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POSTURECTOR- THE POSTURE CORRECTOR

Santhana Lakshmi.P
B.Tech ECE (Final Year)
SRM University
Chennai, India
lakshmicr07@gmail.com

Anupam Kumar
B.Tech ECE (Final Year)
SRM University
Chennai, India
kumaranupam030394@gmail.com

Mr.C.Aravindan
Assistant Professor ECE Dept.
SRM University
Chennai, India
aravindan.c@rmp.srmuniv.ac.in

***Abstract* - Millions of people are suffering from back pains in the United States and all around the world. The most common reason behind this is poor posture of the back. This paper is motivated by the need of a tool to remind students and heavy computer users to correct their poor postures automatically to prevent back pains. We aim to develop a posture correction system with a biofeedback mechanism. This paper focuses on the construction, working and applications of a posture corrector.**

***Keywords* –Posture, Flex sensor, Poor posture warning, posture correction, biofeedback, wearable device, automatic life system..**

I. INTRODUCTION

According to the American Chiropractic Association, as much as 80% of the population experiences back pain. It has been found out that the major reason for back pain is poor posture. Bad posture includes swaying back, pelvic tilt, slouching and bending over. It gives you increased spinal wear and tear, feelings of depression, and a higher chance of back injury.

Some studies explain good body postures by measuring head incline angles – the true horizontal angle in conjunction with any of the following lines: the Ear-Eye line (from the tragus to the can thus), the Frankfurt line (from the tragus to the bottom of the eye socket), the tragus-to-nasion line, the tragus-to-infraorbital-notch line, and more. The down side of using head tilt angles is that they only refer to one aspect of the complex geometry involved in head and neck posture.

Other research uses head/neck angles – the angles between true vertical (or horizontal) and a line connecting C7,T1, to various skull landmarks like those described above. The C7 vertebra supports and stabilizes the head and neck, and is the most prone to be affected by poor head and neck posture. A comfortable head/neck angle is about 30° in a normal sitting posture and about 40° in using computer. A posture below 25°or beyond 50° is considered poor and needs to be corrected.

Studies show that for every 15 degrees of forward neck tilt, as much as 10-20 lbs. of increased weight is added onto your spine, back, and neck.

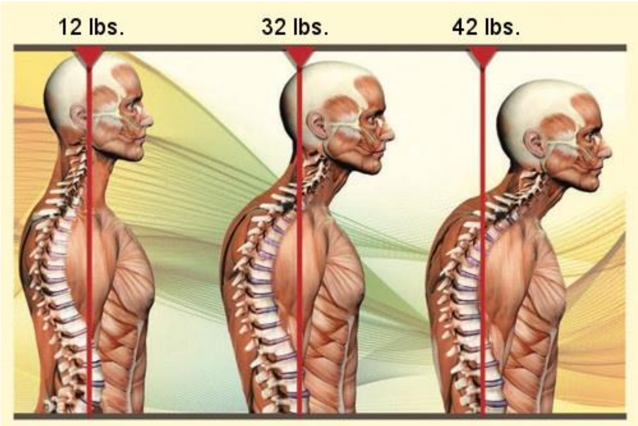


Fig 1: Bad posture representation

Current means for monitoring and measuring ergonomic effects upon workers are based on surveys, or consulting companies, with the aid of the local occupational health departments so that corrective measures can be taken for improving work health. As result of current advances in electronics, there are software solutions for simulating and improving work spaces accordingly to the worker’s needs. Unfortunately, surveys can only determine causes based on common trends in discomfort according to ergonomics standards, answers can be vague or misinterpreted.

The advanced technology of wearable devices has provided a way to correct our posture and avoid severe consequences in the future. Wearable devices are smart electronic devices that can be worn on the body as an implant or accessory. The design depends on the need and uses. The aim of the paper is to design an easy-to-use product for those who want to better their posture during everyday tasks, such as working at a desk or sitting in class.

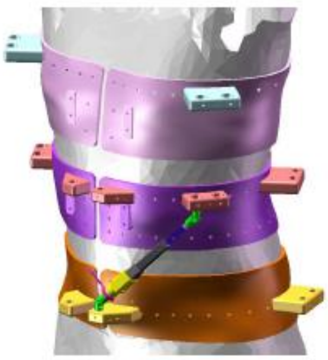
II. EXISTING SYSTEM

Generally if anyone suffers from a back pain, they are advised to undergo surgery or to use complicated equipment's like dynamic joint braces. These are very complex and are too expensive.

The back surgery can usually be done with a minimally invasive approach, and will usually result in early return to normal function in 6 to 12 months. The success rate is generally not so high

Heat/cool pads and some acupuncture techniques are also suggested but they provide temporary relief from pain.

Sometimes the patients are advised to try spinal disks which are rubbery pads that have a tough and fibrous outer members and an elastic core. The disks are firmly embedded between the vertebrae and are held in place using ligaments. This process is painful and may involve serious side effects.



(a) Brace model on scanned figure.

(b) Brace with internal supports.

Fig 2: Existing systems to correct the back pain

III. PROPOSED SYSTEM

The purpose of this paper is to create a simple wearable device that helps the users to correct their posture during everyday tasks, such as working at a desk or sitting in class in order to alleviate back pain and maintain a healthy lifestyle.

The components used are PIC microcontroller, flex sensor, buzzer, a LCD, flexible belt and DC gear motor. The flex sensor and the buzzer are attached to the lower back of a compression shirt that is worn by the user. The microcontroller uses the output of the sensor to determine if the user is in proper posture or not and then, sends a signal to the buzzer accordingly. A LCD display is also included that allows provides information to user about their poor posture. The values of flex sensor are taken at an initial stage and is set as a threshold.

Initially, when the person deviates from his/her normal position, the buzzer alerts the user. After a delay, if the user doesn't return to his/her normal position, the DC motors present on the flexible belt is activated. The motor is programmed in such a way that it automatically lifts back the slouching user to the normal position.

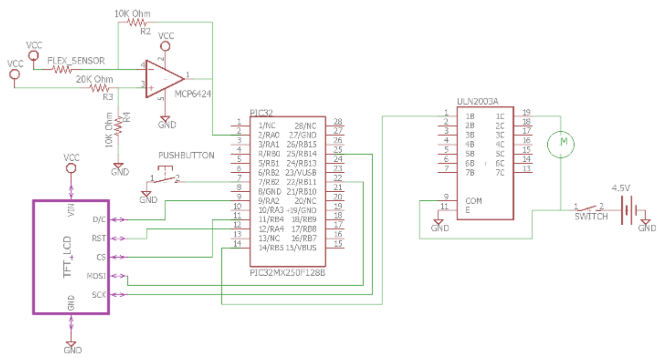


Fig 3: Basic schematic diagram

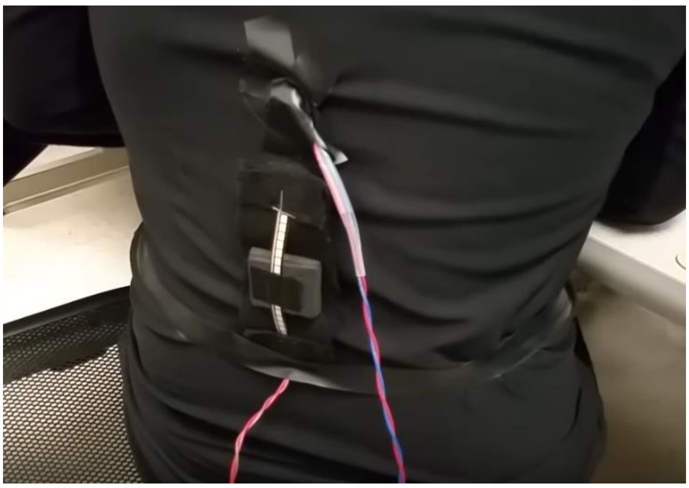


Fig 4: Our proposed system

IV. BIOLOGICAL RESEARCH

A biological research was done on the different types of bad postures in order to find out the ideal position for the placement of the sensor. There are three types of faulty posture: flat back, sway back, and kephotic lordotic.

The common observation in the 3 mentioned posture is that due to the fact that the head's center of gravity is more forward in comparison to the base of the neck, the neck bends and the shoulder blades hunch forward. As a result, the back extensors of the neck get overworked (to prevent the head from tilting too far forward), while the front extensors get underworked; which can cause chronic neck pain.

Furthermore, the hunching of the shoulders can cause weakening of upper/mid back extensors, tightening in the front chest muscles, and the weakening of the muscles.

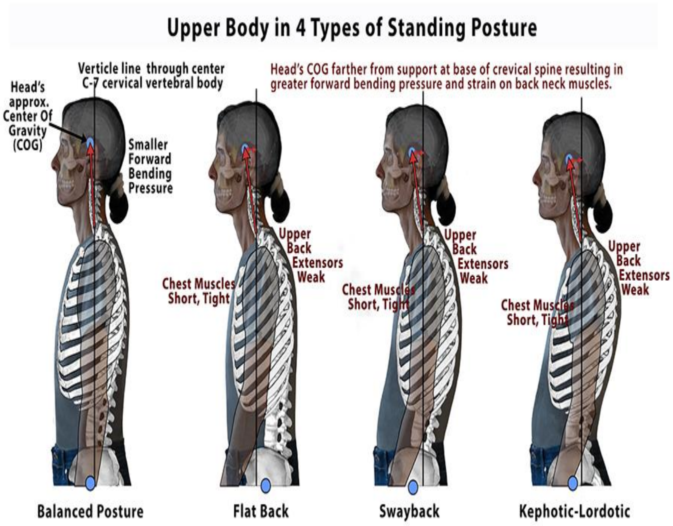


Fig 5: Three poor posture related to upper back

Having good lower back posture actually helps keep good upper body posture because the inward curve of the lower back (called the lordotic curve) is what positions the upper body above the hips.[3] The degree of tilt in the pelvis is what determines the degree of curvature in the lordotic curve, and this tilt is dependent on four muscles: the abdominals, the hip flexors, the hip extensors, and the lower back extensors. Neck posture is also determinant on the lower back, as the angle of hip and knee joints helps shape the neck. Figure 6, below, depicts the effects of poor lower back posture for the same three bad postures mentioned above.

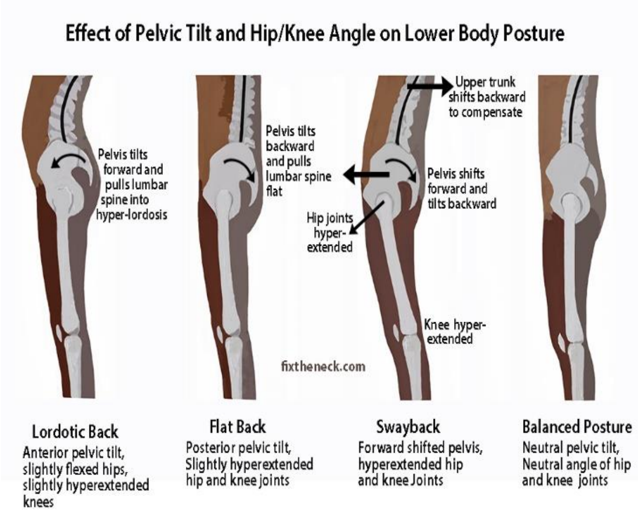


Fig 6: Three poor postures related to lower back

Given the results of our research above, we tried experimenting with flex sensor sensitivity in three main locations: a) the neck, b) the upper back and c) the lower back/in the lordotic curve. We also experimented with using different flex sensor sizes. Regarding the latter, we found that the 2.2" flex sensors that we had were not able to measure a large range of body motion, so we decided to experiment more with the larger 4.5" flex sensors throughout our project.

Based on our own experimentation and the information we obtained from our research, we confirmed that lower back posture heavily influences the posture of both the upper back and neck, so we decided that a 4.5" flex sensor on the lower back was sufficient in aiding a user to maintain good posture.

V. WORKING

The user is made to wear the entire setup. Initially, the user is in his/her normal posture. Once the user deviates from the normal posture, the value of flex sensor varies. Programming is done in such a way that once the flex sensor value changes, the buzzer is activated which acts as a feedback and it alerts the user to get back to the normal position.

After a delay, if the user doesn't go back to his/her normal position, the DC gear motors fixed to the elastic belt are activated. They are programmed in such a way that it pulls the user back to the normal position.

Simulation is done using Proteus software in order to verify the program and working. CSS C compiler is used to program the microcontroller.

VI. BIOFEEDBACK MECHANISM

A biofeedback process uses physiologic information that is monitored and feedback through the biofeedback instruments. Biofeedback instruments monitor the physiologic processes, measure and transform the measurement data into auditory, visual, or vibrating signals in a simple, direct, and immediate way. It involves the monitoring and use of physiologic information to teach patients to modify specific physiologic functions. A biofeedback mechanism includes both a biofeedback process and the instruments used in the process.

The goal of biofeedback is to enable the individual being monitored to change his (or her) physiologic process, guided by the information provided by the biofeedback equipment.

In the proposed paper, a buzzer would be used to provide a feedback to the user when he/she deviates from the correct posture. Also, the flexible belt with motor prototype acts like a feedback to correct the posture of the user.

VI. SIMULATION OUTPUTS

Before implementing the hardware, we used Proteus software to simulate our proposed prototype.

For image purposes, we have used the standards 20% ,40%, 60% and 80% to represent a range of values of the flex sensor. The outputs are given below where Fig 7 represents the initial setup. Fig 8 represents the correct posture where the value of flex sensor is and the standard 20% is used. Fig 9 shows the standard 40% which is again depicting the correct posture. In both the images we can observe that the led and motors are in off state. In Fig 10, the standard 60% depicts poor posture and thus, the led is activated. A buzzer would be used in the hardware setup instead of led. Fig 11 shows the working of the motor because of incorrect posture and is represented as standard 80%.

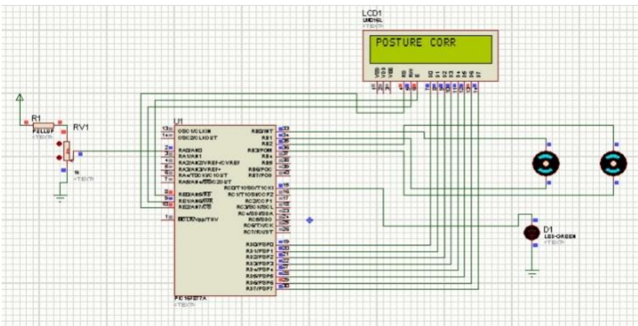


Fig 7: Initial setup simulation

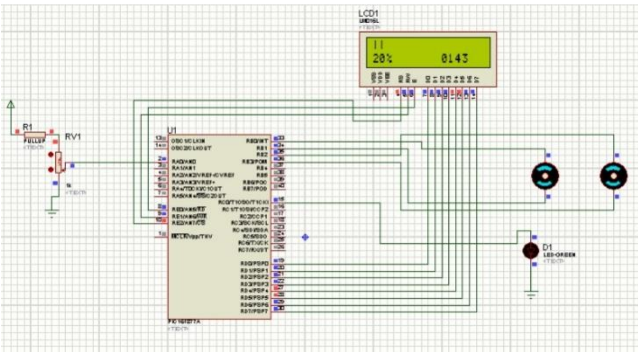


Fig 8: Correct posture simulation

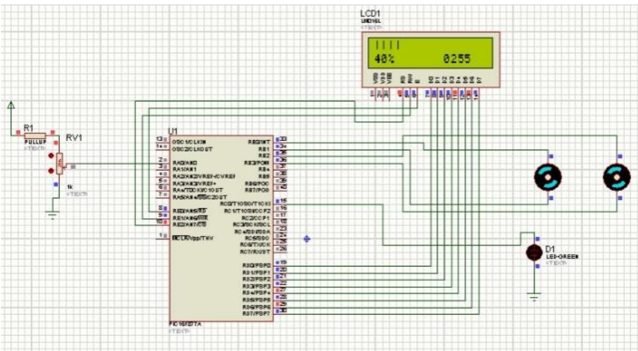


Fig 9: Correct posture maintained simulation

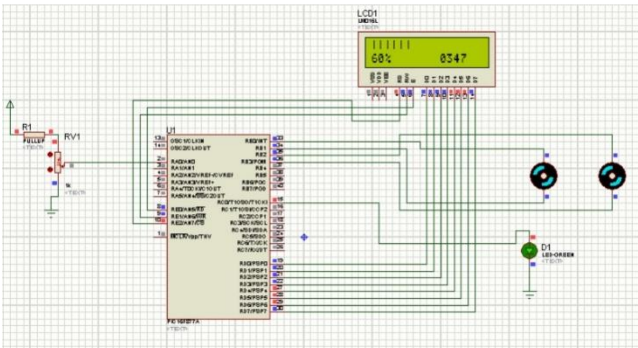


Fig 10: Feedback using LED when deviated

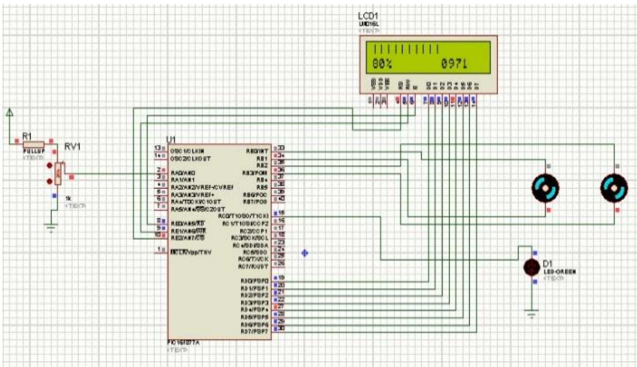


Fig 11: Initiating motors for automatic lift setup

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VII. RESULTS

Thus, we successfully created a wearable device that determines correct posture and indicates if a user is in bad posture. Only one flex sensor was used on the lower back to determine poor posture instead of five placed in multiple areas on the back. In addition to the simple prototype of detecting the wrong posture, we also succeeded in implementing an automatic posture correction system using simple DC motors.

The flex sensor thresholds are set based on a certain percentage that the user deviates from his or her good posture, and we tested this accuracy by displaying the outputted values from the flex sensor and ensuring that the motor turned on or off appropriately. The PIC is constantly reading values from the flex sensor, giving an accurate measurement of the user's posture, and the response time of the buzzer is almost immediate. This quick response is necessary to alert the user right away that he or she is in poor posture allowing him or her to correct him or herself.

VI. CONCLUSION

In terms of functionality, our design (in terms of placement of the sensor on the shirt, software on the TFT, etc.) worked exactly as expected. This means that when a visually poor posture was reached, our software (i.e. body image screen + "back breaker" counter) and hardware (vibration motor) would indicate the change correctly. This was true for going from both good to poor posture and vice versa.

VII. FUTURE ADVANCEMENTS

Using latest technologies and innovations, various improvements can be carried out in order to make the project more sophisticated and user friendly.

Wireless and Bluetooth technology can be used, where the flex sensors could communicate with the PIC (and, consequently the TFT) without using so many wires. We can also use a mobile app to help control the device and collect user data or use the TFT to create a wearable device such as a user watch setup (similar to a Fitbit or Apple Watch configuration).

The entire setup can be made more sophisticated by using feather light circuits. The circuit can be fabricated on "feather light circuit board" which are very thin and have the weight as light as a feather. The sheet is made up of very thin electronics that are built on stretchy polymers. Hence it can be expanded to twice its length and even crumpled like a paper without disturbing working.

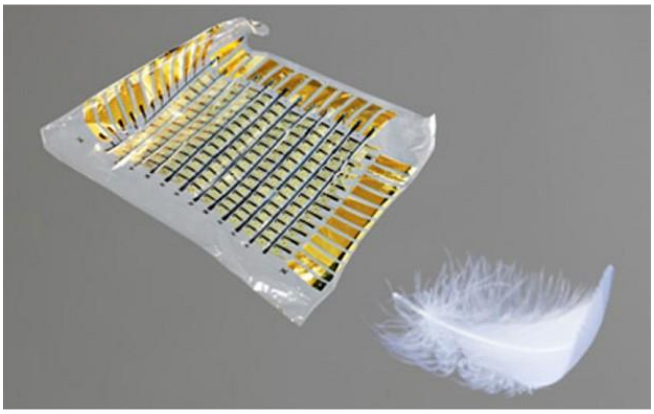

Fig 12: Feather light circuit representation

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