A Literature review paper on Devanagari Handwriting Generation

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Abstract: Handwriting generation has emerged as a crucial area of research, with applications ranging from digital ink recognition to font creation. In the context of Devanagari script, which is widely used for languages such as Hindi, Marathi, and Sanskrit, generating natural-looking handwritten text poses unique challenges. The review encompasses various approaches, including deep learning-based methods, generative adversarial networks (GANs), and rule-based systems, highlighting their strengths, limitations, and future research directions.

Keywords: Handwriting generation, Devanagari Script, RNN, LSTM, GAN

Introduction

Digitization of handwritten document is important for better processing and storage. But people Specially Editor, Writer,Poet,Students as well as Doctors or any other Person wish to have their own personal handwriting as font because Personal font style gives a personal touch and make the document more eye-catching and easily Readable and Understandable. Due to that Handwritten character generation is a popular topic with a variety of applications ranging from Digital Ink Recognition to font creation. Font generation is a process of generation of a handwritten document based writing characteristic which is specific to user's writing style.

Handwriting Generation

People of personalized era desire to have their own personal font so that documents can be displayed as handwritten by their own hands. If you use personal style font than it makes communication more attractive. Personal handwriting fonts will also attract the eye. We can create personal touch while inviting by card by our own writing, writing books in our Personal writing style. For students creating notes on their own writing. Even we can create logo and header using attractive personal writing which creates good impacts on reader minds. It is thought that different language calligraphy can mirror one's emotion and persona. Many authors have been long looking for personal fonts so that they cannot only present their idea but also show their personality and feelings to readers.

Devanagari script

In India, Devanagari script is one of the highly popular scripts and used as basis for the most spoken languages such as Marathi, Hindi, Nepali, and Sanskrit. Devanagari script follows left to right direction for reading and writing. Horizontal line is used at the top of the letters which continue till end of each word. The horizontal line is called as "Shirorekha" and used to separates one word from other. With its origin in Sanskrit, the script has been adopted and modified for native languages in India. Handwritten Devanagari script is peculiar compared to English script as there is no cursive connected writing and one has to scribble letters or even curves, matras by lifting the hand. Upper case and lower case categorization is not included in Devanagari script.

Devanagari script comprises of total 60 characters. Apart from these characters it also consists of composite characters which are combination of two or more basic characters. Devanagari script has 13 vowels and 36 consonants and 11 modifiers

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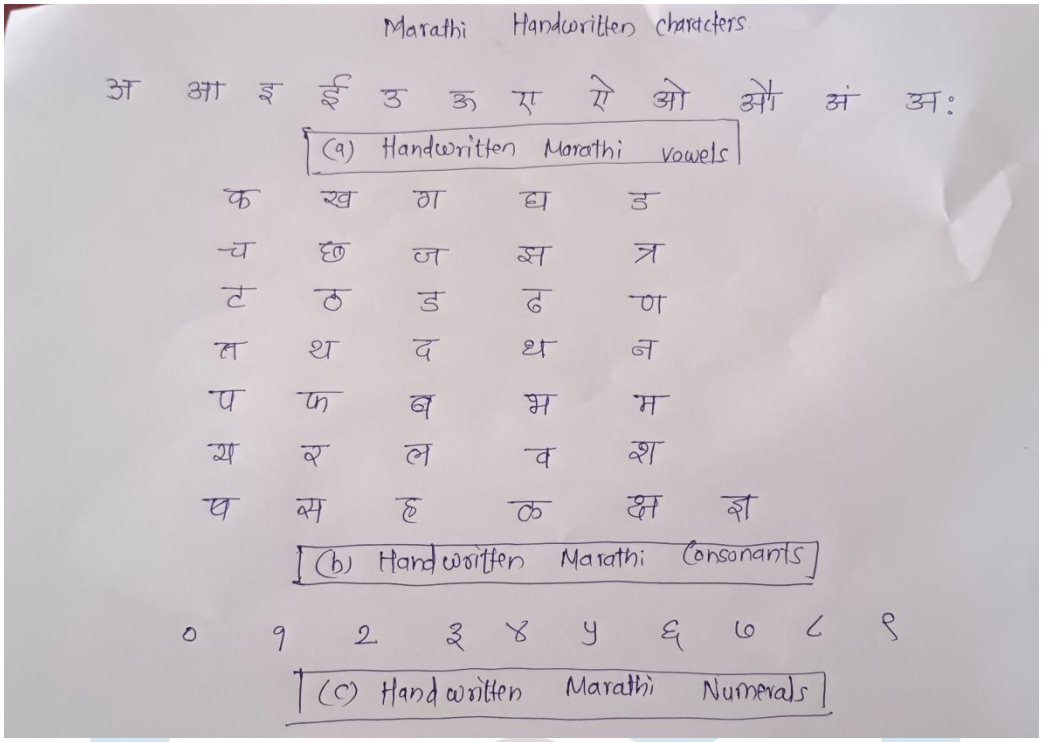
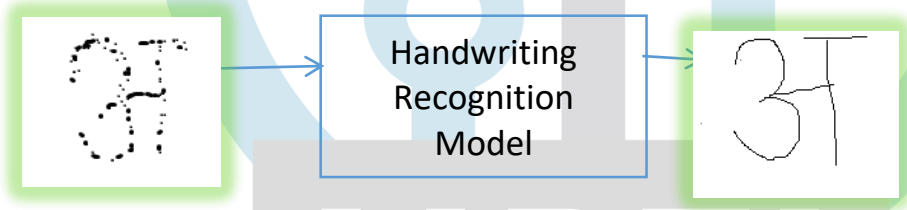


Fig 1. Handwritten Marathi Vowels, Consonants, and Numbers

Devanagari Handwriting Generation Challenges

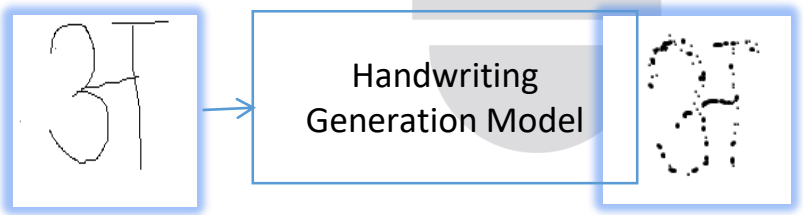
Generating human-like handwriting by machine from an input text given by the user may seem as an easy task but is very complex in reality.



Scanned Image Recognized image

Fig 2 Handwriting Recognition Model

Fig 2. Aseries of pen, points represent the letter 'अ'.It is quite easy to generate character 'अ' from series of pen points letter. A much more difficult to reverse the process, i.e. to train a model that takes the letter 'अ' as an input and produces a series of points that we can connect to make the letter 'अ'.



Scanned Image Generated Image

Fig 3 Handwriting Generation Model

Literature review

For generating Chinese character two phases are proposed, pre-processing phase and production phase. In the pre-processing phase sizes and positions of components of every Chinese character is label manually. In the production phase for creating personal handwriting, the user had to hand write the small subset of the Chinese character. The system can track every stroke, distinguish

from the user's handwriting character by character. Different methods are explained for it such as component analysis, positions and sizes of components in Chinese character, component extraction and glyph synthesis [1].

This paper focus on Macro Structure model.Every writing has macro structures like neighbouring word roughness, line orientation, margin orientation, and interline spacing etc. as well as micro properties like inter-character transitions individual character shapes. Bangla writing is more complex in nature because of the same, a grouping of stored character database and stroke synthesis by a spline with paint brushing is used. [2].

Paper describe not only about font recognition but also about font generation specific to author's writing style. For recognition different methods like converting to gray scale, thresholding, and smoothing, etc method are uses. For generating font RNN and LSTM is use. For handwriting recognition 98.2% accuracy was achieved [3].

This paper proposed the methodology for handwritten text recognition and text generation using AMA Algorithm for devnagari script. This paper discusses about a method for classifying online handwritten text and non-text elements within the Devanagari script, possibly employing a combination of classifiers to improve accuracy or efficiency.[4]

This dissertation thesis discussing the use of Generative Adversarial Networks (GANs) for generating handwritten characters in both the Devanagari and Gurmukhi scripts. This work explore how GANs trained to generate realistic handwritten characters, potentially for applications such as font creation or data augmentation in character recognition systems.[5]

The paper focuses on enhancing the resolution of handwritten Devanagari characters using a Super-Resolution Generative Adversarial Network (SRGAN). This technique involves using deep learning methods to generate high-resolution images from low-resolution inputs, specifically tailored to improve the clarity and quality of Devanagari handwritten characters. [6]

This study investigates the feasibility and effectiveness of using Recurrent Neural Networks (RNNs) for generating handwriting, particularly when dealing with limited or small datasets. The authors explore techniques to mitigate the challenges posed by small datasets, such as data augmentation or transfer learning. Their findings could provide insights into the practical applications of handwriting generation models in scenarios where large amounts of training data are not readily available.[7]

Ref no	Language	Classifier	Fatures
[1]	chinese	Parametric Character Shape Representation Novel Algorithmic method	For characterize the shape difference between components in a standard Chinese character and their counterparts in a personal handwritten character sample parametric character shape representation method is use. Novel algorithmic method first split Chinese character into multiple constituent parts and then algorithm analyses and learns the characteristics of character.
[2]	Bangla	Macro Structure Model	Work on combination of stored character database and stroke synthesis because Bangla language is complex.
[3]	English	RNN LSTM	RNN allow generation of arbitrary lengths of recurrent network and also ideal for text and speech analysis. LSTM store previous input for long and also it was design for remove long term dependency.
[4]	Devanagri	AMA algorithm	method for classifying online handwritten text and non-text elements within the Devanagari script, possibly employing a combination of classifiers to improve accuracy or efficiency.
[5]	Devanagari and Gurmukhi	GAN	GANs trained to generate realistic handwritten characters, potentially for applications such as font creation or data augmentation in character recognition systems.
[6]	Devanagari	SRGAN, Deep Learning	This technique involves using deep learning methods to generate high-resolution images from low-resolution inputs, specifically tailored to improve the clarity and quality of Devanagari handwritten characters.

[7]	English	RNN	generating handwriting, particularly when dealing with limited or small datasets

Conclusion and Future Work

This paper discussed about Handwriting generation or Synthesis of Handwritten Characters and also comparative study different methodology used for generation of Chinese, English, Bangla,Devanagari, gurumukhi languages with there implementation methods like RNN, macro structure model, and LSTM.
Since there is no any work or implementation is done for marathi language so in Future trying to develop a model for Marathi handwriting generation for our own writing by using studied methods .

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