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Research on the Wireless Audio Transmission System Based on the Infrared

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Abstract: This system used STC89C52 SCM to control the infrared emission diode to transport the audio to the infrared receiving diode wirelessly in the short distance. The infrared emission diode sent signals. The wireless signals done the square wave modulation with the signals with its frequency as high as 38 kHz generated by the SCM. The infrared receiving diode demodulated the received signals and then done the signals transduction. The system used one channel to transport the value of the temperature from the infrared emission based on the 38 kHz to infrared receiver wirelessly. And it used another channel to transmit audio signals from the infrared to the infrared receiver tube under the control of the transistor. Compared to other wireless transmitting equipment, the infrared tubes had the low power consumption, low price, the moderate transmission distance, particularly suitable for short-distance transmission. The system has the widespread application in the remote control devices in the smart home.

Key words: Infrared wireless communication, temperature sensor, codec technology

INTRODUCTION

Namie and Nakagawa (2013) created and examined an indoor positioning system using standard cellular phones with built-in GPS and infrared rays data communication functionalities. Bruyneel *et al*. (2013) done a digital infrared camera and with a speaker/microphone system for bidirectional audio/video communication via Skype is able to communicate with Dream and with Internet through a wi-fi/3G interface. Zhang *et al*. (2012) said a design model with an integrated passive infrared detector was developed to implement burglar alarm in vehicles simply and economically, which can detect body infrared to alarm and wireless signals to cancel alarm by the integrated passive infrared detector, with the embedded solution applied to the vehicle circuits. Hong *et al*. (2011) implemented a transceiver for the visible light communication that based on wireless communication driving technology for LED illumination-based infrared ray communication and measurement analyzed a design error rate of a transceiver variable rate has made about distance change -2.5 m. O'Shaughnessy and Evett (2010) developed wireless sensor networks for monitoring crop canopy temperature using a moving sprinkler system as a platform. Feng *et al*. (2013) said a non-sub sampled Contour let coefficient compressive sensing based on infrared and visible image fusion method was proposed to solve the problem that the infrared light sensor and the visible light sensor was failed to get clear images simultaneously. Mei *et al*. (2008) said infrared images always have little priori-information and blurry boundaries or even with discontinuous boundaries and therefore the segmentation of infrared image is very difficult. Fujiwara *et al*. (2004) focused on far-infrared region, in which there are many important research fields.

OVERALL PROGRAM DESIGN

The flow chart of the hardware system is as follows (Fig. 1):

- In one channel, the infrared emission amplified the audio signals by the transistor and transmitted them in the wireless way. And the infrared receiver processed the received audio signals. The audio signals are amplified through the LM386 and are filtered. They output to the headphones
- In another channel, the infrared emission used the frequency as high as 38 KHz to transmit the temperature digital signals. The receiver of the infrared used the VS1838 to get the temperature under the control of the STC89C52 SCM. And the value of the temperature is displayed on the LCD screen. So the short-range wireless transmission is achieved

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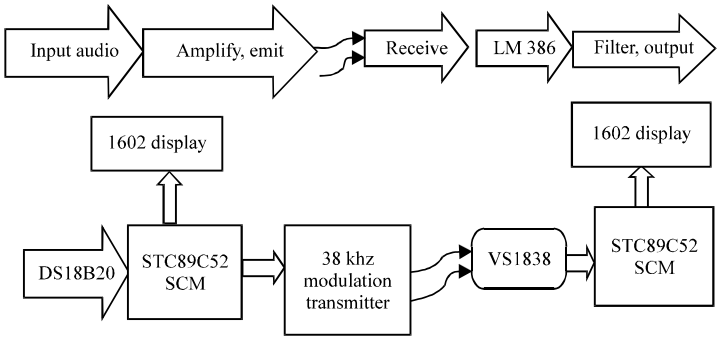

Fig. 1: System structure

SOLUTIONS FOR THE WIRELESS COMMUNICATION

The short distance communication can use discrete components to build a wireless transmission system. But mutual interference between discrete components is severe and some elements are affected by temperature. It is not easy to communicate successfully in the ASK or FSK mode.

The radio frequency wireless transceiver modules can the wireless communication distance longer. But the communication is relatively complicated based on the SPI.

Although, the communication distance is short by using the infrared, the power consumption and the price is low. The system can realize simplex communication. The codec is relatively simple. The procedures are debugged easily.

The 89C52 micro-controller is cheap, cost-effective, more functions. Its internal flash is 8KB. It is sufficient to program for most small and medium systems. It takes charge of the data processing, data generation and transmitting control commands of the entire system. So the chip can meet the following requirements. First, the speed of executing instruction is faster. And the sensitivity is high. Second, the program memory space and the instructions are abundant. Third, it is easy to operate.

The high-speed industrial AVR micro-controller is from ATMEL. Based on 51, more registers and instructions are expanded. The speed is much faster than the 51. And the price is several times.

Temperature acquisition chip: The DS18B20 is popular. It is half digitized temperature sensor from the Dallas. It supports the interfaces for one line bus. The way is economical and unique. It is that users can easily set up the network through the bus. And each chip has a unique code.

The range of the DS18B20 measurement is from -55 to +125° with a resolution of 0.0625°. The DS18B20 temperature sensor can output the result. It used the 3-wire connecting with the micro-controller and reduced the external hardware circuitry. Its accuracy has been improved. And its cost is also low. It only requires an I/O port in the micro-controller. And each DS18B20 has a unique serial number.

CIRCUIT DESIGN AND RATIONALE

The infrared communication is completed by the transmitter and the receiver. The system can use a dedicated decoder chip or the software to decode. This design used the software codec.

This system uses the serial output. To transmit the digital '1', the value of the pulse width, the interval and the cycle is 0.565, 0.56 and 1.125 msec, respectively. To transmit the digital '0', the value of the width, the interval and the cycle is 0.565, 1.685 and 2.25 msec, respectively.

The launching codes from the emitter consists of a start code, a result code, low 8 user codes, high 8 user codes. The waveform of the remote control codes is shown in the Fig. 2. The remote control signal is shown in the Fig. 3.

The VS1838 infrared receiver is the module which integrates the infrared receiver and amplifier circuit. It completes the receiving from the infrared emitter and processes the TTL level signals. The volume is as the same as the ordinary transistor's. It is fit to apply the infrared remote control and the short-distance data transmission fields.

The infrared receiver misplaces the 38K carrier signals. And it obtains the codes reversing to the transmitting codes. The key for the decoding is how to identify the '0' and '1'. According to the codes' format, after 9 and 4.5 msec, real codes begin to be read. The SCM detects the time interval for low and high level of the output interface in the infrared

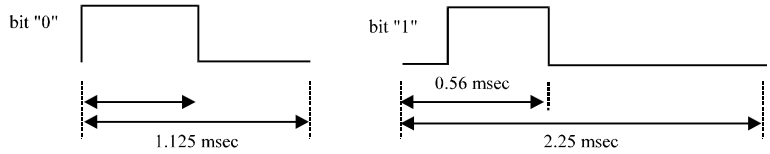

Fig. 2: Waveform of the infrared remote control codes

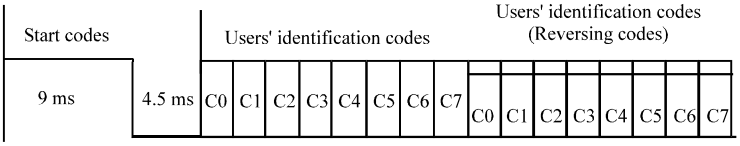

Fig. 3: Remote control signal

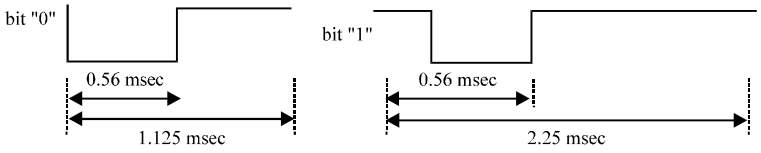

Fig. 4: Waveform of the '0' and '1' to the receiving end

receiver. Then it decodes. The waveform of the '0' and '1 to the receiving end is shown in the Figure 4.

It is also called 1602 character LCD which is a specifically to display letters, numbers, symbols and other dot matrix LCD module. It has a number of other 5X7 or 5X11 dot matrix character bits. The 1602LCD can display two lines. Each line has 16 characters LCD module which display characters and numbers.

Three lithium batteries rated at 3.7 V in series power the system. And then after LM7805 regulator, the power is transformed to 5 V to supply the chip and the system. Some reserved 5 V interfaces are left for other modules.

SYSTEM CIRCUIT AND THE PRINCIPLE

The STC89C52 SCM controls the DS18B20 to complete the temperature data acquisition in the emitting part. It reads twelve bits temperature data from a bus of the DS18B20. On the one hand, it displays the temperature data on the LCD1602. On the other hand, the four bits from the right dislocation of the temperature data's high eight bits combines another four bits from the left dislocation of the low eight bits. They merged into one byte to be sent. Then the byte modulates the 38Khz square wave signal and is transmitted.

The STC89C52 micro-controller scans the port 0 of the external interrupt from the P32 continuously in the infrared receiver. Once it detects the level signals, it turns

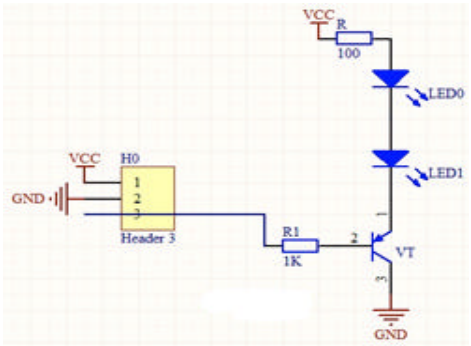

Fig. 5: Part of the infrared emission

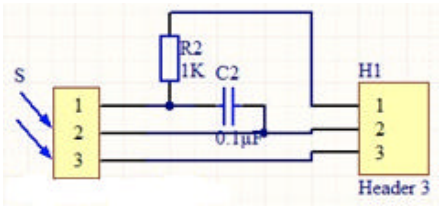

Fig. 6: Infrared receiver with the metal shield

off the external interrupt port. It will not accept the infrared signals until the current infrared signals are to be decoded. After processing data, analog temperature will display on the LCD1602.

The Hardware circuit board design of the demo emitting portion and the receiving portion of the transceiver are shown in Fig. 5 and 6.

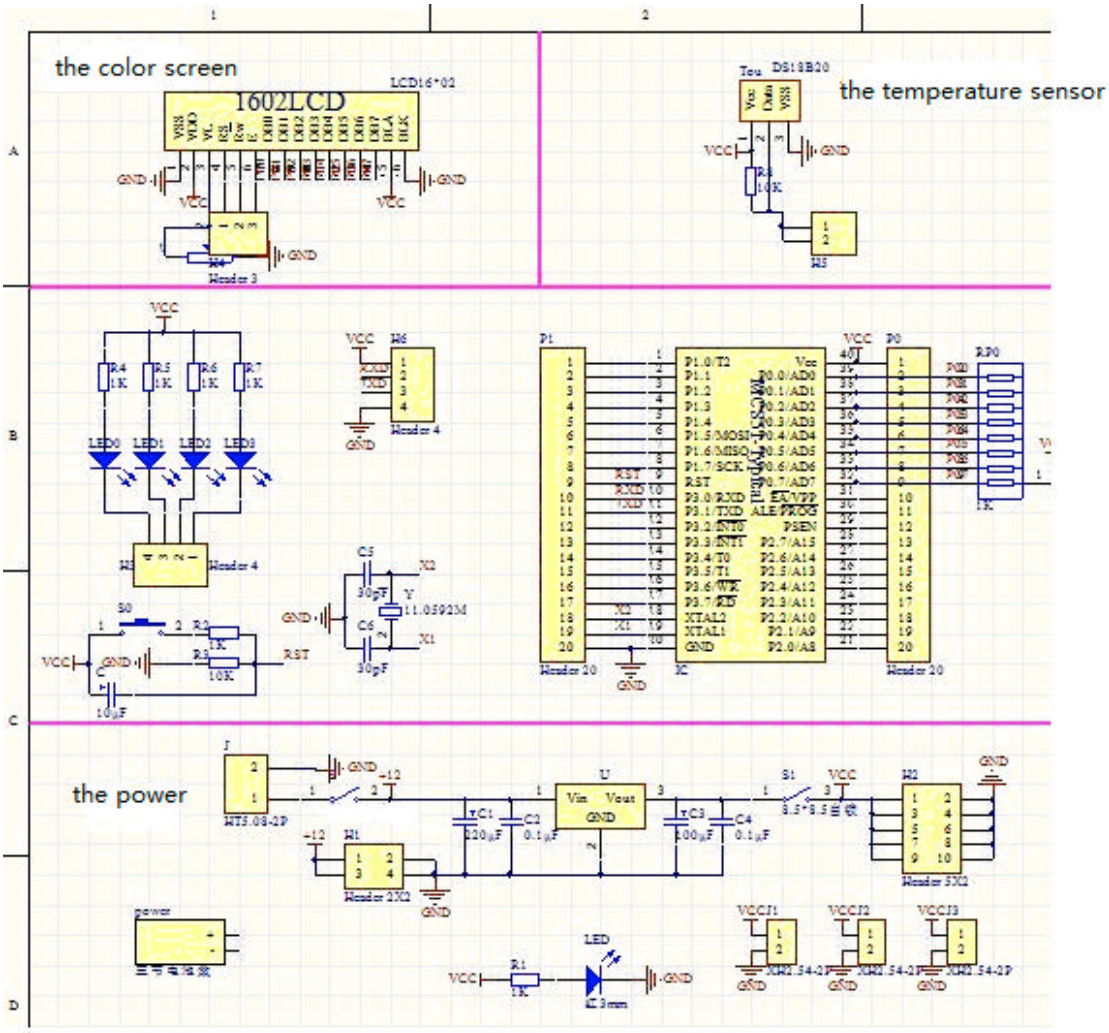

Fig. 7: Circuit of the system

The position of the launch tube and the integrating receiver is on a line of the same plane. If the red light flashes, it indicates a successful decode. You can observe a red light will change the frequency of the flashing, when the distance between master and slave moving is altered or the relative orientation of the launch tube and the integrating receiver is not on a line. This shows when the most suitable conditions are changed, the error probability of the infrared decoding process will change.

SOFTWARE DESIGN FLOW

The infrared transmitter detects the temperature data continually, encodes and transmits it (Fig. 7).

When the infrared receiver senses effective signals, the micro-controller performs the decoding operations and verifies the accuracy of the data. Then the data will be displayed on the 1602LCD.

The process of the infrared decoding and temperature data is performed by the interrupt 0 service routine which is triggered by falling edge of the signal.

The main program is responsible for the initialization of each module and wait for the interrupt to occur.

The main codes is as follows.

```
write_com(0x80);
    for(i=0;i<16;i++)
    {
    write_date(table1[i]);
    delay(5);
    }
    write_com(0x80+0x40);
    for(i=0;i<16;i++)
    {
```

```
        write_date(table2[i]);
         delay(5);
         }
        while(1)
        {
         write_com(0x80+0x40+10);
         write_date(wend/10+0x30);
         write_com(0x80+0x40+11);
         write_date(wend%10+0x30);
  }
}
```

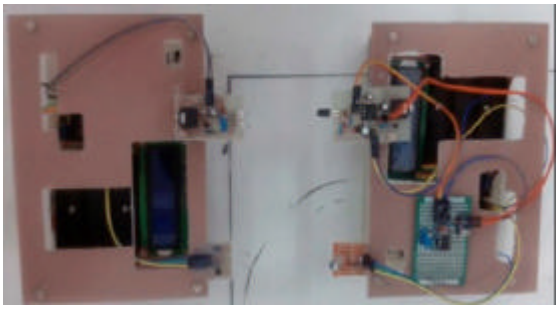

Fig. 8: Transmitter and the receiver

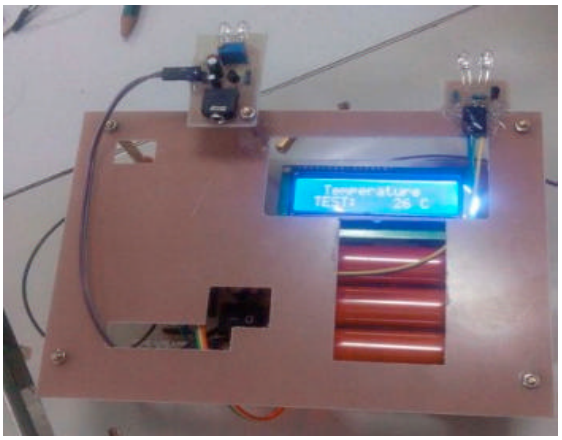

Fig. 9: Test result of the system

MAIN TEST RESULT

The main test instrument is the digital millimeters and Oscilloscope. The figure of the production is shown as the Fig. 8 and 9.

The head of the transmitter faces the receiver. There is not any obstacle in the middle. When the distance between them is becoming larger, the noise appears and the digital audio signals appear unstable or latency. The data is recorded. The results are shown in Table 1 and 2.

The error test for the wireless transmitting the temperature is finished at the two meters long between the infrared transmitter and the infrared receiver.

Table 1: Test distance result

Distances	100	150	200	250	300
Audio signals	Clear	Clear	Little noise	Little Noise	Some noise
Digital signals	Stable	Stable	Stable	In-stable	In-stable

Table 2: Temperature test result

Type	Temperature (Celsius degree)
Temperature in the transmitter	31
Temperature in the receiver	30

The result of the test is that the temperature error rate is 3.33%

CONCLUSION

The system completed wireless audio and digital temperature signals transmission. It used STC89C52 as the core chip and got the value of the sensor DS18B20 temperature from the interface of the bus. The micro-controller will generate 38Khz square wave modulation with the digital temperature and sent the result through the infrared launch tube. The infrared receiver demodulated the received signals and displays the digital temperature on the LCD1602.

After continuous hardware circuit test and software programming, although the audio signal transmission is still some noise, the system still worked normally in the personal area. Now the technique applied in the personal area has the Zigbee, Bluetooth and the infrared. The Zigbee protocol is complex and needs larger memory. The Bluetooth and the infrared need small memory. They have more applications in the smart home and so on.

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References

Bruyneel, M., S. Van den Broecke, W. Libert and V. Ninane, 2013. Real-time attended home-polysomnography with telematic data transmission. Int. J. Med. Inform., 82: 696-701.

Feng, X., X. Wang, J. Dang and Y. Shen, 2013. Fusion method for visible light and infrared images based on compressive sensing of non-subsampled contourlet transformation sparsity. Inform. Technol. J., 12: 672-679.

Fujiwara, M., M. Akiba and M. Sasaki, 2004. Study for far-infrared and faint light detection technology. J. National Inst. Inform. Commun. Technol., 51: 51-58.

Hong, G.B., T.S. Jang, T.H. Kim and Y.K. Kim, 2011. A study on analysis of disturbance in VLC transceiver module based on LED communication. Trans. Korean Inst. Electrical Eng., 60: 1391-1395.

Mei, X., L.Z. Xia and J.X. Li, 2008. A segmentation algorithm of infrared image based on variational formulation level set model. J. Electron. Inform. Technol., 30: 1700-1702.

Namie, H. and M. Nakagawa, 2013. Development of indoor positioning system by using the infrared rays data communication tags for pedestrian navigation. IEEE Trans. Electron. Inform. Syst., 133: 713-721.

O'Shaughnessy, S.A. and S.R. Evett, 2010. Developing wireless sensor networks for monitoring crop canopy temperature using a moving sprinkler system as a platform. Applied Eng. Agric., 26: 331-341.

Zhang, L.H., W.M. Chen, X.Z. Yang, W. Zhang, X. Liu and P. Li, 2012. Design of burglar alarm device system based on body infrared detection. J. Tsinghua Univ., 52: 112-115.