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# Ball Detection and Tracking through Image Processing using Python

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**Abstract**
In this paper, the ball detection and tracking through image processing using python is presented. The Ball Detection and Tracking through Image Processing using Python is a project that aims to identify and track a ball in real-time using computer vision techniques. The project involves the use of a camera to capture the video of the ball, which is then processed by the software using OpenCV library in Python. The project comprises two stages, i.e., ball detection and tracking. In the first stage, the algorithm identifies the ball in the video frame by detecting the circular shape of the ball. The second stage involves tracking the ball's movement by using optical flow techniques. The software is designed to run on a Raspberry Pi or a PC, and it is capable of processing video in real-time. The output of the software is the position of the ball, which is displayed on the screen. The position can also be used to control other devices, such as a robot, to follow the ball's movement. The project has several applications, such as in sports analytics, where it can be used to track the movement of a ball in a game like football or basketball. It can also be used in industrial automation, where it can be used to track the movement of objects on a conveyor belt. Overall, the Ball Detection and Tracking through Image Processing using Python project is an excellent example of the application of computer vision techniques in real-time video processing. It has the potential to revolutionize various industries and open up new possibilities for automation and analytics.

**Keywords:** Ball detection, ball tracking, Image Processing, Robotics, Application.

## 1. Introduction

Image processing is a way to convert an image to a digital aspect and perform certain functions on it, in order to get an enhanced image or extract other useful information from it. It is the class of methods that deal with manipulating digital images through the use of computer algorithms. It is an essential pre-processing step in many applications, such as face recognition, object detection, and image compression. It is a type of signal time when the input is an image, such as a video frame or image and output can be an image or features associated with that image. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods. This is important in several Deep Learning-based Computer Vision applications, where such pre-processing can dramatically boost the performance of a model [1].

Today's surveillance provides a major drawback which is that it rests on the involvement of humans which as we all know can be easily distracted, so it was to our utmost importance to discover a system which can monitor regions autonomously and continuously. And also we want to identify obnoxious or unwanted things and dangers while simultaneously making decisions and respond accordingly. So object tracking with the use of intelligent systems and computers is essential and crucial to achieve automated surveillance. Any outdoor surveillance system must be able to track objects moving in its

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field of view, classify these objects and detect some of their activities. We should develop a method to track and classify these objects in realistic scenarios. Object tracking in a single camera is performed using background subtraction, followed by region correspondence [2].
This takes into account multiple cues including velocities, sizes and distances of bounding boxes. A ball tracking robot is a type of robot that uses sensors and algorithms to detect and follow a ball's movement in real-time. The robot can be programmed to track and follow the ball's movement, making it a useful tool in various applications. This robot tries to find the object based on its colour or shape, if it finds a ball of that colour it follows it. We have chosen raspberry pi as micro-controller for this project as it gives great flexibility to use Raspberry Pi camera module and allows to code in Python which is very user friendly and OpenCV library, for image analysis [3].

## 2. Literature Reviews / Surveys

In this section, the review on the various imaging applications that could be used for a host of image processing applications is presented in a nut shell. In [1], the authors have used omnidirectional camera to detect objects and measure the real angle and distance. The system detects the object efficiently using a simple algorithm based on the colour information obtained from the colour extraction process and colour segmentation. But there are major problems in using camera as the main sensor, it was the speed of program execution. With so many tasks that must be executed in real-time, it needs faster algorithm to be able to process all the tasks. In addition, another challenge is the various lighting conditions may affect the image produced by the camera [4].

## 3. Basic System Model & Methodology Adopted

Simple Basic Model - The robot uses a camera to do image processing by taking frames and track the ball. To track the ball various features like its colour, size, shape is used. We have chosen Raspberry Pi as micro-controller in this project because it allows us to use its camera module and gives great flexibility in code as it uses python language which is very user friendly and also it lets us use OpenCV library for analysing the images. For controlling the motors, we will use an Dual H-Bridge motor drivers to switch from clockwise to counter-clockwise or to stop the motors [8]. This we will integrated via code when direction and speed has to be controlled in different obstacle situations. For the image analysis, We are taking each frame and then masking it with the colour needed. Then we find all the contours and find the largest among them and bound it in a rectangle. And show the rectangle on the main image and find the coordinates of the centre of the rectangle. Finally, the bot tries to bring the coordinates of the ball to the centre of its coordinate axis. This is how the robot works as shown in the Fig. 1 [7].

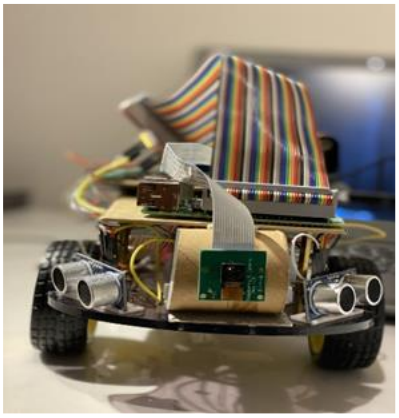

Fig. 1. Basic system model of ball tracking robot

## 4. Methodology adopted

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The hardware as seen in the Fig. 3, the circuit involves a PI camera, Motor Driver module and a pair of motors connected to the Raspberry pi [18]. The complete circuit is powered by a Mobile Power bank (represented by AAA battery in the circuit below) [17]. The Ultrasonic sensors VCC are connected to the common terminal same is with the GND (ground) and the remaining two ports of the ultrasonic sensor is connected to the GPIO pins on the Raspberry Pi. To drive the Motors, we need four pins (A,B,A,B). This four pins are connected from GPIO14,4,17 and 18 respectively. The orange and white wire together forms the connection for one motor. So we have two such pairs for two motors [9].

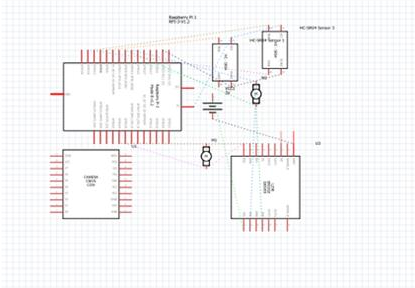

Fig. 2 : Schematics for ball tracking robot

**5. Evaluation Results & Future Prospects**

A ball tracking robot is that it should be able to accurately track the movement of a ball and move in the direction of the ball, with the goal of either intercepting the ball or following it. The accuracy and speed of the tracking will depend on the capabilities of the hardware and software used, as well as the environment in which the robot is operating [11].

Fig. 4 : Ball detection by the ball tracking robot-1

**6. Conclusion**

In this review article, a brief informative description is given about the ball detection and tracking robot through image processing using python. In particular, we have described how to detect a ball using its centroid and marking it as a separate entity for further tracking by a robot. We have also discussed about its applications in security surveillance cameras, sports and robotic competitions. In conclusion, the Ball Detection and Tracking through Image Processing using Python project demonstrates the power of computer vision techniques in real-time video processing. By utilizing OpenCV library in Python, the software is capable of detecting and tracking the movement of a ball in a video feed. The project has various applications in sports analytics, industrial automation, and many other fields. With the ever-increasing demand for automation and analytics, this project has the potential to revolutionize these industries and open up new possibilities. Therefore, this project serves as an excellent example of the practical application of computer vision techniques in solving real-world problems.

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