Reward Based Trash Detection Using CNN

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ABSTRACT

To protect the environment from trash pollution, especially in modern societies, cutting-edge solutions are needed to improve the environment's cleanliness. The rise of artificial intelligence (AI), especially with respect to Deep Learning, provides an excellent opportunity to develop trash detection. It is now possible to detect trash in images thanks to latest progress in computer vision and machine learning. The Trash Recognition system must detect and locate trash in a cluttered scene, extract features, and classify it. Convolution Neural Network is used to implement the trash recognition system (CNN). As a result, we've created Gward, which awards points for trash detection.

Keywords— CNN, Deep Learning, Trash Recognition, Artificial Intelligence, Feature extraction

I. INTRODUCTION

When a city is clean and healthy, its residents appreciate it the most. However, as the world's population grows, more people are moving into cities, resulting in more trash than ever before, making it extremely difficult to keep the city clean. We can understand how tough it is when we examine South Asian countries. Despite the fact the early stage nations possess a very well waste handling programme, because they possess the financial means to invest in and maintain one, they do not have the resources to do so, most developing countries cannot do so properly, despite the fact that they account for the majority of the world's population. As a result, waste management has become a global concern.

Recent advances in deep learning research have resulted in significant advancements in computer vision. CNNs establish themselves as one of the most popular and capable algorithms based on CNN, with a wide range of uses in segmentation, detection and image classification. In short, Gward can detect the type of trash a user uploads and award points based on that type of trash.

A convolutional neural network is nothing but a feedforward based artificial network used in machine learning. The connectivity pattern between neurons in the animal visual cortex was inspired by the organisation of its neurons. Individual neurons react to stimuli in the receptive field, a limited area of space. Because the receptive fields of different neurons partially overlap, the visual field is tiled. A convolution operation can be used to approximate an individual neuron's response to stimuli within its receptive field. Biological processes influenced the evolution of convolutional networks.

II. LITERATURE SURVEY

Rumana Sultana [1] demonstrated processing of image techniques and deep learning technology for trash detection in public places in preparation for municipal trash collection. It is a CNN-based algorithm that detects garbage and non-trash while also distinguishing landfill and recyclable materials in the trash category in order to build an automatic trash collection system. On interior photographs, this algorithm was more accurate, but on outside images, it was less efficient. Furthermore, it is less effective on real-time photos of multiple types of trash in close proximity to one another in an environment with a colourful or gradient background.

Deep Patel [2] proposes a trash detection system for detecting and locating garbage in original photos and videos using object detection models. YOLOv5M guarantees a good precision value, according to the findings of numerous models for the proposed system, and gives reliable and sharp predictions on pictures, satellite photos, and other images. Cannot be used on photographs obtained from various sources, such as CCTV footage, drone images, satellite images, and so on. Predictive time reductions remain a challenge.

Xiujie Xu [3] proposed a study which presents a trash categorization and identification system based on transfer learning and lightweight neural networks. MobileNetV2, a lightweight neural network trained through migration and transformation, was used to extract features, which were then integrated into SVM for classification, resulting in the recognition of six different garbage categories. The algorithm is based on the uniform trash distribution Trash net dataset, which has a uniform trash distribution. As a result, this strategy may not be effective for waste with large volatility. This method cannot be used to classify waste in everyday life. It only detects six different forms of garbage.

Melinte, Daniel Octavian [4] proposed a research which examines convolutional neural network based object detectors for recognising municipal waste in great detail. The major objective was to increase some of the pre-trained models' capabilities. The research focuses on recognising a single waste object per picture, rather than aggregating waste objects, which generates inefficient results. To address the problem of global waste contamination.

Sylwia Majchrowska [5] proposed a study on the use of artificial intelligence in waste identification and classification. As a result, they proposed a DL-based framework that employs two independent neural networks to locate and classify trash in an image. When it comes to locating medium and large things, the chosen detectors function effectively, however recognising little trash is difficult.

Md. Samiul Haque Sunny [6] proposed the concept of a smart dustbin which is based on CNN and object recognizer .study. The goal of this design is to persuade people to use this smart garbage can in exchange for a few selected items. Installation, operation, and maintenance costs may be significant. This system's proper monitoring may necessitate the use of human resources.

To solve the issues involved with monitoring garbage across broad regions, Dan Zeng's [7] study proposes a two-step approach for locating waste locations built on multispectral aerial remote sensing techniques. The initial approach is to categorise HSI using MSCNN. MSCNN extracts multi-scale features from HSIs using multi-scale structures, allowing it to extract spectral as well as spatial data. The second stage uses the Search Selective algorithm as an unsupervised item identification strategy to find trash regions based on the segmentation maps created in the previous phase. Because Selective Search does not offer box confidence, the size of the detection boxes is utilised as the confidence based on the object characteristics. It's possible that classes will cross. Smaller litters may be undetected.

III. PROPOSED TECHNIQUE

We present an system where an user register himself to the system. The user uploads an trash image which will then be processed by the CNN algorithm. Later the result along with the prediction will be stored in database and sent to admin for verification. Once the admin accepts the points received for that particular trash will be added into the user account wallet. If trash is rejected during verification then details of that trash is removed from the database as shown in Figure 1.

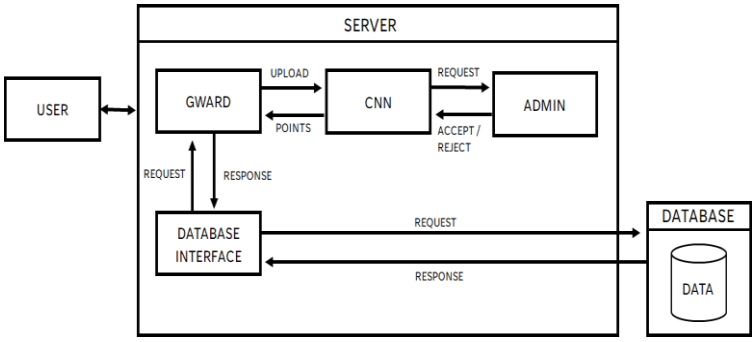

Figure 1: Proposed System.

A. **Algorithm**

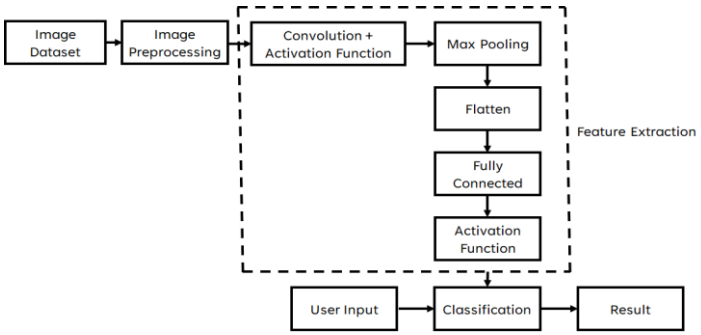

Figure 2: The flow diagram for detection of the trash.

Step 1: Pre-processing

These stages are made up of algorithms that improve the characteristics of the input trash image so that the resulting picture enhances the efficiency of the proposed system's subsequent stages.

Step 2: Convolution layer

The product of every filter and picture patches in the layer is used to obtain final dimensions. We'll receive 32 x 32 x 12 output volume if we utilise a sub total of about 12 filters for the layer.

Step 3: Pool layer

This layer is inserted into the concussion regularly, and its main purpose is to shrink the size of volume which increases the computation, preserves memory, and avoids generalisation. Maximum pooling and average pooling are the dual pooling layer types. The volume shall be 16x16x12 if we utilise a maximum pool of 2 x 2 filters including stride 2.

Step 4: Activation Function layer

The result of convolution layer will be applied to this layer, which will use an element-by-element activating function. RELU: max(0, x), Sigmoid: 1/(1+e-x), Tanh, Leaky RELU, and other activation functions are common.

Step 5: Feature extraction

Feature extraction are a part of the reduced dimensionality process that splits and lowers a large set of raw data into smaller groupings. The good number of variables in these large data sets is the most important feature. To handle these numbers, a significant amount of computing power is required. CNN was used in

this step (Convolutional Neural Network) The following characteristics are easy for usage whilst at the same time to accurately and uniquely describe the actual data-set.

Step 6: Image classification

Image classification is a computer vision technique for categorising images upon their visualisations.. In this step, various classifiers such as CNN and Naive Bayes are used (NB).

Step 7: Trash detection

The procedures perform trash detection as the system's final stage. First, the image's useful features are extracted. These features are then used to determine the type of trash.

IV. RESULTS AND DISCUSSION

A collection of unique procedures have been developed by us for teaching a Convolutional Neural Network (CNN) for recognition of garbage. The CNN architecture was trained to take images and classify them based on the type of trash. After determining the type, a reward will be generated and saved in the user's account. We trained the CNN model using publicly available train datasets with 400+ images in each category and performed the testing resulting CNN consisting of a set of images from four categories (Glass, metal, cardboard, plastic)

The following dataset details are shown for various categories:

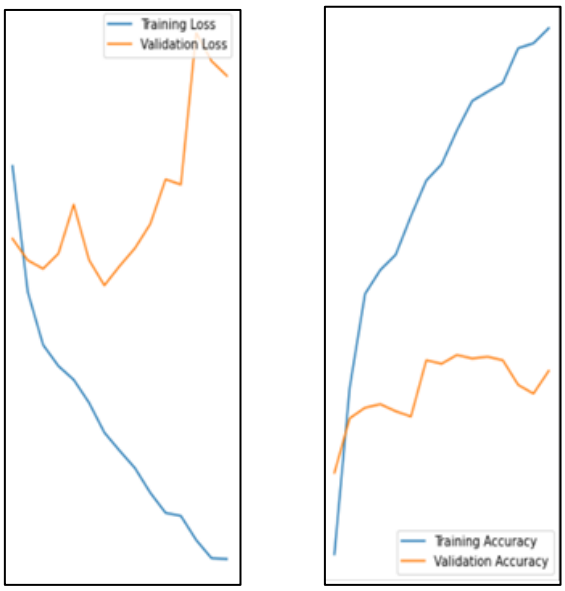

Figure 3: Training and Validation Accuracy.

Category: Plastic

Figure 4: Example of plastic training images.

Category: Metal

Figure 5: Example of metal training images.

Category: Glass

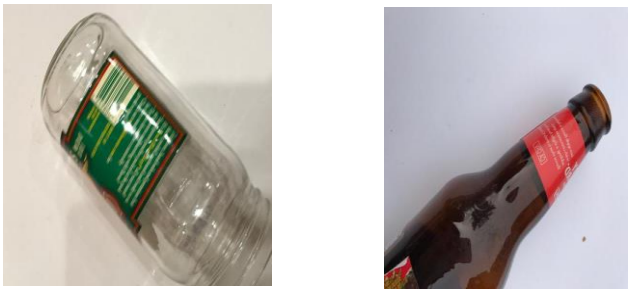

Figure 6: Example of glass training images.

Category: Cardboard

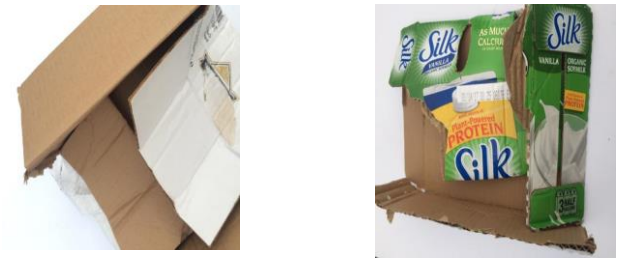

Figure 7: Example of cardboard training images.

V. CONCLUSIONS

We created a Convolution neural system for recognising garbage and distributing points based on the type of rubbish found in this research. The algorithm begins with pre-processing to remove noise. To obtain the result, feature extraction is used to extract important features from the trash, followed by trash classification. The method was tested on a set of images, and the results were evaluated. According to the analysis, the results obtained are satisfactory, and the method's accuracy was 86%. The model can learn some useful features for distinguishing different types of trash.

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