

# ENGLISH CHARACTER RECOGNITION USING ANN WITH HOG FEATURES

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**Abstract :** English character recognition using ANN (Artificial Neural Network) with HOG (Histogram of Oriented Gradients) features is a very useful software in the field of character recognition. Here we do this project by using Open CV platform. The system is divided into two stages. They are training and testing stage. Both stages include image acquisition, pre-processing segmentation and feature extraction respectively. Image pre-processing is technique of enhancing data images prior to computational processing ie,removing low-frequency background noise ,normalizing the intensity of individual particles images, removing reflections and masking portions of images. Preprocessing involve normalizing image into 35X35 matrix, de-skewing ,smoothing, and extract character feature from image by using HOG(Histogram of Oriented Gradients) method. Here we set neural network as ANN (Artificial Neural Network) .The result indicates that artificial neural network provides good recognition accuracy more than 85% of hand-written English alphabets

**IndexTerms - Handwritten Character Recognition, English Alphabets, Feature Extraction, HOG (Histogram of Oriented Gradients) Method, Open CV.**

## I. INTRODUCTION

English character recognition using ANN with HOG (Histogram of Oriented Gradients) features is a very useful software in the field of character recognition. As we all know character recognition is the one of the emerging field in branch of Artificial Intelligence (AI) and Machine Learning (ML).Our brain is like a super computer tuned lack or millions of years and superbly adapted to understand visual world. Artificial Intelligence (AI) and Machine Learning (ML) is a concept in which we are training the computer and make it to behave as like humans. This software is very useful in many fields such as post offices, banks etc. Handwritten character recognition is a very difficult problem due to variations in writing style, different in size and orientation angles of characters .It is an area of pattern recognition that has become subject of research mining during last decades. Neural Network plays an important role in character recognition. Many papers of character recognition in English have been published, but still high recognition accuracy and minimum training time of hand-written alphabets is an important problem .So in this paper, we use HOG (Histogram of Oriented Gradients) feature extraction method which extracts the exact feature of the image which increases the accuracy of recognizing alphabets and thus by improving the recognition of English Alphabets. Here we done the project by using Open CV (Open Source Computer Vision Library) platform. Open CV is open source computer vision and machine learning software library. It was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products [4].

## II. EXISTING SYSTEM

In existing system the feature of character that is extracted from the image is just its intensity, which is used as feature vector [3]. Image intensity means value of a pixel in an image matrix, and depends upon the physics of imaging device. So when we use image intensity as feature vector the accuracy in the recognition of character or alphabet is less.

## III. PROPOSED SYSTEM

The proposed system uses HOG (Histogram of Oriented Gradients) feature extraction method to extract the feature of the image after its pre-processing and segmentation. HOG (Histogram of Oriented Gradients) feature extraction method which is used in the field of computer vision and image processing. This method counts the occurrences of gradient orientations in the localized portions of an image. It is similar to some other methods such as scale invariant feature transform and shape contents, but the main difference is that it is computed on a dense of grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy [5].

#### IV. SYSTEM ARCHITECTURE

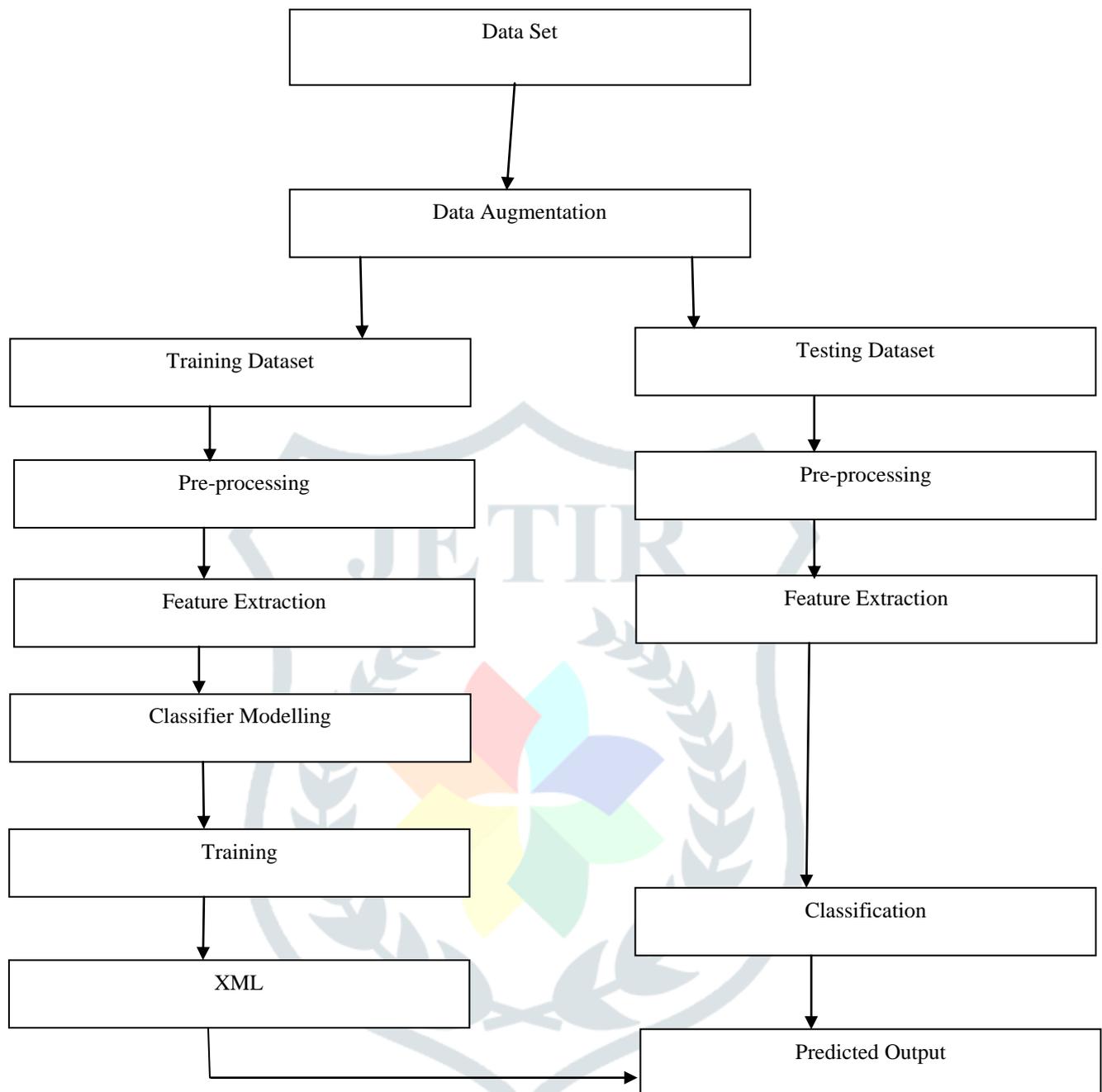


figure 1: System Architecture

The system architecture is shown in Figure1. It shows overall view of the system. Here the data set of the characters is undergone data augmentation. Data Augmentation is the process of .After that we divide data set in two categories such as training data set and testing data set. Then the data set of both training data set and testing data set will undergo through two important steps pre-processing and feature extraction, whereas image pre-processing is the process that is used to improve the performance and used to reduce variations and produce the more consistent set of data and feature extraction is the process of extracting the exact image feature. Here in this project the feature that we used is HOG (Histogram of Oriented Gradients) feature extraction method .Then after extracting feature by using feature extraction method HOG (Histogram of Oriented Gradients) we will get feature vector of the characters, then we will set ANN and we will train the ANN with the feature vector and we will get the output an XML document. Whereas in Feature of the characters that is extracted by using HOG (Histogram of Oriented Gradients) feature extraction method of the testing stage will undergo classification with the help of XML document that we got from the training stage and after that we will get the predicted output.

#### V. METHODOLOGY

(A)Artificial Neural Network (ANN)

Here we use Artificial Neural Network (ANN) to train the network. Artificial Neural Network (ANN) are biological neural network that constitute animal brain.

#### (B) Stages in Proposed System

The proposed system is divided into two sections. The first is training section and second is recognition section which is shown in figure 2 and figure 3 respectively. Both training and recognition includes image acquisition, pre-processing and feature extraction

##### 1) Image Acquisition

The proposed system starts with Image Acquisition process that takes input image by scanner.

##### 2) Pre-Processing

The raw data is subjected to a number of preliminary processing to make it usable in character analysis. Pre-processing aims to produce an image that are easy for the character recognition systems to operate accurately. The following are pre-processing steps.

##### a) Gray Scale Image Conversion

Here RGB image is converted into gray scale image. A gray scale image has the pixel value starting from 0 to 255. the lowest value of the pixel indicate black intensity and highest value of the pixel indicate white intensity.

The following formula is used to convert RGB image into gray scale image.

$$g(x, y) = 0.299 \times R(x, y) + 0.589 \times G(x, y) + 0.114 \times B(x, y) \quad [1]$$

Where  $R(x, y)$  is the red component,  $G(x, y)$  is the green component,  $B(x, y)$  is the blue component and  $g(x, y)$  is the gray scale image.

##### b) Thresholding

Thresholding is the process of setting background values for pixels below a threshold value and using different set of values for the foreground.

$$F(x, y) = \begin{cases} 255, & \text{if } F(x, y) > T \\ 0, & \text{otherwise} \end{cases} \quad [2]$$

##### c) Binarization

It is the process of converting gray scale image into binary image.

##### d) Character Extraction extracting each character as character by character from the given input image.

##### e) Normalization

Normalization is the process of converting images of different sizes into equal sizes. Here in this system all the image are normalized into 35X35 size.

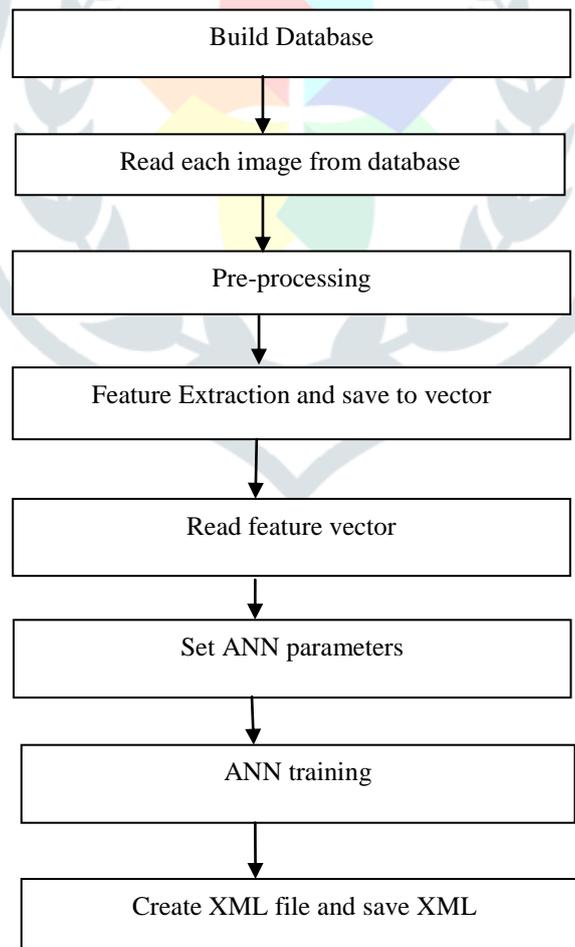


figure: 2

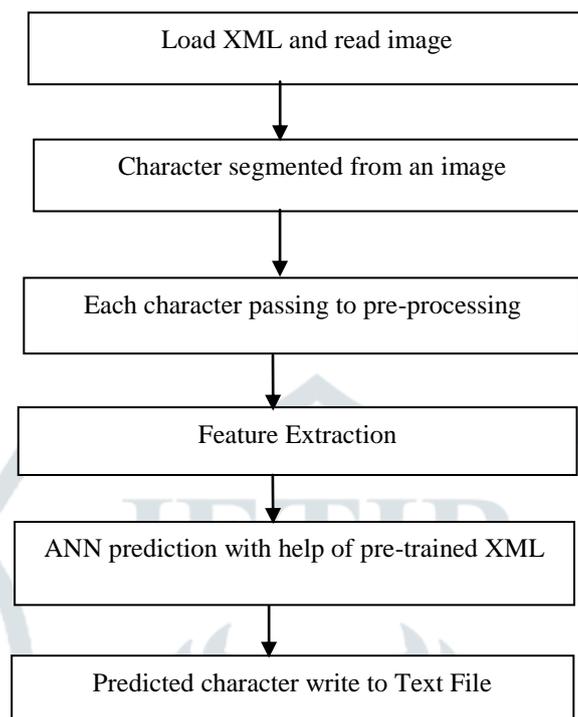


figure: 3

### 3) Feature Extraction

Feature Extraction is the process of extracting feature if the image. Here we use HOG (Histogram of Oriented Gradients) feature extraction method to extract the exact image feature. HOG (Histogram of Oriented Gradients) feature extraction method which is used in the field of computer vision and image processing. This method counts the occurrences of gradient orientations in the localized portions of an image. It is similar to some other methods such as scale invariant feature transform and shape contents, but the main difference is that it is computed on a dense of grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy. The HOG (Histogram of Oriented Gradients) feature extraction method is implemented though five steps. They are:

Step 1: Gradient Computation

Step 2: Orientation Binning

Step 3: Descriptor Blocks

Step 4: Block Normalization

Step 5: Object Recognition

### 4) Training the Classifier

The classification stage is the decision making part of the recognition system. An Artificial Neural Network (ANN) is used in this project for classifying and recognizing the hand written English characters.

### 5) Output Prediction

Here will predict the correct output with the help of XML file (which contains feature vector i.e., the feature extracted from the image by using HOG (Histogram of Oriented Gradients) feature extraction method) and trained ANN.

## VI. IMPLEMENTATION

Initially, the algorithms character extraction and feature extraction are made. Open CV is used as tool for implementing the project, Open CV was designed to be a cross platform, the library was written in C and this makes Open CV portable to almost commercial systems. Then Neural Network is designed .since there is no particular way to find correct model of Neural Network, it is found by adjusting its parameters such as number of neurons in hidden layer, scale, momentum and number of iterations. Then Neural Network is trained with different parameter values and output accuracy is noted .The system is divided into two stages training stage and recognition stage. In training stage we will train the character images in the training dataset

and test with the images in the testing dataset and create xml file. And in recognition stage we will read a scanned image and separate each character by character from the image and recognize the characters with help of xml file that is created in the training stage. At last the characters that is recognized from the scanned image is written to the notepad file, which is an editable format.

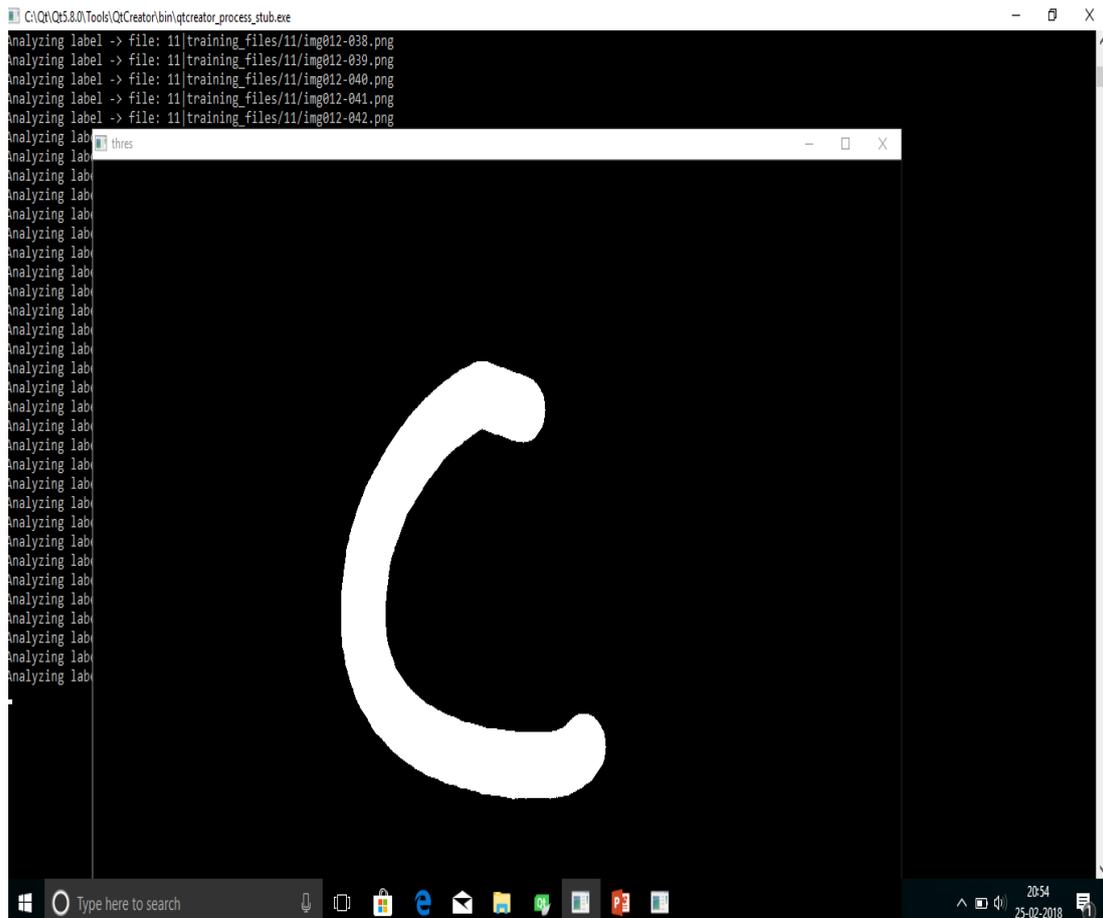


figure: 4

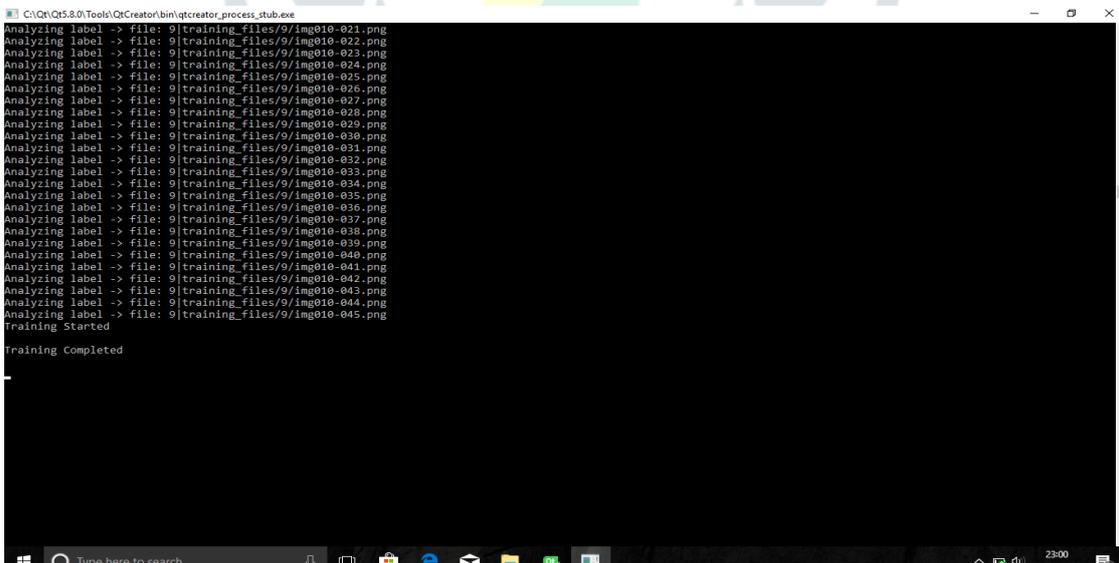


figure: 5

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Select C:\Qt\Qt5.8.0\Tools\QtCreator\bin\qtcreator_process_stub.exe
correct
Analyzing testing files -> file: 11|test_files/11/img012-046.png
pred = 11   expec = 11
correct
Analyzing testing files -> file: 11|test_files/11/img012-047.png
pred = 11   expec = 11
correct
Analyzing testing files -> file: 11|test_files/11/img012-048.png
pred = 11   expec = 11
correct
Analyzing testing files -> file: 11|test_files/11/img012-049.png
pred = 16   expec = 11
wrong
Analyzing testing files -> file: 11|test_files/11/img012-050.png
pred = 11   expec = 11
correct
Analyzing testing files -> file: 11|test_files/11/img012-051.png
pred = 11   expec = 11
correct
Analyzing testing files -> file: 11|test_files/11/img012-052.png
pred = 11   expec = 11
correct
Analyzing testing files -> file: 11|test_files/11/img012-053.png
pred = 8    expec = 11
wrong
Analyzing testing files -> file: 11|test_files/11/img012-054.png
pred = 11   expec = 11
correct
Analyzing testing files -> file: 11|test_files/11/img012-055.png
pred = 31   expec = 11
wrong
Analyzing testing files -> file: 12|test_files/12/img013-046.png
pred = 38   expec = 12
correct
Analyzing testing files -> file: 12|test_files/12/img013-047.png
```

figure: 6

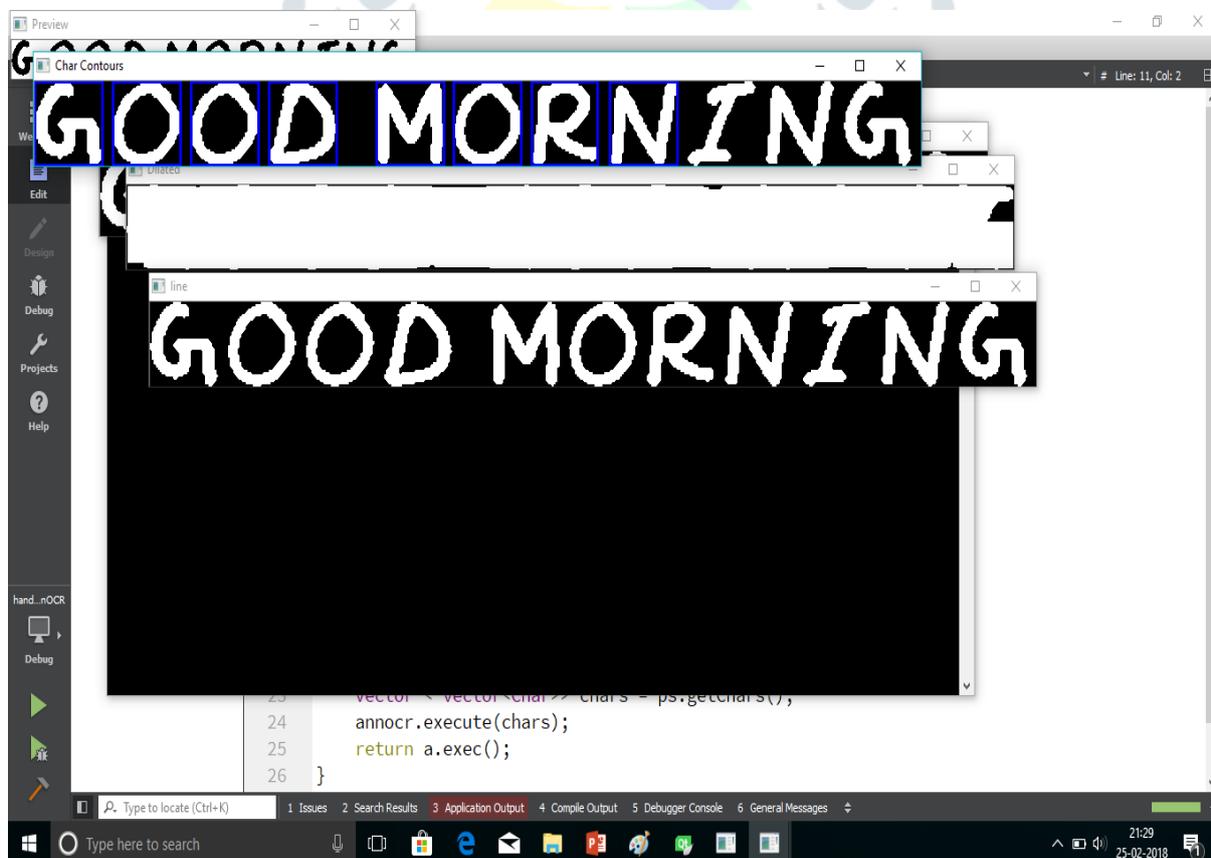


figure: 7



figure: 8

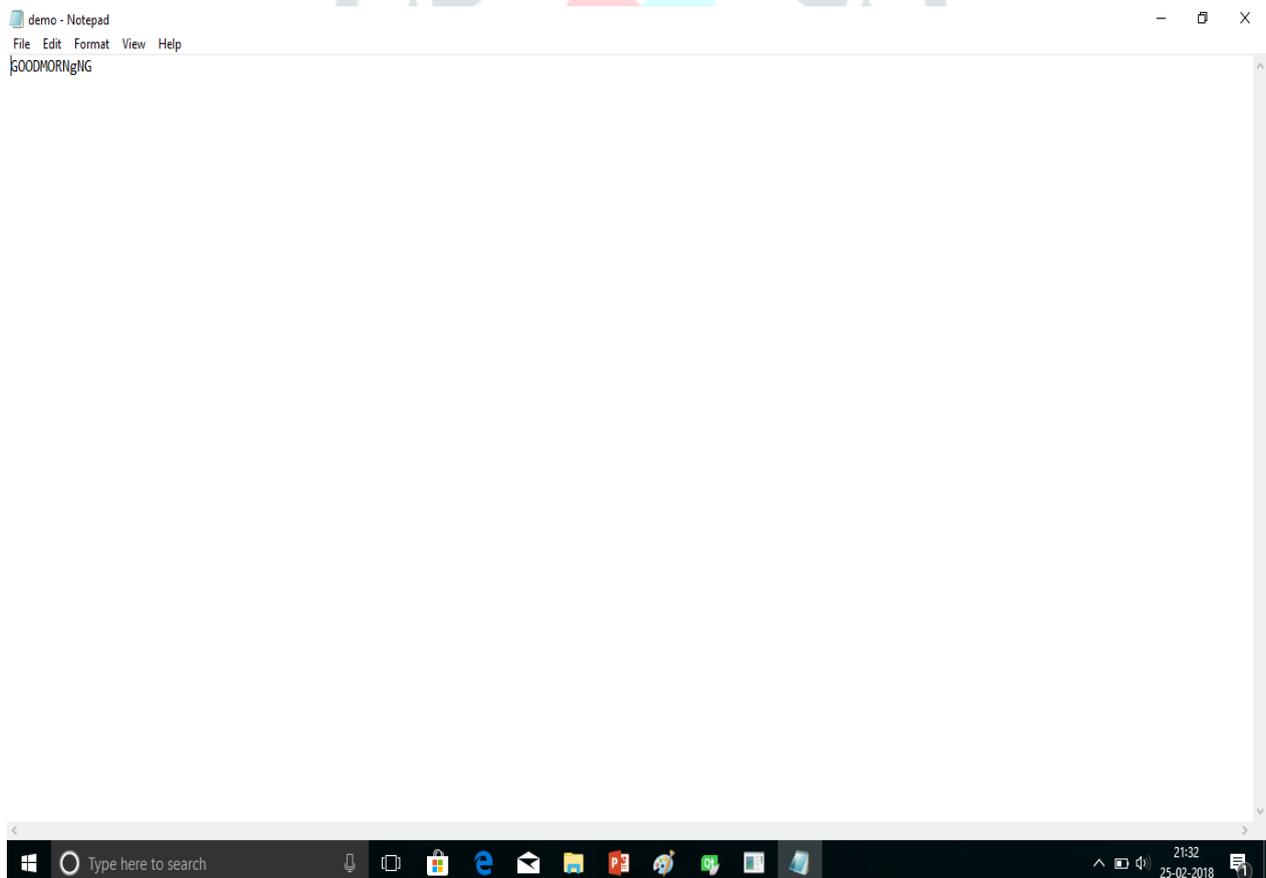


figure: 9

figure: 4 and figure: 5 shows training of characters in the training dataset. figure :6 shows the result obtained after training the dataset is tested with the characters in the testing data set and last we get the result as an XML file which features of the characters that is extracted from the images in the of training and testing data set by HOG(Histogram of Oriented Gradients)

feature extraction method. figure: 7 shows reading the scanned input image and separating the character by character from the image and extract Character Feature by using HOG (Histogram of Oriented Gradients) feature extraction method. figure: 8 shows recognize the characters on the scanned input image with the help of XML file that is already created. figure: 9 shows recognized characters of the scanned input image is written to notepad file, which is an editable format.

## VII. CONCLUSION

This work proposes a good method for recognition hand written English alphabets. In this work we use HOG (Histogram of Oriented Gradients) feature extraction method to extract the exact character feature rather than using the image intensity as feature vector. HOG (Histogram of Oriented Gradients) is a feature extraction method which counts the occurrences of the gradient orientations on the localized portions of an image. Our system produces a good result. The result indicates that artificial neural network provides good recognition accuracy more than 85% of hand-written English alphabets. In future I plan increase the amount of images in the training and testing data set to increase the accuracy of recognition of the characters and also I plan to work for Malayalam Character Recognition with CNN (Conventional Neural Network) because Malayalam is our mother tongue.

## VII. ACKNOWLEDGMENT

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