. For example, the \$GPGGA sentences that received from GPRS modem is GPGGA, 044755.000, 0133.549709, N, 10338.571274, E, ". For third (0133.549709) and fifth (10338.571274) segment, the two digits immediately to the left of the decimal point are whole minutes and to the right are decimals of minutes. While the remaining digits are left of the whole minutes are whole degrees. The coordinates that are extracted from the string will be displayed in the text box of latitude and longitude. If the returned coordinate is valid, the mapping button will be enabled in order to display the point on Google Maps. The coordinate of the user is then stored in a text file and the message that was received from the tracking module is deleted to avoid the inbox to become full. All the messages inside the inbox is deleted by using command of "AT+CMGD=1,4\r".

4.3.1. AT Command

AT which stands for ATtension is a set of instructions that are used to control modems such as GSM/GPRS modem and GPS modem. AT command can be divided into two types, which are the basic commands and extended commands [22]. The basic commands are commands which do not have "+" after "AT", such as ATA, ATD, ATO and ATH. For extended commands, there is a "+" after "AT" such as "AT+CMGD" and "AT+GMCF". Since this work needs the operation of sending, reading and writing the SMS messages, an external AT commands which are defined in the GSM modem will be used.

Table5.1. Shows some of the AT commands for GPS modem and GSM modem.

AT Command For GSM	Function
AT + CMGD	Delete SMS message
AT + CMGF	Select SMS message format
AT + CMGR	Read SMS Message
AT + CMGS	Send SMS message
AT + CMGW	Write SMS message to memory
AT + CNMI	New message indication
AT + CSCB	Select cell broadcast SMS message
AT Command For GPS	Function
AT+CGPSIPR	GPS reset mode (Cold/Warm/Hot)
AT+CGPSPWR	GPS power control
AT+CGPSRST	Set TE-TA fix local rate

4.4. Visual Basic 6

The "Visual" part refers to the method used to create the graphical user interface (GUI). Rather than writing numerous lines of code to describe the appearance and location of interface elements , you simply add prebuilt objects into place on screen. If someone used a drawing program such as paint, already have most of the skills necessary to create an effective user interface. Visual Basic has evolved from the original BASIC language and now contains several hundred statements , functions, and keywords, many of which relate directly to the Windows GUI. Beginners can create useful applications by learning just a few of the keywords , yet the power of the

language allows professionals to accomplish anything that can be accomplished using any other Windows programming language.

5. RESULT AND ANALYSIS

5.1. Results and Analysis

The entire system is tested to ensure that the people tracking system is working well and meets the requirement. About the results that are obtained from testing the functionality of the system.

5.1.1. Tracking Module

Tracking module which consists of GPS/GSM module is responsible for tracking the current location of the user, extracting the \$GPGGA sentences and send out the signal through GSM network.

The operation of the GPS and GSM can be viewed by connecting the GPS/GPRS/GSM modem to a PC through the serial port. In Fig 4.1 shows the commands sent to GPS/GSM module for setting the GPS mode. The power and reset vector of GPS was set to High in order to turn ON the GPS power and reset the GPS in autonomous mode. Autonomous operation mode causes the GPS to receive the signal from satellite by using radio signal only, without using other network resources.

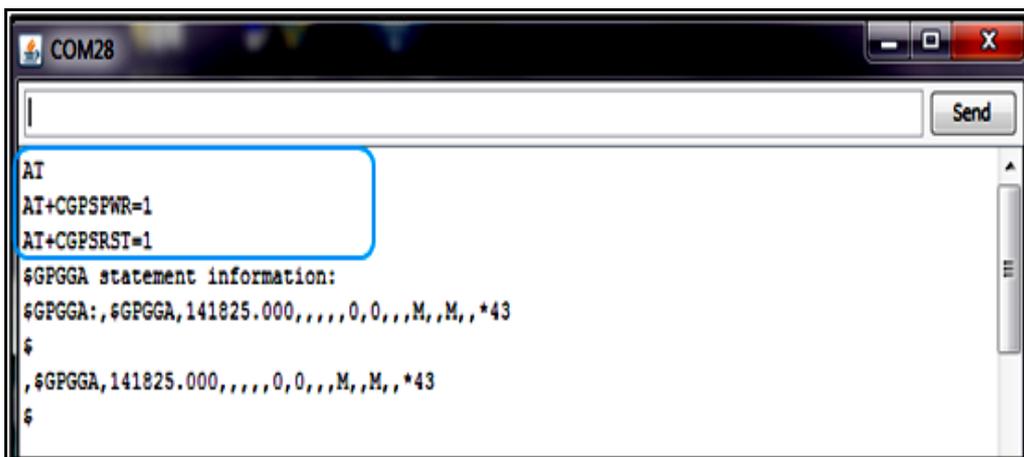


Fig5.1. Turn on the GPS Mode

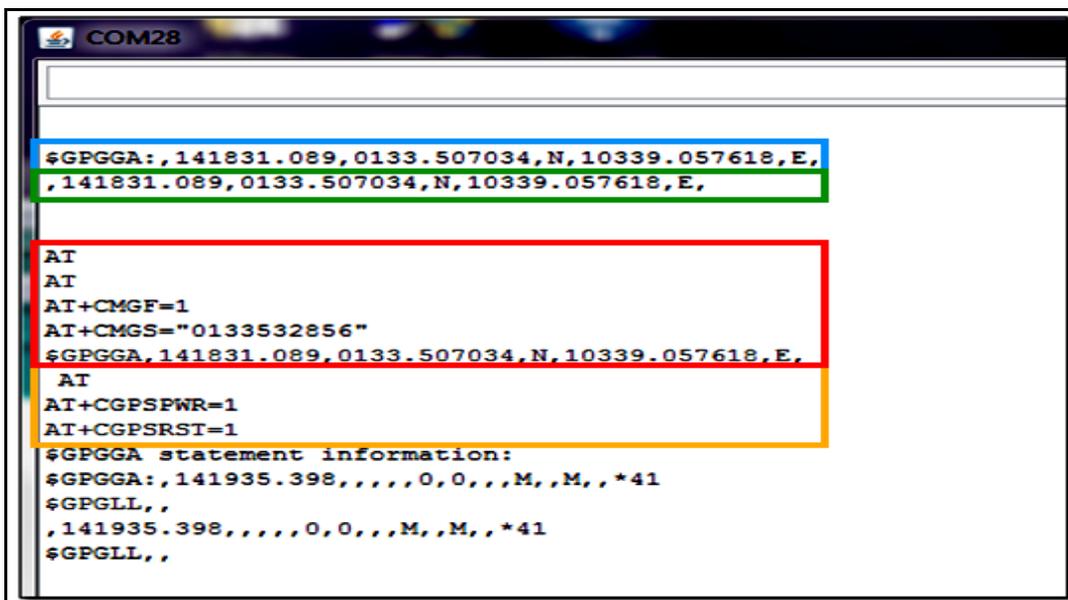


Fig5.2. Operation of GPS/GSM Module

5.1.2. Displaying Module

Displaying part is used to display the user location on Google Maps and to store this information in a text file.

5.2. Valid Coordinate

When the GPRS/GSM modem receives “AT” command which is sent by the PC, it gives the response “OK” to indicate that it was ready to communicate with PC. After that, PC will conFig the modem to use the text mode by sending the command of “AT+CMGF=1”. In order to read the messages in SIM card, AT+CMGL= “ALL” was sent to GPRS/GSM modem. Red box in Fig 4.2 shows the message that received from the GPRS modem.

The contents of the message are:

- +CMGL: List the message
- 1 : Index that specify the location SMS message in message storage area. 1 means first message.
- REC UNREAD: It is the status of the message. It shows that this is a new message that just received.
- 9421030609 : This is originator phone number that stored in the sms message header and type of the phone number.
- @??v_ : Text associate to the recipient phone number in the phone book.
- 13/12/13: Date SMS message arrived.
- 22:19:03+32 : Time SMS message arrived.
- \$GPGGA, 1652.2374,N,07411.4778,E, : Body of SMS message.

The data of Latitude and Longitude for the body message is extracted and displayed on the LCD as a text of latitude and longitude which is shown in Fig 5.3



Fig5.3. Coordinate of Tracked

After the coordinate is updated on the text box as latitude and longitude, the coordinate of the user is stored in a text file named Coordinate.txt .Fig 5.5 shows the user location in text file. The text file contains the location of the user at a particular time and date.



Fig5.4. Current Position of User on Google Maps

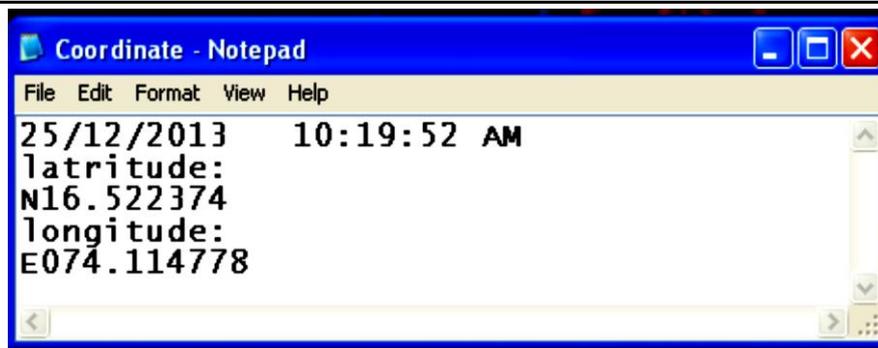


Fig5.5. User Location in Text

This text file is useful for monitoring the user. After that, the message which was sent from the tracking module is deleted to avoid inbox from becoming full. Although the message is deleted, the latest latitude and longitude still remains in the text box until the next coordinate comes in. The current location that is displayed in the text box of latitude and longitude can be displayed on the Google Maps as shown in Fig 5.4 by clicking the button "Mapping" at the main form. Furthermore, this displaying system can be stopped by clicking the button "Stop Updating". The displaying part will not receive messages from GPRS modem.

6. CONCLUSION

GPS/GPRS/GSM modem for real time tracking of people in 2D map had been prototyped; GSM modem has been implemented for receiving the information from GPS receiver and sending the message to caretaker in the form of latitude and longitude. The people tracking system is dividing into tracking module and displaying module. Tracking module is used to track the user location while the displaying module is used to plot the user location on Google Maps. The user location is updated every 2 minute.

This system is very useful for Alzheimer's Patients for monitoring their activities also tracking their position & prevents them from hazardous area. So family members or caretaker easily find patients location.

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