A Tally System Based on CNN and Block Chain

Jinting Ni, Xiaoyi Chen, Yunyang Yan, Rongling Hu, Quanyin Zhu*

Faculty of Computer & Software Engineering, Huaiyin Institute of Technology, Huaian, China
*Corresponding author's email: hyitzqy@126.com

Abstract—In order to design a reliable and convenient tally method, the emergence of a tally system solves the problem of high database maintenance costs, such as management of the site factory, telecom, power companies, etc. The novel phases, constituted of the Convolutional Neural Network (CNN) and the block chain, extracts character characteristics through the VGG network training character classification model. The principal component analysis(PCA) algorithm accelerates feature comparison efficiency by reducing the dimensions of the feature matrix. In terms of data storage, the consistency of the Practical Byzantine Fault Tolerance(PBFT) algorithm ensures the accuracy of the data. The experiment demonstrates that practicability of the system can catch the requirements of the automatic bookkeeping method in the construction site.

Keywords- tally; convolutional neural network; block chain;

I. INTRODUCTION

In recent years, due to the large mobility of workers at construction sites and other places, the proportion of temporary workers is exceeded 50%, and the maintenance costs for constructing relevant databases for the statistical work information of employees is always high.

The development of pattern recognition technology has a milestone impact on the management of daily attendance and tally. Strengthening technology level of pattern recognition is also an important aspect of user attendance management. The idea of convolutional neural network in deep learning is an important aspect of pattern recognition. How to introduce modern pattern recognition technology in attendance tally work to improve attendance tally efficiency, become the focus of attention. Traditional user attendance accounting requires many handwriting-recording operations. If the number of users is large, it takes many human resources and the accuracy of the recorded data is not satisfactory. A method of extracting character features for similarity comparison based on convolutional neural network can improve the efficiency of the user attendance. Users can operate an efficient time and attendance system quickly and efficiently on the WeChat public platform of mobile devices.

Blockchain is a new application model of computer technology that uses consensus algorithms to solve the problem of trust and reputation in the Internet era [1]. The blockchain consists of into three levels: P2P network, storage layer, and final application layer. The completely decentralized nodes jointly maintain the entire chain of information. Through a blockchain consensus algorithm, a dispersed, trust-free, collectively-maintained we established a reliable distributed database [2], and data storage insecurity can be resolved through technical encryption, time stamping, distributed consensus, and economic incentives. The characteristics of the tally system are transparent, fair and open [3].

II. SYSTEM ARCHITECTURE

The proposed system consists of three modules: human pattern recognition module, data storage module, mobile information interaction module. The human pattern recognition module consists of human positioning, human feature extraction and human similarity comparison module. The data storage module encrypts the data filtered by the consensus mechanism and distributes it for storage on employees' mobile phones. The mobile interaction module of terminal information uses personal private keys to obtain relevant work information at the WeChat side, and is responsible for provides a visualized summary of job information.

The proposed system is a creative system that contains two key components. The first key part focuses on the use of convolutional neural networks for human pattern recognition, and the second key part focuses on the filtering and storage of information by blockchain technology. Figure 1 shows its architecture.
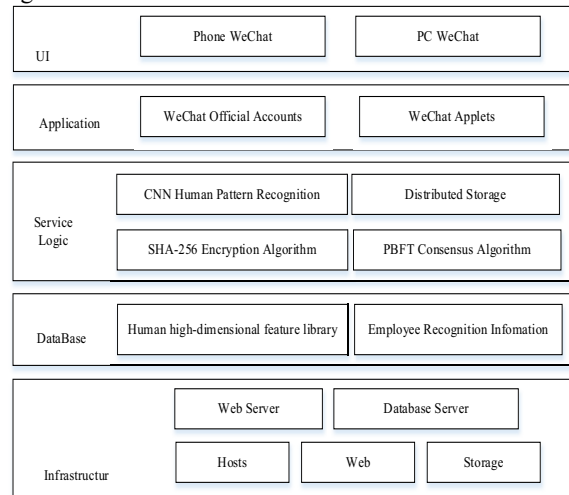

Figure 1. System Architecture

III. HUMAN PATTERN RECOGNITION

The human pattern recognition module is one of the cores of the proposed system. In this section, we will discuss the human body positioning, human body feature extraction, and human body similarity comparison.

Human body location interception adopts Google open source Object Detection Demo, uses ResNet-50 convolutional neural network for classification, and uses Faster-RCNN for target search. The specific implementation of human positioning shows as in Figure 2.

Figure 2. Human positioning interception

Figure 3. Human Body Location

Human Feature Extraction and Comparison

This module uses VGG16 neural network for human character extraction. The structure of the network is in [4].

VGG Net inspired by [5] and [6] compares three different widths of the network. Through simulation, Simon and Zisserman studied the influence of network depth on classification accuracy and used the 3X3 filter replaces Alex Net's 7x7 filter to extract finer features and significantly reduce the total number of network parameters. During training, the input is a fixed-size 224x224 RGB image.

Figure 4. Labeled Data

We tagged each individual user's photo acquired using the Object Detection API and used OpenCV to scale the photo. Some of the labeled data show as in Figure 4. The first digit represents the label value, and the second digit represents the serial number.

The cross-entropy loss function measures the similarity of real and predicted results [7]. We use the cross-entropy loss function instead of the variance loss function; because the cross-entropy loss function is a convex function, which can effectively alleviate the local minimum problem and overcomes the problem of slow learning speed [8]. The formula for the cross-entropy loss function is:

$$H(p,q) = -\frac{1}{m}\sum_{i=1}^{m} p^{(i)}\log(q^{(i)}) + (1-p^{(i)})\log(1-q^{(i)}) \qquad (1)$$

Where p is the true sign of distribution, q is the training model predicting sign distribution of equation for measuring the distribution of the two labels, the equation in real output q p and predicted values closer to the time, value all converge to zero.

We used RMSprop(Root Mean Square) as an algorithm to optimize loss function. RMSprop is a self-adaptive learning rate method proposed by Geoff Hinton and is an improved version of the SGD optimizer. It is a special case of Adadelta, which performs better in non-convex conditions. RMSprop still relies on global learning rates. RMSprop optimizer always keeps a moving average over the root mean squared gradients; by which RMSprop divide the current gradient [9], Equation (2) shows how to update velocity of, $v(w,t)$ refers to velocity function of weight and times, $\nabla Q_i(w)$ refers to loss of the gradient, and γ refers to a constant which is slight then 1. Equation (3) shows how to update weigh, η refers to learning rate.

$$v(w,t) := \gamma v(w,t-1) + (1-\gamma)(\nabla Q_i(w))^2$$

(2)

$$w := w - \frac{\eta}{\sqrt{v(w,t)}}\nabla Q_i(w)$$

(3)

Using the SoftMax function handles three or more multi-classification problems. Using the SoftMax function's algorithm is to supervise learning [10].

$$\sigma(z)j = \frac{e_j^z}{\sum_{k-1}^{k} e_k^z} \qquad (4)$$

Equation (4) is the SoftMax function, the SoftMax calculate the parameters of each incoming e summation as the total power to control the output of each unit with a point value between 0 and 1, the output is an object belongs to a kind of probability, and thus the sum of the output of 1[11].

We trained a 26-category model through the VGG network and extracted the high-dimensional features by deleting the last three layers of the VGG network full-connected layer and using the PCA algorithm to reduce the features and compare the features.

Because the user's photo data obtained at present is too small, the classification accuracy of the test set when the model basically fits the training set still fluctuates between 25% and 30%, but the success rate of the test set recognition

is on the rise, and thus the establishment can be confirmed the correct model. Iterate to about 1500 times the basic model of the model, the relevant accuracy rate show as in Figure 5,6.
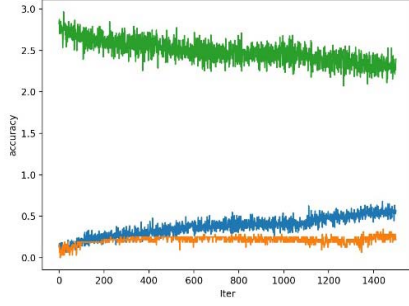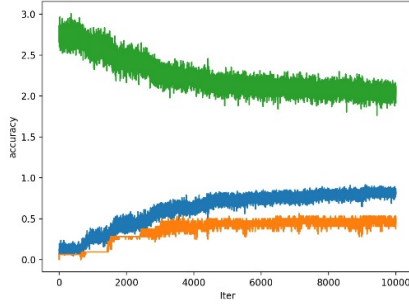

Figure 5.   Accuracy in VGG16

Figure 6.   Accuracy in InceptionResNet_v2

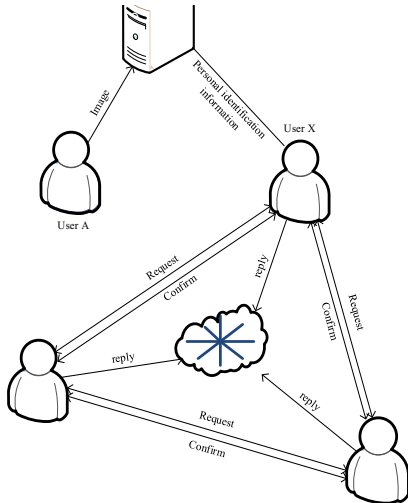IV.   DATA STORAGE MODULE

PBFT Consensus Algorithm

Figure 7.   PBFT Consensus Algorithm

This module uses the blockchain classic PBFT consensus algorithm to filter the required stored information. The example of this algorithm is show as in Figure 7

Through the transmission of user photos' identification information between employees' mobile phones, when more than half of the same person appears, the employee's job information is determined to be correct and stored in the block. The block content is shows as in Figure 8.
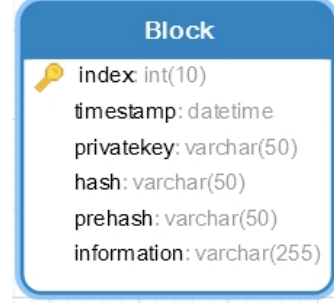
Figure 8.   Block Content

The index marks the location of the block and the time stamp identifies the memory block and prevents simultaneous storage problems. The user confirms the identity through the private key. Each user can only view the content consistent with its own privatekey, hash and prehash. The information encrypted with the SHA-256 algorithm is different from the hash value of each string. Therefore, when the content tampered with, the hash value of the block where it is located will also change, ensuring the security of the data. The specific content of a block shows as the JSON format in Figure 9.

Figure 9.   Json Format of Block

V.   MOBILE INFORMATION EXCHANGE MODULE

In order to obtain employee information and facilitate the query and statistics of related work information, we use the WeChat public number form to obtain and send information.

In daily life, a user carries a mobile terminal and uploads information through a public entrance. The specific flow chart shown in Figure 10.
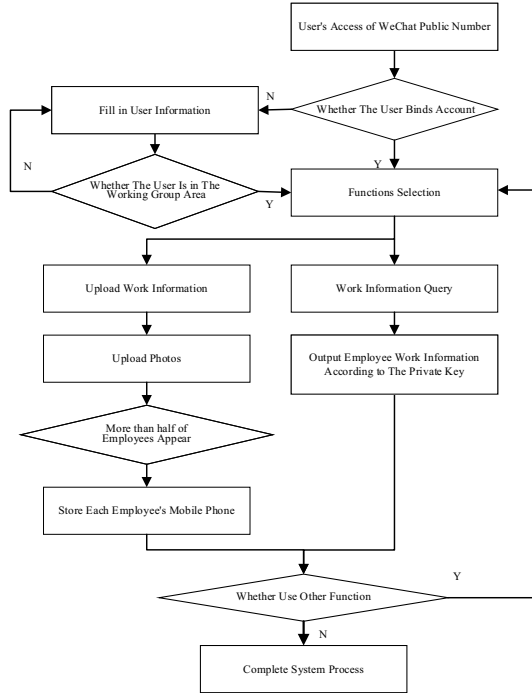
Figure 10. Flow Diagram Of Mobile Check-in

As shown in Figure 10, the entire process can be divided into the following steps:

1) Enter the interface. The user needs to subscribe to the WeChat public number to enter the system. When you enter the main page, you can see some functions, skip to Step 2.

2) Check if the user is bound. If the user is already bound, skip to Step 6; otherwise, skip to Step 3.

3) The user fills in his job number and other information. Go to Step 4.

4) Request information from the server, skip to step 5.

5) Check if the user exists. If there is a jump to step 6, otherwise go to Step 3.

6) Enter the function selection interface. If the user selects work information upload, go to Step 7. If the user selects the job information query. Go to Step 9.

7) The Upload Photos screen appears. Go to Step 8.

8) If an employee appears more than half of the time, the generated job information is stored in each employee's mobile phone, skip to Step 10.

9) Display the corresponding employee job information based on the employee's private key, skip to Step 10.

10) Check whether the user uses other functions. If the user uses other functions, skip to step 6, otherwise go to step 11.

11) Complete system process.

VI. CONCLUSIONS

By the proposed system, we not only eliminate the cost of stakeholder's accounting, but also use blockchain technology to solve the trust problem between workers and bookkeeping personnel. Even though the proposed phases recognition rate on the test set is lower, but still rising, this proves that the model is correct, this method still has room for improvement, such as using a variety of photos of people under the working environment for model training.

ACKNOWLEDGMENTS

REFERENCES

[1] Xinping Min,Qingzhong Li,Lanju Kong,Shidong Zhang,Yongqing zheng,Zongshui Xiao.Licensing chain multi-center dynamic consensus mechanism[J].Computer Journal,2018: 1-15.

[2] Tianxu Zhang,Jin Liu.Invariant moment stability and target recognition based on multi-level feature model[J].Computer Journal,2014(10): 1335-1340.

[3] Qifeng Shao,Cheqing Jin,Shao Zhang,Weining Qian,Aoying Zhou.Blockchain Technology:Architecture and Progress[J].Computer Journal,2017: 1-20.

[4] Simonyan K, Zisserman A. Very Deep Convolutional Networks for Large-Scale Image Recognition[J]. Computer Science, 2014.

[5] A. Krizhevsky, I. Sutskever, G. E. Hinton, "ImageNet classification with deep convolutional neural networks", Proc. Adv. Neural Inf. Process. Syst., pp. 1097-1105, 2012.

[6] M. D. Zeiler, R. Fergus, Visualizing and understanding convolutional networks, Nov.2013.

[7] Hinton, Geoffrey, O. Vinyals, and J. Dean. "Distilling the Knowledge in a Neural Network." Computer Science 14.7(2015):38-39.

[8] Gou, Xunjie, Z. Xu, and H. Liao. "Hesitant fuzzy linguistic entropy and cross-entropy measures and alternative queuing method for multiple criteria decision making." Information Sciences s 388–389(2017):225-246.

[9] Mukkamala, Mahesh Chandra, and M. Hein. "Variants of RMSProp and Adagrad with Logarithmic Regret Bounds." (2017).

[10] KAGAN TUMER, and JOYDEEP GHOSH. "Error Correlation and Error Reduction in Ensemble Classifiers." Connection Science 8.3-4(2015):385-404.

[11] Campuzano, Francisco, et al. "Generation of human computational models with machine learning." Information Sciences 293.293(2015):97-114.