International Institute of Professional Studies

Devi Ahilya Vishwa Vidyalaya

Indore, M.P.

Project SRS on

Investigation

Of

Efficient Approaches for Image Classification thorough Deep Learning

Report Submitted in the Partial fulfilment of the

Requirement for the Award of the Degree of

Bachelors in Computer Applications

Semester VI

Session January - May, 2023

Under the guidance of

Dr. Shaligram Prajapat

Submitted By:

Shruti Khandelwal

IC - 2K20 - 77

Table of Contents

1. Introduction

The Software Requirement Specification(SRS) of the project provides an introduction of the current and proposed systems. The project is a study on deep learning methods for image classification tasks.

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.

1.4 Abbreviations

1. SRS - Software Requirement Specification
2. CNN - Convolutional Neural Network
3. RNN - Recurrent Neural Network
4. DBN - Deep Belief Networks.

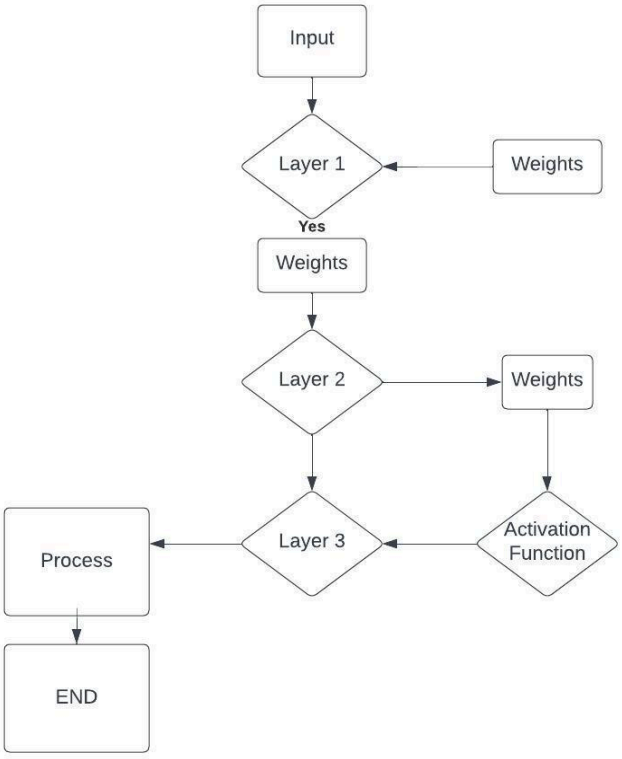
2. Overall Description

This section describes the general factors that affect the product and its requirements. This section consists of five subsections. This section does not state specific requirements. Each of these subsections makes those requirements easier to understand, it does not specify design or express specific requirements.

2.1 Project Perspective

This section describes the content and origin of “Investigation of Efficient Approaches for Image Classification through Deep Learning” being specified. It is a new, self contained product for the system. It allows users to look into different methods of deep learning for image classification.

The project diagram shows the overview of the system modules and the relationship between them.



Functions of System Components:

1. **Input**
   Input, in the form of image data is prepared that can be fed into the neural network.
2. **Layer 1 - Convolutional Layers**
   In this step, the image data is passed through multiple convolutional layers that apply filters to extract data from the image.
3. **Layer 2 - Pooling Layers**
   The image data is then passed into pooling layers that reduce the spatial dimension of data, and preserve the features at the same time.
4. **Layer 3 - Dense Layers**
   After the pooling layer, the image data is then passed through dense layers that make predictions based on the features extracted from the image.
5. **Process - Training**
   The model is then trained using labelled image data.

2.1 Project Functions

The functions of a project on investigation of deep learning for image classification include:

1. Conducting thorough research on existing methods of deep learning for image classification.
2. Collecting relevant image data for training, validation and testing of deep learning models.
3. Developing and implementing appropriate deep learning models for image classification tasks, such as CNN, RNN and DBN.
4. Training the models on training data and evaluating the model's performance on the validation dataset.
5. Testing the model performance on the test dataset, compare the models and select the best performing model.
6. Document the project's methodologies, results and findings in a report.

2.3 Design and Implementation Constraints

The constraints to be implemented and encountered during the design and implementation of this project are:

1. Hardware Limitations

   The performance of deep learning models heavily depends on the hardware used. Availability of high performance hardware, such as GPUs, can significantly affect the model.

2. Availability of labelled datasets

   Deep learning models require a large amount of training data to be trained effectively. The availability of high quality labelled data can be a developmental constraint for the models.

3. Complexity of deep learning models

   Deep learning models are complex and require significant computational resources to train and tune. This is a constraint as there is a limit to the access of computational resources.

4. Technical expertise

   Developing and implementing deep learning models requires specialised technical expertise. The availability of skilled personnel is a constraint for this project.

5. Time constraints

   The development and testing of these models is a time consuming task. The project has time constraints due to the short time frame given to the project.

2.4 User Documentation

The user documentation of a set of written material intended to help the users understand and use a system or a product. It usually includes manuals, quick-start guides, tutorials and other reference material. It depends on the specific design and implementation of the project.

It includes:

1. Overview of the project
   A brief introduction to the project, its objectives and its goals.
2. Installation Instructions
   A guide to installing all necessary software and dependencies required to run the project.
3. User Manual
   A comprehensive guide to using the project's features and functions, including step-by-step instructions and screenshots to provide examples.
4. Troubleshooting Guide
   A list of common issues that users may encounter and how to resolve or troubleshoot them.
5. Frequently Asked Questions(FAQs)
   A list of common questions that the user may have and their answers about the project.
6. Glossary
   A list of technical terms and their definitions that are used in the project.
7. References
   A list of all sources and references used in the project, such as academic papers, or online resources.

2.5 Assumptions and dependencies

Assumptions and dependencies are important factors to consider when planning and implementing a project.

The *assumptions* of this project are:

1. Sufficient computing resources will be available to train and test deep learning models.
2. Appropriate datasets for image classification will be available for use in the project.
3. The team will have necessary knowledge and skills to implement and test deep learning models for image classification.

The *dependencies* of this project are:

1. The project timeline depends on the availability of certain datasets or computing resources.
2. The success of this project depends on external Python libraries and tills for deep learning image classification.
3. The project depends on the cooperation of team members and stakeholders, such as project mentor and subject matter experts.

3. Interface Requirements

3.1 Hardware Interface

The hardware interface for this project involves a computer system with high computational power to train deep learning models. This includes CPUs with multiple cores, GPUs, and a large amount of RAM. In addition, high quality datasets are required for training and testing the models.

3.2 Software Interface

The software interface is a point of interaction between different components of a system. The software components of this project include:

1. Programming languages
2. Deep learning libraries
3. Development environment
4. Hardware requirements
5. Visualisations

4. System Features

System features are the functionalities and capabilities of a software or a system. These features are designed to enable the system to perform its specific tasks.

The system features of this project include:

1. Preprocessing of image data
   The system should be able to preprocess the image data to make it compatible with deep learning algorithms.
2. Training of deep learning models
   The system should be able to train deep learning models using preprocessed data.
3. Evaluation of model performance
   The system should be able to evaluate the performance of the trained model using metrics such as accuracy, prediction and F1 score.
4. Prediction of class labels
   The system should be able to predict the class labels of test data based on the trained model.
5. Visualisation of results
   The system should be able to visualise the results of trained data in the form of charts, graphs and heatmaps.

5. Non-Functional Requirements

5.1 Performance Requirements

The performance requirements for this project are:

1. Accuracy
   The program should be able to accurately classify the images based on their content.
2. Speed
   The program should be able to classify images in real time.
3. Robustness
   The program should be able to handle different types of images, including those images which have different degrees of illumination, angles, etc.
4. Scalability
   The program should be able to handle a large amount of images and classify them efficiently.
5. Resource utilisation
   The program should be designed to use the system resources efficiently.

5.2 Safety Requirements

It is important to note that any data acquired during this project is obtained legally and ethically.

5.3 Security Requirements

It is important that this project does not use any sensitive or confidential data. If such sensitive data is used, appropriate measures must be taken to protect the data from unauthorised access or disclosure. Additionally, the production environment should be secured to prevent attacks from unauthorised access or malware.

Appendix

SRS - Software Requirement Specification

CNN - Convolutional Neural Network

RNN - Recurrent Neural Network

DBN - Deep Belief Network