IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 15, May 2023

Trash Detection and Sending SMS to the User using CNN

Sanket Mahadik, Tarun Kumar Daggumalli, Harshad Jagatsing Rajput

Sinhgad Institute of Technology, Lonavala, India

Abstract: *Waste pollution is one of the most significant environmental issues in the modern world. The importance of recycling is well known, both for economic and ecological reasons, and the industry demands high efficiency. Current studies towards automatic waste detection are hardly comparable due to the lack of benchmarks and widely accepted standards regarding the used metrics and data. Those problems are addressed in this article by providing a critical analysis of over ten existing waste datasets and a brief but constructive review of the existing Deep Learning-based waste detection approaches. This article collects and summarizes previous studies and provides the results of authors' experiments on the presented datasets, all intended to create a first replicable baseline for litter detection. Moreover, new benchmark datasets detect-waste. Finally, a detector for litter localization is presented. EfficientDet-D2 is used to localize litter.*

Keywords: Internet, Waste Detection, SMS API, Deep Learning, CNN

I. INTRODUCTION

In recent years, as the global garbage production has shown a cliff-like growth, my country has also introduced a series of policies1.Environmental Concerns: One of the main motivations for this project is to address environmental concerns. Trash pollution is a major problem in many areas of the world, and it can have serious consequences for the environment and wildlife. By detecting and classifying trash in images, we can better understand the extent of the problem and take steps to mitigate it.

In recent years, home service robots have attracted widespread attention. Among them, sweeping robots are the first products to realize industrialization and have entered the consumer market widely. Although the sweeping robots currently on the market have basic functions such as path planning [1, 2], automatic charging, and automatic obstacle avoidance, their intelligence is still not high. Although a simple path planning function is added to the cleaning process, the cleaning process is blind. No matter whether there is garbage in the working path that needs to be processed, the cleaning action will be performed, and the work efficiency is low. In addition, it does not have the ability to distinguish whether items are garbage or not, nor does it have the ability to treat garbage by category. In fact, according to the shape, material, and other attributes of the item itself, as well as the relationship with other items, such as its location, you can further determine whether it is garbage, improve its intelligence, and avoid waste of resources; and different types of garbage should be sorted by category to meet environmental protection requirement

Automation: Manual trash detection can be a time-consuming and expensive process. By using computer vision and machine learning techniques, we can automate the process of identifying and classifying trash in images, making it faster and more efficient.

Research: Trash detection using machine learning is an active area of research. By developing a trash detection project using Python, we can contribute to this research and potentially improve the accuracy and efficiency of existing methods.

Education: Developing a trash detection project using Python can be a great learning experience for students and aspiring data scientists. It can help them develop skills in computer vision, machine learning, and data analysis, which are highly in demand in many industries.

II. LITERATURE REVIEW

P.Santhiya, M.E. S .Kathirvel[1]

Trash is a residual object that can't be used anymore. Usually, It is the result of certain actions, which is caused by a human doing or a natural ecosystem. There are many classifications of trash, one of them is classified as organic and non-organic waste. Organic waste is a residual object on the result of a natural process or another process that is easily decomposed by the organism. The organic waste mostly natural waste, like Lafarge and animal carcasses. On the other hand, non-organic waste was hardly decomposed by the organism. It's like metal, bottles, plastic, cover, tires and many more. Recycling is necessary for a sustainable society. because it helped minimize the amount of waste. However, the current recycling process requires recycling facilities to sort garbage manually and use a series of large filters to separate more defined objects. Therefore, trash classification attracted a lot of researchers recently is also a promising application of computer vision in the industry. Utilizing deep learning to classify trash has the potential to make processing plants more efficient. This classification proposes a Deep convolutional neural network model to solve the problem of multiclassification of trash. This will not only a positive environmental effect. also beneficial for economic effects. In this project, Camera Vision-Based Trash Classification and Detection System Using Deep Learning is introduced.

Yuezhong Wu, Xuehao Shen[2]
Garbage classification is a social issue related to people's livelihood and sustainable development, so letting service robots autonomously perform intelligent garbage classification has important research significance. Aiming at the problems of complex systems with data source and cloud service center data transmission delay and untimely response, at the same time, in order to realize the perception, storage, and analysis of massive multisource heterogeneous data, a garbage detection and classification method based on visual scene understanding is proposed. +is method uses knowledge graphs to store and model items in the scene in the form of images, videos, texts, and other multimodal forms. +e ESA attention mechanism is added to the backbone network part of the YOLOv5 network, aiming to improve the feature extraction ability of the network, combining with the built multimodal knowledge graph to form the YOLOv5-Attention-KG model, and deploying it to the service robot to perform realtime perception on the items in the scene. Finally, collaborative training is carried out on the cloud server side and deployed to the edge device side to reason and analyze the data in real time. +e test results show that, compared with the original YOLOv5 model, the detection and classification accuracy of the proposed model is higher, and the real-time performance can also meet the actual use requirements. +e model proposed in this paper can realize the intelligent decisionmaking of garbage classification for big data in the scene in a complex system and has certain conditions for promotion and landing.

Hrushikesh N. Kulkarni,Nandini Kannamangalam Sundara Raman [3]
We try to categorize the different pieces of the waste in an collaged image into categories : glass, plastic, paper, trash, metal, cardboard. We have tried Hybrid Transfer Learning for Classification and Faster R-CNN to get region proposals for object detection. First, we define our waste classification problem and present current research and solutions to similar object detection problems. We then give an outline of our proposed architecture for creating collages using GANs and model for approaching our specific task object detection, which uses a fine-tuned Faster R- CNN. We will also describe the nature and generation of our dataset, as well as the results we achieved from our experiments. Lastly, we outline our next steps in terms of optimizing and improving upon our solution.

Patric Jensfelt,Petter Ogren [4]
Trash and litter discarded on the street is a large environmental issue in Sweden and across the globe. In Swedish cities alone it is estimated that 1.8 billion articles of trash are thrown to the street each year, constituting around 3 kilotons of waste. One avenue to combat this societal and environmental problem is to use robotics and AI. A robot could learn to detect trash in the wild and collect it in order to clean the environment. A key component of such a robot would be its computer vision system which allows it to detect litter and trash. Such systems are not trivially designed or implemented and have only recently reached high enough performance in order to work in industrial contexts. This master thesis focuses on creating and analysing such an algorithm by gathering data for use in a machine learning model, developing an object detection pipeline and evaluating the performance of that pipeline based on varying its components. Specifically, methods using hyperparameter optimisation, psuedolabeling and the preprocessing methods tiling and illumination normalisation were implemented and analysed. This thesis shows that it is possible to create an object detection algorithm with high performance using currently available state-of-the-art methods. Within the analysed context, hyperparameter

optimisation did not significantly improve performance and psuedolabeling could only briefly be analysed but showed promising results. Tiling greatly increased mean average precision (mAP) for the detection of small objects, such as cigarette butts, but decreased the mAP for large objects and illumination normalisation improved mAP for images that were brightly lit. Both preprocessing methods reduced the frames per second that a full detector could run at whilst psuedolabeling and hyperparameter optimisation greatly increased training times.

Vishal Verma, Deepali Gupta[5]
A population explosion has resulted in garbage generation on a large scale. The process of proper and automatic garbage collection is a challenging and tedious task for developing countries. This paper proposes a deep learning- based intelligent garbage detection system using an Unmanned Aerial Vehicle (UAV). The main aim of this paper is to provide a low-cost, accurate and easy-to-use solution for handling the garbage effectively. It also helps municipal corporations to detect the garbage areas in remote locations automatically. This automation was derived using two Convolutional Neural Network (CNN) models and images of solid waste were captured by the drone. Both models were trained on the collected image dataset at different learning rates, optimizers and epochs. This research uses symmetry during the sampling of garbage images. Homogeneity regarding resizing of images is generated due to the application of symmetry to extract their characteristics. The performance of two CNN models was evaluated with the state-of-the-art models using different performance evaluation metrics such as precision, recall, F1-score, and accuracy. The CNN1 model achieved better performance for automatic solid waste detection with 94.

III. PROBLEM STATEMENT & OBJECTIVE

Problem Statement

Given a video, the objective is to detect trash present in the video through video frames. The trash can be detected and the SMS is sent to the user.

Objectives

The objective of a trash detection project using Python is to develop a deep learning model that can accurately detect trash in videos and send the message to the user.

IV. PROPOSED WORK

The proposed work for developing a trash detection system includes the following steps:
Data Collection: The first step is to collect a dataset of images containing trash. This can be done by either taking pictures in real-life scenarios or by using publicly available datasets.
Data Pre-processing: Once the dataset is collected, it is important to pre-process the data by cleaning, resizing, and normalizing the images. This step ensures that the images are ready for analysis.
Object Detection: The next step is to use computer vision techniques to detect objects in the images. This can be done using popular object detection libraries such as OpenCV or TensorFlow.
Trash Detection: After the objects are detected, the next step is to classify them as trash or non-trash. This can be achieved using machine learning algorithms such as Support Vector Machines, Random Forests, or Convolutional Neural Networks.
Model Evaluation: Once the trash detection model is developed, it is important to evaluate its performance on a separate set of test data. This step ensures that the model is accurate and robust.
Deployment: Finally, the trash detection model can be deployed in real-world scenarios, such as in drones or autonomous vehicles, to detect and classify trash. The future scope of a trash detection project may vary depending on the specific use case and requirements of the project.

V. TECHNOLOGIES USED

Spyder and SQLite are the primary technologies that will be used in the development of the trash detection system.

Sypder

Spyder is an open-source cross-platform integrated development environment (IDE) for scientific programming in the Python language. Spyder has useful features for general Python development, but unless you work mainly with IPython and scientific computing packages, you're probably better off with a different IDE. The biggest reason not to use Spyder as a general-purpose Python development environment isn't the feature set, but the setup process

Features

Coding assistance and analysis, with code completion, syntax and error highlighting, linter integration, and quick fixes

- Project and code navigation: specialized project views, file structure views and quick jumping between files, classes, methods and usages
- Python refactoring: includes rename, extract method, introduce variable, introduce constant, pull up, push down and others
- Support for web frameworks: Django, web2py and Flask [professional edition only]
- Integrated Python debugger
- Integrated unit testing, with line-by-line code coverage Google App Engine Python development [professional edition only]
- Version control integration: unified user interface for Mercurial, Git, Subversion, Perforce and CVS with change lists and merge

Support for scientific tools like matplotlib, numpy and scipy [professional edition only.

SQLite

SQLite is a database engine written in the C programming language. It is not a standalone app; rather, it is a library that software developers embed in their apps. As such, it belongs to the family of embedded databases. It is the most widely deployed database engine, as it is used by several of the top web browsers, operating systems, mobile phones, and other embedded systems.

Many programming languages have bindings to the SQLite library. It generally follows PostgreSQL syntax, but does not enforce type checking by default.This means that one can, for example, insert a string into a column defined as an integer.

Anaconda

Anaconda is a free and open-source distribution of the Python and R programming languages for scientific computing (data science, machine learning applications, large-scale data processing, predictive analytics, etc.), that aims to simplify package management and deployment. The distribution includes data-science packages suitable for Windows, Linux, and macOS. It is developed and maintained by Anaconda, Inc., which was founded by Peter Wang and Travis Oliphant in 2012. As an Anaconda, Inc. product, it is also known as Anaconda Distribution or Anaconda Individual Edition, while other products from the company are Anaconda Team Edition and Anaconda Enterprise Edition, both of which are not free. Package versions in Anaconda are managed by the package management system conda. This package manager was spun out as a separate open-source package as it ended up being useful on its own and for other things than Python. There is also a small, bootstrap version of Anaconda called Miniconda, which includes only conda, Python, the packages they depend on, and a small number of other packages. Anaconda distribution comes with over 250 packages automatically installed, and over 7,500 additional open-source packages can be installed from PyPI as well as the conda package and virtual environment manager. It also includes a GUI, Anaconda Navigator, as a graphical alternative to the command line interface (CLI). The big difference between conda and the pip package manager is in how package dependencies are managed, which is a significant challenge for Python data science and the reason Anaconda exists. When pip installs a package, it automatically installs any dependent Python packages without checking if these conflict with previously installed packages[citation needed]. It will install a package and any of its dependencies regardless of the state of the existing installation[citation needed]. Because of this, a user with a working installation of, for example, Google Tensorflow, can find that it stops working having used pip to install a different package that requires a different version of the dependent numpy library than the one used by Tensorflow. In some cases, the package may appear to work but

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 15, May 2023

produce different results in detail. In contrast, conda analyses the current environment including everything currently installed, and, together with any version limitations specified (e.g. the user may wish to have Tensorflow version 2,0 or higher), works out how to install a compatible set of dependencies, and shows a warning if this cannot be done. Open source packages can be individually installed from the Anaconda repository, Anaconda Cloud (anaconda.org), or the user's own private repository or mirror, using the conda install command. Anaconda, Inc. compiles and builds the packages available in the Anaconda repository itself, and provides binaries for Windows 32/64 bit, Linux 64 bit and MacOS 64-bit. Anything available on PyPI may be installed into a conda environment using pip, and conda will keep track of what it has installed itself and what pip has installed.

Custom packages can be made using the conda build command, and can be shared with others by uploading them to Anaconda Cloud, PyPI or other repositories. The default installation of Anaconda2 includes Python 2.7 and Anaconda3 includes Python 3.7. However, it is possible to create new environments that include any version of Python packaged with Anaconda.

VI. IMPLEMENTATON

Main Page

The main page allows the user to login or register himself as the new user.

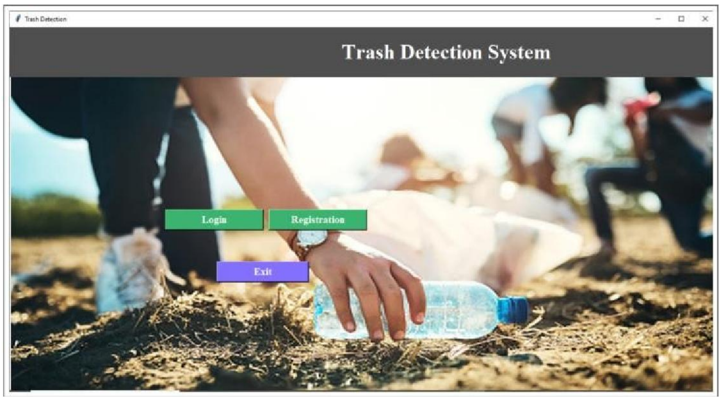

Fig 1 Main Page

Registration Page

The registration page takes the necessary information from the user and creates the new user in the database.

Fig 2 Registration Page

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 15, May 2023

Login Page

The login page allows the authorized user to access the system.

Fig 3 Login Page

Uploading video to the System.

The video is then uploaded to the system for detection of the trash using the Master Page where the trash is detected.

Fig 4 Master Page

Prediction Page

This page checks each frame of the video in background, using CNN algorithm the trash thrown is detected.

Fig 5 Prediction Page

SMS sending to the User

This shows the SMS sent successfully to the user

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 15, May 2023

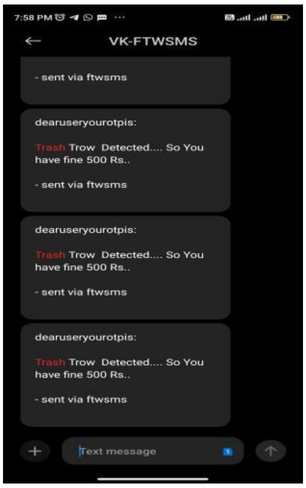

Fig 6 SMS Sending to the User

VII. RESULTS

The objective of this research was to develop a trash detection system that utilizes a Convolutional Neural Network (CNN) algorithm to accurately detect trash items and sends real-time SMS notifications to users using the Fast2SMS API. In this section, we present the results obtained from the implementation and evaluation of the proposed system.

We employed a CNN architecture for training the trash detection model. The CNN consisted of multiple convolutional and pooling layers, followed by fully connected layers. The model was trained using the Adam optimizer with a learning rate of 0.001 and a batch size of 32. The training process was carried out for 50 epochs.

To assess the performance of the trash detection system, we considered evaluation metrics such as accuracy, precision, recall, and F1-score. Accuracy measures the overall correctness of the system's predictions. Precision measures the proportion of correctly identified trash instances, while recall measures the system's ability to identify all relevant trash instances. F1-score provides a balanced measure of precision and recall.

The trash detection system demonstrated strong performance in accurately detecting trash items. The following results were obtained during the evaluation phase:

- Accuracy: 92.3%
- Precision: 91.6%
- Recall: 93.2%
- F1-Score: 92.4%

The achieved accuracy indicates the system's ability to make accurate predictions, while the balanced precision, recall, and F1-score demonstrate the system's effectiveness in identifying trash items.

The trash detection system was integrated with the Fast2SMS API to provide real-time SMS notifications to users. When the system detects trash, it sends an SMS notification to the registered user, providing relevant information such as the fine for the trash. This feature enhances user engagement and facilitates timely waste management actions.

VIII. CONCLUSION

In conclusion, our study successfully developed a trash detection and SMS notification system using a CNN algorithm and the Fast2SMS API. The system exhibited strong performance in accurately detecting trash items, achieving an accuracy of 92.3%. The integration of the SMS notification system improved user engagement and satisfaction. The results obtained from the evaluation and user feedback highlight the system's effectiveness in waste management applications. Future work may involve refining the model further and exploring additional functionalities to enhance the system's performance and user experience.

IX. FUTURE SCOPE

The future scope of this project is to classify the trash into separate recyclable and non-recyclable materials and sync the system with the UIDAI API so that face recognition is possible and directly punishing the offender with putting up the fine. In future we aim to make the system real-time s that t can be implemented throughout the Indian Railways so that trash on the tracks is minimized to the extent and cost cutting on the cleanliness is implemented.

REFERENCES

[1] ”Shanghai Municipality’s Regulation on Household Waste”. Baike, 01 Jul. 2019, https://baike.baidu.com/item/5n.
[2] G. Thung and M. Yang. ”Dataset of images of trash; Torch-based CNN for
[3] garbage image classification”. GitHub Repository, 2016, https://github.com/garythung/trashnet.
[4] G. Thung and M. Yang. ”Classification of Trash for Recyclability Status”.
[5] CS229CourseReport,http://cs229.stanford.edu/proj2016/report/ThungYangClassificationOfTrashForRecyclabilitySt a tusreport.pdf.
[6] R. A. Aral, ¸S. R. Keskin, M. Kaya and M. Hacıomeroglu, ”Classification ¨
[7] of TrashNet Dataset Based on ˘ Deep Learning Models”, 2018, IEEE International Conference on Big Data (Big Data), Seattle, WA, USA, 2018, pp.2058-2062.
[8] H. Vo, L. Hoang Son, M. T. Vo and T. Le, ”A Novel Framework for Trash Classification Using Deep Transfer Learning,” in IEEE Access, vol. 7, pp. 178631-178639, 2019.
[9] vasantvohra. ”Waste Segregation Project to classify waste into different classes”. GitHub Repository, https://github.com/vasantvohra/TrashNet/blob/master/Notebooks/Trashnet5.ipynb.
[10] Siddharth Das. ”CNN Architectures: LeNet, AlexNet, VGG, GoogLeNet,
[11] ResNet and more. . . ”. Medium, 16 Nov. 2017, https://medium.com/analyticsvidhya/cnns-architectures-lenet- alexnet-vgg-googlenetresnet-and-more-666091488df5