

Creature Face Recognition Using Neural Networks

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ABSTRACT

A problem that developed areas are facing today are death and injuries due to road accidents. Collision between animals and the vehicle on the drive way is one such big issue apart from other issues such as vehicle over- speeding, drunk driving and abrupt lane changes and others which leads to such road accidents. Neural networks (NN) have developed dramatically successful methods to solve prediction problems like, object recognition which often surpasses accuracy of human level. We will work on an algorithm which automatically extract features from images and use them in training process. The dataset used consists of different images, where 70% images will be used for training and 30% images for testing. We successfully received a training set accuracy of 0.9 and test set accuracy of 0.88.

Keywords

Vectorization, Logistic Regression Cost Function, Gradient Descent, Image processing, Neural Networks, Forward Propagation, Backward Propagation.

Introduction

Today, there is no single method that can provide reliable and effective solutions for all problems, and animal detection and identification systems are still a challenge. Cutting down of trees and limited source of natural prey and loss of habitat makes the wild animals to

maintain close contact with prey in urban settlements. Cows and other animals attack humans to obtain food. Compared with other tigers, the occurrence of elephants is a major form of conflict and is vital to human life in India. Owing to conflicts between humans and animals, population increase, the rapid development of industries in forest lands, people began to cut down forests. Consequently, animals began to invade nearby villages, losing their livelihoods and drought. Crazy, pretending to feed on crops, livestock, and a lot of times on farmland and people. Nowadays, farmers started to use electric fences to protect the fields from wild animals, so as not to cause seizures due to electric current. Make it behave abnormally. The prime concern is the safety of animals and humans, equally. To tackle this hinderance, a smart surveillance system is highly required, which will precisely track and detect incoming animal images and alert people.

Many methods include communication devices that use IoT for animal intrusion detection, detection equipment, take preparatory actions, distract animals, and send alerts to land owners or nearby forest facilities. Numerous methods and algorithms have been tested and deployed to improve protection against animal intrusion. The purpose of this project is to design an image recognition system using NN to prevent unauthorized breach of animals in restricted area.

Literature Review

Literature research is one of the main components of any research work. In Internet of Things (IoT) applications based on wired and wireless sensors, different methods are used to track, monitor and detect animals in different situations. Saieshwarproposed an animal intrusion detection system based on machine learning and image processing. Used a pool algorithm to segment the animal image in order to highlight multiple objects in the image and check whether a threatening animal is found in the segmentation. If the marked area encounters a different mark, the obstacle is only the outline. When extracting a series of text's to detect facial expressions of different frequencies, Gabor filters are often used. Linear support vector machine is a supervised learning algorithm which is used to train data sets and classify the text and hypertext. The average value of this method of detecting animal invasion is about 54.32%. Xiaoyuanproposed an automatic species identification system, which uses the local feature known as local binary pattern (LBP) constructed in the cell and dense global scale feature

transformation invariant (SIFT descriptor) for feature extraction and improvisation creation, sparse coding, spatial pyramid mapping to extract dense SIFT and LBP descriptors with cell structure as a local object. This global feature uses a multi-scale heap to produce the largest combination and weighted sparse coding. In complicated situations. Usha proposed an animal intrusion detection system based on the Internet of Things. Passive Infrared Sensor (PIR) identifies the movements and activates the camera to take snapshots of animals. After the animal detects the sensor, that signal is transmitted to the camera using the Arduino Uno micro controller. That specific image is classified along with the sample. The images are stored in the database. While identifying an animal such as a giraffe, the bright light emitted will be used, and when identifying a tiger, a loud sound will be used. As a result, forest officials were warned through text messages and were also sent to and owners through the GSM module.

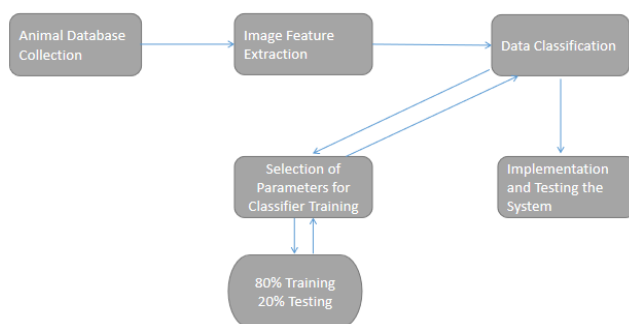


Fig.1 Architecture diagram of methodology used

Proposed System

Machine learning is the study of algorithms that improve over time. Formally speaking, the task has improved in terms of performance and experience. This is a sub-theme of artificial intelligence. When AI participates in intelligent tasks performed by non-human agents, machine learning will make decisions based on the data it receives. Machine learning is a very broad field of computing. Machine learning can be supervised or unsupervised.

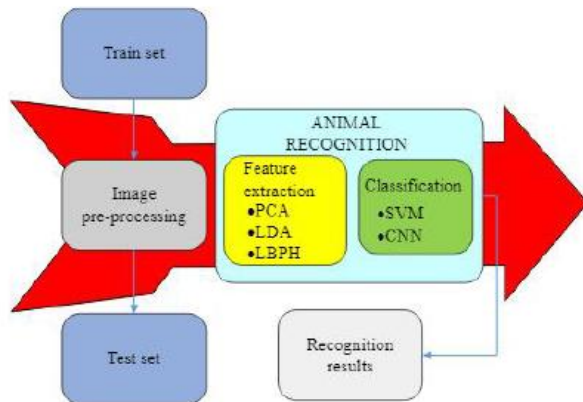


Fig.2 Proposed System

The models that have been shortlisted to be worked upon are:

3.1 Vectorization

It is the art of getting rid of explicit for loops in your algorithm while using arrays. Vectorizing your loops into arrays also help in optimizing Space Complexity.

Example:

Dot product used in our algorithm

$z=0$

for i in range(n):

$z = z + w[i]**[i]$

$z = z + b$

After vectorization:

$z = \text{np.dot}(w,x) + b$

Dot product of vectors is known as scalar products because the result is a single output.

3.2 Logistic Regression Cost Function

Logistic Regression is a learning algorithm that is used when the output labels(Y) in a supervised learning algorithm are 1 or 0. Loss Function is applied to a single training example Cost Function is known as the cost of your parameters, which mans that is minimizes the overall cost function, it also lets us know that how well are we doing in our training set.

3.3 Gradient Descent

Gradient descent is an optimization algorithm which helps us find the local minima of a differentiable function by taking repeated steps in opposite direction to the gradient of the function at the current point

Gradient Descent algorithm:

Repeat until convergence

```
{
Oj := Oj – x(d/dOj) J(Oo,O1)
}
```

for j=0 and j=1

If the learning rate of the Gradient descent algorithm is very large then we would get a very aggressive descent procedure and it might even jump or overshoot the local optima. If the learning rate is too small then it may even fail to converge due to very small descent steps.

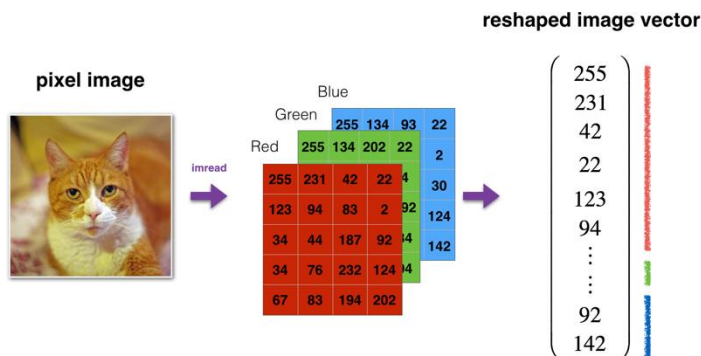


Fig.3 Reshaped Image Vector

3.4 Neural Networks

Neural Networks are a series of algorithms, Neural Networks is an essential AI learning algorithm that tries to mimic the human brain by recognizing underlying patterns and relations in a set of data, it tries to function similar to the human brain. Neural Networks are a system of Neurons either organic or Artificial in nature. Neural Networks can adapt to changing input so the network generates the best possible result without needing to redesign the output criteria. Two main functions would take place in our models Neural Network:

1.Forward Propagation

2.Backward Propagation

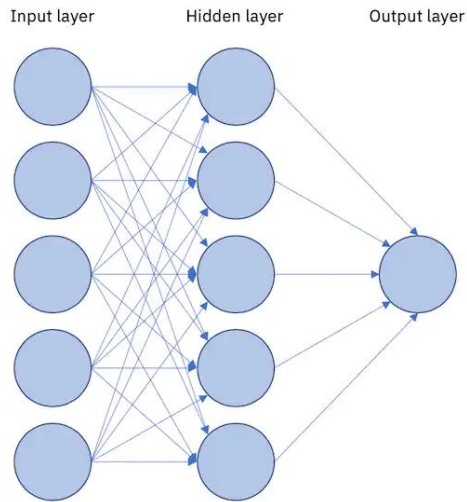


Fig.4 Structure of Neutral Networks

3.4.1. Forward Propagation

The input is forwarded through the network, and each of the hidden layers receives the input, processes it according to the trigger function, and then goes to the next level. The output of the current layer is accepted as in input of the next layer, here we are going to use certain activation functions:

$$\begin{aligned}
 Z^{[1]} &= W^{[1]}X + b^{[1]} \\
 A^{[1]} &= g^{[1]}(Z^{[1]}) \\
 Z^{[2]} &= W^{[2]}A^{[1]} + b^{[2]} \\
 A^{[2]} &= g^{[2]}(Z^{[2]}) \\
 &\vdots \\
 A^{[L]} &= g^{[L]}(Z^{[L]}) = \hat{Y}
 \end{aligned}$$

1.Sigmoid Activation Function:

The sigmoid activation function, also known as the logistic function, it is a very trending and desired activation function when it comes to neural networks. The output of this function is transformed into a value between 0.0 and 1.0.

2.Tanh Activation Function

Tanh is also sigmoidal, The advantage is that the negative inputs will be mapped strongly negative and the zero inputs will be mapped near zero in the tanh graph.

3.ReluL Activation Function

The rectified linear activation function or ReluL for short is a piecewise linear function that will output the input directly if it is positive, otherwise, it will output zero.

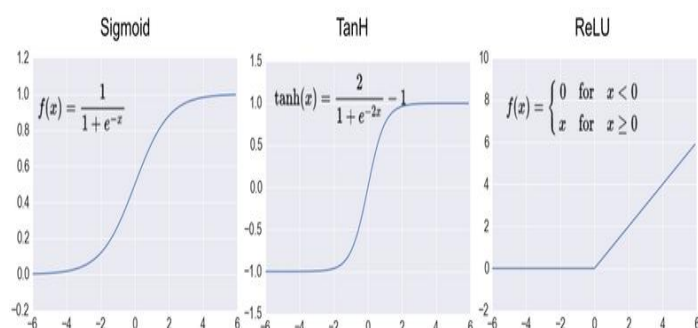


Fig.5 Activation Function Graphs

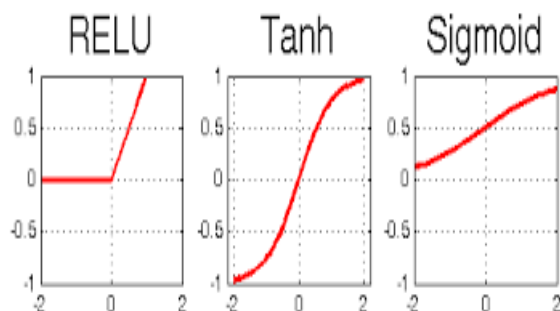


Fig.6 Activation Functions

3.4.2 Backward Propagation

Backpropagation is a monitored learning algorithm used to monitor multilayers (artificial neural networks). In a neural network we initialize some random weights at the beginning of the algorithm, but just in case those weight values do not fit our model and the output is not

what we want it to be. In order to reduce the error occurred we need to help our model change those initial parameters and weight values in order to minimize the error. This way to train our model is known as Backward propagation

$$\begin{aligned}
 dZ^{[L]} &= A^{[L]} - Y \\
 dW^{[L]} &= \frac{1}{m} dZ^{[L]} A^{[L]T} \\
 db^{[L]} &= \frac{1}{m} np.sum(dZ^{[L]}, axis = 1, keepdims = True) \\
 dZ^{[L-1]} &= dW^{[L]T} dZ^{[L]} g'^{[L]}(Z^{[L-1]}) \\
 &\vdots \\
 dZ^{[1]} &= dW^{[L]T} dZ^{[2]} g'^{[1]}(Z^{[1]}) \\
 dW^{[1]} &= \frac{1}{m} dZ^{[1]} A^{[1]T} \\
 db^{[1]} &= \frac{1}{m} np.sum(dZ^{[1]}, axis = 1, keepdims = True)
 \end{aligned}$$

Implementation

We first take the dataset of images and split it into training and test sets with class labels as 1 and 0 for cats and not cats respectively. We then break the images into image vectors RGB of shape (255,255,255) and then combine all of them into a single image vector. The single image vector is fed as input to the 1st neural network layer the output of which passes through an activation function (ReluL/tanh), the output of the 1st neural layer becomes the input to the 2nd layer and so on, this process is known as Forward Propagation. We also use the outputs of Forward propagation to calculate our Cost Function

During forward Propagation we store all of the cache of Forward Propagation and Cost Function values into variables we created in the functions. In a neural network we initialize some random weights at the beginning of the algorithm, but just in case those weight values do not fit our model and the output is not what we want it to be. In order to reduce the error occurred we need to help our model change those initial parameters and weight values in order to minimize the error

This way to train our model is known as Backward propagation

We do this by backtracking the values we stored as cache in variables during Forward propagation and then optimize the values. We combine all of these processes into a single and run it through 100s of iterations with a suitable learning rate.

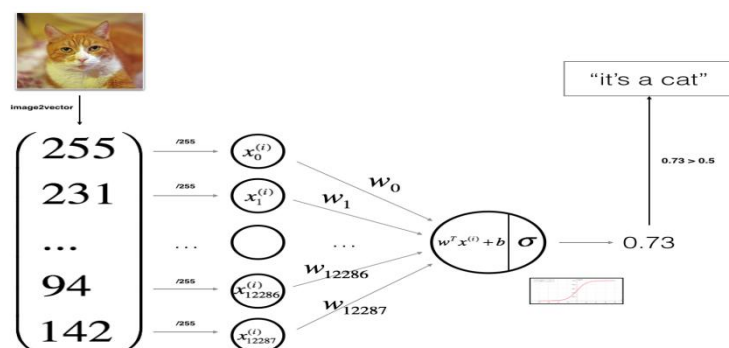
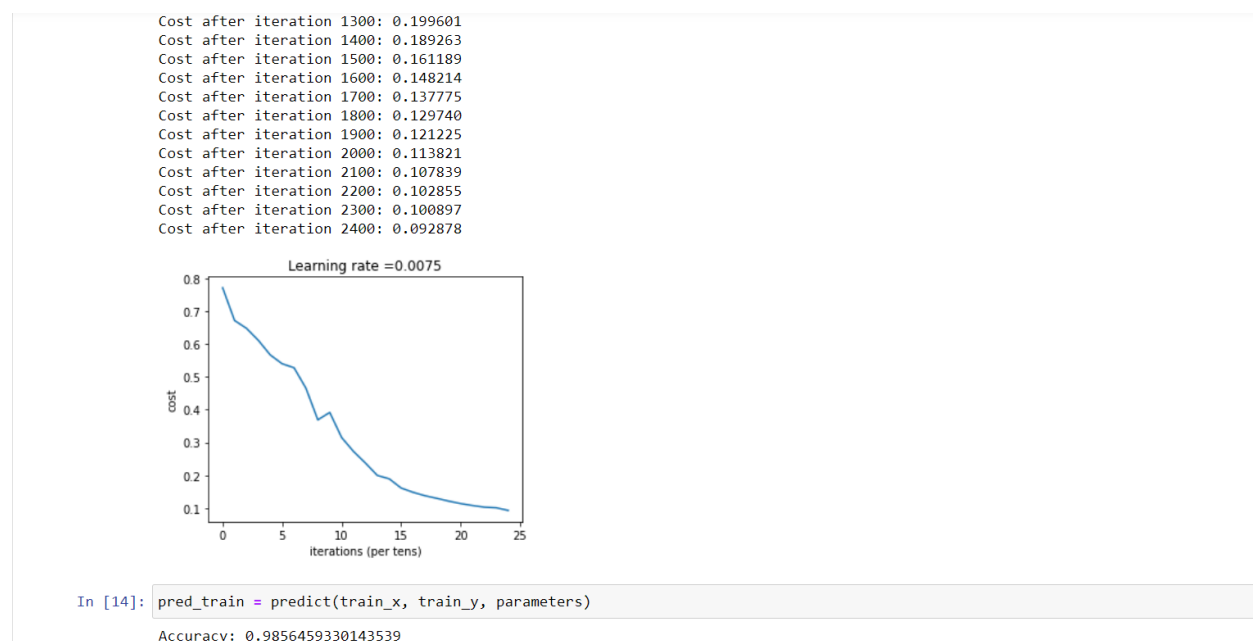


Fig.7 Implementation

Results

We successfully received a training set accuracy of 0.98 and test set accuracy of 0.88.



Discussions

This was the best result found after using various variations in the number of iterations that varied from 2000-2500-3000 with combinations of different learning rates 0.0060, 0.0065, 0.0070, 0.0075, 0.0080, 0.0085

By Observations we noticed that the algorithm proves to be most optimised with 2500 iterations and a learning rate of 0.0075

Conclusion

Therefore, the project uses NN (Neural Network) algorithm to identify wild animals. The algorithm can effectively classify animals with high precision, and can also display images of recognized animals for better results, so that they can be used for other purposes, such as recognition. Wild animals invade human habitats and it can be used prevent poaching and even human conflicts.

When an animal is found to the nearest forest office, this work can be extended by sending a warning message. It can also be used to reduce wildlife conflicts and accidents between humans and animals.

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