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Detecting 3D object

What is the 'Detecting 3D object' about? What it means?

Since the appearance of 3D detection technology, 3D detection methods have gradually occupied a large number of industrial markets because of superiority of 3D function. For more regular geometry, the traditional measurement method is competent, but for irregular objects, the data obtained by the traditional measurement method, such as volume and shape, will be inaccurate. 3D detection can fully utilize the lasers or high-coherence beams to decompose the objects in space into three direction of x, y and z, and measure them respectively. After the measurement is completed, the information such as size, pose and position of the object can be accurately calculated though the collection of the light and the analysis of the data. It can be finished in real-time or offline. The 3D measurement technology places extremely high demands on the accuracy of inspection instruments, such as ZEISS' success in manufacturing the world's first CNC coordinate measuring machine. For some irregular or huge objects, high-precision 3D measuring instruments can obtain accurate measurement results within the range of errors allowed without changing the position and state of the object. With the continuous innovation of technology, 3D detection technology is gradually becoming well known from the industrial field. People are also willing to accept the convenience of this high technology. So the iPhone introduced the face unlock function, in addition to some game companies to provide players with VR visual effects game modes.

3D detection technology uses images as input sources to convert object features into digital signal outputs. As a new type of detection technology, 3D detection has great potential for development in object detection, image capture and information security.

Why is it useful? What is its applications?

Compared with the traditional measurement methods, which usually require lots of manual operation, the 3D detection mostly can be completed by machine. As a result, this new detection method greatly reduces labor costs and improves the safety during detection. In the field of archaeology, ordinary detection techniques are often difficult to carry out in small spaces, or may damage the characteristics of cultural relics, while 3D detection techniques can avoid most of the shortcomings of ordinary detection techniques. Most of the work can be done with small instruments and intelligent operation. Moreover, 3D detection can also clearly detect the outline of the environment within the archaeological site such as grave. In people's daily lives, 3D detection is also ubiquitous. For example, in the parking lot, the machine senses the arrival of the car. Through the information of the front profile of the car, the computer can distinguish the location of the car's license plate. So the computer can record the time that the car gets in and out of the parking lot without staff. For individuals, forgetting a password is a very annoying thing, which can make people miss out on a lot of important meeting or dating. Apple introduced the face unlock function to replace the traditional password unlock function with each person's special face. Cameras capture and recognize each person's face, then extract millions of details of the face and turn them into digital signals to form a unique encoding. This way, it is simply impossible whenever a stranger wants to turn on the phone. It not only solves the problem of people forgetting passwords, but also increases the security of mobile phones, and these advantages depend on the invention of 3D detection technology.

Technical principles

First of all, when archaeologists are carrying out archaeological work, the device of camera should be with high resolution. Because high resolution camera is the guarantee of getting more light beam reflected by the wall. As the result, when the camera received the light beam, the optical receiver will transfer the optical signal into digital signal. These digital signal will be calculated by the calculator of the device and send the conclusion of artifacts and the corner. Besides, archaeologists can also get the full view of the tomb and then make a detailed plan for entering the tomb.

Due to the uniqueness of light, when the CPU is processing the digital signal, the light reflected back from each object carries a unique message. In this way, some technician could collect these light beams and classify them by Matlab. This is like filtration and distillation technology in chemistry, a range of techniques such as reducing noise to improve signal-to-noise ratio(SNR) are used to extract each unique signal. A ‘purity’ signal can finally be obtained through several cycles of operation.

When converting digital signals into 3D visual effects, this requires the application of spatial imaging techniques. As we all know, the reason why people can see the color of an object mainly depends on the absorption and scattering of light by the object at a specific wavelength. As a result, without any object as a medium, light cannot be imaged directly within space. Therefore, the easiest way to do this is to transform 3D space into a 2D plane. Archaeologists compare and stitch these 2D pictures together to derive the entire environment of the ruins.

Literature review

I read a literature published by an MIT scholar on how to solve the problem of three-dimensional imaging of polarized beams. Generally, the polarization of light also carries a lot of information, which can lead to the overlap of critical information and useless information during imaging, resulting in inaccurate results. Scholars have offered a new solution: using a combination of optics and computation to improve the signal-to-noise ratio.This approach is done by combining the captured coarse depth map with the normals produced by polarization. This way has minimal impact on the environment and light sources. Therefore, it is believed to provide a new way of thinking for 3D imaging.
The other paper by another MIT scholar is a combination of archaeology and 3D exploration. This gave me great inspiration. However, the method he uses is 3D modeling to achieve the reproduction of monuments. I think it's very exciting because it's possible to present the whole face of the ruins almost entirely in a model way. So I combined the characteristics of the two papers. What I want to research is using 3D probing techniques to give feedback on the full picture of the unknown environment when an archaeologist is confronted with a relic that has never been discovered.

Open source research

There are other wide applications of 3D detection technology, such as: ranging, AR decoration, etc. During the class, some students mentioned the AR wear function of sneakers on the sneaker company's App. I think it's a very good example because it satisfies the consumer's need to try on it and avoids the return or exchange operation due to the problem of unsuitable size. In addition, 3D detection for ranging is also a very useful function. Now widely used are 3D rangefinders. The principle is very simple, that is, to calculate the time difference between the optical transmitter and the optical receiver to transmit and receive signals, so to calculate the measured distance.

Reference

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