SPINAL CORD POSITION, MONITORING & INDICATION SYSTEM

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Abstract

Today's work environment maximally involves seating in the chair for hours together. This elevates the issue of repositioning spinal cord and related body stability issues. Through this research proposal, an attempt of monitoring and analysis of the seating posture with subsequent corrective suggestions will be addressed. This will be achieved through design and development of a belt which monitors your posture and notify on the LCD screen or on your cell phone or on your laptop.

Keywords—Posture correction, Spinal cord Flex sensor, Arduino

I. INTRODUCTION

Nowadays we know back pain is the major common issue among everyone. It is ignored by everyone and taken as granted but nowadays this issue is growing in society which results the injure in spine, bad posture, spinal dysfunction, lack of strength, low metabolism and degenerative disk. The sitting for long periods of time leads to the piling up of the spine disc causing the low back pain. Moreover, in a wide percentage range of adolescents (7 and 58%) with age range between 13 and 15 are suffering from a hyperkyphosis. This spine deformation is caused by the bad posture during sitting for extended periods of time leaning over their computers, tablets and smart phones.The back problems are still difficult to cure and usually need long duration therapy[1].

The five correct postures for back/ spine:

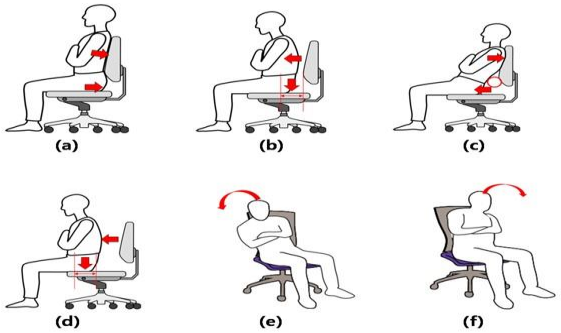


Fig. 1. Types of sitting postures: (a) upright sitting with backrest; (b) upright sitting without backrest; (c) front sitting with backrest; (d) front sitting without backrest ; (e) left sitting ; and (f) right sitting [2].

Here are so of the problems that everyone is facing:

Forward Head Posture (FHP): The head is positioned forward of the shoulders. Can lead to neck pain, headaches, and increased stress on the cervical spine [3].

Kyphosis: Excessive rounding of the upper back or hunchback. May cause back pain, breathing difficulties, and impact the spine's alignment.

Lordosis: Exaggerated inward curvature of the lower back. Can contribute to lower back pain and discomfort.

Scoliosis: Sideways curvature of the spine. Uneven shoulders or hips, potential pain, and difficulty breathing in severe cases [4].

Text Neck: Neck strain due to prolonged use of smartphones or devices, leading to a downward head position. Neck and upper back pain, headaches, and increased stress on the cervical spine [5].

Slouching or Rounded Shoulders: Forward slumping of the shoulders. Can lead to upper back pain and affect the alignment of the spine.

Sedentary Lifestyle: Prolonged periods of sitting with little movement. Weakens core muscles, contributes to poor posture, and increases the risk of **various health problems.**

Improper Ergonomics: Poor workplace setup, such as an uncomfortable chair or desk. Can lead to back and neck pain, muscle strain, and long-term posture problems.

This are some of the major issues of back pain leads to the bad posture and back problems so from the surveys and the and this increasing back problems we came on a solution. Posture correction belt using Arduino, flex sensor, vibrating motor. For a habit we decided to add vibrating motors in it so when a user is sitting in a good posture the motor will turn on and it will give a massage to the user this can make a habit to the user as he consciously focus on the massage and a relief this can also increase the productivity of the user as he is relaxed [6].

II. LITERATURE SURVEY

R. R. Kanase et. al.[7] used multi stage CNN to detect a user posture, they use the method in which spatial locations of key body points are calculated. A pose estimator called OpenPose is used in this application. their proposed application utilizes pose estimation and detects the user’s exercise posture and provides detailed, customized recommendations on how the user can improve their posture.

Carl Mikael Lind et. al.[8] the authors introduce the Smart Work wear System, a sensor-based platform designed to address work-related musculoskeletal disorders by supporting risk assessments, work design, and work technique training. The system utilizes a module-based platform, offering flexibility in sensor-type utilization based on specific applications. The article focuses on a system that incorporates haptic feedback for work technique training. Through a simulated mail sorting task with novice participants, the study demonstrates that haptic feedback can significantly reduce adverse upper-arm postures after short training periods. Participants reported positive experiences with the haptic feedback, finding it effective in improving postures and movements. The authors suggest the sensorized system, employing haptic feedback training, holds promise for introducing new employees, teaching ergonomics in physically demanding jobs, and conducting ergonomics interventions.

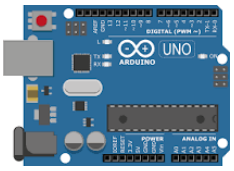
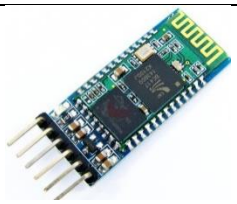
In this paper the authors Slavomir Matuska et. al. [9] proposes a smart chair system with six flexible force sensors to detect and notify users of incorrect sitting positions, focusing on addressing spinal pain caused by poor posture. An Arduino-based Internet of Things (IoT) node connects the sensors, and a mobile application provides real-time notifications and feedback to users. Geonil Kima et. al. desined a smart office chair with movable textile sensor is used to monitor sitting posture The system consists of a presence textile capacitive sensor with different levels of activation with a signal conditioning device. The proposed system was integrated into a chair to monitor/ detect posture The microcontroller measured the capacitance by means of a cycle count method and provided the position information The information could be analysed to set up warnings to prevent incorrect postures. So everything is inside the chair which monitors the posture and notifies the posture [10]

In this paper they have compared the various posture positions Author Ferdews Tlili et. al. addresses the prevalent issue of spinal pain resulting from poor sitting posture, affecting both adults and young individuals engaged in prolonged computer and electronic device use. To mitigate this problem, posture monitoring systems have emerged to assess and enhance sitting posture. [1]

From the various survey research paper from respective journals and conferences we have observed that the exact human sitting postures which is recommended, spinal cord positions, increasing problems due to bad sitting posture and spine problems. And there is a need to provide the solution to overcomes the respective problems.

The Author Jongryun Roh [2]et. al. proposed a proposes a sitting posture monitoring system with a few embedded load sensors in the seat of the chair. The system is composed of four load cells that provide the weight data measurement to a computer via the Arduino board which is an open-source electronics platform based on easy-to-use hardware and software. The proposed system is able to classify sitting postures by inserting pressure sensors into backrest plate and seat plate.

Table 1. Table of hardware components

Sr. No.	*Components*	*Diagram*
1.	Arduino UNO	
2.	Flex Sensor	
3.	HC05 Bkuetooth	
4.	Vibrating Motors	

III. MOTIVATION

As the increasing problem of spinal cord this project aims to enhance awareness and preventive care by providing real-time feedback on posture. It serves as a valuable tool for individuals with back-related issues/problems, offering personalized alerts and relief logging capabilities for continuous improvement. Beyond individual health, the system contributes to research and collaboration in the development of innovative of a belt for spinal health. By empowering users to actively manage & Correct their posture, this project aligns with a broader mission of promoting well-being through technology.

IV. EASE OF USE

a. Design an intuitive interface for easy interaction with the system. Bluetooth Connectivity Streamline Bluetooth pairing and ensure stable connections with minimal user effort. Simplify initial setup with straightforward instructions for connecting Flex, Arduino, and HC-05 Bluetooth.

b. Clear Feedback Provide simple and understandable feedback, such as visual or haptic cues, for effective user guidance. Develop a system that requires minimal user intervention and offers a hassle-free experience..

c. Mobile App: Design an uncomplicated mobile app interface that presents information in a user-friendly manner.

d. The flex sensor is fitted into the posture correcting belt at the thoracic part of back/spinal chord to get the perfect readings

IV . METHODOLOGY

i. HARDWAREE SETUP-

Connect one leg of the flex sensor to the 5V output on the Arduino. Connect the other leg of the flex sensor to the analog pin on the Arduino (for e.g., A0). Connect a resistor (of 10k ohms) between the same Analog pin and the ground(GND) on the Arduino. Vibrating Motor Connect the positive (red) lead of the vibrating motor to a digital pin on the Arduino (Pin 9). Connect the negative lead of the motor to the ground on the Arduino. HC-05 Bluetooth Module Connect the VCC pin of the HC-05 to the 5V output on the Arduino. Connect the Ground pin of the HC-05 to the ground on the Arduino. Connect the TX pin of the HC-05 to the RX pin on the Arduino and Connect the RX pin of the HC-05 to the TX pin on the Arduino.

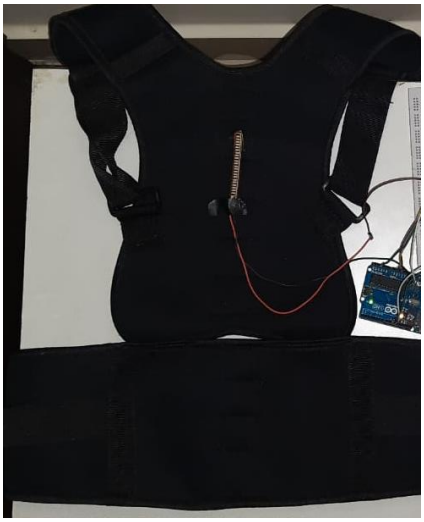


Figure 1. Hardware Setup

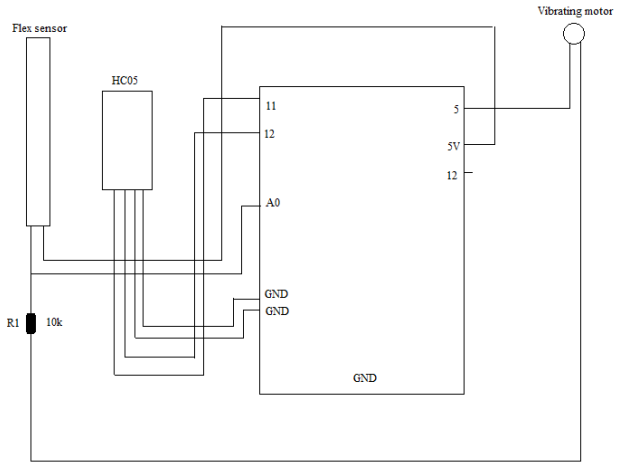


Figure 2. Circuit diagram posture monitoring system

ii. WORKING

In the initial phase, we have to were the belt in ehich the flex sensor will exactly Fitted on the belt where the thoracic/ the middle part of back I, the flex sensor is connected to one of the analog pins on the Arduino. The analogRead() function is used to measure the voltage at the flex sensor, converting it into a digital value. This value represents the degree of bending or flexing of the sensor. The flex sensor reading is then used in the Arduino sketch to make decisions. If the flex sensor reading is above a certain threshold (for example 805), the vibrating motor starts (connected to a digital pin) is turned on. If the reading is below the threshold, the motor is turned off. We can see the output values as well as the message on the app as “Good posture” if the value is above 805 and “Bad posture” if the values are below 805. The Software Serial library is used to set up a software serial communication channel on two digital pins of the Arduino. This is done to communicate with the HC-05 Bluetooth module.

Pedro Ribeiro et. al. A novel wearable device combines accelerometer, gyroscope, and magnetometer for real-time spine posture monitoring. Individual calibration is required, and a probabilistic classification algorithm compares sensor data with calibration results. The device, incorporating permanent magnets, significantly improves posture classification accuracy (89%) over using only accelerometer data (47%). A pilot trial with a single adult test subject validated the method's effectiveness. The approach holds promise for addressing and enhancing monitoring of posture-related issues.[11]

iii. Algorithm

Read the analog value from the flex sensor connected to an analog pin on the Arduino.

Threshold Comparison Compare the flex sensor reading to a predefined threshold value (in the example, the threshold is set to 805).

Vibrating Motor Control If the flex sensor reading is above the threshold turn on the vibrating motor connected to a digital pin If the flex sensor reading is below the threshold turn off the vibrating motor. It also outputs the posture status

Bluetooth Communication Use the SoftwareSerial library to set up a software serial communication channel with the HC-05 Bluetooth module.

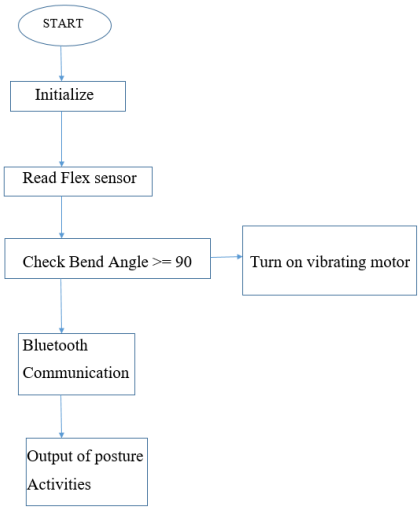


Figure 3. General Flow Diagram of the System

V. RESULT AND DISCUSSION

1) RESULT –

The posture correction project utilizing Arduino, flex, hc05 and vibrating motor sensor aims to enhance user awareness and encourage proper body alignment and monitors. In this project, a flex sensor is strategically placed on a wearable belt and typically attached to back. The Arduino continuously reads the sensor data and sends on application via HC05 establishing a baseline for correct posture during calibration. Real-time analysis of the sensor readings enables the system to detect deviations from the desired posture. To provide immediate feedback, the project has included vibrating motors when user sits in a correct posture motor gets on and gives massage to the user. its User-friendly feedback mechanisms of massage consciously reminds to sit in a correct posture and the massage may give a back relief so it contribute to the effectiveness of the system, fostering improved posture habits over time and more productivity. [12]
Limitations of Belt: It is observed that the moment of body is restricted when the belt is used so it not recommended to were more than 2 hours a day it causes muscles Contraction which can cause various muscles problems etc [13].

Successful to getting flex values to print the postural activities.

OUTPUT ANALYSIS

After analyzing the code throughly we determined that there were some assumptions we made while predicting or determining the output

The assumptions were as follows:

1.The sensors used are highly calibrated and provides optimum output in all conditions
Actual: the sensors we are using are low end basic sensors, which struggles to provide optimum output in conditions, and voltage

2. we assumed that the improper posture will be determined when the value reaches 800>
Actual: as the sensor are low end they struggle to reach values we determined as threshold, so we for prototyping considered a lower threshold value in instance like 300>

3. We assumed that the system will have a fixed power supply Actual the system currently implemented uses a hefty breadboard and a laptop/power-bank making the system non-portable

4. As we can see in the observation the table there are various types of posture angles after wearing the belt so the minimum angle starts from 90degree.

Table 2: Flex sensor bend degrees, Resistance from 90 to130 degree and Resistance(ohms)

Resistance (ohms)	Bend angle	Postural activity
15853.97	36.00	Good Posture
15689.21	36.00	Good Posture
2	37.00	Good Posture
3	37.00	Good Posture
4	37.00	Good Posture
5	37.00	Good Posture
6	38.00	Good Posture
7	38.00	Good Posture
8	38.00	Good Posture
9	38.00	Good Posture
10	39.00	Good Posture
11	39.00	Good Posture
12	39.00	Good Posture
13	39.00	Good Posture
14	40.00	Good Posture
15	40.00	Good Posture
16	40.00	Good Posture
17	40.00	Good Posture
18	40.00	Good Posture
19	41.00	Good Posture
20	41.00	Good Posture
21	41.00	Good Posture
22	41.00	Good Posture
23	41.00	Good Posture
24	42.00	Good Posture
25	42.00	Good Posture
26	42.00	Good Posture
27	42.00	Good Posture
28	42.00	Good Posture
29	43.00	Good Posture
30	43.00	Good Posture

VI. CONCLUSION

In conclusion we surveyed various papers and gets the exact, posture angles & correct way sitting and on this survey we developed a system of posture correction & monitoring project employing Arduino and a flex sensor represents a noteworthy endeavor in promoting healthier habits and enhancing body awareness. By combining sensor technology with real-time feedback mechanisms, the system not only detects deviations from optimal posture but also actively engages users in cultivating better alignment habits.

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