Design of children's home TV monitoring system based on HT66FU50

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Abstract: In today's electronic technology world, the use of home TV has become very common and at the same time, due to the relatively weak self-control ability of children, the phenomenon of excessive use of home TV will often occur. This ultimately affect their study life in both physical and mental health. Thus, this paper designed a home TV monitoring system based on HT66FU50 through the trigger judgment of the pyroelectric sensor and the time data analysis of the timing system, the effective data obtained by the algorithm calculation is used to control the power on and off of the home television. In addition, the mobile application is designed to allow parents to control the duration of their home TV use at anytime and anywhere. Finally, combining with the humanized functions such as voice notification, touch screen interactive function, close-range smart reminder and electrical power abnormal protection which makes the home TV monitoring system have a very high practical value and good market prospects.

1. Introduction

Home TV is one of the most commonly used electronic devices in our life. During the summer and winter vacations, young children spend a lot of time going to watch TV, but because parents need to go to work during the day, it is not convenient enough for them to manage the situation as such the problem of child's myopia degree to be significantly deepened during the holidays period. Therefore, this paper designs a TV monitoring system for children which is very necessary and very practical because it can reasonably arrange the length of time for teenagers to watch TV and strictly control the distance between them and the TV.

2. System design

2.1 The structural system design

The monitoring system designed in this paper uses HT66FU50 as the control core, and uses the pyroelectric infrared sensor to realize the effective monitoring and control of the distance between the human body and the TV.

The infrared remote control module and the remote mobile phone client are used to set the TV usage time which uses the SD card voice module to count down the voice reminder; the delay relay to turn off the TV power and the system hardware block diagram is shown in Figure 1 and the software design block diagram is shown in Figure 2.
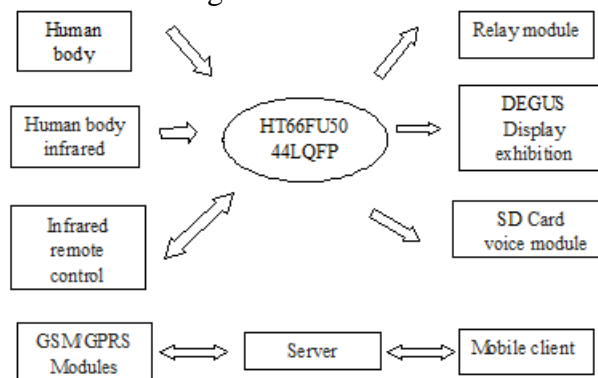

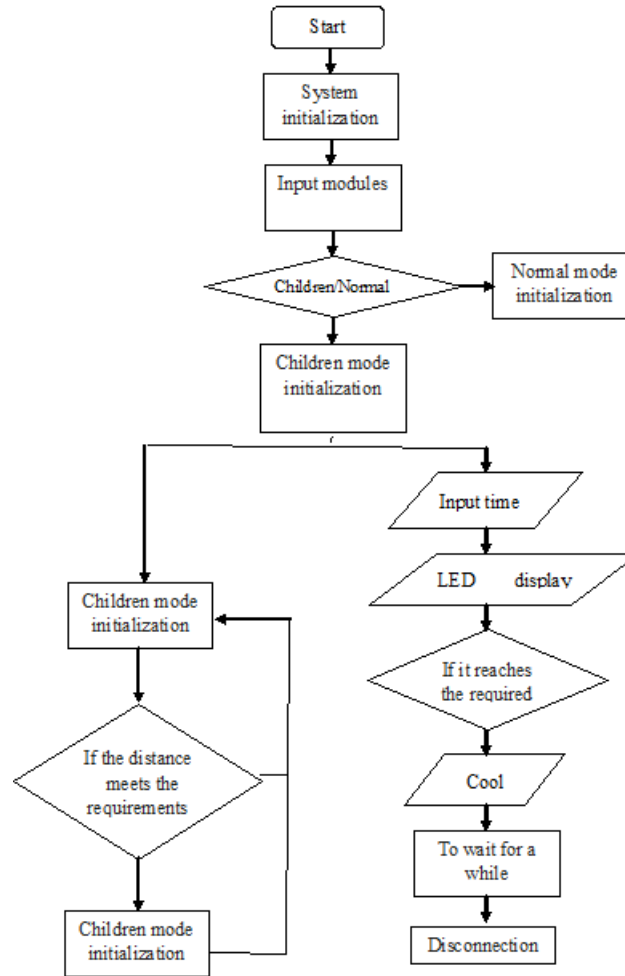Figure 1. System hardware block diagram

Figure 2. Software flow diagram

3. Working principle

3.1 Working principle

The working principle of the monitoring system is to control the power on and off of the home TV by using the triggering judgment of the pyroelectric sensor and the time data analysis of the timing system, also using the effective data obtained by the algorithm calculation when the TV is set to the child mode, the data transmission between the human body infrared sensor module (HC-SR501) and the HT66FU50 microcontroller is enabled. By performing formula analysis and abnormal data filtering on the data acquired in real time, in this case the purpose of real-time monitoring of the distance between the user and the television can be achieved. In addition, in this mode, the user can input the TV viewing duration through the remote control button or the mobile phone client, and then compare the set time and allowed the range time by the matching algorithm to determine whether the set viewing time has been reached, at the same time, when the touch screen is activated, the system name and the set duration, as well as the final time are displayed in real time.

When the distance between the user and the TV is too close or the time for the user to watch the TV has reached the set time, the system will make a voice prompt through the voice synthesis module. If the user does not correct their behavior after 1 minute of the voice prompt, the system will cut off the power of the TV through the delay relay module. At the same time, in order to protect the electrical appliances, this paper designs a power protection circuit under special circumstances such as power-off protection circuit to ensure the safety of electrical appliances.

Finally, it is worth mentioning that, due to the ingenious power management design in this article,

users do not need to purchase a matching power adapter to use 220V mains to supply power to the device.

3.1.1 HC-SR501 Human Body Infrared Sensor Module

The module operates from 5 to 20V DC and the pyroelectric sensor is a temperature sensitive sensor. It consists of a ceramic oxide or piezoelectric crystal element which is made up of electrodes on both surfaces of the element. When there is a temperature change of ΔT within the sensor monitoring range, the pyroelectric effect produces a charge ΔQ on both electrodes, i.e. a weak voltage ΔV is generated between the two electrodes. When the human body enters the detection zone, ΔT is generated due to the difference between the human body temperature and the ambient temperature. Therefore, the pyroelectric human infrared sensor outputs ΔV, and the distance between the human body and the television set in the system is calculated according to ΔV.

The human body infrared sensor module (HC-SR501) has two trigger modes: L is not repeaTable and H can be repeated. For this system, the system can be set to repeaTable trigger mode: after the induction output is high, during the delay period, if the human body is active in its sensing range, the output of this module will remain high until the person leaves and the delay turns the high level to low level.

However, during the use of this article, the module has several ineviTable shortcomings:

1) It is easy to be interfered by various heat sources and light sources;

2) Passive infrared penetration is poor, the infrared radiation of the human body is easily blocked and is not easily received by the probe;

3) When the ambient temperature and the human body temperature are close, the detection and sensitivity are significantly reduced, sometimes causing short-term failure.

In order to deal with the above shortcomings, the influence of the above problems on the actual use effect of the device is avoided. In this paper, the HT66FU50 single-chip microcomputer performs formula analysis and abnormal data filtering on the data obtained in real time, and obtains more accurate and sTable values to avoid the influence of hardware defects on the system.

3.1.2 Delay Relay Module

This system uses the NE555 time delay relay module. The module is equipped with NE555 chip and adjusTable resistor, which makes the delay time 0~10 seconds adjusTable, and can control the equipment below AC 220V/10A (maximum control equipment 2000W). Through the delay time formula: $T = 1.1\ RC$, adjust the value of the capacitor resistance to achieve the purpose of delay power off.

The system sets the relay module to the normal open mode. When the system is in normal use, the control relay module uses the 5VDC input as the switching signal to make the relay absorb and provide 220V AC power to the TV also when the user watches the TV time exceeds the setting. Duration, when the TV power supply needs to be cut off, the HT66FU50 MCU will pull the switch signal low to control the relay module to disconnect the power supply.

In addition, the relay module designed in this paper combined with theroistat that has an anti-shock current circuit which can better ensure the safety of the electrical appliance. The wiring diagram of the time delay relay module is shown in Figure 3. The thermostat anti-shock current circuit is shown in Figure 4.
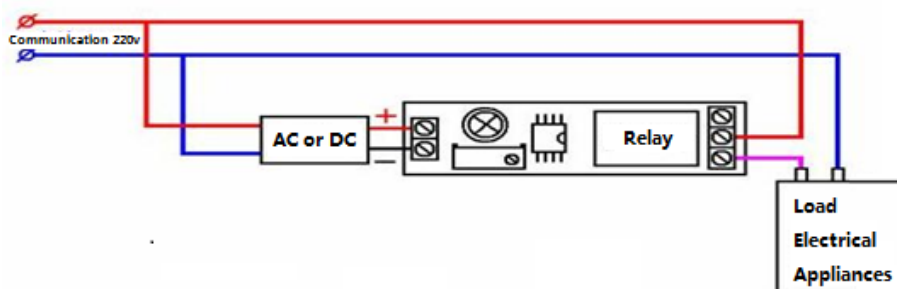

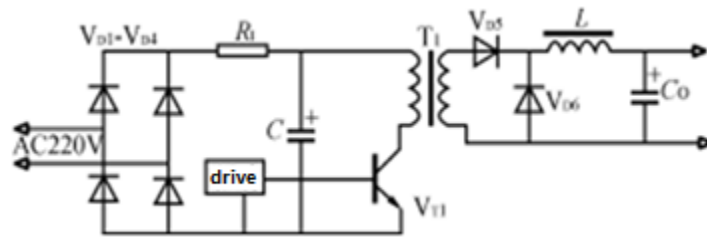
Figure 3. Wiring diagram of delay relay module

Figure 4. Thermistor shock current protection circuit

3.1.3 DGUS display

DGUS® (DWIN Graphical Utilized Software) is the abbreviation of Dwin Graphic Application Service Software. It is a completely independent and innovative intelligent GUI system software designed based on the Dwin K600+ core. This article is the purchase of this LCD screen.

This paper also independently designed a set of human-computer interaction theme interface with humanistic feelings, on the interface, the user can intuitively see the current and available remaining time of the current TV set. The system uses the serial communication method to update the previously set TV viewing time, remaining time and prompt information to the DGUS screen in real time to construct a comforTable human-computer interaction environment. Compared to the large number of parallel screens on the market today, the use of DGUS screens not only frees up more I/O resources, but also makes data background processing and front-end display become too relatively independent systems avoiding program exceptions and equipment downtime when such things happen. The display effect of DGUS screen is shown in figure 5.

Figure 5.　DGUS screen renderin

3.1.4 Infrared remote control module

The infrared remote control system consists of three parts: modulation, transmission and reception. The system uses the HT66FU50 single-chip microcomputer to complete the infrared transmission coding and receiving and decoding chip functions. In addition, the HS5104 is used as the transmission coding chip, and the ten digits of 0~9 are used as the set duration. Input, a confirmation button and a clear button, then the requirement to enter a two-digit number is to ensure that the child can watch TV for up to one and half hours. Press the clear button remotely to set the duration to 0 automatically.

3.1.5 SD card voice module

This system uses the WTV020 chip external SD card module, supporting 32M ~ 1GBit capacity card. This WTV020 external SD card voice module, WTV020 chip selected by the main control chip, voice content can be directly connected to the PC through the SD card reader to update, the module supports FAT file system, supports WAV and ADPCM file playback, supports second line Serial port control mode, button mode and UART232 serial port mode, and can automatically recognize the voice sampling rate and voice file format. The voice module application circuit is
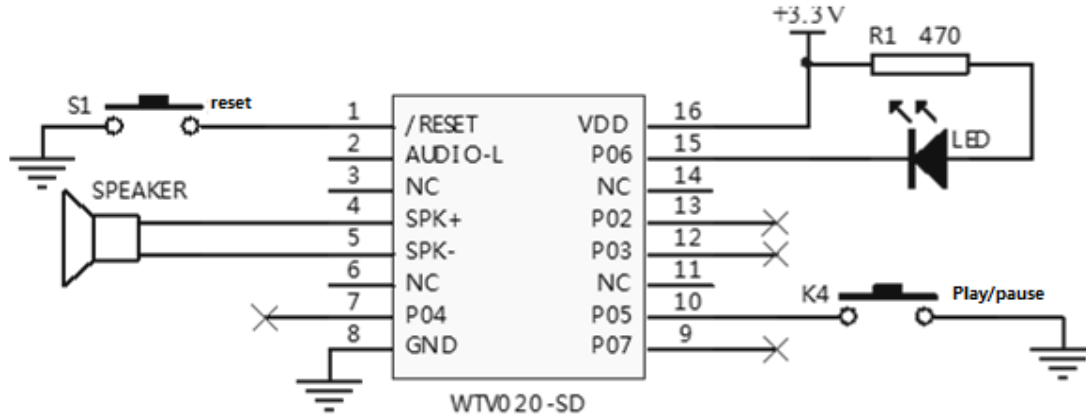
shown in Figure 6.

Figure 6. Voice module application circuit

3.1.6 GSM/GPRS module

This system uses a special SIM900A module. Compared with the most common SIM900A driver circuit on the market, its operating current average is only 50mA, and the standby current is only 20mA. What's more special is that it has a peak emission current of only 1A during registration, so it can operate stably in a more harsh circuit environment.

The system uses TCP/IP protocol to establish a sTable communication channel between the GSM/GPRS module and the remote server. Here, the sTable communication channel refers to the long connection based on HTTP, which is realized by long polling method. The server pushes the technology. The advantages of this kind of long connection are obvious, the message can arrive at the server end instantly, no useless request is made, and the server is relatively easy to manage in the background.

The HT66FU50 MCU can obtain a number of parameters including the TV usage duration configured by the remote mobile phone mobile application through the serial port to form a specified format message. The message parsing enables the system to complete the remaining work according to the remote configuration information. The circuit design of GSM/GPRS module is shown in Figure 7.
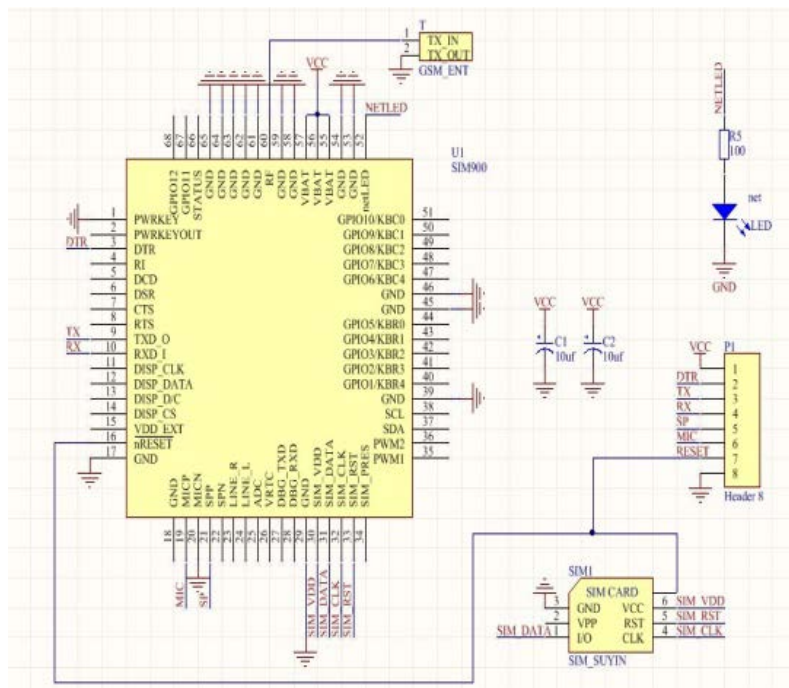

Figure 7. GSM / GPRS module circuit

3.1.7 Mobile APP Module

The system uses the Android mobile phone software development tool to design the mobile phone client of the system and uses JDBC to establish the connection between the client and the server's MySql database, and finally realizes the communication between the remote mobile phone client and the single chip computer through the server and effect of the remote control setting duration of the TV is reached.

Figure 8   Mobile APP interface

4. Test results

4.1 Test TV length control function

The TV duration control is divided into two modes: the remote control input setting duration and the mobile phone client input setting duration.

Remote input setting time: Uses the infrared remote control to input the set duration (0~99 minutes) when you press the confirm button after inputting OK. When you make a mistake then u can press the Clear button and re-enter.

Mobile client input setting duration: The new user first registers a new account, after the registration is successful, you can then enter the length of time you want the TV to work and after inputting the set time, the MCU starts counting down the time and the mobile client synchronizes with a countdown display. When the TV usage time reaches the set duration, the SD card voice module is triggered to perform voice reminder. The test results are shown in Figures 5 and 8.

4.2 Testing the distance detection function between the human body and the TV when the human body is less than 3m away from the TV, the SD card voice reminder module is triggered to perform voice reminder.

5. Conclusion

The main function of the system is to realize the real-time monitoring of the distance between the human body and the TV set and strict control of the length of the TV when the human body watches the TV at a close distance, the output voltage of the pyroelectric sensor changes to an alert. The value is controlled by real-time monitoring of data and voice prompts to control the distance between the human body and the TV set. On the other hand, when the TV viewing time exceeds the set time, a voice reminder will be given and a warning slogan will be displayed on the LCD screen, in such a way that the voice reminder is invalid and the data will be uploaded to the server and send notification to the mobile client that has been bound in advance. In addition, by using the mobile client of the mobile phone, the parent can input the length of time that the child wants to watch the TV thereby it can realize the purpose of controlling the child's reasonable use of TV in time even during the day when the parents are busy with their daily schedules.

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