

Opencv to determine distance

Abstract

This attempts to determine the distances between the camera and the subject using OpenCV. It relies on the apparent size of the image as the subject gets closer to the camera. We use a three-centimeter diameter circle coloured black and using the radius of the minimum enclosing circle, we can find the radius of the image. It is demonstrated that for small distances between the camera and subject, we were able to find a relation between the distance and the radius of the image.

introduction

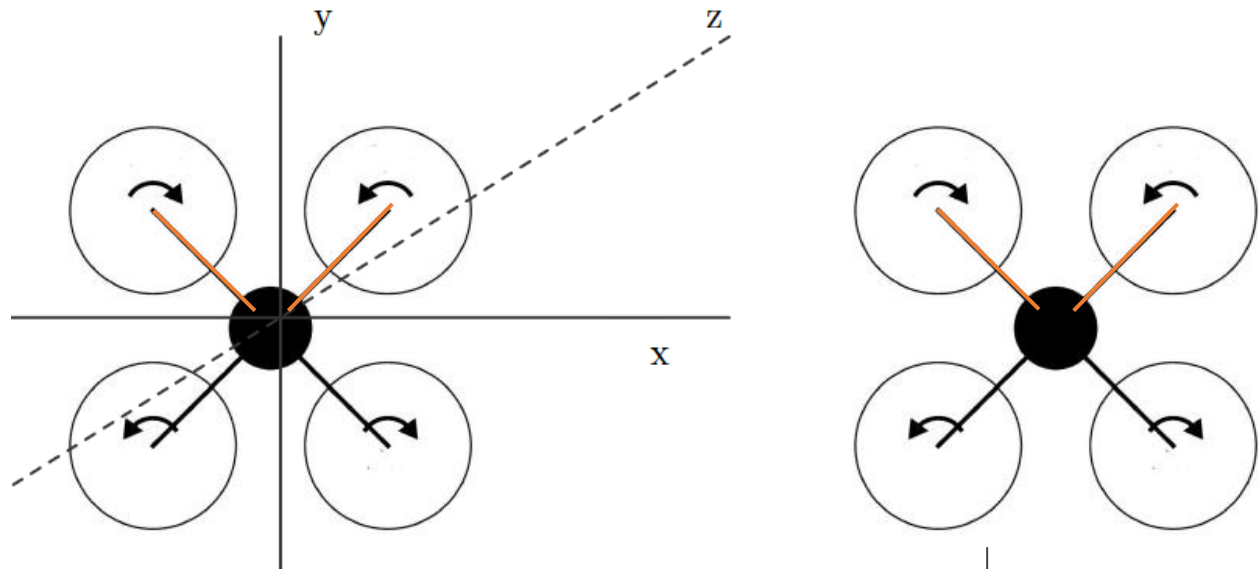


Figure 1: UAV system(top view)

Consider a system of two UAVs we take the axes to be as shown in the above figure. X direction points to the right of the UAV(also the direction of the camera), y direction points towards the front and z direction point down to the earth.

Distance between them

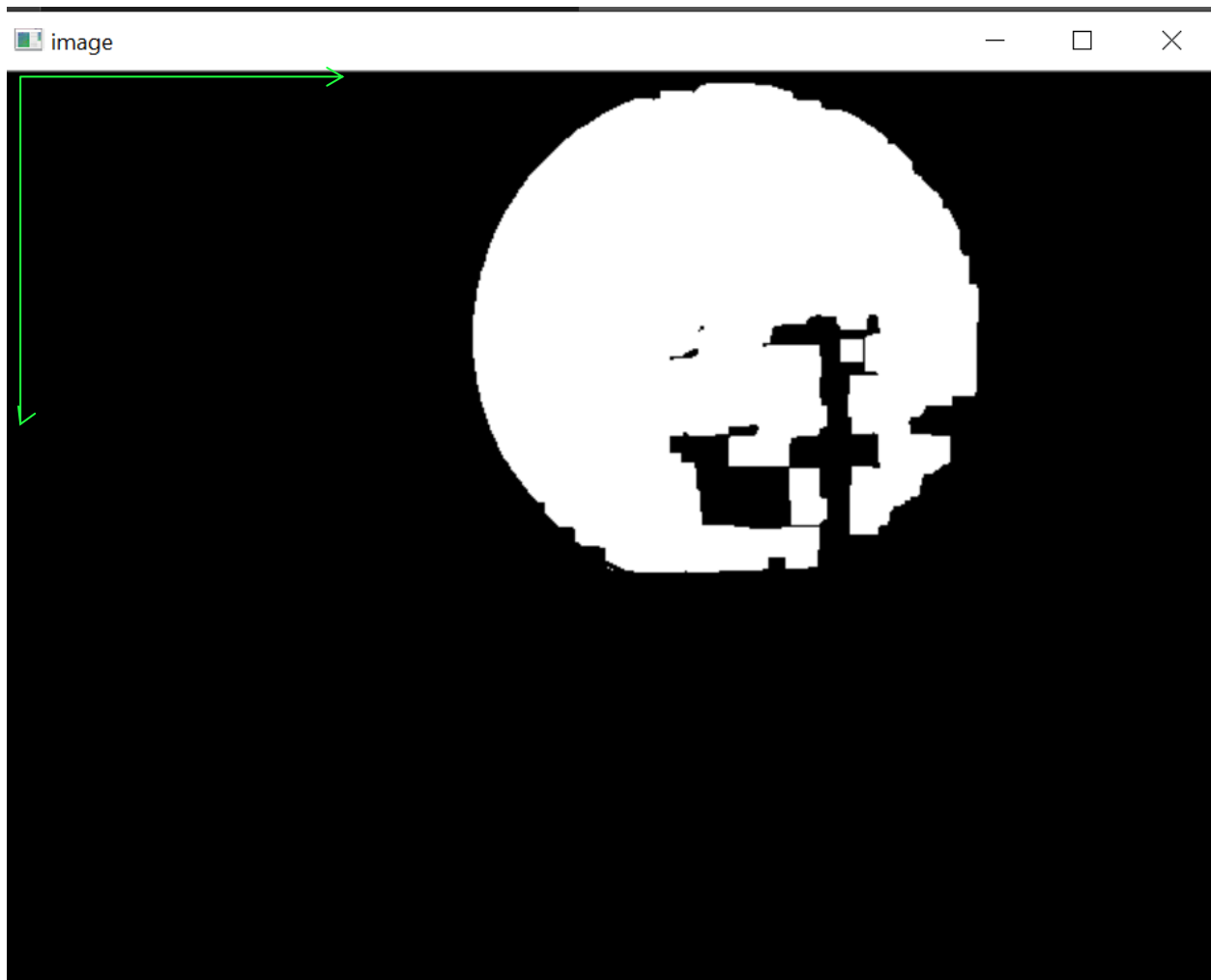
Images of the 3cm diameter circle is included here after some processing to remove any details that is not black. We can then find any contours in the image and find the minimum enclosing circle, some examples of the images are attached below. We can see that there is a relation between the radius of the enclosing circle and the distance between the UAVs in the x direction.

alignment

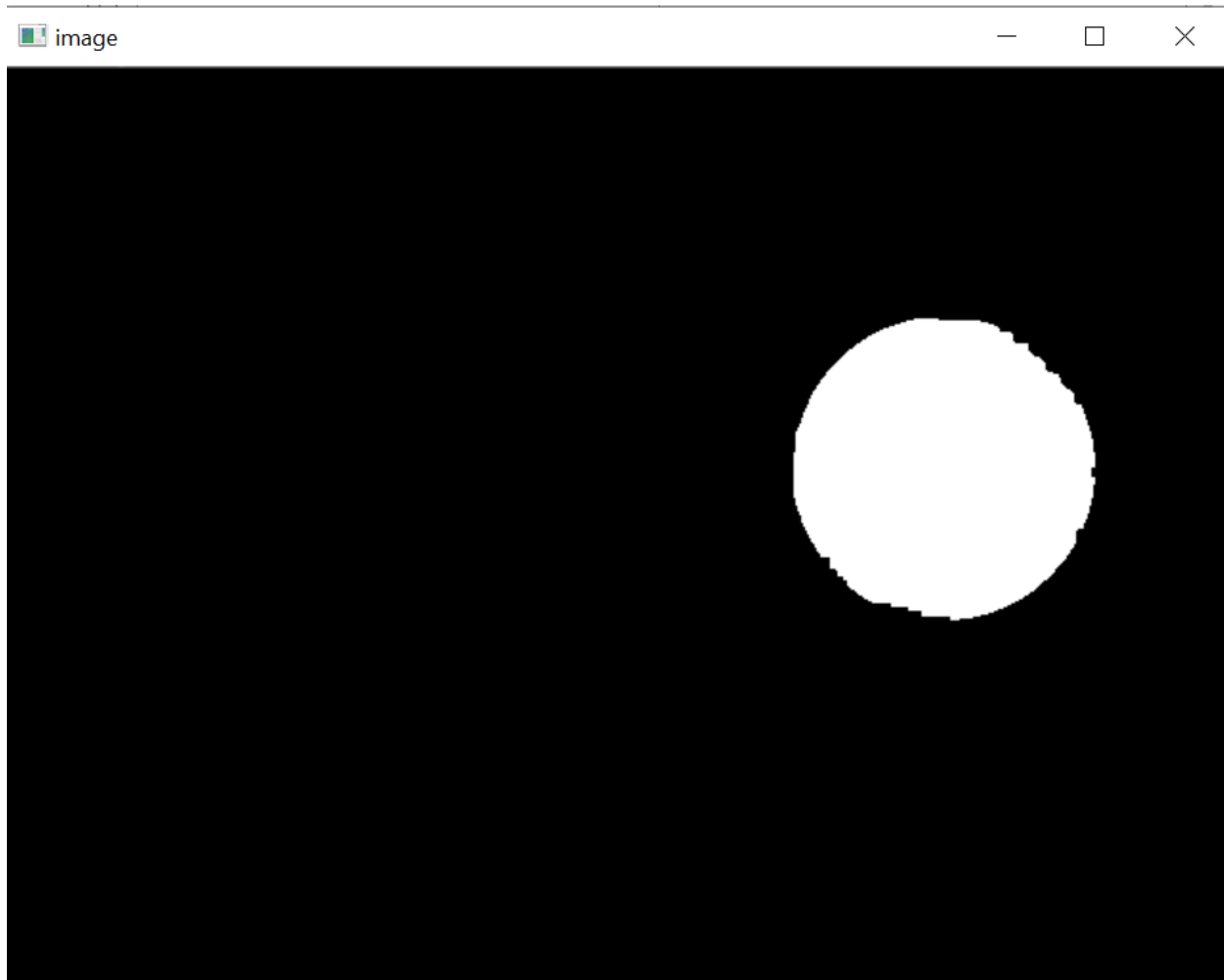
Apart from finding the radius of the enclosing circle, we can also find the center of the circle. For aligning the two drones, we need to have the camera and the subject to be aligned and that would require the center of the circle to be at the center. The alignment of the UAVs in the y and z directions are closely related to the x and y coordinates of the center of the circle in the image.

Examples

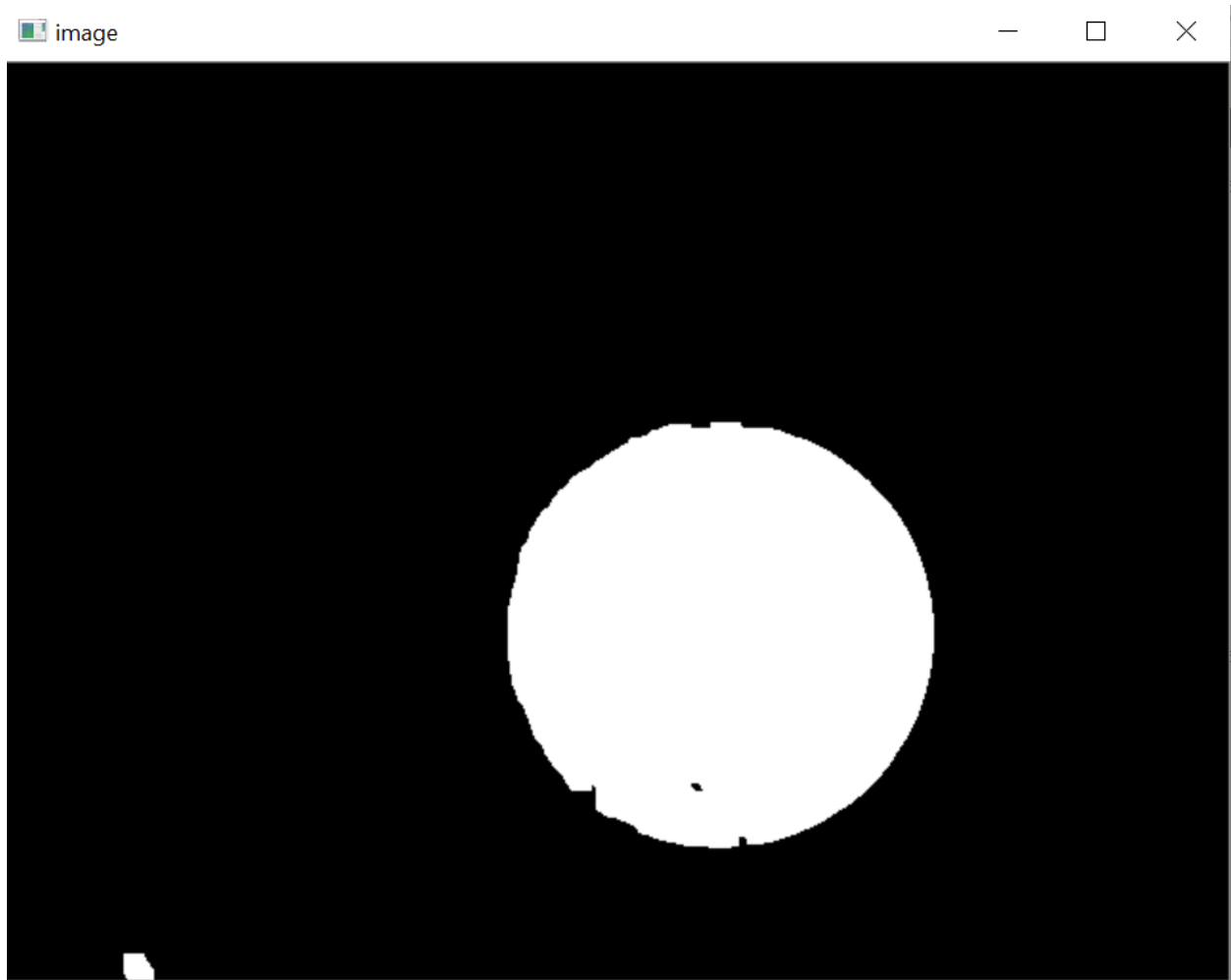
We have attached some image examples from this program. We can see how the program finds the circle and prints center coordinates and radius of the enclosing circle. Each of these images are 640x480 pixels and the axes are shown in the first picture



Circle: - Center: (383, 139) - Radius: 136



Circle: - Center: (491, 209) - Radius: 81



Circle: - Center: (373, 298) - Radius: 114

Limitations

The program is limited to around 15cm distance between the camera and the subject. We hope to improve that by having a subject circle of higher diameter. This program does not take into account any alignment problems due to difference in attitude. This might be fixed by using a shape that is not symmetric, but that requires further research.

Further work

We hope to tabulate the data obtained from the program and either find a mathematical relation between the data and the actual distance between the UAVs, or we hope to train a regression model based on this data to determine the distance.