ABSTRACT

In fact, falls exponentially increase with age-related biological changes, which is leading to a high incidence of falls and fall-related injuries in the aging societies. In this context, assist device that could help to alleviate this major health problem are a social necessity. Most traditional medical alert monitoring systems rely on a pendant or button that your loved one must press in order to call for help. These systems are highly effective and save lives every day. Some seniors, though, are at a higher risk of falling than others. There is the possibility that when your loved one falls, they may be unable to press their medical alert button to call for help. This is where Automatic Fall Detection comes in. The benefits of automatic fall detection to seniors can be great. Also, if you or your loved one has diabetes or another condition that increases your risk of falling, this feature might provide you with additional piece of mind. If your loved one sustains an injury or becomes unconscious from a fall and they are alone, their chance of getting help fast is increased significantly by automatic fall detection technology.

Key words: Fall detection, fall prediction, feature extraction, gait monitoring, patient-specific, support-vector machine, threshold detection, wearable sensor.

1. INTRODUCTION

The rising populace of elderly people has increased the risk of accidental and unassisted fall events [1]. Accidental falls are a major concern for the elder people; being the main cause for hospitalization and the second leading cause of unintended injury-related demises among the elder people in the world [1]-[3]. According to the U.S. Centers for Disease Control and Prevention, 25% of the Americans aged 65 or above experience a fall once each year [4]. Every 11 second an elderly person is treated in the hospital for a fall and, every 19 seconds an elderly person dies from a fall. These falls cause more than 27,000 deaths and more than 800,000 injuries annually and cost tens of thousands million dollars every year [1], [2]. Fig. 1 shows the number of reported fatal fall events and their expenses per age group for elder people (> 65
A PATIENT-SPECIFIC SINGLE SENSOR IOT-BASED WEARABLE FALL PREDICTION AND DETECTION SYSTEM

years) in the USA only in 2010 [3]. The undesirable effects of fall events have led to wide attention in the fall risk assessments, detection, and prediction systems by health-care professionals. It is crucial for the healthcare providers to determine circumstances and scenarios that led to a fall event and advise a mechanism to mitigate such falls [5]. In practice, most of the fall risk assessment are usually collected through patient’s interviews and questionnaires, fall diaries, phone calls, and simple physical performance tests [6]. Data collection through the formerly mentioned methods provides pertinent information, but these statistics cannot be treated always as the reliable medical record since elderly people often forget or fail to recall the precise circumstances of their fall event [5], [6]. Identifying the person as a high fall-risk patient is not sufficient to protect the patient. Therefore, accurate continuous monitoring with a decentralized on-spot decision [7] - [9], and recording mechanism is critical for the fall-prone patients and elderly people [10]-[13]. Several research studies have proposed different methods to detect a fall event, however, very few ones predicted the fall event before it occurs [10]-[15].

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The study in [6] presents an algorithm to classify elder women subjects as high or low fall risk patients. Ref. [15] proposes a fall prediction and detection algorithm based on a tri-axial accelerometer, predicting the fall event 200~400msec before the collision with a limited number of test cases. Falls can be detected by monitoring a person’s surrounding using a fixed video camera with computer vision [14]-[17], wearable cameras [18], pressure sensors [19], smart tiles [20], and acoustic sensors (Microphone Array System) [21]. Radar-based systems [22], and Microsoft Kinetics [23]. The alternative approach is to utilize inertial wearable sensors such as a gyroscope and an accelerometer [24], [25] or the inertial sensors of the mobile-phones [10], [26]-[27]. However, the gyroscope is typically not preferable due to higher power consumption than the accelerometer [11]. To continuously monitor fall events, it is more suitable to use wearable devices with detection and prediction capabilities as they can be utilized anywhere and not limited to certain locations [24]. Several fall detection algorithms recognize multiple features to differentiate between fall cases and regular activities of daily living (ADL). These features include falling speed, stride time, acceleration coordinates, posture information, inactivity periods, and angular velocity [2], [25], [28]. The extracted features are then classified as a fall event or an ADL, using a threshold value or by combining posture information and kinematic thresholds, to generate a decision [11]. Nevertheless, the falling speed and gait features exhibit deviation from person-to-person and varies with aging too [29],[30]. Therefore, it is essential for a fall detection system to tackle these differences for accurate fall detection [31].

This paper presents a patient-specific (PS) fall prediction and detection prototype system. In this work, a single tri-axial accelerometer sensor attached to a person’s thigh is utilized to predict and detect the fall events and save their data for detailed follow-up by the medical practitioner. The patient will be notified if a fall event is predicted while the occurrence of a fall event will initiate an alarming notice to the concern healthcare providers by connecting it through the internet. The performance of the proposed system is verified on 77 subjects with 600 recordings including 100 recordings of Fall/ADLs from 20 elder subjects (aged above 65 years).

2. EXISTING SYSTEM

In existing system, multiple view approach to achieve this goal, where motion is modeled using a layered hidden Markov model. The posture classification is performed by a fusion unit, merging the decision provided by the independently processing cameras in a fuzzy logic context. In each view, the fall detection is optimized in a given plane by performing a metric image rectification, making it possible to extract simple and robust features, and being convenient for real-time purpose.
2.1. DISADVANTAGES OF EXISTING SYSTEM

- Low accuracy
- Low robustness
- NO IOT

3. PROPOSED SYSTEM

The proposed system is to find the place where it is and locate the person and sending a message using a system which is placed inside of system. Most of the times we may not be able to find fall accident location because we don’t know where accident will happen. In order to give treatment for injured people, first we need to know where the accident happened through location tracking and sending a message to your related one or to the emergency services. So in this work we are using the Node mcu microcontroller. GPS which helps to trace the vehicle anywhere on the globe. The exact location of the vehicle is sent to our remote devices using IoT when the accident occurs, the accident are determined with the help of gyroscope sensor.

3.1 ADVANTAGES OF PROPOSED SYSTEM

- High Efficiency
- More accuracy

3.2. APPLICATION

- Patient monitoring Hospitals and home,
- Child care monitoring

4. BLOCK DIAGRAM

5. HARDWARE REQUIREMENTS

- MICROCONTROLLER
- LCD
- PC
-gyroscope sensor
6. MICROCONTROLLER
A microcontroller (abbreviated MCU or μC) is a computer system on a chip that does a job. It contains an integrated processor, memory (a small amount of RAM, program memory, or both), and programmable input/output peripherals, which are used to interact with things connected to the chip.

![Microcontroller](image1.png)

**Figure 1 Microcontroller**

7. LCD
A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome.

![LCD](image2.png)

**Figure 2 LCD**

8. PC
Stands for "Personal computer." PCs are what most of us use on a daily basis for work or personal use. A typical PC includes a system unit, monitor, keyboard, and mouse. While PC stands for "personal computer," the term can be a bit ambiguous.

![PC](image3.png)

**Figure 3 PC**
9. GYROSCOPE SENSOR
Gyro sensors, also known as angular rate sensors or angular velocity sensors, are devices that sense angular velocity. Angular velocity. In simple terms, angular velocity is the change in rotational angle per unit of time.

Figure 2 Gyroscope Sensor

10. SOFTWARE REQUIREMENTS
- EMBEDDED C
- KEIL COMPILER IDE

11. CONCLUSION:
In this work, we propose a PS single sensor fall prediction and detection prototype system. It will alarm the patient to take action if a fall case is predicted while if a fall event is detected, it will be communicated to health care providers. The detected fall events will be alarmed to the health care providers through Clouds to provide immediate help to the fallen elder person.

REFERENCES
