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IJIEMR Transactions, online available on 27th Dec2020. Link :http://www.ijiemr.org/downloads.php?vol=Volume-09&issue=ISSUE-12

DOI: 10.48047/IJIEMR/V09/I12/109

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Volume 09, Issue 12, Pages: 651-654

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Recognition of Human Being through Handwritten Digits Using Image Processing Techniques and AI

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Abstract: Image recognition is gaining very important in the field of computer vision and Graphics. In specific Handwritten Recognition (HWR) plays an important role in computer vision and forensics. There are many available techniques existing which use conventional methods in recognising handwritten digits. In this paper we not only recognize handwritten digits but also a person who is responsible for handwritten. For classification of handwritten digits we used Convolution Neural Networks (CNN). CNN has an advantage over other neural networks in terms of feature extraction, enhancing 2-dimentional shapes knowledge and higher degree of accuracy. In this paper we used LeNet as our multilayer network which accepts each handwritten digits has 28 X 28 grey scale intensities. These images are given as input layer and then passed to hidden layers containing activation, convolution and pooling layers. Finally classification is done using softmax classifier. In this paper we used keras deep learning (DL) with inbuilt python library. We have created our own database of human beings writing handwritten digits. Once classification was done on handwritten digits, using openCV we recognize human being who had written the digit.

Keywords: Image Processing, Artificial Intelligence, Convolution Neural Networks.

I. INTRODUCTION :

The human brain contains millions of neurons which are connected to each other. Whenever the human tries to make a decision, each neuron makes a decision and the messages are passed through each neurons and the decision takes place. This concept is used to detect the handwritten digits [1,2]. There are some rules established and based on that rules, the output is detected. In convolution neural networks, there is an input layer, an output layer and between them hidden layers[3]. The input is given in the form of an image. The weights are also provided. In the first layer, the input is multiplied with the weights and makes a decision. The output from the first layer is then given to the next layer[5,6,7]. This layer makes a decision which is a little complex than the first layer. Finally the output is retrieved through the output layer. The output is given 0 or 1 based on the weighed sum is less or more than the threshold value provided. Based on different weights and different threshold values different models are created. We constantly change the weights to train our model to get the accurate output. First we start with the small weights, gradually we increase the weights to get the valid output. In our case the valid output is one of the values from 0-9. Here the architecture that we use is called as LeNet Architecture[8]. The main reason to use this architecture is it gives better accuracy than other architectures. We use keras library which is run using tensorflow as backend. After that we use openCV to retrieve the person who had written that digit.

II. LITERATURE SURVEY:

In [1] authors proposed a convolution neural network model for recognizing handwritten Bengali characters. They proposed a convolution neural network using two convolution layers and then using three densely connected layers, on the final dense layer Softmax Function is used. The first layer scans for 5*5 receptive field throughout the image. After scanning it is then passed through ReLu activation function. The output from this layer is then passed to max pooling layer having size 2*2. This output then again passed to second convolution layer having 64 kernels of size 3*3. As in first layer same function ReLu and pooling of size 2*2 is applied. The output through this layer is actually used for classification process. They achieved 98.66% accuracy on numerals, accuracy

of 94.99% on vowels, accuracy of 91.23% on alphabets and 89.93% accuracy on all Bengali characters. Some of the error in their prediction was due to misleading of the dataset.

In [2], authors made an extensive study to investigate the performance of deep convolution neural network on the Persian handwritten character dataset. To determine the outperformance of conventional method in PHCR problem, in this paper two type of CNN have been implemented. First network is single CNN which is based on the simple structure of CNN for example (LeNet-5). To extend it into ensemble CNN the bagging paradigm applied on CNN with a variety of network parameters. This paper concluded that the performance is 97.1% when ensemble CNN model was implemented and 96.3% accuracy when single CNN was implemented.

In [3] authors proposed system for recognizing devnagari characters. They propose their own dataset of devnagari characters. In the dataset, 92 thousand images of 46 different classes of characters are segmented from handwritten documents. Along with the dataset they also propose the CNN architecture which was based on simple CNN.

They built two models, model A and model B. In model A, the image in the dataset is rescaled from 36*36 to 28*28 which was convolve with 5*5 filter and a 2*2 size pooling layer was used which gives a output of 14*14 feature map. In the second convolution layer this 14*14 feature map got convolved with 5*5 filters after that 2*2 max pooling layer was applied on it and the final output was of size 5*5 feature map after that Softmax Function was applied. The model B was derived from LeNet family. It has shallow architecture that means it consist of fewer number of parameters. They used mini batch size 200 and 50 epochs with learning rate 0.005 for model A and for model B it is 0.001 then stochastic gradient descent optimizer with momentum 0.9 is applied. The higher test accuracy obtained for model A is 0.98471 and for model B the higher test accuracy is 0.982681 addition of dropout show better result in model B.

In [4], the authors implemented minimal CNN containing dual computational networks. They used MNIST dataset for recognising hand written characters with 28 X 28 grey scale images and a kernel size of 9 X 9 to generate 20 convolved feature map. This convolved feature rectified by ReLu activation function finally pooling layer perform mean pool to rectify feature map. Another proposed model is the extended version of the minimal model where they used 2 pooling layer; 2 convolution layer and 2 ReLu layer they called this model as extended minimal model. And then compare this with LeNet-5. The performance of the minimal model is 97.3% and extended minimal is 98.50% with epoch 10.

III. EXISTING SYSTEM:

The existing system recognizes handwritten digits of human being. It is done using convolution neural networks. The dataset is taken from MNIST dataset. The present system only recognises the handwritten digits of a human being.

IV. PROPOSED SYSTEM:

Our work has been divided into two modules.

- In first module, we take the handwritten digit as an input and predict the digit using CNN.
- In second module, we take the predicted number as the input image and compare the image in the database .If both the images are same, then the system displays the digit along with the data of the person who wrote the digit.

Expected hurdles or Challenges of System:

The system architecture is shown in Figure 1.

- The handwritten numbers are of variable height and width. They are at variance from human to human.
- The common trouble would be classifying the digits due to the resemblance between digits like 1 and 7, 2 and 7, etc.
- This difficulty is occurred when individuals write a single digit with a variety of handwritings.
- The individuality in the handwriting of different folks also affects the pattern and look of the digits.
- Reducing the error rate to the minimum extent.

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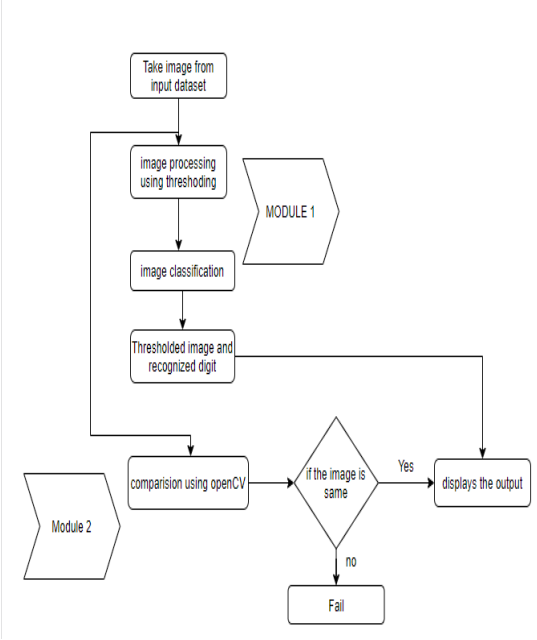

Figure 1: System Architecture

Module Description:

The system takes input as image from the dataset and predicts the digit in the image. The image is converted into a threshold image .The classifier classifies the image and predicts the digit. The image is compared with the images in the dataset. For the same image in the dataset, the system displays the output.

Modules:

1. **Prediction of Digit:**
Based on the weights of the LeNet model, the maximum weight is taken and predicted as the digit.

2. **Image comparison:**
The image is compared with the images in the dataset. For the same image in the dataset, the system displays the output as the name and image of the person along with the threshold image

V. RESULTS:

From the implementation and obtained result shows that classification was done with higher degree of accuracy and the person written the digit was also recognized successfully.

1. Image Classification:

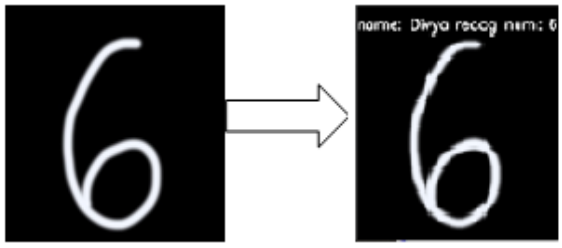

Figure 2: Input handwritten image to Thresholded output image

From Figure 2 the digit was "6" and using Lenet it was classified and recognized accurately.

2. Image comparison using openCV

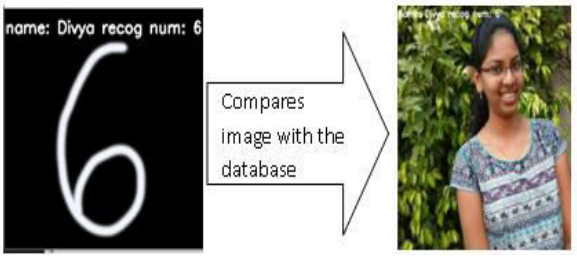

Figure 3: Image along with recognised digit is retrieved

Using OpenCV the person was identified correctly as shown in Figure 3.

VI. CONCLUSIONS & FUTURE ENHANCEMENT

We have implemented HDR with human being prediction using CNN and OpenCV. We used LeNet-5 architecture for digit classification and OpenCV for human being recognition LeNet-5 architectures produced great accuracy when compared with other state of art architectures.

In future this work can be extended for verification and validation of signatures. There is always a need for implementing using unsupervised neural networks. Combining optimization techniques with above proposed method, we can improve accuracy to greater level. This work can be extended for illiterates who don't know to sign, uses thumb impression only, and this work can be used to recognize such persons also.

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