

SMART WEARABLE SPECTACLES WITH MULTIMODAL MONITORING

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Technology degree in Biomedical Engineering

By

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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APRIL - 2023



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **ARAVINTH.R (39240008)**, **DHARANIVASAN.V (39240014)**, who carried out the project entitled "**SMART WEARABLE SPECTACLES WITH MULTIMODAL MONITORING**" under my supervision from **October 2022 to April 2023**.

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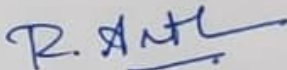
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DECLARATION

We, , **ARAVINTH.R (39240008)** , **DHARANIVASAN.V (39240014)** hereby declare that the Project Report entitled "**SMART WEARABLE SPECTACLES WITH MULTIMODAL MONITORING**" done by us under the guidance of, **Ms.A.SABARIVANI,M.Tech.,(Ph.D.)** Department of Biomedical Engineering is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Biomedical Engineering.

DATE: 18-4-2023

PLACE: Chennai

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SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

We are pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to **Dr.T.Sudhakar, M.Sc., Ph.D.**, and Head of the Department, and **Department of Biomedical Engineering**, for providing us necessary support and details at the right time during the progressive reviews.

We would like to express our sincere and deep sense of gratitude to our Project Guide **Ms.A.Sabarivani, M.Tech., (Ph.D.) Department of Biomedical Engineering** for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of our project work.

We wish to express our thanks to all **Teaching and Non-teaching** staff members of the **Department of Biomedical Engineering** who were helpful in many ways for the completion of the project.

ABSTRACT

Utilizing technological devices is like living a part-time life in this contemporary fast-paced society. Similar to a coin, technology has both a good and a bad side. Prolonged usage of electronic devices leads to major health problems. We developed a smart device like an add on that can recognize neck and eye strain caused by prolonged use of a laptop or smartphone. If the person's neck position doesn't change, or if they blink less frequently than usual, or if display is closer to the eye an alarm will ring to warn them to switch positions. While working for a long time, this will help with posture correction. Many posture-related irregularities and digital eye strain can be avoided in this way. Many posture-related irregularities and digital eye strain can be avoided in this way.

Keywords- neck strain, digital eye strain, posture correction, computer vision syndrome

LIST OF ABBREVIATIONS

ABBREVIATION	EXPANSION
CVS	- Computer vision syndrome
DMP	- Digital Motion Processor
ESP	- Espressif Systems
EOG	- Electrooculogram
IR	- Infrared rays
IDE	- Integrated Development Environment
MPU	- Magnetic pickup
SOC	- System on chip
VFS	- Visual Fatigue Scale

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CHAPTER-1

INTRODUCTION

In this modern Tech world Digital device usage has increased substantially in recent years across all age groups, so that extensive daily use for both social and professional purposes is now normal. Technology is like a coin which has both positive and negative sides. Prolonged use of e-gadgets which leads to major health defects. Taking this into account, we cannot dismiss the fact that our prolonged exposure to screens and incorrect use of modern devices has health Implications. Reduced physical activity, poor sleeping patterns, and digital eye strain are just a few of the negative consequences of smartphone use. We spend most of our time in front of digital screen. Over 90% of people aged between 16 - 35 uses digital devices every day. On average, we spend 8 hours in front of the digital screen. During these pandemic even more usage of mobiles, PC, laptops increased enormously. As we know school, college students and IT workers doing their work in front of the digital screen. Computer vision syndrome (CVS) is a very common phenomenon amongst computer users. A total of 90% of computer users, who spend more than 3 hours a day in front of the computer screen, suffer from CVS. So the only organ being exposed more on it is "EYE ". So in order to rectify these health defects our prototype help in monitoring and produce the output as a buzzer sound.

It is important to note that digital devices also have many positive impacts on our lives. For example, they have revolutionized communication, making it easier to stay in touch with loved ones and connect with people all over the world. They have also made it possible to work remotely, which can be a major benefit for people who live far away from their workplaces or who have mobility issues. In addition, digital devices offer access to a wealth of information and entertainment, from online courses and educational resources to streaming services and social media platforms.

Furthermore, while excessive screen time can lead to negative health impacts, it is not always feasible or desirable to completely eliminate screen time. For many people, digital devices are a necessary and valuable part of daily life. Therefore, it is important to find ways to mitigate the negative effects of screen time while still enjoying the benefits of technology. This can involve setting limits on screen time, taking frequent breaks, practicing good posture and eye hygiene, and using tools like blue light filters to reduce eye strain.

It is also worth noting that technology is constantly evolving, and new solutions for mitigating the negative effects of screen time are being developed all the time. For example, some devices now have built-in features that remind users to take breaks or adjust screen settings to reduce eye strain. Additionally, researchers are exploring new technologies like virtual and augmented reality that could potentially reduce the negative effects of screen time by providing more immersive and interactive experiences.

In summary, while excessive screen time can have negative health impacts, digital devices also offer many benefits and are an essential part of modern life. By taking steps to mitigate the negative effects of screen time and embracing new technologies, we can enjoy the benefits of technology while still prioritizing our health and wellbeing.

CHAPTER - 2

LITERATURE SURVEY

Vinaya Kulkarni, et.al.(2018) states that the usage of computers in our day-to- day activities has increased enormously leading to both positive and negative effects in our lives. The negative effects are related to health problems such as Computer Vision Syndrome (CVS) etc. Prolonged use of computers would lead to a significant reduction of spontaneous eye blink rate due to the high visual demand of the screen and concentration on the work. The proposed system develops a prototype using blink as a solution to prevent CVS. Various experiments are done and their algorithms are compared and concluded that the proposed algorithm yields 99.95% accuracy.

Jaehyun Lee,et.al,(2013) states that the neck pain is fairly common occurrence. Forward head posture and text neck are poor postures which may be related with neck pain but the evidence is not enough. We developed the wearable sensor which can assess the head & neck posture in daily life. Microprocessor, Bluetooth low energy, and 3-axis accelerometer, rechargeable battery and vibrator for reminding are used to implement the wearable sensor.

Simone Benedetto, et. al (2022) states that to this end, participants performed a longitudinal study in which two last generation e-readers (LCD, E-ink) and paper book were tested in three different prolonged reading sessions separated by - on average - ten days. Results from both objective (Blinks per second) and subjective (Visual Fatigue Scale) measures suggested that reading on the LCD (Kindle Fire HD) triggers higher visual fatigue with respect to both the E-ink (Kindle Paper white) and the paper book.

Kampanat WangsanPhit, et. al (2019) states that this cross-sectional study aimed to explore the prevalence, characteristics and associated factors of CVS. A total of 527 students who were currently studying in a virtual classroom. The most intense symptoms were the feeling of worsening eyesight (15.9%). The factors associated

with CVS were female ($p < 0.001$), age ($p = 0.010$), atopic diseases ($p = 0.020$), prior ocular symptoms ($p < 0.001$), astigmatism ($p = 0.033$), distance from display < 20 cm ($p = 0.023$), presence of glare or reflection on screen ($p < 0.001$), low screen brightness ($p = 0.045$), sleep duration ($p = 0.030$), inadequate break time between classes ($p < 0.001$) and increased screen time usage during online study ($p < 0.001$). Recommendations to prevent CVS based on the adjustable factors might reduce the burden of online study.

Sundus Alfaitouri, et. al (2019) states that the main objective of this study was to measure and examine changes in the neck flexion angle while using a Smartphone according to posture and duration of usage. Photographic analysis procedures were carried out to measure the neck flexion angle. The participants in this study were twenty young adults (half males); they stood against a scaled board and used the same Smartphone for web-browsing for twenty minutes. Photos were taken at zero, five, ten, fifteen and twenty minutes. This procedure was repeated for each participant at three postures (standing, sitting without arms rest, sitting with arms rested on a table). The results revealed statistically significant effects of both posture and duration of usage; neck flexion angle increased significantly over time in all postures and was significantly smaller in the standing posture than in the sitting postures.

CHAPTER -3

AIM AND SCOPE

3.1 AIM

- To create a smart glass that detects eye and neck strain while using Laptop or mobile phone for an extended period of time.
- To remind the person to change positions if the neck position is unchanged, if the person blinks less than the normal or if the person keeps his/her mobile nearer for an extended period of time.
- To aid in posture correction while working for a prolonged duration which will avoid many posture-related anomalies and improves productivity.
- And to reduce digital eye strain & to avoid computer vision syndrome.

3.2 SCOPE

- The scope of the smart wearable health spectacles is to provide users with a simple and effective way to monitor and improve their neck posture and eye-related health.
- By using various sensors and automatic processes, the product detects any abnormalities and alerts the user through a buzzer sound.
- The user can then make adjustments to correct their posture or position, promoting better neck posture and reducing the risk of related health problems.
- In addition, the product can be modified with additional features, such as

measuring EOG of the eye movement and sensing body temperature, which can provide further insights into eye health and overall health. This flexibility allows for the product to adapt to user needs and preferences.

- Overall, the scope of the product is to improve users' quality of life by promoting good neck posture and reducing the impact of eye-related health defects. By using technology to monitor and correct abnormalities, the product helps users maintain good health and prevent future health problems.

CHAPTER - 4

MATERIALS AND METHODS

4.1 METHODOLOGY

- This prototype helps in monitoring the eye related defects and neck posture correction for the user.
- Here we implement various ultrasonic sensor, Accelerometer sensor, IR blink sensor are incorporated along with ESP- 32 Microcontroller has been used in it which is shown in Fig 4.2
- Therefore, we introduce microcontroller based smart wearable spectacles in order to detect these eye and neck related health defects.

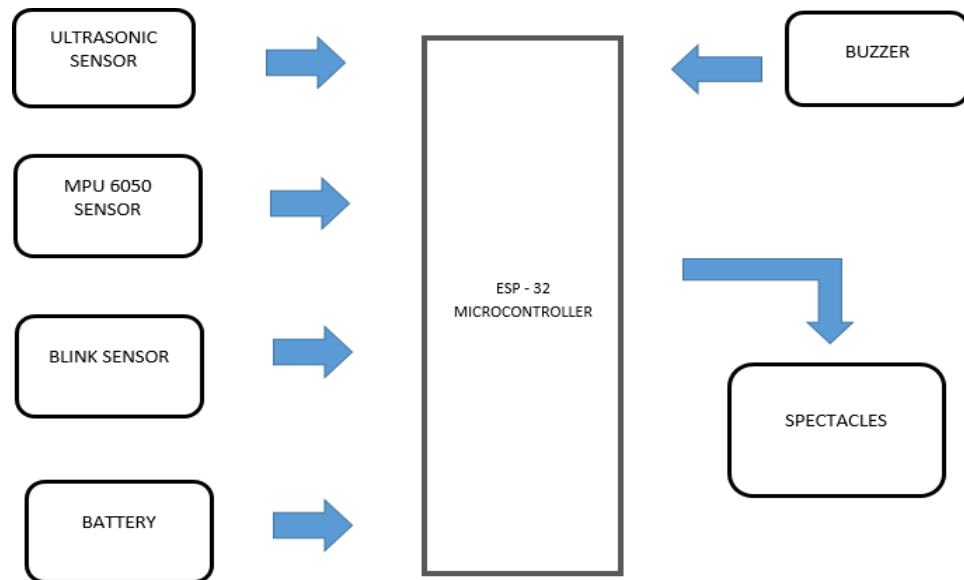


Fig: 4.1: Block diagram of smart wearable spectacle

Our project helps in monitoring the improper eye blink, digital eye strain, improper neck posture using blink sensor, MPU 6050 gyroscope sensor, and ultrasonic sensor are inbuilt in the spectacles and if the user crosses the threshold level of the given parameters the buzzer will alert the user to change his /her position. These projects aid in neck posture correction and eye-related defects.

4.2 HARDWARE USED

4.2.1 ESP 32 Microcontroller

The ESP32 is a very versatile System on a Chip (SoC) which is shown in fig .4.2 that can be used as a general purpose microcontroller with quite an extensive set of peripherals including WiFi and Bluetooth wireless capabilities. Another module commonly referred to as an ESP32 is what is more appropriately called an ESP32 Development Module. This is basically an ESP32 module mounted on a board with additional support circuitry such as a voltage regulator and a serial to USB chip allows direct connection to a desktop PC that can then be used to compile, download, and run programs directly on this module.



Fig: 4.2: ESP 32 microcontroller

ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems, the developers of the famous ESP8266 SoC. It is a successor to ESP8266 SoC and comes in both single-core and dual-core variations of the Tensilica's 32-bit Xtensa LX6Microprocessor with integrated Wi-Fi and Bluetooth which is shown in Fig 4.3.

Specifications of ESP32:

- Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240MHz.
- 520KB of SRAM, 448 KB of ROM, and 16 KB of RTC SRAM.
- Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps.
- Support for both classic Bluetooth v4.2 and BLE specifications.
- 34 Programmable GPIOs.
- Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC.
- Serial Connectivity includes 4 X SPI, 2 X I2C, 2 X I2S, 3 X UART.
- Ethernet MAC for physical LAN Communication (requires external PHY).
- 1 Host controller for SD/SDIO/MMC and 1 Slave controller
- Motor PWM and up to 16-channels of LED PWM.
- Secure Boot and Flash Encryption.
- Cryptographic Hardware Acceleration for AES, Hash (SHA-2), RSA, ECC, and RNG.

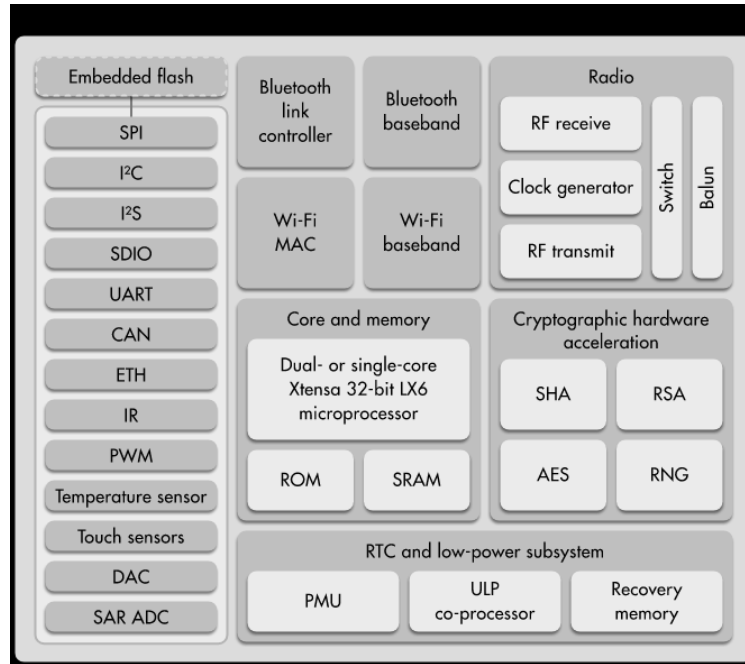


Fig: 4.3: Functional block diagram of ESP - 32

4.2.2 Ultrasonic sensor

Ultrasonic sensor is an electronic device which is shown in fig .4.4 that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emissions of the sound by the transmitter to its contact with the receiver. The formula for this calculation is $D = \frac{1}{2} T \times C$ (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second).



Fig: 4.4: Ultrasonic sensor

4.2.3 MPU 6050 Gyroscope sensor

A gyroscope and accelerometer in a single module: the MPU-6050 3-Axis Gyro & Accelerometer module which is shown in Fig .4.5. But the main advantage of the MPU-6050 module is no doubt its DMP (Digital Motion Processor) embedded on the same silicon die, since it supports 9-axis Motion Fusion algorithms while correcting any alignment problems and errors caused by small components. It can also detect sensors and movement. The MPU6050 consist of 3-axis Gyroscope with Micro Electro Mechanical System (MEMS) technology. It is used to detect rotational velocity along the X, Y, Z axes. A 16-bit analog to digital converter is included in the MPU6050.

It can catch three-dimensional motion at the same time because of this capability. This module offers several well-known and generally accessible functionalities; as a result, it may be used with a well-known microcontroller such as Arduino.

The MPU6050 is a perfect alternative if you're looking for a sensor to regulate the motions of your drone, self-balancing robot, RC vehicle, or something similar. For connection with Arduino, this module employs the I2C module. The MPU6050 is less costly and has the advantage of being easy to integrate with an accelerometer and gyro.

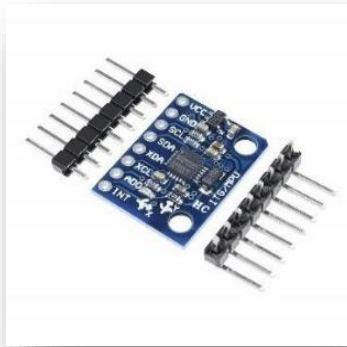


Fig: 4.5: Gyroscope sensor MPU 6050

4.2.4 IR sensor

This Eye Blink sensor is IR based which is shown in Fig .4.6. The Variation Across the eye will vary as per eye blink. If the eye is closed means the output is high otherwise output is low. This to know the eye is closing or opening position. This output is given to logic circuit to indicate the alarm.

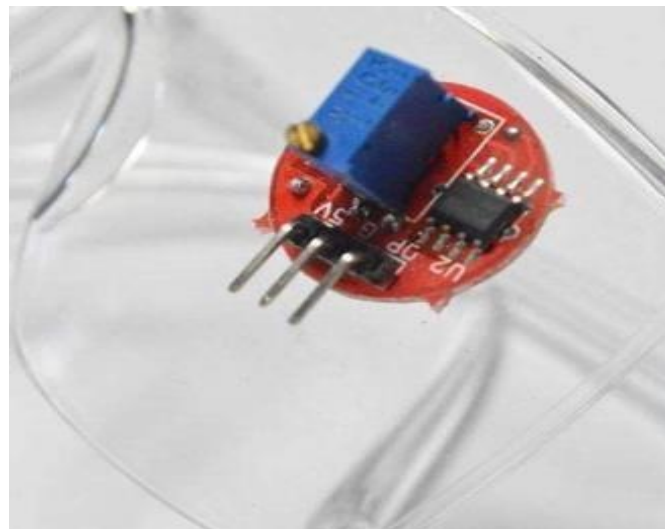


Fig: 4.6: IR sensor

4.2.5 Buzzer

An audio signaling device like a beeper or buzzer which is shown in Fig .4.7 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. The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '-' symbol or short terminal and it is connected to the GND terminal.



Fig: 4.7: Buzzer

4.2.5 Rechargeable battery

A lithium-ion battery or Li-ion battery is a type of rechargeable battery composed of cells which is shown in Fig .4.8 in which lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge and back when charging. Li-ion cells use an intercalated lithium compound as the material at the positive electrode and typically

graphite at the negative electrode. Li-ion batteries have a high energy density, no memory effect (other than LFP cells) and low self-discharge. Cells can be manufactured to either prioritize energy or power density. They can however be a safety hazard since they contain flammable electrolytes and if damaged or incorrectly charged can lead to explosions and fires.



Fig: 4.8: lithium ion rechargeable battery

4.3 SOFTWARE USED

4.3.1 Arduino IDE

Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus which is shown in Fig .4.9. It connects to the Arduino hardware to upload programs and communicate with them. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuine and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.'

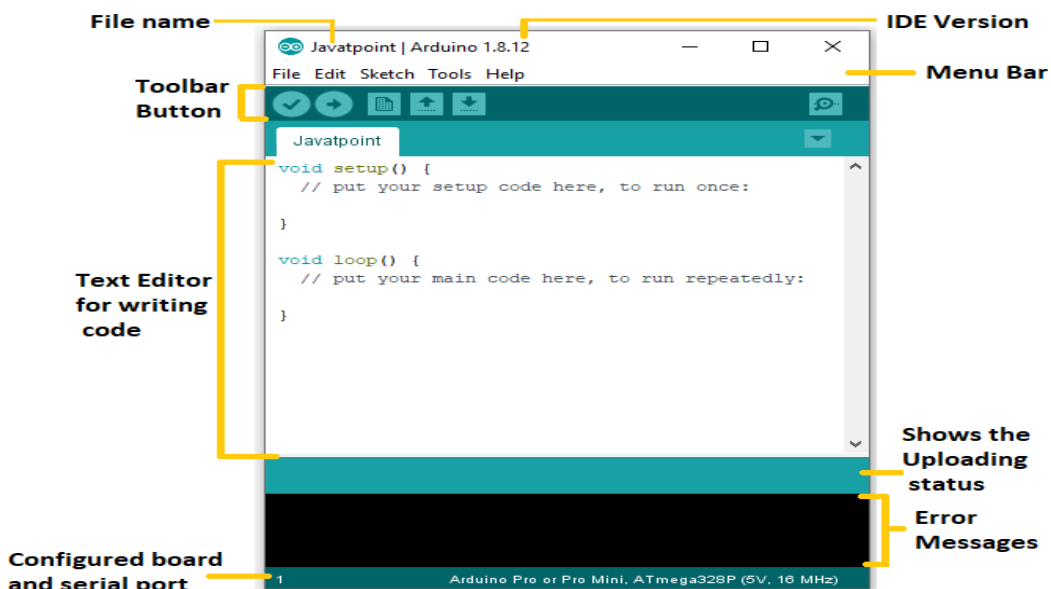


Fig: 4.9: Arduino ide

Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than \$50

Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

4.2.3 Google firebase

Firebase from the Google stable is one such platform that has won over developers across the globe which is shown in Fig .4.10. Firebase gives developers many options for creating highly functional and versatile web, Android, and IOS platform applications. While there are several contenders in the app development space, Firebase is always conversing with the best currently available platforms. Firebase is fundamentally a collection of tools developers can rely on, creating applications and expanding them based on demand.

Firestore aims to solve three main problems for developers:

- Build an app, fast
- Release and monitor an app with confidence
- Engage users,

Developers relying on this platform get access to services that they would have to develop themselves, and it enables them to lay focus on delivering robust application experiences. Some of the Google Firebase platform's standout features include databases, authentication, push messages, analytics, file storage, and much more. Since the services are cloud-hosted, developers can smoothly perform on-demand scaling without any hassle. Firestore is currently among the top app development platforms relied upon by developers across the globe.

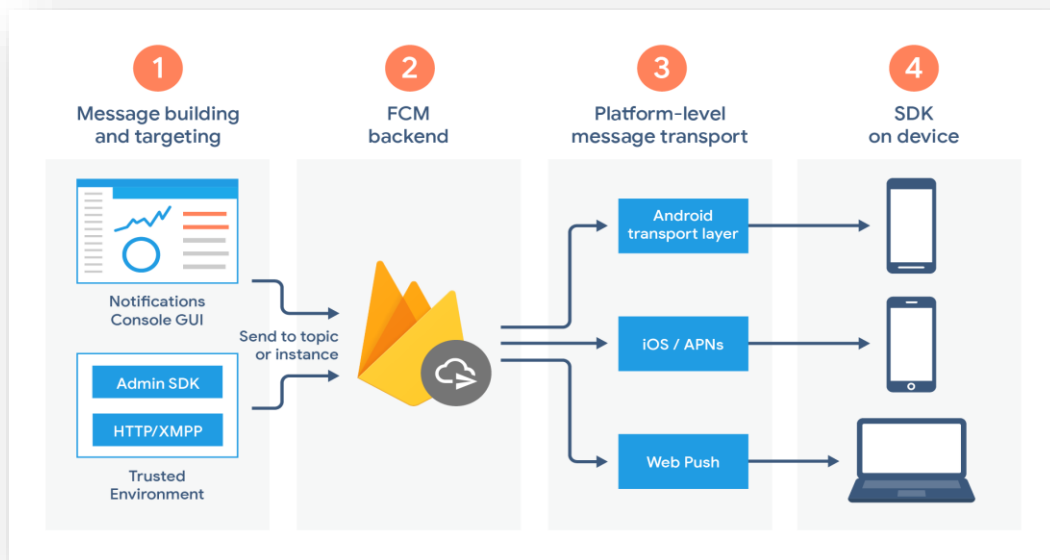


Fig: 4.10: Google Firebase

4.3.3 Kotlin

Kotlin is a statically typed, general-purpose programming language developed by Jet Brains that has built world-class IDEs like IntelliJ IDEA, PhpStorm, Appcode, etc which is shown in Fig .4.11. It was first introduced by JetBrains in 2011 and is a new language for the JVM. Kotlin is an object-oriented language, and a “better language” than Java, but still be fully interoperable with Java code. Kotlin is sponsored by Google, announced as one of the official languages for Android Development in 2017. Concise syntax: Kotlin has a more concise and expressive syntax compared to Java, which allows developers to write less code to accomplish the same task. Null safety Kotlin's type system ensures that null pointer exceptions are caught at compile-time, rather than at runtime, reducing the number of crashes in production.

Interoperability with Java Kotlin is fully interoperable with Java, meaning that developers can use existing Java libraries and frameworks seamlessly in their Kotlin code. Coroutine Kotlin provides support for coroutines, which are lightweight threads that allow for asynchronous programming with less overhead compared to traditional threads. Extension function Kotlin allows developers to add new functions to existing classes without having to modify the class itself, improving code reuse and readability. Kotlin has gained popularity in recent years, especially among Android developers, due to its ease of use and improved safety compared to Java

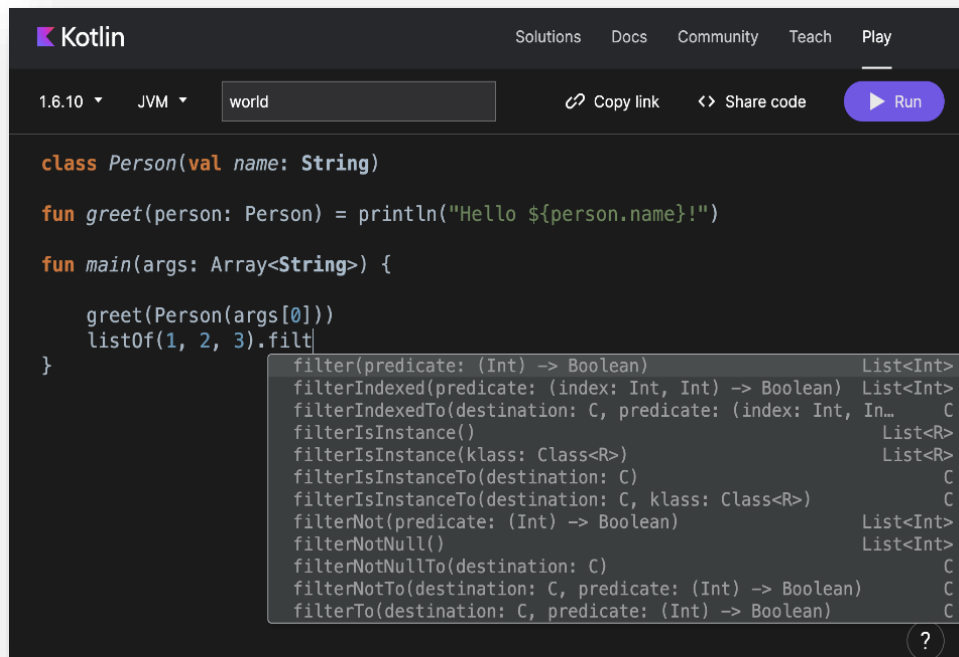


Fig: 4.11: kotlin

CHAPTER-5

RESULTS AND DISCUSSION

5.1 RESULTS

In these project, we use various sensors to monitor the eye related defects such as, improper eye blink, digital eye strain and improper neck posture. We use ESP 32 microcontroller to implement the working of our prototype. The measured parameters are monitored and if exceed the threshold level the buzzer reminds the user to change the position.

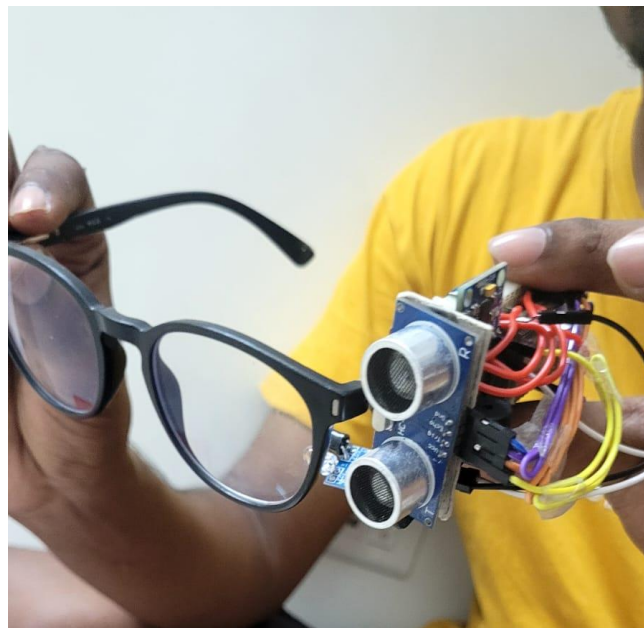


Fig: 5.1: Hardware setup

The final prototype of the smart wearable spectacle is incorporated with the Ultrasonic sensor, MPU 6050 Gyroscope Sensor, IR Blink sensor, Buzzer along with ESP 32 microcontroller and the mobile is built in order to receive notification which is shown in Fig 5.1



Fig: 5.2: The MPU 6050 gyroscope sensor detect the neck posture

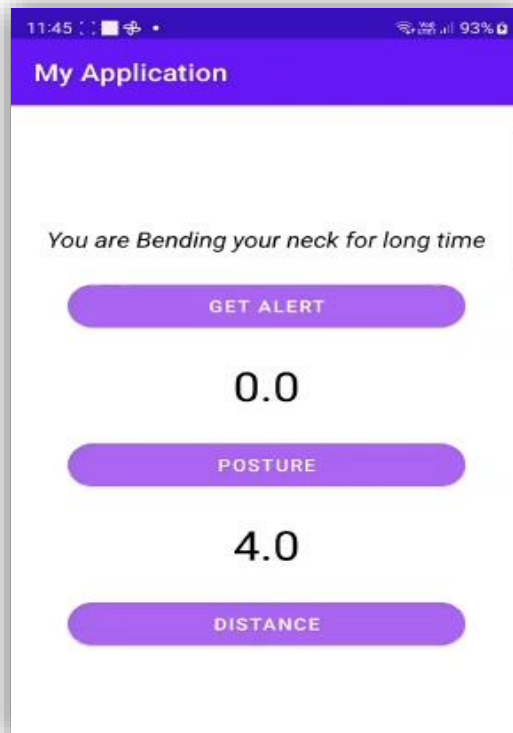


Fig: 5.3: Representation of neck posture in the app

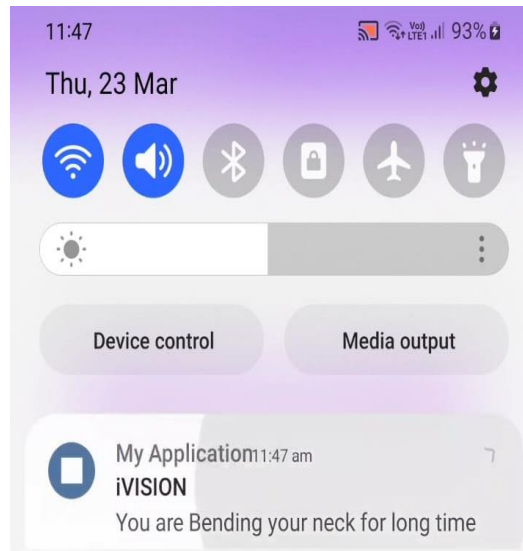


Fig: 5.4: The user gets notification in their mobile

The results and working of the detection in the improper neck posture of the user using the MPU 6050 gyroscope sensor which is shown in Fig 5.2 which detects and give alert with buzzer sound to the user to remind to change their neck posture and the data which are acquired in the mobile app and gives notification to the user which is shown in Fig 5.3 & Fig 5.4.



Fig: 5.5: The ultrasonic sensor sense distance between screen and user.

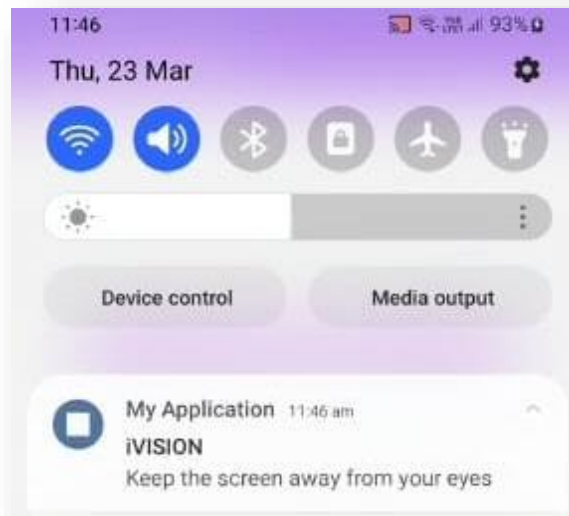


Fig: 5.6: The user gets notifications on their mobile screen.

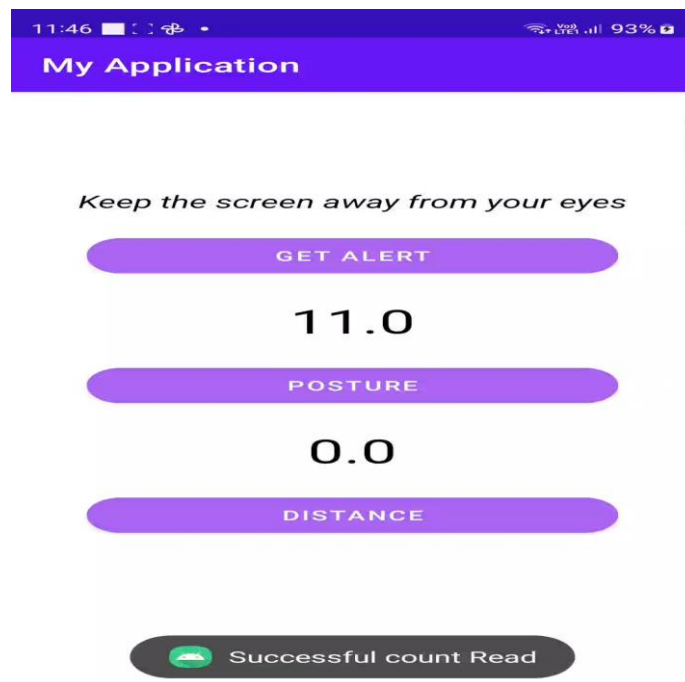


Fig: 5.7: Representation of distance from screen the app

The results and working of the detection in the looking closer to the digital screen by the user using the ultrasonic sensor which is shown in Fig 5.5 which detects and give alert with buzzer sound to the user to avoid closer contact with mobile and the data which are acquired in the mobile app and gives notification to the user which is shown in Fig 5.6 & Fig 5.7.

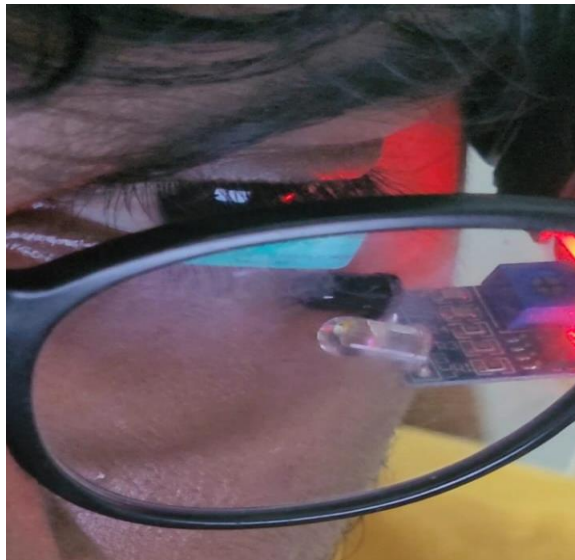


Fig: 5.8: The IR sensor which sense the eye blink of the user

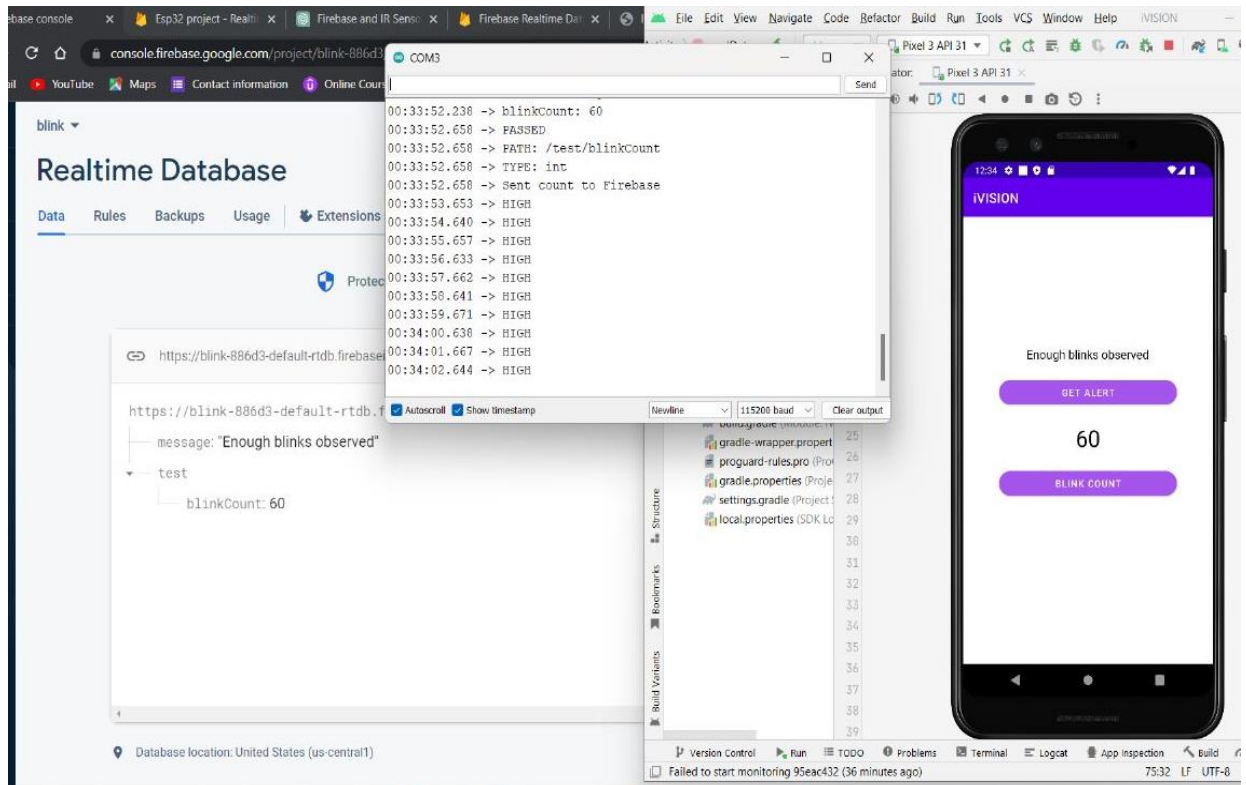


Fig. 5.9: Representation of eye blink in the app

The results and working in detection of improper eye blink by the user using the IR sensor which is shown in Fig 5.8 which detects and give alert with buzzer sound to the user to avoid improper eye blink and the data which are acquired in the mobile app and gives notification to the user which is shown in Fig 5.9.

5.2 DISCUSSION

In this project, we have reviewed the applications of various sensors and systems. Through successful implementation and testing of our coding, we have achieved the desired output. As shown in the figure, we have developed a prototype of the spectacles.

Moving forward, we plan to add some additional features to the prototype. For instance, we plan to measure EOG (electrooculogram) of the eye movement to gain insights into eye health. We also plan to incorporate sensors that can detect body temperature and modify the buzzer to send notifications to mobile devices. These additional features will help enhance the overall functionality of the product and improve its usefulness for users.

Overall, we believe that this project has the potential to make a positive impact on individuals' health and well-being. By incorporating various sensors and systems, we can gain valuable insights into eye health and other important health indicators. We are excited to continue refining the product and incorporating additional features in the future.

CHAPTER- 6

SUMMARY AND CONCLUSION

6.1 SUMMARY

Our focus on eye health and neck posture led us to develop the concept of smart wearable health spectacles. By using various sensors, we are able to monitor and detect eye-related health defects as well as correct neck posture. The product is designed to be easy to use and affordable for users.

When an abnormality is detected, the product alerts the user through a buzzer sound. The user can then adjust their posture or position to correct the issue. This automatic process helps to minimize the impact of eye-related health defects and improve overall posture.

In addition to being effective, the product is also designed to be economical and safe for users. We have taken into consideration the importance of affordability and safety when designing the product. The goal is to ensure that anyone can benefit from this product without having to worry about cost or safety concerns.

Overall, we believe that the smart wearable health spectacles will make a positive impact on individuals' health and well-being. By using technology to detect and correct abnormalities, we hope to improve the quality of life for users and help prevent future health problems.

6.2 CONCLUSION

Our prototype is designed to aid in the prevention of eye-related health defects and assist with neck correction. The product is flexible and affordable, making it accessible to a wide range of consumers. Through rigorous testing, we have achieved good accuracy results, ensuring that the product is effective for its intended use.

Given the increasing amount of time people spend in front of screens, this product has the potential to be useful for a variety of individuals, such as IT employees, online class students, and mobile game players. By implementing it as a real-time user application in desktops, laptops, and mobiles, we can ensure that it is easily integrated into people's daily routines.

To protect our intellectual property, we plan to secure patents, trademarks, or copyrights. We also plan to obtain relevant safety and performance certifications to ensure that our product is safe and reliable. Through marketing and distribution partnerships, we will reach our target audience and make the product available in a variety of locations.

As we collect feedback from users, we plan to make continuous improvements to the product, ensuring that it stays relevant and effective. To finance product development, production, and marketing, we plan to seek investors or other sources of financing.

In addition to the benefits we have already mentioned, the product is designed with ergonomics in mind, ensuring that it is comfortable and doesn't cause additional strain or discomfort. Using eco-friendly materials and designing for easy repair or recycling will also help reduce waste and improve sustainability.

Overall, our product has the potential to make a positive impact on individuals' health and well-being while remaining affordable and environmentally responsible.

REFERENCES

- [1] Alfaitouri S. and Altaboli A., "The Effect of Posture and Duration of Smartphone Usage on Neck Flexion Angle," Industrial and Manufacturing Systems Engineering Department, University of Benghazi, Benghazi, Libya, Proceedings of the Human Factors and Ergonomics Society 2019 Annual Meeting, 2019, pp no 1953-1957.
- [2] Baker.R., Howie.E, Williamson.A. and Straker L., "The Short Term Musculoskeletal and Cognitive Effects of Prolonged Sitting During Office Computer Work," International Journal of Environmental Research and Public Health, vol. 15, , Aug. 2018. no. 8, pp no 1678-1689.
- [3] Bazazan. A, Dianat.I, Feizollahi.N., Mombeini.Z.,Shirazi..A. M., and Castellucci. H.I, "Effect of a posture correction-based intervention on musculoskeletal symptoms and fatigue among control room operators," in Journal of Occupational Health, vol. 62, no. 1, pp. e12152, Jan. 2020, doi: 10.1002/1348-9585.12152. pp no 123-155
- [4] Bulling.A.,Roggen.D and Tröster.G., "Wearable EOG goggles: seamless sensing and context-awareness in everyday environments," Journal Article, 2009.pp no 22-25.
- [5] Chernyshov. G.,. Ragozin. K, and Kunze K., "EOG Glasses: an Eyewear Platform for Cognitive and Social Interaction Assessments in the Wild," in Proceedings of the 21st International Conference on Human-Computer Interaction with Mobile Devices and Services, Oct. 2019, pp no 1–5.
- [6] Caffier P. P., Erdmann U, and Ullsperger P, "Experimental evaluation of eye-blink parameters as a drowsiness measure," in European Journal of Applied Physiology, vol. 89, Mar. 2003, doi: 10.1007/s00421-003-0808-4. , no. 4, pp. 319-325.
- [7] Chen R., Zhang. Z., Deng. K. Wang D. and Pan T"Blink-sensing glasses: A flexible iontronic sensing wearable for continuous blink monitoring," in Biosensors

and Bioelectronics, vol. 183, Aug. 2021, doi: 10.1016/j.bios.2021.113195. pp no 113-195.

[8] Credeur, D. P. Miller S. M, Jones R, Stoner, D. Dolbow, S, Fryer, K., Stone, McCoy S.M., and. Parker J.K, "Impact of Prolonged Sitting on Peripheral and Central Vascular Health," The American Journal of Cardiology, vol. 123, no. 2, , Jan. 2019. pp no 260–266.

[9] Hellec. J.,. Chorin .F, Castagnetti A., and. Colson S. S, "Sit-To-Stand Movement Evaluated Using an Inertial Measurement Unit Embedded in Smart Glasses—A Validation Study," in Sensors, vol. 20, no. 18, , Sep. 2020, doi: 10.3390/s20185226. pp no 5226-5277.

[10] Kulkarni, "An Eye Blink and Head Movement Detection for Computer Vision Syndrome," in International Journal Science and Engineering Applications, vol. 7, , Feb. 2018, ISSN: 2319-7560. no. 2, pp no 20-22

[11] Kunhapan S. et al., "Self-Reported Computer Vision Syndrome among Thai University Students in Virtual Classrooms during the COVID-19 Pandemic: Prevalence and Associated Factors," Int. J. Environ. Res. Public Health, vol. 19, , Mar. 2022, Art no. 3661. pp no. 7-15.

[12] Lee J., Chee Y., Bae .J., Kim. H., and. Kim. Y, "The Wearable Sensor System to Monitor the Head & Neck Posture in Daily Life," Interdisciplinary Program of Medical & Biological Engineering, Graduate School, University of Ulsan, Korea and College of Engineering, School of Electrical Engineering, Biomedical Engineering, University of Ulsan, Korea, 2016, pp no 1-3.

[13] J. H. Lee, H. Kim, J.-Y. Hwang, J. Chung, T.-M. Jang, D. G. Seo, Y. Gao, J. Lee, H. Park, S. Lee, H. C. Moon, H. Cheng, S.-H. Lee, and S.-W. Hwang, "3D Printed, Customizable, and Multifunctional Smart Electronic Eyeglasses for Wearable Healthcare Systems and Human–Machine Interfaces," ACS Applied Materials & Interfaces, vol. 12, , 2020. pp No. 21424–21432

[14] Niiijima .A., "Posture Feedback System with Wearable Speaker," in Proceedings of the 2021 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), 2021, , doi: 10.1109/EMBC49707.2021.9480216. pp no. 2663-2666

[15] Paterson .C, Fryer. S., Zieff G Ston., K. e, Credeur, B. Gibbs, J. Padilla, J.. Parker I, and L. Stoner, "The Effects of Acute Exposure to Prolonged Sitting, With and Without Interruption, on Vascular Function Among Adults: A Meta-analysis," Sports Medicine, vol. 50, , 2020. pp no 1929–1942

[16] Schweizer, T. Wyss T., and Gilgen-Ammann R., "Detecting Soldiers' Fatigue Using Eye-Tracking Glasses: Practical Field Applications and Research Opportunities," in Military Medicine, Dec. 2021, doi: 10.1093/milmed/usab509. [Online]. Available: <https://doi.org/10.1093/milmed/usab509>. License: CC BY 4.0 pp no 38-56

PROOF OF ACCEPTANCE



APPENDIX

```
// Basic demo for accelerometer readings from Adafruit MPU6050 #include
<Adafruit_MPU6050.h>
#include <Adafruit_Sensor.h>
#include <Wire.h>

Adafruit_MPU6050 mpu; long
int time0;
int count = 0;
int xdata = 0;
int led=2;
void setup(void) { Serial.begin(115200);
pinMode(led,OUTPUT);
while (!Serial)
delay(10);
// will pause Zero, Leonardo, etc until serial console opens

//Serial.println("Adafruit MPU6050 test!");

// Try to initialize! if (!mpu.begin()) {
//Serial.println("Failed to find MPU6050 chip"); while (1) {
delay(10);
}
}
//Serial.println("MPU6050 Found!");

mpu.setAccelerometerRange(MPU6050_RANGE_8_G);
//Serial.print("Accelerometer range set to: ");
switch (mpu.getAccelerometerRange())
```

```

{
case MPU6050_RANGE_2_G:
//Serial.println("+2G"); break;
case MPU6050_RANGE_4_G:
//Serial.println("+4G"); break;
case MPU6050_RANGE_8_G:
//Serial.println("+8G"); break;
case MPU6050_RANGE_16_G:
//Serial.println("+16G"); break;
}

mpu.setGyroRange(MPU6050_RANGE_500_DEG);
//Serial.print("Gyro range set to: "); switch (mpu.getGyroRange()) {
case MPU6050_RANGE_250_DEG:
//Serial.println("+ 250 deg/s"); break;
case MPU6050_RANGE_500_DEG:
//Serial.println("+ 500 deg/s"); break;
case MPU6050_RANGE_1000_DEG:
//Serial.println("+ 1000 deg/s"); break;
case MPU6050_RANGE_2000_DEG:
//Serial.println("+ 2000 deg/s"); break;
}

mpu.setFilterBandwidth(MPU6050_BAND_21_HZ);
//Serial.print("Filter bandwidth set to: ");
switch (mpu.getFilterBandwidth()) { case MPU6050_BAND_260_HZ:
//Serial.println("260 Hz");
break;
case MPU6050_BAND_184_HZ:
//Serial.println("184 Hz"); break;
case MPU6050_BAND_94_HZ:
//Serial.println("94 Hz"); break;
case MPU6050_BAND_44_HZ:
//Serial.println("44 Hz"); break;

```

```

case MPU6050_BAND_21_HZ:
//Serial.println("21 Hz"); break;
case MPU6050_BAND_10_HZ:
//Serial.println("10 Hz"); break;
case MPU6050_BAND_5_HZ:
//Serial.println("5 Hz"); break;
}

```

```

//Serial.println(""); delay(100);
}

```

```

void loop()
{

```

```

/* Get new sensor events with the readings */ sensors_event_t a, g, temp;
mpu.getEvent(&a, &g, &temp);

```

```

/* Print out the values */
//Serial.print("Acceleration X: ");
/* Serial.print(a.acceleration.x);
Serial.print(", ");
Serial.print(a.acceleration.y);
Serial.print(", ");
Serial.println(a.acceleration.z);*/

```

```

// long int time0;
// int count = 0;
xdata = (a.acceleration.x) + 10;
Serial.println(count);
if(xdata <= 9)
{

```

```

count++;
}
else
{
count=0; digitalWrite(led,LOW);
}
if(count > 1000)
{
digitalWrite(led,HIGH);
Serial.println("tAKEN LONG tIME");
}
//Serial.println(" m/s^2");

```

```

//Serial.print("Rotation X: ");
//Serial.print(g.gyro.x);
//Serial.print(", Y: ");
//Serial.print(g.gyro.y);
//Serial.print(", Z: ");
//Serial.print(g.gyro.z);
//Serial.println(" rad/s");

```

```

//Serial.print("Temperature: ");
//Serial.print(temp.temperature);
//Serial.println(" degC");

```

```

//Serial.println(""); delay(5);
}

```

ultrasonic code

```
int trigPin = 5;
int echoPin = 18;
int duration;
int distance;
int count = 0;
int xdata = 0;
int led=2;
void setup()
{
  Serial.begin(115200); pinMode(trigPin, OUTPUT); pinMode(echoPin, INPUT);
  pinMode(led,OUTPUT); while (!Serial)
  delay(10);
}
void loop() { digitalWrite(trigPin, LOW); delayMicroseconds(2); digitalWrite(trigPin,
HIGH); delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance= duration*0.034/2;
//Serial.println(distance);
// long int time0;
// int count = 0;
xdata = distance;
Serial.println(count);
if(xdata <= 30)
```

IR BLINK SENSOR CODE

```
int ir=13;
int led=14;
int count =0;
```

```

int a=0;
int b= 0;
void setup()
{
  pinMode(ir,INPUT);
  pinMode(led,OUTPUT);
  Serial.begin(115200);
}
void loop()
{
  int irvalue=digitalRead(ir); if(irvalue==LOW)
  {
    Serial.println("LOW");

  }
  else if (irvalue==HIGH)
  {
    Serial.println("High");

  }

  a++;
}
b++;
if (b==15)
{
  if(a<4)
  {
    Serial.println("not enough"); digitalWrite(led,HIGH);
  }
  else if (a>=4)
  {
    Serial.println("enough"); digitalWrite(led,LOW);
  } b=0; a=0;
}

```

```
}
```

```
delay(1000);
```

```
}
```