

Design of automatic processing and testing furniture system based on SCM

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Abstract. In the automatic processing of products, most factories only put forward improvement schemes in processing efficiency, ignoring qualified rates after processing. Therefore, an automatic processing and testing furniture system based on SCM is proposed in this paper. Based on automatic processing, the workpiece detection device is added. In this paper, MCU as the core, using a vision sensor, stepper motor module, system alarm module, wireless transmission module and LIQUID crystal display module, the workpiece processing and detection. It is used to solve the subsequent detection of processed workpieces. In the whole machining process, the first complete processing and testing process, through a transmission belt, can connect processing and testing using the Keil and Proteus simulation. It is realized the size of the visual sensor, step motor positive & negative, buzzer alarm and LCD display, screening unqualified products for secondary processing, further improve the workpiece factory pass rate, has important application value.

Keywords: single-chip, microcomputer, Automatic processing, Feedback detection, Proteus simulation.

1. Introduction

With the development of society and the progress of science and technology, intelligent factory of automatic production has become a new stage of modern factory development. In the production of industry, agriculture or other industries, the defects of artificial production gradually emerged, product quality is difficult to guarantee, adverse environmental harm to human health, high production costs and a series of problems. The application of automation in various fields to improve efficiency and quality has become an inevitable trend and choice.

The automation of shrimp shucking significantly improves production efficiency and reduces environmental and microbial pollution. The quality of shrimps was significantly improved [1], Luo Shunming introduced automation in wood processing, turning machine tools and working places into an assembly line by using roller or belt type to achieve mass production [2]. Automatic processing system improvement by li table leg, the table legs after processing, cohesion grinding device, the obvious increase production efficiency, improving the quality of the table legs [3]. However, they lack detection devices, whether to meet the production requirements, a second process without a clear judgment, whether it need not do big data analysis for a batch of products, such as error range, percent of pass. In Lin Junyao's improvement of automatic wood processing, the relay is controlled by PLC to reduce the incidence of equipment failure, but the processing and transportation process of wood is cumbersome [4].

Because of the analysis of the above problems, this paper relies on STM32F103C8T6 single-chip microcomputer to design a system for automatic processing and detection of furniture, which achieves automatic processing of furniture workpiece, positioning and measurement of the size of the workpiece processed by visual sensors, and screen out unqualified workpiece for secondary processing. To improve the workpiece's qualified rate, it ensures that the factory products agree with the standard requirements.

2. System Total Design

This system is a kind of material processing and material detection whether to meet the production standard of the automation system, real-time detection does not meet the production requirements of the workpiece alarm and processing. A single-chip microcomputer processing system for power, the motor work, machine by setting procedure to carry on the processing of raw materials, full in the implementation of the program, the single-chip microcomputer control transfer the stepper motor work, will be transported to the testing area of workpieces, the processed workpiece is measured by visual sensor, display real-time display measurement data, The data is sent to the computer terminal through the wireless transmission module, and the workpiece with qualified measurement results is processed. The buzzer beeps intermittently for the workpiece with unqualified measurement results, and the transmission motor reverts to the processing table for secondary processing. After the workpiece meets the production standard, the buzzer stops beeping, and the processing ends. The structural block diagram of the system is shown in Figure 1, the system flow chart is shown in Figure 2.

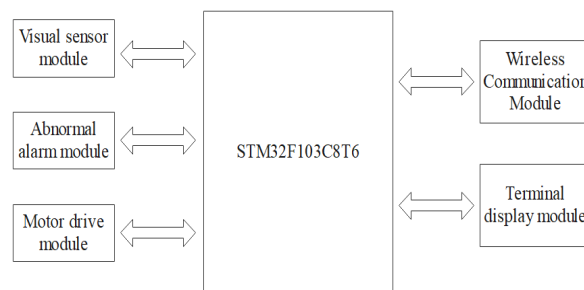


Figure 1. Microcontroller minimum system.

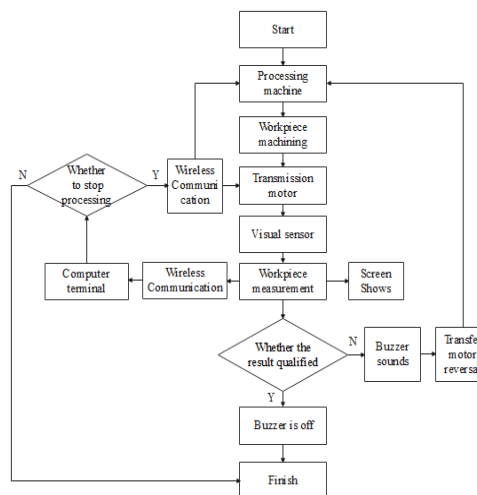
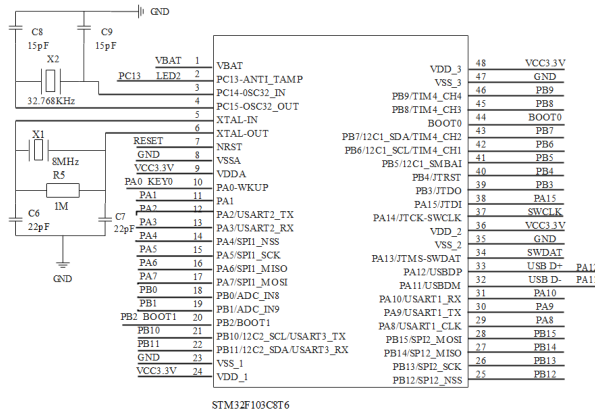


Figure 2. Structural block diagram of the system.

3. System hardware design

3.1 Master Control Module

This automatic furniture cutting and measuring system use an STM32F103C8T6 micro-controller as the processing core of the micro calculator. STM32F103C8T6 MCU as the main control module control the stepper motor, buzzer, wireless communication and other modules and connect them. The MCU application in this system completely meets the production requirements. Figure 3 is the minimum system diagram of a single-chip microcomputer.



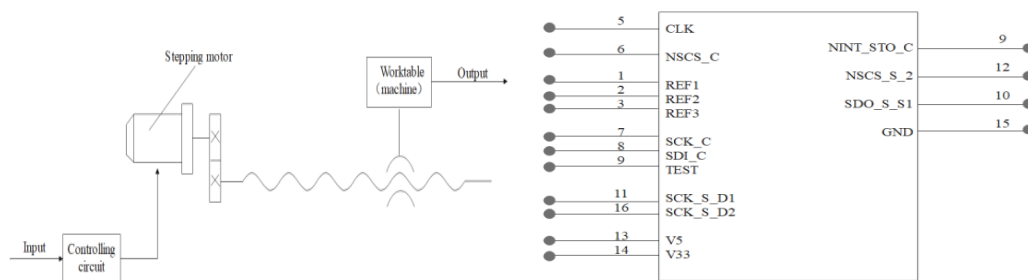


Figure 6. Chip pins diagram and motor drive schematic diagram.

3.5 Wireless Communication Module

Wireless communication uses CC1101 chip 433MHZ wireless module [7], ultra-small size, ultra-low power consumption, but also has strong anti-interference ability, good transmission performance, high efficiency, wireless communication modules are installed in the machine and computer terminals to achieve wireless transmission between the machine and the computer terminal. The chip pin diagram is shown in Figure 7.

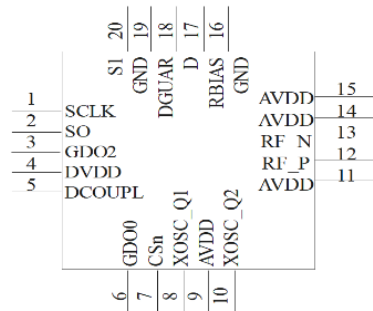


Figure 7. 433 CC1101 chip pin figure.

3.6 Display Module

LCD uses TFT industrial display screen, can adapt to most of the harsh environment, long service life, high resolution, LCD display module is used to display the rough outline of the workpiece and the size of each dimension of the furniture being tested, the liquid crystal display is shown in Figure 8.



Figure 8. Liquid crystal display.

4. System software design

In the system design, software debugging is Keil51, Keil provides including C compilers, assemblers, linker, library management, and a powerful simulation debugger, a complete development plan, through an integrated development environment will these parts together, to compile the code effectively improve the development efficiency of a single-chip microcomputer.

4.1 Main Programming

After the worktable is powered on, the processing machine scans the I/O port of the STM32F103C8T6 microcontroller to collect the processing information and make the corresponding

processing operation through the fixed processing program input the microcontroller. Then the corresponding module is controlled by the microcontroller to complete the subsequent transmission, detection, information transmission, secondary processing, alarm and other operations. The main flow diagram is shown in Figure 9.

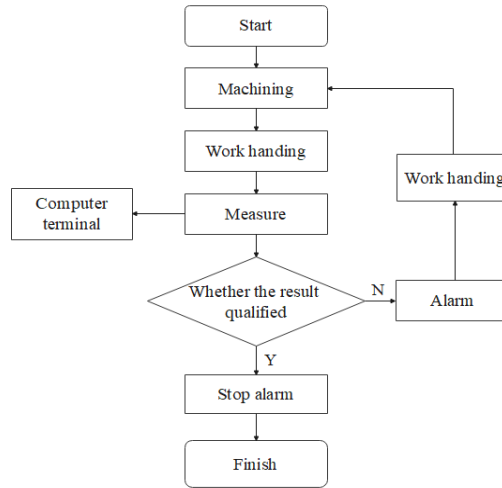


Figure 9. Block diagram of main program flow.

4.2 Visual Sensor Programming

After the system is started, the visual sensor module will continue to scan the inspection area to detect any workpiece to be tested. If there is, the workpiece will be photographed by the camera, and the size of the workpiece in all aspects will be measured by image processing. If the difference value x exceeds the production standard Y , it will be judged as unqualified and secondary processing will be required. The workpiece measurement schematic diagram and sensor flow diagram are shown in Figure 10, the data values are shown in Table 1.

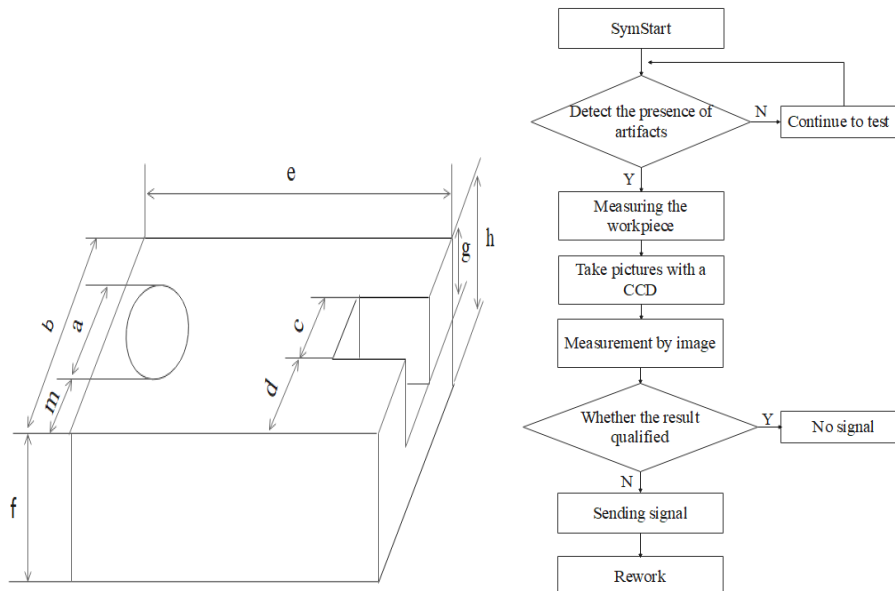


Figure 10. Schematic diagram and sensor flow diagram of workpiece measurement.

Table 1. Date Value

Measurements	Ideal Value	Difference
a	a_0	$ a-a_0 $
b	b_0	$ b-b_0 $
c	c_0	$ c-c_0 $
d	d_0	$ d-d_0 $

e	e ₀	e-e ₀
f	f ₀	f-f ₀
g	g ₀	g-g ₀
h	h ₀	h-h ₀
m	m ₀	m-m ₀

4.3 Alarm Programming

When the workpiece size is detected to be substandard, the micro-controller gives the buzzer a low level. When the I/O port of the buzzer input a low level, the buzzer sound. Processing in line with production standards, the single-chip microcomputer buzzer a high level so that the buzzer off. The buzzer alarm flow diagram is shown in Figure 11.

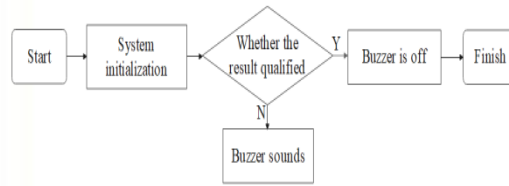


Figure 11. Buzzer alarm flow diagram.

4.4 Stepper Motor Programming

After the system is powered on, the single-chip microcomputer controls the processing motor, and the machine begins to process the workpiece. After processing, the single-chip microcomputer controls the transmission motor and transmits the workpiece to the inspection area. The block diagram of the motor operation process is shown in Figure 12.

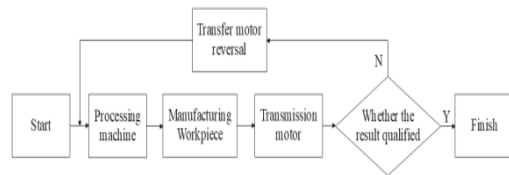


Figure 12. Block diagram of motor operation flow.

4.5 Wireless Communication Program Design

The program design of the wireless communication module uses the CC1101 chip to realize the communication and data transmission between computers and equipment. The computer terminal can stop the processing machine with one click through wireless communication. The wireless transceiver flow diagram of computers and machines is shown in Figure 13.

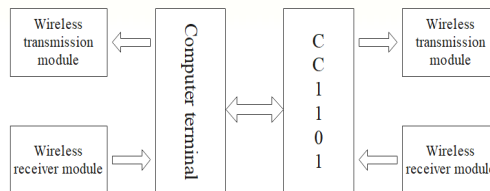


Figure 13. Block diagram of wireless reception flow.

5. Simulation Test

The system was co-simulated and tested by Keil and Proteus. The hardware schematic diagram was drawn in the Proteus simulation platform, and the program was written in Keil software with C language. After debugging, hex files were generated and tested with the Proteus platform. Figure 14 is the schematic diagram of the system hardware. The functional status of each module during the experiment is shown in Table 2.

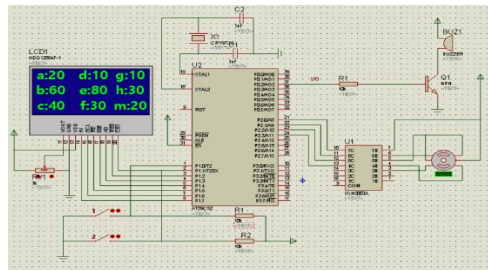


Figure 14. Schematic diagram of system hardware.

Table 2. Working Status of Each Module

Number of Trials	Differences	Whether Results Qualified	Motor Forward	Motor Reverse	Buzzer Sound	Display
1	X>Y	N	Y	Y	Y	Abnormal
2	X<Y	Y	Y	N	N	Normal
3	X<Y	Y	Y	N	N	Normal
4	X>Y	N	Y	Y	Y	Abnormal
5	X<Y	Y	Y	N	N	Normal
6	X<Y	Y	Y	N	N	Normal

Two hundred times the workpiece measurement experiment based on the system, a random sample of six groups of experimental data, existing in the experimental group 1 and 4 data error than the standard value, judged to be unqualified, the entire process, the motor is normal transmission, drive reversal switch motor reversal, secondary processing, The buzzer sounds properly, but the data display is abnormal. In experimental groups 2, 3, 5 and 6, the processing data were all within the standard error range and were judged to be qualified. The motor was normally transmitted forward during the whole process without motor reversal or buzzer sound, and the data display values were all normal.

In 200 test experiments, there are 8 groups of experiments in which the value exceeds the standard error range, and the unqualified rate is 4%. After the detection and secondary processing of the system, the qualified rate of the factory is as high as 99.5% in the 200 test experiments. A computer remotely controls the processing line to realize the stopping of the motor, the lifting of the system alarm and the emergency stop of the system, etc. The control interface is shown in Figure 16.

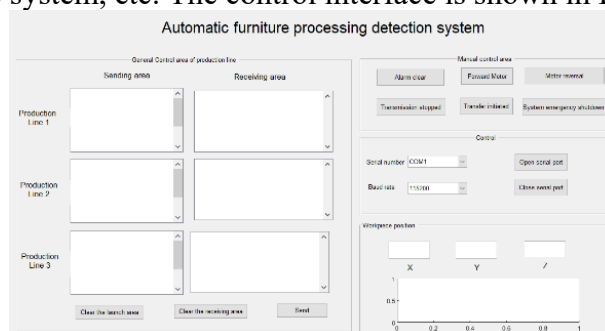


Figure 15. System remote control interface.

6. Conclusion

There are in the process of raw material and machining automation, which lacks the detection device. It does not meet the requirements of processing, real-time detection-machining processing complete follow-up tests. This paper designs an automatic processing detection system of furniture that can solve the problem of processing the workpiece after detection through the Keil and Proteus simulation. The visual sensor, buzzer, stepper motor, wireless communication, and other modules are combined. In many experiments, each module runs normally, and the factory pass rate of the

experimental workpiece is as high as 99.5%. The processing and detection effect of the workpiece is remarkable.

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