

STUDY AND DEVELOPMENT OF MOBILE TRACING TERMINAL BASED ON GPRS FOR AGRICULTURAL PRODUCTS QUALITY TRACKING

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Abstract: Traceability system has become an important means for food safety management. Global food industry and many countries have paid increasing attention to the construction of food traceability system, but rarely referred to tracing terminal. According to the technical requirements of cereal and oil products quality safety tracing process, we design and develop a mobile tracing terminal based on GPRS for agricultural products quality tracking to facilitate quality supervisors and consumers to track and trace the quality of related agricultural products anytime ,anywhere.

Keywords: cereal and oil products; quality tracking, GPRS; tracing terminal; embedded software; microelectronics

1. INTRODUCTION

The quality safety of agricultural products influences consumers' benefit. To carry on the research on key technology for quality tracking and tracing in the full supply chain of food production, inspection, storage, processing, and transportation, will contribute a lot to stabilize national cereal safety,

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improve agricultural products quality safety management system, and protect consumers' rights.

Traceability depends on the terminals. The mobile tracing terminal based on GPRS(General Packer Radio Service) provides an effective traceable means for quality supervision departments through the internet or wireless network. Taking advantage of the technology, like electronic label, bar code and digital document management, we can track the agricultural products quality information about food production, supply, sale, storage, etc, strengthen the real-time monitoring and checking of the quality information, and improve full-supply-chain quality information management, which will play an important role in establishing a mechanism for agricultural products quality information acquisition and interaction.

2. MAIN RESEARCH CONTENT

2.1 Construction of hardware platform

Constructing a hardware platform is the basis of mobile tracing terminals, and needs the support of the specific, strong low-level hardware to develop the platform's functions. The hardware platform aims at the research and design of GPRS wireless data transmission module's peripheral circuit, the interface between GPRS module and monolithic processor, between bar code scanner and monolithic processor, between LCD(Liquid Crystal Display) and SCM(Single Chip Microcomputer), between keyboard input and SCM. In order to strengthen the system's expansibility, we also extend the COM and USB interface. The architecture is shown in Fig1.

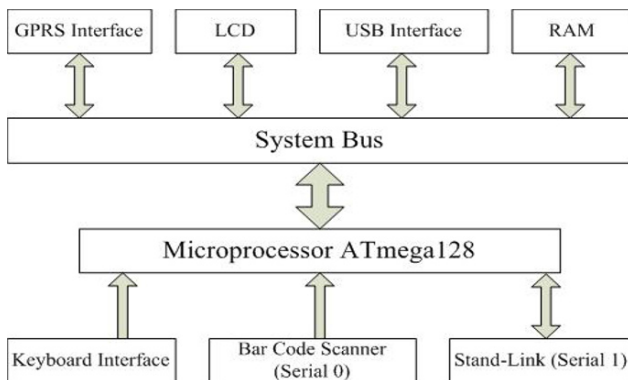


Fig 1: The architecture of hardware platform

2.2 Application and design of embedded software system

The application and design of embedded software system contains the design of embedded operating system uC/OS-II for software module between bar code scanner and SCM, interface driver between GPRS module and SCM , and low-layer driver for USB devices.

3. IMPLEMENTATION OF MOBILE TRACING TERMINAL

The mainboard of the hardware consists of two parts: GPRS MODEM module and tracing module at the core of monolithic processor.

3.1 GPRS MODEM Module

Because the data sent to the remote server only contains the traceable code, and the data received from server only includes key quality information, so the data is very small and cannot reduce the data transmission speed through GPRS.

Based on SIM300, produced by SIMCOM, we design the peripheral circuit to implement GPRS wireless receiving and sending module. The module can be used separately or integrated with tracing module. The design electronic principle of the module is shown in Fig2-3.

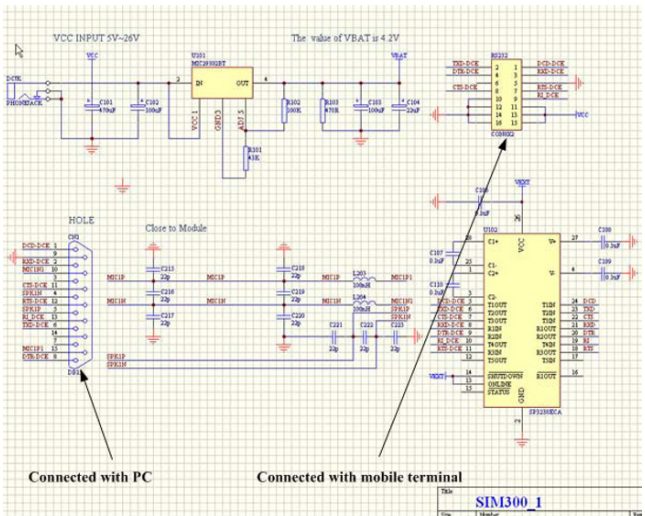


Fig2: GPRS MODEM electronic principle

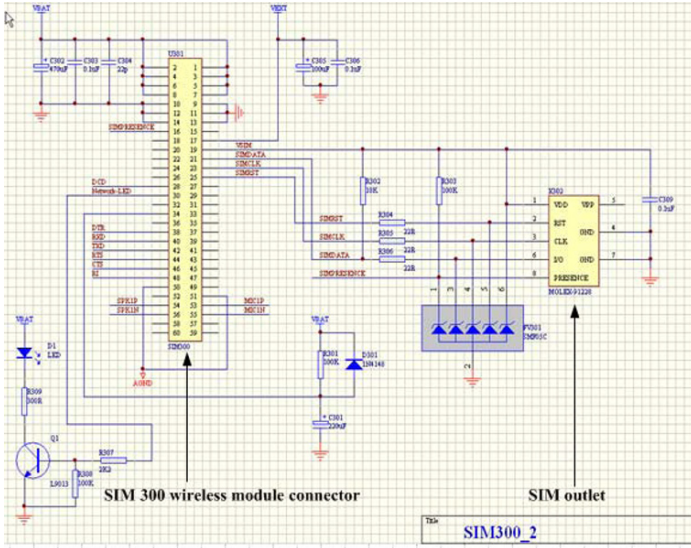


Fig3: GPRS MODEM electronic principle

3.2 Main Components

Tracing terminal mainly consists of Microprocessor ATmega128 and UART(Universal Asynchronous Receiver/Transmitter) SC16C550. The ATmega128 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega128 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed (Atmel Corporation,2007).

Although The ATmega128 provides many features, like 128K bytes of In-System Programmable Flash with Read-While-Write capabilities, 4K bytes EEPROM, and 4K bytes SRAM, it cannot support Modem control functions. Therefore, we integrate UART SC16C550 with 16-byte FIFO and infrared (IrDA) encoder/decoder to achieve data delivering and controlling through MODEM. The SC16C550 operates at 5V, 3.3V and 2.5V, and the Industrial temperature range, and is available in plastic DIP40, PLCC44 and LQFP48 packages. It not only supports Automatic software/hardware flow control , but also provide Modem control functions (CTS, RTS, DSR, DTR, RI, DCD)(Koninklijke Philips Electronics N. V.,2007).

3.3 Research and Development of tracing module

The hardware system follows the bus organized structure. Its' address space is divided into 4 parts:

- (1) 32K RAM: 0000000H-7FFFFFFH
- (2) LCD: A000H-A001H
- (3) GPRS interface SC16C550: B000H-B007H
- (4) USB bus interface CH375: C000H-C001H

The electronic principle is shown in Fig4-6.

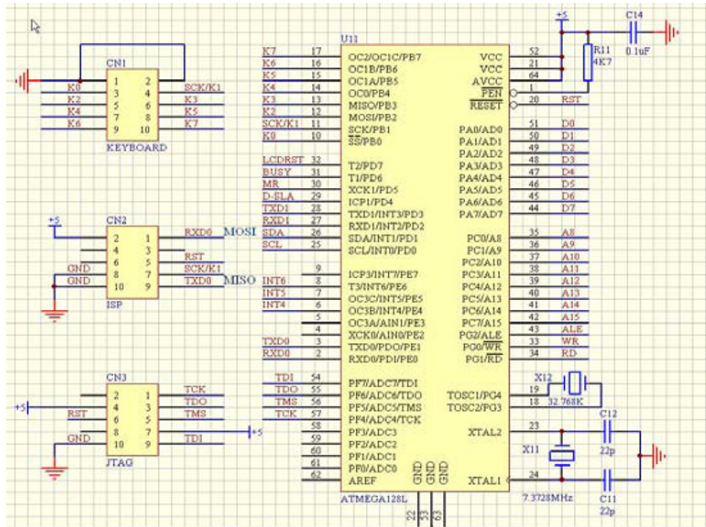


Fig4: MCU electronic Principle

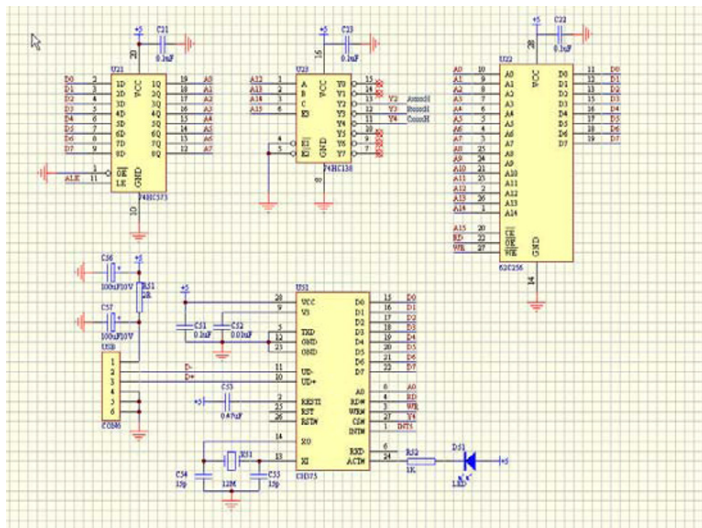


Fig5: Address decoding, 32K RAM and USB interface circuit

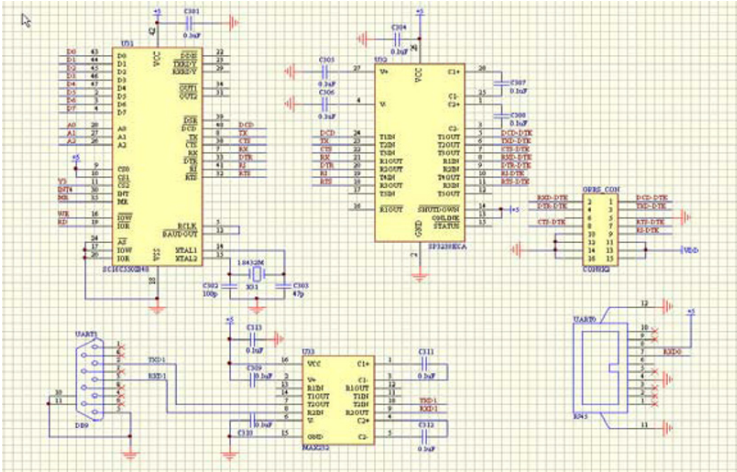


Fig6: MODEM and Serial circuit

4. SOFTWARE PROGRAMMING FOR TRACING TERMINAL

Software programming, implemented by ICCAVR, mainly consists of five modules: Initial setting of MCU, Functions related to GPRS operation, function set achieving display of LCD, low-layer driver of USB interface chip and task decomposition of uC/OS-II embedded operation system. Tracing process is illustrated in Fig7.

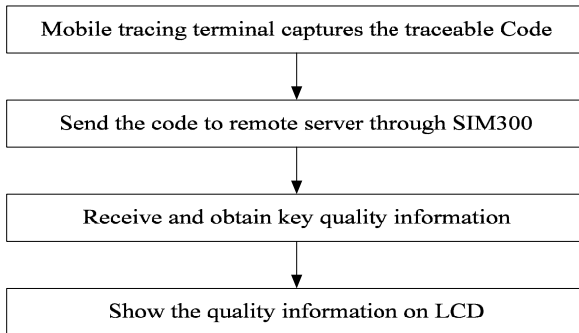


Fig 7: Tracing information process

4.1 Functions related to GPRS operation

The implementation of mobile tracing terminal for agricultural product quality tracking, based on GPRS, depends on SIM300 which is

manufactured by SIMCOM. The connection between SIM300 and MCU is completed via UART (Universal Asynchronous Receiver Transmitter). The essence of microprocessor dataflow operation is to achieve the data exchange based on GPRS through the serial that expands the function of modulation and demodulation TCP/IP is embedded in SIM300, so SIM300 can send the data to serials and activate corresponding commands. SC16C550 contains the following functions:

```
void Init_SC550(void) //16C550initial function, BaudRate=115200
void SC550_Write_Register( unsigned char address, unsigned char val )
//write commands into register 16C550
void SC550_Send_Char(unsigned char tc) //write single-byte data
void String_Send( char *send_buff ) //write string
unsigned char SC550_Read_Char(void) //write single-byte data
void String_Read( char *read_buff ) //write string
```

In order to achieve network data transmission based on TCP/IP by SIM300, we should take the following steps:

Firstly, tracing terminal, as the client, sends a TCP connection request to remote server. The specific command is: AT+CIPSTART="TCP", "Server's IP Address", "Server's Port".

Secondly, If the network is connected successfully, the server will return "CONNECT OK". Then we can send traceable data to remote server by the command "AT+CIPSEND", and the module will automatically receive it via certain serial. We can also close the TCP connection by the command "AT+CIPCLOSE".

Main functions contain:

```
void TCP_Connect( void ) //achieve TCP connection
unsigned char* TXD_Reply( unsigned char *tx_str, unsigned char
*reply_str )
void TCP_Connect( void ) //specific program
{ // AT command
  unsigned char con_cmd0[] = "AT\r";
  unsigned char con_cmd1[] =
  "AT+CIPSTART=\\"TCP\\",\\"211.147.18.79\\",1433\r";
  unsigned char con_cmd2[] = "AT+CIPSEND\r";
  unsigned char con_cmd3[] = "AT+CIPCLOSE\r";
  // SIM300 respond
  unsigned char ans0[] = "\r\nOK";
  unsigned char ans1[] = "CONNECT OK";
  unsigned char ans2[] = ">";
  unsigned char ans3[] = "SEND OK";
  unsigned char ans4[] = "CLOSE OK";
  //send data
```

```

unsigned char data[] = "CAAS_AII| traceable code\x01a";
if( (TXD_Reply( con_cmd0,ans0 ))==0) // Catch Exception
if( (TXD_Reply( con_cmd1,ans1 ))==0) // Catch Exception
if( (TXD_Reply( con_cmd2,ans2 ))==0) // Catch Exception
if( (TXD_Reply( data,ans3 ))==0) // Catch Exception
if( (TXD_Reply( con_cmd3,ans4 ))==0) // Catch Exception
}

```

4.2 Low-layer driver of USB interface chip

CH375 is the interface chip of USB-HOST. It can not only define Host mode, but also Device mode. Moreover, the two modes can be dynamically exchanged to each other. Here we define it as Host mode. Under Host mode, CH375 can be used to connect with U-Disk or data capturing device with USB interface. Functions contain:

```

void CH375_WR_CMD_PORT(UINT8 cmd) //write commands into CH375
void CH375_WR_DAT_PORT( UINT8 dat ) //write data into CH375 port
UINT8 CH375_RD_DAT_PORT( void ) //read data from CH375 data port
void CH375HostInit( void ) //initiate CH375
unsigned charmInitDisk( void ) //initiate U disk
void RD_USB_DATA(void) //read data from U disk

```

5. DISCUSSIONS

1 Recently, taking the monolithic processor as the core, and researching the application of GPRS technology on tracing cereal and oil products are not very popular. According to the requirements of research subject, we design and develop the mobile tracing terminal based on GPRS for agricultural quality tracking.

2 The application of RFID on cereal products quality safety traceability is still a problem, mainly owing to the characteristics of cereal packing and transportation. So it is still hard to solve, and needs many more tentative researches on the application of RFID during cereal dispersive storage and transportation, even if we have prepared stand-link interface for RFID identifying device.

3 Our research result is demonstrated well only in some small areas, and has not been widely applied. With the countries and markets' increasing requirements of agricultural product quality safety standards, we can improve the tracing terminal technically.

ACKNOWLEDGEMENTS

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