Smart Assistive Aid for Cognitive Decline Patients

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Abstract: Since many years, physical ailments have always been given more importance with respect to assistive technologies and for good reason. But this has led us to ignore mental health which is equally important. The stigma associated with mental health issues and the lack of awareness, results in worsening of the condition. Dementia is seen as a progressive condition, currently being detected in an increasing number of people. Thus, the relatively modern approach of overseeing and monitoring the activities of the dementia people creates a revolution in the assistive technology realm as it provides the patients the option to be self-dependent at their own habitat. The project proposes a new solution in the form of a smart wearable device, which is small, cheap to cater the need for in-home care of elderly patients. This device allows older people to live independently, in spite of the risk of forgetfulness or delusions. Using IoT, the project integrates the device with online cloud computing using ThingSpeak which stores and processes the data from the RFID and GPS sensors. Complex Process Analysis is performed on the data collected to predict possible ailments or future actions of the patient. This helps doctors deliver timely treatment and families to check in on their loved ones. Using IFTTT, the project aims to notify the patients to follow their daily routines and reported to their physician. Thus, by analyzing real time visualized data and monitoring 24/7, the smart device ensures good quality independent living of elderly dementia patients

Index Terms: GPS, Cognitive decline, RFID, Sensor.

I. INTRODUCTION

A majority of our world's population consists of people aged over 65 years, and among these adults nearly 18 million are diagnosed with dementia. It has also been estimated that this number will reach 35 million by 2050. The patients show symptoms of progressive cognitive deterioration and hence find it difficult to complete daily life activities. This forces them to hire a professional caregiver or permanently shift to a nursing home. Since patients are made to decide between staying at home and the inability to live independently, the introduction of assistive technology in their home environment will prove to be a savior. At the higher end in terms of cost, smart homes use sensor data along with machine learning and data mining to make intelligent decisions regarding the people under consideration. This project focuses on all ranges of assistive technology available for the elderly suffering from dementia. By monitoring the person's activities, the project has been able to predict their future tasks and actions thus enabling the people to stay at their homes for longer without the need for an external caretaker. Sensors are the basic foundation for these types of smart homes as they are used to capture the patient's movements and interactions with their surroundings.

Using these sensor data, learning is carried out using their behavioral patterns which in turn enable us to provide customized assistance for completing daily life activities. The most common problem arising and which motivates to pursue this project is a multi-inhabitant home, where the patient lives along with other family members. Thus, importance has been given not only to the activity being performed but also to the person performing it. Ability to distinguish the person under study from the others enables personalized decision making that solely depends on the patient's behaviors. Possible solutions to this problem include precise arrangement of sensors around the house and using video monitoring that may overcome the multi-inhabitant problem. Analysis of the behavioral patterns of the person under study can also help distinguish them from their co-inhabitants. However, along with these solutions, questions on practicality, efficiency, and privacy arise. Steps have been taken to tackle these problems as well in the form of snowflake data models to represent the activities' sensor data. Further a learning algorithm is built to derive the behavioral patterns of the inhabitants in a probability distribution format of their activities over various contexts. These patterns are then used to assist the patients complete their daily life activities by predicting their most likely action and partially observed sensor data. We prove novelty to the fact that the project comprises hardware that helps patients care their everyday routine but the other findings. That makes the project more interesting and taking assistive aid to next level for mental health.

II. SYSTEM MODEL

The block diagram represents the different stages during the execution of the system. The input is read by the microcontroller through RFID and GPS module. The RFID reads the tag value to verify that the tag is possessed by the patient and hence the behavior is monitored. Now, the GPS module converts microwave signal to satellite signal to detect the exact location based on the satellite. Also, this RFID and GPS is interlinked where the boundary detection is done by RFID and after crossing the defined boundary the GPS gives the information. The output of these data will be sent as a notification to users mobile. The target users will be made to easily understand the data through visualizing the output exactly needed at the moment.

Fig 1. Block Diagram

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The NodeMCU is connected to RFID and the RFID is connected to GPS through the interlink of NodeMCU. The RFID works on all condition, but for GPS module works only when it faces a clear sky. So, it gives location anywhere outside the patient's house which takes care f not only In-home elderly care but also during situation such as

Doctors visit, Shopping, so forth and so on. The NodeMCU is connected to a laptop through a micro USB cord as is essential. Connection to the internet is quintessential in this project, as information gets communicated to the cloud server for analysis in real time.

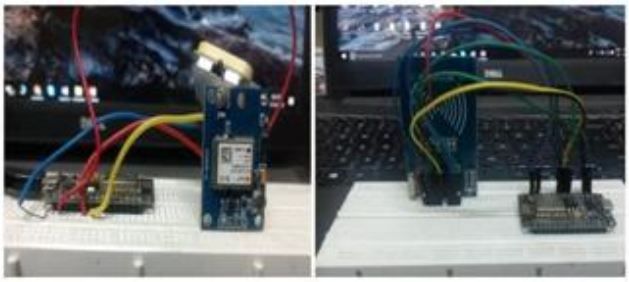

Fig2.Working Model

All the components used are very cost-effective, enabling an easy and economical approach to the problems stated.

III. SPECIFICATION OF THE COMPONENTS

A) Node MCU:

Fig3. ESP 8266

It is a WIFI enabled shield which can be comfortably accessed Arduino IDE. The term "NodeMCU" is basically ESP8266 Module with

0.9 and 12E versions. ESP can be programmed using Java script, CPP and Lua.

B) RFID:

Fig 4. RFID

An RFID is a Radio Frequency Identification technology which works with the help of radio waves. This technology is used to identify the objects such as books in a library, car, ID card etc. An RFID tag is attached to the object which is used to track.

C) GPS:

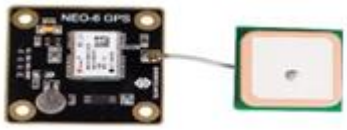

Fig5: GPS MODULE

GPS is used to locate places that are not really far away especially for this purpose of application. GNSS abbreviates to Global Navigation Satellite System, used as term for satellite navigation systems that provide geospatial locating on global scale.

The GPS firstly works in a clear sky view. When the GPS is setup, microwave signals are transmitted to GPS. Once the satellite signals are used to spot the exact latitude and longitude of the place. The receivers takes in the signals from many GPS satellites at a same time. These radio waves are electromagnetic energy that travels at the speed of light. So, a GPS can give both real-time and historic data. There are passive and active GPS. Passive can be used to the store location data based on events. Active helps finding the real time location that is sent to the central system. These data obtained from a passive GPS system can be stored in micro SD card. Now, the data can also be pushed through wireless medium to the cloud storage for further process or analysis.

IV. PROGRAM ALGORITHM

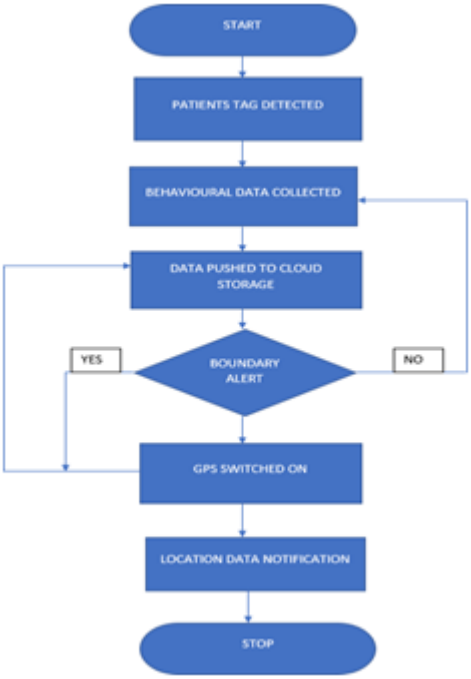

Fig 6. Algorithm of the Integration

The Arduino IDE was used to interface NodeMCU ESP 8266 with the computer in order to run the program. Arduino IDE can be used by customizing it for ESP 8266 by installing the required libraries and making certain changes in the specifications of the connectivity.

The algorithm flowchart of the code is shown above. Furthermore, provisions are also made in the code to detect RFID data and GPS Locations efficiently.

V. OUTPUT

(A) Sensor Triggered output to the client:

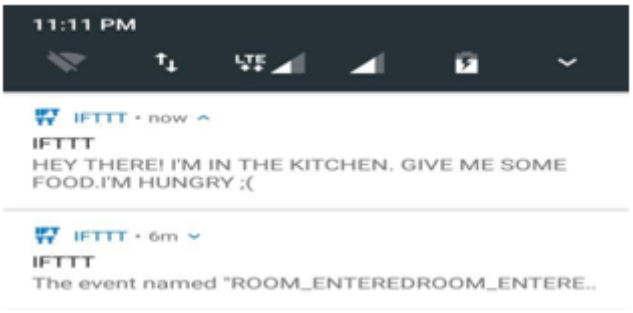

Fig 7. Output for various rooms entered at house

The figure 7 shows the screenshot of the program on the NodeMCU in different rooms entered at client's house. As it is noted from the Serial Monitor of the IDE.

Fig 8. Graph representing the entry to rooms

This system, as shown in figure 8 sends periodic mobile alerts to the client to keep him updated. It also provides an extensive graphical analysis of the number of times the client enters the different rooms.

```
Location: 12.973897
80.184536
  Date/Time: 2/11/2019 03:12:12.00
Location: 12.973897
80.184536
```

Fig. 9. Serial monitor output for GPS Location

This output is shown using the sensor data of location on the basis of latitude and longitude. This visual data helps to find the patient exactly at the place he/she is at.

Fig 10. Mobile notification for GPS Alert

Figure 10 represents the output in mobile notification to make the alert at the users end. This visual data helps to find the patient exactly at the place he/she is at.

The fig shows the reminder for tablets. It can be customized to remind the patient to have their breakfast, lunch, snack and dinner at proper time intervals to maintain a healthy lifestyle.

This reminder for tablet will be set to 6 hours interval where the patient is reminded to take their pills every 6 hours will the prescribed name and color of the pill if they couldn't differentiate between them. Here, again depending on the medical requirements, the time intervals can be customized.

By practicing the habit of taking food and pills on time, the problem of worsening might delay or even the possibility of getting better by health might increase.

Besides this, the fact that there is no involvement of caretaker in this process is a big advantage as there is no need to set reminder for everyday manually like a normal alarm clock reminder available in mobile phones. This reminder works until it is programmed with a different routine.

This can also be useful to anyone despite just the elder people, to take their vitamin supplements or any kind of supplements they are prescribed, apply lotions, skin care routine, remind daily work routine etc.,

As future work, the patient can also be monitored to check if they have actually followed through with the remainder and taken their pills/food etc. If the event doesn't happen within a stipulated time, the caretakers can be informed of this to take further steps to persuade them to do the action.

Later on, there could be an NLP used to recognize and understand the language spoken by the patient to read out or Text to Speech in technical terms which would allow users from diverse land of languages to understand the alerts and make them feel at ease.

This the test output which is later being customized to an actual patient's tablet list.

VI. CONCLUSION

Recent times have seen a tremendous growth in the domain of Internet of Things (IoT), wearable technology, cloud computing and sensor networks. Thus, this project provides improved services by collecting and processing huge amounts of data, analyzing and evaluating complex scenarios, identifying potentially dangerous situations and providing solutions. The project proposes the usage of assistive technology to oversee and monitor patients in the following stages:

- Providing the caretakers better information to allow them to better adapt to the gradual decline of the patient's health condition and also to sudden changes like fractures from falling down.
- Provides information to the researchers about the intersection between many ideas of the patient to create more assistive aids for their care.
- The strong skeleton to integrate components integration providing the assistance needed with splitting the resources to further improve the assistive care.

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