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Wink Lens Smart Glasses in Communication Engineering: Catalyst for Metaverse and Future Growth Point

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Abstract: *Meta-universe is a very hot concept recently in the field of communication engineering, which is a virtual world where people can interact and communicate using VR/AR and other means. Since XR headset is one of the hardware that is crucial to the metaverse for consumers, the rise of metaverse is likely to be the main catalyst for the growth of XR headset shipments in the coming years. Smart glasses are one of them and one of the most promising wearable smart devices in the field of communication engineering. Smart glasses are similar to smartphones with autonomous operating systems that can be installed with software to achieve various functions, such as adding schedules, map navigation, interacting with friends, taking photos and videos, making video calls, etc., and enabling wireless network access through mobile communication networks. With the development of communication technology, smart glasses are also gradually connected with other devices, such as cell phones and tablet PCs, which can share and transmit information through Bluetooth, WI-FI and other communication technologies. In addition, in the field of smart glasses, there are many key technologies that need continuous innovation and breakthrough, such as binocular stereo display technology, human-machine interaction technology, voice recognition technology, etc. The continuous improvement of these technologies will further promote the development of smart glasses.*

Keywords: *Communication Engineering, XR Headsets, Voice & Motion Control*

1. Introduction

With the development of technology [1], the development of the technology of everything connected, the era of smart home has slowly penetrated into all aspects of life. Life in the household products continues to upgrade and open intelligent control, to bring consumers a new experience of good intelligent life [2]. Home printers have also become an increasingly common member of family life in the context of the times. In the cloud services, the rapid promotion of the Internet of Things, printers and PCs, tablets, smart phones and other devices are developing a closer connection; the printer's trend of intelligent connectivity has been unstoppable.

Information can be superimposed on the field of view through an optical head-mounted display (OHMD) [3] or embedded wireless glasses with a transparent flat screen display (HUD) [4] or augmented reality (AR)[5] overlay, as shown in Figure 1. These systems have the ability to reflect projected digital images and allow the user to navigate or better view them. While earlier models could perform basic tasks, such as serving as front-end displays for remote systems, such as smart glasses using cellular technology or Wi-Fi, modern smart glasses [6] are wearable computers that can run standalone mobile applications. Some are hands-free and can communicate with the Internet via voice commands in natural language, while others use touch buttons. Like other computers, smart glasses can collect information from internal or external sensors. It can control or retrieve data from other instruments or computers. It may support wireless technologies such as Bluetooth, WI-FI and GPS. A few models run mobile operating systems and act as portable media players to send audio and video files to users via Bluetooth or WiFi headsets. Smart glasses models also have full life logging and activity tracker capabilities.

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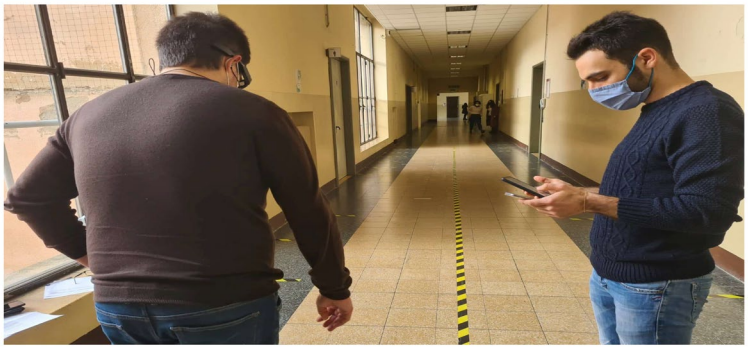

Figure 1: User walking with embedded wireless glasses with information superimposed on the field of view.

The core technology of Wink Lens is blink printing, which simply means that users wear the developed contact lens in their eyes, blink to get the information of the object they see and take photos to keep, and then print from a distance through wireless data transmission. The chip in the contact lens can not only identify any scene or object in 2D [7] in real life, but can also be scanned in 3D by the chip, and the details of the scanned object can be transmitted to the corresponding printer for printing over long distances [8], which greatly saves time and costs and greatly facilitates daily life. The original intention of this product design is divided into two parts, the first is to achieve in daily life can be fast to take pictures or obtain information, the second is to hope that our product can become an indispensable helper in work, scientific research, etc.[9]. Relying on virtual reality technology using head-mounted devices to simulate the real world '3D interactive environment. XR [10] between VR [11] and AR can realize the user's perspective experience and operation behavior in the virtual world and the real world, which can realize the complex environment of real-time interaction [12]. Therefore, our products are also divided into different models for different user groups, as shown in Figure 2. According to the trial purpose is divided into trial version and full version.

(**a**) (**b**)

Figure 2: Different models of embedded wireless glasses.

With security, fault tolerance, applicability and scalability, the Wink Blink Printer solves a number of product problems such as the lack of packaging and cooperation, closed sales channels, late start of sales and security and health issues with Google Glass [13]. Combined with the technology used in the product, in the actual product quality, product wearing comfort and other factors for consumers to think

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about, and strive to create a comfortable to wear, different from person to person, the maximum protection of social privacy Wink Blink printer [14].

2. Design Solutions

2.1. Voice Control

In people's daily communication, speaking is the most common way, and by introducing voice interaction into the wearable field, people will be able to enjoy a more natural and easy interaction experience. Voice control means that computing devices can understand what people say, and also can execute corresponding commands according to what people say. For small, body-worn smart glasses, voice control is a proven way to interact. A voice control module is shown in Figure 3.

Figure 3: A voice control module.

2.1.1. Principle of Voice Control

The most central part of voice control is the recognition technology of voice. Bone conduction technology allows for efficient recognition and transmission of voice, and is used in several smart glasses. Buhel's Sound Glass, for example, is equipped with indirect bone conduction sensors. The sound generated by the vibration of the inverter is transmitted to the inner ear through the bones on the side of the user's head, so that the user can hear the sound. Although voice control is an important interaction method in smart glasses, voice control has encountered many difficulties.

2.1.2. Defects of Voice Control

First of all, there are a lot of interference factors to the extraction of speech signal, such as the difference of vocalization between individuals and the change of their own intonation, the difference of the way people speak in different regions and different cultural backgrounds, and the interference of the noise of the environment to the speech signal, etc. All these factors will have a negative impact on the extraction of speech signal. Secondly, the efficiency and speed of speech recognition still need to be improved, and these two points directly affect the application value of speech control in smart glasses, which is an important measure of the application value. In addition, users have high expectations of voice control, but the actual situation is that voice control is not yet able to meet the needs of users.

2.2. Gesture Recognition

The advantage of using gestures as input to complete the interaction function with smart glasses is that it uses a non-contact method. Gesture recognition technology can be divided into three categories from simple and rough to complex and fine: two-dimensional hand type recognition, two-dimensional gesture recognition, and three-dimensional gesture recognition. The difference between three-dimensional gesture recognition and two-dimensional gesture recognition is that the input information of three-dimensional gesture recognition also contains depth information, and smart glasses using three-dimensional gesture recognition can realize more and more complex interaction methods.

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2.2.1. Gesture Recognition Principle and Sensor

Three-dimensional gesture recognition uses depth information to be able to recognize various gestures, hand shapes and movements. To obtain the depth information, special hardware is needed, and in conjunction with the recognition algorithm, 3D gesture recognition can be achieved. Next, we introduce several sensors dedicated to gesture recognition: TMG399, a non-contact optical IR gesture recognition sensor equipped with a four-in-one sensor module for gesture recognition, ambient light detection, proximity perception and color perception; MGC3130, a 3D gesture recognition chip launched by Microchip Technology, which can sense gestures without contact under the action of its electric field and is capable of detecting gestures at a distance of up to 15cm at 150 dpi. The MGC3130, a 3D gesture recognition chip from Microchip Technology, senses gestures without contact under its electric field and is capable of determining coordinate positions with high accuracy at 150 dpi within a distance of 15cm; MYO, a product from the startup Thalmic Labs, which is an arm band worn on the arm; and 16Lab, a smart ring for gesture control with a built-in inertial sensor module, as shown in Figure 4, processor and low-power Bluetooth module.

Figure 4: A smart ring set for gesture control: (a) smart glasses; (b) wearable gesture control ring.

2.2.2. Defective Gesture Recognition

Use 16-point type for the subtitle, aligned to the center, linespace exactly at 14-point with bold and italic font style.

Words like “is”, “or”, “then”, etc. should not be capitalized unless they are the first word of the subtitle. The initial letters should be capitalized. No formulas or special characters of any form or language are allowed in the subtitle.

2.3. Eye Tracking

Eye tracking is the process of measuring the eye's point of gaze or the movement of the glasses in relation to the head. Google Glass is able to sense the user's emotions through eye tracking technology to determine the user's reaction to the ad they are viewing.

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2.3.1. Eye Tracking Principle

Eye-tracking measurement techniques for smart glasses are primarily image- and video-based methods that encapsulate a variety of techniques for measuring distinguishable eye-tracking features such as heterochromatic edges of the sclera and iris, the intensity of light reflected from the cornea, and the shape of the pupil's appearance. Image-based methods that incorporate pupil shape variation as well as corneal reflection are widely used in measuring the focus of the user's vision.

2.3.2. Eye Tracking Defects

Although the eyes are the most extensive and fastest way to receive information in the body, eye-tracking is a long way from human interaction. Due to the inherent blinking and jittering characteristics of the eyes themselves, many interfering signals are generated that may cause interruptions in the data, which can make it much more difficult to extract accurate data from eye movement information.

3. Design & Implementation

This product is a corneal contact lens, is a kind of electronic glasses worn on the cornea of the eye, can help people quickly obtain the parameters and data needed for 2D and 3D printing, the company follows the national industry implementation standards: GB/T4754-2017, indeed the quality of the company's products, the warranty period of 1 year from the date of purchase (non-normal use of the product damage, burned out, is not part of the warranty).

3.1. Technical Features and Principles

XR technology, iris recognition technology, and brain-computer interface technology are used in this product to improve the user's experience. Users can wear the product without interfering with their daily life, and they only need to blink twice in a row when they need to use the product (blink twice is the default setting, which can be changed according to users' own habits).

3.1.1. XR Technology, Brain-Computer Interface Technology

Extended Reality (XR) refers to the combination of the real and the virtual through computers to create a virtual environment for human-computer interaction, which is also the collective name of AR, VR, MR and other technologies. By integrating the visual interaction technologies of the three, it provides users with a seamless transition between the virtual world and the real world of "immersion".

XR (extended reality) technology includes AR (augmented reality), VR (virtual reality), MR (mixed reality), using hardware devices combined with a variety of technical means to integrate virtual content and real scenes.

Brain-Computer Interface (BCI) refers to the creation of a connection pathway between the human brain and computers or other electronic devices for information exchange, information exchange and control. Through this channel, a person can express ideas or manipulate devices directly through the brain, without the need for words or actions.

The combination of XR technology and brain-computer interface technology allows real-time selection of shooting scenes and object parameters, such as framing the scope of the desired print in the vision or observing and adjusting 3D models of real objects, and then transmitting the data to other devices of their own via wireless transmission. Eliminating the step of parameter adjustment on the computer improves the portability and efficiency of the product.

3.1.2. Iris Recognition Technology

The iris recognition system mainly contains three major modules: iris image acquisition mount, live iris detection algorithm, feature extraction and matching. The acquisition of iris image is the first step in iris recognition, which can be expressed by the mathematical formula:

$$I(x,y) = I_0(x,y) + S(x,y) + N(x,y) \quad (1)$$

Here, $I(x,y)$ represents the collected iris image, $I_0(x,y)$ represents the iris image itself, $S(x,y)$ represents speckle noise under illumination conditions, and $N(x,y)$ represents additive Gaussian noise. Due to the small size of the iris area and the large difference in iris color among different races, special iris image acquisition equipment is required, including an infrared optical imaging system, electronic control unit, and appropriate software algorithms. Liveliness iris detection algorithms, such as Pupil

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Dilation Ratio (PDR) algorithm and Three-Dimensional Wavelet-Based Contourlet Transform (3D-WBCT) algorithm, are used to prevent iris image spoofing attacks.

Iris image acquisition is the first step in iris recognition. The small size of the iris and the great variation in iris color among different ethnic groups make it impossible for an ordinary camera to capture a clear iris image that can be used for recognition, so a dedicated iris image acquisition complex must be used, including an infrared optical imaging system, an electronic control unit, and an appropriate software algorithm.

Feature extraction and matching is the core part of the iris recognition system, i.e., the iris image is described using valid features, and the similarity between feature vectors is inscribed, and the system eventually compares the captured information with the information in the database to determine the user's identity and authority, etc.

In this product, the iris recognition technology is mainly used to identify the identity and perform real-name authentication. Matching the iris characteristics of the user with the data entered into the database in advance serves to store the initialization function and privacy protection set by different people. Only iris feature matching can call data related to your person, preventing the leakage of personal privacy.

3.1.3. BDS Positioning System

China BeiDou Navigation Satellite System (English name: BeiDou Navigation Satellite System, BDS for short) is a global satellite navigation system developed by China itself. The product can use its own BDS positioning module to send its own position signal to the positioning background to achieve the positioning of the product. With this system, users can achieve all-weather, continuous, real-time three-dimensional navigation and positioning and speed measurement around the world; in addition, with this system, users can also carry out high-precision time transfer and high-precision precision positioning.

3.1.4. Fresnel Lenses

In order to perfect the user's wearing experience and to achieve the above mentioned technology, the product needs to be small and light. If the size is to be small, then the focal length of the lens must be as short as possible; if the weight is to be light, then the thickness of the lens must be as thin as possible. For traditional lenses, small focal length and thin lenses are not compatible, so new technology is needed to solve this contradiction. In addition to ordinary lens imaging, there are two other means, Fresnel lens imaging and folded optical path image imaging. Fresnel lens is the mainstream device using solutions, well-known Pico neo3 and Oculus Quest 2 and so on. Its focal length is slightly reduced, the mass is lighter, the production cost is smaller than the ordinary lens, but due to the curvature discontinuity, affecting the image quality. Short focal length system by folding the optical path (composite lens) way, the lens will be thinner so as to greatly reduce the weight of the device, is the future direction of VR equipment development. Due to the complex design of the optical path, and the need to go through multiple reflections and refraction, the optical path loss is large, the coating technology, optical path design capabilities require high. The basic principle of lenticular imaging is as follows:

Sure! Here's the translation:

$$\frac{1}{f}=\frac{1}{s}+\frac{1}{s'} \tag{2}$$

Where fthe focal length of the lens is, s is the distance from the object to the lens, and s' is the distance from the image to the lens. This formula describes the basic principle of lens imaging, that light passing through a lens will converge on the other side to form an image. By adjusting the distance between the object and the lens, the size of the image can be magnified or reduced. When designing short-focus systems, this formula is also one of the factors that must be considered.

Refractive optical path (short focus system) mainly consists of reflective polarizer, complex optical components and display screen. The reflective polarizer only allows the light path of a specific polarization direction to pass. The design of the optical assembly is more flexible, and consists of a combination of Bragg grating, polarizer, quarter wave sheet and other optical components to change the direction of polarization, reflection and refraction of the optical path. Specifically, light is emitted from the display, passed through the beamsplitter, reflected on the polarizer, reflected again through the beamsplitter to realize the optical path folding, and then shot into the human eye through the polarizer.

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However, due to its complex optical path design, multiple reflection and refraction, the light loss is large, the process manufacturing and easy to appear stray light problems. Its light intensity can be expressed as

$$I = I_0(T^2) \tag{3}$$

3.2. Product Composition

The product includes two in-eye lenses, charging compartment, charging cable, manual, and professional care solution. The use of the product also needs to be combined with the company's APP, the download method is attached to the first page of the manual. The lenses are available in your choice of colors, including sunset brown, red birch brown, smoky black, brown and gray gold, caramel crystal, cherry soft pink, glacier lake blue, morning fog gray, turquoise green, etc.

3.3. Use and Operation

First of all, wash your hands clean and do not wear this product with dirty hands to prevent contamination of the eyes. Secondly when wearing this product be sure to use both hands to separate the upper and lower eyelids, rest the glasses on top of your index finger and gently snap them on the black eye, your eyes should look forward. After putting on the contact lens, you should gently close your eyes so that the glasses are evenly and smoothly flattened on top of the black eye. First time purchasers of this product must practice repeatedly under the guidance of a professional, it is easy to damage your eyes if you don't wear them well. The company will record a teaching video for each buyer to learn how to wear and operate the product, so buyers can watch the video to get a preliminary understanding of some common functions of the product. At the same time, the buyer can also buy online teaching to learn, the company is fully committed to achieving the perfect product experience for the buyer and efforts.

3.4. Repair and Maintenance

This product needs to be cleaned with the cleaning solution that goes with it after taking it down after use, do not just take it down and put it in the charging compartment to ensure the cleaning of the charging compartment and the lens. This product must be cleaned with the cleaning solution that goes with this product when it is in use, not with water or other brands of cleaning solution, otherwise it will cause damage to the product. Cleaning glasses cleaning fluid if found expired, you can no longer use, need to replace the cleaning fluid, to use the cleaning fluid in the safe use period to clean.

This product is best not out of low battery state for a long time, otherwise it will reduce the life of the battery. This product does not support the replacement of the battery, but can be replaced with a damaged product; the valuation standard is determined by our company.

The charging compartment of this product also needs to be cleaned regularly. Monthly maintenance is recommended to ensure that it is non-toxic and bacteria-free, thus protecting the eyes of the user with this product.

4. Possible Application Areas

Like other vital recording and activity tracking devices, the Wink Lens smart glasses have a GPS tracking unit and digital camera that can be used to record historical data. For example, after a workout, data can be uploaded to a computer or online to create a log of workout activity for analysis, displaying a map and current coordinates. Users can "mark" their current location and then edit the name and coordinates of the entry so they can navigate to these new coordinates. The smart glasses model can be used completely as a standalone product and consumers can purchase a phone running the same operating system so that the additional features and enhancements of both devices can be synchronized. The smart glasses can be used as a flat screen display (HUD) for the phone or as an extension of the remote control and alert the user to communication data such as calls, SMS messages, emails and calendar invitations.

Wink Lens Smart Glasses is a special glass for augmented reality (AR technology). Grafting video imaging technology onto the glasses is equivalent to projecting large video images of 106" or more in a space 3-5 meters from the user. Even in a small environment, you can enjoy the visual enjoyment of a

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large screen. In addition to having the function of video glasses head-mounted display, Bluestar Technology has introduced augmented reality technology for Wink Lens based on video glasses. Users can use the Wink Lens smart glasses while simultaneously interacting with their social circle at all times, browsing, sharing and discussing topics related to TV content. It can also be paired with a smartphone via Bluetooth, connect to the Internet via Wi-Fi, listen to music, and take photos and videos, and more.

5. Conclusion and Innovation

In the future, human interaction will shift from 2D interaction to more efficient 3D interaction. 3D visual interaction systems depend on the development of virtual reality (VR), augmented reality (AR) and mixed reality (MR), collectively known as "extended reality" (XR). Relying on virtual reality technology uses head-mounted devices to simulate real-world '3D interactive environments. Between VR and AR, XR enables users to experience and operate in the virtual world and the real world from the perspective of a complex environment that allows real-time interaction. XR technology, iris recognition technology, and brain-computer interface technology are used in this product to improve the user's experience. Users can wear the product without interfering with their daily life, and they only need to blink twice in a row when they need to use the product (blinking twice is the default setting, which can be changed according to the user's own habits).

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The combination of XR technology and brain-computer interface technology allows real-time selection of the parameters of the scene and the object to be photographed, such as framing the visual range of the desired print or observing the 3D model of the adjusted real object, and then transmitting the data to their other devices via wireless transmission. The step of parameter adjustment on the computer is eliminated, which improves the portability and efficiency of the product.

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