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Automatic Classification for Home Appliances Image

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Abstract: The image recognition technology based on deep learning is rapidly occupying the research topic of experts and scholars in the field of artificial intelligence with the advantages of high accuracy and strong scalability. Compared with other kinds of information sources, images have the characteristics of large information capacity and high complexity, which makes the image recognition research difficult. combines the current popular e-commerce enterprise application requirements with deep learning-based image recognition technology, and uses Markov random field algorithm to extract image features of a large number of electrical image sets, and then completes an online image recognition system, in which result is the brand and type information of the appliance in the picture.

Keywords: Deep learning, image recognition, Markov random field.

1. Introduction

The development of information technology makes people's lives more and more accessible. Under the influence of the Internet and IT, e-commerce has gradually emerged. Therefore, how to provide users convenient and effective services in the platform of e-commerce has gradually become the focus of business attention. Therefore, the image recognition technology based on deep learning is rapidly occupying the research topic of experts and scholars in the field of artificial intelligence with the advantages of high accuracy and strong scalability. Compared with other kinds of information sources, images have the characteristics of large information capacity and high complexity, which makes the image recognition research difficult. The characteristics of e-commerce data are various categories and fast update speed. Through the identification of the main electrical appliances in the image, it can be classified, so as to solve the problems in the images uploaded by the merchants, and effectively distinguish the types and brands of electrical appliances. In this paper, we

promote a different approach, the current popular e-commerce enterprise application needs and image recognition technology based on deep learning are fused.

Markov random field (MRF) is an important research position in probability graph model, which was originally introduced to solve the problem of parametric explosion caused by the failure to consider the relationship between parameters. As early as 1988, Judea Pearlfirst mentioned the concept of probability graph. In 1990, based on the study of statistics, J.Hittaker proposed the probability graph model. Since then, researchers have found that probability graph can well describe the relationship between various random variables, and have used it to solve a variety of practical problems. Among them, because of the similarity between its structure and the image structure, the use of MRF is also very common in studying the direction of image processing. Since the calculation of the joint probability density of MRF is relatively complex, the calculation of the joint probability density of Markov random field can take advantage of the equivalence of MRF and Gibbs. In 1906, Markov first proposed the MRF sequence. In 1942, ITO established stochastic analysis theory to study Markov's special process -- diffusion process, which opened up a new direction for the study of Markov chain. Then the large-scale research and application of Markov random field are triggered.

At present, Markov processes, Markov random fields, infinite particle Markov processes, measure branching processes, and Markov processes on manifolds are all urgently needed to be studied. In this paper, we promote the Markov Random Field based image recognition system for e-commerce appliances proposed, considering the complex background of some pictures in the actual situation, and identify images with simple and complex background.

2. Convolutional neural Networks (CNN)

It was in order to solve the problem of handwritten character recognition that LeCun et al. proposed LeNet network and used convolutional neural network (CNN) for the first time in the field of image processing and recognition. The structure is shown below.

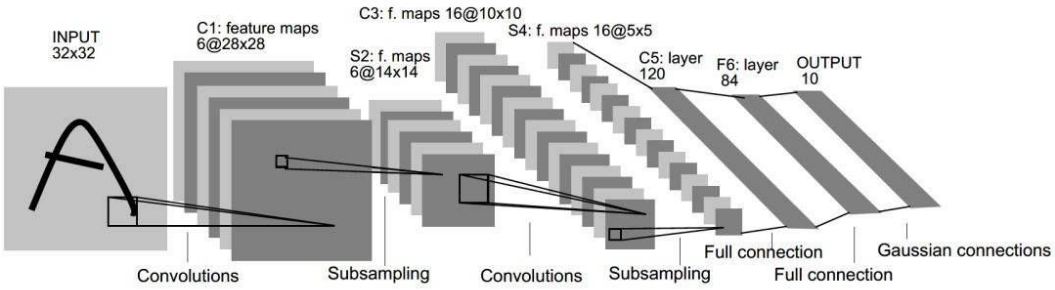

Fig. 1 Convolutional neural LeNet

ResNet reproposed a residual structure based on the 152-layer network to effectively

propagate the residual in the opposite direction. If the input of a certain segment of neural network is set as X, the expected output is H(X), and the original learning objective is F(x) = H(x)-x. It will completely change the learning objective, and its model accuracy is higher than human's recognition accuracy in image classification for the first time.

3. Computing Model

Markov model

Markov model, which describes a process that changes randomly over time. If a system has a finite number of states, its states will change over time. Is a sequence of random variables, respectively are the states of, then the probability of being in the state of, is determined by all the preceding states. In special cases, the state of time is only related to its previous state of time, then we call it a discrete first-order Markov Chain.

$$P(\mathrm{q}_t = s_j \mid \mathrm{q}_{t-1} = s_i, \mathrm{q}_{t-1} = s_k, \dots) = P(\mathrm{q}_t = s_j \mid \mathrm{q}_{t-1} = s_i)$$

When we only consider independence in time, If a first-order Markov process has a state, it means that it has a number of state transitions, and its state transitions can be expressed in matrix form.

$$\begin{aligned} P(p_1, p_2, p_3, \dots, p_T) &= P(\mathrm{q}_1)P(\mathrm{q}_2|\mathrm{q}_1)P(\mathrm{q}_3|\mathrm{q}_1, \mathrm{q}_2)\dots P(\mathrm{q}_T|\mathrm{q}_1, \mathrm{q}_2\dots\mathrm{q}_{T-1}) \\ &= P(\mathrm{q}_1)P(\mathrm{q}_2|\mathrm{q}_1)P(\mathrm{q}_3|\mathrm{q}_2)\dots P(\mathrm{q}_T|\mathrm{q}_{T-1}) \\ &= \pi_{q_1}\prod_{t=1}^{T-1} a_{q_t q_{t+1}} \end{aligned}$$

The probability of Markov chain is equal to the probability multiplication of the transition arcs between all the states that form the state sequence.

$$P(h, e, l, p) = P(q_1 = h) * P(q_2 = e \mid q_1 = h) * P(q_3 = l \mid q_2 = e) * P(q_4 = p \mid q_3 = l)$$

When n=2, in fact, is a Markov model. When n>3, we call it the order Markov model, which refers to the number of previous states used to predict the next state.

Random field mode

We add the values of each position in the CRF formula which defines the same feature, and change the local eigenfunction into the global eigenfunction, so that CRF can be expressed as the inner product of the weight vector and the eigenvector.

$$f_k(y, x) = \sum_{i=1}^{n} f_k(y_{i-1}, y_i, x, i), k = 1, 2, \dots, K$$

$$F(y, x) = (f_1(y, x), f_2(y, x), \dots, f_k(y, x))^T$$

$$P_W(y|\mathrm{x}) = \frac{\exp(W \cdot F(y, x))}{Z_W(\mathrm{x})}$$

MRF learning model

Assuming that it is expressed by inner product, the order matrix (the number of marked values) is defined for each position marked with the start and end states.

$$\beta_{n+1}(y_{n+1}|\mathrm{x}) = \begin{cases} 1, y_{n+1}=stop \\ 0, \text{否则} \end{cases}$$

$$\beta_i(y_i|\mathrm{x})=M_i(y_i, y_{i+1}|\mathrm{x})\beta_{\mathrm{i}-1}(y_{i+1}|\mathrm{x})$$

$$E_{P(X,Y)}[f_k] = \sum_{x,y} P(\mathrm{x},\mathrm{y}) \sum_{i=1}^{n+1} f_k(y_{i-1}, y_i, x, i)$$

$$= \sum_{x} \tilde{P}(x) \sum_{i=1}^{n+1} \sum_{y_{i-1}y_i} f_k(y_{i-1}, y_i, x, i) \frac{\partial_{\mathrm{i}-1}^{T}(y_{i-1}|\mathrm{x})\, M_i(y_{i-1}, y_i|\mathrm{x})\beta_i(y_i|\mathrm{x})}{Z(\mathrm{x})}$$

$$E_{\tilde{P}}[s_l] = \sum_{x,y} \tilde{P}(x)P(y|x) \sum_{i=1}^{n} s_l(y_i, x, i)\, exp(\delta_{k_l+1}T(x))$$

$$= \sum_{\boldsymbol{x}} \tilde{\boldsymbol{P}}(\boldsymbol{x}) \sum_{\boldsymbol{y}} \boldsymbol{P}(\boldsymbol{y}|\boldsymbol{x}) \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{s_l}(\boldsymbol{y_i}, \boldsymbol{x}, \boldsymbol{i})\, \boldsymbol{exp}(\boldsymbol{\delta_{k_i+1}} \boldsymbol{T}(\boldsymbol{x}))$$

$$\delta_i(l) = \max_{1\le j\le m}\{\delta_{l-1}(j) + w \cdot F_i(y_{i-1}=j, y_i=l, x)\}, l = 1,2,\ldots,m$$

$$\Psi_i(l) = \max_{1\le j\le m}\{\delta_{l-1}(j) + w \cdot F_i(y_{i-1}=j, y_i=l, x)\}, l = 1,2,\ldots,m$$

4. Image recognition

In the first step, the user chooses to upload the image to be recognized. The second step, the system carries on the image recognition stage. In the third step, the system extracts the image features and classifies the recognition model through the algorithm and returns the electrical appliance type and brand. This result is the recognition result of the image uploaded by the user in this mode.

The main methods of image processing are: flipping, random cutting, color jitter, shift, scaling, contrast, noise, rotation, etc. This paper mainly uses the scaling change, brightness adjustment and grayscale to process the image. The algorithm of training the classifier based on the feature data is as follows：

1. Create image data for post-processing training
2. Create classifier CV2 ml.SVM_ create()
3. Determine the SVM type setType (CV2 ml.SVM_ C_ SVC)
4. Set kernel (CV2 ml.SVM_ LINEAR)
5. Utilization svm.train (train_ data, cv2. ml.ROW_ SAMPLE, train_ Label) to train the classifier

5. Conclusion

In order to solve the problem of image recognition, based on the theoretical basis of Markov random field in deep learning, this paper firstly elaborates the main theory and algorithm of Markov random field, as well as the algorithm framework of the system. Then based on the content of software engineering, requirements analysis, design, implementation and test analysis of the whole system and its key use cases are carried out. In the future, we will study how to optimize the Markov random field algorithm.

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