Design of radar portable maintenance auxiliary equipment

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Abstract. Aiming at the battlefield maintenance of radar and other weapons and equipment, a portable radar maintenance and detection equipment is developed. Planning the overall design principles of maintenance equipment, the equipment of the realization of the function and module, describes the testing equipment, the hardware structure and software design, suitable for field under the condition of individual maintenance support requirements.

1. Introduction

The integration level of radar equipment is getting higher and higher. In the process of equipment maintenance, a large number of radar structure, circuit and other maintenance information and measurement tools are involved, which need to be completed by multiple professionals. Therefore, we combine the electronic manual of multimeter and data query, cooperate with advanced embedded development technology and network communication technology, and develop portable maintenance equipment to solve the problem of maintenance resources.

2. Application of portable radar maintenance equipment in maintenance support system

Portable maintenance auxiliary equipment makes use of PMA which is installed with equipment maintenance information system. Under field conditions, individual maintenance personnel can consult the maintenance data saved in the maintenance operation location, and help maintenance personnel to make maintenance decisions and carry out operations according to correct requirements and steps, thus improving the maintenance efficiency. Its application model is shown in figure 1. In the application of remote support technology, remote communication activities can be used to make up for the shortcomings of traditional on-site maintenance diagnosis, so that experts from all over the country can carry out remote collaborative diagnosis of the fault phenomenon of an equipment within a specified period of time, and improve the efficiency of equipment maintenance. When data update is needed, it can also be carried out through the mode of network communication. Among them, network communication is connected with the remote support system by wired or wireless means. Wireless is adopted when confidentiality requirements permit, and wired connection is adopted when confidentiality requirements are high.
Figure 1. Application model of portable radar maintenance equipment in maintenance support system.

In this system, the portable maintenance terminal based on equipment remote auxiliary maintenance realizes the maintenance auxiliary equipment integrating wireless (wired) LAN technology, data detection and collection technology, video and audio compression transmission, and information query function, realizing the long-distance transmission required by equipment remote maintenance support. To realize the effective combination of field equipment maintenance and equipment remote cooperative diagnosis will meet the requirements of equipment fault diagnosis under the information condition. Therefore, we will apply in the maintenance of detection, information query technology and remote technical support together effectively, develop a new type of maintenance auxiliary terminal (PMA), will greatly improve the equipment maintenance efficiency.

3. General design principles for portable radar maintenance equipment

When designing portable radar maintenance equipment, the following design principles shall be followed:

3.1. High reliability

As the PMA is mainly used in the battlefield, its work environment is more special, against shock, resistance to electromagnetic interference and so on have higher requirements, therefore, the high reliability of structure is used in this system to choose the reasonable components, on the premise of meet the system requirements, try to use simple and mature circuit design.

3.2. Principle of low power consumption

Since PMA mainly relies on batteries for power supply when working in the external field, the system requires very high power consumption, so low-power devices and good power supply scheme should be selected in the design.

3.3. Modular design

Most embedded systems adopt modular design. PMA designed in this paper belongs to embedded system. This paper adopts modular design and fast and safe connection mode to ensure the system has strong reliability, testability and maintainability. Specifically divided into hardware circuit module and software module, hardware circuit modular design function division should be clear, circuit functional units between each other, and facilitate the expansion of the system. Software design should be universal, open, easy to use, choose a reasonable operating system, system readability and portability is good, to facilitate secondary development.
4. Design scheme of portable radar maintenance equipment

4.1. Implemented function
With embedded devices as a platform for the project, the development and application in the field of portable auxiliary equipment maintenance (PMA), the integration of PMA the camera and wireless network communication technology, the interactive electronic technical manual (IETM) software in portable maintenance equipment, through the wireless local area network (LAN) associated with maintenance support center, is mainly used to implement the following functions:

- Realize information transmission between maintenance site and maintenance support center through network technology;
- Collection and processing of audio (visual) frequency information;
- Inquire and update equipment maintenance information data;
- Interactive remote diagnosis.

4.2. Module composition
The design of the maintenance equipment terminal adopts a three-layer structure, which is mainly divided into maintenance data layer, maintenance application layer and man-machine interaction layer. Its structure is shown in figure 2. The maintenance data layer mainly completes maintenance detection and IETM database access and other functions. The former includes not only video and audio acquisition equipment, implemented by embedded network camera technology, but also a universal personal multimeter module for field diagnostic testing.

![Figure 2. Functional structure model of PMA maintenance equipment terminal.](image)

The maintenance application layer provides application modules and programs for equipment auxiliary maintenance. It mainly includes remote video and audio collaborative maintenance, spare parts storage information query and database information browsing, maintenance tasks, maintenance records download and view, as well as security authentication and transmission encryption for remote maintenance diagnosis. The man-machine interaction layer provides the maintenance technicians with interactive means, such as software interface, touch screen, microphone, etc.

4.3. The research scheme of hardware platform
The PMA maintenance terminal is mainly composed of head-mounted devices and hand-held pdas, as shown in figure 3. As the product is positioned at the maintenance terminal, it needs to support wireless Internet access, voice processing and other applications that require high processing capacity. Therefore, the core processor is required to have powerful processing power, rich interface, support DMA mode, audio interface and low power consumption. At the same time, to simplify software development, the processor needs to have good support for embedded operating system. The camera of the headset provides the real-time picture of the maintenance site and transmits it to the remote maintenance support center through wireless network. The microphone and earphone are the means of communication between the remote maintenance center and the on-site maintenance personnel. The handheld part is an atom-based tablet computer device that integrates audio and video digital coding module on the ATOM motherboard for digital processing of audio and video information. In addition,
a personal multimeter module is integrated for on-site maintenance and inspection. Wireless LAN module is a means of information communication with the outside world. Hardware system design, the key is video processing and wireless connection technology.

Figure 3. Schematic diagram of hardware design.

4.4. Software development
Equipment maintenance information platform software is the core of the equipment, including equipment hardware call software, remote communication control and maintenance information system. The maintenance information system USES the layered structure interactive electronic technical manual, updates the latest technical data through the USB interface or the network, has the general electronic technical manual function. The usage steps are as follows: maintenance personnel can browse the whole work item next to the equipment, and then complete each operation step and various auxiliary maintenance functions. If there is doubt, maintenance personnel can apply for expert assistance; If parts and components are needed in the maintenance process, they can enter the resource information system to inquire. PMA and the built-in maintenance information system can also output failure, parts and equipment maintenance cases and other forms for management reference. The system design is shown in figure 4.

Figure 4 The overall structure of software development.

5. Conclusion
PMA is widely used in radar maintenance, and its application can also be extended to other equipment maintenance, which has great practical value. Portable radar maintenance equipment is an innovative combination of network communication technology, interactive electronic manual technology and
portable maintenance auxiliary equipment, which is developed according to the needs of basic-level maintenance on the basis of full analysis, and is suitable for the needs of individual maintenance support under field conditions.

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