

# *Design of Embedded system for tracking and locating the patient suffering from Alzheimer's disease*

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**Abstract** -The proposed project is to design a system to track and locate mobile Alzheimer's disease patients who suffer from lapses of memory and concentration. Alzheimer's disease is a type of dementia that causes problems with memory, thinking and behavior and is the most common form of dementia. It is a progressive disease, where dementia symptoms gradually make over a number of years. In these circumstances, tracking and locating a patient becomes very essential. In this paper the patient carries a tracking module that when queried from the caregiver, automatically locates itself by a GPS receiver, and then relays this information to the caregiver via GSM. The system is highly useful in tracking the patient's and informing the caregivers regarding their position.

**Index Terms** - GPS, GSM, LCD, Tracking System, PSOC and Alzheimer's disease.

## I. INTRODUCTION

Alzheimer's disease (AD) is a progressively neurodegenerative disease. It is the most common type of dementia in elderly patients. Currently, approximately 5 million people about 10 percent of the population over 60, in the U.S. are affected by AD. The estimated direct cost to care the patient's is over 100 billion per year. As the population ages over the next several decades, the AD cases and the associated costs are expected to go up drastically. AD researchers have thus intensified their efforts to investigate ways to delay, cure, or prevent the onset and progression of AD [1]. Though the mortality is high for the people aged above 65, the number of people affected by the disease is more in the age group of 40-65. Thus early diagnosis is needed to have quality life. There are various risk factors which contribute to the development of the disease namely age, genetics, smoking, consuming alcohol, cholesterol, Down syndrome [2]. The symptoms of Alzheimer's diseases are poor judgment, misplacing things, impairment of movements, having problem with verbal communication, abnormal moods and loss of memory.

The elderly Alzheimer's patient encounters risk of losing their memory capabilities and are unable to live a normal life. The AD will have great impact on the behavior of the person and lot of behavioral changes may

be observed. The loss of memory makes the patient's to forget the place from where they have come and this leads to aimless wandering of patient. Finding the whereabouts of such patient's is a difficult task. So there is a requirement to design a system which helps in finding the location of the patient.

The tracking system will find effective, real time location of the patient. A GPS based tracking system will inform location of the patient, by reading the geographic positions from the Global Positioning Satellites. The system informs the caregiver using GSM. The use of GSM and GPS technologies allows the system to track patient and provides the most up-to-date information about the location. The system has a patient module and caregiver module. The patient module which resides with the patient has to be tracked. The patient module consists of GPS receiver, a GSM modem and PSoC1 controller. This module informs the caregiver regarding the position of the patient.

The remaining part of the paper is organized as follows. Section 2 describes the symptoms, Risk factors of Alzheimer's Disease. This also briefs about the PSoC controller and the existing approaches used for tracking AD patients. The Proposed design for tracking the patient is detailed in Section 3. The flow charts, Test modules and results are shown in section 4. Section 5 describes the conclusion and future work.

## II. LITERATURE SURVEY

The detection and characterization of cognitive deficits associated with age related neurodegenerative diseases such as Alzheimer's disease (AD) is the focus of growing clinical research interest as increasing numbers of people survive into older age. There is a need to accurately detect the cognitive changes that signal the beginning of a progressive dementia syndrome and to differentiate among relative disorders [3]. In US according to National Center for Health Statistics of the centers for disease control and prevention 83,495 people have died because of Alzheimer's disease [4]. There are various neuro related disorders which reduce the quality of human life. Dementia is one such disorder. Dementia takes its roots

from Latin, where *de* means apart and *mentis* means mind. Dementia is the disease of the brain causing loss of cognitive functions (reasoning, memory and other mental abilities) due to trauma or normal ageing. Brain scans are essential for diagnosing dementia. They are needed to check for evidence of other possible problems that could explain a person's symptoms, such as major stroke or a brain tumor. Dementia is further classified into various types. They are Alzheimer's disease: Abnormalities are deposits of the protein fragment beta amyloid and twisted strands of the protein tangles. Parkinson's disease: The abnormality in this disease is abnormal deposits of the protein alpha syncline inside nerve cells in the brain. Dementia with Lewy Bodies: Abnormal deposits of the protein inside the nerve cells in the brain. Vascular Dementia: Impairment is caused by decreased blood flow to parts of the brain. Front temporal Dementia: Involves damage to brain cells, especially in the front and side regions of brain. Alzheimer's disease accounts for 60-80. The symptoms of Alzheimer's diseases are Decision making, poor judgment, misplacing things impairment of movements, Verbal communication, Abnormal moods, complete loss of memory.

PSoC (Programmable System on Chip) is a family of mixed signal arrays, featuring a microcontroller and Configurable integrated analog and digital peripherals. PSoC is software configured, mixed signal array with built in MCU core. PSoC is the world's first Programmable embedded System on Chip integrating configurable analog and digital peripheral functions, memory, and a microcontroller on a single chip. Powered by Cypress's proprietary 8 bit M8C core, the PSoC portfolio of devices provides the system designer analog integration, flexible IO routing and complete control of power consumption. Supported by an integrated development environment PSoC Designer and easy to use PSoC development kits, PSoC provides the most cost effective system solution for many 8 bit embedded designs. Some of the most prominent features of PSoC microcontrollers are MAC unit, hardware 8x8 multiplications, with result stored in 32 bit accumulator, Changeable working voltage 3.3V or 5V Possibility of small voltage supply to 1V Programmable frequency choice [5].

Mohd Fadhil Abuha et.al in their paper on Tracking Elderly Alzheimer's Patient Using Real Time Location System have discussed about tracking Alzheimer's disease patients. The elderly Alzheimer's patient's encounters risk of losing their memory capabilities which may lead them to wander aimlessly. This in turn may lead to accidents. Hence, the Alzheimer's patients need to be monitored closely to ensure their safety. The system tracks all the patient's instantaneously in real time and helps in analyzing patient spatial movement for enhancing their care management. The paper provides the Active Radio Frequency Identification Localization System (ARFIDLS) is successfully supporting the Alzheimer's Real Time Location System (ARTLS) functionality. The tracking

system consists of a transponder (tags) and interrogators (reader), location engine middleware and end user application software. As a general result, ARTLS relieves the care givers burden and enhances patient's safety by closely monitoring the wandering movements of the patient's in real time [6]. The project is useful for a limited range and if the patient leaves the area, tracking is not possible.

Korhonen et.al in their paper has used a system based on the GPS, WLANS, Bluetooth, Tele diagnosis and Ascension Technology. It describes a Bluetooth enabled in home patient monitoring system, facilitating early detection of Alzheimer's disease. They take advantage of short range Bluetooth communications for in home patient location tracking, and the location information can then be recorded in a local database. With the knowledge of the movement pattern of a patient, a medical practitioner is more likely to be able to determine the Alzheimer's disease patient. They also conduct a feasibility study and the study shows that the proposed in home patient monitoring system is feasible and can be applied in practice. They proposed e healthcare solution to facilitate medical treatments to improve the quality of life of senior people and to reduce healthcare costs [7]. In this paper as authors are using Bluetooth technology the distance is limited to 10 meters. The proposed project will overcome this disadvantage.

Silva et.al in their paper have discussed about a system designed with the purpose of continuously monitoring health parameters and location of the diseased inside a building, normally in assisted living facilities. The system is designed to be worn by each patient as a necklace that senses heart rate, involuntary falls and location and automatically generates alarms. When some abnormality in these variables is detected, the sensors integrated on the necklace communicate wirelessly to a central monitoring station. This in turn communicates with a portable device that the care givers wear with them. The ultimate goal of the system is early detection of critical situations and facilitates an early intervention [8]. In this paper distance is restricted to length of the building and is taken care of in the proposed work

### III. PROPOSED METHODOLOGY

In this proposed work, a novel method of patient tracking and locating is used to track the patient suffering from Alzheimer's disease. This system uses GPS and GSM technology. This is an embedded application, which will continuously monitor a patient from its source and reports the location of patient as and when required. PSoC unit forms the heart of tracking unit, which acquires and process the position data from the GPS module. The GPS receiver of patient terminal receives and resolves the navigation message broadcasted by GPS position satellites, computes the longitude and latitude of patient coordinates, transforms it into the GSM message form by

GSM communication controller, and sends the message to the caregiver mobile via the GSM network.

The Block Diagram of Patient Module and Caregiver Module based on GPS and GSM technology are shown in Figure 1 and Figure 2. The system consists of two modules: The caregiver module and the patient module. Both the modules have been implemented using PSoC1 devices, with appropriate peripherals such as LCD, Keypad, power supply, GSM and GPS modules. Both the systems use Cypress PSoC chips, namely the CY8C28433 as controllers. The entire communication will be in the form of SMS, done via a SIM900A chips that resides on both the care module as well as the patient module.

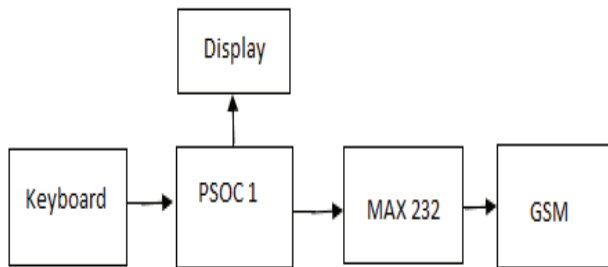


Figure 1: Block Diagram of Caregiver Module

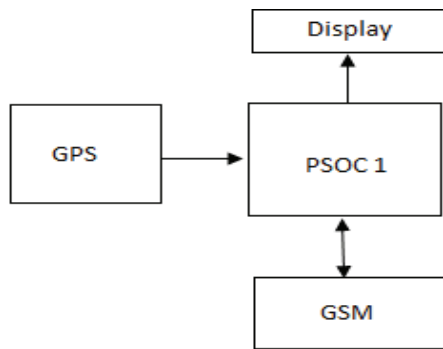


Figure 2: Block Diagram of Patient Module

Figure 1 and Figure 2 show the block diagrams of Caregiver Module and patient module respectively. Whenever the caregiver has to track the patient the care giver gives a signal to PSoC through keyboard. The PSoC sends the signal to the patient through GSM. The GSM in the care giver module receives the information and sends the signal to the controller. The controller initiates GPS. The GPS reads the information and sends the same to the controller. The controller extracts the required information and displays it on the caregiver LCD. The same information is conveyed to the patient module through GSM. In the caregivers module the number of the patient and the number from where the message is received is compared. If they match the latitude and longitude will be displayed on the LCD, otherwise it is discarded.

#### IV. RESULTS

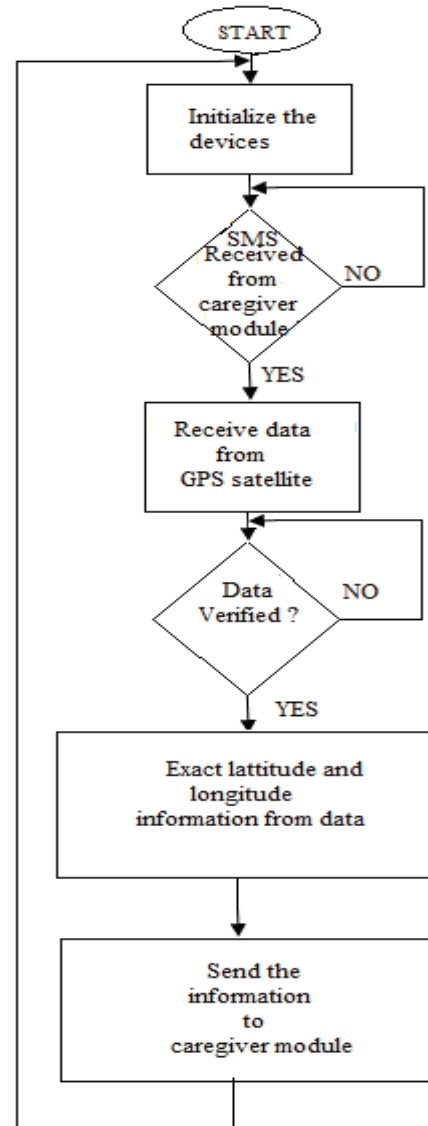


Figure 3: Flow Chart of Patient Module

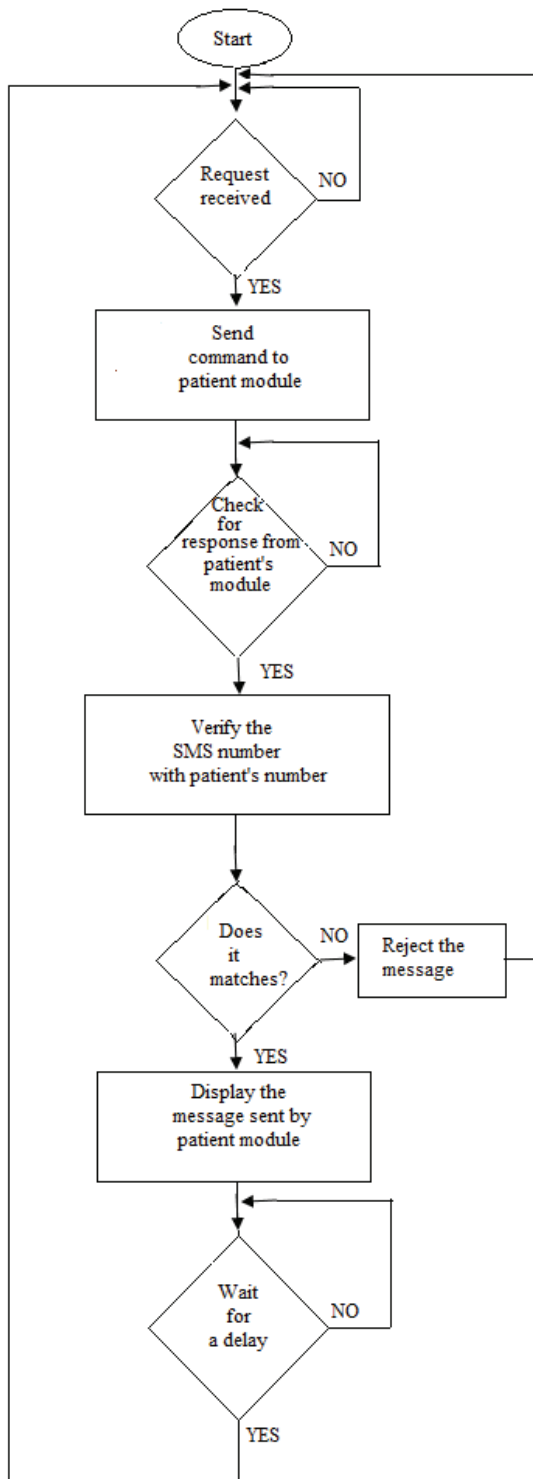


Figure 4: Flow Chart of Caregiver Module

Figure 5 and Figure 6 show the test modules of caregiver and patient respectively.

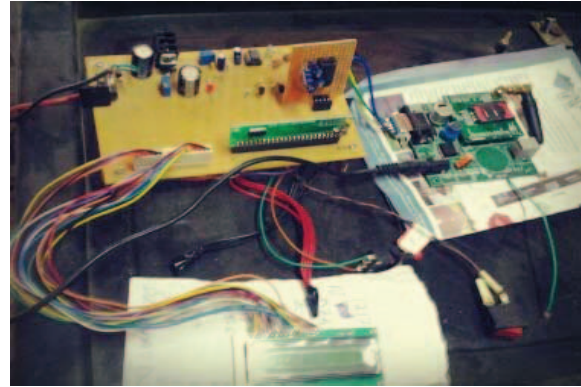


Figure 5: Set up of caregiver Module

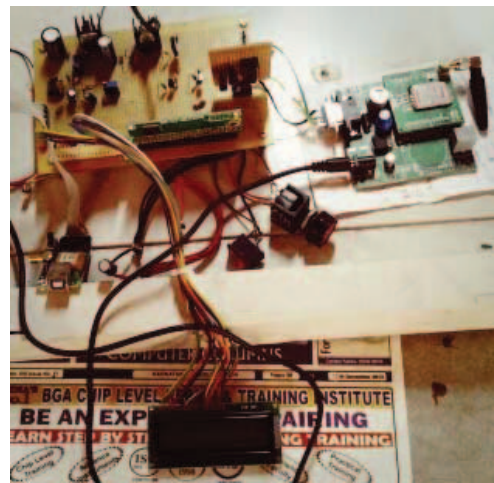


Figure 6: Set up of patient Module

The patient module has the controller, power supply, LCD and GSM module. The caregiver module has the controller, power supply, LCD, GPS and GSM module.

In this paper, we proposed a novel method of tracking and locating the patient's suffering from Alzheimer's disease by using GPS and GSM technology. GPS is a space based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. GPS is easy to navigate the exact location.

## V. CONCLUSIONS AND FUTURE WORK

PSoC1 is a mixed signal controller with configurable digital and analog resources with an onboard microcontroller. PSoC1 is the newer technology. PSoC1 provides the most cost effective system solution for many 8 bit embedded designs. Patient tracking module needs GPS to determine the patient location and tracking to which it is attached and using GSM modem, this

information can be send to the care giver mobile. This module helps the caregivers to track and locate the patient's once their absence is observed. The caregivers will be able to get information without delay.

Using of PSoC instead of any other controller makes the hardware small which in turn leads to reduction in power consumption, increase in performance.

Due to its low cost, it is very easy to integrate into other technology. A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. This method of communication allows a path to be established between two devices. GSM facilitates faster communication between the devices. The devices mentioned in the literature survey will be able to identify the location of the patient's but have the limitations of the distance. This problem is being taken care in this model.

In the patients module the GPS will be activated only after getting signal from the controller. This reduces the power consumption of the device and increases the life of the battery. This is a very useful project to mankind and people who are in need.

The future work is to design a system where by having the latitude and longitude, the location can be found using Google map.

This product is designed for tracking one patient, in the future work the number of patients covered may be increased.

The care giver module may be moved to a mobile (smart phone).

The size of the patient module circuit may be reduced by using advanced technologies.

Alternate energy sources of supply for the patient module could be investigated.

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