Character Recognition using Support Vector Classifier (SVC)

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***Abstract*: In this paper, the clustering Algorithm known as Support Vector Classifier (SVC) is used. SVC offers classifiers such as logistic regression and decision trees that provide very high accuracy compared to others. The model first preprocesses the input after that extracts the required details then it classifies the details and finally detection. SVC presents a workload that is data intensive and compute. To reduce the workload the model trained offline, achieving *97.95*% top-1 accuracy. And it also segmentation and preprocessing is also used to minimize input image size fed into SVM.**

***Keywords*: SVC, Segmentation, Regression, preprocessing**

1 Introduction

Making digit recognition using machine learning techniques have been an important issue of research nowadays. Among them there was a model to detect the single digits at a time which drastically decreased the efficiency of the algorithm. In order to restore the effectiveness of the system the proposed system is a multiple digit recognition system which will not only enhance the efficiency but also save time to detect and analyze the digits in a system.

Among them, the identification of handwritten numbers still has a long way to go, unlike the identification of printed digits or the identification of handwritten sentences. In this paper, Artificial neural networks are presented for multiple handwritten digit recognition systems using deep learning. Typing again the handwritten logs and documents into systems will be a sturdy job.

Therefore, an artificial Neural network that can recognize any handwritten number with an accuracy of 97% is introduced in this research paper. This system will ease the work of teachers to upload marks of students in any online platform. And also help government officials as well as private financial sectors which deal with numerical data. Furthermore, there are billions of numeric data which needs to be entered in the database while working with aadhar number. Conversion of hard copy to soft copy in traditional form requires a lot of time and human effort which can be easily handled using the proposed model.

2 Related work

Convolution neural network has proved its impenetrable accomplishment for several computer vision problems. Over the past few years, many applications have worked on recognizing a single object. Whereas the focus of the proposed algorithm is to target multiple digits in one go, because we use documents that have multiple numbers present on them.

Some previous work used Convolution neural networks, Spatial Displacement Neural Network with a hidden markov model to recognize the digits in a string. This system will accomplish good performance on a fast operating system but can face certain challenges such as for multiple number strings to undergo multiple passes which will consume more time.

Main objective to use SVC is its higher faster prediction and accuracy. SVM classifiers require fewer memory since they apply a subset of training points in the decision phase.

The purpose of a Linear Support Vector Classifier is to adjust to the data you bring forth, returning a "best fit" hyperplane that splits, or classifies, your data. Accordingly, after acquiring the hyperplane, you can then feed some features to your classifier and get to know about the "predicted" class.

3 Proposed Multiple Digit Recognition System

Using this paper a system is developed which can recognise multiple handwritten digits in a single pass.
This paper has adapted several optimization techniques to reduce time complexity and achieve high validation accuracy, including segmenting digit patches, preprocessing. This paper has also provided comprehensive analysis about the system.

3.1 Support Vector Machine (SVM)

SVM is a supervised machine learning algorithm which is capable of conducting classification, regression and even outlier detection. Work of the linear SVM classifier draws a straight line between two classes. The data points which are on one side are

labeled as one class while data points on the other side are labeled as the second. In Fig.3.1, two different classes are created using a hyperplane to separate different categories.

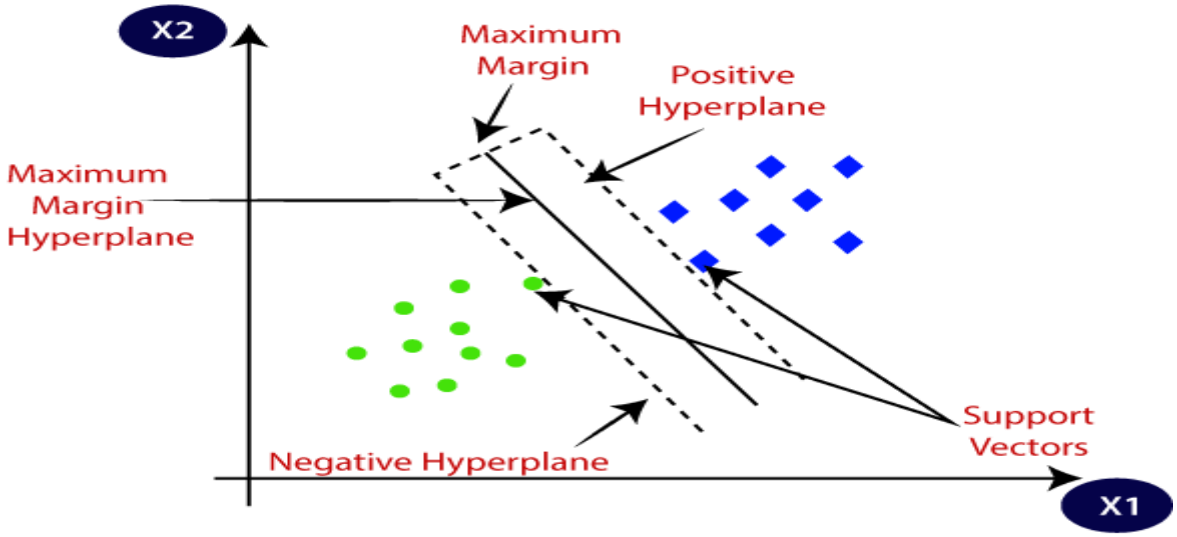

Fig. 3.1 Two different categories are classified using a decision boundary or hyperplane

The system is subject to use the limited memory and low latency requirement, to overcome those limitations several techniques are adapted. The multi-digit recognition process consists of:

- Preprocessing
- Segmentation
- Recognition
- Detection

A Database of multiple dissimilar depictions of every digit is established for the training database .Initially digits are manually segmented into 5 classes to reduce the time taken to acquire the hyperplane. Later the input is rechecked across the two classes by 2-class SVM classifier.

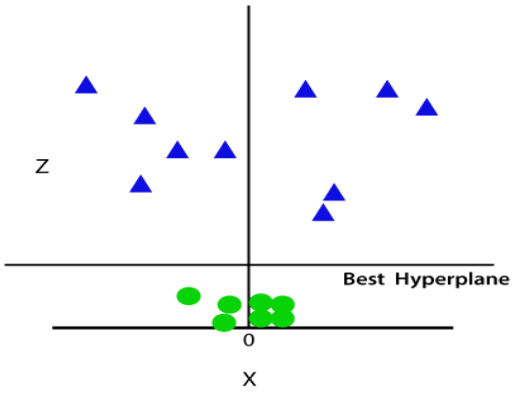

Fig.3.2 Dataset divides into classes by SVM

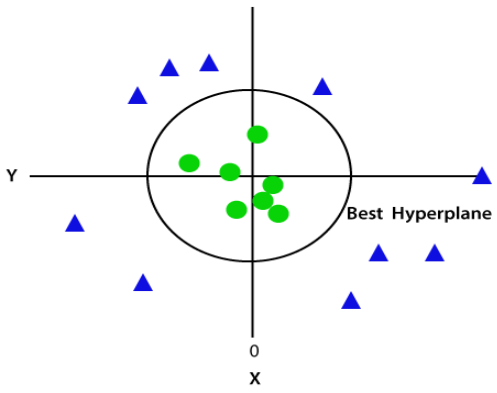

Fig.3.3 Image(Fig.3.2) converted into 2D with z=1

After the third dimension is added in a linear equation using($z=x^2+y^2$) then SVM divides the dataset as shown in Fig.3.2. Since the image is in 3D space it looks like the plane is parallel to the x-axis. Therefore, it is converted to 2D space using z=1 as shown in Fig.3.3. The Experiment proved that the suggested features can provide excellent recognition results using Support Vector Machines at a recognition rate 97.95%, compared with 91% obtained by MLP neural network classifier using same test set and features.

3.2 Result outcome

	precision	recall	f1-score	support
0	1.00	1.00	1.00	27
1	0.82	1.00	0.90	37
2	1.00	0.86	0.92	28
3	1.00	0.80	0.89	35
4	0.92	1.00	0.96	24
5	0.74	0.94	0.83	34
6	0.89	0.96	0.92	25
7	0.94	0.89	0.91	35
8	1.00	0.68	0.81	31
9	0.81	0.88	0.84	24

Fig.3.4 Accuracy analysis

In Fig. 3.4, the accuracy of the proposed system is shown which is made by taking different datasets into consideration.

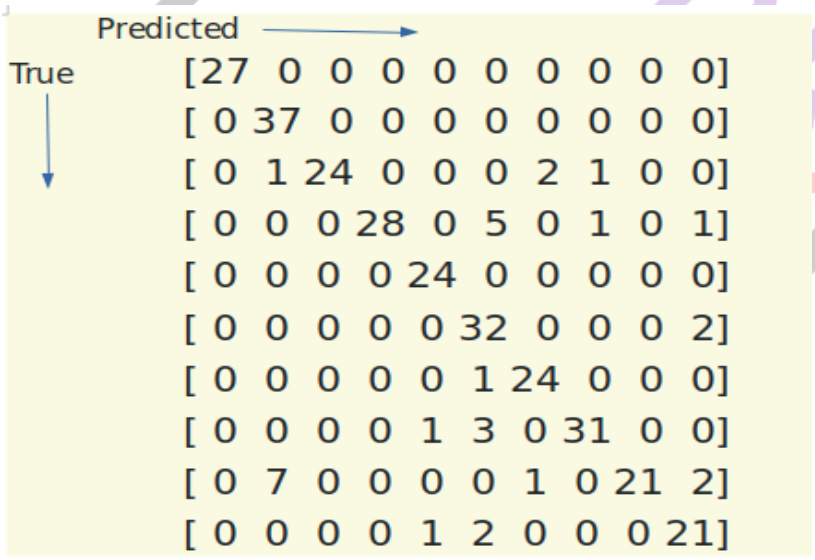

Fig. 3.5 Confusion matrix

Confusion matrix is the matrix which is applied to outline the execution of a classifier on a trained dataset where the result can be of two or more classes.

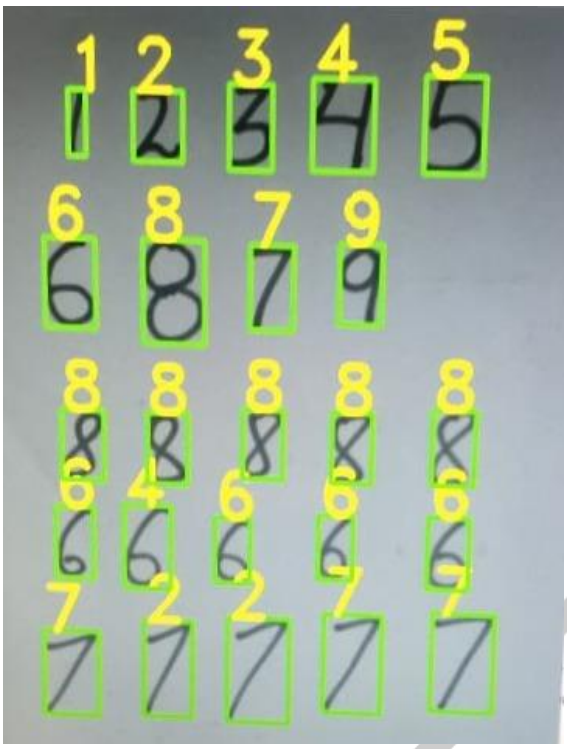

Fig.3.6 Output image 1

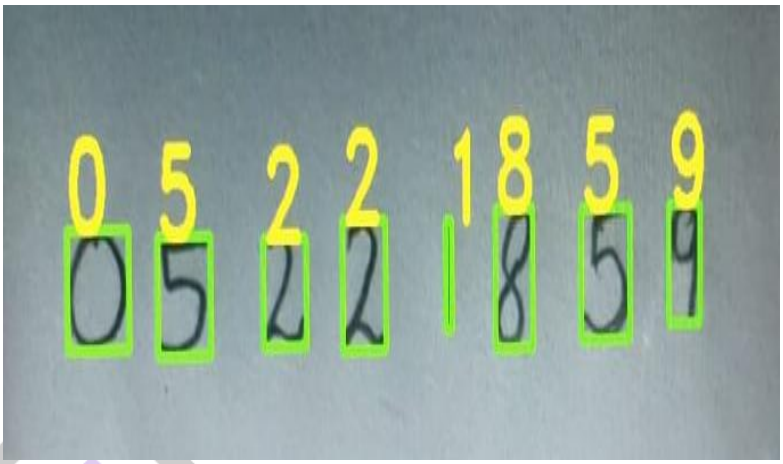

Fig.3.7 Output image 2

Using the proposed system the dataset passed should be in uniformed data structure with which the image passed through the model will be divided into rectangles each unit will be divided into a rectangle and then will be compared with the trained dataset. As a result, the system detects the digits from the provided data set and then they are classified and are shown as in Fig.3.6 and Fig3.7 for different inputs provided.

4 Conclusion

The main objective of this project is to construct an algorithm that can identify and recognize multiple digits simultaneously from an image. For this HOG (Histogram of Oriented Gadgets) and Support Vector Classifier are implemented. In every recognition the main issue is to label the feature extraction and correct classification approach. The suggested algorithm tries to be good with regards to time complexity and accuracy. This work is carried out as an initial attempt, and the aim of the paper is to facilitate recognition of multiple digits without using any standard classification techniques.

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