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# Design of Electronic Work Card based on Enhanced Device Protocol

Huimin Su, Li Chen*

Department of Electronics and communication engineering, Suzhou Institute of Industrial Technology, Suzhou, 215000, China

## Abstract

**The electronic work card is significant to improve personnel management efficiency. WiFi module and E-ink panel are used in the system to realize communication with cloud platform and information display respectively. To control the card remotely, Enhanced Device Protocol is used due to its flexibility, long connection and etc. After debugging, the display information can be modified online.**

## Keywords

**Electronic Work Card; Enhanced Device Protocol; OneNET.**

## 1. Introduction

With the development of information technology, personnel management becomes more intelligent. The application of smart electronic work cards is of great significance to improve the efficiency of management [1]. The electronic work card developed by Jimi IOT, Qiguo IOT and other enterprises can realize the functions of positioning and signing. Since display screens aren't included, the systems cannot receive instructions remotely. Some enterprises have developed electronic cards based on LED display, which have poor display effect and high power consumption.

In order to realize remote monitoring and information display, display panel is necessary. Taking power consumption as an important consideration, low-power E-ink display module is selected[2]. Since remote information sharing is helpful to release job, cloud platform is used. Appropriate application layer protocol should be selected. OneNET cloud platform supports many kinds of protocols, including the commonly used protocols like MQTT, HTTP and etc[3-5]. The platform also supports customized EDP (Enhanced Device Protocol). Among these three types of protocols, the clients send requests and the servers response the requests using HTTP protocol. Since the servers cannot actively send information, this kind of protocol is not suitable for remote control. Moreover, it is a short connection protocol, which closes the connection after transmission. When information needs to be transmitted again, it needs to re-establish the connection, which consumes resources. MQTT protocol and EDP protocol can be connected for a long time. Remote control and remote monitoring can be realized. They are more suitable for work card applications. The research shows that EDP protocol has smaller packet size compared with MQTT protocol when the same function is realized[6]. The EDP protocol is also more flexible, which can realize information transmission between devices. Therefore, EDP protocol is selected.

An electronic work card with WiFi module and E-ink display panel is designed. Remote control can be realized using OneNET cloud platform through EDP protocol.

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# 2. Hardware Structure Design

## 2.1. Overall Design

The specific design is provided in Figure 1.

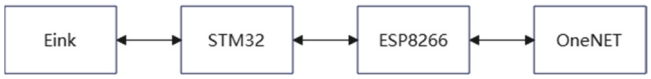


**Figure 1.** System structure diagram

The system uses STM32F103 to drive the E-ink panel through SPI interface. Information dual-direction transmission among MCU and cloud platform can be achieved through ESP8266.

## 2.2. Communication Circuit

The communication circuit is shown in Figure 2. WiFi module is connected with STM32F103 through UART interface. Reset signal is also provided by MCU. When UART interface is used, IO15 and IO13 are set to be RTS and CTS respectively. IO0 is recommended to be grounded through 1K resistance.

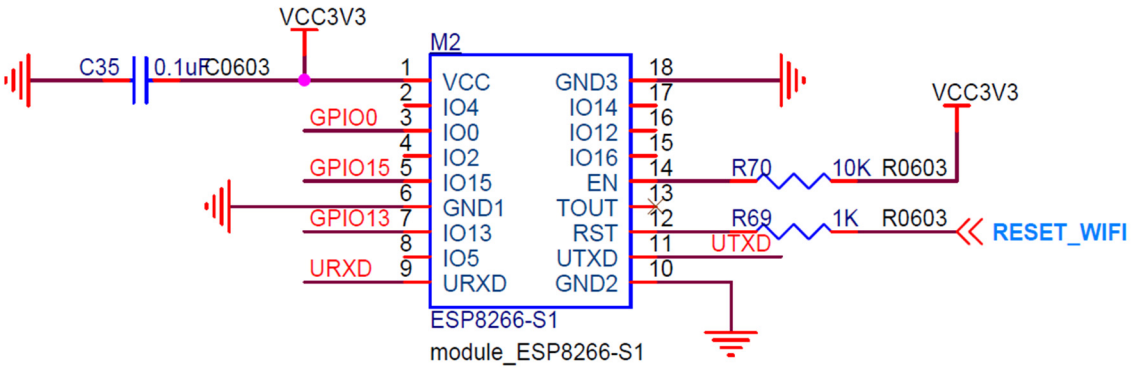


**Figure 2.** Communication circuit

# 3. Configuration

## 3.1. Wifi Module

WiFi module is used to upload the data collected by MCU and receive the commands from the cloud platform. By referring to relevant data manuals of the module and the cloud platform, AT instructions are configured through the serial port. The specific configuration instructions are as follows (Table 1).

**Table 1.** AT instructions

| AT instructions | Instruction meaning |
|---|---|
| AT | Test AT instruction |
| AT+CWMODE | Configure operating mode |
| AT+CWJAP | Connect AP |
| AT+CIPSTART | Connect server |
| AT+CIPMODE | Configure transparent mode |
| AT+CIPSEND | Enter the transparent transmission |

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1. AT instruction test

"AT" is sent. When the feedback is "OK", it indicates that the AT instruction configuration can be carried out normally.

2. Configure operating mode

STA mode is configured using the instruction AT+CWMODE=1. When the feedback is "OK", the configuration succeeds.

3. Connect AP

AT+CWJAP is used to connect the WiFi module to the WiFi AP. When the feedback is "GOT IP", the connection is established.

4. Connect server

The client should be connected to the server to realize information transmission. AT+CIPSTART is used. The format is shown as following. AT+CIPSTART = "TCP", "IP", port. The IP of EDP server is 183.230.40.39 and the port number is 876. When the feedback is "connect", the connection between client and server is established.

5. Configure transparent mode

After the connection is established, transparent mode should be configured. AT+CIPMODE have to be 1. When the feedback is "OK", the configuration succeeds.

## 3.2. EDP

EDP is a kind of application layer protocol defined based on OneNET platform. The protocol stipulates the packaging rules for establishing connection between terminal equipment and cloud platform, uploading data, parsing instruction and transparent data.

All messages contain the following three parts: message header, options and message body. The message header is composed of message type, reserved bits and remaining message length. The message type accounts for the upper four bits of the first byte. Reserved bits occupy the lower four bits of the first byte and generally reserved bits which are all zeros. The remaining message length can occupy 1-4 bytes. The specific value is the sum of the number of optional bytes and the number of bytes occupied by the message body. The remaining message length is determined according to the calculation results. The protocols of establishing connection, uploading data and parsing instructions are introduced respectively.

1. Connection

When establishing a connection between the terminal device and the cloud platform, it must send a connection request that meets the requirements of the protocol. The first byte of the message header is 0x10.

The options of connection request include protocol name, protocol version, connection flag and connection holding time. The protocol name consists of 5 bytes. The lower three bits are the protocol name "EDP", and the upper two bits represent the length of the protocol name. The protocol version occupies 1 byte and the value is 1. The connection mark takes up 1 byte and it is authenticated by distinguishing the device login method through the highest bit. When the highest bit is 1, the product ID and auth_ Info are used for authentication. When the highest bit is 0, the device ID and APIkey are used for authentication. The connection holding time accounts for 2 bytes with the unit seconds.

The content of the message body corresponds to the connection flag. When the highest bit of the connection flag is 0, the message body contains two parameters, device ID and APIkey. Each parameter consists of length and parameter value. When the highest bit of the connection flag is 1, the message body contains the device ID, product ID and auth_ Info, where the device ID is directly set to two byte 0. The latter two parameters also include parameter length and parameter value.

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Finally, the remaining message length is calculated according to the options and message body. The message header is synthesized.

After sending the connection request, a connection response of 4 bytes is received from the platform. The message type is 0x02. The fourth byte indicates the connection return code, and 0 indicates that the connection is successful.

2. Information upload

The uploading data message type is 0x08. The options include flags, destination addresses, and message numbers. The flag occupies 1 byte, and the highest bit indicates whether there is a target address. When there is no target address, the value is 0. The second highest bit indicates the message number, which is used to distinguish different messages. The target address is set according to the highest bit value of the flag. This item is not necessary. The message number takes up 2 bytes.

The message body is the specific uploaded data. The first byte represents the data type. The last two bytes represent the message length. The following is the specific message content.

Finally, the remaining message length is calculated according to the options and message body.

3. Parsing instructions

Receiving commands from cloud platform to realize remote control is one of the important applications of cloud platform. In such applications, the device enhancement protocol specifies the message mode sent by the cloud platform to the device. The device receives the message and parses it according to the protocol rules.

The message type of issuing the command is 0x10. The remaining message length is determined by the subsequent content, occupying 1 ~ 4 bytes.

The remaining messages consist of the command ID and the command message body. For each command issued, the system will assign a command ID. When a response is required, the ID needs to be added to the response information for targeted reply. The command ID contains a ID length of 2 bytes and a specific ID value. The command message body consists of a command message body length of 4 bytes and a command message body of no more than 64K.

## 4. Results

Communication with OneNET platform is realized based on EDP. After the connection package is sent by WiFi module to cloud platform, the status of device is online.

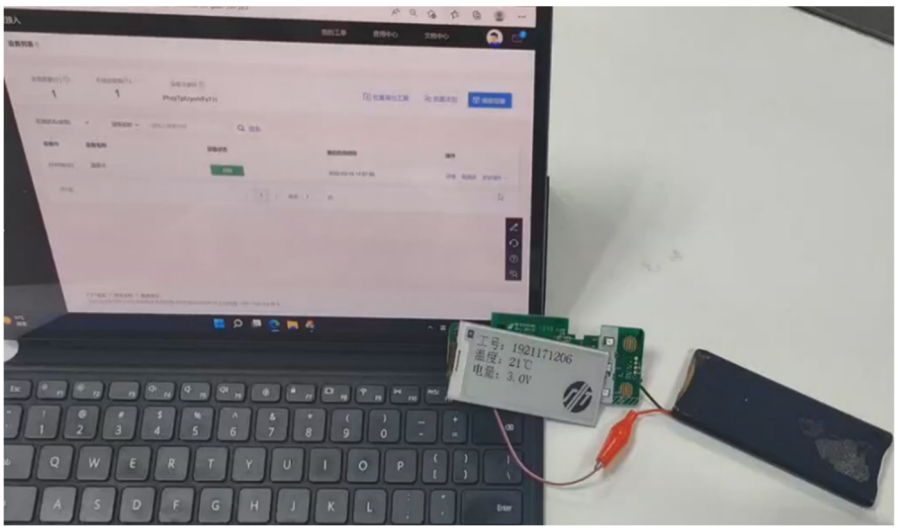


**Figure 3.** Logging in to the cloud platform

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After the device logs in, the displayed information can be modified by issuing instructions from the cloud platform. The images before and after modification are shown in the figure 4 respectively.


(a) before modification (b) after modification

**Figure 4.** Receiving commands from cloud platform

## 5. Conclusion

An electronic work card is designed using WiFi module and E-ink display panel. WiFi module is used to uploading data and receiving information from cloud platform. Data is packaged according to the EDP rules to ensure the information can be recognized. Information from cloud platform is also parsed based on EDP and displayed on E-ink panel. The card is significant for improving personnel management efficiency.

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