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Cat Breed Classification Using Convolutional Neural Network

Sourabh Dhavare, Onkar Vallakati, Rana Deshmukh, Piyush Kharche, Prof.K.S.Balbudhe

Department of Information Technology, Pune Vidyarthi Griha's College of Engineering and Technology, Pune, India

ABSTRACT: Pattern recognition (PR) is realized as a human recognition process which can be completed by computer technology. We should first enter useful information of identifying the object into the computer. For this reason, we must abstract the recognition object and establish its mathematical model to describe it and replace the recognition object for what the machine can process. The description of this object is the pattern. Simply speaking, the pattern recognition is to identify the category to which the object belongs, such as the face in face recognition. The automatic classification of animal images is an onerous task due to the challenging image conditions, especially when it comes to animal breeds. This paper addresses the problem of biometric identification of animals, specifically Cat. Here we are going to apply advanced machine learning models such as Convolutional neural network on the photographs of pets in order to determine the pet identity.

KEYWORDS: CNN, automatic classification.

I. INTRODUCTION

Despite being the oldest computing technique, image classification remains an indispensable one. It has come a long way from using Fourier transforms to using neural networks. However, it remains a complicated computation because of the challenges in the images such as pose variations, occlusion, illumination, camouflage and more. With Deep learning, one can make a system to perform classification on its own [1]. Deep learning, a kind of machine learning lets the model perform classification directly from the training source like images, text, or sound. This requires the construction of a Deep Neural Network (DNN). Building a model from scratch may have better performance but it is quite complicated and time-consuming too. Instead, one can use the concept of Transfer Learning to build very efficient neural networks.

While image classification is used almost in all aspects, its use is not fully accomplished in certain fields. One such field is the classification of animal species. The Automatic classification of animal images remains an unsolved problem due to the challenges in images. When it comes to image classification and recognition, animals are the difficult ones [2]. Deep learning can aid in such scenarios. It provides a wide range of powerful algorithms with which the whole process can be simplified and automated.

II. LITURATURE SURVEY

Tensorflow is a novel machine learning software library from Google's Brain. It is well suited for the automatic classification of images despite the number of training images. In [1], S. DIVYA Meena and L. Agilandeeswari focused on classifying 27 classes of animals with 35,992 training images. In summary, they were able to classify the 27 classes of animals with the highest accuracy of about 96% and 98% in category I and V dataset respectively with Tensorflow. The author further worked on reducing the misclassification rate by applying Modified Hellinger Kernel Classifier to the training dataset of misclassified categories. This approach has further increased the training accuracy to about 99.52% of the overall model. Furthermore, we utilized the semi-supervised learning based pseudo-labels to handle any new classes of images with no ground truth. This is one of the crucial requirements for an automated real-time system. For a fine-grained animal breed classification, we utilize the MP-CNN, that has been tailored for our dataset and with which we improved the accuracy to about 99.95%

In [2], Kenneth Lai et al explore the possibility of using different types of "soft" biometrics, such as breed, height, or gender, in fusion with "hard" biometrics such as photographs of the pet's face. The author applied the principle of transfer learning on different Convolutional Neural Networks, in order to create a network designed specifically for breed classification. The proposed network is able to achieve an accuracy of 90.80% and 91.29% when differentiating between the two dog breeds, for two different datasets. Without the use of "soft" biometrics, the identification rate of

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Cat is 78.09% but by using a decision network to incorporate "soft" biometrics, the identification rate can achieve an accuracy of 84.94%.

In [3], task is to develop an algorithm to classify images of cats, which are the Dogs vs. Cats competition from Kaggle. Tibor Trnovszky et al mainly investigated two approaches to address this problem. The first one is a traditional pattern recognition model. Bang Liu, Kai Zhou extracted some human-crafted features like color and Dense-SIFT, represented images using bag of words model, and then trained Support Vector Machines (SVMs) classifiers. For the second approach, we used Deep Convolutional Neural Networks (CNN) to learn features of images and trained Backpropagation (BP) Neural Networks and SVMs for classification. Authors tried various experiments to improve our performance on the test dataset, and finally got the best accuracy of 94.00% by the second approach.

In [4], the Convolutional Neural Network (CNN) for the classification of the input animal images is proposed. This method is compared with well-known image recognition methods such as Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Local Binary Patterns Histograms (LBPH) and Support Vector Machine (SVM). The main goal is to compare the overall recognition accuracy of the PCA, LDA, LBPH and SVM with proposed CNN method. For the experiments, the database of wild animals is created. This database consists of 500 different subjects (5 classes / 100 images for each class). The overall performances were obtained using different number of training images and test images. The experimental results show that the proposed method has a positive effect on overall animal recognition performance and outperforms other examined methods.

Dog Breed Categorisation is a very specific application of Convolutional Neural Networks. The classification of Images by Convolutional Neural Network has proven to be highly efficient, but it has some drawbacks. This methodology requires a significant amount of images as training data and substantial time for training and achieving higher accuracy on the classification. Transfer Learning can be used to overcome this problem. Through Transfer learning, a pre-trained model can be fine-tuned to perform classification on image datasets that may be outside the domain of the pretrained model. Due to limitation of image datasets available for non-popular dog breeds, we propose to use transfer learning to perform Image Classification of 11 different non-popular cat. SajjaTulasi et al [5] used Google's Inception-v3 model trained on 100,000 images covering 1000 different categories. These categories of images originally do not include dog breeds like Belgian Malinois, Cavalier King Charles Spaniel, Havanese and 8 more types of breed. We retrained the Inception model to classify the dog images, using the Tensorflow Library and achieved an overall accuracy of 96% on the images taken from Google.

Deep Learning is-one of the machine learning areas, applied in recent areas. Various techniques have been proposed depends on varieties of learning, including unsupervised, semi-supervised, and supervised-learning. Some of the experimental results proved that the deep learning systems are performed well compared to conventional machine learning systems in image processing, computer vision and pattern recognition. Paper "Deep learning and transfer learning approaches for image classification" provides a brief survey, beginning with Deep Neural Network (DNN) in Deep Learning area. The survey moves on-the Convolutional Neural Network (CNN) and its architectures, such as LeNet, AlexNet, GoogleNet, VGG16, VGG19, Resnet50 etc. We have included transfer learning by using the CNN's pre-trained architectures. These architectures are tested with large ImageNet data sets. The deep learning techniques are analyzed with the help of most popular data sets, which are freely available in web. Based on this survey, conclude the performance of the system depends on the GPU system, more number of images per class, epochs, mini batch size [6].
Object detection is one of the most important and challenging branches of computer vision, which has been widely applied in peoples life, such as monitoring security, autonomous driving and so on, with the purpose of locating instances of semantic objects of a certain class. With the rapid development of deep learning networks for detection tasks, the performance of object detectors has been greatly improved. In order to understand the main development status of object detection pipeline, thoroughly and deeply, in [7], Licheng Jiao et al first analyze the methods of existing typical detection models and describe the benchmark datasets. Afterwards and primarily, we provide a comprehensive overview of a variety of object detection methods in a systematic manner, covering the one-stage and two-stage detectors. Moreover, we list the traditional and new applications. Some representative branches of object detection are analyzed as well. Finally, we discuss the architecture of exploiting these object detection methods to build an effective and efficient system and point out a set of development trends to better follow the state-of-the-art algorithms and further research.

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III. PROPOSED SYSTEM

Image from database is taken as input image. The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions (i.e. noise removing) or enhances some image features important for further processing. It is sometimes of interest to process a single subregion of an image, leaving other regions unchanged. This is commonly referred to as region-of-interest (ROI) processing.

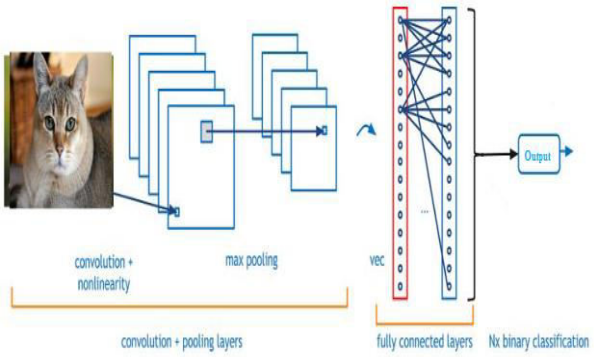

Fig 1. Block diagram of proposed system

A region of interest (ROI) is a portion of an image that you want to filter or perform some other operation on. ROI is extracted from input image in pre-processing step. Features like texture, colour, statistical features are extracted in feature extraction step. Further DNN algorithm is applied on extracted feature to classify Cat Detection and Breed Recognition.

Algorithm –CNN

CNN is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics.

The architecture of a ConvNet is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex. Individual neurons respond to stimuli only in a restricted region of the visual field known as the Receptive Field. A collection of such fields overlap to cover the entire visual area. A ConvNet is able to successfully capture the Spatial and Temporal dependencies in an image through the application of relevant filters. The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights. In other words, the network can be trained to understand the sophistication of the image better.

IV. RESULTS

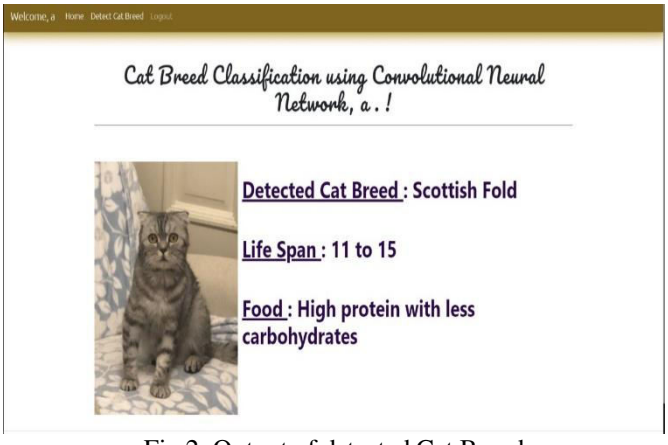

Fig 2. Output of detected Cat Breed

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V. CONCLUSION

In the end, we concluded that deep learning models have a very great capability to surpass the human potential if the data provided is sufficient. Engineers and scientists are still working on the deep learning field because till now the exploration of deep learning is limited. In the future, the deep learning will create other deep learning models on its own and deep learning model will write codes and surpass the human capabilities. Deep learning has a lot of scope in medical sciences by analyzing the images by deep convolution neural network.

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