Study of Real-Time Monitoring Human Motion System for Ergonomic Posture

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Abstract

Ergonomics is described as fitting tasks, interfaces and workplaces, to the needs, capacities and limitations of human beings. The aim of ergonomics is to optimize health, safety, comfort and efficiency for humans in a work system. Ergonomics contributes to the prevention of inconveniences and, to some degree, improves system performance in terms of increased productivity. There are more such serious ill effects of sedentary behavior which cannot be avoided as sitting is the prime stance to earn one's living and is one of the pertinent stances by the humans throughout the day.We have of ergonomic chair, but there is no such thing as a "one size fits all" ergonomic chair. Sitting keeps the upper body stable and requires very less muscular effort than standing but only when the posture is correct and enough for the body to be comfortable.

This paper shows Real time Ergonomic Monitoring System provides an individual to correct his posture and also alerts him to reduce longevity of sitting. Besides monitoring ones posture it also provides alerts for an individual to maintain an optimum distance from the monitor. The main aim is to design a device for an individual which helps to reduce menace of sitting. It is cost effective and comfortable to use. This device is used to guide individuals with the help of display alerts, vibrational, and audio (buzzer) alerts. It also provides the posture correction through web server interfacing using a webpage where an individual can get to know his posture effects.

1. Introduction

Our project Ergonomic Monitoring System will enable people to eradicate their bad habits, thus leading to a healthy life[1]. Compared to our grandparents or parents, we spend more time in environments that not only restricts physical activity but requires prolonged sitting – at work, at home, and in our cars. This limits human movement and muscular activity, thus causing trouble to humans as we were designed to move (to locomote and engage in manual labor)[2 3]. Now a days a lot of work is done while sitting[3]. So sitting in a correct posture is very important. We need to reduce habitual sedentary behavior (prolonged sitting) as well as to maintain an optimum distance from the desktop/laptop while working.

The Ergonomic Monitoring System enables the user to correct his posture and reduce prolonged sitting. A healthy mind rests in a healthy body. So one must take care of his posture so that he does not encounter physiological ailments and thereby improving his work efficiency.Ergonomic Monitoring System aims to reduce the health hazards caused due to prolonged sitting and sitting in wrong posture through different kinds of alert mechanisms- audio,

visual and vibrational. It also aims to make people aware of their mistakes and provides them with corrective measures.This project will help people correct their mistakes and minimize health risks. It is based and corrective and preventive mechanism concepts to eradicate health issues due to sitting.

2. Block Diagram Real Time Monitoring human motion Ergonomic System
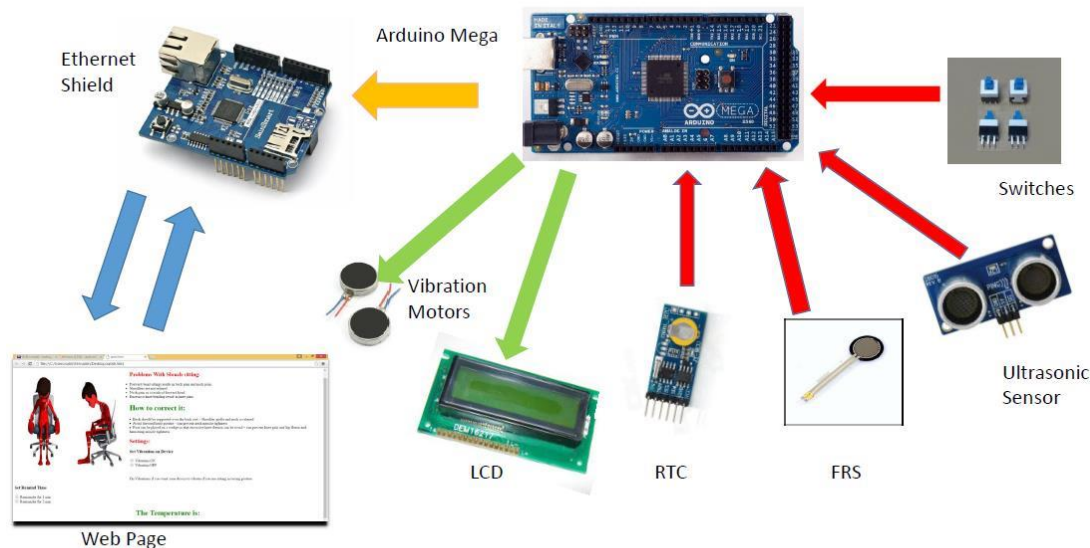

Fig. 1. Block Diagram of Ergonomic Monitoring System[1,2]

     The block diagram describes the process of complete project. The inputs are the posture sensing device which consists of Force resistive sensor circuitry, Ultrasonic sensor, temperature sensor, RTC module. The Output devices are LCD and Buzzer.The output can be displayed on the LCD screen and also on webpage which also consists of controls like operation of vibration motor, temperature of the room, posture analysis like sedentary behavior. Vibration motors can be controlled manually using switch and their status is display through green LED.

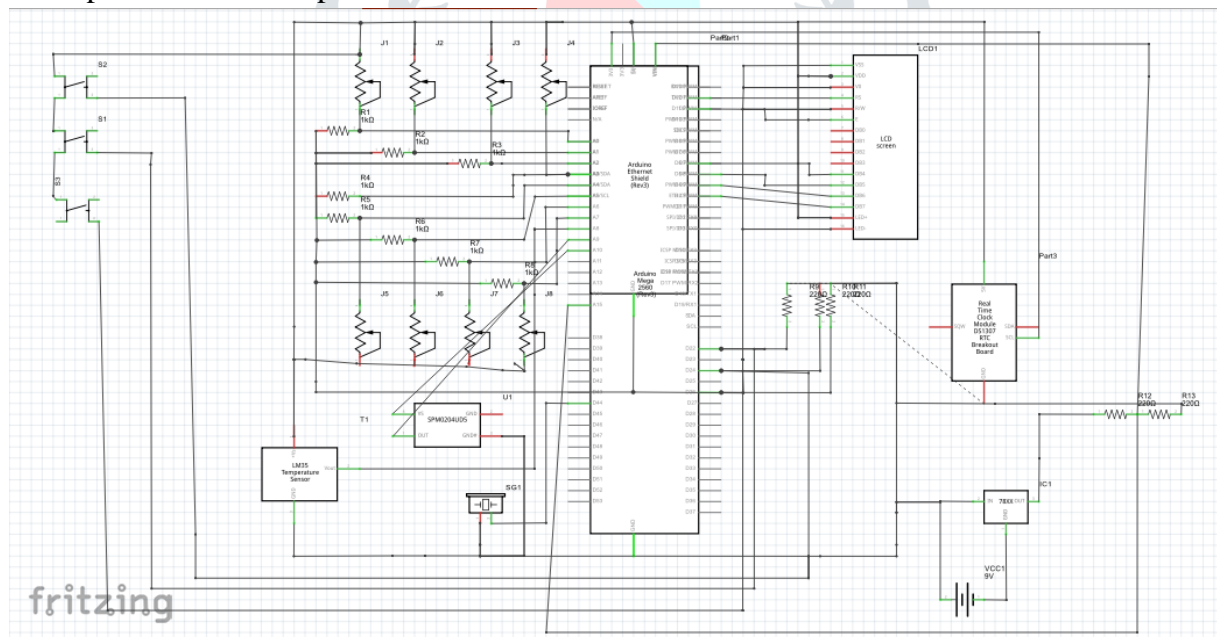## 3. Flow Chart Real Time Monitoring human motion Ergonomic System
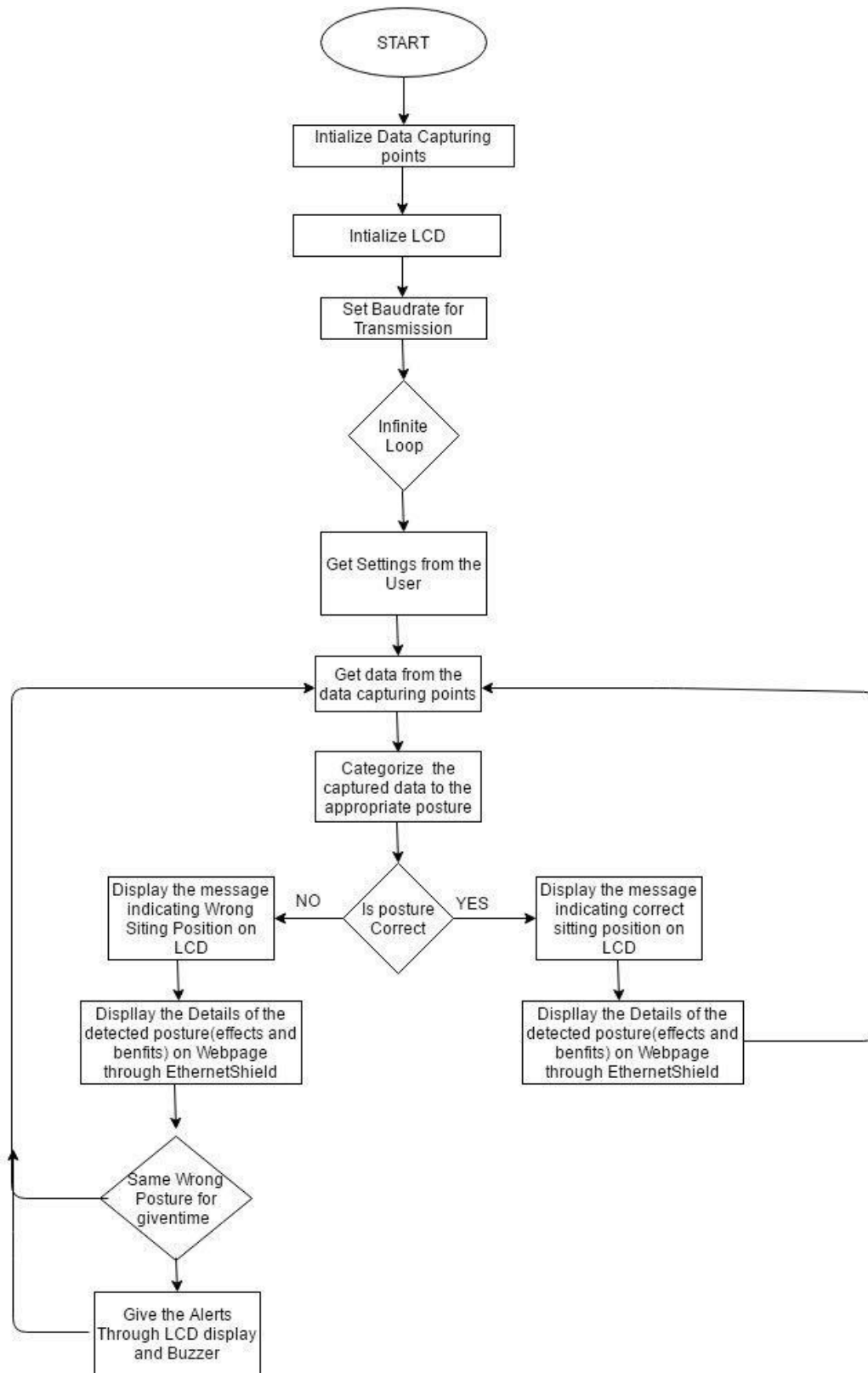
When the posture sensing device is switched on it starts capturing the posture. At frequent intervals of time and it sends the data to the Arduino and based on the analysis according to the categorization of posture the Arduino sends the result to LCD which displays whether the person is sitting in a wrong posture or right posture. It also displays the longevity of sitting, because sitting for a long time is also harmful. If a person accesses the webpage of the device, he can change the setting and get a miniature report, which consists of problem with the posture and corrective measures. It also display distance between the person sitting and the desktop/laptop. A person can also change the settings manually through switches or through the webpage interface.

Vibration motors and buzzers are also incorporated to alerts the individual. A person can set his longevity time from the switches manually or from the web interfacing. RTC is used to specify time and date of particular posture and it is saved in SD card for future reference. The room temperature is also displayed on the webpage. The device aims to correct you by providing feedback according to your actions.

4. Ultrasonic sensor interfacing for monitoring

If a person is using a chair in front of a desktop he need to maintain an optimum distance from the screen. For that purpose ultrasonic sensor module is interfaced with Arduino. Ultrasonic sensor device is to be placed below the monitor. It detects the distance between the person and the desktop accordingly and displays the message on the screen to correct his/her position (distance) from the screen. This feature enables the user to maintain a prescribed or acceptable distance from the monitor which reduce
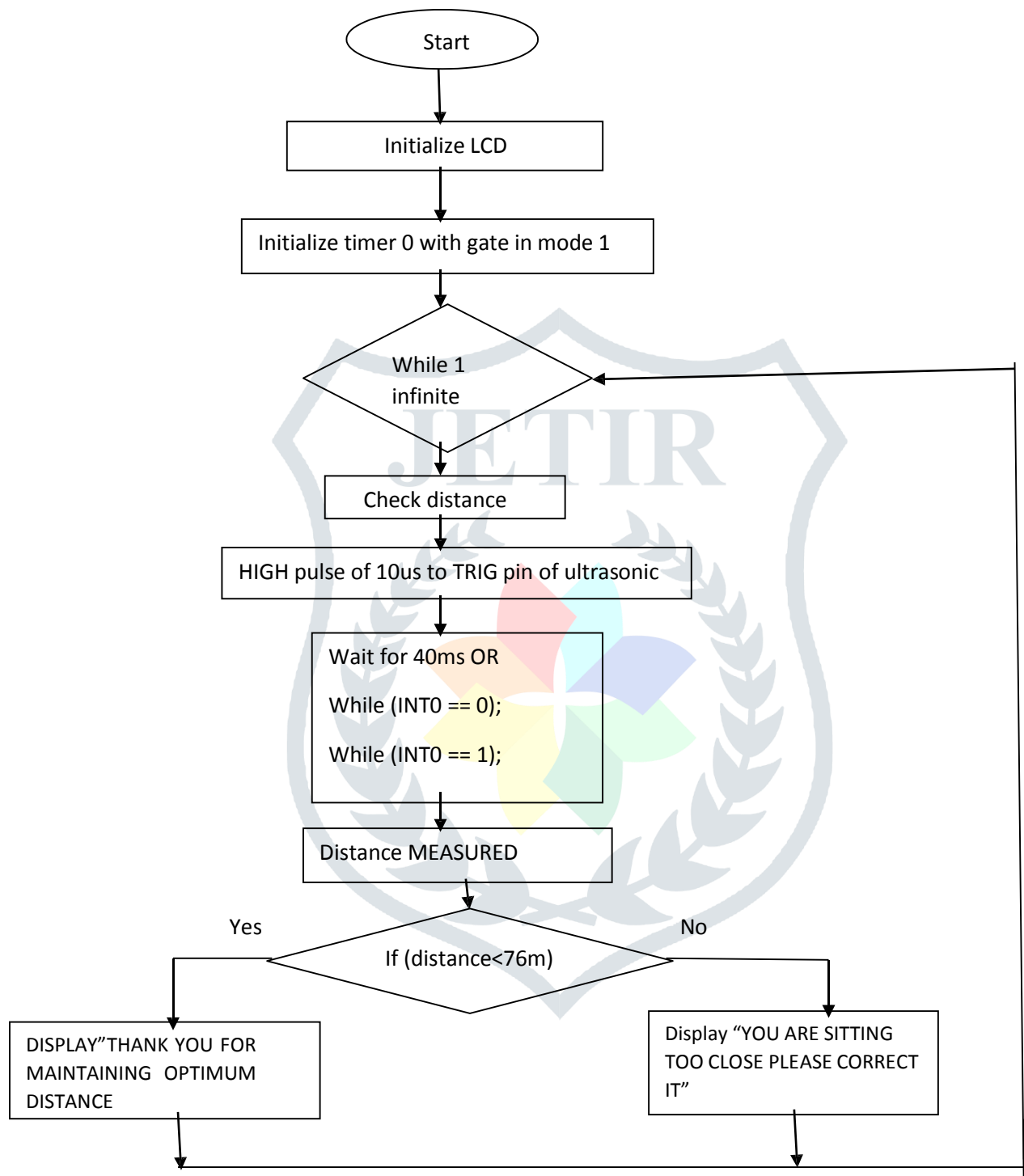
4..1 Flow Chart

```
                          ┌─────────────┐
                         (    Start      )
                          └──────┬──────┘
                                 │
                       ┌─────────▼─────────┐
                       │   Initialize LCD   │
                       └─────────┬─────────┘
                                 │
              ┌──────────────────▼──────────────────┐
              │  Initialize timer 0 with gate in mode 1  │
              └──────────────────┬──────────────────┘
                                 │
                            ◇ While 1 ◇
                            ◇ infinite ◇
                                 │
                       ┌─────────▼─────────┐
                       │   Check distance   │
                       └─────────┬─────────┘
                                 │
          ┌──────────────────────▼──────────────────────┐
          │  HIGH pulse of 10us to TRIG pin of ultrasonic  │
          └──────────────────────┬──────────────────────┘
                                 │
                       ┌─────────▼─────────┐
                       │   Wait for 40ms OR │
                       │   While (INT0 == 0);│
                       │   While (INT0 == 1);│
                       └─────────┬─────────┘
                                 │
                       ┌─────────▼─────────┐
                       │  Distance MEASURED │
                       └─────────┬─────────┘
                                 │
          Yes            ◇ If (distance<76m) ◇            No
```

Fig. 3 Flow chart to calculate distance of a person from desktop

DISPLAY"THANK YOU FOR MAINTAINING OPTIMUM DISTANCE

Display "YOU ARE SITTING TOO CLOSE PLEASE CORRECT IT"

5.Result And Discussion

5.1 Advantages And Limitations

In this project we have made an ergonomic monitoring system which detects the problems with sedentary behavior and other work related musculoskeletal problems. System has following advantages and limitations:

Advantages:

- Accurate detection of a particular posture.
- Can be easily mounted on any type of chair.
- Accurate analysis of data of a particular posture.
- Minimum physical interface.
- Less training time.
- Very low cost.
- Low power consumption. Battery can last up to 3days once charged.
- Detection of distance from the Desktop.
- Both manual and webpage setting which provides users easy navigation.
- Both audio and text alerts for every wrong sedentary behavior.
- Availability of sitting posture data in SD card module along with time.
- Because of its lightweight it is portable.

Limitations:

Certain improvements are required in our device due to the following limitations:

- Due to less data capturing area of sensors, detection of postures at micro level is a complex task
- Differentiation between lean, major lean, minor is not feasible at this level. However as all of the come under wrong posture category all those are grouped together.
- A person can get irritated and confused by sound of beep or vibrations. If he opts to switch them off then there are chances that his wrong posture message cannot be delivered to him

Improvements which can be done:

- The device can be further enhanced by using VLSI technology to design the PCB units as it makes the system more compact.
- We can increase the sensing area so that data capturing area can be increased.
- A monthly report of person's posture can be done and sent to the user.
- Sending alerts for most frequent wrong posture can be done once when a person starts sitting in particular wrong posture.
- Instead of beep sound voice alerts can be send for every wrong posture.

- Further wearable aspect of this system can be improved using wireless connectivity between the components of the system.
- Despite these difficulties, it is hoped that the proposed system will efficiently aid individual in posture correction and proper molding of his/her sedentary behavior.

5.2 APPLICATIONS

- This projects main purpose is to provide a monitoring device which is help in correcting the posture and minimizing the sedentary behavior of an individual.
- This project can be used in working areas like offices and other work places.
- This project can also be used on any type of chair it can be easily mounted and used.
- This project can have modification and can be built to a more sophisticated version of itself by using sensors large sensing area and accelerometer based lean detection technique. It can be useful as a medical device in physiotherapy of medical field
- It can be used by patients who are suffering from spondylitis, degenerative disc disease, spinal stenosis, and scoliosis.
- It can also be used as a medical assistance for people who have back pain and eyesight problems.

6. Conclusion And Future Scope

6.1 CONCLUSION

We have made a project which will help an individual to correct his sitting posture and also maintain a safe distance from desktop, if he is using it. This will help him to gain awareness of his well-being physically and increase his efficiency at work. The key element which we have followed is to prevent wrong posture problems and to avoid long periods working while sitting and repeating the same wrong posture.

Our main goal is to make a system that will be cost effective and easier for each and every individual to handle. In order to make it easier for the person to use, we have added both audio and visual alerts. Webpage interfacing is also done where all the features as well as settings are displayed. Therefore the person can use both manual and webpage setting and get alerts accordingly. Battery recharge circuit is also provided. Once charged fully, the battery can last up to 3 days. All the data is stored in SD card along with time and date using RTC module, so that even if user is not connected to webpage he can go through it after connecting.

We hope that the device will be an effective and low-cost solution for people who suffer from back pain and other problems related to siting. Hence, it offers an innovative solution to make sitting healthy and minimize sedentary behavior. So we tried to develop a user friendly ergonomic monitoring system for an individual, especially working people with greatest accuracy.

6.2 Future Scope

In this era where new technologies are evolving day by day, the health problems faced by an individual physically are also increasing. The life span of an individual has decreased and now the average life span of a person is between 46-50 years.

Even youngsters are facing problems like back pain, knee join pain, etc. The reason behind this is that people are settling in their comfort zone, for example- children play video games rather than playing outdoor games. Constantly sitting while doing all types of work, people are getting habituated to sit which results in ailments. So there is a need of a device which can alert an individual of his sedentary behavior.

Our project enables the user to make his sitting healthy through various kinds of alerts. In future, the report generated can be sent to doctor automatically or a family doctor can also have a facility to watch an individual sitting posture, and can analyze and diagnose his problems easily and treat him effectively. Rather than using a webpage, the device can be integrated with a mobile application and voice alerts can be sent to user.

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