

Handwrite Recognition using Convolutional Neural Network

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Abstract

Handwriting is a technique of speaking and keeping statistics in normal existence even after the advent of new technologies. A handwritten person is generated with the aid of processing a series of strokes.[3] A shape or a shape-primarily based characterization of the stroke is used wherein a stroke is taken into consideration to be a string of functions of the shape. An input stroke is compared with strokes gift in the database using a flexible string matching technique.[3] A entire person is identified by way of analyzing all of the stroke additives. The handwritten textual content reputation machine can be utilized in diverse applications[3]..

Keywords: Machine learning, Convolution Neural Network, Handwriting Recognition and Character Recognition

1. Introduction

The limit of a gadget to peruse penmanship as a genuine book is Handwriting acknowledgment [4]. The current day age mobiles handwrote notoriety as an enter without a moment's delay outfitted to a touchscreen through a stylus or finger. It licenses to snappy scribble down numbers and names for contacts instead of giving the indistinguishable realities by means of an in plain view screen console. This is on the grounds that the dominant part are more calm with composing and may do it quicker.[4] This trademark may not be appropriate to most extreme cell phones or different devices, yet there are numerous projects that are to be had for penmanship notoriety.

1.1 Machine learning:

AI presents strategies to diminish human endeavors can in detecting the written by hand characters. Profound examining is a subset of gadget contemplating which creates calculations that work like a human mind with the guide of picking up information on from enormous datasets. These calculations reduce human endeavor in various districts. Through this approach, PC frameworks figure out how to order obligations from pictures or substance of any record. The models can accomplish most noteworthy exactness, which is past the human-organize generally speaking execution. Digit acknowledgment designs require enormous datasets to perceive digits from assorted assets.[5]

2. Paper Work

Online handwriting recognition is studied in detail in the past research literature and extensive reviews are available [5], [6]. Recently, [7] also summarized the current state of the art. There are two important methods for online handwriting recognition: Over segment and Classify:

This method is used in the Newton[8] and the TabletPC [9].

2.1 Time-sequence Interpretation:

This method consists of Hidden Markov Model (HMM) [5], Time Delay Neural Network (TDNN) [10], and Recurrent Neural Network (RNN) [11]. Among these Long Short-Term Memory Network (LSTM) [12] is a particular methodology which is receiving the most attention in the current machine learning approaches.

All these approaches can be combined, for example in [9], the over segment and decode methods are used at global level and TDNN is used for segment classification. Distinct preprocessing steps are discussed in the literature [7], [13], of which we only employ very few. It includes the size normalization, density, rotation, and slant along with re-sampling or strokes smoothing.

Generally, features are acquired from the ink which is used to represent the input in a way to contribute itself to recognition. The commonly used features include:

(1) Pointwise features where each point computed in the ink are well suited for its usage in the approach of time sequence interpretation.

(2) Global features are computed for large blocks of ink.

The first approach can be used to assemble global features on a segment, like a histogram. The second approach is commonly applied to the segments in the segment & decode approach. Descriptions of many commonly used features can be found, including normalized coordinates, aspect ratio, inflection points, linearity, velocity, curvature, curliness, stroke crossings, ascenders, descenders, directional features, moments, rendered bitmaps, number of strokes, and orientation maps. [10], [12],[13],[14],[15]

3. Objective

Handwriting character recognition using machine learning is a process in which the human-written text is converted to normal text form and vice versa. Handwriting recognition systems are generally applied in OCR, conversion of handwritten documents to text form and in many advanced handwriting recognition systems.

There are many cases in real life where the content of old scripture needs to be preserved. A way to do it is by changing that content into text which can be reserved in the memory. Hence we are implementing handwriting character recognition. In this project, we are trying to convert English characters to text form.[2]

4. Proposed System

The purpose of the project is to create an interface that can recognize user handwriting and give appropriate output. Convolutional Neural Networks is used in order to get higher accuracy. Several kinds of research have been undertaken to improve the accuracy of alphanumeric character prediction. The model is implemented using TensorFlow [9] and Keras. Firstly, we define a model that is trained with the EMNIST dataset which contains trained data and is validated using the test dataset provided by Emnist again. Then, python is used to segment characters by identifying the stroke features from the given input. [8]

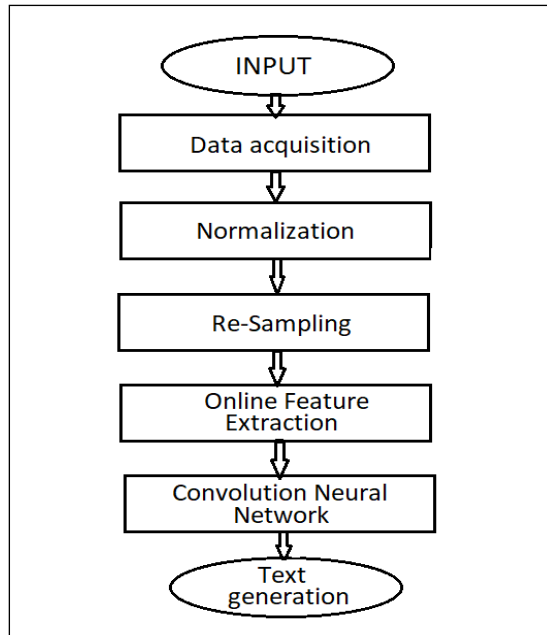


Fig.1. Block Diagram of Online Recognition System

5. Methodology

The aim of our project is to make an interface that is used to recognize user handwriting characters. We implemented the model with CNN in order to get higher accuracy. Several kinds of research have been undertaken to improve the accuracy of alphanumeric character prediction[22].

5.1 Convolutional Neural Network :

CNN is a main class for picture characterization and acknowledgment. Article identification, face acknowledgment and so on., are not many of the fields where CNN is generally utilized. CNN is likewise called ConvNet. CNN picture arrangement inputs a picture, forms it and orders it into a specific classification. PCs recognize a contribution as a variety of pixels which depends on the picture goals. As per the goals of the picture, it checks ($h \times w \times d$) where, h : Height, w : Width, d : Dimension).[23] Generally, deep learning is used to train and test. Each input image passes through a series of convolution layers which have different filters. Then pooling is applied to fully connected layers and others for the object to be classified.[23]

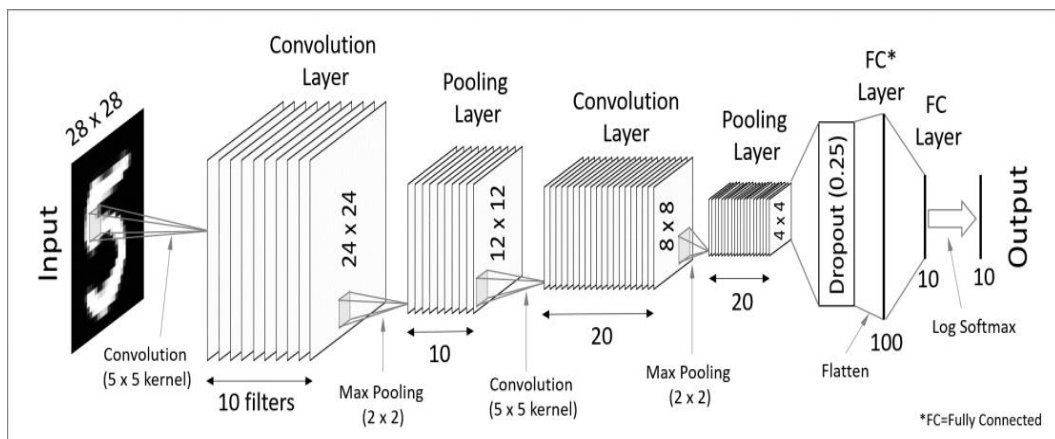


Fig.2. Layers of Convolution Neural Network

5.2 Convolution Layer:

Convolution layer is the underlying advance to separate highlights from the information. Convolution saves the connection between the pixels by learning the picture includes through little networks of information. It is a numerical activity which accepts two contributions as a picture framework and a channel or a portion.

Let us think about a (5 x 5) grid whose picture pixel esteems are 0, 1 and channel lattice (3 x 3). the convolution of picture with (5 x 5) grid increased with separated (3 x 3) network which is called Feature Map. Picture convolution which comprises of unmistakable channels can perform tasks like haze, hone and edge location by applying the channels. The quantity of movements on the pixels over an information framework is called Stride. In the event that walk is 1, the channels are moved 1 pixel at once. In the event that it is 2, at that point the channels are moved 2 pixels one after another, etc.

5.3 Padding :

Some of the time the info doesn't fit in the channel, at that point we cushion the picture so it fits or drop that picture part where it doesn't fit . It is a legitimate cushioning as it keeps just a substantial picture part.

5.3.1 Non Linearity (ReLU) :

Redressed Linear Unit for a non-straight activity is utilized to determine non-linearity in CNN. The yield is $f(x) = \max(0,x)$.

5.3.2 Pooling Layer :

The pooling layer limits the quantity of parameters for huge pictures. Pooling is additionally alluded as sub-examining or down-inspecting since it diminishes the individual guide measurements and holds the key data. Spatial pooling is of different kinds :

- Max pooling
- Average pooling
- Sum pooling

Max pooling breaks down redressed include maps to procure the biggest component. The way toward getting the normal of the considerable number of components is viewed as normal pooling. The summation of the considerable number of components of the element map is called aggregate pooling.

5.3.3 Fully Connected Layer :

We convert the framework to vector utilizing level and feed it to completely associated layer as a neural system. This layer empowers us to consolidate all the highlights and makes a model. At last, an actuation work like softmax or sigmoid is utilized to group the yield. [23]

5.3.4 Activation Function :

The initiation work executed on the last completely associated layer is commonly unique in relation to the others. Correspondingly, an appropriate initiation work should be chosen. An initiation work, softmax is applied to the multi-class order task, which standardizes genuine worth yields from the last completely associated layer into an objective class probabilities, in which each worth ranges in the middle of 0 to 1 and total of all qualities result 1.[24]

5.4 Applications:

CNN is widely utilized in facial acknowledgment recognizing one of a kind highlights. It centers around every one of a kind face regardless of outside components like light, presents, and so forth. It additionally contrasts the gathered information and the current information in the database. It is utilized for breaking down records. It can't utilized for penmanship investigation yet additionally to contrast singular penmanship and a current database. CNN that is utilized in a model and calculation can cut down the mistake rate to 0.4% as for characters. It is utilized in self-conclusion of clinical issues so the individual need not require a meeting with a specialist to guarantee that a basic wheeze is only an influenza and no sort of ailment. CNN is utilized for sedate disclosure that predicts the connection between an atom and its organic proteins to recognize huge medications. In future frameworks, for example, computerized vehicles, robots that can emulate human conduct like giving mapping ventures, anticipating quakes and other cataclysmic events CNN can be utilized.

5.5 Limitations:

CNN is a profound learning feedforward calculation that is utilized to dissect visual data sources. A portion of the impediments of CNN are recorded underneath. A hyperparameter tuning is where a parameter is fixed even before the learning procedure. Hyper-parameter tuning is huge. It has an issue with overfitting and is costly as it requires an enormous dataset for preparing. CNN is a profound model and subsequently, it sets aside longer preparing effort for each progression.

6. Results

The data is collected from EMNIST dataset. The dataset contains total of 131600 data which is split into 112800 training data and 18800 test data. The data is normalized and feature extraction is performed. The model used is CNN which consists of 6 layers. The system provides an output in the text form with an accuracy of 86%.

The approximation of each character which are similar to the given input is also predicted. The below figures display few of the experimental examples.

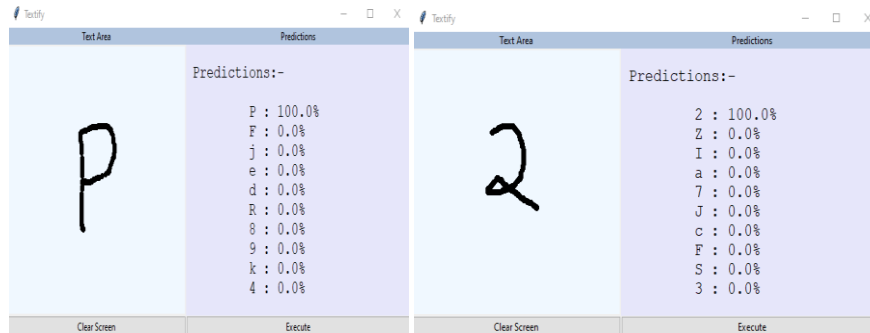


Fig. 3.Example 1

Fig. 4.Example 2

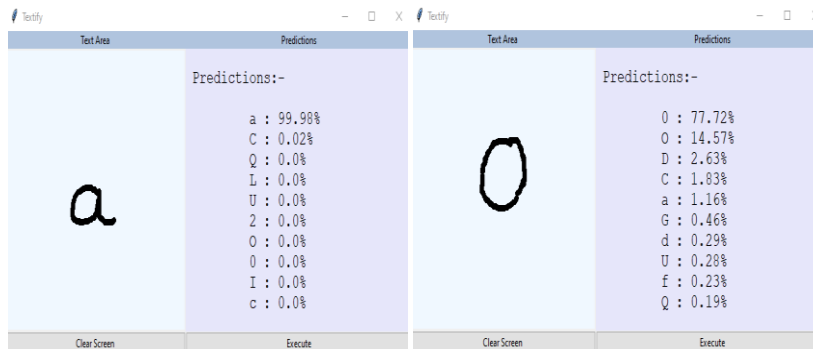


Fig.5. Example 3

Fig.6 Example 4

7. Conclusion And Future Scope

Solid development in the utilization of versatile registering devices, equipped with contact screens permit simple chronicle of internet penmanship input. One of the significant needs being the accessibility of various cell phone gadgets that transport with a stylus. The longing to help more contents, some of which are especially hard to type on a delicate console, and for some of which no standard console design is normally embraced, (e.g., Khmer). Advances in the innovation in fields like discourse recognition, deeplearning, machinetranslation, and optical character recognition, can be applied to internet penmanship recognition. [1]

Utilizing present day procedures like neural systems to actualize profound figuring out how to fathom fundamental errands which are finished with a squint of an eye by any human like content acknowledgment is only the start of the potential behind AI. Customary OCR used to work like a biometric gadget. Photograph sensor innovation was utilized to procure the match purposes of physical traits which are then changed over into database of known types. [22] But utilizing current methods like convolution neural systems we can examine and comprehend words with an exactness never observed in history. [22]

The android application can be created in future utilizing google common language API that can give regular language understanding advances like, opinion analysis, entity acknowledgment, element assessment examination and content explanations to comprehend the content better by giving word references that will correct the mix-ups made by the model to give precise outcomes. Another advancement can be the utilization of cloud vision API accessible in google to improve the precision of the information peruse and even to distinguish various items. [22].

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