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AN ENHANCED FALL DETECTION SYSTEM FOR ELDERLY PERSON MONITORING USING CONSUMER HOME NETWORK

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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 paper, 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, cardiotachometer 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

***Keywords** : ECG,MEMS,GSM,GPRS*

I. INTRODUCTION

Now a day's population ageing is unprecedented in the history of humanity and started in the western world during the 20th century. It is considered as a human success story, through triumph of public medical and health advancements. But this ageing process also puts a lot of challenges regarding national development, issues concerning heath of the elderly individual, the sustainability of families, and the ability of health care system to provide for ageing populations. The terms "Elderly", "Older population"and "Senior citizens" are generalized to refer to people aged 60years or older. People aged 80 years or older is referred as the oldest of old [1].A consumer home network usually contains various types of electronic devices like sensors, remote appliances and actuators, so that home users can control them in a smart way or intelligent and automatic way to improve their quality of life. In recent years, particularly with the proliferation in Micro-Electro-Mechanical Systems (MEMS) technology which has facilitated the development of smart sensors. These sensors are small, with limited processing and computing resources, and they are inexpensive compared to traditional sensors. These sensor nodes can sense, measure,and gather information from the environment and, based on some local decision process, they can transmit the sensed data to the user. During the last de cades, many solutions have been

proposed for elderly fall detection. Such solution can be categorized into three types. One of the earliest solutions 3-axis Micro-Electro-Mechanical Systems accelerometer, such system continuously monitor the elderly people in all direction and when it detect a fall, caregivers are notified about the occurrence of such event. In last decade many studies pointed or proposed out that the elderly often delay treatments after falls occur because of the disorder. They cannot use phones to inform the medical treatment about the exact fall location or emergency help, most of the fall simply lying on the ground and missing the best rescue timing,which may even lead to incurable consequences. Many old people with fall experiences are not willing to conduct the rehabilitation work in the future because they are worried to fall again. They often limit the range of actions by themselves, which not only affects their life quality seriously but also results in their muscle atrophy; some of them even require long-term care in their daily life. This paper proposes the new model by using advanced modern technology to detect the fall and also continuously monitoring the elderly person in various levels. And also when the fall is detected GPS is used to track the exact location of elderly person.

II. 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.

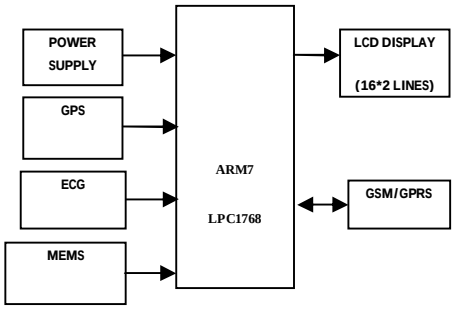

Fig: 1:Block diagram

III. BOARD HARDWARE SYSTEM

MEMS:

Micro-Electro-Mechanical Systems(MEMS) is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through microfabrication technology. While the electronics are fabricated using integrated circuit (IC) process sequences (e.g., CMOS, Bipolar, or BICMOS processes), the micromechanical components are fabricated using compatible "micromachining" processes that selectively etch away parts of the silicon wafer or add new structural

layers to form the mechanical and electromechanical devices. MEMS promises to revolutionize nearly every product category by bringing together silicon-based microelectronics with micromachining technology, making possible the realization of complete systems-on-a-chip. MEMS is an enabling technology allowing the development of smart products, augmenting the computational ability of microelectronics with the perception and control capabilities of micro sensors and micro actuators and expanding the space of possible designs and applications.Microelectronic integrated circuits can be thought of as the "brains" of a system and MEMS augments this decision-making capability with "eyes" and "arms", to allow micro systems to sense and control the environment. Sensors gather information from the environment through measuring mechanical, thermal, biological, chemical, optical, and magnetic phenomena. The electronics then process the information derived from the sensors and through some decision making capability direct the actuators to respond by moving, positioning, regulating, pumping, and filtering, thereby controlling the environment for some desired outcome or purpose. Because MEMS devices are manufactured using batch fabrication techniques similar to those used for integrated circuits, unprecedented levels of functionality, reliability, and sophistication can be placed on a small silicon chip at a relatively low cost.

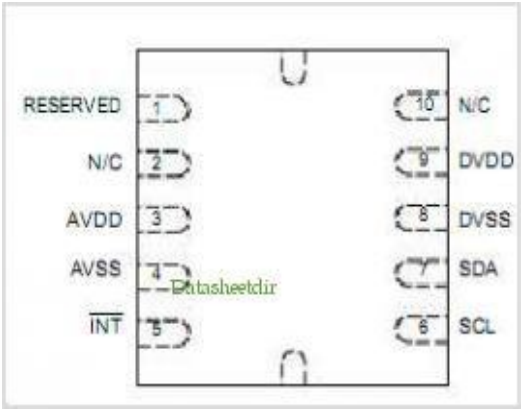

Fig: 2:MEMS IC

GPS:

Global Positioning System (GPS) technology is changing the way we work and play. You can use GPS technology when you are driving, flying, fishing, sailing, hiking, running, biking, working, or exploring. With a GPS receiver, you have an amazing amount of information at your fingertips. Here are just a few examples of how you can use GPS technology.

GPS technology requires the following three segments.

- Space segment.
- Control segment.
- User segment

Space Segment

At least 24 GPS satellites orbit the earth twice a day in a specific pattern. They travel at approximately 7,000 miles per hour about 12,000 miles above the earth's surface. These satellites are spaced so that a GPS receiver anywhere in the world can receive signals from at least four of them.

Control Segment

The control segment is responsible for constantly monitoring satellite health, signal integrity,

and orbital configuration from the ground control segment includes the following sections: Master control station, Monitor stations, and Ground antennas.

User Segment

The GPS user segment consists of your GPS receiver. Your receiver collects and processes signals from the GPS satellites that are in view and then uses that information to determine and display your location, speed, time, and so forth. Your GPS receiver does not transmit any information back to the satellites.The following points provide a summary of the technology at work:The control segment constantly monitors the GPS constellation and uploads information to satellites to provide maximum user accuracy Your GPS receiver collects information from the GPS satellites that are in view.Your GPS receiver accounts for errors. For more information, refer to the Sources of Errors. Your GPS receiver determines your current location, velocity, and time.Your GPS receiver can calculate other information, such as bearing, track, trip distance, and distance to destination, sunrise and sunset time so forth.Your GPS receiver displays the applicable information on the screen.

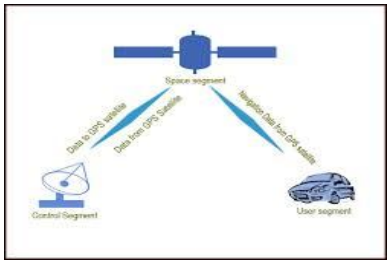

Fig: 3:GPS Working

GPRS:

GPRS (general packet radio service) is a packet-based data bearer service for wireless communication services that is delivered as a network overlay for GSM, CDMA and TDMA (ANSI-I36) networks. GPRS applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. Packet switching is where data is split into packets that are transmitted separately and then reassembled at the receiving end. GPRS supports the world's leading packet-based Internet communication protocols, Internet protocol (IP) and X.25, a protocol that is used mainly in Europe. GPRS enables any existing IP or X.25 application to operate over a GSM cellular connection. Cellular networks with GPRS capabilities are wireless extensions of the Internet and X.25 networks.

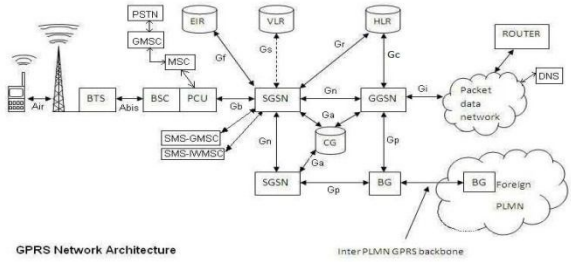

Fig:4: GPRS Architecture

ECG Sensor:

The electrocardiogram (ECG or EKG) is a diagnostic tool that is routinely used to assess the electrical and muscular functions of the heart. The electrocardiogram (ECG) has grown to be one of the most commonly used medical tests in modern medicine. Its utility in the diagnosis of a myriad of cardiac pathologies ranging from myocardial ischemia and infarction to syncope and palpitations has been invaluable to clinicians for decades.

Fig:5:ECG Sensor

IV. 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 cardiotachometer, the impacts of falls can successfully be distinguished from activities of daily lives reducing the false detection of falls. It is found that the proposed fall detection system achieved a high accuracy of 97.5%, and the sensitivity and specificity are 96.8% and 98.1% respectfully. The proposed system is ready to be implemented in a consumer device.

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