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Research on Human-Computer Interaction Technology of Wearable Devices Such as Augmented Reality Supporting Grid Work

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Abstract

This study is based on speech recognition and interaction, augmented reality, the movement of the head gesture interaction interactive technology, human-computer interaction system is designed to meet the power equipment installation, operation and maintenance operations, to enhance formation of reality for the show, with gestures and head movements as the main way of interaction, with voice commands and touch as a unified interactive model of secondary interaction the way.

Keywords: human-computer interaction, augmented reality, wearable devices;

1. Introduction

With the rapid development of mobile communications technology and continuously introduce high-performance low-power chips, wearable device form began to diversify, gradually from conceptualization to commercial applications, new wearable devices appear constantly. Google, apple, Microsoft, SONY and other technology companies have started to explore in this field, industry experts believe that wearable technology will be after the smartphone, the next potential field of technology development[1].

At present, in the grid work, there exist the following problems: standardized work instructions, CARDS and maintenance record, test report, the management and working ticket is complex, it is not convenient for field use, adopt in dealing with the daily sheet paper records are complete, this model has some shortcomings, such as not connected to the production management system maintenance, easy to lost, not easy work for data sharing and statistical analysis, etc., cannot be effective real-time control to the work site; In the production management system error, more artificial entry in larger workload; Substation are numerous, personnel flow faster, many managers are

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not familiar with substation road, affect the real work[2]; Substation main wiring diagram changes frequently and consult the inconvenient; Drawings, specifications, site often carry inconvenience to use information, conditions of work area is limited, no archives.

To solve above problems and the rapid development of wearable technology, introducing wear equipment in power grid operation become the important industry trends. And, therefore, necessary for wearable equipment such as power grid operation of augmented reality human-computer interaction technology research and application of somatosensory interaction, movement and interact, gestures, physical interaction, eye movement interaction, augmented reality, such as interaction, through the grid and the integration of business, the liberation of the hands and minds of people, bring new work mode, improve the health level of equipment, reduce the intensity of field staff, improve the efficiency of business processing[3]. Predictably, as practical wearable equipment in electric power, will bring a new round of management innovation for the electric power enterprise.

2. The research status and abroad

2.1. The human-computer interaction technology

In wearable devices interaction in addition to the regular interaction, natural interaction pattern mainly has the following categories: voice, gestures, tactile and visual, etc.

Voice interaction technology is currently one of the development of a mature technology, the field research hot spots are: speech recognition, speech synthesis, natural language understanding, etc[4]. With the support of national 863 plan, voice interaction techniques are included in the research topic in the field of computer system. Domestic rapidly launched several mature commercial applications, based on the technology of Chinese voice interaction xunfei sound at hkust, typical wormhole voice assistant. Gesture interaction technology has been widely studied, especially the gesture recognition based on vision[5]. Visual gesture recognition is captured on video collection equipment consists of gesture image sequence, using computer vision technology for processing, then to the gesture is recognized. In recent years, the human head gesture recognition technology is more and more attention by the researchers both at home and abroad, also appeared a lot of head pose information measurement method. At present in the field of wearable devices appeared a variety of measuring head posture information technology at home and abroad, such as mechanical, magnetic, optical, and ultrasonic method and inertia method, based on the two-dimensional graphics, based on the three-dimensional image and the movement of the head based on depth image recognition algorithm has a deeper research[6].

Above all, wearable device the human-computer interaction technology at home and abroad has been a research hot spot, the various technology according to their maturity has been commercialized, and showed a trend of convergence between each other.

2.2. The Augmented reality technology

Augmented reality with reality technology, interactive technology, sensor technology and computer graphics computer generated virtual environment and users around the reality of the environment be in harmony are an organic whole, the user from the sensory effects that virtual environment is part of its real surroundings[7].

Google company in 2012 launched the world's first augmented reality Glasses, Google Glasses, Google Glasses can dock with the powerful distributed search engine Google, developers can use Google to provide software development kit will Google Glasses used in their own virtual simulation system. AR startup Magic Leap was established in 2011, the Magic of Leap "Cinematic Reality" the effect of soft hard suite, will adjust focus according to the human eye, automatically convert light field Angle and depth, embodies the most advanced technology level.

From the perspective of the development of domestic augmented reality at present, although the relative to foreign late start, but focus on the system application technology, scope and research points are single, but a lot of research institutions, colleges and universities, especially in augmented reality some algorithms and design technology has larger, such as camera calibration algorithm as well as the virtual object registration algorithm and so on, the success of these algorithms research can help solve the problem of shade in the augmented reality, display design, etc.

3. The key technology

Support power grid operation of augmented reality wearable device such as human-computer interaction technology research technical route overall framework is shown in figure 1.

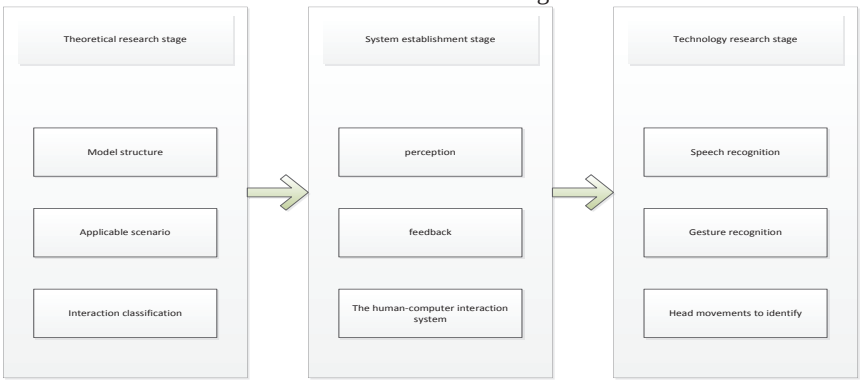

Fig.1.Research contents and technical route framework

3.1. Research on human computer interaction technology system in power grid operation environment

Research system of human-computer interaction technology, model design analysis of different levels, from cognitive science, human-computer interaction model of analysis of how users interact with the computer, the behavior model of another kind from the Angle of the system design to understand users, analyzing the characteristics of the different users in order to improve the pertinence and adaptability of the system design, namely the user characteristic model, a class from the structure of the system, discuss the interface in the system status and decomposition, namely interface structure model; Through the study of different hierarchical model structure and the application of the scene, the worker's hands in the work of power grid operation inconvenient operation helmet or glasses, the characteristics of the multimodal interaction, establish grid operation environment includes system, user, input, output, the human-computer interaction system of four parts, as shown in figure 2.

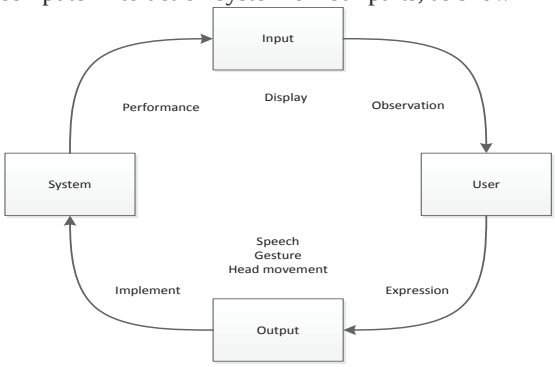

Figure.2.Human computer interaction framework

User setting objectives, by voice, gestures, head movements, such as information input, conversion as the core language transfer to the system, system, based on the description of the operation will be the result of the execution to output in the form of voice, video, text and display, and control target evaluation, complete circulation part of the assessment phase, the interaction process completed the expression, perform, performance, and to observe four forms of change.

3.2. Research on human computer interaction technology of wearable devices such as speech and gesture

Research in speech recognition, speech synthesis, the key technology of the semantic understanding as the core voice interaction, set up the basic process of voice interaction module, as shown in figure 3: users via mobile intelligent terminal of microphone input speech signal, speech signal after the speech recognition module into the text, the text with semantic understanding module into semantics, namely the user's intent, perform module is responsible for user's intent, and returns the results of text, the execution result deliver the speech synthesis module text into speech, the text, together with the synthetic speech respectively through the screen and the speaker to show to the user.

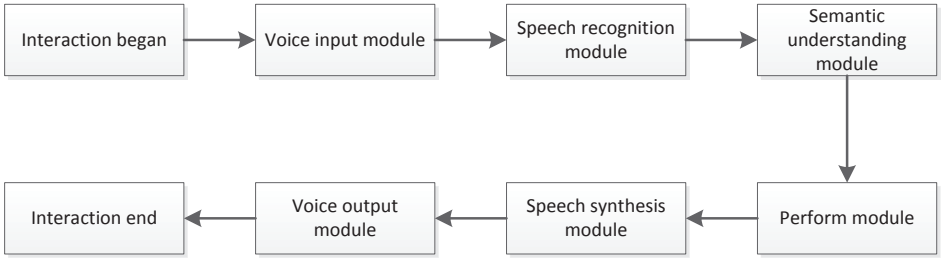

Figure.3. Voice interaction module

Study is given priority to with gesture recognition, head movements of somatosensory interaction technology, build stereo feeling interaction process module, as shown in figure 4: first of all, by one or more of the inertial sensors signals generated in hand or head movement, collect data, and then the data preprocessing, feature extraction and selection, according to the extracted features for classification and identification of movement.

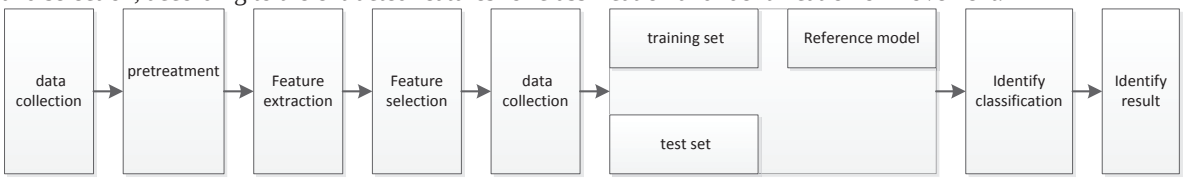

Figure.4.Somatosensory interaction module

Compared to hardware implementation three technology, this subject adopts the technology of light fly time as hardware implementation for gesture recognition. Depth cameras are used to get the depth information of the object, information access for user gestures, middleware technology is adopted to improve the data analysis and processing, transform the data into the corresponding gestures instruction, the study of the characteristics of signal dynamic, track the movements of hand gestures, and then identify the gestures and hand movements together complex action, realize the user gesture wearable device terminal interaction techniques.

3.3. Research on the interactive technology of wearable devices based on augmented reality

The augmented reality system, the system of the four basic steps: 1) the real scene information; 2) analyze the real scene and scene location information; 3) generated virtual scene; 4) the combination of video or display directly. First using the markers for scene location information in the video streaming, and graphics system according to the camera position and location information obtained from the real scene coordinate calculation virtual object to the camera plane of affine transformation, through transformation matrix in the plane map virtual objects. Finally depend on the output device shows that synthetic scenes. Output devices, tracking and positioning technology, interactive technology, and the merger between the real and the virtual technology is to implement an AR system is the basic supporting technology.

Tracking research on image registration technology, this topic in augmented reality system will be integrated using the following many types of tracking technology. Video detection: the use of pattern recognition technology, using template matching and edge detection methods such as object identification tags defined in advance, or benchmark, and based on its shift and rotation coordinate transformation matrix calculation; GPS: used in outdoor

AR system to track and determine a user's location; Ultrasonic: principle is similar to the GPS, using accept measurement device with three known the distance of the ultrasonic waves to determine the location of the user; Gyroscope: used to determine the user's head rotation Angle, to determine how to convert the coordinates of the virtual scene in the field of view and content.

Study virtual show nakedness superposition of information fusion technology, wearable devices through gyro sensors such as on-site personnel head rotation Angle, using image tracking technology equipment to recognize the need to show, recorded in the equipment, to sign, then connect the backend server, query and need to show the device information content, generate virtual display screen, eventually merged into the real image, the virtual information of the overlay display, on-site staff to check the power equipment appearance can quickly obtain three-dimensional model of electric power equipment of the internal and external structures or operational guidelines for school official cites use video, according to the model or operational guidelines for school official cites use of the video tips for the operation of the equipment, auxiliary workers quickly find accurately the fault of the problem.

3.4. Interactive mode switching

By adopting the idea of complementary operation, for a single interaction, under different scenarios, according to the working environment dynamic choice one of them. Such as overly bright/dark light, preferred voice interaction, second signal interaction; Environmental noise, the preferred gesture interaction, voice interaction next;

Need to test environment, the corresponding hardware software for auxiliary judgment.

Later can use the ideas of the mutual operation, for a variety of interactive way, under the same operation scene, two or more interaction with each other, completes the tasks together. Such as when a distant view, the head rotation choice field of vision, gesture interaction amplification, narrow view, etc.

4. Conclusion

This system in real-time compute the position of the camera image and Angle and combined with the corresponding image, combined with the operation of power grid equipment complexity and the diversity of information push, using the actual fusion and 3 d registration tracking technology from information show diversity, authenticity and the Angle of human-computer interaction flexibility, virtual overlay on the field of all kinds of different shapes and rules to identify the track of the power equipment, according to the tasks push recognition show the types of information will be different information (including text, 3 d models and multimedia, etc.) in accordance with the specific work scenes in the most appropriate location and under different modules, with the change of the field personnel head posture, gestures, voice input, show the information also followed by change, guide through words, speech output, reasonable guide on-site personnel is more accurate and convenient to operate power equipment.

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