Application of handwriting numeral recognition utilizing deep learning in the scoring APP for checking test papers

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Abstract: Manual scoring, which is adopted in traditional examination paper grading process, is not efficient and error-prone. This paper studies the application of handwriting recognition technology based on deep learning in examination paper verification. The examination paper score scoring APP, which is designed for Android mobile phone, has been validated. This paper also discusses the design, development and validation process of the APP. The APP allows teachers and educational administrators to obtain test scores and check the total score easily; thus, improving the efficiency of manual marking and the accuracy of scoring.

1. Introduction

Examination is an important part of the teaching process and an effective means to examine and evaluate students' learning outcomes. Examination paper is the carrier of measuring and analyzing students' learning quality and testing teaching effect. The traditional paper test still plays an irreplaceable role in the current teaching. How to reduce the rate of manual error and reduce the workload of teacher audit is the problem that should be considered under the current informatization. With the rapid popularization of smart phones, the functions become more and more powerful. We use the handwriting recognition technology to apply in the examination paper scoring work, on the one hand standardizes the teaching management, on the other hand greatly reduces the artificial error.

This paper is based on deep learning to complete the recognition of Arabic numerals. Recognition work is divided into three modules: image acquisition, recognition module, display module.

The image acquisition module takes pictures of the test paper by calling the camera of the Android device and preprocesses the image. In the preprocessing process, it mainly finds the molecular image of the ROI of the image and carries out the size normalization processing for the recognition module to call and recognize. The recognition module can locate the recognition area, segment characters and identify characters, and get the score information and the total score of each question. The display module will display the recognition results on the user interface of Android devices and give a prompt message whether the score is correct or not.

2. Process of project

The system will add the scores of each question identified to obtain the total score, and compare it with the artificial composite score identified in the last item. If the score is the same, the valid score will be checked and passed. If not, the system will give an alarm and display the calculated score.

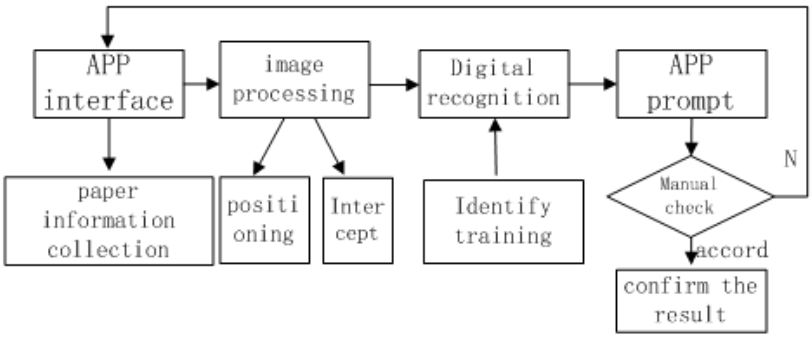

Figure 1. Process of project.

1) On the Android side, you need to customize A custom Camera layout with A viewfinder, and use the Camera and SurfaceView to make A custom viewfinder.

2) Load OpenCV library engine by initialization and open Camera rendering; Gray-scale and binarization processing are carried out for the pictures taken.

3) Tess-two library was introduced to load the handwriting recognition model; Call the corresponding API to pass the image processed in step 2 into recognition processing.

4) In this paper, Python is adopted, and Tess -two API is selected to realize handwritten number recognition. In order to improve the recognition rate of Tess -two, the self-trained data set tessdata is loaded.

5) Combine each question score, calculate the total score, and give the prompt information in the APP.

3. Training identification

3.1 Analysis of test score

The handwritten scores of traditional paper examination papers have some of the same characteristics:

1) the area to fill in the score is a rectangle, only the ratio of length to width may be different, counting the number of cells from 1 to 5 to 9, indicating the question number, and fixing the last cell as the total score.

2) the text area of the first line is printed black, and the text area of the second line is handwritten red. The gray contrast between the background and the text is very obvious.

3) handwritten words are arranged in rows, and there are some strokes beyond the rectangular area, and some slanting angles are affected by the shooting factors

3.2 network model

A convolutional neural network model is designed to meet the requirements of fractional review. Lenet-5 network structure model is a classical convolutional neural network mainly used in handwritten number recognition. The network model is supervised and trained with the MNIST database until the specified practical accuracy is reached, and the training is stopped.

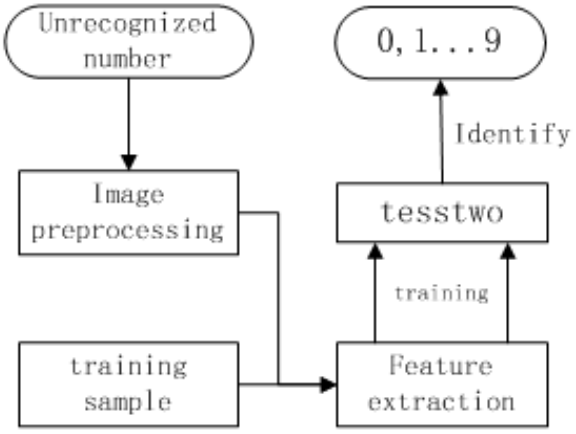

Figure 2. recognition process

4. Handwritten numeral recognition

4.1 Handwritten numeral recognition

The algorithms in character recognition (OCR) mainly include template matching based OCR algorithm and deep learning-based OCR algorithm.

The main feature of template matching is that it is easy to implement and suitable for recognition of regular characters, such as answer CARDS. The recognition of marks on test paper is suitable for the method based on deep learning.

There are two main methods for deep learning character recognition:

1) The method is to extract the features of recognition characters first, and then use the acquired features to train the neural network classifier. The recognition effect is related to the extraction of character features, which is time-consuming.

2) The method makes full use of the characteristics of neural network, directly inputs the image to be processed into the network, and automatically realizes feature extraction and recognition by the network.

It mainly consists of the following five steps.

1. Train the model into pb files

2. Put the trained pb files into the Android project app/ SRC /Place the TensoFlow jar and so libraries in app/libs

3. The app \ build. Gradle configuration

4. Create a new class tsf.java, call the model in this class, and get the output. Use the TSF class in MainActivity

5. Generate App

4.2 Summary

After testing, it is found that the image preprocessing method proposed in this topic has poor processing effect when the handwritten score exceeds the dividing column and the handwriting is illegible. Therefore, it is advisable to explore the preprocessing algorithm such as enhanced local binary method.

Preprocessing for specific scenes can significantly improve the recognition rate. For example, the written scores are all red.

5. Conclusion

This program has completed the preliminary experimental work. Although it is aimed at the recognition of handwritten Arabic numerals in the scoring scene of test paper, the working principle of machine learning is the same. In the future, it can be improved from the following aspects:

1) Expand the functions of the program to add data statistics functions, from the realization of simple characters to intelligent marking.

2) Improve the recognition accuracy of the program and feed back to the training library. From the implementation results of some literature on deep learning, it can be seen that the simple model combined with a large number of training samples is often better than the complex model combined with a small number of training samples. The recognition rate can be improved as the software is used more often.

3) Improve the recognition speed and the algorithm, such as eliminating interference of correction points.

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