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An Analysis of Various Machine Learning Algorithms for Image Processing

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ABSTRACT Image processing is prominent in the area of science and technology image recognition and many other fields. If large amounts of images are obtainable, as it is the case in image files, image repossession technologies are necessary to help the user to find needed information. In order to build such queries possible, images have to be enriched with content-based interpretation. As manual explanation is very costly, system support is desired. The aim of image processing is to enhance or compress image information whereas in machine learning, it is used to optimize differentiable parameters so that a confident loss or cost function is minimized. So, grouping of these two has led to a better conception about recognition and processing of images. There are many fields and uses where, frameworks that study images could have much benefit. Extraction and machine learning algorithms provide a feasible approach to creating such a system. Here discussing about various image processing using machine learning framework.

KEYWORDS Computer Vision, Image Preprocessing, Machine Learning, Algorithms

I. INTRODUCTION

In all the history of centuries to reduce the overhead work of humans. In the remembered century formed the mechanical revaluation (steam engines), electrical revolution (telephone, light), digital revolution (pc internet, communication), intelligence revolution (machine learning, big data, IOT, robotics, 3rd printing, nano technology, genomics). Let's to be continued to find the new technology. In today's world, where information and technology dominate with the graphical advancement, images play an increasingly important role in many aspects. In contrast to earlier period, it is very easy for everyone to produce complex graphical images, appreciation to the great move in digital technologies. With such a reward of pictures, conventional picture preparing strategies need to adapt more mind-boggling issues and need to confront their flexibility as per human vision. Traditional image processing has faced with great pitfall. In the grouping of machine learning in image processing is believable to this field, which will lead to a better conception about images

II. COMPUTER VISION

Computer Vision is defined as a field of learn that seeks to develop techniques to help computers "observe" and understand the content of digital images such as photographs and videos. Naturally, this involves developing methods that try to replicate the capability of human vision. Understanding the content of digital images may involve extracting a description from the image, which may be an object, a text report, a three-dimensional model, and so on.

Image processing is the process of creating a new image from an existing image, naturally simplifying or enhancing the content in some way. It is a type of digital signal processing and is not concerned with kind the content of an image. A given computer vision system may require image processing to be functional to raw input.

Studying biological vision requires an kind of the perception organs similar to the eyes, as well as the interpretation of the perception within the brain. Much progress has been made, both in charting the process and in terms of discovering the tricks and shortcuts used by the system, although similar to any study that involves the brain, there is a long way to go.

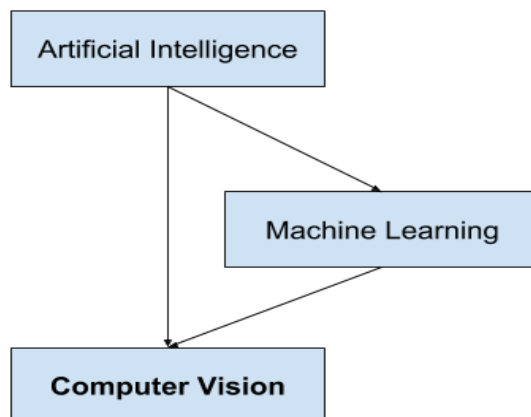


Fig. 1 three-dimensional model of Computer Vision

III IMAGE PRE-PROCESSING AND PREPARATION

Pre-processing is a general name for operations with images at the lowest level of concept both input and output are concentration images.

3.1 Need for Image-Preprocessing

Computers are able to perform computations on numbers and is unable to interpret images in the way that do. The aim of pre-processing is an improvement of the image data that suppresses unwilling distortions some image features important for further processing.

Steps for image pre-processing:

- Read image
- Resize image/scaling
- Data Augmentation
 - Gray scaling of image
 - Reflection
 - Gaussian Blurring
 - Histogram Equalization
 - Rotation
 - Translation

3.1.1 Step 1 - Reading Image

In this step, simply store the path to our image dataset into a variable and then create a function to load folders containing images **into** arrays so that computers can deal with it. Using the commands Open(), show(), save() to open the file/image then rotate with show then convert and save.



Fig 2. Input Image

3.1.2 Step 2 - Resize image

Some images captured by a camera and fed to our algorithm vary in size. Images with different height and width are not a valid element to be stacked in an array or input to a machine learning algorithm. Throughout interpolating pixel color values, the output resized image can introduce a permanent transition.

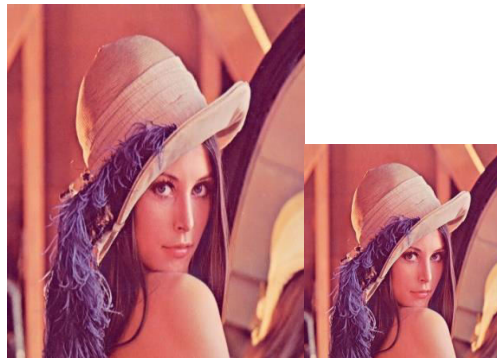


Fig 3. Original and resized image

3.1.3 Step 3 - Data Augmentation

Data growth is a way of creating new 'data' with different orientations.

❖ Gray Scaling

The image will be converted to gray scale the computer will assign each pixel a value based on how dark it is. All the numbers are put into an array and the computer does computations on that array.



Fig 4. RGB Image and Grayscale Image

❖ Reflection

Reflection images horizontally and vertically. Some frameworks do not provide function for vertical flips. But, a vertical reflection is equivalent to rotating an image by 180 degrees and then performing a horizontal reflection.



Fig 5. Reflection Image

❖ Gaussian blur

This is one of the widely used process to reduce the noise and augment image structures at different scales. The image below for a skateboard indicates the steps from the original image to resizing then reducing the noise by gaussian blur.. It is a widely used effect in graphics software, typically to reduce image noise

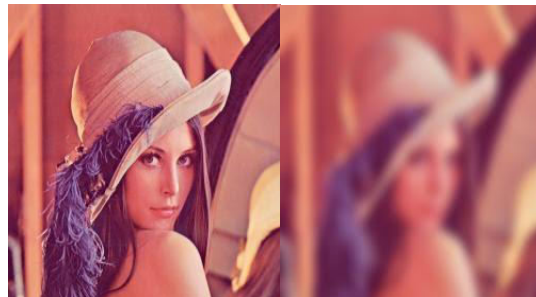


Fig 6. Noise Image

❖ Histogram Equalization

Histogram equalization is another image processing technique to increase global contrast of an image using the image strength histogram. This method needs no parameter, but it sometimes results in an abnormal looking image.

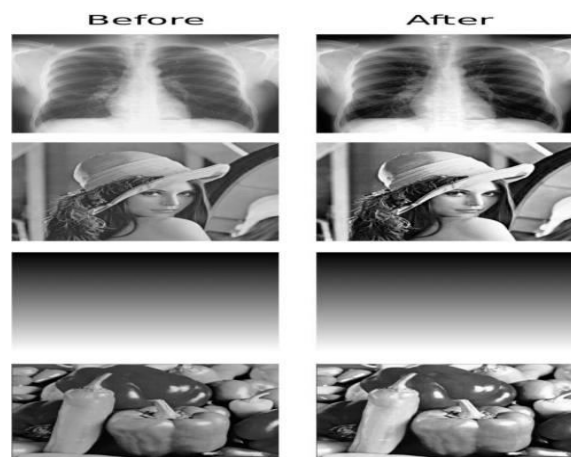


Fig 7. Contrast of an image

❖ Rotation

This is yet another image augmentation technique. Rotating an image might not preserve its original dimensions. The images are rotated by 90 degrees clockwise with respect to the previous one, as we move from left to right.

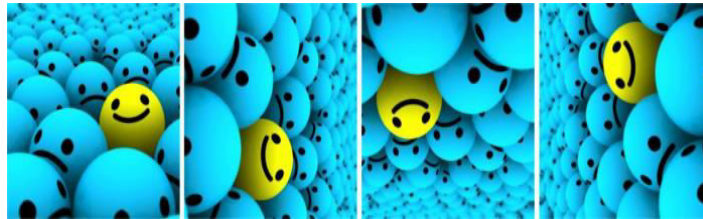


Fig 8. Rotating an image

❖ Translation

Translation just involves moving the image along the X or Y direction or both. This method of growth is very useful as most objects can be located at almost any place in the image. This forces our feature extractor to look everywhere.

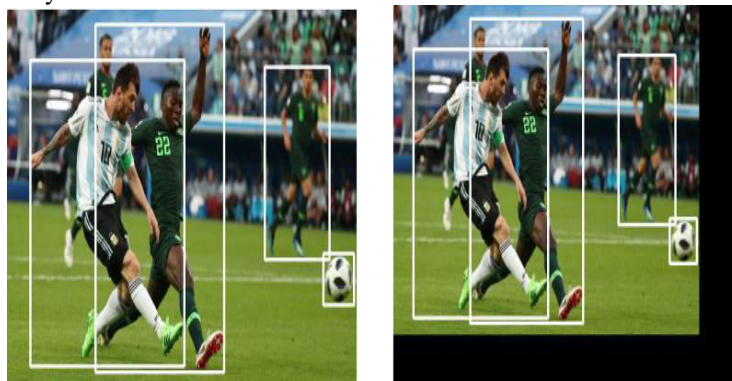


Fig 9. Translation image

IV. IMAGE PROCESSING

It can be defined as the technical analysis of an **image** by using complex algorithms. Here, **image** is used as the input, where the useful information returns as the output.

In a visual inspection of film defects, we investigated the effectiveness of using machine learning techniques for categorization of fault images.

Computer vision, the field relating to machines being able to understand images and videos, is one of the newest topics in the tech industry. At the heart of computer vision is image recognition, the task of recognizing what an image represents. Before performing any task related to images, it is almost always necessary to first process the images to make them more suitable as input data. Throughout this project, It will start by exploring our dataset, then show how to preprocess and prepare the images to be a applicable input for our learning algorithms.

V. MACHINE LEARNING

Machine Learning (ML) is creating computer programs that develop solutions and improve with experience solves problems. Perception is to model human way of solving some problems which require experience.

5.1 Machine Learning Techniques

Before going throughout different techniques that can be used for image categorization. By applying and developing machine learning techniques and architectures as given table 1.

Table 1. Different technique of machine learning for image processing

1	Viewpoint variation	Object orientation with respect to a camera.
2	Scale variation	The Same class can variation in size.
3	Deformation	The nature of the object that it can't be firm all the time.
4	Occlusion:	Sometimes only a small portion of an object could be visible.
5	Illumination conditions:	Drastic effect of the illumination on the pixel level.
6	Background clutter:	The object of interest to be mixed with its environment
7	Intra-class variation:	Broad types of the same class.

In addition, there are about 10,000 to 30,000 different object categories that can be detected. Hence a continuous work and research in this field are trying to find a good image classifier that is invariant to all these variations.



Fig 10. Image and variations

Consequently, an association with the image information and with image priors is important to drive show determination systems. It is surveys certain areas in Image processing where machine learning was applied and is discussed in the following section.

5.2 Machine Learning Algorithms

The following machine learning algorithms used for the image classification.

1. K-Nearest Neighbor algorithm (KNN)
2. Support Vector Machine algorithm (SVM)
3. Ensemble Learning algorithm
4. Multi-layer Perceptron (MLP)
5. Convolutional neural networks (CNNs)

5.2.1 K-Nearest Neighbor algorithm (KNN)

KNN is a method for classifying objects based on closest training examples in the feature space. The training process for this algorithm only consists of storing feature vectors and labels of the training images. The classification task itself occurs by assigning labels to a testing example by the majority labels of its k nearest neighbors.

The advantages of the KNN algorithm are its simplicity and the ability to deal with multi classes. The major disadvantage of the KNN algorithm is using all the features equally for similarity computing. The KNN algorithm using python

5.2.2 Support Vector Machine (SVM) algorithm

SVM is a representation of the examples as points in space, mapped so that the instances of the different classes are separated by a dividing plane that maximizes the margin between them. A main advantage of SVM is that it can perform a non-linear classification using the [kernel trick](#). However, a major disadvantage of SVM classification is the limitations in speed and size during both training and testing phases of the algorithm.

5.2.3 Ensemble Learning algorithm

This algorithm is a technique for aggregating a group of predictors and then predicts the class that gets the most votes. Most popular are bagging and boosting. This way of combining different learning techniques is expected to get better results.

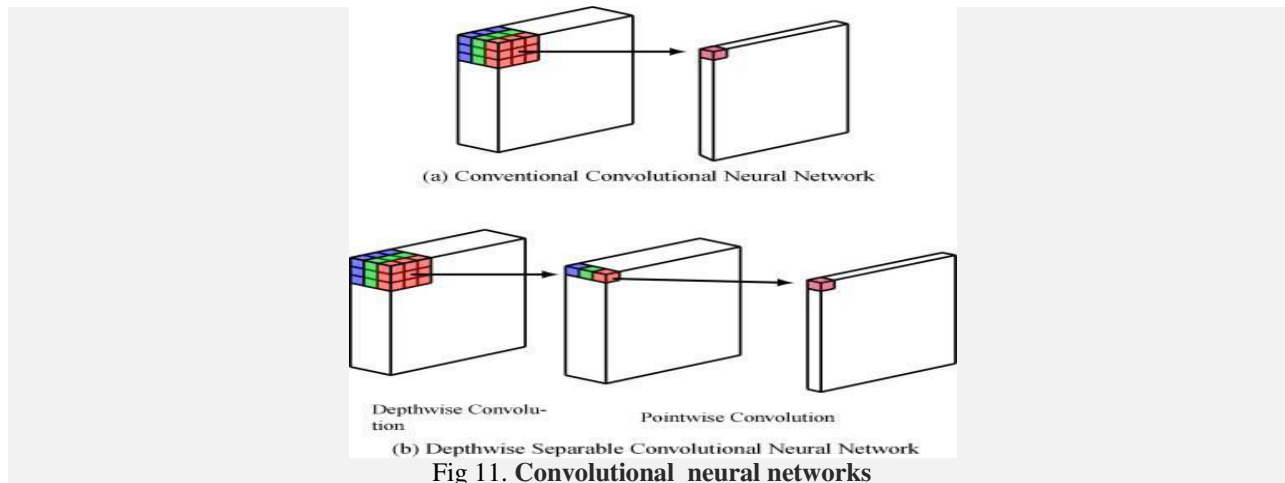
5.2.4 Multi-layer Perceptron (MLP)

This is different from logistic regression, in that between the input and the output layer, there can be one or more non-linear layers, called hidden layers. A major advantage of MLP is its capability to learn non-linear models. However, there are major disadvantages such as having a non-convex loss function and tuning for the number of hidden layers and neurons.

5.2.5 Convolutional neural networks (CNNs)

CNNs have emerged as the master algorithm in computer vision in recent years, they have managed to achieve superhuman performance on some complex visual tasks with the increase in computational power and one of the out-performer architecture that has been implemented.

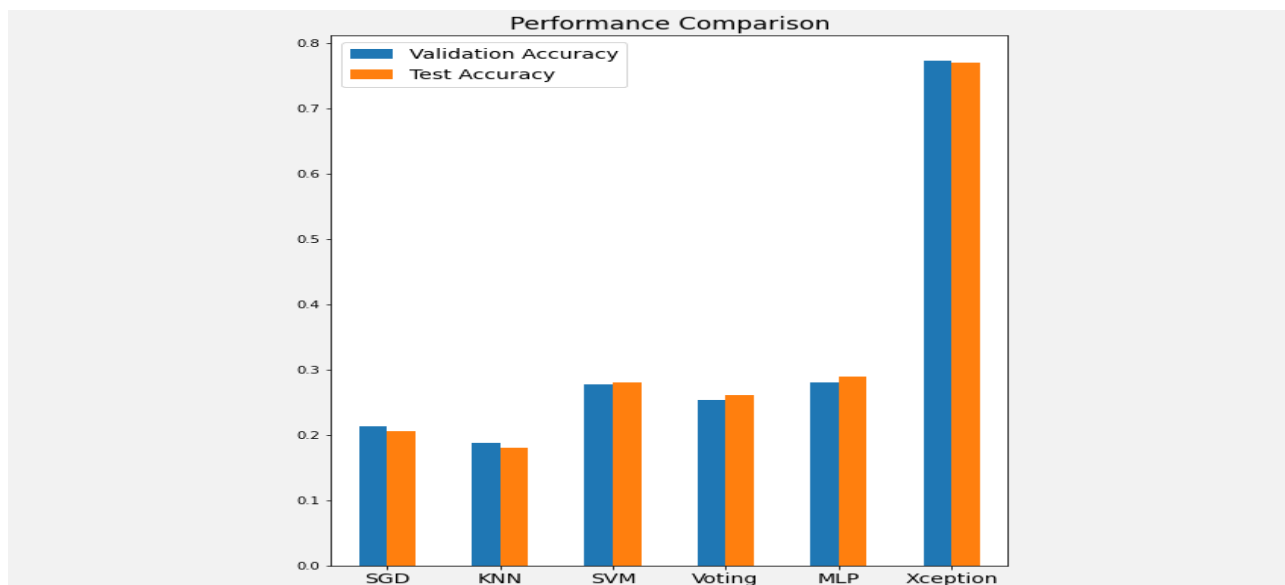
It merges the ideas of other well-known CNN architectures replaces the inception modules with a special layer called a depthwise separable convolution. whilst the standard convolutions simultaneously learn the spatial and cross channel patterns, the separable convolution layer split feature learning over two simpler steps as shown in the figure(11) below. The first step applies a single spatial filter for each input feature map, and after that the second step looks for cross-channel patterns.



Aside from the better performance, it uses smaller amount of parameters, memory and computations than normal convolutional layers.

VI. ACCURACY EVALUATION AND TIME

The Chart is given below compares the performance of our best model against the other baseline techniques on the validation and test sets are shown in given figure



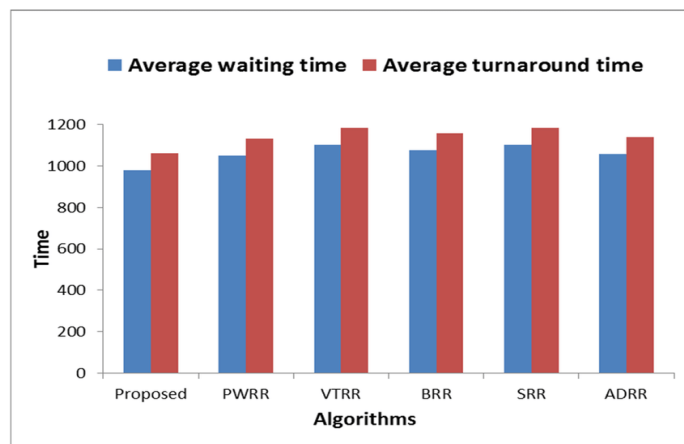


Fig 12 Performance Analysis of Various model and baseline Technique

VII. CONCLUSION

Here discuss the various cases where images and machine learning framework being used in this fields. It was establish that, machine learning presented a new model that helped in processing images in a better way. It was implemented in image processing to overcome all problems that was faced earlier. It provides a feasible approach to create such a framework. The recognition of the content of images was not successful as in case of diagnosing phases, but successful enough to merit more attention and research in this area. Finally explain relevant and the implemented machine learning techniques for image classification such as Support Vector Machine (SVM), K-Nearest Neighbor (KNN), Multi-Layer Perception (MLP) and Convolution Neural Networks (CNN). An idea about machine learning and their observations that not only can be used for image classification but other computer vision applications as well. It showed the challenges that the computer has to deal with while doing a task like image classification and how image preprocessing help to get better images to train. The procedure results exposed the correctness and less time. The non-linear classifiers such as SVM with Gaussian kernel, Voting and MLP reveal a better performance than the linear ones and KNN. The precision on the test set slightly better than on validation set for SVM, Voting and MLP, while the accuracy on validation set is also a little better for the remaining classifiers.

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