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Tracking of Elder People Using Smart System

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ABSTRACT: The current paper presents an outdoor monitoring of elderly people using smart system and Fall detection for elderly and patient is a important service that has the potential of increasing autonomy of elders while minimizing the risks of living alone, which can transmit information on physiological signals and falling events to a healthcare center and family members at any time and from any place. To detect simultaneously the occurrence of any falling event using triple axes accelerometer and gyroscope. using pulse and temperature sign to detect early disease prediction using classification algorithm like SVM or Naïve Bayes algorithm and to avoid false alarm .

KEYWORDS: elderly fall detection, outdoor healthcare monitoring, support vector machine.

I. INTRODUCTION

Telemedicine information systems [1]-[4] have become increasingly essential, particularly intelligent systems used to provide high-quality healthcare monitoring, which save on medical and manpower costs [5]-[8]. Population aging is inevitable, and with the progress of civilization and medicine, the primary cause of death has changed from infectious to chronic diseases. Thus, rescuing elderly patients in the event of accidents and illness are of primary importance. To address the needs of an aging society, a number of challenges should be overcome in developing a healthcare system, namely, 1) the timely and accurate delivery of physiological signals of elderly patients to the healthcare center and family members using early disease prediction using classification algorithm like SVM 2) the detection of any falling event of the elderly patients using sensors which a rescue notification is sent to the nearest healthcare center and to the families concerned intelligently assemble the components into a robust, friendly-user and effective system, making no false alarm and detecting each fall case, without affecting elderly daily living patterns. Several healthcare applications have also been presented. Lin et al. [9] proposed a real-time multiuser wireless physiological monitoring system with bidirectional communication. The system comprises mobile physiological examination devices that record body temperature, blood pressure, and pulse signals. Zhou and Hou [10] proposed a comprehensive cardiac monitoring system to support an ubiquitous computing and real-time cardiac monitoring service. Additionally, the system presented four operation modes and defined the transmission priorities of symptoms for different patients. However, the proposed instruments by both Lin and Zhou did not allow remote access from the healthcare center for immediate management of the system. An intelligent computer-aided nursing system proposed by Wang et al. [11] examined blood pressure and pulse signals using an intelligent healthcare box. Vaidehi et al. [14] used a camera placed inside the room of a patient to detect a falling event. The drawback of the system was that the patient had to stay in the same place for a prolonged period. Although early vision-based approaches use RGB cameras, depth sensors such as the Microsoft Kinect have recently become popular [6]. Depth sensors not only have a lower price tag and more functionality, but also help preserve the privacy of the monitored person when only the depth map is used [7]. Hsieh et al. [15] presented a system that utilizes a wrist-worn motion-sensing device to detect falling events; the sensing device consists of a tri-axis accelerometer and a three-axis gyroscope, but the location of falling objects could not be determined immediately.

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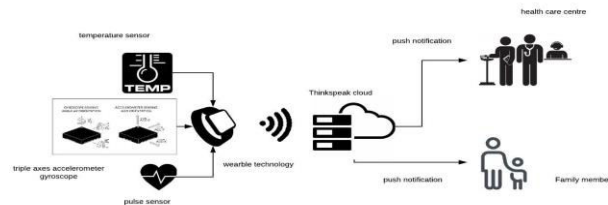


Figure 1.0 architecture of the Expert System

A. System Architecture: Expert System

A healthcare system is beneficial for elderly persons because it enables them to take care of themselves on a daily basis, because the occurrences of accidents when an elderly who is alone is very dangerous. Thus, a healthcare system is proposed to reduce medical costs. The proposed expert System can be miniaturized as a watch or a portable device that can be carried easily, as shown in Fig. 1.0. In the event of a fall or upon transmission of an abnormal pulse and acceleration signal, the device can send an emergency notification to both the healthcare center and a family member to facilitate emergency rescue. As shown in Fig. 1.0, thus, the Expert System functions as a healthcare center that serves as the relay station for processing responses to the emergency event, and a family-notification device that can observe the status of the elderly patient. The details are presented in the following section.

B. Hardware and Software Description:

The hardware used in the system comprises major component as arduinonano, Accelerometer and Gyroscope sensor (GY-521 MPU Tri-axial accelerometer gyroscope module), Pulse Rate sensor, Temperature Sensor, Node MCU. The detailed explanation of sensors is given in subsequent sections.

Accelerometer Gyroscope Sensor:

The GY-521 MPU-6050 sensor contains a MEMS accelerometer and a MEMS gyro in a single chip. It contains 16-bits analog to digital conversion hardware for each channel. Therefore it captures the x, y, and z channel at the same time. The sensor uses the I2C-bus to interface with the arduinonano. The values from the sensor are used to determine threshold range for fall.

Temperature Sensor:

The Temperature sensor used to measure temperature of elderly is LM35. This integrated circuit gives a precise output voltage which is linearly proportional to centigrade temperature. LM35 is rated to operate over a -55°C to $+150^{\circ}\text{C}$ temperature range

Pulse Sensor:

Pulse Sensor Amped is a plug-and-play heart-rate sensor for Arduino and Arduino compatibles. Who want to easily incorporate live heart-rate data into their projects. Pulse Sensor adds amplification and noise cancellation circuitry to the hardware. It's noticeably faster and easier to get reliable pulse readings. Pulse Sensor Amped works with either a 3V or 5V Arduino.

Wi-Fi Module:

Connect ESP8266 module with arduinoESP8266 runs on 3.3V, so need to power from the 3.3V output of arduino. Connect VCC and CH_PD of ESP8266 module to 3.3V output of arduino and the ground of ESP8266 to the ground of arduino. The RX pin of the ESP8266 is not 5V tolerant so, need to reduce the 5V TX output of arduino to 3.3V using voltage dividing resistors. Here, using three $1\text{K}\Omega$ resistors connected in series for that. So, connect pin 10 (TX) of Arduino to RX of ESP8266 module via voltage dividing resistors. Can directly connect TX pin of ESP8266 to 9th (RX) of Arduino as it will detect 3.3V as logic HIGH.

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II. MATH EQUATION

A. Fall Detection System

A gyroscope and accelerometer to measure acceleration along the x, y and z axis and the module can be computed as:

$$a^2 = \sqrt{aX^2 + aY^2 + aZ^2}$$

where in equation (1) aX, aY and aZ are the acceleration readings in directions of x, y, and z-axis measured by the accelerometer. A fall is directly assumed if the measured module of the acceleration exceeds a predetermined decision threshold. While the gyroscope sensor r denoted as (gX), (gY) and (gZ).

$$GT = \sqrt{gX^2 + gY^2 + gZ^2}$$

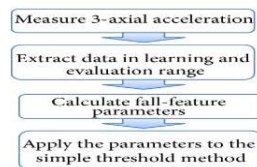


Fig 1.1 Flowchart of fall detection

Algorithm for fall detection

- (1) if the parameter > threshold value of the parameter then
- (2) (if θ > threshold value) then
- (3) return fall detection
- (4) return no fall detection

B. Health Monitoring:

Table 1: Threshold values for alarming mechanism.

type	Threshold value of heart rate and temperature ,BP.
Normal	$60 \leq HR \leq 100$ (beats/minute) and temperature = $36.5-37.5^\circ C$
Bradycardia	$HR \leq 60$ (beats/minute)
Tachycardia	$HR \geq 100$ (beats/minute)
Hypertension (Stage1)	Blood pressure = Sys/Dys $\geq 140/90$ mmHg
Hypertension (Stage2)	Blood pressure = Sys/Dys $\geq 150/95$ mmHg
Hypotension	Blood pressure = Sys/Dys $\leq 90/60$ mmHg

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Fever	Temperature $\geq 37.8^{\circ}\text{C}$
Hypothermia	Temperature $\leq 35.0^{\circ}\text{C}$

Algorithm for Health Monitoring:

HR = Heart rate; BP = Blood pressure; Temp = Temperature; VL = Very low; L = Low; H = High; VH = Very high

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IF (HR is L) and (BP is L/H) then "Warning for Bradycardia"
ELSE IF (HR is L) and (BP is L/L) and (Temp is L)
Then "Warning for Hypothermia"
ELSE IF (HR is L) and (BP is L/L)
Then "Warning for Hypotension"
ELSE IF (HR is H) and (BP is L/H)
Then "Warning for Tachycardia"
ELSE IF (HR is H) and (BP is L/H) and (Temp is H)
Then "Warning for Fever"
ELSE IF (HR is H) and (BP is HH/HH)
Then "Warning for Hypertension"
ELSE IF (HR is VL) and (BP is VL/VH)
Then "Alarm for Bradycardia"
ELSE IF (HR is VL) and (BP is VL/VL) and (Temp is VL)
Then "Alarm for Hypothermia"
ELSE IF (HR is VL) and (BP is VL/VL)
Then "Alarming for Hypotension"
ELSE IF (HR is VH) and (BP is VL/VH)
Then "Alarm for Tachycardia"
ELSE IF (HR is VH) and (BP is VL/VH) and (Temp is VH)
Then "Alarm for Fever"
ELSE IF (HR is VH) and (BP is VH/VH)
Then "Alarming for Hypertension"
ELSE Patient is normal
(No signs of above mentioned diseases detected)

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III. EXPERT SYSTEM IMPLEMENTATION

Fall detection method

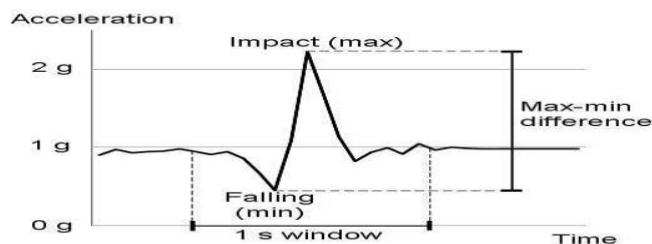


Fig1.3: Graph fall detection System

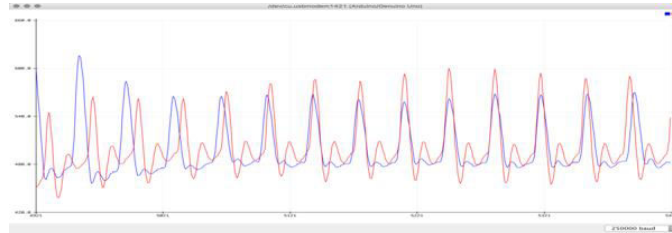
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Health monitoring using serial monitor



IV. CONCLUSION

Tracking of elder using expert system was proposed to monitor the condition of elderly persons using a multi-function expert system placed outdoors. The proposed system can assist doctors and nurses in immediately observing the physical condition of their elderly patients. An Expert System was implemented to collect the physiological data send to cloud respectively. The system can detect whether the person is falling by analyzing the collected information. The accelerometer and gyroscope module is an auxiliary apparatus that is used to determine the status of elderly patients. The healthcare center would be notified of the need for rescue when the fall was continuously detected and pulse and temperature sensor interaction monitoring information. Furthermore, a two-thread system was proposed to improve the successive probability of fall detection. According to the experimental results, the successful detection time can be improved by 38% based on 4,000 samples thereby increasing rescue opportunities for elderly patients

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