

# Handwritten Character Recognition Using CNN Algorithm

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**Abstract-** Handwritten character recognition is one of the practically important issues in pattern recognition applications. The main purpose of this project is to build an automatic handwritten digit recognition method for the recognition of handwritten digit strings. To accomplish the recognition task, first, the digits will be segmented into individual digits. Then, a digit recognition module is employed to classify each segmented digit completing the handwritten digit string recognition task. The applications of digit recognition include postal mail sorting, bank check processing, form data entry, etc. The heart of the problem lies within the ability to develop an efficient algorithm that can recognize handwritten digits and which is submitted by users by the way of a scanner, tablet and other digital devices. The handwritten digit recognition problem becomes one of the most famous problems in machine learning and computer vision applications. Many machine learning techniques have been employed to solve the handwritten digit recognition problem. This paper focuses on Neural Network (NN) approaches. The most three famous NN approaches are deep neural network (DNN), deep belief network (DBN) and convolutional neural network (CNN).

## I. INTRODUCTION

Handwriting recognition is the ability of a machine to receive and interpret handwritten input from multiple sources like paper documents, photographs, touch screen devices etc. Recognition of handwritten and machine characters is an emerging area of research and finds extensive applications in banks, offices and industries. The main aim of this project is to design expert system for , “HCR using Neural Network” that can effectively recognize a particular character of type format using the Artificial Neural Network approach. Neural computing Is comparatively new field, and design components are therefore less well specified than those of other architectures. Neural computers implement data parallelism. Neural computer are operated in way which is completely different from the operation of normal computers. Neural computer are trained (not Programmed) so that given a certain starting state (data input); they either classify the input data

into one of the number of classes or cause the original data to evolve in such a way that a certain desirable property is optimized. In the past three decades, much work has been devoted to handwritten text recognition, which is used to convert human-readable handwritten language into machine-readable codes. Handwritten text recognition has attracted a great deal of interest because it provides a method for automatically processing enormous quantities of handwritten data in a variety of scientific and business applications.

The underlying problem with handwritten text has been that various individuals representations of the same character are not identical. An additional difficulty experienced while attempting to decipher English handwritten characters is the variance in personal writing styles and situational differences in a persons writing style. In addition, the writers disposition and writing environment may influence writing styles.

## II. REQUIREMENTS SPECIFICATION

### Functional Requirements

The functional requirements for a system describe what system do. The developed system should recognize handwritten English character present in the image. System shall show the error message to the user when given input is not in the required format. System must provide the quality of service to user. System must provide accuracy for character recognition.

### Normal Requirements

These are the requirements clearly stated by the customer hence requirement must be present for customer satisfaction. Application should have graphical user interface. Input of characters with various font size and styles should recognize. Database should identify computer based English character by comparison .

### Validation of Requirements

The project “HCR using Neural Network” will be recognized as successful Implementation if it provide all the required images on the basis of suitable input with minimum time.

## SYSTEM REQUIREMENTS

### Hardware Requirements

- Intel i3 Processor
- 128 MB RAM
- 10 GB Hard Disk.

### Software Requirements :

- Windows 7/8/8.1 Language
- Java(J2SE) JDK 1.7.
- Eclipse

## SYSTEM DESIGN

### Process Model

Process Model are processes of the same nature that are classified together into a model. Thus, a process model is a description of a process at the type level. Since the process model is at the type level, a process is an instantiation of it.

### Incremental Model

Incremental model is used as the process model in our system To save actual problems in an industry setting, Software Engineering must incorporate a development strategy that encompasses the process, method and the tool layers; this strategy is often referred as process model.

## SYSTEM ANALYSIS

### Projects scheduling and Tracking

We have selected an appropriate process model we have identified the software engineer-ing tasks that we have to perform, we estimated the amount of work and the number of people, and we know the deadline.

### Project Schedule

In project management, a schedule consists of a list of projects terminal elements with in- tended start and finish dates. Terminal elements are the lowest elements in a schedule, which not further subdivided.

## MODULE DESCRIPTION

### Preprocessing Gray Scale.

An image is an array, or a matrix, of square pixels(picture elements) arranged in columns and rows. In an (8 bit) gray scale image each picture element has an assigned intensity that ranges from 0 to 255.

### Feature Extraction

In pattern recognition in image processing, Feature extraction is a special form of dimensionality reduction.

## SOFTWARE IMPLEMENTATION

### Image Processing

Preprocessing includes steps that are required to shape the input image into a form suitable for segmentation. Color image is converted into gray scale. Image transform into binary image that means in the form of black in white image.The goal of training is to answer a question or make a prediction correctly as often as possible

### Segmentation

Once image preprocessing is done it is necessary to segment document into lines, lines into words and words into characters.When characters has been extracted from document we can extract features from it for recognition.Segmentation of image is performed to separate the characters from the image.

### Line Segmentation

To perform line segmentation, we need to scan each horizontal pixel row starting from the top of document. The lines are separated where we finds a row with no black pixels

### Word Segmentation

To perform word segmentation, we need to scan each vertical pixel column starting from the left of line. The words are separated where we finds a column with no black pixels for more than predefined columns.

## SOFTWARE TESTING

### Unit Testing

1. Select the scanned input image of handwritten document.
2. Apply Preprocessing.
3. Apply Segmentation.
4. Apply Feature Extraction.
5. Extract Digital character.

### GUI Testing

1. Loading image
2. Convert the image to greyscale
3. Resize the image to 28x28
4. Reshape the matrix into 28x28x1.

### Integration testing

Integration testing integrates individual modules and tested as a group. Integration testing takes as its input modules that have been unit tested, groups them in larger aggregates, applies tests defined in an integration test plan to those aggregates, and delivers as its output the integrated system for testing

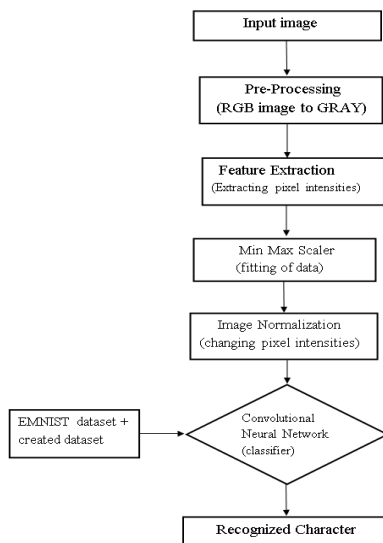


Fig.1.Handwritten character Recognition Architecture

### III. CONCLUSION

Handwritten character recognition has been a challenging task in the past few years. But due to development of machine learning domain in recent years and creation of huge amount of data from our day-to-day life, image recognition for computer vision has seen enormous improvement. EMNIST dataset provides about 132,000 images of 47 characters to be trained and recognised. The convolution neural network was used to train EMNIST dataset

to obtain high accuracy. The EMNIST dataset is extended to support the 12 characters from Tamil language and the recognition of these character are tested. The input image is pre-processed, standardized normalized and given to the classifier to predict the character. The model improves the true positive rate and reduces the false positive rate.

### IV. FUTURE WORK

The proposed system takes 28x28 pixel sized images as input. The same system with further modifications and improvements in the dataset and the model can be used to build Handwritten Character Recognition System which recognizes human handwritten characters and predicts the output. These features are based on shape analysis of the digit image and extract slant or slope information. They are effective in obtaining good recognition accuracies. When combined with commonly used features, Slope Detail features enhance the digit recognition accuracy.

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