Waste Classification

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***Abstract*— A large amount of solid waste is generated in urban areas with a variety of types like plastic, garden waste, paper, glass, etc. For efficient waste management it is necessary to treat different types of waste in a different manner. In order to achieve this, waste must be separated into various categories. Thus, the concept of segregating wet and dry waste has been introduced by the government. By following the guidelines given by the government, a huge amount of budget for waste segregation is saved and can be used for further waste management. Keeping all of this in mind, the proposed system aims to classify wet and dry waste based on the captured image of the waste. The captured image of waste is passed through the system to classify the type of waste. This can help us get data relating to a variety of waste types. Furthermore, it can help analyze the waste disposal habits of people at different locations, which can help create awareness in places where improvement is required.**

Index Terms: **Classification, Machine Learning, Object Detection, Segregation of waste.**

I.INTRODUCTION

Biodegradable and Non-Biodegradable waste go through different waste management techniques. Thus, separation of waste comes before management. In various waste management organizations, the waste comes in unsegregated. As a result, these institutions have to spend a lot of manpower and money in classification and separation alone. The idea behind this project is to aid these organizations in waste classification. 3.5 million tons of waste is generated every single day in the entire world. This is a conservative estimate and the amount is still increasing. This is because of rapid urbanization and industrialization. Increase in different types of solid and hazardous waste is becoming a huge challenge for governments in attaining environmental sustainability. There is an urgent need to spread awareness about waste management. Addressing this problem would require help from all levels of society from local to global level. A system that can classify waste is likely to save a lot of money and resources. An application that users can use to upload image and classify waste solely based on that image would be really helpful. Themotivation behind our system was to build an application with above mentioned characteristics.

II.LITERATUREREVIEW

"Waste Profiling and Analysis using Machine Learning" Farzana Shaikh, NagmaKazi, Zaid Thakur, Farheen Khan
2020[1]:
The system classifies the waste as dry waste or wet waste based solely on the image of the waste taken. Focusing on simplicity, it is intended to propose an application which will only be required by the civic bodies to upload the captured images of garbage bins and sent to the system to analyze whether the garbage is wet, dry or mixed.

"A Waste Management Technique to detect and separate Non-Biodegradable Waste using Machine Learning and YOLO algorithm"
Aishwarya, Parth Wadhwa, Owais, Vasudha Vashisht 2021[2]
In this system a machine learning model was created that was trained on the data set of all three categories of the images of non- biodegradable waste. After completion of training a number of files were obtained that were further used in testing model of the application.

"Research on Garbage Image Classification Method Based on Convolutional Neural Network".
Kangjian Tang, ZhanWen, Yahui Chen, Wenzao Li 2019[3]
In this system two types of Convolutional Neural Networks (CNNs)–Inception V3 and Inception V4 were used to train Huawei's public garbage data set (Garbage Date) and establish a garbage classification model. By observing the changes in the accuracy rate

and cross-entropy loss function of the two models on the training and test sets in the experiment, it is found that both models can obtain higher accuracy of garbage classification The network model using Inception V4 is more stable and accurate than the network model using Inception V3.

"Classification of Trash for Recyclability Status" Gary Thung, Mindy Yang
2016[4]
The dataset contains images of recycled objects across six classes with about 500 photos each. The data was hand collected. Neural network training with another 50 epochs was run, a learning rate of 0.01, and batch size of 25 and got a similar testing accuracy of 25.

"Waste Object Detection and Classification"
Hrushikesh N. Kulkarni, Nandini KannamangalamSundara Raman
2016[5]
The system categorized the different pieces of the waste in a collaged image, into categories: glass, plastic, paper, trash, metal, cardboard. Hybrid Transfer Learning for Classification and Faster R-CNN to get region proposals for object detection were used. Outline of proposed architecture created collages using GANs and model approached specific task object detection.

"An Automatic Classification Method For Environment". S.Sudha, M.Vidhyalakshmi, K.Pavithra, K.Sangeetha V.Swaathi
2016[6]
It is an automated recognition system that uses Deep learning algorithm in Artificial Intelligence to classify objects as biodegradable and non-biodegradable, where the system once trained with an initial dataset, can identify objects real- time and classify them almost accurately.

III.PROPOSEDMETHODOLOGY

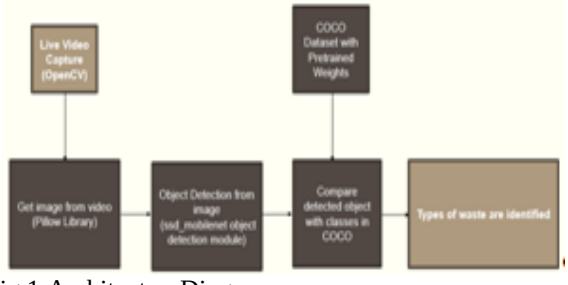

Fig.1.ArchitectureDiagram

Tools:
Desktop or Laptop (Intel core)
Speed:2.80GHz,
RAM:8GB,
HardDisk:40GB

Technology:
Windows10 O.S., Anaconda Framework, Spyder IDE, SQLite, ssdMobileNet, ResNet 50

Dataset Description:
Dataset: COCO Dataset.
Link: https://cocodataset.org/home
Description: COCO dataset 90 classes in which an object can be classified.
Examples: Toothbrush, Bottle, Carrot, Apple, Cake, Car, etcetera.

Methodology:
User Registration: User registers with a valid email-id, phone number, name, date of birth, gender. User enters 'user name' and 'password' of their choosing. These are stored in the database.

User Login: User logs in with their credential's user name and password.
Live Video Capture: As the user logs in, the application accesses the Web Camera of Desktop/Laptop. This will be followed by Live Video Capture by the Web Camera.

Object Detection: Object detection will be used to get object images from the video. This will be done by 'ssdMobileNetv1.

Object Identification and Classification: The detected object is passed through the trained model for identification and classification. This will be done by 'ResNet 50' trained on 'COCO dataset'.

Displaying the result: The object is classifiedas Biodegradable or Non-biodegradable along with the confidence level. The result is displayed on the bounding box around the object.

IV.RESULTSANDDISCUSSIONS

User Interface:
Registration:

Fig.2.Registration Pass Case

Fig.3.Registration Fail Case

Login:

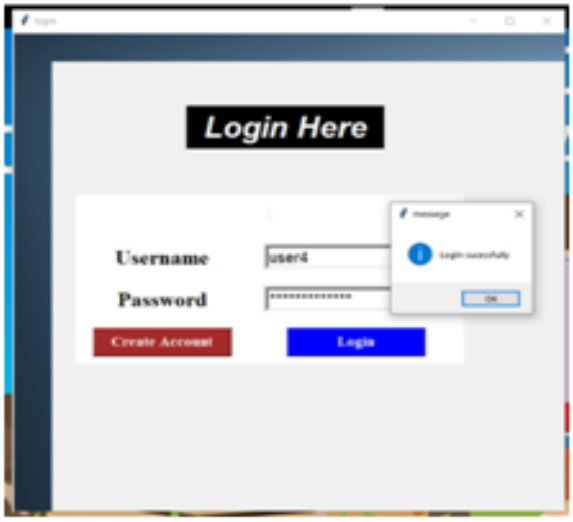

Fig.4. Login Pass Case

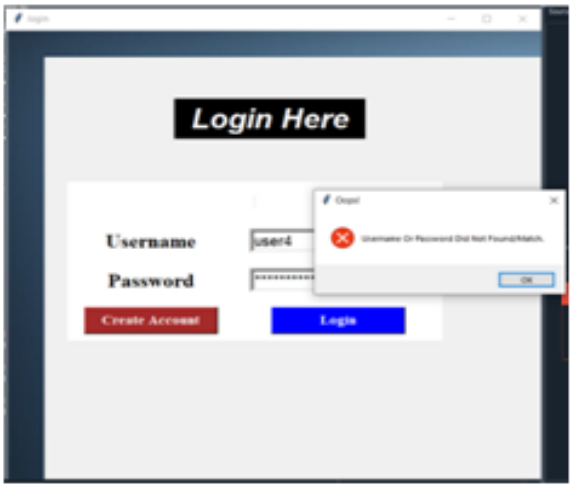

Fig.5. Login Fail Case

Model Results:
Biodegradable

Fig.6. Cup

Fig.7.glass

Non-biodegradable

Fig.8.Bottle

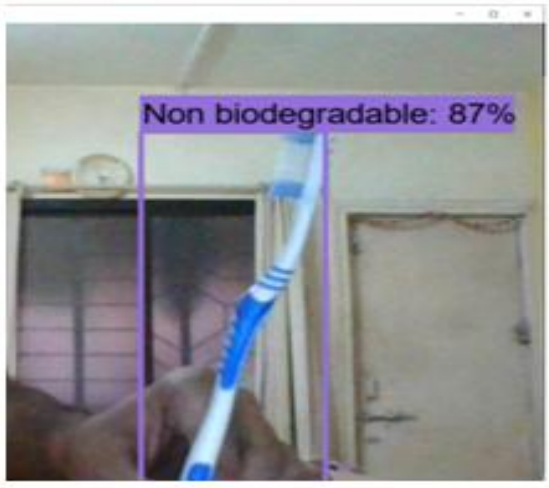

Fig.9. Toothbrush

Result Analysis and Discussion:

- The application can successfully store user data in the database.
- The application allows only authorized individuals with correct credentials to use the model.
- The model can identify and classify objects belonging to the 90 classes with high confidence level.
- The model can detect multiple objects at a time.

V.CONCLUSIONANDFUTURESCOPE

The proposed system is a desktop/laptop application that uses ssdMobileNetV1 and Resnet-50 to detect and identify objects and classify them as Biodegradable and Non-biodegradable. ResNet 50 is a type of ResNet model which consists of 48 Convolution layers along with 1 MaxPool and 1 Average Pool layer. It has 3.8 x 10(to the power 9) Floating points operations. ResNet is trained on COCO dataset which has a total of 90 classes. SQLite is used as Database Management system that manages user data such as user name, password, email-id, age, etcetera to provide security.

FUTURE WORK:

- More classes can be added.
- Waste percentages for each type of waste can be predicted.
- Application can be made more portable and configured to run on Ubuntu, MacOS and so on.

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