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Dementia Patient Tracking and Monitoring System

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Abstract

This paper presents a low-cost Dementia patient tracking device implementing GPS module for real-time monitoring and focusing on the reduction of burden on the caregivers. As our focus is Dementia, specific vital parameters monitoring were taken into account so that they give flexibility and peace of mind to the caregivers. This system has a wearable transceiver that monitors the distance of the patient from the caregiver and alerts the caregiver upon reaching the threshold. Tracking the patient beyond the threshold alert is done with the GPS module. The MEMS unit of the device performs fall detection of the patient. When a fall is detected an alert is sent to the caregiver and emergency contacts via GSM. Two vital health parameters, blood pressure and temperature of the patient are monitored and intimated to the caregiver for crucial values through GSM. The dementia population in India accounts to 3.7 million in 2020. This is expected to reach 6 million by 2040.

Keywords- Dementia, RSSI, GPS, MEMS, Blood Pressure, Temperature, GSM

1. Introduction

Dementia is a syndrome that does not have a definitive diagnosis. As dementia progresses, it can have a huge impact on the ability to function independently. It occurs when brain cells are damaged or weakened. Many mental conditions lead to dementia like, Alzheimer's, Parkinson's, Huntington's and vascular dementia. Each of these occurs as a result of damage to brain cells. Symptoms of dementia vary from one another, but typically include memory loss, speaking problems, and cognitive impairment.

Dementia is determined after physical tests and interrogations on mental health record of the patient. Cognitive tests and blood work may exclude other problems which could imitate dementia. The diagnosis can take an extended time. Since the relations or caretakers of dementia patient find it hard to maintain continuous monitoring of a patient, because the patient is prone to wander and will go outside of home without notifying the caretaker and may wander off.

It will create a burden on the caregiver to keep a continual watch on the patient. Treatment options for dementia are very much limited. While there are medications available, the effect is restricted. Maintaining a balance on physical health through exercising has proven to maintain cognition. A treatment that can reverse the process of dementia has not been identified.

According to WHO, Alzheimer's disease is liable for about 50 to 70 percent of all cases of dementia. Over 4 million people are estimated to suffer from Alzheimer's and other kinds of dementia in India, making it the third most affected in the world after China and U.S.

The idea of the project is to implement a low-cost, wearable tracking device that supports monitoring of the dementia patients. In this proposed wearable device, a highly accurate GPS module is used which can detect the patient's

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location based on the proximity to the caregiver. When the patient falls down within the proximity or away from the caretaker the MEMS sensor immediately sends an alert along with wandering patient's location.

2. Existing Works

2.1.1 Extend Lifesaver

Project Lifesaver provides a protection to the lives of the patients who meander due to dementia and other mental conditions. Patients who are enrolled to Lifesaver are given a transmitter device that is worn around their leg.

Off the chance if the patient seems to meander, immediately the caretaker calls the nearby Project Lifesaver office. A group is assigned and recuperation time is normally 30 minutes and many who meander is found within two miles from their home. Project Lifesaver works with organizations to0 address the issues related to wandering.

2.1.2. Mindme

The client can provide an alert to the Mindme circle if there is any crisis with the dementia patient. The basic gadget resembles a pendant and can be placed in a pocket or sack and permits tracking the patient online. Guardians are allowed to set a span and will be notified if the subject goes outside that span.

2.1.3 GPS Shoe

It is a rechargeable device that sends an alert to a local checking framework with the goal that guardians can track them through site. The area is refreshed and updated on a timely basis and enables to be monitored whenever. The shoes can be charged within a short span of two hours and can be charged when and where required.

2.1.4 GPS Smart Sole

The GPS smart sole can be fit into any shoes and can enable the guardians to monitor their loved ones through the sites. The equipment provides a point by point change in location of the intended patient and enables to be monitored securely to the ease of the care-giver.

2.1.5 Safe Link

Safe Link is a little device that conveys the geographic location of the dementia patient to the local servers and the care-givers. The device should be worn all the time and the sites are refreshed periodically for updating the locations.

2.2 Global Positioning System

The remarkably tinier size of the GPS modules has made it possible for implementing this technology for tracking the real time location for transportation and mobility purposes. Its accuracy has made it efficient in the field of providing the safe zones for tracking of patients with liabilities as in case of dementia. This module provides the latitude and longitude of the location with accuracy so that, it can be monitored and intimated to the care-taker.

3. Proposed Work

The proposed project involves implementation of a low-cost tracking device enabled with monitoring the vital physiological parameters of the dementia patient with mild cognitive impairment that are frequently prone to wander. It is enabled with ZigBee. The tracking module enabled with GPS is present as a wearable device(hardware module) with the patient.

The patient device is coupled to the guardian module with the help of Zigbee device. If the patient gets beyond the vicinity of the care-giver an immediate alert is sent to the care-taker and immediate circle of contacts.

Multiple vital parameters of the patient like the heart rate and temperature is measured. Fall detection of the patient is done with the help of MEMS unit. Upon fall detection the latitude and longitude of the patient is sent to the caretaker's mobile and other emergency contacts of the patient.

4. System Modules

4.1 Patient Module

This module consists of Zigbee transmitter, GPS, GSM and MEMS sensor, Heart rate sensor and Temperature sensor. The distance between the patient and the guardian is calculated by measuring the RSSI value by the RF module. If the patient steps beyond the threshold (100m) an immediate alert is

given to the guardian via the GSM with accurate latitude and longitude values. The patient module is shown in figure 1. The microcontroller is the central control for all the devices in patient module. The commands are established with Embedded C. The Zigbee module establishes a profound communication between the end modules on both sides on a wireless medium. Vital physiological parameters of the patient like the heart-rate and the temperature are monitored using the sensors and are conveyed periodically to the caregiver. When there is an occurrence of fall the MEMS detects the action and provides an immediate alert via the GSM to the guardian along with the latitude and longitude values.

4.2 Temperature Sensor

The most commonly measured and important physiological parameter, the temperature of the patient is measured with the help of the sensor by placing it in contact with the subject's body. This project implements a LM35 temperature sensor. LM35 is a precision IC temperature sensor with its output proportional to the temperature (in ℃).

It has been chosen for its features, such as direct reading in Celsius, Linear + 10-mV/°C scale factor; it measures temperatures from -55°C to +150°C range, the accuracy ±0.5°C.

4.3 Heart rate sensor

Sensor for measuring the heart-rate provides a digital notation of the heart-beat when a finger is placed inside of the sensor. This digital output can directly be connected to the microcontroller to get the value of Beats per Minute. IC LM358 is implemented in this sensor that works on the principle of modulation of light upon blood flow. It has two low power op-amps that work on bright LED and light detector. One acts as an amplifier and another as comparator. The LED source is very bright as it has to pass through the finger to the other end of the detector. When a pulse of blood flows through the blood vessels in the finger, it becomes partially opaque and less light is detected at the detector end. For each pulse of blood there is a change detected in the detector and the values are recorded as electrical pulses that are displayed digitally.

4.4 MEMS Sensor

The MEMS unit performs fall detection and the latitude and longitude values are sent to the caregiver of the patient. We are using MEMS SENSOR (MMA7600FC) is used for fall detection. This may arise due to low or high Blood Pressure (BP). With the help of this MMA7600FC, whether fall detection occurred or not is known. A secondary alert is also given to the immediate circle of contact of the patient in case of emergency.

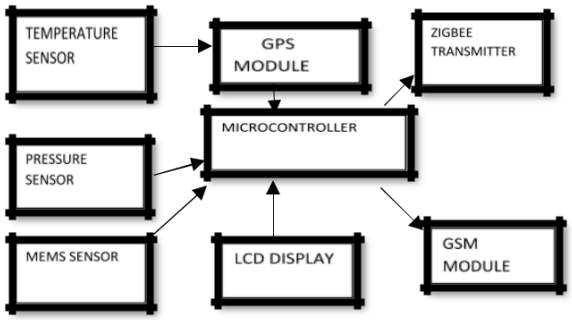

Fig 1: Patient Module

4.5 Caretaker Module

This module is implemented with a ZigBee receiver, a microcontroller and LCD. The ZigBee receiver communicates with the patient transmitter and calculates the proximity. An immediate alert is provided via the GSM when the patient gets beyond the vicinity (100m).The LCD displays the vital parameter measured from the patient. The caregiver module is shown in figure 2.

Fig.2: Caregiver Module

5. Result and Discussion

The alert is sent to the caregiver upon fall detection within the proximity of the caregiver. This is shown in figure 3.

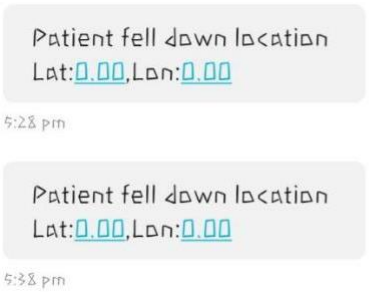

Fig. 3: Alert to the caregiver upon fall detection in proximity.

If the patient is beyond the vicinity of the caregiver an alert of the current location is sent to the caregiver and also to the immediate circle of contacts of the patient to reach out in case of an emergency. The alert message which is given to the caregiver when the patient is beyond vicinity is shown in figure 4. The Alert to the immediate circle of contact is shown in figure 5. The temperature and pressure values are displayed in the LCD display is shown in the figure 6.

Fig. 4 *Alert to the caregiver when the patient is beyond vicinity.*

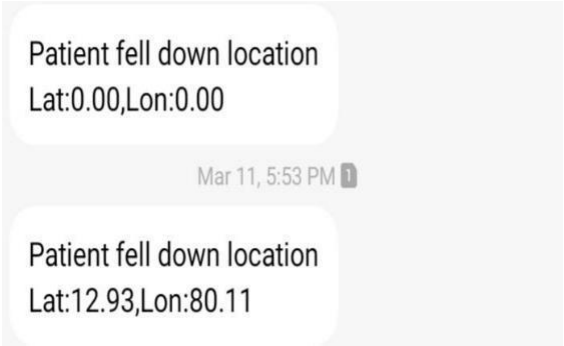

Fig.5 Alert given to immediate circle of contacts.

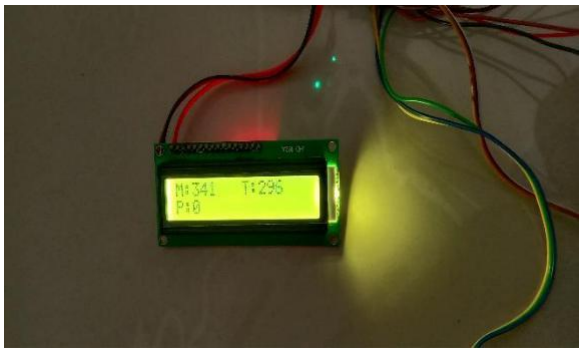

Fig.6 Display of temperature and pressure values

6. Conclusion

The analysis made in this paper has produced a easily portable and low-cost device to address the issue of meandering in dementia patients. The disadvantages of available technologies like high-cost and installation are overcome. This paper paves an easy method to monitor the activities of our near and dear ones who are suffering from this disease at low cost through an easily portable device. The merits are low cost, high speed networking, low power consumption and light weight network and broadcast communication. This device can be implemented for real time patient monitoring in elderly care, for continuous monitoring of vital parameters in ICUs and for remote patient monitoring. This can be made viable by utilization of appropriate sensors and unhindered communication between the devices.

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