An Micro Head Positioning Slot Recognition Detection System Based on Machine Vision

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Abstract. In view of the rapid development of the current 3C electronics industry and the large scale mass production of various USB charging lines, the identification and detection of various Micro head positioning slots still rely on manual detection, which is not only difficult and inefficient, but also leads to a series of false detection. Therefore, a Micro head slot identification and detection system based on machine vision technology is proposed. Through the self-developed Micro head location slot identification detection algorithm, through the Micro head location slot image binarization processing, Micro head location slot feature segmentation to open and close operation, combined with OpenCV developed Micro head location slot feature location algorithm, Micro head location slot identification and detection. The system successfully completed the identification and detection test of Micro head positioning slot, and the identification and detection speed is fast and the accuracy is high, which is of great promotion and use value.

1. Introduction
With the development of science and technology and the implementation of the strategy of rejuvenating the country through science and education, China is paying more and more attention to the development of high-end science and technology, among which artificial intelligence technology is one of them [1]. Vision technology is one of the artificial intelligence technologies, which is increasingly used [2]. Machine vision technology makes use of the principle of photoelectric imaging to collect files, and then carries out image information processing through a computer or on a special processor. Finally, it analyzes the appearance of recognized objects to judge and execute a series of instructions [3-4]. With people's yearning for a better life, artificial intelligence machine vision technology has become an increasingly indispensable part of people [5]. Machine vision technology has been widely used in medical treatment, national defense, dimension measurement and other aspects [4]. If visual technology is applied to schools, it will also provide convenience for schools and reduce the burden on teachers and students.

Machine vision technology has no contact, no damage and other characteristics, and can carry out precise and accurate instructions, with strong reliability [6-7]. With the rapid development of computer technology and integrated circuit, laser barcode has been formed to improve the speed and quality of data input. Laser barcode is a graphic identifier composed of corresponding characters, blanks and bars with certain rules. There is certain data information in the graphic identifier composed of blanks and bars, which is converted into binary information by laser barcode identification technology.
[8] With the development of computer technology and image processing algorithm, replacing human eyes with machine vision technology for defect detection will greatly improve efficiency, improve accuracy and reduce working intensity [9-10]. Relevant experts and scholars put forward based on grey value template matching algorithm was used to extract gray-level maximum correlation, compared with the configured threshold to extract defect, as a result of template matching based on grey value in light remains constant, the similarity function of the measurement result is very good, once the dramatic changes in illumination, grey value change, also can have the value of the similarity function has great changes.

Therefore, a Micro head slot identification and detection system based on machine vision technology is proposed. Through sensor sensing, industrial camera photography, through the independent development of Micro head location slot identification detection algorithm, combined with OpenCV developed Micro head location slot feature location algorithm, brother Micro head location slot identification and detection.

2. System framework design
The system consists of two parts: the hardware part and the software part. Image sensor by means of this is triggered, then industrial camera received signal, began to Micro head positioning groove image information acquisition, the collected Micro head positioning groove image transmission after gigabit netcom - end, control the Micro head positioning groove at the intelligent recognition system through the development of Micro head positioning groove information feature recognition algorithm, to determine Micro head positioning groove, so as to complete identification and detection of Micro head positioning groove, the overall framework is shown in figure 1.

![Figure 1. Overall structure of the system](image)

3. Hardware design
The system hardware mainly includes industrial lens, industrial camera, light source, sensor, PC terminal, etc. The sensor is connected to the industrial camera through the signal line. When the industrial camera is connected to the industrial lens, Micro head positioning slot images can be
collected. The light source is installed directly under the camera to provide better illumination intensity.

3.1. Industrial camera
Due to Micro head positioning groove for planar grooves, and close to the edge of the Micro head location, relatively fixed position, this system adopt the model for the 900 million pixel array industrial camera, frame rate, considering the Micro head positioning groove for the metal parts, small size, so choose black and white industrial camera, to meet the recognition of Micro head positioning groove .Figure 2 shows the real picture of industrial camera.

![Real picture of camera](image)

**Figure 2.** Real picture of camera

3.2. Industrial lens
Since Micro head positioning slot is a plane groove, the industrial lens model of megapixel is selected in combination with industrial camera. Figure 4 shows the real picture of industrial lens.

![Lens](image)

**Figure 3.** Lens

The MTF graph of the lens is shown below.

![MTF curve](image)

**Figure 4.** MTF curve
3.3. The light source
In terms of light source, considering that Micro head positioning slot is plane groove, and all of them are made of metal material, and the surface has metal coating, the annular blue light source is selected for lighting and image collection combined with actual use. The Angle of the lamp band is 60°, which can collect the characteristic information of Micro head positioning slot and avoid the influence of ambient light, thus obtaining high-quality images. The light source is shown in figure 5.

![Figure 5. Annular light source](image)

3.4. Multi-sensory coordination
Automatic and intelligent detection of Micro head positioning slot shall firstly ensure that sensors of the detection system can cooperate with each other. Acquisition trigger sensor and image processor are used in the image acquisition and image processing parts of Micro head positioning slot identification and detection software system respectively. The selection and parameters of each sensor are shown in table 1.

| Name          | Model            | The main parameters |
|---------------|------------------|---------------------|
| The camera    | CM900–GM–04      | 12 fps              |
| The lens      | OPT–C0420–5M     | 5 million pixels    |
| The light source | -                | 60°                 |

4. System software framework design

4.1. Software framework design
The system software processing process is shown in figure 6, including image acquisition part, pre-processing part and Micro head positioning slot identification and detection part. When the sensor is triggered, the camera begins to collect Micro head positioning slot images, and the collected Micro head positioning slot images are processed in a series of pre-processing parts. At last, the software system detects the identification of roll surface and displays the results.

![Figure 6. Software system flow](image)
4.2. Software system
According to the automatic intelligent detection function of Micro head positioning slot determined, the identification and detection system is designed by using VS2010 software development platform. The system mainly includes image collection display window and detection result display window. There are two ways of image acquisition, single frame acquisition and continuous acquisition. The figure shows the software interface diagram.

![Software system interface](image)

Figure 7. Software system interface

5. Test and analysis
In order to further verify the performance of the designed system, six groups of tests are carried out on the system respectively, which are carried out in the same test environment. Specific test results are shown in table 2.

| The serial number | Methods  | Time/s | Correct identification quantity | Wrong number | Error rate % |
|-------------------|----------|--------|---------------------------------|--------------|--------------|
| 1                 | system   | 125    | 198/200                         | 2            | 1            |
| 2                 | 122      | 199/200                         | 1              | 0.5          |
| 3                 | 125      | 197/200                         | 3              | 1.5          |
| 4                 | 123      | 198/200                         | 2              | 1            |
| 5                 | 121      | 199/200                         | 1              | 0.5          |
| 6                 | 122      | 199/200                         | 1              | 0.5          |

As can be seen from the test results, the highest false detection rate of 200 images identified by the system is 1.5%, and the time spent is all within 125 seconds, meeting the design requirements of the system.

6. Summary
The Micro head positioning slot identification and detection system designed based on machine vision technology has better identification and detection of Micro head positioning slot information. The
software identification and detection greatly reduces the time of manual identification and detection, and greatly improves the accuracy and efficiency, which is conducive to the improvement of product quality. The detection system, with high quality and high efficiency, detects the characteristic information of Micro head positioning slot, achieves the intelligence of Micro head positioning slot identification and inspection, and can improve the identification and detection efficiency of Micro head positioning slot. High use value, worthy of market promotion.

Acknowledgments
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