

# Recognition of Hand Written Devnagri Characters Using Effective Thinning and Fuzzy Logic

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**Abstract**— Various techniques have been developed for documenting the handwritten text as it is an effective tool in the world of communication. There are certain exceptional techniques that describe the environment of handwritten scripts and further convert it into electronic data by implementing various algorithms. Devnagri is one of the widely used script for most popular and commonly used languages like Marathi and Hindi. Recent development in the field of handwritten character recognition based on different methodologies like neural network, fuzzy logic, deep neural networks has shown remarkable improvement in recognition accuracy from 75% to 96%. A fuzzy logic based hand written Devnagri compound character recognition system using a rotation invariant rule-based thinning algorithm has been proposed. Thinning the characters to their central line, preserving the shape of the character are the distinctive features of thinning algorithm. Concurrent application of different rules to each pixel of the character image results into symmetrical thinning as well as improves the overall speed of the system. Results obtained for the fuzzy logic based system with thinning helps in preserving the topology of the characters written in Devnagri and prove that accuracy of the system has stabilized in the band of 91-94% which was fluctuating in the band of 75-96% for the previously implemented systems. The system also shows a considerable improvement in accuracy for recognition of compound characters in comparison with the previously implemented neural network based system.

**Keywords**— Character Recognition, Neural Network, Rotation Invariant, Thinning, Fuzzy Logic, Image Acquisition, Segmentation, Feature Extraction.

## I. Introduction

Recognition of handwritten characters is a difficult task for machines while the same task is carried out accurately when given to the humans. Devnagri is one of the widely used scripts for most popular and commonly used languages like Marathi and Hindi. Optical Character recognition (OCR) for Devnagri script becomes specifically complex due to complicated curves and various shapes present in these languages [1].

Optical character recognition is nothing but electronic translation of scan images of handwritten, typewritten or printed wording interested in system-encoded content [4]. This process can be used for converting books and documents into electronics form, managing a record-keeping system in an office, or publishing the text on a website. Using OCR we can also modify the text, search for a phrase, store it efficiently, display a replica free of scanning artifacts, as well as use processes like machine translation, text-to-speech and text mining to it.

### *Fundamental stages in character recognition*

Many times it is impossible to differentiate the characters even to the human eye, and that they can only be distinguished by context for some hand-writing. It becomes essential to identify the minute differences between them in order to distinguish such characters. An important issue of different relative proportions while writing the character by different writers needs to be considered, while dealing with handwritten characters. Even the same person may not always write the same letter with the same proportions. The fundamental stages in hand written character recognition system are shown in Fig. 1. The process of scanning and translating a paper document in to digital form is called **image acquisition**. Jon Almaz et al. addressed the issues related to word spotting and word identification of images [8], [9]. N Vasudeva et al. suggested a method with more appropriate results in comparison of matching with normalized word-image [16].

While capturing the image depending on the quality of the scanner noise may be introduced. **Preprocessing** focuses on deduction of such noise. Few more activities like thinning, normalization and segmentation [13] of image needs to be carried out for improving the process of recognition. Normalization involves resizing of characters for