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Introduction to Problem Statement :-

- ✓ Developing a Handwriting Recognition Web Application : The web application should allow users to add data to their training dataset and also the recognition of letters.
- ✓ Starting to create an application or service has many problems but one of the main problems is which tool, language, stack or framework to build one's service or application on. As this is a deep convolutional neural network project so I have to use the libraries , frameworks and train dataset accordingly.

BASIC OVERVIEW :-

- ✓ This web app is basically like a quiz which has two option in the landing page i.e. practice and add the data.
- ✓ Within Practice page one is given letter to write within a canvas and if a congratulatory message will be shown if he had written it correct else incorrect message.
- ✓ Within add data user is asked to write Upper case alphabets which are added to the training dataset and can to used further to train the model to increase its accuracy.
- ✓ It is basically hosted on a local host and if left idle for long time server will have timeout.

INTRODUCTION

Handwriting is writing that is done by hand using a pen, pencil, digital stylus, or another instrument. The art, skill, or manner of handwriting is called **penmanship**. The two main handwriting styles are **print** and **cursive**. These are separate from normal calligraphy or typeface. Because each person's handwriting is unique and evolves differently, handwriting can be used to verify a document's writer.

Handwriting Recognition (HWR) is the capability of computers and mobile devices to receive and interpret handwritten inputs. The inputs might be **offline** (scanned from paper documents, images, etc.) and may be sensed "offline" from a piece of paper by optical scanning or intelligent word recognition or **online** (sensed from the movement of pens on a special digitizer) and Alternatively, the movements of the pen tip may be sensed "online", for example by a pen-based computer screen surface, a generally easier task as there are more clues available.

A handwriting recognition system also includes formatting, segmentation into individual characters, and training a language model that learns to frame meaningful words and sentences. The most popular technique for handwriting recognition is **Optical Character Recognition (OCR)** . It allows us to scan handwritten documents and then convert them into basic text through computer vision.

Once the handwriting is recognized by breaking the characters into segments, then it can be used for various applications like Text-detection from number plate , encryption and decryption of the messages that are used by National Intelligence Agency (NIA) and so on.

SOFTWARE / HARDWARE **REQUIREMENT**

Software Required:

- Operating System: Windows 7 or higher
- Programming: Basic HTML, Javascript and Python 3.9 or higher
- Libraries / Frameworks: Tensorflow , Flask, Sklearn

Hardware Required:

- Processor: Any Processor above 1 GHz.
- Ram: 4 GB
- Hard Disk: 4GB
- Input Devices: Standard Keyboard, Mouse
- Output Devices: VGA and High-Resolution Monitor.

TECHNOLOGY USED / ALGORITHMS

- 1- **TENSORFLOW** :- TensorFlow is an open-source software library for dataflow and differentiable programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks. It was developed by Google Brain team. TensorFlow allows developers to create data flow graphs to perform mathematical computations, and it also provides a library of highly optimized and efficient operations, including support for hardware accelerators such as GPUs. It is widely used in industry and academia for a variety of tasks such as image and speech recognition, natural language processing, and video analysis.

- 2- **FLASK** :- Flask is a micro web framework written in Python. It is classified as a microframework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. Flask is a lightweight web framework that provides useful tools and features for creating web applications in the Python programming language. It is easy to get started with and provides a small and easy-to-extend core. It is also compatible with several different templating engines and gives the developer the freedom to choose the one that best fits their project. Additionally, Flask supports extensions that can add application features as if they were implemented in Flask itself. It is popular for building small and simple web apps, and is often used as a starting point for larger projects.

3- SCIKIT-LEARN (Sklearn) :- Scikit-learn (also known as sklearn) is a free, open-source machine learning library for the Python programming language. It is built on top of other popular Python libraries such as NumPy and pandas, and provides a consistent interface for a wide range of machine learning tasks, including classification, regression, and clustering. The library is built on a modular design and provides easy-to-use and efficient tools for data mining and data analysis.

Scikit-learn provides a wide range of tools for data preprocessing, model selection, and evaluation, which makes it easy to use and allows for fast experimentation. It also has built-in support for various datasets, including the popular ones like the iris and digits datasets, and it also provides easy-to-use interfaces for loading and working with external datasets.

Scikit-learn is widely used in industry and academia, and is considered to be one of the most efficient and easy-to-use machine learning libraries available. It is a great tool for beginners and experts alike, as it provides a consistent and easy-to-use API for a wide range of machine learning algorithms, and has a large and active community which provides support and contributes to the development of the library

PROPOSED METHODOLOGY

Our main aim was to create a Handwriting Recognition App with Python , Tensorflow and Flask. The steps are as follows :-

- **Collect and preprocess the data** : Gathered a dataset of handwriting images and preprocess the data by resizing, normalizing, and converting the images to grayscale.
- **Develop the model** : Used Tensorflow to train a convolutional neural network (CNN) model on the preprocessed data. The model should be able to take an image of handwriting as input and output a predicted label for the text.
- **Test the model** : Evaluated the model's performance on a test set of data to determine its accuracy.
- **Integrate the model into the app** : Used Flask to build a web app that allows users to upload an image of handwriting, which is then passed through the trained model to predict the text.
- **Deploy the app** : Deploy the app on a web server so that it can be accessed by users.
- **Improve the model** : Continuously improved the model by trying different architectures, or by collecting and annotating more data.
- **User testing** : Test the app with users and gather feedback to improve the app's usability and overall performance.

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