**N A Project on**

**Fashion MNIST Using Deep Learning**

***Submitted in partial fulfillment of the requirement for the award of the degree of***

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**CANDIDATE’S DECLARATION**

I/We hereby certify that the work which is being presented in the thesis/project/dissertation, entitled **“Fashion MNIST Using Deep Learning”** in partial fulfillment of the requirements for the award of the **Maters of Computer Application** submitted in the School of Computing Science and Engineering of **Bennett University, Greater Noida**, is an original work carried out during the period of month, Year to Month and Year, under the supervision of **Prof. Dr. Mala Saraswat** Professor, Department of Computer Science and Engineering/Computer Application and Information and Science, of School of Computing Science and Engineering, Bennett University, Greater Noida

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

**CERTIFICATE**

The Project ……………… of ………………

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# Abstract

Fashion has always been an essential feature in our daily routine. It also plays an important role in everyone’s lives. In this project, Convolutional Neural Network were used to train images of different fashion styles which is in the form of gray scale images to be predicted with a high accuracy. Deep Learning has been widely used in a variety of fields. When we are going to tackle with real world situations then, CNN is a deep neural network which plays an important role to deliver the most accurate solutions. Fashion business have used CNN on their e-commerce to solve many problems such as clothes recognition, search, and recommendation/ suggestion. Classification is done with a convolutional layer, filter size and ultimately connected layers.

**Keywords are-** Convolution Neural Network (CNN), Image, Fashion classification, Model Comparison, Deep Neural Network

# Table of Contents

|  |  |  |
| --- | --- | --- |
| **Title** |  | **Page No.** |
| **Abstract** |  | **I** |
| **List of Table** |  | **II** |
| **List of Figures** |  | **III** |
| **Chapter 1** | **Introduction**   * 1. Motivation   2. Problem Statement   3. Aim and objectives of the study | **1** |
| **Chapter 2** | **Literature Survey**   * 1. A review of relevant literature and existing work related to the project. |  |

|  |  |
| --- | --- |
| **Chapter 3** | **Project Design**   * 1. Hardware/Software Requirement   Proposed Methodology   * 1. Details on data collection methods and tools   2. Procedures and techniques used in the project |
| **Chapter 4** | **Result and Discussion**   * 1. Presentation of the findings or results of the project   2. Use of tables, charts, graphs, or other visuals for clarity |

# 1-Introduction

**1.1Background of project:**

As we seen in recent few year **E-Commerce** industries are highly increased and there are lots of categories, the clothing category demands this technology more urgently. At present**, Business- to- Consumer** (**B2C**) e-commerce is on rise.

# About the Fashion MNIST:

# 

# Fashion MNIST, is a dataset of fashion items i.e., represented in form of gray scale images are commonly used with Convolutional Neural Network

# for image classification. It consists of 40,000 gray scale images which of different fashion items categorized into 10 classes.

# 

# The dataset is breaks into two parts: -

# Training set- This set contains 40000 images from the data set used to train the machine learning models.

# Test set- This test set is used to evaluate the performance and model’s accuracy, generalization and how reliable in unseen data.

# Image classification is an important part of the Artificial Intelligence. It involves several tasks like image normalization, image segmentation, such Features extraction, or all kinds of neural networks. Convolutional Neural Network (CNN) is the Deep learning model that has been proved to be an effective network in image classification. CNN is an extension class of Artificial Neural Network (ANN) is a class of supervised learning methods in which the huge amount of data is stored into them. It used to deal with Structured data arrays for instance images. Deep Learning has been widely used and achieved very good and accurate solutions in different domains such as computer vision, big data, speech recognition, and NLP (Natural Language Processing). A common architecture of DNN (Deep Neural Network) is CNN. It is multi-layer neural network that extracts the properties form the input data and is trained with the neural network back propagation algorithm. The main advantage of CNN is that it extracts the salient/main features that can never be changed.

# 1.2 Statement of the Problem

# Image classification needs massive amount of dataset to feed the deep learning platforms, which includes machine learning, image recognition and convolution neural network. As the amount of the data increases the privacy concern is also increased that the data could not be lost, and the accuracy of the model would not be correct.

# 1.3-Aim And Objectives Of The Study

# In this research Fashion MNIST using deep learning mainly focus is to develop a robust, secured, and high-performance image classification model for various fashion related items.

# Objectives of the Study

# Model Development: In this we develop and implement a deep learning model architecture i.e., suitable for image classification tasks on the fashion MNIST dataset. This involves selecting the appropriate neural networks layers.

# Data preprocessing: In this step prepare and preprocess the Fashion MNIST dataset to ensure that the images can be able to training. This step includes tasks such as normalization, resizing the images

# Image Classification: In this step we upload an image as an input the model should be able to predict the right class label from the 10 possible

# Categories.

# Accuracy: - After classify the right classes the model should achieve high accuracy on the fashion MNIST test data.

# Robustness: - The model should be robust to classify the images and predict the accurate results.

# 2-Literature Survey

**Literature Survey based on various research paper.**

The Fashion MNIST dataset, which is often used in domain of image classification and identification, which consists of 70000 grayscale images of 10 different categories of fashion products. Currently in the recent times CNNs have been able to attain success with a certain accuracy in attaining outcomes on the dataset[1].

Levi and Hasner came up with CNN architecture to overcome the problem of a smaller number of images[2]. The classification task with the Fashion-MNIST dataset has been made in several works of literature, and in some cases the accuracy comes out to be greater than 90% [3]. CNNs are mostly used for clothes detection with the MNIST dataset, following was presented in [4], [5]. In the work, the authors put into effect a CNN by training the final layer of a GoogLeNet to classify fashion products[5]. In other work, the Fashion-MNIST dataset was tested on two different networks[4].

According to (A. Vijayaraj et al., 2022) in his research datasets were used to perform classification of images in deep learning taking MNIST dataset provided by Zailando, both CNN and ANN were used as implementation tools in the study[6], [7]. (Lead et al., 2021) In his study employed different CNN models stated as GoogLeNet, MobileNet v2, ResNet-50, ResNeXt-50 with MNIST dataset for digit recognition written by hand[7], [8]. CNNs have been remarkable with their success in classification of images from the fashion-MNIST dataset, and various designs have been proposed to get better results[1].

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CNN was trained on the MNIST dataset handwritten digital database using a algorithm called the back propagation algorithm LeNet-5 convolutional network, which is useful in classification of changing patterns[2].

The input layer has been built with 28\*28 neurons which represents the size of images, the hidden layer comprises of 100 neurons with sigmoid activation function which lies along with the output layer which comprises of 10 neurons[2]. In the given paper we have used a small dataset which comprises of 70000 images and 10 categories namely the fashion MNIST for our results, so that we can get higher model accuracy with small amount of data.

From our review we can come up with the fact that there have been lots of methods for training the fashion-MNIST and some of them performed well during the practices, despite the fact there can be further improvements considering the accuracy of the dataset[3].

# 3-PROJECT DESIGN

# Hardware:

# A system must have GPU (Graphical processing unit). It is widely used in deep learning models. It helps to speed up the training process of the frameworks like TensorFlow.

# Software:

# System must have the operating system with the application support. The version of the operating system must not to be outdated. The operating system can be of any type like windows, Linux, Ios, etc.

# Working Modules and Libraries of Applications: -

# The Fashion MNIST model can be implemented using various libraries, machine learning models and deep learning frameworks.

# 3.2 Proposed Methodology

Import Libraries

Load and pre-process the data

Build the CNN model

Compile the Model

Train the model

Evaluate the Model

# Import libraries: -In this step we import all the necessary libraries which requires to build and train the model. TensorFlow is used as the deep learning framework and some specific classes from TensorFlow an scikit-learn.

# Loading and pre-process the data: - In this step the Fashion MNIST dataset is loading using tf.keras.datasets.fashion\_mnist.load\_data(). The values of the images in the form of pixel are normalized between 0 and 1. The dataset is divided into two parts training and validation sets.

# Build the CNN Model: - Create a sequential model using the Keras sequential API. It includes three convolutional layers with max-pooling which lies in between. The activation function used in the convolutional layers is ReLU and the dense layer uses SoftMax activation function for multi-class classification.

# Compile the Model: - In this step the model is compiled with the Adam optimizer, categorical.

# Train the model: - The model is trained on the training set for 10 epochs, and the validation data is used to check the model’s performance.

# Evaluate the model: - The trained model which is already trained is evaluated on the trained test set and finally the test accuracy is printed.

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# 3.3 Details on data collection methods and tools

# Dataset Description

# The Fashion MNIST dataset we used in this project. It contains a total 50000 images of 28x28 pixels. In Fashion MNIST dataset, 40000 train images and 10000 test images exist. These all images are chosen from 10 categories of fashion products, which are T-shirts, Shirts, trousers, dresses, coats, sandals, sneakers, shoes, sleepers, shirt, bag. With 7,000 different images in each category. The images in the dataset are all type of grayscale images which is blur in nature.

# 

# Data Preprocessing

# After loading the dataset into the model, we did some preprocessing tasks on the images to make them suitable for our purposes. We reduced the size of all the images to 32x32 pixel squares accordance with the input requirements of the models which we were selected. *Then, next we converted the grayscale images into RGB images by copying the single channel twice*

# Initially, the dataset contains grayscale images where every pixel is represented by a single intensity value. To converting grayscale images into RGB images involves the replicating(copying) the single channel(grayscale) three times to create a three channels image (RGB) where all three channels (RED, GREEN, BLUE) contain the same intensity values from the grayscale images.

DATA SET LOADING

MODEL CREATION

# 

MODEL TRAINING

MODEL ANALYSIS

IMAGE TESTING

# FLOW CHART

# 3.4 Procedures and techniques used in the project

# CNN Models:

# In this project we use CNN Models to train the dataset by applying the CNN layers. CNN (Convolutional Neural Network) are particularly fitting for image recognition task, and they have proved effectiveness in managing the Fashion MNIST Dataset.

# 

# CNN Architecture

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# Using CNN (Convolutional Neural Networks) to train the MNIST dataset including several steps. i.e., loading the dataset, preprocessing the data to make them suitable, defining the CNN architecture, training the model using ‘model.fit()’ for a specified number of epochs and evaluates the trained model on the test data using ‘model.evaluate’ to visualize its performance.

# Neural networks are a part of machine learning, and they are the foundation of the deep learning algorithms. They are made up of node layers which includes an input layer, one or more than one hidden layer and at last output layer. Every node is connected to each other and each node has a fitted weight and threshold. If the result of any separate node is exceeding the specified threshold value, that node is activated and sending the data to the next layer of the network. Or if the result of any individual node is below from the specified threshold does not sending the data to the next layer.

# There are various types of neural nets, which are used for different use cases and datatypes. For ex. Basically recurrent neural network are commonly used for speech recognition or natural language processing, whereas CNN is commonly used for image recognition or computer vision.

# Working Of CNN Model:

# Convolution Neural Network are more better from other neural networks for their better performance by their superior performance with image, speech signal inputs.

# CNN have three types of layers: -

# Convolutional Layer

# Pooling Layer

# Fully Connected Layer

# Convolutional Layer – Convolutional layer is the very first layer of the CNN. It can be followed by the additional convolutional layers or pooling layer, fully connected layer which is the final layer, with each layer the CNN increases in its complexity, it identifying the greater portion of the image. It requires a few components, which are input data, a filter and a feature map.

# 

# Pooling Layer – Pooling layer are inserted between convolutional layer. It is also known as down sampling, it reduces the dimensionality or reducing the number of parameters in the input while used for retaining the important features.

# There are two common techniques of pooling: -

# Max Pooling: - Max pooling is a down sampling operation commonly used in convolutional network to reduce the spatial dimensions. Max pooling is one of the most popular pooling techniques and it is used to select the pixels with the maximum value form a set of value to send to the output array.

# Min Pooling: - Min pooling is less commonly used in convolutional neural network. The idea behind Min pooling is used to select the pixels with the minimum value in every region.

# While using the pooling a lot of information getting lost, it also has several benefits to the CNN. It helps to reduce the complexity or it improves the efficiency and limits the risk of overfitting.

# Fully-Connected Layer: - In the end CNN connects with one or more fully connected layers, it is also known as dense layer. Fully connected layer connects every neuron to every neuron in the subsequent layer. It allows the model to make predictions based on the previous result of the layers. Fully connected layer performs the task of classification based on the feature extracted through the previous layers and the filters of these layers

**4.Result and Discussion**

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| --- | --- | --- |
| Models | Losses | Accuracy |
| **Model 1(Using SoftMax function)** | 0.5417 | 0.8008 |
| **Model 2 (Retraining Model By RElu function)** | 0.4538 | 0.8395 |
| **Model 3 (Using Sigmoid Function)** | 0.4659 | 0.8386 |

# In this model we use many models and techniques to train and test the model by which

# we get the accuracy with lost images we get 0.54 loss and 0.80 matched accuracy.

# After train the model1 we retrain the model and in this we get 0.45 loss data and 0.83

# matched accuracy which is better than model1.

# After retrain the model, we use the sigmoid function to train the model in we got the

# better and most accurate result previous ones.

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