Indian Institute of Information Technology, Vadodara
Government Engineering College, Sector-28, Gandhinagar, Gujarat - 382028

B.Tech. Project Report

on

Monitor body postures using Sensors

submitted by

Ajay Shewale[1]
(201351030)

under the supervision of

Prof. Kamal Kishor Jha[2]

Abstract

Nowadays, back pain, headaches, joint pain are common for people who work with a computer. It also raised the issues of heart disease, heart attacks or other cardiovascular diseases. Such problems made worse by bad posture and sitting in the improper way. Many people are unaware of the harmful consequences of such actions. The purpose of the research is to develop a product which monitors the person's posture and alerts when it needs correction. Moreover, it also provides the heartbeat monitor, which helps to circumscribe the activity level of the individual. The research is mainly meant to focus on the first problems cause due to bad posture and how to avoid it. The product we have to develop is basic, but research aims to design low cost, power, and mobile solution.

1 Introduction

A computer plays a vital role in today's life. Prolong, and inappropriate use of a computer can cause harmful effects on health. It can cause back and neck pain, muscle, and joint pain, internal injuries to the shoulder, arm, and wrist.
The human spine is devised to be in an upright neutral position with shoulders back and a slight curvature at the base [1]. Computer use for a long time, leaning forward to reach the keyboard, bending the head to see the computer screen disturb the natural position of the spine. This research is aim to provide a convenient way to solve the basic yet injurious fitness problem. It would let the user know when the bad posture is detected. The user is expected to correct bad posture and avoid inimical health issues in old age.
There are many existed systems in posture detection but have their disadvantages. Some of are a high cost or drain much power, or it may not be portable.
To overcome this issues we propose a system, to build the sensor technology which will provide real-time information about the body posture. Additionally, this new technology has to be cost efficient and consume less power so that it will lead existed technology.

2 Literature Review

Poor sitting posture causes computer related injuries. Proper position places you in an alignment where the tension of muscles and ligaments are equally distributed. As a result, muscles and joint can work efficiently. Furthermore, future problems regarding health problems can be avoided.
There are many existed systems for posture detection. This literature survey examines relevant past research. In some paper, posture is a monitor using the accelerometer, in some other, ultrasonic sensor is used.

Jampani srirampavan design a system which used to monitor and detect bad posture using an accelerometer. The central purpose is to develop a system with low cost, high performance, and less power consumption. The sensor is designed to attach to the user body on the back when a bad posture is detected it will alert the user to change its position by threshold value set. In this sensor, ARM processor, accelerometer, and LED are used. Real time data of sensor is sent to the microcontroller, the code is written is such a way that buzzer or LED will give an alert by threshold values set [4].
Figure 1 represents flow chart using the accelerometer [4]
In this system ARM processor is used along with voice module which will help user to correct posture over voice module.

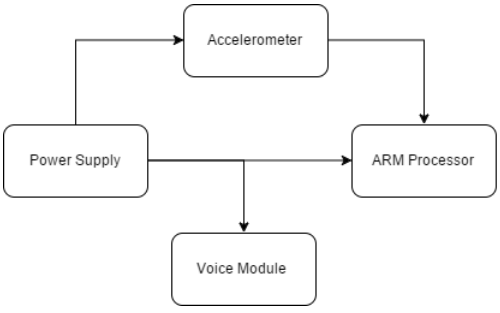

Figure 1: Accelerometer

[1] 201351030@iiitvadodara.ac.in
[2] kamal@iiitvadodara.ac.in

Wang et al. design posture monitoring and correction technology which is used to detect bad posture and avoid future possible spinal problems [6]. In this paper, the key aspect is to measure spinal movements using thoracic posture of an individual. It calculates the thoracic angles between the alpha and beta characters, where alpha and beta are the angles which are measured by using two inertial sensors. AN Arduino board processes the values and give vibrational feedback to the user, audible alarm systems. This research describes the design and development of Smart Rehabilitation Garment (SRG) a wearable system designed to support posture correction. This research plays a crucial role in posture detection system because it covers two central aspects; bad posture recognition and posture correction feedback.
Figure 2 describes thoracic angles.

Figure 2

Dunne et al. Describe the sensor for monitoring seated spinal posture. Their research elaborates the three type of sensors, elongation sensor, inertial sensor and bend sensor. Elongation sensors measure the stress caused by bending. Inertial sensors have built-in accelerometer and gyroscope which used to identify orientation and posture. Bend sensor A piezoelectric sensor that uses to estimate changes acceleration, strain, or force by converting them to an electrical charge.
From the above sensors, the inertial sensor and bend sensor are efficient as they are low cost and light weight.

The analysis mentioned in this section has rendered helpful insight comprising all principal features of a posture monitoring system. The purpose of the present research is to address all the issues which this system displeased to meet. In other words, to design a sensor technology, which is economical, mobile and consumes less power.

3 Presentation Investigation

3.1 Hardware Components

1. Arduino Uno
The Arduino Uno is a microcontroller board based on the Atmega328 (datasheet). It has 14 digital input/output pins (of which six can be used as PWM outputs), six analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started[3] .

Technical Specification

Microcontroller	Atmega328P
Operating Voltage	5V
Input Voltage	7-12 V
Digital I/O Pins	14
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20mA
SRAM	2KB
EEPROM	1KB
Flash Memory	32KB
LED_BUILTIN	13

The Arduino Uno (Figure 3) can be powered via the USB connection or with an external power supply. The power source is selected automatically.

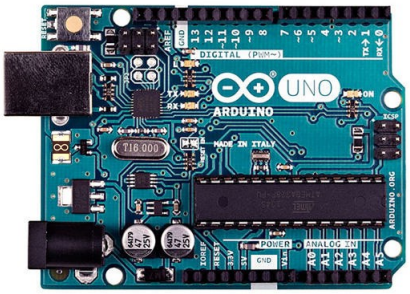

Figure 3: Arduino Uno

2. Ultrasonic Sensor
An ultrasonic sensor is a device which used to calculate the distance between the sensor and the obstacle. It measure the distance sending out sound waves and at a specific frequency and listening to the sound wave. The sensor has transmitter and receiver on it which is used for sending and receiving the sound waves.
The sensor has four pins:

- VCC (+5V)
- Trig
- Echo
- Ground

Trig pin is an output pin, and Echo pin is an input pin.2. Ultrasonic Sensor

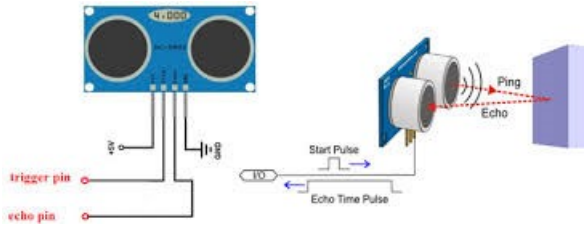

Figure 4: Ultrasonic Sensor

An ultrasonic sensor[4] is a device which used to calculate the distance between the sensor and the obstacle. It measure the distance sending out sound waves and at a

[3] http://www.arduino.org/products/boards/arduino-uno
[4] http://www.geekfactory.mx/tutoriales/tutoriales-arduino/sensor-ultrasonico-hc-sr04-y-arduino/

specific frequency and listening to the sound wave. The sensor has transmitter and receiver on it which is used for sending and receiving the sound waves. The sensor has four pins: VCC (+5V) Trig Echo Ground Trig pin is an output pin, and Echo pin is an input pin.

3. Flux Sensor

A flux sensor (Figure 5) is 2.2 inches in length and very light weight sensor which weighs about 7 gm. Also, it is not expensive. The flex sensor has resistors whose resistance increases as the sensor is bent. The resistor values change from 10k to 20k ohms as the flex sensor is changed from zero bends to maximum bend[5]. Based on the direction of the bend, flux sensor measure angles. The flux sensor can easily track the inappropriate posture of the spine.

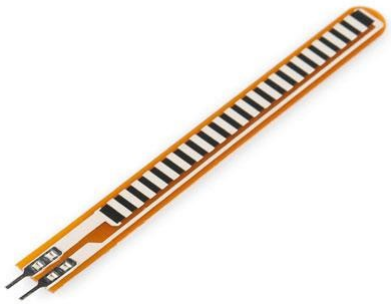

Figure 5: Flux Sensor

4. Inertial Sensor

Inertial Sensor (Figure 6) is based on the technology Micro Electro Mechanical Systems (MEMS)[6]. It consist of Accelerometer and Gyroscope

Accelerometer - this sensor is used to gauge the acceleration of the object. It uses to measure both static and dynamic acceleration. One of the broad spectrum application of accelerometer is tilt sensing. Nowadays in almost every smartphone, it is used to identify portrait or landscape mode. It usually comes with three linear axes which used to detect acceleration in three dimensions.
Gyroscope - it measures the angular velocity, the rate of change of angular velocity. It is used to measure changes in orientation and direction.

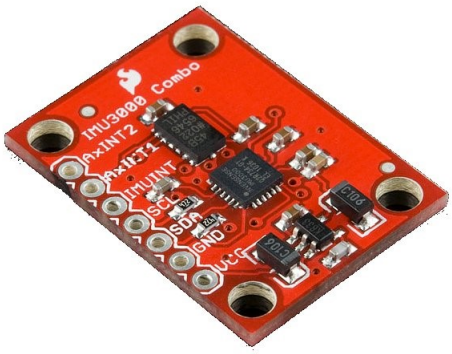

Figure 6: Inertial Sensor

3.2 Test Bed

Main components are Arduino Uno, Ultrasonic sensor, Accelerometer, LEDs, and breadboard.
For performance and analysis, each of the sensors was individually tested. The product we have performed is just an overview of the entire system; it is a simple demonstration of how this whole posture recognition system will work.
Sensors such as flux and inertial, we have tested on Proteus software.
In the simple demo, we used an Ultrasonic sensor to measure the distance from the user and the computer. Figure 7 show proper position

Figure 7

A recent study shows that 40 to 75cm is the optimal distance of the user from the computer screen. I will not only help the user to sit proper but also strain on the eye will be reduced.

Figure 8 represents the working protocol, where ultrasonic sensor has been used to measure the distance.

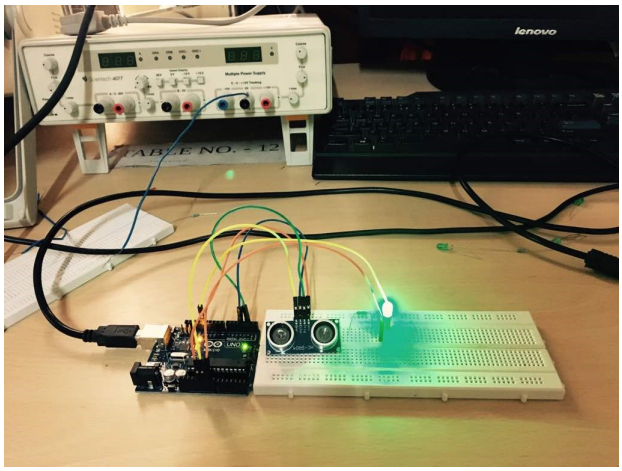

Figure 8: Working Protocol

4 Results and Discussions

4.1 Using Ultrasonic Sensor

Arduino board collect the real-time information from the sensor. For demo purpose, ultrasonic sensor has been used, but the main product is based on inertial sensor, flux sensor, and heart sensor. To study this sensors simulations

[5] http://www.instructables.com/id/How-to-Interface-With-Flux-Sensor-22inches/
[6] http://www.robotshop.com/blog/en/arduino-5-minute-tutorials-lesson-7-accelerometers-gyros-imus-3634

are recorded in Proteus so that brief idea about the overall product can be obtained.
Results of the demonstration using ultrasonic sensor are given below:

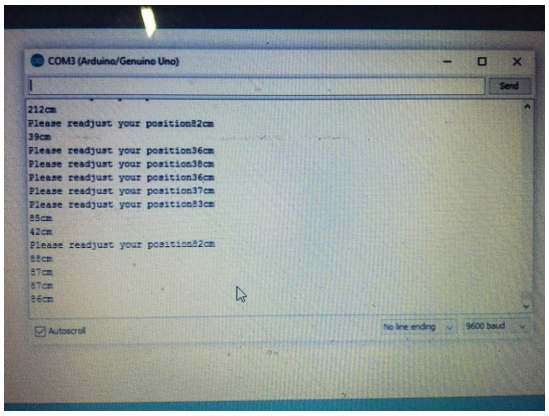

Figure 9: Working protocol 1

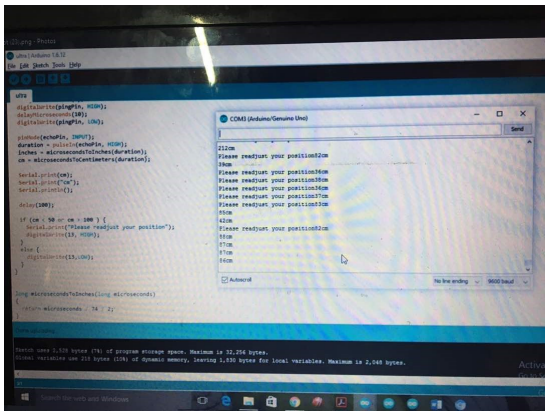

Figure 10: Working protocol 2

4.2 Using Heart Sensor

In this protocol Heart Sensor is used to measure the pulse. The simulations are based on proteus and Arduino IDE. Figure 11 represents the graph of cardiovascular activity.

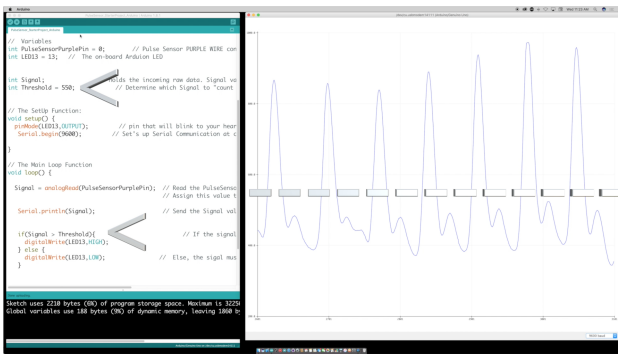

Figure 11: Output for Heart Sensor

5 Conclusions and future work

5.1 Conclusion

Correct posture aligns everything in body, muscles, ligaments and bones. But today's world body posture is the most neglected part. Also because of sedentary and inactive lifestyle, many people face health issues. Although there are some research studies for posture correction and monitoring system, these studies have some drawbacks such as more power consumption, high cost or system is not wearable. We have proposed the system which addresses this problem.
The primary goal of this research is to provide a user-friendly interface that alerts the user about posture problems. The device which will me mobilize and easy to use. For that goal, this paper proposed to use inertial sensor and flux sensor which are lightweight and cost efficient. Heart monitor proposes in this system is extra functionality which allows the user to keep track of cardiovascular activities. Ultimately, we have proposed a commercial product which is economical and user-friendly.

5.2 Future Work

This section provides how our prototype can be enhanced. We hope this prototype would serve as a basis for further evolution. A real-time mobile application can be used to notify the user activities. There are some other enhancements. First, instead of using Arduino, Intel chips can be employed, which will not only reduce the size, but power consumption also is reduced. Integrated sensors for posture monitoring systems can be introduced which may use less power. Second, heart monitor system can be enhanced; it could be used to detect any heart-related issues. Third, integrated sensors and board can be garment together which will improve the mobility of the system. Ultimately, with the further intensification, the entire system can be used for health care system.

Acknowledgement

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