Design of Digital Voltmeter for Microcontrollers

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Abstract

This paper which introduces a kind of Digital Voltmeter is based on Microcontrollers design. The circuit of the voltage meter is mainly consisted of three mould pieces: A/D converting mould piece, A/D converting is mainly completed by the ADC0808, it converts the collected analog data into the digital data and transmits the outcome to the manifestation controlling mould piece. Data processing is mainly completed by the AT89C51 chip, it processes the data produced by the ADC0808 chip and generates the right manifestation codes, also transmits the codes to the manifestation controlling mould piece. Also, the AT89C51 chip controls the ADC0808 chip to work. The voltmeter features in simple electrical circuit, lower use of elements, low cost, moreover, its measuring precision and reliability. The voltmeter is capable of measuring voltage inputs from 1 route ranging from 0 to 5 volt, and displaying the measurements though a digital code tube of 7 pieces of LED.

Keywords

Microcontroller; Digital voltmeter; A/D converter; AT89C51; ADC0808.

1. Introduction

This paper is based on the design of simple DC digital voltage meter, which mainly includes three modules: conversion module, data processing module and display module.In which, A/D Convert adopts ADC0808 to transform the analog signal input, and control the core AT89C51 to perform operation on the result of the conversion, and finally the output device LED displays the digital voltage signal [1].

2. Design Scheme

The hardware circuit design consists of 6 parts:A/D conversion circuit,Microcontroller of AT89C51 system, LED display system, clock circuit, reset circuit and measurement voltage input circuit.The block diagram of hardware circuit is shown in figure 2.1.

3. Hardware Circuit Design

3.1 A/D Conversion Module

The successive approximation type A/D converter consists of A comparator, A/D converter, memory and control circuit.It takes advantage of the internal registers to start from the high to low levels to start the bitwise comparison.

The conversion process is as follows:

Started, register your reset, the transformation, the highest position 1 first, to transform the data into A/D converter, convert the results compared with the input analog, if the conversion of the analog input analog quantity is small, the 1, if the conversion of analog quantity is greater than input analog, 1 don't keep, and then from the second, in turn, repeat the process until the lowest, and finally the contents of the register is the binary digital quantity input analog corresponding [2].

The principle block diagram is shown in figure 3.1:

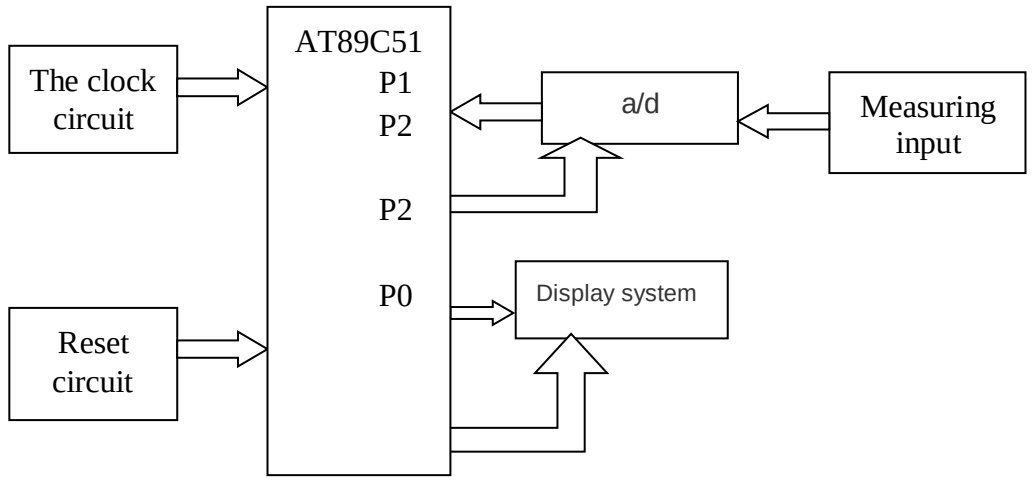

Figure 1. Hardware design block diagram of Digital Voltmeter system.

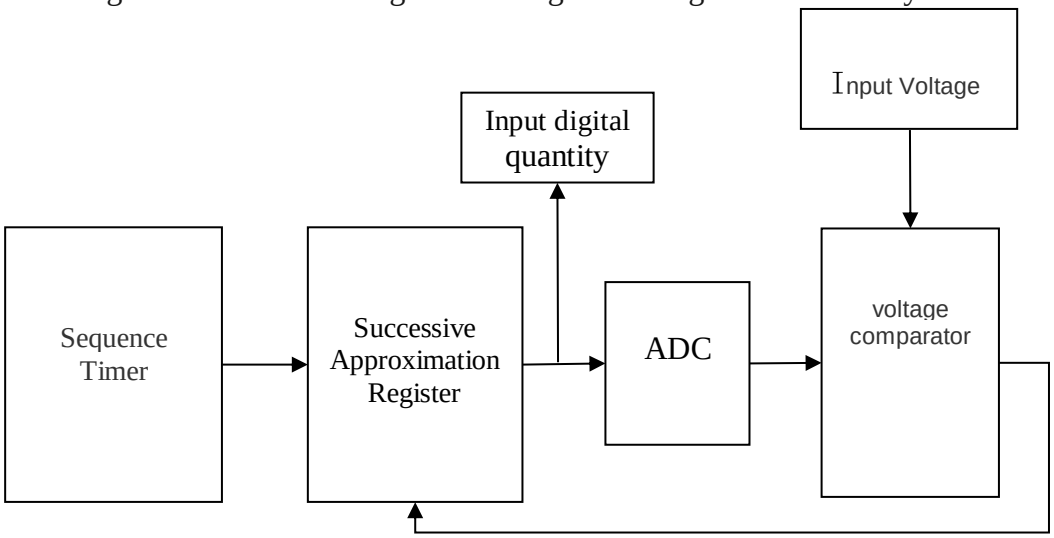

FIG 2. Schematic diagram of successive approximation A/D converter.

3.2 Reset Circuit Design

The Microcontroller needs to be reset at startup, so that the CPU and other parts of the system are in a defined initial state and start working from that state.Microcontroller of McS-51 has a reset pin RST, which USES schmidt to trigger the input.When the vibrator vibrates, the device will be reset as long as the high level of two machine cycles is present on the pin, and the device is reset [3].After the restoration, if the RST continues to maintain a high level, the McS-51 will remain in the reset state, so long as the RST recovers low level, the single chip will be able to enter other working conditions.On microcontroller reset means has two kinds of electric automatic reset and manual reset, figure 3.2 is 51 series microcontroller system commonly used in electric reset and manual reset circuit, as long as the Vcc rise time is less than 1 ms, they all can be a very good job [3].

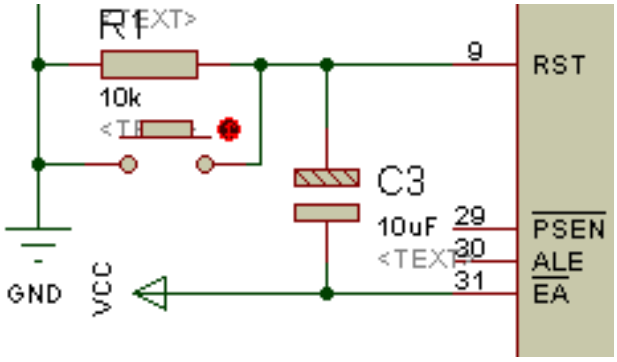

Figure 3. Reset Circuit.

3.3 Clock circuit design

Microcomputer CPU each execution of an instruction that must be unified under the control of the clock pulse of strictly according to time to the beat, and the clock is a sequential circuits of Microcomputer control.The time sequence of each microoperation of the CPU executing one instruction is called the time sequence of the single chip.Microcontroller of McS-51 chip inside a high-gain Inverting Amplifier, is used to form oscillators, XTAL1 as the input of the amplifier, XTAL2 for the amplifier output, but also need to attach other clock circuit formed circuit [3].The design system adopts the internal clock mode, and use the high gain inverter amplifier inside the Microcomputer, and the external circuit is simple. Only one crystal oscillator and two capacitors are required, as shown in figure 3.3.

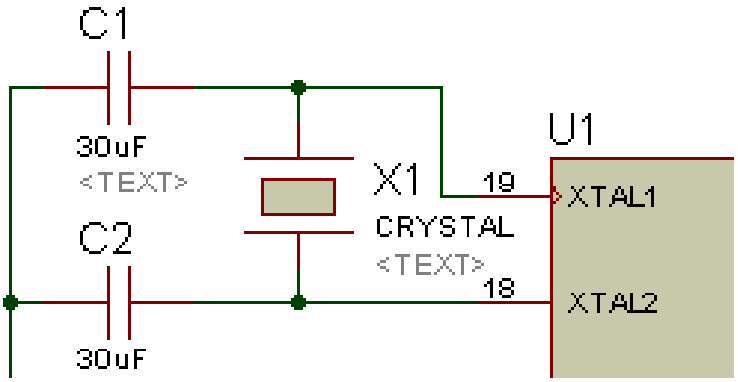

Figure 4. Clock Circuit.

Device selection in the circuit may be determined by calculation and experiment, also can refer to some typical parameters of the circuit, the capacitor C1 and C2 have fine effect to the oscillation frequency, is usually the scope of 30±10 pf, chose 33 pf in the system;

The maximum choice of quartz crystal vibration is 24MHz, which determines the oscillation frequency of clock signal generated by the Microcomputer circuit. the oscillation frequency of the clock signal is 12MHz.

3.4 LED display and single chip interface design

As a result of the Microcomputer parallel port can't direct drive LED display, in general, must use a dedicated driver circuit chip, to produce enough current, can display normal work [4].If the driver circuit ability is poor, the load capacity is not enough, the display brightness is low, and drive circuit under overload operation for a long time easy to damage, therefore, the LED display driver circuit design is a very important problem.DC digital voltage meter is aimed to simplify the circuit design, on the design of the LED driver circuit, can take advantage of the Microcomputer P0 mouth on external pull-up resistors, the LED A - G segment display pin and DP decimal pins parallel to the P0 mouth and pull resistance between, such, can increase the P0 mouth DE as the output driving capability, in accordance with the normal brightness of LED can show Numbers, as shown in figure 3.4.

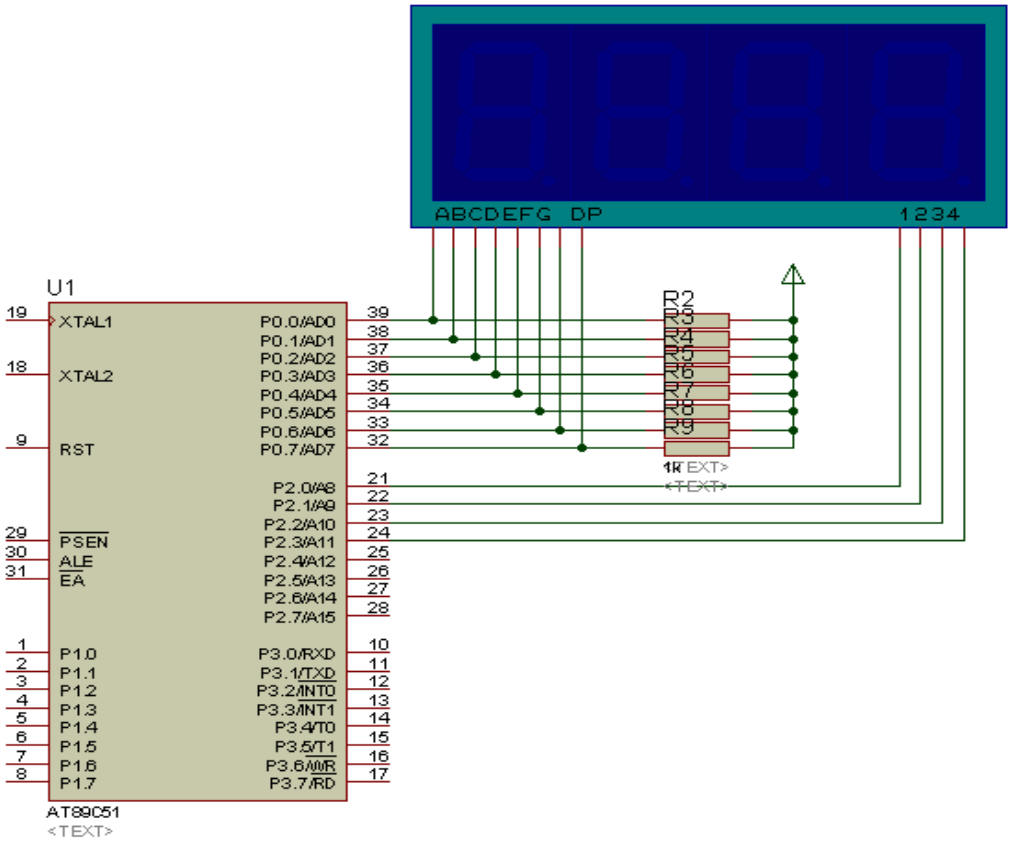

Figure 5. Design between LED and single chip interface.

4. System subroutine design

4.1 General plan of program design

According to the principle of module division, to divide the program initialization module, A/D conversion subroutine and display subroutine, the three program module of the system software of the main program, as shown in figure 4.1.

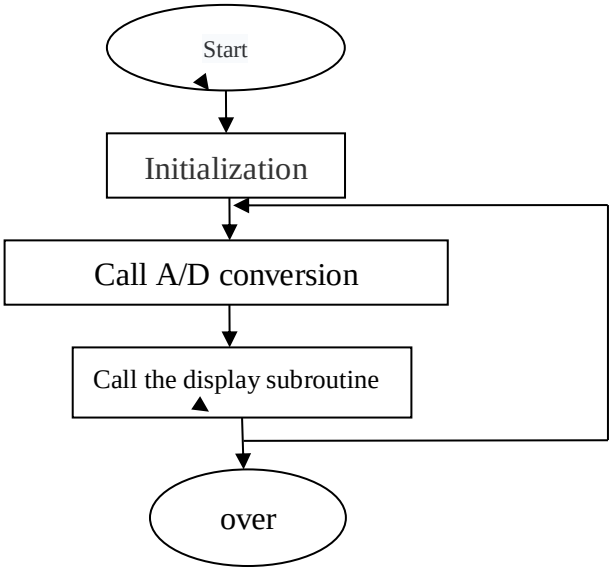

Figure 6. Main block diagram of digital dc voltmeter.

4.2 System subroutine design

A/D conversion subroutine is used to control the acquisition and measurement of the input module voltage signal, and the corresponding values are stored in the corresponding memory unit. The conversion flow chart is shown in figure 4.2.

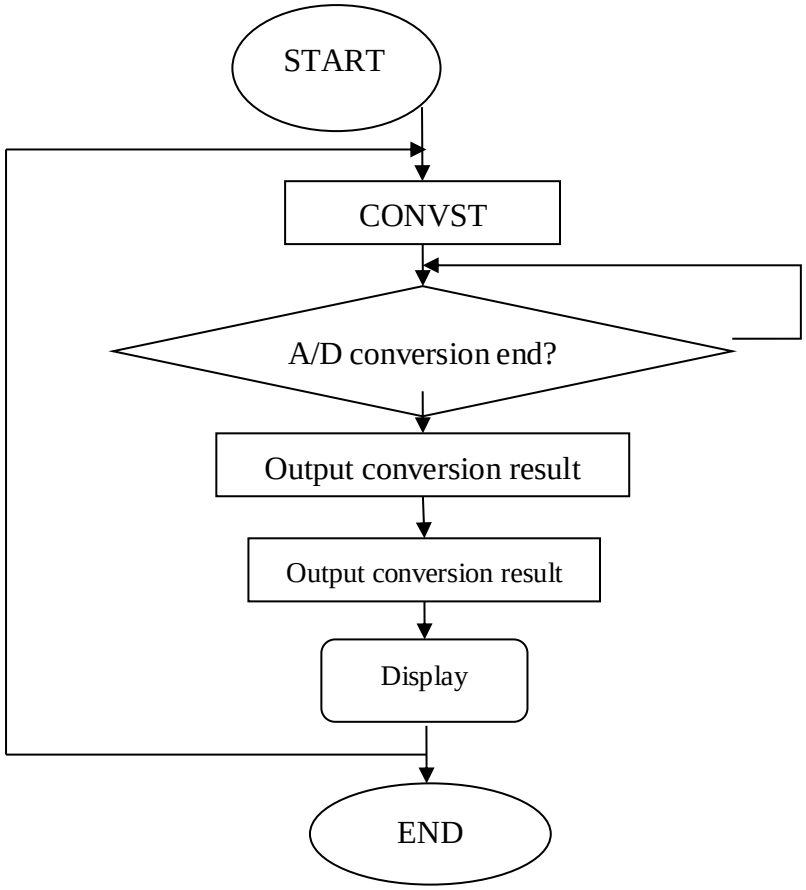

Figure 7. A/D conversion flow chart.

Dynamic scanning display subroutine are realize the value of four digital tube display, when using dynamic scanning display mode, to make the LED display is evener, and have enough brightness, you need to set up the proper scanning frequency, when scanning frequency at about 70 hz, can produce a good display effect, general interval of 10 ms can be used for the LED dynamic scanning time, each LED display time of 1 ms [5].

5. Display results

1. When the input voltage value of IN0 is 0V, the display result is shown in figure 14, and the measurement error is 0V, as shown in figure 5.1.

2. When IN0 input voltage value is 1.50V, the display result is shown in figure 15.

The measurement error is 0.01V, as shown in figure 5.2.

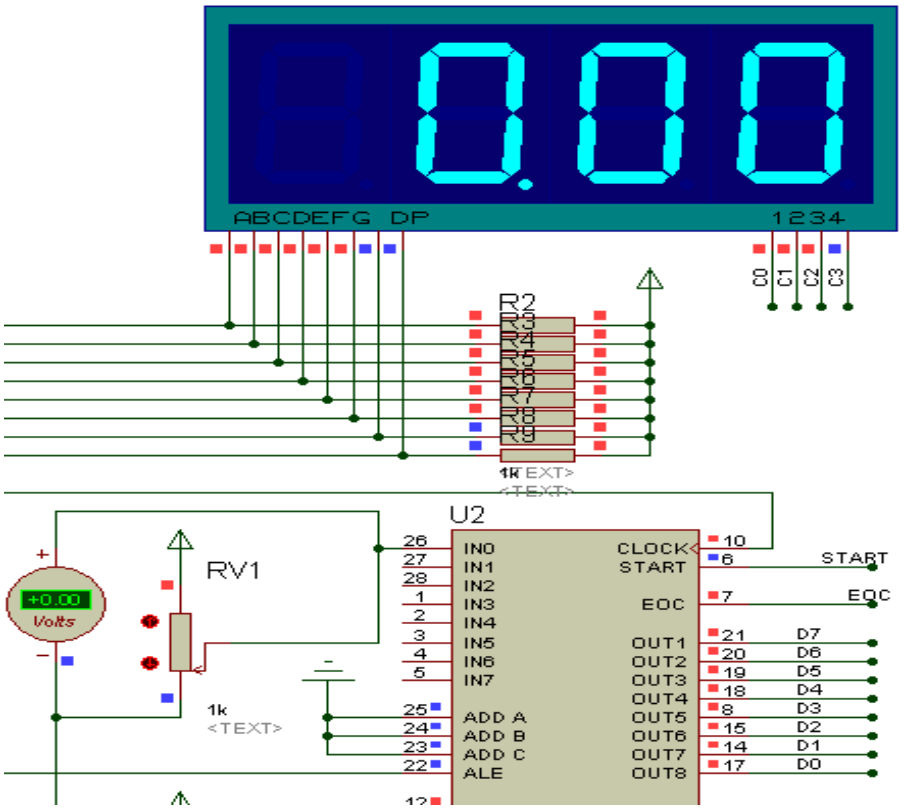

Figure 8. When the input voltage is 0V, the LED display results.

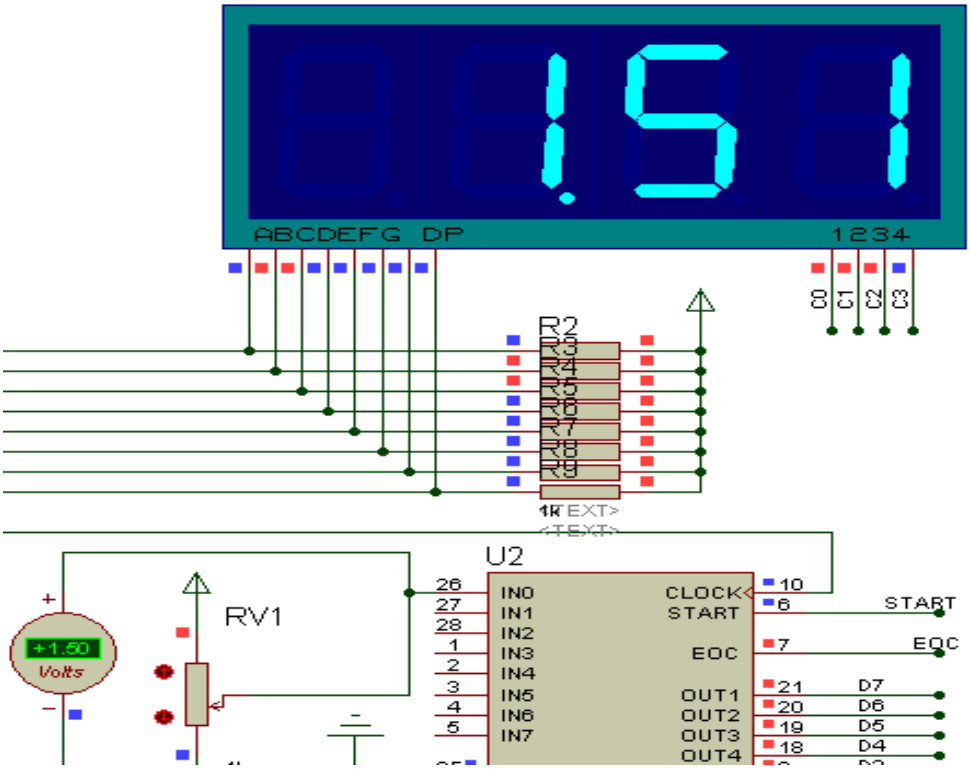

Figure 9. Input voltage of 1.50V, LED display results.

6. Conclusion

The digital voltmeter based on single chip microcomputer has strong usability, simple structure, low cost and few external components. The practical application should be good, the measurement voltage is accurate, and the precision is high. The system functions and indexes have reached the expected requirements of the project, and the system has fully considered the extensibility in hardware design.

After some modifications, the function can be added. In this paper, a simple digital voltmeter is designed to measure the voltage of the voltage, and the design of the schematic diagram is described in detail.

References

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