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ALERT SYSTEM FOR POSTURE CORRECTION

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***Abstract*— Millions of people across the globe are suffering from back pain. The main reason behind is bad posture of back. We always tend to ignore these little symptoms of back pain, which would lead to serious deformities in the future. In the present, computers, laptops, electronic gadgets have been an important routine. So as prevention, we require a bio-electronic device which could give the inference on his posture and help maintain a better posture, hence maintaining a good spine health. The main focus of this paper is about the construction, working, testing of the posture alert system device developed using Arduino Uno and flex sensors. This device being developed is low cost, reliable and user friendly for most ages.**

***Keywords*— Keywords: Back pain, user friendly, bad posture, computers, electronics, Arduino, flex sensor**

I. INTRODUCTION

Back pain is a common problem across the globe. Nevertheless, it has always been ignored until it turns out to be a serious deformity. It is always uncomfortable and debilitating. It can result from injury, activity, bad posture, prolonged work hours and some medical conditions. Back pain is common among all ages, for different reasons. As people get older, the chance of developing lower back pain increases, due to factors such as previous occupation, lack of strength, lower metabolism and degenerative disk disease. Lower back pain may be linked to the bony lumbar spine, discs between the vertebrae, ligaments around the spine and discs, spinal cord and nerves, lower back muscles, abdominal and pelvic internal organs, and the skin around the lumbar area. Upper back pain also called scoliosis is mainly caused due to rolled shoulders or hunch back. People who sit in front of laptop or monitor for prolonged hours are more prone to have scoliosis .Pain in the upper back may be due to disorders of the aorta, tumors in the chest, and spine inflammation.

Causes: The human back is composed of a complex structure of muscles, ligaments, tendons, disks, and bones, which work together to support the body and enable us to move around. The segments of the spine are cushioned with cartilage-like pads called disks. Problems with any of these components can lead to back pain. In some cases of back pain, its cause remains unclear. Damage can result from strain, medical conditions, and poor posture, among others.

- Ruptured discs: Each vertebra in the spine is cushioned by disks. If the disk ruptures there will be more pressure on a nerve, resulting in back pain. Bulging disks: In much the same way as ruptured discs, a bulging disk can result in more pressure on a nerve.
- Arthritis: Osteoarthritis can cause problems with the joints in the hips, lower back, and other places. In some cases, the space around the spinal cord narrows. This is known as spinal stenosis.
- Abnormal curvature of the spine: If the spine curves in an unusual way, back pain can result. An example is scoliosis, in which the spine curves to the side.

II. MOTIVATION

Adopting a much hunched sitting position when using computers can result in increased back and shoulder problems over time. Back pain can also result from some everyday activities or poor posture.

Examples include:

- coughing or sneezing
- muscle tension
- over-stretching
- bending awkwardly or for long periods
- pushing, pulling, lifting, or carrying something
- standing or sitting for long periods
- straining the neck forward, such as when driving or using a computer
- long driving lessons without a break, even when not hunched
- sleeping on a mattress that does not support the body and keep the spine straight.

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III. LITERATURE SURVEY

In this paper, the Literature survey has been conducted by reading each and every paper covered. A relation of disease and the device have been interconnected in the process.

Review 1: The first review that is considered is retrieved by searching on IOT Based Smart Wearable Posture Detection & Alert System. This includes searches in IEEE Xplore, Science direct and Research Gate.

The slouching has an effect on the transverses abdominal muscle. When an individual maintains a slouched pose, the breadth of the transverse abdominal muscle has shrunk substantially. Low back pain has been attributed to intransitive abdominals dysfunction. Two major parts are very important in this design and those are, controller board with wireless connectivity feature and IMU to give more than 6DOF data to process the position of the user in different conditions of movement. Thus we used Node MCU as our central control board and MPU6050IMU unit for angular data measurement and positional data measures, also we fixing the flex sensor to measure the spine moment for achieving more correct and accurate response to raise an alert signal and make and corrective actionable decision before making and alert via notification and vibration motor. The system needs 3.7V power to operate. Additional requirement for implantation of this device is the access to the electronic testing platforms like, CRO setup and multi-meters for carry out testing and troubleshooting work. For software part they just used a laptop enabled with internet and Arduino IDE installed onto it, with suitable library files accessible for handling IOT operations.

Review 2: The second review is considered by reading Sitting Posture Alerting System for Pain In Back and Neck Region. This includes searches in IEEE Xplore, Science direct and Research Gate.

Poor body posture is the root cause of most mental and physical health complications. The human body was designed to move and not to be seated on a chair for several hours at a time. Sitting on a chair overtime leads to fatigue, depression, pain and headaches. When a body remains in seated position overtime, all of its internal processes slow down. It starts with Proposed Design of Microcontroller where we choose a microcontroller suitable for our project. We have chosen RL78 Renesas Microcontroller since it is capable of running on low power. Next, we went ahead with the Test Code Preparation wherein we prepared the code for the three accelerometers. The code prepared is such that when the accelerometers detect inappropriate body posture, user is alerted. This is followed by Logic Development where we determine the threshold values for each of the three accelerometers with reference to REBA.

We also developed an android app in this phase to alert the user about his/her inappropriate body posture. The next phase is Accelerometer and Microcontroller Testing where they connect the microcontroller to one of the accelerometers and test if the accelerometer is able to sense the change in body movements and send the data to the microcontroller. On its success, we went ahead with Android Application Testing where we checked if an alert was sent in the form of a message to the android app. In the Final Testing phase, they connected all the three accelerometers to the microcontroller and checked for their functioning followed by a final testing of the android application.

Review 3: The third review that is considered is retrieved by reading Posture Detection and Alerting System Using RTSC Algorithm. This includes searches in IEEE Xplore, Science direct and Research Gate.

Posture is the situation in which we hold our bodies during the actions like standing, sitting, or resting etc. Without the posture and the muscles that control it we might have chance of basically tumble to the ground. The wearable garment is designed which as an accelero-meter, node mcu ESP8266 with build in Wi-Fi module and buzzer with a power supply. The web interface support is also given with an authentication for individual user. Accelerometer calculate axis of user upper body A RTSC (Real Time & Self Calibrating) Algorithm Based on Tri-axial Accelerometer Signals is used for calculating human posture and activity Device compares the posture value with the threshold value The threshold value normal human posture from Intelligent Chair Sensor paper Classification and Correction of Sitting Posture is collected from 5 neural network data which is normalized and used. Accelero-meter reading measured in the voltages are converted into accelerations (xG, yG, and zG), measured as multiples of g by $\cdot$ $xG=(x - V0)/Sx \cdot yG =(y - V0)/Sy \cdot zG = (z - V0)/Sz$ If the value exceeds the threshold limit for the duration of a minute the device remains the user to correct the posture through the buzzer. When buzzer is activated then device sends posture value to the server using the Wi-Fi on the device The accelerometer reading data that are collected are stored in database along with the date, time and user id. This information areanalyzed to form real-time monthly statistically varying graph. The report can be generated in PDF form which contains graph and analyzed table. The analyzed table has the highest value and the average value for every day.

Review 4: The fourth review that is considered is retrieved by readinga Wearable Sensor System for Physical Ergonomics Interventions Using Haptic Feedback**.** This includes searches in IEEE Xplore, Science direct and Research Gate.

Work-related diseases and disorders constitute a large problem globally and affect societies, organizations, and individuals. International surveys indicate that the amount of manual handling activities has not declined substantially in the last decades, although an increasing number of industrial processes for goods handling have been automated. Manual handling is still a feasible solution in many situations due to its high flexibility and low investment costs compared with many fully or semi-automated solutions. Therefore, future manufacturing systems, such as Industry 4.0, which has increased utilization of automated processes, may partly rely on the manual handling of goods for the foreseeable future. When manual handling cannot be avoided, employers are obligated to perform a risk assessment to ensure that operations can be performed without adverse health effects An alternative is to shift the focus to proactive risk management , where risk assessments of potential hazards are performed at earlier stages before symptoms such as work-related pain have emerged . Such risk assessments are often performed by professional ergonomists with the direct or indirect support of observation-based assessment tools. Despite the broad applicability of observation-based assessment tools, they can have low precision and reliability, and can additionally be less cost-efficient than technical measurement instruments when considering the precision of the obtained data. To compensate for such disadvantages, the assessment of risk factors for MSDs by using observation-based assessment tools may benefit from being complemented with increased use of technical measurement instruments, such as sensors.

Review 5: The fifth review that is considered is retrieved by readingSit straight (and tell me what I did today): A Human Posture Alarm and Activity Summarization System. This includes searches in IEEE Xplore, Science direct and Research Gate.

It presents a novel system for monitoring a computer user's posture and activities in front of the computer (e.g., reading, speaking on the phone, etc.) for self-reporting. In their system, a camera and a microphone are placed in front of a computer work area (e.g., on top of the computer screen). The system monitors the computer user's postures and summarizes his or her activities. The system gives the user real time feedback on the goodness of his current posture, triggers alarms if the postures are not good postures, and generates summarized postures and activities over a specified period of time (e.g. Hours, days, months, etc.

All elements of the system are highly customizable: the user decides what "good" postures are, what alarms are triggered, if any, and what activity and posture summaries are generated. They presented novel algorithms for posture measurement (using geometric features of the user's silhouette), and activity classification (using machine learning).Finally, they presented experiments that showed the feasibility of our approach, and discuss privacy issues and applications of the techniques presented (health monitoring, productivity analysis, and others).The user sets up a "user profile" for the alarms and summary. In particular, he sets parameters that determine when an alarm is triggered and what the summary contains. For example, the user might want to see a summary after 6 months and show it to his doctor, who can use the summary to explain why the user might be having need to error back pains. He can specify if the summary should contain the time spent on each posture, and which postures are important for the summary (e.g., he might be interested in only one or two postures).The health monitoring application can be used by anyone, but it is of particular interest to information workers that spend several hours per day in front of the computer. This includes secretaries, researchers, data entry operators, and many others.

IV. AIM & SCOPE

AIM

In the present times, working with computers has become a daily routine and working time in sedentary posture is increasing. To address this problem, we are developing a device with flex sensors, which can detect a wrong posture/irregular, bend from the natural status of the spine and alert the user as an inference from his posture. This device will help millions of people suffering from back pains or any complexities relating to spine in their future years.

V. EXISTING SYSTEM

Double Strap Posture Corrector: This double strap back brace has a waist strap and another elastic belt to offer extra lumbar support and comfort as you wear it. It also has two auxiliary support bars in the padded back strip for added structure.Eivotor Posture Corrector Trainer: This smart posturecorrector is made of an ergonomic elastic and nylon material that fits over your shoulders. It also comes with a sensor that vibrates when your posture is out of alignment to help you establish muscle memory and develop a habit of straightening with a gentle reminder.

Upright GO Electronic Posture Trainer: All you need is a gentle reminder to alert you when you're slouching, you can try one of the wearable devices, Smith says. These attach either via a clip to the front of your bra or with adhesive to the skin on your upper back and vibrate when your posture starts to slip. Some also come with an app for your phone so you can track your stats over time.

VI. PROPOSED SYSTEM

In the proposed system, 3 flex sensors have been used, 2 flex sensors placed on either side of the spine, in the region between scapula (shoulder bone) & rhomboid major, to check on rounded shoulders/hunch back. The 3^{rd} one is

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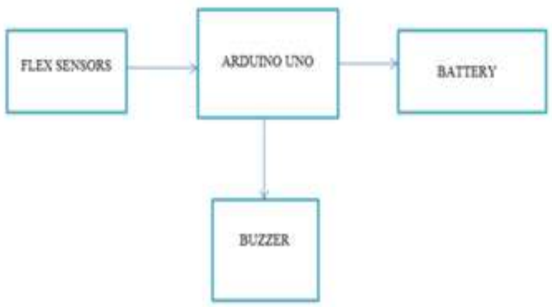
placed on the lumbar region to detect the frontal bending. These flex sensors are connected to 47kohm resistors in series forming a voltage divider circuit, this is made to test the bending of the flex sensor. A 9V battery is used as a power supply to the Arduino. This programmed in a way such that it gives an alert to the user on his bad posture retained for a longer period (say 10s).This process is controlled by the user on handling the button.
Next, we went ahead with the code, the code was prepared on Arduino.cc. The code was made such that, the flex data will be collected at first and then a threshold data was set(15 degree data-accordance to recent research),then, when the user bends time allowance of few seconds (10s) (delay) is given so that the user doesn't have to keep changing his position very often. Once the user remains in a bent posture for more than the set threshold time, the buzzer alerts the user to go back to his normal position. This process continues until the user wears this device, which is battery operated.

VII. METHODOLOGY

HARDWARE IMPLEMENTATION
Components used in this system are:
1. Flex sensor used for bend detection
2. Buzzer
3. 10K resistors
4. ARDUINO UNO
5. Battery
6. Breadboard

Block Diagram



Abstract Specifications Of Subsystems
a) Flex Sensor

Fig 1. Flex Sensor

A **flex sensor** or **bend sensor** is a sensor that measures the amount of deflection or bending usually, the sensor is stuck to the surface, and resistance of sensor element is varied by bending the surface. Since the resistance is directly proportional to the amount of bend it is used as goniometer and often called flexible potentiometer. Our project will be using a conductive ink based flex sensor (4.5 inches).

Features and Specifications
1. Operating voltage of FLEX SENSOR: 0-5V
2. Can operate on LOW voltages
3. Power rating: 0.5Watt (continuous), 1 Watt (peak)
4. Flat Resistance: 25K Ω
5. Operating temperature: -45ºC to +80ºC

b) Arduino UNO

Fig 2: Arduino UNO

The Arduino Uno is an open-source microcontroller board based on microchip ATmega328P microcontroller. The board is equipped with sets of digital and analog input/output (I/O) pins. The board has 14 Digital pins, 6 Analog pins, USB connector, Power port, Microcontroller, Reset Switch, Crystal Oscillator, and USB interface chip, TX RX LEDs.

c) Battery

Fig 3: 9V-Battery

The **nine-volt battery**, or **9-volt battery**, is a common size of battery that was introduced for early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in smoke detectors, gas detectors, clocks, walkie-talkies, electric guitars and effects units. The battery is used to power up the Arduino.

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d) Buzzer

Fig 4: Buzzer

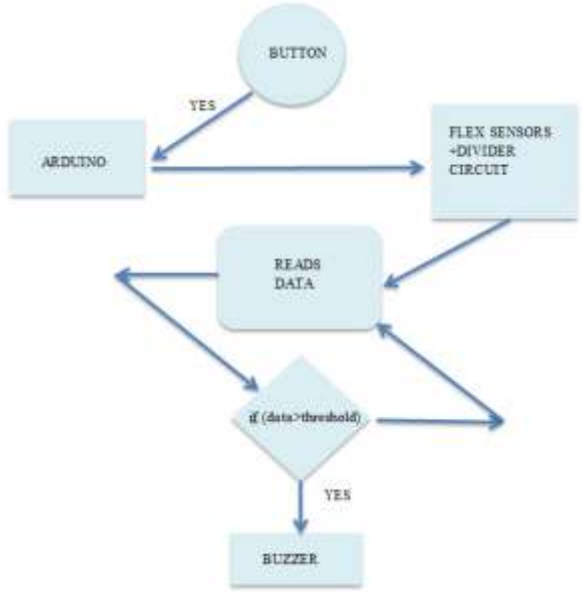
An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

e) Breadboard & resistors

Fig 5: Resistor & Breadboard

A breadboard is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to prototype (meaning to build and test an early version of) an electronic circuit, like this one with a battery, switch, resistor, and an LED (light-emitting diode).A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

VIII. SOFTWARE ALGORITHM



MECHANISM

- Switch on the button, to activate the Arduino
- The starts collecting data from the flex sensor system & voltage divider circuit
- Arduino checks for the data limit, if the data limit is above the threshold, then it alerts the user through the buzzer, and alerts until the user corrects his posture and the same repeats.
- If the user is in proper posture and data limit is within the threshold, then the process continues to check.

IX. RESULTS & DISCUSSION

Software Implementation On Tinker Cad

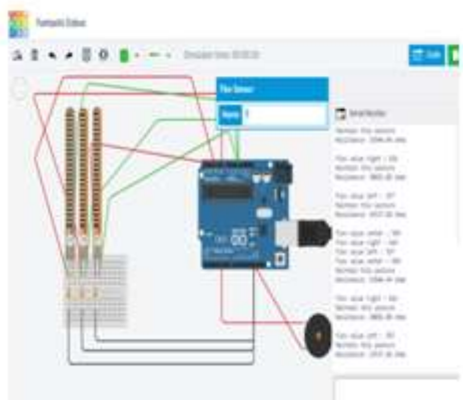


Fig 6: Implementation On Tinker Cad

Hardware Implementation

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Fig 7: Implementation

The 2 flex sensors on either side of spine placed between the scapula & rhomboid major. The last flex sensor placed on the lumbar region.

Hardware Assembly

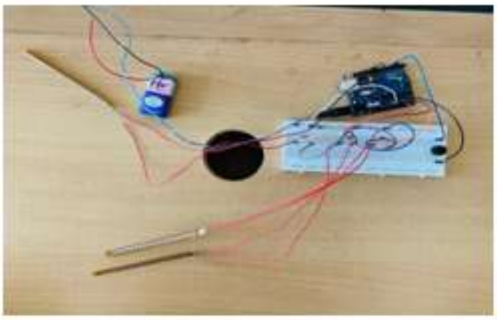

Fig 8: Hardware Connections

The 3 flex sensors being connected in a voltage divider connection to the Arduino. The battery was connected to the Arduino for powering up the device.

Final Model
Pros
Several trials were done to test the accuracy and intimacy of the device. The users felt it useful to use this device which alerted them when they were in a wrong posture.
Cons
The flex sensor is too sensitive to changes in any resistance; hence it requires timely fabrication and programming, which can be done at higher level processing.

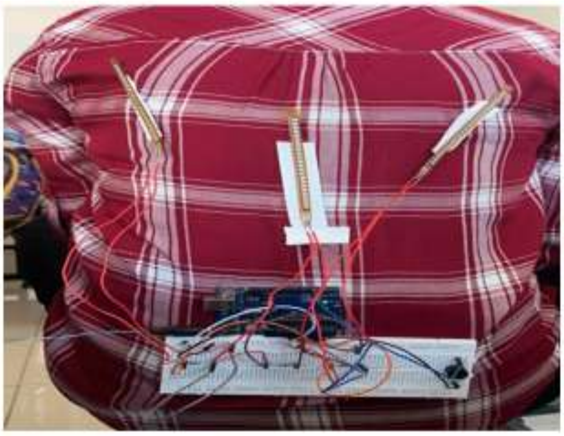

Fig 9: Final Model

X. CONCLUSION

In the present proposed system, flex sensors have been connected to the Arduino and data has been collected in perspective of the user's posture. The user's posture was monitored thoroughly by using timing codes. A timer of around 10 seconds was set for the leisure of the user to be at a certain position (bad),if the user retained his position for a long period (in this case 10 sec),the alert is given to the user. The process repeats until the user wears the device and wishes to use it to monitor his posture.

ADVANTAGES

- The proposed has no complexities of operation and utilization
- The device is user friendly
- This device efficiently monitors posture and alerts the user

APPLICATIONS
Posture monitoring devices have been proven to be effective to all people suffering from back pains or due to bad posture might suffer from hunch backs. It can be used by all sections of the society, having a higher incidence rate for the IT people who work continuously for prolonged hours.

SCOPE FOR FUTURE WORK
The project can be further modified by introducing IOT and tracking the patient's position health every time the device is being used. The device can be fabricated into a unit device and make it wireless. It can help a lot of people from getting into serious deformities in spine leading to several other issues.

XI. ACKNOWLEDGEMENT

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XII. REFERENCES

[1]. A RTSC(Real Time & Self Calibrating) Algorithm Based on Tri-axial Accelero-meter Signals for the Detection of Human-Posture and Activity done by DavideCurone, Gian Mario Bertolotti, Andrea Cristiani, EmanueleLindoSecco, and Giovanni Magenes July 2010

[2]. Bearing defect and detection using onboard accelero-meter measurements by Dr. John Donelson and Dr. Ronald L. Dicus April 2002

[3]. Clinical apps of sensors for human-posture and movement analysis: A review by WAI YIN WONG, MAN SANG WONG, & KAM HO LO March 2007

[4]. Design of an InLine Accelero-meter Based In-clination Sensing-System Xu Yao, Wen-Yen Lin, Wen-Cheng Chou, Kin Fong Lei, Ming-YihLee, and GuangminSun,May 2012.

[5]. Forward flexed Posture-Detection for the Early Parkinsons Disease-Symptom by Wen-Shao Wu, Wen-Yen Lin and Ming-Yih Lee October 2014

[6]. Light Weight Online Un-supervised Posture Detection by Smart-phone Accelero-meter ÖzgürYürür, Chi Harold Liu & Wil frido Moreno August 2015.

[7]. 7.A. Lindegard, C. Karlberg, E. WigaeusTornqvist, A. Toomingas and M. Hagberg,"Concordance between VDU-users' ratings of comfort and perceived exertion with experts' observations of workplace layout and working postures". Applied Ergonomics 2005; 36: 319- 32

[8]. Dunne, L. E., Walsh, P., Hermann, S., Smyth, B., and Caulfield, B. Wearable monitoring of seated spinal posture. Biomedical Circuits and Systems, IEEE Transactions on 2, 2 (2008), 97–105.

[9]. L. Dunne, S. Brady, B. Smyth, and D. Diamond. Initial devel- opment and testing of a novel foam-based pressure

[10]. sensor for wearable sensing. J NeuroEngineeringRehabil, 2(4), 2005.

[11]. R. M. Shubair and H. Elayan, "In vivo wireless body communications: State-of-theart and future directions," in Antennas & Propagation Conference (LAPC), 2015 Loughborough. IEEE, 2015, pp. 1–5.

[12]. challenges," in Antennas and Propagation (EUCAP), 2017 11th European Conference on. IEEE, 2017, pp. 2478–2482