Extended Aid to Alzheimer and Dementia Patients using Novel Wearable Technology

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ABSTRACT

In India, Alzheimer's is becoming prevalent as the country continues to grow with the enormous population. Also, more than 4 million people in India suffer from some form of dementia [21]. The gravity of this situation makes Alzheimer's and Dementia disease an emergency mental health issue must to be addressed.

Till now the research directions are directed towards enabling technology assistance for patients' suffering with Alzheimer's and Dementia in mainly two ways: Assisting in day to day life and Helping in memory recall and reinforcement. The third major challenge to be addressed is monitoring 'Wandering Behavior'. It is observed in study that among many other challenges related to monitoring and offering care to Alzheimer's and Dementia patients, wandering behavior is the most challenging to manage.

In this work, a wearable jacket for location tracking in order to keep track of patient is proposed. The objectives of proposed work are: Implement visual display for assistance, implement easy to carry and maintain wearable, aid caregiver and patient and offer user friendly interface

General Terms

Artificial Intelligence, Wearable Technology, Assistive Technology, Mobile based Technology, GPS tracking, Internet of Things

Keywords

Dementia, Alzheimer, wearable jacket, location monitoring, GPS tracker, assistive technology, mobile based technology, wearable technology.

1. INTRODUCTION

People with dementia and Alzheimer's disease often require assistance in managing day-to-day activities. Following points help to comprehend the depth of difficulties faced by Alzheimer's patient:

- Getting lost in one's own neighborhood
- Forgetting who one's family members are
- Forgetting what kind of car, one owns

Forgetfulness is major challenge to handle in life of Alzheimer's or Dementia patient and his/her caretaker. Forgetfulness may often result in patient wandering off which is major cause to institutionalization of patient. Worldwide, around 50 million people have dementia, with nearly 60% living in low- and middle-income countries. Every year, there are nearly 10 million new cases. The estimated proportion of the general population aged 60 and over with dementia at a given time is between 5 to 8 per 100 people. The total number of people with dementia is projected to reach 82 million in 2030 and 152 in 2050. Much of this increase is attributable to the rising numbers of people with dementia living in low- and middle-income countries [1].

In solution to address this problem and aid the patients, a wearable jacket for location tracking and provide assistive technology is proposed. The jacket will have GPS tracking mechanism and display screen to display Name and address of patient, in case of emergency. Also, this jacket will have panic button. When user pushes this panic button, the alert notification will be sent along with display of name, address of patient, current location information, stored images of family member's or caregivers.

2. SIGNIFICANCE OF THE STUDY

The technology assistance to dementia and Alzheimer's is broadly divided under three different categories:

1. Assistive Technology
2. Mobile based Technology
3. Wearable Technology

Different forms of technologies that could be useful for person with memory impairments for different purposes such as daily life, safety.

For example, some forms of technology assistance in daily life are as follows:

Automated prompts and reminders
The reminders forms are varying from playing a pre-recorded voice prompt for reminding medication time or doctor's appointment to using motion sensor to remind action to be performed. The sensor-based reminder could be found helpful in reminding closing the door, turn off the equipment and so on.

Tracking of the day and date
To keep track of the day and date, there are lots of products available. Automatic calendar clocks can be helpful to show both the date and day of the week along with showing whether it is morning or evening.

Medication Aid
Automatic pill dispenser proves helpful in assisting to remind to take medication on the right day and at the right time.

Communication aids
Pre-programmed telephones, video calls could support people with dementia or Alzheimer's to stay in touch with others.

Some other applications using technologies for safety are as follows:

An alarm system
When someone has moved outside a set boundary, an alert goes on.

Location monitoring services
It includes watch-based devices, smartphone apps to locate and keep track of the person. Bed occupancy sensors, Door and Window sensors could be useful in monitoring location of person.

Technology for caretaker
It is also important to offer technology support for those who take care of patient. Reminder, Auto pill dispenser with messaging service, video monitoring, Motion Detector with electrical appliances to alert on/off state of appliance proved helpful for caretaker.

The mentioned technologies make an Alzheimer's or Dementia patent's life manageable up to certain extent. The assistive technologies are further enhanced by using smart phone technologies along with wearable device.

3. REVIEW OF RELATED WORK

The typical symptoms of cognitive impairments in different stages of Alzheimer's includes [2]

Table 1 Different stages of Alzheimer's

Alzheimer's Stage	Symptoms
Mild	• Progressive loss of memory • Declining in cognitive functions • Misplacing of items
Moderate	• Disorientation of time and place • Poor or misjudgment • Problems with abstract thinking • Difficulties in carrying daily activities
Severe	• Change in mood, behavior, personality • Depression • Barrier to communication • Aimless wandering

In work of Lauriks S. et. al.[3], author discussed requirement of persons with dementia, as follows:

Table 2 Needs of persons with dementia

Need for General and personalized information on
Dementia
Service Offerings
Legal, financial issues, on care, support services
Personal condition, care appointments and care planning
Need for Support with regard to symptoms of dementia
Emotional support for people with dementia
Support for people with dementia and caretakers with regard to behavioral and psychological changes and how to cope with them
Need for Social contact and company for the person with dementia

The above two table shows that technology could play vital role in meeting demands of health and social care of Alzheimer's and dementia.

Technology allows elderly population suffering from memory impairments in maintaining quality life. Different forms of technology including assistive technology, smart phone-based technology and wearable devices are enabling improved help to Alzheimer's and Dementia patients and their caretakers. One of such apps is 'Alzimio' [4] which includes Safe-zone Geofencing, activity-based alarm; take me Home feature, Check-On-me features. With Safe-zone Geofencing, it is possible to keep track of user's location by determining whether user is within the fences or outside. User's home address is saved on app and with the help of Google Map; user can be navigated to home. Parodic safety check is performed under Check-On-Me feature where timer is sunning in background and triggers messages at present intervals.

Another experimental study named 'VALMA' [5] discussed the set up comprising of Smart phone and accelerometer on each ankle. The project aimed to monitor activity related to physical, social, intellectual, and sleep. Accessing the everyday activities under mentioned domains will help to recommend exercise, sleep, and social involvements to avert and slow disease development.

Aimless wondering is one of the symptoms in sever stage of Alzheimer's and major concern of caregiver. The LaCasa-Location and context aware safety assistant [6] proposed decision theoretic model to estimate risk face by dementia sufferers by learning wondering patterns. In other attempt, a novel personal guidance system based on passive RFID tags [7] proposed. The design of system is based on spatial navigation and includes PDA and tracking systems. The prototype of system is implemented at campus of Chung Yuan Christian University, Taiwan. The other approach researched for wayfinding based on spatial navigation is based on Bluetooth Beacon [8]. Personal wayfinding is achieved through Bluetooth beacons and ID scanning. At remote server, wayfinding sequences are established by identifying position of user by reception of Bluetooth beacon. User senses Bluetooth beacon on his handheld PDA to receive guidance with the videos just in time.

The mPCA- Mobile Patient Care-Giving Assistant offers indoor tracking system [9]. This smart phone app assists patients to overcome difficulties in carrying out daily activities with the help of reminders, orientation, and context-sensitive teaching, and monitoring. A tool named WanderRep aimed to help both the caregiver and the patient to be protected against possible vulnerabilities [10]. The app is design in layered manner including layers for Patient Mobility, Distributed Database, Machine Learning, Service, Caregiver Mobility and Client Database. An iWander app uses the user's social network as a monitoring service for remote monitoring [11]. This android application collects data from the android phone sensors for location, time, and weather. The app also records stage of dementia and take user feedback. The collected data is analyzed using Bayesian Network to determine whether the person's wandering probability. If person is wandering, application navigates person to safe location, notify caregiver, and call 911.

The wondering behavior is analyzed to map GPS trace of person in the work of [12]. With method name as θ_WD to detect outdoor wandering pattern in real time. In experimental work of [13], the location tracking system based on telemetry is proposed where GPS receiver is worn by patient and family member or caregiver could call and able to view location of wearer on map showed on CRT. The variety of location

tracking solutions are offered and few studies are conducted to evaluate effectiveness of offered solutions such as in work [14], prototype is created and evaluated for improving care for dementia. A mobile app with prime functions such as locate, call, alarm, service hotline and two secondary functions such as zone mapping and zone sharing served as locating system. Table III shows technology assistance available for Alzheimer's And Dementia

Table 3 Applications available for Alzheimer's And Dementia

Application	Features
Timeless[15]	AI enabled face recognition
	Smart Phone App
	Memory Reinforcement
Dementia Day Clock[16]	Clock to display date and time with related view
	Assistive Technology
	Daily Routine
Safewonder[17]	Wearable sensor to raise alert when wearer wake up from bed or chair or far away
	Wearable Technology
	Location Tracking
Mindme Locate[18]	Wearable GPS tracker to send alert when wearer move out of safe zone
	Wearable Technology
	Location Monitoring
PocketFinder[19]	Wearable GPS tracker
	Wearable Technology
	Location Tracking
AngelSense[20]	Wearable GPS tracker to monitor router and send text alert
	Wearable Technology
	Location Tracking

4. SYSTEM ARCHITECTURE

The proposed wearable jacket will have on sleeve display along with GPS tracker and control board. Following figure shows system representation of proposed work.
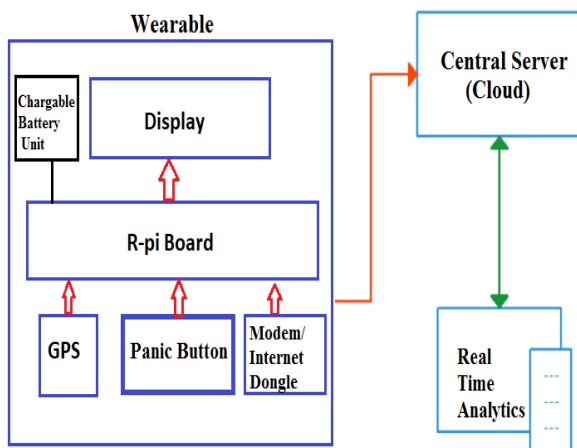

Figure 1 System Architecture

Wearable Unit:

This unit comprises of Raspberry Pi board, GPS tracker, Modem or Internet dongle, push button and touchable screen type display.

Figure 2 Wearable Jacket with in built tracker and display unit

Data Processing:

The data from the control board is sent to cloud-based server which will be analyzed real time. On server, image module is running which will be called on press of trigger button. When location message is sent along with that name and address of patient will be display.

Setup Interaction:

1. GPS tracker enabled Raspberry Pi board will track location of user. The location will be sent in real time to server.

2. At server, user's usual visiting locations are stored. The location data will be verified with data of stored location.

3. If user location mapped to regularly visiting location, then timely notification will be sent to registered mobile number of family member/caregiver. But if mapped location appears to be different than stored location, then emergency alert will be sent to registered mobile number of family member/caregiver and emergency help services.

4. When alert notification is sent along with that on name and address of user will be shown on wearable's display.

5. In case of situation when user will find himself/herself lost, there will be panic button to push.

When user pushes this panic button, the alert notification will be sent. Also, on wearable display, the name and address will be flashed. In parodic interval, information of location and images of family members/ caregiver will be display.

5. CONCLUSION

The result and discussion of study certainly concludes scope for future development. The trend of wearable technology heavily depends on wearable GPS tracker in different forms. In proposed work we extend scope of wearable location tracker to not only notify location of wearer but also display name and address of patient for emergency assistance and provide panic button for emergency assistance.

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