XR-OS Wearable Reduces E-waste and Personalizes Computer

A PROJECT REPORT

submitted by

Adarsh M(CHN17CS005)

Andreas Shaji Jacob(CHN17CS020)

Nandagopan Gopi (CHN17CS078)

Praveena Elma John(CHN17CS091)

to

the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree

of

Bachelor of Technology

In

Computer Science and Engineering

Department of Computer Science and Engineering

College of Engineering Chengannur

Chengannur

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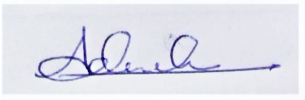
DECLARATION

We undersigned hereby declare that the project report "XR-OS WEARABLE REDUCES E-WASTE AND PERSONALIZES COMPUTER" submitted for partial fulfilment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by us under supervision of our guide Prof.Ahammed Siraj K K, Associate Professor, Department of Computer Science Engineering. This submission represents our ideas in our own words and where ideas or words of others have been included that have adequately and accurately cited and referenced the original sources. We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.



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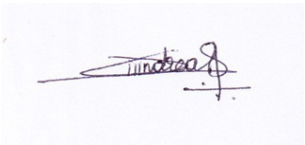
Adarsh M



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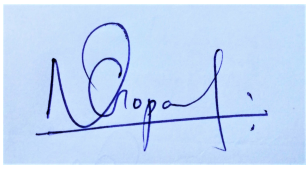
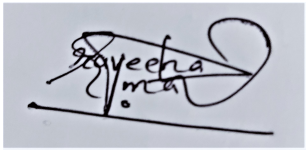


Nandagopan Gopi



Praveena Elma John

COLLEGE OF ENGINEERING, CHENGANNUR
KERALA

Department of Computer Engineering

CERTIFICATE

This is to certify that the report entitled **XR-OS WEARABLE REDUCE E-WASTE AND PERSONALIZES COMPUTER** submitted by **Adarsh M, Andreas Shaji Jacob, Nandagopan Gopi** and **Praveena Elma John** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Internal Supervisor **External Supervisor**

Project Coordinator
Smt. Jyothi R L

Head of the Department
Dr. Smitha Dharan

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Last but not the least, We extend our heartfelt gratitude to our parents and friends for their support and assistance.

ABSTRACT

Every second, the planet evolves on all dimensions of matter. Even a cursory examination of the technology sector is enthralling. The Extended reality (XR) is a concept that emerged in this industry over the last decade. This notion gave birth to the project's core concept. A quick summary of the concept is to develop a fledgling form of a personal computer-based on XR. The cellphones we use are one of the unavoidable forms of technology. They can even be considered as an advanced prosthetic. Do they, however, deter people from purchasing computers? No, that is not the case. Except for the ease of mobility, PCs are significantly more advanced than cellphones in terms of usability. The project's concept is a response to that problem. The goal of the project is to construct a wearable head-mounted device that could act as a PC with a few features based on the XR concept. The present device is a nascent version of this concept. However, the possibilities are limitless. Even though this concept isn't that far from the XR devices that surround us. It's an attempt to grasp the concepts associated with the world's vast population. That is normal technology users' affordability, aesthetic values, and conveniences. On the head-mounted gadget with see-through capabilities, a user can accomplish tasks such as listening to music or searching for a phrase on the internet. Finally, the device is a proof-of-concept for an idea with a wide range of potential applications. .

List of Figures

ABBREVIATIONS

AI ..... **Artificial Intelligence**
API ..... **Application Programming Interface**
AR ..... **Augmented Reality**
CD-ROM ..... **Compact disc read-only memory**
CPU ..... **Central processing unit**
DRAM ..... **Dynamic random-access memory**
ESP ..... **Event-stream processing**
gTTS ..... **Google Text-To-Speech**
IEEE ..... **Institute of Electrical and Electronics Engineers**
LCD ..... **Liquid-crystal display**
MQTT ..... **Message Queuing Telemetry Transport**
MR ..... **Mixed Reality**
OLED ..... **Organic light-emitting diode**
OS ..... **Operating System**
PC ..... **Personal Computer**
QA ..... **Question and Answer**
RAM ..... **Random Access Memory**
ROM ..... **Read-only memory**
STT ..... **Speech-To-Text**
TTS ..... **Text-To-Speech**
USB ..... **Universal Serial Bus**
XR ..... **Extended Reality**

Chapter 1

INTRODUCTION

1.1 General Idea

In the last few decades, the world as we know it has evolved at a breakneck pace. The changes that have occurred in the world and many sectors are enormous. The way things changed in the sphere of technology is a fascinating chapter in human history. But have these changes had any unwelcome consequences in the world? Yes, it is true. The amount of e-waste generated by these technological and manufacturing breakthroughs is staggering. We plan to build something new in order to put a stop to this heinous crime.

We discovered that the primary weakness is within ourselves after conducting significant research on the internet, reading published articles, and having personal experiences. The bulk of us buy modern electronic equipment to hide our susceptibility rather than to appreciate the benefits they provide. We buy the latest gadget to show to ourselves that we require it to live comfortably.

The answer given above is not the genuine one we need to find in this decade. We could live comfortably with only the most basic technologies at our disposal. We don't need a phone with 10 GB of RAM or more to watch a movie or listen to music on the internet. A super-fast machine is not required to write a letter or evaluate a data chart. The software industry exaggerates the pervasive requirement for high specifications. This is where our concept takes shape.

The origins of our concept are linked to the XR concept and the PC environment. Our motivations served as stepping stones to the realisation of our current concept. The reason for this is based on the three primary pillars that the great majority of people examine when purchasing a product. During the creation and construction

of our concept, the pillars, aesthetic values, affordability, and convenience were the most important aspects. The essential cornerstones of our work were the design of a head-mounted wearable device with features such as see-through capabilities, peripherals less interfaces, and so on. The flow of ideas started when we decided to do a project based on our desire to reduce e-waste and personalise our devices.

This gave rise to XR's encapsulation of a typical PC environment. Along with the creation of this project idea, the necessity for portability, usability, and aesthetics were also considered.

1.2 Motivation

We came on an article before even comprehending what kind of project we needed to complete. The article mentioned things that everyone has known for a long time. However, the figures in the article astound us. A turning point for us was the quality of e-waste in terms of tons and how little we recycled or reused. When we realised how much e-waste our country produces, this popped up with such force. The first significant aspect in the creation of this project idea was the minimization of e-waste.

We chose to eliminate the most bothersome features of our typical personnel computers while completing our most crucial duty. Unwanted software is integrated into our systems, and some of it is so hardcoded that removing it causes problems or renders it impossible. These were the fundamental criteria for selecting the best project proposal.

1.3 Objective

Our project's main objective was to construct a computer environment that would help us do the majority of jobs that we try to perform on our mobile phone or computer, such as calculations, email reading, and so on. It's also something that simplifies hardware such as mouse and keyboard, allowing us to reduce e-waste, which is a huge concern that we're dealing with right now and will become even more harmful in the future. As a result, our concept represents a novel method for e-waste reduction. It also minimises software complexity, allowing for a more personalised system that allows for a more hassle-free workstation and a system that is tailored to user-specific demands. It's a device that will also direct the user to future technological advancements.

Chapter 2

LITERATURE SURVEY

The ideas that allowed us to come up with this project's concept were gathered from a variety of sources. We retrieved data from a variety of sources, including blogs, videos, and journal publications. The number of resources that contributed significantly to the idea, as well as the amount of material available, varies greatly from one to the next. The four important studies that contributed to the development of this plan are listed below.

Initially started by Zhenliang Zhang,Benyang Cao and Dongdong Weng some Chinese engineers.In this paper, interaction modes such as gesture-based interaction and physical-based interaction are developed to construct a mixed reality system to evaluate the advantages and disadvantages of different interaction modes for near-field mixed reality. It enables us to understand the various aspects and provide the solution for issues during our software development they published it in IEEE as the name 'Evaluation of Hand-Based Interaction for Near-Field Mixed Reality with Optical See-Through Head-Mounted Displays'

There is another IEEE paper which support the idea named 'Comparison in Depth Perception between Virtual reality and Augmented Reality Systems' by Jiamin Ping,Yue Liu and Dongdong Weng that helps in understanding how users perceive depth in the virtual environment and augmented reality is an important aspect. Understanding this enables us to find the best approach towards developing the concepts. Based on the results of this paper, using augmented reality is the best approach towards implementing our concept.

An IEEE paper named 'Deployment of a Mixed Reality Experience for a Small-Scale Exhibition in the Wild' by Kelvin Cheng and Ichiro Furusawa says that Space constraint, without a doubt, is a vital issue in the current world. This paper revolved around the understanding of space and the usage of technology to

overcome barriers based on space. An experiment was conducted on the museums using mixed reality. This paper made us realise that mixed reality is the best approach for developing the software for our wearable concept.

The last IEEE paper that support this project is 'Extended Reality in Global Software Delivery - Towards a Common Fabric of Understanding and Insights' publilshed by Vibhu Sharma,RohitMehra,Vikrant Kaulgud and Sanjay Podder.This paper focuses on getting out of the 2D infrastructures to implement the basic humane understanding and representation on the making of the projects. These undergone by the companies seems to be more efficient and perfect. This paper enabled us to understand the requirements of the user base and how effective our concept could become. And also how to make this work.

Chapter 3

EXISTING SYSTEM

3.1 PC and XR-glasses

Personal Computers

A PC is a multi-purpose computer that is small enough, capable enough, and inexpensive enough to be used by one person. Rather than being operated by a computer specialist or technician, personal computers are designed to be operated directly by the end-user. Personal computers, unlike massive, expensive minicomputers and mainframes, do not allow several users to use the same computer at the same time.

A typical personal computer assemblage consists of a CPU, which contains the computer's arithmetic, logic, and control circuitry on an integrated circuit; two types of computer memory, main memory, such as digital RAM, and auxiliary memory, such as magnetic hard discs and special optical compact discs, or ROM discs (CD-ROMs and DRAM); and two types of computer memory, main memory, such as digital random-access.

They have, as we all know, been updated throughout their history, from the time they were first modelled until now. However, if we dig deeper into that topic, we can observe that during the last few decades, the up-gradation of these systems has increased substantially.

Take, for example, Intel processors. We can observe the difference when we compare the CPU clock speeds of earlier processors, which were 108kHz, to the modern 10th gen CPUs, which have clock rates of 5GHz and greater. There are currently 5k monitors on the market, even in terms of monitor resolutions. These develop-

Figure 3.1: Fig:3.1 Personal Computer System

ments unmistakably show that it is the most widely used hardware infrastructure for development and general use.

XR-Glasses

AR, VR, MR, and everything in between are all referred to as XR. Although AR and VR provide a wide range of innovative experiences, XR is powered by the same underlying technologies. In general, XR-glasses are small, light, and comfortable smart glasses that link to a computer or certain smartphones and are powered by high-end Platform for high-performance. The glasses also have stereoscopic 1080p screens that can show up to five virtual screens to the user.

We envisage the smartphone, mobile VR headset, and AR glasses combining into a single XR wearable at some time in the future. XR has the potential to replace all other screens in your life, even your big TV in the living room. Mobile XR, like the smartphone today, has the potential to become one of the world's most pervasive and disruptive computing platforms.

Even though this technology is still in development, it has altered the way people think about and perceive development. Its goal is to make it possible for users to accomplish their work in a more interactive and realistic manner.

Figure 3.2: Fig:3.2 XR Glass

3.2 Disadvantages of Existing System

Personal Computers

- For a long time, the necessary modifications have been too expensive.
- The upgrades that have been taking place over the last several years have given the user market a huge boost. Sadly, this is also true in the e-waste business.
- The client market has been put under strain due to the complexity of both the hardware and software components. The aesthetics are also affected by the size.

XR-glasses

- Despite the fact that the interface is simple and takes up little space, the hardware infrastructure is quite large when compared to the basic use.
- Although the interaction is efficient and enjoyable, the cost of acquiring it for small functions appears to be overwhelming.
- Currently, just like computers, this technology's travel lightweight is greatly hindered.

Chapter 4

PROPOSED SYSTEM

Several talks led to the notion of creating a gadget that would allow the user to be in sync with the surroundings while yet performing various computer-based tasks. As a result, the project's goal became to design eyewear that would help the user do the bulk of the tasks they attempted on their phone or computer.

The concept also included the creation of a futuristic-looking device that could play music or video, type any text, engage in a video conference, and much more. For the time being, we sought to create a prototype of the intended eyewear that would allow users to execute a wide range of jobs, with the exception of those requiring high-performance computers, such as Adobe Editors, high-end programming, video games, and so on. We've devised three ways to assist us in achieving our objective.

The three strategies are:

- Build from scratch a head mounted eye wear.
- Introduce AR application on to the mobile phone based AR head wear.
- Introduce AR web browser on to AR head wear.

Head-mounted displays are the newest craze sweeping the city. We've seen a variety of wearable screens, including the Hololens, Google Glass, and virtual reality systems like the Oculus Rift. Creating a gadget from the ground up was

the most important task because having a blank canvas may go a long way. As a result, we concentrated on the first strategy. We could be able to produce totally customised eyewear as a result of this.

We were ultimately able to adopt the first approach and make a game plan after

a significant amount of study and evaluations. The construction was difficult, but well worth the effort. As a conclusion, the development was broken down into four basic steps, as shown below.

Steps:

1)Hardware and Software design

2)Preparation of Raspberry Pi and Voice Commands.

3)Overlaying screens over the webcam feedback and voice over earphones.

4)The Final Build.

We planned to make a prototype head-mounted device using the Raspberry Pi as the core hardware and other components such as a webcam, microphone, and so on. The main goal was to create a futuristic-looking head-mounted eyewear that also had the capabilities we wanted, such as web search, music playback, and so on.

The device would be a prototype of our concept, with the option to be upgraded in the future with a cutting-edge functionality that would be beneficial to individual users.

4.1 Hardware and Software Design

4.1.1 Hardware

From a hardware standpoint, we intended to devise a strategy for developing a head-mounted display in the shape of a spectacle, cap, or custom-built structure. It's designed to be used as single-eye hardware (ie: the user can able to see the device display with one eye). The hardware was created with the project concept in mind. As a result, a Raspberry Pi, Micro LCD/OLED display, USB webcam with a built-in mic, Headphone with mic, and loupe magnifier with aspheric lens were used. The hardware design for this monocular wearable display is shown below.

The LCD works in the same way as any other computer display. When specified voice commands are used in conjunction with the system, the system displays the necessary results or data in front of your eyes. Email, maps for navigation, Google search, YouTube, webcam recording, and first-person viewing of other cameras are just a few examples. To accomplish these functionalities, the Raspberry Pi

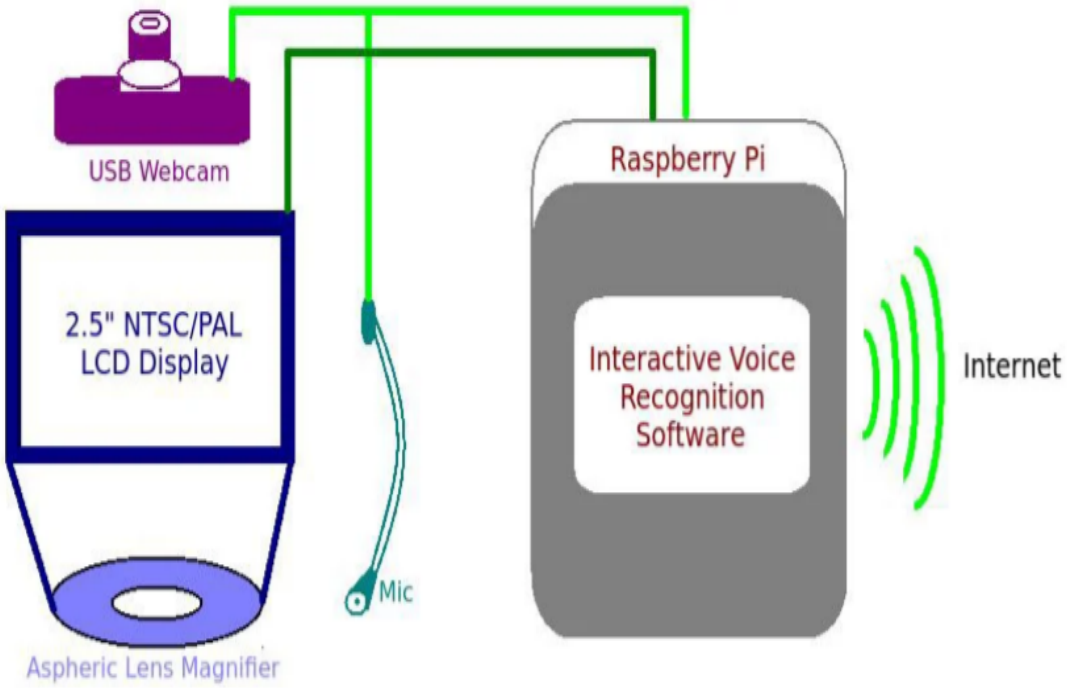

Figure 4.1: Fig:4.1 Hardware Design

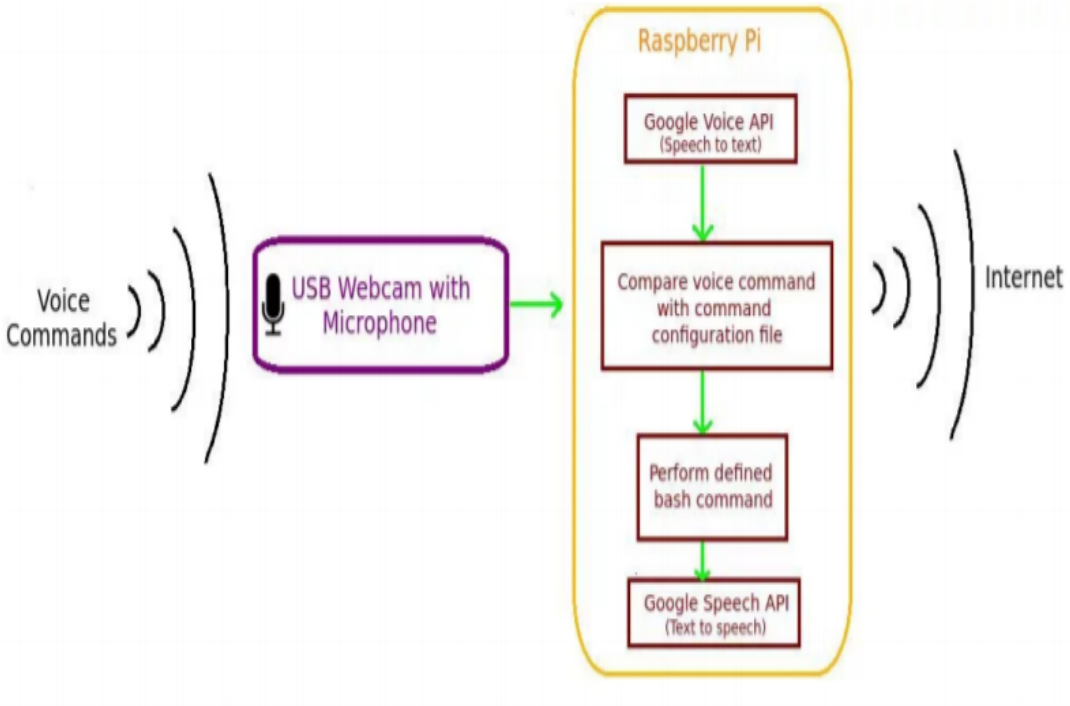

Figure 4.2: Fig:4.2 Software Design

integrated with this head-mounted display must be connected to the internet.

4.1.2 Software

In terms of software, we're working on voice recognition software for the Raspberry Pi. Google Voice and speech APIs are used in the apps described here. The user's spoken command is picked up by the microphone. The Google voice API is then used to transform this to text. The text is then compared to the other commands in the commands configuration file that have already been defined.

The bash command linked with it will be performed if it matches any of them. You may also utilise the Raspberry Pi as an interactive voice response system by having it answer to your requests via speech. This is accomplished by converting the text into speech using the Google Speech API. Here's a block diagram of how the voice recognition software for Raspberry Pi works in general.

4.2 The Development of the Device

4.2.1 Preparation of Raspberry Pi and Voice Commands

Obtain Raspberry Pi 4 Model B and its accessories for the project

We needed a working system to start developing our voice recognition technology and screen overlaying. To make such a system, the following items were purchased and constructed.
The accessories include:

- Raspberry Pi 4 Model B(4GB RAM)
- SD card
- Connectors and Adaptors
- Keyboard and Mouse

The Raspberry Pi 4 Model B with 4GB RAM was chosen to meet one of the criteria, which was to have a device that could handle the applications and needs of the ordinary user. Though peripherals were utilised to set up the system, they are intended to be eliminated in the final phases of construction.

Preparation of Raspberry 4

Following the system's construction, the next critical step was to identify the best pre-built operating system for our needs. Following a thorough examination of various operating systems, the decision was taken to use the Raspberry group's most recent operating system. As a result, Raspbian OS, a Debian-based operating system for Raspberry Pi, is used.

It has a number of features, such as network booting and Chromium out of the box. These features of this OS allow us to meet our needs while also providing the finest user experience.

Creation of Voice Commands

The removal of the peripheral caused a problem with the user's engagement with the system. As a result, we planned to develop voice recognition software that would allow the user to communicate with the system and use some of the device's functions. It's an important aspect of the products infrastructure. This script allows us to add and remove modules from the system. This is an important aspect of the design because it will ultimately be the user's only interaction medium.

Creating Google Cloud Credentials and enabling API's

Aside from the creation of our assistant for various modules that are added to the device, We also need the gadget to execute a few other activities, such as playing music and videos from YouTube and conducting web searches. To do so, we'll need to enable the Google Assistant API as well as the YouTube API.

To do so, we'll need to register a Google Cloud Account, which will get us access to the APIs as well as the ability to leverage their STT and TTS services for our assistant. We can access several Google APIs after creating a project on this account. We used the Google AI assistant and the Youtube API in our project.

Creation of AI assistant.

The development of our own personal assistant Jarvis is the next important step. The device comes with many modules that allow the user to customise it to their liking. The assistant serves as a point of contact for the many modules that come with the device. The Google AI Assistant API is used for normal operation, such as STT and TTS. While gTTS is used for module-based Text-to-Speech.

The bespoke QA Module interaction, for example, is done with the help of the personal assistant and gTTS. The STT is carried out via the Google AI Assistant API and is matched with the pre-programmed commands. The requested module has been located; it is the QA module. The gTTS is used for the response. The main.py and actions.py programme files are the ones that allow you to perform the functions. The user interaction file, on the other hand, allows him to personalise his device using the config.yaml file. There, the user can pick their preferred choices and personalise them.

Training of AI wake word on Pico voice

A physical button or the wake phrase can be used to summon the assistance. Though the device has the capability to do so, the futuristic concept prompts us to develop a non-physical approach for summoning the assistance. Pico Voice was used to train a custom wake word in order to accomplish this.

Using the Pico voice console, developers may train bespoke wake word models. It is compatible with Linux, Mac OS X, Windows, and Raspberry Pi. It's a lightweight wake word engine that's quite accurate. It enables the creation of voice-enabled applications that are always listening. 'Jarvis' is the wake word we prepared. Our gadget is constantly listening. The AI assistant software is activated once the wake word is detected.

Headless Start

The elimination of peripherals necessitates relatively minor changes. As soon as the device is turned on, we need the AI assistant to start working. As a response, the headless start service is created and continues to run in the background. We could eliminate the use of mouse and keyboard with the headless start.

4.2.2 Overlaying Screens Over the Webcam Feedback.

Enabling normal Webcam and unlocking features on Raspberry Pi

The Raspberry Pi is a custom-built computer. As a result, the Raspberry Pi is outfitted with a separate Pi Camera Module to facilitate camera operations. Only this component can easily unlock all of the functions of a standard camera in Raspberry Pi, such as transparency, contrast, and so on.

In a nutshell, the first step is to make the Raspberry Pi accept the regular camera. We can normally only take images using a standard webcam. As a solution, we introduced motion software. This allows us to use a regular webcam with the Raspberry Pi and unlock all of its functionality.

Making Webcam feedback as the background.

The addition of the XR idea is the second significant element of our product. To be more explicit, we're attempting to include the augmented reality notion into the device. We superimpose something over the real world in the AR idea. We use the same principle here, but with a twist. The camera feedback would serve as the real-world view, with the other programme screens superimposed on top.

We accomplish this by streaming camera feedback through a portal and utilising chromium kiosk features. The camera feedback is acquired via an IP address, and it is displayed full screen by chromium. As a result, all new application screens will be displayed on top of the current one. As a consequence, the AR concept is realised.

4.3 The Final Build

The final phase of the project is to complete the construction. A Raspberry Pi, Micro LCD/OLED display, USB webcam with a built-in mic, Headphone with

mic, loupe magnifier with aspheric lens, and Li-Polymer battery are among the hardware components we employ in the design. The LCD/OLED monitor functions similarly to any other PC display. It will show the surrounding area (the webcam feedback). When you use specific voice commands with the system, it displays the relevant results or data in front of your eyes and plays audio through your earbuds (if required).

The final version allows users to execute Google AI Assistant-based Google searches, play music from YouTube, and so forth. Other modules, such as MQTT, EPS, and others, are included in the system. Once the modules have been activated, the user can use them. However, to perform these functions, the Raspberry Pi with a head-mounted display must be connected to the internet.

4.3.1 3D Rendering Of Final Build

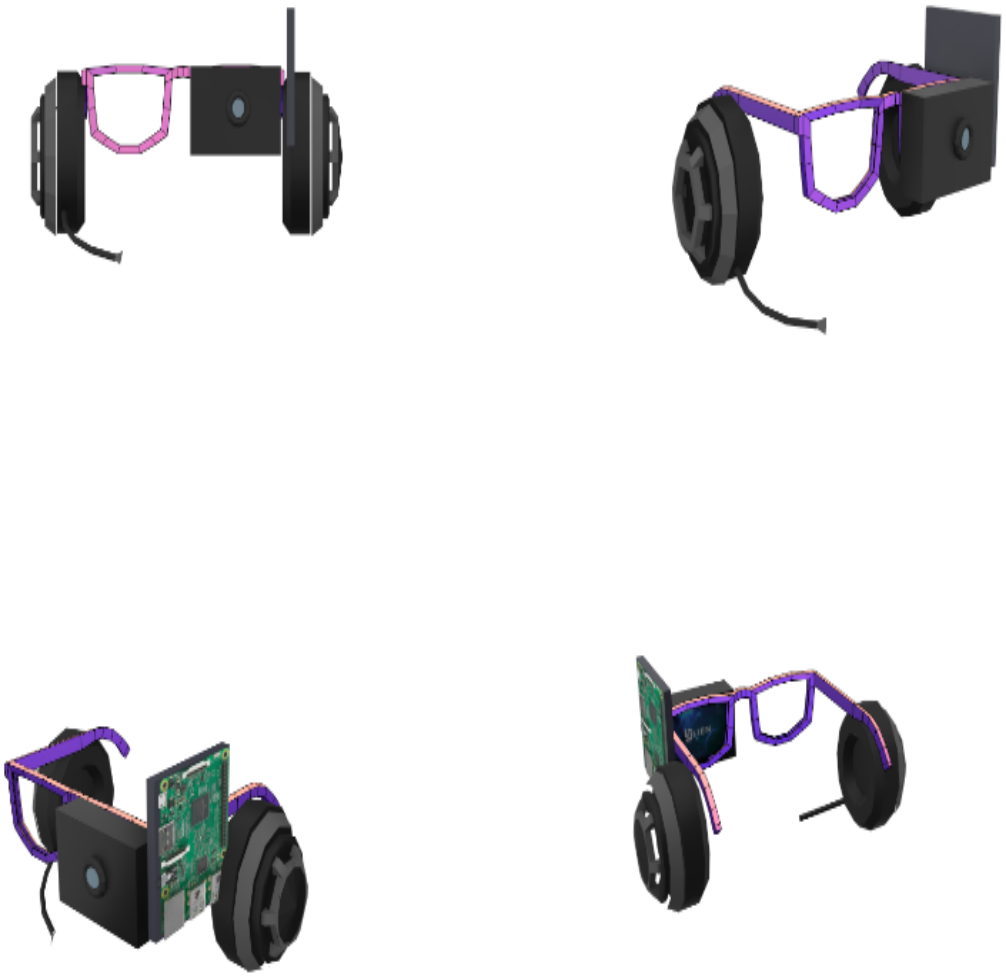

Figure 4.3: Fig:4.3 3D Rendering of Final Build

4.4 Data Flow Diagram

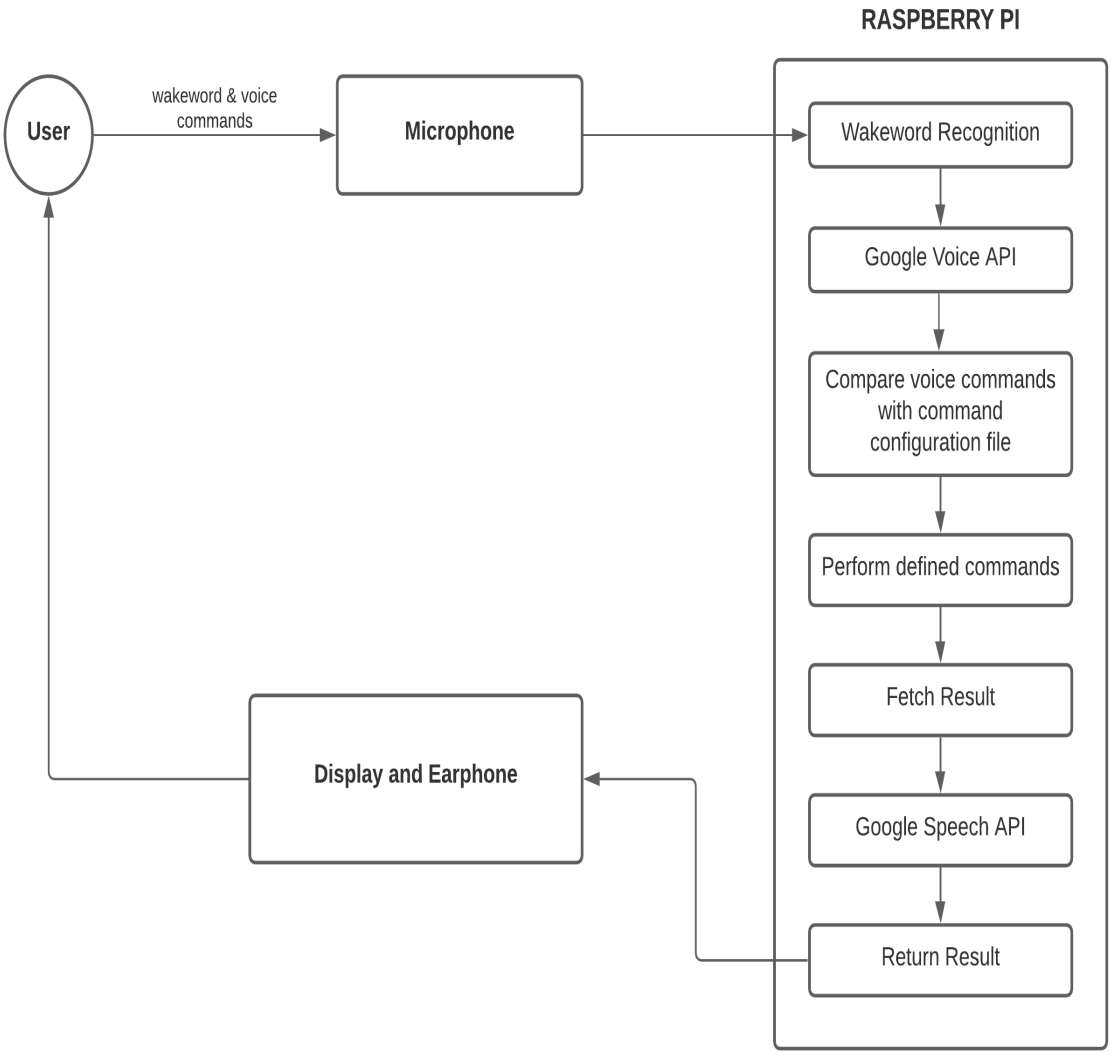

Figure 4.4: Fig:4.4 Data Flow Diagram

4.5 Use Case Diagram

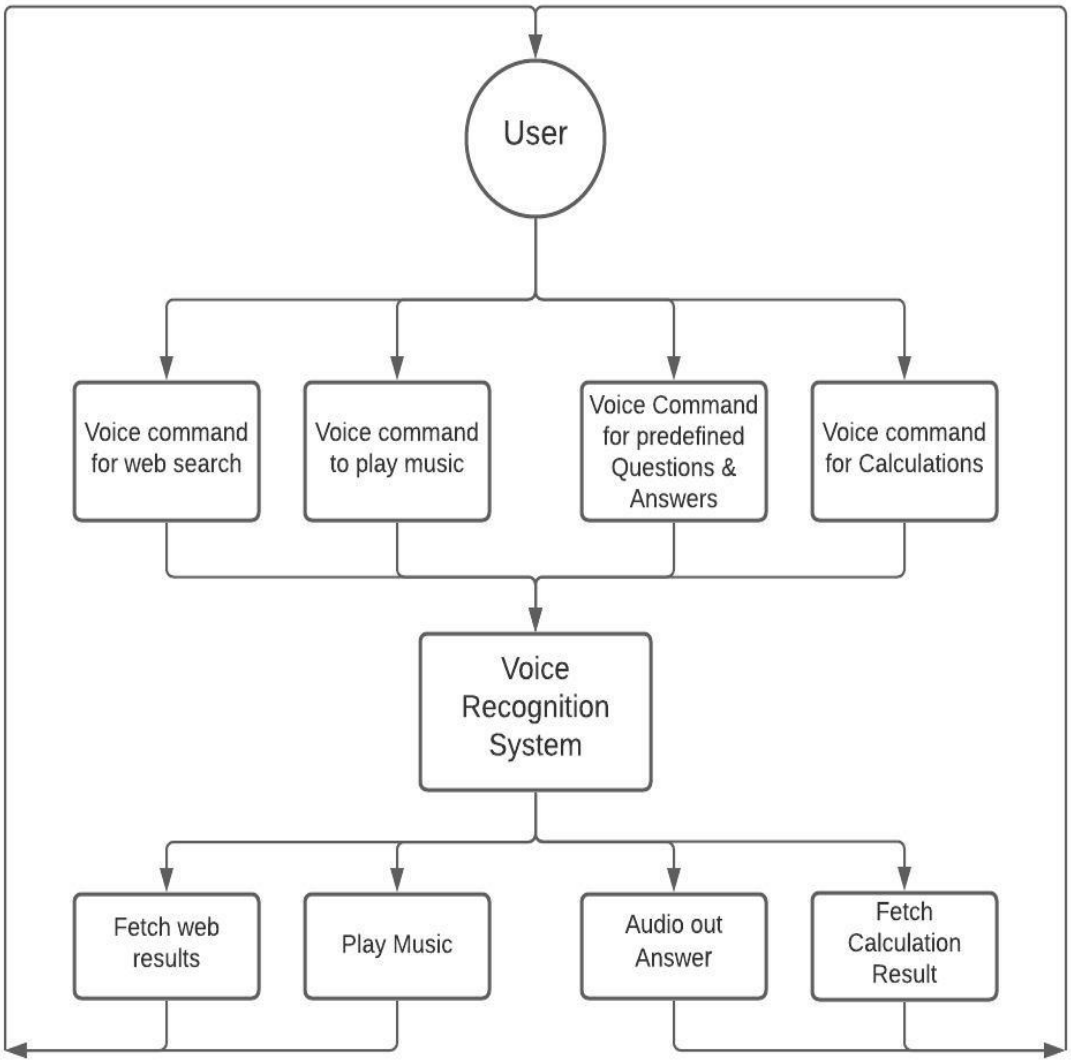

Figure 4.5: Fig:4.5 Use Case Diagram

Chapter 5

RESULT

During the development of the product, there are two types of results that must be obtained. They can be divided into two categories: software results and hardware results. The software outcome focuses on employing AI assistant to communicate with the device, as well as overlaying a screen over webcam feedback and audio over the earpiece. The final built product is the emphasis of the hardware result. The idea of a monocular head-mounted display device based on the AR concept will be realised.

5.1 Software Result

The end product indeed has a hands-free AI assistant calling feature as well as acts as an interface with the device's various built-in modules. The outcome also demonstrates the effectiveness with which the AR concept was executed. When the gadget is turned on, the webcam feedback appears. As a result, the person can watch the outside environment through the eye that is seeing the device's screen. The outputs can also be obtained in the form of audio. However, there is still a screen overlay of other programmes on the job.

5.2 Hardware Result

The overall device that delivers the desired output through the screen and headphones is the major outcome we wanted from the hardware part, as described before. The device also has characteristics that make it simple to attach the device on their heads. The final product is simple to set up and meets our requirements. The final product has a variety of software and hardware elements and features that could be customised.

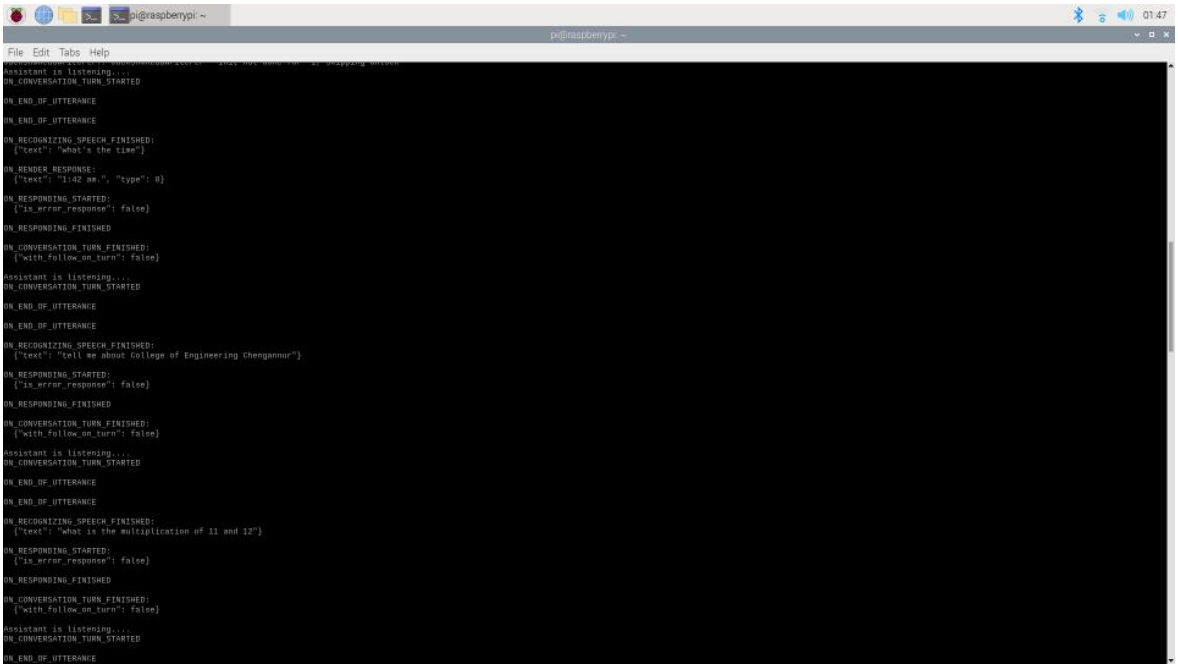

Figure 5.1: Fig:5.1 Working of AI assistant (1)

5.3 Screen Shots

Software Part

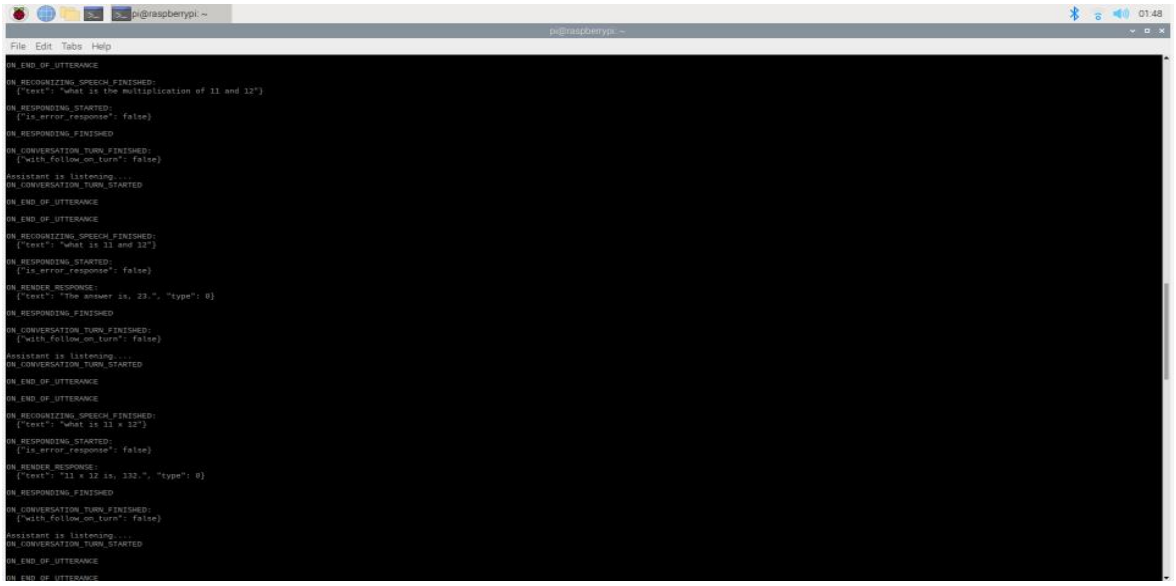

Figure 5.2: Fig:5.2 Working of AI assistant (2)

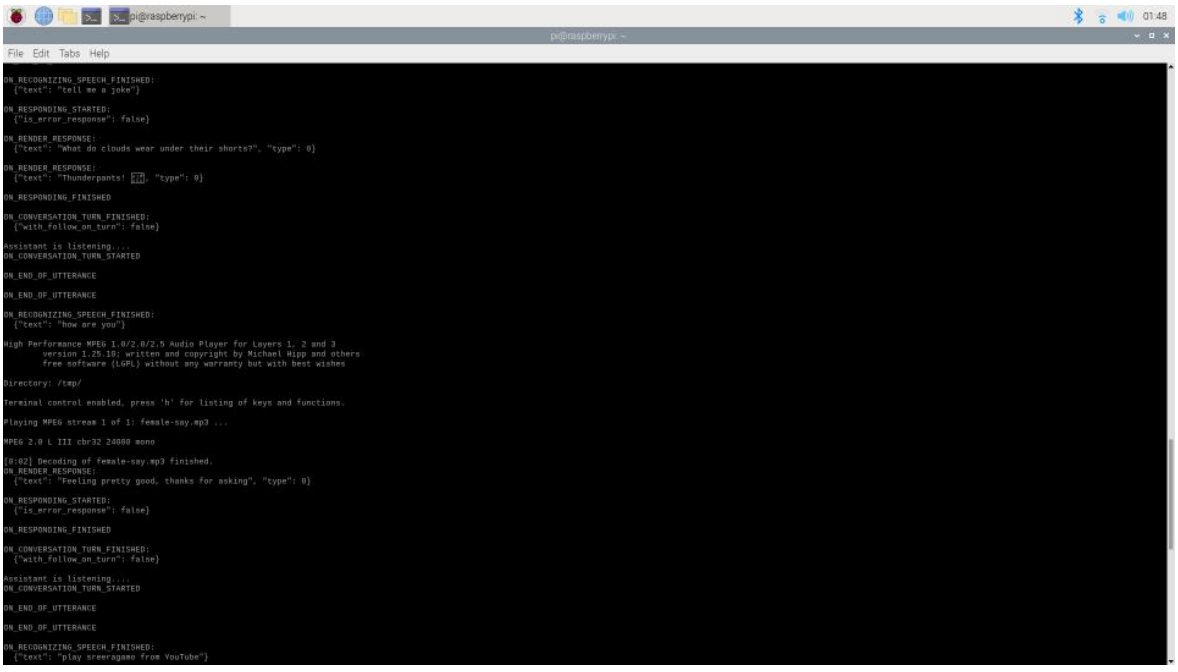

Figure 5.3: Fig:5.3 Working of AI assistant (3)

Figure 5.4: Fig:5.4 The screen of the device once webcam feedback is enabled

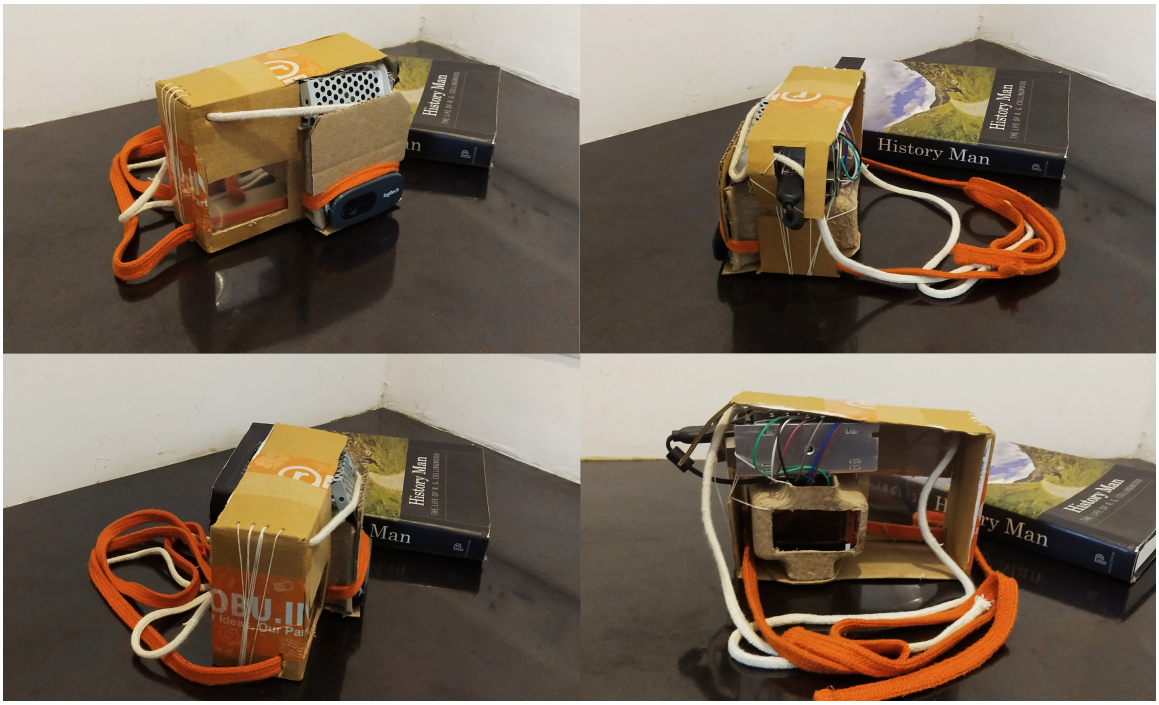

Figure 5.5: Fig:5.5 Product View

Hardware Part

5.4 The Future Scope

The device we've created is only the first draft of our project concept. The idea's uses and functionalities are limitless. We could design a product with features like rapid charging, easy turning on and off, prescribed glasses, bone sound conduction, and so on, to generalise a few things in the hardware structure. These are also shown in the diagram below. We can have a variety of software add-ons in addition to this hardware. To this point, the majority of our web searches can be done using speech up to the point of searching for a specific keyword. But we can change that by creating a new browser that allows us to view, scroll up/down, and perform other tasks with only voice commands. The improvements that can be achieved are unrivalled.

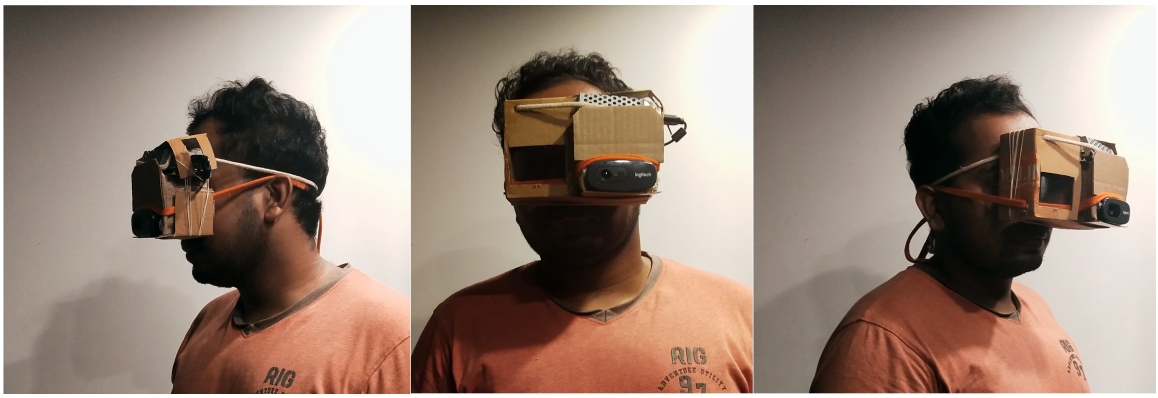

Figure 5.6: Fig:5.6 User with Product

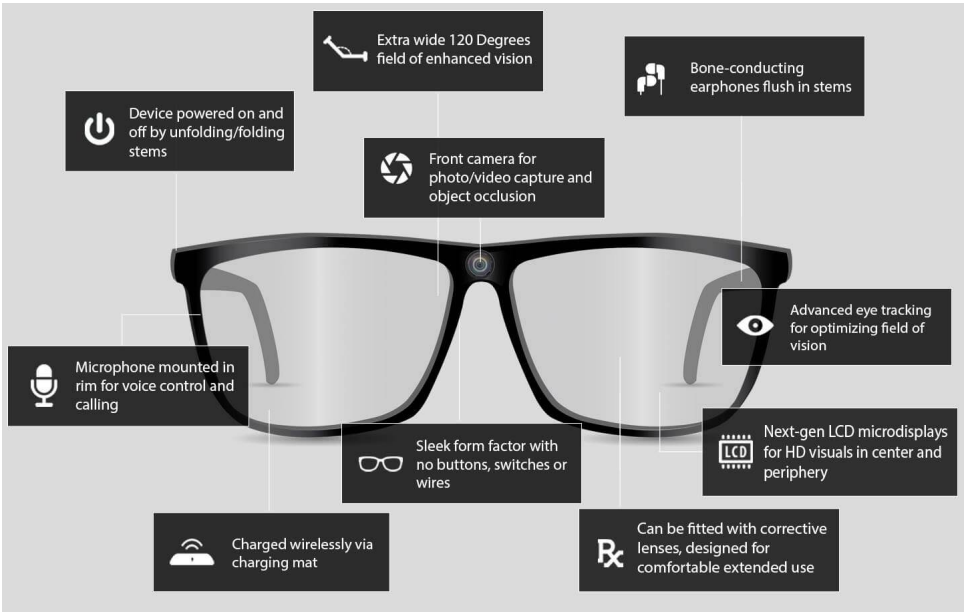

Figure 5.7: Fig:5.7 Future Scope Design of the Product

Chapter 6

CONCLUSION

With the conclusion of this project, three key objectives were met. The first is that the initiative allows users to experience a familiar environment in a much compact gadget. People's reactions to new technology vary from person to person. Especially if the device's entire working environment is different. The gadget built has some significant differences, such as a voice-only interface, a head-mounted device, and so on, but the working environment will still be very similar to that of a personal computer. As a result, users do not need to restart their entire mental process when using the device.

The next goal was to revitalise an area of XR technology that was already in existence but was underutilised. XR technology and concept-based gadgets are significantly more complicated and feature-rich. The companies that construct are more focused on creating devices that are beneficial in engineering, medicine, and other fields. They're more advanced than our product. However, the vast majority of people do not fit into their categories, but they do fit into ours. The use of XR technology in everyday life is an open world that isn't being explored as much as it should be, but our product does provide access to that world.

Finally, the device will achieve the goals of reducing E-waste and computer personalizing. The project's principal motivation can be realised through our product. Because the primary hardware goal is to provide a product with enough features to meet the needs of the average technology user. As a result, for a long time, just the software needs to be upgraded. As an outcome, consumers are less likely to need to acquire new devices, which helps to reduce e-waste. In addition, the product's customisation functionality will help achieve the goal of personalising the PC.

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