International Institute of Professional Studies

Devi Ahilya Vishwa Vidyalaya

Indore, M.P.

Project SDD on

Investigation

Of

Efficient Approaches for Image Classification thorough Deep Learning

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Under the guidance of

Dr. Shaligram Prajapat

Submitted By:

Shruti Khandelwal

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1. Introduction

1.1 Purpose

It describes why the project is being undertaken and the problems associated with the current system:

1. The project aims to explore and investigate current methods and techniques for image classification tasks through deep learning methods.
2. The project aims to look into practical solutions for image classification using deep learning, such as medical imaging, robotics, autonomous driving, and many more.
3. The project aims to provide an educational and learning experience for the project team, allowing them to gain head on experience with deep learning techniques, image classification tasks and project management skills.

1.2 Project Scope

The scope of the project can be described using the following points:

1. Investigate various methods of deep learning for Image Classification.
2. Conduct a comparative study of different models for image classification.
3. Develop and implement deep learning models for image classification.
4. Test and evaluate the performance of the model on various datasets.
5. Document the entire process to be presented in the form of a report.

1.3 Project Objectives

The following are the objectives of this project on the investigation of methods of deep learning for image classification:

1. To conduct a comprehensive literature review of existing deep learning methods for image classification.
2. To implement and evaluate different deep learning methods, including CNNs, DBNs and RNNs, on benchmark datasets such as MNIST, CIFAR-10, and ImageNet.
3. To investigate the impact of various hyperparameters such as learning rate, batch size, and activation functions on the performance of these models.
4. To compare the performance of different methods and provide insights into strengths and weaknesses of each approach.
5. To identify the most effective deep learning methods for image classification and provide recommendations for selecting appropriate techniques for different types of image datasets.

2. System Overview

2.1 Overview

The following points give an overview of the proposed system:

Aim:
To explore and analyse different deep learning techniques for image classification.

Objective:

1. To explore and evaluate the performance of different deep learning methods, including CNNs and RNNs.
2. To identify strengths and limitations of each technique.

Methodology:

1. Study and Analysis Phase
   Conducting a literature review to identify the current techniques and provide a foundation for the experimental phase.
2. Experimental Phase
   Train and test a variety of deep learning models on image classification datasets, using techniques such as cross-validation, to evaluate their performance. Use a range of metrics to evaluate the performance of the models, including accuracy, prediction, recall and F1 score.

Outputs:

1. Comparison of different deep learning techniques for image classification tasks.
2. Identification of strengths and limitations of each technique.
3. Insights into the practical considerations for using these techniques in applications.

Benefits:

1. Identification of the most effective techniques and their potential applications.

2.2 Functionality

The functionalities of the project are:

1. Data preprocessing

   The program should be able to process input data and convert them into a suitable format for the deep learning algorithms.

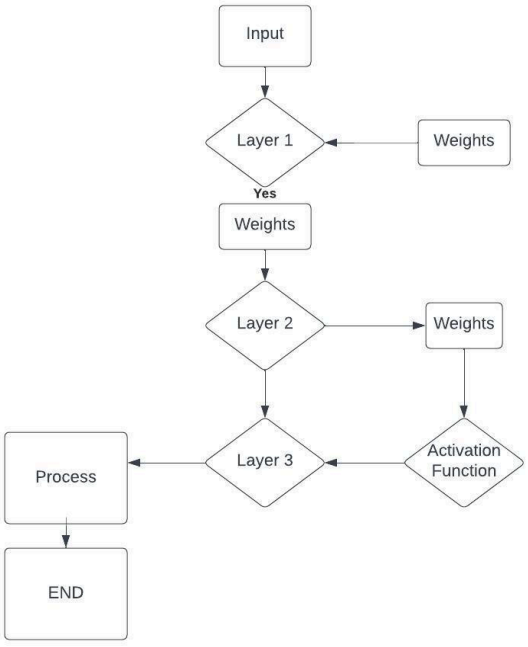
2. Model development

   The project should be able to develop deep learning models that can effectively classify image data.

3. Model evaluation

   The project should be able to evaluate the performance of deep learning models using appropriate metrics.

2.2 Data Flow Diagram



3. System Architecture

3.1 Architectural Design

Convolutional Neural network

CNNs are a type of deep learning neural network that are specifically designed for image recognition and classification tasks.

CNNs are composed of multiple layers, each of which performs a specific type of operation on input data.

1. Convolutional Layer
   The first layer applies a set of filters to the input image. The filters slide over the image, computing a dot product between the filter and local pixel values at each location. The output of this layer is a feature map, which captures the presence of specific features in the input image.
2. Pooling Layers
   They downsample the feature maps to reduce their spatial size and make the neural network more computationally efficient.
3. Dense Layers
   They perform the classification task. They form a series of matrix multiplications to transform the output of convolutional layers into a vector of probabilities for each possible class.
4. Training
   During training, the weights of CNNs are adjusted using back-propagation and gradient descent to minimise a loss function that measures the difference between the predicted and the true class labels for each image in the training dataset.

Recurrent Neural network

RNNs are a type of deep learning neural network that are specifically used for sequential modelling tasks, such as natural language processing and speech recognition, rather than image classification. But, it can be used in image classification for certain tasks, such as video classification.

General steps for using RNNs for image classification:

1. Preprocessing

   The input image is preprocessed to break it down into smaller patches or frames in a video.
2. Encoding

   Each patch or frame in the input sequence is encoded into a fixed length vector representation, such as CNN or a feature extraction method such as Histogram of Oriented Gradients.
3. Sequence Modelling

   The sequence of encoded vectors is fed into an RNN, which processes each vector in the sequence in a sequential manner, updating its hidden state with each new input.
4. Classification

   The final hidden state of the RNN is passed through one or more dense layers to perform a classification task, where the output is a probability distribution over the possible classes.