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Convolutional Neural Network Based Dog Breed Classification

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ABSTRACT

One of the most popular domestic animals is the dog. Numerous problems, including population control, a decline in disease outbreaks like rabies, vaccination oversight, and legal ownership, are brought on by the abundance of dogs. There are currently around 180 different dog breeds. Each breed of dog has unique traits and health issues. It is crucial to identify people and their breeds in order to administer the proper therapies and training. Machine learning provides the ability to train algorithms that can tackle the challenges of information classification and prediction based only on newly emerging information as raw data. For the categorization and detection of images, Convolutional Neural Networks (CNNs) provide a single, widely utilized method. In this effort, we establish a CNN-based method for identifying dogs in potentially complicated photos, and as a result, we consider only one of the types of dog breed identification. The graphical depiction demonstrates that the algorithm (CNN) delivers good analysis accuracy for all the examined datasets because the experimental outcome analysis confirmed the conventional metrics.

Keywords : RTBP, CRTBP, Three Body Problem.

I. INTRODUCTION

Machine learning is a subfield of artificial intelligence (AI). The main aim of machine learning is to comprehend the structure of data and fit it into models that people can comprehend and use. Despite being a branch of computer science, machine learning is distinct from conventional computational methods. Algorithms are collections of deliberately coded instructions that computers employ to do calculations or solve problems in conventional computing. Instead, machine learning techniques enable computers to train on data inputs and make use of statistical analysis to produce values that fall inside a given range. In order to automate decision-making processes based on data inputs, machine learning

enables computers to develop models from sample data.[1] The majority of dog breeds were created to drive behaviors. Knowing a dog's breed can help us anticipate and comprehend its behavior. And this is crucial when managing and raising dogs for jobs. Convolutional neural networks (CNN) are challenging feed forward neural networks in machine learning. Due to its extreme accuracy, CNNs are employed for picture categorization and recognition. The CNN uses a hierarchical model that tries to build a network in the shape of a funnel but eventually produces a layer where all the neurons are connected to one another, processing the output as a result. A computer can learn to categorize sounds, sights, and texts. The computer transforms the image's pixel value to an indoor representation after training with big image datasets so that the classifier can recognize patterns in the input image.

II. METHODOLOGY

There are 120 classes in this multiclass classification problem, which correspond to the various dog breeds. An image is used as input, and the task is to assign it to the correct class. Deep Convolutional Neural Network is used to approach the issue as an Image Classification problem. Further, the accuracy is increased using the transfer learning technique.

The Stanford Dogs set of data, which includes 120 distinct dog breeds and 10222 and 10357 photos for training and testing, was used in this study. This dataset is only a small portion of the tough ImageNet datasets. Instead of labelling the photographs in the training directory with the names of various Dog breeds, this is done with their IDs. By plotting the number of samples per class and randomly selected photographs from each class on an image grid, exploratory data visualization was carried out. The data was presented discretely with a wide range of photos for a certain breed.

It is challenging to work with and train on real-world categorical data, especially when there is no ordinal link between the classes. The numerous photos needed to be divided into a predetermined number of categories in accordance with their respective classifications and breed names. Each image was individually looked up from the label.csv file and placed into the appropriate class, breed, and id categories based on the train path. However, the number of samples obtained for each label was skewed and ranged from a low of about 65 to a maximum of more than 125.

Convolutional neural networks (CNNs) are used for feature extraction and have grown in popularity as a result of the various architectures that some frameworks support. Convolution layers and Pooling Layers are the two basic building blocks that make up the CNN's Convolution section. [2] Convolutional layers add depth by computing the output of local layer-connected neurons. Down-sampling is performed by pooling layers. The feature vectors are extracted from the input photos using CNN. A CNN-provided feature vector is used by an ANN model to categorize the input. Transfer learning is a DL technique where the model is built using pre-trained models. Weights and pre-trained architecture are initialized. Due to the fact that not everyone has access to the necessary computing power for training Deep Learning models, this concept gained notoriety.

Neural Network: The term "neural network" is often used to refer to **an Artificial Neuron Network (ANN).** Additionally, it is a computer model that is based on the design and operation of biological neural networks. For instance, in the phase of computer science, it is comparable to an artificial human nervous system for receiving, processing, and transmitting information.

A neural network is basically divided into three layers: -

1. Input Layer - All inputs are processed through the model's first layer, known as the input layer.

2. Hidden Layers - The inputs from the input layers are processed by one or more hidden layers, which may be present.

3. Output Layer - At the output layer, the data that has been processed is made available.

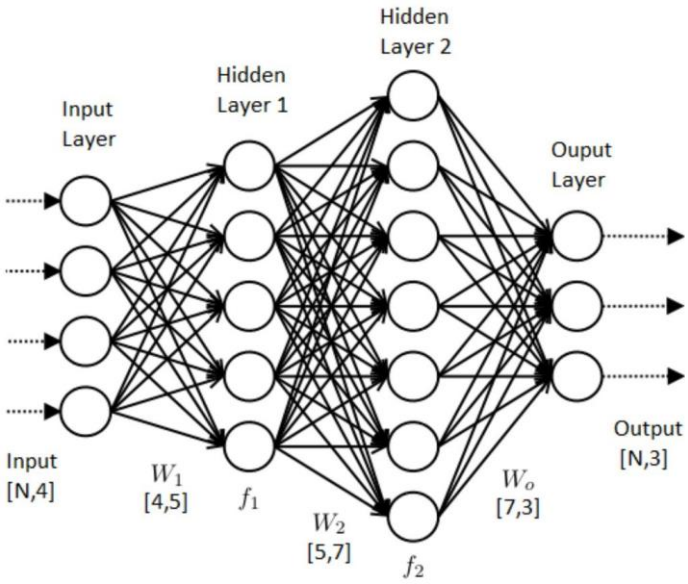


Fig 1. Artificial Neural Network

Convolutional Neural Network: The convolutional layer is the core building block of a **CNN**, and it is where most of the computation occurs. It requires a few components, which are input data, a filter, and a feature map. Let's assume that the input will be a color image, which is made up of a matrix of pixels in 3D. This means that the input will have three dimensions—a height, width, and depth—which correspond to RGB in an image. We also have a feature detector, also known as a kernel or a filter, which will move across the receptive fields of the image, checking if the feature is present. This process is known as a convolution. An uncommon type of reinforcement for developing artificial neural networks is convolutional neural networks, which are driven by the visual cortex. Because each neuron in a layer in CNN is only associated to a tiny portion of the layer above it rather than to every neuron in the layer in a completely related fashion, CNN manages far fewer weights and a much smaller number of neurons. An input layer, hidden layers, and an output layer make up a convolutional neural network. Any intermediary layers in a feed-forward neural network are referred to as hidden layers since the activation function and final convolution conceal both their inputs and outputs. The hidden layers of a convolutional neural network are made up of layers that will execute convolutions. This layer primarily consists of multiplication or dot product.

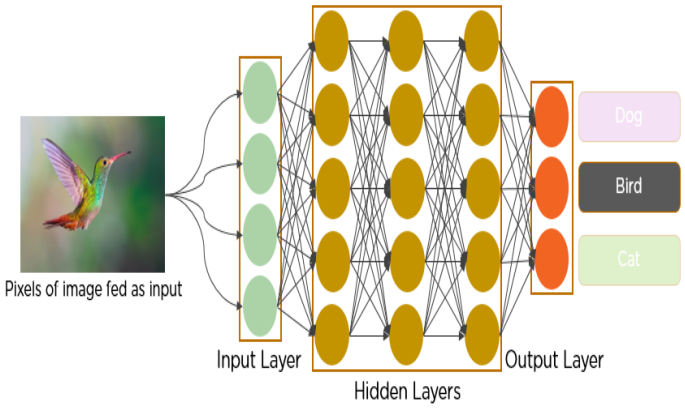


Figure 2. Convolutional Neural Network

Transfer Learning: Transfer learning is a machine learning method where a model developed for a task is reused as the starting point for a model on a second task.

[3] It is a popular approach in deep learning where pre-trained models are used as the starting point on computer vision and natural language processing tasks given the vast compute and time resources required to develop neural network models on these problems and from the huge jumps in skill that they provide on related problems.

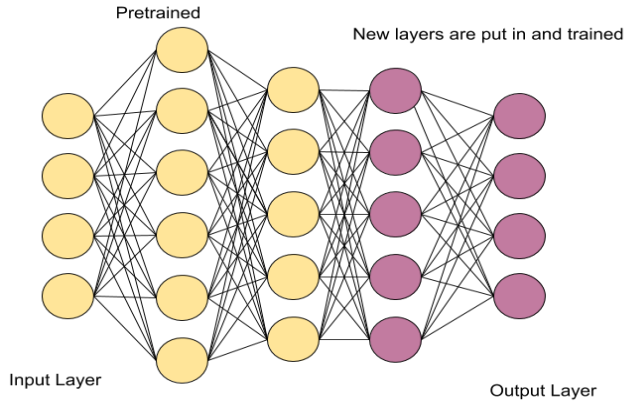


Figure 3. Transfer Learning

TensorFlow: Since it's extensively used for machine learning applications like neural networks, it was chosen as the back-end library for constructing our model. JavaScript and a high-level layer's API may be used to define, train, and run machine learning models directly within the browser. It is made to manage data that is stored in tensor format.

III. PROPOSED SYSTEM

In this paper we propose a system that helps identify and classify the various dog breeds across the world. Our system uses a pretrained model called mobile net v2 from Google's TensorFlow hub, which drastically decreases the network's complexity cost and model size, making it ideal for mobile devices or devices with little processing capacity.

Using TensorFlow hub, a library for consuming reusable elements of machine learning models that may be reused across jobs in a process known as transfer learning. Data batching is also used, which separates a huge data collection into 32 batches, maximizing memory usage.

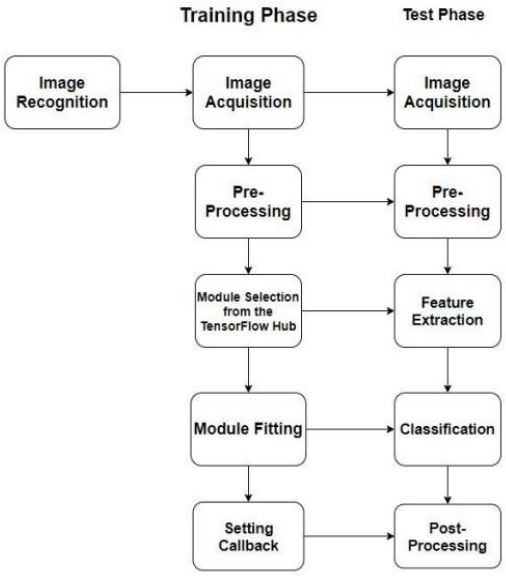


Figure 4. Proposed System

[4]A strong training dataset is a critical first step in creating a robust model. The Stanford Dogs Dataset contains around 20K photos of dogs from 120 different breeds. Each image in the collection has the breed of a dog put on it as an annotation. As you may have noticed, training a deep neural network requires more than just 20K photos of 120 different breeds (200 photographs each breed). There aren't enough training samples for the convolutional neural network (CNN), which is by far the best machine learning model for classifying images in this situation. It would be unable to identify enough general patterns from this dataset to categorize various dog breeds. Most likely, it will just be overfit to this small amount of training examples so that accuracy on the test set will be low.

The best approach: the training must be executed on the original dataset and training the "classification head" which has just several fully connected layers will not require a lot of time and resources. The approach with training pre-trained model with "classification head" attached to it on a smaller dataset is called transfer learning.

Inception model is fed a picture. [5] The output of the Inception model passes through several fully connected (FC) layers before being output by the SoftMax, which calculates the likelihood that an image belongs to each class. It is necessary to train only the FC layers that represent the "classification head". Inception model's established model parameters stay fixed.

IV. RESULTS

The **figure 5.** given below displays the output of the final output. As we have seen it is possible to train a robust image classifier if you have access to pre-trained deep neural networks and modern machine learning libraries like TensorFlow even if you do not have enough training images and/or computing resources.

For a set of 50 dog breed classes, the results achieve nearly 85 percent accuracy in breed categorization, and 64 percent accuracy for 120 other less prevalent dog varieties.

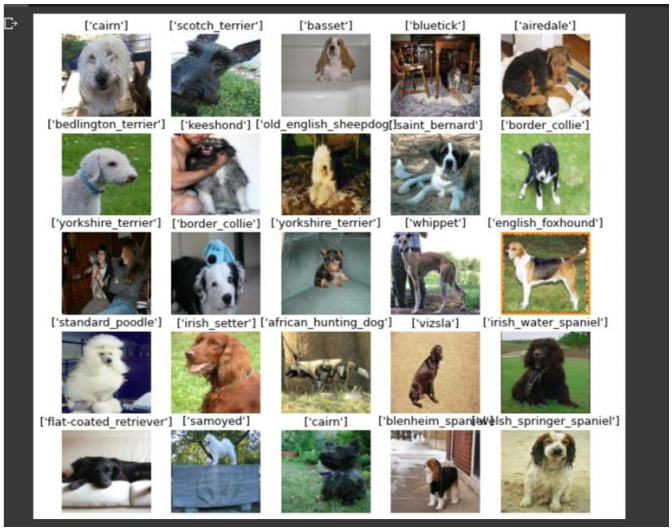
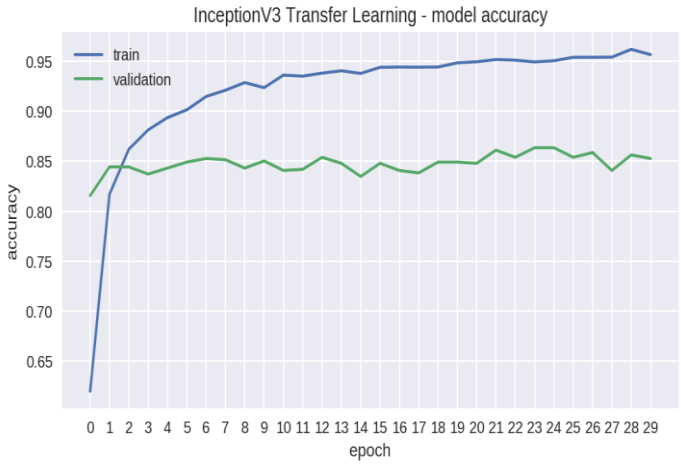


Figure 5. Result

Motivation of the project:

1)To make people's life easier by assisting them in recognizing dog breeds, hence assisting them in deciding which breed of dog to keep as a pet and encouraging more people to have dogs as pets.

2) Existing System: The Food and Image Recognition System for Dietary Monitoring Using Deep Learning provided inspiration for this research.



Graph 1. model accuracy

V. CONCLUSION AND FUTURE ENHANCEMENT

Let's consider our findings to be successful given the substantial number of breeds involved in this fine-grained categorization task. The model is able to predict the right breed with accuracy. over 50% of the time with just one estimate, which is a result that not many anticipate. They could be able to match given the substantial heterogeneity both within and between individuals. The following adjustments can be made to boost performance even more: Data masking can be carried out on the train set as an upgrade and future task. By masking photos, background noise from the images (particularly from barcodes) can be eliminated. The model may be trained better, and performance can be considerably enhanced without background noise and by limiting visibility to the dogs. On the picture data, several dimensionality reduction techniques can be used. For feature extraction, the setup can be altered to rely on a different deep learning architecture. The model trained using ImageNet's weights are the only ones used to initialize the weights in the current study. After initialization, the model can be trained on the current dataset for improved performance. To further enhance performance, certain layer ratios can be frozen, unfrozen, or reinitialized.

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