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Independent Living For Persons with Disabilities and Elderly People Using Smart Home Technology

Vanaparthi.suresh [1,] R.venkatesh [2] MD.Jabirullah [3]
[1,] Dept Of ECE, CMR Engineering college, Hyderabad, Telangana.
[2,] Assistant professor, CMR Engineering college, Hyderabad, Telangana.
[3,] Associate Professor, CMR Engineering college, Hyderabad, Telangana.

Abstract:
Various fall-detection solutions have been previously proposed to create a reliable surveillance system for elderly people with high requirements on accuracy, sensitivity and specificity. In this project, an enhanced fall detection system is proposed for elderly person monitoring that is based on smart sensors worn on the body and operating through consumer home networks. With treble thresholds, accidental falls can be detected in the home healthcare environment. By utilizing information gathered from an accelerometer, cardio tachometer and smart sensors, the impacts of falls can be logged and distinguished from normal daily activities. The proposed system has been deployed in a prototype system as detailed in this paper. From a test group of 30 healthy participants, it was found that the proposed fall detection system can achieve a high detection accuracy of 97.5%, while the sensitivity and specificity are 96.8% and 98.1% respectively. Therefore, this system can reliably be developed and deployed into a consumer product for use as an elderly person monitoring device with high accuracy and a low false positive rate.

Keywords — Wireless Sensor Networks, Fall Detection System, Elderly Monitoring, Heart Rate Fluctuation, Sensitivity, MEMS, ECG, ARM Microcontroller, GPS, GSM.

I. Introduction

In recent years, many types of consumer electronics devices have been developed for home network applications. A consumer home network usually contains various types of electronic devices, e.g. sensors and actuators, so that home users can control them in an intelligent and automatic way to improve their quality of life. Some representative technologies to implement a home network include: IEEE 802.11, Ultra Wide Band (UWB), Bluetooth and ZigBee, etc. ZigBee is suitable for consumer home networks because various sensors can be deployed to collect home data information in a distributed, self-organizing manner with relatively low power. Some typical applications include home automation, home activity detection (like fall detection) and home healthcare, etc. Kinsella and Phillips found that the population of 65-andover aged people in the developed countries will approach 20% of total population in the next 20 years and will obviously become a serious healthcare issue in the near future. In China alone, the population over the age of 60 years old is 133.9 Million. Among the elderly, the fall events can be an unpredictable and dangerous event. Statistics show that one among three 65-and-over aged person falls every year. Among these fall events, 55% occur at home and 23% occur near the home. In 2003, the global number of deaths caused by fall events was approximately 391,000 and specifically 40% of the falls were from people over 70 years of age . Thus, reliable consumer based fall detection systems need to be designed, tested and commercially deployed to countries all around the world. Furthermore, the cost of healthcare is highly related to the response and rescue time, and can be greatly reduced by fast detection and delivering signals to the specified operator for immediate consideration . Thanks to the development of wireless sensors and low-power sensor nodes, many novel approaches have been proposed to solve the problem. In this paper, an enhanced fall detection system for elderly person monitoring through a consumer home network environment is proposed that based on smart sensors which are worn on the body. The proposed system has been deployed in a prototype system and tested with a group of 30 healthy participants, it is found that the system can achieve very high accuracy of 97.5%, the sensitivity and specificity are 96.8% and 98.1% respectively.

II. The Hardware System

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project

because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

III. Design of Proposed Hardware System

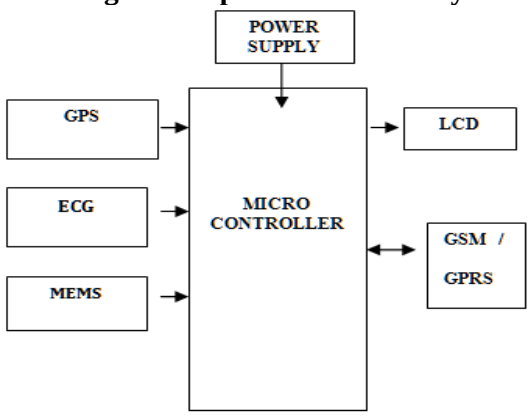


Fig.1.Block diagram

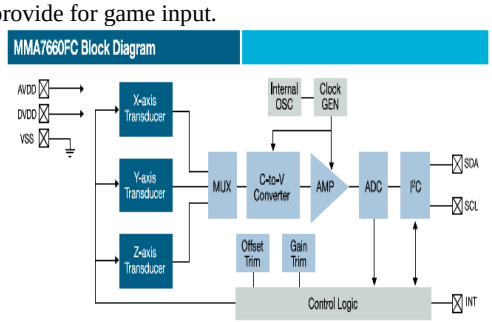
IV. Board Hardware Resources Features

Accelerometer

An **accelerometer** is a device that measures proper acceleration ("g-force"). Proper acceleration is not the same as coordinate acceleration (rate of change of velocity). For example, an accelerometer at rest on the surface of the Earth will measure an acceleration g= 9.81 m/s^2 straight upwards. By contrast, accelerometers in free fall orbiting and accelerating due to the gravity of Earth will measure zero.

Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. Accelerometers are used to detect and monitor vibration in rotating machinery. Accelerometers are used in tablet computers and digital cameras so that images on screens are always displayed upright. Accelerometers are used in drones for flight stabilization. Pairs of accelerometers extended over a region of space can be used to detect differences (gradients) in the proper accelerations of frames of references associated with those points. These devices are called gravity gradiometers, as they measure gradients in the gravitational field. Such pairs of accelerometers in theory may also be able to detect gravitational waves.

Single -and multi-axis models of accelerometer are available to detect magnitude and direction of the proper acceleration (or g-force), as a vector quantity, and can be used to sense orientation (because direction of weight changes), coordinate acceleration (so long as it produces g-force or a change in g-force), vibration, shock, and falling in a resistive medium (a case where the proper acceleration changes, since it starts at zero, then increases). Micro machined accelerometers are increasingly present in portable electronic devices and video game controllers, to detect the position of the device or provide for game input.



ECG SENSOR:

An ECG is used to measure the heart's electrical conduction system. It picks up electrical impulses generated by the polarization and depolarization of cardiac tissue and translates into a waveform. The waveform is then used to measure the rate and regularity of heartbeats, as well as the size and position of the chambers, the presence of any damage to the heart, and the effects of drugs or devices used to regulate the heart, such as a pacemaker.

GPS:

GPS (Global Positioning System) technology is used to find the location of any object or vehicle to monitor a child continuously using satellite signals. Three satellite signals are necessary to locate the receiver in 3D space and fourth satellite is used for time accuracy. GPS will give the information of parameters like longitude, latitude and attitude. With the help of these parameters one can easily locate the position of any object. In this GPS technology, the communication takes place between GPS transceiver and GPS satellite.

GSM:

GSM (Global System for Mobile communications) is the technology that underpins most of the world's mobile phone networks. The GSM platform is a hugely successful wireless technology and an unprecedented story of global achievement and cooperation. GSM has become the world's fastest growing communications technology of all time and the leading global mobile standard, spanning 218 countries. GSM is an open, digital cellular technology used for transmitting mobile voice and data services. GSM operates in the 900MHz and 1.8GHz bands GSM supports data transfer speeds of up to 9.6 kbps, allowing the transmission of basic data services such as SMS.

Conclusion

In this project, an enhanced fall detection system based on on-body smart sensors was proposed, implemented, and deployed that successfully detected accidental falls in a consumer home application. By using information from an accelerometer, smart sensor and cardio tachometer, the impacts of falls can successfully be distinguished from activities of daily lives reducing the false detection of falls. From the dataset of 30 participants, it is found that the proposed fall detection system achieved a high accuracy of 97.5%, and specificity are 96.8% and 98.1% respectfully. The proposed system is ready to be implemented in a consumer device.

REFERENCES

[1] I. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: a survey," Journal of Computer Networks, vol. 38, no. 4, pp. 393-422, March 2002.

[2] J. Yick, B. Mukherjee, and D. Ghosal, "Wireless sensor network survey," Journal of Computer Networks, vol. 52, no. 12, pp. 2292-2330, Aug. 2008.

[3] K. Kinsella and D. R. Phillips, "Global aging: the challenge of success," Population Bulletin, vol. 60, 2005.

[4] Tabulation on the 2010 population census of the people's republic of China, China Statistics, May 2013, on-line.

[5] S. Demura, S. Shin, S. Takahashi, and S. Yamaji, "Relationships between gait properties on soft surfaces, physical function, and fall risk for the elderly," Advances in Aging Research, vol. 2, pp. 57-64, May 2013.

[6] S. R. Lord and J. Dayhew, "Visual risk factors for falls in older people," Journal of American Geriatrics Society, vol. 49, no. 5, pp. 508-515, Dec. 2001.

[7] WHO, "The injury chart-book: a graphical overview of the global burden of injury," Geneva: WHO, pp. 43-50, 2012.

[8] M. Mubashir, L. Shao, and L. Seed, "A survey on fall detection: Principles and approaches," Neurocomputing, vol. 100, no. 16, pp. 144-152, Jan. 2013.

[9] Q. Zhang, L. Ren, and W. Shi,"HONEY a multimodality fall detection and telecare system," Telemedicine and e-Health, vol. 19, no. 5, pp. 415-429, Apr. 2013.

[10] F. Bagalà, C. Becker, A. Cappello, L. Chiari, and K. Aminian, "Evaluation of accelerometer-based fall detection algorithm in realworld falls," PLoS ONE, vol. 7, no. 5, pp. 1-8, May 2012.