

# WASTE CLASSIFICATION AND NATURAL DISASTER IMAGE CLASSIFICATION USING CNN AND TRANSFER LEARNING

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## ABSTRACT

Natural calamities can exert a deep and extensive impact on human beings, influencing people on personal, communal, and societal levels across various dimensions such as physical, mental, economic, and social aspects. The utilization of machine learning algorithms to categorize images depicting natural disasters can prove highly beneficial to humans, offering valuable insights and aid in managing and responding to disasters effectively. Each year, the Earth generates 2.01 billion metric tons of municipal solid waste, and a conservative estimate suggests that at least 33 percent of this waste is not managed in an environmentally responsible manner. Waste management is a worldwide problem that has an impact on all nations, with each day producing 4.4 pounds of waste per person [1]. The categorization of waste images holds promise for improving waste management procedures, elevating recycling percentages, minimizing environmental pollution, and promoting sustainable development. A Convolutional Neural Network (CNN), a subset of machine learning algorithms and artificial neural networks tailored for image-related tasks, has played a transformative role in computer vision and image processing applications. This is attributed to its capacity to autonomously acquire and extract meaningful features from images. In this article, we are proposing for a CNN system for classifying Waste and Natural Disaster images.

**Keyword:** - Natural disasters, waste, machine learning algorithms, image classification, CCN- convolution neural network

## 1. INTRODUCTION

In our rapidly evolving world, effectively managing waste and predicting natural disasters have become crucial challenges for humanity. The issue of waste management, continuously expanding, not only poses environmental threats but also carries social and economic implications. On the flip side, natural disasters, ranging from hurricanes and earthquakes to wildfires and floods, persist in causing substantial loss of life and extensive property damage. Tackling these challenges requires innovative approaches, and one such method involves the application of artificial intelligence and deep learning algorithms.

Convolutional Neural Networks (CNNs) have emerged as potent tools in the field of computer vision, demonstrating the ability to extract intricate patterns and features from images and videos. This technology has found success in various applications, spanning from image recognition and autonomous vehicles to medical diagnosis. In the realms of waste management and natural disaster classification, CNNs present a promising avenue for automating processes that were previously reliant on manual labor and expert knowledge. Following this, we describe our proposed model for automating waste management and natural disaster image classification.

## 2. NECESSITY OF WASTE CLASSIFICATION

Waste management is crucial for maintaining environmental sustainability, public health, and the overall well-being of communities. Proper waste management helps mitigate pollution, conserves resources, and reduces the negative impact of waste on ecosystems. Waste management is essential for several reasons, backed by compelling statistics that highlight the critical need for effective waste management practices. global waste generation is expected to increase to 3.40 billion tonnes by 2050. [2] Improper waste disposal contributes to soil and water pollution. Over 8 million metric tons of plastic enter the oceans each year. [3] Inadequate waste management leads to public health issues. Around 2.01 billion people lack access to proper waste disposal facilities, exposing them to health risks. [4] Recycling plays a crucial role in conserving resources. Recycling one ton of paper can save 17 trees, 7,000 gallons of water, and 463 gallons of oil. [5]

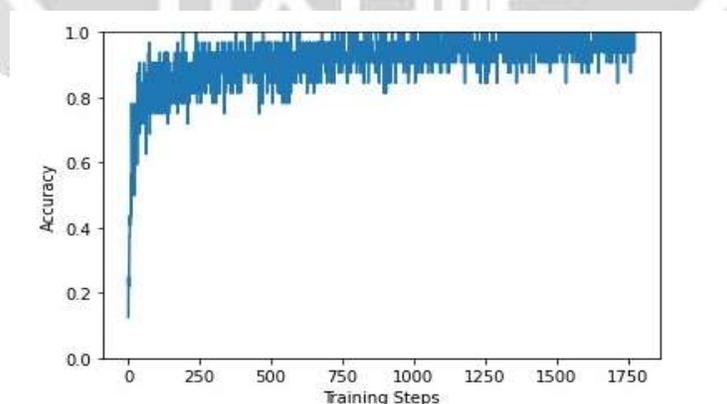
## 3. BUILDING THE WASTE DETECTION CNN CLASSIFIER WITH TRANSFER LEARNING

Our system utilizes transfer learning with the Keras framework, seamlessly integrated into TensorFlow, to implement a Convolutional Neural Network (CNN) for waste classification. Transfer learning extends the capabilities of CNNs by leveraging knowledge gained from pre-trained models on general tasks. Implementing a Convolutional Neural Network (CNN) for waste classification involves creating a neural network architecture capable of learning and distinguishing between different waste categories from images. Transfer learning extends the capabilities of CNNs by leveraging knowledge gained from pre-trained models on general tasks. Keras, originally an independent deep learning library, has become an integral part of TensorFlow. We import Keras into TensorFlow for building the waste classification model.

Next, we build the transfer learning model. After building, the model has learned intricate features from a vast dataset and can serve as a solid foundation for waste classification.

Then we loaded our waste dataset, preprocessed the images, and trained the model. To enhance the model's performance, we fine-tuned it by unfreezing some of the pre-trained layers.

By combining the strengths of transfer learning, Keras, and TensorFlow, we have created a robust CNN model for waste classification. This approach not only benefits from the knowledge encapsulated in pre-trained models but also allows customization to the unique challenges posed by waste classification tasks. As we advance in the era of smart waste management, the integration of machine learning techniques promises to elevate our ability to categorize and manage waste items effectively, contributing to a more sustainable and environmentally conscious future.



**Chart -1:** Accuracy of the proposed model

### 3.1 Overview of the Training of the System

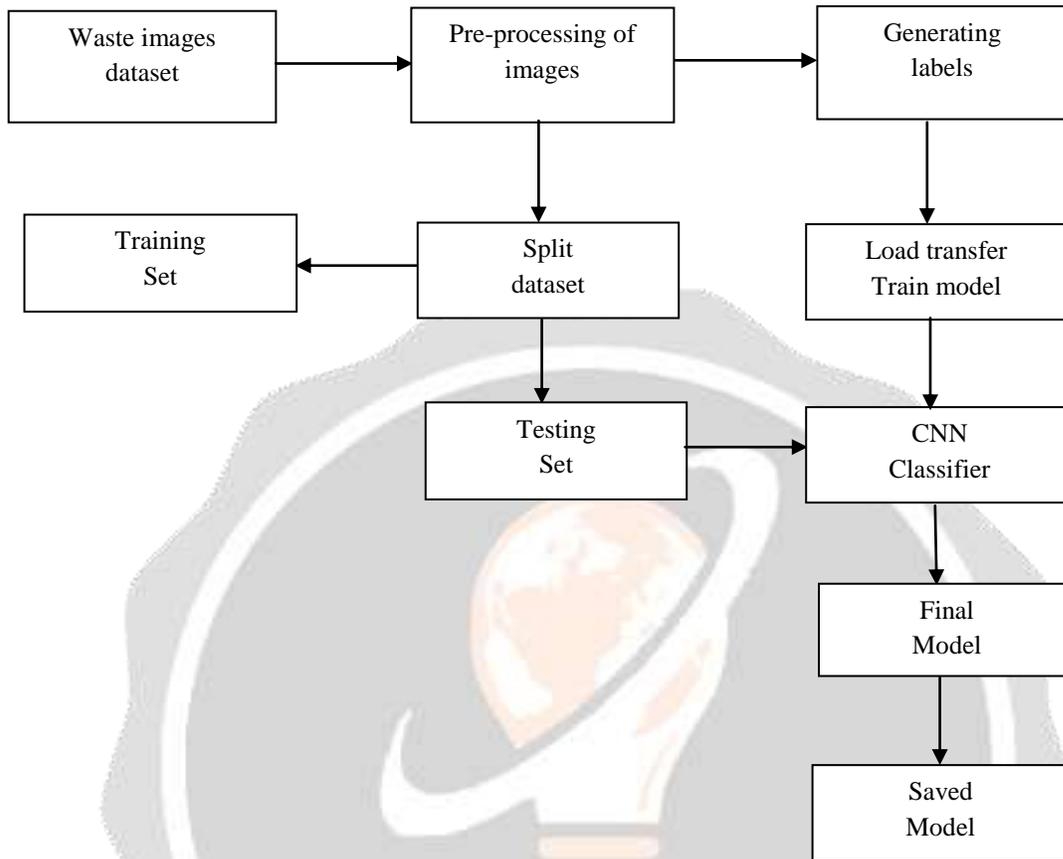


Chart -2: Training the Model

### 3.2 Overview of the Testing of the Model

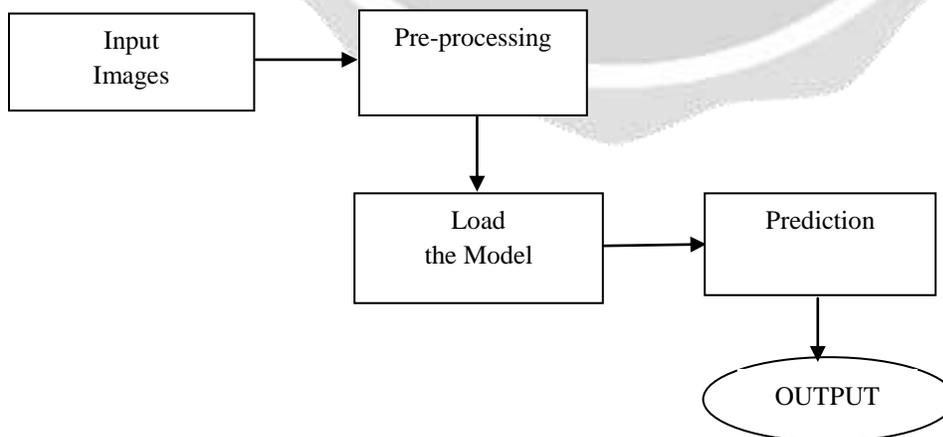


Chart -3: Testing the Model

### 3.3 Sample Prediction



Chart -4: Sample Prediction

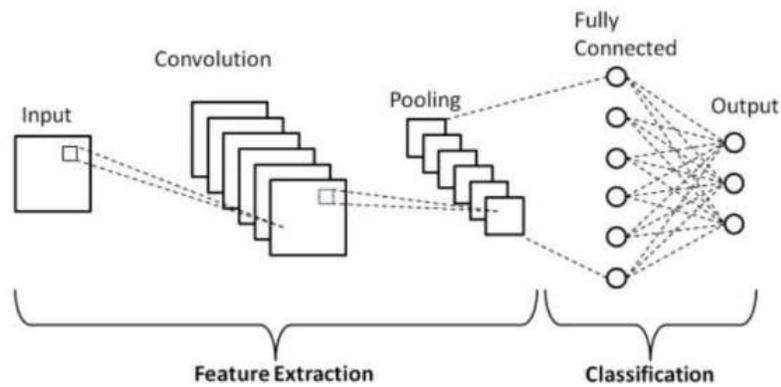
## 4. NECESSITY OF NATURAL DISASTER IMAGE CLASSIFICATION

Natural disaster image classification is crucial for several reasons, and its necessity becomes evident when considering the impact it can have on disaster management, response efforts, and overall public safety. Such a model helps in proactive disaster management, effective response coordination, and minimizing the human, economic, and environmental toll of such events. Between 2000 and 2019, there were 7,348 natural disasters worldwide, resulting in 1.23 million deaths and affecting 4.2 billion people. These disasters included earthquakes, floods, hurricanes, and other events. [6] The annual global cost of natural disasters ranges from \$520 billion to \$560 billion. [7] Integrating advanced technologies like machine learning and image classification into disaster management systems enhances our ability to address and mitigate the impact of natural disasters.

## 5. BUILDING NATURAL DISASTER CNN CLASSIFIER

We define the problem on hand and specify the categories of natural disasters we want to classify – cyclones, earthquakes, floods and wildfires. The dataset is then processed where the images are resized to a uniform size to ensure consistency. All pixel values are normalized to a range between 0 and 1. We designed the CNN model with a stack of convolutional layers followed by pooling layers to capture spatial hierarchies. The preprocessed images are fed into the CNN for training using the fit method. The trained model was then evaluated on a separate test set to assess its performance on unseen data.

Building a CNN for natural disaster classification is an iterative process that involves experimentation and optimization. In this process, we create a robust model capable of accurately classifying images related to different types of natural disasters.



## 6. RESULTING SYSTEM

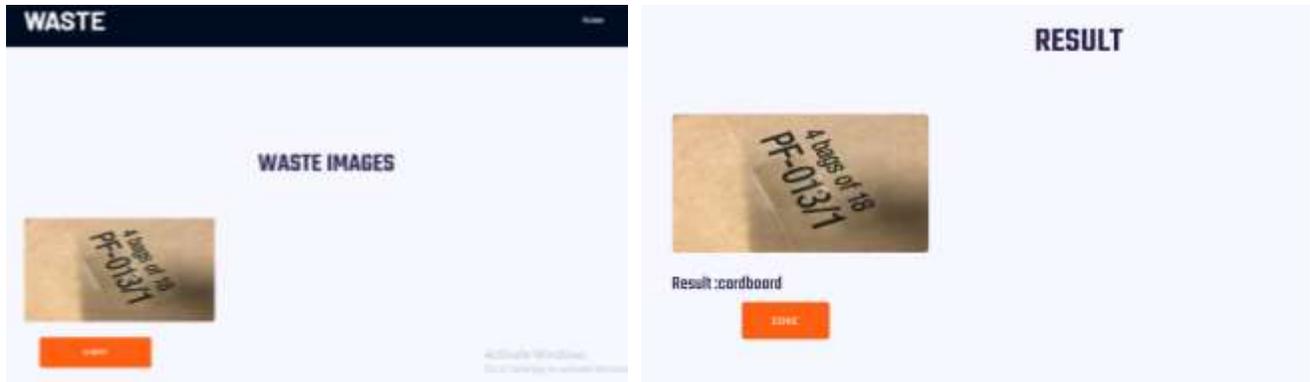
The following is the welcome page of the Waste and Natural Disaster Prediction System.



After logging in, the user can upload the image to be classified and use the system to predict the category. Upon clicking the submit button, the prediction will be displayed on the screen.



**Chart-5:** Prediction page for Disaster images



**Chart 6:** Prediction page for Waste Image Classification

## 6. CONCLUSIONS

Convolutional Neural Networks are revolutionizing waste management by providing a sophisticated and efficient solution for waste classification. Their ability to learn from visual data, adapt to diverse waste items, and operate in real-time positions CNNs as valuable assets in the pursuit of sustainable and technologically advanced waste management practices. As technology continues to evolve, the integration of CNNs is poised to play a pivotal role in shaping the future of waste management worldwide. Embracing these innovations is not just a step forward; it's a leap toward a cleaner, greener, and more efficient future.

In the field of natural disaster image classification, convolutional Neural Networks have emerged as indispensable tools, offering high accuracy, adaptability to diverse data, and real-time processing capabilities. As technology continues to advance, the integration of CNNs into natural disaster response systems promises to provide more accurate, efficient, and timely insights, ultimately contributing to better disaster preparedness and mitigation strategies worldwide.

## 6. REFERENCES

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