The Design and Research of a Kind of Timing Charging Controller

Li Ping and Jin-gang Xu

Abstract This paper is describing a kind of method which is based on SCM (model STC89C52) to design the software and hardware of a timing charging controller. It shows the working principle of the controller, and also focuses on the ways that read, write and operate the LCD module, clock chip, and the principle of turning a relay on or off, and it gives some pictures of the circuit principle diagram and the C language program code of the SCM.

Keywords Controller • SCM • Timing charging

1 Introduction

Since Chinese economic is developing steady and rapidly, the problem of the energy supply has appeared. The concept of green, low carbon, and saving energy has become more and more popular [1]. The rechargeable electric bicycle has entered into many ordinary families, the research and application of the electric cars has also gradually advanced.

People start to concern the problem of charging the storage battery and battery safely, overcharging is the most important thing that affect the life of the battery and storage battery. The controller designed in this paper can control the charging time accurately and prevent the overcharging [2].

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E. Qi et al. (eds.), *Proceedings of 2013 4th International Asia Conference on Industrial Engineering and Management Innovation (IEMI2013)*,
DOI 10.1007/978-3-642-40060-5_2,

2 The Working Principle of the Controller

The SCM got the time information by reading the clock chip, the user can press the key to set an appointment charging time and the charging duration, the LCD display the setting time. After Setting, press the start key to charge. When the charging time is up, the single-chip microcomputer send a high frequency signal to the control end of the relay, then the control relay cut off the charging circuit, stop charging.

3 Design the Hardware

3.1 The Diagram and Picture of the System Hardware

As Fig. 1 shows the diagram and picture of the system hardware, it mainly includes the STC89C52 single-chip microcomputer, clock chip (DS12C887), the liquid crystal display module of Model 12864, buttons, relay, buzzer, and the master plate power [3].

A brief introduction of the Chip and electronic components:

1. The SCM of model STC89C52 is a kind of 8-bit microcontroller that has a high performance and low power consumption, it has 8 k chip program memory and 256 bytes chip data memory, the model of the kernel is 8051.
2. The clock chip of model DS12C887 can generate the time information such as century, year, month, day, minute and second automatically. It brings the lithium battery, when the external power cuts off, the internal time information can still maintain 10 years, and it has two different system modes: the 12 and 24 h system. AM and PM were used to distinguish the morning and afternoon; There are two ways to express the time, one is a binary number representation, and the other one is the BCD code.

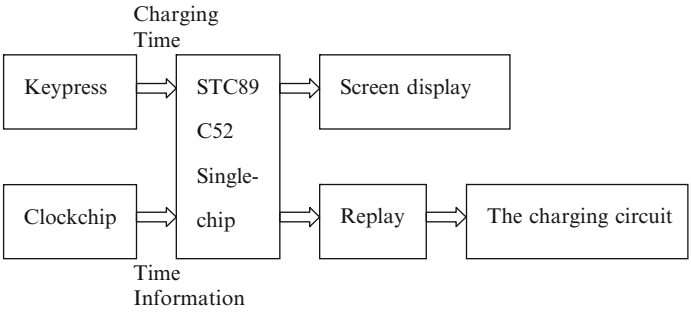

Fig. 1 The diagram and picture of the system hardware

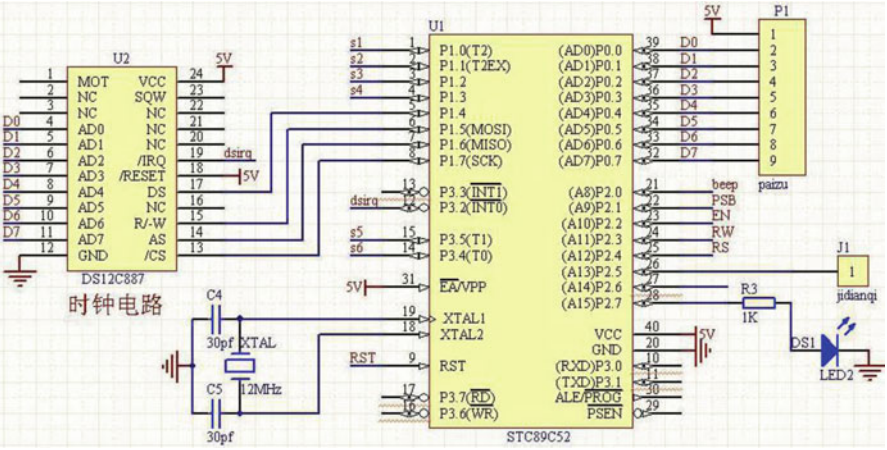

Fig. 2 The interface circuit of the Clock chip

3. The model of the liquid crystal display module is 12864, it contains g simplified Chinese word stock, with 128 16 * 8 points ASCII character sets and 8192 16 * 16 point Chinese characters, there are four lines and each line shows 8 Chinese characters or 16 English characters. The interface is simple, and quite easy to operate, it constitutes the interface of the human-computer interaction system [4].
4. The relay using the dc control exchange model, the limited terminal voltage is 5 V dc high level signal, connected the output end with a 220 V mains ac circuit, both the control and output end have the protection of the light coupling isolation, and the noise to switch on and off is very low, it will not affect the normal work of the SCM weak current control system [5].

3.2 The Interface Circuit Design of the Single-Chip Microcomputer and Clock Chip DS12C887

Figure 2 has shown the principle of the clock chip interface circuit. Inside the DS12C887 there is a crystal oscillator which eliminates the need of the external crystal oscillator. The AD0–AD7 is a signal wire. Through a 10 k pull-up resistor, each can be connected to the ports P0.0–P0.7 of the SCM. MOT tube feet up has decided the Intel work mode system of the clock chip, and the DS pin can be read when the input end is using it.

R/W pin allowed to be used as write in the Intel work mode. AS is the inputting foot of the address gate, when reading and writing, the rising edge of AS will latched the address information which appeared on AD0∼AD7 on to DS12C887. CS is a piece-selected input end, when this pin is at a low electric frequency, DS12C887 works [6].

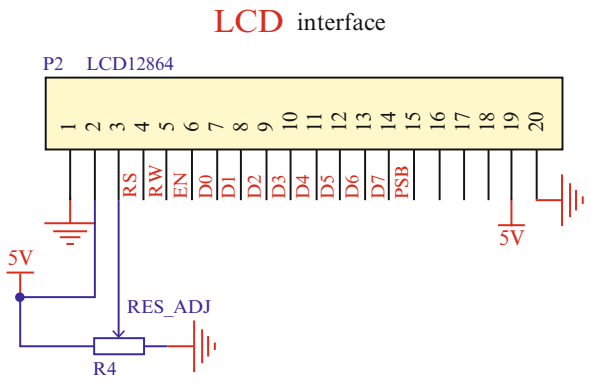

Fig. 3 The interface circuit of the 12864 LCD module

When welding and drawing the circuit diagram, we should pay attention to the following aspects: capacitance C4, C5 and crystal oscillator XTAL should near to the XTAL1 and XTAL2 end as close as possible, and apply copper surround it, minimum the leading of the electromagnetic interference by the wire, and get the system operating frequency of higher precision as far as possible [7].

3.3 Single-Chip Microcomputer and the Interface Circuit Design of the 12864 LCD Module

There is a single-chip microcomputer and the interface circuit principle diagram of the 12864 LCD module in Fig. 3. In this picture the "D0–D7" is the data port of the LCD module. It respectively connect to the P0.0–P0.7 of the single-chip microcomputer through a 10 k pull-up resistors for passing the signal data of the LCD module and the order data. RS end is the choosing end of the "data/orders". When the electric frequency is high, D0–D7 passes the signal data; when the electric frequency is low, D0–D7 passes the signal data [8].

RW is a choosing end for "read/write". When the electric frequency is high, the single-chip microcomputer read the LCD data; when the electric frequency is low, the single-chip microcomputer will write the data into the LCD. EN is a possible end, when the electric frequency is high, the LCD module and the single-chip microcomputer exchange the information. PSB is a selection end for the serial/parallel working mode, the system adopts the parallel way to pass the data, so PSB should be fixed to join the high electric frequency. The pin jumper 2 and 3 connect to a precise adjustable resistance of 10 k ohm. It can adjust the brightness of the LCD module display through changing its resistance [9].

4 The Design of the Program

The program of the timing charging controller is mainly includes three parts: the reading and writing program of the DS12C887 clock chip, the on-off procedures of the relay, the interactive program (that is the liquid crystal display and the key input program) [10].

4.1 The Procedure Chart

After the electric is connected to the system, the microcontroller reset initialization register and the peripheral devices will read the clock chip, and displayed the time information on the LCD. At the same time, the system is waiting for the key operation from the user. And the users can adjust the time through pressing the key, set the charging time and charging duration in advance, then after pressing the ok key, the system will start to count down (Fig. 4).

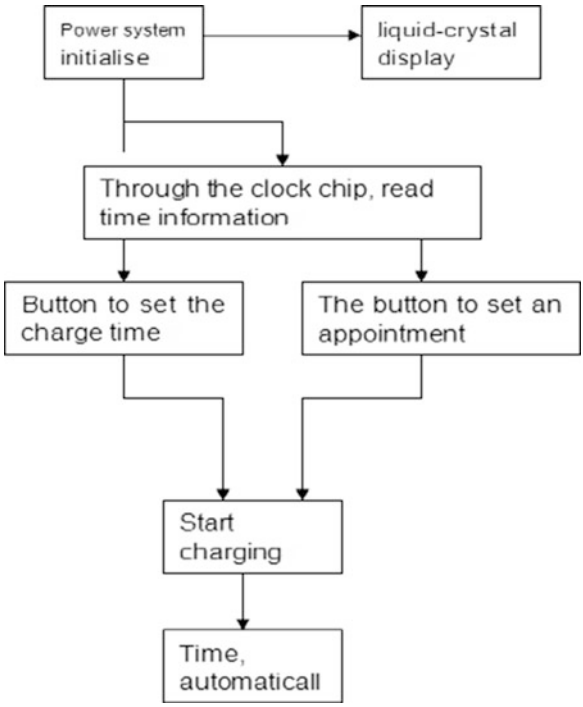

Fig. 4 The procedure chart

When the appointment time is up, the will send a high frequency signal to the control end of the relay, the relay will close the charging circuit and start to charge [11]. When the charging time is up, the single chip microcomputer will send a low frequency signal to the control end of the relay, and the relay will cut off the charging circuit, then the charging is over [12].

4.2 The Reading and Writing Program of the DS12C887 Clock Chip

The rule of reading and writing operation of DS12C887 is to send the address first, and then read the data. The following is the complete code and note to read the clock data:

```
Unsigned char read_ DS12C887 (unsigned char add) / /
  read the clock data
Unsigned char ds date; / / defined variables, it is
  used to store the clock data
     dsas=1;
     dsds=1;
     dsrw=1;
dscs = 0; / / DS12C887 temporarily stop to interact
  with the single-chip microcomputer
P0 = add; / / send the address of the data will be read
  into DS12C887
dsas = 0; / / clean the address be sent
DSDS = 0; / / prohibited the reading operation
P0 = 0 XFF; / / initialize all the clock signal wire to
  a high frequency
Ds_date = P0;
DSDS = 1; / / start to the reading operation
Dsas = 1; / / set high, allow to receive the next
  address information
DSCS = 1; / / allow DS12C887 to send the information
  to the single chip microcomputer
Return (ds_date); / / return to the reading clock data
  [13]
```

4.3 The Reading and Writing Program of Model 12864 LCD Module

The reading and writing rule of the Model 12864 LCD module is: write a command first, then write the data. The following is the complete code and note of the data son function [14]:

```
Void write_lcd_date (unsigned char date) / / write the
  son function of the LCD data
Lcd_RS = 1; / / chose the operating way to write
Lcd_RW = 0; / / open the function of writing LCD
Lcd_EN = 0; / / liquid crystal break-off
P0 = date; / / will wait for sending into the display
  data
Delay (5); / / delay for 5 millisecond, and wait for the
  data delivering completely
EN = 1;/ / liquid crystal start to work, display
delay (5);
EN = 0; }
void Lcd_display(unsigned char shi,fen,miao)
```

Then establish the liquid crystal display subfunction, and complete the displaying function:

```
Void Lcd_display (unsigned char shi, fen, miao)
{write_shifenmiao (6, miao); / / write the second to
  the second-line second position of the liquid crystal
Write_shifenmiao (4, fen); / / write the minute to
  the second-line minute position of the liquid crystal
Write_shifenmiao (2, shi); / / write the hour to the
  second-line hour position of the liquid crystal}
```

4.4 The Action Program of the Relay

When the control end of the relay get the high electric frequency, the output end closed, or the output end off.

```
Void jidianqi_ctrl () / / The on and off of the relay
  control the sub-procedure [15]
```

```
{If (shi = = dian) and & (xiaoshi! = 0) / / the
  reservation time is up
{Jidianqi = 1; / / the circuit of the relay is on,
  start to charge
If (shi = = (dian + xiaoshi) | | (shi = = (dian +
  xiaoshi - 24))) / / the charging time is up, stop
  to charge
{Jidianqi = 0; / / the circuit of the relay is
  disconnected, stop charging}}
else {Jidianqi = 0; / / other time periods, prohibit
  to charge}}
```

5 Conclusion

This paper studies the software and hardware problems of the timing charging controller in design by using the devices of the single-chip microcomputer, the clock chip, the relay and the liquid crystal display module. It also designed the hardware circuit of the controller completely, detailed explained the key program code, and has received the expected effect by building the hardware system through the all purpose circuit and the testing experiment.

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