Automated Kinking Device System Design Based on Microcontroller

Peng Gao*, Wei Li, Jian Fang and Yue Wu
Jilin Engineering Normal University, Changchun, Jilin 130000, China

*Corresponding author e-mail: gaopeng@jltiet.edu.cn

Abstract. To solve the problem that traditional Kinking equipment cannot meet the needs of handcrafters today, the system to automation, intelligence as a breakthrough point, the use of STC12C5A60S2 microcontroller as the control core of the entire system, through the Hall encoder, film keyboard, LCD display, so that producers can use only keys to control the wire-tanger, and can be real-time from the display to observe the state of work, so as to achieve low-cost, high-efficiency wire production. Experiments show that in the case of 14 hours of continuous work, the tanger can still complete the normal tanger work and the accuracy rate is as high as 99.8 percent. Low cost, good stability, high efficiency, small size, wire-tanger can assist people's production and life, to achieve the goal of efficient production.

Keywords: Automatic Line-Tangle, Sensor, Micro-Controller

1. Introduction
In today's hand-crafting industry, producers need to use a large number of different specifications of wire plates. Traditionally, relying solely on pure manual slate to make wire plates, time-consuming and laborious and high production costs. Although the traditional tanger can assist people to carry out tangling work, but its main application is put into the motor paint wrapping wire, wire winding and other industrial production, and large, high cost, and need to be regular maintenance, can not fully meet the needs of hand-industrial workers, therefore, to produce an efficient, low-cost, can count accurate new intelligent tanger machine is particularly important. This paper uses a variety of sensors to combine small gearbox motors with sensors to create a small, low-cost, thread-accurate new wire-tanger, thus filling the gap of the handicraft automatic wire-tanger [1].

2. System Design
The intelligent wire-tanger system is mainly composed of signal acquisition part, control unit, actuator, adjustable hardware components.

The signal acquisition part is mainly to collect the pulse value transmitted by the Hall sensor, the control unit monitors the collected signal in real time: the control unit uses the STC12C5A60S2 microcontroller as the control core of the data acquisition system, which has the advantages of high speed, low power consumption and strong anti-jamming, and the microcontroller uses the external interrupt to detect the transmitted pulse value. And use the fuzzy algorithm to calculate the number of
tangled coils that have actually been completed by the tangling machine, once the set number of laps, the tangent opportunity to make voice prompts, and once the tanger in the course of work there is a problem, the tanger will be emergency braking and voice alarm.

The system mainly uses the Hall sensor to detect the number of tangled coils, the MPU6050 sensor monitors the condition of the tanger itself, the USART HMI LCD monitor observes the process of the tanger, the film keyboard achieves control of the tanger, and the system structure diagram is shown in Fig.1 [2].

![System Structure Diagram](image)

**Figure 1.** Overall design of the system structure diagram

2.1. **Signal Acquisition System Design**
In order to achieve precise control of the wire-tanger, the system uses the Hall sensor and adapts the traditional DC gearbox motor, and the Hall sensor composition can be adapted to the design of the system.

Hall sensor is a magnetic field sensor based on the Hall effect design, because of its high stability, low cost, has been widely used in all walks of life. As we all know, one of the magnetic effects is the Hall effect, and the magnetic field strength is an important factor affecting Hall voltage. However, the direct hall voltage value is often small, so it is necessary to add an amplifier to the Hall sensor to amplify it to the extent that it is capable of outputting a strong signal. The tanger combines the Hall sensor with the motor, installs a circular magnet at the bottom of the motor, and the magnet on the short shaft rotates as the motor rotates, according to the Hall effect, whenever the motor turns a fixed distance, it produces a Hall voltage difference, which is passed back to the microcontroller, after a D conversion, the microcontroller After determining its specific actual lap number by algorithm, the control unit compares the actual number of rotation turns with the predetermined set number of laps, and once the threshold we set is reached, the control unit will give a stop signal and the motor stops turning.

2.2. **Intelligent Monitoring System Design**
As a tool to assist people in the production, the tanger will certainly appear in the tangent ingesting process, such as wire skew, tangent position is not accurate and other unexpected problems, for this reason, we have added a real-time monitoring system, with gyroscope real-time monitoring of the position status of the tanger.

In the case of rotation, the direction of the rotating axis of the object does not change when not affected by external forces, and the gyroscope is born.

When working, the gyroscope will always monitor the situation of the wire-tanger itself in real time, once it is found that at some point there has been a large offset, that is, the line-tanger is judged...
to have an accident, at this time the tanger stops working and issues an alarm to remind people to come to view.

In the actual test case, we found that, because the wire tanger will not produce too much in the course of work, so we can basically ignore the offset generated by the tanger itself, in addition, in general, the user will place the tanger in a more stable, based on a large number of practical experiments, we found that the use of gyroscope monitoring of the tanger is feasible and effective.

2.3. Human-computer Interaction System Design
In terms of human-computer interaction, the system uses the USART HMI LCD display, which is low cost, has a long life, has good display, and supports touch. The user can visually observe the current working state of the tanger on the screen, meeting the monitoring requirements of the tanger. As shown in Fig.2

![Image](image1.png)

**Figure 2. SART HMI LCD**

Another feature of the tanger is that the user can enter different working parameters according to their own different needs, thus completing the need for precise tangent. In order to meet the needs of parameter input, the system uses a thin-film keyboard, the user can directly input on the film keyboard the number of laps that require the tanger to work, and through the pause, start, zero, acceleration, deceleration five keys to control the working state of the tanger [3].

3. Circuit Design

3.1. Control Unit Circuit Design
Tanger itself has an emergency emergency situation, once the above two cases, the tanger stops working and issues a voice alarm, prompting people to go forward to view. The control unit circuit diagram is shown in Fig.3

![Image](image2.png)

**Figure 3. Control unit**
3.2. Threshold Signal Acquisition Circuit Design
Threshold signal detection mainly includes the detection of the actual working ring of the tanger and its own offset. By using the Hall sensor, the actual working process of the tanger is calculated by collecting the Hall voltage and by converting. Using the MPU6050.6 axis sensor, the instantaneous displacement deflection amount of the tanger itself is detected. The inspection circuit design is shown in Fig. 4.

![Figure 4. Detection of circuit design](image)

3.3. Voice Prompt System
When the tanger completes the tangent working under the set threshold, the control unit will give the voice prompt system a signal, the voice module will make a prompt after receiving this signal, indicating that the work has been completed, ask edging people to look up. signal, enabling the voice prompt system to provide corresponding feedback. The audio prompt system circuit diagram is shown in Fig.5.

![Figure 5. Voice prompt system](image)

3.4. Drive Circuit Design
The actuator consists mainly of the L298N chip specially controlled motor, the L298N chip consists mainly of two H-bridge circuits, and the two H-bridge drive circuits are controlled by a 4-channel logic drive circuit: EnA, IN1, IN2 Control all the way, EnB, IN3, IN4 control another way, because the system has only one external output drivemotor, so only one drive is used. This circuit has the advantages of strong driving force (single 2A drive current) and wide range of drives. Moreover, due to the use of electro-optical-electric conversion, the output and input of the circuit have optically
isolated parts, so that the circuit is not affected by external influences. The drive circuit is shown in Fig. 6

![Drive Circuit Diagram](image)

**Figure 6.** Drive circuit

4. **Software Design**

4.1. **Procedure Process Design**

The control unit is mainly made up of a single-chip mechanism, which is programmed to meet the requirements of use by programming the microcontroller through the actual requirements of the user, including data acquisition, analysis and comparison of the sensor, determination of thresholds, drive motor output and voice alarm. Through five function keys to the system to start, pause, zero, acceleration, deceleration and other different operations to meet the needs of the user for the different working state of the wire-tanger, the user through the film keyboard input a predetermined number of work rings, and through the display screen real-time observation of the tanger working status, the software flow chart as shown in Fig. 7 [4].

![Software Flowchart](image)

**Figure 7.** Software flowchart

4.2. **System Testing**

The overall test composition of the system is shown in the following figure, the system for different models of 20 types of tanger plate, respectively, carried out 20 experiments, the number of tangents vary, the accuracy rate reached 99.8%. In addition, the tanger remains extremely stable for 14 hours of
The above tests show that the system can effectively assist people's daily production and life. The specific parameters are shown in the table below.

**Table 1. Normal working conditions test**

| Number of planned tangled coils | Actual number of tangled coils | Time (seconds) | Accuracy |
|--------------------------------|--------------------------------|----------------|----------|
| 120                            | 120                            | 24             | 100%     |
| 200                            | 200                            | 39             | 100%     |
| 367                            | 367                            | 65             | 100%     |
| 446                            | 446                            | 85             | 100%     |
| 500                            | 500                            | 101            | 100%     |
| 555                            | 555                            | 110            | 100%     |
| 580                            | 580                            | 117            | 100%     |
| 650                            | 649                            | 129            | 99.8%    |
| 672                            | 672                            | 133            | 100%     |
| 700                            | 700                            | 141            | 100%     |
| 750                            | 750                            | 151            | 100%     |
| 780                            | 780                            | 157            | 100%     |
| 820                            | 820                            | 165            | 100%     |
| 850                            | 849                            | 170            | 99.8%    |

14 hours of continuous work  

| Number of planned tangled coils | Actual number of tangled coils | Time (seconds) | Accuracy |
|--------------------------------|--------------------------------|----------------|----------|
| 120                            | 120                            | 25             | 100%     |
| 250                            | 250                            | 45             | 100%     |
| 800                            | 799                            | 160            | 99.8%    |
| 850                            | 850                            | 170            | 100%     |

5. Conclusion
In this paper, the intelligent tanger device system is designed, through a variety of sensor angles, to detect the actual number of coils of the machine and monitor the state of the tanger itself, thereby assisting people's daily production and life, the design of this system for improving the automatic tangled intelligent control system design of the hand-made industry provides an important reference [5].

Acknowledgements
Automatic Kinking Device System Design Based on Microcontroller, Jilin Teachers’ Institute of Engineering and Technology 2019 Innovation and entrepreneurship training program for college students.

Educational robot innovation team of jilin normal university of engineering technology

References
[1] A.B.M. Supian, S.M. Sapuan, M.Y.M. Zuhri, E.S. Zainudin and H.H. Ya: Defence Technology, (2019) Crashworthiness performance of hybrid kenaf/glass fiber reinforced epoxy tube on winding orientation effect under quasi-static compression load[J], 2019.
[2] L. Zheng: Technology and Innovation, (2019) No.24, p133 (In Chinese)
[3] J.M. Liao: Manufacturing Automation (2019) No.10, p.68 (In Chinese)
[4] Z.S. Huang, S.Y. Ruan, J. Wang, R.S. Wang, H. Yang, S.P. He, J. Xie: Mechanical and Electrical Engineering Technology, (2019) No.48, p.188
[5] J. Fang: Equipment Manufacturing Technology, (2018) No.2 p.51 (In Chinese)