

Handwritten Telugu Character Recognition Using Convolutional Neural Networks

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Abstract- Handwritten recognition plays vital role in the recognition of characters of old documents by using Optical character recognition and Convolution Neural Networks. The main challenge in the existing Telugu OCR system is unable to recognize and the slant correction of the Handwritten text of Telugu characters. To overcome this problem using different Telugu character images as dataset and convolutional neural network method to obtain high accuracy and recognition rate. Generally conventional neural network method will have different layers like convolutional layer, max pooling layer, fully connected layer and SoftMax layer. Once the input character image is passed through these layers and finally obtain the recognized character as output image from SoftMax layer.

Keywords- Optical character recognition(OCR) , Convolution Neural Networks, Recognition, Hand written Recognition(HCR) .

I. INTRODUCTION

This section introduction of different methods or algorithm on provides valuable information on different approaches to recognition of Telugu characters. The HCR (Hand Written Character Recognition) is plays a vital role in the recognition the characters that are placed in the old documents that's are used and they are using as follows.

OCR: In systems like text-to-speech translators, handwritten document recognition is crucial. Online and offline character identification are two categories that can be used to categorise OCR. Additionally, offline character identification is divided into two parts: printed handwritten and machine characters. Compared to documents that were printed on a machine, there are many more difficulties with character recognition in handwriting. The topic of written character detection, which makes use of numerous real-time applications, is both demanding and exciting. For printed Telugu characters, there are many commercial OCR systems available, however they have a lot of technical flaws and produce unappealing results, especially during the segmentation stage. For the majority of widely-spoken languages, including Telugu, an OCR system is currently being developed. Telugu OCR is now quite difficult, and the Telugu character recognition (TCR) system's creator has specific difficulties. Considerable research has recently been done in the direction of creating a TCR scheme that works.

CNN: The next approach that is used to recognise that is an method called Convolution Neural Networks (CNN) is used to recognise handwritten documents. The cornerstone of a CNN is hand written identification. The variables of the layer are a series of learnable filters with modest receptive fields that cover the entire depth of the input volume. Each filter is convolved across the width and height of the input volume during the forward pass, computing the dot product between each filter entry and the input to create a 2-dimensional activation map of the filter. As a result, the network picks up filters that turn on when it locates a certain kind of feature in a particular location in the input.

II. GENERAL ARCHITECTURE OF TSDR SYSTEM

The General Architecture of consists of five steps as shown in fig.1. The first step is Input handwritten image which consists of collection of the handwritten image. This collection of images considered handwritten of people. These images be taken from people and these images taken through capture. The next step is pre-processing for the collected images. This is pre-processing is very important because it will remove the noises and the dataset will be divided as train and test data set.

The next step is pre processing of the collected images. This pre processing stage is essential to remove various noises in images such as random variation of brightness or color information in images. Some of the pre processing techniques include mean filter, high pass filter, Gaussian filter, image filter[3]. Pre processing techniques must be selected in a way that they require less time for the processing and are able to enhance the image features which are necessary for further computation.

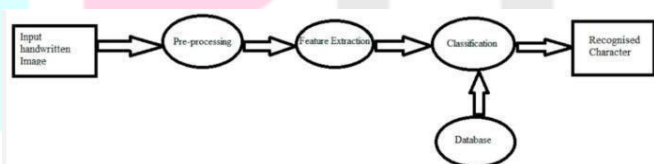


Fig 1 General Architecture Diagram

The third step consists of Feature Extraction for the dataset. The dataset is extracted from the images and further sub divided according to the model used. The next step is Classification is the assigning a class label to an input pattern. The last step is Recognised Character, which means after extracted the dataset by using model to the processed image and recognise the character. Neural networks are widely used because it gives best results for the automated processing images.

III. LITERATURE SURVEY

This section review of different research papers on similarity related papers provides valuable information on different approaches to recognition of telugu characters. The research papers are analysed on chronological order.

Sri Lakshmi Inuganti et.al [11] proposed a pre-processing methods using online data from a dataset of telugu strokes. They suggest that the pre-processed character be recognised using KNN based on dynamic time wrapping distance measuring. The size and starting position of the stroke are normalised in this research. This method evaluates the following parameters: recognition time, accuracy as well as the erroneous acceptance rate (FAR) and false rejection rate (FRR). The total number of characters that were recognised is divided by the total amount of time needed to recognise all test samples to arrive at the average recognition.

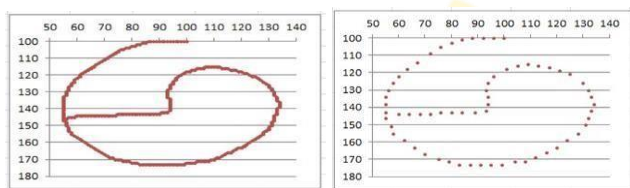


Fig2 (a) Interpolated Character (b) Resampled Character

Mayur Bhargab Bora et.al [4] proposed they conferred OCR using the Error Correcting Output Code (ECOC) classifier with CNN. Both texture feature and classification are performed using the CNN and ECOC, respectively. After comparing the output from the network with that needed for counselling, the error is calculated. The ECOC classifier operates on any image pixels by obtaining the choices from the input image and then feeding those to all or any of the binary learners. By using the right threshold, a token can be generated out of the entirety of the possible outcomes in a text. The token produced by the ECOC category is compared, as well as the category where the closest codeword is the anticipated output is also considered

Kamakshi Prasad et.al [21] proposed to enhance productivity, variant evaluation, handwritten telugu text authentication for internet use. They carried out an experiment employing a dataset made up of 28 straightforward features that are simple to acquire, along with a variety of strokes-based perclassification technique that produced a recognition performance. Their research revealed that pre-processing was skipped, extraction of features and online data collecting coincided, and which was before came earlier authentication. When compared to previous methods, the suggested one exhibits greater recognition results.

Soumya T Soman et.al [14] proposed the development of a method for the recognition of offline handwritten telugu characters. to create a system that is effective at reading handwritten characters utilising two distinct data sources. They carried out their investigation utilising a dataset made up of 47428 CV pictures and the MINST database. They discovered that two distinct types of voting impacted how well an intend to support worked on test datasets. The inventive findings demonstrate that the suggested strategy performed well in terms of vowels and consonants recognition.

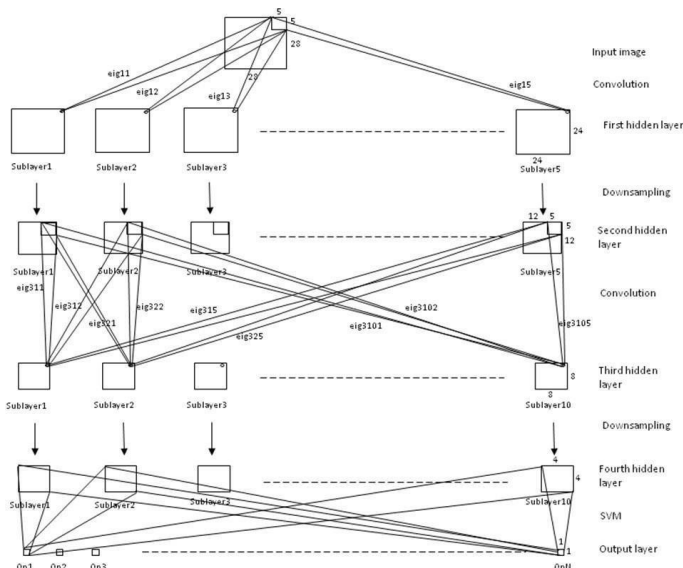


Fig3 PCA-CNN-SVM Architecture

Vasantha Lakshmi et.al[18] proposed the Recognition of optical characters software for Telugu textual content (TOSP). OCR translates human readable characters into machinereadable codes by automatically reading optically detected document text. To handle different font sizes and sizes, TOSP has a unique capability. The results of this experiment are significantly superior than those often obtained using lower text sizes, and they are frequently even enhanced by scanning using neural recognizers that are identical but have had their training data generated using scanned images.

Naragudem Sarika et.al[2] proposed the CNN based mostly visual recognition system and applications frequently involve character-by-character monitoring of the text images, processing of the digital documents, and conversion of the character images into character codes. Here, a Telugu character data set is employed to train the CNN (VGG-16) model, and its efficiency is tested. They also talked about the design of text to speech conversion. Telugu character recognition employs the VGG-16 to train the dataset, which was developed. show coaching damage, nonexistent, learning precision, and testing set.

Tejasree Ganji et.al[25] proposed to sight the Telegu character recognition victimization CNN. They had improved the accuracy rate of recognition. In this paper they planned one technique solely. Here the CNN was accustomed get results additional effectively find the character recognition, these each methods they improved the issues of poor detection potency, uncomprehensible detection and false detection of characters of telugu. The take a look at results of CNN have corrected several uncomprehensible detections and makes it additional correct. The findings of the experiment conducted area unit they need improved the telugu character recognition. that they had improved the accuracy which provides effective results.

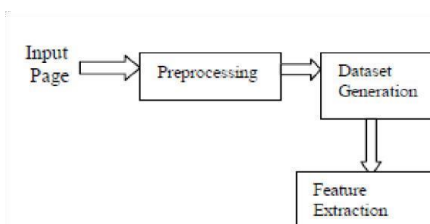


Fig4 Phases of the OCR system image

Prameela et.al[23] proposed to acknowledge offline Hand written Telugu characters exploitation Optical character recognition, This study suggests a multiple OCR solution for Telugu documents that includes pre-processing, extraction of features, and categorisation. In this research, character photos were statistically analysed and the results feature vector data, and 3*3 grids were set up for each character. Thus, the generated results are further considered as the primary feature vector for the proposed recognition software. SVM and RBF classifiers must be added for classification purposes. The quality info contains two hundred samples from every of the forty seven classes Telugu character info 2 classifiers.

Naresh babu Muppalaneni et.al[6] proposed a penned Guninthalu, a telugu composite character that combines vowels and consonants, for identification. CNN was used to suggest the technique. Characters typed by hand are recognised using CNN. Researchers have gathered the information and stored them in IEEE Dataport. telugu Guninthalu each character is hard to classify and just about identical to others. The subject of pattern recognition and image processing contains many active and hard relevant studies, and messy handwriting recognition is one of them. With a little dataset of 516 samples, the CNN architecture shown in the research provides improved accuracy.

Dr.Anupama Angadi et.al[12] proposed a method that it is CNN is to identify online handwritten Telugu characters and to increase identification accuracy even on a larger dataset. The suggested solution made use of a convolutional neural network for the accurate recognition of telugu characters on sizable datasets. ReLU , Soft max activation functions, max pooling, and two dense layers are among the network's four layers. A thorough investigation of an intriguing dataset demonstrated the proposed CNN's effectiveness when compared to previous technologies. The finding is more accurate than some recently suggested. The result of the proposed approach is when compared to modern algorithms,

this is extremely outstanding. The classification method achieved better accuracy on the test dataset.



Fig 6 Sample handwritten Telugu characters

Panyam Narahari Sastry et.al[22] proposed a way that it's doable to spot written characters each on-line and offline aspects of the segmentation technique. In order to differentiate between written characters, the segmentation technique was utilised. In the Zoning feature extraction approach, zones of famed sizes are created. The feature vector of a picture will be determined by adding all the component intensities at intervals such a given zone. This technique is employed to make coaching and check pictures. AN rule for evaluating images mistreatment five hundred samples has additionally been developed with success.The planned segmentation technique achieved a more robust recognition accuracy.

T.Sitamahalakshmi et.al[1] proposed a method that is identification can be attributed to original sources including papers on paper, images on camera, touch screens, and other online and offline gadgets. utilising CNN for image processing more obvious and advantageous. They had to created their own dataset. Initially, there is a collection of Telugu letters written by individual. Various formats of guninthalu are scanned into exact symbols. There are 275520 written glyphs in all, divided among the 21 guninthalu, each of which includes 16 characters. The built-in dataset was used to develop CNN. In comparison, the RMSprop optimizer performs better than the ADAM and SGD optimizer.

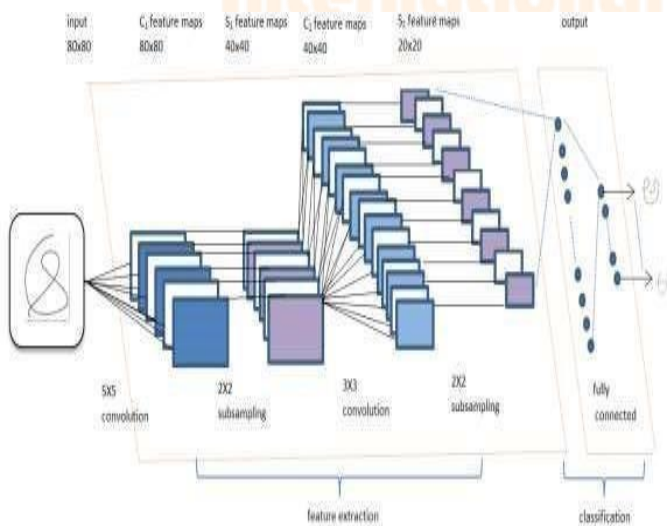


Fig 5 Visual features in CNN

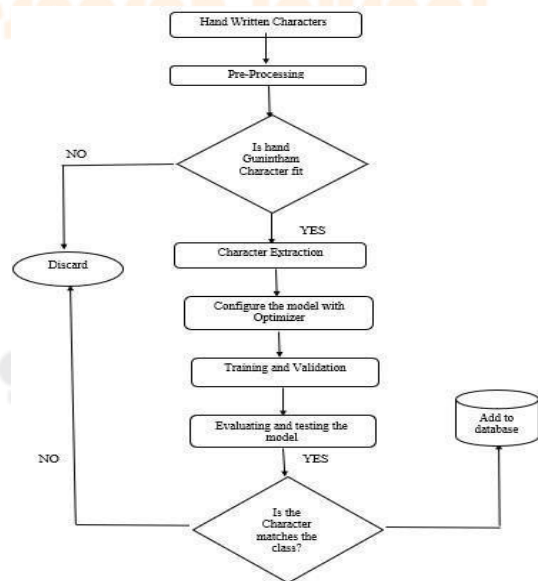


Fig 7: process flow

Table 1: Literature Survey Analysis

Techniques	Dataset	Pre-Processing	Ability to recognise a character	Ability to recognise a word	Ability to correct a slant
Optical character recognition	MIT dataset that consists of 138 telugu characters.	Yes	Yes	Yes	No
Convolutional neural networks	Telugu Dataset contains in training and MNIST database are used for testing.	Yes	Yes by combining with different classifiers.	No	No
Adaptive Zoning	Used HP Labs(hpl) handwriting datasets as input images.	Yes	Yes	Yes	No
KNN Algorithm	HP Labs which consists of 270 samples of 146 users.	Yes	Yes	No	No
RNN Algorithm	Self OrganisingMap(SOM)	Yes	Yes	No	No

IV. ANALYSIS AND DISCUSSION

The Table I explains about the features considered in the reference papers. Here four different features are considered from each Technique.

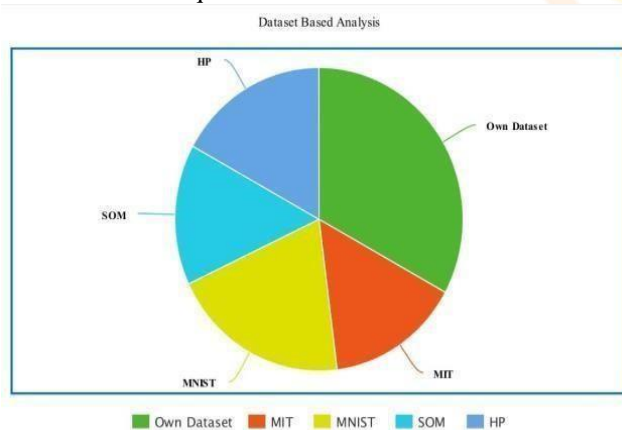


Fig.8. Dataset Based Analysis

V. CONCLUSION

This paper provides a survey on hand written telugu character recognition using CNN. We analysed how different methodologies solve the problem of recognition. we have considered four features for recognition those are data preprocessing, Ability to recognise a word and Ability to correct a slant .Most of the users recognises only character and word but does not correct the slant. The correction of slant based recognition is also a challenge which need to be addressed further.

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