SYNOPSIS OF PROJECT

PROJECT REFERENCE NUMBER: 46S_BE_3842

PROJECT TITLE: "ANKE GYANNI" – Creation and Recognition of Handwritten Tulu Numerals

NAME OF THE COLLEGE: Srinivas Institute of Technology, Mangaluru

NAME OF THE STUDENT & GUIDES:

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INTRODUCTION

Numerals are an integral part of a language and Handwritten Numeral Recognition (HNR) has become an attractive research area due to its different uses in everyday life in both handwritten and printed forms. Individual languages have different numeral sets; and structure, similarity, and other complications in a numeral set increase the complexity of Handwritten Numeral Recognition.

The fundamental script in India is Brahmi. Such a significant number of works has been done in various Indian dialects except for Tulu which is one among the various created types of Brahmi content. Tulu is a south Indian Dravidian Language with rich set of handwritten patterns. There are limited numbers of benchmark document image databases available. This project focuses mainly on creating and recognizing Tulu Numerals datasets. This will show the English and Kannada equivalent of the Tulu Numerals.

OBJECTIVE

The Dravidian language of Tulu is primarily spoken in the state of Karnataka in the southwest of India, which contains many historical documents available in handwritten form. Traditional research was primarily focused on handcrafted features that are domainspecific and not always available. Since, it is not an official language th research is still ongoing. This is mainly due to the following reason:

i. Lack of datasets and codes for extending and reproducing results.

ii. The uniqueness and variations in the handwriting of different individuals also affect the appearance and formation of numerals.

iii. Dataset creation is the challenging part, and the segmentation of text from degraded document images is a challenging task that comes under the image processing area with the application of handwritten character recognition.

The aim of this project is to develop a system to recognize Tulu handwritten numerals. The entire emphasis and attention will be paid to collecting a large number of samples of handwritten Tulu numerals from different individuals, with variations in writing style, size, and other factors. OCR

aims to convert text from documents, including handwritten text and scanned text images, into editable digital formats for more thorough processing. Feature vectors must be saved in designated folder during the first stage's training phase. Using this folder, the classifier model compares the test input features to the stored features. The character from the input image will be located and recognized after the comparison.

METHODOLOGY

- Collecting the handwritten Tulu numerals as a dataset.
- In this handwritten Tulu numerals are captivated in document fashion and are subjected to Pre-processing and attribute extraction processes.
- The handwritten Tulu numerals will be scanned and pre-processed.
- After picture pre-processing, the digit will be recognized to kannada and English numerals

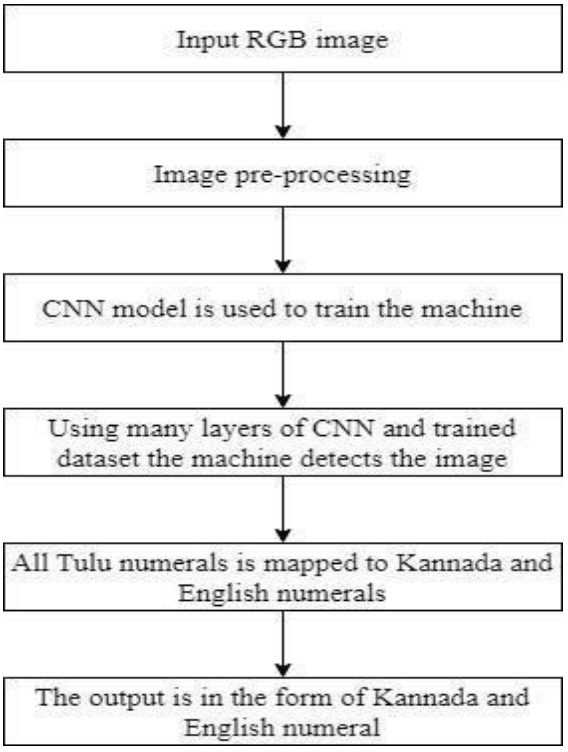

Figure 1.1: *System Architecture of Numerals Recognition.*

System design, also known as high-level design, seeks to define the modules that should be in the system, the identifications of these modules, and how they interact with one another to create the desired results. The principal data structures, file formats, output formats, main system modules, and their needs are all listed at the conclusion of the system design process.

- **Dataset:**

  Over 100 people's handwritten Tulu numerals were gathered to build the dataset for this project. After scanning them, they are converted into grayscale images. The characters were separated using code by thresholding method.There are 1557 photos in the entire dataset.

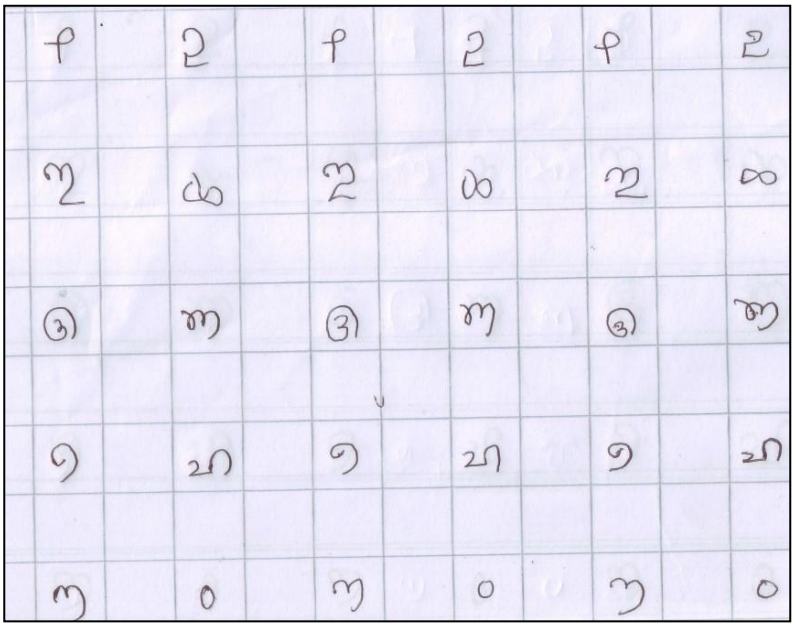

Figure 1.2: *Sample of Tulu Handwritten data sheet*

- **Dataset Splitting for Training and Testing:**

  The image dataset is split into two portions for testing and training. The optimalsplit of the training and testing datasets is 70:30.

- **Preprocessing Steps :**

  Before being used for model training and inference, pictures are formatted through preprocessing. Additionally, this preparation procedure involves size, orienting, and color adjustments. Following the split, 1023 and 354 photos wereused for training and testing.

  The process includes converting images to grayscale, evenly distributing contrast and intensity, and normalizing pixel values to the 0–1 range for better convergence.

Figure 1.3: *A sample numeral of the dataset*

Additionally, picture augmentation is practiced, which is responsible for image changes. With a shearing range of 0.2 and a zoom range of 0.2, the width and height shifts were applied.

1.4 Use Case Diagram Creation and Recognition of Tulu Numeral Dataset

A use case diagram shows the way a user interacts with the system and shows the use case specifications. The many user types and the varied methods in which they interactwith a system can be displayed in a case diagram of use.

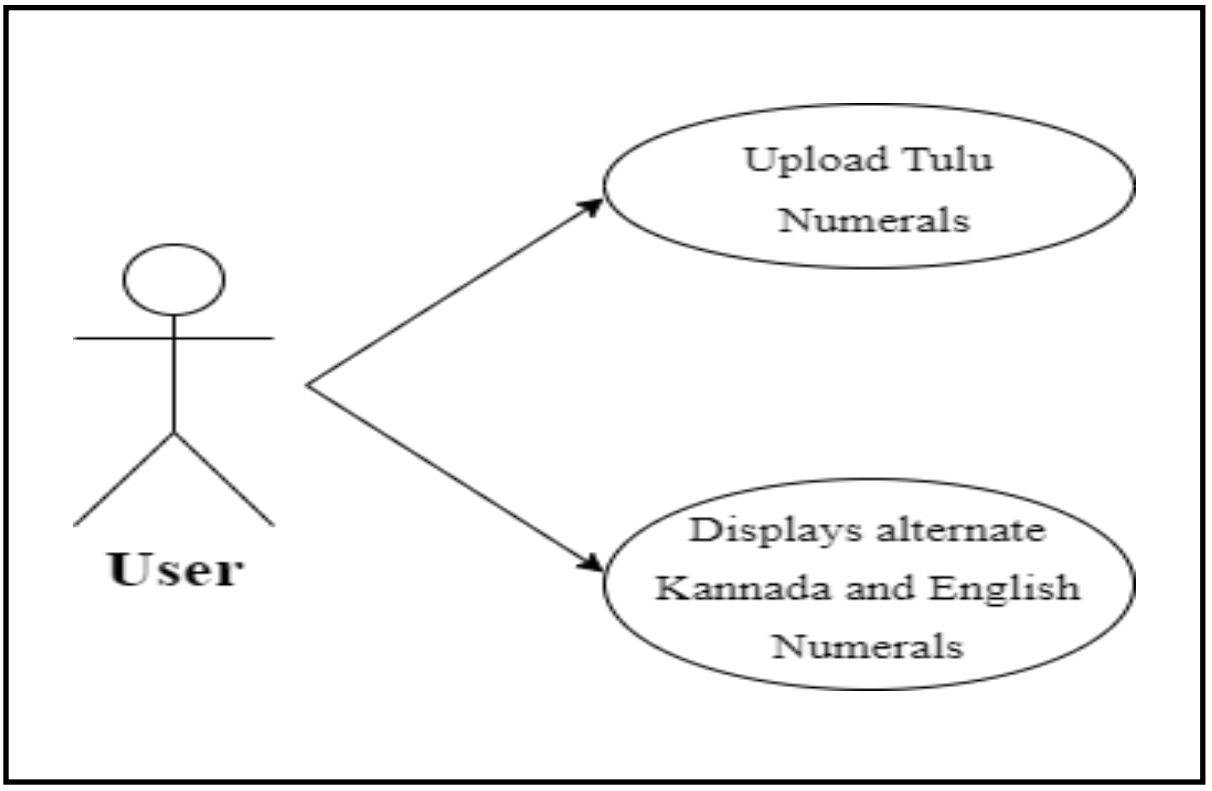

Figure 1.4 shows the use case diagram of Tulu Numerals Dataset Creation and Recognition. User have to upload the Tulu Numeral that is need to be translated then the alternate Kannada and English character will be displayed.

RESULTS:

Procedure for Numeral Recognition

Step 1: Begin

Step 2: Input RGB image

Step 3: Image pre-processing

Step 4: CNN model is used to train the machine

Step 5: Using many layers of CNN and trained dataset the machine detects the image

Step 6: Creation and Recognition of Handwritten Tulu Numerals

Step 7: The Output is in the form of Kannada and English

Step 8: Stop

Table 1.1: *Test cases for Tulu Numeral Recognition*

Sl. No	**Test Procedure**	**Pre-Condition**	**Expected Result**	**Passed/ failed**
1	Click on Upload Image	Enter only images From selected Tulu Dataset Folder	Selected image is displayed	Passed
2	Click on Predict	Matches the alternate Kannada and English Numeral	Alternate Kannada and English Numeral image is displayed	Passed
2	Click on Exit		Exits from application.	Passed

Tulu Numeral Dataset Creation and Recognition will accept the Handwritten Scanned images as Input. Later recognizes the Tulu Numerals. Then provides a Translated Kannada and English language Numerals a Result . The model's performance for numeral identification can be enhanced even more with the usage of large datasets for training. This endeavour will aid in the detection of words and sentences in the future. Even though the CNN model was used in this study, accuracy could be increased in the future using other models.

Accuracy = TP+TN/(TP+TN+FP+FN).

Table 1.2: *Result Analysis Table*

Image Name	No. of Testing Images	No. of images in each classes	Result
Numeral Images	354	100+	98

Accuracy=0.98=98%

CONCLUSION AND FUTURE SCOPE:

This project focuses on the developing Numeral recognition system for Tulu scripts. Usually, there are numerous steps in the numeral recognition system, including preprocessing, segmentation, feature extraction, and classification. The goal of this researchis to investigate

various segmentation methods and classifiers that can be applied to enhancethe performance and accuracy of the recognition system. Scholars have not adequately addressed this problem, despite its importance and necessity. The lack of standardized benchmark databases on Tulu numerals is a significant challenge in the field of character recognition, and that this can make it difficult for researchers to evaluate their results and compare them to other studies. The aim of the project is to create a database of images thatresembles individual number in Tulu script. The dataset probably contain pictures ofhandwritten numeral combined with annotations or labels identifying the particular numeralthat each picture represents. For the Tulu language, there is no publicly accessible document picture database. Therefore, the researchers had to gather the photos themselves in order tobuild a database for Tulu numeral identification. The model's performance in numeral recognition can be increased even more by using large datasets for training. In the future, this project will aid in the detection of two numbers , three numbers and more. Although the CNN model was used in this work, other models could be used to increase accuracy in the future.