Human-machine integration interactive system based on mixed reality technology

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Abstract. With the development of science and technology, human-computer interaction has attracted more and more attention from all walks of life. With the emergence and maturity of Mixed Reality (MR), new ways of interacting with this new technology are developing. From the study, research, to entertainment, production, marketing and other fields can find the development direction and interest needs of this new type of interaction.

1. Introduction

The interactive system designed in this paper mainly uses Microsoft HoloLens to integrate digital content such as application, information and multi-dimensional video into the surrounding physical space, and directly observes and controls the mechanical arm in industrial production for the convenience of workers. At the same time, it can avoid large mechanical accidents.

2. Technical basis

2.1. Microsoft HoloLens

Microsoft HoloLens is Microsoft's first cable-free holographic computer device that enables users to interact with digital content and interact with holographic images in real-world environments. It is a hybrid reality head-mounted device. It is not subject to any restrictions - no cables and earpieces, and no need to connect to a computer, with holograms, high-definition lenses, stereo, etc., allowing you to see and hear the holographic scene around you.

Microsoft's HoloLens does not generate a 3D world that everyone can see, as the movie does, only the wearer can see; while HoloLens does not present a completely different world to the user, but superimposes certain computer-generated effects on the real world. The user can still walk freely and talk freely with people, without having to worry about hitting the wall because they can't see.

2.2. Mixed Reality (MR)

The progress of mixed reality technology and virtual reality technology has attracted wide attention from all walks of life around the world, leading to a vision for the future in the fields of education, medical care and games. Mixed Reality (MR), Virtual Reality (VR), Augmented Reality (AR), and Augmented Virtuality (AV) are all concrete manifestations of scene technology. There is a connection between them. There is a difference. To put it simply, the visual presentation of VR is to block the
connection between the human eye and the real world, and create a whole new world through the real-time rendering of the device. AR is a technology that increases the user’s perception of the real world through the information provided by the computer system, applies the virtual information to the real world, and superimposes the computer-generated virtual object, scene or system prompt information into the real scene, thereby realizing the reality. Enhanced. MR is an integrated application and promotion of VR and AR. It combines the real environment and the virtual environment to construct a multi-scenario multi-dimensional scene experience required by users through the combination of real scene and virtual scene. According to Steve Mann's theory, intelligent hardware will eventually transition from AR technology to MR technology.

2.3. Human-computer interaction

Human-computer interaction is an important supporting technology of MR, and it is also a research hotspot at home and abroad in recent years. Human-computer interaction has now entered a natural human-computer interaction phase represented by a multi-touch interface, a tangible user interface (TUI), a 3D user interface (3DUI), and a multi-channel user interface. As MR technology continues to mature, more and more scholars are beginning to seek new ways of interacting to adapt to the development of this new technology. They have summed up new interaction design principles and evaluation methods from practice, developed a new interactive technology for MR technology, and developed new interactive systems and applications on the basis of this, which greatly promoted MR and human-computer interaction technology development.

3. Design concept

Nowadays, in the era of mechanized assembly line production, robots with various functions have become an essential part of the production line of the water shop. The robot arm itself can assist the worker to do a lot of work that cannot be done by humans. Therefore, the original intention of the system design is to make the robot arm more efficient, standardized and safe to use.

This program was designed with HoloLens' Holograms function to design a human-computer interaction system (Fig. 1) to realize all-round observation of the mechanical arm in industrial production to protect the operator's safety and prevent accidents or machine damage.

![Figure 1. Human-computer interaction system](image-url)
However, in the design process, through the addition of three interaction modes: gaze, gesture, and voice, the program realizes HoloLens and PC communication under the WiFi environment using HoloLens as the main body, realizing man and robot arm. Interactions extend the role of the original single observation machine of this program. This design can change the way of controlling the robot arm in the traditional industry, to reduce the number of times the worker walks back and forth to observe the position of the arm, and realizes the working range of the robot arm while observing the working arm at a close distance. To the extent that the operator is safe and the robot arm has more room to move.

In the process of designing this interactive system, the scope of application of the traditional robot arm has been continuously expanded, and the operation interface in HoloLens has been continuously added, so that this technology can be applied to more fields and can be used in various more complicated environments. Working in the middle. When this man-machine communicative interaction system is perfected, it will be able to accomplish many tasks that are difficult to complete by human resources, and can achieve industrial production with no difference in the whole environment, to improve production efficiency, improve the working environment of industrial production personnel, and save labor.

4. Program design

4.1. Market demand
From the industrial point of view, the design uses the mixed reality technology that is now widely concerned to realize the communicative interaction between the user and the robot arm. It is more convenient to control than the traditional robot arm, easy to operate and easy to use.

The products designed in this paper enable workers to work without going to harsh environments. They only need to wear glasses to control the work of the robot arm, reducing the workload, alleviating the work intensity and improving work efficiency.

4.2. Feasibility analysis
On the technical level, AR technology has appeared for more than 30 years, and it has been able to achieve the boundary between the fuzzy real world and the virtual world generated by computers by enhancing the perception, sound, smell, touch and listen. The “seamless” integration of real-world information with virtual world information has led to a new direction in the field of virtual reality in recent years – Mixed Reality (MR), which was developed and developed by Steve Mann.

The emergence of mixed reality provides ideas and technical support for the human-machine integration interactive system. In early 2015, Microsoft introduced the first holographic computer HoloLens running Windows 10. It is completely self-contained, requires no cables or a mobile phone, and does not require a computer connection. Microsoft HoloLens can incorporate holographic images into the physical environment, giving people a new way to see the world around them. And the corresponding SDK support program development, so that the system can use HoloLens as a carrier, use the unity development platform to import the industrial robot ABB IRB1200 model compiled by RAPID language (Fig. 2), connect HoloLens and PC with TCP/IP communication, and finally Realize the use of MR technology to achieve man-machine interaction, and achieve the purpose of directly controlling the robot with HoloLens. This technology has been perfected to directly command real-world robots to respond to changes by changing the HoloLens operator interface in sight.
5. Summary
At the industrial production level, the interactive system establishes a channel between the ABB IRB1200 and the ABB IRB1200 in the HoloLens interface, enabling the system to accurately observe the robot's real-time moving distance and position, making the operation more precise and reducing product errors. Hologram technology can be used to achieve full angle observation and check the working condition of the robot, and real-time understanding of the working state of the robot to extend the working life of the instrument.

In terms of manual operation, HoloLens is the only product in all existing HMDs that does not need to be plugged in during development, configuration and use, so HoloLens can be connected directly via WiFi. The characteristics can effectively protect the safety of industrial workers, and make the machine only contact the products to be manufactured during the work, thereby reducing accidents and unnecessary losses. This requires only one HoloLens, and does not require a large console such as a machine tool in a conventional industry. Therefore, the use of the human-machine blending system at the industrial production level is feasible and positive.

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