Research and Application of Spacecraft Product Inspection System Based on Smart Glasses

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Abstract. Based on scenarios, studies the construction of the digital test system based on smart glasses, based on the standard operating procedure operation guide, inspection data online and conformity intelligent decision, heterogeneous data packet generation and analysis of key technology, realized the application of spacecraft product inspection process, improves the working efficiency and quality.

Keywords: Smart glasses, Spacecraft product, Inspection

1. Introduction

With the continuous development of the space industry, in the future, the development of space products mainly presents the following characteristics: the number of research missions will increase substantially, and the characteristics of multi-model and short-period will become more obvious; The proportion of new complex spacecraft products increased significantly, and new technologies were applied more widely. Spacecraft products AIT development information, the digital, intelligent degree is getting higher and higher, a large number of advanced equipment used in the development process. Quality inspection was conducted for spacecraft products quality detection, prevention, control, and improvement of an indispensable link of quality control, product quality control in the process of production is an important one part, the characteristics of space products inspection ability put forward higher requirements, need to use the means such as digitization, automation, intelligent, more advanced equipment in the inspection process and the application of the degree of refinement, enhance the level of space products inspection technology capability and quality assurance.[1]

2. Development and application status of smart glasses
Smart glasses are one of the most promising wearable smart devices that have been proposed in recent years. In 2012, Google launched Google Glass, the first smart glasses, which set off an upsurge in the development and application of smart glasses.[2] In March 2014, SONY introduced smart glasses -- Sman Eyeglass. Later, a French technology company, introduced the Eyephone, a special augmented reality smart eyeglass. With the rapid development of mobile Internet, artificial intelligence, sensors, etc., smart glasses greatly expand the visual dimension of human beings by virtue of AR (Augmented Reality), image recognition, cloud computing, big data, and other technologies.

The research and application of smart glasses have been widely carried out in various industries. In the medical industry, medical records and disease-related information are entered into the computer through smart glasses, and all the reports are superimposed with the images during the surgery process. In the automotive industry, in early 2014, BMW automotive engineers were able to see information and 3D animations of their engines being repaired through smart glasses. In civil aviation, happy aviation uses smart glasses to realize the functions of operation training, inspection guidance, real-time remote interaction, inspection data analysis, and early warning, which greatly improves the quality of inspection work.

3. Training Research on spacecraft product inspection system based on smart glasses

3.1. establishment of digital inspection platform for smart glasses

According to the inspection characteristics of spacecraft products, the hardware selection of glasses mainly considers the operation convenience of the non-fixed station, camera resolution, endurance ability, degree of software customization, safety, user interaction convenience, maintenance, and warranty, etc. In terms of functional requirements, according to the assembly inspection process of the spacecraft product, it mainly includes inspection operation guidance, training, and teaching, multimedia record inspection, generation and data extraction of inspection packets, etc. In terms of man-machine interaction and data collection, it is necessary to have voice interaction, bar code scanning, multimedia recording, image and text recognition, etc. In addition, also needs to have backstage personnel management, the quantity has the management, knowledge base management, and so on. Based on the above requirements, WLZ aid-p1 smart glasses were selected as the hardware. The user interface of the digital inspection system based on the smart glasses and the software architecture (Fig.1) were built. The background is based on the website development of JavaEE environment, adopted SSM project framework and layui interface framework, and adopted Mysql database to operate data. Terminal using Android6.0 SDK version, the local data storage using lightweight Sqlite database[3].
3.2. Inspection operation guidance based on standard operating procedure (SOP)

The guidance technology of inspection work is the key function of the system, which directly determines the guidance and standardization of the inspection work. How to import the inspection program into the system conveniently and accurately in the smart glasses system, form the operation guidance program, and establish auxiliary information such as picture, form, text, and warning information at the key inspection nodes is the technical difficulty of this project.

SOP based inspection operation guidance needs to carry out adaptive development based on SOPs, realize the combination of inspection SOP and smart glasses system, and establish the import and generation functions of sops. Process intelligent glasses analyze and sort the operating procedures, and guide and prompt the inspectors step by step. When carrying out the inspection, operate according to the voice and text prompts provided by the system, and collect and store on-site data synchronously through voice input, image recognition, scanning, and other methods. At each step, the system automatically completes the sorting and saving of product data and inspector information, and the inspection records are automatically saved into product packets after all the completion. For key inspection items, mandatory requirements can be established in the process to reduce errors and improve inspection quality. The process of the inspection guidance module is shown in Fig.2.
By converting the format of the inspection SOP file and saving it to the server job guide profile database, the smart glasses job profile library is updated when the smart glasses are connected to the server. When inspectors work, they will invoke the corresponding standard inspection boot file according to the specific inspection items, and the smart glasses will conduct operation boot and information record storage according to the contents of the invoked boot file, and finally form the inspection packet. The establishment and application process of the standard job guide library is shown in Fig.3.

3.3. online data collection

The inspection process needs to include information such as personnel, environment, working tools, products, inspection data, and photos. Because intelligent glasses are intelligent dressing equipment, distinguished from the PAD, computer, and so on, can't use the keyboard in the process of using manual input methods such as information input, the need to use smart glasses with voice input, bar code scanning, image intelligent identification, and multimedia data acquisition function, realize the fast accurate acquisition.

3.4. Intelligent decision of data

In order to avoid the inspectors of man-made data conformity to produce quality impact may determine errors, intelligent glasses system needs to have structured data conformity intelligent
decision function, which automatically according to preset criteria for collected data, and according to determine whether the results suggest the analyst accept, according to the checker's instruction to take the next step of the work process.

Data collection and intelligent determination of conformity during spacecraft inspection are shown in Fig.4.

3.5. packet generation of heterogeneous validation data
For heterogeneous inspection data packets generated, carding the data which is formed by the inspection process, through the establishment of a database, data acquisition, storage, sorting, refining process, such as establishing standard data in the form of the inspection report, the report contained in the personnel information, product information, environmental information, process information, testing information, workers gauge information, multimedia information, such as project all inspection data, inspection after the completion of the project output statements and stored automatically. The packet generation process of heterogeneous validation data is shown in Fig.5.

4. Key technology
Image recognition is a part of pattern recognition.[4] Google's tesseract Ocr engine technology is introduced, the corresponding language library is selected, and the packaged tesseract Ocr method is used to automatically recognize and extract the text in the image. The acquired image was binarized, and the image was expanded and corroded, then the surface of the image was made smooth and flat by means of opening and closing. The universal value is shown in Fig.6.
5. The application

The digital inspection system based on smart glasses was applied in the process of pasting the heating plate in the product storage box of a spacecraft. The inspection of the whole process was successfully completed according to the guidance program. The inspection data formed in the inspection process was formed into the inspection report and a structured digital packet of heterogeneous data was established. It avoids the risk of "wrong inspect" and "missing inspect" under the traditional manual inspection and manual recording mode, and improves the formation and utilization level of inspection data.

6. Conclusion

According to the characteristics of the space product inspection work, combined with the powerful features of the intelligent glasses, glasses digital test platform based on intelligence, solved the key technology such as image intelligent identification, implement the inspection operation guide, personnel training, packets of production, and other functions, has been applied in a certain space products inspection process, improve the efficiency and quality of the inspection work, enrich the space products inspection method.

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