IMAGE CLASSIFICATION WITH CIFAR-10

A Project Report

submitted in partial fulfillment of the requirements

of

…….Track Name Certificate……

by

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ABSTRACT

The image classification is a classical problem of image processing, computer vision and machine learning fields. In this paper we study the image classification using deep learning. We use AlexNet architecture with convolutional neural networks for this purpose. Four test images are selected from the ImageNet database for the classification purpose. We cropped the images for various portion areas and conducted experiments. Cifar-10 is a well-known dataset having a variety of images divided into specific classes for image classification using different models. Among all models of image classification, deep learning methods of image classification have achieved great popularity due to good results, ease of usage, and deep learning of features in shorter time. This paper proposed a Convolution Neural Network(CNN) model of increasing and decreasing sizes, VGG-16, VGG-19, K-Nearest Neighbors(K-NN), and Random Forest(RF) with 2GB CPU operation system memory. The results showed that K-NN and RF obtained least correctly classified images. However the proposed CNN increasing filter size architecture classified 88% of images accurately, whereas VGG-16 and VGG-16 got accuracy around 61%. The results of experiments were also compared on various benchmarks.

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CHAPTER 1

INTRODUCTION

Classification is a systematic arrangement in groups and categories based on its features. Image classification came into existence for decreasing the gap between the computer vision and human vision by training the computer with the data. The image classification is achieved by differentiating the image into the prescribed category based on the content of the vision. Motivation by in this paper, we explore the study of image classification using deep learning.

The conventional methods used for image classifying is part and piece of the field of artificial intelligence (AI) formally called as machine learning. The machine learning consists of feature extraction module that extracts the important features such as edges, textures and a classification module that classify based on the features extracted. The main limitation of machine learning is, while separating, it can only extract certain set of features on images and unable to extract differentiating features from the training set of data.

Deep learning (DL) is a sub field to the machine learning, capable of learning through its own method of computing. A deep learning model is introduced to persistently break down information with a homogeneous structure like how a human would make determinations. To accomplish this, deep learning utilizes a layered structure of several algorithms expressed as an artificial neural system (ANN). The architecture of an ANN is simulated with the help of the biological neural network of the human brain. This makes the deep learning most capable than the standard machine learning models.

1.1. Problem Statement:

Image Classification is a fundamental task in vision recognition that aims to understand and categorize an image as a whole under a specific label. Unlike object detection, which involves classification and location of multiple objects within an image, image classification typically pertains to single-object images. When the classification becomes highly detailed or reaches instance-level, it is often referred to as image retrieval, which also involves finding similar images in a large database.

1.2. Problem Definition:

It involves defining a set of target classes and training a model to recognize them using labeled example photos. The task is to assign an input image one label from a fixed set of categories. Image classification is one of the core problems in Computer Vision and has a large variety of practical applications. Modern techniques such as Convolutional Neural Networks (CNN) can be used to address this problem.

1.3. Expected Outcomes:

- Due to its great feature learning ability, deep learning has become the first choice to solve image classification.
- The rapid development of deep learning in the past decade, image classification using deep learning has achieved tremendous progress.
- However most existing reviews focus on the methods based on CNN, while the summary of relevant research progress in recent years is not much.
- This is not friendly for scholars who want to have a more comprehensive understanding of image classification.
- In addition to the mainstream methods, the relatively novel and prominent methods and related research work in recent years are also introduced.

CHAPTER 2

LITERATURE SURVEY

The literature survey for the project "Image Classification" is a fundamental task in vision recognition that aims to understand and categorize an image as a whole under a specific label. Unlike object detection, which involves classification and location of multiple objects within an image, image classification typically pertains to single-object images. Here are summaries of relevant works:

1. **Article Title:** Large scale visual recognition challenge

   Authors: Berg, J. Deng, and L. Fei-Fei.

   Summary: This article introduces the persistently break down information with a homogeneous structure like how a human would make determinations. To accomplish this, deep learning utilizes a layered structure of several algorithms expressed as an artificial neural system (ANN).

2. **Article Title:** Learning generative visual models from few training

   Authors: L. Fei-Fei, R. Fergus, and P.

   Summary: An incremental bayesian approach tested on 101 object categories. Computer Vision and In-age Understanding.

3. **Paper Title:** Novel compact asymmetrical fractal aperture Notch band antenna. Leonardo Electronic Journal of Practices and Technologies.

   Authors: Ramkiran D.S, Madhav B.T.P, Prasanth A.M, Harsha N.S, Vardhan V,Avinash K,Chaitanya M.N and Nagasai U.S.

4. **Authors Name:** Kartik G.V.S, Fathima S.Y, Rahman M.Z.U, Ahamed S.R, Layekuakille A.

Title: Efficient signal conditioning techniques for brain activity in remote health monitoring network. IEEE Sensors Journal .

5. **Authors Name:** Kishore P.V.V, Prasad M.V.D, Prasad C.R, Rahul R.

Title: Camera model for sign language recognition using elliptical fourier descriptors and ANN, International Conference on Signal Processing and Communication Engineering Systems Proceedings of SPACES 2015, in Association with IEEE

Paper-1

Image classification using Deep learning

2.1.1. Brief Introduction of Paper:

Classification is a systematic arrangement in groups and categories based on its features. Image classification came into existence for decreasing the gap between the computer vision and human vision by training the computer with the data. The image classification is achieved by differentiating the image into the prescribed category based on the content of the vision. Motivation by [1], in this paper, we explore the study of image classification using deep learning.

The conventional methods used for image classifying is part and piece of the field of artificial intelligence (AI) formally called as machine learning. The machine learning consists of feature extraction module that extracts the important features such as edges, textures and a classification module that classify based on the features extracted. The main limitation of machine learning is, while separating, it can only extract certain set of features on images and unable to extract differentiating features from the training set of data

2.1.2. Techniques used in Paper:

A deep learning model is introduced to persistently break down information with a homogeneous structure like how a human would make determinations. To accomplish this, deep learning utilizes a layered structure of several algorithms expressed as an artificial neural system (ANN). The architecture of an ANN is simulated with the help of the biological neural network of the human brain. This makes the deep learning most capable than the standard machine learning models.

In deep learning, we consider the neural networks that identify the image based on its features. This is accomplished for the building of a complete feature extraction model which is capable of solving the difficulties faced due to the conventional methods. The extractor of the integrated model should be able to learn extracting the differentiating features from the training set of images accurately. Many methods like GIST, histogram of gradient oriented and Local Binary Patterns, SIFT are used to classify the feature descriptors from the image.

CHAPTER 3

PROPOSED METHODOLOGY

3.1 Overview

Classification is a systematic arrangement in groups and categories based on its features. Image classification came into existence for decreasing the gap between the computer vision and human vision by training the computer with the data. The image classification is achieved by differentiating the image into the prescribed category based on the content of the vision.

3.2 Key Components

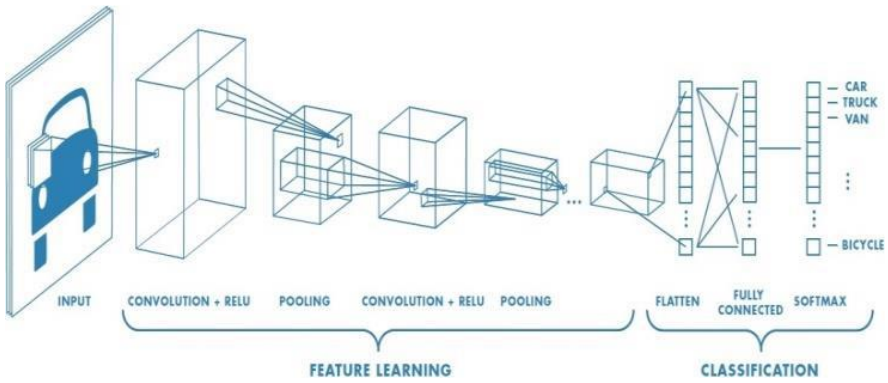
- **Artificial Neural Network:**

A neural network is a combination of hardware bonded or separated by the software system which operates on the small part in the hu-man brain called as neuron. A multi layered neural network can be proposed as an alternative of the above case. The training image samples should be more than nine times the number of parameters essential for tuning the classical classification under very good resolution. The multi-layered neural network is so complicated task with respect to its architecture in the real world implementations.

- **AlexNet:**

AlexNet is used to solve many problems like indoor sense classification which is highly seen in artificial neural intelligence. It is a powerful method of knowing the features of the image with more differential vision in the computer field for the recognition of pat-terns. This paper discuss about the classification of a particular size of image of required choice. It can very effectively classify the training sample of images present in the AlexNet for better vision.

3.3 Data Flow Diagram (CNN)



3.4 Advantages

- Deep learning is used for image classification because it has a powerful learning ability that can integrate feature extraction and classification processes to improve image classification accuracy.

- Deep learning approaches work best with large amount of training data and often involve the use of a pre-trained convolutional neural network to train an image category classifier to identify selected features in images and videos automatically.

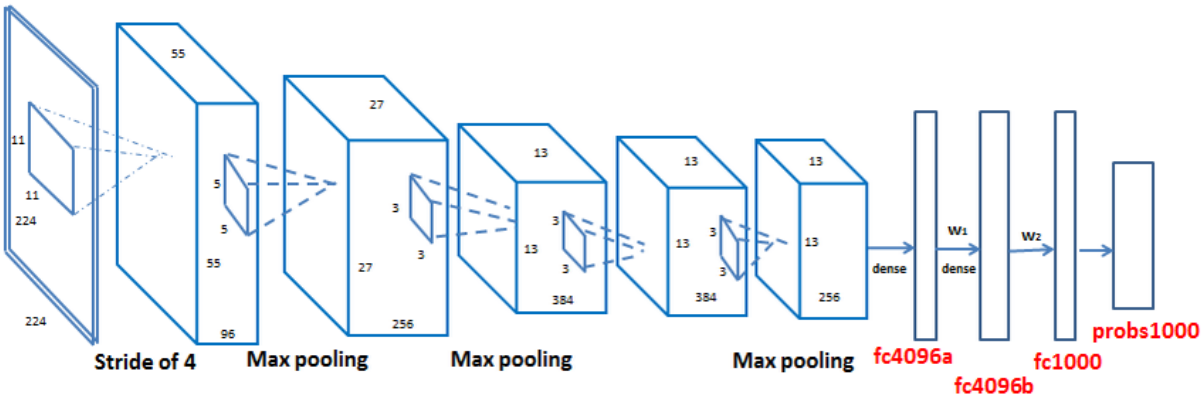
- Deep learning techniques have also been successful in medical image processing.

3.5 Requirements

- **Hardware:**
  - ✓ Windows 10 or 11
  - ✓ NVIDIA Graphics
- **Software:**
  - ✓ Python
  - ✓ Dataset
  - ✓ CNN Library

Data Flow Diagram

We selected four images Anemone, Barometer, Stethoscope and Radio Interferometer from the ImageNet database for experimentation purpose . The block diagram of the architecture shown in Fig and the corresponding implementation is illustrated below



CHAPTER 4

IMPLEMENTATION and RESULT

4.1 Implementation

- **Image Pre-Processing:**

  Image classification is a computer vision task that involves assigning labels or classes to input images. It is a fundamental task in vision recognition that aims to understand and categorize an image as a whole under a specific label.

- **Feature Extraction:**

  When the classification becomes highly detailed or reaches instance-level, it is often referred to as image retrieval, which also involves finding similar images in a large database

- **Object Classification:**

  Unlike object detection, which involves classification and location of multiple objects within an image, image classification typically pertains to single-object images.

4.2 Results

Our implementation achieved the following outcomes:

- After image classification, the computer assigns labels or classes to input images based on their visual content .
- The objective of image classification is to identify and portray, as a unique gray level (or color), the features occurring in an image in terms of the object these features actually represent on the ground .
- The outcomes of image classification can vary depending on the application.
- For instance, image classification can be used to identify the presence of a particular object in an image, such as a car or a person. It can also be used to classify images into different categories, such as animals, plants or buildings.

CHAPTER 5

CONCLUSION

In conclusion, the implementation Deep learning is a powerful tool that has become a leading machine learning tool in computer vision and image analysis. A survey report by IEEE provides a snapshot of this fast-growing field, image classification, specifically. The report briefly introduces several popular neural networks and summarizes their applications in image classification. It also discusses the challenges of deep learning in image classification.

A study on photo quality classification using deep learning shows that deep learning has shown great promise in solving complex tasks by using a black-box approach to the problem. Another survey on deep learning-based medical image classification presents various models like CNN, Transfer learning, Long short term memory, Generative adversarial networks, and Autoencoders and their automatic feature representations, which have high accuracy and precision.

Four test images sea anemone, barometer, stethoscope and radio interferometer are chosen from the AlexNet database for testing and validation of image classification using deep learning. The convolutional neural network is used in AlexNet architecture for classification purpose. From the experiments, it is observed that the im-ages are classified correctly even for the portion of the test images and shows the effectiveness of deep learning algorithm.

ADVANTAGES:

The implementation of the real-time face detection system within a Flask web application offers several key advantages:

- **High Accuracy**:

  Deep learning models have shown high accuracy in image classification tasks**.**

- **Automation:**

  Image classification can be automated using machine learning algorithms and computer vision techniques.

- **Efficiency:**
  Data augmentation techniques can be used to improve the efficiency of deep learning models in image classification.

- **Versatility:**
  Image classification can be used in various applications such as security, surveillance and object detection.

- **Scalability:**
  Deep learning models can be scaled to handle large datasets and complex tasks.

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