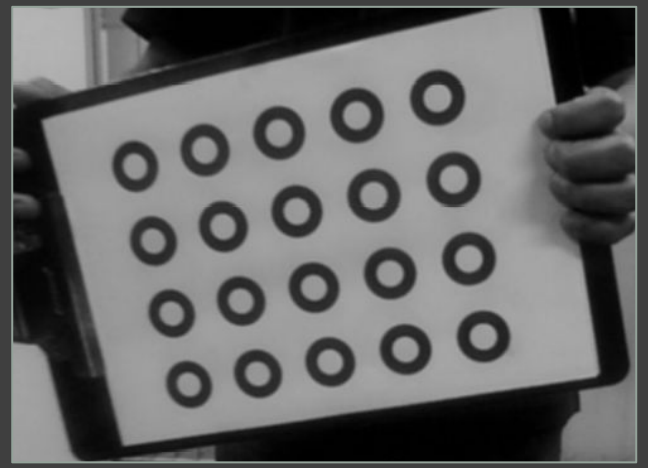
Camera Calibration

Solange Ramos Cooper

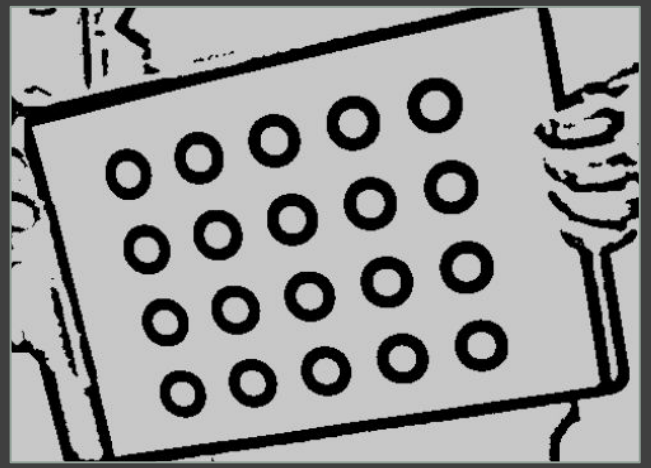
Approach

1. Detection of concentric ring in each frame
2. Filter ellipses and find the center point of each concentric ring
3. Arrangement in a systematic order
4. Calibrate camera and get parameters

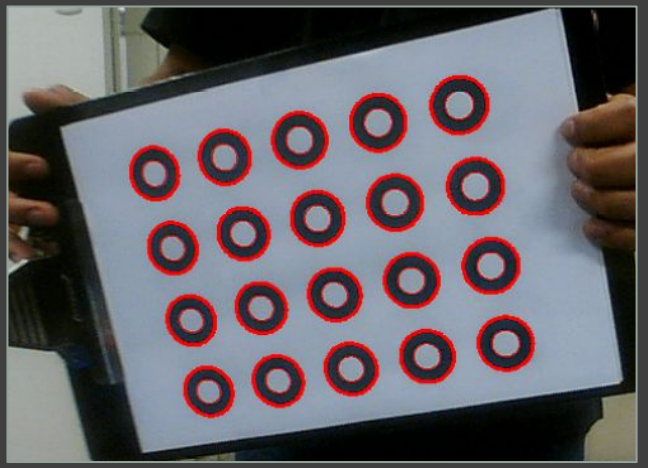
1. Detection of concentric ring in each frame



Convert to GrayScale and apply a Blur Filter



Convert to binary image (Adaptative Threshold)

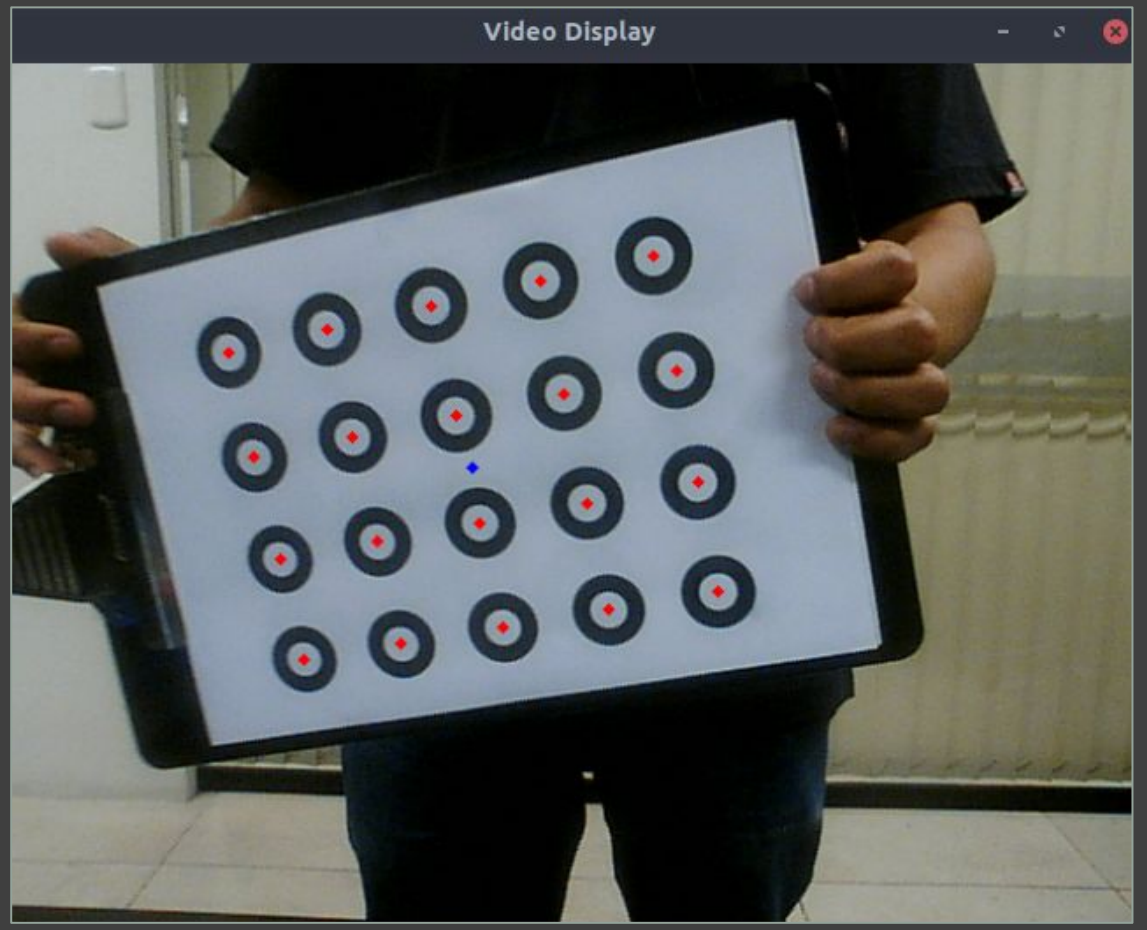


Find contours and fit to ellipses

2. Filter ellipses and find the center point of each ring

- Look for Parent-Child relationships and check distance between center points.

- Compute the average central point and look for a maximun distance that contains at least 20 points. Consider only the points that are in that range.



2. Arrangement in a systematic order

- Find the four corners, order them in a universal order and be sure they the correct ones (distance and area).

- Compute slope between corners and look for colinear points .

MainWindow

Source

Live Video

/videos/cam1/anillc Search

Pattern Size

Width 5 Height 4

Detection Sumary

Total Frame Count	3337
Pattern found (%)	46
Average time (ms)	43.52

Calibration Sumary

RMS	0.161377
Fx	516.18
Fy	515.13
U0	327.56
V0	182.49
K1	-0.01
K2	0.08

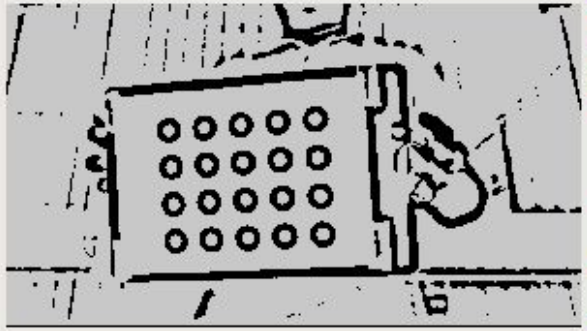
Start

367 1421

PREPROCESS

Grayscale Gaussian Blur

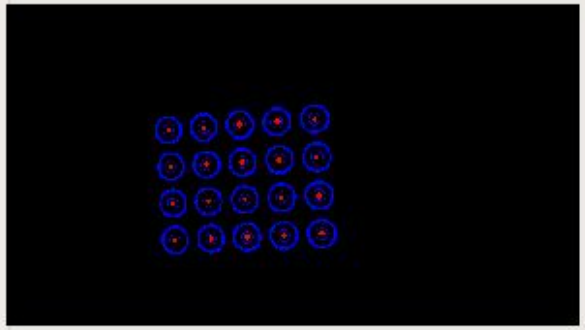
Binary



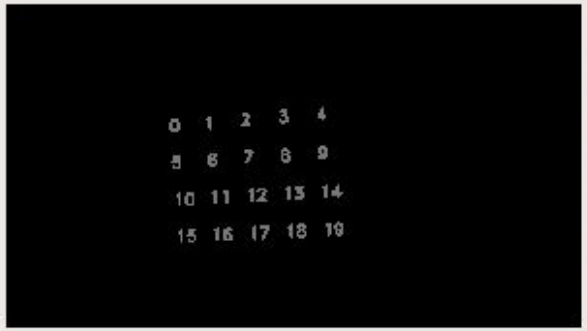
Contour

PATTERN DETECTION

Identify Rings



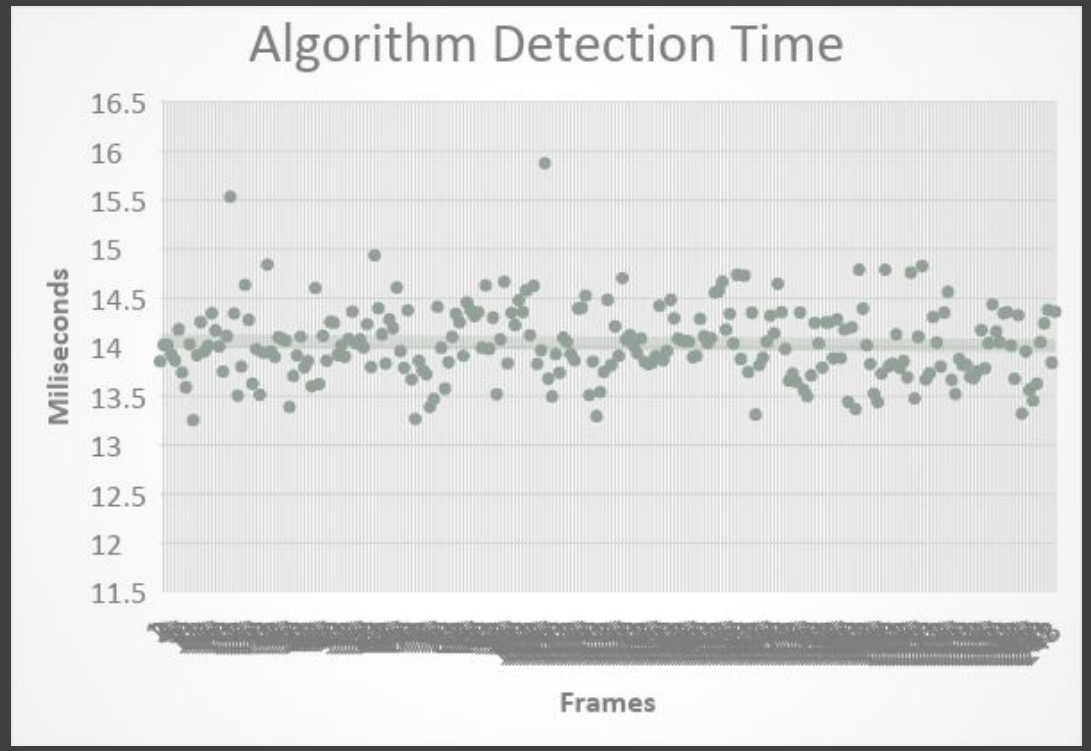
Find Grid



Tracking

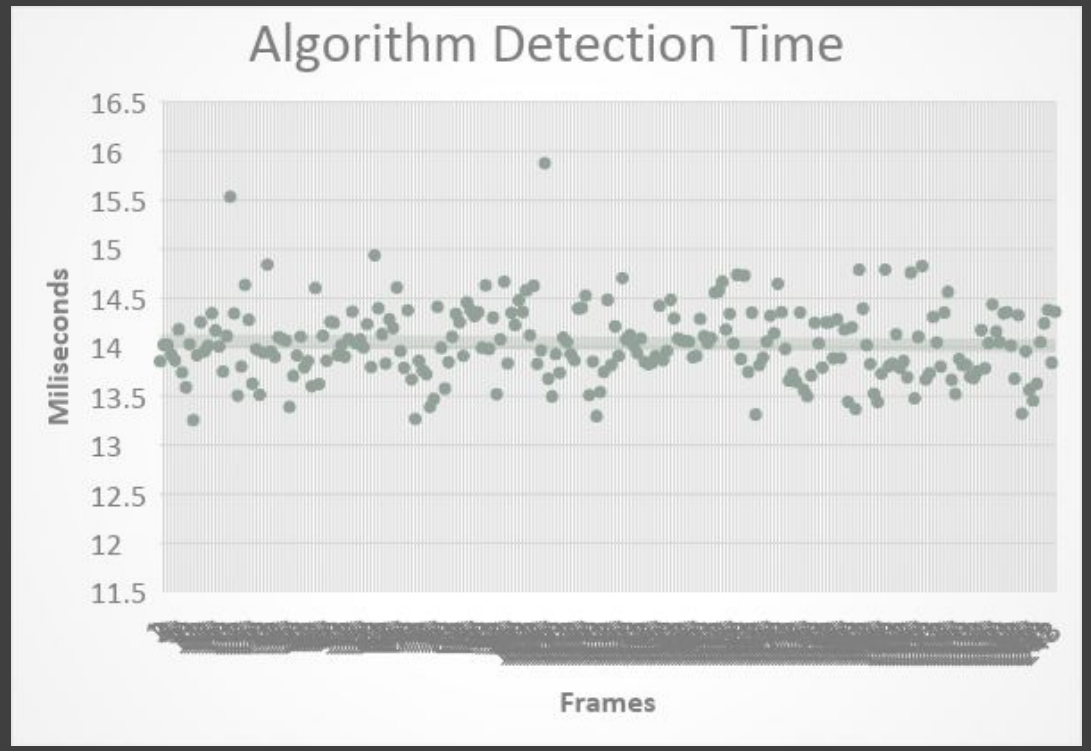
Testing Algorithm Acurracy

Pattern N° 1: 20 elements



Total	Less Pattern Size	More Pattern Size	Corrected Identify	% Correct
5144	194	4	4175	81.1 %

Pattern N° 2: 12 elements



Total	Less Pattern Size	More Pattern Size	Corrected Identify	% Correct
5972	444	1	5101	85.4 %

Testing Camera Calibration Acurracy

Camera 1

Parameters	Chessboard Pattern	Circle Pattern	Ring Pattern
F_x	726.21	684.63	701.88
F_y	727.24	683.84	701.83
U_0	283.32	324.07	323.29
V_0	272.38	253.37	274.30
K_1	-0.35	-0.40	-0.42
K_2	-0.46	0.17	0.34
RMS	0.55	0.35	0.19

Camera 2

Parameters	Chessboard Pattern	Circle Pattern	Ring Pattern
F_x	499.30	496.03	516.19
F_y	498.82	480.71	515.13
U_0	314.48	319.89	327.56
V_0	173.03	176.06	182.50
K_1	0.02	0.04	-0.01
K_2	-0.04	-0.15	0.09
RMS	0.44	0.24	0.16