GE-103
Object Distance Measurement

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Abstract— **This project intends to find the distance of an object by webcam using the OpenCV library. The principle of the project is that the contour area decreases as the distance from the camera increases. We first convert our video frame to HSV and then put the range of the object's colors to be detected. On detection, it will start recording the area of contours. The obtained contour area and the measured distances will be stored in a dataframe. The OpenCV library of python is the most widely used tool for image processing. It is used in tracking moving objects, face detection, object disclosure, etc. We are just using it here for distance estimation.**

Keywords— **OpenCV, Numpy, Contour, Distance, Hue, Saturation, Value**

I. Introduction (Reference [1])

As the name suggests, 'Object Distance Measurement' takes the image using a webcam and gives the Distance of Objects in it. Objects can be anything ranging from faces and even the handwriting of humans. It uses python libraries like
1. OpenCV is used here for image processing
2. NumPy is used for mathematical operations
3. MatPlotLib is used to plot graphs between independent and dependent variables
4. sklearn is used to apply linear regression to our observations of distances and area of the contour

II. Literature Review (Reference [1],[2],[3])

Object detection and Image Processing is a computer technology widely used in Computer Vision, such as face detection, military intelligence, activity detection, vehicle counting, etc. Face detection and Pedestrian detection is the most commonly used research interest in this domain. This research domain was launched in the 1970s, and it remained on track until the 1990s, when computers became more advanced. Computer vision aims to mimic the human visual system that can be helpful for advancement in Robotic intelligence.

Various Literary works are done in this direction. Some of them are discussed below:

A. Scikit-image: Image processing in Python (Reference [4])

Various scientists like Stefan van der Walt, Juan Nunez-Iglesias, François Boulogne, Johannes L. Schonberger, Joshua D. Warner, Neil Yager, and Emmanuel Gouillart created scikit-image (a suite of image processing algorithms written in python and released under BSD Open Source License).

The simplicity of the python language has also led to a wide range of discoveries in computer vision. The easier to grasp feature of the python language has taught students to jump on higher concepts faster and solve challenging problems quickly. These parameters have helped python showcase itself as a perfect scientific programming language and its usage in digital image processing.

B. Image Processing in Python: Algorithms, Tools, and Methods You Should Know (Reference [5])

This article explains what image processing is and how it is done, and its crucial role in real-world applications. It praises the fantastic libraries of python that solely dominate this domain. This article explains the morphological image processing that

removes the imperfections from Binary images. It describes the two fundamental operations under morphological technique, namely 'Erosion' and 'Dilation.'

1) *Erosion:* This operation removes the pixels from the object boundaries.
2) *Dilation:* This operation adds pixels to the object's boundaries in an image.

This article also explains using the NumPy library that performs simple image techniques like flipping images, extracting features, and analyzing them.

In this article, the author briefly explains Morphological Filtering, Gaussian Filter, Fourier Transformation, and Wavelet Transformations. These techniques are undertaken by famous python libraries like OpenCV, NumPy, scikit-learn, etc.

C.   A Gentle introduction to Object Recognition with Deep Learning (Reference [6])

This article is written by Jason Brownlee, who has a Masters and Ph.D. degree in Artificial Intelligence. He is a professional developer and machine learning practitioner; he has also worked on Machine Learning systems for defense. Startups and severe weather forecasting. This article mainly tells us about

1) The tasks involved in the process of Object recognition with the help of computer vision in python language. For example, Image Classification, Object localization, and Object Detection.
2) Region-based Convolutional Neural Networks or R-CNNs is a Family of techniques for addressing object localization and recognition tasks designed for model performance. this includes the methods of Fast R-CNN, Faster R-CNN developed and demonstrated for object localization and object recognition
3) A secondary family of techniques for object recognition designed for speed and real-time use is called the You Only Look Once or YOLO model.

III. OBJECTIVE

This project emphasizes calculating the object distance from the camera lens using its 2D image. This project serves as the basis of many new and upcoming algorithms and useful applications.

Using a similar approach, we can make algorithms for filling empty spaces in the 2D image or implement a similar code to find the area of an object in the picture. All these will also serve as a basis for new and upcoming algorithms.

Moreover, our project code can be implemented in various fields like Police Investigations to calculate distances and locations for understanding crime scenes. We can also use it in automatic cars to avoid accidents and possibly deadly crashes. It also finds its usage in satellite systems; they can use it to calculate the distances of stellar objects in space, comets, and asteroids to predict whether they will hit earth or pass-by by calculating the trajectory of the same from its 2D image.

This project is also beneficial for ongoing research in Defence and Robotics. In Defence, it helps detect enemy sites, plan war strategies and action plans, and function automated missiles and guns. In Robotics, it is used to provide AI Road tracking for the robots to prevent collisions with nearby objects and things. It is also helpful in enhancing attacking capabilities for Drones and UAVs by determining the object distance. Object detection part of this project can be beneficial in surveillance of suspicious activities, which Intelligence agencies can use for national security.

IV. CONCLUSIONS

After running the code, we were able to get the object's distance from the webcam according to its area of contour. However, one of its demerits is that it needs a stable or static background with perfect contrast and must be different from the object color we want to detect. One more demerit could be that it can't catch more than one object at a time. Also, we have to know the HSV range of the object color that we want to detect. One more thing is that the distance is calibrated according to the area of only the object we measured with.

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