Research on Augmented Reality (AR) Intelligent Maintenance Guide System

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Abstract. The augmented reality (AR) intelligent maintenance guide system is researched. To do the maintenance with high efficiency and low cost, AR technology is a solution. The system is to provide a guide system with interactive display of virtual and reality. The test results show that the system has the function of reading, scanning, communication. The system can combine the virtual and reality.

1. Introduction
To provide high efficient maintenance, the augmented reality (AR) technology is widely used on the aircraft. Boeing 777 is delivered without any entity experiment by using AR technology. The AR technology can also be applied at the area of customer service, maintenance training and education. A virtual maintenance training (VMT) based on AR technology is designed to do the training exercise for flight crew and maintenance personal. It is shown that the efficiency of the training is improved by 30%.

With the flourished development of civil aviation, the maintenance of aircraft takes more challenges. To do the maintenance with high efficiency and low cost, AR technology is a solution. This research is aimed at creating an intelligent maintenance guide system based on AR technology. The system is to provide a guide system with interactive display of digital aircraft maintenance manual (AMM) and reality.

2. Principle of the maintenance guide system
AR technology means virtual objects superimpose over the real objects. Virtual and reality combined by computer are shown together at the display (such as glasses).

The research uses method of SLAM to combine the virtual and reality. Fig.1 shown the principle of environment sensing. It combines the virtual and reality by locating and identifying the people and surroundings. Sk means the data that sensors get at Time k. Mk-1 means the map at Time K-1. Rk means the location at Time k. Mk means the map at Time k. Environment sensing get the data of the people location and map, the location and identification of the equipment of all time. The display shows the calculation of the result.
3. **Frame of the AR intelligent maintenance guide system**
The frame of AR intelligent maintenance guide system consists of software, application and terminal.

3.1 **Software**
The software frame uses Model-View-Controller (MVC) module which separates the work logic with display. It is shown in Fig.2

- **View** means the display which users see and communicate with.
- **Model** means the part which processes the data.
- **Controller** means the equipment which receives the request delivered by users and fulfil them with the Model and View.

3.2 **Application**
Four scenes are designed in the application which are cockpit, landing gear, indicator and guide system. It is shown in Fig.3.
Cockpit virtual frames are shown in the display (such as glasses) when maintenance personal walks into the cockpit. AMM procedure will also be shown. The equipment and AMM procedure will also be shown on the PC. The expert can communicate with the maintenance personal by the PC which connects the AR intelligent maintenance guide system.

Maintenance personal can read the landing gear by scanning with the equipment. Maintenance personal can also get more information by voice. Expert is always available.

3.3 Terminal
The research uses the Hololens2 delivered by Microsoft which is shown at Fig.4.

3.4 Test of the AR intelligent maintenance guide system
The test shows a very distinct picture of the cockpit, refer to Fig.5. All the equipments are demonstrating. It means the AR intelligent maintenance guide system is working property.
4. Conclusion
Based on the results and discussions presented above, the conclusions are obtained as below:

(1) It is shown that environment sensing combines the virtual and reality by locating and identifying the people and surroundings all time.

(2) It is shown that Model-View-Controller (MVC) module can process data delivered by the sensors.

(3) It is concluded that the AR intelligent maintenance guide system can combine the virtual and real objects.

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References
[1] Zhao Xincan, Zuo Hongfu, et al. Research on key technologies of augmented reality maintenance guidance system [J]. China Mechanical Engineering, 2008, 19 (6): 678-682(in Chinese).

[2] Zhao Min, Liu Bingqi, et al. Technical research on increasing practical assembly and maintenance system [J]. Optical Instruments, 2012, 34 (2): 16-20(in Chinese).

[3] Yu Rong, Wu Jiaju, et al. Research on ietp technology based on S1000D standard [J]. Computer Measurement and Control, 2016, 24 (11): 163-170(in Chinese).

[4] Wu Xiang, Liu Yanni, et al. Research on the application of ietp in ship integrated support [J]. Ship Electronic Engineering, 2011, 31 (2): 161-164(in Chinese).