

Design of printer data senseless acquisition device

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Abstract—Under the strong impact of the Internet, the operation of traditional shopping malls has become more and more difficult and urgently needs to be reformed. What can help the reform of shopping malls is the massive sales data generated in the long-term operation. However, because the cashier systems of merchants are independent of each other, it is difficult for shopping malls to acquire and audit the sales data reported by merchants in a unified manner. Therefore, a printer data senseless acquisition device is designed and completed. Subsequently shopping malls can use the merchant sales data acquired by the device to collect rent and optimize the types of merchants. In this paper, without affecting any function and printing process of the cash register printer, a data acquisition device is connected in series between the cash register and the printer. The device is plug and play, compatible with USB ports and serial port micro printers. For a cash register, the device is simulated as a printer; for a printer, the device is simulated as a cash register, which completes adaptive simulation (without configuration) and transparent transmission functions and can realize network data transmission or SD card temporary storage.

Keywords—traditional shopping mall, data acquisition, USB, serial port, network data transmission

I. INTRODUCTION

The acceleration of the pace of life has led to a sharp increase in people's demand for convenient shopping. Taobao, JD.com, Pinduoduo and other e-commerce platforms have sprung up one after another. These epoch-making products not only facilitate people's lives, but also violently impact traditional shopping malls. A variety of goods and convenient logistics and transportation in the online store have attracted a large number of physical customers, but the types of goods of the merchants are difficult to meet the needs of customers. This huge gap makes the operation of the mall itself more and more difficult. Therefore, it is urgent to optimize the types of merchants.

There must be a receipt printer in the cash register system of a traditional shopping mall. The receipt printed by the receipt printer is not only the guarantee of the legitimate rights and interests of consumers, but also the basis for the sales data reported by the merchants to the shopping mall. Large shopping malls have generated massive amounts of consumption data in their long-term operations. However, due to the large number of merchants in the shopping mall and the independent checkout systems as well as most of the merchants underreporting for the purpose of earning rent, it makes the acquisition of sales data difficult and prone to errors,

which is not conducive to later auditing. In the era of big data, the importance of these data is self-evident. If these data can be effectively used, it will provide continuous impetus for the development of shopping malls. Therefore, it is particularly important to explore ways and methods to effectively collect consumption data.

II. HARDWARE DESIGN

The purpose of this paper is to design a plug-and-play data acquisition device that can be directly connected in series between the cash register and the printer, so as to realize adaptive simulation (without configuration) and transparent transmission without affecting the printing process. And perform printer data senseless acquisition and network transmission of printer data.

A. Functional Requirements

- Automatic operation after power-on, compatible with USB port and serial printer.
- Adaptive simulation (without configuration) and no impact on the print process.
- Senseless acquisition of printer data.
- If the network status of the device is good, data network transmission can be performed, otherwise, the data will be stored in the SD card. When the network returns to normal, the SD card data upload will be performed automatically.
- Have a backup power supply. When the external power supply fails, the backup power supply is automatically switched to ensure the integrity of the data.

B. Design ideas

The device consists of a data acquisition board and a upper-level network board stacked up and down. The data acquisition board mainly obtains the receipt information through the USB or serial communication line connected between the cash register and the printer without affecting the printing process, and sends the data to the upper-level network board through the SPI interface. Then perform data network transmission or SD card temporary storage according to network conditions. The system framework is shown in Fig.1.

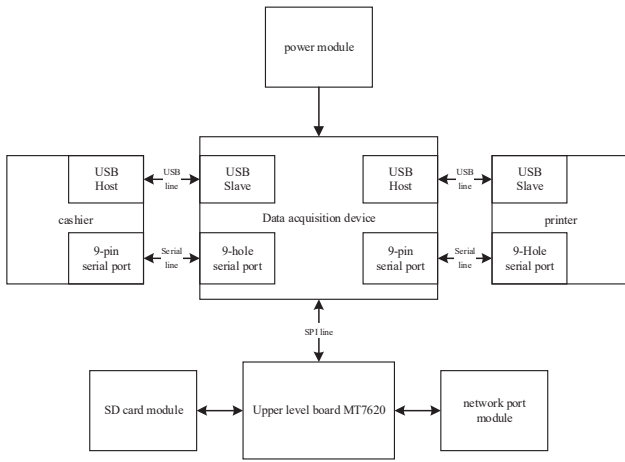


Fig. 1. System Framework

C. Device selection

The mainboard hardware of this device is packaged in a 20*20*10 black acrylic box, which can be fixed on the back of the cash register for use. In order to realize the required data acquisition and network transmission functions, the core chip of the data acquisition board selects STM32F427[1,2], and the core chip of the upper-level network board selects MT7620; On the data acquisition board, a USB host interface is designed for a compatible USB port micro-printer, which is used to simulate a cash register and connect with the printer, therefore, the same A-type USB interface as the cash register is used, and a 1.5K Ω pull-down resistor is connected to both the D+ and D- data lines, so that the interface becomes a host interface[3]. At the same time, a USB device interface is designed to simulate a printer and connect with the cash register, therefore, the same B-type USB interface as the printer is used, and a 1.5K Ω pull-up resistor is connected to the D+ data line, so that the interface runs in full-speed mode[4]; A 9-pin serial port is designed for the compatible serial port micro-printer for connecting with the printer and a 9-hole serial port for connecting with the cash register; In order to realize the data transmission between the data acquisition board and the upper-level network board, an SPI host interface is designed on the data acquisition board, and an SPI slave interface is designed on the upper-level network board to transmit the acquired print data to the upper-level network[5]. On the upper-level network board, a network port is designed for network transmission of data, and a temporary storage module of SD card is designed at the same times.

III. SOFTWARE DESIGN

The main process of software design of printer data senseless acquisition device includes function initialization of each module of MCU, while main program (infinite loop) and each interrupt handler.

A. MCU initialization design

The initialization process of MCU is shown in Fig.2. The main contents include the following five points:

- **NVIC configuration:** NVIC is the interrupt controller in the entire MCU, which controls various functions related to interrupts in the entire system. In this design, NVIC is mainly used to set the priority of each interrupt.
- **Delay configuration:** Configure SysTick according to the system clock. Since SysTick can perform accurate

interrupt overflow and automatically recover after a certain period of time, the automatic recovery time can be determined by setting SysTick, which is mainly used for program accurate delay.

- **Uart initialization:** It is mainly used to communicate with the upper-level network board.
- **Timer initialization:** It is mainly used for timing in the program. In this design, it is mainly used to judge the SPI reception timeout.
- **USB module initialization:** It is mainly used to set two USB interfaces as host interface and device interface respectively.

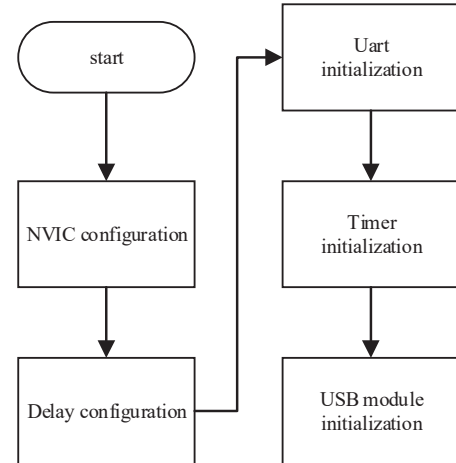


Fig. 2. MCU initialization process

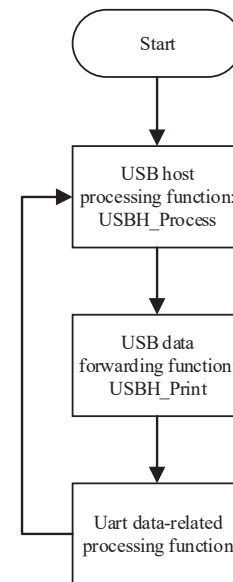


Fig. 3. Main program flow

B. main program design

The main program mainly includes the USB host processing function, which is mainly used to enumerate or reset the module according to the connection of the printer, as well as the status monitoring and event processing of the control transmission; The USB data forwarding function is mainly used to transparently transmit the print data sent by the cash register; Uart data-related processing function is mainly

used to communicate and interact with the upper-level network board. The process is shown in Fig.3.

C. Interrupt handler design

The interrupt handler flow is shown in Fig.4. The main function of the interrupt handler is to handle the interrupt handler involved in USB data forwarding. When the cash register sends the print data to the printer, it will trigger the interrupt function of the data acquisition device and enter the interrupt. On the one hand, in this interruption, the print data can be uploaded to the upper-level board through the SPI interface for data network transmission or SD card temporary storage. After receiving the print data, the upper-level board will send a reply command to the data acquisition device, indicating that the print data is successfully received this time. On the other hand, after the data acquisition device acquires the printer data, it directly sends the printer data to the printer. If the sending is successful, it will transparently transmit the next printer data. If the sending fails, it will retry 3 times, and when the test fails, the system will reset the USB module and re-enumerate the printer.

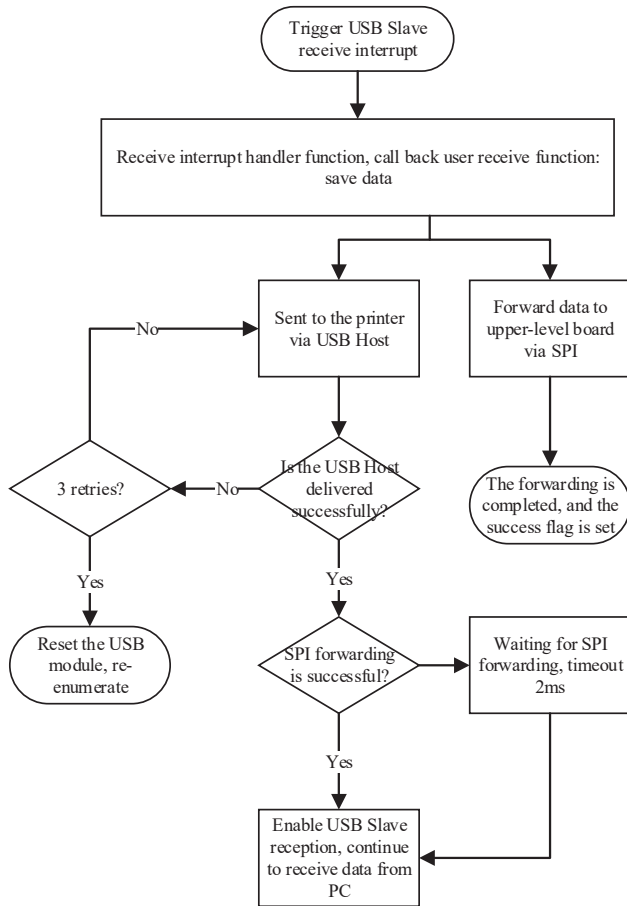


Fig. 4. Interrupt handler flow

IV. EXPERIMENTAL VERIFICATION AND PERFORMANCE TEST

Connect the data acquisition device to the cash register and the printer respectively through the USB port and then power on. At this time, the cash register prompts that the printer is connected instead of the unknown USB device, that is, the adaptive simulation function of the data acquisition device is normal; Open the software Bus Hound on the cash register to monitor the USB port connected to the data acquisition device. At this time, the print data is sent from the cash register to the receipt printer. The text of the print data is

shown in Fig.5(a). The data acquisition device can successfully transmit the print data to the receipt printer for receipt printing. The printing result is shown in Fig.5(b). The two information are consistent, indicating that the transparent transmission function of the data acquisition device is normal; After the printing is completed, use the cash register print data stream captured by the software Bus Hound, as shown in Fig.6, and use the SPI general debugging tool to capture the print data stream in the upper-level network board, as shown in Fig.7. After the comparison, it is found that the two are consistent, so the data acquisition function of the surface data acquisition device is normal.

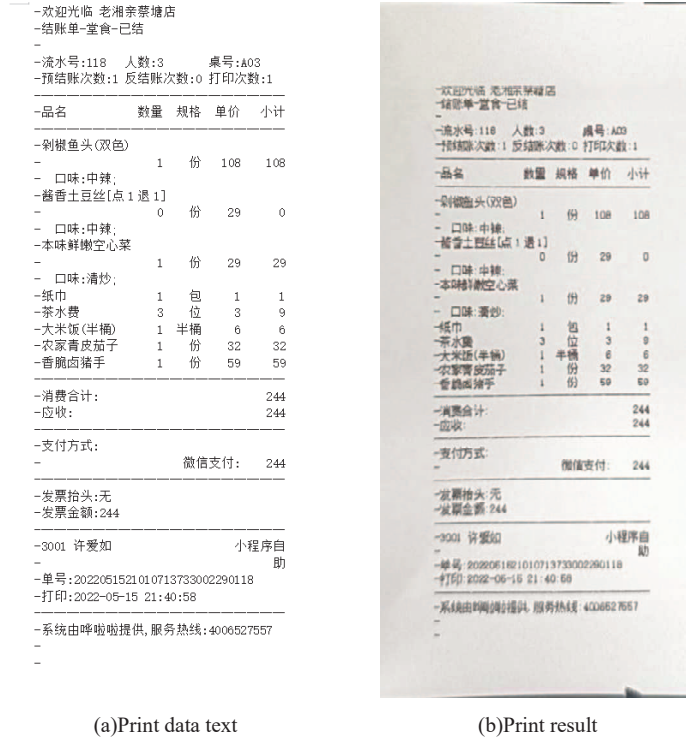


Fig. 5. Comparison of print data text and print result

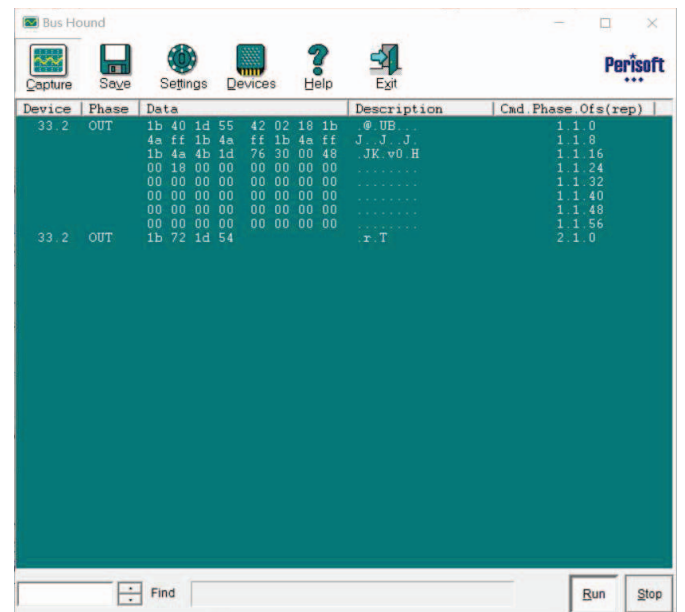


Fig. 6. PC-side print data flow captured by Bus Hound

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1b 40 1d 55 42 02 18 1b
4a ff 1b 4a ff 1b 4a ff
1b 4a 4b 1d 76 30 00 48
00 18 00 00 00 00 00 00
00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00
1b 72 1d 54

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Fig. 7. The upper-level board print data flow captured by the SPI general debugging software

V. SUMMARIZE

By analyzing the difficulty of acquiring sales data in traditional shopping malls, this paper designs and implements a printer data senseless acquisition device. The device is connected between the PC and the printer, and can acquire printer data without affecting the printing process, providing effective help for the shopping mall to check the sales data of merchants and optimize the types of merchants. After testing, the device is stable and reliable, compatible with USB port and serial port micro-printer, excellent acquisition efficiency, complete data network transmission and SD card temporary storage function. In the next step, we will carry out in-depth optimization of the data acquisition device, adopt the parallel communication method to replace the serial communication method, so as to increase the data transmission volume, and conduct in-depth thinking on security issues such as data leakage.

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