Waste Classification Using Convolutional Neural Network And Keras Library

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Abstract- *Proper waste classification is extremely important to save time and reduce expenditure for large scale waste management. Here we have tried to classify various Indian household items and tried to classify them into either dry or wet waste by their images. The images can be taken via a camera and an image classification Neural Network will classify the image into its proper waste type.*

Keywords- Waste classification, Image classification, Convolutional Neural Network (CNN), Keras Library.

I. INTRODUCTION

Waste Classification is a major problem that is overlooked by general people of large cities where waste is produced at alarming rates. It is evident in common households that residents are not bothered about waste segregation which causes major difficulties to the waste management board of the city. Thus, lots of potentially recyclable waste products end up being mixed with non-recyclable waste materials which causes these recyclable materials to lose their usefulness. The government has incessantly urged the residents to keep two disparate bins for dry and wet waste but people find it hard to classify the waste item and hence they throw the waste item in any one of the bins based on their whim. Here, the Neural Network comes into picture which can save a lot of time and effort for classification purposes on the people's end. Considering these and many other factors, we have developed a Neural Network that uses image classification to classify the most common waste materials found in common households.

II. NEURAL NETWORK

A neural network is an advanced method based on Machine Learning which tries to mimic the way a human brain learns, based on neurons. In a Neural Network, there are multiple called the input layer, hidden layer and output layer which work together by sending data to each other, this data is a combination of data received from the previous layer and special weights assigned to each neuron. This results in an intricate and efficient learning method, based on data that can help us in solving problems related to image processing, voice recognition and, handwriting recognition, etc.

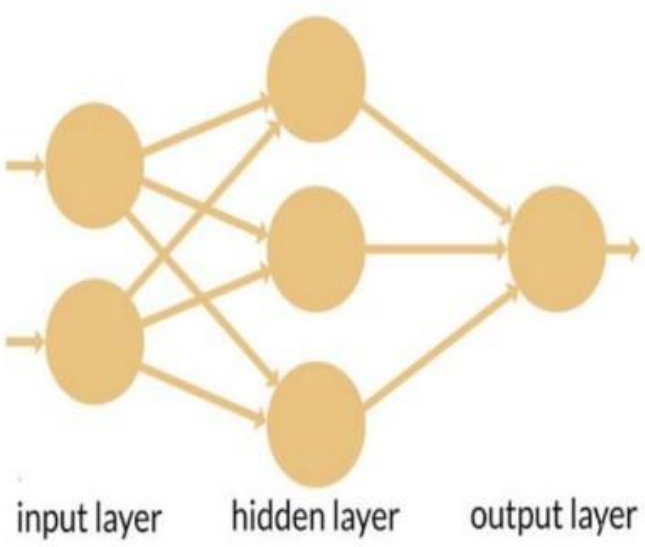

Figure1: Neural Network

III. COMPONENTS

The hardware components used for the project has been mentioned below:

A. Camera

We have used a camera for two purposes: To acquire training data set for training the Neural Network and for testing the Neural Network on real- world images.

B. SD Card

It is used for storing data set images.

The software components used for the project has been mentioned below:

A. Python

We have used the Python Programming Language for writing the code of the Neural Network.

B. Keras Library

Keras is a popular, high-level library by Google which has a lot of Machine Learning and Deep Learning algorithms stored in it. We have used the algorithms from this library for implementing the Neural Network.

C. Google Colab

Google Colab provides a runtime environment for running the Neural Network by providing virtual machine GPU for high computational power.

IV. METHODOLOGY

In the Proposed System, we are trying to classify common household waste products as dry or wet waste using image classification algorithms. Here, Python programming language is used, Keras library is used in Python. Along with dry & wet waste classification, the system can help decide whether the waste material is recyclable or non-recyclable. Image of waste items taken via web cameras of 2MP resolution of 640*480.

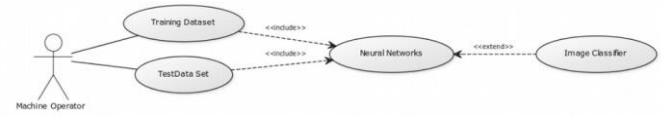

Fig1. Use-Case Diagram

The project is carried out by implementing the following steps:

1. Image Acquisition
2. Trained Neural Network
3. Model Optimization
4. Test data-set execution

1. Image Acquisition

In the acquisition phase, the images of waste materials found in common households were taken using a camera to train the Neural Network. The captured images are stored in the SD card.

2. Trained Neural Network

Developed a Neural Network using Keras Library, used Adam Optimizer and cross-entropy loss function for training the Neural Network. Used other python libraries such as Numpy, Matplotlib.

3. Model Optimization

We optimized our Neural Network's accuracy using augmentation and max-pooling.

4. Test data set execution

Tested the Neural Network on test-data set and images of real-time waste products and achieved an accuracy of 98%.

V. CONCLUSION

This project can help solve the major problem of segregation large scales of waste quantities efficiently. The system presents a neural network that classifies waste items based on their characteristics and hence classifies them as wet or dry waste using image classification. The system is trained in Google Colab and written in Python Programming Language which can help reduce human time and effort for classification of waste as dry or wet waste, hence, making the segregation a lot easier than before.

VI. FUTURE WORK

For future development, the system can be integrated with IoT(Internet of Things) which segregates the waste by using a robotic hand and puts the waste items into their respective compartments, hence, minimizing human intervention.

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