IMAGE CLASSIFICATION USING CNN ALGORITHM

K. RAMBABU,VELLA KAVYA SRI

ASSISTANT PROFESSOR IN NAME DEPARTMENT OF MASTER OF COMPUTER SCIENCE, BHIMAVARAM 534202.

Email id:- kattarambabudnr@gmail.com

PG STUDENT, D.N.R. COLLEGE, P.G. COURSES (AUTONOMOUS), BHIMAVARAM-534202.

Email id:- vellakavyasri9@gmail.com

ABSTRACT

In recent year, with the speedy development in the digital contents identification, automatic classification of the images became most challenging task in the fields of computer vision. Automatic understanding and analyzing of images by system is difficult as compared to human visions.

Several research have been done to overcome problem in existing classification system, but the output was narrowed only to low level image primitives. However, those approach lack with accurate classification of images. In this paper, our system uses deep learning algorithm to achieve the expected results in the area like computer visions.

Our system present Convolutional Neural Network (CNN), a machine learning algorithm being used for automatic classification the images. Our system uses the Digit of MNIST data set as a bench mark for classification of grayscale images. The grayscale images in the data set used for training which requires more computational power for classification of images. By training the images using CNN network we obtain the 98% accuracy result in the experimental part it shows that our model achieves the high accuracy in classification of images.

1. INTRODUCTION

In recent years, due to the explosive growth of digital content, automatic classification of images has become one of the most critical challenges in visual information indexing and retrieval systems. Computer vision is an interdisciplinary and subfield of artificial intelligence that aims to give similar capability of human to computer for understanding information from the images. Several research efforts were made to overcome these problems, but these methods consider the low-level features of image primitives. Focusing on low-level image features will not help to process the images. Image classification is a big problem in computer vision for the decades. In case of humans the image understanding, and classification is done very easy task, but in case of computers it is very expensive task. In general, each image is composed of set of pixels and each pixel is represented with different values. Henceforth to store an image the computer must need more spaces for store data. To classify images, it must perform higher number of calculations.

For this it requires systems with higher configuration and more computing power. In real time to take decisions basing on the input is not possible because it takes more time for performing these many computations to provide result. In [1], has discussed extraction of the features from Hyper Spectral Images (HSI) by using Convolutional Neural Network (CNN) deep learning concept. its uses the different pooling layer in CNN for extraction of the feature (nonlinear, Invariant) from the HIS which are useful for perfect classification of images and target detection. It also addresses the general issues between the HSI images features. In the perspective of engineering, it seeks to automate tasks that the human visual system can do. It is concerned with the automatic image extraction, analysis and understanding useful information with images. In last decade,

several approaches for image classification was described and compared with other approaches. But in general image classification refers to task of extracting information from the image by labelling the pixels of the image to different classes. It can be done in two ways one is Supervised classification, Unsupervised classification. In [2], has discussed the use of the Unsupervised learning algorithm in underwater fish recognition framework for classifying images. This technique the pixels of the image are clustered into groups without intervention of the analyst. Grounding on the clustered pixels the information is retrieved from the image. In real world the availability of labelled data is very less hence unsupervised classification is done in most cases. In [3], has discussed Supervised classification techniques that analysis and train the classifier on the labelled images and extracting features from them.

By using the learned information of the training, the newly provided image will be classified based on the features observed in the image. Now a days, Deep learning algorithms are providing successful results in the areas like computer vision. The Convolutional Neural Network, a machine learning algorithm is being used for the image classification. In [4], uses deep learning algorithm for classify the quality of wood board by using extracted texture information from the wood images. he also made the comparison with machine learning architecture. CNN is a type of feed-forward artificial neural network that has been successfully applied to analyze visual images. It is inspired by the biological processes and the neurons are connected as in animal visual cortex.

In [5], as discussed automatic recognition cattle images using CNN which helps to extract the necessary characteristic from the cattle images and Support Vector Machine (SVM) techniques is used for classification of those images. In [6], has uses high resolution images in ImageNet data set having 15 million labelled images with 1000 different classes used for classification with help of deep convolutional Neural Network.

CNN having three different layers such as input layer, hidden layers and an output layer. In general images is constructed as a matrix of pixels and these pixel values are given as input to input layer along with weights and biases (for non-linearity). The output layer will be a fully connected layer usually to classify the image to which class it belongs to. The hidden layer may be convolutional, pooling or fully connected. In [7], has discuss the manifold -learning techniques for classifying remotely sensed hyperspectral data. The Convolutional layer is core building block and has learnable filters as parameters. Each filter is spatially small (width and height) but extends across the depth of the input volume. The 2-dimensional activation map is produced by performing dot product between input and entries of filter for every filter. As a result, the network learns filter that activate when it detects specific feature in some spatial position in the input. The pooling layer is used in down sampling the image without losing any information from the image. Max pooling uses the maximum value from the cluster of neurons at prior layer. The fully connected layer connects every neuron in one layer to every neuron in other layer. CNNs use little pre-processing when compared to traditional classification algorithms which use filters that are hand engineered.

The independence of human intervention in learning filters is good advantage of CNN.CNN is supervised deep learning approach which requires large labelled data for training on the network. After training the model will learn the weights and the accuracy of the classifier is improved.

2. LITERATURE SURVEY AND RELATED WORK

Image classification is a widespread research area in the field of deep learning, Pattern recognition, Human Computer Interaction and got substantial attraction in many research scientists. In [9], classification of images done by extracting the features from the image. Usually most midlevel feature learning methods focus on the process of coding or pooling but here they emphasize that the mechanism behind the image composition also strongly influences the extraction of features from the image. In feature extraction, image content exploration is effectively done by using hierarchical image decomposition approach. Here each image is decomposed into a series of semantic components like the structure and texture images.

The semantic image content (structure and texture) can be matched with other images by using various feature extraction methods. The following two different schemas used to for representation of different image property related feature such as Hand-crafted features used in single staged network and the second ones learns features from raw pixels automatically by multistage network. In [10], has discussed classification of Natural images using biological stimulated model. Its uses well known analogous progress in visual information system and inference procedure of human brain functionality. This model primarily used for image analysis and Natural classification. This system is composed of three important units as biologically inspired visual selective attention unit, Knowledge structuring unit and Clustering of visual information unit. It uses the low-level features in the images to automatic extraction of important relationships between images. The system follows the limitation in the human visual system to achieve higher accuracy in classification of images.

The biologically inspires system having two components namely Bottom-up saliency map module which produces a salient area from the low-level features extracted from natural images and Top-down selective attention module which performs decisions on interesting objects by interaction of humans. These two components closely follow the mechanisms of the visual what pathway and where pathway of the human brain. These components have been integrated in knowledge structuring unit., The clustering of visual information is achieved by using output of the knowledge clustering unit and it is based on high-level top-down visual information perception and classification model. In [11] has discussed spoof finger print detection using Convolutional Neural Network (CNN), the goal of biometrics is to discriminate automatically between subjects in a reliable way and as per target applications basing on one or more signals derived from traits like face, fingerprint, iris, voice or written signature. There are more advantages from biometric technology than the traditional security methods based on something we remember or know like PIN, PASSWORD and something physically we have like KEY, CARD etc. In yearly days Several [12,13,14] fingerprint detection algorithm has been proposed and they can be divided into two categories the namely Hardware and Software.

In hardware approaches specific device is attached to any hardware sensor device to detect the living attribute in the Human such as blood pressure, heart beat rate etc. Finger print image feature are used to distinguish between real and fake fingerprints. In this model two feature extractors have been used namely Convolution Networks and Local Binary Patterns. In the interim Support vector machine classifier (SVM) also used in conjunction with both techniques for classification of original and fake finger prints. This system uses the dataset comprising of real and fake fingerprints images retrieved from different sensorsto train the model. Fingerprints are obtained from following sensors namely Biometrika FX2000, Digital 4000B, Italdata ET10 and fake fingerprints were obtained from different materials like gelatin, wood glue, eco flex and silgum.

To training the classifier the following four different phases used such as,

1. Pre-processing of data using image reduction, contrast equalization, filtering and region of interest extraction.

2. Feature extraction done by implementing two techniques LBP and Convolutional Network 3. Data normalization and dimensionality reduction.

4. Classification of the images using SVM. Extraction of patterns found within local regions of the input images done by convolutional networks that are common throughout dataset. Local Binary patterns (LBP) is used for feature extraction in texture descriptors normally. Using both the methods feature extraction is done and in pipeline these are applied distinctly. Human face detection is becoming a very important in the fields of image reorganization due to extensive growth related to its applications in various fields like security access control, advanced human-computer interaction and content-based video indexing etc. In [14], has discuss novel detection approach for detection complex types of face image having variable image pattern in the real world. It's also using the CNN for automatic extraction of image feature from the training set having set of face and Non-face images. All the existing algorithm uses local facial features for detecting human faces in last decade many approaches [15,16] has been presented and compared about local facial features and classification of images using geometric model of human face. Some other approaches focus on template matching methods used to detect the local sub feature of images.

This system detects semi-frontal human faces in complex images datasets by classifying the image as face image or non-face image. CNN also used to automatically extract the important feature from the images. Furthermore, the pre-processing of image is not required, and fast processing is automatically done by successive simple convolutional and subsampling operations. CNN having three different kinds of layers to process the images. They are convolution layers, sub sampling layers and classification layers containing sigmoid neurons. The convolutional layers containing certain number of planes. Each plane is considered as a feature detector. After finding the image feature then locate the images. Then subsampling layer used to performs input dimension reduction by preserving the information of the image. Then it uses sigmoid neurons function to perform the classification operation.

The rest of the paper is organized as follows section 3 present the proposed system architecture for image classification using CNN, section 4 implementation section 5 present conclusion and future enhancement.

3. EXISTING SYSTEM

On the surface, teaching a computer to do something like image classification seemed very intriguing to us. Moreover, there are countless real-world applications of this concept. It is in light of these reasons that we decided to work on Image Classification. Thankfully though, this topic has been well-researched by the scientific community, and we didn't break a sweat finding resources to learn from. So naturally, we perused a bunch of research papers that dealt with image classification, each from a different perspective. We then decided to implement image classification on a small-scale with the limited hardware we were in possession of. As difficult as it was, we started with SVM and a very small dataset to achieve an accuracy of 93%. Although SVM is a very strong technique, achieving such a high accuracy is still an anomaly. We realized that our results boasted such a high accuracy due to the lack of a large enough dataset. So, using data augmentation, we more than tripled the size of our dataset. On performing SVM now, we achieved an accuracy of 82%, a significant decrease. Unsatisfied with the results, we decided to move to other deep learning techniques. This quest led us to Neural Networks and, CNN. On successfully implementing CNN, we achieved an accuracy of a staggering 93.57% on the very same dataset. This

stands as a testimony to the increased potential of deep learning techniques over the more traditional machine learning techniques.

4. PROPOSED SYSTEM

Our proposed system uses CNN for implementation purpose. Convolutional Neural Networks are very similar to ordinary Neural Networks, which are made up of neurons that have learnable weights and biases. Every neuron performs dot product by receiving some input and using bias it follows non-linearity. The whole convent still expresses a distinct score function, from the raw pixels on one end to class scores at the other end. They have a loss function like SoftMax on the last layer which is fully connected layer. As the inputs are images to convent, it allows to encode certain properties in architecture. These properties make the forward function more efficient to implement and vastly reduce the number of parameters in the network. The mail goal of the image classification able to extract the feature from raw images.

5. IMPLEMENTATION

DATASET

This paper utilizes the dataset provided by revolution analytics for the detection of the fraudulent credit card transaction from Kaggle. Dataset has 51149 legal transactions and 3312 fraudulenttransactions. The dataset is divided as 60%, 20% and, 20% in the Train, Valid and Test set, respectively.

DATA PREPROCESSING

For efficient implementation of the classification algorithm, data preprocessing is performed before feature selection. Under-sampling is performed to make the dataset balanced to avoid the biasing of the classification algorithm towards the majority class. Feature Selection is implemented on a balanced dataset.

FEATURE SELECTION

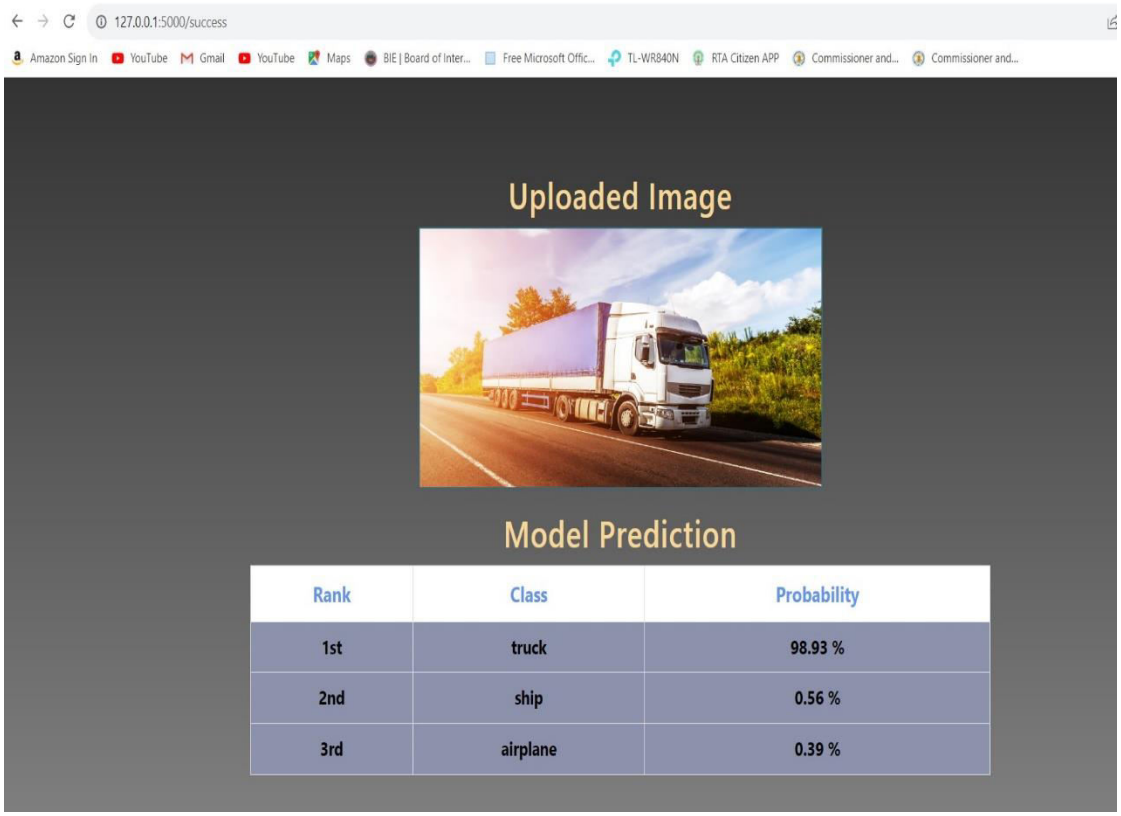
Feature selection methods are used to remove unnecessary, irrelevant, and redundant attributesfrom a dataset that do not contribute to the accuracy of a predictive model, or which might reduce the accuracy of the model. In this paper seven feature selection techniques namely Select-K-best, Feature Importance, Extra tress classifier, Person's correlation, Mutual Information, step forward selection and Recursive feature elimination are used.

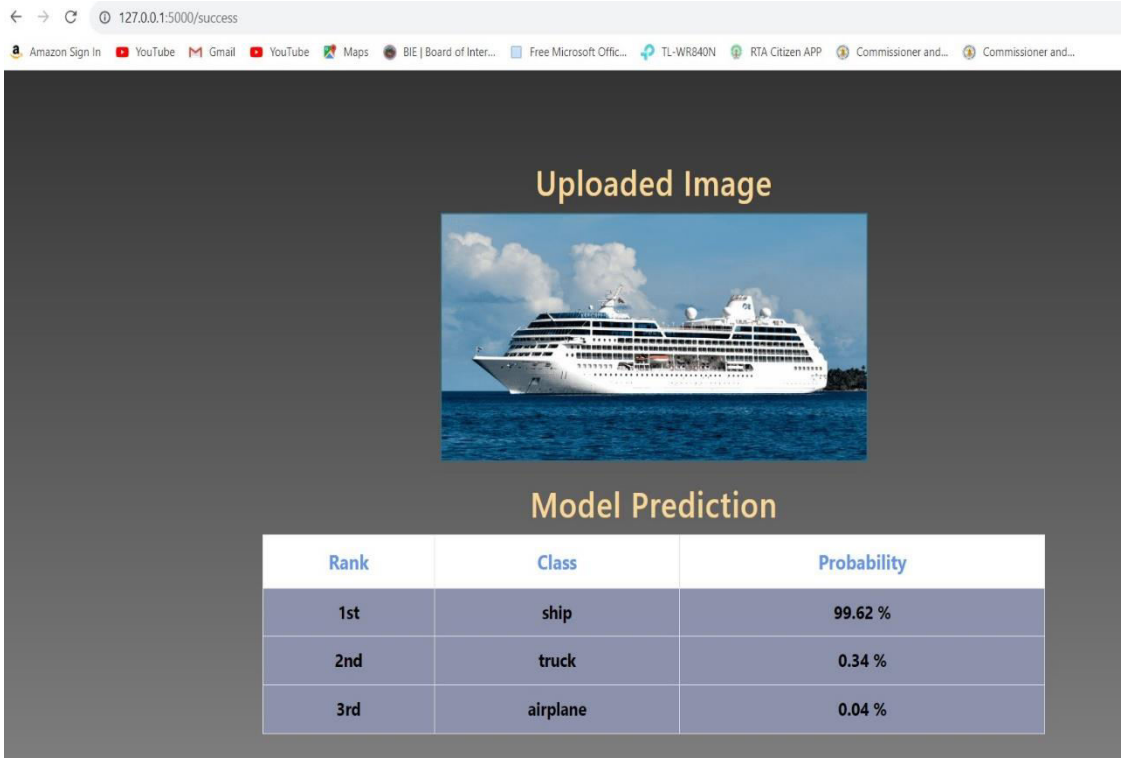
FEATURE IMPORTANCE

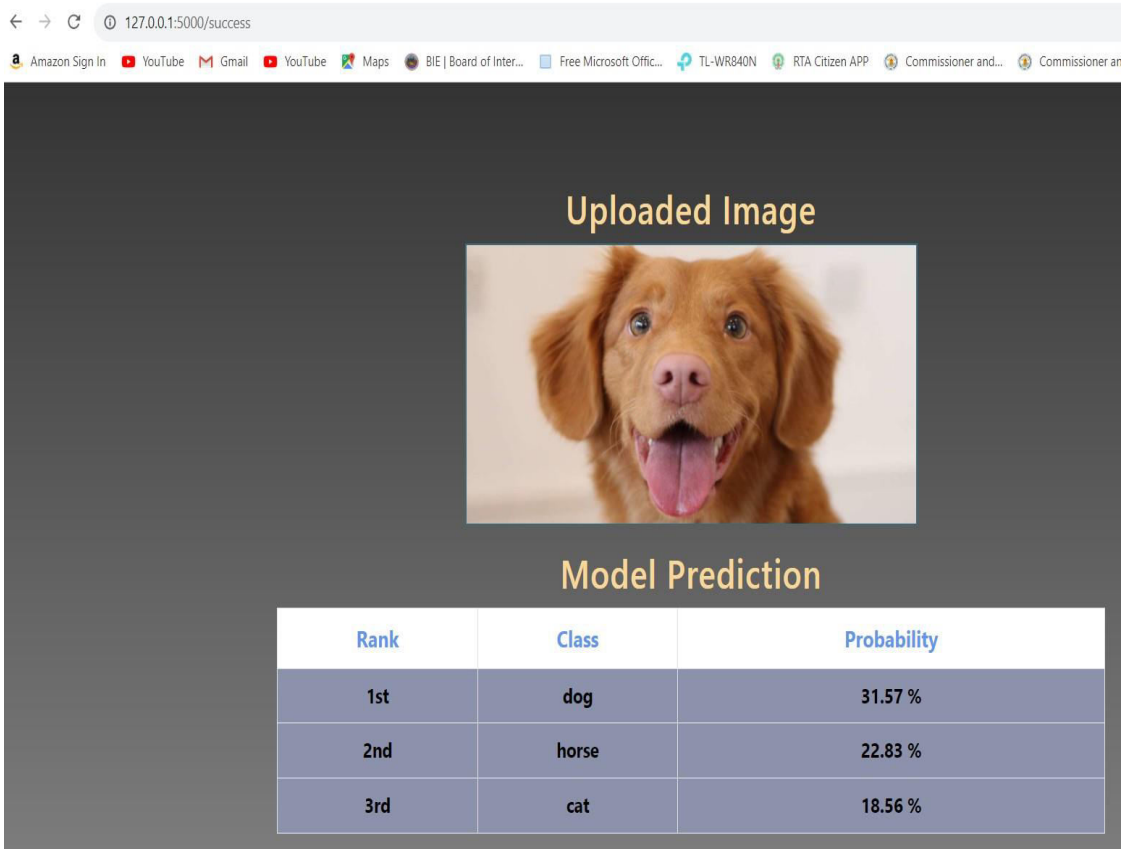
Feature importance is a class of techniques for assigning scores to input features to a predictivemodel that indicates the relative importance of each feature at the time of making a prediction.It reduces the number of input features. In this paper, feature importance is implemented usingan extra tree classifier from the decision tree. Extra Trees is similar to Random Forest, it buildsmultiple trees and splits nodes using random subsets of features, but unlike Random Forest, Extra Tree samples without replacement and nodes.

5. RESULTS AND DISCUSSION SCREENSHOTS

OUTPUT SCREENSHOTS



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YouTube
Maps
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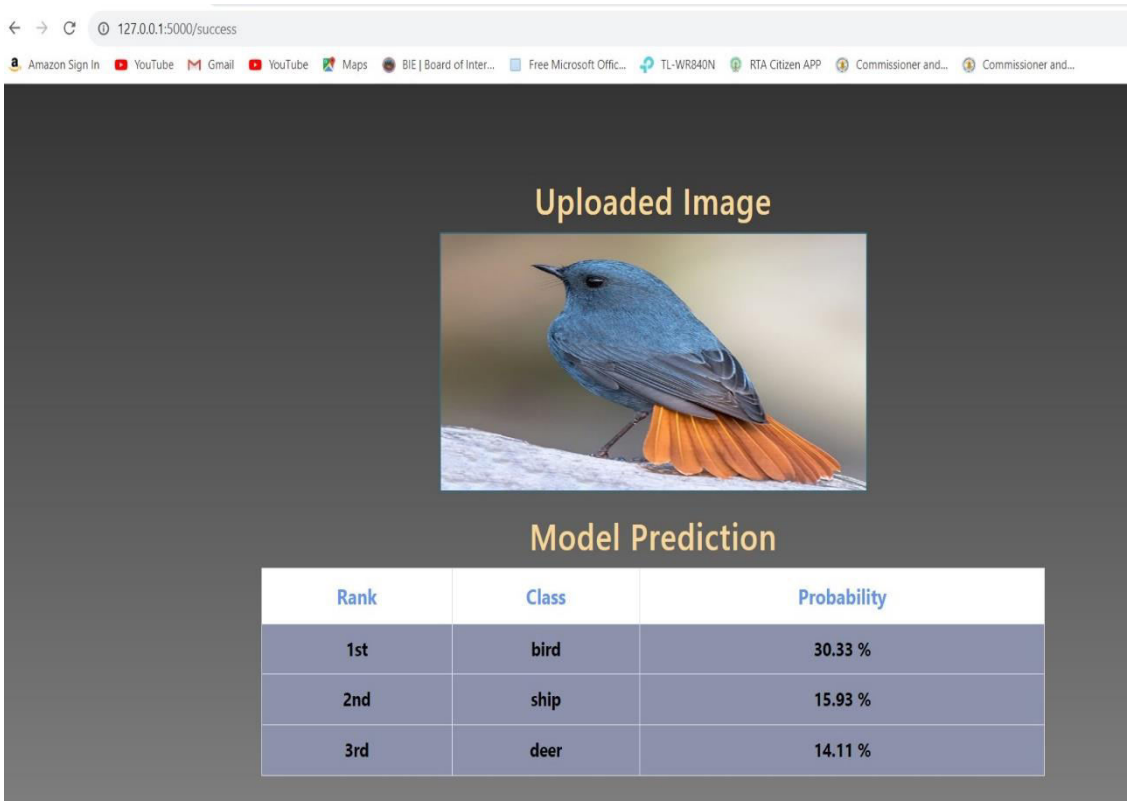
Free Microsoft Offic...
TL-WR840N
RTA Citizen APP
Commissioner and...
Uploaded Image
Model Prediction
Rank
Class
Probability
1st
dog
31.57 %
2nd
horse
22.83 %
3rd
cat
18.56 %



7. CONCLUSION AND FUTURE SCOPE

CONCLUSION:

After using the CNN method, we were able to obtain 94 percent validation accuracy of our model. We trained and then tested the images and used the CNN method for the classification. This study focused on the CNN model and the accuracy of validation. After 20 epochs, the CNN model reached 90 percent accuracy of validation and then we loaded that model to label the images. We did the literature survey and found that different CNN techniques are been used to perform different operations and based on the computational power of any project or the complexity different methods of CNN can be compared.

FUTURESCOPE:

we used Convolutional Neural Networks (CNN) for image classification using images form handwritten MNIST data sets. This data sets used both and training and testing purpose using CNN. It provides the accuracy rate 98%. Images used in the training purpose are small and Grayscale images. The computational time for processing these images is very high as compared to other normal JPEG images. Stacking the model with more layers and training the network with more image data using clusters of GPUs will provide more accurate results of classification of images. The future enhancement will focus on classifying the colored images of large size and its very useful for image segmentation process

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