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Monitoring the Health of the Alzheimers Patients and Geofencing their Location

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Abstract: ***The aim of this project is to help the care takers of the Alzheimer patients who losses their memory and have minimal sense to take care of themselves. So it is sensitive to handle them without anyone's external guidance and presence, which is not always possible in this busy world and patients may not feel comfortable under the watch out of external guidance always. So there is need for a device which will make the job of the care taker much easier by replacing that external guidance with an electronic device. This project is aiming to give the guardian, the patient's location (using Geofencing System) along with their health parameters. This will fix the boundary for the patients movement and when if they move out their boundary location, an alert message will be given to the concerned guardian. The health parameters of the patients are also lively updated in the App. Bluetooth Low Energy (BLE) location fingerprinting technique is used for Geofencing system. As our project mainly aims for the Indian busy streets, this geofencing system mainly deals with the indoor localization.***
Keywords: Alzheimer Patients, Geofencing System, Health Monitoring System, Bluetooth Low Energy Fingerprinting Technique

I. INTRODUCTION

Alzheimer disease is the most common type of dementia. Alzheimer causes problems with memory, thinking and behavior. In the early stage, dementia symptoms may be minimal, but as the disease causes more damage to the brain, symptoms worsen. The rate at which the disease progresses is different for everyone, but on an average, people with Alzheimer's live for eight years after symptoms begin. In India, more than 4 million people have some form of dementia. Worldwide, at least 44 million people are living with dementia, making the disease a global health crisis that must be addressed. Among the 4 million cases of Dementia, approximately 2 million cases are of Advanced Dementia i.e Alzheimer Disease. The risk of Alzheimer disease and other types of dementia increases with age, affecting an estimated 1 in 14 people over the age of 65 and 1 in every 6 people over the age of 80. Worldwide, the global prevalence of dementia was estimated to be 3.9 % in people aged 60+ years. In India around 2 million people are suffering from Advanced level of Dementia. Taking care of them has always been a difficult task. With the increasing work pressure, we fail to take care of them. Being a responsible human it's our duty to take care of Elders and not to make them feel trapped inside the closed area.

As the patient loses their memory, Sometimes, they may leave home for a walk and may forget the path to comeback or they may completely forget who they are and where they want to go. In such cases, keeping track of their location and activity is very important. Many systems are present to achieve this goal but they fail in some of the criteria. So this project is to design a system which monitors the health of the Alzheimer patient with optimal power usage along with geofencing system. This product is especially designed to monitor the health (Temperature, Pulse rate, and Oxygen level) of the Alzheimer patients and includes the geofencing system that limits the boundary of 100m.

II. EXISTING METHODOLOGIES

In the existing methodology, usually all the location tracing system for Alzheimer's patients are designed using GPS (Global Positioning System) , Ultra Wide Band (UWB) Technology, RFID technology.

Lot of existing products are there in the market using Global Positioning System (GPS), but this Global Positioning System can be very effective in Outdoor Localization, but when coming to Indoor Localization it fails in some aspects and especially in India, in the congested streets, it may fail to track the patients.

The RFID technology is a low power consumption technology and its cost is also very cheaper when compared to other source; but it usually senses the object/product up to 10m which is not enough for the location tracing. It also works on lower frequency which makes the product to be narrowed down in case of the coverage area.

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In Ultra Wide Band (UWB) Technology, the coverage area is higher than all the existing methodology, as it works on the higher frequency; which results in the increases of the coverage area along with the increase in accuracy. The accuracy of the UWB is about 30cm. But this hardware setup requires a higher economical input which is not possible in the existing world. Since we can't make this happen in the real world for the patients, which makes us to move on the other feasible technology that is Bluetooth Low Energy (BLE) location finger printing.

III. MATERIALS AND METHODS

A. Characteristics of Sensors

1) LM35D Temperature Sensor

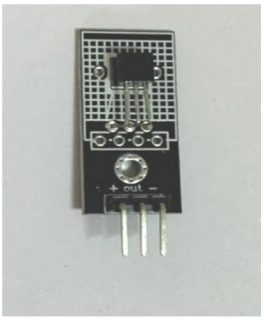

Figure 1 LM35D Temperature Sensor

LM35D sensor is used to measure the body temperature of the Patients. LM35 is the three terminal linear temperature sensor which can measure temperature from -55 degree Celsius to +150 degree Celsius. The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. It can be operated from a 3.3V to 5V supply and the stand by current is less than 60uA. This LM35D sensor works on a basic principle of increasing voltage in a diode. As the temperature increases, the voltage across a diode increases, from which could measure the body temperature of the patients.

Temperature (in mV) = (Output Voltage (in mV)/1024)*3300)
Temperature (in C) = Temperature (in mV)/10
Temperature (in F) = (Temperature (in C)*9/5) + 32
Where mV – milliVolts,
C – Celsius,
F – Fahrenheit.

2) MAX30100 Pulse Oximeter

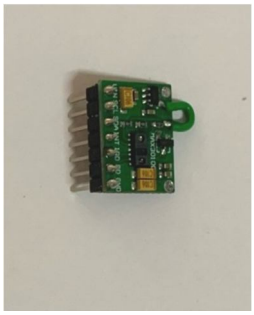

Figure 2 MAX30100 Pulse Oximeter

MAX30100 Module is used to measure the heart rate and oxygen level of the patients. The Max30100 sensor have two emitting lights, they eliminate red light and infrared light respectively. It read the absorption levels for both light sources and stored them in a buffer. When the heart pumps blood, there is an increase in oxygenated blood and when the heart relaxes, the volume of deoxygenated blood also increases. By calculating the time between the increase and decreases of oxygen rich blood, this sensor calculates the pulse rate. Oxygenated blood absorbs more infrared light and passes more red light while deoxygenated blood absorbs red light and passes more infrared light, by which we will be able to measure the blood oxygen level of the patient.

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3) NODEMCU ESP8266



Figure 3 NodeMCU (ESP8266) Module

NodeMCU is an open-source Lua-based firmware and development board designed specifically for Internet of Things (IoT) applications. It comprises software that operates on Espressif Systems' ESP8266 Wi-Fi SoC and hardware based on the ESP-12 module. The NodeMCU is utilised in this project to build a Wi-Fi connection so that we may update the detected data in the ThingSpeak cloud and the Blynk App.

Arduino Nano 33 IoT:

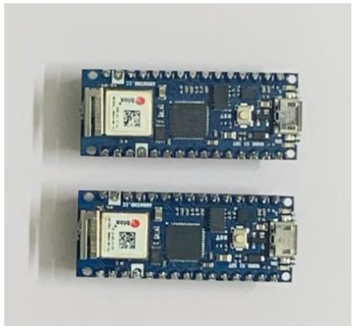

Figure 4 Arduino Nano 33 IoT

A Cortex M0+ SAMD21 CPU, a Wi-Fi + BT module based on ESP32, a crypto chip that can securely store certificates and pre-shared keys, and a 6-axis IMU are all included in the Arduino Nano 33 IoT. The module may be soldered directly to the castellated pads as a DIP component (when using pin headers) or as an SMT component (when using pin headers). It is utilised as the anchor Node in this project, and it comprises of both Wi-Fi and Bluetooth connections, allowing the distance of the position tag to be determined.

4) Arduino Nano 33 BLE



Figure 5 Arduino Nano 33 BLE

The Arduino Nano 33 BLE is a small module with a NINA B306 module based on the Nordic nRF52480 with a Cortex M4F processor and a 9-axis IMU. The module may be soldered directly to the castellated pads as a DIP component (when using pin headers) or as an SMT component (when using pin headers). It is utilised as a location tag in this project, and it has Bluetooth connectivity, from which it will produce a Bluetooth signal that may be recorded by the Anchor Node.

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IV. WORKING PROCEDURE

For Health Monitoring System the Sensors will be attached to their body in order to make connection between the body and the sensor. In this process of health monitoring system (Temperature, Pulse Rate, Oxygen Level), Temperature is monitored using LM35D sensor and the sensed reading is updated in the ArWar Mobile Application which has been developed using a platform called MIT App Inventor. Pulse Rate and Oxygen Rate has been sensed in single sensor which is MAX30100 and this readings will also be updated in the ArWar Mobile Application. As this sensed data can be updated for every 15 seconds in the ArWar App as an real time application, it can be viewed by the concerned guardian at anytime from anywhere. This App has a certain features of alertment; ie.,when any one of the health parameter of the patients goes abnormal (above or below the normal reading) their concerned guardian will get an alert message. The normal body temperature for an adult is given as 98.6 F and can be varied from 97 F to 99 F. The normal pulse rate of an adult can be varied from 60 to 85 Beats/Minute and the oxygen level can be varied from 95 to 100%.

In Geofencing System, the Location can be traced using a Location Fingerprinting technique called Bluetooth Low Energy. In this project the fencing boundary is fixed as 50m in the app. So when the patient crosses their boundary limit, the concerned guardian will get an alert message. This limitation of the boundary can be widen or narrowed according to the care takers wish and the patient's condition, but this can be altered accordingly with the help of app creator only by modifying the boundary limit in the app.

For this project we have used three Anchor Nodes and one Location Tag. In Anchor node, it has both the Wi-Fi and Bluetooth module; where as in Location Tag, it consist of only Bluetooth module. Here the three anchor nodes are deployed at the certain location of particular latitude and longitude.

Anchor Node	Latitude (ºN)	Longitude (ºE)
I	9.97019834	78.12057107
II	9.969807451	78.120648317
III	9.9697841677	78.120664922

Table 1 Position of the Anchor Nodes

The three anchor nodes are deployed as these position and it will be powered by a power source. The location tag has been attached to the patient's cloth so when the location tag will transmitting an Bluetooth signal at an time of interval. When the location tag comes under the coverage area of any one of the anchor node; it will try to establish a connection with it.

When it gets connected together, the anchor node will try to calculate the RSSI value (Received Signal Strength Identification), from which the distance has been calculated as,

V = M_Power – RSSI

Ratio = V/(10*N)

Distance = power (10, Ratio)

Where N = no. of Anchor Nodes;

M_Power = 60.

Using this distance and the trilateration algorithm, the exact location of the patient has been identified which is displayed in the Arwar App. In this module we have created a boundary of 100 m by fixing four pairs of latitude and longitude.

The boundary for the Geofencing System has been created in the ArWar App. Here for 100 m a four pair of latitudes and longitude of (9.969049 ºN, 78.120389 ºE), (9.970276 ºN, 78.119816 ºE), (9.970738 ºN, 78.121056 ºE), (9.969660 ºN, 78.121572 ºE) has been taken for consideration and given an condition that when latitude is greater than 9.969.49 ºN or else lesser than the 9.970276 ºN or the longitude is greater than 78.121572 ºE or else lesser than 78.119816 ºE, it will create an alarm. As a result it will send the alert message to the guardian that the patient is outside the boundary.

V. RESULTS AND DISCUSSION

The ArWar mobile application will be the overall output of this project which will show the three health parameters and the location of the Alzheimer patients along with geofence system.

The three health parameters which has been sensed from the particular sensors will be displayed in the ArWar App and so the guardian can get the spot time health condition of the patient. When the reading of the any health parameter goes abnormally then immediately the alert message will be give to care taker via the ArWar app.

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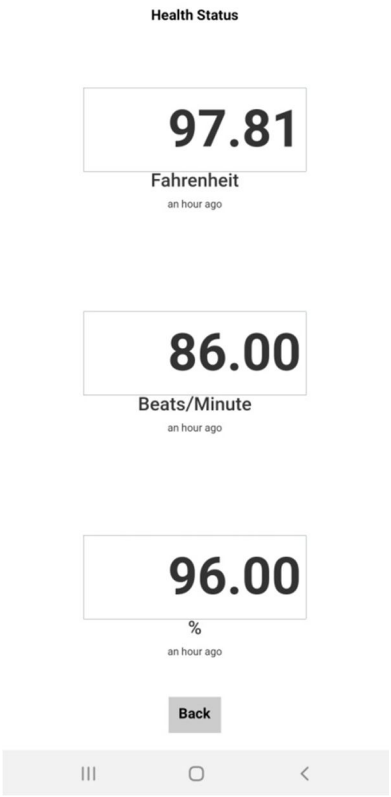

Figure 6 Health Parameters of the Patient

In geofencing the location of the patient will be broadcasted along with the alert message if the patient go out of the fencing boundary area. In this project we have created a boundary for 100m radius as the fence. We have tested the geofencing part in the Madurai with the radius of 100m by considering the latitude and longitude as our input for this project. For this project we have considered four pairs of latitudes and longitude of (9.969049 ºN, 78.120389 ºE), (9.970276 ºN, 78.119816 ºE), (9.970738 ºN, 78.121056 ºE), (9.969660 ºN, 78.121572 ºE) from which we have created the boundary. This test gave the result as the alert message to the app when the patient crossed the boundary area.

Here the patient crosses the fence, where his location is given as the latitude and longitude of 9.970012 ºN, 78.12101 E; so the concerned guardian got an alert message as “Patient is outside the Boundary”.

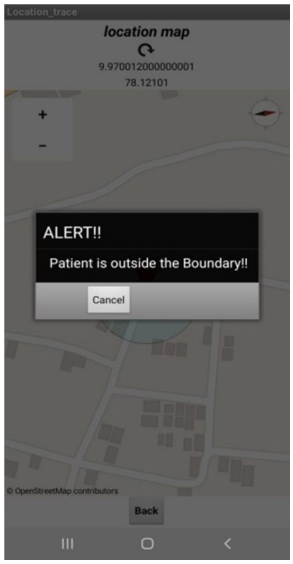

Figure 7 Alert Message in ArWar Mobile Application

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VI. CONCLUSIONS

In this work, monitoring of the three health parameters of the Alzheimer patients are successfully sensed and updated to the patient's care taker through the ArWar mobile application and also the alert message if the health parameter goes abnormal. In Geofencing part, the live location of the patient along with the boundary fixed for that particular patient displayed in the mobile app, and again the alert message has been given to the guardian of the patient.

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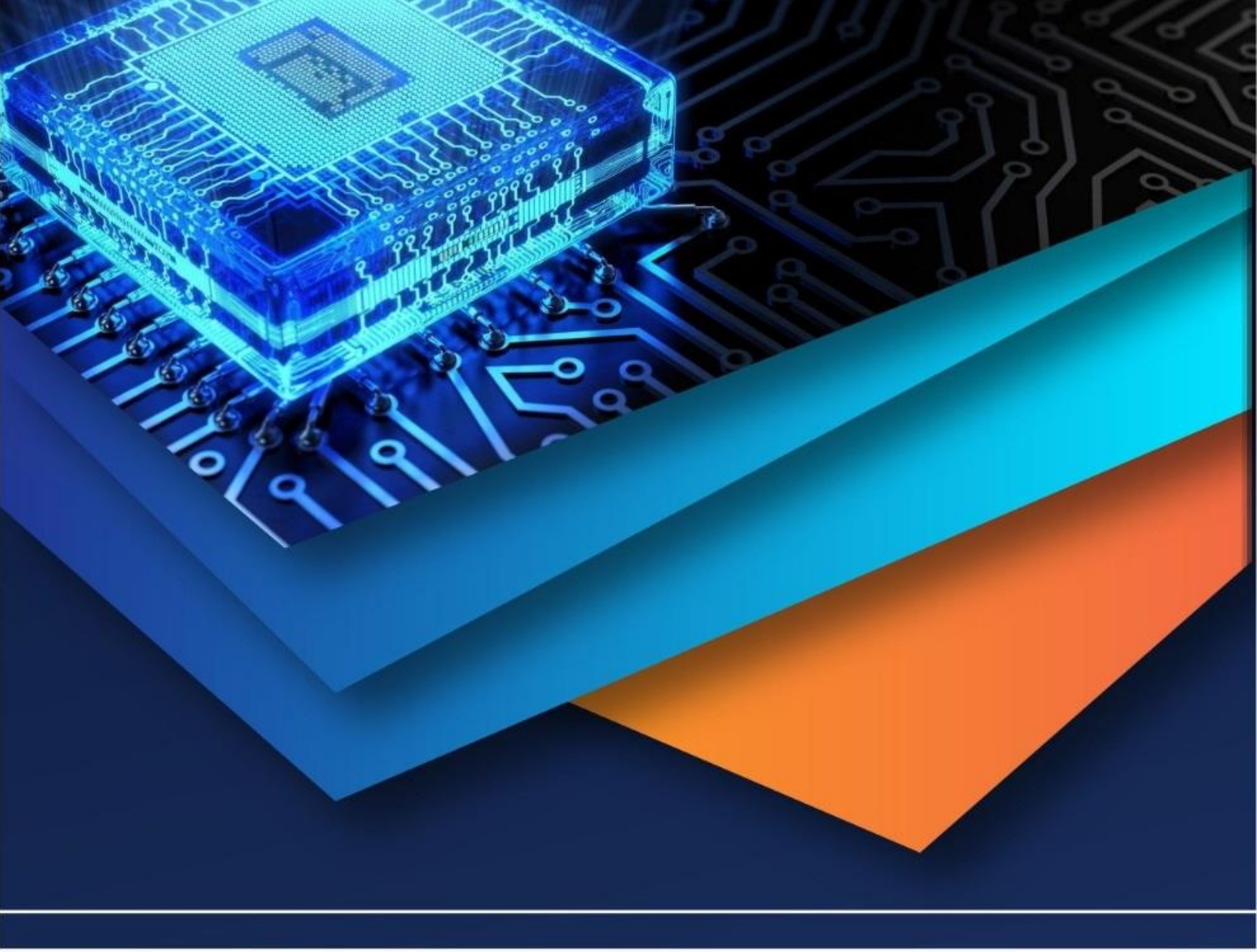

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