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Smart Shoes: Walking Towards a Better Future

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***Abstract*—Gait analysis using smart sensor technology plays a vital role in the medical diagnostic process and has several applications in health and fitness monitoring, rehabilitation and therapy. In this paper, a portable system is presented called smart shoes. Smart shoes are used to analyze different functionality of gait while walking. Implemented system is based on Bluetooth technology working at 2.4Ghz to collect data using a Smartphone in any environment. The system combines different working modules like a step counting(pedometer), obstacle detection, electricity generation, fall detection and health tracking in one system. The excess number of calories of energy being burnt everyday motivated me to do this project with which energy can be generated that can be used to power few electronic boards and mobile just while walking. The smart shoes with sensors can also be helpful for a blind person. So the designed system will help to be a better future for user.**

Keywords*— *Gait analysis, Smart sensor technology, Electricity generation, Health tracker.

I. INTRODUCTION

Gait Analysis plays a major role in the clinical assessment of the act of walking for analyzing and quantifying how someone walks. Walking every day is important for physical fitness and is achieved through proper nutrition and daily physical activities. Smart technology to analyze gait is included in shoes.

As we know, everyday distance walked by each human being is about 3.5miles that is 7500 steps. While a walking number of calories burnt by each human is 7500×0.063 = 472.5 calories. The huge number of calories are burnt by the whole human population just by walking. The designed system used the concept of Gait to monitor the number of steps taken and calories of energy burnt. The excess number of calories can use for energy harvesting. Energy harvesting is to capture free energy that is available without cost from the environment. So, the excess of energy by each human can be used to generate electrical energy by foot pressure while walking.

II. RELATED WORK

A. A Wireless IoT system towards gait detection in stroke patients

The proposed system is designed to monitor gait in stroke patients through Internet of Things. The methodologies used in this system are Smartphone built-in sensor and IoT shoe. The Objective of this system is to monitor walking pattern, insole pressure, acceleration of patients motion, to warn the patient about abnormal gait and save them from free of falling [1]

B. Smart Navigation system for Visually Challenged people

The aim of proposed system is to help visually impaired persons to live their social life independently. The author uses obstacle avoiding techniques using ultrasonic sensors which are mounted on spectacles, waist belt and shoes for detecting obstacles like ground, waist level and head height. The obstacle present in path of user is informed by pre-recorded audio message [3].

C. Wearable Fall Detection, Monitoring and Alert system

The objective of author is to overcome the problems like loss of Consciousness and fall-induced injuries faced by elder people. The system is designed to sense and alert doctors about falls and other related incidents of distress. Designed system uses Internet of Things technology for seamless connectivity between patients, doctors and relatives that it relays data constantly [11].

D. Production of Electricity Through Pressure Based Sensors

In this paper, the designed system is based on studies of utilizing the waste of energy of foot power with human locomotion for generation of power. Piezoelectric sensor is used to convert energy wastage is useable form. So by using energy saving method by simply walking or running on footstep the power generation system is designed [5].

III. BLOCK DIAGRAM

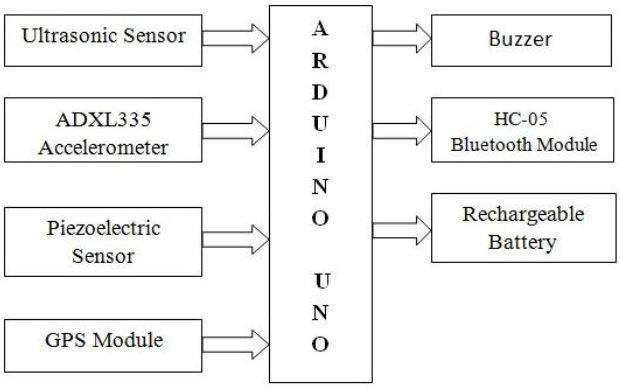

Fig. 1: Block Diagram: Arduino Uno controls the functioning of all components in the system. The sensors on input side of arduino uno used for detecting obstacle, counting number of steps, fall detection, generating electric energy and location of user. The sensed data is collected by output module along with Rechargeable battery.

IV. WORKING PRINCIPLE

The wearable device with the concept of Gait analysis is implemented in Smart shoes. Smartness in the proposed system includes the features like Generate electricity while walking, obstacle detection for a blind person, Tracking location of the user, pedometer. The Arduino Uno microcontroller is used for controlling functions of all components attached to it. The huge amount of calories of energy are wasted just by walk. The piezoelectric sensor used to generate electricity from the excess energy by foot pressure. The piezoelectric sensor are connected in the parallel on shoes

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sole to get output up to 4-5v and 50 60mA. The ultrasonic sensor is attached on front of shoes which detects the obstacle in front of it at the distance of 100cm and informs user by buzzer sound. The ADXL335 accelerometer works as pedometer in shoes Accelerometer and Bluetooth module are interfaced to display the number of steps taken and calories burnt on blueterm app on users mobile. By calculating longitude and latitude using GPS module attached on shoes, the location of user is found.

V. RESULTS

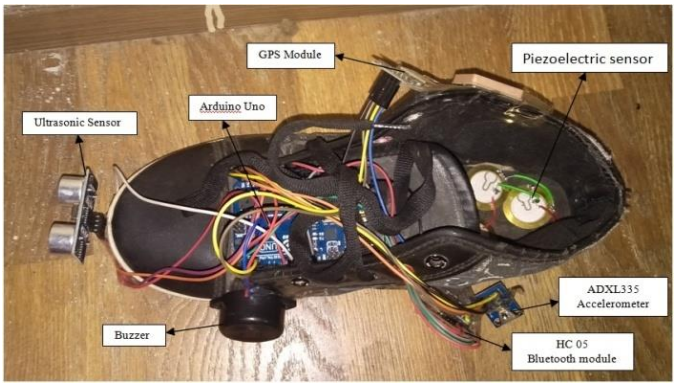

Fig. 2: The overall system implementation is shown in the above figure. All hardware is mounted in shoes.

A. *Ultrasonic Sensor*

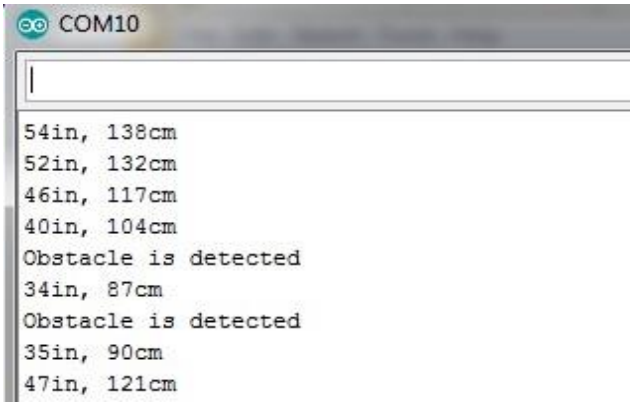

Fig. 3: Ultrasonic sensor detects the obstacle in the range between 0-100cm to help blind person/user for safe walk. HC-04 Ultrasonic sensor used in shoes have non-contact detection range from 2cm-400cm.

B. *Piezoelectric Sensor*

Table 1: voltage generated as per users weight by foot pressure

Sr. No	Weight in kg	Voltage in v
1	30	2.7
2	45	3.8
3	55	4.3
4	60	5.5

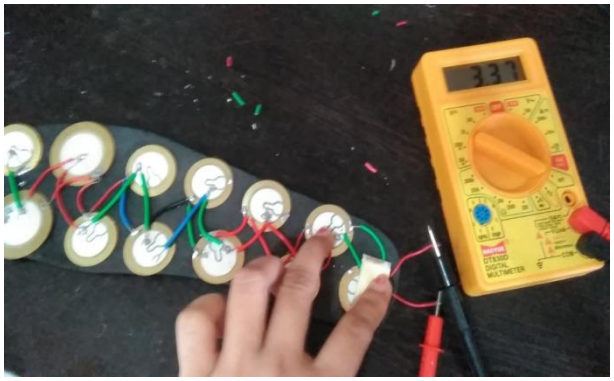

Fig. 4: Above figure shows the output of the piezoelectric sensor which is mounted on sloe of shoes. In the proposed system twelve piezoelectric sensors are connected in parallel to generate electricity by foot pressure while walking. The sensor output can reach up to 4-5v and above as per users weight on foot. The different voltage readings take during this project as per the weight of the user are shown in table 1.

C. *Accelerometer*

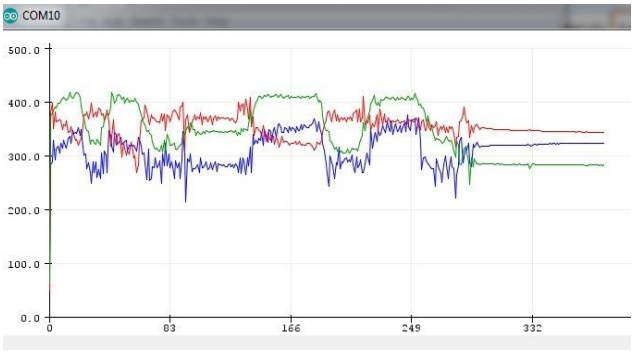

Fig. 5: Figure shows the acceleration of adxl335 accelerometer in X,Y,Z axis.

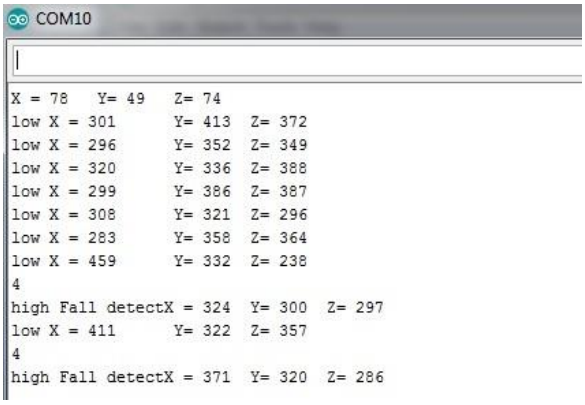

Fig. 6: The accelerometer used in the implemented system helps to detect fall. The raw data of accelerometer in three axis is collected. As per the raw data when acceleration in X-axis goes beyond 400 then fall is detected.

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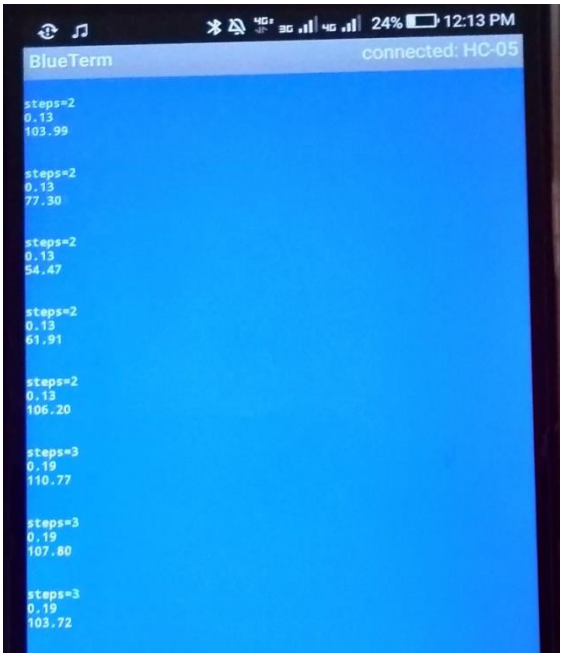

Fig. 7: Adxl335 accelerometer works as pedometer in the system. The number of steps taken and calories burnt are displays on users Smartphone from the Bluetooth module. The Bluetooth module used in system works at 2.4Ghz.

CONCLUSION

Ideation and design of smart shoes system is a result of rigorous work done during implementation of a Gait analysis system. User can check pedometer data on Smartphone through Bluetooth technology. Smart shoes are useful for a blind person to walk independently and safely on their way. A blind person gets alert about the obstacle and falls through buzzer sound. Designed system will motivate everyone to walk each and every day to generate electricity. The overall smartness of the proposed system will be toward a better future

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