Distance Tracking With Aruco Markers

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KEYWORDS
Aruco markers, distance calculation, orientation, text tagging

1 INTRODUCTION
The program distance.py uses Aruco markers as well as their di-

dmensions 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:

\[
distance = \frac{\text{knownWidth} \times \text{focalLength}}{\text{rectangleArea}} \tag{1}
\]

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
Table 1: Accuracy of Detection

<table>
<thead>
<tr>
<th>Calculated Distance (ft.)</th>
<th>Actual Distance(ft.)</th>
<th>Accuracy(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.95</td>
<td>3</td>
<td>98.33</td>
</tr>
<tr>
<td>5.98</td>
<td>6</td>
<td>99.67</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>0.55</td>
<td>0.5</td>
<td>91</td>
</tr>
</tbody>
</table>

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).