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EYE-PEX : AI Computed Smart Glass

Bhagirathi S Telkar , Nithin PS , Neeraj Kumar G , Uday Hiremath , Priya D
Department of Mechatronics Engineering , Acharya Institute of Technology , Bengaluru , India.
Department of Mechatronics Engineering , Acharya Institute of Technology , Bengaluru , India.
Department of Mechatronics Engineering , Acharya Institute of Technology , Bengaluru , India.
Department of Mechatronics Engineering , Acharya Institute of Technology , Bengaluru , India.

Abstract: As observed, most of the electronic gadgets that we use have become smart. One such device can be a smart glasses. The smart glasses that is developed here consist of a smart features where in the device is controlled completely through voice commands and also any device or gadget can be integrated and be controlled through the smart glasses seamlessly. The smart device also consist of a transparent display that assists the user with necessary data like time, date, notification, weather.This work gives the information about the technology used for the implementation of various devices and interface of the devices through a smart glass and also, the detailed working principle of the new smart glass hardware and software with the description of each component under work.

Keywords--Transparent reflecting visual display , Modules , NodeJS, Electron JS , SPI, GCC, UTF-8.

I. Introduction

In recent years technology has witnessed a greater advancements in mobile and wearable devices. In industries or any professional workplaces, there is a need to simultaneously get a assistance of a device or communicate with others as well as to work with a reference information. So to accomplish these applications ,wearable devices have to be used , one such wearable device can be Spectacles. By adding or implementing versatile devices, required applications can be achieved. In existing smart glasses the problems are that they display a single colour output or the glasses which have multi color are too costly. And the existing smart glasses cannot execute the programs with voice command. In most of the smart glass the displays are mounted to the lens and hides the vision of one eye entirely. The conventional smart glasses needs input as a physical interface through touch or gestures.

II. Literature survey

It is observed that in [2] The designer has used the Arduino nano for smart glasses which has limited computing power and also has a limited display of data and Data is displayed using OLED display which has only single color output. And also Arduino has less computing power and limited display of data.

In [3] using only Arduino nano IOT cannot be achieved and also controlling the software and hardware cannot be done with voice commands. In [4] the designer has used a technology that is capable of detecting the distance , face recognition and Image processing but only with hand gestures or touch gestures. In order to over come the above mentioned drawbacks we are proposing a solution which can have multiple color display , high computational power ,display of all the required data , provide IOT and also run the IOT devices with the voice commands and also required solutions in software

III .Objective

The objective is to use Raspberry pi as the micro-controller for processing all the data and control the IOT devices, project data into the display, get the software assistance and get the whole mobile computer into the eyesight and control it through voice commands. The glasses which have multi colour display such as Google glasses, Microsoft HoloLens are way too costlier , Whereas using a 1.3 inch IPS LCD display would be a easily affordable and better solution.

IV. Methodology

1. Setting up the hardware using Raspberry pi ,1.3inch IPS LCD display, USB mic ,Power source and headphones , Micro Sd card used to boot the OS in Raspberry pi , convex lens , a plane Mirror and the assembly pf all the hardware components is as shown in the figure.
2. Software- Software that is used for the smart glass is implemented through Raspbian OS using root user . The software that runs on the backend is through the set of instructions with JavaScript, and the visual design of the data to be displayed is done by using Css and that is displayed through a Html native electron frameless desktop application.

3. Testing the hardware and software using Raspberry pi 3 with a 7 inch LCD display to test the data to be displayed on to the spectacles screen and also to compute and control the IOT devices also get the software assistance with the help of Voice commands.
4. The glasses which have multi colour display such as Google glasses, Microsoft HoloLens are way too costlier , Whereas using a 1.3 inch IPS LCD display would be a cheaper and better solution.

V. Methods

Various methods are used to build and implement the smart glass for various desired applications.

5.1 Voice control

The smart glass is controlled completely by voice assistance. Basic commands are used to get the desired output from the device. Google assistant is configured into the device. With google assistant, messages, communication, remainders ,YouTube and google based application assistance, can be acquired. And also Alex is configured into the device to control other devices with our own set of standard voice commands.

5.2 Internet of things

The Internet of things describes the network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet. And is controlled through voice assistant Alexa.

5.3 In-display Notifications

All kinds of notifications such as calls, messages, data from the devices are shown in the transparent visual display mounted to the glasses.

5.4 Transparent reflecting visual display

The Transparent reflecting visual display is mounted on to one side of the spectacles. This kind of display can be used into the spectacles as it has the transparent property.

5.5 Software using a native Electron application

The software used to display the required information on to the screen is done creating a native desktop electron application that is in turn built using web technologies like HTML , CSS , Javascript.

VI.Working Principle

6.1 Hardware

The working principle of such kind of display is based on the laws of reflection and also the principles of lens. This kind of display consists of a digital 1.44 inch IPS Lcd display , mirror , convex lens , and a transparent light reflector. The mounting of all the above listed components is as shown in the figures below.

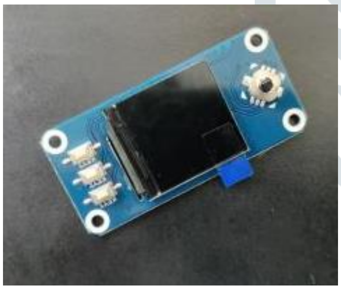


Fig:12 a) 1.3 inch Lcd display

Fig:12 b) Convex lens

Fig:12 c) Plane mirror

The mounting and the arrangement of the all the Components listed in the above paragraph is as shown in the figure 7.4

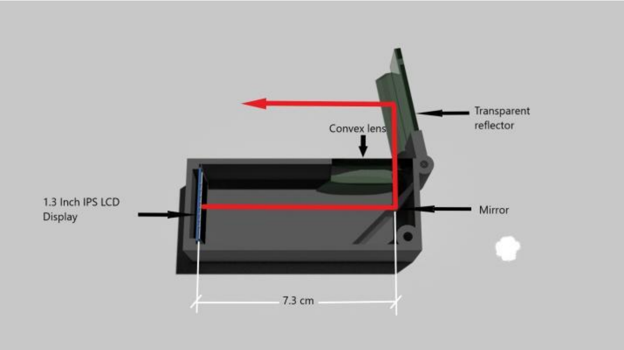


Fig:13 a) Dimensions and Assembly of display hardware

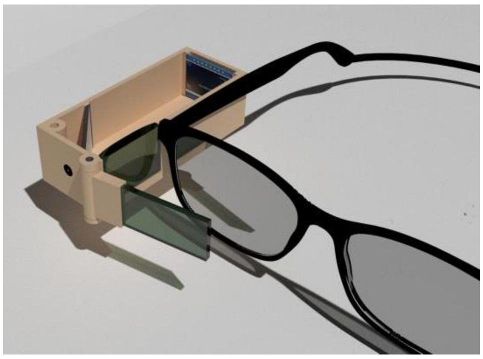


Fig:13 b) Outlook of the display Assembly

The working of the system is as follows,
The Lcd display is placed at a distance of 7.2cm from the mirror which has a offset angle of 45^0 with that of the Lcd display. And a convex lens of focal length 10cm is placed at a distance less than the focal length of the lens from the mirror and is placed in such a way that it makes an offset angle of 45^0 with the mirror and a offset angle of 90^0 with respect to Lcd display. The detailed arrangement system is as shown in the .figure 7.6

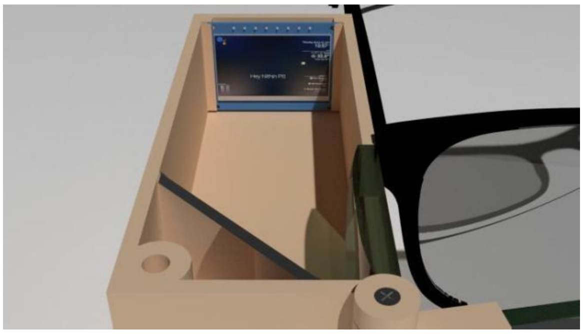


Fig:14 Mounting of 1.3 inch LCD display.

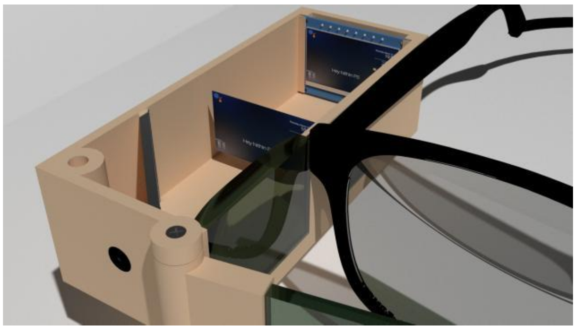


Fig:15 Path of light of the Display

When the 1.3 inch IPS lcd display gives out any kind of output , the light projected out from the display reaches the mirror that is placed at angle of 45^0 and at a distance of 7.2cm away from the display.
As the light from the display falls on the mirror, it reflects out 97% light to the convex lens (focal length 10cm) that is placed at an angle of 45^0 with respect to the mirror.
The mirror reflects 97% of light since 3% of it is being absorbed by itself .Since the mirror is placed at an angle of 45^0 with respect to convex lens ,the rays of light falls on to one side of the lens parallel to its line of axis. The schematic representation of the path of light of the display is as shown in the figure 7.7.

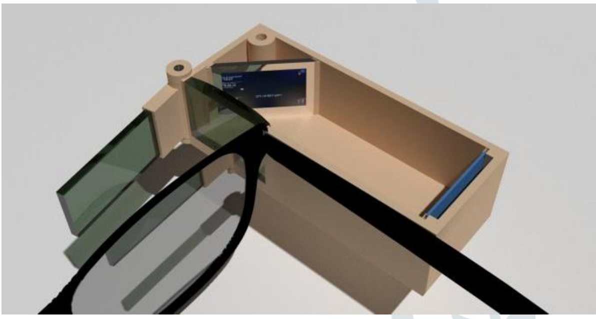


Fig:16 Reflection of the display in the mirror.

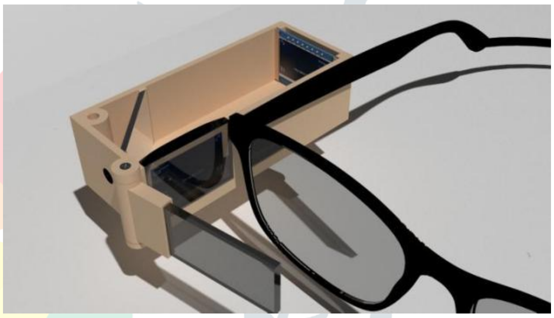


Fig: 17 Light of display passing through convex lens.

As the distance between the mirror and the display is 7.2cm , the mirror projects the image of the display to the convex lens (focal length 10cm) as it is at a distance of 7.2cm which is less than the focal length of the convex lens. The principle of convex lens says that, if a object is placed at a distance less than the focal length of the lens the real image of the object would not form on the other side of the lens. But when the object from other side of the convex lens is observed, A magnified virtual image of the object will be formed as shown in the figure 7.9. In the case of the object will be Transparent reflecting visual display , the distance of the object i,e the display reflected from the mirror is placed at a distance less than the focal length of the lens. So the real image will not be formed on the transparent reflector, but when the object is from other side of the convex lens is observed, A magnified virtual image of the display is formed on the side of the position of the object i,e on the side where the mirror is placed.

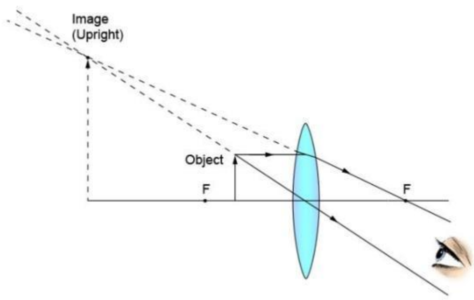


Fig:18 a)Convex lens forming a real inverted image

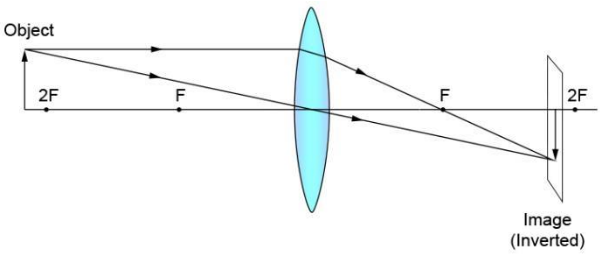


Fig:18 b) Convex lens forming a virtual image.

The Transparent reflecting visual display works on the principle as shown in the figure 7.7. The calculation for the distance between the LCD display and the mirror and the distance of the virtual image is as shown below.

Let,
OD be the distance of the object from the convex lens(display in the mirror).
VI be the distance of the virtual image from the convex lens
F be the focal length of the lens (10cm)

The convex lens equation is given by,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$$

Here, f=focal length of the lens
v=virtual image distance
u=object distance.

Accordingly the equation changes to,

$$\frac{1}{F}=\frac{1}{VI}+\frac{1}{OD}$$

Now, the focal length of the convex lens is 10cm,
The minimum distance at which a human eye can focus a object clearly is 25cm, So to get the distance of the virtual image more than 25cm , from trial and error method the distance of object from the lens is found to be 7.2cm.

Now, substituting all the values of F, OD in the equation we find the value of VI i,e distance of virtual image from the lens.

$$\frac{1}{10}=\frac{1}{VI}+\frac{1}{7.3}$$

$$\frac{1}{10}-\frac{1}{7.3}=\frac{1}{VI}$$

$$0.1\text{--}0.1369 = \frac{1}{VI}$$

$$VI = \frac{1}{-0.0369}$$

VI = -27.10cm

From the above calculation it is evident that the distance of virtual image from the lens is greater than 25cm. So the human eye can focus the image of the display clearly.
The value of VI is negative because ,the virtual image is formed by the lens on the side where the object is placed.
The Virtual image that is formed will be magnified, the equation for the Magnification is given by,

Magnification(M) = $\frac{VI}{OD}$

Magnification(M) = $\frac{27.10}{7.3}$

Magnification(M) = 3.71

From the above calculation it is evident that, the image of display will be magnified by 3.71 times.

6.2 Software

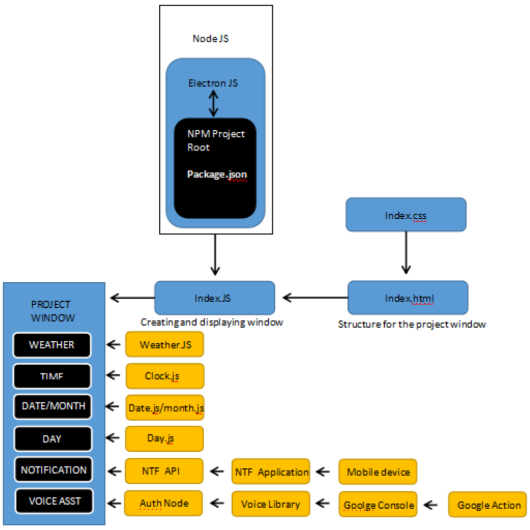


Fig:19 Block diagram of EYEPEX software.

Node js is a run time environment to run Javascript outside the browser, This Node js is generally made by embedding the Google chrome v8 engine that runs Javascript code with the C++ program so that it could run javascript outside the browser suitable for desktop application. Here , the latest version of node js is installed into the raspberry pi OS.

Once the Nodejs is installed ,npm (Node Package Manager) is also installed along with it.

Here, npm (Node package manager) is a package manager that puts all the modules together so that the Node js could fetch and use them easily , it also manages all the modules and dependencies required for the particular project intelligently. It is a repository for millions of modules that are easy to fetch and be used by the Node js for a Project.

Once the latest version of the Nodejs is installed , a new repository is created named after the project name EYEPEX inside /pi/home. Inside this EYEPEX repository , initially a package.json file is created . package.json is a plain JSON (javascript object notation) file that contains all the metadata that is used in the respective project. This file contains information such as name, main file ,version, Project description, test, start, Project dependencies etc. This package.json file is used to give the information to npm that allows it to identify the project and manage the project and handle all the dependencies that are mentioned inside it.

After Package.json file is created , there is a communication established between npm and the electron js package that is installed through it. Thus, npm manages all the dependencies that are required for the project intelligently. Now after establishing all the background code and communication , A Window has to be created to display the required data , so a main Javascript file is created in the same folder where package.json file is created. This javascipt file contains set of lines of code that enables the user to create a window that will be displayed after booting up the EYEPEX system.

In the main Javascript we load/import a HTML (Hyper Text Markup Language) file that contains all the necessary set of code to display a GUI in the application after it is launched. Below is the HTML code that is used to display a Graphical user interface. Here, GUI contains all the necessary modules such as Clock , Weather , Date/month , Day ,Notifications , Voice assistant data , IOT data. So, a proper structure is given to all these modules and also the positions in the main project window with the help of HTML code . and this file is saved in the same repository so that the Index.Js file could access it , since it is loaded into it to display it onto the project Window. All the background functionality of the different modules in the project window is done with the respective responsive Javascript files I,e Background functionality of the Clock module is done with clock.js and for Weather with Weather.js and same for other modules.

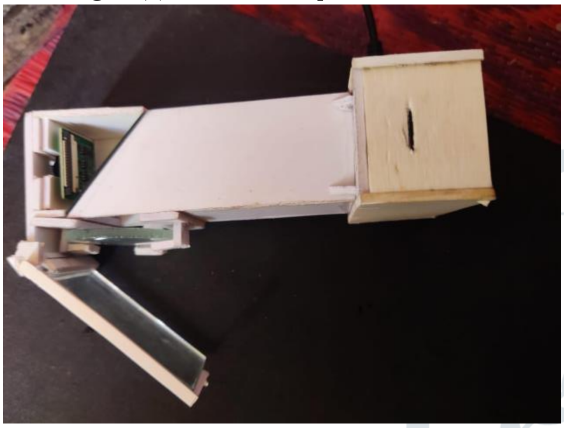
After the creation of the structure to the application window, we need to give a styling to the structure and that can be accomplished through a web technology named CSS (Cascading style sheet).

Css file is coded as per our requirement and is then saved in the same repository and then is loaded into the HTML file to accomplish the required asthetic look for the project Window.

VII. Results

Initializing all modules and connecting to server for communication of data and displaying the respective modules with information. Initial boot-up screen of EYE-PEX ,It shows the Clock with Date at top right corner and real time weather conditions, and a icon showing up the Active Google Assistant and General greeting to user. At bottom right corner it displays the Notifications from the device it is connected with in bottom right corner .Notifications include calls, text messages ,Mail notifications and other useful data.

Fig:23(a) Initial Bootup screen Fig:23(b) Initial Bootup screen in listening mode



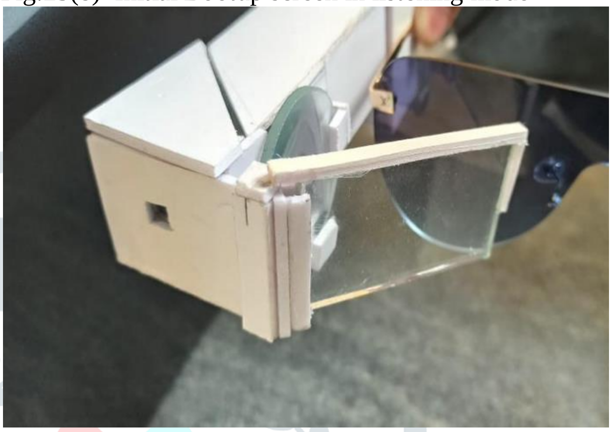


Fig:21 (a) Hardware Top view Fig:21 (b) Hardware with camera

VIII.Design approach

The below image shows the Design of EYE-PEX smart glasses. As shown in image it consists of a display module mounted on one side of the spectacles and a band of connecting wires that spans on either side of the temples of spectacles. The band of wires further extends to back of the vertebral and connects to the belt chamber , Which consist of Microcontroller such as Raspberry pi ,Beagleboard etc . And power source such as Powerbank, portable battery As shown in the Figure VII.(b).

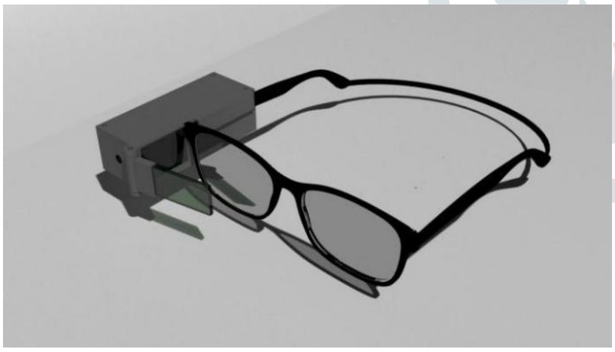


Fig:22 Smart glasses

The belt that is attached ,consists of A micro-controller such as Raspberry pi, Beagle board and a Power source such as power banks , battery etc. The below images shows the physical appearance of the EYE-PEX smart glasses along with the belt holding the micro-controller and power source.

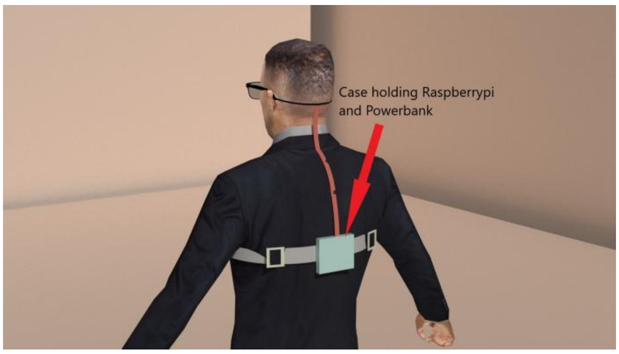


Fig:23 (a) Showing Position and size of belt backside. Fig:23 (b) Showing Position and size of belt front side.

Fig:24 (a) Users perspective of Viewing.

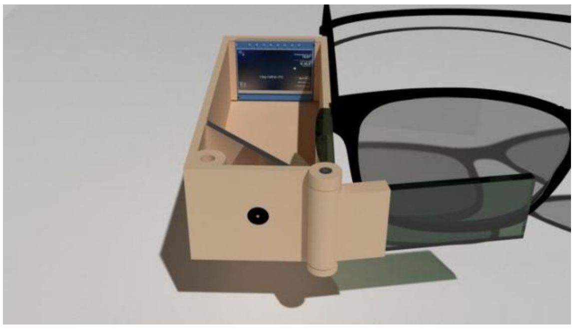


Fig:24 (b) Mounting of all hardware inside the case.

IX.Application

Among all the available wearable devices, smart glasses have emerged into many sectors finding its applicability and scope for solving real-time problems. Few applications were explored and discussed below:

9.1 *Atmospheric Study*

With the help of smart glasses, the user can study the visual patterns of the atmospheric things. Can identify the parameters that influence the environment

9.2 *Food and Agricultural Sector*

Smart glasses can play a vital role in the food and agricultural sector. Scanning of packed food bags, quality check of the Agri-products, vegetables, live to monitor of Agri crops health etc.

9.3. *Health Care and Medical*

In healthcare and medical field, the smart glasses can be used in the surgery performing activity, helps in giving the voice-enabled instructions to the blind person, to refer to the case studies of the medical operation activities, it also helps the deaf persons in visualizing the subtitles of the instructions in wearers interest .

9.4 *Industrial On-site and Off-site*

Smart glasses, head mounted display with 13their computing capabilities can perform intelligent on-site and off-site operations. For example, in the telecom sectors tower construction instructions etc.

9.5. *Traffic Crime Detection Management*

With the help of smart glass and optical head-mounted displays, the traffic in charge can record the incidents that happen on the roads. In the later stages, the incidents can further analysis to detect the what exactly happened.

9.6. *Navigation and Travel Experience*

With the help of a smart glass, the navigation experience can be improved. One can easily identify the location maps ,finding shortest and safe ways. With the integration of traffic management systems with smart glass, the traveller can estimate and visualize the time required. The traveller can visualize the tourism places virtually before he visits the actual places.

9.7 *Personal Assistant*

This device is meant for personal assistance which is capable to maintain our daily on-going events,receive calls,play songs and videos ,answering for question,discussing about issues ,daily updates,email,message notification, call notification, meetings,read out phrases and sentences and other health related updates.

9.8. *Military field*

The military stands a first priority for innovation. The device is compatible with all IOT and wifi devices thus it can be accessed for communication in war field and to get information of places and others. This also helps in analyzing distance of enemy and by image processing it will help to determine the kind weapons were employed and also it give clear picture of war field. Even some device and vehicles can be controlled very easily.Even night time of war this device will provide night vision which helps a lot for soldier in there war. In Air force exact target can be found using these devices. In navy this can be used for targeting and for other purpose.

X.Future scope

Our project is especially focused use to blend information technology with human vision . But by adding some more features we can make it use for augmented reality with AI with the help of which we can easily get the information about any object or thing which is in sight of the Smart Glass wearer like its basic information its speed if the object distance calculation, different scenarios of situation can be calculated, etc.

Smart glasses, the eyewear technology that layers information onto a user’s field of view, started off as simple front-end displays. Throughout the years, we saw it progressing to being capable of performing complex computer powered tasks.

Unlike the 100% immersive virtual reality headsets, smart glasses give users a sense of physical and digital worlds simultaneously, providing a much more natural experience. This experience is achieved through either an Optical Head-Mounted Display (OHMD), Augmented Reality (AR) technology, or through Heads Up Display Glasses (HUD).

The smart glass can be changed as a powerful personal assistant with the AI and IOT. Even a set of coding can be executed through voice commands. Designing of buildings, mechanism or any other complex structure can be accomplished in seconds.

XI.Conclusion

With how fast the current generation is now moving, it was foreseeable that something like the EYE-PEX smart glass will eventually come around. Having a wearable device with a more powerful computer system and monumentally cheaper price tag than the whole Apollo mission is a great way to compare and show how far technology has come. The EYE-PEX with its camera features, GPS navigation, and interactive AI might be a ways to go when it comes to legality and social acceptances but it has definitely already broke ground and raised concerns.

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