

# A real-time ball trajectory follower using Robot Operating System

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# Outline

- Introduction
- Brief Methodology
- System Description
- Proposed Approach
- Experimental Results
- Conclusion
- Questions

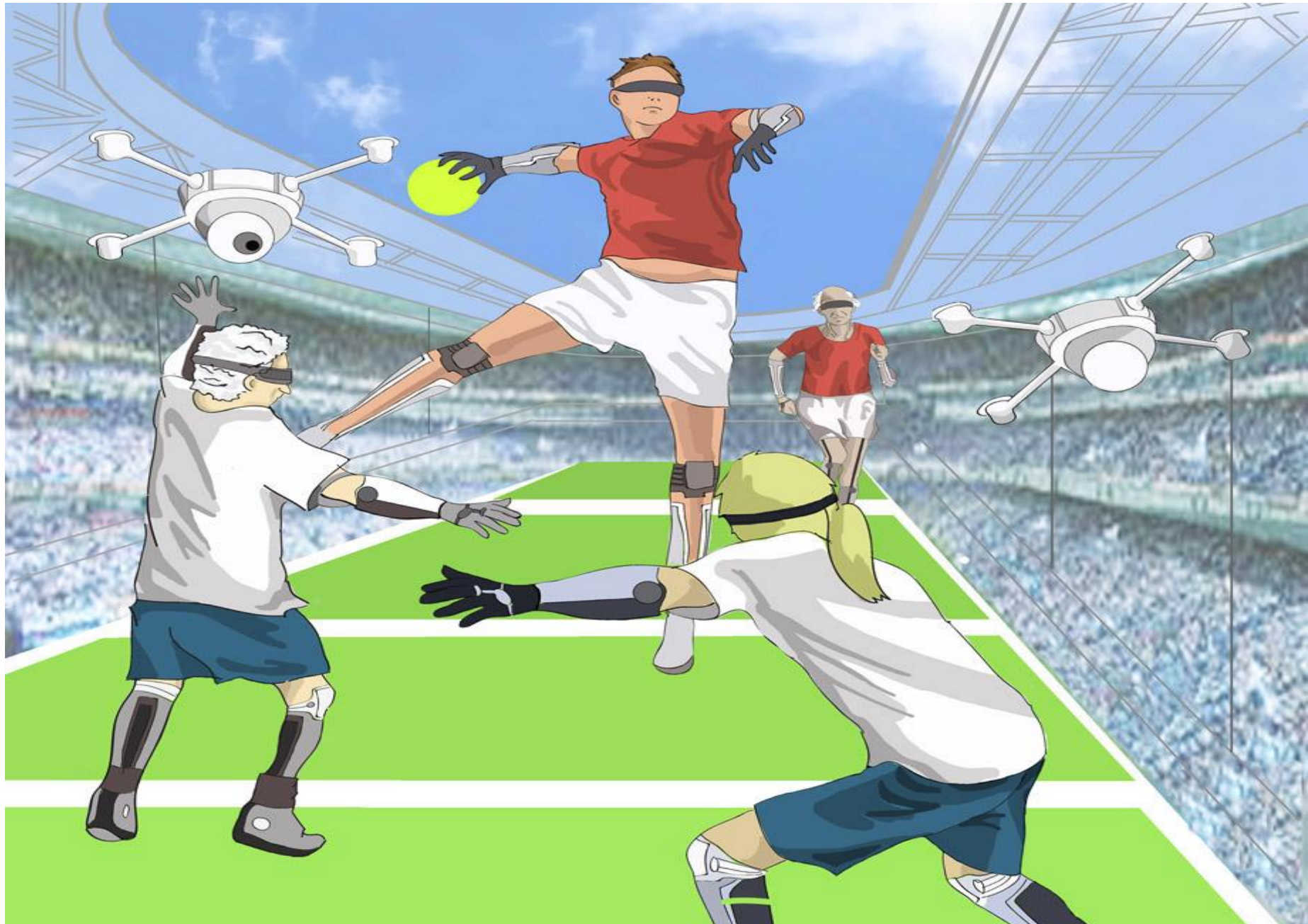
# References

- Superhuman Sports Society aims to bring Harry Potter's Quidditch, Dragon Ball to life by Yuzuha Oka  
[http://www.japantimes.co.jp/news/2015/06/03/business/tech/superhuman-sports-society-aims-bring-harry-potters-quidditch-dragon-ball-life/#.VnUA\\_vI97IV](http://www.japantimes.co.jp/news/2015/06/03/business/tech/superhuman-sports-society-aims-bring-harry-potters-quidditch-dragon-ball-life/#.VnUA_vI97IV)

# Introduction







# Use of UAVs (Unmanned Aerial Vehicles) for sports events



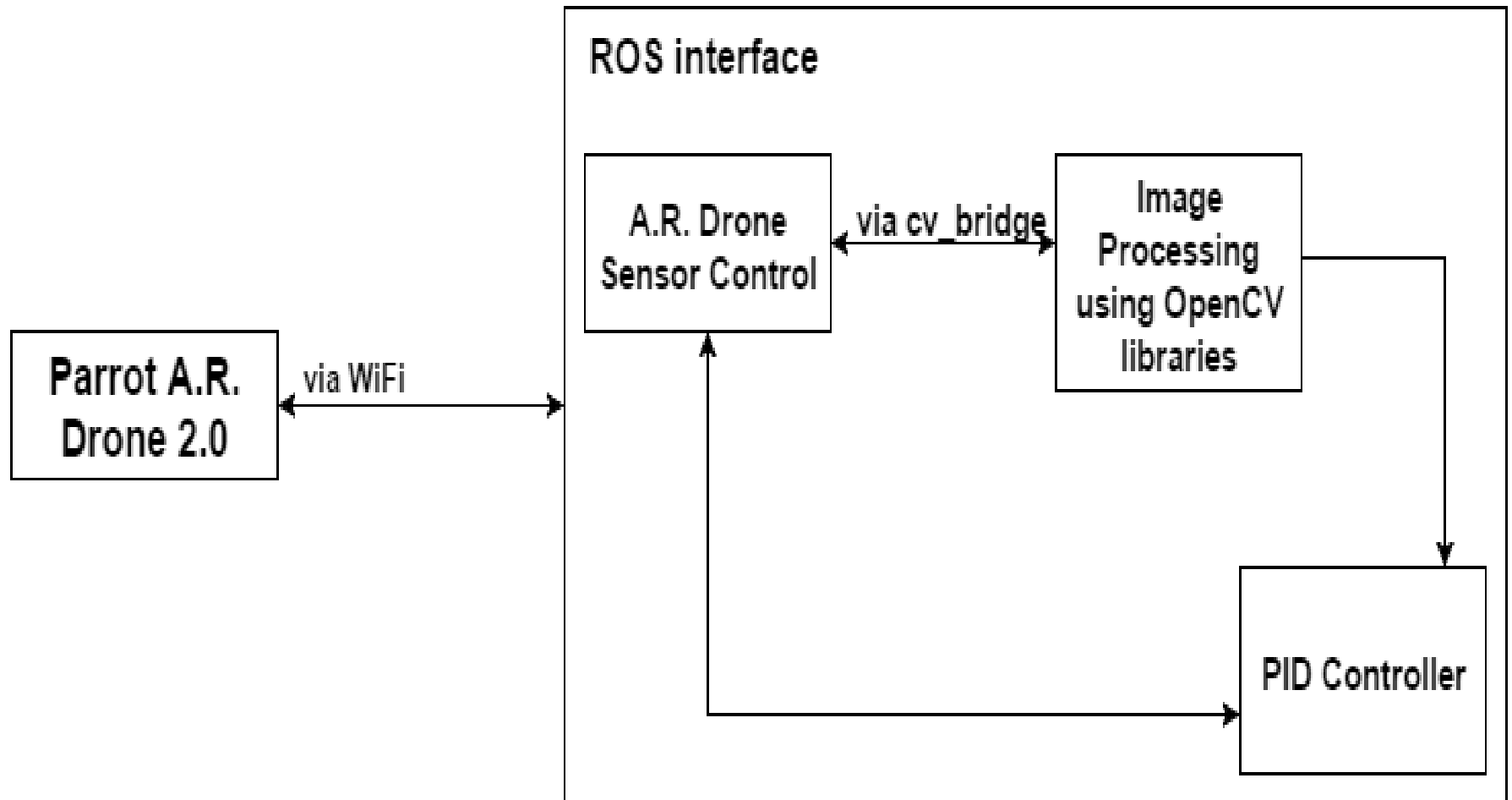
# Why UAVs?

- Inexpensive
- Autonomous flight: lesser human involvement
- Closer and real time view: allows better tracking of the ball and players



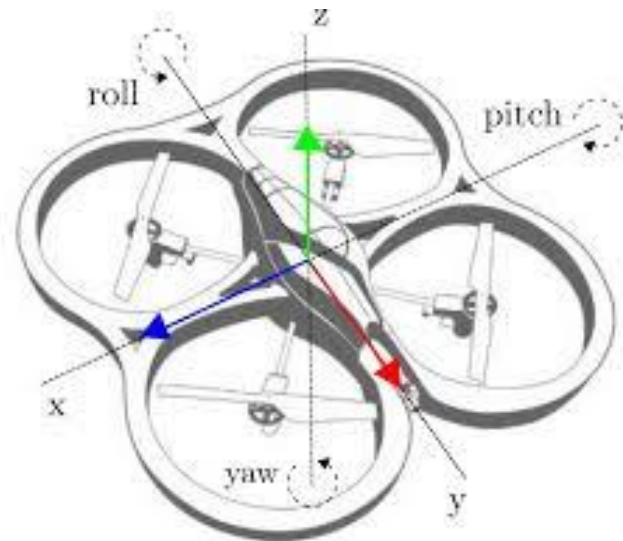
# Brief Methodology

Substation running on Ubuntu 14.04.2



# System Description

- Mechanical System
- Software System
  - Robot Operating System(ROS) interface
  - Image Processing
  - Control System



# Proposed Approach

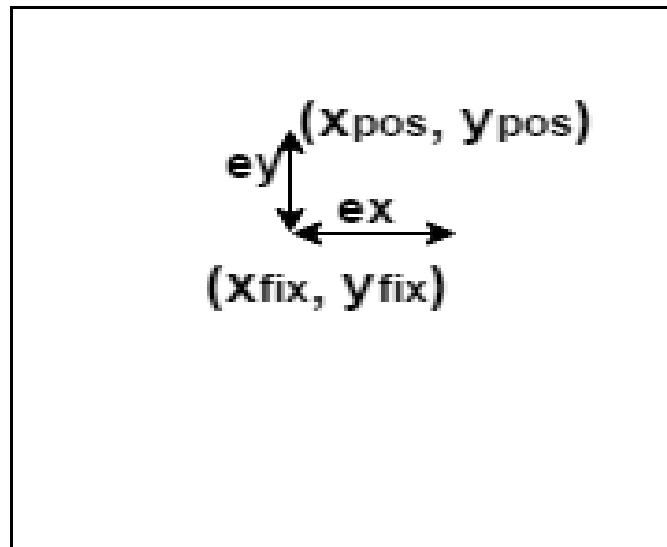
- Image retrieval
- Image processing
  - Colour Segmentation
  - Morphological Operations
  - Object Recognition using image moments

$$C_x = \frac{M_{10}}{M_{00}} \quad C_y = \frac{M_{01}}{M_{00}}$$

- Object Tracking
- Control System

# Object Tracking

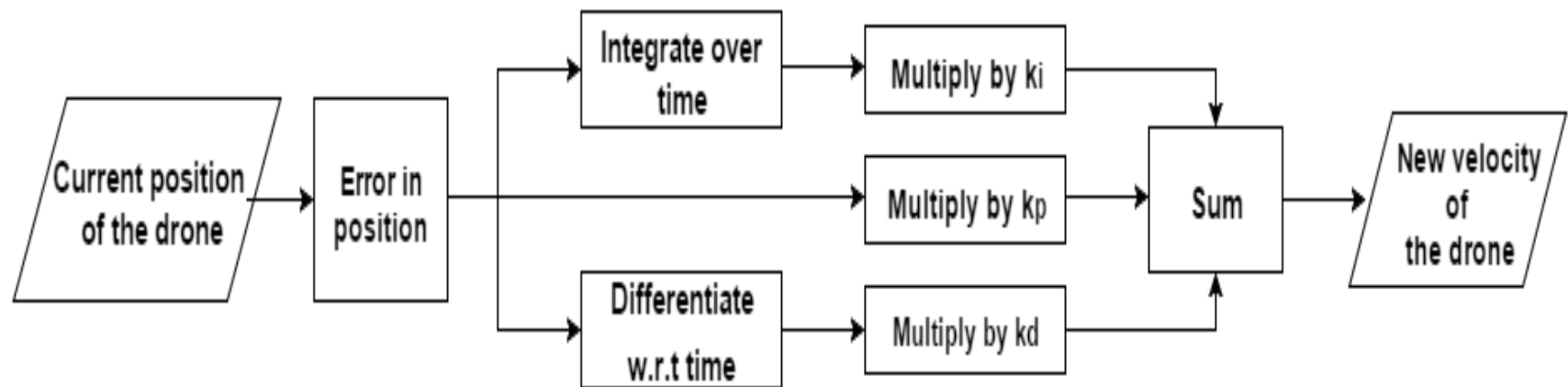
Error in position = Centre of object detected - Image view centre



# Control System

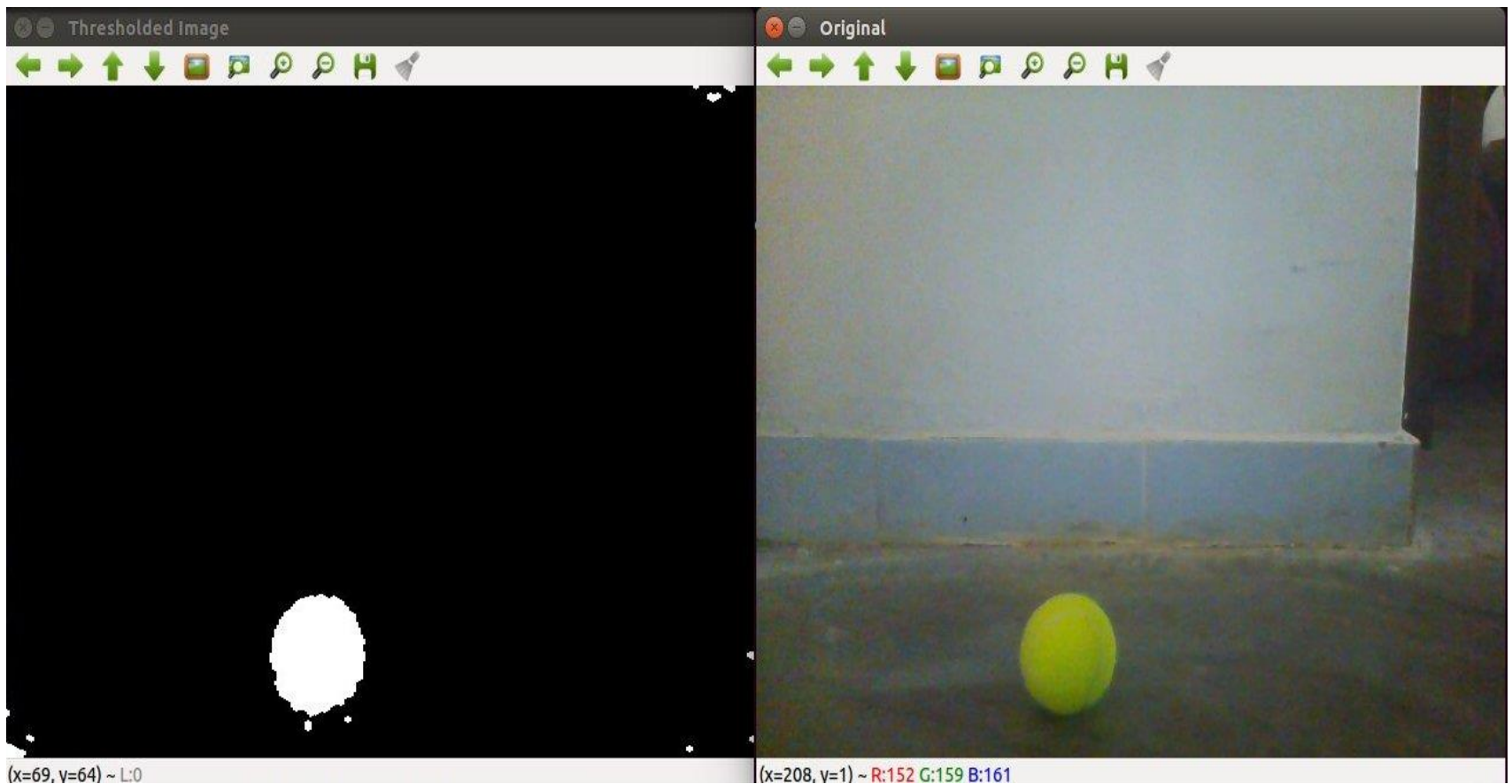
$$\text{Output} = K_P e(t) + K_I \int e(t) dt + K_D \frac{d}{dt} e(t)$$

Where :  $e = \text{Setpoint} - \text{Input}$



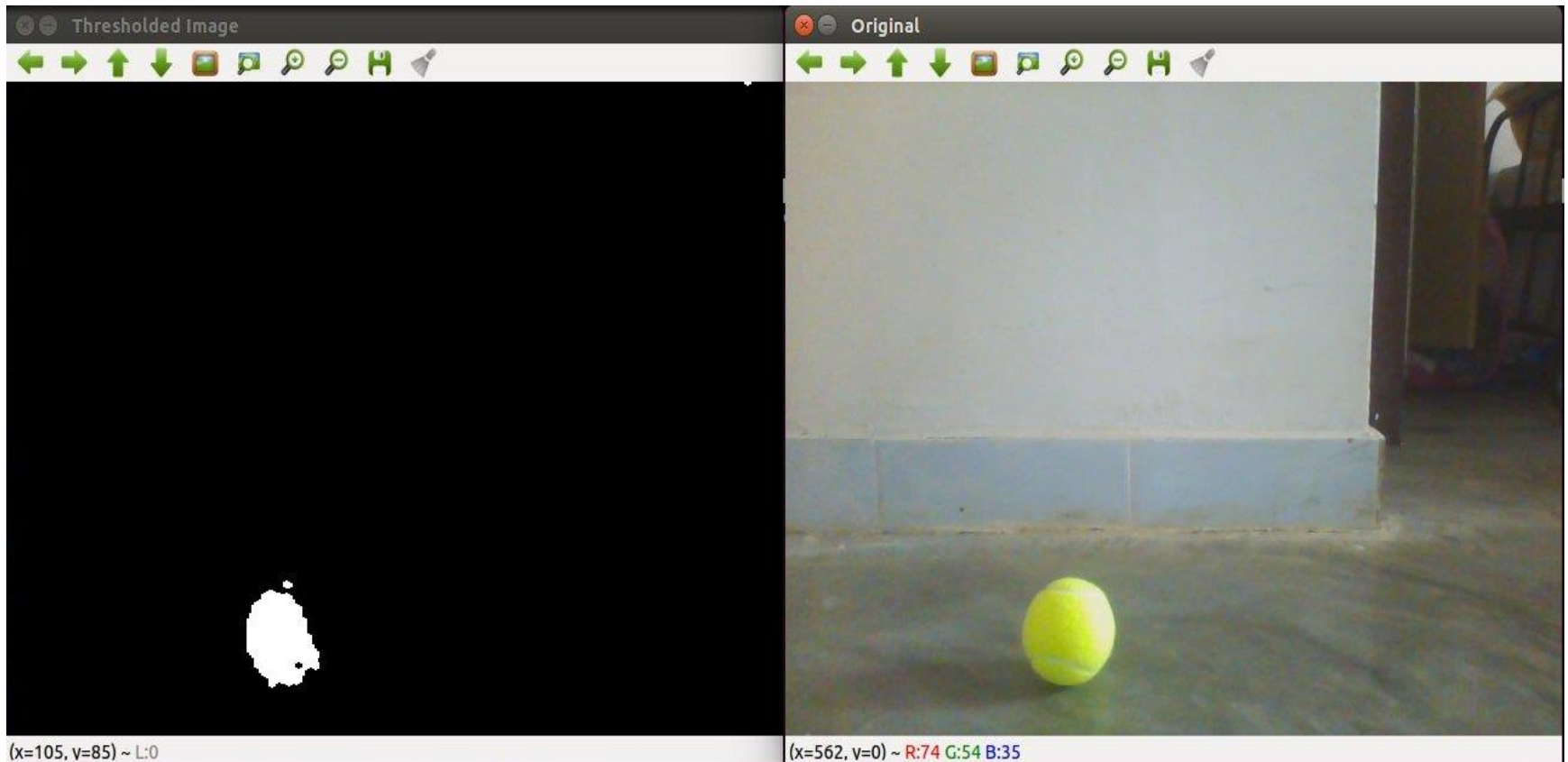
# Experimental Results

- Ball Detection



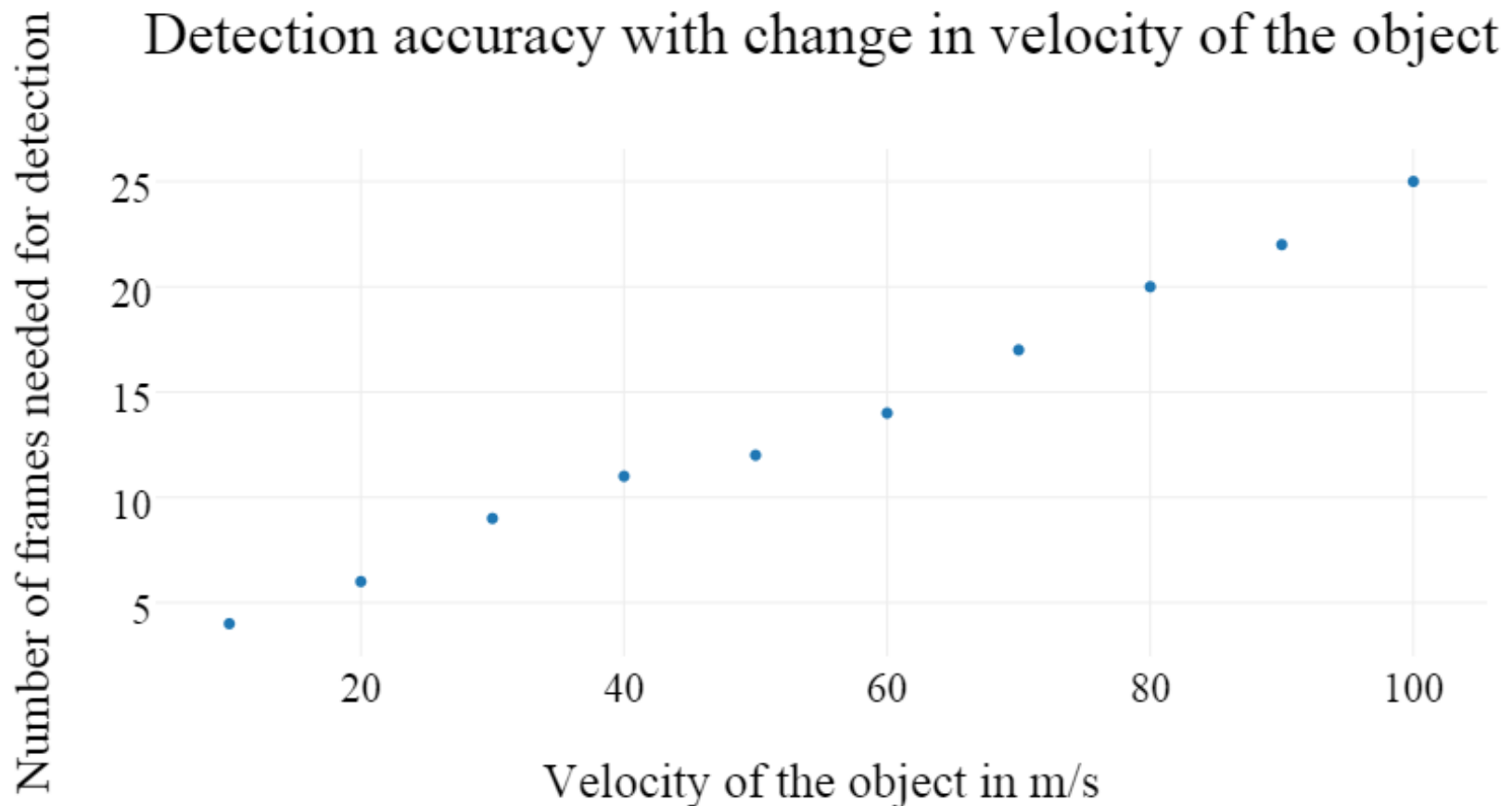
# Experimental Results

- Ball Detection



# Experimental Results

- Detection accuracy with change in ball velocity





# Experimental Results

- Processing Speed

| Operation           | Time taken(in milliseconds) |
|---------------------|-----------------------------|
| Image acquisition   | 1                           |
| Colour segmentation | 1.5                         |
| Ball localisation   | 1.2                         |
| Total               | 3.7                         |

# Conclusions and Future Scope

Questions?