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SMART TILES FOR FALL DETECTION OF ELDERLY PEOPLE

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ABSTRACT

Fall detection for elderly and patient is a very important service that has the potential of increasing autonomy of elders while minimizing the risks of living alone. It has been an active research topic due to the fact that health care industry has a big demand for products and technology of fall detection systems. Owing to the recent rapid advancement in sensing and wireless communication technologies, fall detection systems have become possible. They allow detecting fall events for the elderly, monitoring them, and consequently providing necessary help whenever needed. This paper describes the ongoing work of detecting falls in independent living senior apartments using force sensors and 3-axis accelerometers concealed under intelligent tiles. The force sensors permit detecting elders' falls, locating, tracking and recognizing human activities (walking, standing, sitting, lying down, falling, and the transitions between them). However, the detection accuracy on real data contains false alarms coming from falling and lying postures. To solve this issue, we propose the fusion between the force sensor measurements and the accelerometer sensor decisions. As a consequence, the system accuracy is satisfactory and the results show that the proposed methods are efficient, and they can be easily used in a real elder tracking and fall detection system.

Keywords: Elder Tracking, Detection Systems, Embedded platform and Elderly population.

1. INTRODUCTION

One-third of the elderly population aged 65 years or more fall at least once each year, whereas half of the elderly population older than 80 years fall each year. The increase in elderly population, notably in developed countries, and the number of elderly people living alone can result in increased healthcare costs which can cause a huge burden on the society and individuals. Due to the shortage of nursing homes, more elderly people are required to stay at home. Fall detection systems are used by elderly people who live alone and cannot alert anyone for help when a fall occurs if they sustain serious injuries or if they become unconscious. Fall detection systems classifiers two sets of data, activities of daily living (ADLs) and fall activities. ADLs are a “wide set of actions characterizing the habits of people, especially in their living places e.g. walking, sitting, standing, and etc.” Fall detection systems have evolved over the past few years, from a button pendant to the following fall detection systems - wearable sensors, ambient sensors, and camera-based sensors. With wearable sensors being the most popular, due to the fact it provides both outdoor and indoor monitoring. However, many fall detection systems make use of experimental/ laboratory data when designing these systems, which results in low accuracy when tested outside the experimental environment. In most studies the systems are trained to detect a small subset of activities. In this paper, personalization techniques in fall detection system are explored which increases the accuracy of the overall system by learning from the user movements better and allows inclusion of new activities. Current research in fall detection systems relies solely on experimental data which make use of young people to perform these activities.

The problem is that young people move differently compare to elderly people, which can cause the fall detection system to produce false alarms; since the system does not know the movements of the elderly people. Duration of falls for elderly people may be longer compared to that of young adults. We are exploring

personalization techniques in fall detection to increase the performance, accuracy, and to increase the elderly's independence by not forcing them to perform limited activities. The personalization model will adapt to the person's movements and the lifestyle of the user in terms of the activities the user performs. Thus, personalization model will reduce false alarms and ensure that a fall is detected. The contribution in this paper is the approach for the personalized fall detection system, which provides the following advantages, the inclusion of new activities, deduction in false alarms; and the system does not require fall data. The remainder of this paper is organized as follows. The common approach is designing of a fall detection system and the problems of the fall detection system approach are presented in section II and III, respectively. Then, in section IV, the personalization fall detection system approach is presented. Moreover, the personalization model and how personalization works are described in section V and VI. Finally, the simulation model and simulation results, experiments and the experimental results are shown. Assistive technology or adaptive technology is an umbrella term that encompasses assistive and adaptive devices for people with special needs. Special needs and daily living assistance are often associated with seniors, disabled, overweight and obese, etc. Assistive technology for ageing-at-home has become a hot research topic since it has big social and commercial value. One important aim of assistive technology is to allow elderly people to stay as long as possible in their home without changing their living style.

Wearable sensor-based systems for health monitoring are an emerging trend and in the near future they are expected to make possible proactive personal health monitoring along with better medical treatment. Inertial measurement units (IMUs) are low-cost and low power consumption devices with many potential applications. Current miniature inertial sensors can be integrated into clothes or shoes. Inertial tracking technologies are becoming widely accepted for the assessment of human movement in health monitoring applications. Wearable sensors offer several Correspondence: bkw@agh.edu.pl 1AGH University of Science and Technology, 30 Mickiewicza Av., 30-059 Krak´ow, Poland Full list of author information is available at the end of the article advantages over other sensors in terms of cost, weight, size, power consumption, ease of use and, most importantly, portability. Therefore, in the last decade, many different methods based on inertial sensors were developed to detect human falls. Falls are a major cause of injury for older people and a significant obstacle in independent living of the seniors. They are one of the top causes of injury-related hospital admissions in people aged 65 years and over. The statistical results demonstrate that at least one-third of people aged 65 years and over fall one or more times a year [5]. An injured elderly may be laying on the ground for several hours or even days after a fall incident has occurred. Therefore, significant attention has been devoted to developing an efficient wearable system for human fall detection.

2. LITERATURE SURVEY

ELDER TRACKING AND FALL DETECTION SYSTEM USING SMART TILES

Fall detection for elderly and patient is a very important service that has the potential of increasing autonomy of elders while minimizing the risks of living alone. It has been an active research topic due to the fact that health care industry has a big demand for products and technology of fall detection systems. Owing to the recent rapid advancement in sensing and wireless communication technologies, fall detection systems have become possible. They allow detecting fall events for the elderly, monitoring them, and consequently providing necessary help whenever needed. This paper describes the ongoing work of detecting falls in independent living senior apartments using force sensors and three-axis accelerometers concealed under intelligent tiles. The force sensors permit detecting elders' falls, locating, tracking, and recognizing human activities (walking, standing, sitting, lying down, falling, and the transitions between them). However, the detection accuracy on real data contains false alarms coming from falling and lying postures. To solve this issue, we propose the fusion between the force sensor measurements and the accelerometer sensor decisions. As a consequence, the system accuracy is satisfactory, and the results show that the proposed methods are efficient, and they can be easily used in a real elder tracking and fall detection system.

HUMAN FALL DETECTION ON EMBEDDED PLATFORM USING DEPTH MAPS AND WIRELESS ACCELEROMETER

Since falls are a major public health problem in an ageing society, there is considerable demand for low-cost fall detection systems. One of the main reasons for non-acceptance of the currently available solutions by seniors is that the fall detectors using only inertial sensors generate too much false alarms. This means that some daily activities are erroneously signaled as fall, which in turn leads to frustration of the users. In this paper we present how to design and implement a low-cost system for reliable fall detection with very low false alarm ratio. The detection of the fall is done on the basis of accelerometric data and depth maps. A

tri-axial accelerometer is used to indicate the potential fall as well as to indicate whether the person is in motion. If the measured acceleration is higher than an assumed threshold value, the algorithm extracts the person, calculates the features and then executes the SVM-based classifier to authenticate the fall alarm. It is a 365/7/24 embedded system permitting unobtrusive fall detection as well as preserving privacy of the user.

ELDERLY FALL DETECTION SYSTEMS

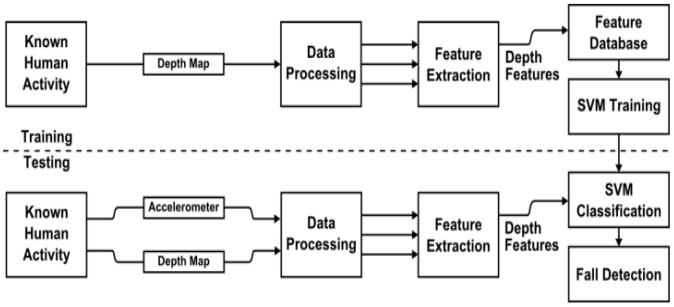
Falling is among the most damaging event elderly people may experience. With the ever-growing aging population, there is an urgent need for the development of fall detection systems. Thanks to the rapid development of sensor networks and the Internet of Things (IoT), human-computer interaction using sensor fusion has been regarded as an effective method to address the problem of fall detection. In this paper, we provide a literature survey of work conducted on elderly fall detection using sensor networks and IoT. Although there are various existing studies which focus on the fall detection with individual sensors, such as wearable ones and depth cameras, the performance of these systems are still not satisfying as they suffer mostly from high false alarms. Literature shows that fusing the signals of different sensors could result in higher accuracy and lower false alarms, while improving the robustness of such systems. We approach this survey from different perspectives, including data collection, data transmission, sensor fusion, data analysis, security, and privacy. We also review the benchmark data sets available that have been used to quantify the performance of the proposed methods. The survey is meant to provide researchers in the field of elderly fall detection using sensor networks with a summary of progress achieved up to date and to identify areas where further effort would be beneficial.

SMART TILES FOR ELDER TRACKING AND FALL DETECTION SYSTEM

Fall disclosure for progressively settled and indefatigable is an essential association that has the limit of developing autonomy of seniors while confining the dangers of living alone. It has been a working examination point by virtue of the way where that human organizations industry has an imperative energy for things and advancement of fall territory structures. Inferable from the constant quick advancement in recognizing and remote correspondence degrees of progress, fall unmistakable confirmation structures have wound up being conceivable. They award seeing fall occasions for the old, checking them, and as such giving basic assistance at whatever point required. This paper depicts the driving work of seeing falls in free living senior townhouses using power sensors and 3- centre point accelerometers confirmed under dubious tiles. The power sensors permit seeing progressively arranged people's falls, discovering, following and seeing human activities (walking, standing, sitting, resting, falling, and the developments between them). Everything considered, the revelation exactness on veritable data contains false alerts beginning from falling and lying positions. To light up this issue, we propose the mix between the power sensor estimations and the accelerometer sensor decisions. In like manner, the structure exactness is exquisite and the results show that the proposed approaches are productive, and they can be plausibly used in an authentic senior after and fall divulgence system.

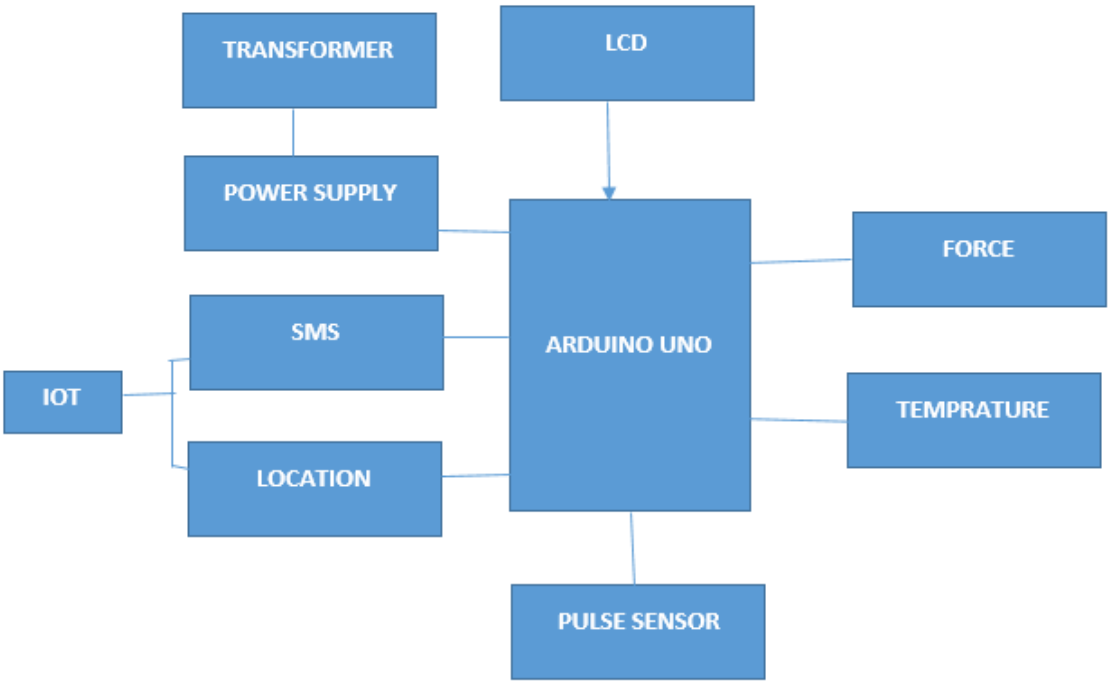
3. EXISTING SYSTEM

A wide variety and large amount of passive monitoring systems are currently available to detect when an individual has fallen. These systems can be wearable or non-wearable systems. However, they are costly and there is consequent lack of privacy for elderly people because these systems require the sensors to be strategically placed. Smart phone based detectors are also available but they may face difficulties with real time operations, sensing architecture, stability of the accelerometers sampling frequency etc.



4. PROPOSED SYSTEM

The Proposed method which uses two type of sensor system pulse sensor and force sensor. The force sensor is used to enforce the differentiation between the falling and the lying down posture. Firstly, the database tables are fragmented into fall and non-fall fragments to obtain two different classes, and then we proceed to do the windowing of each signal in each class. From each window, we extract some useful parameters and then select the most pertinent of them in order to be used to differentiate between the two states: falling and non-falling. The force sensor senses the position of the elder people and corresponding tiles pressure also measured and then it will decide the people standing or sitting or falling. The toggle switch also provided to on/off operation because when people are rest in position or sleep to turn off the device. When fall occurs means people occupies more number of pressure sensor (i.e. tiles) and also position identified and decide the fall occurs send message to the caretaker, family members and hospital etc.



5. HARDWARE COMPONENTS

Arduino Uno
Board Types
Liquid-Crystal Display (Lcd)
Transformer
Temperature and Humidity Sensor
Pulse Sensor

6. CONCLUSION

This paper proposes a fine elder tracking, activities recognition, and fall detection system using a set of nonintrusive sensors. The proposed system uses the fusion between pressure sensors and accelerometers hidden under the smart tiles. First, we presented the aging population problem and the advances in medicine and public health services to track and monitor activities of elderly people at home in order to assist their independence. Second, we showed the proposed algorithm and results to distinguish different postures using the signals generated by force sensors of the INRIA-Nancy smart tiles platform. We deduced that force sensors cannot differentiate between falling and lying down postures because they have the main characteristics in term of the load exerted on tiles, tiles proximities, and the duration. Third, we proceeded to the accelerometer signals to differentiate between the falling and lying down postures. We had extracted some useful parameters and then selected the pertinent one to detect falls. Fourth, we showed the flowchart of the fusion between the force sensors and the accelerometers that finally permitted the ability to locate and track the elders, recognize

their activities, and detect fall cases. To end up, our challenge is to offer a usable system with maximum privacy within a reliable, efficient and affordable framework.

7. REFFERENCE

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