Dewarping 360 Image by OpenCV C++

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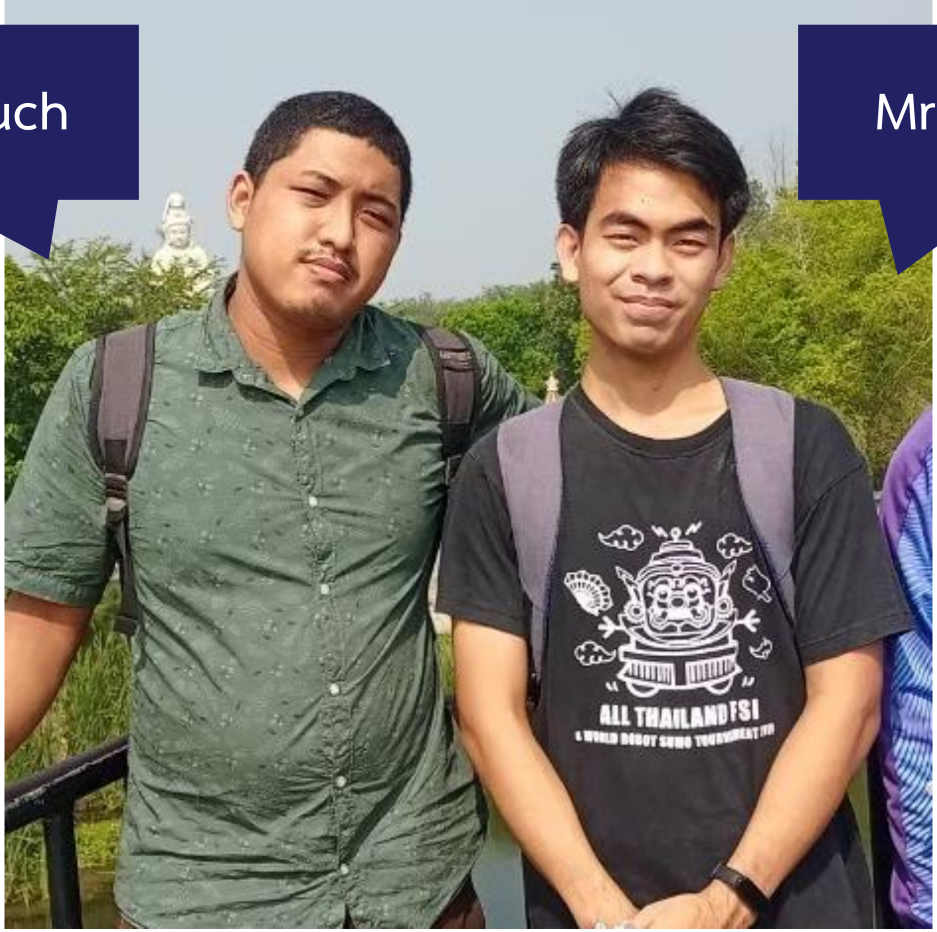
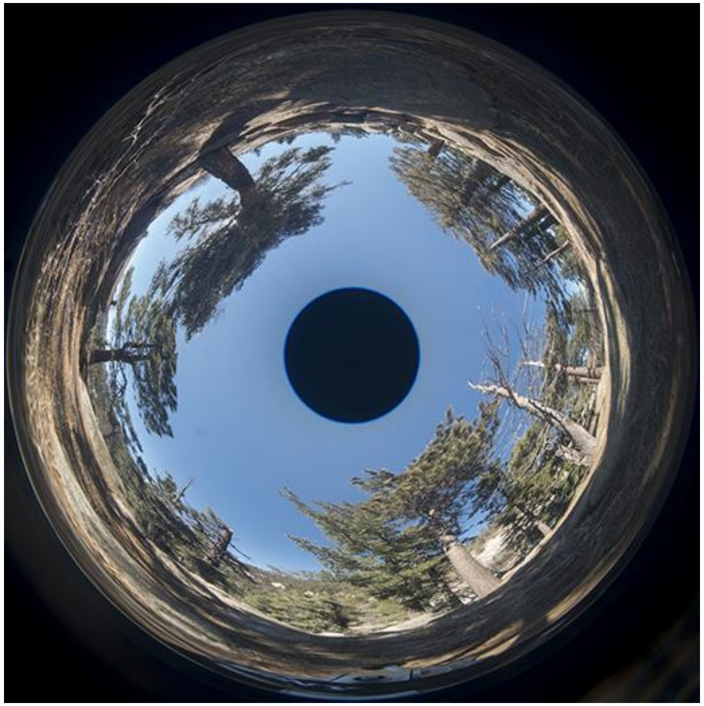


Agenda

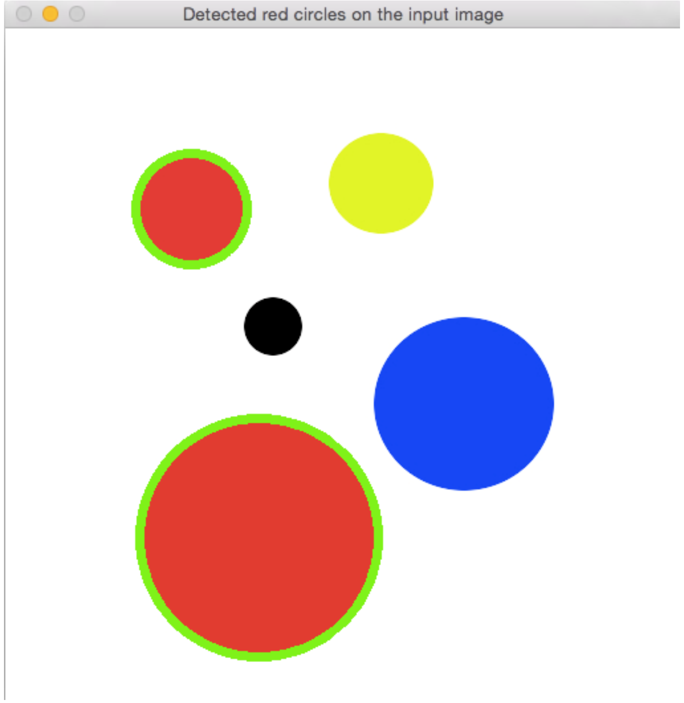
- Overview
- Hardware
- Platform
- Principal
- Method
- Environment
- Experiment
- Result
- Summary

Overview

Dewarping 360 Image

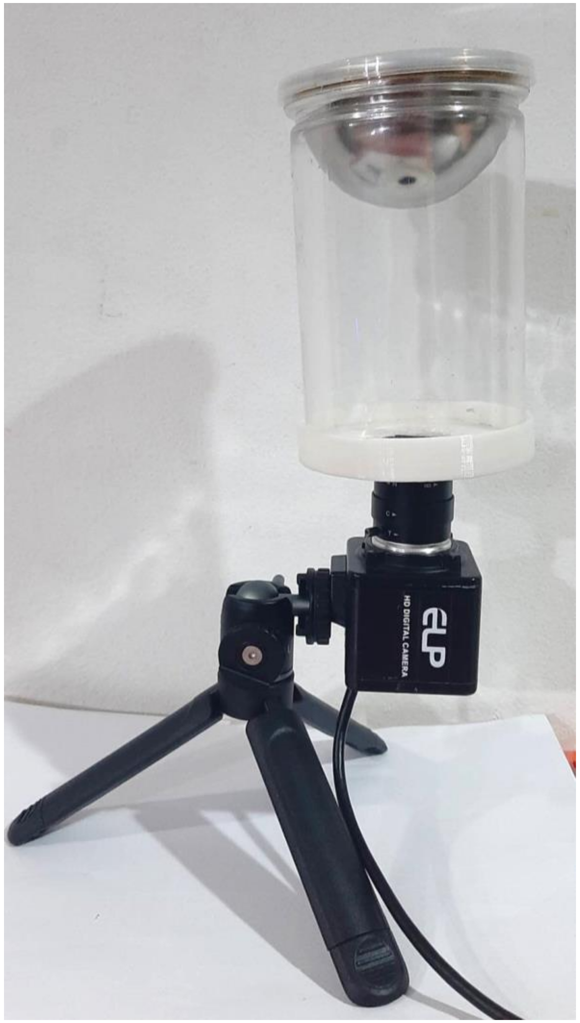


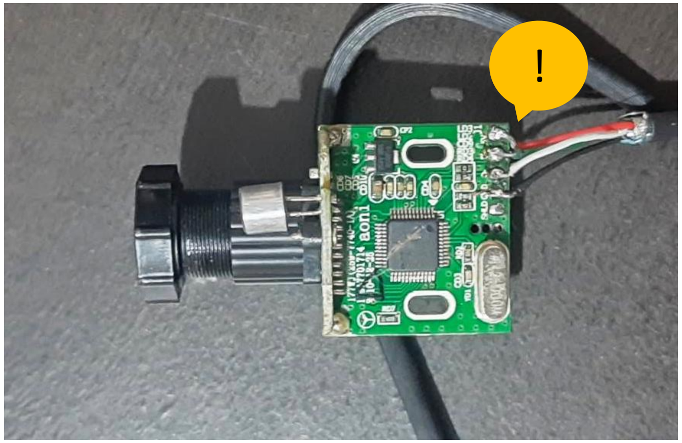
Ball Tracking



Detected red circles on the input image

Hardware


ELP
HD DIGITAL CAMERA

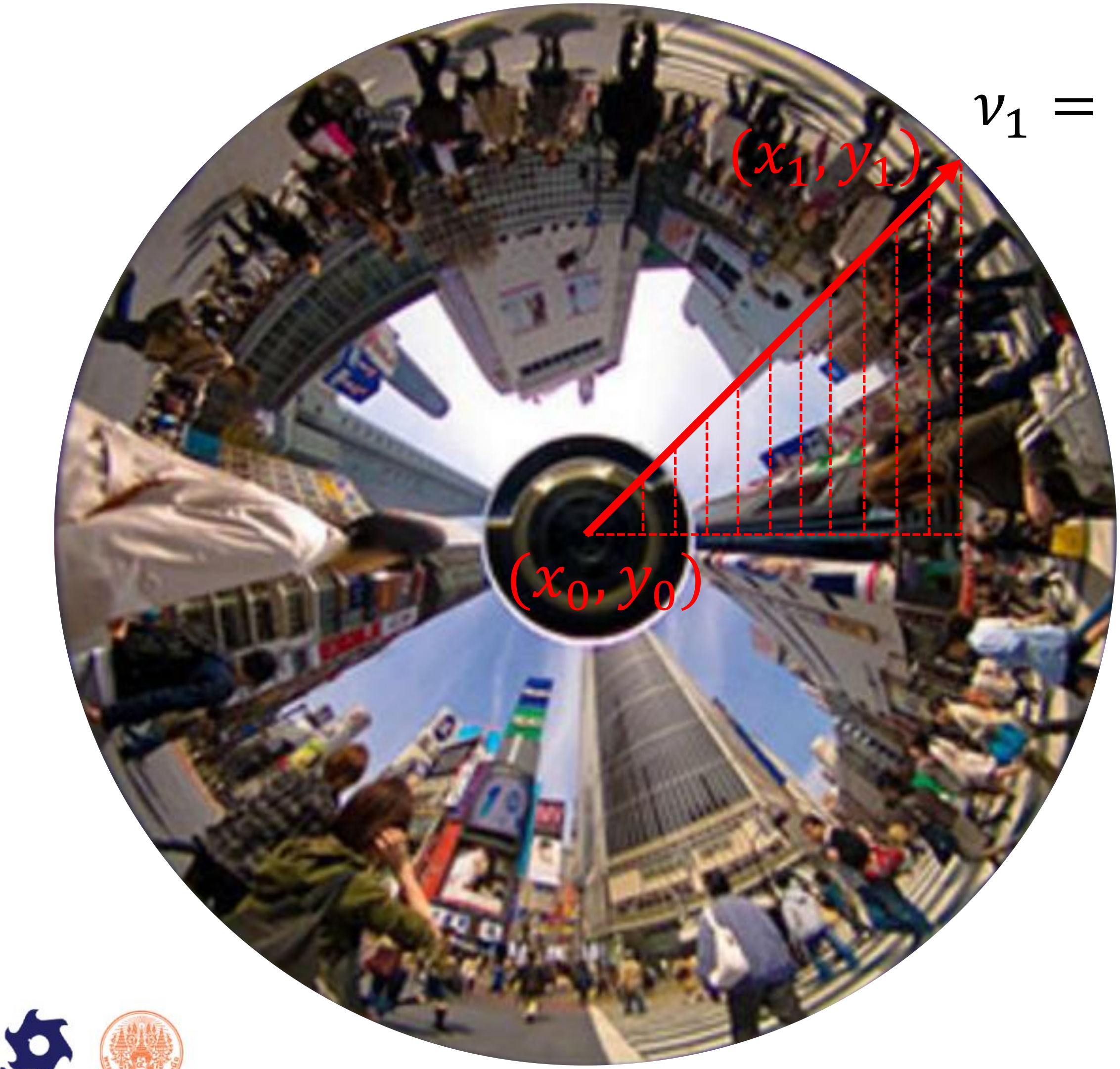

!

ELP
HD DIGITAL CAMERA
2.8-12mm 1:1.4
1/2.5" CS IR

Platform

Visual
Studio

Principal



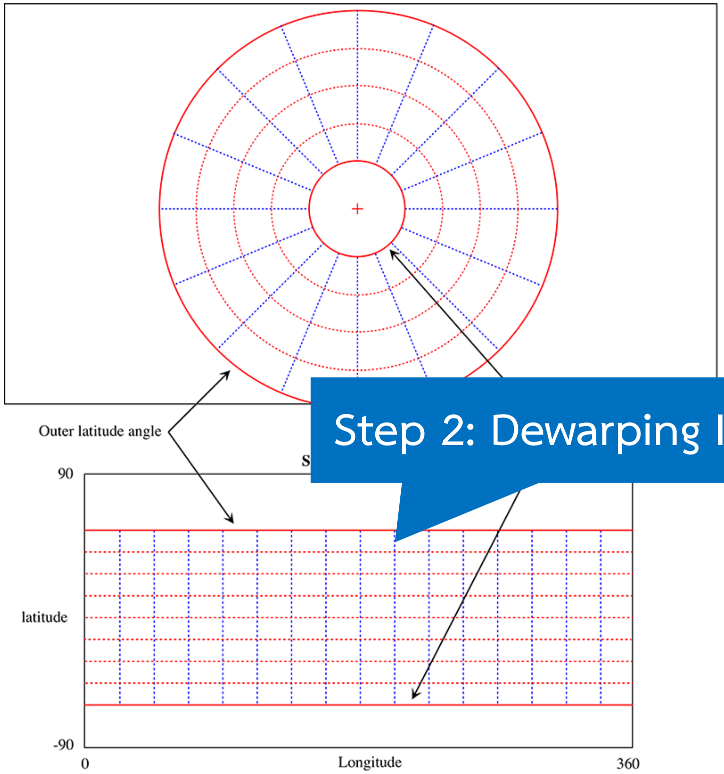
$$v_1 = (x_1 - x_0)i + (y_1 - y_0)j$$

$$x_1 = r \cdot cos\theta$$
$$y_1 = r \cdot sin\theta$$

$$0 < \theta < 360$$
$$0 < r < r\_max$$

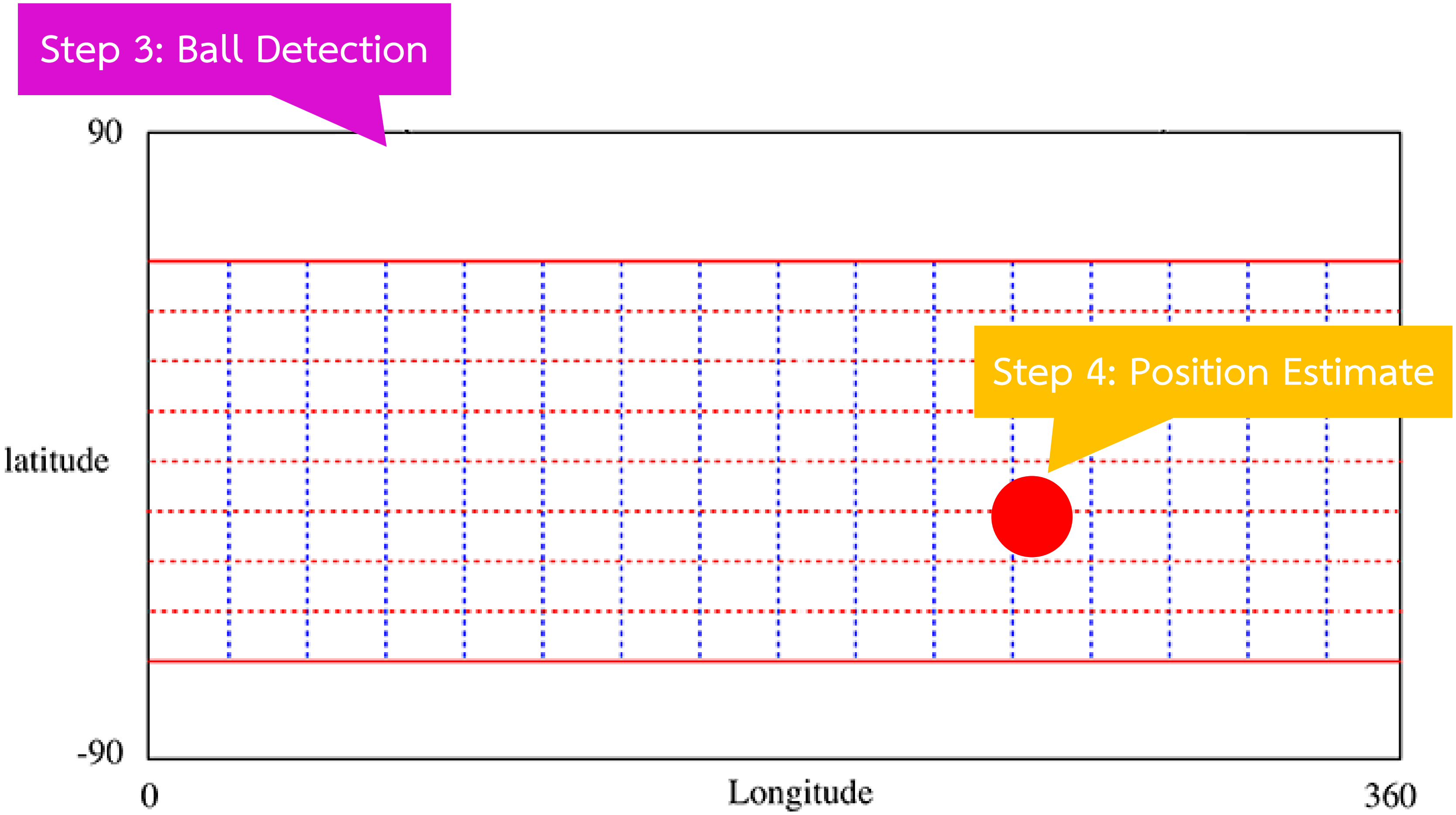
Method

Step 1: Get Image



Step 2: Dewarping Image

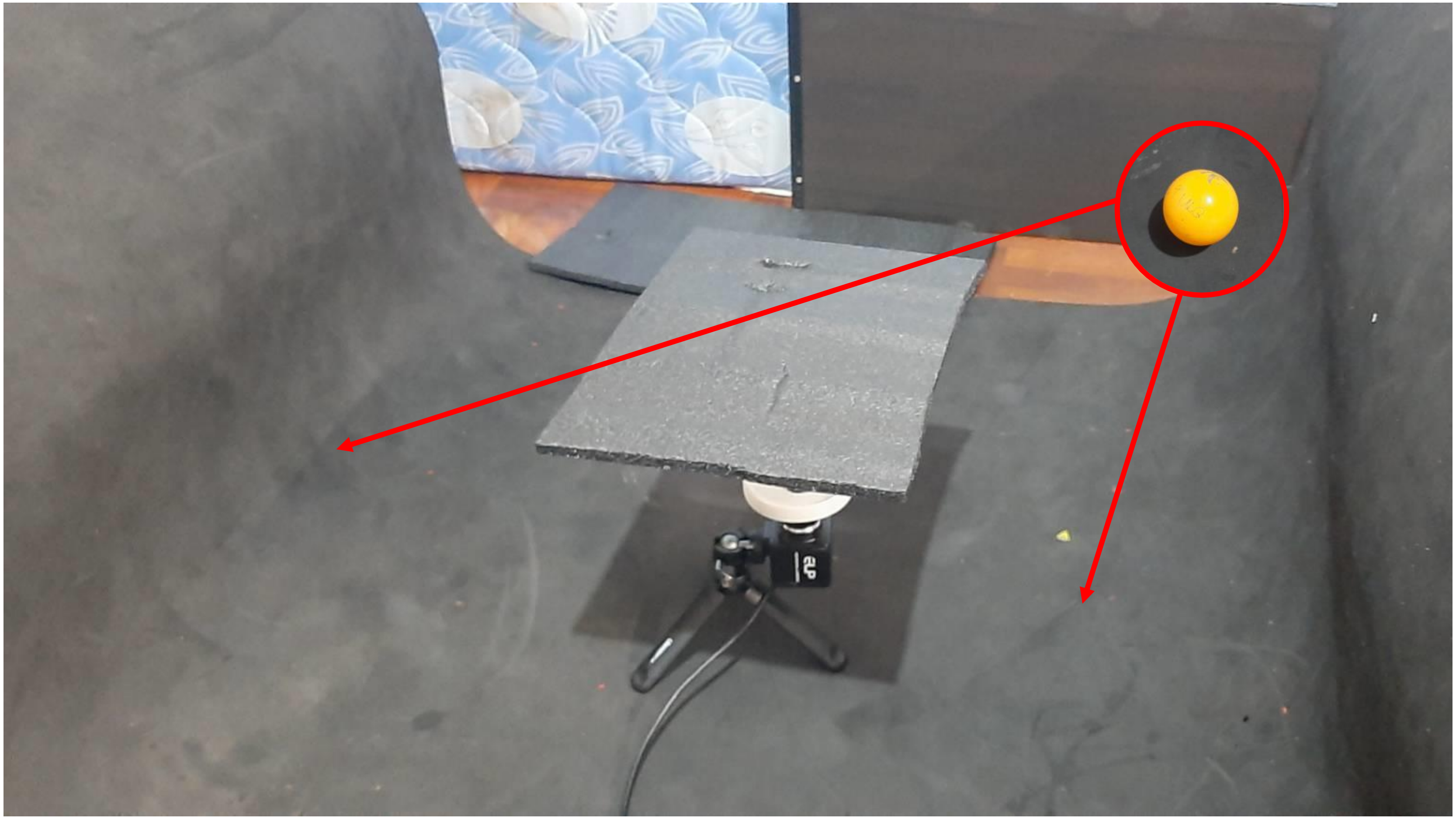
Method



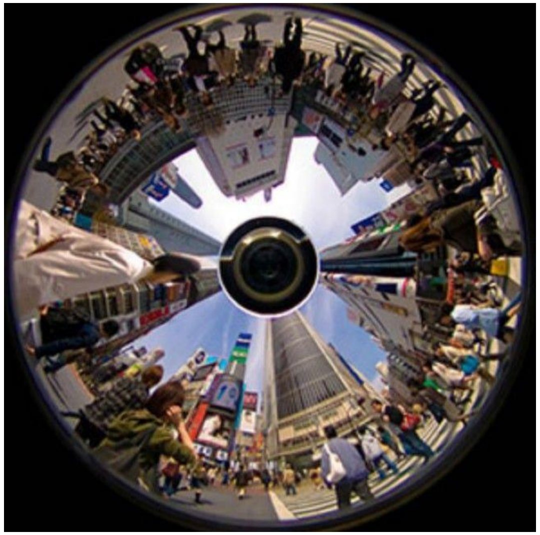
Step 3: Ball Detection

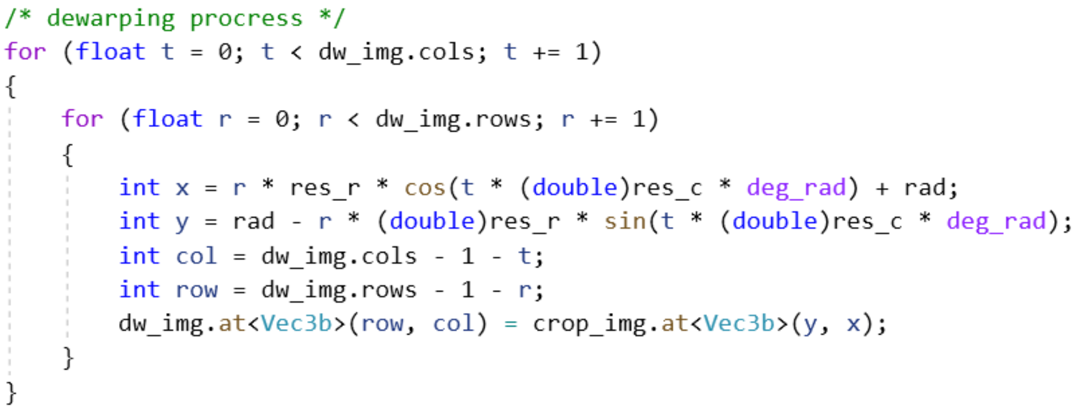
Step 4: Position Estimate

Environment

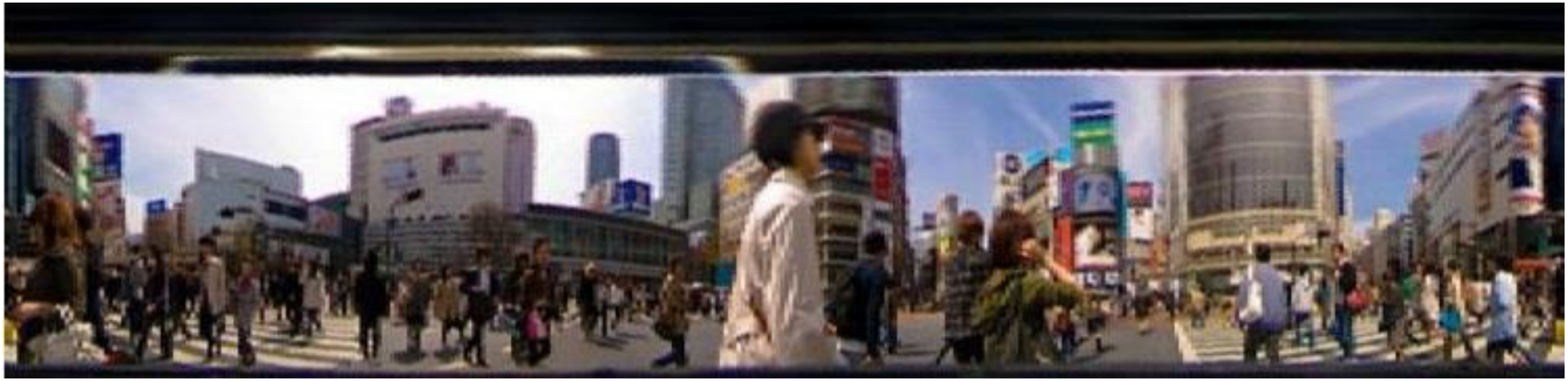


Experiment : Dewarping Image

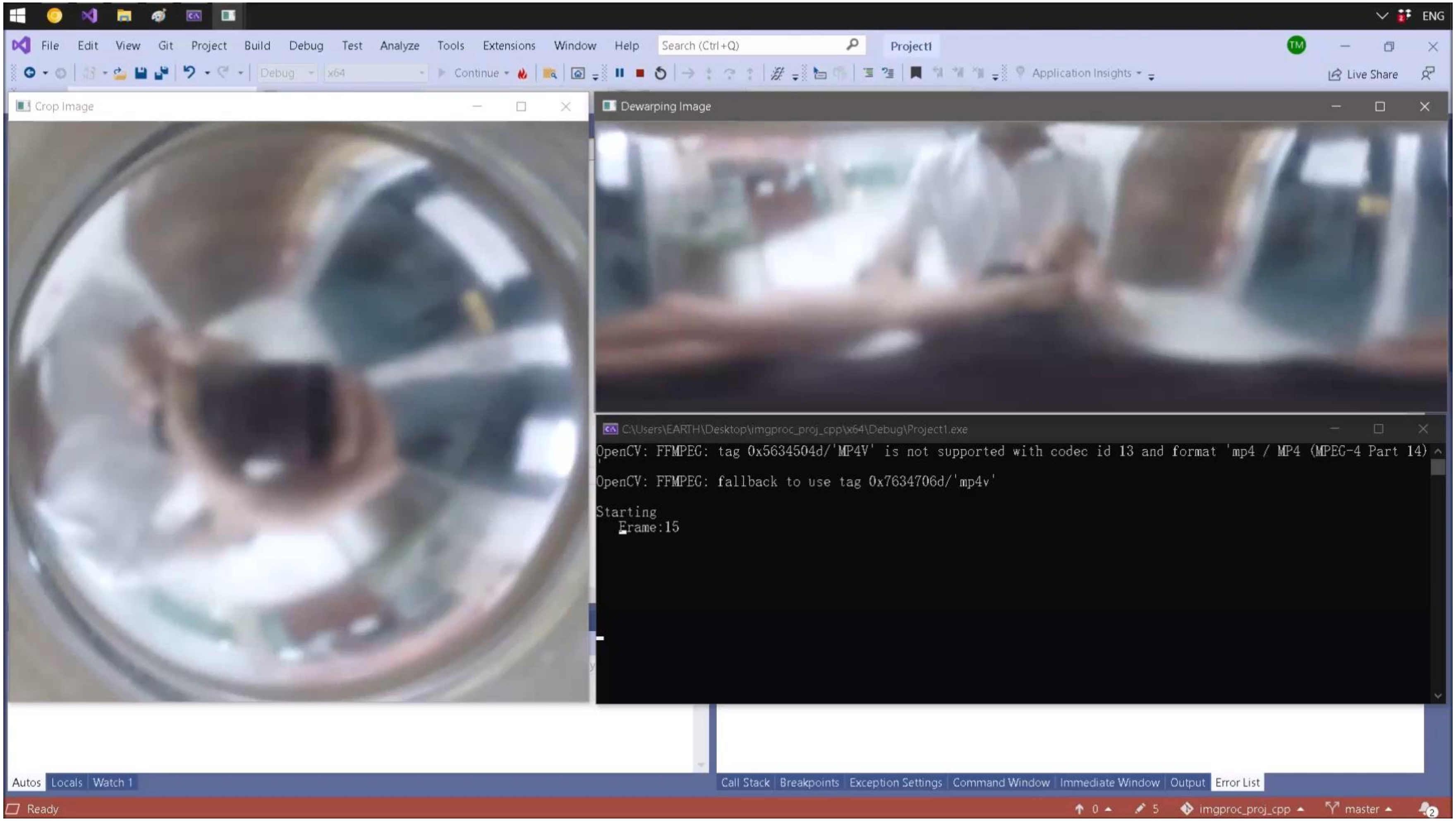




```
/* dewarping procress */
for (float t = 0; t < dw_img.cols; t += 1)
{
    for (float r = 0; r < dw_img.rows; r += 1)
    {
        int x = r * res_r * cos(t * (double)res_c * deg_rad) + rad;
        int y = rad - r * (double)res_r * sin(t * (double)res_c * deg_rad);
        int col = dw_img.cols - 1 - t;
        int row = dw_img.rows - 1 - r;
        dw_img.at<Vec3b>(row, col) = crop_img.at<Vec3b>(y, x);
    }
}
```

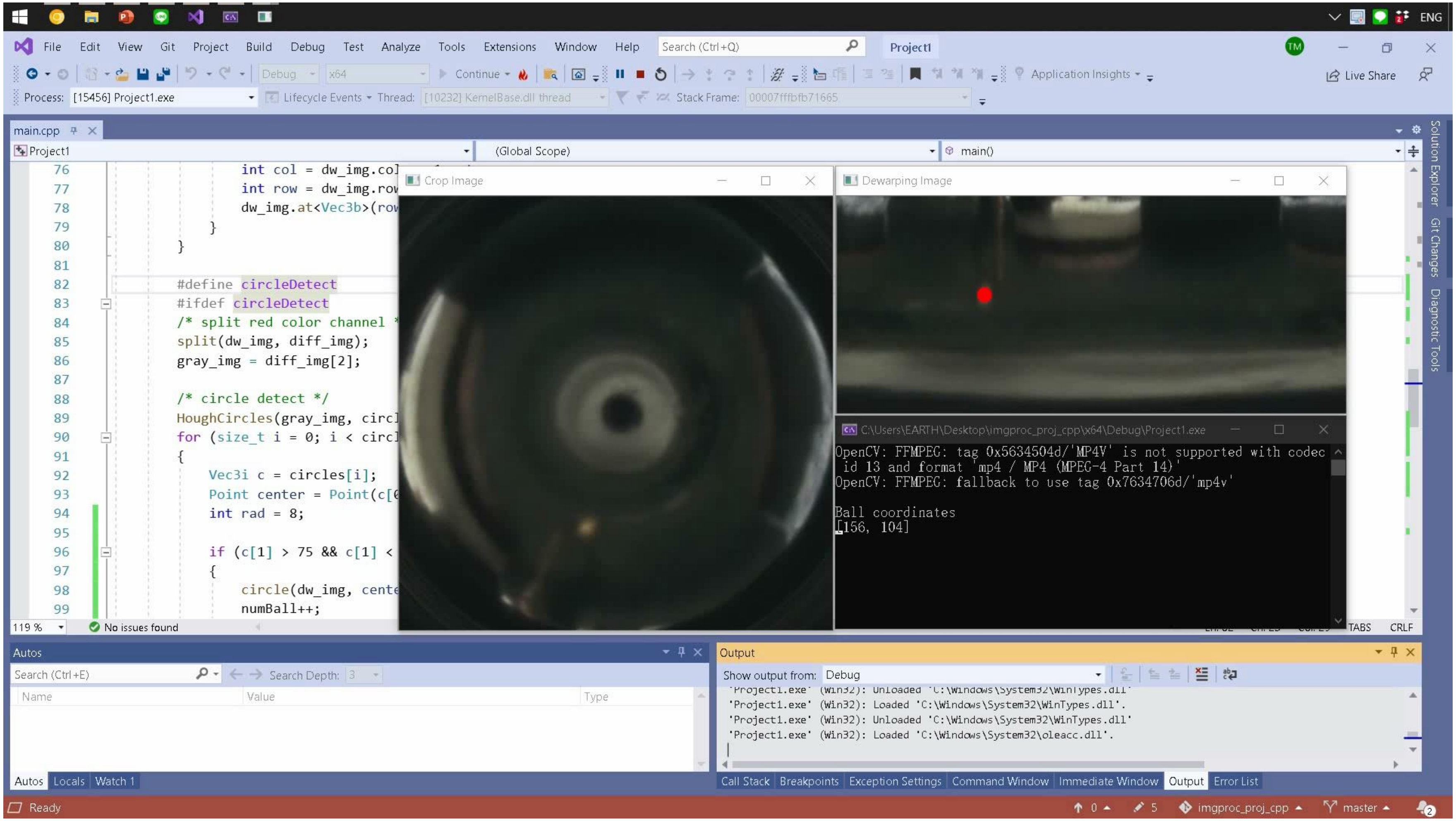


Experiment : Dewarping Video



```
OpenCV: FFMPEG: tag 0x5634504d/'MP4V' is not supported with codec id 13 and format 'mp4 / MP4 (MPEG-4 Part 14)

OpenCV: FFMPEG: fallback to use tag 0x7634706d/'mp4v'

Starting
   Frame:15
```

Experiment : Ball Tracking



Process: [15456] Project1.exe

Thread: [10232] KernelBase.dll thread

Stack Frame: 00007fffbfb71665

Search Depth: 3

```
            int col = dw_img.col
            int row = dw_img.row
            dw_img.at<Vec3b>(row
        }
    }

    #define circleDetect
    #ifdef circleDetect
    /* split red color channel *
    split(dw_img, diff_img);
    gray_img = diff_img[2];

    /* circle detect */
    HoughCircles(gray_img, circl
    for (size_t i = 0; i < circl
    {
        Vec3i c = circles[i];
        Point center = Point(c[0
        int rad = 8;

        if (c[1] > 75 && c[1] <
        {
            circle(dw_img, cente
            numBall++;
```

C:\Users\EARTH\Desktop\imgproc_proj_cpp\x64\Debug\Project1.exe

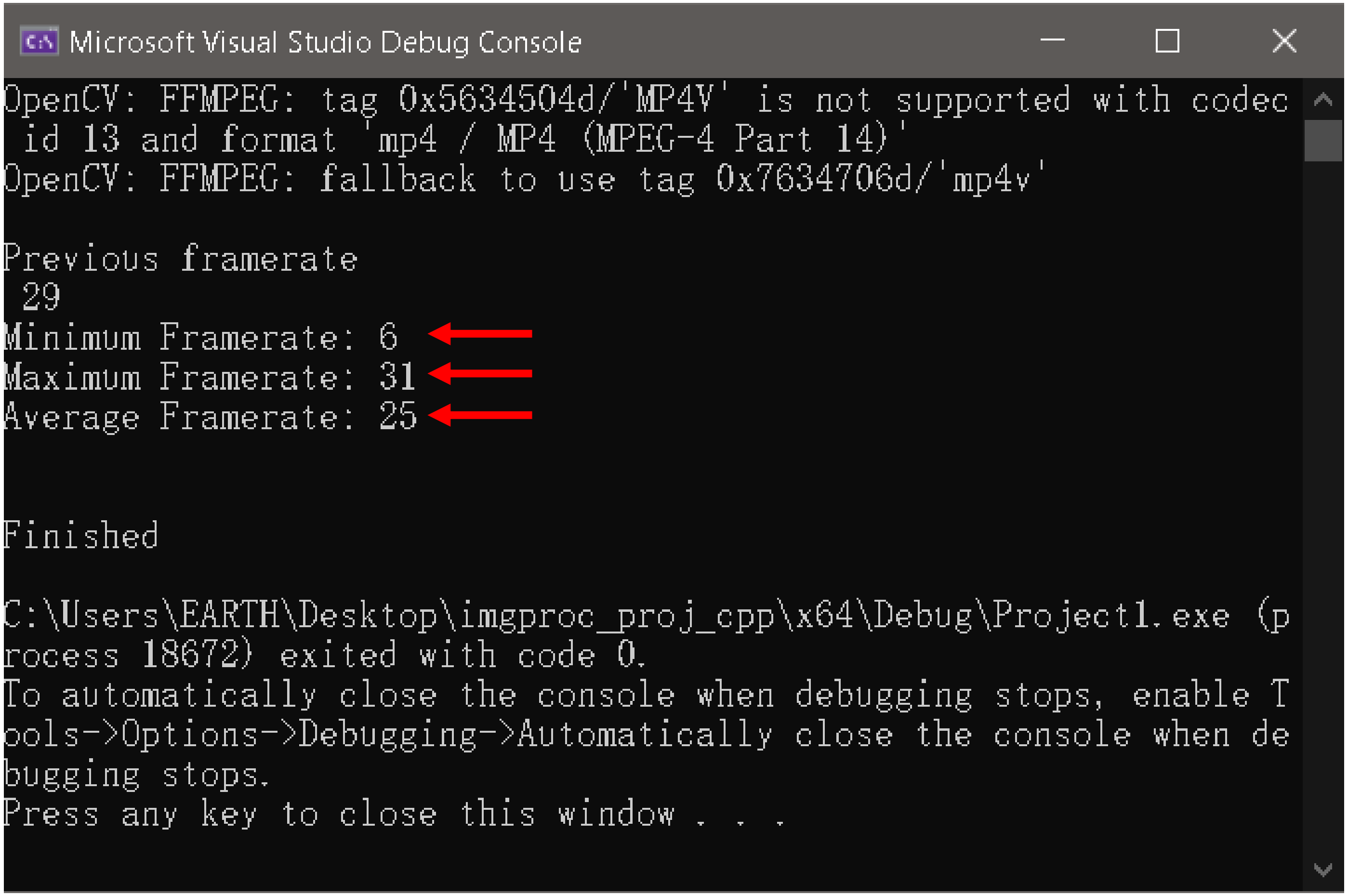
```
OpenCV: FFMPEG: tag 0x5634504d/'MP4V' is not supported with codec
 id 13 and format 'mp4 / MP4 (MPEG-4 Part 14)'
OpenCV: FFMPEG: fallback to use tag 0x7634706d/'mp4v'

Ball coordinates
[156, 104]
```

Show output from: Debug

```
'Project1.exe' (Win32): Unloaded 'C:\Windows\System32\WinTypes.dll'
'Project1.exe' (Win32): Loaded 'C:\Windows\System32\WinTypes.dll'.
'Project1.exe' (Win32): Unloaded 'C:\Windows\System32\WinTypes.dll'
'Project1.exe' (Win32): Loaded 'C:\Windows\System32\oleacc.dll'.
```

Result : Framerate

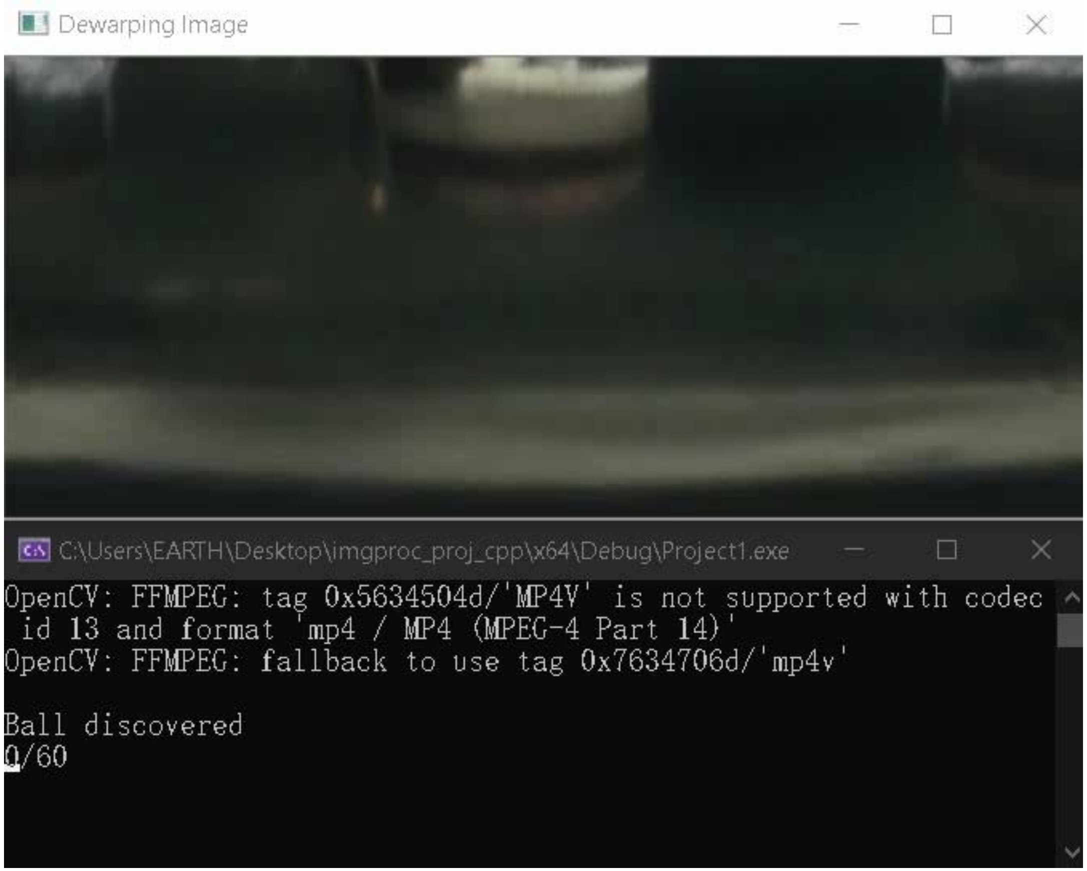
(Source: 960x540 pixel)



```
OpenCV: FFMPEG: tag 0x5634504d/'MP4V' is not supported with codec
 id 13 and format 'mp4 / MP4 (MPEG-4 Part 14)'
OpenCV: FFMPEG: fallback to use tag 0x7634706d/'mp4v'

Previous framerate
 29
Minimum Framerate: 6
Maximum Framerate: 31
Average Framerate: 25


Finished

C:\Users\EARTH\Desktop\imgproc_proj_cpp\x64\Debug\Project1.exe (p
rocess 18672) exited with code 0.
To automatically close the console when debugging stops, enable T
ools->Options->Debugging->Automatically close the console when de
bugging stops.
Press any key to close this window . . .
```

Result : Tracking

(Source: 1min7sec)


Dewarping Image
C:\Users\EARTH\Desktop\imgproc_proj_cpp\x64\Debug\Project1.exe

```
OpenCV: FFMPEG: tag 0x5634504d/'MP4V' is not supported with codec
 id 13 and format 'mp4 / MP4 (MPEG-4 Part 14)'
OpenCV: FFMPEG: fallback to use tag 0x7634706d/'mp4v'

Ball discovered
0/60
```

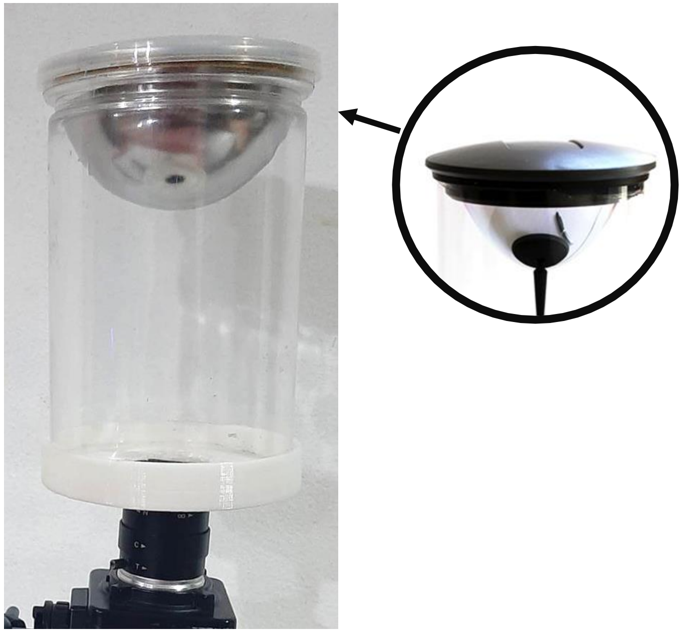
Ball discovered

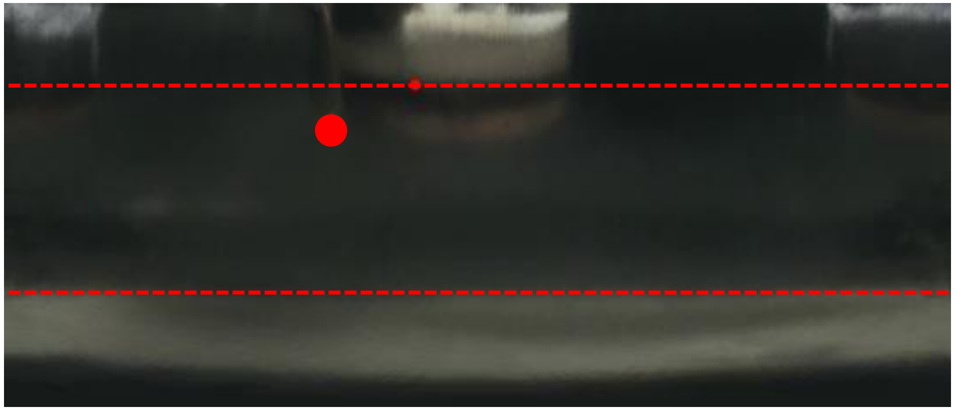
= 656/1629 Frames

%Discovered

$$= \frac{656}{1629} x100 = 40.27\%$$

Summary





Factor of dewarping process

- Image quality
- Framerate
- Reflection mirror

Factor of ball tracking

- Image quality
- Dynamic light
- Camera distortion

Appendix

Source Code

Available : https://github.com/M-TRCH/Dewarping_360_Image

Dewarping 360 Image Principal

Available : http://paulbourke.net/panorama/LucyCamera/

Contours Hierarchy

Available : https://docs.opencv.org/3.4.1/d9/d8b/tutorial_py_contours_hierarchy.html

Contour Detection

Available : https://learnopencv.com/contour-detection-using-opencv-python-c/

Shape Detection

Available : https://opencvproject.wordpress.com/projects-files/detection-shape/

Hough Circle Transform

Available : https://docs.opencv.org/3.4/d4/d70/tutorial_hough_circle.html