Answer Card Identification Method Based on Pattern Recognition Technology

Jing Xu¹, a, Kun Fang Zhang¹

¹The College of Information and Electric Engineering Shenyang Agricultural University, 110866, China

Abstract. The traditional answer card reading method using OMR (Optical Mark Reader), most commonly, OMR special card special use, less versatile, high cost, aiming at the existing problems proposed a method based on pattern recognition of the answer card identification method. Using the method based on Line Segment Detector to detect the tilt of the image, the existence of tilt image rotation correction, and eventually achieve positioning and detection of answers to the answer sheet. Pattern recognition technology for automatic reading, high accuracy, detect faster.

1 Introduction

Examination questions include two types: objective and subjective questions, which objective standard, specification format can through the answer card answer, batch marking by computer systems. The traditional answer card automatic marking system, often adopts the photoelectric reader and a special card reader, can greatly improve the efficiency of the checking work, but at the same time, there are complicated operation, high cost and other shortcomings. With the development of digital image processing and pattern recognition techniques, the use of relatively inexpensive digital camera or scanner as the image data input device to capture the answer sheet image pattern recognition technology to achieve automatic marking the answer sheet, it can greatly reduce equipment costs, and can also identify a variety of types of answer sheet, which has good versatility.

2 Answer card image recognition

Answer card image recognition processing components, to achieve the picture adjustment, cutting, recognition and associated with the data, the bulk of the answer sheet for the recognition process.

The examination system transmits answer card picture information, paper information, student number, after answer sheet image processing component processing, required to achieve:

1) The picture of answer card is associated with the student number;
2) Divided the picture into several parts by object answer area, every sub-picture is associated with corresponding papers questions.
3) If the test questions is for the choice questions, the judge, then the corresponding answer card picture of the segmentation image need to identify the corresponding option.

Answer card image recognition work flow shown in figure 1:

![Image](image1.png)

Figure 1. Image recognition work flow.

3 Closed area detection

Detailed algorithm description of the contour region.

1) From top to bottom, from left to right traverse figure 2 successively.

![Image](image2.png)

Figure 2. Demonstration of legend.

2) As shown in figure 2A, A is experiencing an outer contour point (in fact, white spots on the traversal of the...
first encounter is the outer contour point), and if it has not
been marked, then give A a new tag number. Started from
point A, in accordance with certain rules (the rules in
detail later) of the outer contour point A where the whole
track to, and then back to point A, points on the path of
all marked label A.
(3) As shown in figure 2B, if you have already
encountered the outer contour point A 'which has been
marked , from A' to the right, it would point to the right
are labeled A 'label, until it encounters a black pixel up.
(4) As shown in figure 2C, if you encounter a point B,
which has been labeled, and is the inner contour of the
point (which is black pixel and not outside the contour),
then start from the B point, tracking inner contour, the
point on the path is set to B label, because B has been
labeled with A same, so the inner and outer contour will
be labeled with the same label.
(5) As shown in figure 2D, if the point on the inner
contour is traversed, it also mark the point on the right
side of the right side with the contour until the black
pixels are encountered.
(6) End of traversal. As shown in figures 3 and figures 4:

4 Image slope detection and rotation correction

In the process of image acquisition, the answer card may
produce image tilt for a variety of reasons, and to
properly identify must be corrected. Tilt correction,
including the following two steps
(1) Tilt angle detection
(2) Image rotation correction

4.1 Image tilt angle detection

Using the Line Segment Detector (LSD) Line Segment
detection method to detect whether the image is
tilted. LSD is the core of pixels merging in error
control. LSD is in linear time that the accuracy of sub-
pixel level line segment detection algorithm. LSD in the
actual use, the need to set the sampling rate and
determine whether the two pixels are merged in the
directional difference. Actually detection in the image
line is looking for the larger pixel in the image gradient
change. For a pair of images i and a rectangular r, denoted
k (i, r) for the number of aligned points, n(r) is the total
number of pixels within the rectangular r. Then hope to be
able to see:

\[ N_{\text{test}} \cdot P_{H0}[k(r, I)] = K(r, i) \]  (1)

Among them, N_{\text{test}} is the number of rectangles to be
considered. PH0 is a probability. I is a random image in
the H0 model. In this paper, adopting H0 model, which
mainly has the following two properties:
(1) \{LLA(j)\}, J is the pixel, is composed of a set of
random variables;
(2) LLA (j) uniform distribution on [0, 2 \pi].
So, determine whether a pixel is not point aligned can be
recorded as probability:

\[ p = \frac{1}{\pi} \]

Thus, then through error control, finally for line segment
detection results are shown in figure 5.

4.2 Image rotation correction

For tilting the image, three steps are needed to complete
the rotation transformation.
(1) Translation of x'o'y' coordinate system to xoy;
(2) Rotation transformation under xoy coordinate system;
(3) After transformation, the coordinate system is
translated back to the original position.
By matrix:

\[ (x 1 0 \ y 1 0 \ 1)T R T^{-1} \]
5 Identification Numbers and letters

Digital and letter recognition algorithms are random forests. Random Forest(s), is called Random Trees, it is a combined forecasting model, which is composed of multiple decision trees, which can be used as a fast and effective multi class classification model. Every decision tree of the RF is composed of numerous split and node: the split by entering the test values give direction to output (left or right); Node as the leaf nodes, decided to final output of the single decision tree and probability distribution of the genus for the class in the classification problem or maximum probability category, for the value function in regression problems. The output of the whole RT is determined by the number of common tree, argmax or avg, as figure 9.

Using random forest algorithm, generating training documents, as shown in figure 10, the results of the training to identify letters and figures, the results are shown in figure 11.
6 Conclusion

The server is 64 bit Linux system, support as a component integrated into the platform, also support independent release application. Pictures from uploaded successfully start time, adjusted, cutting, recognition to the output paper number, student id as a result, the processing speed is not less than 200 pieces of sheet per minute; After abnormal data processing to complete the confirmation of the beginning of the time, after cutting, identification to the output of the test results, processing speed shall not be less than 60 per minute; Image processing, should not affect the normal use of docking system, the use of 4 core processor 16G memory server, it is recommended that the CPU share of no more than 10%, memory usage is not more than 20%. The other component needs to support multi-threaded processing, processing speed to provide parameters adjustment. Image is divided into normal and abnormal images images, for the picture of the normal scope of cutting accuracy of 100%, image recognition accuracy of 100%; For abnormal image output image type is abnormal. Abnormal image is defined as: scan the answer sheet because the occurrence of wrinkles, deformation, missing picture critical information.

Acknowledgement

This research was financially supported by the science foundation of Liaoning Province (L2014265) and science and technology project of Liaoning Province (2014104017).

References