AUTOMATIC FALL DETECTION BY SENSING TILES

Dr.S.Jabeen Begum,Janani,
Velalar College of Engineering andTechnology , Erode
jananibtech95@gmail.com, S. KarthikGowtham,kartheik1996@gmail.com
sjabeenbegum@gmail.comG.Sakthiprabha,sakthiganesh13197@gmail.com

Abstract: *Automatic fall detection is a major issue in taking care of health of the elderly people and has potential of increasing autonomy and independence while minimizing the risks of living alone. It has been an active research area due to the large demand of the healthcare association for fall detection goods. Smart tiles permits to monitor elders and detect their falls, and consequently provides emergency support whenever needed. We present up-to-date advancement of data collection, feature extraction, feature selection, and signal changing detection, which are essential phases of this work. We use vibrator, GPS system and IOT module to detect the fall and send alert to the care person mobiles which includes location also.*

INTRODUCTION:

Falls are a major threat to the health of older people. It is estimated that approximately one in three people over 65 years of age fall at least once every year, and these falls account for 90% of hip and wrist fractures and 60% of head injuries. In addition to physical injuries, many older people develop a fear of falling, which significantly reduces confidence to live independently and to actively participate in social activities, ultimately reducing the quality of their lives and contributing to an increase in frailty due to reduced activity levels. Tinetti et al. have reported that of 313 non-injured fallers, 148 (47%) were unable to get up after at least one fall. A possible sequela of such incapacity is a long lie (i.e. remaining on the floor or ground for an hour or more) which can have adverse consequences including dehydration and hypothermia. Further, half of the older people who experience a long liedie within six months. To overcome this serious health threat, personal emergency response systems with functions of automatic fall detection and alarm transmission (fall detectors) have been developed.

Embedded Systems:

An Embedded system employs a combination of software and hardware and perhaps to other mechanical parts to perform the system.Embedded systems are controlled by one or more main processing core that is typically either a microcontroller.The key characteristic is however being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each RADAR probably includes one or more embedded systems of its own.)

An embedded system targeted at network applications:

Embedded systems are designed to do some specific task, rather than be a general-purpose computer for multiple tasks. Some also have real-time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs.Embedded systems are not always standalone devices. Many embedded systems consist of small, computerized parts within a larger device that serves a more general purpose. For example, the Gibson Robot Guitar features an embedded system for tuning the strings, but the overall purpose of the Robot Guitar is, of course, to play music. Similarly, an embedded system in an automobile provides a specific function as a subsystem of the car itself.The program instructions written for embedded systems are referred to as firmware, and are stored in read-only memory or Flash memory chips. They run with limited computer hardware resources: little memory, small or non-existent keyboard and/or screen.

Characteristics

- Power, cost and reliability are important attributed that influence design.
- Increase in high performance and real time constraints.
- Application specific processor design can be a significant component of some embedded system.

Real Time Applications

Physically , an embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

Literature Review:

Implementation of a Real-Time Human Movement Classifier Using a Triaxial Accelerometer for Ambulatory Monitoring

Author: Dean M. Karantonis, R. Narayanan
Year: 2006

The real-time monitoring of human movement can provide valuable information regarding an individual's degree of functional ability and general level of activity. This paper presents the implementation of a real-time classification systemfor the types of human movement associated with the data acquired from a single, waist-mounted triaxial accelerometer unit. Themajor advance proposed by the system is to perform the vast majority of signal processing onboard thewearable unit using embedded intelligence. In this way, the system distinguishes between periods of activity and rest, recognizes the postural orientation of the wearer, detects events such as walking and falls, and provides an estimation of metabolic energy expenditure. A laboratory-based trial involving six subjects was undertaken, with results indicating an overall accuracy of 90.8% across a series of 12 tasks (283 tests) involving a variety of movements related to normal daily activities. Distinction between activity and rest was performed without error; recognition of postural orientation was carried out with 94.1% accuracy, classification of walking was achieved with less certainty (83.3% accuracy), and detection of possible falls was made with 95.6%accuracy. Results demonstrate the feasibility of implementing an accelerometry-based, real-time movement classifier using embedded intelligence.

Improving Compliance in Remote Healthcare Systems Through Smartphone Battery Optimization

Author: Jo-Ann Eastwood, SuneilNyamathi
Year: 2015

Remote health monitoring (RHM) has emerged as a solution to help reduce the cost burden of unhealthy lifestyles and aging populations. Enhancing compliance to prescribed medical regimens is an essential challenge to many systems, even those using smartphone technology. In this paper,we provide a technique to improve smartphone battery consumption and examine the effects of smartphone battery lifetime on compliance, in an attempt to enhance users' adherence to remote monitoring systems. We deploy WANDA-CVD, an RHM system for patients at risk of cardiovascular disease (CVD), using a wearable smartphone for detection of physical activity. We tested the battery optimization technique in an in-lab pilot study and validated its effects on compliance in the Women's Heart Health Study. The battery optimization technique enhanced the battery lifetime by 192% on average, resulting in a 53% increase in compliance in the study.

Power-Efficient Interrupt-Driven Algorithms for Fall Detection and Classification of Activities of Daily Living

Author: Jian Yuan, KokKiong Tan
Year: 2015

Falls lead to major health problems for the elderly. Immediate help could lower the risk of complications and death and greatly increase the likelihood of returning to independent living. Automatic fall detectors are useful devices that can alert family members and caregivers at those life-critical moments. Traditional accelerometer-based fall studies focus on accuracies and largely neglect the fact that algorithms will mostly be implemented in microcontroller units (MCUs) with limited speed and random access memory. In addition, it is desirable for a fall detector to have a battery life of several weeks or months. This paper presents a fall detection algorithm and a classification algorithm for activities of daily living using a wrist-worn wearable device. Both algorithms are power-efficient and can be implemented easily in an 8-bit MCU. They adopt an interrupt-driven approach based on a modern digital microelectromechanical systems accelerometer which supports interrupts and data buffering. The approach is completely different from conventional algorithms which must examine and process every piece of data sampled at high frequencies.

Nicolas pepin , Olivier simonin, Francois charpillet-Intelligent tiles:putting situated multi agent models in real world-2009

In this paper they propose to pave indoor floors with "Communicating "tiles in order to extend perception and communication of the mobile agents and more generally to implement environment-based multi-agent models. Each tile supports a real-time process which ensures communication with its neighbor and any agent laid on it. We detail algorithms required for tiles to interact with mobile agents and to carry out distributed process.

H.Rimmien ,J.Lindstrom and R.Sepponen-"Positioning accuracy and Multi target separation with the Human tracking system using near field imaging

Analyze the performance of a novel Human tracking system,which uses the electric near field to sense human presence. The positioning accuracywith moving target is measured using raw observation, observation centroids and kalmanfiltered centroids. In addition to this, the multi targeted discriminization performance is studied with two people and a Rae-Blackwellized monte carlo data association algorithm.

Lidu university of Akron, Jiangzhenm space university of Akron-An Inductive sensor for real-time measurement planter normal and shear force distribution.

The objective of this project is to demonstrate a multiplexed inductive force sensor for simultaneously measuring normal force and shear forces on a foot. In this project they demonstrate a multiplexed inductive sensor for user related foot force monitoring the sensor consists of three mini –sized planas coils. The normal forces and shear forces on the foot during walking were simultaneously measured by monitoring inductance changes of the three sensing coils.

Tae liu,yoshio Inoue and Kyoko Shibata "2010"- A wearable ground reaction force sensor system and its application to the measurement of extrinsic gait variability.

In this paper a wearable ground reaction force(GRF) sensor system its application to measurements extrinsic gait variability are presented. To validate the GRF and center of pressure measurement of the sensor system and examine the effectiveness of the proposed method for gait analysis. We conducted an experiment study on seven volunteer subjects.

Fall Detection with Body-Worn Sensors

Author: LorenzoChiari, Jorunn L Helbostad **Year:** 2013

Falls among older people remain a major public health challenge. Body-worn sensors are needed to improve the understanding of the underlying mechanisms and kinematics of falls. The aim of this systematic review is to assemble, extract and critically discuss the information available in published studies, as well as the characteristics of these investigations (fall documentation and technical characteristics). Methods: The searching of publically accessible electronic literature databases for articles on fall detection with body-worn sensors identified a collection of 96 records (33 journal articles, 60 conference proceedings and 3 project reports) published between 1998 and 2012. These publications were analysed by two independent expert reviewers. Information was extracted into a custom-built data form and processed using SPSS (SPSS Inc., Chicago, IL, USA). Results: The main findings were the lack of agreement between the methodology and documentation protocols (study, fall reporting and technical characteristics) used in the studies, as well as a substantial lack of real-world fall recordings. A methodological pitfall identified in most articles was the lack of an established fall definition. The types of sensors and their technical specifications varied considerably between studies. Conclusion: Limited methodological agreement between sensor-based fall detection studies using body-worn sensors was identified. Published evidence-based support for commercially available fall detection devices is still lacking. A worldwide research group consensus is needed to address fundamental issues such as incident verification, the establishment of guidelines for fall reporting and the development of a common fall definition.

Evaluation of Accelerometer-Based Fall Detection Algorithms on Real-World Falls

Author: WiebrenZijlstra, and JochenKlenk **Year:** 2012

Despite extensive preventive efforts, falls continue to be a major source of morbidity and mortality among elderly. Real-time detection of falls and their urgent communication to a telecare center may enable rapid medical assistance, thus increasing the sense of security of the elderly and reducing some of the negative consequences of falls. Many different approaches have been explored to automatically detect a fall using inertial sensors. Although previously published algorithms report high sensitivity (SE) and high specificity (SP), they have usually been tested on simulated falls performed by healthy volunteers. We recently collected acceleration data during a number of real-world falls among a patient population with a high-fall-risk as part of the SensAction-AAL European project. The aim of the present study is to benchmark the performance of thirteen published fall-detection algorithms when they are applied to the database of 29 real-world falls. To the best of our knowledge, this is the first systematic comparison of fall detection algorithms tested on real-world falls. We found that the SP average of the thirteen algorithms, was (mean±std) 83.0%±30.3% (maximum value = 98%). The SE was considerably lower (SE = 57.0%±27.3%, maximum value = 82.8%), much lower than the values obtained on simulated falls. The number of false alarms generated by the algorithms during 1-day monitoring of three representative fallers ranged from 3 to 85. The factors that affect the performance of the published algorithms, when they are applied to the real-world falls, are also discussed. These findings indicate the importance of testing fall-detection algorithms in real-life conditions in order to produce more effective automated alarm systems with higher acceptance. Further, the present results support the idea that a large, shared real-world fall database could, potentially, provide an enhanced understanding of the fall process and the information needed to design and evaluate a high-performance fall detector.

EXISTING SYSTEM:

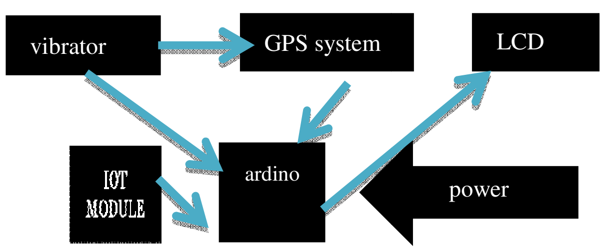
The demographic changes related to the increasing numbers of elderly people living alone are leading to a significant change in the social and economic structure.Many countries; especially in the developed world; are now refreshing themselves for the fact that their fastest growing demographic is the over 80 years old.Those people prefer growing old at home and saving their free lifestyles that often come generally with high risks.Actually, 61% of accidents occur at home and 85% of them are due to falls.

They have around 10,000 deaths each year.Therefore, many supportive technologies and systems have been developed to track elderly persons and monitor their activities of daily living in order to allow them to age comfortably at home. In this project they use multiple set of sensors were embedded with each tileand kept over the surface area. Higher Cost is the major drawback.

PROPOSED SYSTEM:

The proposed project aims to offer a friendly-user and effective system, without disturbing elders in their daily living lifestyles.For this propose, a smart apartment consists of (kitchen, bathroom, bedroom and living room), with several smart and connected devices was built within INRIANancy.Each tile is equipped with an vibrator positioned at each corner.From the intensity generated by the vibrator under the tiles, a set of parameters are extracted to build our databasewe extract some useful parameters falling and non-falling.We included medical and personal assistant contact numbers which is used to receive alert from IOT Module.The Low power assist device is a part of an indoor fall detection monitoring system and assist device designed for elderly people living alone. The medical assistant who receives the message, a medical monitoring group can contact the user, and then decide whether to set assistance.

IMPLEMENTATION:



ARCHITECTURE

PHASE-1:

VIBRATOR -Detects vibrations that occurs on the floor.Modes of Vibrator**:**1) low (0<5),2)Medium(5>30),3)High(>30).For this project the medium level mode is used.

IOT MODULE-Interfaces between hardware and mobile hotspot.Ready Message will be displayed after getting wi-fi signal.

In first phase the vibrator and iot module is connected which is used to sense the fall and the system connect with the hotspot.

PHASE-2:

GPS MODULE –To detect the accurate location of longitude and latitude.We can able to track the location of the elder from anywhere.

AURDINO UNO-The **Uno** is a great choice for your first **Arduino**. It's got everything you need to get started, and nothing you don't. It has 14 digital input/output pins (of which 6 **can** be used as PWM outputs), 6 analog inputs, a USB connection, a power jack, a reset button and more.

In phase 2 these systems are connected which senses the vibration and track the location and get ready to send alert.

PHASE-3:

GSM MODULE – It holds SIM card and message will be sent to the variant users of the hardware. Messages will be send to the alternate subscribers simultaneously.

LED DISPLAY-It display current status of the system.

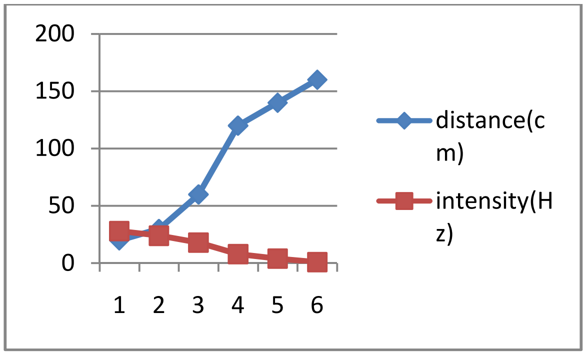
In phase 3 the system sends the alert message and fall location to the care person and the medical assistance.

ADVANTAGES:

Create a list of factors contributing to an individual older person's fall risk.Identify risk factors and triggers related to recent or recurrent falls.Identify the factors that are easiest to modify or change. This is partly about the factor itself, and partly about what's feasible for my patient to try to change. (Stairs can be a risk, but changing houses can be tricky.)Implement practical strategies to address modifiable fall risk factors.

RESULT DISCUSSION:

In graph(1) it was plotted between intensity (Hz) and distance (cm).When the distance is high, the intensity level becomes low.

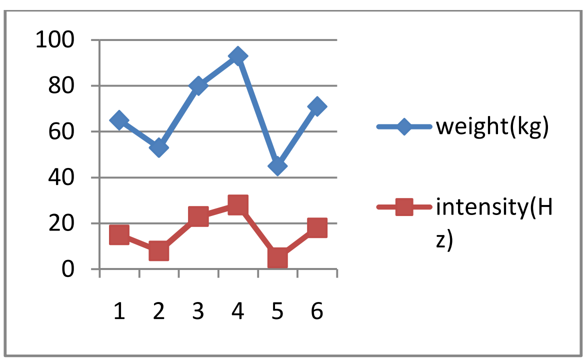


Graph(1)

X denotes distance(cm)

Y denotes intensity(Hz)

In Graph(2) it was plotted between intensity(Hz) and weight(Kg) .when the Weight is increased then the intensity becomes high.



Graph(2)

X denotes Weight(kg)

Y denotes intensity(Hz)

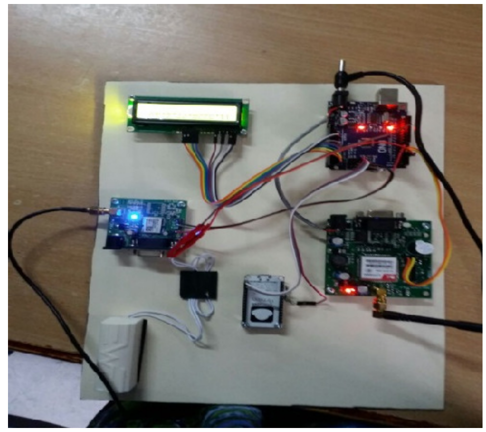


Fig [1]: Sensing tile.

Fig [1] consists of:

1)LCD display (16x2)

2)ardunio UNO

3)vibrator

4)GPS system

5)IOT module.

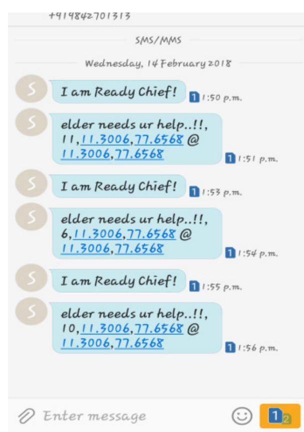
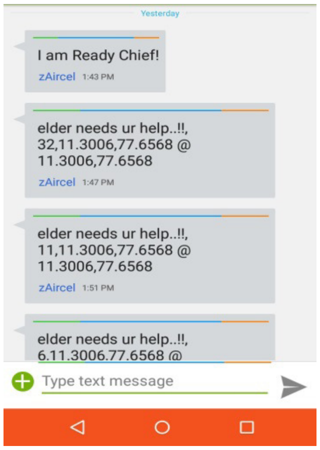


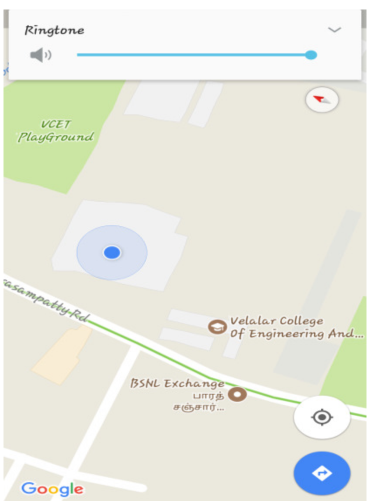
Fig [2]. Medical Assitant

Fig [2] represents the alert message and location address were send to the medical assitant.



Fig[3].Care person.

Fig[3] represents the alert messagew and location address were send to care person.



Fig[4].location.

Fig[4] denotes the GPS location image.

CONCLUSION:

This paper described our up-to-date progress on automatic fall detection system using sensing floors.A novel approach was presented that tackle problems such as efficiency, accuracy and usability in fall detection systems.The next contribution of this work is to fuse the dataset collected from the accelerometers with force sensors data sources to get profit in determine the all ADL states.Merging multi-sensing data with prediction technologies such as artificial intelligence and machine learning will encourage to develop intelligent fall prevention system.Finally, the proposed system has a little high cost especially for the old apartment, but the price of sensors is rapidly decreasing, making it feasible to implement such system.The great challenge of this project is to provide a friendly-user and effective system that doesn't affect elderly daily living patterns.

REFERENCES:

1]S. R. Lord, C. Sherrington, H. B. Menz, and J. C. Close, Falls in older people: risk factors and strategies for prevention. Cambridge, UK: Cambridge University Press, 2007.

2]S. N. Robinovitch, F. Feldman, Y. J. Yang, R. Schonnop, P. M. Leung, T. Sarraf, et al., "Video capture of the circumstances of falls in elderly people residing in long-term care: an observational study," Lancet, vol. 381, pp. 47-54, Jan 5 2013.

3]M. E. Tinetti, W. L. Liu, and E. B. Claus, "Predictors and prognosis of inability to get up after falls among elderly persons," Jama-Journal of the American Medical Association, vol. 269, pp. 65-70, Jan 6 1993.

4]D. Wild, U. S. L. Nayak, and B. Isaacs, "How dangerous are falls in old-people at home," British Medical Journal, vol. 282, pp. 266-268, 1981.

5]L. Schwickert, C. Becker, U. Lindemann, C. Marechal, A. Bourke, L . C h i a r i, et al., "Fall detection with body-worn sensors: a systematic review," Zeitschrift Fur Gerontologie Und Geriatrie, vol. 46, pp. 706-719, Dec 2013.

6]R. Igual, C. Medrano, and I. Plaza, "Challenges, issues and trends in fall detection systems," Biomedical Engineering Online, vol. 12, p. 66, Jul 6 2013.

7]F. Bagala, C. Becker, A. Cappello, L. Chiari, K. Aminian, J. M. Hausdorff, et al., "Evaluation of accelerometer-based fall detection algorithms on real-world falls," Plos One, vol. 7, p. e37062, May 16 2012.

8]N. Alshurafa, J. A. Eastwood, S. Nyamathi, J. J. Liu, W. Y. Xu, H. Ghasemzadeh, et al., "Improving compliance in remote healthcare systems through smartphone battery optimization," IEEE Journal of Biomedical and Health Informatics, vol. 19, pp. 57-63, Jan 2015.

9]D. M. Karantonis, M. R. Narayanan, M. Mathie, N. H. Lovell, and B. G. Celler, "Implementation of a real-time human movement classifier using a triaxial accelerometer for ambulatory monitoring," IEEE Transactions on Information Technology in Biomedicine, vol. 10, pp. 156-167, Jan 2006.

10]Jo-Ann Eastwood, Suneil Nyamathi2015

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11]C. Wang, W. Lu, M. R. Narayanan, S. J. Redmond, and N. H. Lovell, "Low-power technologies for wearable telecare and telehealth systems: A review," Biomedical Engineering Letters, vol. 5, pp. 1-9, 2015.

12]Dean M. Karantonis, R. Narayana2006.Implementation of a Real-Time Human Movement Classifier Using a Triaxial Accelerometer for Ambulatory Monitoring