DEMENTIA PATIENT MOVEMENT DETECTION AND FALL DETECTION USING SMART PHONE TECHNOLOGY

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ABSTRACT

Now a day's worldwide millions of people are suffering from Dementia and the cost associated with the disease is extremely high, with the majority being incurred by provision of care for these individuals. This project aims to design and develop a Smartphone application to help those with memory disorders (Dementia). The aim is to help patients retain their independence, whilst reducing the demand on care givers as well as providing patients freedom of independently walks outside. The project will cover research on current GPS solutions as well as available Smartphone technologies; it will also examine the benefits of exercise in slowing down the loss of cognitive function and show how a Smartphone based solution can help to ease multiple problems for dementia patients and their care givers simultaneously. The project will also detect fall detection of dementia patient with the help of newly advanced mobile sensor technology.

Keywords - ***Dementia, Android, Smart Phone Technology, Alzheimer's Disease, Fall Detection, Movement Detection, Tracking***

I. INTRODUCTION

A Dementia is the loss of cognitive functioning. This effects the person's daily life and activities such as the ability to think, remember and reason. Alzheimer's disease, the most common form of dementia, is progressive and slowly destroys the brain limiting functionality, decreasing quality of life and eventually leading to death. In these days' smart phones becoming the ubiquitous, all over the world everyone is now connected. Mobile is the computing device which is widespread use by most people around the globe, in developed country and developing countries also. So we are focusing to use mobile as assistive technology. Assistive technologies are continuously being developed and utilized to help those suffering from dementia perform tasks, which they would not normally be able to perform. These technologies can make vast differences to the quality of their lives, such as prolonging the length a Dementia patient can live in their own home and help them to independently complete certain tasks which otherwise they would have forgot.

During the last decade, mobile phones have been witnessing many improvements in their computing power, memory size, and the number of sensors embedded in the device (e.g. GPS, accelerometer, magnetometers). Meanwhile, location-based services (LBS) have also been gaining an increasing focus. Most of those applications depend on either using GPS or network (GSM or WiFi) -based localization techniques to estimate the user's location, that is why we choose mobile devices as our main equipment to track and keep alerting to care taker in regular interval of time.

Classification of human movements is very useful in several application fields such as to evaluate the quality life of disable and or elderly person, in sport applications to evaluate the energy expenditure. Many organizations and universities are continually researching ways in which Smartphone technologies can be used to create cheap and functional assistive solutions to improve patients' lives as well as reducing strain on their carers. For all these applications the basic tool is the triaxial accelerometer, possibly with other additional sensors, to measure other vital parameters. Accelerometers are very useful because they are very small, low cost and easily available as integrated devices. Since the measured acceleration include both the gravity and the inertial components they are suitable for measuring postural orientations as well as body movements. Obviously the use of accelerometers only is not sufficient to carry out the monitoring of a human subject and for this purpose it is necessary to employ other information and communication technologies.

Our study is mainly focusing on assisting dementia patient in his day to day life activity, Tracking him regularly and giving his location update to care taker person. Also we are performing fall detection. Here in section I we are giving brief introduction about dementia and its symptoms. In section II we are giving information about related work in this area. In section III we are giving project Idea and related information. Finally, in Sec. IV, we are focusing on challenges that need to face and In last we are giving conclusion.

II. DEMENTIA AND IT'S SYMPTOMS

A Dementia is not a single illness. It is a group of symptoms caused by specific brain disorders. The most common cause is Alzheimer's disease, but dementia can also be the result of a stroke or mini-strokes. The main symptoms are:

1. Loss of memory – such as forgetting the way home from the shops, forgetting names or places, or being unable to remember what happened earlier in the day.
2. Mood changes – because of damage to parts of the brain that control emotions, people can become frightened, angry or sad more easily.
3. Communication problems – a decline in the ability to talk, read and write.

Dementia is progressive – the symptoms will get worse over time. Although there is no cure, treatments can slow the progression of the disease, and there are ways of helping to keep it manageable. Definitely we need a care taker to keep watch on these dementia patients, and to make healthier life of dementia patient we all focusing on technology to help us.

III. RELATED WORK

The Today, there are an increasing number of technological devices on the market to help in the search and rescue of people with Alzheimer's disease or a related dementia who have become lost, whether from a home, long-term care residence or other location. There are pros and cons to each of these "active" systems, and no one service can guarantee that an individual can be found or found unharmed every time—underscoring the need to deploy all possible prevention methods to stop elopement from occurring in the first place. However, since the majority of people with Alzheimer's disease will wander away at some point during the disease, possibly despite the best precautions taken, systems should be in place to aid families and law enforcement in the event that a situation mandates a search and rescue.

Approximately 70 percent of people with Alzheimer's disease receive care at home. Noting the potential market, more companies have been developing technologically-advanced systems aimed at ensuring the safety of the person with dementia and the peace of mind of the family caregiver. Given the importance of ensuring the safety of residents in long-term care facilities as well, these systems—even if not marketed as such—can also be used for persons living in these types of settings.

3.1 Related Work in Tracking and Locating Dementia

While most of the available products share some similar characteristics, there can be distinct differences among them regarding:

- Underlying location technology (i.e., GPS, cellular, radio; and potential signal transmission problems);
- Degree and type of communication (i.e., instant or time-specific alerts; notifications to or access by one or multiple contacts; call, text or e-mail alerts);
- Hardware (i.e., hand-held or wearable; size and weight; user-activated; battery life; risk of removal; waterproof/water-resistant);
- Location tracking (i.e., constant, regular intervals, emergency-only; consumer/law enforcement involvement);
- Involvement of third parties that assist in notification and search and rescue, such as call centers or law enforcement;
- Cost (i.e., device, activation fee, monthly monitoring fee, other products like chargers, batteries);
- Ongoing support (i.e., call center, affiliation with private company or nonprofit organization that provides training for public/law enforcement, and education or other resources to caregivers); and
- Accuracy of location and success rates for search, rescue and safe return.

These entire technology products helping dementia patient to relieve stress, and helps to then in proper functioning of day to day life activity.

3.2 Related Work in Fall detection

As we all focusing on fall detection of dementia patient, there are already so much work done to find out human movement detection and fall detection. While previously different approaches suggested to detect fall and monitor patient. CCTV cameras, the cameras are used to keep eyes on dementia patient and to monitor him regularly. But as cost associate with this equipment is high, this approach is quite expensive. Second approach is to make use of accelerometer sensors. Sensors are attached with body; so each time patient moves or if there is sudden change in his activity against to gravity it detects that movement and based on algorithmic approach it detects fall. Above discussed technology comes in category of non-wearable and wearable devices.

Current fall detection systems generally use one of the below methods for sensing a fall condition:

- Image recognition can be used to detect fall condition by placing cameras at overhead positions, thereafter tracking and learning movement patterns. The system becomes adaptive to the locations where a single human enters the room and remains stationary (conditions of sitting on chair, lying on bed etc.). Common paths from point of entry to inactive areas are then remembered. If the person turns inactive in between of a common path then fall condition is detected and alerted.

- Recognition by acoustic/vibration: This system detects fall condition by matching the obtained vibration from the floor against a set of known safe vibrations of walking, running, and small objects falling etc.
- Worn sensor devices: This system detects fall condition by analyzing data received from sensors worn by the user. Usually the sensors used are tri-axial accelerometer or gyroscope. If the data received from the sensors crosses a pre-defined threshold value then fall condition is detected.
- Recognition by acceleration threshold: This system detects fall condition by analyzing acceleration data from an accelerometer. If the amplitude of the acceleration crosses the lower and upper thresholds and if there is a change in position then fall condition is detected.

With advancements in mobile technology smart phone prices have reduced significantly resulting in smart phones becoming easily affordable for all. Most of these smart phones have an in-built accelerometer which is generally used for user interaction and orientation detection. Same accelerometer can be re-used for fall detection, eliminating the need of any additional hardware or sensors and thereby reducing the cost involved. Smartphone also have the necessary capabilities for alerting in case of such emergency conditions of fall, by SMS, GPRS, call etc. GPS capabilities in smart phone can also be utilized to append the geographic location to the ongoing alert message making the alert more effective and precise.

IV. METHOD AND MATERIALS

We propose to use the Android open source mobile software platform produced by Google. Android is a package of operating system, middleware and key applications. Applications for android are written in Java and are run in Dalvik Virtual Machine (DVM). Android platform has SQLite database to store persistent data for the application. Android devices have a built in accelerometer which gives acceleration values along the three axes. It measures acceleration in the frame of reference of device in free fall.

Unlike dedicated systems this software is intended to integrate with the device's existing applications; this application must share resources with other applications. To make for a pleasant integration, it runs as inconspicuously as possible while using limited resources. We launch a background service that requests the GPS location and other data. Only when the probability of wandering is high will the activity wake up and interrupt the patient. Based on the probability evaluation and patient's response the app can take different actions. Which allows our application to run harmoniously on the system while minimizing memory consumption and providing ease of use to the patient.
Basically we are focusing on accelerometer to detect fall and GPS tracking for monitor location of patient.

4.1 Architecture of Proposed System of GPS tracking

As shown in figure, we are using two Android OS enable phones to complete the whole activity. As there is one patient system and another care taker system, patient system should have GPS technology available on mobile, so by using that GPS we can track the current location of patient.

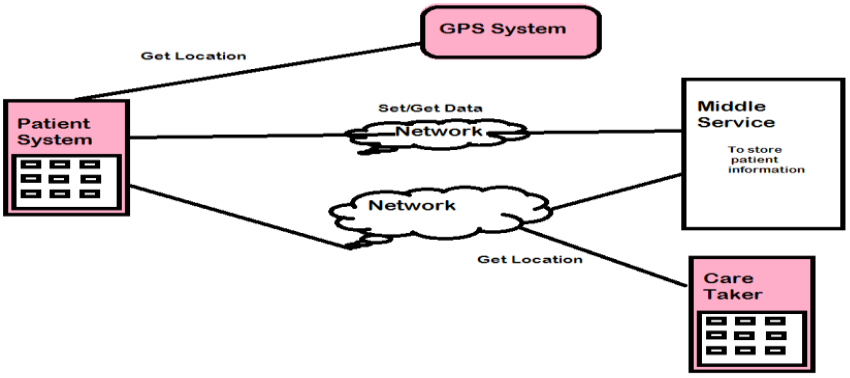

Fig.1 Client-Server Architecture for Position tracing

We are registering these two systems to a middle layer service which will store information about the client. Care taker can access this information via network from middle layer service. Our patient system will send location in background after short interval time and care taking system will retrieve it from the middle layer service. This is how it keep updating and monitoring.

4.2 Fall detection

This paper is basically concerned about detection of fall and monitoring dementia patients wondering activity so he could not get lost. To detect fall we are using algorithm which is based on threshold. This is most classical approach to fall detection. The accuracy of fall detection is high as compare to other algorithms.

Basically we have X, Y, Z axis orientation. And our algorithm is based on three axis acceleration; Acceleration in X-axis, Y-axis, Z-axis are represented by Bx, By and Bz respectively. And equation is represented by,

$$B_{sum}=\text{SquareRootof}\ (\ Bx^2 + By^{2+} Bz^2\ )$$

We need to fix some threshold value and by comparing this threshold values we are analyzing fall detection.

V. CHALLENGES

As we are relying on mobiles to be responsive for fall detection and Patient tracking, all we need to have good battery power mobiles to function for whole day and if possible at night. Also the position of mobile is matters a lot. To determine fall detection the position of mobile should be vertically upward.

Also carrying mobile device by Dementia is most important, So care taker should be responsible for that to keep mobile in the pocket of dementia patient. Or we can consider it is day to day activity so patient may carry mobile every day with him.

VI. CONCLUSION

As the purpose of this paper to discuss the techniques available to track down the patient, and also discuss about fall detection algorithm. This paper is focus on implementation of system which will relieve stress on care taker and also enable dementia patient to perform there day to day life task without any interruption. This paper suggests the client-server architecture for tracking down the patient and focusing on threshold based algorithm to detect fall.

REFERENCES

[1] Michihiro Shimada, Takashi Minatot Evaluation of Android Using Unconscious Recognition, IEEE 2006

[2] Frank Sposaro, Justin Danielson, Gary Tyson iWander: An Android Application for Dementia Patients. 32nd Annual International Conference of the IEEE EMBS Buenos Aires, Argentina, August 31 - September 4, 2010

[3] Moustafa Alzantot, Moustafa Youssef UPTIME: Ubiquitous Pedestrian Tracking using Mobile Phones. IEEE Wireless Communications and Networking Conference: Services, Applications, and Business 2012

[4] Yabo Cao, Yujiu Yang, WenHuang Liu E-FallD : A Fall Detection System Using Android-Based Smartphone. 2012 9th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD 2012)

[5] Silvia Nunnari, Flavio Cannavò Implementation of a Real-time Human Movements Classifier by using Mobile Equipment, IEEE 2013

[6] Vo Quang Viet, Gueesang Lee, Deokjai Choi Fall Detection based on Movement and Smart Phone Technology. IEEE 2012

[7] Frank Sposaro, Gary Tyson iFall: An Android Application for Fall Monitoring and Response. 31st Annual International Conference of the IEEE EMBS Minneapolis, Minnesota, USA, September 2-6, 2009

[8] Bruno Stanislas Beauvais, Vincent Rialle and Juliette Sablier MyVigi : An Android Application to Detect Fall and Wandering. IARIA, 2012.

[9] Shih-Hau Fang, Yi-Chung Liang and Kuan-Ming Chiu Developing a Mobile Phone-based Fall Detection System on Android Platform. IEEE 2012.

[10] Rahul Tiwari, Atul Kumar Singh, Shazeb Nawaz Khan Using Android Platform to detect Free Fall. International Conference on Information Systems and Computer Networks 2013.

[11] Gregory A. Koshmak and Maria Linden Evaluation of the Android-Based Fall Detection System with Physiological Data Monitoring. 35th Annual International Conference of the IEEE EMBS Osaka, Japan, 3 - 7 July, 2013