



Smart Glasses Landscape Report

Danny Lau
Debjani Banerjee
Deepa Bhatt
Prashanth Godey
Sudhish Rema
Yun-Ching Chang

This work was created in an open classroom environment as part of a program within the Sutardja Center for Entrepreneurship & Technology and led by Prof. Ikhlaq Sidhu at UC Berkeley. There should be no proprietary information contained in this paper. No information contained in this paper is intended to affect or influence public relations with any firm affiliated with any of the authors. The views represented are those of the authors alone and do not reflect those of the University of California Berkeley.

Executive Summary

In recent years, the smart glasses market has seen steady growth, driven in part by advances in technology such as augmented reality (AR) and virtual reality (VR). Smart glasses are wearable devices that have a display, a camera, and various sensors that can be used for a variety of purposes, including gaming, productivity, and healthcare. The market for smart glasses is expected to continue growing in the coming years, with some analysts predicting it to reach \$45 billion by 2025.

One area where smart glasses have seen particular interest is in the sports and fitness industry. Smart glasses can be used to provide athletes and fitness enthusiasts with real-time data on their performance, including heart rate, calorie burn, and distance traveled. This data can then be used to optimize training and improve performance. Smart glasses can also be used to provide coaching and guidance, either through pre-recorded videos or through live communication with a coach or trainer.

In terms of market dominance, US tech giants like Apple, Google, and Meta have significant advantages due to their manufacturing capabilities, AI, and cloud technology. These companies have the resources to invest heavily in research and development, and they have a large existing customer base that can be leveraged to promote and sell their products. Apple, in particular, has a strong track record of dominating markets with its innovative products, and the company has been rumored to be working on its own smart glasses for several years. Google and Meta have also made significant investments in AR and VR technology and have been exploring ways to integrate this technology into their existing products. In the global market outside the US, tech giants like Xiaomi, Huawei, Oppo & Vivo have invested significantly to capture and dominate the emerging users in this sector.

Overall, while the smart glasses market is still in its early stages, the potential for sports and fitness to drive mass adoption is significant. With the backing of tech giants like Apple, Xiaomi, Google, and Meta, the market is poised for significant growth in the coming years.

Previous Attempt

Smart glasses market first came to life with the launch of Google Glasses in 2012. However, Google shut it down a few years later. Ever since, companies have struggled to find the right combination of features to drive demand in this market segment.

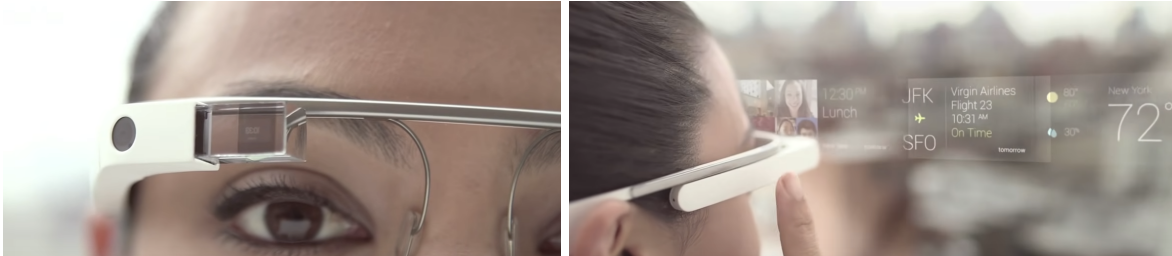


Figure XX: Google Smart Glasses in 2012

To understand the 2023 trends, we have to explore some of the reasons behind the google glass failure. Several studies have been conducted and the reasons for failure are generally narrowed down to the following

- Safety, Privacy & Health Concerns - primarily around radiation, distractibility while operating motor vehicles and lack of privacy for individuals in a public/private setting.
- Poor Aesthetics - resulting in product perceived as a quirky device worn by geeks without lack of any style that is normally associated with luxury glasses
- High Priced Beta product - at \$1500 with a 3 hour battery life and a 604x340 resolution while not providing any major hardware upgrades in the 2 year timeline
- Poor software - Very limited functions like reading time, weather, calendar, navigation and translation , but none with sufficient utility or impact. Lack of a robust developer app store.

Market Overview

Overall smart glasses market consists of both VR and AR headsets, Meta currently dominates the global market with 81% market share by revenue in Q4 2022. Small players DPVR and Pico tie for second at 7% each. However, these three companies make VR headsets. We believe the smart glasses market using AR technology will emerge rapidly in the next decade.

Alphabet recently announced discontinuing the Google Glass Enterprise Edition, and looks to be regrouping their AR product portfolio. Other tech giants like Apple and Samsung also have not released any AR smart glasses related products.

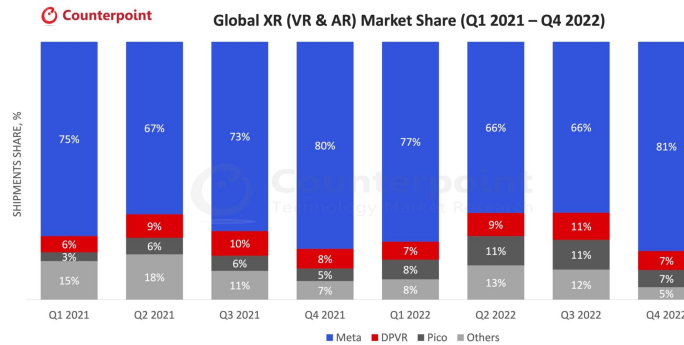


Figure XX: Global Smart Glasses Market Share (Revenue)

In 2022, only about 448.8 thousand units of AR smart glasses are sold in the U.S. and 721 thousand units are sold worldwide. Compared to 8 million units of VR smart glasses sold worldwide in the same time period, AR smart glasses is an extremely green field.

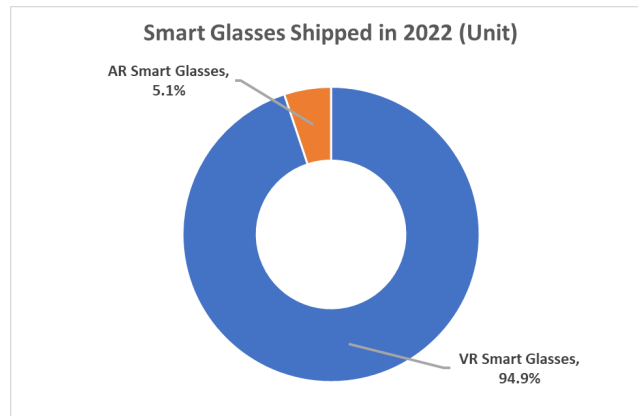


Figure XX: Smart Glasses Shipped in 2022 Divided by VR and AR

By 2030, it is expected that AR smart glasses shipment will jump to 97.7 million units. This can result in an over \$40 billion market. China will have the fastest growth at 104% CAGR. Japan

and Canada, will also have decent growth, each forecast to grow at 73.9% and 79.9% respectively. Within Europe, Germany is forecast to grow at approximately 85.2% CAGR.

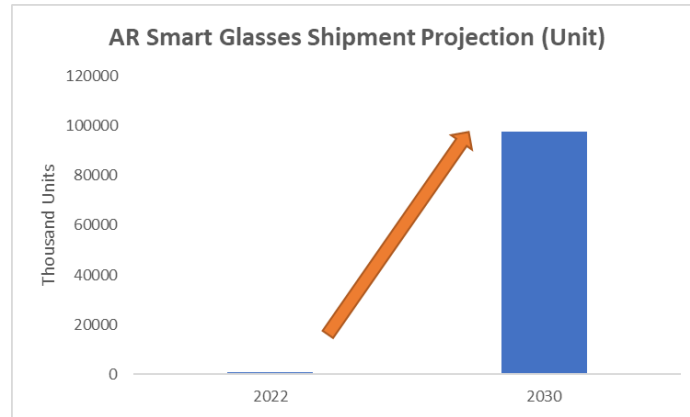


Figure XX: Global AR Smart Glasses Market Growth

China's market landscape looks very different, and it is full of AR smart glasses products. Players such as Nreal, Thunderbird Innovation and Rokid have all released AR smart glasses to the market. Smartphone companies such as Xiaomi and Oppo have also made announcements in 2022. Only counting AR smart glasses, Nreal currently rank first with a market share of 34.5%. Thunderbird Innovation and Rokid rank second and third with a market share of 28.6% and 24.4% respectively. Xiaomi stays behind in fourth at 8.5%. Judging from the small gap in market share between the top three companies, the China market is very competitive.

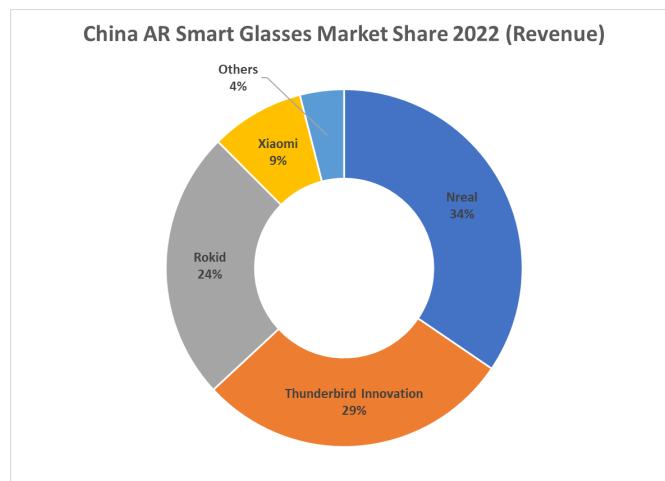


Figure XX: China AR Smart Glasses Market Share

We believe AR smart glasses will have tremendous applications in various consumer and industrial sectors, such as sportswear, social media, surgical equipment and industrial wearable. Of which the sportswear sector has generated \$161 billion revenue in 2022.

AR Smart Glasses Customer Feedback

While U.S. vendors are developing products to enter the AR smart glasses market. Chinese products have already been evaluated by customers. However, these AR smart glasses have room for improvement. Dissatisfaction is mostly in short battery life and heating up of the device. There is also a lack of application ecology. Some noteworthy applications of smart glasses come from Oppo, who partner with Chinese search engine giant Baidu. Oppo promises their product will revolutionize how people view and consume information. The real time Chinese-English translation has captured the spotlight. User is able to see the translated text on the smart glasses display.

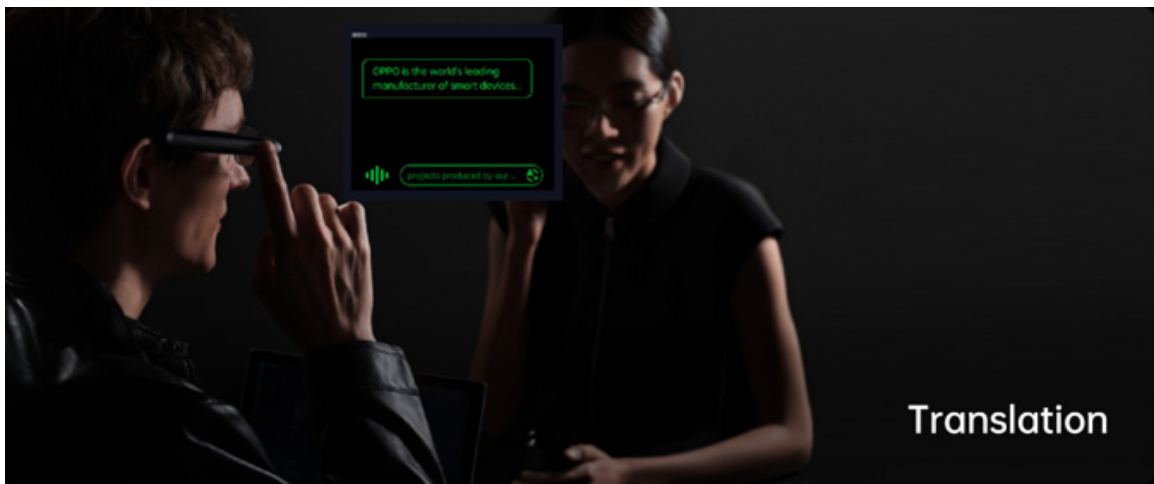


Figure XX: Oppo Air Glasses Real Time Translation

In China, smart glasses usage in the surveillance sector is also gaining traction. Beijing police debuted facial recognition glasses in 2018. Powered by AI, the glasses can compare faces and cars to a blacklist in real time and display a warning to the police within milliseconds.



Figure XX: Beijing Police Wearing a Pair of Facial Recognition Smart Glasses

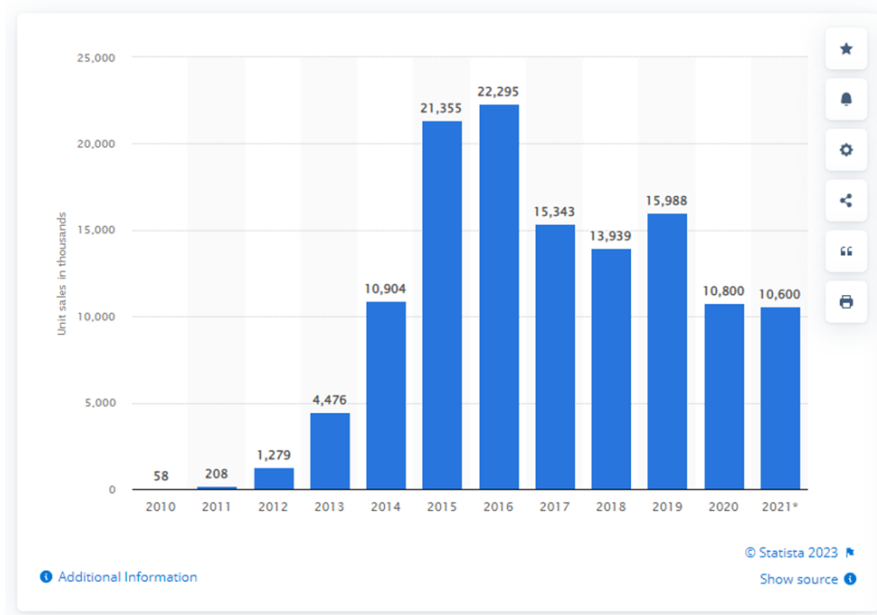
Market Drivers and Challenges

Sportswear will be the main driver of smart glasses for the early adopters' market, like the evolution from smart wearable fitness tracker, e.g., Fitbit to smart watches, e.g., Apple Watch. In 2009, Fitbit released their first product, Fitbit Tracker. The Fit Tracker was a small black and teal device that could be clipped discing and worn 24/7. A wireless base station is included to receive data from the Tracker and to charge its battery. When connected to a computer, the base station will upload data to the Fitbit website, where a number of features are available: seeing an overview of physical activity, setting and tracking goals, keeping food and activity logs and interacting with friends. 58,000 Fitbit Trackers were sold in 2010. Two years later in 2012, Fitbit announced Fitbit One and the Fitbit Zip, which were the first wireless activity trackers that can sync with iOS and Android devices using Bluetooth 4.0 or Bluetooth Low Energy technology. Since then, the smart wearable device market started to take off. Since 2010, Fitbit has sold over 127 million devices worldwide and counted around 111 million registered users in 2021. [ref1] In 2015, Apple announced their first smart watch, Apple Watch (First generation). An estimate by IDC states Apple shipped over 12 million units in 2015. [ref2] In late 2016, a veteran of the Swiss watch industry said Apple sold about 20 million watches and had a market share of about 50 percent. [ref3] The global wearable fitness tracker market size was valued at USD 39.5 billion in 2022. It was projected to reach USD 187.2 billion by 2032, growing at a CAGR of 17.3% during the forecast period between 2023 and 2032. The current players include Apple, Garmin, Fitbit, Samsung, LG, Huawei, etc.[ref]

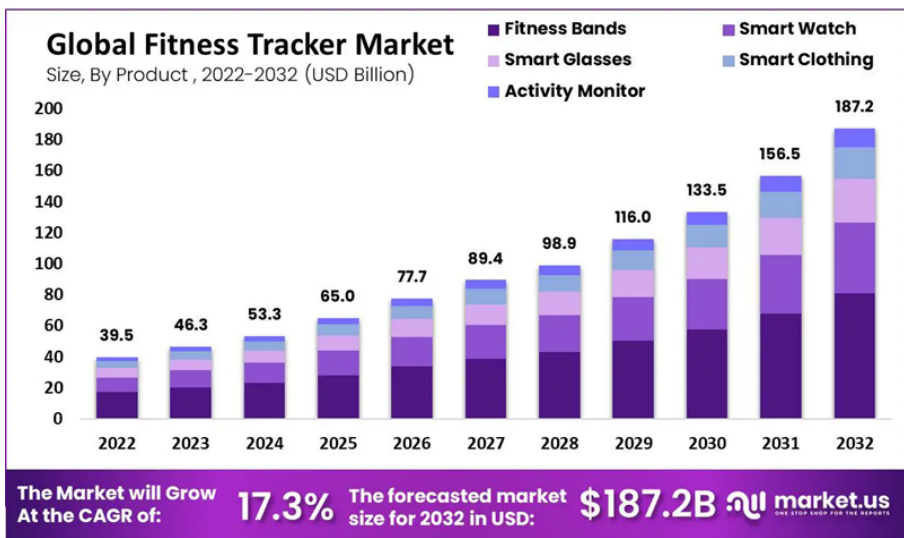
Sports eyewear, like sunglasses and goggles, can be partially replaced by smart glasses for sports and fitness enthusiasts. The global sports sunglasses market size was valued at \$3.1 billion in 2019, and is projected to reach \$3.4 billion by 2027, registering a CAGR of 6.8% from

2021 to 2027. The major players include Oakley, Nike, Adidas, Puma, and other sportswear brands.

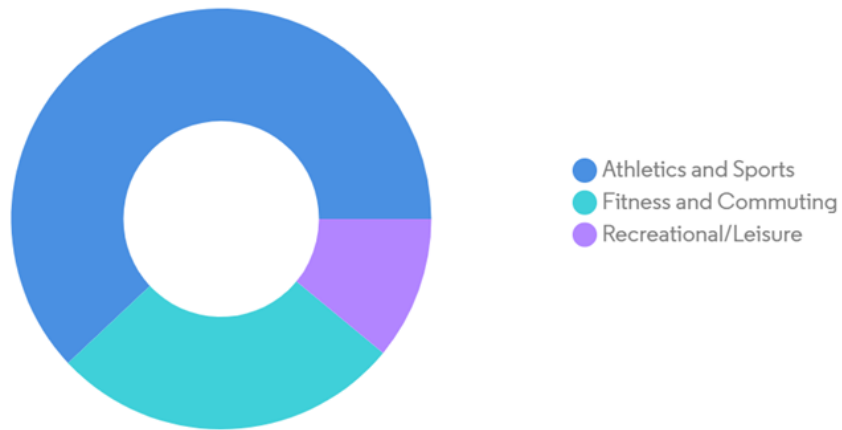
GPS Bike computers can also be challenged by smart glasses in the cycling equipment market. Traditionally, cyclists use a GPS bike computer to navigate, track the activities, and monitor the real-time performance. The GPS bike computers market was valued at around USD 542.5 million in 2021, and it is expected to reach USD 768.0 million by 2027, registering a CAGR of about 6.0% during the forecast period (2022 – 2027). The current players include Garmin, Wahoo, Polar, and Bryton. Although currently the Athletics and Sports application takes the majority of revenue share, the Fitness and Commuting segment will be likely to have significant growth.[ref5] With rising health consciousness among cyclists, the demand for bike computers is growing. These devices track numerous parameters such as energy level, water percentage, calories burned, and heart rate based on the course and energy effort. An increase in daily commute travels and fitness-related travels via bikes across the world encourages navigation system companies to offer products aimed at this group of customers. The development of e-bikes also drives the demand of GPS navigation on the long routes. The growing adoption of cargo bikes for last-mile delivery is anticipated to drive the demand for a navigation system. It can help the delivery person navigate through the addresses across cities. Such developments are also expected to contribute to the adoption of smart glasses that potentially combine the function from both sports eyewear and GPS bike computers.



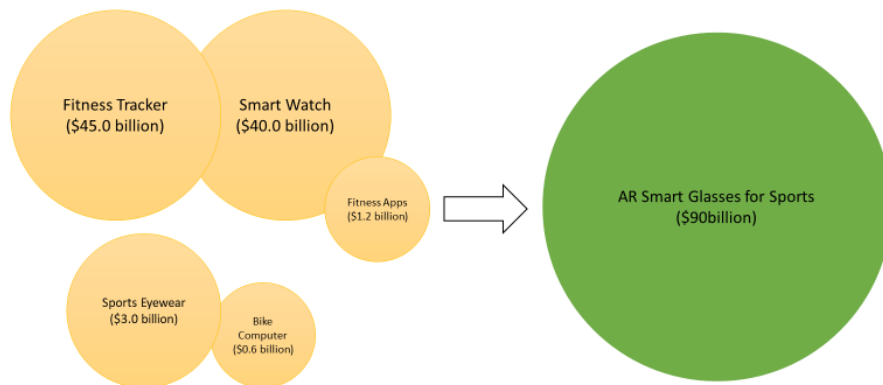
Number of Fitbit devices sold worldwide from 2010 to 2021(in 1,000s)



GPS Bike Computers Market - Revenue Share (%), By Application, 2021



Source: Mordor Intelligence



Competitive Landscape

EverySight Ltd. is an Israeli technology company established in 2014. EverySight develops smart glasses based on augmented reality technology. The company's main product is Raptor launched in 2018. This \$649 smart glasses is intended for outdoor athletes (road cyclists and mountain bikers). It enables users to see real-time graphic information projected directly from the lens, which appears as an augmented reality layer superimposed over the scene. This

information includes physiological data, map navigation, training options, and location and media sharing. The device is an Android OS-based computer incorporated into the glasses, as well as a camera, memory storage, audio system, voice commands, wireless interfaces (Wi-Fi, Bluetooth & ANT+), touchpad, and batteries. [Ref 1] Although the scope of Raptor is to replace existing bike computer products in the market, this expensive and catch-all product is hard to sell for a niche bicycle market. Another problem with this product is the lens cannot be interchangeable. Since it is important to capture all ride data regardless of the weather, it is not an option to leave your wearable device at home because of dark or bright days. Some users also found it can be difficult to wear it on certain helmets.

Garmin is a global leader of fitness and training devices, offering a wide range of products from GPS-enabled smartwatches to advanced cycling computers and activity trackers. Garmin's products have become essential tools for athletes, fitness enthusiasts, and health-conscious individuals alike. Garmin introduced their Varia Vision in 2016. The \$399 device attaches to the arms of sunglasses, providing riders with a virtual, transparent display that projects essential data and alerts right in front of their eyes. Cyclists can keep track of critical metrics such as speed, distance, and time, without having to take their eyes off the road. The device can also be paired with all Garmin sensors and software ecosystems to receive turn-by-turn directions, receive incoming call and text notifications, and access advanced cycling metrics. [Ref 2] The downside is still a high price tag and not great for aerodynamics and aesthetic look.

The latest attempt on sports smart glasses is from ActiveLook, a branch of organic LED display company MicroOLED (Grenoble, France). MicroOLED specializes in the design, production and marketing of OLED microdisplays for near-eye applications. The team focuses on "light AR" for, with a near-eye display placed discretely within the lens of a pair of sunglasses that has light weight and long battery life. In 2021, ActiveLook partnered with Sunglasses manufacturing company, Julbo, to launch their first product Julbo EVAD-1 with price tag of € 499 EUR. The product is marketed as the world's lightest connected eyewear (30-34g). [ref 3-4] In 2023, ENGO Eyewear launched ENGO 2 using ActiveLook 2.0 technology. This new \$329 device has touchless gesture control that makes it easy to toggle between custom data screens by waving a hand in front of the lens. ENGO 2 also offers long battery life (10-12 hours) with only 36 grams.

Apparently, ActiveLook has conquered a few critical issues in sport smart glasses, e.g., weight, battery life, and gesture control. With photochromic or interchangeable lenses, the platform should have legs in cycling sectors. Looking forward, the sports smart glasses should keep driving on higher display resolution, and better augmented reality (AR). To convince early adopters to switch from existing smart wearable devices or bike computers, the sports smart glasses should have better integration to existing fitness Apps and their ecosystems, e.g., Strava™, Garmin Connect™, and Apple Fitness.

EverySight Raptor (Left), Garmin Varia Vision (Center), and ActiveLook (Right)

1. <https://www.eversight.com/>
2. <https://www.garmin.com/en-US/p/530536>
3. <https://www.activelook.net/news-blog/press-release-next-the-worlds-lightest-and-most-miniaturized-technology-platform-by-activelook-r>

4. https://www.julbo.com/en_gb/evad-1
5. <https://www.prnewswire.com/news-releases/engo-eyewear-introduces-engo-2-the-lightest-heads-up-display-for-training-and-competition-for-endurance-athletes-301598459.html>



Everysight Raptor (Left), Garmin Varia Vision (Center), and ActiveLook (Right)

Industry Trends

2023 AR/VR Industry Trends

- **Increased affordability**
 - The price points on VR glasses have dropped by 30-40% over 12/24 months. This makes the current generation of glasses much more affordable to the consumer base.

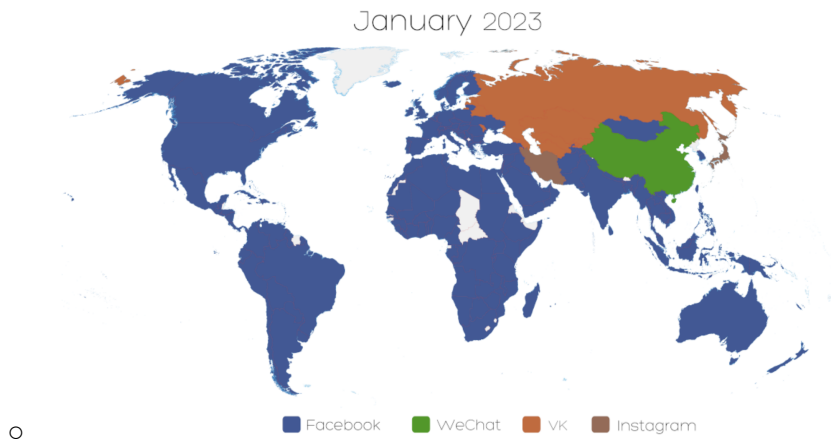


Comparing \$1500 google glass vs \$500 Rokid

- **Improved weight/battery life:**
 - Majority of the AR glass manufacturers are now offering 8+ hours of battery life with a sub 100g body weight. The price of LiON batteries have fallen by 90% from 2010 and this is reflected in the pricing of most consumer devices where rechargeable batteries are a major component
- **More comfortable & attractive design:**
 - AR glass manufactures are paying closer attention to developing glasses that are more comfortable to wear for extended periods of time while also looking good from a stylistic point of view
- **Graphics Quality:**
 - The emergence of high resolution and realistic graphics, enable immersive experiences in gaming , conferences, sports events , social media and streaming video content.
- **Enterprise applications:**
 - Use in Training, manufacturing, and healthcare.

2023 Software Industry Trends impacting Smart Glasses

- **Social Media:**
 - Smartphone ecosystem is well connected with numerous social media apps today - In the APAC market WeChat/TikTok/Instagram/Youtube are very entrenched while the Americas market is dominated by Meta/Tiktok and Snapchat. Connection with friends and family is a strong use case for the smart glasses market



- **NLP & Speech Synthesis**
 - Advances in speech synthesis, voice recognition and gesture control built for smartphones and smartwatches are now available to the smart glasses market.
- **Generative AI, Edge AI, LLM & ChatBots**
 - The launch of Large Language models and chatbots (Bard, chatGPT) make information summaries possible.

- **Cloud & Edge computing**

- The wide availability of low latency compute power from 5g networking and Cloud service providers combine fast, low latency access to high compute power enabling applications in AI, industrial automation, gaming and computer vision.

Smart Glasses in Sports & Fitness

The rise of Smart glasses with such capabilities is projected to directly impact the Sports and Fitness industry where the Social Media, AI & Cloud capabilities can all be harnesses to improve everything from athlete performance to sports analytics.



Smartwatches when launched were good at helping consumers with step counting and tracking runs. We project smart glasses to outdo the watches in the sports and fitness arena by offering analytics, gamified interfaces, virtual coaches and safety tools. Sports and Fitness provides Smart glass vendors with an easy to launch beachhead application.

Conclusion and Recommendations

In this study we talked about smart glasses, from their inception (via technologies like Google Glass), to their present day use. We analyzed different markets and deep dived into the sports category, highlighting how GPS navigation technologies, AR/VR, interactive social features and “hands-free” nature of smart-glasses will revolutionize this market.

We believe that companies in the future looking to develop smart glasses must focus on the following features -

1. Narrowing down on primary use case - Earlier glasses focused on a lot of features, unsure of which ones to highlight. Companies working on smart glasses need to focus on one core area (like fitness or social networking) and build around that. Otherwise consumers will be left confused like before.
2. Determine primary audience - Companies working on smart glasses must keep in mind their target audience. Example: The latest version of Snap Glasses is hyper-focused on the social content creator market; Garmin Varia is for the fitness market. Any company working on smart glass technology should also conduct extensive testing to see if these glasses meet quality standards.
3. Design focus - Earlier glasses were clunky and unfashionable, looking more like a tech gadget being worn on the face instead of fashionable eyewear. People are particularly conscious about what they wear on their face, so the design for these glasses matters a lot.
4. Privacy and security - Since smart-glasses are collecting and transmitting user data, it is important that user data be kept securely. It is also important that glasses not be seen as a “creepy”-device that is secretly capturing photos/video of others. There could be regulations around making sure smart glasses either make a sound or show a signal while taking photos or videos to prevent illegal covert photography activities.
5. Leveraging AR and AI: Augmented Reality can be a game-changer for the smartglass market as it can provide a unique and immersive experience. It can provide real-time information, enhancing user productivity. It can create interactive training environments, where trainees can practice procedures in a safe and controlled environment. It can also be used for entertainment and gaming. AR married with AI can be a killer-combination for someone looking to adopt smart-glasses

References

Set of References used across the research paper

1. <https://www.statista.com/statistics/472591/fitbit-devices-sold/>
2. Nick, Statt (February 24, 2016). "Apple shipped 11.6 million Apple Watches last year, says IDC (Feb 24, 2016)". TheVerge.com. Archived from the original on January 2, 2017. Retrieved January 1, 2017.
3. "Swiss watch sector set for smartwatch boom". Reuters. January 1, 2017. Archived from the original on January 1, 2017. Retrieved January 1, 2017
4. <https://www.globenewswire.com/news-release/2023/04/06/2642293/0/en/Fitness-Tracker-Market-Predicted-to-Garner-US-187-2-Bn-by-2032-At-CAGR-17-3.html>
5. [https://www.mordorintelligence.com/industry-reports/gps-bike-computers-market#:~:text=GPS%20Bike%20Computers%20Market%20Analysis,period%20\(2022%20%E2%80%93%202027\).](https://www.mordorintelligence.com/industry-reports/gps-bike-computers-market#:~:text=GPS%20Bike%20Computers%20Market%20Analysis,period%20(2022%20%E2%80%93%202027).)
6. <https://pandaily.com/chinas-consumer-facing-smart-glasses-market-heating-up/>
7. <https://pandaily.com/market-share-of-xiaomis-ar-glasses-ranks-fourth-in-china/>
8. <https://www.globenewswire.com/en/news-release/2023/02/27/2615765/28124/en/Smart-Augmented-Reality-AR-Glasses-Global-Market-Report-2023-Smart-AR-Glasses-Emerge-as-Enticing-Options-to-Improve-Business-Flows-and-Efficiency.html>
9. <https://www.businessinsider.com/china-police-using-smart-glasses-facial-recognition-2018-3>
10. <https://www.demandsage.com/smartwatch-statistics/>
11. <https://www.business2community.com/tech-gadgets/5-reasons-google-glass-miserable-failure-01462398>
12. <http://www.catwig.com/google-glass-teardown/>
13. <https://kguttag.com/2023/03/15/meta-quest-pro-part-2-block-diagrams-teardown-of-headset-and-controller/>
14. <https://vincos.it/world-map-of-social-networks/>
15. <https://www.cnn.com/2022/12/28/metaverse-off-to-ominous-start-after-vr-headset-sales-shrank-in-2022.html>
16. <https://www.counterpointresearch.com/global-xr-ar-vr-headsets-market-share/>
17. <https://appleinsider.com/articles/23/02/22/apple-watch-dominated-smartwatch-market-sales-and-profits-in-2022#:~:text=According%20to%20the%20data%2C%20Apple,for%20the%20entire%20market%2C%20globally.>
18. <https://www.idc.com/promo/arvr#:~:text=NEEDHAM%2C%20Mass.%2C%20March%2024.and%20Virtual%20Reality%20Headset%20Tracker.>
19. <https://www.demandsage.com/smartwatch-statistics/>
20. <https://www.cnet.com/tech/mobile/the-race-to-build-ar-glasses-is-heating-up-and-samsung-is-surprisingly-quiet/>

Backup

In the adjacent smartwatch market, Apple continues to lead the pack in 2022 with 34.1% in market share by revenue. Apple's strong understanding in the consumer wearable market can be an advantage when they enter the AR smart glasses market.

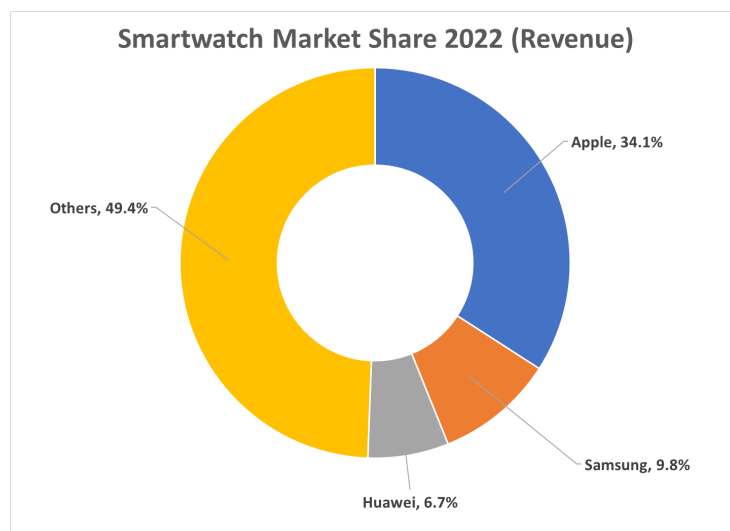


Figure XX: Global Smartwatch Market Share