

# **“ Gujarati Handwriting Recognition ”**

## **A PROJECT REPORT**

*Submitted by*

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*In partial fulfillment for the award of the degree*

*Of*

**DIPLOMA OF ENGINEERING**

*In*

**COMPUTER ENGINEERING**



**GOVERNMENT POLYTECHNIC, PORBANDAR**

**Gujarat Technological University, Ahmedabad**

**Academic Year: 2022-23**

# **GOVERNMENT POLYTECHNIC PORBANDAR**



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To achieve excellence in Computer Engineering by imparting technical and problem-solving skills along with ethical value to meet industrial requirements having social and environmental concerns.

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M1: To provides a learning ambience to enhance discipline knowledge, technical skill and problem-solving skill.

M2: To motivates students for lifelong learning to adapt challenges in rapidly changing technology.

M3: To induces ethical values and spirit of social commitment.

M4: To provide opportunities to promote leadership skill required in Computer Engineering industry's diverse culture.

**Subject: Project 1**

**Subject Code: C305, 3350706**

**Course Outcomes:**

- C305.1 Identify problem statement by surveying variety of domains.
- C305.2 Identify design methodologies based on requirement analysis.
- C305.3 Apply advanced programming techniques.
- C305.4 Present technical report by applying different visualization tools and Evaluation metrics.



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## DECLARATION

We hereby declare that the Reports, submitted along with the Project Report for the project entitled **“Gujarati Handwriting Recognition”** submitted in partial fulfillment for the degree of **Diploma in Computer Engineering** to Gujarat Technological University, Ahmadabad, is a Bona-fide record of the project work carried out at **Government Polytechnic Porbandar** under the supervision of Respected **Kartik Detroja** sir and that no part of any of these reports has been directly copied from any students' reports or taken from any other source, without providing due reference.

**Student Name**

**Student's Sign**

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Nena Maitri V (206270307038)

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Desai Riya J (206270307049)



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## **CERTIFICATE**

This is to certify that the reports, submitted along with the project entitled **“Gujarati Handwriting Recognition”** has been carried out by **Sonegra Harsh B (206270307079)** under my Guidance in partial fulfillment for the degree of: **Diploma in Computer Engineering** of Gujarat Technological University, Ahmadabad during the academic year 2022-23. These students have successfully completed report activity under my guidance.

**Internal Guide**  
Kartik Detroja Sir

**Head of Department**  
J.M. Pavagadhi



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## **CERTIFICATE**

This is to certify that the reports, submitted along with the project entitled **“Gujarati Handwriting Recognition”** has been carried out by **Nena Maitri V (206270307038)** under my Guidance in partial fulfillment for the degree of: **Diploma in Computer Engineering** of Gujarat Technological University, Ahmadabad during the academic year 2022-23. These students have successfully completed report activity under my guidance.

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**This is to certify that the reports, submitted along with the project entitled “Gujarati Handwriting Recognition” has been carried out by Naina Kuldip V (206270307006) under my Guidance in partial fulfillment for the degree of: Diploma in Computer Engineering of Gujarat Technological University, Ahmadabad during the academic year 2022-23. These students have successfully completed report activity under my guidance.**

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Kartik Detroja Sir

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J.M. Pavagadhi



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## **CERTIFICATE**

**This is to certify that the reports, submitted along with the project entitled “Gujarati Handwriting Recognition” has been carried out by Desai Riya J (206270307049) under my Guidance in partial fulfillment for the degree of: Diploma in Computer Engineering of Gujarat Technological University, Ahmadabad during the academic year 2022-23. These students have successfully completed report activity under my guidance.**

**Internal Guide**  
Kartik Detroja Sir

**Head of Department**  
J.M. Pavagadhi



## **ACKNOWLEDGEMENT**

I am grateful to Mrs. J. M. Pavagadhi head of department of computer engineering for providing me all the facility that was required for the successfully completion of our project. Our special thanks of gratitude to our internal guide Kartik Detroja sir for their valuable guidance and support in completing our project.

I would like to thanks to all professors, parents and friends who helped me a lot in finalizing this project within the limited time frame. Last but not the least we are grateful to authors of the reference and other literatures referred to in this project.

## ABSTRACT

The aim of this project was to design and create a machine learning model that gives accurate output to the input from various interfaces. This model allows the input of image that consist of Gujarati handwritten digits and it produces accurate output for that image.

The model interfacing is simple, user friendly and secured after launching it as an API.

The main goal this project is to learn the trending technology and automations. This is to facilitate all people who are in model's use cases.

It has many technical elements and the rules are fairly simple. This simplicity makes it a good choice for learning a new program environment. It covers a range of areas (machine learning, deep learning, mathematics, image processing, etc.) but none too difficult.

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- **Selection of project field:**

As the field of automation and machine learning is growing up , we've decided to identify such problem that can be automated by implementing machine learning models and can reduced the amount of effort and time of human being.

- **Identification and selection of problem:**

There are many problems that can be solved by implementing models of machine learning like OCR, Detection of many diseases, etc. so we've decided to implement a Gujarati Handwriting recognition model that can recognize the Gujarati Digits given in input with good accuracy.

- **Abstract:**

The model will be trained with many examples of Gujarati handwriting digits. And after a certain amount of digits are feed into model. It can then identify the unknown image that is given as input.

- **Selection of resources:**

**Language:** We've chosen python as language to code the model because of following points.

- Easy to learn ( syntactically )
- Rich library support
- More resources and references available
- Less complex

- **Dataset:** There is no dataset available in Gujarati digits to use it in our model so we have to build our own dataset by clicking photos of Gujarati handwritten digits.

- **Dataset processing (pre-processing):**

- After collection of the dataset, the images might be in blue/black/red writing through pen so, we'll have to go through whole dataset and convert it into grayscale.
- The images might have different size (px-px) so we have to go through whole dataset and convert it into same sized images in terms of pixel.
- If the images are might be blur or unclear we'll have to remove it or we'll have to sharpen it fir better accuracy.

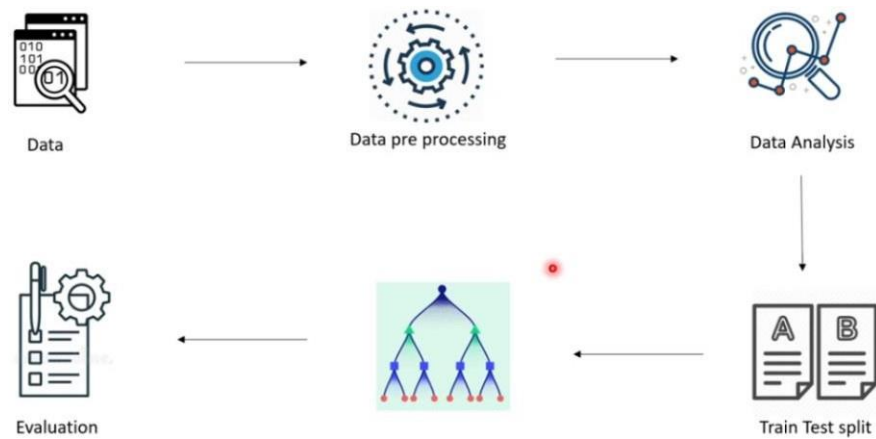
- **Learning:**

- We're currently trying to implement less complex models for better understanding of our final project.
- We've seen the basics of machine learning, AI and deep learning.
- We've seen the types of data available in dataset which is structured and unstructured data. Our project is based on unstructured data.
- We've seen types of learning: supervised / unsupervised and reinforcement learning.
- Now, we're trying to build some simple models like house price prediction using linear regression, and classification using logistic, etc.
- After trying various projects models on available dataset we'll finally try to implement our custom dataset model that would be our final year project.
- We've done python basics for machine learning, we've done processing of images that is required for our project, we've learnt libraries of python like Numpy, pandas, Matplotlib, sea born etc.
- We've done essential mathematics that is also required like linear algebra, statistics, probability etc.

- **Use cases of model:**

- Computer vision.
- Real-time embedded systems for detection and identification of Gujarati handwriting.
- Banking receipts.
- Phone books.
- Text-to-speech Gujarati.

- **Flow of our project:**

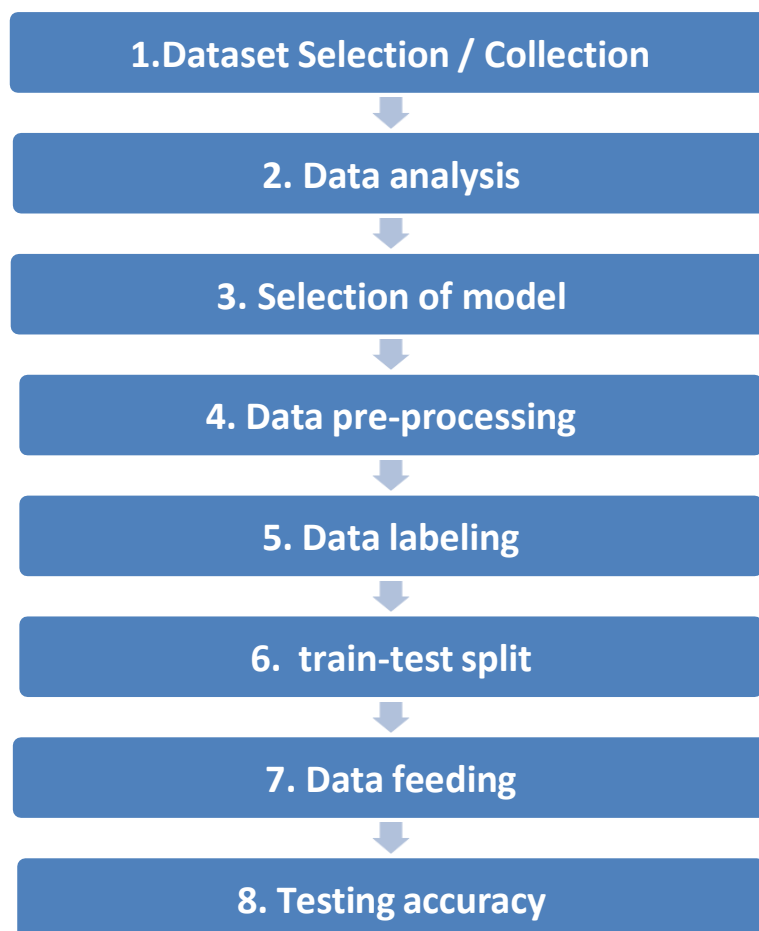


- Data: we've to build our own dataset for this project.
- Pre-processing: We've to process the data in following ways
  - Grayscale
  - Sharpening
  - Resizing
- Analysis: get the properties of images and analysis of it.
- Split the set into two set of getting accuracy of model.
- Feed set into model.
- Evaluate the dataset for various models to get best accuracy.

### ❖ Semester 5: Presentation-1 Project (Cat vs. Dog) information:

- As we have to learn machine learning first and then we'll try to implement our final year project on our custom dataset of Gujarati handwriting, we've built a similar model that can classify between cat image and dog image.
- As this model includes raw dataset available in kaggle, we've used this dataset for our presentation -1 model.
- This model include image resizing, labeling and train-test split that is useful for understanding the flow of any model.
- This Cat vs. Dog dataset is a colored image dataset which is not re-sized.
- We've chose this dataset because it includes classification on unstructured data which is similar to our handwriting recognition project.
- The dataset and code is available on respective folder.

### ❖ Flow of cat vs. dog model:



## **1. Data collection**

- Data collection / selection include the dataset selection from available set of data
- Here, we're using dog vs. cat dataset uploaded by kaggle itself.

## **2. Data analysis**

- Data analysis includes getting insights of the dataset.
- It means how the images are arranged.
- Whether they are in same size or not.
- Whether they are grayscale or not.
- Whether the images are in same folder or in different folder. Whether the training and testing folders are given. What is the directory structure of the Dataset
- In our data analysis we have found that the images are colored, the images are not in grayscale and they are not of the same size. Also they are in different folders for cat and dog ad train and test folders are not there.
- Also there are total 12000+ images of both cats and dogs I means it has about 24000 images.

## **3. Selection of model**

- After data analysis based on the data we've to decided which model to choose it must give high accuracy and optimum results.
- We've chose tensorflow feature vector because it gives high accuracy on classification on unstructured dataset.

## **4. Data pre-processing**

- In data pre-processing we process on the dataset before feeding it into model for better accuracy.
- We've found that the images are not of the same sizes and there are many images for a simple classification problem.
- We've cut the  $\frac{1}{4}$  part of the whole set into total 6000 images it means we've chose 3000 images of both dog and cat.
- Also the images are not of the same size so we've resized the images into 224x224 pixel dimensions.
- So, after pre-processing we have new set of images which consists 3000 images of both cats and dogs of the same size which is 224x224 pixels.



## 5. Data labeling :

- The data for the classification (supervised learning) needs labels to predict the class / output name of the given input.
- Sometimes the dataset already gives us labels but we found that we had no labels for this set in our data analysis.
- We've labeled the pre-processed set as Cat as label 0 and dog to label 1.

## 6. Train – test split:

- In our data analysis we found that there are no separate folders for testing and training.
- So, we've separated the pre-processed set into 2 sub-sets which are training set and testing set along with the labels of individual records.
- We've split the pre-processed set that consist of 3000 images of dogs and cats into 300 testing images which is 10% of whole set.
- After train test split we have 2400 images of dogs and 2400 of cats and 300 images for testing of both. So there are 5400 images for training and 600 for testing.

## 7. Data feeding:

- Data is then feed to model we've chose to train the model.
- We've converted all the images into RGB equivalent images and scaled the matrix into value between 0-1 by dividing the matrix values with 255.
- Then these scaled image metrics are feed into model with epoch=5.
- It means we've trained the model 5 times with the 5400 images.

## 8. Testing accuracy of model:

- After training the model is testing with the testing set with equivalent labels.
- We've tested the model with 600 records and the accuracy of our model is 97 percentages.
- It means our model predicts 97 images correct out of 100 images and it predicted 582 images correct out of 600 testing set.

```
In [26]: score , acc = model.evaluate(x_test,y_test)
```

```
19/19 [=====] - 7s 302ms/step - loss: 0.0608 - acc: 0.9783
```

```
In [27]: print(f'Accuracy of test dataset is : {int(acc*100)} %')
```

```
Accuracy of test dataset is : 97 %
```

### ❖ Working of the model:

- The feature vector automatically extracts features which are important and produces more dependencies on output.
- For example: The size of dog is bigger than the cat, so the algorithm takes this feature to a vector. Then the colour of various dogs / cats species are different so algorithm will extract this feature from dataset to a vector. The shape of dog and cat faces / eyes / nose are different and have huge dependency on output.
- By this model makes a feature vector / matrix to predict whether the unidentified image given in input matches the features of that feature vector.
- And that's how the unidentified images are classified based on this feature vector.
- In this type of model the dataset must be huge because it takes more images to identify the features from the set automatically.
- **Dataset must be huge enough.**
- **In small training set model will under fit.**
- **Gives High accuracy**
- **Note: we've not gray-scaled the images because it might be possible that the algorithm has colour feature vector so if we do it the accuracy is affected.**

### ❖ Hyper parameters of model.

- Number of classes: 2 (dog/cat) -> states the number of classification objects.
- Optimizer: The magnitude of change in value of model parameters is decided by optimizer. In this case we've used optimizer 'adam'.
  - The magnitude of change is determined by formula of adam optimizer in our model. Formula is given by

$$w_t = w_{t-1} - \eta \frac{\hat{m}_t}{\sqrt{\hat{v}_t + \epsilon}}$$

- Epochs: 5 -> the dataset are iterated 5 times with given images in dataset. Provides better accuracy.

### ❖ Conclusion:

- We've selected machine learning / deep learning project to learn more about automations and trending technologies products.
- We've selected python as it is easy to learn and more tutorials and resources are available for machine learning with python.
- We've first learnt python as language and then we've understood basic concepts for machine learning like definitions and difference between machine learning, Ai and deep learning.
- After that we've understood the types of learning: supervised, unsupervised and reinforcement learning.
- After that we've learnt basic maths needed for machine learning like linear algebra, statistics and probability.
- We've also learnt libraries that are essential for machine learning: Numpy, Matplotlib, seaborn, pandas etc.
- After that we've learnt algorithms used in many learning like linear regression, logistic regression and we're trying to implement it using python.
- We're also trying to implement various projects using models on ready-made dataset like house price prediction, fake news detection, and other.
- The ultimate goal of this project is not to just build handwriting recognition model but get used to machine learning models and to implement algorithms in any given problem.