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Financial Original Voucher Classification and Verification System Based on Deep Learning

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Abstract. Aiming at the problems of voucher preparation errors, numerous verification rules, lengthy audit cycle and low efficiency in the process of voucher preparation and audit of financial reimbursement in Colleges and universities, based on the implementation process of financial reimbursement process, this paper designs a framework of financial original voucher classification and verification system based on deep learning, and proposes a deep learning algorithm to identify the key contents of financial original vouchers, so as to support the voucher preparation process of financial reimbursement personnel Review and verification process of financial personnel. By testing the existing financial reimbursement process, the original voucher can be accurately classified according to the requirements of the national tax system for the classification of goods, for the identification of the type of daily reimbursement; based on the preprocessing of bills, FRCNN algorithms in deep learning can be applied to identify the key contents of bills.

Keywords. Deep learning, Classification and verification, Financial original voucher

1. Introduction

In recent years, with the rapid development of artificial intelligence, big data, and information technology, the applications of deep learning have become increasingly broad, especially in the fields of finance and taxation [1-4]. In the daily operation of enterprises and institutions, the financial management system plays an essential role. These systems including financial accounting, financial analysis, financial sharing and industry finance integration, to help enterprises and institutions achieve efficient financial management. Financial accounting is the basis for data storage and financial analysis of the entire system. Financial accounting consists of original voucher review, bookkeeping voucher preparation, banking system settlement and additional links. For financial accounting, it is necessary to verify the authenticity of the original vouchers. On this basis, the financial staff will review the reimbursement form and corresponding original vouchers filled in by the reimbursement applicant, and prepare accounting

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vouchers. Finally, the cashier will complete the bank settlement. However, in the financial reimbursement system of colleges and universities, the reimbursement applicant needs to select the corresponding reimbursement entry according to the content of the original voucher when filling in the reimbursement form. Due to limited financial knowledge errors are inevitable when choosing a particular type of reimbursement. After being reviewed by the financial staff, the reimbursement form is returned to its original state and the reimbursement applicant has to repeat the above voucher preparation process, which is a huge waste of time. Therefore, the original reimbursement voucher must be initially verified and classified to reduce the unnecessary turnover process in the reimbursement process and improve the efficiency of financial reimbursement.

In order to make accounting more accurate, efficient and automatic, optical recognition technology (OCR) has been gradually applied to the recognition of financial bills. The invoice text contains highly significant information [5-6]. Making full use of this information can considerably improve the recognition effect of invoices. However, because the collection of financial bills is formed by scanning or photographing, the layout of financial bills is diverse, including a variety of different fonts, sizes, colors and backgrounds, as well as mixed Chinese and English characters, resulting in the complexity of financial bills, which makes OCR technology face great challenges in identifying and extracting bill information. Image recognition technology, especially the application of image recognition technology based on deep learning, provides necessary support for accurate recognition and efficient processing of financial original vouchers. At present, among the deep learning algorithms, the text recognition algorithms include fast RCNN, mask RCNN [7], YOLOs [8], Textboxes [9], Graph Convolutional Network [10], and the character recognition algorithms include CRNN [11-12], RARE [13], and FOTS [14]. These algorithms are implemented by training on a large amount of sample data, and deep learning models are able to learn the features and patterns of different types of vouchers to accurately match vouchers in a graph with known vouchers. This accuracy is not only reflected in the identification of the voucher itself, but can also be extended to the identification of the words, numbers, and other key information in the voucher. At the same time, the image recognition technology based on deep learning can complete the processing of a large number of vouchers in a relatively short time.

Therefore, this paper designs a system framework of financial original voucher classification and verification based on deep learning, and proposes a deep learning algorithm to realize the identification of the key content of the original bill, and support the preparation process of the financial reimbursement person, the review and verification process of the financial person.

2. Process and Framework of Classification and Verification System

2.1 Voucher Processing Process

With the digital transformation of financial governance, the delivery reimbursement is the current mode of use in colleges and universities. It places an online voucher delivery machine in the school, and the reimbursement applicant can put the reimbursement form into the delivery machine in time according to his own situation without waiting at the financial site. In this mode, the reimbursement applicant will put the reimbursement form approved by the project leader into the delivery machine, and the delivery machine will allocate the reimbursement form to the financial accounting personnel, who will receive

the reimbursement form for financial processing by themselves. At the same time, combined with the online feedback function of the financial system, the reimbursement results will be pushed to the reimbursement applicant by SMS. When the reimbursement document is approved, the system will automatically send a message of successful reimbursement to the operator after the accounting staff generates an accounting voucher for review. When there is a problem with the reimbursement form, the accounting personnel can also send a text message to inform the reason through the financial system, and the handler will go to the financial operator to continue processing after receiving the text message.

The processing flow of financial reimbursement vouchers is shown in Figure 1.

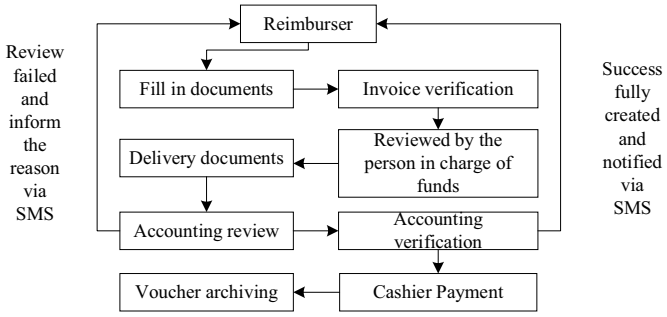

Figure 1. Delivery reimbursement flow chart

In the current financial system, the reimbursement applicant needs to select the reimbursement category according to the original voucher when filling in the reimbursement form, such as daily reimbursement and asset reimbursement. Due to the limited financial expertise of the reimbursement applicant, it is usually unable to accurately determine the corresponding category, resulting in the filling error of the reimbursement form, which needs to be modified and re delivered after being returned by the financial staff. At present, the use of technical means to scan and identify the authenticity of invoices has been widely used in financial reimbursement practice, but the scanning and verification technology only records the contents of the original voucher invoice and associates it with the bookkeeping voucher, and cannot judge the contents of the original voucher and drive the reimbursement applicant to the correct reimbursement category entry. This paper takes the selection of daily reimbursement form and asset reimbursement form as an example, by identifying the two key information of "goods or taxable services, service name" and "unit price" on the original voucher invoice, the system independently judges and selects the correct reimbursement category to ensure the accuracy of voucher preparation.

2.2 Identification Characteristics of Financial Vouchers

In the selection of financial reimbursement category, the "name of goods or taxable services and services" on the original voucher invoice is related to the classification code of goods and services tax implemented by the State Administration of Taxation on May 1st, 2016. Tax classification codes, which are the identity codes of goods, taxable services or services, are composed of 19 digits and are classified according to different levels to strengthen collection management. The first level is divided into six categories:

goods, labor services, services, intangible assets, real estate, and non-taxable items without sales actions, as shown in Table 1.

Table 1. Tax Code Level 1 Classification

Tax classification code	First level classification
1000000000000000000	Goods
2000000000000000000	Labor services
3000000000000000000	services
4000000000000000000	intangible assets
5000000000000000000	real estate
6000000000000000000	Non taxable items without sales behavior

The distinction between daily reimbursement and asset reimbursement in finance mainly involves goods. The second level of encoding is further split based on the first level, where goods are involved in 10 categories. Based on the actual situation of W University, it is concluded that the commodity names with high frequency in the administrative activities of scientific research and teaching are shown in Table 2.

Table 2. Classification of goods and common goods in universities

Second layer coding of goods	Classification	Goods categories commonly involved in universities
105	Wood products and furniture products	Office desks, chairs, laboratory supplies storage cabinets, etc
106	Paper, printed goods, software, cultural and educational, handicraft products	Printing paper, notebooks, neutral pens, books, etc
107	Petroleum, chemical, pharmaceutical products	Chemical materials such as ethylene ether, asphalt, gasoline diesel lubricating oil, etc
108	Metal and non-metallic products	Pliers, steel plates, deck structures, anti-static and impact resistant flooring, etc
109	Machinery and equipment products	Electronic components, sensors, computers and their accessories, etc

2.3 Financial Voucher Classification and Verification System Process and Framework

According to the financial reimbursement process, in the classification and verification process of financial original vouchers, whether the goods need to be reimbursed for asset acceptance depends on its category and unit price amount. Taking this as one of the judgment criteria, the process and implementation framework of the financial voucher classification and verification system are designed in combination with invoice recognition technology, as shown in Figure 2.

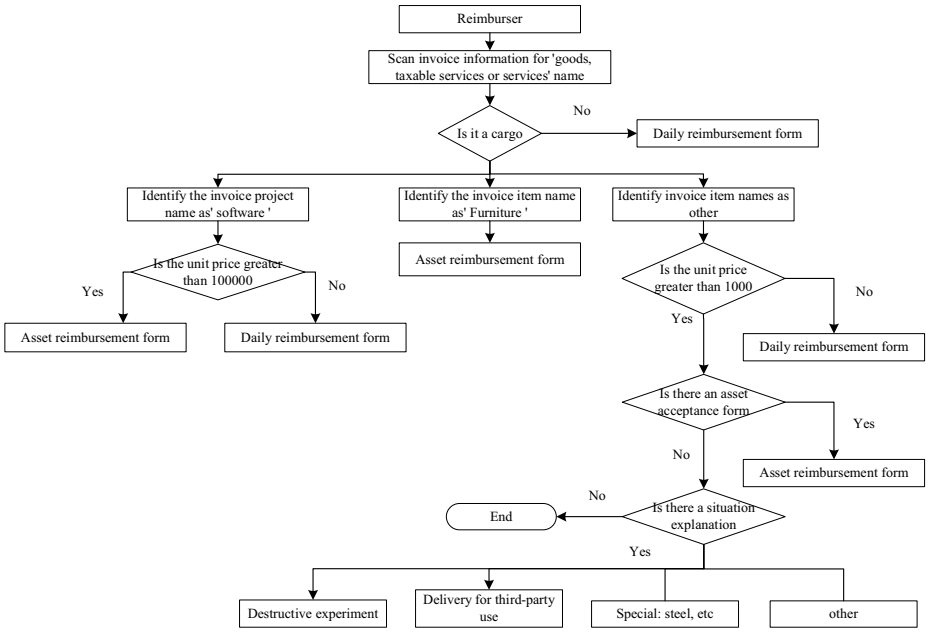

Figure 2. Process and implementation framework of financial voucher classification and verification system

3. Invoice Image Recognition Algorithm based on Deep Learning

The fast RCNN algorithm is mainly used in invoice recognition processing. It is mainly divided into four steps: Invoice region segmentation, invoice text correction, text region detection, and text recognition, as shown in Figure 3.

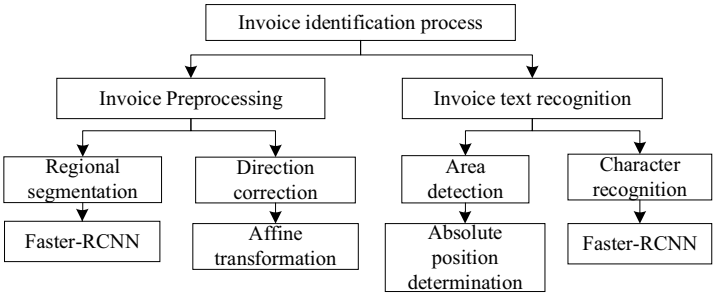

Figure 3. Flow chart of invoice identification

3.1 Invoice Preprocessing

Invoice image preprocessing refers to invoice area recognition and direction correction, so that the image entering the subsequent text recognition can maintain a single invoice area, remove the non-invoice background, and make the text direction more consistent with the recognition direction.

- Invoice area segmentation

There are numerous sources of invoice images and various shooting methods. Some images contain only a single bill, leaving a large background area. These unimportant factors can have an impact on invoice recognition, and invoice region segmentation is essentially to take the invoice region as the target object and detect it in the image. In area segmentation processing, this paper selects the rapid RCNN algorithm to realize the invoice area segmentation function. Fast RCNN combines RPN and fast RCNN. The former is responsible for extracting high-quality suggestion area boxes, while the latter classifies them by learning their features. The flow chart is shown in Figure 4.

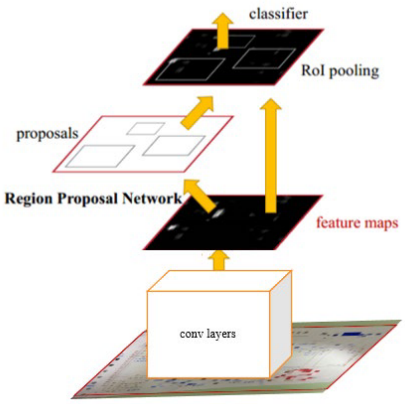

Figure 4. Flow chart of faster RCNN

- Invoice direction correction

The text recognition algorithm used is based on a horizontal image of a single row text field. The actual angle of the invoice image is random, so it is necessary to correct the horizontal direction of the invoice area obtained by the fast RCNN.

3.2 Invoice Text Recognition

- Detection of Text Area

Because this article only needs two kinds of data, namely, goods or taxable services, service names and unit prices, after correcting the text, modify the image to a fixed size, and then crop the images in the column of goods or taxable services, service names and unit prices by setting the absolute position.

- Character Recognition

After text region detection, the region to be detected is selected for character segmentation and recognition. Fast RCNN is used to extract target candidate regions from the feature maps given by the backbone network, and then ROI region features of the same size are obtained by ROI merging, which are sent to multiple classifiers for target classification and location regression. Fast RCNN is a single and unified object detection network with high detection accuracy and speed, As shown in Figure 5.

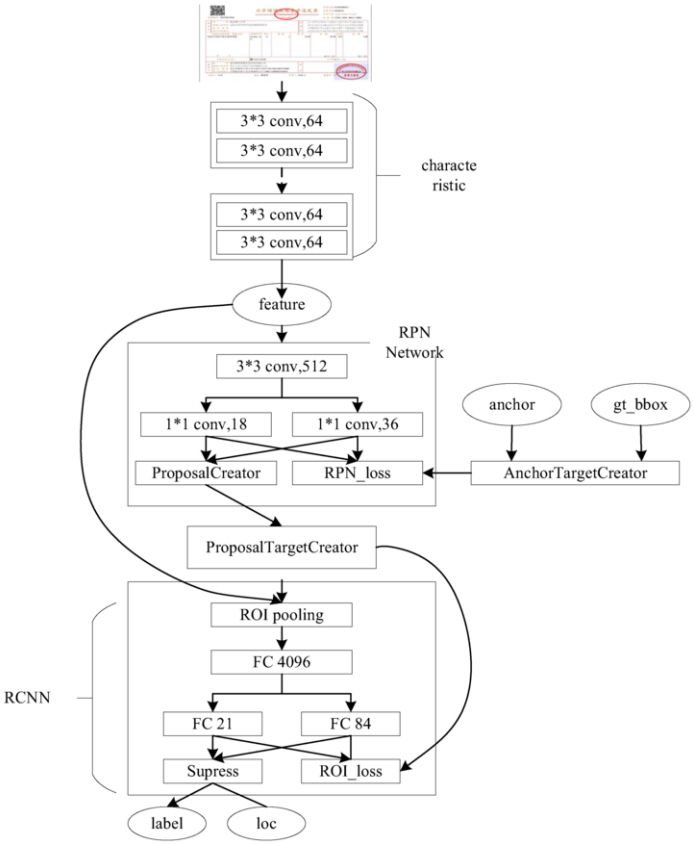

Figure 5. Fast RCNN processing

4. System Example Result Analysis

To test the feasibility of this method, the system inputs different types of invoices for testing. For more complex invoices, such as name classes with multiple lines for different items and multiple lines for the same item, the results of the operation are shown in Figure 6 and the procedure of the operation algorithm is shown in Table 3.

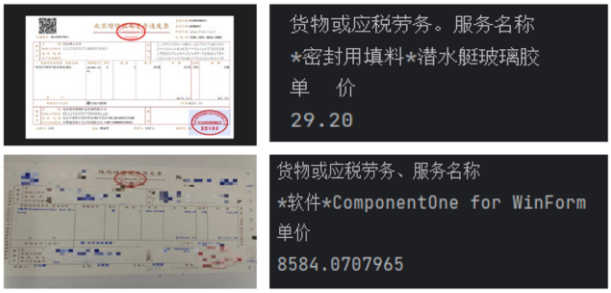

Figure 6. Example demonstration of invoice recognition algorithm

Table 3 Invoice recognition algorithm

(1) Read all images in the folder to the image set images
(2) Loop 1: traverse all images
(3) Using fast RCNN to remove background
(4) Correcting text by affine transformation
(5) Determination of detection position by relative position
(6) Using fast RCNN to recognize characters to get name data set, number of name lines and number set
(7) Index1, unit price data set price, unit price line number set index2
(8) End cycle 1
(9) Loop 2: traversing data1
(10) Judgment 1: if there is no * sign at the beginning of the line
(11) Delete turn mark
(12) End judgment 1
(13) End cycle 2
(14) New dataset name for output data1
(15) Output price

5. Conclusion

In long-term accounting practice, the automation level of financial accounting systems is relatively low, which leads to the need for a large amount of manpower investment in financial accounting work. Due to human reason, various errors often occur. In order to improve the efficiency and accuracy of original financial voucher classification and verification, this article conducts research and analysis on the characteristics of invoice texts, and develops an original financial voucher classification and verification system.

The system adopts region segmentation and text recognition functions based on Faster RCNN algorithm. Through this technology, the system can accurately segment and recognize invoice texts, extracting key information from them. This article categorizes and processes the identified text information based on the differences in reimbursement content and amount. By classifying and annotating different types of text, the system can display the details of each transaction more clearly, avoiding repetitive operations in the reimbursement and verification process caused by human error, greatly reducing the time and cost of manual operation, and improving overall work efficiency and quality.

For the designed system, in practical applications, the following work should also be done well:

1) Data collection and preparation: Ensure that sufficient invoice text samples are collected as training datasets, and clean and preprocess the data.

2) Customized financial rules: Determine the applicable rules based on actual financial needs, such as customized voucher templates, specific project policy requirements, and standardized reimbursement processes.

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