

Object Detection and Tracking and Signal Command Follower-Unmanned Vehicle for Traffic

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ABSTRACT: The aim of this project is to focus on the development of an unmanned vehicle which tracks any specified object based on its color. This is further enhanced to follow the traffic signals which will enable it to move on traffic autonomously. As the name suggests- 'Unmanned Vehicle', it's an autonomous wired vehicle developed to achieve a required task. The main principle is to capture video streams from a webcam which is delivered to the computer where the images are processed in OpenCV and then the desired information is sent to the Arduino via serial communication to take necessary movements in order to keep a track of the desired object and along with that follow the traffic signal commands while travelling on roads.

KEYWORDS: Computer Vision, Robotics, Artificial Intelligence, Intelligent agents, Object Detection, Gaussian filtering, Thresholding, Hough Transforms

I. INTRODUCTION

Object Detection and Tracking deals with identifying our object of interest and distinguishing it from the environment. After successful detection, the task is to keep a regular track on it by moving the camera as per the movement of the object. This ability of the vehicle would help to keep a track on the desired objects which can be enemy weapons or even enemy itself, proving the vehicle of vital importance for defense strategies. The other feature of the vehicle is to follow the commands of the traffic signals thus making it perfect to move on roads autonomously.

The major task in this project of mine was making use of image processing in OpenCV for the first time. OpenCV is an Image Processing library created by Intel and maintained by Willow Garage. It is available for C, C++, and Python, open Source and free and thus easy to use and install. I have worked with Atmega16 and AVR studios but this being my first instance of using Arduino (as the serial communication part is difficult to attain with a normal Atmega16 microcontroller using a simple USB cable). I had to figure my codes for different aspects of Arduino right from scratch. When I got the knowledge of using Arduino & Open CV, which took up substantial amount of our time, I began with my codes using Open CV & tried some basic processing codes to detect the desired objects and to separate them from the rest of the boundary. Then I clubbed these two together, and wrote a simple code, that would control the motors depending on our camera inputs. One major issue that cropped up was the availability of a wireless cam compatible with the microcontroller I was using(this was my first priority).But due to non-availability & cost issues I had to settle for a webcam in which the image processing would have to be done on the computer. I used a long USB extension cord for this purpose.

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II. IDEA

I used a standard 5MP webcam which gives image inputs to a laptop .The laptop remains connected to the camera throughout (this could be made entirely wireless as well but due to cost issues I had tested my project with a wired one). I then made use of image processing using Open CV libraries compiling the whole of the program on Visual Studio. The first step was to filter the colours using the Thresholding technique. The colours of interest were filtered between a minimum and a maximum of the threshold. The range of the colours were decided by selecting the appropriate values for Hue, Saturation and Value which is specific for a particular object in a particular environment. The threshold image has a lot of noise and disturbances which has to be removed. I employed Gaussian filters to remove the undesired noise and the output enabled me to get a smoothed image devoid of noises. Now the demand was to differentiate the object from the rest of the environment. I preferred to encircle the detected object within circles. The next objective was to encircle the colours of interest to designate them as objects. This was achieved using Hough circles with the help of which the centre of the circle is determined. We declare a particular colour for the circle and a separate colour for its centre so as to highlight the detected object. The x and y coordinate of the centre was obtained. This information is utilized for directing the robot to move specifically. Focussing only on the horizontal movement of the object, distinct characters are sent to the Arduino based on the x coordinate of the object on the screen. These characters are pre-defined in the Arduino for desired movements. One can keep a 3-D track of the object but due to cost issues I have tested only for the horizontal movement. As soon as the Arduino receives the characters rather command, it directs the motors to move the camera in the direction of the object under supervision. Thus, making use of serial communication, this task is achieved. The RX(receiver) and the TX(transmitter) blinks accordingly when the serial communication initiates helping us to get an alert as soon as the communication starts.

III. BASIC ALGORITHM

The basic algorithm of the entire approach can be enlisted as follows:

For Object Detection and Tracking:-

The basic algorithm for the entire approach can be enlisted as:

- Capturing image by a webcam
- Transferring the image details to the laptop
- Processing the image
- Detecting the desired object
- Enhancing its features
- Distinguishing it from the rest of the environment
- Encircling the detected objects within colorful circles
- Obtaining the coordinates of the circles with respect to the window in which they are displayed
- Sending commands to arduino based on these coordinates to move accordingly
- The detected object is successfully tracked

For Traffic Signal Commands Follower:

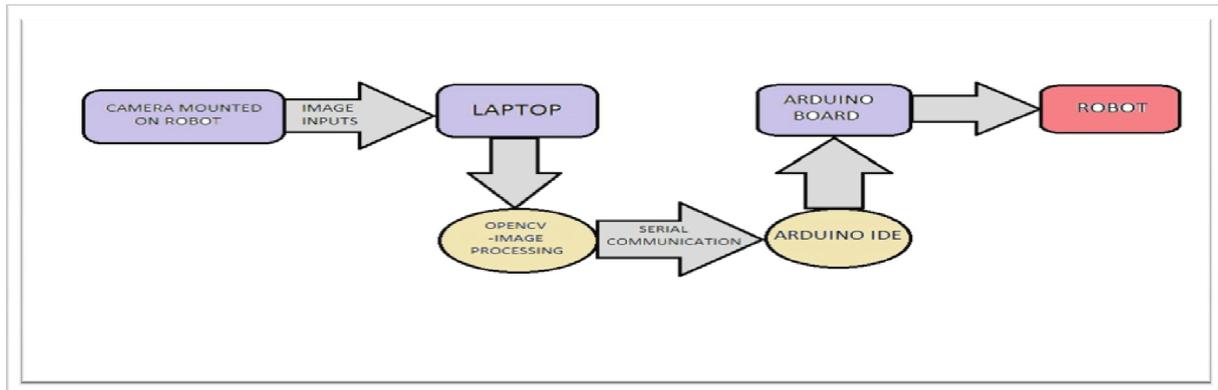
- This is similar to Object Detection
- Here the different traffic signal colors are thresholded separately
- Different commands for different signals are defined
- This information is passed on to the arduino
- The vehicle then acts accordingly.

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Flow diagram of the Algorithm:



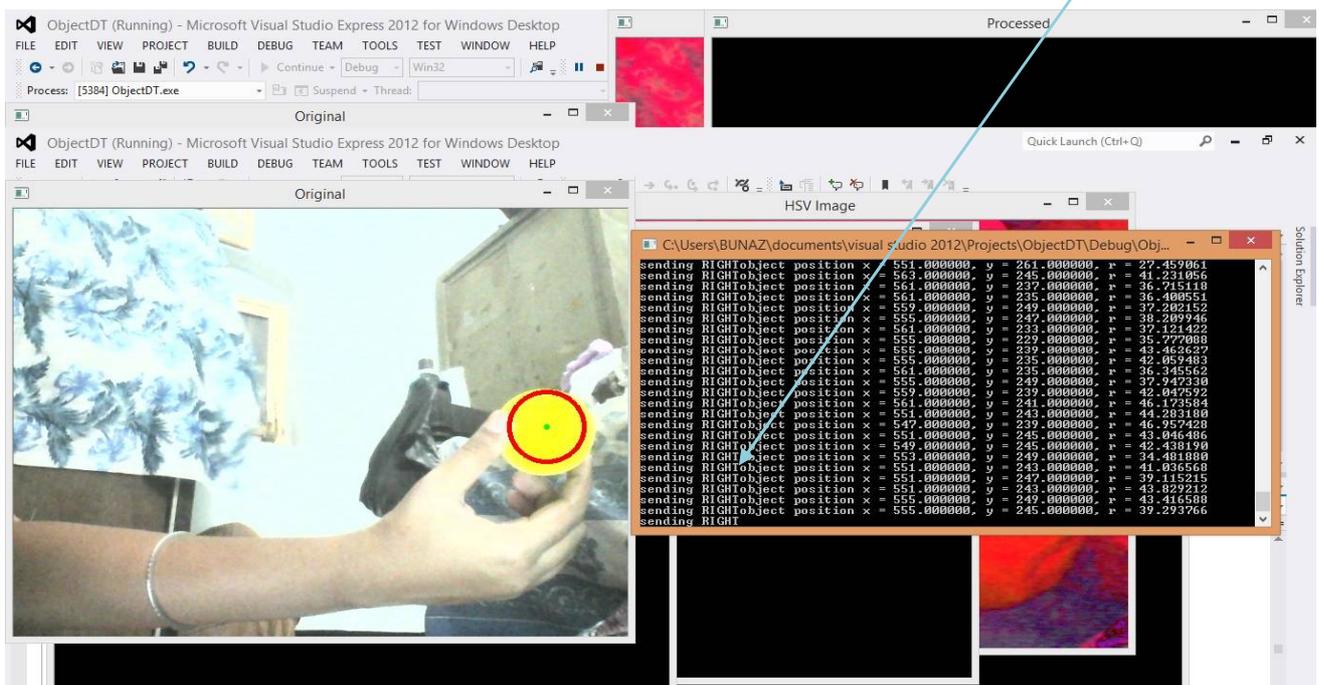
IV. RESULTS

The above approach was successfully implemented on a vehicle driven by Arduino and gave satisfactory results:

Here I have assumed a yellow ball as my object which has to be detected and tracked.
The following images will illustrate the whole of my approach

Detection of object as it moves RIGHT :

As the object moves towards right , the vehicle moves towards right. The window displays 'sending RIGHT'. We can observe the coordinates of the centre of the object as well.



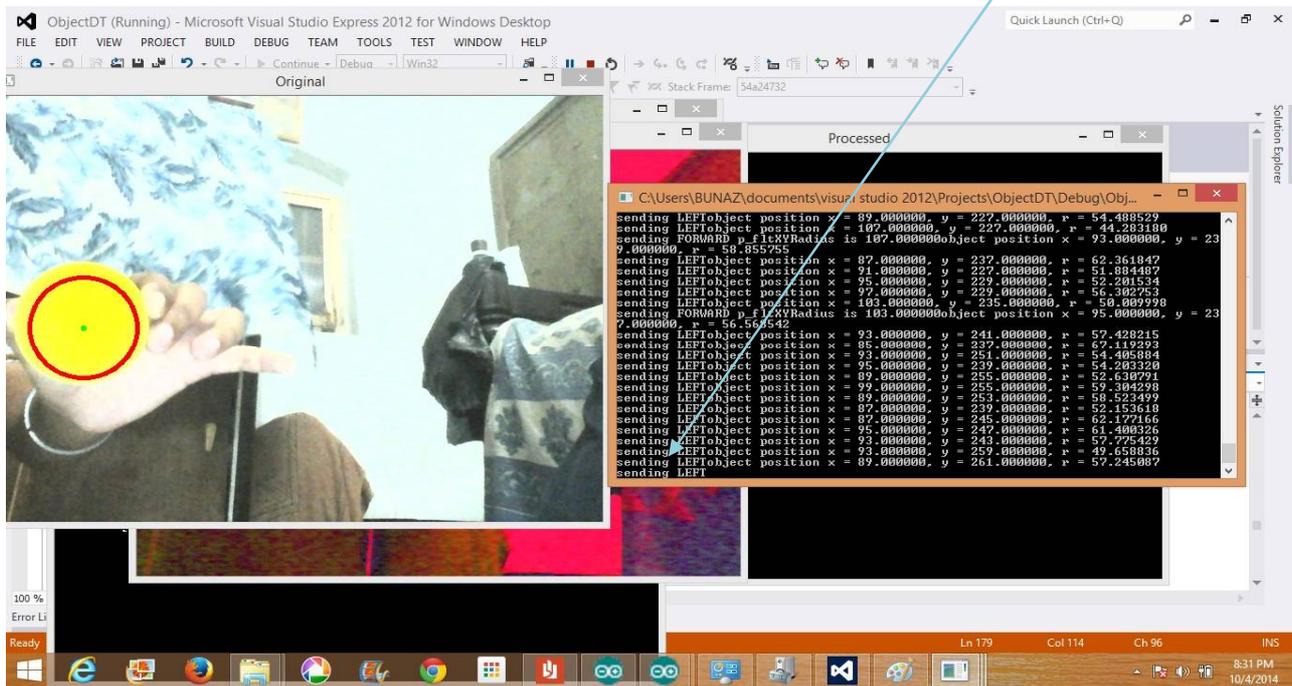
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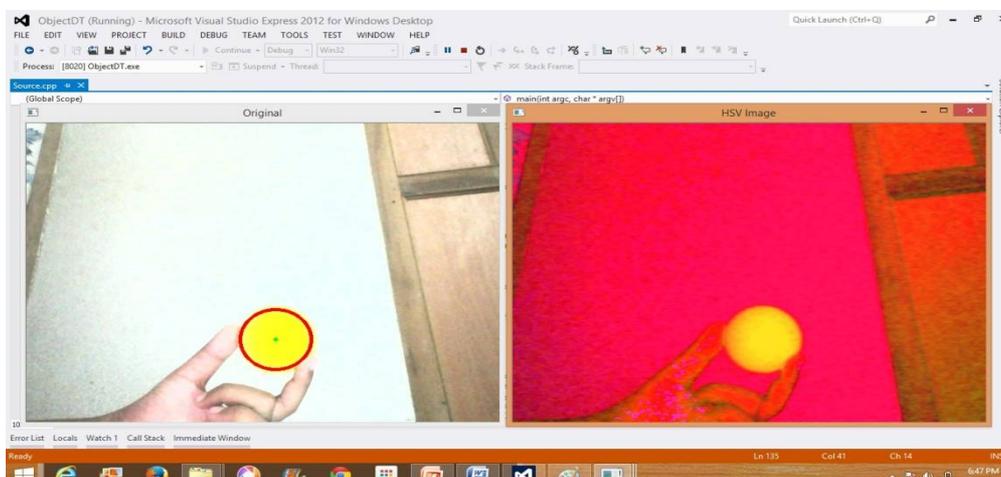
Detection of object as it moves LEFT:

As the object moves towards left , the vehicle moves towards right. The window displays 'sending LEFT'. We can observe the coordinates of the centre of the object as well.



Various Steps of Image Processing involved :

The various steps in the processing of the image of the object is displayed below:
Conversion of RGB image to HSV image:.

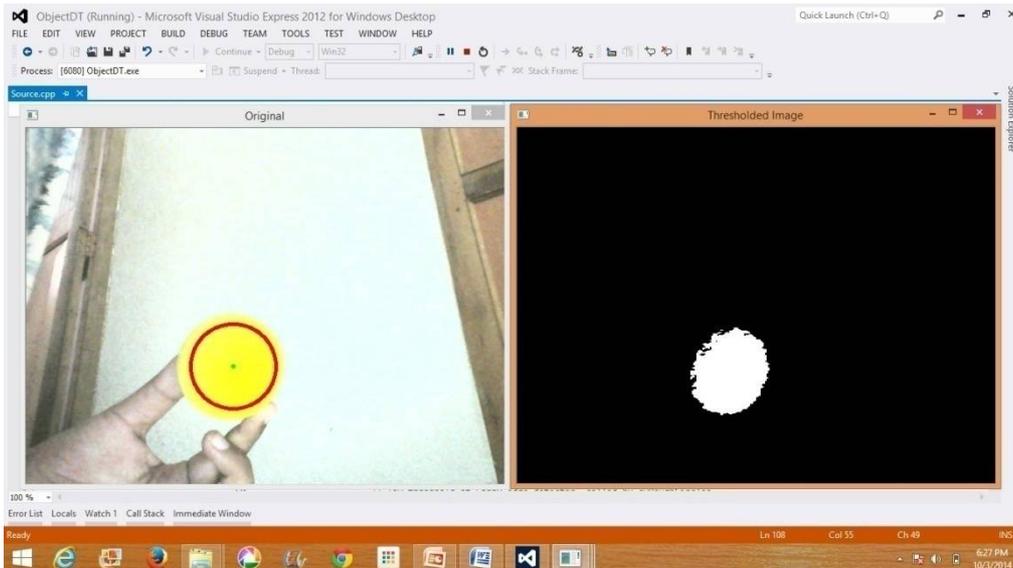


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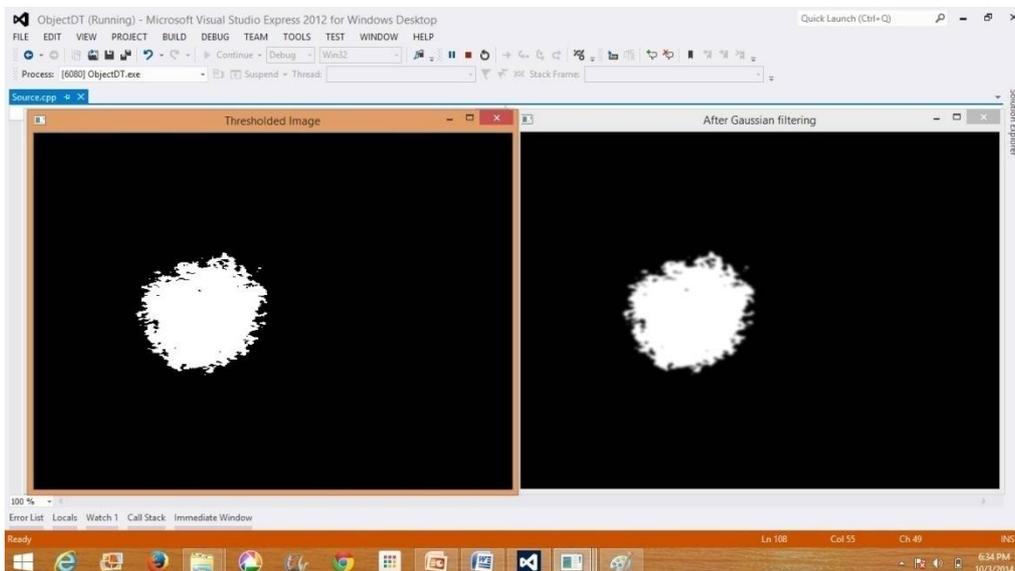
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Producing a thresholded image :



Applying Gaussian filters to smooth the images:

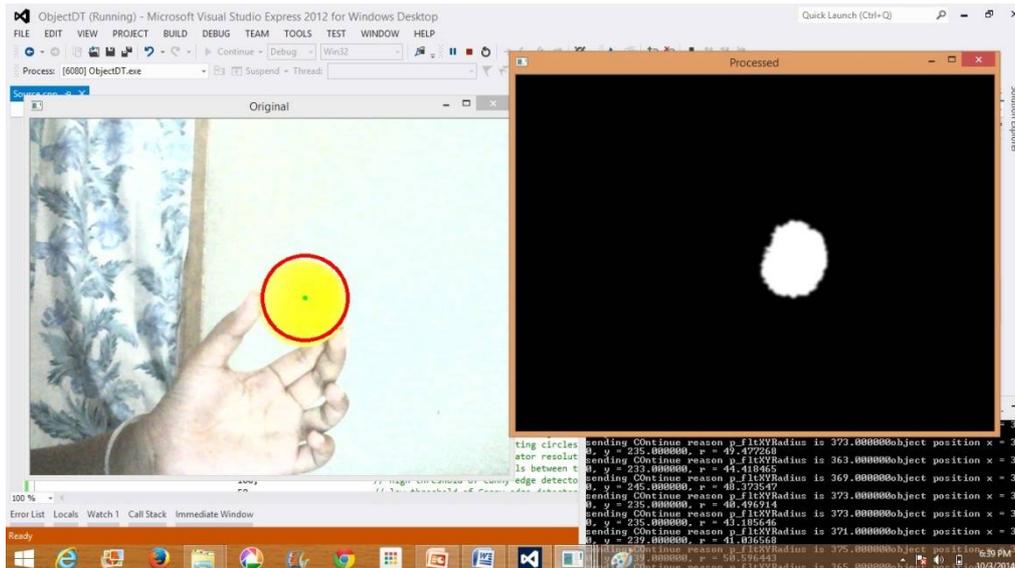


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Getting the final processed image:



V. CONCLUSION

The success of this attempt of mine proves that this approach could be very beneficial for the development of a Real Unmanned Vehicle for Traffic. The object detection and tracking technique can prove to be a vital tool for detecting enemy vehicles or even enemies proving it to be of utmost importance to the Defence Department, though not limited to this department. The traffic signal command follower technique provides enough intelligence to the vehicle to decide its movements in traffic autonomously.

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