Fall Detection and Medical Alert System for Deaf and Dumb using Hearing Aid

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Abstract— Falls are the leading cause of accidents and injuries worldwide. Falls are regarded as a significant health risk for the elderly and for those suffering from neurological diseases. Those with balance problems are particularly prone to falls. In particular, hearing accidents make people less aware of their current situation, causing them to fail to see other pets or activities around them. Consequently, hearing loss can impair spatial perception. Finally, hearing loss causes more resources in the cortex to hear and translate speech and sound, so fewer resources are used to walk or balance. These factors can also cause patients with hearing loss to misjudge their harmony and fall. This led to the development of fall detection systems for hearing aids. In addition, this study provides a state-of-the-art analysis of smartphone application-based fall detection. Much research has been done to reduce the negative effects of falls, mainly in fall detection. To increase the usability of the systems, our time series analysis shows a trend towards the integration of external sensors into hearing aids and Android applications.

I. INTRODUCTION

A person's ability to hear allows them to interact socially and converse with others. Those who are deaf have hearing loss, which has an impact on many elements of their lives and makes it difficult for them to interact socially or communicate with those around them. Also, deaf people's safety is frequently jeopardized, because they are unable to make the best option resulting from the process of interpreting noises in the brain, particularly worrisome ones. Accidental falls pose a serious health danger to older persons, typically result in a loss of independence, and frequently affect how they live out their later years. Hearing loss People typically don't go out in the public eye until something dreadful occurs, such as someone becoming harmed, ill, or even passing away. If fall injuries are not treated right away, by 2030 there will be a 100% rise in injuries. A societal imperative, in this case, is an assistive technology that could lessen this major health issue. The answer to these issues is a fall detection system, which lowers such dangers. The number of devices created to detect falls has rapidly expanded since falls are a significant public health issue for impaired people. This paper proposes an improved Android-based fall detection system for deaf and dumb people who use hearing aids with additional features. Below are the main contributions to the work presented in this paper.

i. For fall detection, an Accelerometer sensor – MPU6050 is used to detect the falls automatically. The fall detected by the sensor triggers the Android application directly by means of the Bluetooth module.

ii. On the application, wearer can stop the timer anytime, if wearer feels okay. Hence it will prohibit the call forwarded to the carer. Whenever the wearer hits hard after falling and unable to stop the timer, it will instantly transfer the call and message to the carer. The application will therefore be user-friendly.

iii. A heart rate and temperature sensor is used to measure the wearer's heartbeat and temperature in order to assess their health.

II. LITERATURESURVEY

1) Elderly fall detection using wearable sensors, a low cost highly accurate algorithm. Saleh and R. L. B. Jeanne's (April2019).IEEE Sensors Journal. The hardware resources of wearable devices are limited, designing highly accurate embeddable algorithms with feasible computational cost is still an open research challenge. It is low cost highly accurate.

2) Machine learning-based fall characteristics monitoring system for strategic plan of falls prevention. Hsieh, W. Shi, H. Huang, K. Liu, S. J. Hsu, and C. Chan, (April 2018). IEEE International Conference on Applied

System Invention (ICASI).TheproposedmultiphaseidentificationalgorithmcanautomaticallyandobjectivelyIdentifyfallphasesusingasinglewearableinertialsensor.Theproposedalgorithmcombinesmachinelearningtechniquesandfragmentmodificationalgorithmtoprovidefine-Grainedfallinformationaboutstarting point, endingpointandduration of fall phases for Clinical professionals.

3) Human fall classification system for ceiling mounted Kinect depth images'. Kasur and K. Jo (October 2017).17th International Conference on Control, Automation and Systems (ICCAS),The proposed system presents a vision based human fall classification method to discriminate falls from non-fall events. The depth images from a ceiling mounted Kinect camera are considered in the proposed system to preserve privacy, reduce the influence of occlusion and complex cluttered background.

4) Boosted neural network ensemble classification for lung cancer disease diagnosis.JAALzubi,B Bharathikannan, S Tan war, R Manikandan, A Khanna (July 2019). An effective Weight Optimized Neural Network with Maximum Likelihood Boosting for LCD in big data is investigated to improve the LCD diagnosis accuracy and to minimize the false positive rate as well as classification time.

III.PROPOSEDSYSTEM

The suggested system makes use of the 32-bit RISC processor NodeMCU ESP8266. The Wi-Fi connection on the NodeMCU allows it to access the internet. A standalone SOC with an integrated TCP/IP protocol stack, the ESP8266 Wi-Fi___33 Module allows any microcontroller access to your Wi-Fi___33 network. The ESP8266 has two options: it can host an application or delegate control of the entire Wi-Fi network to another application processor. For deaf people wearing hearing aids, a proposed fall detection and medical warning system would typically incorporate the following elements:

Hearing Aid with Sensors: The hearing aid would be equipped with sensors or accelerometers that can detect falls or sudden movements. These sensors would be integrated into the hearing aid circuitry and with heartbeat, temperature sensor. In the proposed system, the person with hearing loss has a wearable accelerometer for measuring the subject's acceleration and angular velocity, along with the NodeMCU. The accelerometer provides relevant data regarding inertial changes due to body impact and relevant data regarding body rotational speed during a fall event. These types of sensors are cheap, the installation is moderate, and they protect the privacy of the person.

Alert System: Acquiring acceleration and angular velocity data of the wearer is difficult to obtain because similar activities of daily living take place in the same way like lying, sitting, jumping, running, etc. Therein lies a significant difficulty, since many of these actions provide analog readings similar to that of falling. In order to accurately identify a fall, we need to eliminate the other activities of daily living. As pure thresholds of accelerometer readings, you won't be able to tell the fall; therefore, a series of checkpoints are created to determine if a particular event is a fall. The movement of a body produces accelerations that can be measured with accelerometers. When we have the accelerometer as a handheld device, it detects linear acceleration along three perpendicular axes and measures acceleration in units of g (gravity). When a wearer falls, both the X and Y axis readings must be 0 since it is parallel to the ground, while the Z axis reading must be the maximum, hence the values in g (0g, 0g, 1 g) be. Show in Fig 1. [Based on these parameters, an algorithm was developed to detect a real fall.

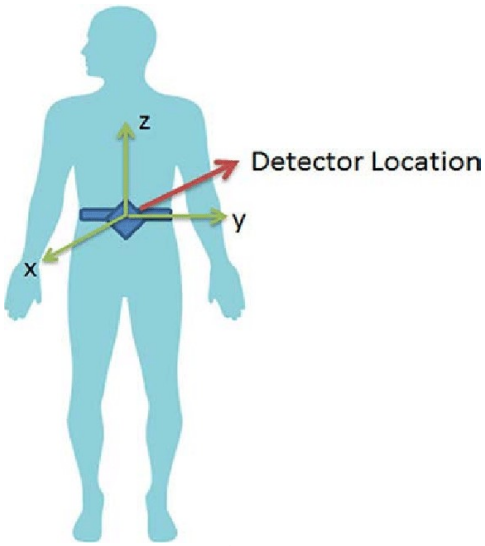

Fig.1.Alert System

HUMAN REPRESENTATION ALONG X Y Z CO-ORDINATES

When a fall or other emergency is detected, the data transmitted by the sensor goes directly to the microcontroller, which triggers the alarm application via Bluetooth. For the timer to start counting down. Whenever a wearer is feeling good and ready to move from a location, they have the option to stop the counter by pressing the timer. Otherwise, when the timer goes to zero, the call, message, and location are forwarded to the caretaker

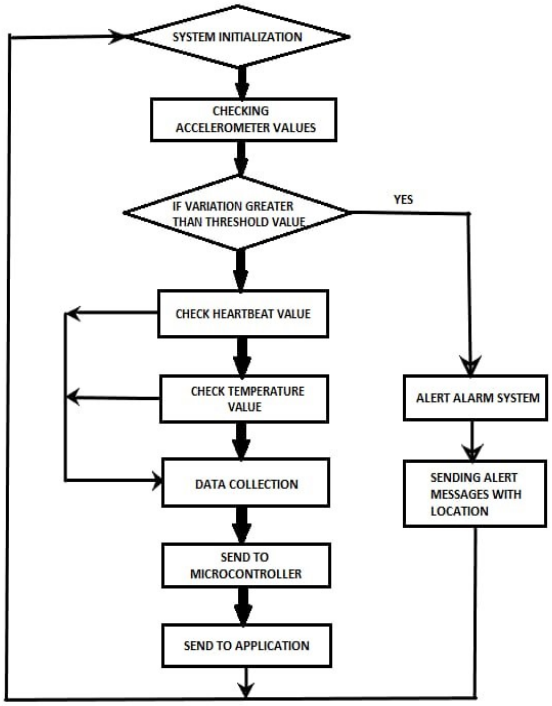

Fig.2.Algorithm to detect fall and alert system.

Bluetooth Connectivity: The NodeMCU and the application would be connected via Bluetooth, allowing carers and emergency responders to access real-time information about the person's location, health status, and contact information. Whenever the fall is detected, the microcontroller triggers an application via Bluetooth and forwards a call, message, or location using the application itself.

Android App: A mobile app could be developed that would allow caregivers to monitor the person's health status and receive notifications. The heart rate and temperature value can also be viewed through the application itself.

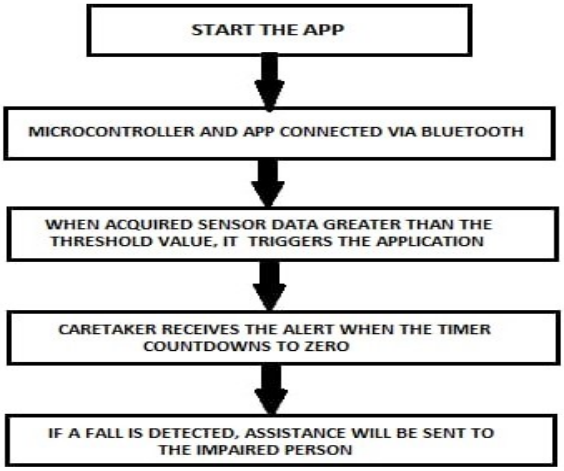

Fig.3.Algorithm for developed Android application for fall detection system.

Overall, the proposed fall detection and medical alert system for deaf and dumb individuals using a hearing aid would provide an innovative solution to enhance the safety and well-being of individuals with hearing and speech disabilities, as well as their caregivers.

IV.PROBLEM DESCRIPTION

Falls are a major source of anxiety for the elderly. Hearing and balance naturally deteriorate as we age. According to the Centers for Disease Control and Prevention (CDC), more than one in every four Americans aged 65 and up falls each year. Even if you are not injured, a fall is frightening. People tend to retreat to their chairs, which begins a downward spiral: you move less, you become weaker, and you are more likely to fall again. Age-related hearing loss, is a gradual loss of hearing that affects the majority of us as we age. It is one of the ailments that older and elderly persons experience the most frequently. About half of Americans over the age of 75 have hearing problems, and one in three Americans between the ages of 65 and 74 have hearing loss. Hearing loss can make it challenging to comprehend medical advice, heed warnings, hear phones, doorbells, and smoke alarms. Moreover, hearing loss might make it difficult to enjoy conversing with family and friends, which can cause feelings of loneliness. It is crucial for the public health that modifiable risk factors for falls in older adults are identified. Shared cochlear and vestibular pathology, poor awareness of the auditory and spatial environment, or mediation through the effects of hearing loss on cognitive load and shared attention are a few possible explanations for this association's observation. Because hearing loss is extremely common but is still incredibly undertreated in older adults. Typically, elderly people don't fall into the public eye until something terrible happens, like someone getting hurt, badly or even pass away. If immediate action is not taken to prevent injuries from falls, those injuries are expected to increase by 100% by 2030. The doctors say that although the crippling effects of aging cannot be avoided, risks can be reduced through careful planning. In this situation, assistive technology that could lessen this serious health issue is a social necessity. The fall detection system is the solution to these issues, in order to lower these kinds of risks. Given that falls are a significant public health concern for seniors, the number of systems

designed to detect them has dramatically increased. This paper suggests an improved android-based fall detection system for the deaf and dumb person using hearing aid.

V.SYSTEMARCHITECTURE

*Module 1: Hearing Aid***:** Depending on your lifestyle, there are high-end, intermediate, and general kinds of hearing aids. Prices for hearing aids are also influenced by a variety of factors, such as how busy you are, how much you socialize, and how much time you spend at home. We advise you to evaluate your way of living and pick the best hearing aid for you.

Module 2: NODEMCU ESP8266: NodeMCU is a development board and open-source Lau-based software that is specifically designed for Internet of Things (IoT) applications. It has hardware based on the ESP-12 module and firmware that operates on Expressive Systems' ESP8266 Wi-Fi SoC.

Module 3: AccelerometerSensor-MPU6050: Learn how to use the Arduino board with the MPU-6050 accelerometer and gyroscope gadget. The MPU-6050 IMU is an accelerometer and gyroscope instrument with three axes of motion. The gyroscope measures rotational motion, while the accelerometer measures gravitational acceleration. This module additionally monitors temperature. This sensor is perfect for detecting a moving object's orientation.

*Module 4: Bluetooth Module***:** A Bluetooth module is a tiny component of hardware that enables wireless communication between two devices. Everything from mobile phones and headsets to keyboards and mice contain Bluetooth modules.The fact that Bluetooth does away with cables—which can be untidy and inconvenient—is one of its main advantages.

*Module 5: Voltage Regulator 7805***:** Most electronics tasks use the 7805 Voltage Regulator IC, which is a widely used voltage regulator. For a supply with varying input voltage, it offers a constant +5V output voltage.

*Module6: Heartrate Sensor***:** Using a heart rate monitor while exercising can help you achieve your goal heart rate safely and effectively without going over your maximum heart rate.

Module 7: Temperature Sensor-NTP Thermistor: The DS18B20 sensor will measure the temperature when the ESP32 development board boots. Following that, a request to view the current time and date will be sent to the NTP server. After logging the temperature measurement and its timestamp to the micro SD card, the ESP32 goes into deep sleep for 5 minutes.

VI.BLOCK DIAGRAM

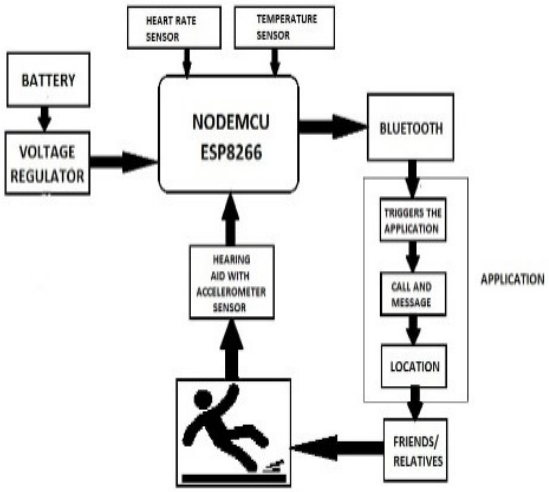

Fig.4.Block Diagram of fall detection system.

VII.METHODOLOGY

This system is about upgraded fall detection system using Accelerometer sensor along with the heart beat sensor and the temperature sensor to assess the health of their wearer. The methodology for developing a fall detection and medical alert system for deaf and dumb individuals using a hearing aid would typically involve several steps:
Research:The firststepistoconsiderexistingfalldetectionandmedicalalertsystems,especiallythosedesignedforpeoplewithhearingandspeechimpairments.Weneedtoidentifythestrengthsandweaknessesofthesesystemsanddeterminehowtheycanbeimproved.

Requirements Gathering: After conducting the survey, you must determine the system's requirements based on user needs, current technology, and governmental regulations. Working with those who have hearing and speech problems, medical professionals, and regulators would be required for this. The needs are constantly dependent on how to improve the current system.

Design: With the requirements gathered, the next step is to develop a detailed design for the system, including hardware and software components, sensors, algorithms, and the user interface. The design should consider factors such as reliability, accessibility, ease of use, and affordability. The hardware and software should be reliable and user-friendly to meet the needs of the users.

Development: The next step after the design step is to develop the hardware and software components of the system. To integrate the various sensors and parts into the frame. This includes connecting the different parts together, arranging them so that they work together, and testing prototypes of the system.

Testing: When the framework has been incorporated, the subsequent stage is to test the system in a controlled environment to evaluate its performance and identify any issues or bugs. This would involve running simulated fall scenarios and emergency situations to ensure the system can detect and respond appropriately.

Validation: Validate the system in a real-world environment, such as a home or healthcare facility, to assess its usability and effectiveness. This would involve working with individuals with hearing and speech disabilities and their caregivers to gather feedback and make any necessary adjustments to the system.

Regulatory Compliance: Ensure that the system meets all regulatory requirements, such as those related to medical devices and accessibility.

Deployment: Final step is to deploy the system in healthcare facilities or homes of individuals with hearing and speech disabilities, and provide training and support to users and caregivers.

Maintenance and Upgrades: After the development of the system, ongoing maintenance and upgrades are required to ensure its reliability, usability, and effectiveness over time.

VIII.CONCLUSION

Using a hearing aid to transmit visual or tactile alerts is a promising solution for fall detection and medical alert systems for individuals who are deaf and dumb. Integrating fall detection sensors with a hearing aid can improve the safety and well-being of these individuals. However, the system must be designed and tested carefully to ensure its effectiveness and usability. The use of hearing aids as an assistive technology in this context is an important area of research and development.

IX.FUTURE SCOPE

Integration with Wearable Technology: Wearable gadgets like smart watches or fitness monitors could be combined with the fall detection and medical alert system. As a result, the system would be able to gather information from a variety of sensors and provide more precise fall detection and health tracking.

*Integration with a Mobile Application***:** The system might be connected to a mobile application, enabling careers or emergency services to get warnings and updates on the user's health in real time. Caretakers would feel more at ease as a result, and emergency reaction times would be quicker.

*Advanced tracking Capabilities***:** The system could be improved with advanced tracking features like monitoring heart rate and blood pressure. As a result, the system would be able to recognize possible health issues at their earliest stages.

X. RESULTAND DISCUSSION

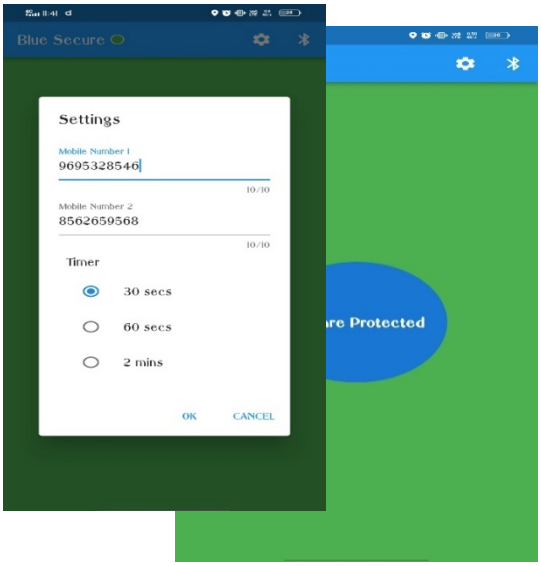

Fig.6.Default settings to store the number of caretaker and timer seconds.

In these Fig 6 it indicates that the person needs to enter the caretaker's numbers and they needs to enter the time, According to that the message and call will process.

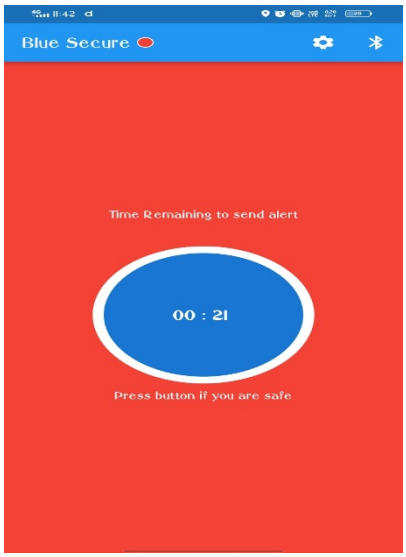

Fig.7.The application page, when the fall is detected.

Fig.7, The timer starts to run until the timer gets end which was set in the previews page.
Fig.8.Alerts the user with location through application.

Fig.8, The message and call will be send to the caretaker's register number, when the timer gets end.

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