Project Report Format

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1 .INTRODUCTION

1.1 Project Overview

Intelligent Garbage Classifcation Using Deep Learning

Category: Artificial Intelligence

Skills Required:

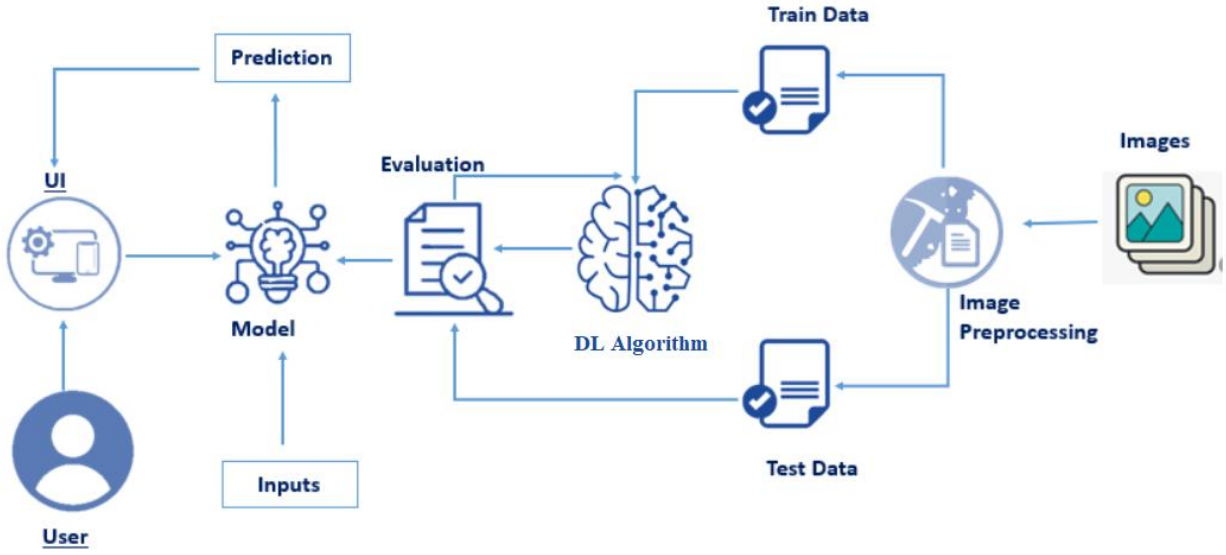
Python,Python Web Frame Works,CNN,Deep Learning,Python-Flask

Project Description:

According to the next 25 years, the less developed countries' waste accumulation will increase drastically. With the increase in the number of industries in the urban area,the disposal of the solid waste is really becoming a big problem, and the solid waste includes paper, wood, plastic, metal, glass etc. The common way of managing waste is burning waste and this method can cause air pollution and some hazardous materials from the waste spread into the air which can cause cancer. Hence it is necessary to recycle the waste to protect the environment and human beings' health, and we need to separate the waste into different components which can be recycled using different ways.

The present way of separating waste/garbage is the hand-picking method, whereby someone is employed to separate out the different objects/materials. The person who separates waste, is prone to diseases due to the harmful substances in the garbage. With this in mind, it motivated us to develop an automated system which is able to sort the waste. and this system can take a short time to sort the waste, and it will be more accurate in sorting than the manual way. With the system in place, the beneficial separated waste can still be recycled and converted to energy and fuel for the growth of the economy. The system that is developed for the separation of the accumulated waste is based on the combination of Convolutional Neural Network

Technical Architecture:



1.2

Purpose

The purpose of an intelligence garbage classification system using deep learning is to optimize waste management and promote sustainability. With the increasing amount of waste being generated worldwide,it has become necessary to efficiently manage and optimize its disposal.

Through utilizing deep learning, the intelligence garbage classification system can accurately identify and classify different types of waste materials, such as plastic, paper, metal, and glass. This information can be used to it is essential to have a more efficient and effective way of managing it.

The traditional methods of garbage collection and disposal are not sustainable in the long run, and they can have a negative impact on the environment and human health. By using deep learning techniques, an intelligence garbage classification system can automate the process of identifying and sorting different types of waste.

The system can learn to recognize various waste materials, such as plastics, metals, and paper, from images, videos, or other sensory inputs. This will enable waste management companies to streamline their operations, reduce the amount of waste sent to landfills, and increase recycling rates.

Ultimately, an intelligence garbage classification system using deep learning can contribute to a cleaner and healthier environment.

2.IDEATION & PROPOSED SOLUTION

2.1 Problem Statement Definition

In many cities around the world, garbage management has become a major issue. Proper disposal of waste is a necessity to reduce pollution and maintain healthy environment. Garbage classification is a crucial step in waste management, as it helps in segregating recyclable waste from non-recyclable waste. However, manual classification of garbage is time-consuming, labour-intensive, and error-prone. This cleanliness in the environment. However, the process of waste segregation is often carried out manually, which can be tedious, time-consuming and prone to error.

Moreover, improper segregation can lead to incorrect handling and treatment of waste material There is a need for a technology that can quickly and accurately classify waste into different categories based on its composition. This will enable effective management of waste and its safe disposal.

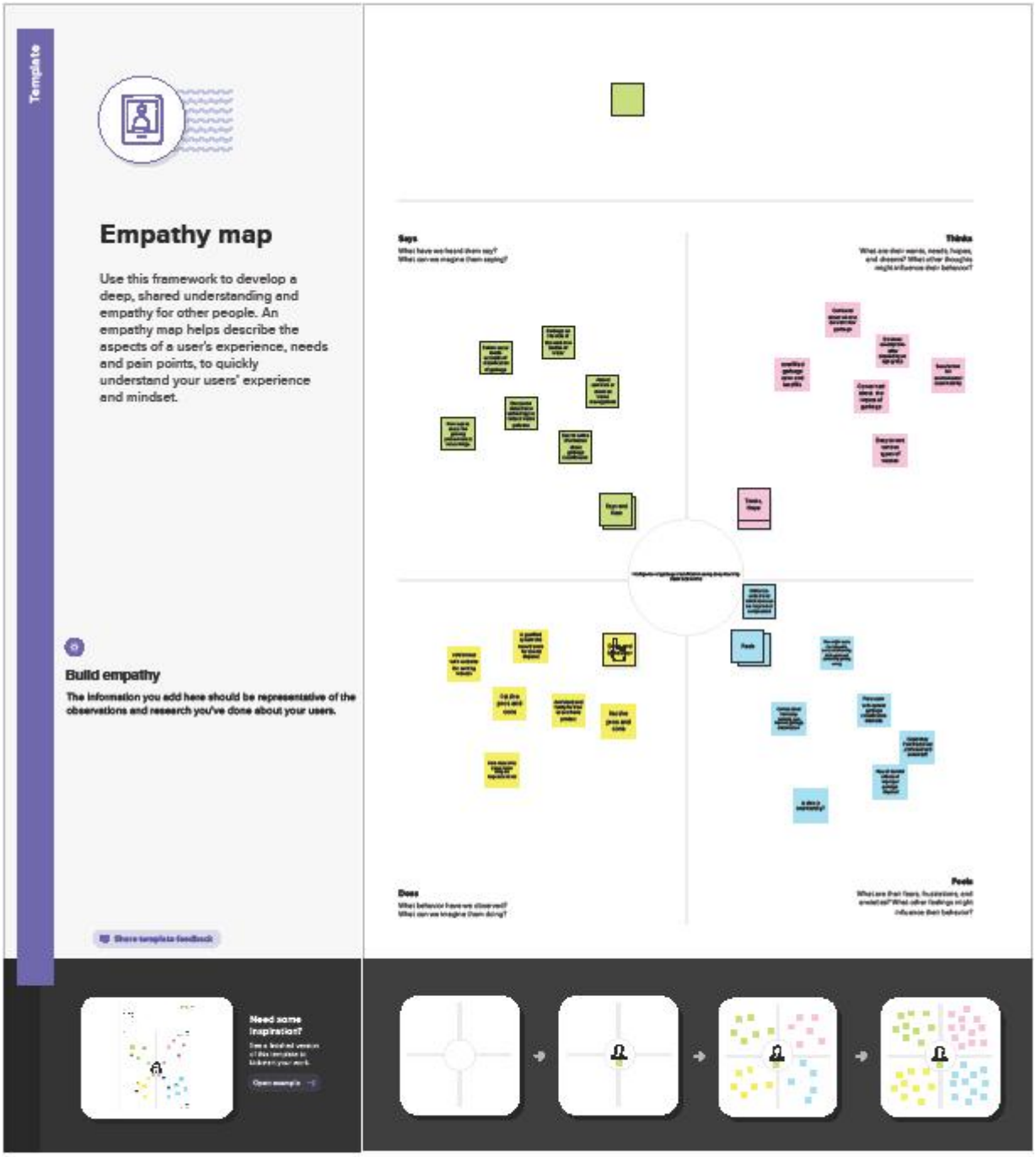
Problem Statement (PS)	I am (customer)	I'm trying to	But	Because	Which makes me feel
PS1	a street cleaner	Sorting different type of garbage categories	It is difficult to analyze texture of that wastes	Some particles are damaged	confusion
PS2	a Forest officer	reduce soil pollution at environment	It takes more time to classify the materials	It has huge space so we unable to collect the all things easier	frustrate d
PS3	a Drainage cleaner	to resolve water pollution at street canal to separate the garbage like organic wastes,plastics.....	No one voluntarily come forward do that work	It has high toxic level and hazardous for skin and eye .it will lead to diseases like Cholera, Polio , Diarrhoea, Typhoid	awful
PS4	a teacher	Teach my students to split garbage as BioDegradable and Non – Bio Degradable waste	Some students are not interested to do that work	Students aren't look at real time recycling machinery so they doesn't believ	doubtful

2.2 Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's Behaviour and attitudes It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it.

REFERENCE:

https://app.mural.co/invitation/mural/idhayaengineeringcollegeforw8311/1682921928088?sender=u7e2d0598d35afb661b879970&key=e8c1426e-b38a-40f8-acdb-c4cb0635047b

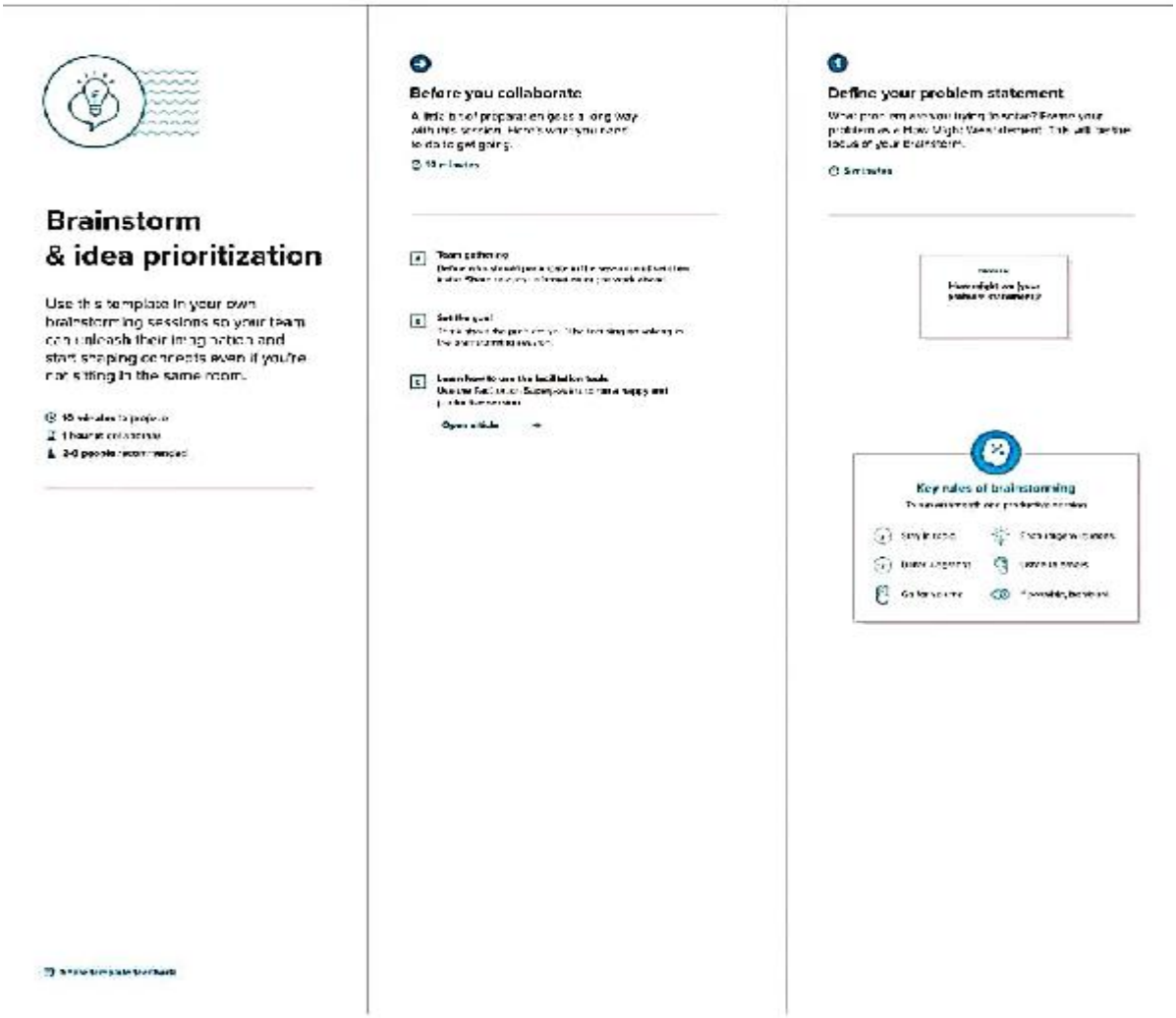


2.3 Ideation & Brainstorming

REFERENCE:

https://app.mural.co/invitation/mural/idhayaengineeringcollegeforw3467/1682947567139?sender=u7e2d0598d35afb661b879970&key=0798b754

STEP 1: TEAM GATHERING, COLLABORATION AND SELECT THE PROBLEM STATEMENT



2 .Brainstorm ,Idea Listing and Group

2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

Person 1

- Use machine learning algorithms to train a model to recognize different garbage images and labels, such as organic waste,plastic waste, paper waste, metal waste, and electronic waste.
- Implement computer vision techniques to extract features from garbage images such as shape, texture, and color.
- Use sensors and IoT devices to collect real-time data on the types of garbage(plastic waste, paper waste, metal waste, and so on.

Person 2

- Implement sensors on garbage bins that can detect the type of waste being thrown away and sort it automatically.
- Develop a mobile application that assists users in identifying the proper way to dispose of their waste and lead them to nearby recycling facilities.
- Provide incentives for citizens who properly categorize their garbage, such as discounts on city services or waste management fees.

Person 3

- Introduce educational programs for schools and households to raise awareness about the importance of garbage classification and the impact it has on the environment.
- Incorporate image recognition technology to automatically identify different types of garbage based on their visual characteristics.
- Curious about the latest advancements in technology, particularly in deep learning(Pain Points, and Gains. Below is an example of what each section could include:

Person 4

- Concerned about the impact of garbage on the environment - Frustrated with current garbage classification meth
- Satisfaction in taking steps towards environmental sustainability
- Difficulty understanding which items can be recycled or composted
- Lack of consistency in garbage classification guidelines

Person 5

- Search online for information about garbage classification
- Knowledge and understanding of proper garbage disposal methods
- App can be used for classify the materiel

3.Idea Prioritization

3

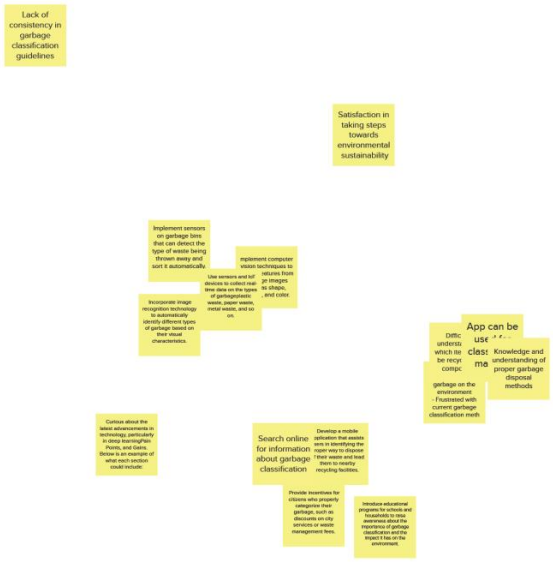
Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.



4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

TIP

Importance

Feasibility

2.4 Proposed Solution

S.NO	Parameter	Description
1	Problem statement (Problem tobe solved)	Waste management has become a crucial issuein our society due to the increasing amount of garbage that is generated every day. Inefficientwaste management often leads to serious consequences such as environmental pollution,soil degradation, and air pollution, which affects human health. A major challenge in waste management is the lack of proper sorting and segregation of waste, which leads to the mixing of different types of waste management systems lead to environmental pollution and health hazards. However, waste sorting and recycling can reduce the negative impact of waste on the environment. The current system of garbage collection and disposal does not effectively segregate waste, leading to a lack of efficient recycling.
2	Idea/Solution description	Our idea is to develop an intelligent garbage classification system that uses deep learning algorithms to segregate waste materials. By leveraging image recognition and classificationtechniques, we can accurately identify and categorize different types of waste. This system aims to encourage people to sort their garbage correctly, making waste management more efficient and sustainable.
03	Novelty/Uniqueness	Our solution is unique because it uses deep learning algorithms to classify waste materials, eliminating the need for manual sorting. This approach is not currently employed in most waste management systems, which rely on manual labour to sort garbage. The use of deeplearning can significantly improve the efficiency of garbage classification and increaserecycling rates, leading to a more sustainable waste management system.
04	Social Impact/Customer Satisfaction	The social impact of intelligence garbage classifications using deep learning is significantand far-reaching. Some of the major impacts are: 1. Environmental Impact: Garbage is a major environmental issue around the world. Intelligent garbage classificationsystems can help to reduce the amount of waste that ends up in landfills by improving the accuracy of waste sorting. With deep learning technology, garbage classification can be automated, and the accuracy of is amajor environmental problem that has resulted in landfills and oceans filled with waste that will take hundreds or thousands of years to decompose. 2. Employment Opportunities: The implementation of garbage classification using deep learning can create new employment opportunitiesin the waste management industry. The need for skilled technicians to operate the technology and sort garbage can create jobs and improve the economy. 3. Public Health: Garbage that is not classified properly can cause health hazards for the public. For instance,food waste can attract rodents and other disease-carrying pests. 4. Sustainability: Deep learning can beused to analyze the garbage composition and provide valuable information for city planners and policy 5. Education: The implementation of garbage classification using deep learning can also create awareness among the public about the value of recycling, waste reduction, and the importance of proper disposal of waste. This can lead to a positive change in behaviour towards waste management among individuals. Customer satisfaction:

		The intelligent garbage classification system offers many benefits to customers. Firstly, it makes garbage disposal and sorting more convenient and less time-
05	Business Model(Revenue Model)	The business model for intelligence garbage classification using deep learning can be basedon a number of models. One possible model is a B2B sales model where the solution is sold tomunicipalities and waste management companies who are looking to improve their waste sorting processes. The solution can also be sold as a value-added service to waste collection companies, who can then offer it to their clients as part of their waste management the solution is sold to waste management companies or municipalities. Another model could be a B2C model wherethe solution is sold directly to households to aid in their waste management efforts.
06	Scalability of the Solution	- The technology is highly scalable: Deep learning technology used for intelligent garbage classification is highly scalable since itcan process large amounts of data in real-timeand adjust to changing scenarios. - Increased accuracy: As the system collectsmore data, it becomes more accurate in predicting and Categorizing waste. - Potential for integration: Intelligent garbage classification can be integrated with other waste management systems, such as transportation and recycling programs. This integration can enhance overall efficiency andsustainability of the waste management process. Cost-effective: The technology is cost- effective as it eliminates the need for manual sorting and can be applied to a variety of wastestreams

3 . REQUIREMENT ANALYSIS

3.1 Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Garbage Classification	The user should be able to input the type of garbage into the system for classification, such as plastic waste, organic information.
FR-4	Image capture	Image capture: The system should allow users to capture an image ofthe garbage item they want to dispose of.
FR-5	Image recognition	Image recognition: The system should use deep learning to accuratelyclassify the garbage items based on the images captured by the users.
FR-6	Feedback:	Feedback: The system should provide real-time feedback to userson the correct category for the garbage item they captured.
FR-7	Location-based information:	Location-based information: The system should provide location-based information,for example, nearest recycling facilities and disposal sites, to users.

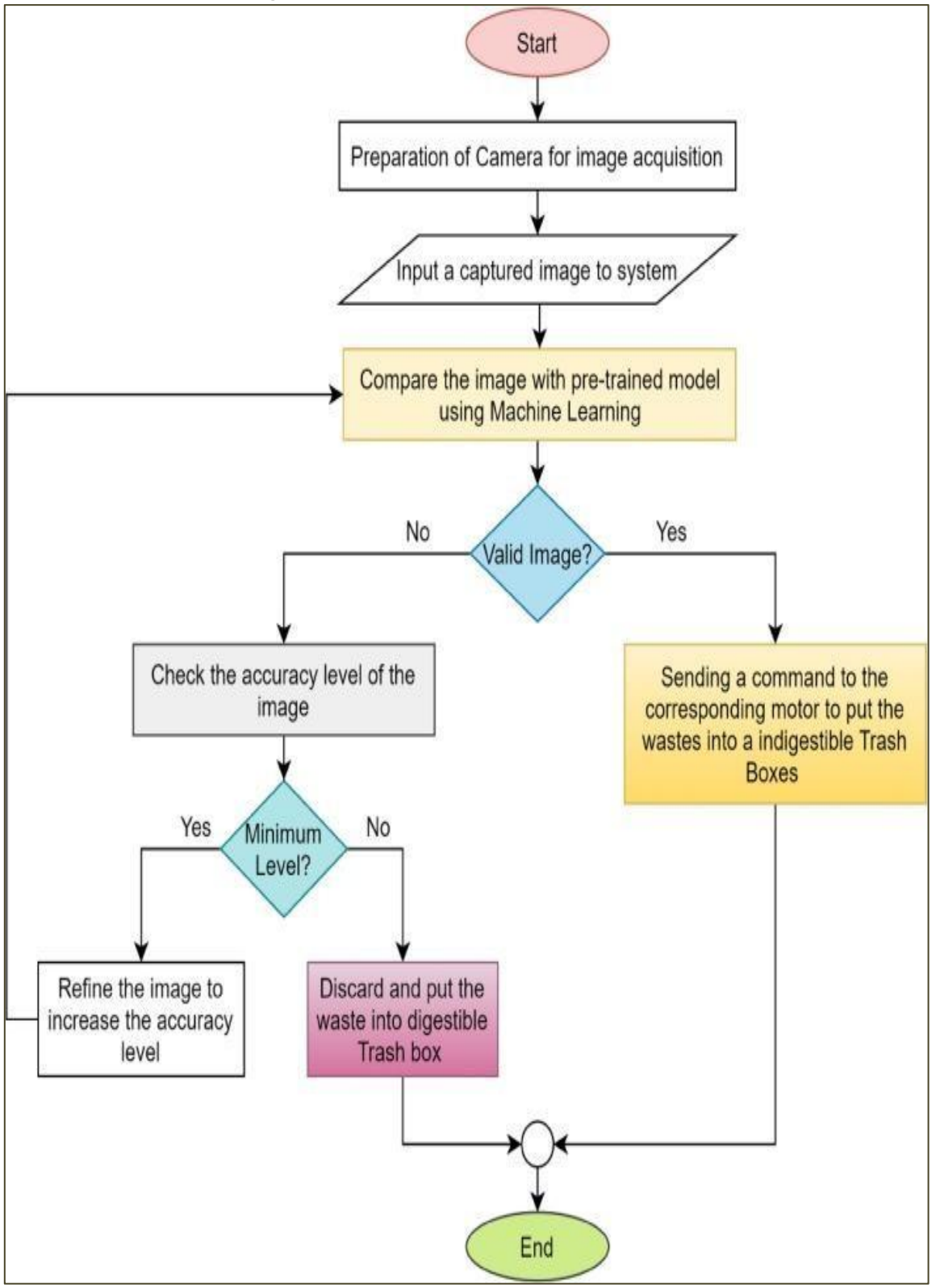
FR-8	Multilingual support:	Multilingual support: The system should support multiple languages to caterto the needs of diverse users.
FR-9	User management:	User management: The system should allow users to manage their account information, view their garbage disposal history, and provide feedback or submitcomplaints.
FR-10	Integration with other systems	Integration with other systems: The system should be compatible with other waste management systems and provide seamless integration.
FR-11	Reporting and analytic	Reporting and analytic: The system should generate reports and provide data analytic on garbage disposal patterns and trends to helpimprove waste management practices.

3.2 Non-Functional requirements

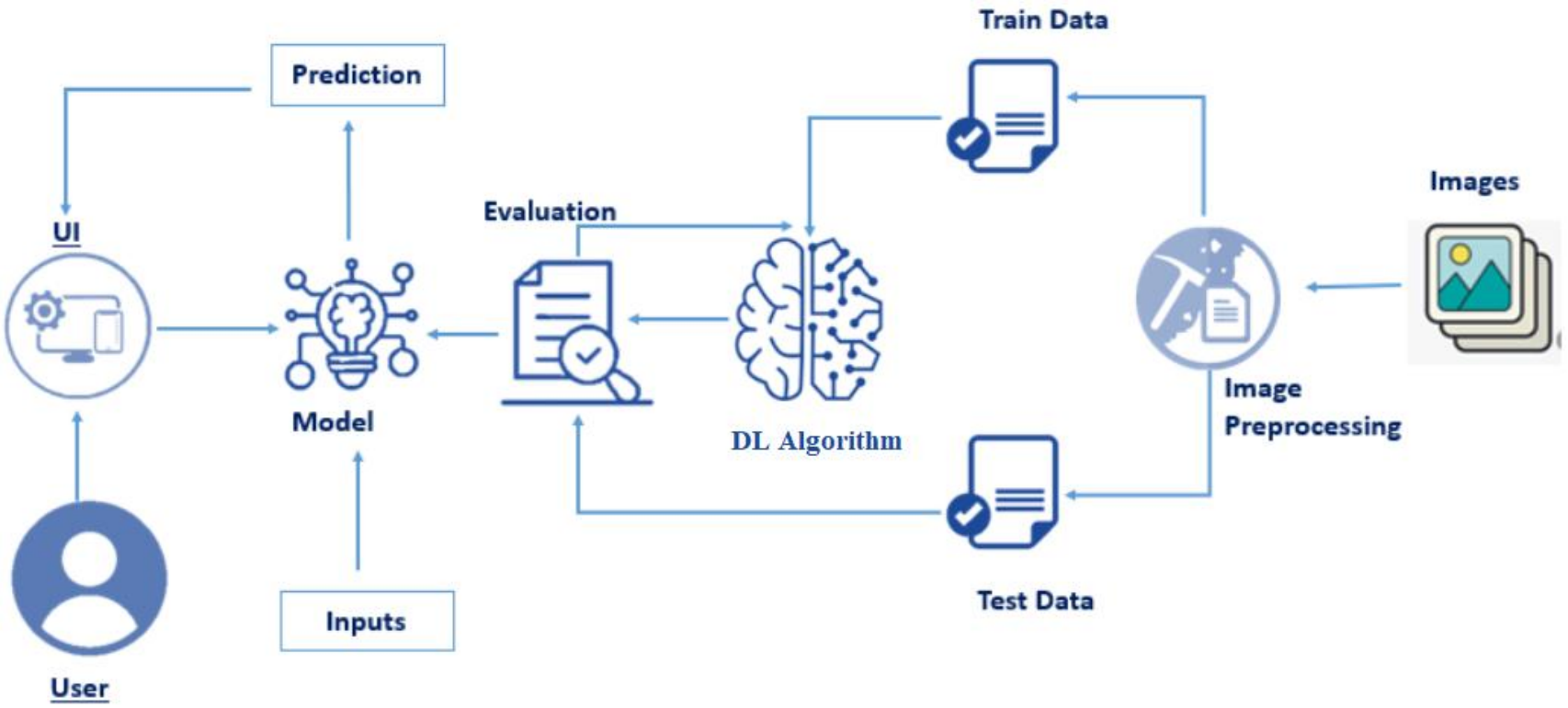
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	1. The system should be user-friendly and provideclear instructions for proper disposal of varioustypes of waste. 2. The interface should be intuitive and easy to navigate, even for individuals with limited technological knowledge or physical disabilities.
NFR-2	**Security**	3. The system should have robust security measures in place to protect user data andprevent unauthorized access. 4. This includes secure login credentials, encrypted communication protocols, and regular security
NFR-3	**Reliability**	5. The system should be able to handle largevolumes of data and users without compromising its performance. 6. It should be designed to accommodate futuregrowth and expansion.
NFR-4	**Performance**	7. The system to ensure the system is protectedagainst cyber threats and attacks. 8. The system should be designed to follow industry best practices in terms of security andcomply with relevant regulations.
NFR-5	**Availability**	9. The system should be highly available, withminimum downtime for maintenance or upgrades. 10. It should be able to handle high traffic volumesand provide continuous service without disruption. 11. It should also have a solid disaster recoveryplan in case of unexpected events such as natural disasters or cyber-attacks.
NFR-6	**Scalability**	12. The system should be able to handle a large volume of users and data as it increases in sizeover time. 13. It should be designed to be easily scalable , allowing for additional features to be added asneeded.

4. PROJECT DESIGN

4.1 Data Flow Diagrams



4.2 Technical Architecture



Solution Architecture

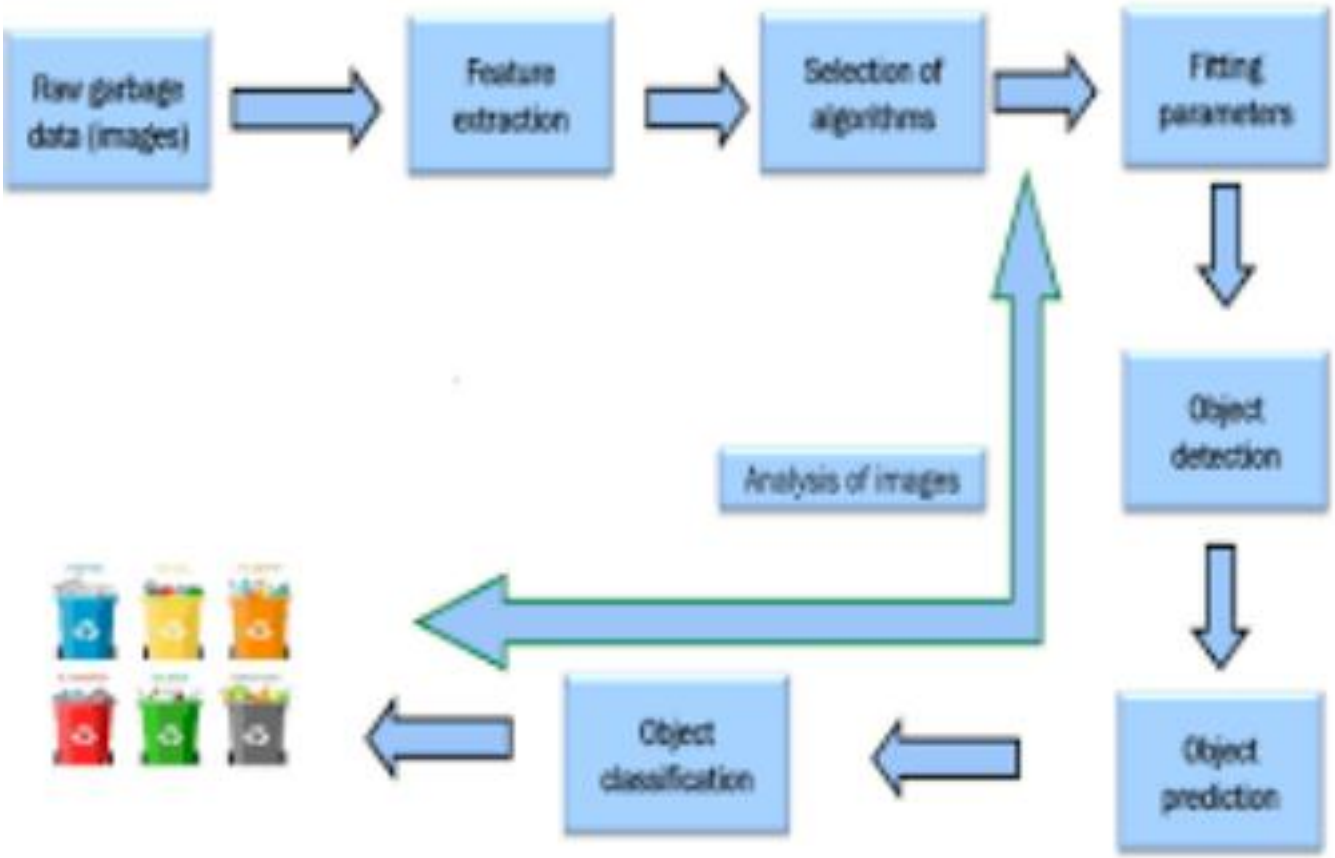


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js /React Js etc.
2.	Application Logic-1	Handles the input from the user interface and passes it to the appropriate application logic module.	Python, Flask, Django
3.	Application Logic-2	Responsible for storing the input in the databaseand maintaining a record of the user's disposal history.	Python, Node.js, Java
4.	Application Logic-3	Uses: The first application logic captures the image of the garbage and preprocess it beforesending it to the machine learning model. Thisincludes re-sizing the image and adjusting brightness and contrast.	Python, Node.js, Java, Shell Scripts
5.	Database	This component stores information about the garbage disposal records. This information includes the type of garbage disposed of, thetime and date of disposal, and the location ofdisposal.	MySQL, PostgreSQL, MongoDB
6.	Cloud Database	This database is used to store data on a cloud-based platform.	Amazon RDS, Google Cloud SQL, Microsoft Azure SQL

7.	File Storage	This component stores the images of the garbagefor future reference.	IBM Block Storage or Other Storage Service or Local File system,Amazon S3, Google Cloud Storage, Microsoft Azure Blob Storage
8.	External API-1	This component interacts with external systems,such as waste management systems, to provideinformation about the garbage disposal.	IBM Weather API,
9.	External API-2	This component can interact with other applications, such as weather applications, toassist in the garbage classification.	Aadhar API
10.	Machine Learning Model	This model is trained to classify the garbage accurately based on the input image.	Object Recognition Model, etc.
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / CloudLocal Server Configuration: Cloud Server Configuration :	Infrastructure server configuration:TensorFlow, PyTorch,Keras, Scikit-learn Cloud Server Configuration: Amazon Web Services (AWS), GoogleCloud Platform (GCP), Microsoft Azure, DigitalOcean

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks provides easy touse tools and libraries for implementing machine learning models	Technology of Open source framework,Tensor flow, Keras , Python.
2.	Security Implementations	As with any system that handles user data, security is paramount. The system should implement measures such as encryption, authentication, and role-based access control to ensure the safety of user data.	Encryption, Authentication,Role-based access control,etc.
3.	Scalable Architecture	The garbage classification system should be designed to handle a large number of users and accommodate for growth in the future. This couldbe achieved by deploying the system on cloud infrastructure	AWS , Google cloud
4.	Availability	The system should be highly available, with little tono downtime. This could be achieved through measures such as redundancy..	Redundancy, and regular backups.
5.	Performance	The garbage classification system should be optimized for fast inference times and accurate classification results	Deep learning models and GPUs.

4.3 USE CASE Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Team Member
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Manjula
		USN-2	As a user, I will receive confirmation emailonce I have registered for the application	I can receive confirmation email & click confirm	High	Kousalya
		USN-3	As a user, I can register for the applicationthrough Facebook	I can register & access the dashboard with Facebook Login	Low	Banupriya
		USN-4	As a user, I can register for the applicationthrough Gmail		Medium	Kousalya
	Login	USN-5	As a user, I can log into the application byentering email & password		High	Banupriya
	Dashboard	USN-6	As a user I want to personal details with Recent garbage classification through images		High	Manjula
AI-Based Garbage Classifier	Classification of garbage		As a user, I want to be able to use an AI-based garbage classifier to dispose of my waste properly and contribute to waste management efforts	Split the Garbage in various types	High	Manjula
			1. Develop a mobile application that can capture an image from the camera in the device	Capture images through Cameras	High	Manjula
			2. Build a deep learning model that can classify the image accurately	Create a learning algorithm to classify accurately	High	Banupriya
			3. Integrate the deep learning model with the mobile application			

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Team Member
			4. Train the model on a large dataset of waste images to increase accuracy	Large dataset of garbage images increase clasification efficiently	High	kousalya
			5. Test the application and model in real-life scenarios to ensure accuracy in classification	Test the real time scenarios	Medium	Kousalya
Waste Management Platform with Deep Learning Classification		USN 01	As a waste management industry professionalor municipality, I want a waste management platform that utilizes deep learning algorithms to accurately classify and track waste, so that we can efficiently manage waste and reduceits impact on the environment.			Banupriya
		USN 02	As a user of the waste management platform,I want the platform to accurately identify different types of waste based on their characteristics, so that we can segregate them properly and dispose of them safely.			Kousalya
			Task-1 Develop a deep learning algorithm: Develop a deep learning algorithm that can accurately classify waste based on its characteristics such as color, texture, shape,etc.	The waste classification algorithm must classify waste accurately based onits characteristics.	High	Manjula
			Task-2Train the algorithm: Train the algorithm using a large dataset of waste images and their labels, so that it canlearn to classify waste accurately	The algorithm must be trained using a large dataset of waste images and their labels to ensure accuracy.	High	Manjula
			Task 3 - Test the algorithm: Test the algorithm using a new dataset of waste images to ensure that it can classifywaste accurately in real-world scenarios.	The algorithm must be tested using a new datasetof waste images to ensure accurate classifications in real-world scenarios.	Medium	Banupriya

5 . CODING & SOLUTIONING

```
# Importing libraries
from flask import Flask, jsonify, render_template, request
from keras.models import load_model
from PIL import Image
import numpy as np
import os
import io

# OS Environment
os.environ['TF_CPP_MIN_LOG_LEVEL'] = '3'
```

```
# Setting up Flask Application
app = Flask(__name__,static_folder='Static')
```

```
# Loading model to backend
print("Checking backend Garbage Classifier Model")
model_filename = (os.path.join(os.getcwd(),'model','Garbage.h5'))
print(model_filename)
model = load_model(model_filename)
```

```
# Routing Homepage
@app.route('/')
def home():
    return render_template('index.html')
```

```
# Routing Classify page
@app.route('/classify')
def classify():
    return render_template('classify.html')
```

```
# Backend Model prediction using api
@app.route('/predict', methods=['POST'])
def predict():
    print(request.form)
    img = request.files['file'].read()
    img = Image.open(io.BytesIO(img))
    img = img.resize((64, 64))
    img_array = np.array(img) / 255.
    img_array = np.expand_dims(img_array, axis=0)
    pred = model.predict(img_array)[0]
    class_idx = np.argmax(pred)
    class_names = ['Cardboard','Glass','Metal','paper','Plastic','Trash']
    predicted_class = class_names[class_idx]
    return jsonify({'class': predicted_class})
```

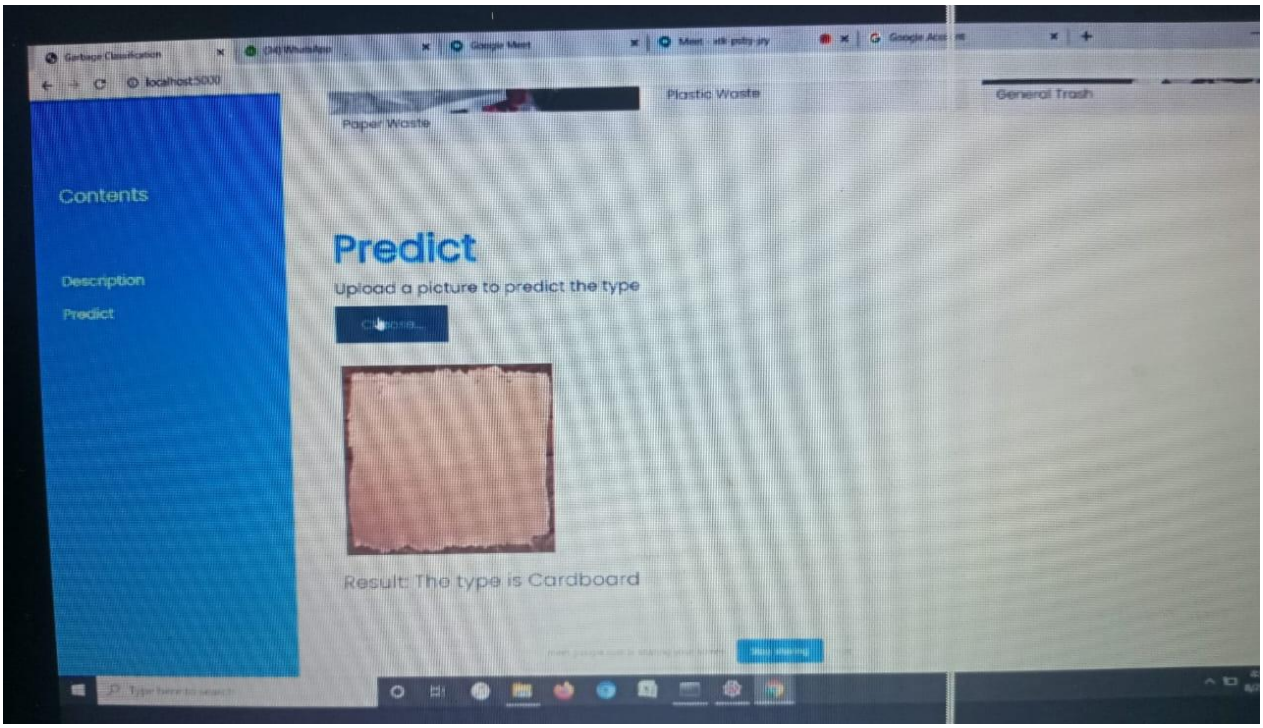
```
# Routing About page
@app.route('/about')
def about():
    return render_template('about.html')
```

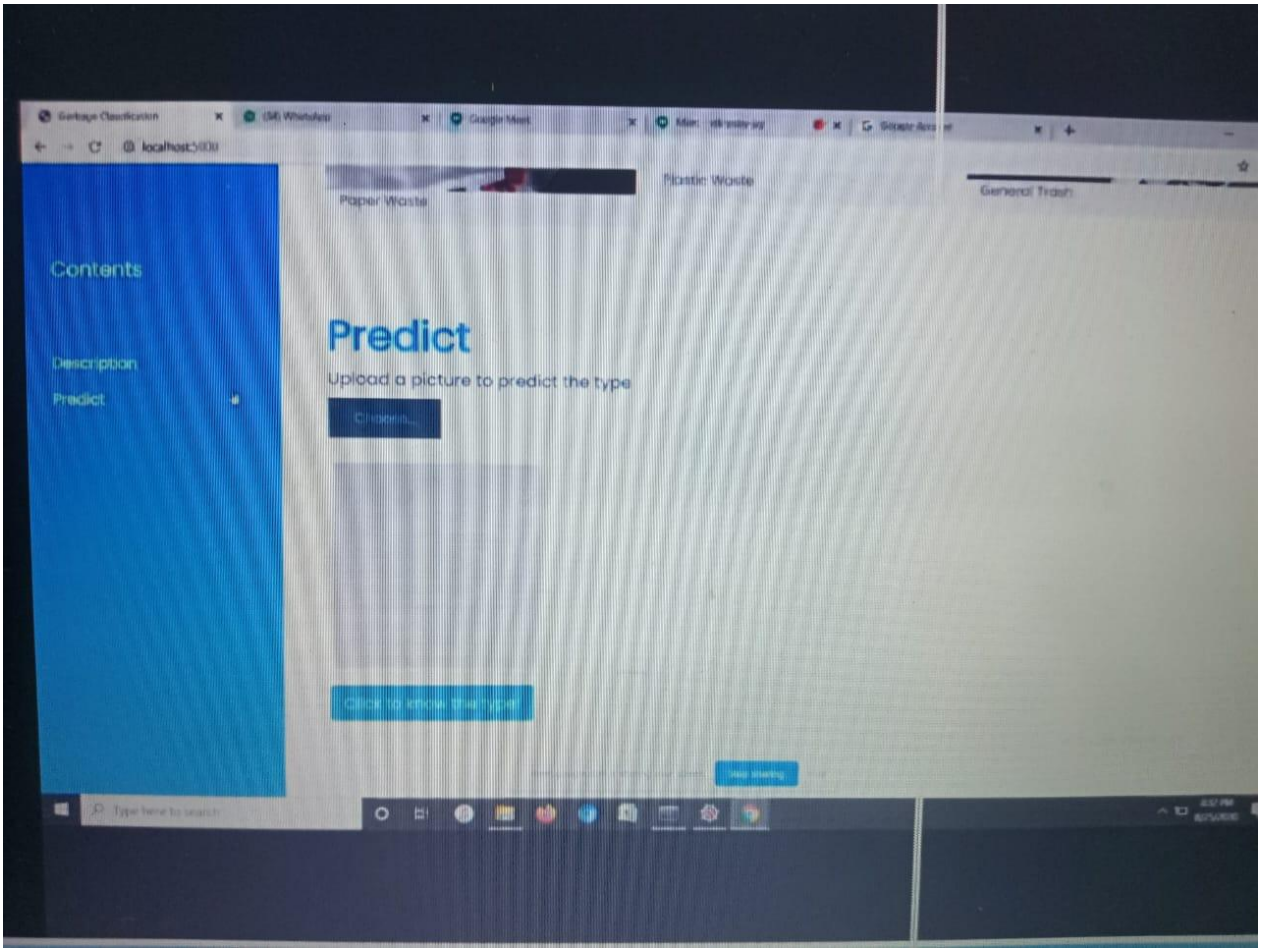
```
# Running Flask Application in ip address = 127.0.0.1 port = 5000
```

```
if __name__ == '__main__':
    app.run(host = '127.0.0.1',port = 5000, debug = False)
```

OUTPUT:

6 .RESULT





7.PROS

- **Efficient Garbage Classification**: The intelligent garbage classification system provides a hassle-free and efficient way of sorting out different types of waste materials such as paper, plastic, metal, etc. This helps in proper disposal and recycling of waste materials, reducing the impact on the environment.

- **Cost-Effective**: The deep learning-based garbage classification system helps in reducing the associated costs of manual waste such as plastic, glass, metal, paper, and organic waste. It helps in reducing the time and effort required for manual sorting of garbage.

- **Increased Recycling**: With proper sorting of waste, the intelligent garbage classification system can increase the recycling rate of waste materials. This will result in a cleaner environment, reduction of carbon footprint, and conservation of natural resources.

- **Cost-effective**: The use of deep learning algorithms in garbage classification can potentially reduce the costs involved in waste management. It can help in

optimizing the waste disposal process, reduce the frequency of garbage collection, and avoid unnecessary expenses related to waste disposal.

- **Enhanced Public Health**: An intelligent garbage classification system can play a vital role in maintaining public health and hygiene. By preventing the mixing of hazardous waste with regular garbage, it can curb the spread of diseases and infections.

CONS:

- **Initial Cost**: The implementation of an intelligent garbage classification system requires a significant investment in terms of hardware, software, and infrastructure. This could be a barrier for small-scale waste management companies or municipalities.

- **Maintenance**: Regular maintenance and updates of the system are necessary to ensure its proper functioning. This can be time-consuming and require skilled professionals, which could be a challenge for some organizations.

- **Limited Scope**: The intelligent garbage classification system is limited to waste classification only. It cannot provide solutions for waste reduction or prevention, which are equally essential aspects of waste management.

8 .CONCLUSION

An intelligent garbage classification system using deep learning algorithms is a promising solution for efficient waste management. It has numerous advantages such as faster and more accurate waste sorting, increased recycling, cost-effectiveness, and enhanced public health. Although it has its limitations and challenges, the future scope of the system is vast and promising. With regular updates and enhancements, it can be an essential tool for sustainable waste management in the future.

9. FUTURE SCOPE

- **Integration with IoT:** The integration of an intelligent garbage classification system with the Internet of Things (IoT) can enhance its capabilities. For example, IoT sensors can monitor the level of waste in bins and provide real-time alerts when they need to be emptied.

- **Expansion of Functionality**: The future scope of the system is not limited to garbage classification only. It can be expanded to include other aspects of waste management such as recycling, waste reduction, and waste prevention.

- **Customization**: The system can be customized to suit the specific needs of different regions or organizations. This will ensure its effective implementation and maximize its benefits.

10 . APPENDIX

GitHub & Project Video Demo Link

Video link : https://youtu.be/Op_UBXXOHto

```
!pip install -q kaggle
```

```
from google.colab import files
files.upload()
```

```
Choose Files No file chosen  Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.
Saving kaggle.json to kaggle.json
{'kaggle.json':
b'{"username":"manjulachinnasamy","key":"995aeac43bcec59ed6f1f2b95f425cf8"}'}
```

```
# create a kaggle folder
! mkdir ~/.kaggle
```

```
# copy the kaggle.json to folder created
! cp kaggle.json ~/.kaggle/
```

```
# Permission for the json to act
! chmod 600 ~/.kaggle/kaggle.json
```

```
# to list all dataset in kaggle
! kaggle datasets list
```

```
ref                                                         title                                          size  las
----------------------------------------------------------  ---------------------------------------------  -----  ---
arnabchaki/data-science-salaries-2023                       Data Science Salaries 2023                      25KB  20
fatihb/coffee-quality-data-cqi                              Coffee Quality Data (CQI May-2023)              22KB  202
ashpalsingh1525/imdb-movies-dataset                         IMDB movies dataset                              3MB  202
iammustafatz/diabetes-prediction-dataset                    Diabetes prediction dataset                    734KB  202
utkarshx27/inflation-rate-in-asia                           Inflation Rate in Asia                           3KB  202
radheshyamkollipara/bank-customer-churn                     Bank Customer Churn                            307KB  202
desalegngeb/students-exam-scores                            Students Exam Scores: Extended Dataset         695KB  202
chitrakumari25/corona-virus-latest-data-2023                Corona virus latest data 2023                   10KB  202
omarsobhy14/university-students-complaints-and-reports      University Students Complaints & Reports        38KB  202
utkarshx27/starbucks-nutrition                              Starbucks Nutrition Facts                        2KB  202
utkarshx27/survey-of-labour-and-income-dynamics             Survey of Labour and Income Dynamics            54KB  202
rajkumarpandey02/rainfall-in-all-india-dataset-1901-2016    Rainfall in All India Dataset 1901-2016          3KB  202
faisaljanjua0555/best-video-games-of-all-time               Best Video Games of All Time                    24KB  202
utkarshx27/world-gdp-growth-1980-2028                       World GDP growth 1980-2028                      53KB  202
utkarshx27/global-poverty-and-inequality-dataset            Global poverty and inequality dataset            4MB  202
ursmaheshj/top-10000-popular-movies-tmdb-05-2023            Top 10000 popular Movies TMDB                    2MB  202
gyaswanth297/world-population-insights-1970-2022            World Population Insights: 1970-2022            16KB  202
sougatapramanick/happiness-index-2018-2019                  Happiness Index 2018-2019                       15KB  202
utkarshx27/smoking-dataset-from-uk                          Smoking Dataset from UK                         17KB  202
utkarshx27/non-alcohol-fatty-liver-disease                  Non-alcohol fatty liver disease (NAFLD)          3MB  202
```

```
! kaggle datasets download -d asdasdasasdas/garbage-classification
```

```
Downloading garbage-classification.zip to /content
 99% 81.0M/82.0M [00:00<00:00, 110MB/s]
100% 82.0M/82.0M [00:00<00:00, 99.2MB/s]
```

```
! unzip /content/garbage-classification.zip
```

```
Streaming output truncated to the last 5000 lines.
  inflating: Garbage classification/Garbage classification/cardboard/cardboard152.jpg
  inflating: Garbage classification/Garbage classification/cardboard/cardboard153.jpg
  inflating: Garbage classification/Garbage classification/cardboard/cardboard154.jpg
  inflating: Garbage classification/Garbage classification/cardboard/cardboard155.jpg
  inflating: Garbage classification/Garbage classification/cardboard/cardboard156.jpg
  inflating: Garbage classification/Garbage classification/cardboard/cardboard157.jpg
```

```
inflating: Garbage classification/Garbage classification/cardboard/cardboard158.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard159.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard16.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard160.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard161.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard162.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard163.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard164.jpg
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inflating: Garbage classification/Garbage classification/cardboard/cardboard168.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard169.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard17.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard170.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard171.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard172.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard173.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard174.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard175.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard176.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard177.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard178.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard179.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard18.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard180.jpg
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inflating: Garbage classification/Garbage classification/cardboard/cardboard185.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard186.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard187.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard188.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard189.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard19.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard190.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard191.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard192.jpg
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inflating: Garbage classification/Garbage classification/cardboard/cardboard197.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard198.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard199.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard2.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard20.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard200.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard201.jpg
inflating: Garbage classification/Garbage classification/cardboard/cardboard202.jpg
```

Data Augmentation

```
#import necessary libraries

from tensorflow.keras.preprocessing.image import ImageDataGenerator


# data augmentation for training variable

train_datagen = ImageDataGenerator(rescale = 1./255,zoom_range = 0.2,horizontal_flip=True)



# data augmentation for testing variable

test_datagen = ImageDataGenerator(rescale = 1./255)
```

```
 #data augmentation on the training data

xtrain = train_datagen.flow_from_directory('/content/garbage classification',
                                           target_size =(64,64),
                                           class_mode = 'categorical',
                                           batch_size = 100)
```

```
Found 2527 images belonging to 1 classes.
```

```
xtest = test_datagen.flow_from_directory('/content/garbage classification',
                                           target_size =(64,64),
                                           class_mode = 'categorical',
                                           batch_size = 100)
```

```
Found 2527 images belonging to 1 classes.
```

CNN Model Building

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense


## adding layers

model = Sequential() # Initializing sequential model
model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,3))) # convolution layer
model.add(MaxPooling2D(pool_size=(2, 2))) # Max pooling layer
model.add(Flatten()) # Flatten layer
model.add(Dense(300,activation='relu')) # Hidden layer 1
model.add(Dense(150,activation='relu')) # Hidden layer 2
model.add(Dense(4,activation='softmax')) # Output layer


# Compile the model

model.compile(optimizer = 'adam',loss = 'categorical_crossentropy',metrics = ['accuracy'])


model.fit_generator(xtrain,steps_per_epoch=len(xtrain),
                    epochs=10,validation_data=xtest,validation_steps=len(xtest))
```

```
<ipython-input-18-13293428a2ee>:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a futur
  model.fit_generator(xtrain,steps_per_epoch=len(xtrain),
Epoch 1/10
26/26 [==============================] - 24s 879ms/step - loss: 28.0212 - accuracy: 0.3019 - val_loss: 37.0530 - v
Epoch 2/10
26/26 [==============================] - 22s 860ms/step - loss: 281.9343 - accuracy: 0.2390 - val_loss: 483.4936 -
Epoch 3/10
26/26 [==============================] - 22s 852ms/step - loss: 1904.1967 - accuracy: 0.2770 - val_loss: 3646.8049
Epoch 4/10
26/26 [==============================] - 21s 817ms/step - loss: 5978.7725 - accuracy: 0.2085 - val_loss: 12379.352
Epoch 5/10
26/26 [==============================] - 22s 855ms/step - loss: 19026.4004 - accuracy: 0.2085 - val_loss: 33474.85
Epoch 6/10
26/26 [==============================] - 22s 860ms/step - loss: 46912.5547 - accuracy: 0.2374 - val_loss: 108690.2
Epoch 7/10
26/26 [==============================] - 22s 840ms/step - loss: 123430.6484 - accuracy: 0.2770 - val_loss: 110085.4
Epoch 8/10
26/26 [==============================] - 22s 856ms/step - loss: 183070.1562 - accuracy: 0.2374 - val_loss: 97244.5
Epoch 9/10
26/26 [==============================] - 22s 860ms/step - loss: 185264.7344 - accuracy: 0.2374 - val_loss: 245191.
Epoch 10/10
```

```
26/26 [==============================] - 21s 814ms/step - loss: 509704.7500 - accuracy: 0.2770 - val_loss: 1063855
<keras.callbacks.History at 0x7f7da0405c60>
```

##Summary of the Model

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 62, 62, 32)        896

 max_pooling2d (MaxPooling2D  (None, 31, 31, 32)       0
 )

 flatten (Flatten)           (None, 30752)             0

 dense (Dense)               (None, 300)               9225900

 dense_1 (Dense)             (None, 150)               45150

 dense_2 (Dense)             (None, 4)                 604

=================================================================
Total params: 9,272,550
Trainable params: 9,272,550
Non-trainable params: 0
_________________________________________________________________
```

```
# Save model

model.save('Garbage5.h5')
```

Test the model

```
from tensorflow.keras.preprocessing import image
import numpy as np


# Testing 1

img = image.load_img('/content/garbage classification/Garbage classification/cardboard/cardboard10.jpg',target_size =(64
img
```

```
x = image.img_to_array(img) # converting the image into array
x = np.expand_dims(x,axis = 0) # expanding dimensions
pred = np.argmax(model.predict(x)) # predicting the higher probability index
op = ['paper','glass','metal','cardboard']
op[pred]
```

```
1/1 [==============================] - 0s 122ms/step
'metal'
```

```
# Testing 2

img = image.load_img('/content/garbage classification/Garbage classification/paper/paper101.jpg',target_size =(64,64))
x = image.img_to_array(img) # converting the image into array
```

```
x = np.expand_dims(x,axis = 0) # expanding dimensions
pred = np.argmax(model.predict(x)) # predicting the higher probability index
op = ['paper','glass','metal','cardboard']
op[pred]
```

```
1/1 [==============================] - 0s 29ms/step
'metal'
```

```
# Testing 3

img = image.load_img('/content/garbage classification/Garbage classification/paper/paper100.jpg',target_size =(64,64))
x = image.img_to_array(img) # converting the image into array
x = np.expand_dims(x,axis = 0) # expanding dimensions
pred = np.argmax(model.predict(x)) # predicting the higher probability index
op = ['paper','glass','metal','cardboard']
op[pred]
```

```
1/1 [==============================] - 0s 20ms/step
'metal'
```

```
# Testing 4

img = image.load_img('/content/garbage classification/Garbage classification/glass/glass100.jpg',target_size =(64,64))
x = image.img_to_array(img) # converting the image into array
x = np.expand_dims(x,axis = 0) # expanding dimensions
pred = np.argmax(model.predict(x)) # predicting the higher probability index
op = ['paper','glass','metal','cardboard']
op[pred]
```

```
1/1 [==============================] - 0s 22ms/step
'metal'
```