Logo detection and recognition using CNN

by

Artykbayev Kamalkhan Serzhanovich

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ABSTRACT

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Artykbayev Kamalkhan Serzhanovich

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Thesis supervisor: Senior Lecturer MSc. Konstantin Latuta

Keywords: Logo detection, Logo recognition, Computer Vision, Machine Learning, Convolution Neural Network, Classification, Recurrent Neural Network, Pattern Recognition, Object Recognition,Data augmentation

This thesis describes the research work carried out to fulfill the Bachelor in Computer Science at the Suleyman Demirel University. Research was in Technopark at Suleyman Demirel University and was supervised by Konstantin Latuta. Logo detection and recognition continues to be of great interest to the document retrieval community as it enables effective identification of the source of a document. This paper contributes the design of the system able to detect the logo of any product from the documents and images after that recognize it from the archive via the convolutional neural network. For detecting and recognize of logos implemented via convolutional neural network, which creates initial classification to determine the presence of the logo on the document or image.As regards to the former, a collection of logos was designed and implemented to train the classier, to identify and to extract the logo features which were eventually used for logo detection and recognition. The latter regards the detection of logos from an input image. In particular, the experimental study aimed to detect if the input image contains one or more logos and to decide which logos are contained.

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LIST OF SYMBOLS/ABBREVIATIONS

MSE	Mean-square-error
CNN	Convolutional neural network
RNN	Recurrent Neural Network
CV	Computer Vision
ML	Machine Learning
LRT	Learning Rate
Conv	Convolutional layer
Pool	Pooling layer
ReLU	Rectified Linear Unit
Softmax	Normalized Exponential Function
Sigm	Special case of logistic function
SS	Selective Search

CHAPTER 1

INTRODUCTION

1.1. Overview

Object recognition and object detection are ones of the lasting and most important goals in the computer vision.Because of this problem in a extremely considerable range of usage. For example, in copyright detection, contextual advertise placement, vehicle logo for an intelligent AI-based traffic-control system and brand detecting in social media. As well as these algorithms have many applications in location recognition, advertisement, and marketing. Presently advertising is a very powerful tool for income and attracting of customers.For this reason, the analysis of the brand and mention on different resources are very important and primary tasks for business analysts.In order to captive, attractive their customers and make better decisions, companies needs for analyzing the presence of their logos in photos, videos and another type of contents. Logos help to evaluation of identity between something.[1604.06083] [1701.02620] [1711.09822]

The logo mainly includes text and graphical symbols. In such cases, when the logo is in different parts of the image, the logo is inverted, the logo is distorted, as well as changed in size - recognition and definition of the logo is a very problematic and difficult task. For example, logos on their clothes, which are often deformed, which complicates its detection and recognition. [1511.02462]

Recent breakthroughs in deep learning improve recognition models with very extremely minimal loss function.Models which was created for recognition based on neural networks have excellent accuracy, speed, as well as these models, have the ability to be really smart. In short, the ultimate goal of the system, which is based on the recognition model, is to create a method that defines logos accurately and continuously learn from new logos.[1711.09822]

1.2. Related Work

In literature, I can find many works on logo detection, logo extraction, logo classification , logo retrieval and logo recognition.Research that has been done on for the last 20 years and that are related to logos have been done with datasets, which consist too small data. For example, ”Flickr-Logos” dataset, which includes only 32 logos, which distributed to 5644 objects on 8240 images.Obviously available public datasets not enough for creating real-time detector machine. And this machine, will not be able to fully use its potential

of detection with a neural network, due to the lack of data about other logos.[1511.02462]

Most of recent applications of detection and recognition of object have been based mostly on Scale-Invariant Image features.Scale-invariant image features algorithm provide us transformations and representations to gradients of images. These gradients are invariant to affine type transformations and despite the conditions.Models that were made based on SIFT, basically make a better that part of the picture that is specifically different from the rest of the content.At the moment, although there is a plural number of methods for logo recognition, the performance, and power of Convolutional Neural Network is growing very strongly in the field of computer vision. After all, CNN solves many of the problems of the basic classical computer vision algorithms and includes a large range of uses in the recognition of images and objects. The structure of convolutional neural networks is very hierarchical and multilayered, as well as it is designed so that the pattern can be recognized only from the pixels themselves.[1604.06083]

In this [bianco2017deep] paper they propose a method of logo detection and recognition with using main deep learning algorithms.Their recognition and detection process have given with pipeline, which consists main 5 step. These steps: taking an image, doing object proposal, cropping to regions, passing through the trained convolutional neural network and making a prediction.This algorithm recognizes logos well even if they are not exactly localized in the image.The neural network was trained and tested on the ”FlickrLogos-32” database.For improving result they trained CNN with very differently benefits. As an example, for avoiding overfitting they used class - balancing in every batch. Also, they confirm sample-weighting and add a new class ’no logo’, which includes only images without any logos.

Also, this [1511.02462] paper presents a method that works perfectly with logo recognition, and returns the bounding box of the found logo. In particular, recognition of the logo has broad application and uses it in many areas. To protect people intellectual property, logo recognition is the most convenient and effective tool.As mentioned earlier, in the area of logo recognition and identification, most tools have a very small dataset.But researchers from this article had presented a large-scale database, which has 160 classes distributed among 130608 objects. This dataset is really huge and it is called ”LOGO-net 160”. For cropping the image into regions and search regions of interest(RoI) they used selective search algorithm, that efficient for this type of tasks. After features extraction with CNN, fully connected two layers divided into softmax predictor and bounding box regressor. This mathematical operations provided us classification of logo and it’s position on image.

Guys from this [1604.06083] paper demonstrate method for recognition, which based on Region-based Convolutional Networks.A distinctive feature of this approach to solving the problem is the recognition of multiple objects in the image.

CHAPTER 2

PROBLEM STATEMENT AND THESIS ORGANIZATION

2.1. Introduction

In this chapter, we will explain the main problems that researchers faced when they recognize and detect logos. And also, briefly explain how you can solve difficulties of this complex process. We will also present you the content of the thesis, which will briefly clarify what will be shown in the following chapters.

2.2. Statement of the Problem

Logos are 2-dimensional shapes of varying complexity,with interior and exterior contours that are not necessarily connected. Therefore the recognition process seems to be difficult because of its complexity.For this reason, the logo recognition process is a difficult task.In this problem, you can also highlight the moments when the method works very well with perfectly made images, but when using some images that may be deformed, inverted and blurred, then at such moments the method was simply useless.After all, such methods are usually trained on a perfect images dataset. So, in this case, the model can work with real images.[1-s2.0-S0031320302001280-main]

Because of any transformations such as rotation, shift and scaling, as well as the position in which the logo is placed, makes the task of recognition a special case, because the slightest shift can significantly affect the result of recognition, since the classical methods of computer vision are very sensitive to the slightest changes in images.Even lighting and illumination can greatly affect the result, as they strongly affect the inversion of any pixel.Most of the methods cant cope with the recognition of logos because they are very limited in terms of the application and the structure of the algorithm.The variety of logos and their size's requirements makes it very difficult to create a fixed model that will be adapted to this variety.Optimization methods in most models are not very suitable for the case of logo recognition.Complex geometric shapes of logos and the lack of information about the cascade of the logo on the image during the training of the model lead to the fact that the model is underfitting or overfitting.[1-s2.0-S092523121631387X-main]

Another problem in logo recognition is the limited number of datasets, and collecting your own dataset is very costly and hard work.With a rapid jump in the creation of multimedia technology, the number of logos is growing up very quickly, which makes it a difficult process in the protection of intellectual property, as

well as a very interesting and challenging task.[1612.08796]

Also, the problem is complicated by the fact that most of the available and targeted images for experiments are very limited, with a small number of classes and the same type.[1803.11417]

2.3. Thesis Organization

The structure of the thesis is organized as follows:

- In Chapter 3, a general review of the most important adaptive filters used for echo cancellation application is presented.
- In Chapter 4, the proposed algorithm is presented. A review of the VSSLMS algorithm and a broad concept of the p-norm constraint are provided. The mean square convergence analysis and a stability criterion of the proposed algorithm are also carried out and presented.
- In Chapter 5, an experimental study is provided in order to compare the performance of the proposed filter with other l_1-norm and p-norm based sparse adaptive filters in the context of AEC.
- In Chapter 6, conclusions and a discussion on possibilities for future work are provided.