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SAVITRIBAI PHULE PUNE UNIVERSITY

A PROJECT REPORT ON
APPLICATION FOR REAL TIME OBJECT MEASUREMENT

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NBN SINHGAD SCHOOL OF ENGINEERING, PUNE-41

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CERTIFICATE

This is to certify that the Project entitled **APPLICATION FOR REAL TIME OBJECT MEASUREMENT,**

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Is record of bona fide work carried out by him/her, under my guidance, in partial fulfillment of the requirement for the award of the Degree of Bachelor of Engineering (Computer Engineering) of Savitribai Phule Pune University.

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Content

Abstract

Image processing is a form of signal processing in which the input is an image such as a photograph or video frame, the output is an image or set of characteristics related to image. OpenCV is a library of programming functions mainly used for image processing

This study presents an augmented technique for detecting objects and computing their real-time measurements from an IoT video device such as a webcam.We have suggested an object measurement technique in real-time using AI and IoT technologies like OpenCV libraries and webcam respectively.. OpenCV includes many libraries and algorithms that are used in this project. The technique has four stages: (1) capturing image (2) object measurement process (3) save output (4) displaying output.

1.Introduction

Over the past decade the industrial revolution has been undergoing major transformation. Real-time object detection is an important aspect from an industrial point of view.

Image processing is a form of signal processing in which the input is an image such as a photograph or video frame, the output is an image or set of characteristics related to image. OpenCV is a library of programming functions mainly used for image processing.It contains low level image processing functions and high level algorithms for face detection, feature matching and tracking.

Application For Real Time Object Measurement is a program that uses the OpenCV library to measure the objects in the frame of our IOT device and get their dimensions This is an essential topic of computer vision problems. As stated, this project presents a technique for computing the measurements in real-time from images. To explain it's working it basically uses a webcam and a white paper background to detect the object. After detecting the object, it displays its dimensions in specified measuring units at real time. In the implementation of the proposed technique, we designed a system that used OpenCV software library.

Some advantages of using this methodology are that it is very useful in the industrial field, it simplifies human work, and many more which are noted below in the advantages and disadvantages section. To calculate the size of each object, the prerequisite is that we need to determine the reference object. In this case, it is, plain white paper. After that, the dimensions of the objects inside the reference are measured or it will be calculated and hence the size of the object is displayed.

1.1Motivation

Scientists use many skills as they investigate the world around them. They make observations by gathering information with their senses. Some observations are simple. For example, a simple observation would be figuring out the color or texture of an object. However, if scientists want to know more about a substance, they may need to take measurements.

Measurement is the action of measuring something.Measurement is perhaps one of the most fundamental concepts in science. Without the ability to measure, it would be difficult for scientists to conduct experiments or form theories. Not only is measurement important in science and the chemical industry, it is also essential in farming, engineering, construction, manufacturing, commerce, and numerous other occupations and activities

Measurements require tools and provide scientists with a quantity.

These are the most commonly used tools for measurement:

- Rulers.
- Tape measures.
- Yard sticks.
- Meter sticks

Using these tools and finding the measurement is time consuming and as there is human interference the probability of error is high.Hence detecting the object and measuring it in real time comes to our rescue.Real time object measurement will be able measure the object dimensions in real time. This is an essential topic of computer vision problems. As stated, this project presents a technique for computing the measurements in real-time from images. To explain it’s working it basically uses a webcam and a white paper background to detect the object. After detecting the object, it displays its dimensions in specified measuring units at real time. In the implementation of the proposed technique, we designed a system that used OpenCV software library.

1.2 Future Scope

Machines are used in every part of human life. Machines work according to us but in today's world, we work according to machines. The rush to soar high is immense. Hence, machines are important and so are the parts of them. If the parts do not fit well a machine cannot work properly. The dimensions of the objects sure make a great impact. This AI IOT based project will help in measuring the dimensions in real-time. It is convenient and easy to use. It also gives accuracy and assurance of the manufactured product. As it is a one-time investment it surely has a great future scope.

1.3 Problem Statement

Object detection is perhaps the main exploration research in computer vision. Object detection is a technique that distinguishes the semantic objects of a specific class in digital images and videos. Detecting and recognizing objects in unstructured as well as structured environments is one of the most challenging tasks in computer vision and artificial intelligence research.

Our research focuses on detecting and measuring the object in real time .Mostly tapes are used while measuring the object which leads to some or the other error.The primary object of the project is to measure the dimensions i.e. length and breadth of the object in real time. This method uses a single lens webcam camera that performs in real-time, and also provides a binary obstacle image at high resolution

2. Edge Detection

2.1)Canny Edge Detection:-

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. It was developed by John F. Canny in 1986. Canny also produced a computational theory of edge detection explaining why the technique works.

The Canny edge detection algorithm is composed of 5 steps:

1. Noise reduction;
2. Gradient calculation;
3. Non-maximum suppression;
4. Double threshold;
5. Edge Tracking by Hysteresis.

2.1.1.Noise Reduction

Since the mathematics involved behind the scene are mainly based on derivatives (cf. Step 2: Gradient calculation), edge detection results are highly sensitive to image noise.One way to get rid of the noise on the image, is by applying Gaussian blur to smooth it. To do so, image convolution technique is applied with a Gaussian Kernel (3x3, 5x5, 7x7 etc…). The kernel size depends on the expected blurring effect. Basically, the smallest the kernel, the less visible is the blur. In our example, we will use a 5 by 5 Gaussian kernel.

2.1.2.Gradient Calculation

The Gradient calculation step detects the edge intensity and direction by calculating the gradient of the image using edge detection operators.Edges correspond to a change of pixels' intensity. To detect it, the easiest way is to apply filters that highlight this intensity change in both directions: horizontal (x) and vertical (y)

When the image is smoothed, the derivatives *Ix* and *Iy* w.r.t. *x* and *y* are calculated. It can be implemented by convolving *I* with Sobel kernels *Kx* and *Ky*, respectively:

$$K_x = \begin{pmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{pmatrix}, K_y = \begin{pmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{pmatrix}.$$

Sobel filters for both direction (horizontal and vertical)

Then, the magnitude $\boldsymbol{G}$ and the slope $\boldsymbol{\theta}$ of the gradient are calculated as follow:

$$|G| = \sqrt{I_x^2 + I_y^2},$$
$$\theta(x, y) = arctan\left(\frac{I_y}{I_x}\right)$$

Gradient intensity and Edge direction

The result is almost the expected one, but we can say that some of the edges are thick and others are thin. Non-Max Suppression step will help us mitigate the thick ones.Moreover, the gradient intensity level is between 0 and 255 which is not uniform. The edges on the final result should have the same intensity (i-e. white pixel = 255).

2.1.3.Non-Maximum Suppression

Ideally, the final image should have thin edges. Thus, we must perform non-maximum suppression to thin out the edges.The principle is simple: the algorithm goes through all the points on the gradient intensity matrix and finds the pixels with the maximum value in the edge directions..The way this works isEach pixel has 2 main criteria (edge direction in radians, and pixel intensity (between 0–255)). Based on these inputs the non-max-suppression steps are:

- Create a matrix initialized to 0 of the same size of the original gradient intensity matrix;
- Identify the edge direction based on the angle value from the angle matrix;
- Check if the pixel in the same direction has a higher intensity than the pixel that is currently processed;
- Return the image processed with the non-max suppression algorithm.

2.1.4.Double threshold

The double threshold step aims at identifying 3 kinds of pixels: strong, weak, and non-relevant:

- Strong pixels are pixels that have an intensity so high that we are sure they contribute to the final edge.
- Weak pixels are pixels that have an intensity value that is not enough to be considered as strong ones, but yet not small enough to be considered as non-relevant for the edge detection.
- Other pixels are considered as non-relevant for the edge.

Now you can see what the double thresholds holds for:

- High threshold is used to identify the strong pixels (intensity higher than the high threshold)
- Low threshold is used to identify the non-relevant pixels (intensity lower than the low threshold)
- All pixels having intensity between both thresholds are flagged as weak and the Hysteresis mechanism (next step) will help us identify the ones that could be considered as strong and the ones that are considered as non-relevant.

2.1.5.Edge Tracking by Hysteresis

Based on the threshold results, the hysteresis consists of transforming weak pixels into strong ones, if and only if at least one of the pixels around the one being processed is a strong one.

3.Literature Survey

1)Detection of Real Time Objects Using TensorFlow and OpenCV by Ajay Talele, Aseem Patil, Bhushan Barse

In this paper the authors have proposed ways to detect object in real time i.e. using YOLO and OpenCV.

2)Multiple Object Recognition Using OpenCV by D. Kavitha ; B.P. Rishi Kiran ; B. Niteesh ; S. Praveen

In this paper the authors have proposed object detection using OpenCV as well as also reviewed object detection using R-CNN,Fast R-CNN,YOLO .

3)"Edge Detection Techniques for image Segmentation" International Journal of Computer Science & Information Technology (IJCSIT) by Muthukrishnan.R and M.Radha

In this paper the author has reviewed different edge detection techniques like Roberts edge detection,Sobel edge detection, Prewitt edge detection, Kirsch edge detection,Robinson edge detection, Marr-Hildreth edge detection,LoG edge detection, Canny edge detection.

4)OpenCV for Computer Vision Applications by M. Naveenkumar , A. Vadivel

In this paper the authors have given examples of alarm systems using motion detection,Face recognition and Edge detection .They have used Canny Edge Detection for the edge detection.

4.System Configuration

4.1)Software Requirement:-

Windows,Python,OpenCV,Numpy,Pycharm.

Python :

Python is an interpreted, high-level, general-purpose programming language developed by Guido Van Rossum and initially released in 1991. Python's design philosophy emphasizes code readability, as seen by its extensive use of whitespace. Its language elements and object-oriented approach are intended to assist programmers in writing clear, logical code for both small and large-scale projects. Python is garbage collection and dynamically typed. It is compatible with a variety of programming paradigms, including procedural, object-oriented, and functional programming.

NumPy :

NumPy is a Python-based array-processing library. It includes a high-performance multidimensional array object as well as utilities for manipulating these arrays. It is the core Python library for scientific computing. It has several features, the most notable of which are: ● A powerful N-dimensional array object ● Sophisticated (broadcasting) functions ● Tools for integrating C/C++ and Fortran code

OpenCV:

It is an open-source library used in computer vision, machine learning, image processing. It was created by Intel and was subsequently sponsored by Willow Garage and Itseez (which was later acquired by Intel). The library is a cross platform and free for use under the open source Apache 2 license. There are various applications and functionality of OpenCV which makes it versatile. According to a stated list of supported layers, OpenCV supports models from deep learning

frameworks such as TensorFlow, Torch, PyTorch (after converting to an ONNX model), and Caffe.It performs tasks like face detection, object tracking, landmark detection and much more.

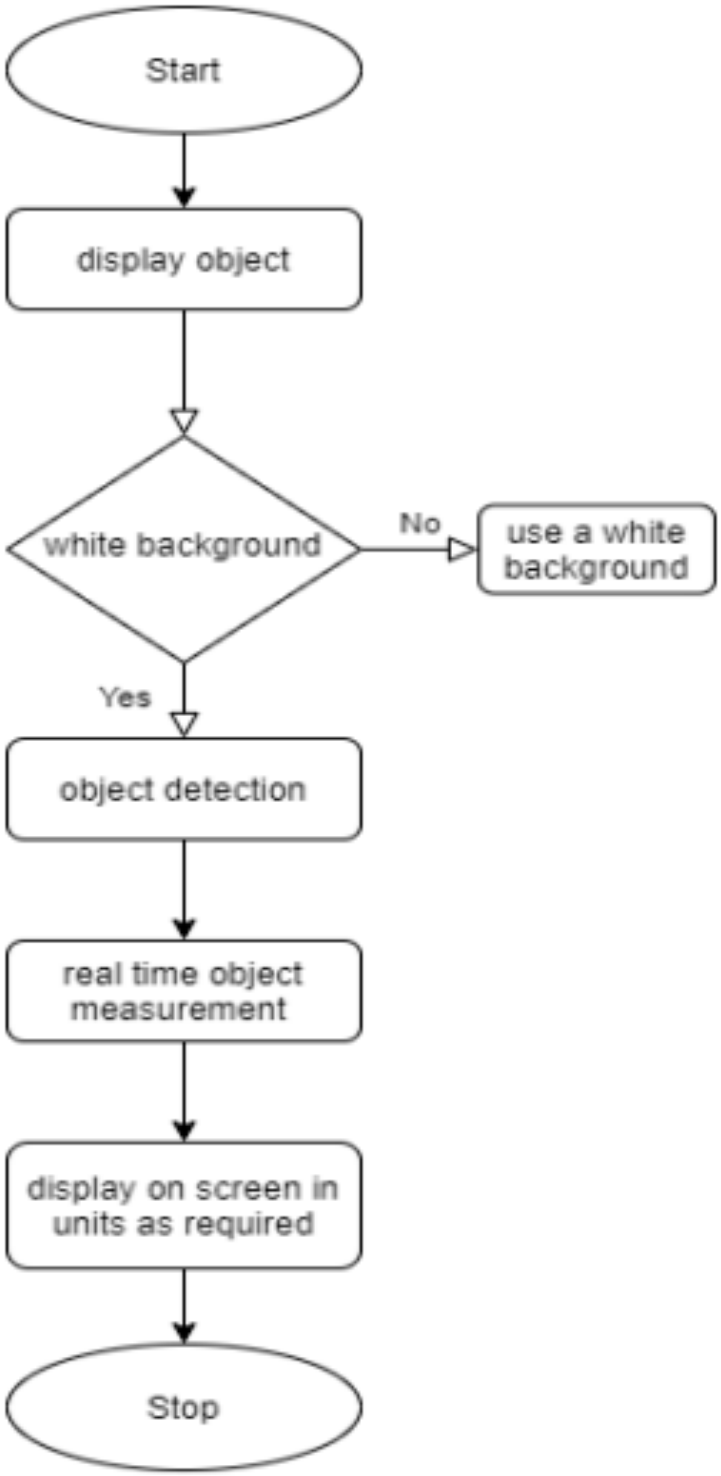
PyCharm:

It is an IDE (integrated development environment) specifically used for the python language. It was developed by the Czech company JetBrains. It provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems (VCSes) and supports web development with Django. PyCharm is easy to use.PyCharm is a cross-platform with windows, macOS, and linux versions.

4.2) Hardware Requirement:

- Processor: Intel core i5 or above.
- Webcam
- 64-bit, quad-core, 2.5 GHz minimum per core
- Ram: 4 GB or more
- Hard disk: 10 GB of available space or more.
- Display: Dual XGA (1024 x 768) or higher resolution monitors
- Operating system: Windows

5.Flow Chart


Start
display object
white background
No
use a white background
Yes
object detection
real time object measurement
display on screen in units as required
Stop