A KANNADA HANDWRITTEN CHARACTER RECOGNITION AND SPEECH CONVERSION SYSTEM TO PROMOE DIGITAL LEARNING OF KANNADA IN RURAL SCHOOLS

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Keywords:

Kannada Handwritten character Recognition, Convolutional Neural Network, DenseNet-121, Chars74k.

Introduction:

Handwritten character recognition is done when the handwritten text on paper, postcards, etc is converted into digital form. A lot of development has been done on the handwritten character recognition of popular languages like English. But there are other regional languages like Kannada. In the project, we have made use of a Convolutional Neural Network to recognize handwritten Kannada Characters. The type of convolutional neural network used is called densely connected-convolutional networks or DenseNet. DenseNet is preferred in our project as it solves the vanishing gradient problem, improves feature propagation, promotes feature reuse, and cuts the number of parameters in half. The dataset used in the project is a standard Char74k dataset. The aim of this project is to develop an application to recognize Kannada Characters with good accuracy and the least number of errors and convert them into digital text.

Kannada handwritten character recognition is a challenging problem because to its vast number of characters and complex script. N. Shobha Rani et al., [2020] model uses VGG19 NET architecture to recognize kannada handwritten characters in which Block 1 of VGGNET 19 architecture is used for feature extraction and rest of the blocks uses CNN and max pool for classification of the characters [1]. Abhishek S. Rao et al., [2020] model uses Artificial Neural Network (ANN) with Fully Connected Layers to recognize kannada characters. The feature extraction is carried out by max-pooling and flattening. Classification is done by a fully connected convolutional neural network [2]. Ramesh G et al., [2019] model uses CNN which has 4 convolution layers and 2 layers of max pooling. On the input, kernel convolution is performed by convolution layers using 3x3 kernels. The output that is obtained after subjecting to max pooling and convolutional layer is then after sent to flattening layer. The accuracies are obtained differently for vowels and consonants [3].

Objectives:

The proposed system will be able to covert Kannada handwritten text into speech. This shall help the students with reading disorder like trouble with word reading accuracy, students who find it difficult to break down the sounds of the Kannada language and the students who have trouble with reading comprehension. This system will allow the student to focus on the content rather than on the act of reading which will result in better understanding of the study material.

The objectives to be achieved include:

1. Data collection for training and validating the model.
2. Proposing an appropriate model which will be able to convert Kannada handwritten characters into text.
3. Once the handwritten Kannada characters are converted into text, the proposed system must be able to convert the Kannada text into speech.
4. Train the model with a large dataset of Kannada handwritten characters.
5. Building the model such that the accuracy is 90% and above, which will help the students to see text and hear the model read it aloud simultaneously.

Methodology:

The dataset is obtained is called chars74k. It has around 990+ classes. Each class represents a character in the kannada Language. Out of these 604 classes are chosen to reduce the complexity and training time of the model. These contain the swaras, vynajanas and the Kagunitha consonants. The input images are then pre-processed. to modify it according to the requirements of the machine learning model which increases the accuracy of the model. There are several processes, the data undergoes before it is fed into the machine learning model. The OpenCV module of python is used extensively used for the process of data pre-processing. All the images in the dataset are grayscale images. These grayscale images get converted into binary images by thresholding. Then the edges and lines of the image are detected. After the edges are extracted, it is smoothened. The unwanted portions are then blurred. The unwanted noise in the image is eliminated. Contouring of eroded images is done. Later to this an approximate rectangle around the binary image. This function is used mainly to highlight the region of interest after obtaining contours from the images.

The input image is first segmented into individual characters. Various data pre-processing methods are applied to the dataset to eliminate imperfections. These characters are then classified and digitally written into a PDF. The model used is DenseNet-121. Additional dense layers and Global Average Pool is added to the model. Densenet-121 consists of 4 denseblocks and 3 transition layers. Each dense block consists of a specific number of convolutional layers with the sequence Batch normalization, ReLU and Conv2D layer. This is followed by the Transition block which consists of the pooling layers. The features are concatenated. DenseNet is preferred in our project as it solves the vanishing gradient problem,

improves feature propagation, promotes feature reuse, and cuts the number of parameters in half.

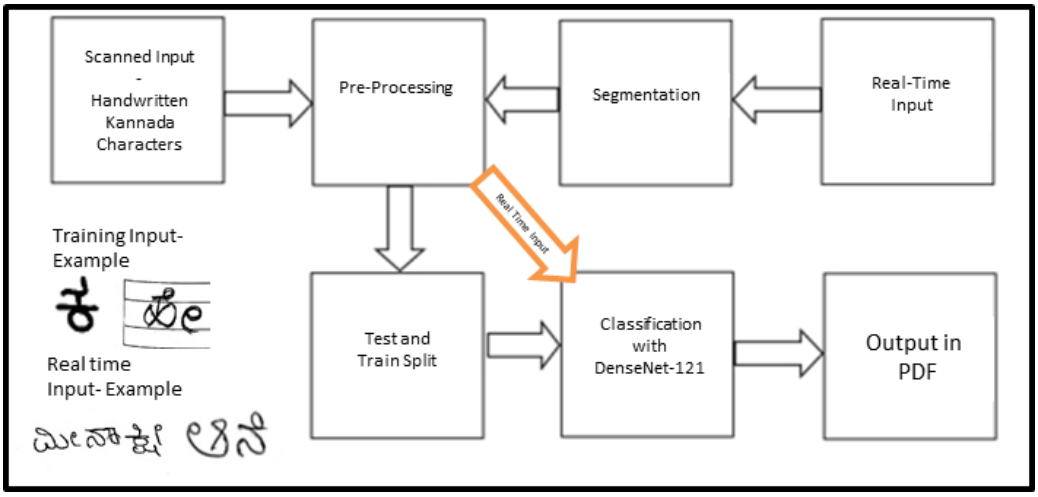

Figure: Block Diagram

Results and Conclusion:

The model is capable of recognizing words and small sentences made of kannada kagunitha characters. A web interface is created using flask which takes scanned input image and writes the output into a PDF. The recognized character is further converted to voice. The input image is first segmented into individual characters. The model used is DenseNet-121. Additional dense layers and Global Average Pool is added to the model. The model uses the pre-trained ImageNet weights. The train-test ratio is 80:20 with 12080 images for training and 3020 testing for training. The testing accuracy of the model observed is 93.87%.

Scope of Future work:

The Kannada handwritten recognition system has significant relevance in the real world. In the state of Karnataka, the government offices and health care departments, all the important documents /reports are written in Kannada language. To reproduce these old documents which are difficult to read and understand, Kannada handwritten recognition system can be used on these old documents. The system uses image preprocessing techniques to enhance the quality of an image and machine learning technique for classification.

The proposed system helps children with visual impairment or learning disabilities as the recognized handwritten words can be further converted into speech. Handwritten characters recognition plays a key role in bringing alive the medieval documents and research studies.

The proposed model would be highly useful in government sectors for documentation purposes. Once the output s obtained in a PDF format it can be further used in translation services. This can also be extended to recognize all the characters in the Kannada Language. Finally, this also paves the way for recognition of other languages with huge datasets like other Dravidian languages, Chinese and Japanese.

References:

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