

Comparative evaluation of Google Glass, Vuzix M100 & Epson Moverio BT-200

Vijay Sanjos Alexander, Venkatesh Babu
Technical Specialist - R&I EM Technologies - TechCoE

Abstract

Smart glasses are wearable devices which have computing capabilities and are worn like a spectacles. This white paper provides a comparative study of top leaders in Wearable Glasses including key features, technical specification comparison and gives some insights into possible challenges during adoption. This paper also highlights the typical challenges faced by developers while developing applications for such eyewear.

1. Brief introduction to smart glasses

Smart glasses are wearable computers which can add information to reality where user gets real-time access to data. They have a front facing camera which can be used to capture images or videos and also be used for Augmented Reality applications. Smart glasses can alter or enhance the wearer's vision. Smart glasses have either a monocular display or binocular display and most of them provide hands-free operation to the user. In the following sections, we provide a brief description of three such wearable glasses – Google Glass, Vuzix M100 and Epson Moverio BT 200.

1.1 Google Glass

Google Glass has a monocular display that is placed just above the user's line of sight of vision. Along with a touchpad interface it supports voice commands for a pure hands-free operation. Google Glass works in combination with user's smart phone and displays important notifications on the glass display. Google Glass displays information in a smartphone-like hands-free format. Also it can communicate with the Internet via natural language voice commands.



Figure 1: Google Glass

Source: pcmag.com

Google Glass runs on Android OS and the application called MyGlass is used to setup, manage and add new features to the Glass. MyGlass application is available for Android & iOS mobile platform. Google Glass currently has a developer edition called explorer edition and costs \$1500.

Developing applications of Glass can be done through Glass Development Kit (GDK) or Mirror API or both. The Google Mirror API allows to build web-based services, called Glassware, that interact with Google Glass. The GDK is an add-on to the Android SDK that lets one build Glassware that runs directly on Glass. This functionality is provided over a cloud based API and does not require code running on Glass.

Glass also uses many existing Google applications such as Google Now, Google Maps, Google+, and Gmail.

1.2 Vuzix M100

Vuzix M100 is the world's first commercially available Smart Glass based on Android. It has a monocular display which sits within the user's line of sight of vision. M100 features 4 control buttons for navigation and supports gesture recognition. Users can also use the remote control application which has to be installed on the user's android device. It has recording features and wireless connectivity capabilities designed for commercial, professional, and prosumer users. M100 features pre-installed apps which can be used to record and playback still pictures and video, track timed events, manage calendar and more. M100 is also compatible with thousands of existing Android applications and can be installed on the device without any changes.



Figure 2: Vuzix M100

[Vuzix](#)

Source:

M100 SDK is comprised of two primary parts, a M100 Smart Glasses hardware unit and a M100 Software & Documentation Package (M100 SDK Software). Vuzix M100 costs \$999.99 and Vuzix M100 SDK needs to be purchased separately for \$199.99

1.3 Epson Moverio BT-200

Epson Moverio BT-200 is a pure see-through binocular vision smart glass. Moverio BT-200 resembles a thick spectacles and can be worn like normal spectacles. The display is projected in the user's line of sight. Each lens has its own display, which is projected into the user's surroundings and boasts 2x the virtual screen size. The glasses of Moverio BT-200 are connected to a controller using

a wire. This controller is used as a touchpad which acts as a normal touch screen of a mobile phone. When compared to other Smart Glasses, Moverio BT-200 can work as a standalone device. Moverio BT-200 operates on Android OS and most of the Android applications work on Moverio BT-200 without any porting.



Figure 2: Epson BT-200

Source: [Epson](#)

Moverio BT-200 costs \$699.99 and is less expensive than Google Glass & Vuzix M100.

2. Features

2.1 Google Glass

- ✓ Record videos & take pictures
- ✓ View & send messages
- ✓ Find information
- ✓ Navigate using Google Maps
- ✓ Live video sharing
- ✓ Translate voice

2.2 Vuzix M100

- ✓ Voice Navigation
- ✓ Gesture Control
- ✓ Three operating modes for applications to run – Local, Heads Up Display & Collaborative mode

2.3 Epson Moverio BT-200

- ✓ Binocular transparent wearable display
- ✓ Immersive 3D
- ✓ Camera and motion tracker
- ✓ Dolby Mobile surround sound
- ✓ Convenient accessories includes a lens insert & two UV shades

3. Technical Specification comparison

Criteria	Google Glass Explorer ver 2	Vuzix M100	Epson BT-200
Operating System	Android 4.4	Android 4.0.4	Android 4.0.4
Display	640×360 Himax HX7309 LCoS display	WQVGA Color display	960x540 Poly-silicon TFT active matrix
Camera	5-megapixel camera, capable of 720p video recording	5-megapixel camera, capable of 1080p video recording	VGA
Connectivity	Wi-Fi 802.11b/g Bluetooth 4.0	Wi-Fi 802.11b/g/n Bluetooth 3.0	Wi-Fi 802.11b/g Bluetooth 3.0
Storage	16GB storage (12 GB of usable memory)	4 GB internal with expandable memory of max 32GB	8 GB internal with expandable memory of max 32GB
Processor	Texas Instruments OMAP 4430 SoC 1.2Ghz Dual core	Texas Instruments OMAP 4460 1.2Ghz Dual Core	Texas Instruments OMAP 4460 1.2Ghz Dual Core
RAM	2GB RAM	1GB RAM	1 GB RAM
Sensors		3 DOF gesture engine (L/R,U/D,N/F) Ambient light sensing and proximity sensor GPS 3-degree of freedom head tracking 3 axis gyroscope 3 axis accelerometer 3 axis magnetometer Ambient light sensing and proximity sensor	GPS 3 axis gyroscope in Headset & Controller 3 axis accelerometer in Headset & Controller 3 axis magnetometer in Headset & Controller

Audio	Bone conduction audio transducer	Ear speaker	Stereo Head-set with Dolby Digital Plus
Battery	One day of typical use	550 mAh rechargeable internal battery Up to 6 hours hands free (display off)	Li-Polymer [2720] mAh Approx. 6 hours

4.

5. Challenges for a Developer

5.1 Google Glass

Google Glass's display usually sits above user's line of sight. Even though it's an advantage that it doesn't hinder user's view, it can be challenging for a developer who needs to look into the display more frequently for development and testing of the application. Since Google Glass doesn't provide an emulator for application testing, it is not easy to do off-line testing.

Google Glass has a compact structure and the hardware is tightly packed. So when an application uses more processing power, e.g., applications which use Augmented Reality, the device heats up and is radiated to the user wearing the Glass.

Google Glass's battery and its operational time are not very clearly specified. Battery backup was very poor during development & testing of applications on Google Glass, requiring frequent recharge cycles.

Even though Glassware applications are based on Android OS, working of a Glassware application is different from that of a normal Android application. Hence porting of an existing mobile application needs complete rework. Since Google Glass is not yet released for production use, it is unstable currently. IGATE has faced issues like Camera freeze and Glass not responding during development of applications, requiring a reboot to bring Glass back to a stable state.

5.2 Vuzix M100

Vuzix M100 is an Android based Wearable Glass and hence most of the Android applications can be used

on this device. Vuzix provides an emulator along with its SDK and developers can make use of this emulator to deploy & test the application.

Even though battery backup is an issue with Vuzix M100, the extra external battery helps to overcome this issue. But usability with this external battery might be a concern for some developers.

Porting an Android application is easy since Vuzix M100 works on the same architecture as that of normal Android. Since it doesn't have a touch pad, the touch events may need migration to key events which may be an over-head depending upon the application.

Vuzix M100 doesn't have Google Play services incorporated, so developers can't develop Google Play service based applications. Also Vuzix M100 SDK costs an additional \$199.99 which is an overhead for developers apart from the Vuzix Glass price of \$999.99.

5.3 Epson Moverio BT-200

Moverio BT-200 is an Android based wearable device which works just like an Android device where the display is connected to the Wearable Glasses. Most of the Android applications work on Moverio BT-200 without any porting or UI changes.

Applications can be developed for Moverio BT-200 using Android SDK without any major UI Changes. Applications can be developed and tested on normal Android phones in landscape mode and later installed on Moverio BT-200. It works well for Augmented Reality applications due to its binocular display feature.

Epson Moverio BT-200 has a good battery backup and has no over-heating issues.

The downside of Moverio BT-200 is the form factor and its usability. Moverio BT-200 is pretty heavy on the users nose and continuous use is strenuous. Also the physical wire that connects the Glass with the controller unit makes it less user friendly.

It doesn't feature Google Play services, so developers can't develop Google Play based service application.

6. Recommendation

6.1 Consumers

Google Glass provides new and intuitive features to its users. However, Google has not released its commercial version of Google Glass. Currently it's in Explorer edition and may take a few more months to release its final product. Currently Google Glass is a bit unstable with battery drain and overheating issues. In terms of weight, size and compactness Google Glass wins over all other wearable glasses. With a price tag of \$1500 Google Glass is most expensive when compared to its competitors for general consumers.

Vuzix M100 is not as compact as Google Glass and the display is in the line of sight of the user. This has its own pros and cons. The display can distract users normal vision since the display is not transparent like Google Glass or Epson BT-200. With advancement of technology the size may also improve in newer version with a better display technology. For a normal user Vuzix M100 doesn't provide any new intuitive features when compared. Vuzix M100 is a relatively stable platform. But with a price tag of \$999 it's not so economical for a normal user.

Epson Moverio BT-200 with its heavy glasses and connected wire doesn't fit in to the market space for consumers for daily use. The Glasses of Epson provides binocular pure see-through display, which enables users to view 2D & 3D contents. These binocular glasses are so thick that it makes the user look like he is visually challenged. Since the display totally sits in the user's vision field, using these glasses hinders user's vision. Epson has specifically

mentioned not to use these glasses while driving, riding a motor bike or bicycle, cooking or performing any other dangerous task. Epson also warns to be aware of surroundings while walking with these glasses. Moverio BT-200 is more affordable when compared and suits for people who would like to try out new technology.

6.2 Enterprise

Google Glass can open doors for enterprises with new business solutions. With its new and intuitive features, verticals like Manufacturing, Logistics & Utilities could take advantage of its light weight and hands-free operation. Even though the Google Glass is in its developer edition, enterprise could invest in these glasses where they can build customer centric solutions before its production release.

Vuzix M100 has focused on enterprises and since it is already a production version, enterprises could go forward for building applications for their business solution. Their gesture and voice based controls helps enterprises in building enterprise solutions for hands-free operation modes. Since porting of application doesn't involve much of effort, enterprises could make use of existing Android applications ported to these wearable glasses with ease.

Epson Moverio BT-200 doesn't provide a pure hands-free solution. Hence usability of these devices will be limited in enterprises. For business solutions which doesn't need hands-free operation, BT-200 could be used. Porting overhead is not there with these devices and hence existing Android application can be directly installed on these devices.

7. Conclusion

Wearable Glasses that are currently available in the market are having their own pros & cons. Some may lack usability or usefulness where as some are overpriced. These devices are yet to be refined to its best and with the advancement of technology which is growing at a rapid pace, soon these devices will be adopted by the common people. Adoption of these glasses depends on how the user would use

the device and for what purpose. Enterprise could have a leap ahead of its competitors by incorporating business solutions with these wearable glasses. Google is a key player in technology innovation and mass adoption of their innovations can be expected. If the aim is to be well ahead of the market and create applications for these users, Google Glass would be a better option. Whereas if it's to solve current business challenges using wearable glasses Vuzix M100 is the better candidate. If the business solution requires better Augmented Reality experience or lesser cost Epson BT-200 is a good choice.

8. References

1. Google Glass: Everything You Need to Know, PCMag website, 2014
<http://www.pcmag.com/article2/0,2817,2416488,00.asp> (Accessed - Dec 2014)
2. Google Glass, Wikipedia website, 2014
http://en.wikipedia.org/wiki/Google_Glass (Accessed - Dec 2014)
3. M100 Smart Glasses – Enterprise, Vuzix website, 2014
http://www.vuzix.com/consumer/products_m100 (Accessed - Dec 2014)

4. Moverio Smart Glasses, Epson website, 2014
<http://www.epson.com/cgi-bin/Store/jsp/Landing/moverio-bt-200-smart-glasses.do> (Accessed - Dec 2014)

9. About Authors

Vijay Sanjos Alexander is a Technical Specialist with more than 7 years of experience in IT industry. At IGATE, he is currently working in the Technology CoE's in Research & Innovation group working on applications of emerging technologies and trends. The technology CoE team works on creating POCs, Solutions, evaluating new technologies and helps in client engagements.

Venkatesh Babu is a Senior Principal Architect working in the Technology CoEs in Research & Innovation group @ IGATE. He has more than 20 years of experience in IT industry and is currently involved in delivering applications of emerging trends & technologies. The technology CoE team works on PoCs, Solutions, and provides thought leadership for evangelization of new trends / technologies for solving business problems of clients.