International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 - 5161
©2014 INPRESSCO®, All Rights Reserved
Available at http://inpressco.com/category/ijcet

General Article

Google Glass: Taking Wearable Technology to the Next Level

Karan Nayak[Á*] and Dhvani Kotak[Á] and Harish Narula[Á]

[Á]Computer Department, DJSCOE, Vile-Parle (W), Mumbai – 400056,India.

Accepted 12 August 2014, Available online 25 Aug 2014, **Vol.4, No.4 (Aug 2014)**

Abstract

Google glass is a type of wearable technology with an optical head-mounted display (OHMD). It was developed by Google with a goal of producing mass-market ubiquitous computers. It looks like a pair of eyeglasses, except, the lens of the Google glass is a user-interactive display and supports Wi-Fi and Bluetooth connectivity. It was primarily designed to take phone calls, send texts, take photos and videos and deliver search results. Google glass also supports natural language voice commands. In this paper, we will see the internal working and modeling of the Google glass. Also in this paper we will see the different advantages and disadvantages that Google Glass possesses.

Keywords: *Google Glass, Glasses, Google, Wearable Technology, Wearable*

1. Introduction

These days, wearable technology seems to be the perfect gadget that both expresses your style, and boosts your functionality woven into one neat package. Wearable technology is related to both the field of ubiquitous computing and the history and development of wearable computers. Along with ubiquitous computing, wearable technology also shares the vision of interweaving technology into the everyday life, making technology pervasive and causing less interaction friction.

Fig.1 Google glass

Wearable technology is still at an 'early adopter' stage in terms of public and commercial use. By their very design, many of these wearable devices can capture a great deal of personal data about the wearer and, in some cases, individuals in the vicinity of the wearer. Google's glass is one such and probably the leading wearable technology in today's market. Though it is just launched commercially it is miles ahead in terms of its market competition. Google Glass is a headset that you wear like a pair of eyeglasses. Glass has a small prism-like screen tucked into the upper corner of the frame that keeps you constantly plugged in to your e-mail, calls and various other notifications so you don't have to miss a beat. It also has a capacitive touch pad on the right to navigate through all your apps and notifications. It is the first of its type in the market. But, nonetheless, it is an extremely intriguing and a "something out of a sci-fi movie" concept.

2. Description

Google glass, as we can clearly see, is not your normal eyewear, inside the right arm are the parts of a smartphone - a processor, 16GB of storage, a Bluetooth radio, a small battery and more. In the front you have the small prism-like screen, which is essentially the display. Following the screen, on the right hand side of the glass, we have a capacitive touchpad used to navigate through the general glass interface. The glasses pair with your phone to get connectivity. Using the Android MyGlass app you can configure the connection and even use a Screencast feature, which mirrors the Glass display on the phone. You pair them with your phone via Bluetooth and if you have Bluetooth tethering you can use your phone's 3G or 4G connection. If you don't, you can connect both the Glass and the phone to WiFi. To the right of that glass box is a 5-megapixel camera. There's a button on the top of the glasses for taking photos, but the easiest way to control that camera is with your voice.

Google glass specs

- **Google glass price**: $1500 (INR 90000)
- **Display:** Optical head-mounted display (OHMD) (Flat Combiner 45 Degrees). According to Google, High resolution display is the equivalent of a 25 inch high definition screen from eight feet away.

*Corresponding author **Karan Nayak** is a U.G. student; **Harish Narula** is working as Asst. Professor

- **Display resolution:** 640x360
- **Camera:** 5MP still shot and 720p HD Video recording
- **Audio:** Bone Conduction Transducer
- **Wi-Fi:** 802.11b/g
- **Bluetooth:** Bluetooth 4.0 low energy(BLE)
- **Weight:** 50g
- **Battery:** Non-replaceable 2.1Wh(570mAh) single-cell lithium polymer unit
- **Storage:** Flash Storage, 16GB(12GB available to the user)
- **Inputs:** Micro-USB
- **Sensor:** Rear facing Sensor array
- **Processor:** Texas Instruments OMAP4430
- **No. of processors:** 1
- **SDRAM:** 1GB DDR2 SDRAM
- **Sensors:** Gyroscope, Accelerometer, Compass, GPS and Ambient light sensor
- **Operating System:** Android 4.4.2 kitkat
- **Capacitive Touch Screen Controller:** Synaptics S03G2010
- **Audio Codec:** Texas Instruments TWL6041B
- **GPS Transceiver:** Cambridge Silicon Radio GSD4E SiRF
- **Frame:** Titanium Frame
- **Inertial Sensor:** Nine-axis InvenSense MPU-9150 inertial sensor
- **Microphone:** Yes

3. Components

The below figure shows the basic components of the Google glass.

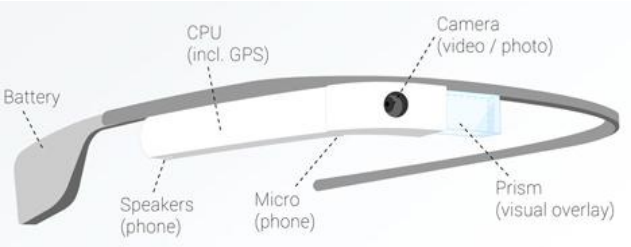

Fig. 2 Various basic components

The body of the Google glass is made up of Titanium, making it extremely bendable. The main circuit of the glass is covered by a plastic body. The first thing on the right side is the "screen". This "screen" is basically a prism. When viewed from the top, you can just about make out a diagonal line which bisects the prism's width. This diagonal line is where the prism has an angled layer. Hidden from the user, under the plastic body, is a tiny projector which projects whatever the Google glass wants to display on to the display. This "screen" has a resolution of 640 x 360. Right next to this "screen" lies the camera. The camera is a 5MP still camera, which also gives us the facility to record 720p videos on it. We can either control the camera by giving vocal commands or use the capture button located, when we wear it, near our right ear on the device. Just below the camera and before the touch pad lies a microphone to pick up the speech commands of the user. After the camera, the logic board of glass is located. Externally it is a capacitive touch pad. Google has used the Synaptics S03G2010 capacitive touch screen controller. It is located around the our temple, giving an onlooker the impression that, the person is just pensively tapping his temple. Internally, under the plastic body, lies the main circuit of glass. It contains the core chips powering glass: a TI OMAP4430, 16GB of SanDisk flash, an Elpida mobile DRAM chip. This board also holds RF devices, including a SiRFstarIV GDC4e GPS engine and an Bluetooth/WiFi module marked as WM-BN-BM-04-a and a data matrix which decodes to "85015340010112111400118159". A flex PCB and an RF cable, anchored with some metal tabs and a U.FL connector, trailed from this board to the behind-the-ear pod. After the touch pad and the logic board comes the "behind-the-ear" pod. Google has used a bone conduction transducer for glass to output audio to the user. A relatively new technology. Right at the back lies the battery of the glass. Glass is powered by a non-replaceable 2.1Wh(570mAh) single-cell lithium polymer unit. It too is placed inside the plastic covering. On the inner side of the battery, lies the power on/off button. The glass also contains a Gyroscope, an Accelerometer, a Compass and an Ambient light sensor. It also contains a nine-axis InvenSense MPU-9150 inertial sensor. The glass also has a mini USB port as an input port. This port also serves as the charging port for the glass. Lastly the glass also has two traditional nose pads to provide further support to the glass.

4. Working

There are different ways to control Google Glass. One method is by using the capacitive touch pad along the right side of the glasses.

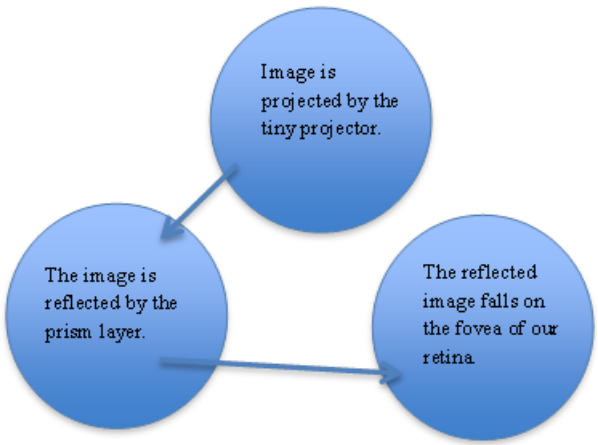

Fig. 3 Flowchart showing how the glass screen

The touchpad responds to the changes in capacitance, which is basically a weak electrostatic field generated across the screen. When our finger makes contact with the panel, a controller chip detects the resulting change in electric capacitance and registers it as a touch. Swiping our finger horizontally allows you to navigate menus on the device. Swiping downward on the touchpad takes you out of a particular choice or, if you're at the top-level menu, puts the glass in sleep mode. Another way is by voice commands. A microphone on the glass picks up your voice and the microprocessor interprets the commands. You can't expect Google Glass to respond to

everything you say, there's a set list of commands that you can use, and nearly all of them start with "OK, Glass," which alerts your glasses that a command will soon be followed. For example, "OK, Glass, take a picture" will send a command to the microprocessor to snap a photo of whatever you're looking at.

The screen of glass is indeed a piece of art. It is prism like screen as mentioned earlier. It contains a diagonal layer, which acts a reflective surface. The tiny projector of glass projects, whatever is to be displayed, on to the diagonal layer of the prism. This layer then reflects the projection onto our Fovea, which is a small area of our retina, which has 20/20 attainable vision. Thus, we are able to view everything clearly and in the highest possible resolution. The prism has a 640 x 360 resolution, but at such a close distance it gives an illusion of being a higher resolution

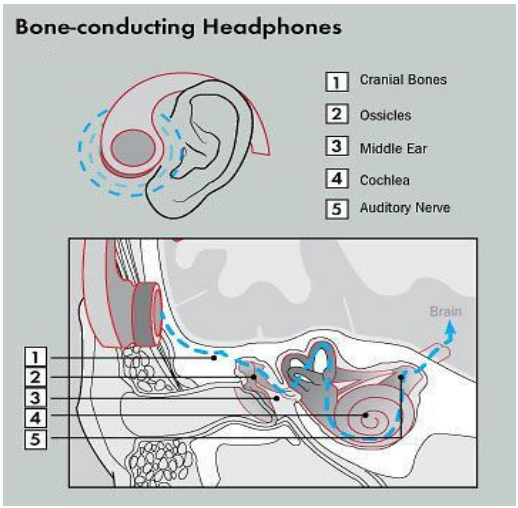

Fig.4 Transmission of bone vibrations to the brain

The glass uses a bone conduction transducer to output audio for the user. The bone conduction transducer is a relatively new technology with it being used practically only since a year. During the normal transmission of sound, the waves enter the outer ear, also known as pinna, which is the large flappy piece of cartilage that helps us focus the sound. From there, the sound waves go into the air-filled middle ear, which consists of the auditory canal and the eardrum, a flap of skin that vibrates when exposed to the vibrations from sound waves. On the opposite side of the eardrum, there are three small bones, the ossicles, which are attached to it. They pass the vibration on to the cochlea, a fluid-filled structure that accepts those vibrations and converts them to electrical impulses that are sent via the auditory nerve to the brain. But on the other hand, bone conduction transmission of sound occurs in the following way. First, when the bones vibrate, the sound is passed to the cochlea, just as it would by going through the middle ear and eardrum, and results in the same type of nerve impulses being sent to your brain. This type of sound passage is called bone conduction. This is how glass transmits is audio output to its users.

The glass also contains various sensors such as a Gyroscope, an Accelerometer, a Compass and an Ambient light sensor. The Gyroscope is used to sense the movements of the users head. The glass has an additional feature where, if the user looks up 30 degrees the glass automatically wakes up. The gyroscope is used to measure the movements of the head for this purpose. The glass also has an accelerometer, which serves various functions. Glass also has an ambient light sensor and it automatically adjusts the screen brightness depending on the surroundings. If out in bright sunlight, the brightness of the screen is maximum whereas for indoor scenarios, the brightness is toned down.

Fig.5 The main logic board of Google glass

You can connect your phone to your Google glass. Android users have an app called Myglass, using which they can connect their glass to their phone via Bluetooth. On the other hand, for IOS users there is no direct app yet, and they have to connect and organize glass using the IPhone's Bluetooth settings.

5. Technologies used

a) Wearable Computing

Wearable computers, which are also known as body-borne computers are in fact miniature electronic devices that are worn by the user. This type of wearable technology has been developed various different information technologies and media development. Weara ble computers are more useful for applications which require complex computations than just hardware coded logic. One of the main features of wearable computer is the constant interaction between computer and user. Another great advantage is the ability to multitask. There is no need to stop doing something you are already doing to use the device. The devices can be of great help to disabled people as thy act as an extension of the user's mind and/or body.

b) Ambient Intelligence

Ambient Intelligence refers to the electronic environments, which are sensitive and responsive to the presence of individuals. Ambient Intelligence is an insight into the future of consumer electronics, Telecommunications and computing. In an ambient intelligence world, the devices work in harmony to help people carry out their everyday life tasks and activities in an easier and natural way using information and intelligence that is available in the network connecting these devices.

c) Eye Tap Technology

An EyeTap device is one that is worn in front of the eye, which acts as a camera to record the picture available to

the eye as well as a screen to superimpose a computer-generated imagery on the original picture available to the eye. This Technology allows the user's eye to behave as a monitor as well as a camera as the EyeTap captures the world around it and augments the picture the user sees allowing the device to overlay computer-generated data on top of the normal world the user would see.

6. Advantages and Disadvantages

The first and the foremost advantage of Google Glass is that it is convenient. Users can easily text without using their hands. It means even if you are driving or on the go you will be able to send messages with the help of its voice to text feature. Another main advantage of Google Glass is that you can capture the important moments of your life in a very simple and hassle free way. The video and camera capabilities that are offered are top-class. Third, multiple options are available which allows the user to either use voice commands or use small hand gestures for operating this fantastic device. The user friendliness and the freedom is one of the highlights of this project. Also, the sound transmission takes place with the help of vibrations, which is considered as less abrasive when compared to headphones. The clarity of the sound is pretty good when compared to normal headphones or speakers. Finally, many apps such as news related and direction related apps are available and the delivery of these apps is done in a completely innovative way. Moreover, app developers can create countless apps for this device.

One of the main disadvantages of Google Glass is that there is high chance of breach in privacy by the person who is using this device. The video and camera can be misused and anybody can capture anything without the other person knowing about it. Another main disadvantage is the total cost which is around $1500. With this much money there are numerous more technology driven things that can be bought. But if the sales numbers are high Google will be thinking of reducing its price. Thirdly, the current power source provided by Google is extremely weak and will require constant charging. Also, The face recognition technology can be very easily misused and it can turn out to be offensive for that person or even put the person in danger. Further, Google glass is not completely wearable for people who have glasses. Google is planning on addressing this problem, but till then it's a huge disadvantage. Finally, there is a complete ban on the usage of Google Glass at several establishments such as bars and clubs. Hence you cannot use this device wherever you want. Thus from the above points we can very well imagine that privacy is one of the greatest issues that are currently being faced by Google. The company is trying to get some other alternative but till that time you have to use Google glass as it is.

7. Future Scope

Most of the current excitement about Google glass is about the point of view photos and videos. But as this technology develops, more and more applications with a variety of uses will be designed which will be a lot more useful. For example, by just looking a certain monument through the glass, the glass will provide us with all the relevant information related to the monument. Also, currently, people with normal spectacles have a hard time wearing the Google glass without their specs. Google is planning to partner up with an optical lens manufacturing company to provide Google glass with already fixed optical lens. Also, there have been a lot of complaints by left handed people about their left eye being more dominant and hence not being able to use glass efficiently. In the future Google should do something to address this problem, as currently it is a big disadvantage for left handed users. Glass clearly has significant opportunities for industrial, scientific, as well as medical applications. It could revolutionize the lives of the disabled. Glass can easily be a head-mounted eye for people with poor vision. It can provide clear, understandable instructions to those who are cognitively impaired. It can also let those who are paralysed surf the Web and communicate.

Conclusion

It is a fantastic technology and its future applications are boundless. It may truly be the start of a new generation, as it was when the smartphone was first introduced. Yes, there are definite flaws and drawbacks, but every new technology ever developed had their own share of them and they were very well overcomed. This truly is the gadget of the future.

Acknowledgment

We would like to thank our honourable principal Dr. Hari Vasudevan of D. J. Sanghvi College of Engineering and Head of Department of Computer Engineering, Dr. Narendra Shekhokar for giving us the facilities and providing us with a propitious environment for working in college. We would also like to thank S.V.K.M. for encouraging us in such co-curricular activities.

References

Google Glass 2014 https://support. google.com/ glass/answer/3064128?hl=en

Strickland, Jonathan. "How Google Glass Works" 29 July 2012. HowStuffWorks.com. http://electronics. howstuffworks.com/gadgets/other-gadgets/project-glass.html

Teardown: Google Glass. 13 May 2014 <http://electronics360.globalspec.com/article/4230/teardown-google-glass>

Stern, joanna. "Google Glass: What You Can and Can't Do With Google's Wearable Computer" 2 May 2013. abcnews.com.

http://abcnews.go.com/Technology/google-glass-googles-wearable-gadget/story?id=19091948&singlePage=true

Tsukayama, Hayley. "Everything you need to know about Google Glass" 27 February 2014 washigtonpost.com http://www.washingtonpost.com/blogs/the-switch/wp/2014/02/27/everything-you-need-to-know-about-google-glass/

What's inside Google Glass <http://www.catwig.com/google-glass-teardown/>