# Project Report

# on

# Automated Handwriting Recognition of English and Native Indian Languages with Deep Learning

(A dissertation submitted in partial fulfilment of the requirements of Bachelor of Technology in Computer Science and Engineering of the Maulana Abul Kalam Azad University of Technology, West Bengal)

Submitted by

Souporno Ghosh

Soumya Nasipuri

Rahul Roy

Sharanya Saha

Under the guidance of

Smt. Jaya Paul

Asst. Prof.,

Dept. of Computer Science and Engineering

# Government College of Engineering and Leather Technology

(Affiliated to MAKAUT, West Bengal)

Kolkata - 700106, WB

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# Certificate of Approval

This is to certify that the project report on “Automated Handwriting Recognition of English and Native Indian Languages with Deep Learning” is a record of bona fide work, carried out by Shri Souporno Ghosh, Shri Soumya Nasipuri, Shri Rahul Roy and Smt Sharanya Saha under my guidance and supervision.

In my opinion, the report in its present form is in conformity as specified by Government College of Engineering and Leather Technology and as per regulations of the Maulana Abul Kalam Azad University of Technology, West Bengal. To the best of my knowledge the results presented here are original in nature and worthy of incorporation in project report for the B.Tech. Program in Computer Science and Engineering.

Signature of Signature of

Supervisor/ Guide Head, Dept. of CSE

# ACKNOWLEDGEMENT

With great pleasure, I would like to express my profound gratitude and indebtedness to Smt Jaya Paul, Department of Computer Science and Engineering, Government College of Engineering and Leather Technology, W.B. for his continuous guidance, valuable advice and constant encouragement throughout the project work. His valuable and constructive suggestions at many difficult situations are immensely acknowledged. I am in short of words to express his contribution to this thesis through criticism, suggestions and discussions.

I would like to take this opportunity to thank Dr. Santanu Halder, HOD, Department of Computer Science & Engineering, Government College of Engineering and Leather Technology.

1. Souporno Ghosh - 11200117028
2. Soumya Nasipuri - 11200117029
3. Rahul Roy - 11200117039
4. Sharanya Saha - 11200117033

# Dedicated to

# Alan Turing, Ada Lovelace and John von Neumann

# The pioneers on whose work we expand upon.

**ABSTRACT**

**Significant amount of research has been done in the field of handwriting recognition, particularly for characters in the Latin-based alphabets (English, French, Spanish, German, etc). However, there is a significant lack of literature and research on handwriting recognition for Devanagari based languages, such as Hindi, Bangla, Sanskrit, etc. In this project, we attempt to remedy that in an attempt to create an API that is able to recognize English, Hindi and Bangla handwriting. The primary goal of the API is to identify the author of a word, sentence or passage from the handwriting written in English, Hindi or Bangla. We also provide the methods used by us in this attempt in order to facilitate further study and replication of this API for future research.**

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# CHAPTER 1: INTRODUCTION

## Motivation

Recognition and analysis of handwriting has applications in various fields such as archaeology, criminal detection, etc. However, so far handwriting analysis has only been performed by human hands. In modern days, handwriting recognition has mostly only been attempted for languages based on Latin-based alphabet. Literature related to handwriting recognition is scarce for Devanagari related languages, such as Hindi and Bengali.

Our great nation has produced many literary geniuses; Munshi Prem Chand, Rabindranath Tagore, Vikram Seth, Bankim Chandra Chatterjee, Sukumar Roy, etc. These pioneers have blessed us with a variety of literary masterpieces that provide not only an insight into their own minds but also insight on humanity and contemporary times. It is sufficed to say one learns a lot about mankind from their works. Moreover, their works and by extension, the manuscripts of said works, are a national treasure. Hence, it is imperative that their original works can be verified as their own. We can achieve this by analysing the handwritings of the writers.

<Some other applications>

These are only few of the applications of handwriting recognition that we drove us to choose this topic for our project.

## Background

<Literature Survey and related work and discuss in detail>

## Summary of present work

## Organisation of the Thesis

The thesis has been organised into primarily four chapters.

The Initial Stages chapter deals with the details of all the work that must be done before the actual programming part can be approached. This includes, but is not limited to data collection and preparation

The Preliminary Knowledge chapter deals with the necessary theory required to approach the problems. This includes any experiments we ran to test out our algorithms and any preliminary work which we referred to help with our project.

The Program Walkthrough chapter deals with all the actual program written for the image preparation and the creation of the model.

The Outputs chapter deals with the output that we get from executing the program and how they are significant.

## Hardware/Software used

Primary language used for programming is Python.

Packages used in Python are TensorFlow (a deep learning library by Google, Inc.), Keras (to help with integrating TensorFlow with Python), NumPy, Pandas, MatPlotLib, Pyplot and Seaborn. The primary algorithm used for image recognition is VGG16.

The primary hardware used comprise the personal laptop computers belonging to the team members Soumya Nasipuri (for initial programming; Intel i5, Integrated Graphics Card, 8GB RAM), Souporno Ghosh (for quality control and testing; 2.6GHz Hexa Core Intel i7 Processor, Integrated Graphics Card, 8GB RAM) and Rahul Roy (for research; 2GHz Quad Core AMD Ryzen 5 Processor, Integrated Graphics Card, 8GB RAM).

The processor and the RAM determine how fast the program will run and the dataset will be trained. The graphics card would also have accelerated the process, if GPU parallel processing was implemented in the project. A major issue with deep learning projects is that if the processing power is too less, then the model might take as long as a few days to train. However, our initial project does not take as much time time and can be replicated with a machine with as low specifications as 1.6 GHz Dual Core Processor, Integrated Graphics Card and 4GB RAM. Anything lower might take too long to process.

# CHAPTER 2: INITIAL STAGES

## Collection of Dataset

A major criterion of success in working on problems whose solutions depend on machine or deep learning is the presence of large datasets. The larger the

// 30 authors or volunteers

One of the main challenges of attempting handwriting recognition in a new language is the lack of sufficient datasets. Our mentor for the project, Smt Jaya Paul, was generous enough to assist us with that. We used volunteers <number of volunteers> of various native languages and asked them to write certain passages in their native and English languages. This provided us with the necessary dataset needed for proper model training.

English Hindi Bangla

Scaling of images. Image segmentation.

## Preparation of Dataset

The handwritten passages were scanned into image. The scanned images passages were then divided into word-sized images <How?>. These images are ready to be fed as inputs for the model.

## Construction of the Model

# CHAPTER 3: PROGRAM WALKTRHOUGH

224 224 rbg file; scaled images; pixel value normalised; data augmentation (what is); Imagenet; vgg16 preprocessing; imagenet dataset;

Way to segregataed dataset

Arranged in author pairs; authornumber\_set\_language\_number

Train: 3 files; Test: 2 files

Tiff files are named as author\_set\_language\_number

Alexnet, capsulenet

Cat dog initial experiment

For each set, we will create one csv file with 2d array with feature matrices of multiple images

# CHAPTER 4: OUTPUTS

# Reference

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