SpotTheLitter - Garbage Detection and Alert System

Gurprasad Singh

Student
Department of Computer Science and Engineering,
Guru Tegh Bahadur Institute of Technology affiliated to Guru Gobind Singh Indraprastha University, New Delhi, India

Abstract: **In recent times, the rapid industrial and economical development has led to the destruction and pollution of the environment, especially for developing countries. As per recent metrics, India produces 277.1 tonnes of garbage every year. In this case, real-time garbage detection is important for environmental pollution monitoring. This project proposes an automatic garbage detection and alert system based on deep learning and computer vision.**
Maintaining a clean, urban and hygienic environment is an essential but a nearly impossible task, especially in developing countries. With the aim of engaging citizens to track and report on their neighbourhoods, I have developed an AI-based project i.e. SpotTheLitter. It functions a real-time detection of open garbage or trash on roads and in case of any trash or garbage detected, it sends the captured images of the garbage with the surrounding area for more accuracy in finding the exact location, and also the location name along with accurate location coordinates to the Municipal corporation so that, they can track the open garbage as soon as possible and get it cleared thereby reducing the environmental pollution.

Index Terms: **Garbage, Garbage Detection, trash, CNN, hygienic environment, clean environment.**

I. INTRODUCTION

Maintaining a clean, urban and hygienic environment is an essential but a nearly impossible task, especially in developing countries. Garbage is everywhere but when left uncollected and uncovered, it often ends up harming the environment and people's health. To deal with this problem effectively and efficiently, we firstly need to focus on the places that are most affected and think of possible ways to effectively clear the garbage.

Managing garbage and generic waste is a very challenging task in developing countries and modern cities. Every area has its distinctive waste production pattern in terms of type and volume of produced waste, and optimizing collection is the key to reduce costs and ensure at the same time that city's hygiene is always maintained.

For some places, this task is made even more difficult and time consuming due to the lack of resources and impossibility of installing underground containers. In this case, it is of course an important need to optimize the collection process and to minimize the amount of garbage bags accumulating at any of these spots.

Recently, many projects have been worked upon which aim to solve this problem but they involve the use of some form of sensors to be scattered through the city. But, these IOT based solutions tend to be very expensive, both for installation and maintenance and are not at all scalable and environmental-friendly. The solution to environmental problems should not involve producing and scattering even more disposable electronics all over a city, thereby polluting the environment in another way.

With the aim of engaging citizens to track and report on their neighbourhoods, an AI-based solution i.e., SpotTheLitter is developed.

II. PROBLEM DEFINITION

Every human activity produces waste. Every business produces one or the other kind of waste. Big and small firms generate tons and tons of waste per day. Pedestrians and households even breed waste every second.

Waste means extravagant use and careless disposal of something to quickly exhaust its value and pollute the environment. Waste also means the futile remains of something of value. Human actions and discipline towards the environment projects a huge environmental injustice. Households are not ready to spend money to properly dispose off their rubbish bins thus depriving household waste of the mien of having an attractive financial value in comparison to the associated risk of handling it. This situation further expands the explanation of why private sector investors are uninterested in developing the household waste industry.

The rash deserting of the sector strictly by the government probably explains why the household waste items are littered in open all over the place. In the locality where the majority of the residents are struggling with poverty, scrambling, and hustling for just a meal per day may not have money set aside for proper waste disposal. The most common attitude is the indiscriminate dumping of garbage because it is believed that it is the responsibility of the government. Despite the fact the government has put in place the working structure to enhance effective household waste handling, we still have experiences like having household waste items negotiating for the right of way with motorists on our streets, with the trash appearing in the morning, having been dumped in the middle of the night by faceless human beings. They then end up as rubbish heap piles on the roads, strictly tending to disfigure the city on every side, like a chain of mountains.

Thus, the safety of the environment or surroundings is the prime concern. SpotTheLitter has tried to inculcate the environment safety and cleanliness in the project by detecting garbage and helping the government agencies to track and clear all the open garbage in our surroundings.

III. MODULES AND METHODOLOGIES

This project is divided into 6 steps:

1. Collecting images: For the dataset, many images are collected through the World Cleanup App and scraped from Google Street View to get used by our model.

2. Selecting images: Most of the images were strategically chosen that went into the model. SpotTheLitter was started with a sample of images, the model was trained and the results were analyzed and based on the results, it was determined what images had to be added to the next iteration of training.

3. Object detection: This step was very time consuming because it required a lot of manual work: marking all the trash in each of the selected images and manually annotating many images for the model to learn what trash is.

4. Training the machine learning model: This was done multiple times, each time adapting the parameters of the Mask R-CNN model to improve the results and adding new images to the training dataset.

5. Result validation and Testing the training: After each training cycle, the best model was chosen and tested by having it predict trash on test images. These images were in the validation dataset and were not used for training the model and also, were used to assess the accuracy of the model.

6. Alerting MCDs in case of open garbage or spotted trash: As soon as the details and captures of open trash or garbage is detected at a location, an alert will be sent via mail and text message to MCD services with location details, links to the directions of those particular locations, location coordinates and captured images of garbage and its surrounded area to accurately spot it without wasting much time and clear it.

Concepts used for this project are Deep Learning (CNN), Computer Vision for real-time video processing (OpenCV), python-based email service (SMTP).

This automated system would reduce environmental pollution and ensure cleanliness on roads to be maintained to a greater extent.

IV. ASSUMPTIONS AND DEPENDENCIES

- The cameras must be installed on forests within a specific diameter.
- The application requires a stable network connection as on roads, the satellite network is used.
- Offline Text Messaging and the online messaging facility should be there.
- The interface of the resulting system will be easy to use and accessible with a time or location constraint.

V. RESULT
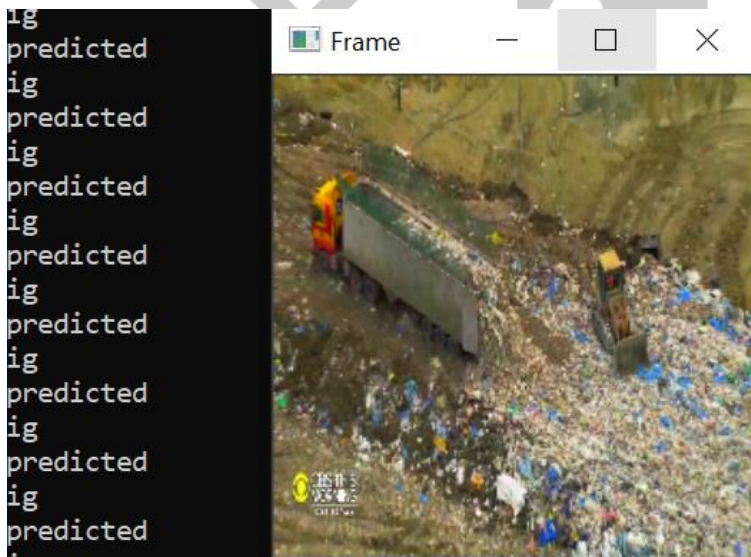
VI. CONCLUSION AND FUTURE SCOPE

SpotTheLitter ensures the reduction of environmental pollution and maintains cleanliness on roads. There are still some areas where satellite connection or internet connection is not available. Areas, where the network is available, can access all the features of the project, while others can access the limited features (i.e., all features except alerting the authorities). Certain features have been decided to be added to the project in future for smooth working:

1. Feature 1:

Currently, SpotTheLitter detects garbage at a bit slower speed and a lesser accuracy at night (or without much light) and also is a bulky software. In future, I will try to reduce space and time complexity to make it more scalable, feasible and faster. And also, automated learning will be integrated to the software so that it learns and trains constantly by every new experience it captures, marked as false or true by the admins thereby increasing more accuracy in conditions with or without light.

2. Feature 2:

Currently the software is designed to be integrated with the cameras installed on roads. But in future, along with cameras, the idea is to propose the government and automobile companies to integrate it with the cars having rear camera based parking facilities, so that on any time of day, the public can also openly contribute to its dataset and also the environment by activating this feature, so that from all the places that the cars pass by, garbage is detected and alerted to the MCD and also whether the detection was correct or wrong will be marked by admin thereby adding more data for training the model and increasing the accuracy.

In each and every scenario, this automated system would reduce environmental pollution and ensure cleanliness on roads to be maintained to a greater extent.

REFERENCES

[1] SpotGarbage: smartphone app to detect garbage using deep learning, Gaurav Mittal, Kaushal B. Yagnik, Mohit Garg, Narayanan C. Krishnan.

[2] DeepID-Net: multi-stage and deformable deep convolutional neural networks for object detection Wanli Ouyang, Ping Luo, Xingyu Zeng, Xiaoou Tang.

[3] Learning Deep Architectures for AI, Y. Bengio.

[4] Going deeper with convolutions, Christian Szegedy, Wei Liu, Yangqing Jia, Andrew Rabinovich..

[5] Urban scene garbage automatic monitoring based image processing. J. Journal of international technology, 6, Wei Shufa, Cheng Zhanglin, p.p 40-52.

[6] V.: What is an object, Bogdan Alexe, Thomas Deselaers, Vittorio Ferrari.

[7] Going Deeper with Convolutions, Christian Szegedy, Wei Liu, Yangqing Jia, Pierre Sermanet, Scott Reed, Dragomir Anguelov, Dumitru Erhan, Vincent Vanhoucke, Andrew Rabinovich.