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## Intelligent Wireless and Enhancing Fall Risk Detection for Pregnant Women & Elderly using IoT for Safety Precautions

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**ABSTRACT:** Smart devices like smart phones and watches provide a good opportunity to realize the developed FDSs based on the available hardware resources and wireless sensors in IoT environments. Evaluating fall datasets generated by different sources and accelerometers may contribute to the robustness capabilities of the proposed detection algorithm, because it can deal with variable resolution and sampling rates, verifying its generality. Furthermore, employing artificial intelligence techniques presents the main module of current FDSs. Nevertheless, a pre-processing stage of sensing data, such as thresholding, is needed to reduce error possibilities in identifying fall cases by machine learning algorithms. The computational and power costs of implementing machine learning techniques for fall detection should be kept at minimum levels during the design and implementation stages of practical FDSs.

#### KEYWORDS: artificial intelligence; internet of things; fall detection; wearable sensors; old people

#### I. INTRODUCTION

Recently, the World Health Organization (WHO) reported that there are approximately 684,000 disastrous falls worldwide each year, with a majority of victims being individuals over the age of 60. This large percentage places it behind road traffic injuries as the leading cause of unintentional injury fatality. Falls are considered as a main public health concern for the elderly around the world, of which over 80% are in low-income and middle-income countries. Without a doubt, the injuries that elderly people sustain as a result of falls have far-reaching effects on their families, as well as for healthcare institutions and society in general. Emergencies can occur without recognition and even without warning. That is why fall detection technology in medical warning systems is such a critical and life-saving feature. If, for any reason, you were not able to reach the assistance button after a fall (or in a medical emergency), a medical alert system's automated fall detection feature could give you a peace of mind that you would still get the care you need.

Fall detection devices employ alert systems technology to identify and provide emergency assistance to a senior who is prone to falls. If the user falls, these systems will quickly activate the sensor. The built-in technology can be placed around the neck, around the wrist, or on the waist, depending on the device. For premium service charges, most medical alert companies incorporate the fall detection capability within their medical alert system. Some firms sell fall detection gadgets that can be worn separately from one's medical alert button. The cost of the second device may be added to the monthly subscription plan. In the last few years, fall detection has garnered significant concern from both industry and academic research, as seen in. It can be noticed that the number of research articles has increased dramatically. Furthermore, the topic of fall-likelihood prediction, which is based on modern applications concentrated on fall prevention, such as the Internet of Things and artificial intelligence, is also quite important.





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Fig 1: A Pressure Insole-Based Fall Detection System

One commercial approach for preventing falls is the use of personal emergency response systems (PERS). Individuals who fall can use these clinical alarm devices to invoke an emergency department by pressing a button. While the PERS system is useful in many instances, it is rendered worthless if the user is completely unconscious or unable to reach the button. Even when the system is available, recent cohort research indicated that roughly 80% of older persons who were wearing a PERS did not use it to call for aid after falling. Passive monitoring approaches have been proposed to identify falls due effectively and precisely to the problems connected with PERS systems. Several options are currently available, the majority of which are wearable devices, cameras, microphones, and pressure sensors implanted beneath the flooring that are incorporated in the domestic surroundings. Based on the best of our knowledge, this article presents the first survey of IoT-based fall detection systems, including different wearable and non-wearable sensor types, machine learning and deep learning detection algorithms. In addition, the article also describes the challenges and the future trends of fall detection systems, such as the availability of public datasets of falls for senior people and the development of new lightweight deep models for accurate fall detection with minimal hardware resources.

#### **II. LITERATURE SURVEY**

Overview of the literature survey is essential because it looks at different analyses. It explores every corner of the earlier works that has been released, taking into account various project characteristics and the project's scope. A literature review's main aim is to look into the project's history in detail, pointing out flaws in the current setup explains how things are arranged and points out areas that still need improvement. It discusses the project's background and highlights the problems and limitations that inspired the project, along with suggestions to solve these issues.

Fall Detection System for Elderly People using IoT and Big Data: Diana Yacchiremaa,b,, Jara Suárez de Pugaa, Carlos Palaua, Manuel Esteve, — Falls are a critical health risk for elderly individuals worldwide, often leading to severe consequences if help is not provided quickly. This work presents a cutting-edge system of falldetection based on IoT, designed to monitor aged individuals in indoor settings. By integrating big data, smart devices, cloud technology and wireless sensor networks with low power, the system achieves high accuracy in detecting falls. This data is processed through a big data model on a smart IoT gateway based on decision tree, ensuring effective and timely detection of fall.





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When a fall is detected, system automatically sends alerts to designated caregivers. Additionally, the system's cloud component enables healthcare providers to access detailed fall records, allowing further analysis and updates to the machine learning model based on new data. Experimental results show high performance in detection accuracy and reliability, highlighting the system's potential to improve elderly care through innovative technology.

The article highlights the issue of the scarcity of publicly available fall datasets for testing these detection algorithms. Finally, it concludes by recommending improved methods, such as lightweight models, as potential solutions, aiming to look towards the future of IoT-based systems for accurate detection of fall in aged people.

Enhancing Elderly Fall Detection through IoT- Enabled Smart Flooring and AI for Independent Living Sustainability: Hatem A. Alharbi, Khulud K. Alharbi and Ch Anwar Ul Hassan-Falls among elderly individuals living alone can lead to serious consequences, such as complications after the fall, making timely fall detection essential. This topic of study presents a novel elder fall detection system that integrates AI technologies and IoT to improve the safety of elderly people. Experiments with 13 participants were conducted to simulate fall events, where the RFID tags sent signals to the readers, allowing the system to distinguish between falls and normal movements. Results revealed that the Random Forest algorithm had a 43% accuracy, GRUs achieved 44%, and XGBoost reached 33%. However, KNN excelled with an accuracy of 99%. This research aims to propose an effective fall detection system that enhances the safety and wellbeing of elderly individuals living independently, while also supporting sustainable IoTand AI solutions for healthcare. Elder Assist - An IoT Based Fall Detection System: Prashant Wakhare, Hrishikesh Tavar, Priyanka Jagtap, Mayur Rane , Harshvardhan Waghmare-With the increasing global population, there is an urgent need for advanced fall detection systems, especially for elderly individuals, as falls can have serious and life- altering consequences. The rapid advancements in sensor technologies and the Internet of Things (IoT) have made human-computer interaction through sensor fusion a promising solution to address fall detection and provide immediate assistance. This paper introduces a solution by proposing an IoT-based device integrated into a walking stick, a common tool for elderly users. The device, built with sensor networks and IoT technology, is designed to aid both elderly and visually impaired individuals. The smart walking stick not only helps with fall detection but also assists in navigation, making it easier for users to move confidently and safely. The system uses an ultrasonic sensor to detect obstacles in the user's path, alerting them to any potential hazards. This enables users to navigate their surroundings without fear of encountering objects. The project also aims to enhance thefunctionality of this walking stick by improving its obstacle detection capabilities, ensuring a more effective navigation experience. By measuring the distance between the user and nearby obstacles, the smart walking stick can notify the user of approaching objects, helping them maintain their independence and mobility with greater ease and safety.

An IoT- Based Wearable Fall DetectionSystem; Alin Anil1, Athira S, Raifa Rafi, Asst. Professor Netha Merin Mathew - Falls are a major health concern, particularly for the elderly. Older adults are more likely to die or get seriously hurt from falls, and this risk grows as they get older. It is estimated that between 28-35% of people aged 65 and above experience a fall annually. While it may not be possible to prevent every fall, steps can be taken to minimize the risk of severe outcomes. The wearable device primarily uses a triaxial accelerometer sensor attached to the user's body to differentiate between daily activities and fall events.

A Novel Iot Based Automatic Fall Detection Cavity For Elderly People Using Mems- 1 Pedditi Satvika, 2 Parankusham Vaishnavi, 3 Mamindla Mounika, 4 Dr. K. Srujan Raju: Here's a reworded version of the text with different wording If not treated promptly, falls can lead to long-term disabilities and a significant decline in an elderly person's mobility, independence, and overall well-being. The most severe effects of falls are not necessarily from the fall itself, but from delays in receiving assistance or lack of timely treatment. To improve the quality of life for elderly individuals and others in need of special care, it is crucial to have a monitoring system that can alert caregivers when emergency help is required. Recent advancements in technologies such as the Internet of Things (IoT) and mobile communication have enabled the collection of data on individuals and their surroundings for various purposes. This study introduces a novel IoT-based automated fall detection system for seniors, utilizing Micro Electro-Mechanical Systems (MEMS). When a falloccurs, a low-cost detection device is used to accurately identify the incident. The fall detection algorithm works by analyzing acceleration data and comparing it against preset threshold values for bothlower and upper limits. To enhance detection accuracy, a post-fall recognition module is added, which combines posture analysis with vertical velocity estimation. The system provides immediatevoice alerts to the user upon detecting a fall and shows the information on an LCD screen. The data is then uploaded to the IoT server, where caregivers can monitor the situation in real time.





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#### **III. METHODS**

In the aftermath of a fall, vital signs are usually altered quickly due to shock. The physiological changes can be used to establish the likelihood of a fall. Electrocardiography is a technique for recording electrical signals generated by the heart muscle and displaying the state of the heart in various scenarios. The procedure of measuring blood volume changes is known as photoplethysmography. Spirometers are diagnostic tools that measure lung capacity and airflow. Galvanic skin response is a component of the human sympathetic nervous system that reveals electrical features of the skin. Blood pressure is measured in systolic and diastolic units, with systolic being the highest and diastolic being the lowest. Furthermore, sensors can track the blood's oxygen saturation. Electroculography is a technique that uses the retina's resting potential to quantify eye movement. Physiological signals can be easily recognized, such as body temperature, or they can be detected more complexly, as indicated above. A system of smart environmental sensors is used in smart environments to detect falls by voice, light intensity changes, and distance between the body and the floor. In, this study proposed radio signals of Wi-Fi connections for detecting falls from the physical components in the environment. In addition, environmental sensors are categorized as vision-based sensors. A fall event can be identified by analyzing RGB images and video streams from 2D and 3D cameras, based on color and/or thermal postures processing.



Fig 2: Sensor Systems for Fall Risk Assessment

The perceptron was fed using extracted features of the obtained data in prior Multi-Layer Perceptron (MLP) investigations. Recent research has suggested that raw data acquired from wearable sensors be fed directly into neural network classifiers. This eliminates the challenge of selecting a suitable feature extractor or the need for additional preprocessing steps before utilizing machine learning models to detect falls. As a result, no computing expense is required to identify data features, and smart detector implementation can be simplified by using inexpensive wearable devices, such as smartwatches.

Raw data, on the other hand, is not necessarily the greatest place to start when building intelligent classification systems. The use of public and open access datasets as benchmarking tools for evaluating algorithms is on the rise. In any event, it is important to emphasize the lack of an internationally agreed benchmarking dataset for evaluating and comparing FDSs. With only four studies employing it, the SisFall repository, one of the largest datasets for the evaluation of FDSs, is the most popular dataset.

#### **IV. RESULT ANALYSIS**

Fall signals are simply measured by body sensors, e.g., accelerometers, and sent to an external device for intelligent decision-making processing, like a PC with a wireless module such as Bluetooth, as presented in. This external device is responsible for analyzing the acquired signals of the accelerometer sensors and, with a developed neural network classifier, the decision of fall detection is taken. In, the authors built a framework using a field-





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programmable gate array (FPGA) kit to apply the ANNs classifier to develop an embedded vision-based detection system of falls. A digital signal processor (DSP) was utilized to accelerate the ANNs functionality in the context-aware system, as described in. A bio-inspired optical sensor has been used in this study. However, embedded wearable detection systems and solutions based on FPGAs and DSPs are still under development and not implemented as realized commercial systems yet. In most previous studies, wearables are just utilized for sensing and collecting data in the experiments. After finalizing the experimental phase, the recorded sample signals are extracted from the datasets for training and testing the proposed algorithm, either in a hardware or a software form using MATLAB and/or other programing languages like C++.

Comparing neural network models with other machine learning and/or thresholding techniques is usually focused on the performance of the discrimination function only, while other technological features are ignored. Therefore, physical characteristics of operation, e.g., memory size, consumption of energy and processor capacity, and running time/speed may affect the outcome performance metrics to evaluate these smart algorithms successfully. The execution time for the training phase of ANN models was estimated to be higher than other methods in a comparative study of six machine learning algorithms. In contrast, the computational time of the testing phase for ANN models can have the same value as, or be even lower than, other methods to obtain the detection decision.



Fig 3: Enhancing Elderly Fall Detection through IoT-Enabled Smart Flooring and AI

In our daily lives, a fall might occur while doing complex tasks like cycling, therefore it is not as straightforward as a fall while walking. The dataset of complicated activities is multi-dimensional, containing dependent and independent information in many dimensions with different formats. The edge, fog, and cloud layers of an IoT architecture provide processing, storage, data management, and decision for fall cases. Three steps have been proposed for a diagnostic system of falls: prediction, prevention, and detection mode, with each stage determining which layer is appropriate. Stages should be implemented on each layer utilizing protocols, energy efficiency, and device-to-device and layer-to-layer transmission techniques, as well as specialized learning algorithms for each layer. A smartphone, for example, can detect falls on the edge and in the fog computing layers.

Because a wearable processor, such as a wristwatch, is currently too weak to execute advanced learning algorithms effectively, data are sent to another device situated in fog. Without the need of additional layers, high-performance processors could be proposed to identify the falls by processing measured data and authenticating fall occurrences at the edge. Smart sensors are more complicated than regular sensors because they contain small microprocessors, noise filters, transducers, and amplifiers. Thousands or millions of them are spread in an IoT environment, and they must be logically connected in order to supply energy, communicate with one another, increase





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sensor lifetime, and overcome the shortage of processing and storage capacities. Even though many research studies have been carried out on sensor placement, which might be static or dynamic, this aspect still remains one of the most difficult subjects in the field.

#### V. CONCLUSION

In this IoT-based fall detection system offers an effective and reliable solution to address the critical need for real-time monitoring and safety assurance for elderly individuals. By integrating wearable sensors and leveraging IoT connectivity, the system successfully detects falls with high accuracy and promptly alerts caregivers, ensuring timely assistance and reducing the potential for severe health consequences. This project demonstrates the potential of IoT in advancing healthcare for the elderly, providing a scalable and accessible technology that enhances the quality of life and peace of mind for both elderly individuals and their families. Future developments could include integrating machine learning algorithms to improve detection accuracy further and expanding functionality to include predictive analytics, allowing for even more proactive health monitoring and intervention.

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