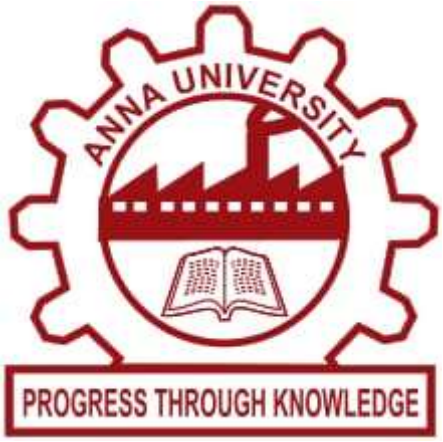
UNIVERSITY COLLEGE OF ENGINEERING VILLUPURAM



A Novel Method for Handwritten Digit Recognition System

SUBMITTED BY

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TEAM ID - PNT2022TMID29320

CHAPTER 1
INTRODUCTION

PROJECT OVERVIEW

Machine learning and deep learning play an important role in computer technology and artificial intelligence. With the use of deep learning and machine learning, human effort can be reduced in recognizing, learning, predictions and in many more areas.

Handwritten Digit Recognition is the ability of computer systems to recognise handwritten digits from various sources, such as images, documents, and so on. This project aims to let users take advantage of machine learning to reduce manual tasks in recognizing digits.

PURPOSE

Digit recognition systems are capable of recognizing the digits from different sources like emails, bank cheque, papers, images, etc. and in different real-world scenarios for online handwriting recognition on computer tablets or system, recognize number plates of vehicles, processing bank cheque amounts, numeric entries in forms filled up by hand (tax forms) and so on.

CHAPTER 2
LITERATURE SURVEY

EXISTING PROBLEM

The fundamental problem with handwritten digit recognition is that handwritten digits do not always have the same size, width, orientation, and margins since they vary from person to person. Additionally, there would be issues with identifying the numbers because of similarities between numerals like 1 and 7, 5 and 6, 3 and 8, 2 and 5, 2 and 7, etc. Finally, the individuality and variation of each individual's handwriting influence the structure and appearance of the

digits.

REFERENCE

Aparna et al, proposed a method to construct a handwritten Tamil character by executing a sequence of strokes. A structure or shape-based representation of a stroke was used in which a stroke was represented as a string of shape features. Using this string representation, an unknown stroke was identified by comparing it with a database of strokes using a flexible string matching procedure.

Renata F. P. Neves has proposed SVM based offline handwritten digit recognition. Authors claim that SVM outperforms the Multilayer perceptron classifier. Experiment is carried out on NIST SD19 standard dataset. Advantage of MLP is that it is able to segment non-linearly separable classes. However, MLP can easily fall into a region of local minimum, where the training will stop assuming it has achieved an optimal point in the error surface. Another hindrance is defining the best network architecture to solve the problem, considering the number of layers and the number of perceptrons in each hidden layer. Because of these disadvantages, a digit recognizer using the

MLP structure may not produce the desired low error rate.

Improved Handwritten Digit Recognition Using Quantum K-Nearest Neighbor Algorithm (2019)

Wang, Yuxiang and Wang, Ruijin and Li, Dongfen and Adu-Gyamfi, Daniel and Tian, Kaibin and Zhu, Yixin

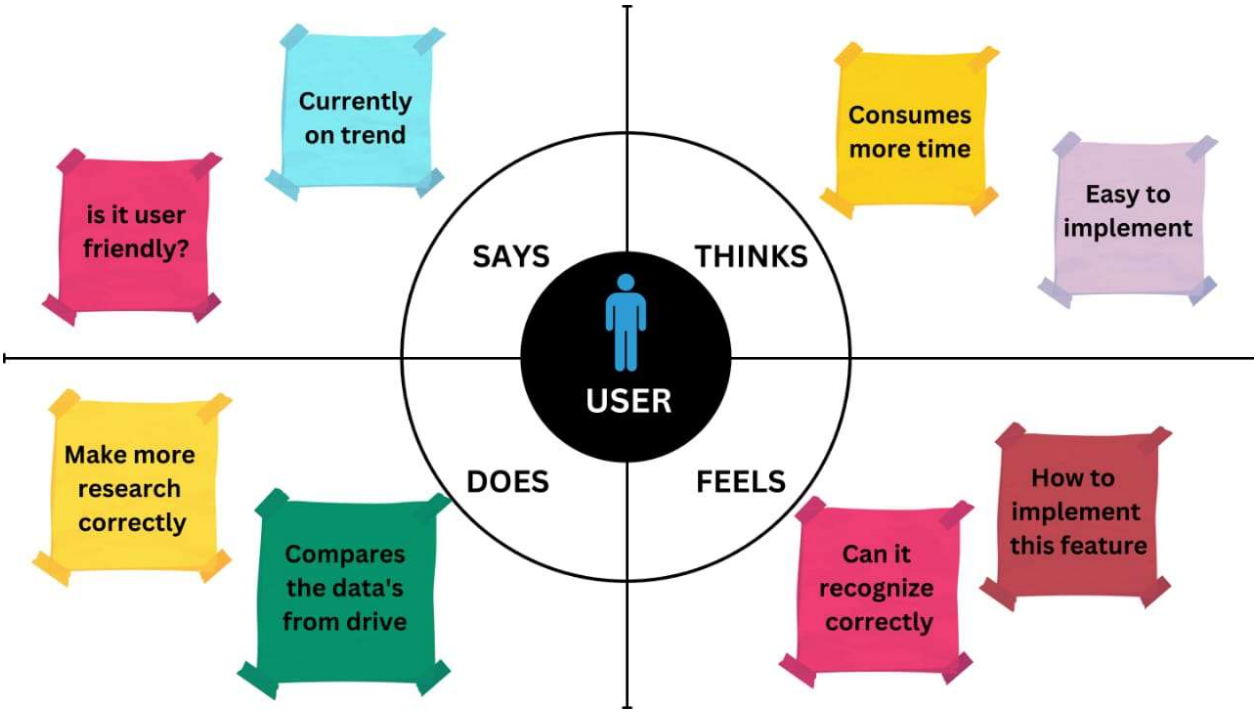
The KNN classical machine learning technique is used in this research to enable quantum parallel computing and superposition. They used the KNN algorithm with quantum acceleration to enhance handwritten digit recognition. When dealing with more complicated and sizable handwritten digital data sets, their suggested method considerably lowered the computational time complexity of the traditional KNN algorithm. The paper offered a theoretical investigation of how quantum concepts can be applied to machine learning. Finally, they established a fundamental operational concept and procedure for machine learning with quantum acceleration.

PROBLEM STATEMENT DEFINITION

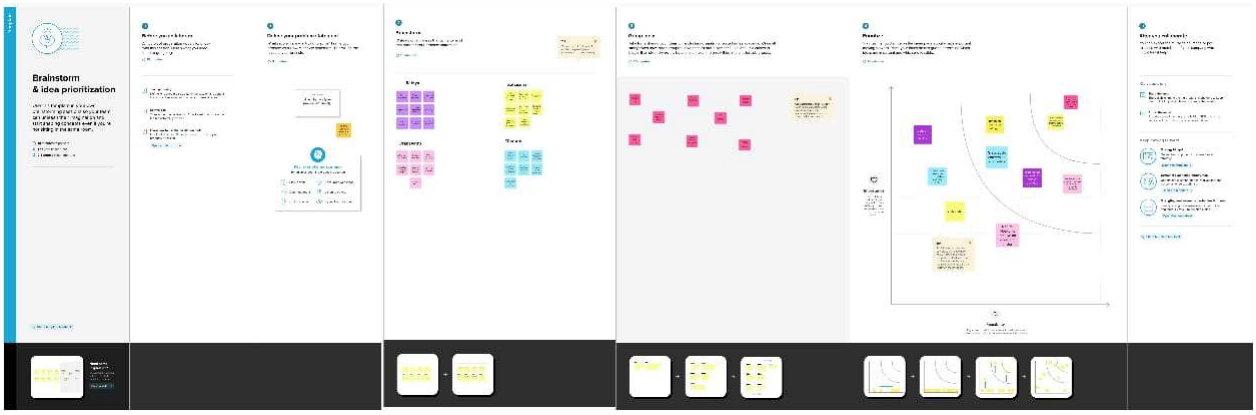
For years, the traffic department has been combating traffic law violators. These offenders endanger not only their own lives, but also the lives of other individuals. Punishing these offenders is critical to ensuring that others do not become like them. Identification of these offenders is next to impossible because it is impossible for the average individual to write down the license plate of a reckless driver. Therefore, the goal of this project is to help the traffic department identify these offenders and reduce traffic violations as a result.

CHAPTER 3

IDEATION AND PROPOSED SOLUTION



IDEATION & BRAINSTORMING



PROPOSED SOLUTION

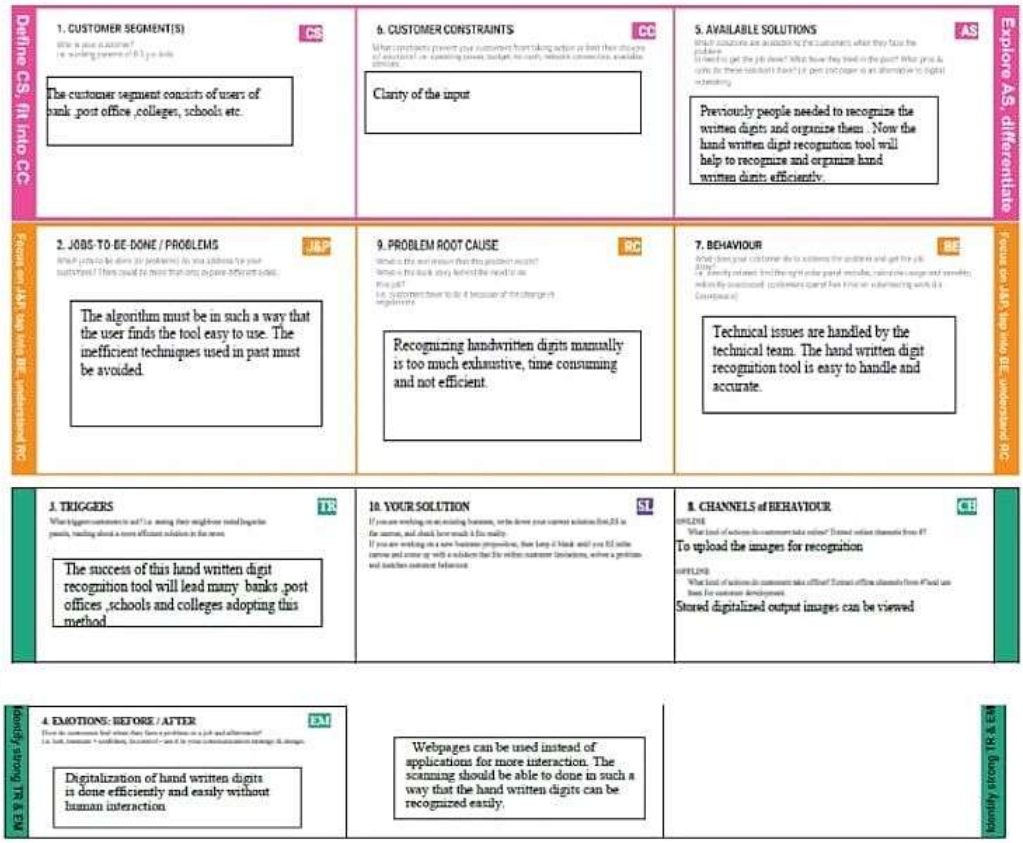
S.NO	PARAMETER	DESCRIPTION

1	Problem Statement	To create an application that recognizes handwritten digits
2	Idea / Solution Description	The application takes an image as the input and accurately detects the digits in it.
3	Novelty / Uniqueness	Instead of recognizing every text, the application accurately recognizes only the digits
4	Social Impact / Customer Satisfaction	This application reduces the manual tasks that need to be performed. This improves productivity in the workplace.
5	Business Model	The application can be integrated with traffic surveillance cameras to recognize vehicle number plates The application can be integrated with Postal systems to recognize the pin codes effectively
6	Scalability of the Solution	The application can easily be scaled to accept multiple inputs and process them parallelly to further increase efficiency

PROBLEM SOLUTION FIT

Project Title: A Novel Method for Handwritten Digits

Team ID:PNT2022TMID29320



SS

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Input correlation	Image Correlation is a technique used to recognize characters from images.
FR-2	Data Preparation	Collecting data and prepare it for training
FR-3	Feature extraction	Feature extraction is analysing the images and derive some characteristics from these images that identify each specific element
FR-4	Character classification	During the classification phase, the attributes of the data in the picture are compared to the classes in the database to determine which class the picture belongs to.

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

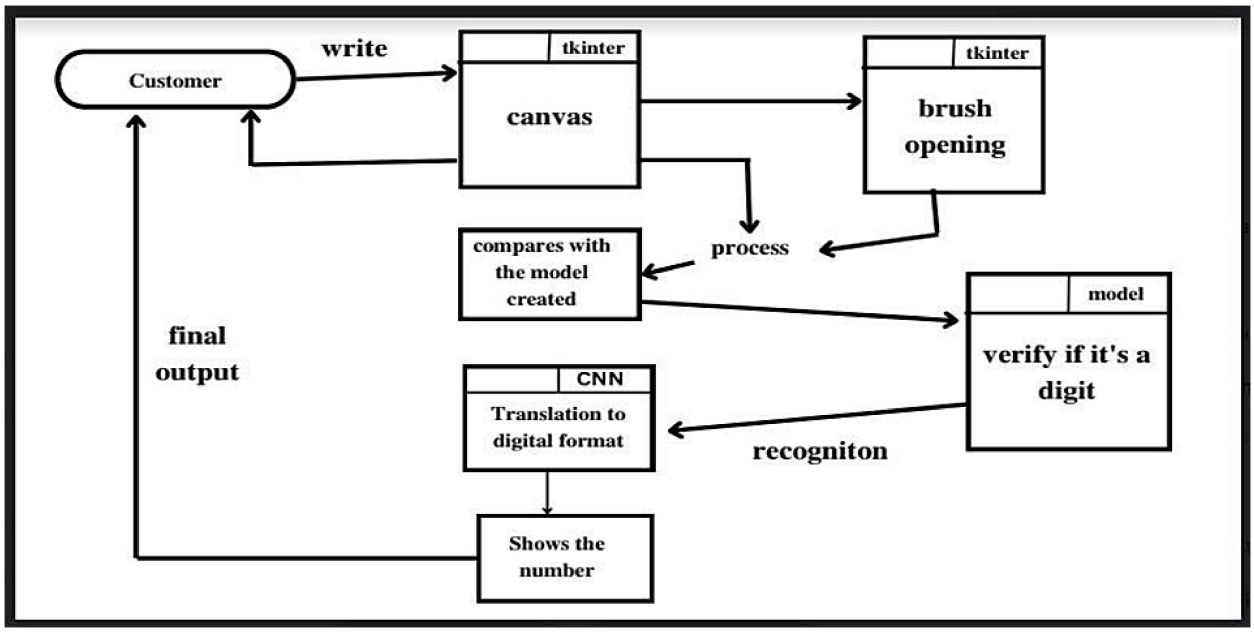
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The software is very easy to use and reduces the learning work.To recognize the digits from bank cheque,papers,numeric entry in forms etc.
NFR-2	**Security**	The handwritten digit recognition can be used by banking sector where it can be used to maintain the security pin numbers, it can be also used for blind peoples by using sound output.
NFR-3	**Reliability**	This software will work reliably for low resolution images and not for graphical images.
NFR-4	**Performance**	Handwritten characters in the input image will be recognized with an accuracy of about 90% and more.
NFR-5	**Availability**	This system will retrieve the handwritten text regions only if the image contains written text in it.
NFR-6	**Scalability**	It contains thousands of handwritten digits that have been used in the development of programs .

PROJECT DESIGN

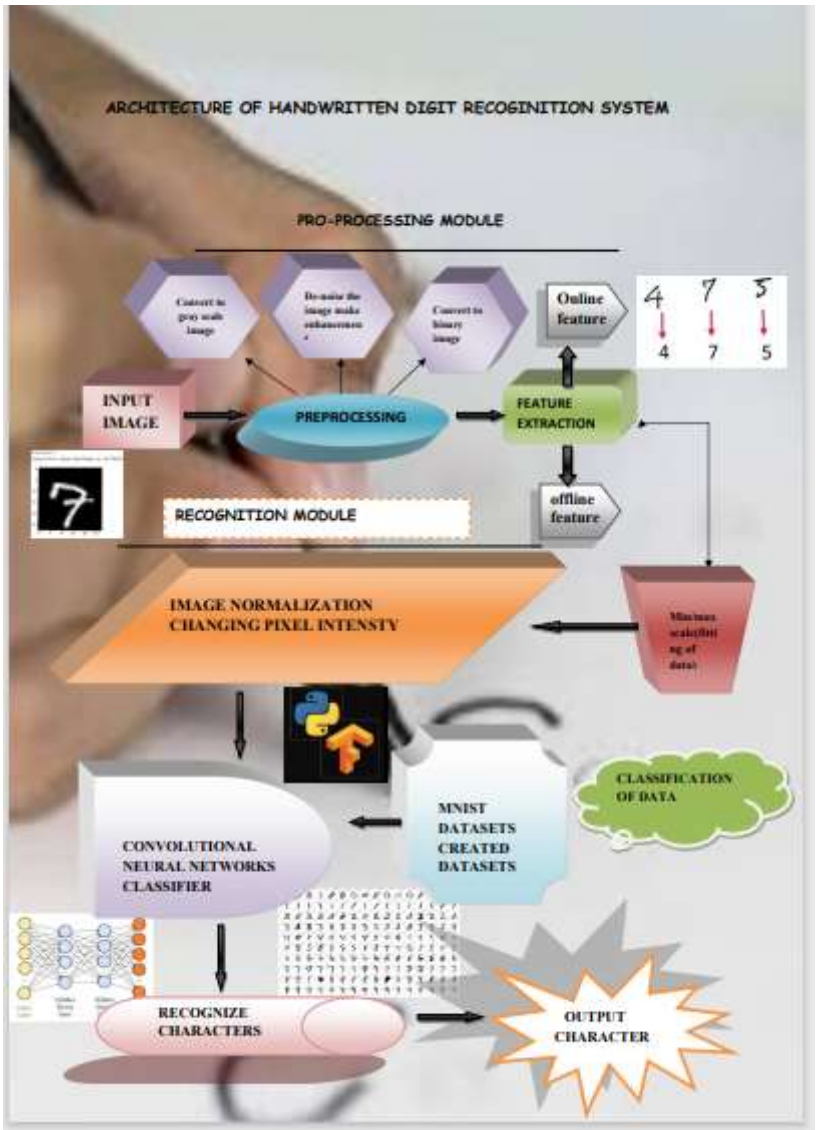
DATAFLOW DIAGRAMS:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

Example: DFD Level 0 (Industry Standard)



SOLUTION AND TECHNICAL ARCHITECTURE



USER STORIES:

User Type	Functional Requirements	User Story Number	User Story / Task	Acceptance Criteria	Priority	Release
Customer	Accessing the Application	USN-1	As a user, I should be able to access the application from anywhere and use on any devices	User can access the application using the browser on any device	High	Sprint-4
	Uploading Image	USN-2	As a user, I should be able to upload images to predict the digits	User can upload images	High	Sprint-3
	Viewing the Results	USN-3	As a user, I should be able to view the results	The result of the prediction is displayed	High	Sprint-3

	Viewing Other Prediction	USN-4	As a user, I should be able to see other close predictions	The accuracy of other values must be displayed	Medium	Sprint-4
	Usage Instruction	USN-5	As a user, I should have a usage instruction to know how to use the application	The usage instruction is displayed on the home page	Medium	Sprint-4

CHAPTER 6

PROJECT PLANNING AND SCHEDULING

SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	As a user, I can collect the dataset from various resources with different handwritings.	10	Low	Ilakiya Kalaiselvi
Sprint-1	Data Preprocessing	USN-2	As a user, I can load the dataset, handling the missing data, scaling and split data into train and test.	10	Medium	Prabavathi Dharani
Sprint-2	Model Building	USN-3	As a user, I will get an application with ML model which provides high accuracy of recognized handwritten digit.	5	High	Ilakiya Kalaiselvi Prabavathi Dharani
Sprint-2	Add CNN layers	USN-4	Creating the model and adding the input, hidden, and output layers to it.	5	High	Ilakiya Kalaiselvi Prabavathi Dharani

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Compiling the model	USN-5	With both the training data defined and model defined, it's time to configure the learning process.	2	Medium	Kalaiselvi Prabavathi
Sprint-2	Train & test the model	USN-6	As a user, let us train our model with our image dataset.	6	Medium	Dharani Ilakiya
Sprint-2	Save the model	USN-7	As a user, the model is saved & integrated with an android application or web application in order to predict something.	2	Low	Ilakiya
Sprint-3	Building UI Application	USN-8	As a user, I will upload the handwritten digit image to the application by clicking a upload button.	5	High	Kalaiselvi
Sprint-3		USN-9	As a user, I can know the details of the fundamental usage of the application.	5	Low	Dharani
Sprint-3		USN-10	As a user, I can see the predicted / recognized digits in the application.	5	Medium	Prabavathi
Sprint-4	Train the model on IBM	USN-11	As a user, I train the model on IBM and integrate flask/Django with scoring end point.	10	High	Ilakiya Kalaiselvi Prabavathi Dharani
Sprint-4	Cloud Deployment	USN-12	As a user, I can access the web application and make the use of the product from anywhere.	10	High	Kalaiselvi Ilakiya

SPRINT DELIVERY SCHEDULE:

Sprint and Duration Chart

Sprint	Functional Requirement	Task
Sprint-1	Image Data	As a User need to collect the Image Data of Handly Written Images to train the model.

Sprint-2	Dash Board or Website	We using Python Flask Framework to create a dynamic Webpage to host our model (UI).
Sprint-3	Classifier Model	Using CNN Model for Image Classification.
Sprint-4	Cloud	Hosting the Organized appication in Cloud platform.

Sprint and Duration Chart

Sprint	Duration	Sprint Start Date	Sprint End Date
Sprint-1	6 Days	25 Oct 2022	29 Oct 2022
Sprint-2	6 Days	31 Oct 2022	05 Nov 2022
Sprint-3	6 Days	07 Nov 2022	12 Nov 2022

CHAPTER 7

CODING & SOLUTIONING

```
import numpy as np
import os
from PIL import Image
from flask import Flask, request, render_template, url_for
from werkzeug.utils import secure_filename, redirect
from gevent.pywsgi import WSGIServer
from keras.models import load_model
from keras.preprocessing import image
from flask import send_from_directory

```

```
UPLOAD_FOLDER = 'C:/Users/Dell/PycharmProjects/A-novel-method-for-digit-recognition-system/flask_app/uploads'


app = Flask(__name__)
app.config['UPLOAD_FOLDER'] = UPLOAD_FOLDER

model = load_model("mnistCNN.h5")


@app.route('/')
def index():
    return render_template('index.html')
```

```
@app.route('/')
def index():
    return render_template('index.html')


@app.route('/predict', methods=['GET', 'POST'])
def upload():
    if request.method == "POST":
        f = request.files["image"]
        filepath = secure_filename(f.filename)
        f.save(os.path.join(app.config['UPLOAD_FOLDER'], filepath))

        upload_img = os.path.join(UPLOAD_FOLDER, filepath)
        img = Image.open(upload_img).convert("L")  # convert image to monochrome
        img = img.resize((28, 28))  # resizing of input image

        im2arr = np.array(img)  # converting to image
        im2arr = im2arr.reshape(1, 28, 28, 1)  # reshaping according to our requirement

        pred = model.predict(im2arr)

        num = np.argmax(pred, axis=1)  # printing our labels

        return render_template('predict.html', num=str(num[0]))


if __name__ == '__main__':
    app.run(debug=True, threaded=False)
```

CHAPTER 8
TESTING

TEST CASES

Test case ID	Feature Type	Test Scenario	Expected Result	Actual Result	Status
HP_TC_001	UI	Verify UI elements in the Home Page	The Home page must be displayed properly	Working as expected	FAIL
HP_TC_002	UI	Check if the UI elements are displayed properly in different screen sizes	The Home page must be displayed properly in all sizes	The UI is not displayed properly in screen size 2560 x 1801 and 768 x 630	FAIL
HP_TC_003	Functional	Check if user can upload their file	The input image should be uploaded to the application successfully	Working as expected	PASS
HP_TC_004	Functional	Check if user cannot upload unsupported files	The application should not allow user to select a non image file	User is able to upload any file	FAIL

HP_TC_005	Functional	Check if the page redirects to the result page once the input is given	The page should redirect to the results page	Working as expected	PASS

BE_TC_001	Functional	Backend	Check if all the routes are working properly	All the routes should properly work	Working as expected	PASS
M_TC_001	Functional	Model	Check if the model can handle various image sizes	The model should rescale the image and predict the results	Working as expected	PASS
M_TC_002	Functional	Model	Check if the model predicts the digit	The model should predict the number	Working as expected	PASS
M_TC_003	Functional	Model	Check if the model can handle complex input image	The model should predict the number in the complex image	The model fails to identify the digit since the model is not built to handle such data	FAIL

RP_TC_001	UI	Result Page	Verify UI elements in the Result Page	The Result page must be displayed properly	Working as expected	PASS
RP_TC_002	UI	Result Page	Check if the input image is displayed properly	The input image should be displayed properly	The size of the input image exceeds the display container	FAIL
RP_TC_003	UI	Result Page	Check if the result is displayed properly	The result should be displayed properly	Working as expected	PASS
RP_TC_004	UI	Result Page	Check if the other predictions are displayed properly	The other predictions should be displayed properly	Working as expected	PASS

USER ACCEPTANCE TESTING

DEFECT ANALYSIS

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Total
By Design	1	0	1	0	2
Duplicate	0	0	0	0	0
External	0	0	2	0	2
Fixed	4	1	0	1	6
Not Reproduced	0	0	0	1	1
Skipped	0	0	0	1	1
Won't Fix	1	0	1	0	2
Total	6	1	4	3	14

TEST CASE ANALYSIS

Section	Total Cases	Not Tested	Fail	Pass
Client Application	10	0	3	7
Security	2	0	1	1
Performance	3	0	1	2

Exception Reporting	2	0	0	2

CHAPTER 9
RESULTS

PERFORMANCE METRICS

Locust Test Report

During: 11/15/2022, 9:50:40 AM - 11/15/2022, 10:01:59 AM

Target Host: http://127.0.0.1:5000/

Script: locust.py

Request Statistics

Method	Name	# Requests	# Fails	Average (ms)	Min (ms)	Max (ms)	Average size (bytes)	RPS	Failures/s
GET	/	1043	0	13	4	290	1079	1.9	0.0
GET	/predict	1005	0	39648	385	59814	2670	1.8	0.0
	Aggregated	**2048**	**0**	**19462**	**4**	**59814**	**1859**	**3.7**	**0.0**

Response Time Statistics

Method	Name	50%ile (ms)	60%ile (ms)	70%ile (ms)	80%ile (ms)	90%ile (ms)	95%ile (ms)	99%ile (ms)	100%ile (ms)
GET	/	10	11	13	15	19	22	62	290
GET	/predict	44000	46000	47000	48000	50000	52000	55000	60000
	Aggregated	**36**	**36000**	**43000**	**45000**	**48000**	**50000**	**54000**	**60000**

-


Charts
RPS
Failures/s
Total Requests per Second
6
5
4
3
2
1
0
9:50:40 AM
9:51:33 AM
9:52:38 AM
9:53:27 AM
9:54:22 AM
9:55:18 AM
9:58:27 AM
9:59:22 AM
10:00:18 AM
10:01:05 AM
Median Response Time
95% percentile
Response Times (ms)
60,000
50,000
40,000
30,000
20,000
10,000
0
9:50:40 AM
9:51:33 AM
9:52:38 AM
9:53:27 AM
9:54:22 AM
9:55:18 AM
9:58:27 AM
9:59:22 AM
10:00:18 AM
10:01:05 AM
Users
Number of Users
120
100
80
60
40
20
0
9:50:40 AM
9:51:33 AM
9:52:38 AM
9:53:27 AM
9:54:22 AM
9:55:18 AM
9:58:27 AM
9:59:22 AM
10:00:18 AM
10:01:05 AM

CHAPTER 10

ADVANTAGE & DISADVANTAGE

ADVANTAGE

- **Reduce manual work**
- **More accurate than human**
- **Capable of handling a lot of data**
- **Can be use any where fom any device**

DISADVANTAGES

- **cannot handle complex data**
- **All the data must be in digital format**
- **Requires a high performance server for faster prediction**
- **Prone to occasional errors**

CHAPTER 11
CONCLUSION

This project demonstrated a web application that uses machine learning to recognise handwritten numbers. Flask, HTML, CSS, JavaScript, and a few other technologies were used to create this project. The model predicts the handwritten digit using a CNN network. During testing, the model achieved a 99.61% recognition rate. The proposed project is scalable and can easily handle a huge number of users. Since it is a web application, it is compatible with any device that can run a browser. This project is extremely useful in real-world scenarios such as recognizing number plates of vehicles, processing bank cheque amounts, numeric entries in forms filled up by hand (tax forms) and so on. There is so much room for improvement, which can be implemented in subsequent versions

CHAPTER 12
FUTURE SCOPE

This project is far from complete and there is a lot of room for improvement. Some of the improvements that can be made to this project are as follows:

1. Add support to detect from digits multiple images and save the results
2. Add support to detect multiple digits
3. Improve model to detect digits from complex images
4. Add support to different languages to help users from all over the world

This project has endless potential and can always be enhanced to become better. Implementing this concept in the real world will benefit several industries and reduce the workload on many workers, enhancing overall work efficiency.

APPENDIX

SOURCE CODE

MODEL CREATION

```
import numpy as np
import tensorflow #open source used for both ML and DL for computation
from tensorflow.keras.datasets import mnist #mnist dataset
from tensorflow.keras.models import Sequential #it is a plain stack of layers
from tensorflow.keras import layers #A Layer consists of a tensor- in tensor-out computat ion funct ion
from tensorflow.keras.layers import Dense, Flatten #Dense-Dense Layer is the regular deeply connected r
#faltten -used fot flattening the input or change the dimension
from tensorflow.keras.layers import Conv2D #onvoLutiona l Layer
from tensorflow.keras.optimizers import Adam #optimizer
from keras. utils import np_utils #used for one-hot encoding
import matplotlib.pyplot as plt   #used for data visualization


(x_train, y_train), (x_test, y_test)=mnist.load_data ()
x_train=x_train.reshape (60000, 28, 28, 1).astype('float32')
x_test=x_test.reshape (10000, 28, 28, 1).astype ('float32')
number_of_classes = 10  #storing the no of classes in a variable
y_train = np_utils.to_categorical (y_train, number_of_classes) #converts the output in binary format
y_test = np_utils.to_categorical (y_test, number_of_classes)
```

```
#adding model Layer
model.add(Conv2D(64, (3, 3), input_shape=(28, 28, 1), activation='relu'))
model.add(Conv2D(32, (3, 3), activation = 'relu'))
```

```
#flatten the dimension of the image
model.add(Flatten())
```

```
#output layer with 10 neurons
model.add(Dense(number_of_classes,activation = 'softmax'))
```

Compiling the model

```
#Compile model
model.compile(loss= 'categorical_crossentropy', optimizer="Adam", metrics=['accuracy'])
```

```
x_train = np.asarray(x_train)
y_train = np.asarray(y_train)
```

```
#Compile model
model.compile(loss= 'categorical_crossentropy', optimizer="Adam", metrics=['accuracy'])
```

```
x_train = np.asarray(x_train)
y_train = np.asarray(y_train)
```

Train the model

+ Code + Markdown

```
#fit the model
model.fit(x_train, y_train, validation_data=(x_test, y_test), epochs=5, batch_size=32)
```

Observing the metrics

```
# Final evaluation of the model
metrics = model.evaluate(x_test, y_test, verbose=0)
print("Metrics (Test loss &Test Accuracy) : ")
print(metrics)
```

```
prediction=model.predict(x_test[6000:6001])
print(prediction)
```

```
plt.imshow(x_test[6000])
```

```
import numpy as np
print(np.argmax(prediction, axis=1)) #printing our Labels from first 4 images
```

```
[9]
```

```
np.argmax(y_test[6000:6001]) #printing the actual labels
```

```
9
```

Save The model

```
# Save the model
model.save('mnistCNN.h5')
```

FLASK APP

```
@app.route('/')
def index():
    return render_template('index.html')


@app.route('/predict', methods=['GET', 'POST'])
def upload():
    if request.method == "POST":
        f = request.files["image"]
        filepath = secure_filename(f.filename)
        f.save(os.path.join(app.config['UPLOAD_FOLDER'], filepath))

        upload_img = os.path.join(UPLOAD_FOLDER, filepath)
        img = Image.open(upload_img).convert("L")  # convert image to monochrome
        img = img.resize((28, 28))  # resizing of input image

        im2arr = np.array(img)  # converting to image
        im2arr = im2arr.reshape(1, 28, 28, 1)  # reshaping according to our requirement

        pred = model.predict(im2arr)

        num = np.argmax(pred, axis=1)  # printing our Labels

        return render_template('predict.html', num=str(num[0]))


if __name__ == '__main__':
    app.run(debug=True, threaded=False)
```

HOME PAGE HTML

```html
<html>

<head>
  <title>Digit Recognition WebApp</title>

  <meta name="viewport" content="width=device-width">
  <!-- GoogleFont -->
  <link href="https://fonts.googleapis.com/css2?family=Prompt:wght@600&display=swap" rel="stylesheet">
  <link href="https://fonts.googleapis.com/css2?family=Varela+Round&display=swap" rel="stylesheet">
  <link href="https://fonts.googleapis.com/css2?family=Source+Code+Pro:wght@500&display=swap" rel="stylesheet">
  <link href="https://fonts.googleapis.com/css?family=Calistoga|Josefin+Sans:400,700|Pacifico&display=swap" rel="stylesheet">
  <!-- bootstrap -->
  <link rel="stylesheet" href="https://stackpath.bootstrapcdn.com/bootstrap/4.3.1/css/bootstrap.min.css"  crossorigin="anonymous">
  <link rel="stylesheet" type= "text/css" href= "{{ url_for('static',filename='css/style.css') }}">
  <!-- fontawesome -->
  <script src="https://kit.fontawesome.com/b3aed9cb07.js" crossorigin="anonymous"></script>

  <script src="https://code.jquery.com/jquery-3.3.1.slim.min.js"  crossorigin="anonymous"></script>
  <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js/1.14.7/umd/popper.min.js"  crossorigin="anonymous"></script>
  <script src="https://stackpath.bootstrapcdn.com/bootstrap/4.3.1/js/bootstrap.min.js"  crossorigin="anonymous"></script>
  <script src="https://cdn.jsdelivr.net/npm/@tensorflow/tfjs@latest"></script>

</head>

<script>
  function preview() {
    frame.src=URL.createObjectURL(event.target.files[0]);
}

    $(document).ready(function() {
          $('#clear_button').on('click', function() {
              $('#image').val('');
              $('#frame').attr('src',"");
            });
        });

</script>
```

```html
<body>

  <h1 class="welcome">IBM PROJECT
  <div id="PNT2022TMID15689">TEAM ID : PNT2022TMID15689</div>
  </h1>
  <section id="title">
    <h4 class="heading">Handwritten Digit Recognition Website</h4>
    <br><br>
      <p>
        The website is designed to predict the handwritten digit.
      </p>
    <p>
        Handwriting recognition is one of the compelling research works going on because every individual in this world
        has their own style of writing. It is the capability of the computer to identify and understand
        handwritten digits or characters automatically. Because of the progress in the field of science and technology,
        everything is being digitalized to reduce human effort.</p>

      <br>
    <p> Hence, there comes a need for handwritten digit recognition in many real-time applications.
        MNIST data set is widely used for this recognition process and it has 70000 handwritten digits.
        We use Artificial neural networks to train these images and build a deep learning model.
        Web application is created where the user can upload an image of a handwritten digit.
        This image is analyzed by the model and the detected result is returned on to UI</p>

  </section>

  <section id="content">

        <div class="leftside">
        <form action="/predict" method="POST" enctype="multipart/form-data">
        <label>Select a image:</label>
        <input id="image" type="file" name="image" accept="image/png, image/jpeg" onchange="preview()"><br><br>
          <img id="frame" src="" width="100px" height="100px"/>
          <div class="buttons_div">
            <button type="submit" class="btn btn-dark" id="predict_button">Predict</button>
            <button type="button" class="btn btn-dark" id="clear_button">  Clear  </button>
          </div>
        </form>
        </div>
  </section>
```

HOME PAGE (CSS)

```css
#clear_button{
  margin-left: 15px;
  font-weight: bold;
  color: blue;
}

#confidence{
  font-family: 'Josefin Sans', sans-serif;
  margin-top: 7.5%;
}

#content{
  margin: 0 auto;
  padding: 2% 15%;
  padding-bottom: 0;
}

.welcome{
  text-align: center;
  position: relative;
  color: honeydew;
  background-color: greenyellow;
  padding-top: 1%;
  padding-bottom: 1%;
  font-weight: bold;
  font-family: 'Prompt', sans-serif;
}

#PNT2022TMID15689{
  text-align: right;
  font-size: 25px;
  padding-right: 3%;
}

#predict_button{
  margin-right: 15px;
  color: blue;
  font-weight: bold;
}
```

```css
}

#title{
  padding: 1.5% 15%;
  margin: 0 auto;
  text-align: center;
}

.btn {
    font-size: 15px;
    padding: 10px;
    -webkit-appearance: none;
    background: #eee;
    border: 1px solid #888;
    margin-top: 20px;
    margin-bottom: 20px;
}

.buttons_div{
  margin-bottom: 30px;
  margin-right: 80px;
}

.heading{
  font-family: 'Varela Round', sans-serif;
  font-weight: 700;
  font-size: 2rem;
  display: inline;
}

.leftside{
  text-align: center;
  margin: 0 auto;
  margin-top: 2%;
  /* padding-left: 10%; */
}

#frame{
  margin-right: 10%;
}
```

```css
#frame{
  margin-right: 10%;
}

.predicted_answer{
  text-align: center;
  margin: 0 auto;
  padding: 3% 5%;
  padding-top: 0;
  /* padding-left: 10%; */
}

p{
  font-family: 'Source Code Pro', monospace,sans-serif;
  margin-top: 1%;
}

@media (min-width: 720px) {
  .leftside{
    padding-left: 10%;
  }
}
```

HOME PAGE (JS)

```js
feather.replace(); // Load feather icons

form = document.querySelector('.upload')
loading = document.querySelector("#Loading")
select = document.querySelector("#upload-image");

select.addEventListener("change", (e) => {
    e.preventDefault();

    form.submit()
    form.style.visibility = "hidden";
    loading.style.display = 'flex';
});
```

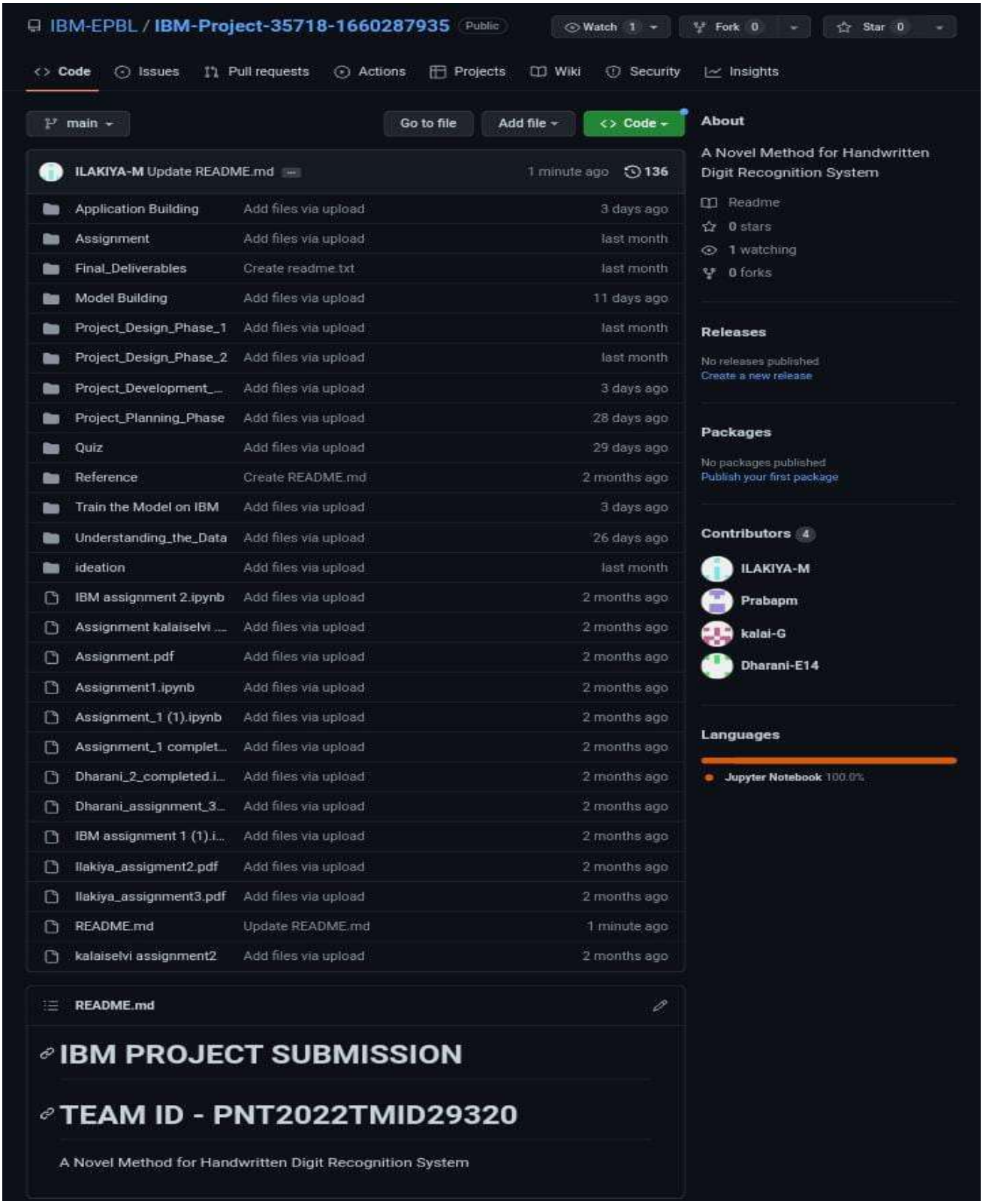
PREDICT PAGE HTML

```
<html>
    <head>
        <title>Prediction | Handwritten Digit Recognition</title>
        <link rel="stylesheet" href="{{url_for('static',filename='css/predict.css')}}" />
        <link rel="icon" type="image/svg" sizes="32x32" href="{{url_for('static',filename='images/icon.svg')}}"
 />
        <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    </head>
    <body>
        <div class="container">
            <h1>Prediction</h1>
            <div class="result-wrapper">
                <div class="input-image-container">
                    <img src="{{url_for('static',filename='data/')}}{{img_name}}" />
                </div>
                <div class="result-container">
                    <div class="value">{{best.0}}</div>
                    <div class="accuracy">{{best.1}}%</div>
                </div>
            </div>
            <h1>Other Predictions</h1>
            <div class="other_predictions">
                {% for x in others %}
                <div class="value">
                    <h2>{{x.0}}</h2>
                    <div class="accuracy">{{x.1}}%</div>
                </div>
                {% endfor %}
            </div>
        </div>
    </body>
</html>
```

```css
@import url("https://fonts.googleapis.com/css2?family=Overpass:wght@200;300;400;500;600;700;900&display=swap");

body {
    color: black;
    font-family: "Overpass", sans-serif;
}

h1 {
    padding-top: 2rem;
}

.container {
    display: flex;
    justify-content: center;
    align-items: center;
    flex-direction: column;
}

.result-wrapper {
    width: -webkit-fit-content;
    width: -moz-fit-content;
    width: fit-content;
    height: -webkit-fit-content;
    height: -moz-fit-content;
    height: fit-content;
    box-shadow: 0 0 10px rgb(125, 125, 125);
    padding: 1.5rem;
    display: flex;
    justify-content: center;
    align-items: center;
    -moz-column-gap: 1rem;
    column-gap: 1rem;
}

.result-wrapper .input-image-container,
.result-wrapper .result-container {
    width: 15rem;
    height: 15rem;
    border: 1px dashed black;
    justify-content: center;
    display: flex;
    align-items: center;
    flex-direction: column;
    background-color: rgb(209, 208, 208);
}
```

```css
.result-wrapper .input-image-container img {
    width: 60%;
    height: 60%;
    background-color: aqua;
    background-size: contain;
}

.result-wrapper .result-container .value {
    font-size: 6rem;
}

.result-wrapper .result-container .accuracy {
    margin-top: -1rem;
}

.other_predictions {
    display: flex;
    justify-content: center;
    align-items: center;
    flex-wrap: wrap;
    column-gap: 1rem;
    row-gap: 1rem;
    font-weight: 700;
}

.other_predictions .value {
    display: flex;
    justify-content: center;
    align-items: center;
    flex-direction: column;
    width: 5rem;
    height: 5rem;
    box-shadow: 0 0 7px rgb(158, 157, 157);
}

.other_predictions .value div {
    margin-top: -1.2rem;
}

@media screen and (max-width: 700px) {
    h1 {
        font-size: 2.3rem;
    }

    .result-wrapper .input-image-container,
    .result-wrapper .result-container {
        width: 7rem;
        height: 7rem;
    }

    .result-wrapper .result-container .value {
        font-size: 4rem;
    }
}
```

GITHUB PROFILE



GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project-35718-1660287935.git

GITHUB ID

IBM-PROJECT-35718-1660287935

https://github.com/IBM-EPBL/IBM-Project-35718-1660287935