Innovations

Alzheimer Patient's Assistance BOT – Instrumentation Approach in Healthcare

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Abstract: *Alzheimer's is the most commonly known dementia, which is characterized by memory loss of the tolerant and changes in basic lifestyle practices. These biological conditions occur due to the inactivity of brain proteins in the brain cells, which results in shrinkage of the brain cells. Memantine is a pill prescribed to recover patients from memory loss. Consumption of memantine includes side effects such as dizziness and hallucinations. Commonly targeting the old age category, Alzheimer patients may stand aloof at times when there is no human assistance. The most needed support for the patient relies on tracking their location as they do not tend to realize their actions. To give a side-effect-free solution; an instrumentation approach is more feasible. The Alzheimer patient's assistance bot is a bio-instrumental approach that can track the patient's activity and assist them with their normal lifestyle, building trust and companionship between the bot and the patient.*

Keywords: *Alzheimer Disease (AD), Mild Cognitive Impairment (MCI), dementia, Instrumentation*

I. Introduction

Dementia is a common term used to indicate a circle of symptoms such as memory loss and problem-solving disability. One such commonly known dementia issue is ALZHEIMER'S. Alzheimer's can be categorized into three categories according to the severity of the symptoms – Preclinical, mild cognitive impairment, and severe stage [1]. In the preclinical stage, the patient may suffer from unnoticeable memory loss conditions but tends to manage things with ease. In the next stage, the patient may tend to find difficulties in working conditions and may also find challenges in remembering road tracks and simple ways to solve a problem statement. In the final stage of Alzheimer's, patients may encounter physical inabilities and eventually tend to forget their names and maybe bed-ridden [2]. Human assistance is the basic subsystem to maintain track of the Alzheimer patient's existence. Our approach targets the patients of the second stage and coordinates them in case of wandering. The assistance bot approach can eventually reduce the intervention of human assistance to continuously track the patient's activity and vital tracking.

II. Methadology:

As mentioned in Fig .1, the first step for the bot to be developed was to choose an appropriate microcontroller, the brain of the bot. We used an ESP32 microcontroller which had more feasible options and supported communication routes required for the assistance bot. The inbuilt Wi-Fi and Bluetooth support of the mentioned microprocessor facilitated the working needs of the assistance bot. The ESP32 microprocessor comes with a 448KB ROM memory and 520KB RAM [4], which satisfies the data and instruction storage requirement of the assistance bot. Secondly, route tracking is the major application of the assistance bot that includes a GPS tracker module as the tracking element within the assistance bot. Best-Search First algorithm was included in the microprocessor coding to navigate the easiest and nearest way possible to reach the home location from the displaced location. Once the connection is established between the guardian device and the Wi-Fi module of the microcontroller, an individual IP address is generated and printed on the Serial monitor of the Arduino IDE software interface (fig 4).

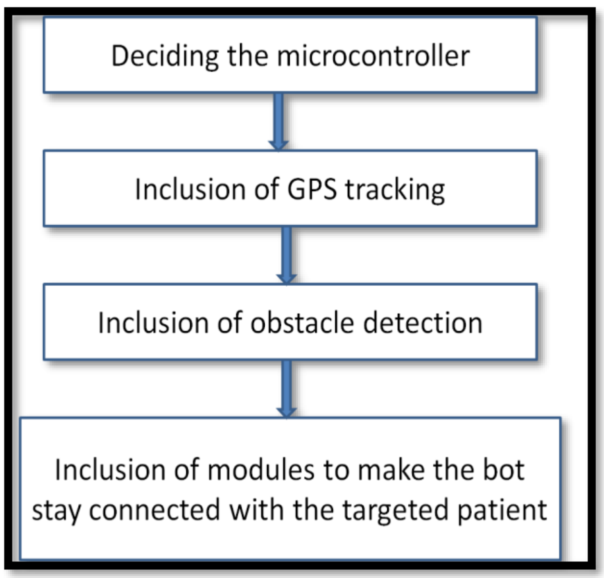

Fig. 1: design workflow for the assistance bot

We identified the latitude and longitude of the home location and set the data as the home location data in the Arduino interface coding. The GPS module we used passed the real-time latitude and longitude readings of the bot's location (indirectly the patient location is derived) to the guardian device via the Wi-Fi communication integrated into the microcontroller. As shown in Fig. 5, the IP address communication line indicates the latitude and longitude data of the assistance bot. As the latitude and longitude data is captured, the input can be fed to the Google Maps search bar to get the location place of the assistance bot that is following the AD patient.

For the system mobility, we attached a motor driver to the microprocessor that controls four motors placed to support the chassis of the model. Each motor is controlled by two input pins, and the states of these pins (HIGH/LOW) determine the direction of the motor rotation. It also includes enabling pins that pass the signal to the gear motors only when triggered by the microcontroller. To make the AD patient follow the assistance bot, we included an LED display that read "Hello –(the patient name)-, follow me to reach home" to ensure that the AD patient would trust the bot and follow it back to reach the home location.

To avoid structural damages, we equipped the assistance bot with ultrasonic sensors with the chassis of the bot. The minimum and maximum sensitivity was studied and noted to be 2-400cm detection range.

$$D=0.017t \quad [7]$$

We included an RFID Module to ensure that the assistance bot is always connected to the desired target and constantly follows the target. We connected the RFID module to the ESP32 microprocessor and the tag was passed to the target patient. The RFID module generates an electromagnetic field that powers up the respective tag handed to the target. The assistance bot with the RFID module ensures that stays in contact with the non-contact tag owned by the target patient.

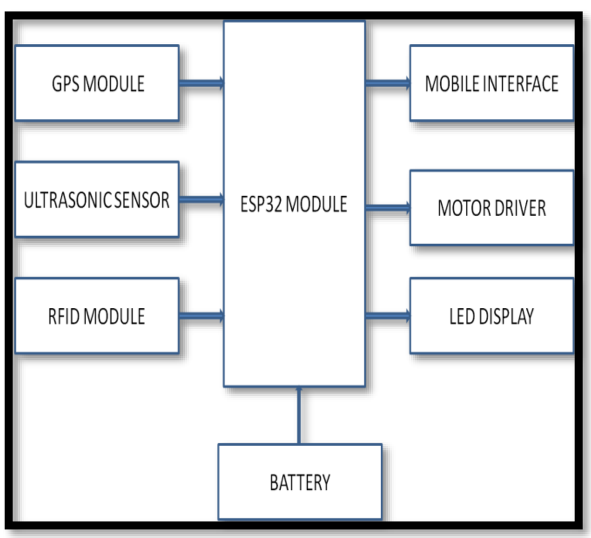

Fig. 2: Block Diagram

II.2. Software Interfaces:

Arduino IDE version 2.3.2, Google chrome search engine and Google maps are the software services used in this assistance bot. Arduino IDE is used to interface the microcontroller and the sensor inputs and outputs and to view the real time data in the serial monitor. Libraries such as TinyGPS++.h, HardwareSerial.h, WebServer.h are used to interface the modules with the microcontroller. Google maps is used to locate the latitude and longitude readings from the GPS module data sent to the guardian device via the Wi-Fi communication. Independent IP address is created for individual communication which can serve the location data.

II. 3. Integrated Working

The chassis of the bot includes gear motors attached to the motor driver that controls the wheel movements of the bot. The targeted patient is given the RFID tag that makes the AD patient stay connected with the assistance bot. We stored the threshold values of the ultrasonic sensor, RFID module, and the home location of the GPS tracker is set and stored in the RAM of the ESP32 microcontroller. Table 1 summarizes the components used with the needed specifications. As the patient makes a displacement, the RFID module ensures that the bot follows the patient. When the patient moves away from the threshold radius set in the GPS tracker, a 2m radius, an alert is passed to the guardian device, and the bot is programmed to track back to the home location ensuring that the patient is following the bot via the RFID module. For secondary assistance of trust, the LED display displays the text with the AD patient name mentioned. Constant assistance of this system is sent to the guardian device via Bluetooth and Wi-Fi communications. Fig. 3 shows the flow chart of the integrated working of the assistance bot.

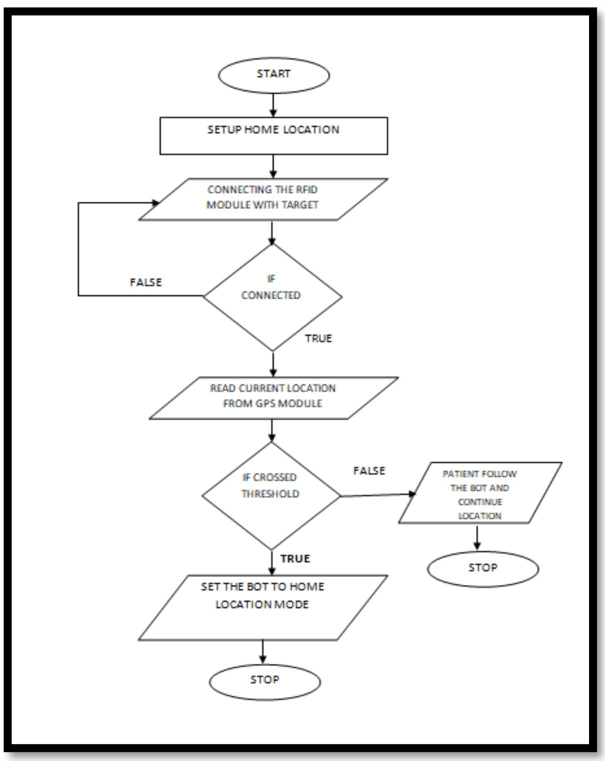

Fig. 3: Flow chart of the working

Table .1: Component list with specifications

S. NO	COMPONENT	MODEL	SPECIFICATIONS	REF
1	Microcontroller	ESP-32	448 KB ROM, 520 KB RAM	[8]
2	MOTOR DRIVE	L298N	5-35V (driver voltage)	[5]
3	GPS MODULE	NEO 6M	2.5-10m (accuracy range)	[4]
4	RFID MODULE	RC522	0-5m(signal acceptable range)	[6]
5	ULTRASONIC SENSOR	HCSR04	2-400cm (detection range)	[9]

III. Results

After the connections were made, we placed the bot in the outdoors for the GPS module to get satellite communication in the first use. Once the communication was established, we used to IP address generated by the microcontroller and loaded the same data in the Chrome search engine and derived the bot location (fig. 4,5). We used the latitude and longitude data as the feed in the Google maps service and monitored the exact location of the assistance bot that is following the patient (fig.6).

Fig. 4: IP address of the communication line from the serial monitor Arduino IDE interface

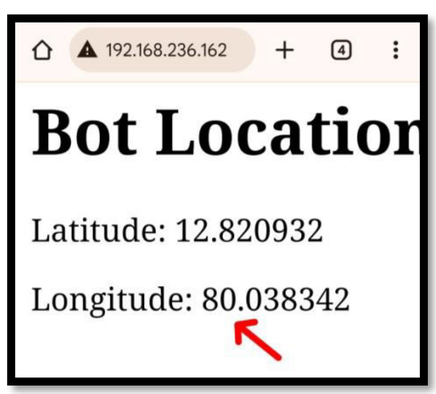

Fig. 5: Latitude and Longitude readings from the GPS module communicated via the unique IP address.

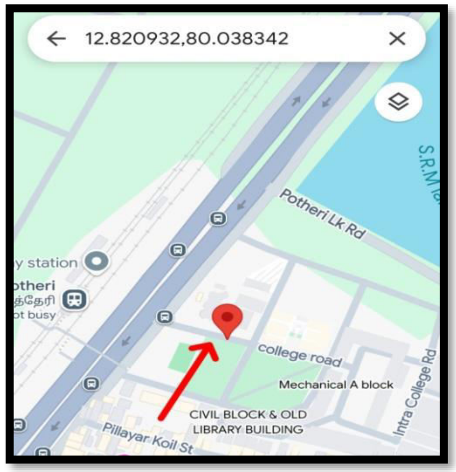

FIG: 6: Location of the coordinates of latitude and longitude marked in the Google maps

IV. Future Scope- Devloping the Human – Bot Trust:

Approaching the medical state and the dementia of the MCI Alzheimer patient, building trust and interaction between the assistance bot and the patient is a major concern. Mild cognitive impairment patients tend to have translucent memory loss and can eventually gather it back via constant revision of major details [3]. For example, the assistance bot can explain the landmarks of the patient's travel path and can revise them back which can help the target patient to recollect their path to reach their destination. Sometimes the targets fail to recollect their fellow being names and in the worst case, they even fail to recollect their own identity. To tackle such discrepancies, the bot can be supported with an image processing technique which is sufficiently supported by ESP-32 as a microcontroller [. As a result, the bot can support the patient in case the patient fails to recollect names.

Dealing with the mental state of the patient when they are left wandering, chronic stress can trigger the patient. In such conditions, bringing back the patient to normal is the key task for the assistance bot. Recalling the target patient's name and introducing the bot to the patient can assure the patient of chronic stress [10]. Principles of cognitive computing can be included in the bot model to add a chatbot design within the bot which can communicate with the target person reduce their stress levels and help in recovery of their translucent memory loss cases [11].

V. Conclusion:

Thus a bio-instrumental approach for the assistance of Alzheimer's patients is proposed and the need for such a system is inevitable as the recent studies depict the increase in count of individuals with Alzheimer's. This approach can reduce the medicinal side-effects and also reduce the human aid for care. Future extensions of this technology may intervene in cyber-security as it includes location data that may result in dynamic inevitable situations. AI algorithms that can speed up the home location backtracking can be introduced to make the bot make its own decision to bring the patient back to the home location in the easiest way possible. The inclusion of a speaking assistant that can communicate and store the patient's details will increase the chances of memory-loss recovery of the patients.

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