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Issues on Smart Glasses Technology Adoption

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Abstract: *About half a decade ago when the idea of smart glass technology was still promising, popular opinion had it that by the year 2020, this interactive technology would have gained so much advancement as a mainstream consumer product and these products became more fashionable, socially acceptable and functional. However, the result from this study has shown that the smart glasses concept has been a rather slow one. Smart glasses are still not mainstream consumer products. Rather, they are specialized tools mainly adopted by the industry for various tasks despite their shortcomings. This paper investigates the field of smart glass technology, providing both an overview of existing products and their application, and also revealed 5 major areas in which smart glasses cannot be easily accepted as consumers product while providing a a research road map for future research work in the usage and acceptance of smart glass technologies for consumers product.*

Keywords: Smart glass, Media technology, AI, Optical display, Adoption Issues.

I. INTRODUCTION

Smart Glasses are a new form of media devices. They cover more simple products with only one prism, such as Google Glass, or more complex ones, such as Microsoft's HoloLens. Smart glasses are more than just wearable's or a new generation of smart phones. They are not just "Eye Phones". Smart glasses are 'the next big thing' in media technology [1]. Smart glasses are wearable smart devices that enable data and Internet access into users' field' of view (FOV) through heads up display (HUD) which is an optic display [2].

Smart glass is one of the intelligent and ground-breaking computing devices developed in recent years. Smart glasses convert the transparency nature of the hard glass into the translucent nature. It is embedded with several components that include liquid crystal devices (LCD), electrochromic, suspended particles, optical head-mounted displays (OHMD), thermochromics, multiple sensors, photochromic, and processing capability handlers [3]. It became more popular with the widespread applications in the medical field as well as the gaming sector. It is one of the wearable devices that is typically worn by the human. As a Person wears it close to the eye, it is called an eye-worn wearable device [4].

Smart glass can be applied or used in diverse fields such as in education as a Teachers aid, in industries such as automobile industries, architectural and construction environment, in healthcare facilities as doctor's aid and generally in business applications and other fields of human endeavors.

The concept of Virtual Reality (VR) has tried to replace a user's perception of the world around him with a purely virtual environment, Mixed Reality (MR) and Augmented Reality (AR) has also tried to combine the real and the virtual together. Thus, the digital information becomes part of the world around us by means of computer generated graphics and displays such as head mounted displays and smart glasses [5]. This means that the idea of smart glasses is based on augmented reality in the area of Artificial intelligence (AI).

Figure 1: Pictorial representation of AR Smart Glasses [6, 10]

It should be noted that the development of smart glasses has its own equivalent technological history to the history of the computer. The best-known proponents are the American pioneers, Professors at MIT, Thad Starner and Steve Mann, back in the 1980s, started experimenting with glasses and attached computers. As computer processes have become faster and technology lesser, the likelihood of more and actual wearable devices has become better [7]. From

the MIT Media Lab, Mann and Thad Starner later proceeded to lead the Google Glass team [8].

Smart glasses has really evolved greatly; army smart glass in 2011, Google glass came into public eye in 2013, Epson Moverio BT-100EC Prototype in 2013, Sony also introduced the Sony Smart Eyeglass in 2015. Other brands that came up include the Microsoft HoloLens, Vuzix M100, Mira prism, Epsom Moverio BT-200 [9].

1.1 Features of Smart Glasses

As with other life logging and activity tracking devices, the GPS tracking unit and digital camera of some smart glasses can be used to record historical data [11]. Smart glass is a type of head-mounted displays (HMD's). Smart glass is a smart wearable device that brings up the wearers, computing facilities, and clients together for handling the most complex task in a simple manner. With smart glasses, the available information at the work site is easily transferred to the controlling and central or distributed monitoring stations. The process of information exchange, information sharing is done very quickly and even can be stored for future reference purpose [12].

Figure 2: Smart glass indicating its features [12]

Figure 2 shows a typical smart glass alongside its features like focus camera, bluetooth, microphone, onboard battery power, memory storage device, photo and video viewer display, GPS, magnetometer, and so on.

1.2 Applications of Smart Glasses

It is observed that among all the wearable devices available, smart glasses have emerged into many sectors finding its applicability and scope for solving instantaneous issues. Some of the application areas of smart glasses are further discussed as follows:

- **Aerospace and Automotive**

In the aerospace and automotive industry, assembly lines are all about swiftness, efficiency, correctness, conformity and excellence control. These qualities happen to be the exact areas in which smart glasses can deliver its services. Since all feature counts, automotive and aerospace manufacturers are implementing the use of eyewear devices to bring instantaneous solutions to the plant. According to [9], virtual information can be given very easily with the aid of smart glasses.

- **Atmospheric Study**

Smart glasses have also helped in the study of visual patterns of the atmospheric things. It can be used to identify the parameters that influence the environment.

- **Cement, Chemicals and Fertilizer**

Smart glasses enabled with thermal cameras and few harmful gasses sensing elements can be applied in the cement, chemical, and fertilizer industries. Using thermal imaging cameras, the wearer can study the heat distributions and their patterns at various points.

- **Documentations**

Smart glasses are also substituting handheld devices, scanners and paper and as a result employees are increasing productivity while declining errors and subsequent costs. Smart glasses with voice-enabled features can help in preparing the documentation on the site during inspection. With the help of cameras, the wearer can even draft an e-copy of the report using the on-site captured images [9, 12].

- **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 agro-products, vegetables, live monitoring of crops health, etc.

- **Gaming**

Augmented reality and virtual reality feature of the smart glass and optical head-mounted displays can help in living the game experience.

- **Education**

In the education sector, smart glasses can help with telementoring, virtual tutoring in order to understand listeners experience, document preparation, instant reference etc [13].

- **Entertainment**

The entertainment sector includes movies, news, etc. In this case, the user can experience the entertainment as required for him in his or her preferences like color

adjustments, language change, voice-controlled movie experience [14].

- **Health Care and Medical**

Ever since the advent of smart glasses, commentators have pointed to the technology's potential within healthcare and the emerging field of telemedicine. Being one of the largest industries 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 wearer's interest [12, 14].

- **Industrial**

On-site and Off-site Smart glasses, head mounted display with their computing capabilities can perform intelligent on-site and off-site operations. For example, in the telecom sectors tower construction instructions, in manufacturing and maintenance support as instructional tool, AR glasses enable experts to train and guide their workers on-the-job (for example repairing equipment or other tasks) from a remote location anywhere in the world [14].

- **Electrical Power System**

Smart glasses acts as an intelligent reference guide in connecting the circuits and troubleshooting components in the electrical system. It also enables video and audio based instruction for operation and maintenance [14].

- **Solar Power Plant Operations**

In solar power plant operation and maintenance, smart glasses and optical head-mounted displays help in addressing the dust issues, the temperature distribution on the module, moisture content on the PV module using the camera and optical devices. Also, helps in identifying the cracks on the PV module, ice effect etc.

- **Wind Power Plant Operations**

In wind power plants, smart glasses help in detecting the damages in the wind blades, wind towers, the effect of ice, cracks at various points [15].

- **Commerce**

Smart glasses with its features can play a smart role in the commerce industry. In many commerce industries, the smart glasses can be implemented for identifying the employee identity. This will act as the best authenticating device and takes very less to verify the candidature. For example, with the help of smart glasses, the wearer can control the visuals played in the video billboard present in the advertising areas. Can even post the live feedback of the product with both audio and video visionary.

- **Remote Control Operations**

In many sectors, the remote control operations can be enabled with the special features of the smart glasses. The special features that help in remote monitoring are voice enabled commands, report generation, visual imaginary, location detection etc.

- **Waste Management and Municipal Operations**

In the municipal waste management department, the smart glasses can be used for segregating the various types of waste generation. In this situation, the smart glass features like image capturing and analysis could help. One can even identify the harmful wastes.

- **Warehouse Goods Management**

In the warehouse, the number of good that would flow is very huge. In such cases, the manual operation of counting and scanning would be complicated. Here, the smart glasses can be used to scan the products in the warehouse, while keeping their hands free and receiving directions and visual cues directly in their field of view, warehouse workers can easily locate, collect, and deliver items with ease. This makes the work more comfortable and fast [9, 12].

- **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 be further analyzed in order to detect what exactly happened.

- **Security Check Record Maintenance**

With the help of smart glasses, the security check process can be simplified during the identity verification process. The feature of augmented and virtual reality can enable the existed identical features with the real-time options. With this process, identification will happen more securely. With the integration of block chain enabled smart glass, the process of verification would even be more secure.

- **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 traveler can estimate and visualize the

time required. The traveler can visualize the tourism places virtually before he visits the actual places.

II. USER'S PERSPECTIVE IN SMART GLASSES

Augmented reality smart glasses (synonym: data glasses, smart glasses) is the new frontier of wearable technologies. According to [15], Smart Glasses are usually worn like glasses, or are devices mounted on regular glasses. Several technologies (e.g., camera, GPS, microphones etc.) capture physical information and augment them with virtual information that can be gathered from the internet and/or stored on the smart glasses memory, primarily accomplished through location-, object, facial, and image-based recognition technologies. smart glasses can be used by a firm's employees to work more effectively. External value creation means that companies can increase revenues by offering applications for smart glasses that can be used by consumers.

It is important to note that smart glasses, as any wearable devices, also include a fashion component [16]. Thus, factors that are known from clothing should also be relevant to the use of smart glasses and in work-related contexts. I use the term wearable comfort to describe the physical comfort (i.e., that wearing them is not associated with physical pressure or even pain) and emotional comfort (i.e., a user does not feel ashamed when wearing them because they make him or her look strange). However, smart glasses next to aesthetic requirements also need to fulfill functional roles, as they are tools worn for work purposes.

Based on a recent research carried out by [17], issues related to smart glass technologies are user's perception and acceptability which includes;

- **Comfortability**

Physical comfort is one of the important rules that should be considered when designing a wearable device. A comfortable product does not disturb the user or brings physical burden such as difficulty in movement to its user. Size and weight of the device are two important elements that play an important role in comfort of a wearable device. Many people prefer a portable device with minimal bulk and weight

- **Safety**

The users should be sure that carrying and wearing a device does not bring harm to their health. Moreover, as the device will be in touch with the skin, the materials used in the device should not cause problems such as sweating and allergies for the skin.

- **Aesthetic**

Aesthetic and appearance of a wearable device is an important part of a design process and has a great impact on user's acceptance. As a wearable device has an important impact in people's identity; it is a part of the style and appearance of the user, and it effects on their self-image. A successful design of a wearable device should appeal the user's taste of beauty and fulfil the need of wide range of customers.

- **Mobility**

one of the advantage of a wearable computers is that it is always with the user, which means it is moving with the user all the time both in inside and outside environments. Users might do many different activities while using the device. They should be able to do activities such as running, climbing or jumping without having the fear that their wearable device might fall down or get wet in the rain. Different parameter such as size and weight and the way it attaches to the body can have an effect on the mobility of the device.

III. STATUS ON TECHNOLOGY AND SMART GLASSES PRODUCTS

When it comes to new technologies, many consumers are skeptical and discuss potential negative consequences for a society. Although potential privacy concerns exist, smart glasses can be used to record one's environment, for example, smart glasses can make rescue teams more efficient, and support doctors at work, and also help law enforcement personnel solve crimes.

Research has also found that smart glasses can facilitate the everyday life of patients with Parkinson's disease and there has been recent discussions about the use of smart glasses in classrooms and education indicating further positive effects on society as a whole [15]. Like any technology, the growth of smart glasses might be limited due to some factors. From a technological perspective, especially the short duration of the batteries, a limited number of applications, and lack of ubiquitous high-speed internet connection are crucial.

However, it is likely that further developments in technology will address these barriers. From a more psychological perspective, users often criticize the design of the extant models, which could be one reason why Google stopped distributing its 'Explorer Program'. Likewise, fear of electro smog, or negative influences on the eyes, are other criticisms that are often discussed among consumers, although current research does not support these fears.

It is important to note that there are several legal, ethical and political challenges that might hinder the development of smart glasses. For example, wearing smart glasses in public could violate privacy and copyright laws. Both the National Association of Theatre Owners (NATO) and the Motion Picture Association of America (MPAA) have allied themselves to prohibit the use of smart glasses in cinemas due to concerns regarding movie piracy by illegal recording.

To reduce potential conflicts with regards to individual privacy concerns, some manufacturers, such as Google, announced not to develop facial recognition applications, but it might be a matter of time, this concept may be compromised. Manufacturers of smart glasses also advertise the benefits of using smart glasses as navigation systems, but whether this distracts drivers and thus provides a risk for other traffic participants is yet unknown. Analogous to older technologies, people might criticize that use of smart glasses might make society more unsocial.

It is surprising fact that, because of public criticism (e. g., privacy concerns), not everybody perceive smart glasses in a positive way. In particular, the user image of smart glasses is often expressed in a negative manner [15–16].

IV. RESEARCHER'S OPINION ON SMART GLASSES TECHNOLOGY ADOPTION ISSUES

There are several research issues surrounding the discovery and acceptance of smart glasses usage for consumers; these issues are raised based on five (5) major perspectives;

- **The Opticians Perspective**

From the optician's view point a crucial question arises, in the time to come how is the smart glass going to influence their business as these smart glasses do not exactly look like normal corrective glasses. Smart glasses are yet to become adopted fully by the mainstream. However, as the adoption is moving ever closer, it is our opinion that opticians should stay ahead of this evolution in technology.

- **The Ophthalmological and Cognitive Perspective**

Smart glasses arouse valid concerns about Computer Vision Syndrome (CVS), and monocular smart glasses may cause a range of conditions such as phoria and binocular rivalry. The question here tends to be what kind of visual or cognitive disorders might result from the use of different types of smart glasses? Again, it is our opinion based on this issue; that a range of experimental setups could be developed i.e. both short and long term measures on the eyes and cognition of subjects.

- **The Sociological and Interactional Perspective**

Smart glasses are interesting phenomena from a sociological and interactional perspective in a number of ways. Since smart glasses are yet to be adopted by mainstream consumers, common norms and etiquette for wearing the new devices have still not emerged. Investigations have it that new norms will not emerge until the smart glasses are actually used by people in real life situations.

- **The Technological and Design-Related Perspective**

In terms of design, smart glasses (not including connected glasses) are still relatively bulky and are perceived as nerdy gadgets rather than fashionable accessories. This fact is also a big component why smart glasses have been embraced by different industries, but not as a consumer product. Therefore, it is our opinion that technological and design developments interviews could be set up with leading experts, trendsetters and designers in the field to ascertain best approach method to solving this smart glass design challenges.

- **The Philosophical and Psychological Perspective**

The challenge here is of the most dystopic future vision in that smart glasses have the potential to isolate wearers from face to face interaction and human touch with grave consequences. The lack of human touch, for example, has been shown to reduce production of oxytocin (i.e. the hormone that positively influences our bonding and nurturing behavior), resulting in the negative psychological effects.

Another possible danger of augmented reality is that wearers get so focused on augmented content that they ignore the physical world. An example of this could be car accidents and body injuries attributed to people playing the extremely popular location based AR-game Pokémon Go, while not paying attention to their surroundings [14].

However, a way forward in this regard could start with a thorough review on the matter, and secondly approach the questions of the effects on smart glasses from different philosophical standpoints. As for the psychological effects, experiments (both short and long term) with subjects using smart glasses in different settings and for different tasks could be set up to monitor both behavioral and possibly neurologic effects.

V. RESULTS AND DISCUSSION

From this study, we figured out that the introduction of new technologies raises the question of how they may affect the human vision and brain. Smart glasses arouse valid concerns about Computer Vision Syndrome (CVS), and monocular smart glasses may cause a range of conditions such as phoria and binocular rivalry. Therefore, more research into the effects of smart eyewear on human vision and cognition is crucial, as the changes in technology may result in a new ophthalmological landscape.

As at 2014, when the google glass was launched, so many had high hopes for the smart glass believing it will have high consumer acceptance. However, the much hyped Google Glass has been taken off the consumer market, and smart glasses are yet to become adopted by the mainstream.

Smart glasses are used successfully in industry settings, and they could possibly alter the way work is done but has not been fully accepted as consumer product.

VI. CONCLUSION

This report has investigated trends in the smart glass technology in order to give a status on where it is now, and where it is headed in the future. In general, smart glass is a type of Augmented Reality Head Mounted Device (AR-HMD). Smart glasses possess relevance in terms of increasing process efficiency through an improved knowledge management. The use cases we have presented here covered a range of applications; potential usage of the technology seems to be more diverse and some not even discovered yet.

It was considered as a useful device especially in industries where it helped the user to multi-task and be more productive. Also, it helped to enhance the use of a smart-phone with using the phone application without taking the phone out of pocket.

In this paper, we have shown the challenges in different perspectives, and also made suggestions on how these obstacles can be handled. This may serve as a foundation for further research to be carried out and development in an entirely new technological context.

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