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The 10th International Conference on Computer Engineering and Networks

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Preface

This conference proceedings is a collection of the papers accepted by the CENet 2020—the 10th International Conference on Computer Engineering and Networks held on October 16–18 2020, in Xi'an, China.

This proceedings contains the five parts: Part I Artificial Intelligence and Applications (51 papers); Part II Communication System Detection, Analysis and Application (32 papers); Part III Information Security and Cybersecurity (25 papers), Part IV Intelligent System and Engineering (17 papers), Part V Internet of Things and Smart Systems (61 papers) and Part VI Medical Engineering And Information Systems (13 papers).

Each part can be used as an excellent reference by industry practitioners, university faculties, research fellows and undergraduates as well as graduate students who need to build a knowledge base of the most current advances and state of practice in the topics covered by this conference proceedings. This will enable them to produce, maintain and manage systems with high levels of trustworthiness and complexity.

Thanks to the authors for their hard work and dedication as well as the reviewers for ensuring the selection of only the highest-quality papers; their efforts made the proceedings possible.

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Artificial Intelligence and Applications



A Unified Framework for Micro-video Background Music Automatic Matching

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Abstract. The current widely spread of micro-form video is undeniable. However, neither the music-orienting nor the video-orienting way to make a video can totally express the idea of the video maker because of the fixed music types and the cost of time to find a proper music. Based on the deep learning method, this paper studies the automatic matching algorithm of background music for micro-videos which analyzes the background information and the emotions of characters in micro-videos and establishes the model to select the proper background music according to the video contents. Experiments are carried out on the database obtained from TikTok and the result shows that the current Micro-Video Background Music Automatic Matching model in this paper is effective.

Keywords: Micro-video · Deep learning · Video feature extraction · Chorus intercepting · Background music matching

1 Introduction

In recent years, with the popularity of the global mobile Internet and the development of network technology, micro videos have become a part of daily life for many people. More and more people are trying to make micro videos. But the traditional way of making micro videos with fixed music, limits this trend. In the current market, innovations in short video production and video filtering processing are imminent. Therefore, we have studied a method based on video content to add suitable background music to fill the gap in the current market demand. In this article, we propose a MVBGMAMA method to solve the above problems, and automatically select and match the appropriate background music based on the scene settings and character emotions in the short video. When analyzing the characteristics of the video, we can analyze the key frames of the video, and then use the scene recognition technology of pictures and facial expression recognition technology to label the scenes and emotional

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tags of the video. Specifically, we first learn a mapping function (V2T) from video to text labels to fully extract the features of the video. By jointly minimizing the reconstruction error and the classification loss, these two features are merged in a supervised manner to arrive at a final label. The obtained tags are then matched with the music tags to select one or more pieces of music that match the video content. When adding background music, we automatically analyze the matching background music and intercept the chorus part of the music.

2 Related Work

2.1 Neural Network Model

In recent years, the development of CNN significantly facilitates the procedure and the implementation of image scene recognition [1, 2]. Currently, the design-related thoughts of CNN model basically develop towards the direction of deep network and more convolution calculation [3]. Residual Network Model (Resnet) has also achieved high accuracy in face recognition and scene recognition problem [3]. There is no obvious improvement in the accuracy of FER in the process of completely removing the full connection layer of the Xception model [4] and the process of depth wise separable solutions based on it. As for scene recognition, Bolei Zhou et al. have created great progress and effects on places data set [5]. AlexNet [1], GoogLeNet [6], VGG [7] and other models are used to verify, and the average accuracy of top-5 is 85.07% [5].

2.2 Music Chorus Interception

The duration of microform videos is generally limited within 15–20 s, but a song is normally about 3 min, and therefore music intercepting is required. There are two available methods to solve it: the first one relies on manual annotation; the second one uses big data of user's preference.

The advantage of the manual annotation is accurate and simple, yet it fails to label a large number of songs in a mass amount. So, there is limited music available for download at present in any music platforms which depends on this method. Another method is based on the big data of the user's playing preferences. According to statistics, a large number of users will choose to repeatedly play in the chorus part, or even directly switch to the chorus part. Through the observation of user behaviors, this method can analyze where the chorus begins, but this method requires adequate user data, and it is not possible to identify the less popular song chorus part.

3 Proposed Framework

As shown in Fig. 1, emotions and background information of the characters from the micro-videos are generated, all of which constitute the basic information of the video.

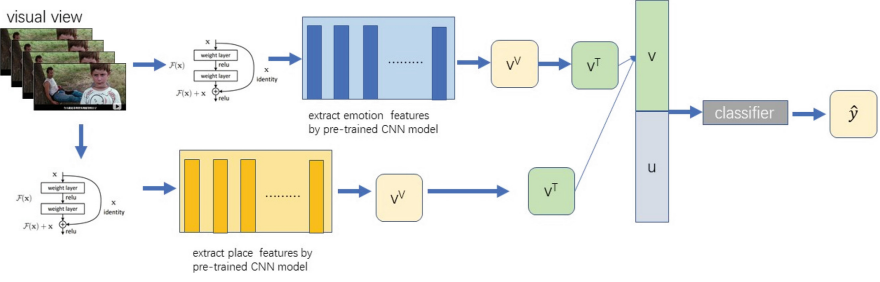


Fig. 1. An example of micro-video on TikTok.

3.1 Facial Expression Recognition

Among the seven facial expression features [8], happy, sad and angry are the three most distinguishable emotional features. In MVBGMAMA, the recognition accuracy of the above three facial expressions should be comparatively high. Our model transforms the input image layer by layer into a smaller but deeper feature map. With the increasing network depth, what this model identifies can be more complex.

According to the facial expression recognition model, the algorithm selects the keyframe expression features and processes the keyframe expression information to get the final video facial expression features.

3.2 Scene Identification

For this research topic, the scene information of the video is an important factor that affects the background music, so the training pictures that need to be selected for the public data set must contain the scene information. So we chose MIT's Places365-Standard data set [5] as the scene training data set, a total of 365 labeled diversified concept scenes. The analysis based on the above data, combined with diversified means to extract corresponding features, can achieve the purpose of training a linear support vector machine (SVM) classifier.

3.3 Intercepting Chorus of the Music

Chorus Identification. Following the experience, the chorus of a song is often repeated several times in the song. Despite different lyrics, the melody maintains basically the same, and the length of the chorus is also stable. Therefore, this characteristic is the criterion for determining the chorus of the algorithm. The reliability of the algorithm depends to a large extent on the correct determination of non-chorus.

Comparison. The FFT transform is applied to transform the original time-domain waveform to the frequency domain, after which a spectrum is obtained. The conversion method is as follows:

$$X(k) = \sum_n^{N-1} x(n) W_N^{nk} \dots k = 0, 1, 2, \dots, N-1 \quad (1)$$

The spectrum chart is three-dimensional, where X coordinate is time, Y coordinate is frequency, and Z coordinate is energy; then a series of maximum points are obtained from the spectrum chart, before the list of landmarks is obtained, and then the landmarks of the two music segments are compared one by one. The landmark is constructed as follows:

$$L = \text{MAX}(|X(k)|)^T \quad (2)$$

It is because the part of the chorus signal holds high energy, that energy works as also the most important evaluation standard. In the process, the larger the difference, the higher the score. This process is divided into X_1 .

At the same time, the position, duration, and interval between repetitions of chorus are stable. Suppose the chorus appears in the $T_i - T_{i+1}$ time period with the probability of P_i , and appears in the duration of T_i with the probability of P_j , and will appear again after the duration of T_k with the probability of P_k (P_i , P_j , T_i , T_{i+1} , and T_j are counted Method), then if the start and end time of the possible chorus paragraph is between T_i and T_{i+1} , the duration is close to T_j , and the interval is close to the interval with the highest probability, then it is more likely to be the chorus of the song. Therefore, this item can also be used as a measurement scoring standard.

If the process score is x_2 , then

$$x_2 = P_i * P_j * P_k \left(1 - \frac{|t_1 - T_j|}{T_j}\right) \left(1 - \frac{|t_2 - T_k|}{T_k}\right) \quad (3)$$

where t_1 is the duration of the possible chorus, and t_2 is the interval between possible choruses.

Overall score is:

$$\text{Mark} = w_1 * X_1 + w_2 * X_2 \quad (4)$$

w_1 is the score weight of X_1 , w_2 is the score weight of X_2 . This weight is assigned as the weight corresponding to the better test result in the experimental test.

3.4 Matching

The algorithm cuts out several frames of the video and performs facial expression recognition and scene recognition on these frames. After receiving facial expression labels, the algorithm will select the most frequent facial expression labels in all frames as the facial expression information of the video; for these scene information labels; the algorithm will select the scene labels with the highest accuracy as the information of the video according to the recognition accuracy of the scene labels.

The current research applies multiple classification logistic regression to classify facial expression tags and background tags. The classification result is one of the 11

preset video features: work, classic, driving, pub, traveling, morning, walking, afternoon tea, studying, night, work-out.

With the final classification of video, the music with the same label can be identified in the music set according to the classification label, and complete the work of matching background music according to the video features.

4 Experiments

4.1 Dataset

Facial Expression and Scene Recognition: CK+ [9] dataset includes 123 subjects and 593 image sequences. Places365 is a subset of Places2, with 1.8 million images per month from 365 scene categories.

Music Dataset. Using web crawler technology, 1133 songs with top popularity and free downloads are crawled from domestic platforms. There are 1056 complete documents and label attributes.

4.2 Evaluation Scheme

Facial Expression and Scene Recognition. In the experiment, CK+ dataset and Places dataset are randomly divided into the training set, verification set, and test set, and each kind of training set, verification set and test set is distributed in a partition as 8:1:1.

4.3 Baselines

This paper applies a series of classification algorithms to our model to predict the categories of facial expression tags and scene tags extracted from the video, to generate the final video features. Therefore, it forms several different models according to the classification algorithm. As shown below: MVBGMAMA multiple classification logistic regression, MVBGMAMA -Naive Bayesian, MVBGMAMA -SVM, verify the accuracy of our MVBGMAMA model for the classification of facial expression tags and scene tags extracted from video.

4.4 Parameter Settings

Neural Network. This paper takes Resnet as a reference and remains its full connection layer. ResNet50 is selected for its proper depth, to optimize the performance of Resnet50, we use the idea proposed in Aggregated Residual Transformations, which changes some hyper-parameters on the basis of ResNet-50 and gets better performance in image feature extracting.

4.5 Results and Analysis

Face Expression Recognition. For the CK+ [9] expression dataset, 327 sequence pictures with expression labels were selected as the expression dataset.

The accuracy of the training model has reached 66.24%. The recognition accuracy of happiness, anger, and sadness has reached 68.65% on average (the recognition accuracy of happiness has reached 87%), which can be used to obtain the facial expressions of video characters.

Scene Recognition. The results of taking Place365 data set as the training set and test set are shown in Table 1. This paper uses the class score averaged over 10-crops of each testing image to classify. Here it also fine-tunes the ResNet on Places365-standard, for 10 crop average it has 85.08% on the validation set and 85.07% on the test set for top-5 accuracy.

Table 1. Places365 dataset’s performance in each model.

	Validation set of Places365		Test set of Places365	
	Top-1 acc.	Top-5 acc.	Top-1 acc.	Top-5 acc.
GoogleNet	53.63%	83.88%	53.59%	84.01%
VGG-16	55.24%	84.91%	55.19%	85.01%
ResNet50	54.74%	85.08%	54.65%	85.07%

Editing of Chorus’ Climax. In this paper, 1056 pieces of music were re-identified, including 500 pieces of choruses and 556 pieces of non-choruses. The actual outcome is shown in Table 2.

The comprehensive accuracy rate is 77.65%, and the recall rate of the counter example is 79.6%. Therefore, it is reasonable to say that the method is effective.

Table 2. Identification of chorus parts of several music clips.

		Predicted value		
		Chorus	Non-chorus	Total
Actual value	Chorus	377	123	500
	Non-chorus	113	443	556
	Total	450	566	1056

Matching. The current study divides the video features into 11 categories. Each video can generate facial expression labels and scene labels through the model. It has conducted experiment to three classifiers with the above 80% data set, and detect the classification accuracy with 20% data set.