

Postuino: Bad Posture Detector using Arduino

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ABSTRACT: Embedded systems have become very popular in recent years, and that field is rapidly advancing especially in health monitoring technology. Therefore, we present in this paper an application for posture correction, utilizing microcontrollers and ultrasonic sensors. When a bad posture is detected, the user is notified. Our system is designed specifically for computer users to prevent them from leaning too close to their computers' monitors.

KEYWORDS: embedded systems, microcontrollers, Arduino, ultrasonic sensors, posture.

1 INTRODUCTION

Consistent use of computers is one of the major risk factors for neck and shoulder disorders. Reports of the lifetime occurrence of neck pain in the general population range from 67-80% [4]. A detailed survey at Harvard University showed that more than half of students experienced pain and discomfort while using a computer [3]. The three factors significantly associated with computer-related upper extremity and neck pain among the students were female gender, eight or more years of using a computer 10 or more hours a week, and using a computer for more than 20 hours per week. Most of the students in the study reported that pain in the neck and upper extremity was related to computer use and the posture assumed while using a computer. As computer adoption increases we can expect a corresponding increase in the occurrence of neck pain if appropriate countermeasures are not employed.

Postuino is a device that warns the computer users if they are leaning too close towards the computer screen. The motivation for this project came from the current popularity of microcontrollers, as well as the availability of the Arduino boards. Health monitoring is one of the most promising applications of embedded systems technology. Posture correction is a field where extensive development has been done. iPosture, for example is a small 1- inch round device designed to detect bad posture and notify the wearer with a vibration [5]. It is convenient to have such a small posture detection device, though it is uncomfortable to wear all the time. Therefore, we designed Postuino as a standalone device that a user can place next to the computer, instead of wearing it, in order to detect slouching on the computer.

2 DESIGN

Our design uses Arduino Micro and ultrasonic sensor. It can be placed next to the computer facing the user, as shown in Fig. 1. When the user leans to the computer, the distance between him/her, the computer, and the Postuino accordingly falls below a certain threshold. Then, an LED lights up and Piezo speaker plays chosen melody in order to alert the user to correct his/her posture.

This method is commonly used in alarm devices; such as is found in stalker guards that measure the distance of objects behind the user and vibrates when something comes too close. The ultrasonic sensor functions on the same principles as radar; it transmits a high-frequency signal and, based on the echo, determines the proximity of a specific object. Ultrasonic sensors can measure the distance of an object accurately at a minimum of 2 centimeters and a maximum of 3 meters from the device.

Therefore, we utilize ultrasonic sensor to measure the distance between the user and computer monitor. In our judgment, this sensor would be enough to detect what we would consider a "bad posture". The sensor is connected to an

Arduino Micro. The reason for using Arduino Micro is the small size compared to other Arduino boards. In addition, Arduino Micro has pins that can be connected straight onto a prototyping breadboard, which allows easy construction of complex circuits without soldering [6]. Two indicators were chosen for this design to notify the user of bad posture, LED and Piezo speaker. The reason for this is to make sure the users can get adequate alert to correct their bad posture. We did not provide an external battery, because connecting Postuino to a USB cable is very convenient, since the device is meant to correct bad posture of computer users. Fig. 2 shows the circuit design of Postuino and Fig. 3 shows the schematic for the circuit.

3 DISTANCE MEASURING ALGORITHM

As sound travels at 1,130 feet per second, there are 73.746 micro-seconds per inch. This gives the distance travelled by the ultrasonic sensor, outbound, and return, so to find the distance of the user we take half of the distance traveled.

$$\text{Distance in inches} = (\text{duration}/74)/2 \quad (1)$$

For metric system users, we use the following equation to calculate the distance in centimeters, since the speed of sound is 29 microseconds per centimeter.

$$\text{Distance in centimeters} = (\text{duration}/29)/2 \quad (2)$$

4 PROTOTYPE SETUP

According to the United States Department of Labor, the preferred viewing distance is between 20 and 40 inches (50 and 100 centimeters) from the eye to the front surface of the computer screen, as shown in Fig. 4. To detect a bad posture, we made the LED and Piezo speaker react when the distance to the user falls below 20 inches (50 centimeters). A program was written and implemented in C++ to measure the distance by converting the time taken by the ultrasound to travel to the object and back to the sensor using the equations mentioned in the previous section.

The circuit presented in Fig. 2 was made with a small prototyping breadboard. The device was placed on a mini tripod stand similar to the one shown in Fig. 5. The stand height can be adjusted based on the user's height and the monitor's height. When the user leans too close to the computer screen, the distance between the user, computer, and Postuino falls below the defined threshold distance which triggers the LED to light up and the speaker to play the melody. Once the user corrects the posture, the distance goes beyond the threshold which causes the LED to turn off and the speaker to stop playing melody.

The reason for this is because our vision of "good posture" involves having the minimal distance between the user and the computer, which implies sitting straight without slouching.

5 RESULTS

The system has been implemented as described above, but has seen relatively little use. Initial tests suggest that this method of posture detection is effective. The Arduino Micro is small and light weight. The breadboard measurements made the prototype little bit bulky. We are in the process of obtaining a smaller board that we can put along with the other components in a hollow sphere that is printed by a 3D printer and placed on the same stand we used in the original prototype. The threshold described earlier was chosen by experimentation, and is subject to change depending on the user's needs and the size of the monitor.

6 CONCLUSION

The basic goal of this project was met. Therefore, it can have different application ranging from encouraging good posture in school children who use computers to ensuring the safety of clerical employees in the workplace. The addition of more sensors could yield more information. Moreover, extensive analysis of the added sensor data could yield information that could be applied to more than just posture correction. The same hardware can be utilized for other applications such as humanoid robotic that reacts when an object gets close to it.



Arduino Micro



LED



Resistors



Ultrasonic Sensor



Piezo Speaker



Jump Wires

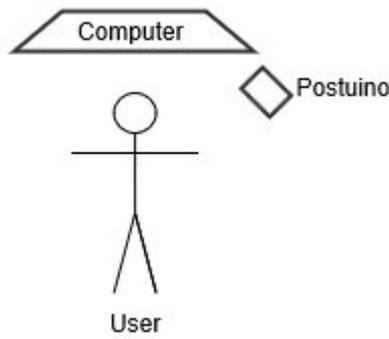


Fig. 1. Postuino Basic Components and Suggested Positioning

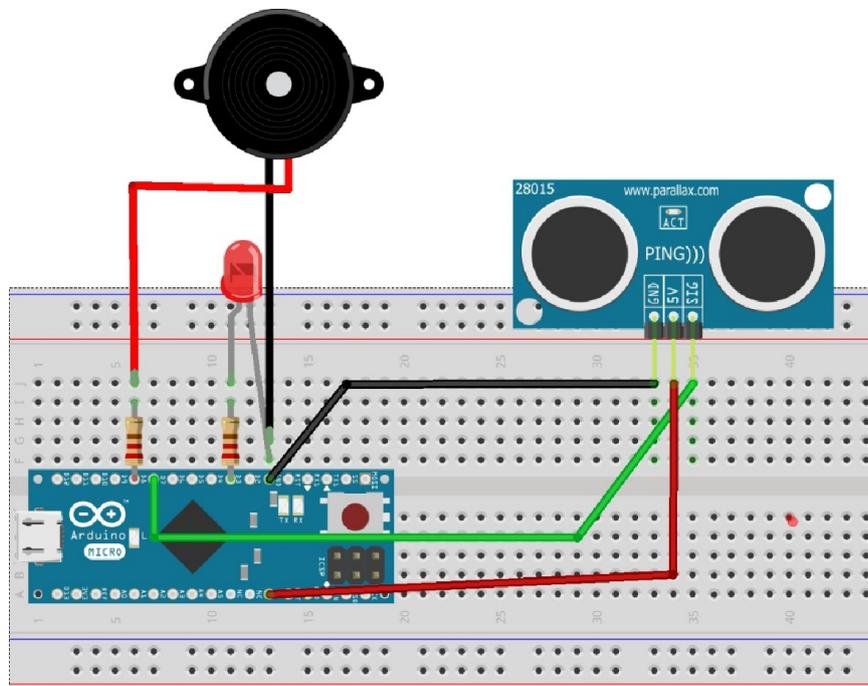


Fig. 2. Postuino Circuit Design

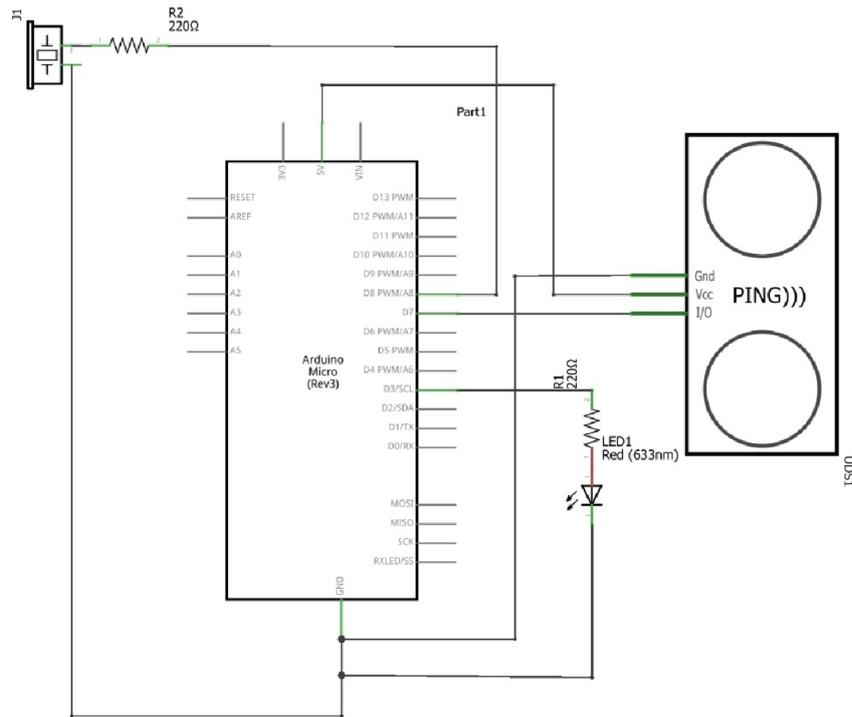


Fig. 3. Postduino Schematic



Fig. 4. Preferred viewing distance is 20 to 40 inches



Fig. 5. Gorillapod SLR-ZOOM Tripod

REFERENCES

- [1] Robbins, M., Johnson, I. P., & Cunliffe, C. (2009). Encouraging good posture in school children using computers. *Clinical Chiropractic*, 12(1), 35-44.
- [2] Breen, P. P., Nisar, A., & ÓLaighin, G. (2009, September). Evaluation of a single accelerometer based biofeedback system for real-time correction of neck posture in computer users. In *Engineering in Medicine and Biology Society, 2009. EMBC 2009. Annual International Conference of the IEEE* (pp. 7269-7272). IEEE.
- [3] Schlossberg, E. B., Morrow, S., Llosa, A. E., Marmay, E., Dietrich, P., & Rempel, D. M. (2004). Upper extremity pain and computer use among engineering graduate students. *American journal of industrial medicine*, 46(3), 297-303.
- [4] Green, B. N. (2008). A literature review of neck pain associated with computer use: public health implications. *The Journal of the Canadian Chiropractic Association*, 52(3), 161-167.
- [5] Rubow, E. (2008). Posture Correction with Wearable Electronics.
- [6] Karvinen, T., & Karvinen, K. (2011). *Make: Arduino Bots and Gadgets Six Embedded Projects with Open Source Hardware and Software (Learning by Discovery)*. Make Books-Imprint of: O'Reilly Media.
- [7] Closeup of iPosture PCB. <http://www.techpin.com/wp-content/uploads/2008/08/iposture-curvature-of-the-spine-5.jpg>.
- [8] United States Department of Labor Occupational Safety and Health Administration. https://www.osha.gov/SLTC/etools/computerworkstations/components_monitors.html
- [9] Coin Slot Detector. <http://www.tinyscissors.com/blog2/?p=586>.
- [10] iPosture home page. <http://www.iposture.com/>.
- [11] Leah Buechley's interactive performance suit. http://web.media.mit.edu/~leah/grad_work/projects/performance/performance.html.
- [12] Leah Buechley's LED tank top. http://web.media.mit.edu/~leah/grad_work/projects/LED_clothing/tank.html.
- [13] Leah Buechley's LilyPad Arduino. <http://web.media.mit.edu/~leah/LilyPad/index.html>.
- [14] Leah Buechley's LilyPad Arduino version 2.0. http://web.media.mit.edu/~leah/grad_work/projects/e-textile_kit/e-textile_kit2.html.
- [15] Leah Buechley's turn signal jacket. http://web.media.mit.edu/~leah/LilyPad/build/turn_signal_jacket.html.
- [16] LilyPad Embroidery. <http://sternlab.org/2008/04/lilypad-embroidery/>.
- [17] Numetrex home page. <http://www.numetrex.com/>.
- [18] Perceptual Expansion Space/Suit. <http://semiotech.org/wp-prod/?p=12>.
- [19] Wi-Fi Detector T-Shirt. http://www.flashwear.com/online_store/wifi_detector_t_shirts_11.cfm.
- [20] Lucy E. Dunne. Minimally Invasive Sensing of Body Position and Movement Using Body-Garment Interactions. November 2007. <http://www.lucydunne.com/LucyDunnePhDThesis.pdf>.