ORIGINAL CONTRIBUTION
Application of Virtual Reality and Robotic Arm

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Abstract— There will still be factory accidents in today's life, such as a machine operation inadvertently causing the person crushed to death, the arm twisted, and machine electric leakage caused personnel to be killed by an electric shock. In addition to the above, there are many high-risk and not conducive to manual operation of the environment exists. If you can take a remote control for the robotic arm to replace the work of professional personnel, reduce the occurrence of danger and improve the efficiency of production. Therefore, this paper explores the use of virtual reality and remote control robotic arm to perform more precise, complex and dangerous work. The design combines a VR device, the multi-axis robotic arm and synchronizing video to VR environment for the user using the head-mounted display and real manipulation operation. We are mainly divided into two parts to discuss. The first part is the image synchronization, how to capture the camera image to display on the headset achieved image synchronization. The second part is the synchronization of operation and control, how to perfectly synchronize the robotic arm's movements and the controller to facilitate complex, precise and dangerous operation. Through virtual interaction and stability of the arm, it can reduce the occurrence of errors and improve the accuracy of the calibration. It is hoped that this method can effectively reduce industrial safety accidents..

Index Terms— Virtual Reality, Robot, Robotic Arm, Remote Control, Internet of things (IoT)

I. INTRODUCTION

With the development and progress of science and technology that many industries began to enter mechanization and bring convenience for life, but also brought a lot of security doubts [1]. In today's life will still be out of the factory accident, such as the machine operation accidentally caused personnel to be mechanically crushed to death and arm broken [2, 3]. The machine leakage caused by the electric stoning. In addition to the above, there are many high-risk and dangerous environments that are not conducive to manual operation, such as high temperature environment, building buildings, undersea exploration, rescue sites and other harsh environments. And, in order to reduce accidental occurrence and environmental constraints, we can reduce accidents by means of virtual reality remote robotic arm.

Virtual reality is calculated via a computer with a head-mounted display and controller to interact the three-dimensional objects in the virtual world. In recent years, the technology of virtual reality has been widely used in education, military, business and entertainment [4, 5]. Due to the limited relationship between technology and resources, it is already great to have such achievements. in the future, virtual reality can have further development, such as: full virtual reality meeting.

The concept of the Internet of Things (IoT) appeared in 1999. The concept proposed by Professor Ashton of MIT Auto-ID Center in the study of Radio Frequency Identification (RFID). It is to extend the PC to PC (P2P) architecture to Machine to Machine (M2M) using RFID combined with the internet architecture. Architecture. It is defined that all the items are connected to the Internet through RFID and other information to realize intelligent identification and management [6].

Under the overall structure of the IoT, household appliances such as refrigerators, air conditioners, and electric lights can be integrated into a unified infrastructure through wireless RFID technology, sensing equipment and internet network [7, 8]. All of interactions between people and machines and machines will be carried out on the above. Then, that integrate the IoT with the existing internet to achieve the integration of human society and physical systems.

Conventional robot behavior more single operation is repeatedly executed mainly through the input command. This mode is suitable for parts assembly and handling heavy needed to be calibrated for more delicate work. The work cannot be done efficiently. There remains a need manual operation and assistance. Thus derived labor security accident and now face a large number of industrial safety accident are still yet to find a solution to develop industrial safety precautions to warn and remind, failed to effectively reduction industrial safety accident. Therefore, in order to reduce the risk of operability and errors occur through virtual reality remotely control the robot arm to perform plant operations and the way the investigation or operation in a high-risk environment. I believe the

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probability of industrial safety accident cannot only effectively reduce, but also can significantly enhance the efficiency in production. For the operation and accuracy of plant operations, there will be significantly improved.

II. VIRTUAL REALITY

The three-dimensional simulation uses a computer technology and high-realistic 3D space. The user uses the wearable analog display device and the controller. That the user feels like the immersive. Contains three features are integration, interaction, and imaginative [9]. Integration refers to the user has the feeling of real ones in a virtual environment allowing users immersed in it. The interactivity means that can apply through in a virtual environment interaction with objects. The imaginative refers to the user after receiving sensory organs stimulated by the nerve transmission to the brain. The illusion produced by past experience, however. This technology is used in many places, such as: education, military, medical, and entertainment [10, 11]. And, this technology has the immersive feel. Through this technology to remotely control the robot arm to perform the work. That technical staff cannot assist in the operation of the mechanical side can have the feeling of presence. As a result, not only reduce accidents, but also handier in operation.

Virtual Reality is a comprehensive integration technology involving computer graphics, human-computer interaction technology, sensing technology, artificial intelligence and other fields. Virtual Reality technology uses the computer 3D graphics generation technology, multi-sensor interaction technology and high-resolution display technology to generate realistic virtual environments [12]. Virtual reality has three basic characteristics, and three "I"-Immersion, Interaction, and Imagination.

A. Immersion

Virtual reality technology is based on human physiological and psychological characteristics such as visual and auditory. It produces realistic three-dimensional images from a computer. Users wear interactive devices such as helmet displays and data gloves to interact with various objects in the virtual environment. As if you are in the real world. When the user moves, the sensor and data glove on the body sense the moving data to the computer, so that the position image in the virtual environment changes in real time, and the system changes the image according to the user's operation, so that the person is in the middle. The three-dimensional feeling.

B. Interaction

Human-computer interaction in a virtual reality system is a near-natural interaction and can be interacted by sensing devices such as helmet displays and data gloves. The user examines or operates the objects in the virtual environment through the movements of the head, hands, eyes, language, and body, and the computer adjusts the images and sounds of the virtual reality system according to the movement of the user.

C. Imagination

Through the interaction between immersion and nature, the virtual reality system can spur the user's imagination. The application of virtual reality can solve the problems in engineering, military and medical fields. The designer and the virtual reality system operate in parallel and exerts their creativity. It depends on human imagination.

III. THE ROBOTIC ARM

The robotic arm is an automatic control device based on the human arm which operates on the basis of the instructions required for the work [13, 14]. Those write in the program and fed into the robotic arm for the execution of the action. Those mainly constructed by the arm body, controller, servo mechanism and sensor. Those divided into three axes and multiple axes. The more the number of axes for the flexibility and scope of the arm is the finer the work done. So, we study the use of multi-axis robotic arm, mainly in order to improve accuracy and maneuverability.

The robotic arm uses sensors, signal processing, machine vision, computer computing, machine learning and other technologies to identify the surrounding environment [15]. And, the robotic arm can analyze and judge the environment, objects, distance, location and other data. And then, user can control the activity and behavior of the mechanical arm by the main control of the computer.

The handling of radioactive materials, the handling of unexploded ordnance, and space work are all life-threatening tasks for humans. In order to avoid the dangers of the work environment and the harm of the work itself for human beings. The robot arm can be replaced with the hands and eyes of the operator by adding various sensory feedback methods. In medical treatment surgery, precision assembly and precision machining often require the skilled of people to concentrate on the work. This type of work can easily lead to worker fatigue which makes the workers less focused to cause the result of the work failure and accidents [16]. In order to achieve this kind of work satisfactorily and meet the accuracy requirements, it is also necessary to remotely operate the robot arm or the automated robot arm instead of manpower.

When the manipulator is used in applications, the high precision is required. The requirements for the fineness and softness of the action of the arm are often very strict. In order to make the arm more similar to human softness in behavior and cooperate with humans or it is a work of independent work. The anthropomorphizing of the manipulator is a necessary development direction. The reason why the robot arm can follow the human thinking mode and the human arm's action mode. In addition to the high flexibility of hardware and software, the most important link is the ability to feel. The robotic arm system relies on various types of sensors to build the sense of sensation. It is like the human facial features which can accept all kinds of external stimuli. The algorithm of the robotic arm system drives the hardware to make the mechanical arm respond appropriately to the received external stimuli.

IV. 3D SENSING

At present, the technology used in 3D sensing includes time difference ranging (time-of-flight, ToF) and structural light [17, 18]. The main function is use the optical refraction principle to obtain three-dimensional depth map (depth map) and further measure the distance between the robot and the object. The operation of components such as diffraction optical components (DOE), complementary metal oxide Semiconductor (CMOS) image sensor and vertical resonance cavity surface laser (VCSEL) are used to measure the measurement with different algorithms.

A wireless or wired internet-based entity addresses all devices or devices over the internet. And, the internet connects them is called the IoT [18]. IoT is connected with things and includes the following three characteristics:

- Internet Road: It is an internet channel that is built on the wireless or wired Internet entity and extends from the client to any object and device for interconnection.
- Identification and communication: The "Things" mentioned in the IoT must have the function of automatic identification, and have

the function of T2T (Thing to Thing) or M2M communication, using different communication technologies. Machines and humans can communicate with each other.

- Wisdom function: The objects and devices have discussed in the IoT. Those must have "Intelligent" functions, including automatic response, self-feedback, and intelligent control. To make things smart, the simplest is to use various senses. The Sensor responds to external signals such as light, electricity, magnetism, sound and chemistry. And those achieve three characteristics: comprehensive sensing, reliable transmission, and intelligent processing. At the same time, the sensor and wireless communication can form a wireless sense network.

V. SYSTEM DESIGN

The initial research process is, first understand the bending angle and structure of the manipulator avoiding the joint axis, and adjust it. In order to adjust the induction and detection of the 3D sensor environment must install it at the end of the arm. After installation, the image synchronization problem is adjusted and set. After setting up, the button on the handset is set and adjusted for different purposes. The button can perform different actions to enhance the flexibility of the operation. After the completion of the setup, the button will start to perform the task. When the operation is performed, the problems and bottlenecks will be discussed and adjusted.
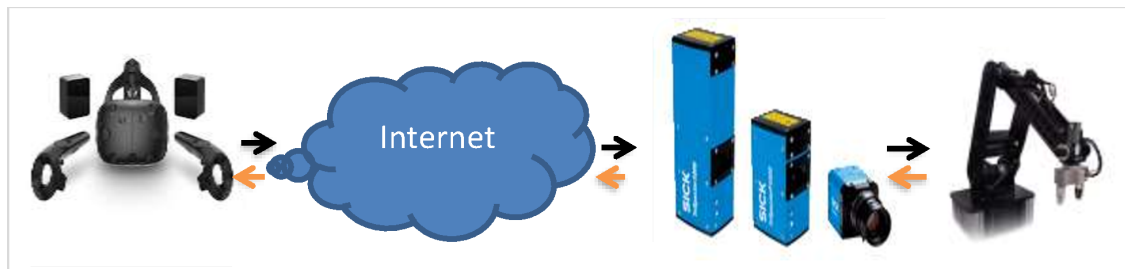

Fig. 1. System design

This research is designed by the IoT, remote control and virtual reality. The research enables the robotic arm to slowly move into the remote-control robotic arm. Through the virtual reality technology, the user is just like the real operation. The robot arm further solves engineering disasters and dangers. The first, simulate with a small robotic arm, control the axis, rotation and grabbing on the arm through the IoT and virtual reality program. And, that mount the network camera to the virtual reality program. So, the program can realize the remote-control arm. It is often necessary for engineers to work in a dangerous environment or remote monitors. Now, the engineers can operate remotely without having to work in a dangerous environment. That can change the work time of the engineering staff by anytime, anywhere. On the one hand, that can reduce the incidence of engineering safety and other problems.

Regarding research design and research methods are following the software engineering. The first, it uses a small mechanical arm as a test to set up the hardware equipment on the robot arm. After determining the feasibility, the next is writing the relation programs, debugging, testing and completion. The program part hopes to develop software that is simple and easy to use across platforms. So, this research chose to use multimedia programs for development. After identifying the research methods, that is collecting the relevant materials, investigating the logistics industry workflow and background, and viewing program-related development books. After collecting the relevant literature, we will conduct a deep understanding of the parts of the literature. At the same time, research on whether there is an improved alternative to the program in order to solve the problem of overwork without hindering the original logistics industry workflow.

VI. CONCLUSION AND IMPLICATIONS

Today, industrial safety accidents have been endless, and no effective reduction has yet been found. Therefore, this paper hope to reduce industrial safety accidents by means of virtual reality remote mechanical arm. By way of the remote way, we can reduce the direct contact between personnel and machinery, and reduce the danger by remote control, and

manipulate the mobile arm through the hand-held button, such as carrying heavy objects and screws. Taking and screw locking can be handy and effective in all aspects. Through virtual interaction and stability of the arm, it cannot only reduce the occurrence of errors, but also improve the accuracy of calibration. It is hoped that this method can effectively reduce industrial safety accidents.

Declaration of Competing Interest

The authors declare that they have no conflict of interest.

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