

Analysis of Object Detection in OpenCV Python

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Abstract:

Object Detection is the process of detecting objects like faces, bicycles, and buildings in images or videos^[5]. There are many softwares like MATLAB, OpenCV using C++ or OpenCV using python.etc for object detection that has been well researched including face detection, character recognition, and vehicle calculator. In MATLAB, we have advantages like powerful matrix library, toolboxes and visualization, and debugging tools etc.but there are also some challenges in Matlab like accuracy and efficiency of the object, learning curves and slower runtime.MATLAB doesn't follow the general purpose programming method. In C++ we have small machine learning library as compared to python and it is difficult to code for OpenCV in C++ and visualizing and debugging is hard in C++ environment.

In this research paper, algorithm are implemented in object detection while making use of OpenCV library python 2.7, improving the efficiency and accuracy of Object detection are presented. The paper wil show some differences between the python and other languages.

Keywords:

Object Detection,Python,Matlab,OpenCV

I)Introduction:

Object detection is a computer technology related to computer vision and image processing that deals with detecting instances of semantic objects of certain class(such as humans, buildings, or cars) in didgital images and videos.[5]

An object can be classified according to its special features. If the object is partially obstructed from direct view they can even be recognized by using more effective algorithms. In the past few years, various approaches have been implemented for this task.

Terms defined in object detection:

➤ Edge matching:-

- The edges are found by using edge detection techniques.
- Observe the changes in light and color.
- The number of overlapping edges should be counted.

➤ Divide and Conquer search:-

- A set defines all the positions.
- The best position in the cell is occupied by the lower bound.
- As the cell becomes small it will end the process.

➤ Grayscale matching:-

- The information of being robust to illumination changes is given by edges.
- Pixel intensity and position both are the functions which are calculated by pixel distance.

➤ Gradient matching:-

- In a comparison of images to making the image robust for more changes, gradient matching is helpful.
- The matching gradient is similar to the matching grayscale image.

To develop a system that reduces human efforts we need to study computer vision in such a manner that can stimulate the behavior of human eyes directly. The main purpose of computer vision is to analyze the 2D information of the object and use it to reconstruct the visual aspect of the 3D object are the representation of real life 3D objects.

The number, location, size, position of the objects in the input images is to determine by the technique of object detection analysis. The tracking and recognition of objects are done in object detection and it affects the effectiveness and accuracy of object recognition. The basic operation of object detection is by using color-based approach i.e. objects are detected on the basis of their color values[3]. This method is preferred due to its strong adaptability and robustness, however, there is a need to improve detection speed because it requires testing of all window by exhaustive search with high computational complexity. In image processing, one of the most challenging application is object detection from a complex background.

II).Categorization of objects under moving object detection:-^[1]

On the basis of shape, motion, color and texture object classification occurs. There are various classes for classification like trees, animals, humans, etc. The concept of object classification is tracking objects and analyzing their features.

a). Classification based upon shape:-

As the input to this detection system, image blob area, the aspect ratio of the blob bounding box and camera zoom is given which are the combination of scene-based and image-based object parameters. At each and every frame of blob classification has been performed. The histogram shows the result of the classification.

b).Classification based upon motion:-

If an image has no objects in motion which is given as an input, hence that type of classification is not needed. Generally, a periodic property is shown by non-rigid articulated human motion and this is used as a strong reason for the classification of moving objects. On the basis of this reason, human motion can be easily differentiated by other moving objects.

c).Classification based upon color:-

In actual, color is not the appropriate measure for detecting and tracking objects, but color may be a very good feature of exploitation because of its low computational cost. For example, in real time for the detection of vehicles, a technique is used which is based upon color-histogram. In a given region, the color distribution is described by the color histogram.

d).Classification based upon texture:-

Texture-based classification is seamless in a manner with motion-based classification. Sometime it may take more time, but by using overlapping local contrast better accuracy can be obtained which may improve by using some fast technique.

III).Tools:

i).OpenCV:

OpenCV is a software library for machine learning which is known as open source computer vision[6]. It was originally developed by Intel and was later supported by Willow Garage. It increases the use of machine perception. This library is cross-platform and free for use under the source BSD license. The algorithms are being effectively optimized and near 3000 algorithms currently embedded in openCV. Real-time vision application is supported by OpenCV. Under the classic algorithm, state of art computer vision algorithms and machine learning are the classifications of all the algorithm. An operating system like Windows, Mac OS, Linux, Android supports all the algorithms and can be easily implemented by Java, MATLAB, Python, C, C++, etc. For the betterment of the technology full-featured CUDA and OpenCL interfaces are actively developed. Functions that compare or support those algorithms are present in more than a number of 500 different algorithms.

A templated interface that works seamlessly with STL contains and written c++ is occupied by openCV.

Installation of NumPy is necessary to work effectively with python2.7 by openCV.

ii) NumPy:-

NumPy is software library of python which supports scientific computing like large, multi-dimensional arrays and matrices[7]. NumPy has many contributors and open source software interfaces.

It also has the following things:-

- An array object with powerful N-dimensions.
- Functions of broadcasting.
- C/C++ and FORTRAN code can be integrated by tools.

NumPy useful for mathematical computation like linear algebra, Fourier transform, etc. In numPy data type and size can be effectively defined. Speedily integration with a large form of databases can be allowed by NumPy. It is also licensed under BSD license but with some restrictions.

The aim of this presearch paper is to identify objects by using various techniques from the surface of a complex background image. The extension of the detection of the object can be done by using automation and robotics. It can pluck the object like apple, bananas from the trees by using image processing techniques which will be easier and faster than manual plucking.

IV).Why to make use of Python for Image Processing?[2]

Python has multiple libraries for multiple purposes like web development, scientific and numeric computing, image processing. To work on images, Python has a library i.e Python Imaging Library (PIL) for image processing operations. The Python Imaging Library provides many functions for image processing. We performed some basic operations using PIL modules.

In python2.7 OpenCV library has implemented along with the help of numPy and the object detection can be explored like by using the sci-kit tool a virtual Artificial Neural network can be created.

V)Differences between Python and other languages for detecting an object:

A domain distinct alternative machine learning prediction problem is known as object detection. A number of programming environment like C#, MATLAB, Octave, R, Python, etc have OpenCV library interfaces available which are implemented in C/C++.

Here are the merits of using python code for detecting objects:

- a).More closely and readable code.
- b). Zero-based indexing is used in python.
- c). Support for the dictionary is present there.
- d). Object Oriented programming is easy and graceful.
- e). Open source and freely available.
- f). One module contains multiple functions.
- g).A lot of options to choose in graphics packages and toolsets.

VI).Existing Algorithms:

a).Features like Haar:-

Haar proposed by Paul Viola and Michal Jones^[8] in 2001 for object detection.

A classifier is trained with the health of a lot of images in a machine learning based method for object learning-based method for object detection and such classifier is for detecting an object in an image.

At first, the algorithm requires an image (image with faces) and negative images (image with faces) and negative images (images without faces) for training a classifier and later this classifier is used to extract features. A logical cascade of the classifier is introduced by this function. All the features are not applied at once and instead, we grouped the features into the distinct classifier and they apply them one by one if it fails at the first phase then discard the window. Continuation of the process is allowed only if it passes the stage. Our desired region will be that window which passes through all the phases.

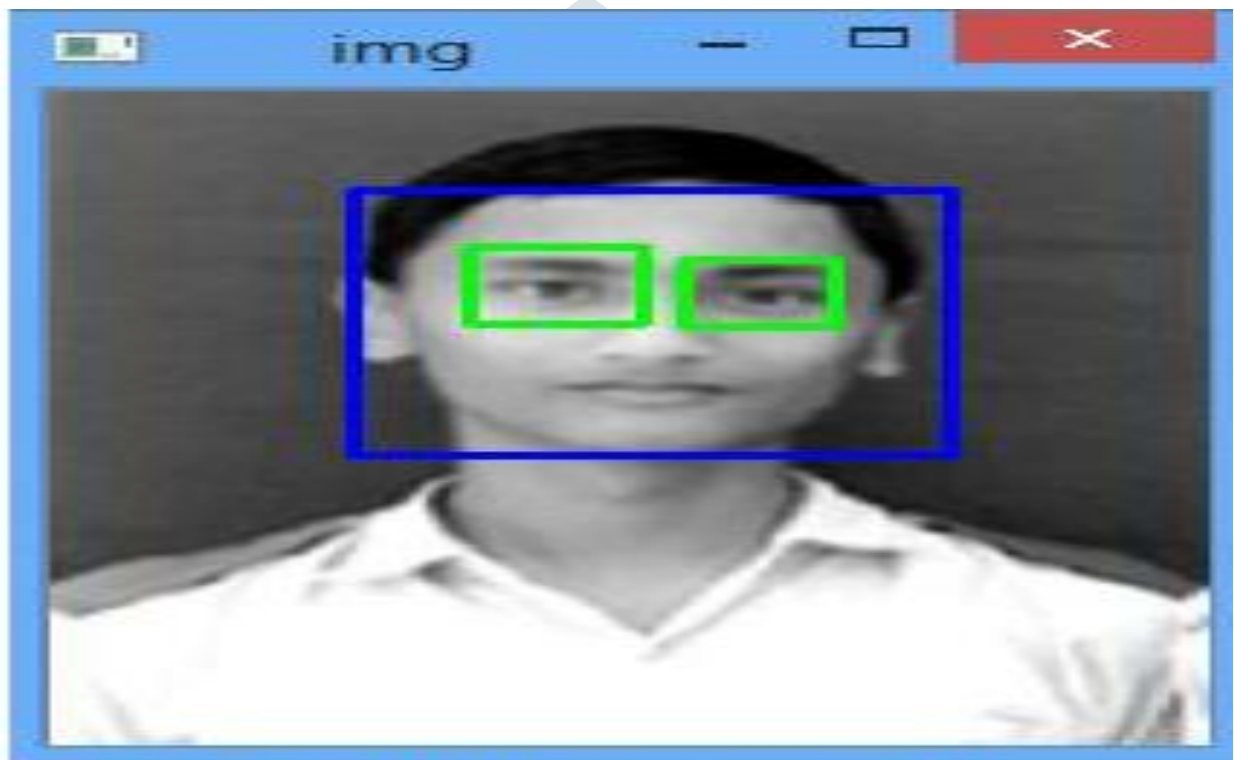


Fig:2 Face Detection using Haar

Fig.(i) Face Detection using Haar

b). Circular Hough Transformation:

HoughTransformation proposed by Richard Duda and Peter Hart in 1992^[9].At first, this transformation was used to detect arbitrary shapes. To detect a circular object in low contrast noisy image we used a modified version of this transformation and this modified transformation is known as CHT.

CHT based equation for circles

$$r^2 = (x-a)^2 + (x-b)^2$$

where,

the coordinates of the center area and band the radius of the circle are defined by the r.

CHT is based on 3 parameters, for them, a larger computation in the time and memory is required but the complexity to extract information from the image is increased by these parameters.

To understand easily, the value of radius is either a constant or a range is provided by CHT programs before running the application.

c).Matching of the template:

To detect objects from an image that matches a given image pattern it required a high-level machine vision technique which is known as template matching[4]. The source image is matched with the template image by this technique featured based approach will only be used if the template image is string otherwise the template-based application will be in use.

d).Blob detection:

In an image, the region that differs in properties is detected by the blob detection method. A region where all the points may be in consideration of similarities with each other known as blob region. Differential method and local extrema method are the two types of blob detection.

e).A method based on Gradient:

To estimate image flow at every location in the image, the gradient method used these two derivatives i.e. spatial and temporal derivatives. The unknown motion has to be restricted to a small range of possible values rather than a multiskills analysis must be registered so that the smoothing prior scale to derivatives estimation is suitable to the flake of motion. This method is computationally expensive by the gradient-based method.

f).Local-Binary Pattern:

In 1990, a visual descriptor is suggested which is known as LBP and for texture classification, it is a powerful method.

A window is divided into cells-

- ✓ In the cell, every pixel is compared with its 8 adjacent pixels.
- ✓ If the value of the pixel is succeeding its neighbor write '0' if not then write '1'.For convenience, the 8 digits binary number will be converted into decimal.
- ✓ Calculation and comparison of all the cells of the histogram have to be done.
- ✓ All the cells of the histogram should be concatenated and normalized. The feature vector of the entire window is given by this.

The classification of images is given by this vector.

g).Bag –of-words-method:-

Bag-of-words-method may be applied for image classification. Like visual words, images treated. Features are basically visual words. Classification of the image by a large vocabulary of many visual words is done by this method which also represents to each histogram of frequency words in the image.

h). Deep face method:

With the help of advanced deep learning, the neural network in Menlo Park and California Deep face software is developed by AI research group of Facebook. A neural network is a piece of software that reproduces an approximation about the real working of neurons. Machine learning can perform Deep face learning. A high-level for recurring faces developed a huge body of data.

VII) The procedure for detecting objects in python2.7:

We can detect various objects by starting from an image (im.jpg).

a).Installation of OpenCV-python:-

Download and install python packages to their default location-python2.7, NumPy and Matplotlib. Into their default locations, packages are to be installed. In C/Python2.7 is being installed. Open the IDLE of python2.7 python. Write import NumPy for working NumPy properly. From Sourceforge, OpenCV is to be downloaded. Move to OpenCV/build/python/2.7 folder. Copy cv2.pyd to C:/python2.7/lib/site-packages i.e. copy the path.

b). How to read an image:-

To read an image a function must be used function called CV2.imread(). The path of the image should be mentioned as the first argument if the image is not present in the current working directory. A flag should be passed as a second argument to read the path of the image.

- 1.) CV2.IMREAD_COLOR: To load a color image this function is used. If there is transparency in an image then that would be neglected. This is called a default flag.
- 2.) CV2, IMREAD_GRAYSCALE: Image loading should be done in grayscale mode.
- 3.) CV2.IMREAD_UNCHANGED: Inclusion of the alpha channel should be there in loading image.

c).Description and feature detection:-

- ✓ Interpretation of features. (To find the main features of an image and their usefulness.)
- ✓ Detection of corners. (Can, corners be a good feature?)
- ✓ Contesting of feature (We know about feature detection and descriptors. So we will start learning match different descriptors. Two techniques are provided by the OpenCV i.e. Brute-force matcher and FLANN based matcher)
- ✓ Mammography (As we know about the matching of features so now mix it with camera calibration and 3D-reconstruction for finding object description in complex image)

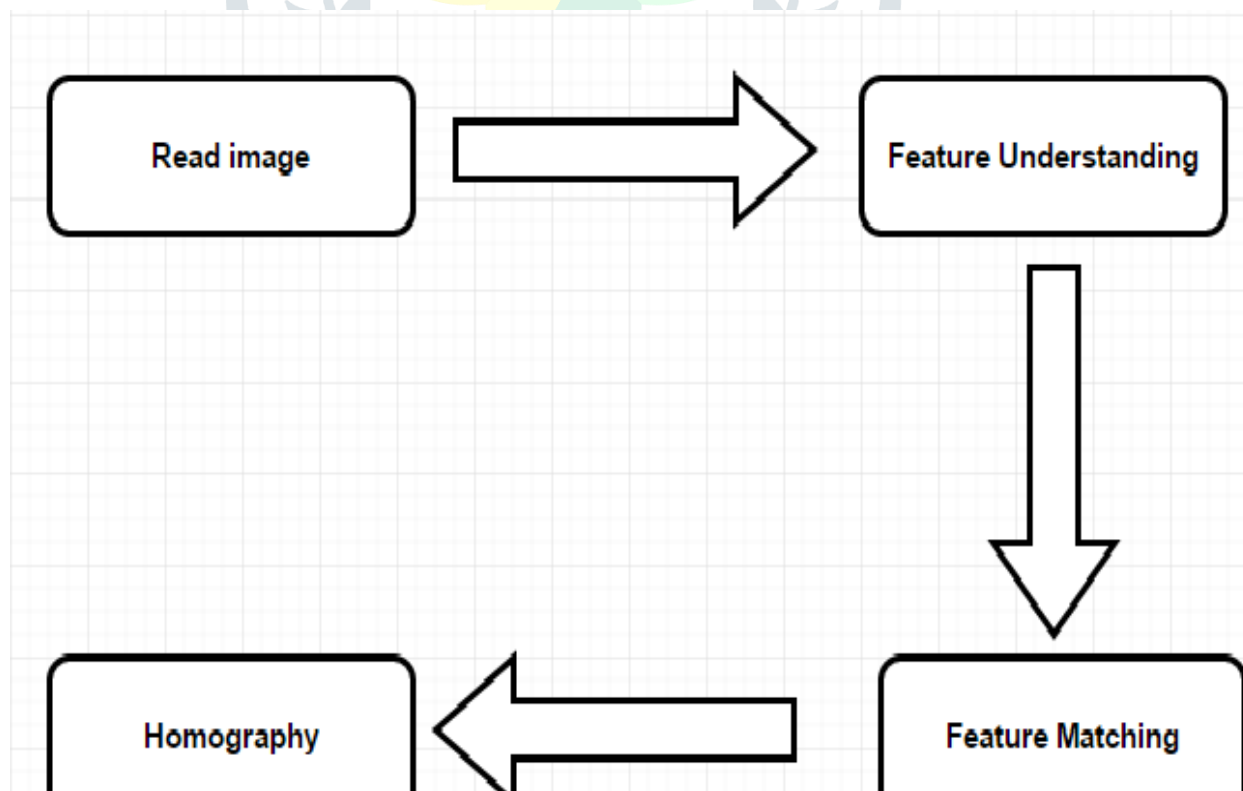


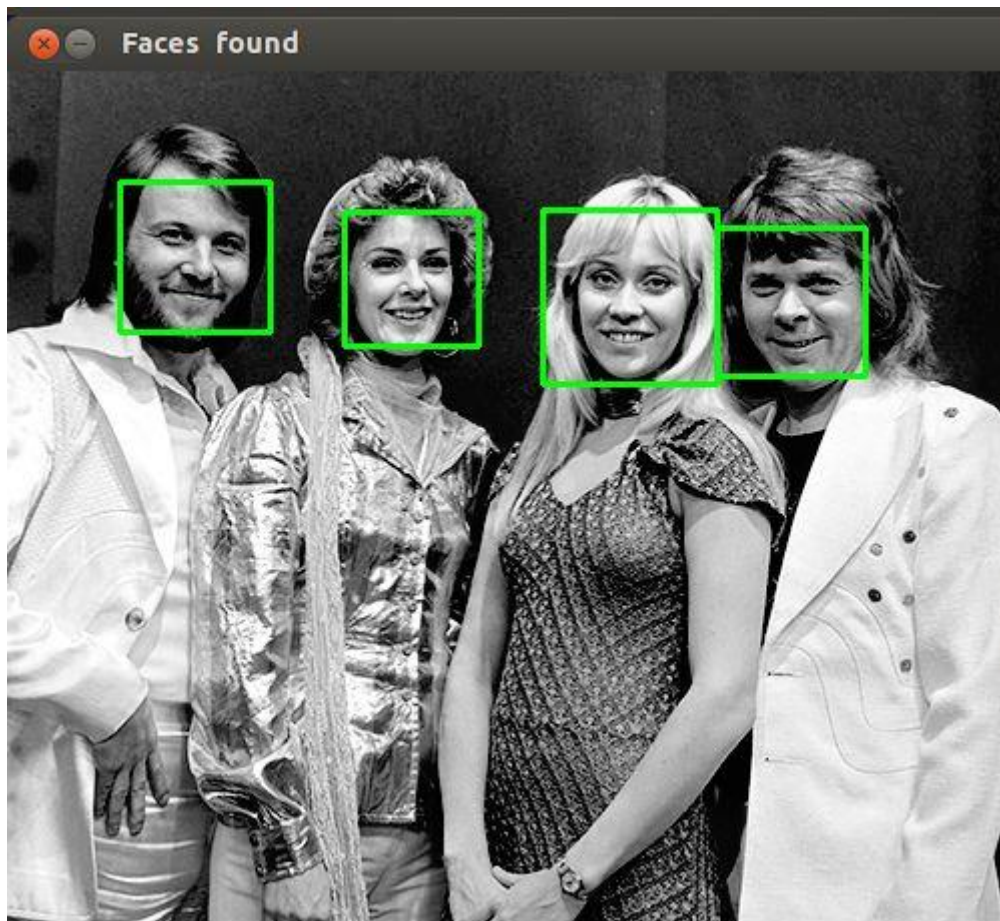
Fig: 1 Flow Chart for Object Detection

VIII). Uses and Future Scope:

In computer vision still there is a need for development, computer vision is still not at its top because in today's phase Computer Vision is not capable of solving real-life problems. In today's life object detection referred to as a sub-domain of machine learning.

Application of object detection are:

a). Detecting of the face can be done by object detection. For example, In our daily life, we noticed that if we upload a profile for Facebook, it not only detect our face but also remembers the face. Even a character can be recognized optically in the scanned document.

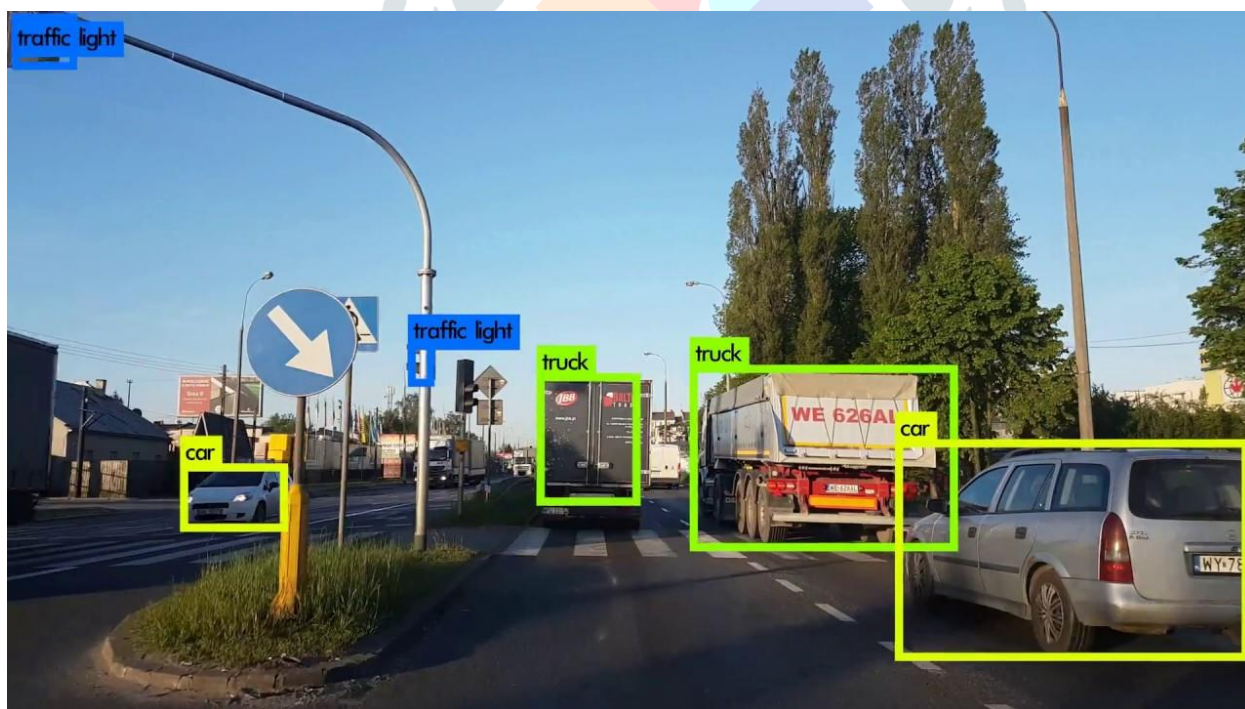


b). In an image or a frame, object detection can also be used for counting purpose like it can count an individual one or a group of people. Let's have taken an example if we apply object detection carefully it not only can count the people but also it can make differences between people on behalf of their dresses.



The above picture can count the number of people showed in frame if we use `print(len(boxes.shape))` function with code.

c).Detection of Vehicles is possible, because a vehicle is also detected as an object so we can also track the vehicle for finding the type of vehicle, even we can make a traffic calculator by extending the application.



d). In Industries, for the identification of different products in the industrial process, the object can also be used. If we want to detect the shape of the object we can do it easily with the help of object detection. For example, for detecting circular objects we can use Hough Circle Detection Transform.

e).As security purpose object detection plays a very important role in identifying unwanted or suspicious objects. This technique is also used for detecting bombs/explosives. For security purpose, object detection is useful. For the security measure, in videos objects can be easily identified and tracked.

f).If we want to recognize a person physically or read his behavior, object detection plays a vital role in security and authentication purpose.[1] Many different biological traits are used such as fingerprints, hand geometry, retina and iris pattern, etc.



g)In detecting disease such as tumor, stones, cancer, in MRI images object detection is useful.



Deep learning algorithm does as well as dermatologists in identifying skin cancer

i).Interaction with a human in the computer can be possible like a human gesture can store in a system and later we can use it for recognizing a dynamic environment to interact with a human by computer.

The scope of object detection is not over here. The future scope of object detection is may be very vast and bright . Because this is the field where more researches may be possible to make it more advance.

IX).Challenges faced in python:

In real time, to recognize a specific object from a huge amount of objects is the main aim of object detection.[2] With many recognizable objects, mostly recognition systems are poorly scalable. As the number of objects rises computational cost also increases. Because two objects might have the same attribute that's why comparing and querying the images using different classifiers are not enough. The system that can behave like human and can do the work with abilities in a dynamic environment is

difficult to design. Lighting, dynamic background, the presence of shadow, the motion of the camera, etc are also a few main challenges.

X).CONCLUSION:

In solving the real world problems the probabilities of using computer vision are extensive. Here the scope and basics of object detection achieving in various ways have been considered. When a MATLAB program is executed on a system, the system gets busy in interpreting the MATLAB code because MATLAB code is built on java that is the reason for preferring Python over MATLAB. Moreover, to start research with object detection having any concept using OpenCV-Python would be easy for someone who knows little about programming.

In object detection, there is a need for high performance and accuracy in feature understanding and matching because these are the major steps. A method which is preferred over Haar-Cascade is Deep Face used in Face detection because most of the social applications used this.

IOU measured are used to improve the performance of object detection. OpenCV will be extensively famous among the coders in the upcoming days of the IT field.

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