# SIMULATION OF SIMPLE CNN MNIST DIGIT CLASSIFIER USING VIVADO

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Abstract- A convolutional neural network (CNN or ConvNet) is a network architecture for deep learning that learns directly from data. CNNs are particularly useful for finding patterns in images to recognize objects, classes, and categories. They can also be quite effective for classifying audio, time-series, and signal data Convolutional neural network (CNN), a class of artificial neural networks that has become dominant in various computer vision tasks, is attracting interest across a variety of domains, including radiology. The MNIST dataset is an acronym that stands for the Modified National Institute of Standards and Technology dataset. It is a dataset of 60,000 small square 28×28 pixel grayscale images of handwritten single digits between 0 and 9...

Keywords: Handwritten Digit Recognition, MNIST datasets, and Convolution Neural Network (CNN), VIVADO

INTRODUCTION The human brain process a huge amount of information the second we see an image. Each neuron works in its own respective field and is connected to other neurons in a way that they cover the entire visual field. Needless to say, there has been a surge of interest in the potential of CNN among radiology researchers, and several studies have already been published in areas such as lesion detection, classification, segmentation, image reconstruction, and natural language processing . This article focuses on the basic concepts of CNN and their application to various radiology tasks, and discusses its challenges and future directions.
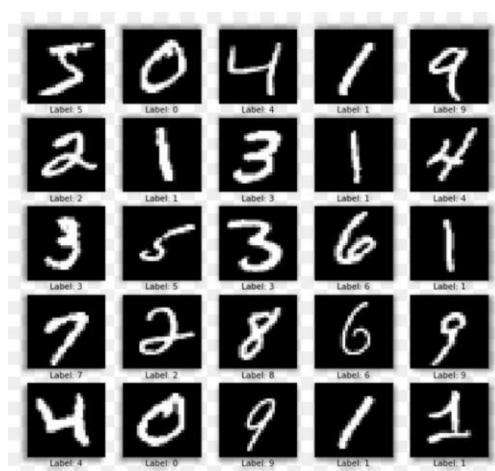
A human can easily solve and recognize any problem, but this is not the same in the case of a machine. Many techniques or methods should be implemented to work as a human. Apart from all the advancements that have been made in this area, there is still a significant research gap that needs to be filled. Consider, for example, online handwriting recognition vs offline recognition . In online handwriting recognition of letters, an on-time compilation of letters is performed while writing because stroke information is captured dynamically. Whereas, in offline recognition, the letters aren't captured dynamically. Online handwriting recognition is more accurate when compared to offline handwriting recognition because of the lack of information. Therefore, there can be research done in this area to improve offline handwriting recognition.

I. DATASET –

Handwritten character recognition is an expansive research area that already contains detailed ways of Implementation which include major learning datasets, popular algorithms, features scaling and feature extraction methods. MNIST dataset (Modified National Institute of Standards and Technology database) is the subset of the NIST dataset which is a combination of two of NIST's databases: Special Database 1 and Special Database 3. Special Database 1 and Special Database 3 consist of digits written by high school students and employees of the United States Census Bureau, respectively. MNIST contains a total of 70,000 hand written digit images (60,000 - training set and 10,000 - test set) in 28x28 pixel bounding box and anti-aliased. All these images have corresponding Y values which apprises what the digit is.
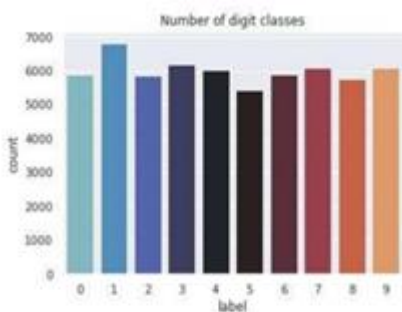

Figure 1. Bar graph illustrating the MNIST handwritten digit training dataset (Label vs Total number of training samples).

2. CONVOLUTIONAL NEURAL NETWORK:

CNN is a deep learning algorithm that is widely used for image recognition and classification. It is a class of deep neural networks that require minimum pre-processing. It inputs the image in the form of small chunks rather than inputting a single pixel at a time, so the network can detect uncertain patterns (edges) in the image more efficiently. CNN contains 3 layers namely, an input layer, an output layer, and multiple hidden layers which include Convolutional layers, Pooling layers(Max and Average pooling),Fully connected layers (FC), and normalization layers [12]. CNN uses a filter (kernel) which is an array of weights to extract features from the input image. CNN employs different activation functions at each layer to add some non-linearity. As we move into the CNN, we observe the height and width

decrease while the number of channels increases. Finally, the generated column matrix is used to predict the output.
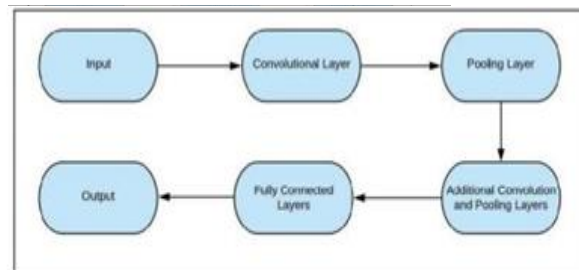

Figure 5. This figure shows the architectural design of CNN layers in the form of a Flow chart.

FUNDAMENTAL LAYERS FOR Convolutional Neural Network

Convolution Layer: The convolution layer is the core building block of the CNN. It carries the main portion of the network's computational load. This layer performs a dot product between two matrices, where one matrix is the set of learnable parameters otherwise known as a kernel, and the other matrix is the restricted portion of the receptive field.
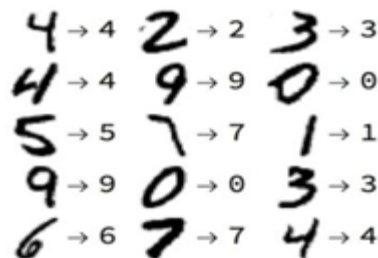

Fig.4.6.Handwritten digit recognition system

Pooling Layer: The pooling layer replaces the output of the network at certain locations by deriving a summary statistic of the nearby outputs. This helps in reducing the spatial size of the representation, which decreases the required amount of computation and weights. The pooling operation is processed on every slice of the representation individually.

Fully Connected Layer: Neurons in this layer have full connectivity with all neurons in the preceding and succeeding layer as seen in regular FCNN. This is why it can be computed as usual by a matrix multiplication followed by a bias effect.

CONCLUSION: In this research, we have implemented three models for hand written digit recognition using MNIST datasets. We have found that CNNgave the most accurate results for handwritten digit recognition. So, this makes us conclude that CNN is best suitable for any type of prediction problem including image data as an

input. The Hand Written digit Recognizer has been implemented and is able to recognize the number digits of different handwriting flavors. The CNN is one of the most widely used machine learning algorithms which has been trained and tested on thegiven dataset in order to compare and analyze.

REFERENCES:
[1]"Handwriting recognition":https://en.wikipedia.org/wiki/Hand wri tingrecognition.
[2] "What can a digit recognizer be used for?": https://www.quora.com/What−can−a−digit−reco gni zer−be − used − f or..
[3] "Handwritten Digit Recognition using Machine Learning Algorithms",S M Shamim, Mohammad Badrul Alam Miah, Angona Sarker, MasudRana & Abdullah Al Jobair,
[4] "An Introduction to Convolutional Neural Networks":researchgate.net/publication/285164 623 An Introduction toConvolutional Neural Networks.
[5]https://github.com/dixitritik17/Handwritten Digit-Recognition