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Smart Spine Posture Detector

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Abstract – *Lower spinal back pain problem treatments costs to billions of dollars every year. Low back pain is often caused by improper seating posture, which in turn affect the spinal muscles. Regularly switching shape and maintaining proper posture helps to improve and maintain a person's health and prevents muscular problems. By indulging into sedentary lifestyle and working long hours in front of technology, good body shape of people gets deteriorated and leads to abandoning of spine health. Proper posture plays an important role to lead a healthy lifestyle. Back pain is the one of the major reasons for people of young age group to seek medical help. The human ability to stay upright has been compromised over a past few years, and health is been overshadowed by improper routine. The purpose of this project is to identify and implement strategies that can be practically used to determine spinal posture alignment. The system identifies and records the user status and it as proper and improper. It also provides statistics to user about his/her posture and prevents user from improper alignment.*

Key Words: Java Development Kit, Arduino UNO, spine bending, Flex sensor, Android SDK.

1. INTRODUCTION

One of the most common human problems is back pain. Many people experience back pain at a particular point in their life. The number of people with back pain increases with increasing age, starting in with children going to school and rising in people of middle age group of age. Proper posture indicates the proper alignment of body parts so that the minimum energy is required to maintain the required position. Good posture makes the circulation of bodily fluids better and enhances breathing. Poor posture feels normal and continues to devolve further from the correct posture after a period of time. When a person gets used to poor posture then it becomes difficult to make it right as the memory of the muscle stores the details for poor posture and neglects the memory for the right posture. The longer poor posture is left uncorrected, it will continue to divagate. One can track the posture easily and also correct it by using a posture monitoring and correcting system.

Although deadly diseases are fought daily, something as simple as a bad posture is often neglected. Wrong posture can start as a habit and quickly lead to acute back pain. To reduce stress it is therefore, important to maintain a good posture. In this project, a flex sensor is used to detect bending. To monitor the position the flex sensor is mounted on the back of the spine. The user gets notified when the posture changes from 'normal' to 'poor'. A microcontroller is used to set good position limits, which may be specific to a particular user. The proposed system aims to use a simple monitoring system that can be set in the workplace easily. This can prevent cases of other spinal problems and scoliosis that often start with the wrong posture.

2. SPECIFICATION AND DESIGN

Today people are very focused on their work, which leads them to spend time doing work through uncomfortable living programs, especially in this covid era of online. Lack of regular exercise adds weight to the problem leading to long-term muscle and spinal health problems. Slouching can cause spinal cords to reach beyond their healthy limits, and improper posture can compress your spinal discs.

When we are working on some desk work or working on a computer then that leads to our head leaning forward and rounded shoulder posture which is called as 'poor posture syndrome'. User will get awareness and reminder of their position using a vibrating response, and adjust it accordingly. Over the period, the system makes the user practice of maintaining and holding good posture, outdoors without the need to be reminded.

2.1 ARDUINO UNO

Arduino UNO is the brain of the system. It acts as a decision maker for the system. Based on the spine bending angle measurements, it decides whether the user is sitting in proper position or not. If the angle of bending is found improper, it takes action of informing the user about his/her sitting position.

In Arduino UNO, programs can be downloaded from the Arduino computer program. Arduino has a comprehensive support system community, which makes it easy way to start working with the embedded electronics.

Arduino Uno is a microcontroller board based on ATmega328. It has 14 digital input / output ports, out of which 6 can be used as PWM, 6 analog inputs, 16 MHz

resonator, USB, power, header, and reset button. It contains everything needed to support a microcontroller; connect it to a computer with a USB cable with an adapter or battery to get started.

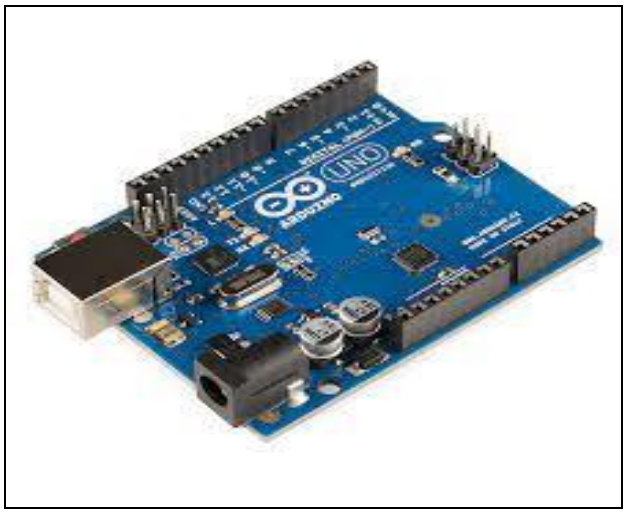

Fig 1. Arduino UNO

2.2 FLEX SENSOR

A flexible sensor is an opposing device that is able to detect bends through visible changes in resistance for every sensor. In Flex sensor SEN-08606 of 4.5 inch is implemented. Output of sensor is obtained in voltage and to display bending angle, voltage can be adjusted.

The sensor specifications are:

i. Resistance (Flat): 10K ohm
ii. Bend resistance range: 60 K to 110 K ohm
iii. Operation: On low Voltage
iv. Power rating: Continuous 0.5 W, Peak 1 W
v. Resistance tolerance: +- 30%
vi. Operating Voltage: 0 – 5 V

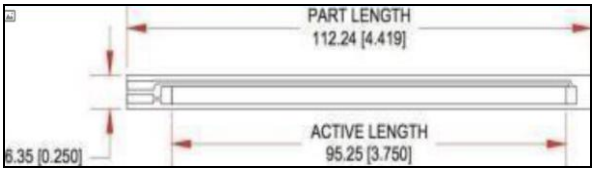

Fig 2: Flex sensor schematic

2.3 ACCELEROMETER

An accelerometer is a device which measures the vibration of motion of a component. The force caused by vibration causes the mass to pressurize the piezoelectric material. This produces an electrical charge proportional to the force acted on it.

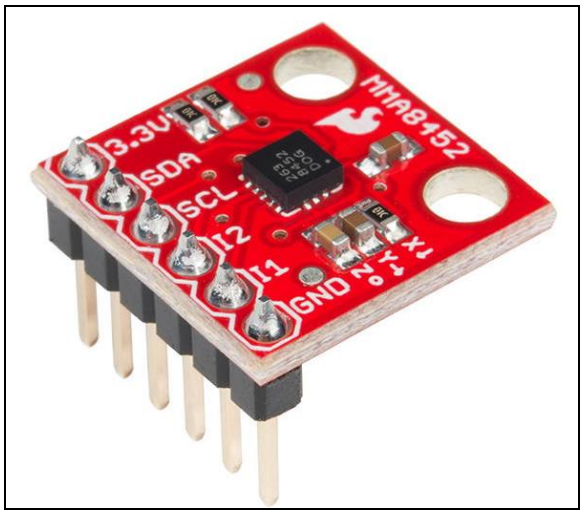

Fig 3. Accelerometer

2.4 Bluetooth Module

HC-05 is a Bluetooth module designed for wireless communication. This module can be used in master or slave configuration.

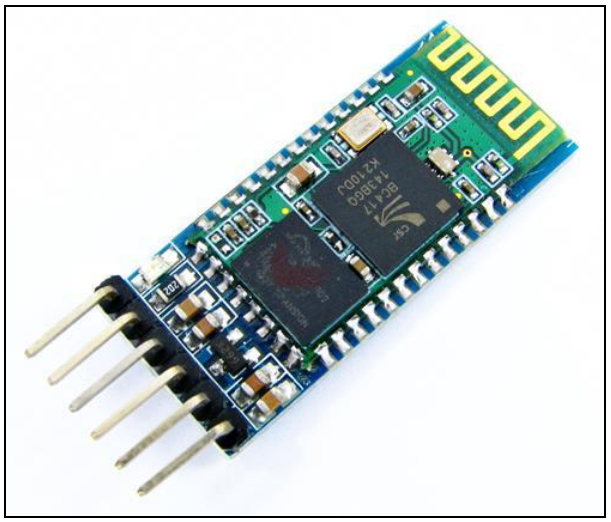

Fig 4. Bluetooth module

3. SOFTWARE WORK

3.1 ANDROID

Android application development supports various operating systems and all the tools required for application

development are the open source. Android app development requires three major things. Software Development Kit (SDK), an Integrated Development Kit (IDE) and Java Development Kit (JDK). The initial step is to have JDK installed in the system.

Various android development IDE are like Android Studio, Eclipse, Unity3D. Android Studio for android application development gives advantage because it has its own SDK called Android SDK and Android Virtual Machine. Android SDK consists of various libraries required for building android applications. It has instance projects including source code and tools required for development.

3.2 JAVA

The Java Development Kit (JDK) is a software development environment used to develop Java applications and applets. It consists of the Java Runtime Environment (JRE), an interpreter (java), a compiler(javac), a documentation generator (javadoc), an archiver (jar) and other tools required in development.

A Java virtual machine (JVM) is an abstract computing machine that enables a computer to run a Java program. The JVM notations are: specification, implementation, and instance. A specification describes what is required to a JVM implementation. A JVM implementation is a computer program that enables with the requirements of the JVM specification. An implementation running in a process is instance of a JVM. It executes computer program which is compiled in Java bytecode.

4. SYSTEM SCHEMATIC

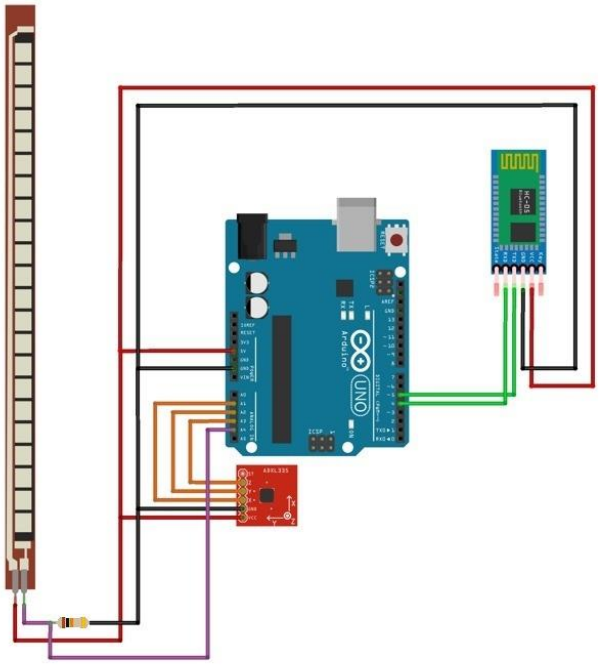

Fig 5. Schematic diagram

4.1 CONNECTIONS

i. To get the bending angle of the flex sensor, we use the voltage divider technique.
ii. 10k ohm resistor is used in a voltage divider circuit with the flex sensor and we get output voltage across the resistor.
iii. 5V supply is given to flex sensor pin1 and the second pin is connected to the A4 analog pin of Arduino and one terminal of 10kohms resistor.
iv. The second terminal of the resistor is connected to ground.
v. ADXL335(accelerometer) has five pins. VCC pin is connected to 5V supply pin of Arduino Uno and GND pin is connected to ground.
vi. X_OUT, Y_OUT and Z_OUT are connected to A1, A2 and A3 pin of Arduino Uno.
vii. HC-05 Bluetooth Module is given a supply voltage of 5V.
viii. The RXD and TXD pin of Bluetooth module is connected to digital pin 4 and 5 of Arduino respectively.

5. TESTING

Testing result is recorded every time a person bends. The table below shows recorded data. The first set of false positives, occurs when the device identifies the back bending but the user may not have bent. Whereas, True Positives shows an actual slouch bending identified by the system. Positives is usually the number of times a person slouches, whether they have been visible or not.
False Negatives are the conditions where algorithm failed to detect the slouch. Sensitivity is the proper rating, on how often the system has detected a slouch. Our system has a sensitivity of 80.1%, which is a promising beginning. In the future, many additional rounds of testing will be required for different age groups and gender groups to find out more reliable performance metric.

False Positive: 6	False Negative : 8
True Positive : 47	True Negative : 55
Sensitivity	80.1 %

Table 1. Testing Results

6. RESULTS

Fig 6. Wearable system

Fig 7. Android app interface

7. CONCLUSIONS

From the above study, conclusions drawn are;

i. Detection and analysis of the position of spinal body part was made, which used compact system gadget. The user could attach it easily on the back body.
ii. If an improper posture is detected, a notification will alert the user accordingly. The module connects the control unit to another device or application. The android app sends feedback to the user and show them their status.
iii. The goal of this project to find the improper posture was implemented, which in a long run habituate the user to maintain upright position and reduce the spinal pain caused by slouching.
iv. The authors can acknowledge any person/authorities in this section. This is not mandatory.

8. FUTURE SCOPE

i. The system can be upgraded to transmit data wirelessly to a computer for analysis in the future.
ii. For additional purposes such as running, walking, etc the system could be made compact.
iii. Due to cost constraints, this model was implemented for static sitting. If cost is not a constraint, then the same project can also be tried for expanded purposes such as posture analysis of entire body.

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