Development of Portable Ball Game Electronic Scoreboard

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Abstract. Aim to the current popularity of various sports which scoring device is inconvenient and defective scoring, this design uses 51 MCU control, battery power, digital display, input keys and wireless control module to develop a portable smart match electronic scoring device. The device has a charging indicator, ball selection, single-sided display settings, size of the Bureau of scores shows that beep audio prompts, change sides scores mobile, long distance remote control and other functions; particularly compact and portable, which one could keep working dozens of hours without any power, and you can add large-screen display, which perfectly suited all size of table tennis, badminton, volleyball and basketball games in the stadiums.

Introduction

With the improvement of people's living standard, all kinds of sports began to spread. Different sports have different rules. The game scoring device is an information system of the rapid acquisition data recording, processing and transmission about the time and score in the sports. Currently, there are two kinds of sports scoring product on the market: one kind is the traditional turn card type, which price is low, function is simple, but the operation is trouble; another is a large electronic type, which the display effect is good, the operation is convenient, but the price is more expensive and it needs of electric power supply. Because these two kinds of products are only adapt to a single game, so they are not popular.

In order to ensure the fairness of the competitive game, people need one kind of electronic scoring device which is easy to carry and suitable for all kinds of fields. Especially the electronic scoring device which integrate table tennis, badminton, volleyball and basketball what people are favorite will have a very good application value.

System Design

Design Goals. To achieve the purpose of portable and intelligent, it requires the game scoring device can be switched among table tennis, badminton, volleyball and basketball mode; can realize the choice of double-sided display options; can use the buttons or wireless remote to control it, have the function of addition and subtraction operations and automatic judging in a single game. It has also the function of points moving at the end of a single inning. And the power consumption is small. It can be used for a long time in a place without power supply. In addition, it provides external extended interface, which can be circumscribed large LED display panel in an important game.

System Composition. System composition as shown in Fig.1, It consists of several function modules. The core of the hardware is the control module, display module, wireless remote control part. The specific function of the core is the software part.
MCU Control Module. AT89C51 is the production of ATMELE Company. It’s an 8 bits single chip which is low voltage and high performance. It contains 4k bytes programmable read-only memory which can be repeatedly erased (PEROM) and 128 bytes random access data memory (RAM) [1]. The circuits design of control module as shown in Fig.2.

Control functions are mainly power control, the switching of single and double-sided surfaces display, game mode selection, the plus and minus key points of both sides score, the score switching when game players exchange fields and the wireless control and so on. Specific design as follows:

P0 port, P1 port: the output signal of single chip; RD0-RD7: the display control of digital tube; M0-M3: correspond to each ball project lamp; BELL: buzzer, ringing when the single bureau is at the end of a game.

P2 port: the input signal of single chip. MK: the choice among table tennis, badminton, volleyball, basketball; DULA: the segment choose of digital tube; WELA: the bit choose of digital tube; KEYA +: the score of one side plus IO detection mouth; KEYA -: the score of one side reduce IO detection mouth; KEYB+: the score of another side plus IO detection mouth; KEYB -: the score of another side reduce IO detection mouth; CHANGE: the score exchange when field switch by the both sides.

P3 port: temporary useless, use as an extension; RST: reset input, when the oscillator work, RST pin appeared two or more machine cycle high level will make single chip reset; ALE/PROG: when
access external program memory or data memory, ALE (address latched allow) output pulse is used for latched the address of low eight bytes, even without access to external memory, ALE still output fixed positive impulse signal in clock oscillator frequency 1/6, so it can be output clock or used for timing purpose; PSEN: program memory allows (PSEN) output is the gating signal of external program memory, when AT89C51 instruction fetch by external program memory, two PSEN are effective in each machine cycle, namely output two pulse, during this period, when access to external data memory, the two effective PSEN signal does not appear; EA/VPP: external access allows, to make CPU only access external program memory, EA end must keep a low level (ground); XTAL1: the input end of oscillator inverting amplifier; XTAL2: the output end of oscillator inverting amplifier[2]

**Display Module.** Digital tube is made of seven luminous tube that consists of 8 characters, plus point is 8 section, were named as A, B, C, D, E, F, G, H. Suppose we want to display the number 2, so as long as A, B, G, E, D the five section. If the digital tube plate joint high potential, then MCU is bright when control end is in low level, is out when it is in high level [3]. From high to low reverse arrangement, P1.7 - P1.0 writes for 01011011 in binary system and 5bH. in 16 system. By the same token, 0=3FH, 1=06H, 2=5bH, 3=4FH, 4=66H, 5=6dH, 6=7dH, 7 =07H, 8=7FH, 9=6FH.This kind of a digital tube controlled by eight of the I/O line is static display. If the number of digital tube is more, it will take a lot of I/O lines.

This design uses the dynamic display. Circuit design is shown in Fig. 3. Dynamic display circuit uses two digital tube section of route selection and together then through the I/O control, due to the output current is too low in single chip microcomputer pin. So it is not suitable for digital tube. Therefore digital tube public end is not connection with power directly, but by 74HC573 latch to drive it. When the digital tube D1 is routing for 1 and D2 routing for 0, at the same time, sending corresponding segment code in the port of P1, the D1 digital tube will display the corresponding numbers. While the digital tube D1 is routing for 0 and D2 routing for 1, at the same time, sending corresponding segment code in the port of P1, the D2 digital tube will display the corresponding number. This in turn display, due to the persistence of vision effect, as long as the cycle period is fast enough, it seems that all the digital tube display together. Dynamic display of the I/O port signal line is less, the line is simple, but the cost of the software, need to CPU refresh periodically. So it will take a lot of CPU time, but also relative to save electricity.

![Figure 3. The circuits design of display module](image)

**Wireless Remote Control.** The circuit of wireless remote control adopt the PT2262 (emission)/PT2272 (receive) low power consumption low price universal decoding circuit chip produced by Taiwan general city company[4], high frequency circuit complete amplitude keying (ASK modulation) is equivalent to 100% of the modulation amplitude modulation, remote control distance can be up to twenty meters.

PT2262 / PT2272 has12 (A0 - A11) three state address end pin (impending, receive high level, then low level), arbitrary combination can provide 531441 kinds of address code, PT2262 can have
six wireless control terminal. Address code and data code output from 17 pin serial, can be used to connect to wireless remote control emission circuit. The coded signal of encoding chip PT2262 contains address code, data code, and synchronous code three parts. After decoding chip PT2272 receives the signal, the address code must be same in two compare, VT feet can output high level, and at the same time corresponding data foot can also output high level.

The circuit of PT2262 emission chip is shown in Fig. 4, the PT2262 address coding pin 1 to pin 8 is hung up. Pin 10 to pin 13 connect to switch SW0 to SW3. When SW0 is pressed then LED is conduction which gives a low level to pin 13. This make TP2262 work to send the signal coding.

![Figure 4. The circuit diagram of wireless transmitting of PT2262](image)

The receiving circuit of PT2272 as shown in Fig. 5, in order to match with the circuit diagram of 2262 chip, the R13 chooses 820k resistance and at the same time address coding pin A0 to A7 also hung up. The outlet tube pin 10 to pin 13 of decoding circuit correspond with PT2262 four launch button that jump from the original low level to the high level.

![Figure 5. The wireless receiving circuit diagram of PT2272](image)

**Software Design.** The software design of sports score indicator is mainly composed of four modules: the dynamic display of digital tube, the selection process of ball games, the process at the end of each round, the process of score plus/minus point key. The software process of key processing as shown in Fig. 6.
Conclusion

This electronic score indicator’s function is perfect. It is reliable operation and easy to carry. It can work in the place where without power supply for dozens of hours. It can still connect to large screen display. Especially the twenty meters of wireless remote control function provides a great convenience to the user. So it is very suitable for all kinds of sports such as table tennis, badminton, volleyball and basketball. It has a great demand in the school sports and has a very good application value. We had applied for patent.

References