Mobile Image Multi-label Recognition Algorithm Based on PaddlePaddle Platform

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Abstract. As one of the core algorithms of machine vision, the mobile image multi-label recognition algorithm has received extensive attention from researchers in recent years and has been widely used in cutting-edge fields such as deep learning framework paddlepaddle platform, video surveillance, intelligent robots, and unmanned aerial vehicles. However, the existing recognition algorithms are not completely satisfied with the practical application in life and production. Due to the complexity of the platform environment, they can often only propose specific solutions based on existing problems, and there is no universal algorithm that is suitable for all kinds of Complex environment. The purpose of this paper is to study the multi-label recognition algorithm of moving images based on PaddlePaddle platform. This research mainly analyzes and researches the mobile image multi-tag space deployment plan and the multi-tag recognition algorithm, and further improves the tag reading rate and recognition reliability of the mobile image on the PaddlePaddle platform. This research first analyzes several key factors that affect the performance of UHF recognition system, considers the improvement plan of PaddlePaddle platform's mobile image multi-tag recognition algorithm from the two aspects of space diversity and frequency diversity, and finally determines the multiple The label space diversity scheme, and the introduction of a multi-label optimization recognition algorithm to improve the recognition efficiency of the PaddlePaddle platform's mobile image multi-label. Experimental data shows that the reading rate can reach 0.907 when identifying 300 tags in the experiment, and when the number of tags is greater than 300, the reading rate is close to 1, which verifies that the algorithm proposed in this paper is used in the multi-tag recognition of moving images on the PaddlePaddle platform.

Keywords: Deep Learning, Moving -Image Recognition, Multi-Label Recognition

1. Introduction
In recent years, with the development of image recognition technology, moving image multi-tag algorithm as an effective recognition method plays an irreplaceable role in medical, sports, computer and other fields [1-2]. However, the inherent characteristics of multi-label mobile images based on the
PaddlePaddle platform and the continuous expansion of data scale make the multi-label recognition of mobile images by manual interpretation face a huge challenge [3-4]. At the same time, the rapid development of the Internet has led to an explosive growth in the amount of image and text data. In addition, the continuous improvement of GPU performance, coupled with the popularity of neural networks, seems to have begun a revolution in deep learning on the PaddlePaddle platform, computer vision led by traditional methods, Tasks such as natural language processing began to be penetrated by deep learning technology [5-6]. In practical applications, the scene of the image is extremely complex, and the image contains many objects. How to accurately identify all objects in the image has begun to be widely studied. The study of multi-label recognition algorithms for moving images has become academia and industry important topics [7-8].

In the research on the multi-label recognition algorithm of moving images based on the PaddlePaddle platform, many scholars have conducted research on it and achieved good results. For example, Huang HW et al. proposed an SRN model to calculate the feature map of each category. Perform spatial normalization on known features, suppress the model's response to the label image, improve the label's response to the image, and achieve normalization through predictive learning. Combine normal features and calculated prediction results with abnormal features to get the final prediction results [9-10]. Allyn J et al. proposed the WAPR algorithm to solve the multi-label classification problem. The model uses the features extracted from the fusion grid to complete the multi-label ranking task, and details the key factors that help improve the recognition accuracy. The prediction result is usually set to K equal to 3 [11-12].

This article first compares traditional multi-label recognition algorithms for moving images, explains the principles of different algorithms, analyzes their respective advantages and disadvantages, and summarizes their three problems in candidate site selection, feature extraction and classification. Next, the overall structure of the multi-label recognition algorithm for moving images based on the PaddlePaddle platform is introduced, several key performance indicators of the recognition algorithm are analyzed, and various important factors affecting the performance of the recognition algorithm are analyzed in detail. At the same time, this research proposes a special improvement plan for the multi-label recognition algorithm of moving images, which mainly analyzes and improves the development position and label control design of the multi-label. At the end of this work, reliability analysis and simulation of the improved recognition algorithm are carried out.

2. Mobile Image Multi-Label Recognition Algorithm based on PaddlePaddle Platform

2.1 Key Performance Indicators of Mobile Image Multi-Label Recognition Algorithm

2.1.1 Reading range. The reading range of the multi-tag recognition algorithm includes two aspects: one is the maximum distance the tag can respond to the read and write signals of the reader, which is related to the minimum power required for the normal operation of the multi-tag; the other is the recognition algorithm can respond to the multi-tag response. The maximum distance of the signal is related to the minimum power of the response signal fed back by the tag to which the identification algorithm can respond.

2.1.2 Reading rate. The tag reading rate refers to the probability that the reader of the recognition algorithm completes the collection of tag information. The tag reading rate and the data transmission rate of the recognition algorithm are different concepts. For a specific RFID identification system, its data transmission rate is limited by the minimum transmission rate of the part of the system involved in data transmission. In real application scenarios, the biggest limitation of the multi-label recognition algorithm for moving images is that there is label missed reading, that is, it is impossible to achieve a 100% label reading rate for labels within the reading range of the system. If the algorithm frequently causes labels In the case of missed reading, its application on the network is very restricted or even not
allowed. Therefore, the reading rate of tags is an important indicator that affects the application and development of recognition algorithms.

2.2 Traditional algorithm for Multi-label Recognition of Moving Images

2.2.1 Query Tree algorithm. In the QT algorithm, in each poll, the reader must send a string to ask whether the tag ID contains a specific prefix. Only tags whose ID matches the query prefix can respond to the reader query command. If more than one tag responds, then a collision occurs and the reader determines that at least two tags have the same prefix. Then, add 0 and 1 after the specific prefix to form a new query prefix. At this time, the tags are divided into two groups, forming a simple binary tree structure. The reader first queries the 0 branch of the tree and then the 1 branch until the ID of only one tag matches the query prefix, the tag can be successfully identified, and finally its ID is sent to the reader.

2.2.2 Collision tree algorithm. The CT algorithm is a stable algorithm. The recognition efficiency and time complexity are not affected by the tag ID, but are only related to the number of tags to be read. According to the flow of the CT algorithm, it is obvious that there are only readable time intervals and conflict time intervals in the entire query process, and there is no delayed time interval. The collision tree structure constructed from this must be a full binary tree. Then, the total number of queries required to identify N tags is 2N-1, and the average identification of a tag requires 2-1/N queries, and the recognition efficiency of the CT algorithm reaches N/ (2N-1). Obviously, the recognition efficiency of the system Higher than 50%.

2.3 BUIP Algorithm for Multi-Label Recognition Used in This Study

The BUIP algorithm consists of two stages: the known tag inactivation stage and the unknown tag collection stage. The first stage includes multiple polls. In each poll, some known tags are inactivated and unknown tags are marked. Until all known tags are inactivated, the first stage ends. In the second stage, the reader uses the DFSA algorithm to collect all unknown tag IDs.

Suppose there are n known tags and m unknown tags in the PaddlePaddle platform. Then, in the i-th poll of the first stage, there are a known tag and an unknown tag participating in the recognition process of the reader. In order to maximize the inactivation rate of the known tag, the optimal frame length is obtained by derivation

\[ f_i = n_i + m_i - 1 \]  \hspace{1cm} (1)

The time required to identify m unknown tags in the system using the BUIP algorithm is:

\[ T_{BUIP} = \left[(n + m) \times e / 96\right] \times t_{ID} + (n + m) \times e \times t_i \]  \hspace{1cm} (2)

Among them, n represents the number of known tags, represents the length of 10-bit information transmitted in the long response time slot, and represents the length of the tag ID.

3. Experimental Research on Mobile Image Multi-Label Recognition Algorithm based on PaddlePaddle Platform

3.1 Experimental Environment

The experiment was implemented in the windows10 environment.

3.2 Experimental Data Set

The survey uses the VOC data set to train the network model and test the performance of the network model. VOC is one of the most authoritative object recognition and image classification competition picture databases in the world. It is widely used in the performance comparison and testing of various image recognition, classification, target recognition and other algorithms. Many classic algorithms
have been experimented on the VOC data set, and the test results obtained on the VOC data set are used as a criterion for judging the performance of a model.

3.3 Experimental Procedure

3.3.1 Frequency hopping technology. Due to the regulations and restrictions on the signal bandwidth in the standard protocol, when frequency hopping technology is used, the position of the blind zone of the signal at different frequency points does not change significantly. It is assumed that the position in the recognition area of the recognition algorithm is a blind spot for the read and write signals at the frequency point. After the frequency hopping technology is adopted, the position of the blind spot does not change significantly for the read and write signals with frequency points, so the effect of frequency diversity in reducing and eliminating the blind spots of the algorithm is not very obvious.

3.3.2 Space diversity setting. Suppose that for a reader tag, the position a of the algorithm recognition area is a blind spot position for a certain tag. When the working frequency of multiple tags is the same, position a is no longer a blind spot position for other tags, but due to the change of the working frequency, the blind spot positions of other tags may overlap with the a position to varying degrees, thereby reducing the effect of spatial diversity on fewer and eliminating system blind spots. Therefore, this research adopts a spatial diversity method in eliminating blind spots, and rationally deploys multi-label spatial locations to achieve a better reduction and elimination of blind spots.

3.3.3 Determine the number of tags. The more tags developed, the closer the distance between tags, the greater the correlation between the recognition rate and the tagging process, and the greater the waste of system resources, so the number of tags should not be too many. In this study, the number of tags in the multi-tag recognition algorithm is determined to be 4.

3.3.4 Multi-label deployment location. The four tags connected to the reader adopt a time-sharing working mode, there is no mutual interference between frequencies, and a multi-tag optimization control algorithm is introduced to improve the efficiency of algorithm identification. The application of multiple tags not only increases the reliable reading rate of the mobile image recognition algorithm, but also improves the overall reliability of the recognition algorithm, and reduces the influence of uncertain factors in the surrounding environment on the recognition algorithm.

4. Experimental Analysis of Mobile Image Multi-Label Recognition Algorithm based on PaddlePaddle Platform

4.1 Relationship between the Algorithm Reading Rate P and the Number of Tags
Before simulating the recognition system, it is necessary to set the relevant simulation parameters, mainly the setting of the number of tags N and the number of reader tags M. The parameter settings used in the simulation process are based on the specific hardware environment. The hardware selected in this article includes UHF readers that can connect four reader tags, circular polarization reader tags, and linear polarization radio frequency tags. In this study, the number of tags is set to N=300, the number of readers is M=4, and the recognition algorithm is simulated for 80 times. First, analyze the relationship between the tag reading rate and the number of tags recognized by the algorithm and the number of tags activated. The simulation results are shown in table 1.

| Read rate P | Number of identification tags (before improvement) | Number of identification tags (after improvement) |
|-------------|-----------------------------------------------------|-------------------------------------------------|
| 0           | 150                                                 | 150                                             |
| 0.2         | 198                                                 | 186                                             |
| 0.4         | 249                                                 | 225                                             |
Figure 1. The relationship between the algorithm read rate $P$ and the number of tags

Figure 1 is the change curve of the total number of tags identified by the algorithm at the tag reading rate. As can be seen from Figure 1, the curve shows that the number of identification tags increases with the increase in the reading rate. Since the reading rate is greater than 0.6, the total number of tags actually recognized by this algorithm is close to the number of tags to be recognized, which is 300. At the same time, the number of tags recognized by the improved multi-tag recognition algorithm increases as the reading rate increases. The trend is slower than the improved multi-label recognition algorithm for moving images.

4.2 Relationship between Algorithm Read Rate and Reliability Factor

In order to more vividly reflect the effect of the improved RFID identification system, the following is to simulate the multi-tag system before the improvement. The simulation parameters are set as: $N=300$, $M=4$ before improvement, $N=300$, $M=3$ after improvement. Similarly, perform 100 recognition simulations on the recognition system. The simulation results are shown in table 2.

Table 2. The relationship between algorithm read rate and reliability coefficient

| Read rate $P$ | System reliability factor (before improvement) | System reliability factor (after improvement) |
|---------------|-----------------------------------------------|-----------------------------------------------|
| 0             | 0                                             | 0                                             |
| 0.2           | 0                                             | 0                                             |
| 0.4           | 0                                             | 0                                             |
| 0.6           | 0.26                                          | 0.15                                          |
| 0.8           | 0.48                                          | 0.26                                          |
| 1             | 1                                             | 1                                             |
Figure 2. The relationship between algorithm read rate and reliability coefficient

Figure 2 is the variation curve of the algorithm reliability coefficient with the single tag reading rate. According to Figure 2, the value of the algorithm reliability coefficient increases with the increase of the reading rate, that is, the greater the reading rate, the higher the system reliability. When the reading rate is less than about 0.4, the system is reliable. The coefficient of sex is 0. After the improvement of the mobile image multi-label recognition algorithm, the reliability of the recognition algorithm has also been improved. From the above analysis of the simulation results of the recognition algorithm, it can be seen that the mobile image multi-label recognition algorithm based on the PaddlePaddle platform can improve the reliability of multi-label recognition. The introduction of multi-tag control algorithm improves the efficiency of the recognition algorithm. The reliability coefficient of the algorithm shows that it can evaluate the reliability of the recognition algorithm.

5. Conclusions

Based on the existing layout of the moving image multi-label recognition system on the PaddlePaddle platform, this paper studies and analyzes the impact of moving image multi-labels in different positions in the space on the performance of the recognition system, and repositions the existing layout of multiple labels. The impact of the improved multi-tag recognition algorithm on the performance of the recognition system is discussed. Considering the operation analysis of multiple tags in moving images, a multi-tag control algorithm is introduced, and the improvement of system performance is analyzed after the introduction of the multi-tag recognition algorithm, which improves the recognition efficiency while ensuring recognition. Finally, the reliability of the improved multi-tag recognition algorithm is analyzed from the aspects of tag reading and the effectiveness of the simulation recognition system, and the multi-tag recognition algorithm is discussed. The research work of this paper mainly involves the application of image management on the network platform, but the research results are not limited to the application of image management. The research on the mobile image multi-label recognition algorithm based on the PaddlePaddle platform can promote the application of recognition technology in various domestic industries.
References
[1] Zhi-qiang, Zhao, Meng, et al. Research on a fusion gait real-time recognition algorithm. Journal of Physics: Conference Series, 2019, 1187(4):42014-42014.
[2] Liang S, Wang L, Zhang L, et al. Research on Recognition of Nine Kinds of Fine Gestures Based on Adaptive AdaBoost Algorithm and Multi-Feature Combination. IEEE Access, 2018, PP(99):1-1.
[3] Wang D, Zhu T, Xie A, et al. Research on Image Recognition Algorithm Technology for Power Line detection. Journal of Physics: Conference Series, 2021, 1732(1):012082 (6pp).
[4] Zhang H, Y Huang, Chen Q, et al. Research on Anti-collision algorithm of Multi-RFID tags in intelligent clinical monitoring system. Journal of Physics Conference Series, 2021, 1774(1):012039.
[5] Mao Q, Pan Z, Si D, et al. Research on Image Recognition Algorithm Technology for Power Line Business Audit. Journal of Physics: Conference Series, 2020, 1650(3):032002 (8pp).
[6] Liu Y, Yang J, Wang C. Research on Behavior Recognition Algorithm Based on Compact Representation of Low-level Feature. Journal of Physics Conference Series, 2019, 1176:032018.
[7] Ren H, Yu X, Zou L, et al. Joint Supervised Dictionary and Classifier Learning for Multi-View SAR Image Classification. IEEE Access, 2019, PP(99):1-1.
[8] Li X, Lv X. Research on Image Recognition Method of Convolutional Neural Network with Improved Computer Technology. Journal of Physics: Conference Series, 2021, 1744(4):042023 (6pp).
[9] Huang H W, Li Q T, Zhang D M. Deep learning based image recognition for crack and leakage defects of metro shield tunnel - ScienceDirect. Tunnelling and Underground Space Technology, 2018, 77:166-176.
[10] Zyurt F. Efficient deep feature selection for remote sensing image recognition with fused deep learning architectures. The Journal of Supercomputing, 2020, 76(4):1-19.
[11] Allyn J, Allou N, Vidal C, et al. Adversarial attack on deep learning-based dermatoscopic image recognition systems: Risk of misdiagnosis due to undetectable image perturbations. Medicine, 2020, 99(50):e23568.
[12] Bogucki R, Cygan M, Khan C B, et al. Applying deep learning to right whale photo identification. Conservation Biology, 2019, 33(3).