Distance Tracking With Aruco Markers

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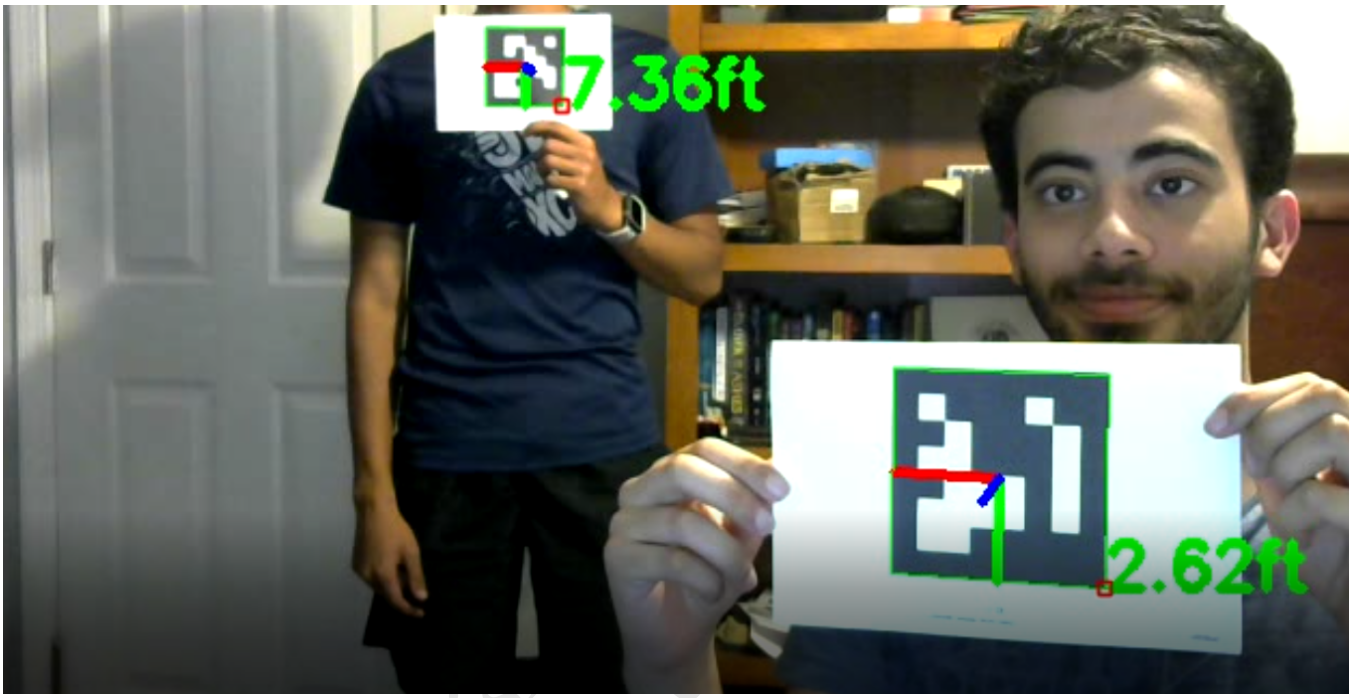

Figure 1: Multiple Markers Detected with Distances

KEYWORDS

Aruco markers, distance calculation, orientation, text tagging

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1 INTRODUCTION

The program distance.py uses Aruco markers as well as their dimensions on the camera in order to calculate the distance away from the camera. The distance is fairly accurate (see Figure 1). It is also able to keep track of multiple markers at once. Accurate distance tracking is important. Using cameras to calculate distance is much cheaper than using other forms such as radar, and it is accurate enough for many use cases. We can also use the distance the camera is away from the marker as a way to designate AOI's as well.

2 CALIBRATION

The program requires several forms of calibration. The camera must first be calibrated and the Camera Matrix as well as the Distortion Coefficients must be passed into the program. Next, we determine the focal length in virtual space. The focal length was calibrated at one foot from the camera. Once calibrated, the value is saved and used in subsequent program runs. This makes the setup easy and inexpensive.

3 MEASUREMENTS

The formula for calculating the distance to the camera is very simple:

$$distance = knownWidth * \frac{focalLength}{rectangleArea} \quad (1)$$

Here the distance refers to the distance between the camera and the Aruco marker. The known width refers to the width of the Aruco Marker. The current version of distance.py uses markers that

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Table 1: Accuracy of Detection

Calculated Distance (ft.)	Actual Distance(ft.)	Accuracy(%)
2.95	3	98.33
5.98	6	99.67
1	1	100
0.55	0.5	91

are 100mm wide. The focal length is the value that we calibrated earlier. It gives the angle of view; how much of the scene will be captured—and the magnification; how large individual elements will be. Finally, rectangleArea refers to the minimum rectangle area of the Aruco marker found in the frame. By inputting the current rectangleArea to the equation, we are able to calculate the distance to the camera.

4 METHODOLOGY AND TESTING

Several trials were run at various distances to calculate the accuracy of the calculated distance at different ranges. It was found that the calculation was much more accurate at ranges past 1 foot (See Table 1).