Development of Application to Recognise Hand Written Digit at run time

Affsan Abbrar[1], Dr. Pranam Paul[2]

B. Tech Student, Department of Computer Science Engineering (Data Analytics), The Neotia University, Diamond Harbour, West Bengal, India[1]

Assistant Professor, Department of Computer Science Engineering (Cyber Security), The Neotia University, Diamond Harbour, West Bengal, India[2]

ABSTRACT: In this paper it is demonstrated how handwritten manuscript such as digits can be recognised while they are being written. It has been achieved by creating a tool that detects digits from the image using HOG and the classification or prediction of the digit is done using SVM classifier. The particular tool have been implemented on several handwritten digits and the result was found to be 86% accurate when it is written in correct orientation. A conclusion is drawn at the end of my paper by which it can be understood how much fruitful tool it is.

KEYWORDS: machine learning, handwriting recognition, machine vision, computer vision

I. INTRODUCTION

We humans are the most intelligent organism on the face of the earth. We have learnt all the required skill to survive in the world by observing the nature and recreating the same scenario to suit us.eg using animal skin to survive winter. Today we have scaled huge technological feats from reaching the moon to vaccines to eradicate diseases like small pox. This has been possible due to the fact that we have been successful in preserving the knowledge in effective manner in forms of books, speeches, tabloids for future generations. In this digital world where two words; fast and reliable are valued, I thought of a mechanism to effectively converting hand written notes into digitally stored information while the notes are being written by using image recognition techniques and machine learning. It has been implemented within a tool through which we can recognize a hand written digit.

Machine learning is a partof artificial intelligence that provides systems the ability to automatically learn to improve from experience without being explicitly programmed**.** Here Machine Learning is being used to train the classifier using Dataset and the classifier is used to predict the Digit.

Electron JS allows for the development of desktop GUI applications using front and back end components originally developed for web applications. [8]The HTML canvas element is used to draw the digits in Electron JS, which is taken as the input for recognition and the output is shown. [16]

The histogram of orientedgradients(HOG) is a feature descriptor used in computer vision and image processing for the purpose of object detection. [4] The technique counts occurrences of gradient orientation in localized portions of an image. This method is similar to that of edge orientation histograms, scale-invariant feature transform descriptors, and shape contexts, but differs in that it is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy.

Support vector machine**s** are supervised learning models with associated learning algorithms that analyse data used for classification and regression analysis.

In this paper section number 2 discuss about the entire work which is to be introduced just after the section,while the execution of the implementation of the whole work will be shown in section 3 but without analysis this entire thing discussed in this paper will be incomplete as the advantage and limitations are being discussed in section number 3 as an analysis. Lastly in section number 4 a conclusion is being injected for concluding our work as a summarised aspect.

II. RELATED WORK

In paper[1] "Static Signature Verification and Recognition using Neural Network Approach-A Survey", KomalPawar and TanujaDhope said how to verify and compare the signature through a software by using Artificial Neural Network through different algorithms.In paper [2]."OCR in a hierarchical feature space." Pattern Analysis and Machine Intelligence by Park, Jaehwa, VenuGovindaraju, and Sargur N. Srihariwork withcharacter recognition methodology known as Hierarchical OCR. In paper [6] Handwritten Recognition Using SVM, KNN and Neural Network by Norhidayubinti Abdul Hamid and NilamNurBinti Amir Sjarif shows the use of SVM in detection of digits. From website [17] the overall algorithm of HOG for feature extraction was taken. All the concepts are designs to recognise or verified for the handwritten signature through the machine learning but it is difficult to identify the "K" and "k" or even "I" and "l" or "1" because all are in similar in nature. So if we create a security code with the help of numeric in these problematic things are being solved. So, hand written digit recognition is very essential not only that it also should during run time.

III.ACTUAL WORK

The following steps are taken to develop theapplication for hand written digit recognition.

Input Medium: We humans have the sense of vision to see and learn about our environment. So to for the computer to see the digits to recognize, I needed a suitable input medium where we could write using our hand for the computer to recognize the writing. I used Electron JS for the purpose. I used the canvas element of HTML5 as an input medium.

Dataset And Classifier: I used python for this purpose required dataset to train the classifier were called from the online repositories. The data were used to train the classifier and saved in the local storage. The datasets were used to make SVM classifier.

Recognition: I provided a button in the input medium which when pressed calls another python script the loads the classifier from the local storage and takes the input from electron canvas.

Detection of Object: HOG(Histogram Of oriented gradients) is used to detect each written digit. In the tool that was developed first the input image is converted to grey scale to fine tune the image. Then Gaussian blur is used to make the image smooth. Then the contours are found in the image after thresholding. Using this contours we found the region of interest. After the region of interest is found for each digit, the exact location is detected using HOG. This can be considered as a sub set of super set which is the whole image. This for process is repeated for each contour.

Prediction: SVM has been used in the tool developed to predict the image.After the exact location of each digit is located, the classifier is used to predict the digit and the result is used is printed on the right side of the screen.
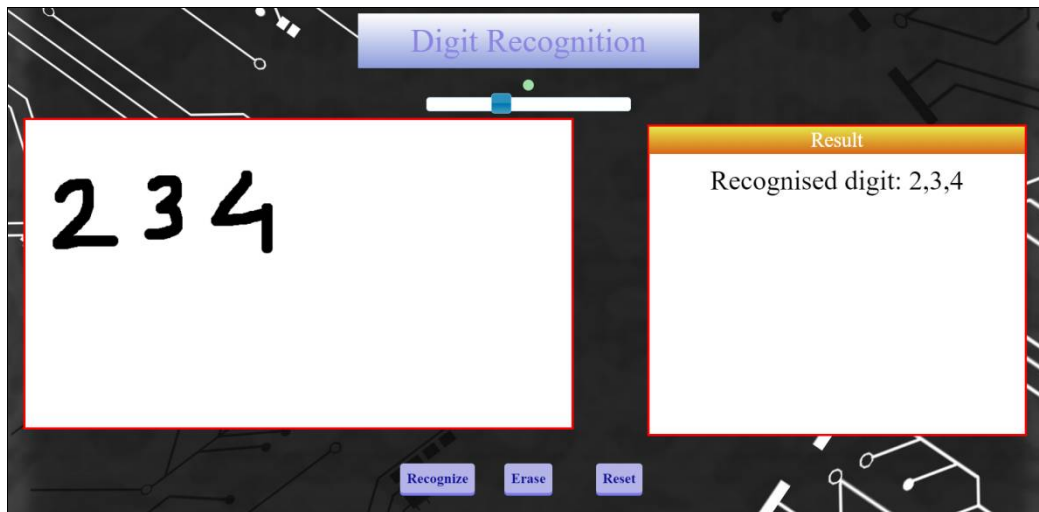
IV. RESULT

Picture 3.1: This is the interface of the Software

The picture 3.1 shows the interface of my software. The left white area is the input space where we use mouse to draw our digits. The left white area is where the OUTPUT is shown. It shows the digits that were recognised by the computer. The slider lets us choose the thickness of our input. Recognize Button fires the recognition script. Erase button lets us correct out input. Reset button gives us a clean input area.
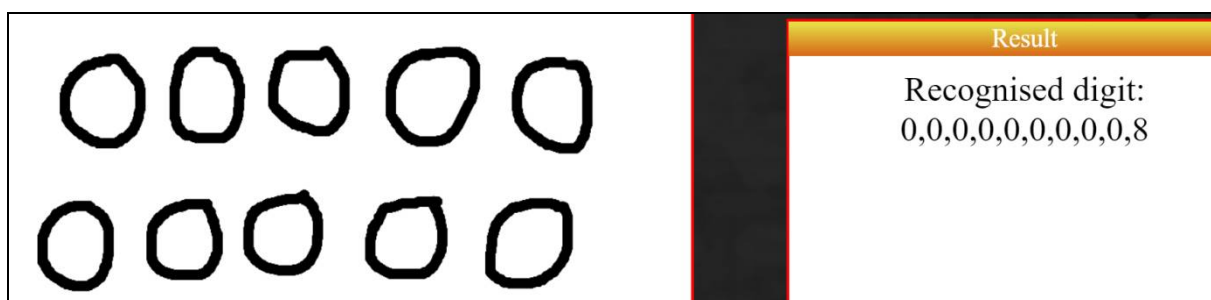
Picture 3.2: Recognition of Zero

Picture 3.2 shows recognition of zero with sample input on the left side of the screen and the output on the right.
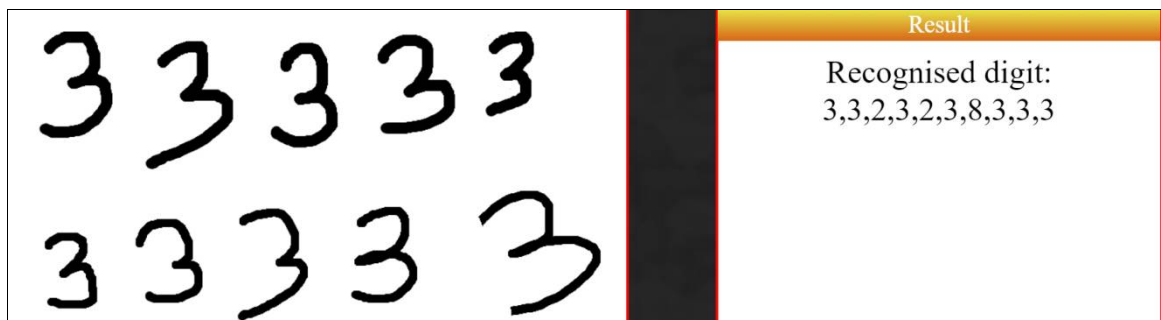
Picture 3.3: Recognition of ONE

Picture 3.3 shows recognition of one with sample input on the left side of the screen and the output screen is on the right.
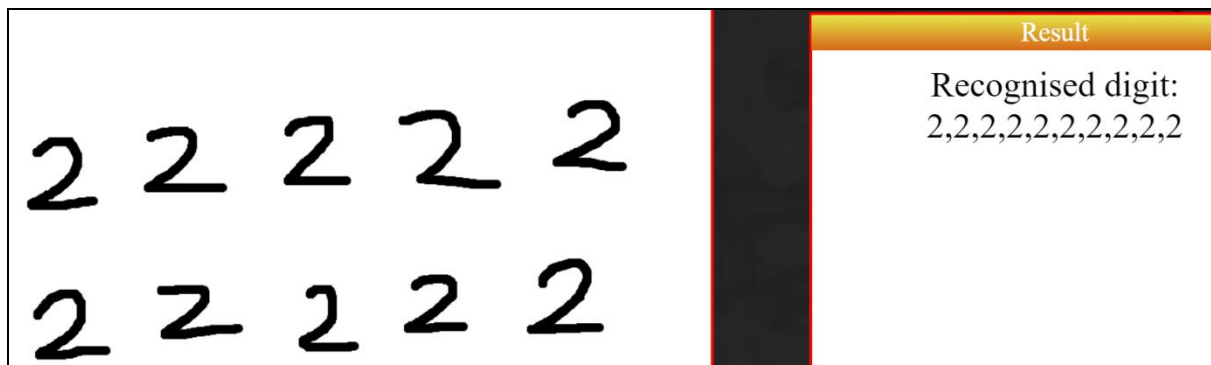
Picture 3.4: Recognition of TWO

Picture 3.4 shows recognition of two with sample input on the left side of the screen and the output screen is on the right.

Picture 3.5: Recognition of THREE

Picture 3.5 shows recognition of three with sample input on the left side of the screen and the output screen is on the right.
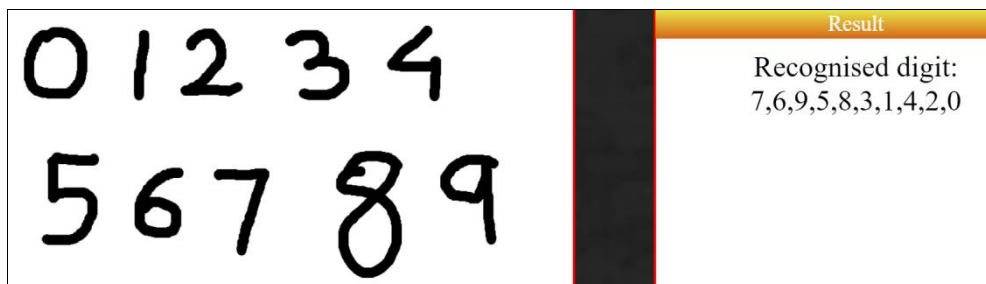
Picture 3.6: Recognition of SEVEN

Picture 3.6 shows recognition of seven with sample input on the left side of the screen and the output screen is on the right.
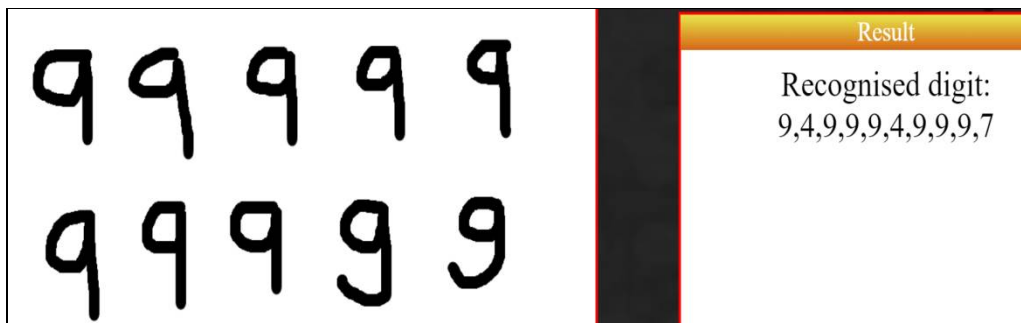
Picture 3.7: Recognition of NINE

Picture 3.7 shows recognition of nine with sample input on the left side of the screen and the output screen is on the right.

Picture 3.8: Recognition of ALL Digits

Picture 3.8 shows recognition of all digits with sample input on the left side of the screen and the output screen is on the right.

Table 3.1: Correctness of Recognition

Digits to be recognised	Total number of tests	Number of correct Recognition	Number of wrong Recognition	Accuracy (in %)
0	50	45	5	90
1	50	45	5	90
2	50	48	2	96
3	50	43	7	86
4	50	36	14	72
5	50	46	3	92
6	50	28	22	56
7	50	50	0	100
8	50	45	5	90
9	50	44	6	88
Average	50	43	6.9	86

The table number 3.1 gives summarised report of our experiment where the experiment of recognition of each digit is repeated 50 times. Sometimes it gives wrong recognition though most of the times it gives correct recognition. So in this table both are shown for getting the actual effect of our experiment on each and every digits. As experiments were conducted huge number of times which is shown in the table, very less number of times, the digit can be wrongly recognised. So, in that table it is also shown how much accuracy we have with our tool and it is shown that percentage of correct recognition among the entire experiment was done which is soundly higher than percentage of wrongly recognised digits.

V. ANALYSIS

In this paper it has been tried to demonstrate how the recognition can be done of our hand written manuscript and to store our manuscript in an efficient manner for future reference while the characters are being written. It can have many future uses like storing the notes taught by the professor while he is teaching, writers and poets who are not that much adept in typing can use this type of tool to store their work digitally without having to think much about typing.

In this process Support Vector Machine (SVM) has been used instead of Artificial Neural Network (ANN) because the training time in SVM is a few minutes but to train ANN we would need heavy computing requiring plenty of hours. To train the ANN the required resources were not at our disposition.

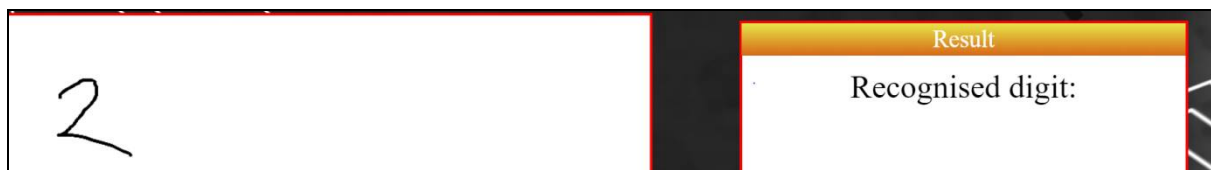Picture 4.1: Wrong recognition because of orientation of 8

Picture 4.1 shows if the orientation of the input is not upright the computer fails to understand the input correctly. Where the computer mistook the first input as 5. This happens because when the classifier is created there were no digits with other orientation than upright in the database.

Picture 4.2: Unable to recognize Due to small font size

Picture 4.2 shows the machine fails to recognise the digit because the computer fails to find the contour. The contour is not found because before the recognition Gaussian Blur is used to make the image smooth and the image gets dilated. As the font size used is already small when the image gets dilated it becomes hazy due to average value with respect to its neighbourhood pixels.

From table 3.1 we can see that the digit six is recognised the least correctly because six is very similar to three,five and eight.From the table we can see that two and seven has the maximum percentage of correct recognition.

The accuracy can be increased by taking larger dataset to train the classifier.Here electron has been used as input medium but any other compatible input medium is also fine. The tool is able to recognise digits as a single entity not as a whole. Like if we write 54 the computer will recognise as five and four.The tool is only able to recognise digit and not alphabets.

VI. CONCLUSION

As the initial goal was converting handwritten manuscripts such as digits into digital data,the tool was successful in converting the data.

Though it has some limitations but I look forward to work out and develop more accurate tool. Above said limitation of my paper can be rectified. I will work out about this limitation in future and hopefully will overcome this limitation.

Apart from this, as I am able to convert handwritten digits to digital data, now I will concentrate on extending my paper so that it will be able to convert entire number such as 211 or 1000 rather than single digit. Not only that, I wish to carry forward my work and developtool which will be able recognise alpha numeric values

REFERENCES

[1]   KomalPawar and TanujaDhope.Static Signature Verification and Recognition using Neural Network Approach-A Survey accepted and published in European Journal of Advances in Engineering and Technology, 2015, 2(4): 46-50

[2]   Park, Jaehwa, VenuGovindaraju, and Sargur N. Srihari. "OCR in a hierarchical feature space." Pattern Analysis and Machine Intelligence, IEEE Transactions on 22.4 (2000): 400-407.

[3]   https://www.opencv.org

[4]   Srihari, Sargur N., et al. "Individuality of handwriting." Journal of Forensic Sciences 47.4 (2002): 856- 872.

[5]   Liu, Xia, and Zhixin Shi. "A format-driven handwritten word recognition system."2013 12th International Conference on Document Analysis and Recognition. Vol. 2. IEEE Computer Society, 2003.

[6]   https://arxiv.org/ftp/arxiv/papers/1702/1702.00723.pdf

[7]   Tappert, Charles C., Ching Y. Suen, and Toru Wakahara. "The state of the art in online handwriting recognition." IEEE Transactions on pattern analysis and machine intelligence 12.8 (1990): 787-808.

[8]   https://en.wikipedia.org/wiki/Electron_(software_framework)

[9]   https://scikit-learn.org/

[10]   https://www.expertsystem.com/machine-learning-definition/

[11]   "Implementation of Data Migration between Two Different Databases for inter connected tables"; Paper ID: V40202106; Accepted for Publication in "International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)"; ISSN No: 2320-9801 (Online), 2320-9798 (Print)); Vol 4, Issue: 1; Feb 2016; pp 2148 – 2154

[12]   https://www.w3schools.com/

[13]   "Conversion of Entire Structure of Database from SQL SERVER to MS Access"; Paper ID: V40505138; Accepted and Published in "International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)"; ISSN No: 2320-9801 (Online), 2320-9798 (Print); Vol 4, Issue: 5; May 2016; pp 9179 – 9185

[14]   https://www.google.co.in/

[15] https://www.w3schools.com/html/html5_canvas.asp

[16]   https://stackoverflow.com/

[17] Histogram of Oriented Gradients,"http://scikit-image.org/docs/dev/auto_examples/features_detection/plot_hog.html"