International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 06, June-2016

# Design to Improve Workstation Environment for Frequent Computer users

Payal Wasnik
Electrical Engineering Department
Veermata Jijabai Technological Institute
Mumbai, India

Amutha Jeyakumar
Electrical Engineering Department
Veermata Jijabai Technological Institute
Mumbai, India

***Abstract*— Computers play an extremely important role in day today's life. It is being used for long hours at Offices, Educational institutes, Home and at many places by small children to adults resulting in Stress, Body ache and various health related issues. Thus, it is very important to maintain proper working environment according to the ergonomics specifications to avoid these consequences. This paper aims at designing workplace using sensors to monitor parameters like distance between computer screen and user, tilt angle of computer screen and stress during work load. These sensors are connected to the microcontroller board Arduino yun which transmits data wirelessly via Wi-Fi. The results obtained are compared with the threshold values of each parameter and an alert notification is sent on Gmail if the desired condition is not satisfied, along with live sensor data updated on Google spreadsheet for future reference or to access this data remotely. This is carried out with the help of Temboo, a web based service that allows connecting Arduino yun to different web based services with the help of Temboo Arduino libraries.**

***Keywords—Sensors; Arduino Yun; Temboo; Wi-Fi; Ergonomics.***

## I. INTRODUCTION

Computer is certainly one of the greatest inventions of humankind. It has become a vital part of everyone's daily lives, and its uses are expanded beyond comprehension since its invention years ago and today it is impossible to carry out any work without computers. It is used in various places such as offices, educational institutes, hospitals, banks and many more. Today mostly every child to adults, begin the day using computer to check mails, surfing net, social networking sites, collect information, gaming or watching movies for long hours. Ultimately it has become a well known fact that everyone is dependent on their PC or computer for daily activities.

Computer work is carried out sitting at one place continuously for long hours. These results in neck, head, shoulders and back aches, strain on eyes, poor blood circulation, fatigue in legs, obesity, insomnia, depression. These can also lead to cumulative trauma disorders or repetitive stress injuries (RSI) creating a life term impact on body) [1] [2]. It is also considered as one of the reasons that children nowadays need the use of spectacles at a very young age. Thus it is very necessary to monitor our use of computer and take precautionary measures to avoid above ill-effects on our body and life.

Ergonomics is basically designing of workplace or arranging the objects used at workplace such as computer screen, chair, keyboard, desk etc according to the ergonomics working environment specifications so that we could reduce the above mentioned ill-effects of continuous sitting or using computer for long hours on the body [3]. In this method, standard specifications are provided for parameters such as how body should be positioned while sitting on chair, position of elbow during typing on keyboard, way palm should be placed on mouse, angles of viewing at computer screen, position of documents placed on desk etc. Ergonomics parameters such as distance between computer screen and user, tilt angle of computer screen is monitored in this project.

Stress at workplace is another important parameter need to be considered along with continuous computer use effects since they both are related to each other. Stress can result in mental, emotional, physical, behavioral changes in person resulting in disparity in his lifestyle [4]. At workplace there are various issues like target deadline, dissatisfaction of job, excessive workload, disruptive work shifts which could result in stress thus increasing heart rate and resulting in hypertension. Thus its continuous assessment at workplace is equally essential and thus heart rates are monitored in this project.

Wireless Fidelity (WiFi), a local area networking technology is especially designed to provide in-building broadband coverage feasible for home, offices required for this project. Internet of Things (IoT) is defined as the network of physical objects such as devices embedded with sensors, electronics, and software along with network connectivity linked together with web services so that information is collected and shared on cloud and also with the concerned people so that it can be analyzed remotely. Similarly, in this project three sensors namely ultrasonic, accelerometer sensor is connected to laptop and pulse sensor is placed on user's finger tip and these are connected to Arduino yun microcontroller board and the received data is live updated to google spreadsheet for future reference or to access remotely and alert notification is sent to user on Gmail, if threshold limit is not satisfied using Temboo, a web based service which connects to over 100+ web based services and resources to connect IoT devices to cloud for storage, processing etc[5].

The rest of this paper is organized as follows: Section II describes Hardware Design. Section III represents the Algorithm. Section IV illustrates the Experimental Results and finally concludes the paper in Section V.

## II. HARDWARE DESIGN

The hardware assembly and specifications is explained in this section.

### *A. Block Diagram*

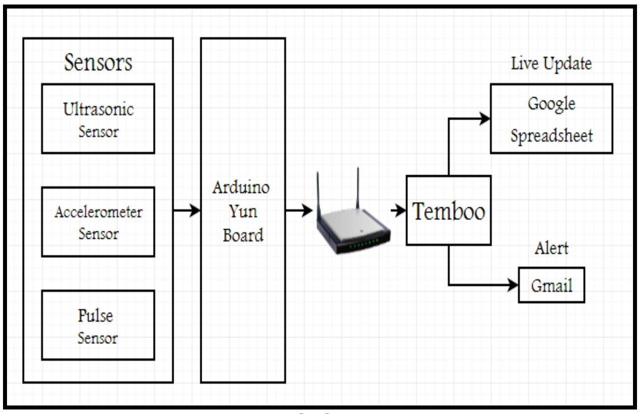



Fig. 1. Block Diagram

Block Diagram explains whole assembly of this project. Ultrasonic Sensor is placed besides the laptop screen to calculate distance between user and laptop screen. Accelerometer Sensor is placed on the laptop screen to calculate tilt angle of the laptop screen and Pulse sensor is placed on user's finger tip to calculate heart rate.

Sensors are connected to the Arduino Yun microcontroller board. Wi-Fi medium is used to send sensors values to serial monitor of IDE and programmed to sent alert on Gmail if threshold limit values are not satisfied along with live data updated on Google spreadsheet. All this is carried out with the help of Temboo, a web based service.

### *B. Hardware with assembly and Specifications*

*1) Arduino Yun:* The Arduino Yun is a prototype board consisting of one microcontroller; Atmel Atmega(32u4) and one Wi-Fi System-on-Chip (WISOC); Atheros AR9331. It includes built-in Ethernet and Wi-Fi support, 2.0 USB-A port, micro-SD card slot, 20 digital input/output pins, 16 MHz crystal oscillator, and micro USB connection. Sensor signals are processed using this board and programmed using the Arduino Integrated Development Environment (IDE). Arduino Yun is configured to connect laptop to any Wi-Fi network required to be connected by its standard settings thus enabling sensor data to be sent wirelessly to the database. To connect arduino yun to a web based service called Temboo, it is necessary to register with it to access its libraries. It has special libraries to connect with Arduino Yun.

Fig. 2. Arduino Yun

*2) Ultrasonic Sensor:* Ultrasonic ranging module HC-SR04 is a very economical distance sensor module mostly used for object detection or avoidance in various projects. The sensor module consists of transmitter, receiver and control circuit. It uses sound instead of light for object detection. Fig 4 shows ultrasonic sensor placed besides the laptop screen to measure distance between user and laptop screen.

Electrical Parameters:
Voltage: 5 V DC
Current: 15mA
Frequency: 40Hz
Range: 2cm to 4m
Measuring Angle: 15 degree
Input Signal (Trigger): 10uS TTL pulse
Output Signal (Echo): TTL level signal
Dimension: 45*20*15mm

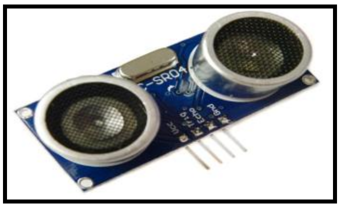


Fig. 3. Ultrasonic Sensor

Fig. 4. Ultrasonic Sensor assembly

*3) Accelerometer sensor:* The ADXL335 accelerometer is a 3-axis, compact, affordable, thin, low power supporting motion and tilt sensing applications with signal conditioned voltage outputs. Fig 6 shows accelerometer placed on laptop screen to measure tilt angle of laptop screen.

Electrical Parameters:
LFCSP package: 4 mm × 4 mm × 1.45 mm
Minimum full scale acceleration range: ±3 g
Low power: 350 µA (typical)
Single supply operation: 1.8 V to 3.6 V
Better temperature stability.

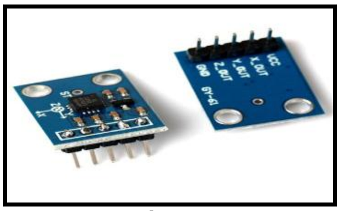


Fig. 5. Accelerometer Sensor

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 06, June-2016

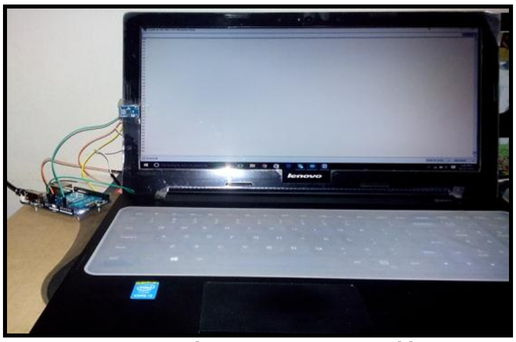


Fig. 6. Accelerometer Sensor assembly

*4) Pulse Sensor:* The Pulse Sensor is a device used to monitor heart rate non invasively. It responds to the relative changes in light intensity and amplifies the raw signal of the previous Pulse Sensor and normalizes the pulse wave around midpoint in voltage. It includes noise cancelling and amplification circuitry thus providing valid readings. The sensor is placed on fingertip and connected with Arduino Yun with the help of jumper cables thus enabling live heart rate data to be monitored for using in projects. Fig 8 shows pulse sensor placed on finger tip of user to measure heart rate of user.

Electrical Parameters:
Current: 4mA
Voltage: 3V or 5V
Dimension: 0.625" Diameter and 0.125" Thick.

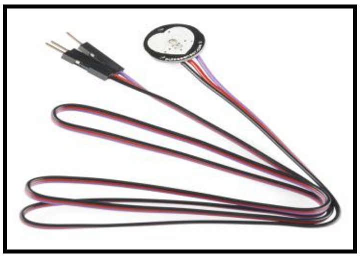


Fig. 7. Pulse Sensor

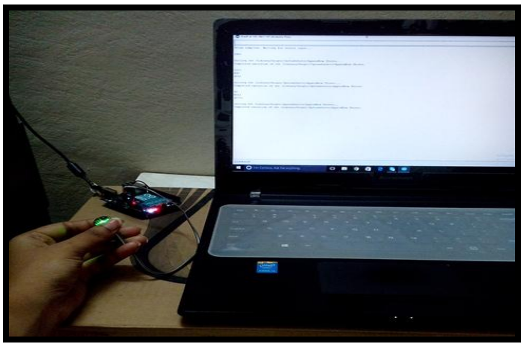


Fig. 8. Pulse Sensor assembly

## III. ALGORITHM

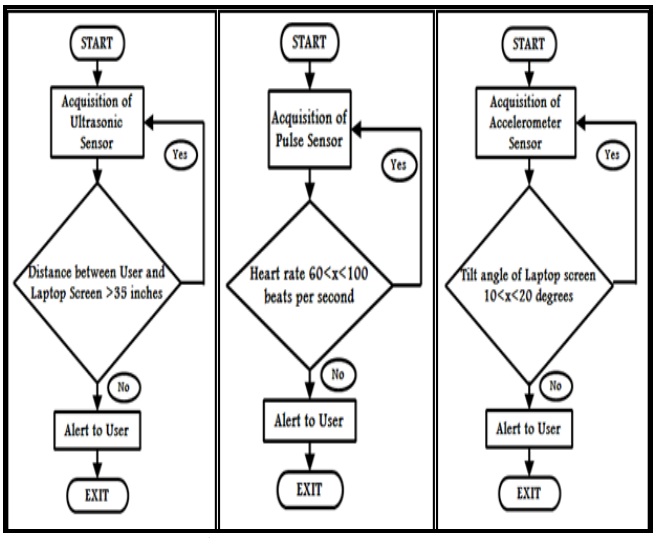



Fig. 9. Flow chart for Ultrasonic, Pulse and Accelerometer Sensor respectively

According to the Ergonomics specification, Computer screen distance should be 35 to 40 inches away from the user. In this project, if the distance is less than 35 inches or 89 cm, alert is sent to user on Gmail to move some distance away from laptop display.

Heart beat of a normal person ranges from 60 to 100 beats per minute. If the obtained value of heart rate is above the range of 100 beats per minute, person is considered to be in a stress and thus alert is sent to user to take rest for few minutes. This will help user to take precautionary measures under stressed condition.

Computer screen should be placed at a tilt angle of 10 to 20 degrees. ADXL335 accelerometer is used to calculate this value. If the angle range is not satisfied, alert is sent to user to maintain screen position according to range to prevent from neck and back ache, eye strain etc.

## IV. EXPERIMENTAL RESULTS

This section presents the Experimental results after implementing above algorithm using Ultrasonic, Pulse and Accelerometer Sensors.

Fig 10, 11 and 12 displays results of Serial monitor, alert on Gmail and live update of Ultrasonic Sensor values respectively.

Fig 13, 14 and 15 displays results of Serial monitor, alert on Gmail and live update of Pulse Sensor values respectively

Fig 16, 17 and 18 displays results of Serial monitor, alert on Gmail and live update of Accelerometer Sensor values respectively.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 06, June-2016

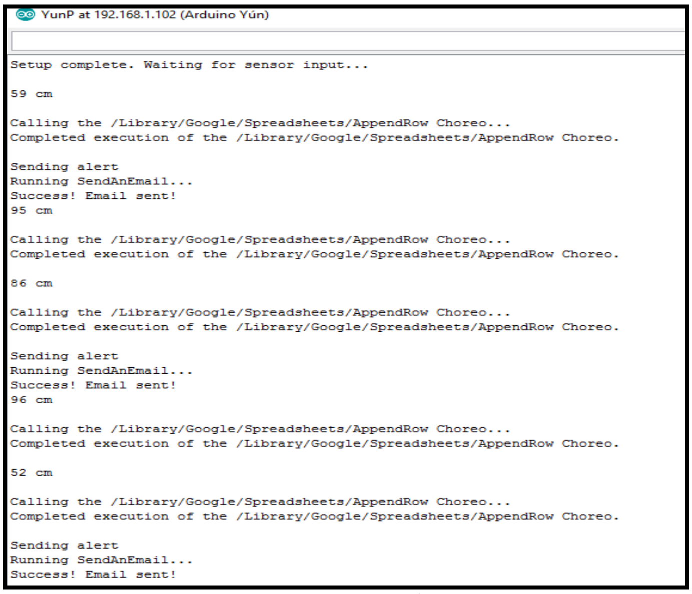


Fig. 10. Serial monitor(IDE) output of Ultrasonic sensor

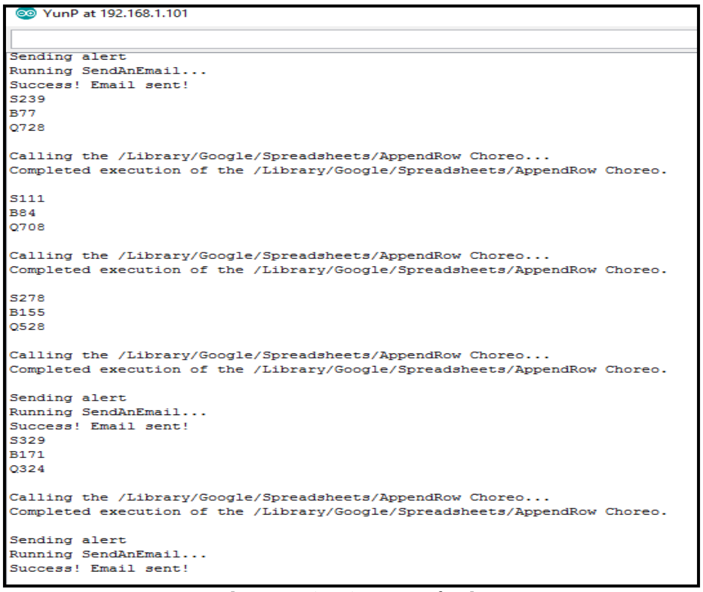


Fig. 13. Serial monitor(IDE) output of Pulse sensor

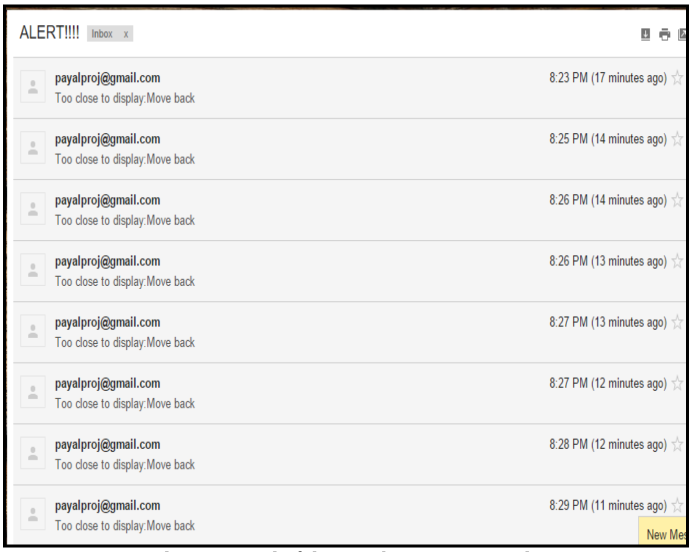


Fig. 11. Alert on Gmail of distance between user and screen

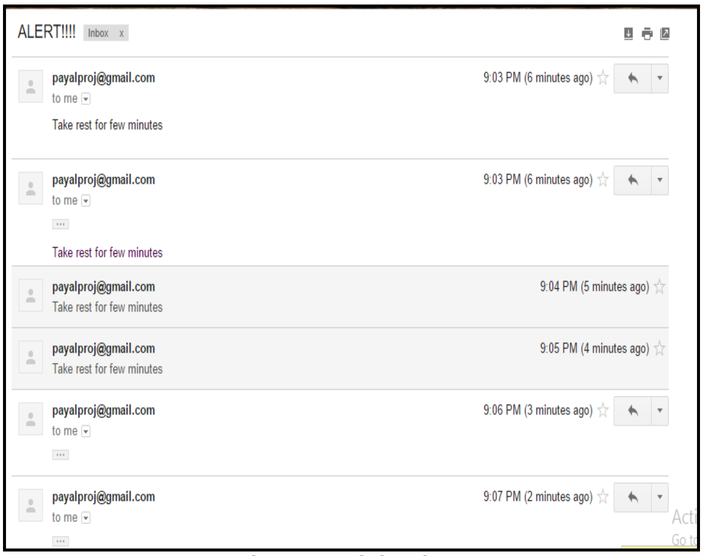


Fig. 14. Alert on Gmail about heart rate

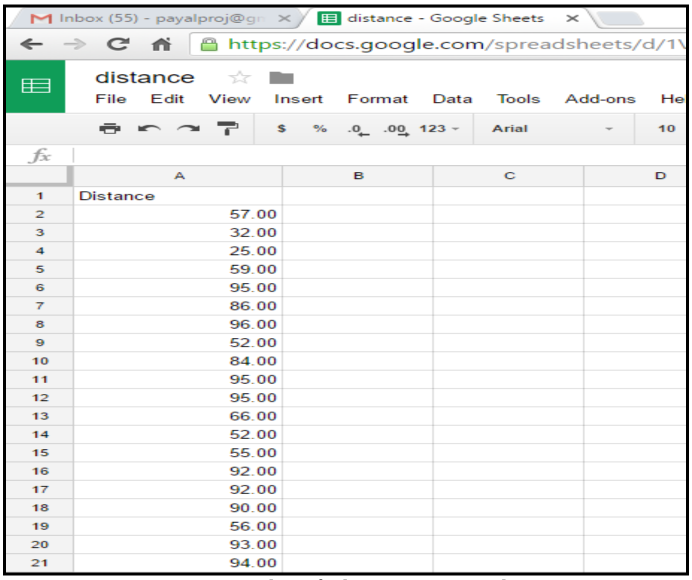


Fig. 12. Live update of Ultrasonic sensor values.

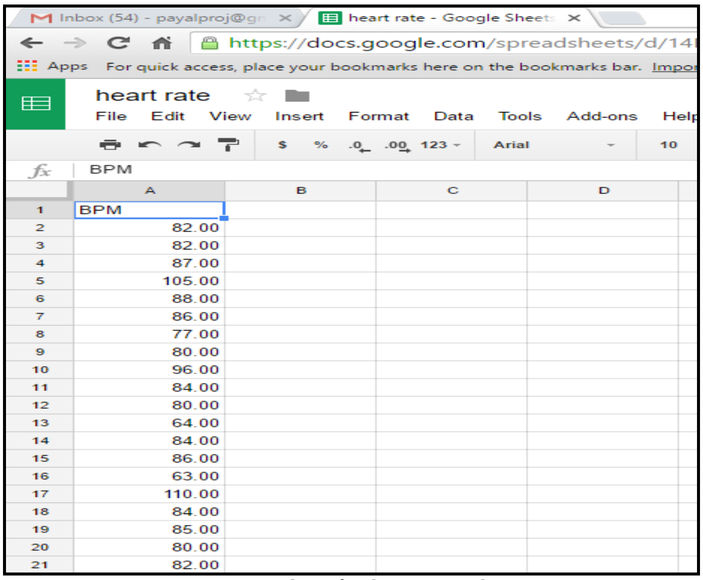


Fig. 15. Live update of Pulse sensor values.

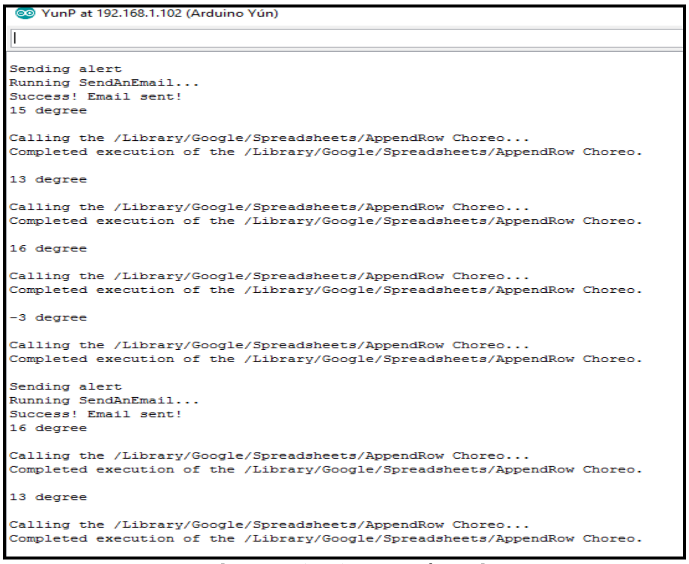



Fig. 16. Serial monitor(IDE) output of Accelerometer

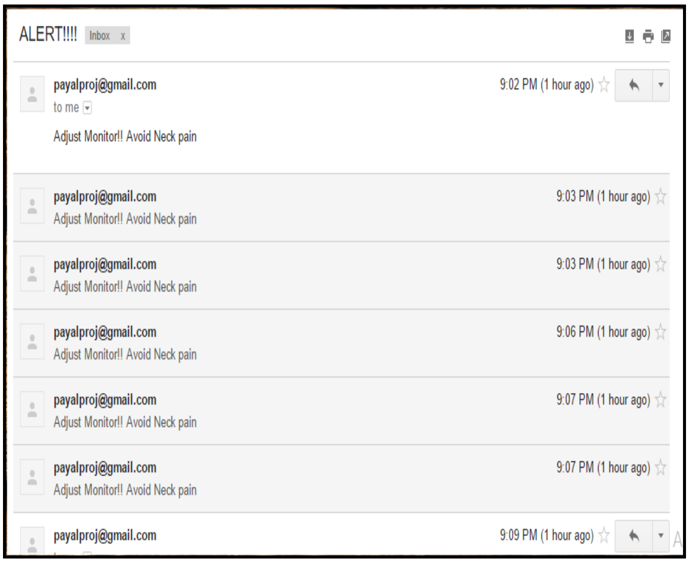
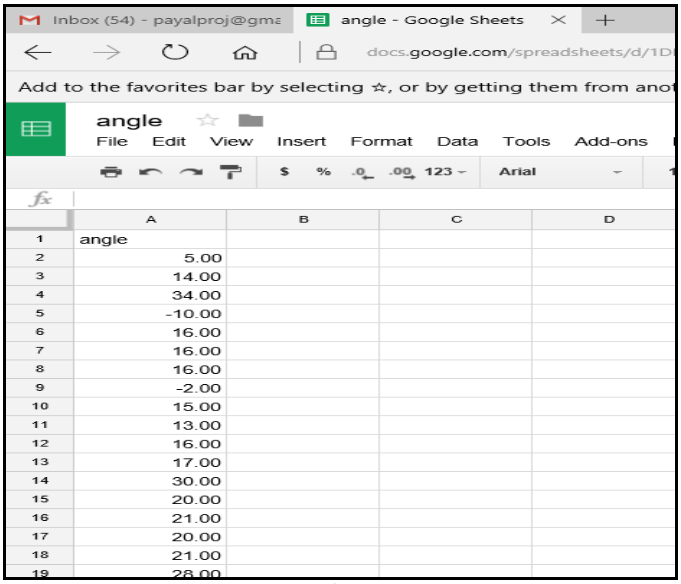



Fig. 17. Alert on Gmail about tilt angle




Fig, 18. Live update of Accelerometer values

## V. CONCLUSION AND FUTURE WORK

Computer use is increasing day by day, thus it is very important to improve the working environment to avoid its harmful effects. Sensors are used as they are cheap and easily programmed with Arduino. Wi-Fi makes it possible to send sensor's data wirelessly to alert the user. Algorithm implemented in this paper keeps track of two parameters of the user's workstation to be according to the ergonomics specification along with stress level parameter being analyzed using sensors and an alert is sent to the user if the desired results are not satisfied. Future scope could include inbuilt of these sensors in computers to alert user by displaying alerts on display if used continuously for long hours.

## ACKNOWLEDGMENT

We would like to express our gratitude towards Dr. R.N. Awale for his key guidance and assistance in our project. We are also thankful to our institute Veermata Jijabai Technological Institute, Mumbai, India for providing the facilities to carry out our research and project work.

## REFERENCES

[1] Cumulative Trauma Disorders In Office Workers. www.state.nj.us/health/eoh/peoshweb/ctdib.pdf Retrieved Sept. 2011.

[2] Akinbinu, T. R., and Y. J. Mashalla, "Impact of computer technology on health: Computer Vision Syndrome (CVS)",Medical Practice and Reviews 5,no. 3 (2014): 20-30.

[3] M. Ghauri and A. Siddiqui, ""Ergonomics: Implications on Computer End-users"," *2005 International Conference on Information and Communication Technologies*, 2005, pp. 217-222. doi: 10.1109/ICICT.2005.1598589.

[4] Vrijkotte, Tanja GM, Lorenz JP Van Doornen, and Eco JC De Geus, "Effects of work stress on ambulatory blood pressure, heart rate, and heart rate variability",Hypertension 35, no. 4 (2000): 880-886.

[5] Payal W., Amutha J.,"Monitoring Stress Level Parameters of Frequent Computer Users", International Conference on Communication and Signal Processing, April 6-8, 2016, India, pp.1449-1453.