

Design of the Counting System for the Sewing Machine Production Line

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Abstract—A counting system of the sewing machine production line is introduced. The circuit and software design of the system are also given. With AT89C51 used as the control center and optoelectronic switch used as the sensor, the system can detect actual quantity of the line, display the time and plan production. The experimental results show that the system has the advantages of good reliability, easy operation and high accuracy. It can be widely used in the field of home appliance and food manufacturing.

Keywords-production line; counting system; AT89S51; optoelectronic switch component

I. INTRODUCTION

With the development of modern production, the traditional artificial measurement methods of counting product quantity are not accurate. In order to manage and count parts or finished products on automated production line timely and accurately, the automatic detection and counting devices are needed to install. The automatic devices can display the number of products and provide dynamic data to the computer management system timely, which are the basis of process control[1-4].

This system is designed for the sewing machine factory assembly line. There are thirty sewing machine production lines in the factory. Each line needs the counting system. The system must have many functions such as detecting and displaying the product quantity of the production line real-time, displaying the time and plan production data, setting parameter online, transmitting data to the master control room, etc.

II. THE COMPOSITION OF THE HARDWARE SYSTEM

The system adopts AT89S51 as the core controller, which is composed of keyboard circuit, signal detection circuit, watchdog circuit, clock circuit, display circuit and communication circuit. System diagram is shown in Fig.1[5-6].

AT89S51 is a low-power, high-performance CMOS 8-bit microcontroller with 4KB of ISP flash memory. The device uses Atmel high-density, nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pinout. On-chip flash allows program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. The system clock uses 6 MHz, port 0 is data port, P1.1~P1.6 are connected to the keyboard circuit, port 2 is used to address control, P3.3, P3.4,

P3.5 joint signal detection circuit, P1.0 is connected to watchdog reset circuit and to provide a periodic pulse input signal.

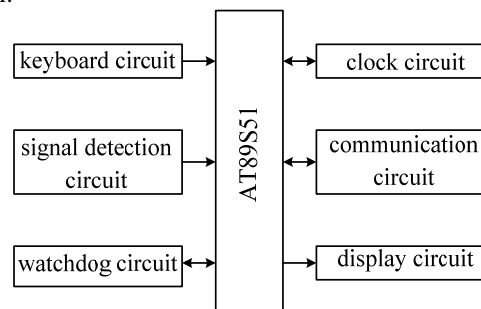


Figure 1. System diagram

Signal detection circuit is used to test product quantity of production line and provide corresponding number of pulse signal to microcomputer, when products pass through the production line. AT89S51 uses on-chip timing / counter to count the number of products. Each product passes forward, the counter "add 1".

The display needs to show the current time, plan production, actual production, etc. The current time is generated by the clock chip DS12887. The plan production which is inputted by the keyboard is the production numbers that needed to get in all day. Actual production is the actual numbers counted by the circuit. The system uses serial communication, and SCM connects to PC through the MAX485.

A. Watchdog Reset Circuit

The watchdog reset circuit uses MicroMonitor Chip DS1232 which is the produce of American Dallas Company. It has many advantages such as higher safe reliability, lower price, better anti-interference ability, etc. The DS1232 monitors three vital conditions for a microprocessor: power supply, software execution, and external override. First, a precision temperature-compensated reference and comparator circuit monitors the status of V_{CC} . When an out-of-tolerance condition occurs, an internal power fail signal is generated which forces reset to the active state. When V_{CC} returns to an in-tolerance condition, the reset signals are kept in the active state for a minimum of 250 ms to allow the power supply and processor to stabilize. Second, the DS1232 performs pushbutton reset control. The DS1232 bounces the pushbutton input and guarantees an active reset

pulse width of 250 ms minimum. The third function is a watchdog timer. The DS1232 has an internal timer that forces the reset signals to the active state if the strobe input is not driven low prior to time-out. The watchdog timer function can be set to operate on time-out settings of approximately 150 ms, 600 ms, and 1.2 seconds. The function is very effective to prevent the interference caused by the microprocessor crash. It forces RST and \overline{RST} signals to the active state when the ST input is not stimulated for a predetermined time period. In the system the time period is set by the TD input to be typically 150 ms with TD connected to ground. P1.0 is connected to ST to provide periodic input signal. \overline{RST} is connected to the INT0 of the microcomputer[7].

B. Clock Circuit

The clock circuit uses a 8-bit parallel interface real time clock / calendar chip DS12887, which contains a lithium battery power to run for more than 10 years without losing data. There is 12 hours system or 24 hours system for a day. Two kinds of bus timing mode can be selected in this clock chip such as Motorola and Intel[8-9]. AT89S51 and DS12887 interface circuit is shown in Fig.2.

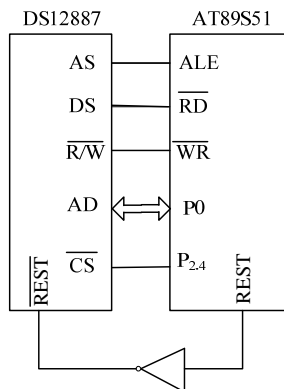


Figure 2. AT89S51 and DS12887 interface circuit

C. The Keyboard and Display Circuit

The display circuit is composed of 16 common anode LED digital tubes and its driving circuit. The plan production and actual production are displayed by 4 digital tubes and the current time is displayed by 12 digital tubes. Digital tubes are driven by CD4511 with latch function. The data signals of CD4511 are given by SCM P0. The chip select signal of CD4511 is given by decoder. The driver circuit of two digital tubes is shown in Fig. 3.

The keyboard circuit's function is to determine the working state of the system and set parameters. There are two kinds of working state of the circuit, one kind is set condition, and the other one is running state. In the set condition we can set plan production and correct the current time parameters by keyboard. In the running state, the system can count product quantity of production line, and can correct the actual production online at the same time.

There is dithering elimination circuit composed of resistance-capacitance circuit, which is used to relieve interference of key dithering.

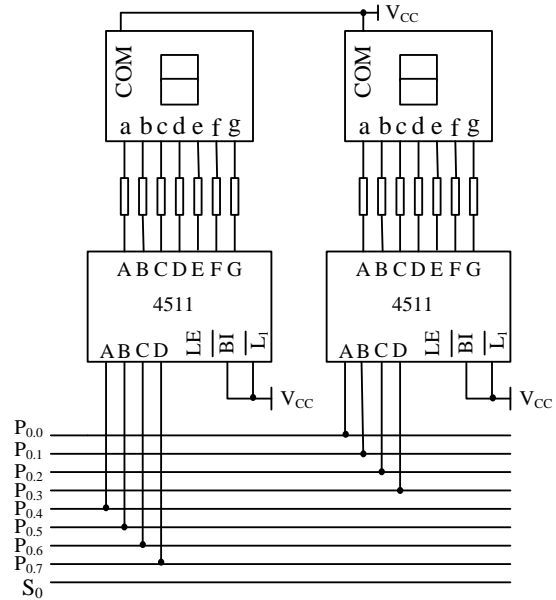


Figure 3. Driver circuit of two digital tubes

D. Signal Detection Circuit

The signal detection circuit is the key of the whole system. We must set detection point in the right position on the automatic production line, and then test the products quantity. The count methods consist of contact measurement and non-contact measurement. But in most cases, the products on the assembly line are difficult to determine the position. The contact detection mode is difficult to achieve, and non-contact detection has many advantages. This system adopts BR85-BP-ST7X/E photoelectric switch sensor, in which the transmitter and the receiver are integrated into a whole. Photoelectric switch adopts photoelectric element as detecting element, and the transmitter emits light through the mirror reflected back to the receiver, when a object is detected by the light, the photoelectric switch produces a detection switch signal[10-11].

The signal detection circuit is shown in Fig.4. Its task is to test the product quantity on production line. IN0, IN1 is photoelectric switch output signal, low level effective. After shaping, filtering the signal by the circuit, they can be send into microcomputer to count. The circuit should be able to judge the direction of the operation of the product, because problem products should be back to retest in the production line. When the product pass forward, counter "plus 1". When the product pass backward, counter "minus 1". To achieve this function, two photoelectric switches are installed on the production line: they can determine product operation direction according to the order of the effective signal into single chip microcomputer.

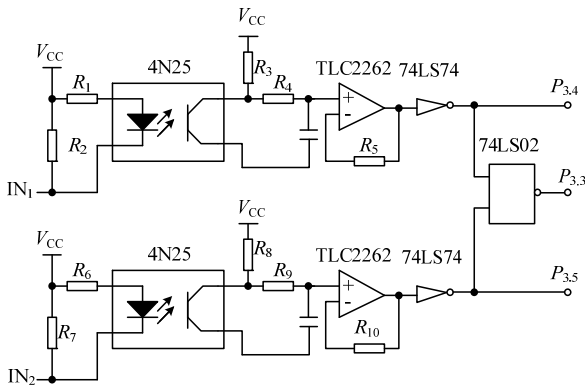


Figure 4. Signal detection circuit

III. SYSTEM SOFTWARE DESIGN

The system software includes a main program, data acquisition subprogram, key processing subprogram, interrupt subprogram, showing subprogram and communication subprogram, etc. The main program mainly complete device initialization, determine whether the key is pressed and whether the interrupt request exists, and then, according to the result of judgment calls the corresponding subroutine. The flow chart of main program is shown in Fig. 5.

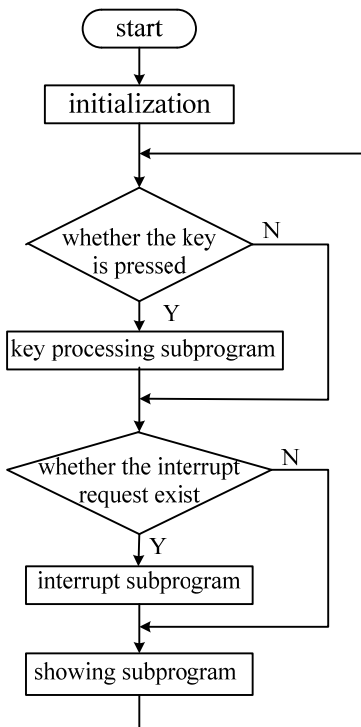


Figure 5. The flow chart of main program

IV. CONCLUSION

The put forward counting system was installed to measure the product quantity on production line of a Sewing Machine plant. With commissioning being completed, the

system was tested. The experimental results are shown in table 1.

TABLE 1. THE EXPERIMENTAL RESULTS

The number	Artificial counting	Automatic counting
1	50	0050
2	150	0150
3	350	0350
4	550	0550
5	1050	1050

The above results show that the counting system with AT89C51 used as the control center and optoelectronic switch used as the sensor has the advantages of simple structure, low cost. According to the test, the device is stable and reliable, has not found the misoperation, and can be widely used quantity statistics in storage, production line and so on.

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