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CLUSTER-ANALYSIS-BASED USER-ADAPTIVE FALL DETECTION USING FUSION OF HEART RATE SENSOR AND ACCELEROMETER IN A WEARABLE DEVICE

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Abstract:

This project proposes an automatic fall detector in a wearable device that can reduce risks by detecting falls and promptly alerting caregivers. For this purpose, we propose cluster-analysis-based user-adaptive fall detection using a fusion of heart rate sensor and accelerometer. The objectives of the proposed fall detector are to have high accuracy with a low-complexity model regardless of diverse conditions. In addition, we verify the performance increment of combining a heart rate sensor with an accelerometer and the effectiveness of the cluster-analysis-based anomaly detection. We also show the effectiveness of the user-adaptive method when using both heart rate and acceleration signals.

In case of any abnormal orientation data values of the user, the system will send an alarm message via GSM to the caretaker. The system design considers a simple and low-cost design with acceptable power consumption rate.

I. INTRODUCTION

Falls are the leading causes of injuries and injury-related deaths in the elderly. Approximately half of the elderly population are unable to get up without help, even if they are not injured. In addition, lying on the floor for a long time often leads to dehydration, muscle damage, and fear of potential falls. Automatic fall detection systems can reduce risks by detecting falls and promptly alerting caregivers. There are three types of fall detection approaches: wearable-based, ambient-based, and vision-based. Although ambient- and vision-based approaches have better accuracy than that of the wearable-based approach, wearable based approaches are advantageous in terms of cost, setup, computational cost, and space restriction. In addition, wearable devices are essential because many elderly people want to live autonomously at home without locational restrictions.

II. LITERATURE SURVEY

Contactless Fall Detection by Means of Multiple Bioradars and Transfer Learning Vera Lobanova (2022)

Fall detection in humans is critical in the prevention of life-threatening conditions. This is especially important for elderly people who are living alone. Therefore, automatic fall detection is one of the most relevant problems in geriatrics. Bioradiolocation-based methods have already shown their efficiency in contactless fall detection. However, there is still a wide range of areas to improve the precision of fall recognition based on view-independent concepts. In particular, in this paper, we propose an approach based on a more complex multi-channel system (three or four bioradars) in combination with the wavelet transform and transfer learning. In the experiments, we have used several radar configurations for recording different movement types. Then, for the binary classification task, a pre-trained convolutional neural network AlexNet has been fine-tuned using scalograms. The proposed systems have shown a noticeable improvement in the fall recognition performance in comparison with the previously used two-bioradar system. The accuracy and Cohen's kappa of the two-bioradar system are 0.92 and 0.86 respectively, whereas the accuracy and Cohen's kappa of the four-bioradar system are 0.99 and 0.99 respectively. The three-bioradar system's performance turned out to be in between two of the aforementioned systems and its calculated accuracy and Cohen's kappa are 0.98 and 0.97 respectively. These results may be potentially used in the design of a contactless multi-bioradar fall detection system.

An interactive fall and loss of consciousness detector system (2020)

A device capable of automatically detecting a fall with loss of consciousness (FloC), and activate an alarm by means of an accelerometer sensor is presented. Four hundred trials were performed by 20 participants (10 young and 10 elderly adults). The algorithm relies on the recognition of the effects of three events characterizing a FLoC: impact of the body against the ground, lying and immobility. All FLoC cases were correctly detected as well as all activities of daily living (ADLs). This result corroborates both usefulness and applic

III. EXISTING SYSTEM

In our society, yearly 33% of senior citizens fall down in their residential area. When our family members come to old age, it becomes essential to monitor them for their in-home health and safety. Although they dwell in home, because of illness and weedy joints they have a big threat of falling down in any corner of home premises. In such circumstances, it becomes significant to recognize if an elderly person has fallen so that he/she can get quick help on time. Physically handicapped person on wheelchair also requires to be monitored for fall detection. Currently CCTV Camera-based monitoring systems are in existence but these systems are very expensive. Common man cannot afford such system.

IV. PROPOSED SYSTEM

In this project, we are using Arduino uno as a main controller. MEMS sensors connected to monitor the axis of the person. If sensor value exceeds, it will turn ON the buzzer and alert the people around the place. Fall detection, alert message will be displayed in the LCD and cloud.

V. BLOCK DIAGRAM:

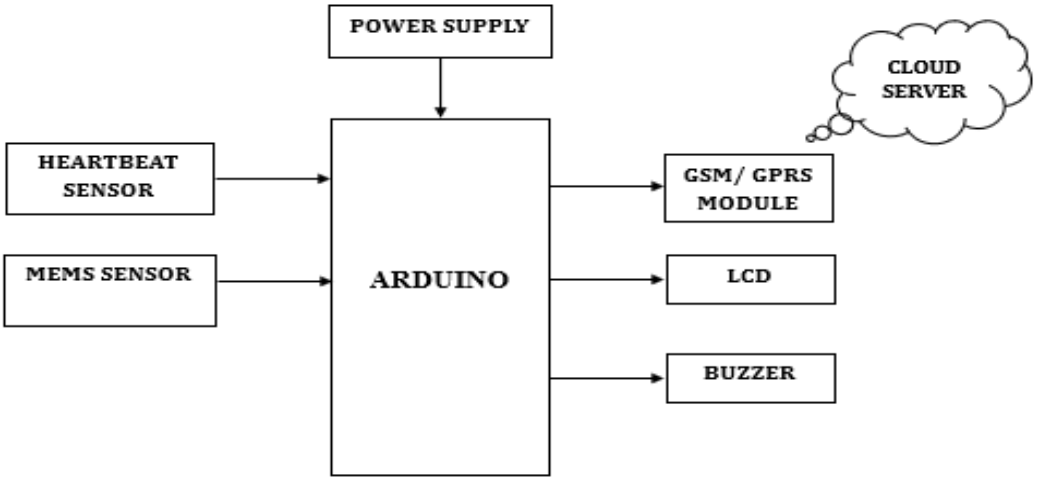


Fig 1: Block diagram of proposed system

VI.HARDWARE ARCHITECTURE DISCRIPTION:

Arduino uno:

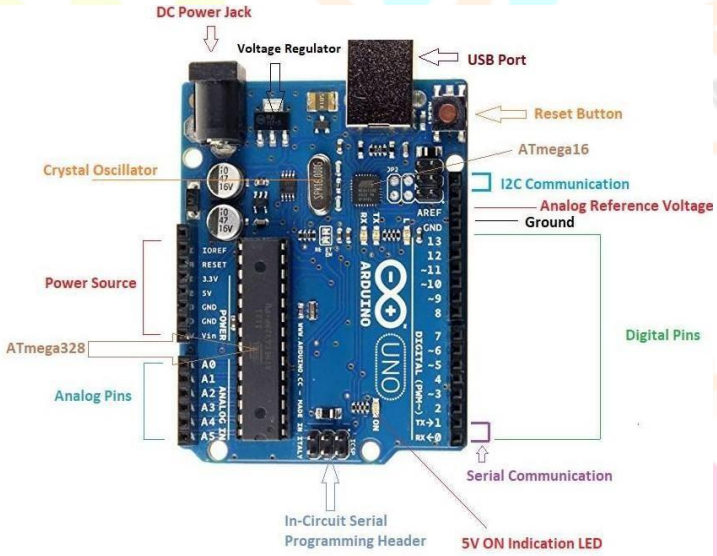


Fig 2 : Arduino uno

The Arduino uno board is a popular open-source microcontroller board that is designed to be easy to use for beginners in electronics and programming. The board is based on the Atmega328p microcontroller chip and has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, and a power jack. The digital pins can be used for digital input/output, pulse width modulation (PWM), and communication with other devices via protocol such as SPI, I2C, and UART, Additionally, the analog inputs can be used to measure voltages within rages of 0 to 5 volts.

13KB of flash memory is used to store the number of instructions in the form of code. The board is powered up in three ways i.e USB, Vin pin the board or DC power jack. Arduino uno comes with built-in LED providing HIGH value when it gets turned ON and LOW when it gets turned OFF. Serial communication is carried out through two pins called pin 0(Rx) and pin (Tx). Here Rx pin for receiving data and Tx pin for transmitting the data.

Heartbeat Sensor:

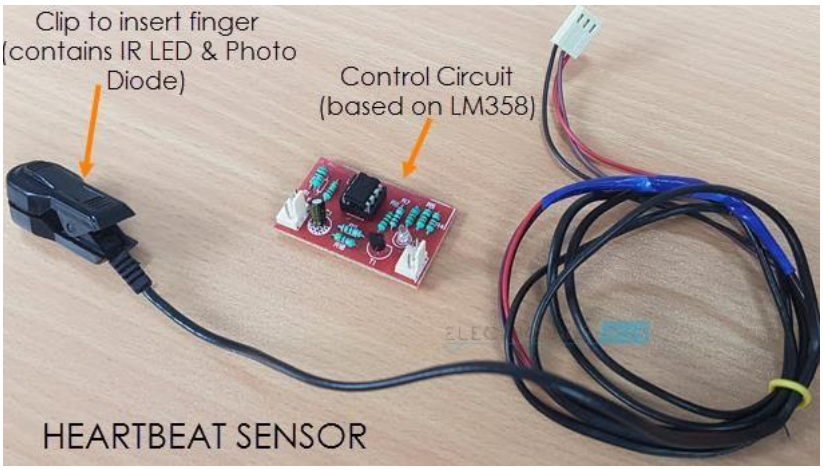


Fig 3: HeartBeat sensor

A heart rate sensor for embedded systems is a device that is designed to detect the electrical activity of the heart and convert it into a digital signal that can be processed by a microcontroller or a similar embedded system. This type of sensor is commonly used in medical applications, fitness trackers, and other wearable devices that require real-time monitoring of heart rate. The heart rate sensor typically consists of an analog front-end circuit that amplifies and filters the electrical signal from the electrodes placed on the skin. The analog signal is then converted into a digital signal using an analog-to-digital converter (ADC), which can be processed by the embedded system. The digital signal is then analyzed using algorithms to extract the heart rate information and eliminate noise and artifacts.

One important consideration when designing a heart rate sensor for embedded systems is the power consumption. The sensor must be designed to operate with low power consumption to extend the battery life of the device. This can be achieved by using low-power components, optimizing the signal processing algorithms, and implementing power-supply.

MEMS SENSOR :

The term MEMS stands for micro-electro-mechanical systems. These are a set of devices, and the characterization of these devices can be done by their tiny size & the designing mode. MEMS are low-cost, and high accuracy inertial sensors and these are used to serve an extensive range of industrial applications. This sensor uses a chip-based technology namely micro-electro-mechanical-system. These sensors are used to detect as well as measure the external stimulus like pressure, after that it responds to the pressure which is measured pressure with the help of some mechanical actions. The best examples of this mainly include revolving of a motor for compensating the pressure change.The MEMS accelerometers can be divided into two important micro system architectures: piezo resistive and capacitive. Even though both of these two types of accelerometers possess internal proof masses which are excited by acceleration, the differences of these two architectures lie in the transduction mechanism which is used to the movement correlation of the internal proof mass to accelerate. Fujitsu successfully developed the 'FAR-S2AB' series, 3-axis Accelerometer, using state-of-the-art MEMS technology. This small and highly sensitive accelerometer can detect acceleration, inclination and vibration by measuring the motion in the x-, y-, and z-axis simultaneously. The MEMS 3-axis accelerometer consists of a Mass at the centre of the sensor's chip, which is suspended by 4 Beams doped with Piezo resistive material. The Capacitive accelerometers possess a differential capacitor whose balance is disrupted by the proof mass movement. Piezo resistive accelerometers commonly rely on inducing, which attach the proof mass to the sensor which is used for identification of the movement of the mass

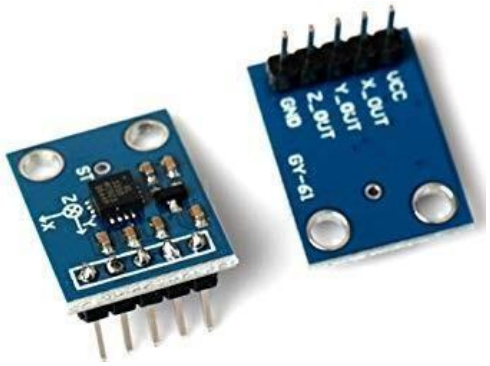


Fig 4 :MEMS Sensor

By sensing the mounting angle, the sensor can assist in compensating for the devices mounting angle, and therefore makes it possible to use ACCELEROMETER FACTSHEET MEMS 3-AXIS ACCELEROMETER normal SMD technology in high density boards, and also to realise the precise detection of the inclination angle. An interface IC within the sensor package also has temperature sensing and self-diagnosis functions.

GSM:

GSM (Global System for Mobile Communications) is a standard for digital cellular communications used for mobile devices. It is widely used in embedded systems for various applications, such as remote monitoring, control, and communication.GSM works by transmitting data over a cellular network using radio waves. The data is encoded and transmitted over a series of base stations, which are connected to the public switched telephone network (PSTN). The GSM standard includes various features, such as voice communication, text messaging, and data transmission.

Fig 5 : GSM

In embedded systems, GSM is typically used for remote communication and control. For example, a device with an embedded GSM module can send and receive data over a cellular network, allowing it to be controlled or monitored from a remote location. This is particularly useful for applications such as remote monitoring of industrial equipment, environmental sensors, or security systems. GSM modules for embedded systems are available in different formats, including compact modules that can be easily integrated into embedded systems. These modules typically provide a serial interface for communication with the host device and canbe programmed to provide different levels of functionality, such as voice communication or data transmission.

LCD:

In embedded systems, LCD displays are a popular choice due to their low power consumption and ability to display clear, easy-to-read text and graphics. LCD displays typically require a small number of pins to control, making them well-suited for use in embedded systems with limited I/O resources.

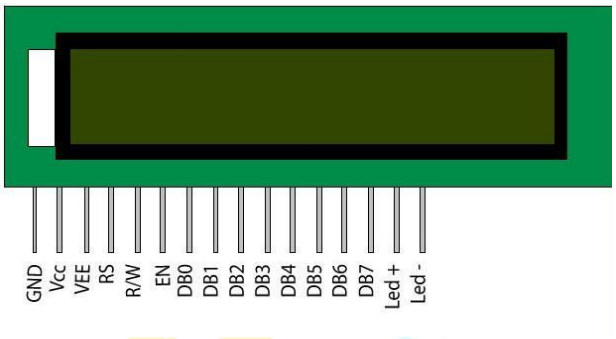


Fig 6 : LCD

Passive matrix LCD displays are often used in embedded systems due to their lower cost and simpler design. However, active matrix displays can offer faster refresh rates and higher resolution, making them a good choice for more demanding applications.One challenge with using LCD displays in embedded systems is the need to manage the display's power consumption to avoid draining the system's battery. This can be achieved by controlling the backlight and adjusting the display's brightness based on ambient lighting conditions.Another consideration is the physical size and durability of the display. Small, ruggedized LCD displays are available for use in harsh environments, while larger displays may require protective enclosures.When selecting an LCD display for use in an embedded system, factors such as cost, resolution, and compatibility with the system's microcontroller or processor should be taken into account.

BUZZER:

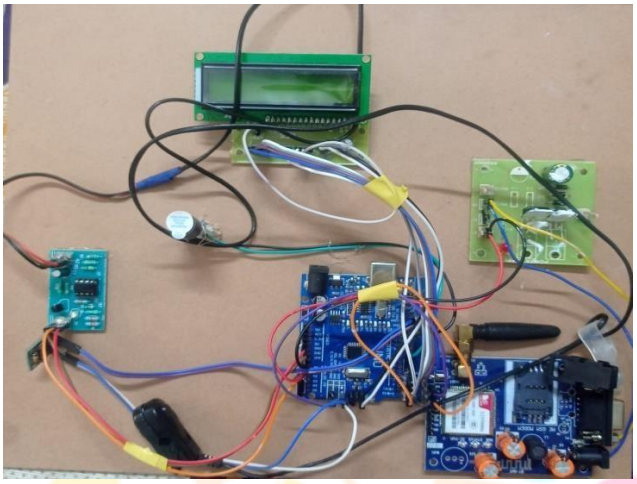
A buzzer is a simple but versatile device used in embedded systems to generate audible alerts or notifications. It is an electro-acoustic transducer that converts electrical signals into sound waves. This makes it easy to use in embedded systems, as it can be driven using simple digital signals from the microcontroller or processor. Buzzer is commonly used in applications such as alarms, timers, and notifications. It can produce a range of sounds, from simple beeps to more complex melodies, depending on the type of circuitry and driver used. Buzzer can also be used in combination with other sensors or modules, such as temperature sensors, to create more sophisticated warning systems. Additionally, buzzer is typically small and lightweight, making it suitable for use in portable or handheld device. It can be made more versatile by incorporating features such as adjustable volume or tone. Overall, buzzer is a cost-effective and reliable component for adding audible feedback to embedded systems.

Fig 7 : Buzz

VII. WORKING OF THE PROPOSED METHOD:

In this project, we are using Arduino uno as a main controller. MEMS sensors connected to monitor the axis of the person. If sensor value exceeds, it will turn ON the buzzer and alert the people around the place. Fall detection, alert message will be displayed in the LCD and cloud.

VIII. RESULTS:



E Fig 8 : Circuit connections

The above figure shows the connection of the circuit. Heart rate values reaches certain threshold values it sends a message to our mobile phone like to High HeartBeat Rate Detected ,Accident Alert

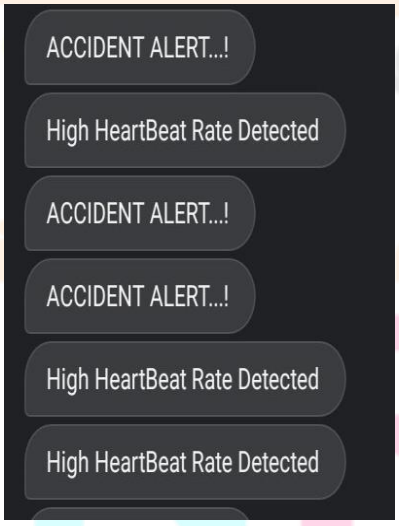


Fig 9 : Messages received to our mobile through the GSM

IX. CONCLUSION

This study proposed a cluster-analysis-based user-adaptive fall detection approach that combines a heart rate sensor and an accelerometer to reduce the risk of falls.By using proposed method we can able to monitor the person while driving. If any accident accrued then GSM will send message to the concerned person so that they can find easily. We can save the person as early as possible.

REFERENCES:

1] Road accidents in India [online] 2007 June 25. Available from: URL: http://www.easydriveforum.com/f44-share-yourroad-experience/road-accidents-in-india834.html
[2] Articles base directory [online] 2011 Feb. 16 Available from: URL: http://www.dwworld.de/dw/article/0,,5519345,00.html
[3] Article from The Hindu [online] 2011 Feb. 10 Available from: URL:http://www.hindu.com/2011/02/10/stories/ 2011021063740500.htm
[4] Yue –Cheng Wu, Yun-qing Xia &, Zhegiang, ―Multichannel reflective PPG earpiece sensor with passive motion cancellation‖ Biomedical Circuits &System, IEEE, 2007, PP 235-241.
[5] Drunk Drivers Beware Of Saab Device,[http://www.buzzle.com/articles/drunkdrivers-beware-saab-device.html]
[6] Nissan to drink drive–proof its vehicles, September 2006,[http://www.nissanglobal.com/EN/NEWS/ 2007/_STORY/070723-01]
[7] Drunken driving protection system International Journal of Scientific & Engineering Research Volume 2, Issue 12, December-2011 1 ISSN 2229-5518
[8] Alcohol sensor and Automatic control system for bike, Volume 2, Issue ICRAET12, May 2012, ISSN Online: 2277-2677.