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DEMEANOR ANALYSIS OF SPINAL CORD USING PLIABLE BASED SENSOR

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***Abstract*— Improper sitting position causes curvature of spinal cord. This is due to the longtime usage of smart phone and laptop by youngsters, IT professionals and working staff which leads to neck pain and low back pain and in turn leads to spinal related disorders. Best way to prevent this is by keeping a good posture as a daily routine.**

The focus of this paper is to build a wearable device to detect wearer's bad posture and alert the user to return back to the erect position. As well as provide a feedback through voice module and LCD display.

In this we use accelerometer sensor for detecting the bending angle once poor posture is detected, and it is processed through Arduino. Massager is attached with this device using DC motor to reduce low back pain and it is switched on whenever needed. Through this project we can train the user to maintain a good posture through its continuous use and we also provide massager to the user and it is used whenever the user experiences an ache in the low back.

I. INTRODUCTION

Posture is the way that a person can sit, stand, walk and perform tasks, it also reflects one's effect on their health. Poor posture leads to poor health conditions like neck pain and low back pain. Maintaining a correct body posture is significant to lead a healthy life which helps in proper functioning of organ and proper blood circulation throughout the body.

Maintaining a good posture not only involves body training but mind training also plays a major role to keep reminding oneself to be in a proper posture. A recent survey on back pain evidently proved that about 80% of people are suffered from back pain, and major causes for back pain are due to bad posture while sitting, irregular exercise, and over body weight. Majority of the people do not seek medication immediately and wait till they feel severe pain. The treatment usually involves some rest and sometimes a doctor's prescription. Its treatment often involves physiotherapy and sometimes surgery depending on the severity of the issue. Hence, lots of money is annually spent on such treatments which would be unnecessary if proper precautions had been taken. Therefore, monitoring of bad posture is most essential in order to avoid complications.

The posture alerting device implemented in this paper helps in achieving this purpose. It detects the back posture and alert the user when back bone bends and also provides massage to the user whenever needed. Back posture is detected using 3 axis accelerometer sensors. when poor posture is detected, it is alerted through a buzzer and a voice module and is processed using Arduino UNO. The bending angle and the number of times the person bends is displayed in an LCD display. Sometimes a person feels ache in their low back, to avoid this a massager is provided with this device and the massager is switched ON whenever the user feels low back pain.

II. LITERATURE REVIEW

"Sitting Posture Alerting System for Pain in Back and Neck Region" by Vijaya shetty S, et al, International Journal of Recent Technology and Engineering published in the year of 2019. In this paper, they use wearable devices with sensors attached on a person to record body positions. The recorded positions are compared with standard positions. The system developed can be used to minimize mental and physical disorders arising due to improper sitting posture.

"Wearable Sensor Array Design for Spine Posture Monitoring During Exercise Incorporating Biofeedback" by Jorge E. Caviedes, et al published in the year of 2018. In this paper, research builds upon the progress in wearable sensor technology, spinal posture monitoring, and biomechanical biofeedback methods to address the need for monitoring compliance and correctness and support data collection to enable improved assessment of the effectiveness of physical therapy for spinal conditions.

"Posture monitoring systems based on pressure sensors" by Jingyuan Cheng et al published in the year of 2018. In this paper, they use four pressure sensors placed under the chair legs. The experimental results show that the system defines different sitting posture and detects, also, the hand and the head motion.

"A novel mobile wireless sensing system for real-time monitoring of posture and spine stress" by Bilal El-Sayed, Noura Farra, Nadine Moacdieh, Hazem Hajj, Rachid Haidar and Ziad Hajj published in the year of 2018. In this paper, the system uses the tilt angle information and weight information to define the sitting posture.

"The role of wearables in spinal posture analysis" by Lauren Simpson, et al, Simpson et al. BMC Musculoskeletal

Disorder in the year of 2019. Poor spinal posture, as defined by relates to the relative position whereby the head and upper trunk is in a forwards flexed position. Neutral posture is considered when the head and upper trunk is at zero degrees to the rest of the spine, with subsequent increase in angle correlating with poorer posture and its associated complications. It is based on physiotherapy session and laboratory evaluation. Such traditional methods have been criticised as costly and impractical with a key inability to measure day-to-day posture and provide timely feedback.

"Abnormal Posture Relating to the Alignment of Spine and Lower Extremity" by Yasushi Oshima , et al, Hindawi in the year of 2019. Adult spinal deformity (ASD) is classified into coronal curve types and three sagittal modifiers (the difference between the pelvic incidence and the lumbar lordosis, the global alignment, and the pelvic tilt). In ASD, sagittal plane deformity is known to be of critical importance for pain and disability; therefore, recently, posterior spinal fusion has been applied for the correction of sagittal spinal malalignment.

"Development of a posture detector using a flex sensor" by Sibei Xia,et al, International Textile and Apparel Association annual conference proceedings, in the year of 2018.A good or ideal posture describes the alignment of the body when all body parts are balanced and symmetrical around the line of gravity, while bad or poor postures occur when asymmetric relationships are adopted . When a person is maintaining a good posture, the spine is aligned with minimum internal muscular stress and maximum efficiency of external strain. When a person is maintaining a bad posture, the stress on the curvature of the spine is increased which causes muscle fatigue.

"Patient Posture Monitoring System Based on Flexible Sensors"by Youngsu Cha, et al, MDPI in the year of 2017.We use flexible sensors based on polyvinylidene fluoride, which is a flexible piezoelectric material. The flexible sensors are inserted into parts close to the knee and hip of the loose patient cloth. We measure electrical signals from the sensors caused by the piezoelectric effect when the knee and hip in the cloth are bent. The measured sensor outputs are transferred to a computer via Bluetooth. We use a custom-made program to detect the position of the patient through a rule-based algorithm and the sensor outputs.

"Posture Determination by using Flex Sensor and Image Analysis Technique", by Abdullah Beyaz, et al, AGRICULTURAL SCIENCE DIGEST - A Research Journal, in the year of 2017. In the sense of safety, searching solutions for the problems of farmers may face during their work in the field of agriculture is important. A safety tracking system with an audible warning support developed for any threshold value that selected during a posture angle measure of agricultural work.

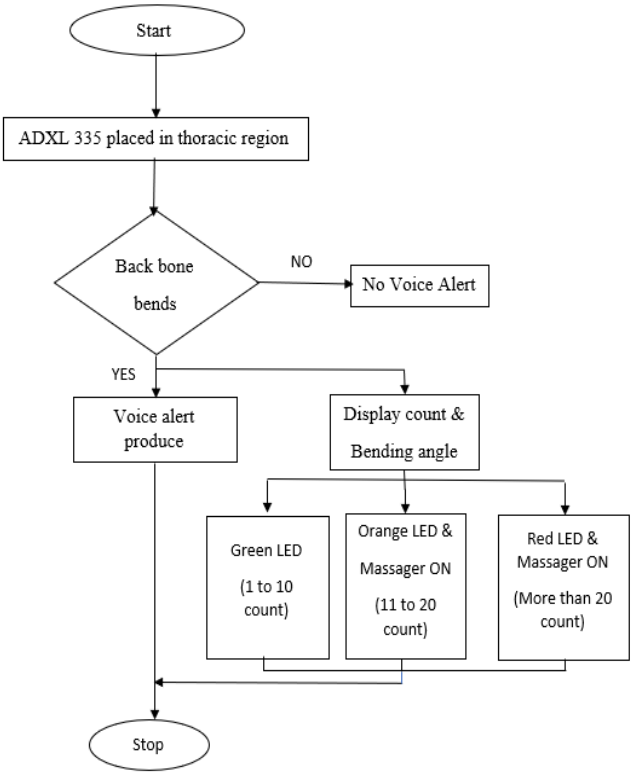
"Wireless Wearable T-Shirt for Posture Monitoring During Rehabilitation Exercises", by Emilio Sardini, et al, IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, in the year of 2015.The subject posture is measured through a sensorized T-shirt using an inductive sensor sewn directly on the fabric. The instrumented T-shirt's output data are compared with the data obtained via an optical system, as a gold standard, that measures the marker positions over the patient's back and chest.

From these literature survey, they use multiple type of technology and sensor to monitor the body posture but in our project only one sensor is used for monitoring the body posture which will useful for the patients and also youths to prevent the spinal diseases.

III. METHODOLOGY

The hardware components we used ADXL335 accelerometer sensor, voice module, LED (red, yellow, green), LCD display, Arduino board, jumper wires, resistor, bread board or PCB board, connecting wires, DC motor, power Supply, vest and the software we used is Arduino IDE.

The ADXL335 accelerometer sensor placed at the thoracic region is used to sense the curvature of the spine and measures the bending angle. Once back bone bends, Voice module alerts the user as "SIT STRAIGHT, DONT BEND". For visual alert LED and LCD display are used. Number of times our spine bends is counted, the count and bending angle is displayed in LCD display. When the count is in between 0 to 25, white LED starts to glow. If the count is between 26 to 50, Green LED starts to glow simultaneously DC motor is switched ON automatically, which act as a massager for low back pain relief. If the user doesn't feel pain, he/she can switch OFF manually. If the count is more than 50, red LED starts to glow at the same time warmer (placed at neck and low back) and massager is turned ON automatically, which act as muscle pain reliever. The whole setup is installed in a vest for easy wearable purpose.



IV. RESULT AND DISCUSSION

In this posture alerting and monitoring device, we measure the bending angle of the backbone, the number of times we bent, and the time spent on poor posture. These are all the parameters we find through this paper. In addition, we also added a massager which gives rhythmic massage to the user and it can be switched off manually when not in use.

Initially we make use of flex sensor to detect the bending angle but the flex sensor is highly cost, not reliable, loss its

function after the usage of 5 to 6 times. So, we make use of ADXL335 accelerometer sensor. At first, we use Arduino UNO, but the analog and digital pins present in the Arduino kit is not at all sufficient to proceed this project. So, we use PIC16f877A microcontroller, which has inbuilt LCD mount, separate sensor port, digital ports and power supply which is more than enough for the placement of LCD, LED, buzzer and DC motor.

V.CONCLUSION

The newly designed posture monitoring and alerting device suggested in this paper measures the degree of slouch, time we spent on slouch and its count. The massager is installed in this kit to give a mild massage which gives relief from low back pain. Visual and audio alert is given using buzzer, LCD and LED.

In future, we can add headphone compatible posture alerting device for personal alert. Bluetooth module can be used along with it to send the data wirelessly to our smart phone for alerting the body posture. Instead of finding the bad posture in 1 axis, 3 axis measurement can be done for monitoring the posture in all axis [X, Y and Z axis].

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