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# IOT Based Health Tracking Shoe For Elderly People Using Gait Monitoring System

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**Abstract** - Modern Technology increases the economic needs of each person in their machine life. This Machine life reduces the time to take care of their elderly parents in the real world. This paper proposed techniques to monitor and track their elderly parents from their shoe embedded with sensors. Proposed Techniques that track their gait structure and blood pressure, heart rate, and information passed to the responsible person of the elderly parents through SMS. This Paper consists of strategies to implement the gait monitoring system through the wireless sensor with a mobile application using the GSM Sim module.

**Keywords:** Elderly Person, Piezoelectric Sensor, Arduino, Applications, GSM Sim.

## I INTRODUCTION

Human phase investigation is actually the focus of many experimental projects. The Information Web Inquiry for Rational Documents with a Style on the Title Reveals More than 3,400 distributions in the 2012 and 2013 range. Since the study of this type of investigation began in the early nineteenth century, it has been determined to illustrate measures to extend the scope of estimates of specific boundaries to different areas, for example, the ID of persons for athletic, security purposes, and medicine. If there is community in the health sector, phase improvements reveal important evidence about the quality of life of individuals. When looking for accurate evidence of the progression of different diseases, it is of particular interest: (a) neurological diseases, for example, multiple sclerosis or Parkinson's; (B) basic infections such as heart disease (in which progression is impaired); (C) dynamic changes caused by stroke and (d) diseases caused by maturity, which affects a large part of the population. Accurate, consistent descriptions of walking characteristics at a given time, and more importantly, analyzing and reviewing them over a period of time can allow for the early detection of infections and their complications and help to find the right care [13-14].

## II BACKGROUND STUDY

Caldas et al. (2020)[1] pointed toward recognizing the norms for the utilization of versatile prescient frameworks to step investigation, given the broad exploration of this field. Moreover, additionally proposed to check whether such strategies can successfully uphold clinicians in deciding the quantity of physiotherapy (Caldas, 2020) meetings important to recuperate stride related dysfunctions. Their information procurement and handling strategies dissected them through specially appointed surveys. Furthermore, it inspected the versatile methodologies quantitatively.

Sampath et al. (2019)[2] proposed an analysis of the gait with the help of IoT to determine (Sampath Achanta, 2019) the persons' living behavior. It's mainly focused on the elderly and the people who are physically disabled. This paper mainly deals with the design, methodology, and approach to extract information about older people or physically challenged people. The proposed methodology is used to track the people's changes and predict the updated values based on the Gait analysis. The sensor may use to monitor the performance of physically challenged and older adults.

Wang et al. (2020)[3] investigate the objective was two-crease: to plan and actualize an incorporated, customized telehealth framework on a network-based level; and to assess the framework from the point of view of client acknowledgment. The framework was intended to catch and record more seasoned grown-ups' wellbeing related data (e.g., everyday exercises, constant imperative signs, and walk practices) through different estimating devices. Best in class information mining strategies (Wang, 2020) can be coordinated to recognize factually huge changes in everyday records, in light of which a choice emotionally supportive network could discharge alerts to more established grown-ups, their relatives, and their guardians for fitting intercessions to forestall further wellbeing weakening. A sum

of 45 more established grown-ups selected from 3 older consideration places in Hong Kong was told to utilize the framework for a very long time.

### III MATERIAL AND METHODS

The Material used to determine the gait analysis for the older people in the home are given in the following table.

Components	Sensor Module	Quantity
Arduino	UNO	1
Piezo Electric Sensor	-	4
Bluetooth Module	HC-05	2
Heart Rate Sensor	-	1
Blood Pressure Sensor	BMP 180	1
GPS Module	NEO -6M	1
GSM Module	SIM 900A	1

Table 1: Related Material – Gait Analysis

The functionalities of each component are described below are

- Piezo Electric Sensor which used to determine the pressure of the leg –older people with four parameters, which consist of x and y-axis, as discussed in experimental results.
- Heart Rate and Blood Pressure sensor used to extract the heart rate and blood pressure of older people.
- GPS Module used to determine the location of the elderly people
- GSM Module which acts as an interface between the application and embedded sensor
- Blue tooth components are used to pass the information via wireless, consisting of both transmitters and receivers.
- Arduino UNO – a proposed code to determine all the components and sensors to transmit the information to the GSM Module where the cloud's data is stored.

#### A.RELATED WORK

An Automated tracking shoe is embedded with various sensors and the component to determine the gait analysis of older adults and data pass via SMS to their guardian or child. The following Figure.1 Represent the working principles of the automated shoe with gait analysis.

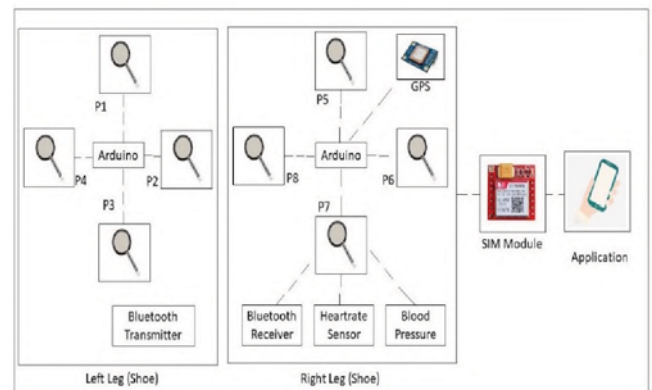


Fig.1 Related Work

Considered, there are two shoes named s1 represent the left-hand side, s2 right-hand side, respectively. Determine the gait analysis embedded with four processes: a) Pressure on the Leg b) Heart Rate and Blood Pressure Sensor and c) GPS Location Tracking.

#### a) Pressure on the Leg

From Figure 1, Left-hand Side Shoe is embedded with four piezoelectric sensors used to predict the older people's pressure. The determination (Tsong-Han Hsieh, 2012)of pressure is shown in figure. 2 below.

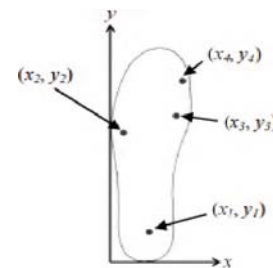


Fig.2 Determination of Pressure.

From the above figure, each leg consists of four-parameter with corresponding x and y-axis to determine the pressure given by older people. The Piezo Sensor will extract the information from the person who wears a shoe with an embedded sensor and passed to the Arduino. This Arduino will send the data via Bluetooth transmitter to the right-hand side leg through wireless. Piezo Sensor and Arduino will follow the Same Procedure. The Bluetooth receiver on the right side will receive the information from the left side and pass the Arduino information.

**b) Heart Rate and Blood Pressure**

Heart Rate Sensor is used to determine from the right side of the shoe and pass the information to the Arduino, which is interconnected.

**c) GPS Location Tracking**

GPS Tracking Sensor device which used to determine the location where the appropriate person locations.

Arduino's right side will send the information to the intermediate module name SIM Module which acts as an interface between the application and embedded system. This SIM Module is designed and developed using a cloud environment with an android based application. This application will display the graphical representation of the older person in mobile applications.

In case of emergency, if the person is facing issues due to lack of stamina, based on the pressure given by the older person, the appropriate information will be passed to the guardian or child of the elder parents. This related work will dynamically check the pressure given by both legs, heart pressure, blood pressure, and the older person's location. If any data is a mismatched or abnormal condition, the information will be passed as SMS to the appropriate persons.

**B. RELATED ARCHITECTURE**

The related work based on the system architecture as shown in Fig. 3

Application Layer	Application Layer [MSG to Child]				
	Presentation Layer				
Middleware	SIM Module				
Embedded	Bluetooth Transmitter	Bluetooth Receiver	Heart Rate Sensor	Blood Pressure Sensor	GPS Sensor
	Arduino				
	Piezo Electric Sensor				

Fig.3 Architecture of related work.

This related work was designed and developed in three layers: a) Embedded b) Middleware, and C) application layer.

a) **Embedded Layer:** This layer mainly connected with all types of sensors and components, as discussed in table 1. Each sensor will perform its role and responsibilities, which is interconnected with Arduino UNO. This

Arduino will transmit the value of the pressure and location to the SIM Module.

- b) **Middleware Layer:** This Layer act as an interface between the embedded layer and the application layer. SIM Module will receive the value from the embedded layer and transmit it to the cloud's application layer.
- c) **Application Layer:** This layer will provide a Graphical Representation of the older person in the android application and also send alert SMS to the Guadian or responsible person

**C. PREDICTIVE DATA FLOW**

The process of related work is represented in Figures 4a,4b, and 4c below.

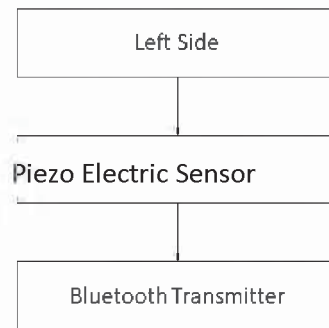


Fig.4a Representation of Data Flow – Left Side Shoe

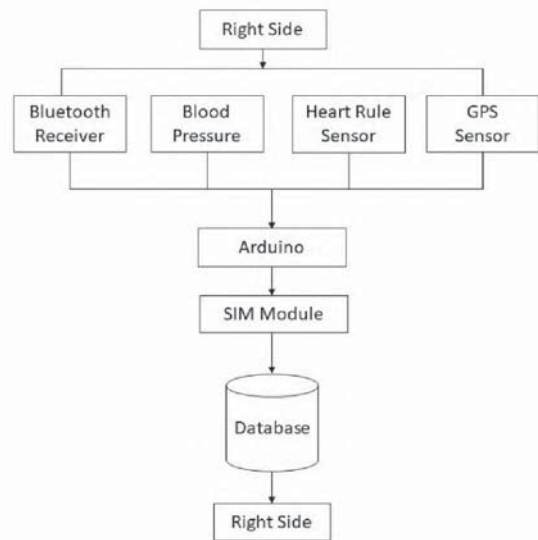


Fig.4b Representation of Data – Right side Shoe

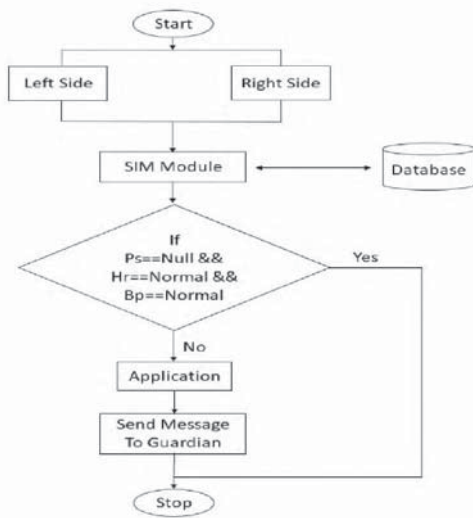


Fig.4c Representation of Gait Analysis

D. RELATED PROCEDURE

a) **Hardware Design based sensor configuration**

- Let P<sub>1</sub> to P<sub>8</sub> Piezo Electric Sensor, which is used to determine the value of the pressure.

**Left Hand Side of the Shoe Consist of the following**

- Considered the set of Piezo Sensor P<sub>1</sub> = { (x<sub>1</sub>,y<sub>1</sub>), (x<sub>2</sub>,y<sub>2</sub>), (x<sub>3</sub>,y<sub>3</sub>), (x<sub>4</sub>,y<sub>4</sub>) } position with {P<sub>1</sub>,P<sub>2</sub>,P<sub>3</sub>,P<sub>4</sub>} sensor respectively.
- Let A<sub>1</sub> be the Arduino to retrieve all the values of the Piezo sensor.
- Let B<sub>1</sub> be the Bluetooth Transmitter, which is used to pass the value received from the Arduino to the Bluetooth receiver on the righthand shoe.

**Right Hand Side of the Shoe Consist of the following**

- Considered the set of Piezo Sensor P<sub>2</sub> = { (x<sub>1</sub>,y<sub>1</sub>), (x<sub>2</sub>,y<sub>2</sub>), (x<sub>3</sub>,y<sub>3</sub>), (x<sub>4</sub>,y<sub>4</sub>) } position with {P<sub>5</sub>,P<sub>6</sub>,P<sub>7</sub>,P<sub>8</sub>} sensor respectively.
- Let A<sub>2</sub> be the Arduino to retrieve all the values of the Piezo sensor.
- Let B<sub>2</sub> be the Bluetooth Transmitter, which is used to pass the value received from the Arduino to the Bluetooth receiver on the righthand shoe.
- Considered Hr is the sensor to determine the heart rate of the person.
- Assume that Bp be the Sensor used to determine the blood pressure of the person

- Let Gps be the device used to detect the location of the person.

b) **Gait Analysis**

// Code on the Application Layer – Android app

String TrackingElderly( float P<sub>1</sub>, float P<sub>2</sub>, float Hr, float Bp, String Gps)

{

- Step 1 : If both legs' pressure is normal, Bp or Hr is normal. Then the older person may be walking.
- Step 2 : If the pressure gives both legs normally, Bp or Hr is abnormal, and then the older person may be in a critical situation while walking.
- Step 3 : If the pressure gives by both legs are null, Bp or Hr is normal, then the older person may be in sitting or sleeping status.
- Step 4 : If the pressure gives by both legs are null, Bp or Hr is abnormal, then the older person may be in a critical situation.
- Step 5 : Gps are used to track the position only when an older person in danger.

}

c) **Alert System**

The Alert system is mainly used to design and develop an application to send Text SMS to the older people's responsible person.

E. EXPERIMENTAL DISCUSSION

The gait of three healthy subjects, one male and 2 females with an age of 65,72, 69 are considered for the experimental results. During the experimental result, the subject was advised to be normal with an embedded system. The following experimental results were observed for 60 minutes, as shown in table 2.

Subject	Left Leg Pressure(Average)	Right Leg Pressure (Average)	Heart Rate	Remarks
Person 1	92.5	101.3	82	Normal
Person 2	87.6	98.5	91	Normal
Person 3	103.5	103.5	89	Normal

Table 2. Experimental Result of Gait Analysis

From the above table, all the three elderly subjects were normal, representing the data in the report, as shown in the figure.5



Fig.5 Experimental Result

The Subject considers is normal when they experimented with the device with IoT.

#### IV. CONCLUSION

The Proposed Gait Analysis System can prove the efficiency with multiple sensors like a piezoelectric sensor, Heart Beat Sensor, and Blood Pressure Sensor. A proposed algorithm was developed to determine the different pressure types with the embedded device and various modules for the older person. This proposed work's objective concluded to be effective and efficiently used by the older person's shoe. This Automated shoes used to track and predict the gait monitoring system proved to an effective for the person who needs to help their elderly parent.

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