Pool Table Recognition

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Outline

Introduction

Goals

- Find the balls in play
- Create a top down map of the table
- Use multiple views
- Classify the balls

Introduction Continued

Topics Covered

- Circle finding
- Projective transformations
- General image statistics

Previous work

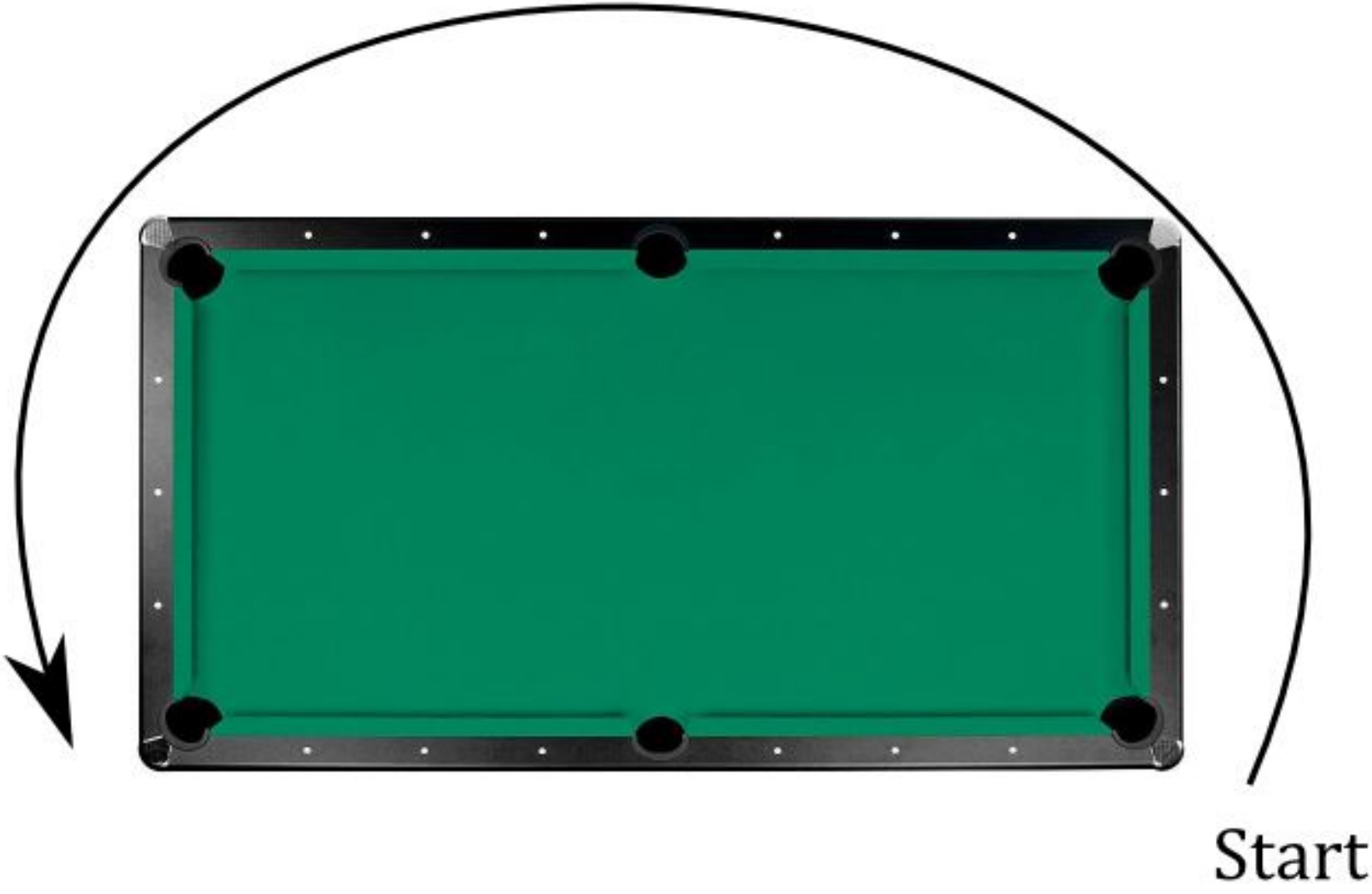
- Three Other Classmates
- Many circle finding algorithms
- Pool table mappings
  - Use a full view of the table
  - Full views are difficult to obtain
  - Require additional equipment

Set Up

Assumptions

- Standard brown and green color scheme
- Bumper markers are circles
- Takes 4 images
- Images taken in a specific order

Image Sequence



Method

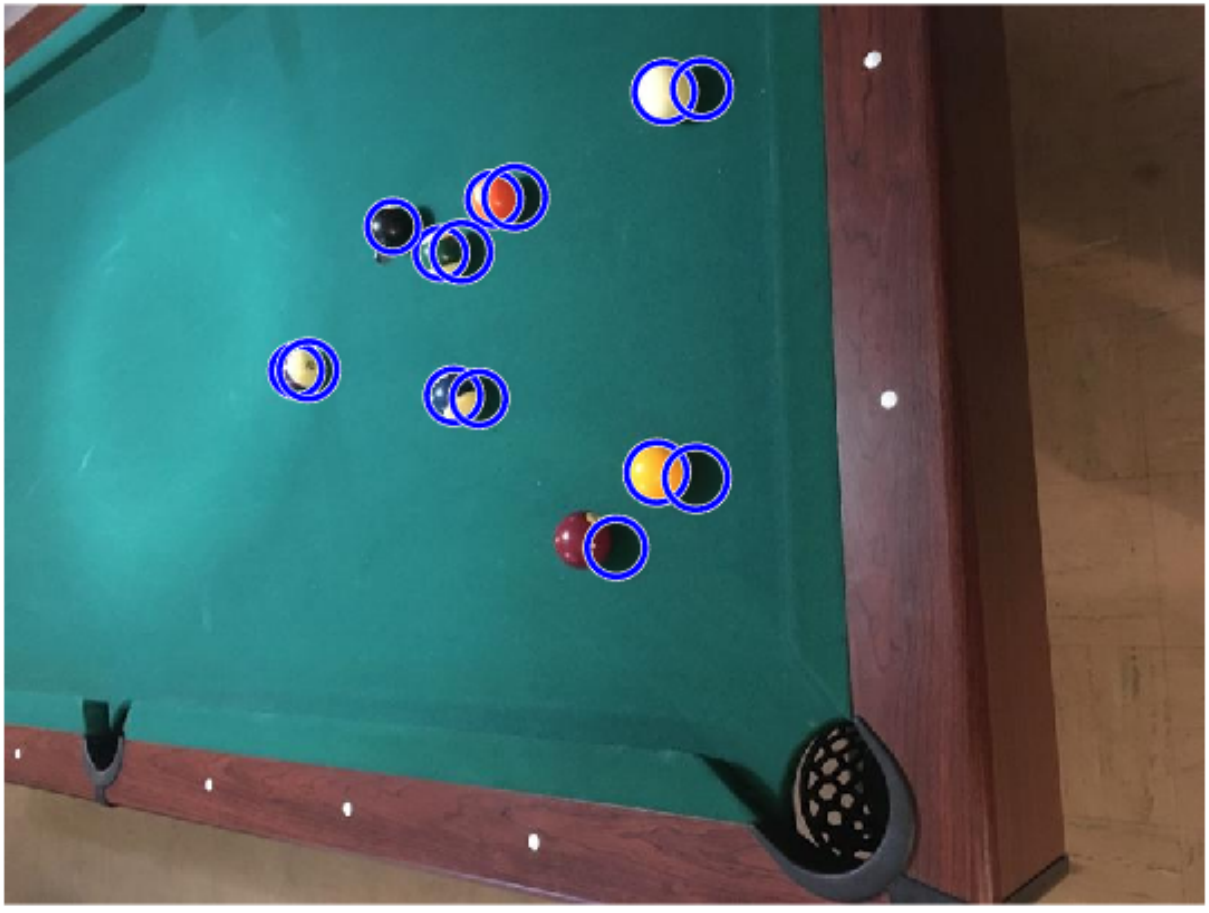
General Steps

- Find the balls
  - Classify the balls
- Map the table
  - Find the edges
  - Identify the edges
  - Project the balls

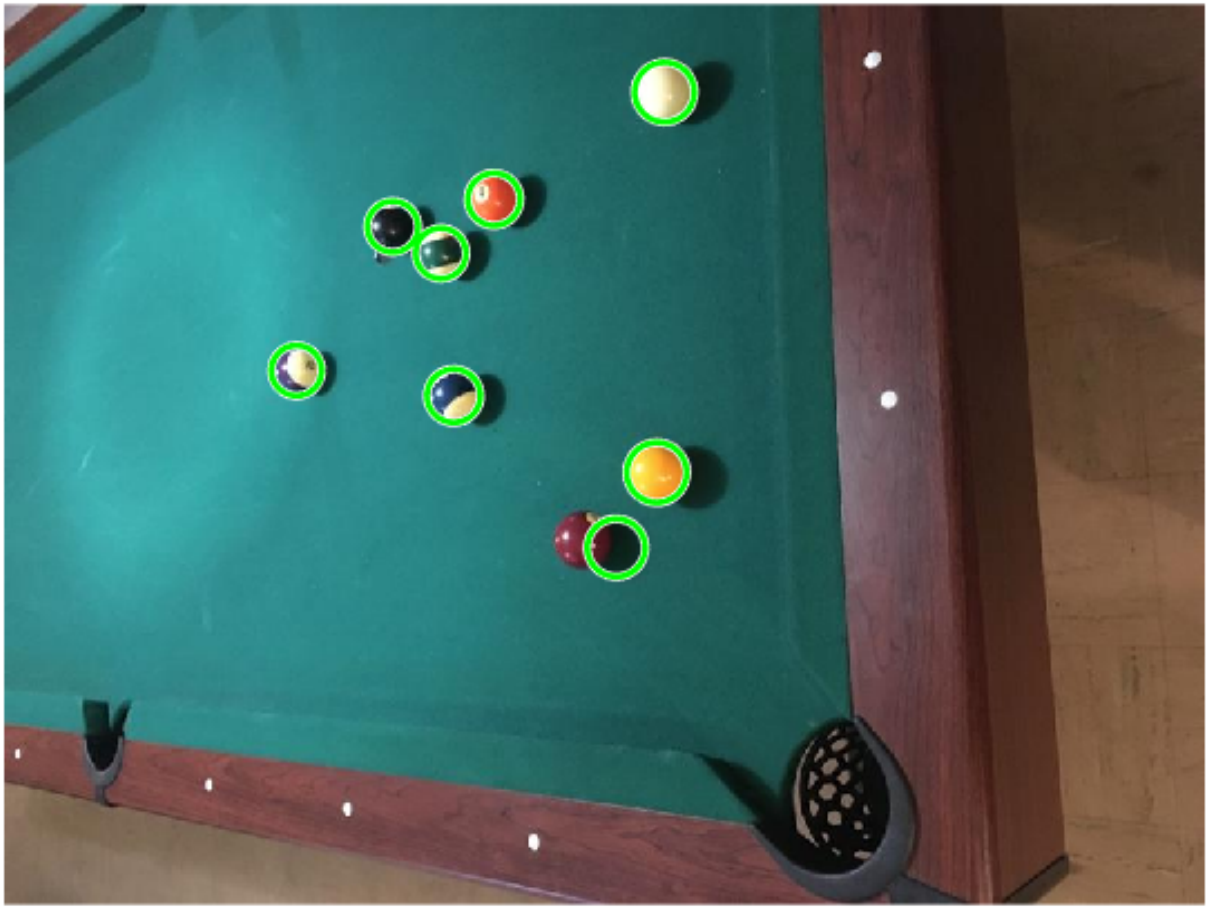
Finding the balls

- Assume we are looking for balls in the specific corner
- Look for dark and light polarity
- Eliminate double detection

Example detection



Example cleaned detection



Ball classification

Secondary goal

Method

- Based of standard deviation
- Solids have fewer instances of color
- Find std inside ball radius
- Threshold with mean value of standard deviations

Example Classification

Mapping the table

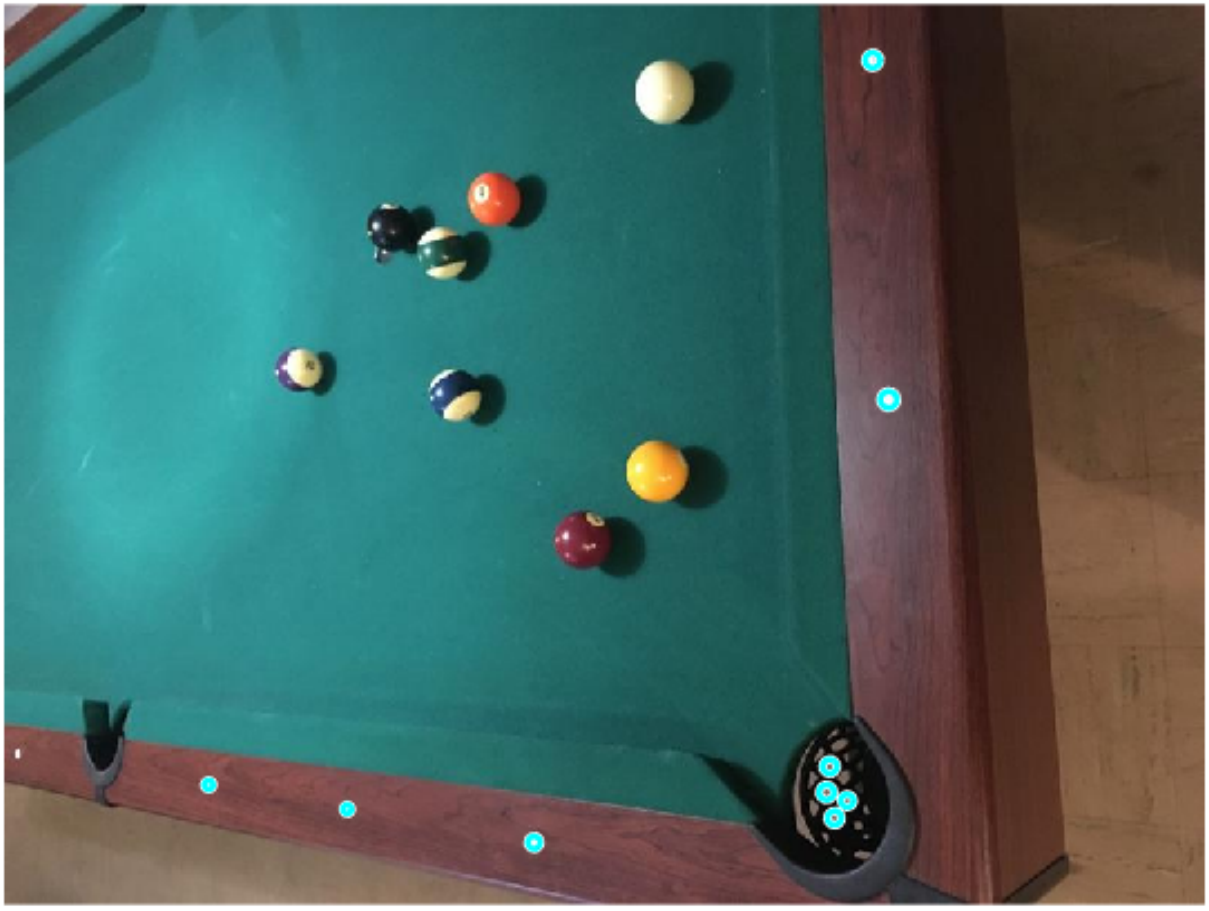
Steps

- Find the edge markers
- Identify
- Create projection
- Project balls onto digital table

Edge Markers

- All pool tables have them
- Spaced set distances
- Circles on most tables
- High contrast
- Found using circle finding

Example found edges

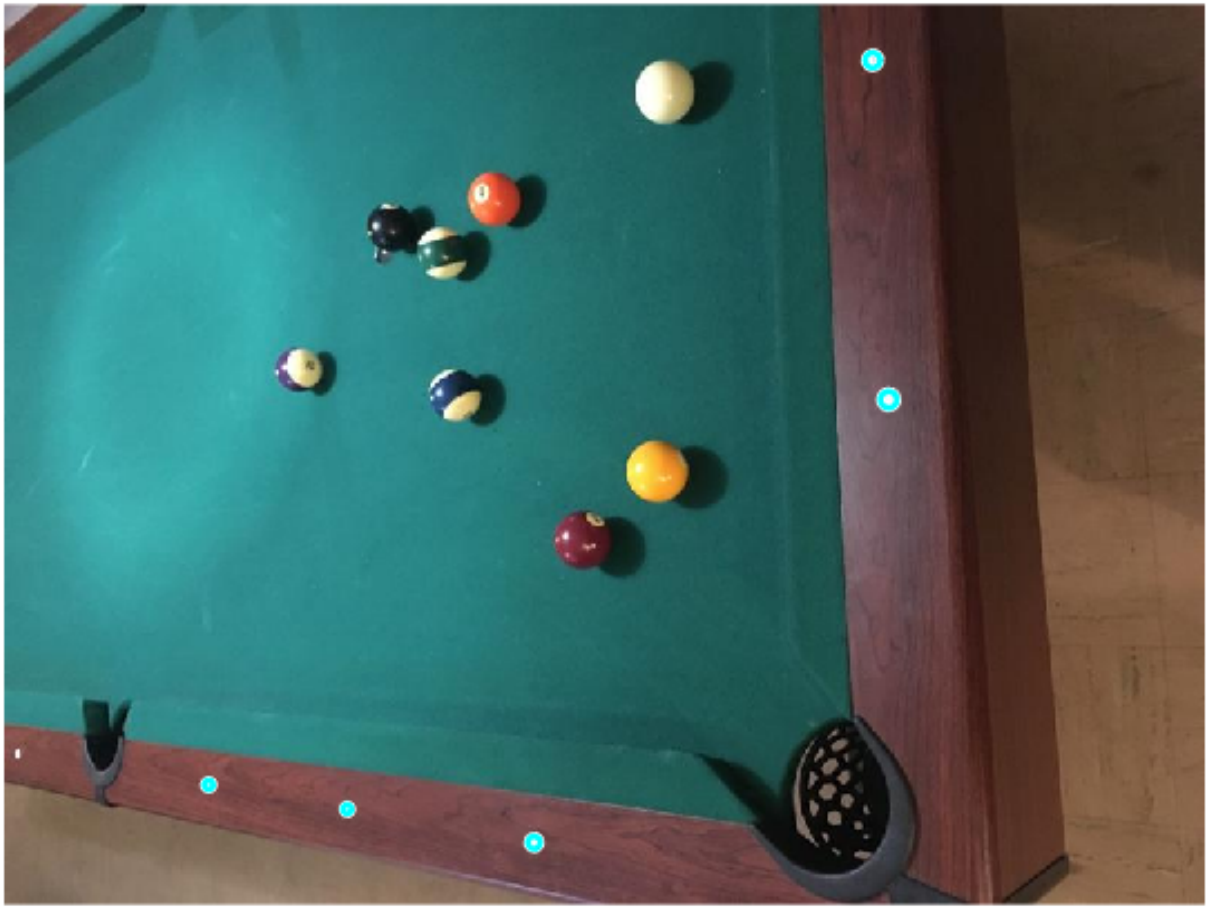


Pixel info: (X, Y) [R G B]

Eliminate false edges

- Eliminate ones on balls
- Eliminate groups

Example cleaned edges



Pixel info: (X, Y) [R G B]

Identifuing the Edges

Steps

- Group co-linearly
- Determine long or short edge
- Use sequence information for global location

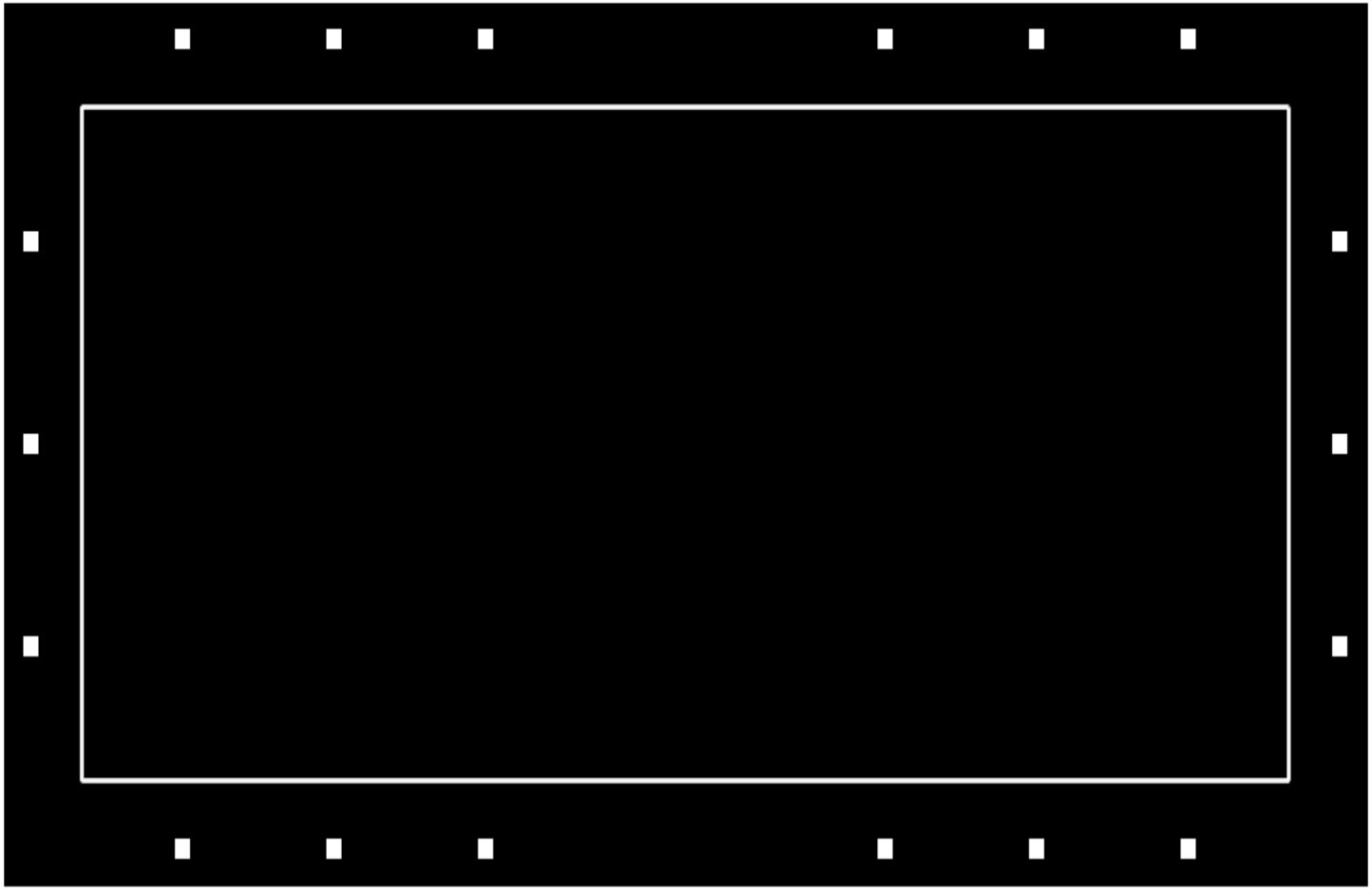
Grouped Edges

Pixel info: (X, Y) [R G B]

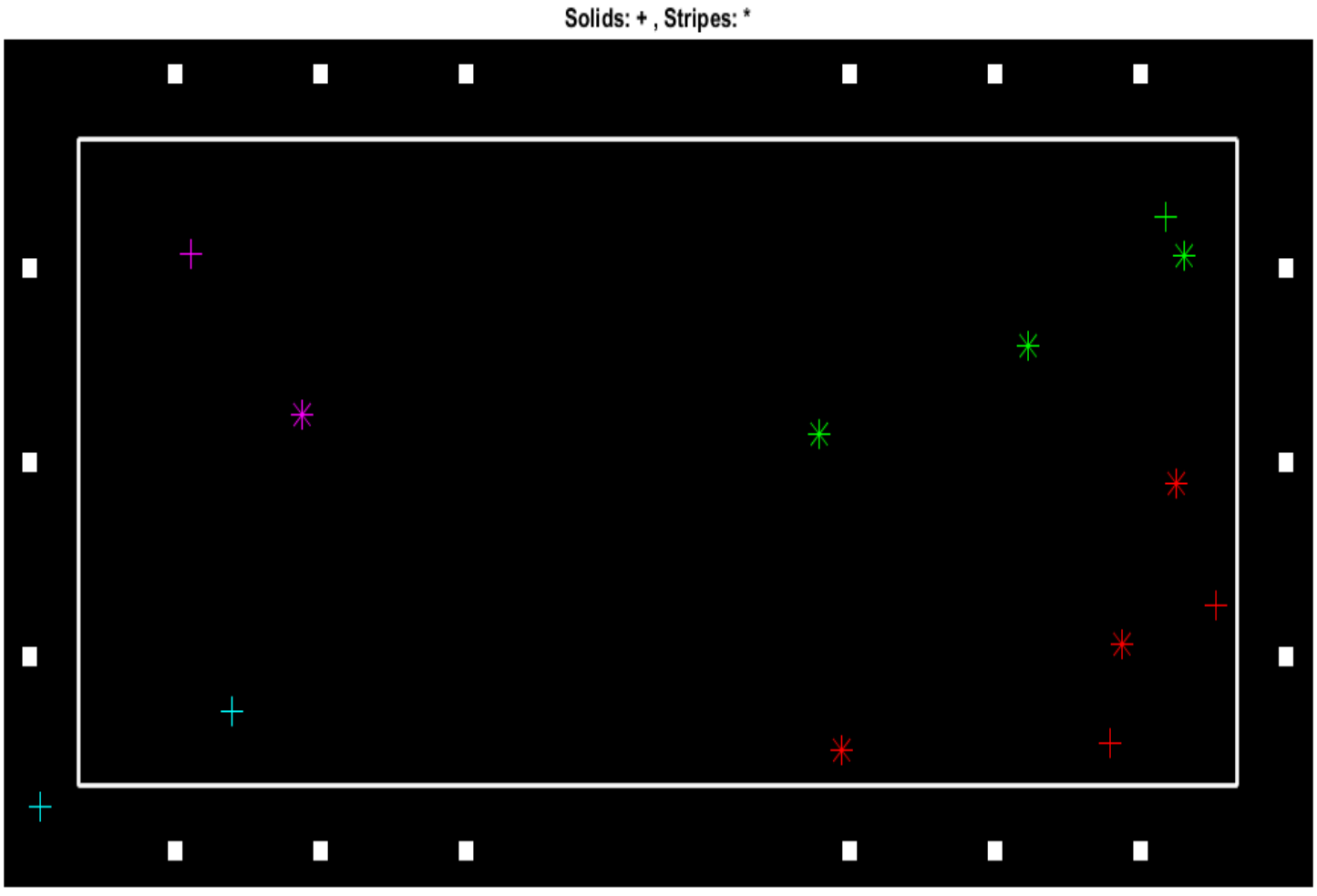
Projecting the balls

- Create a synthetic image with set inches to pixel ratio
- Use fitgeotrans function
  - Needs 4 points
  - Use the located edges
- Transform applied to ball centers
  - Only transform balls in the image corner

Digital Table



Populated Digital Table



Ball Finding

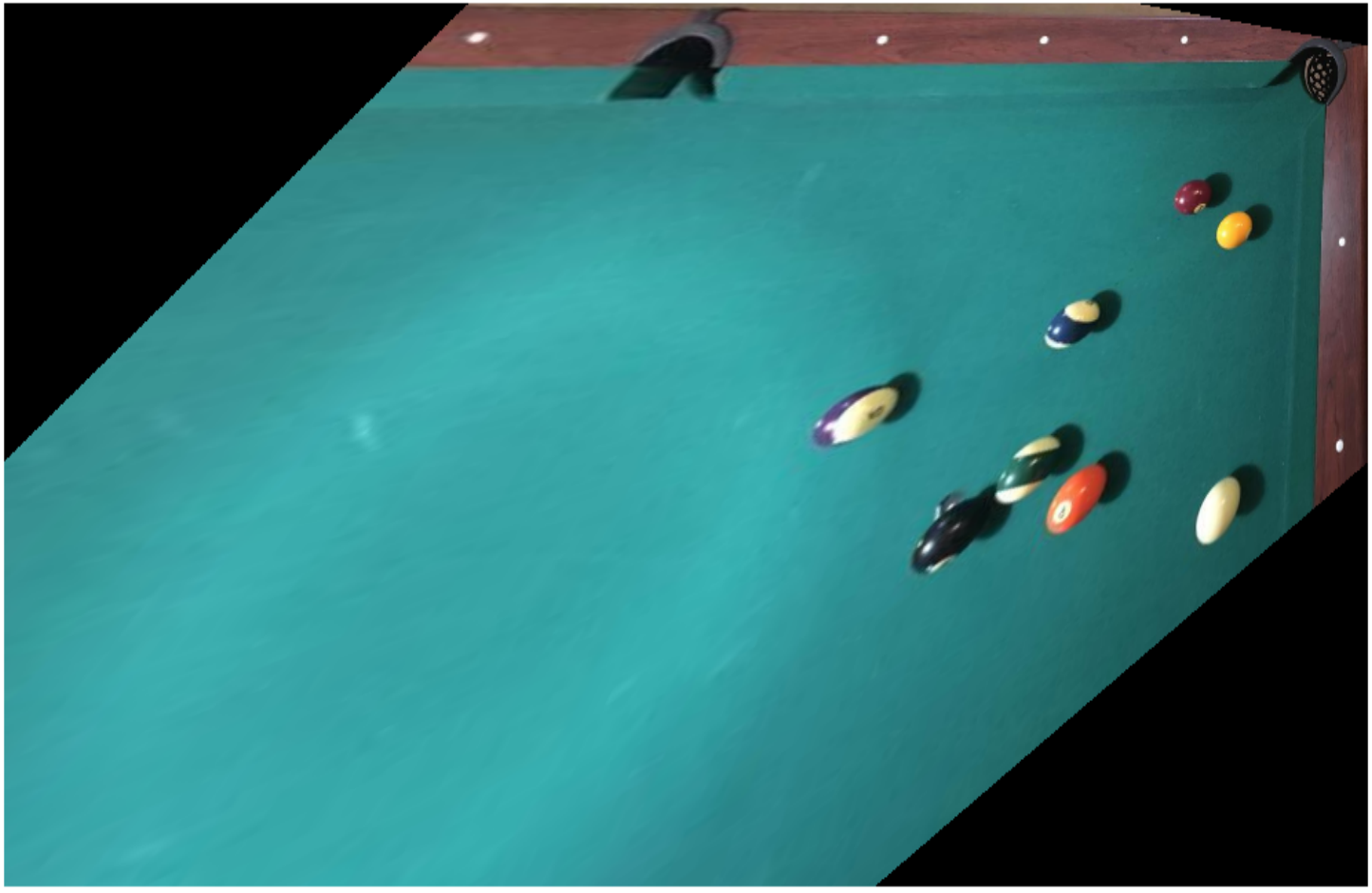
Over 20 Images

True Balls	Found Balls
105	92
Success	87.76 %
True Solids	Found Solids
57	22
Success	38.60 %
True Stripes	Found Stripes
48	69
Success	143.75 %

Table Mapping

- Designed table
  - 5/5 Successful image set runs
  - Edges always found and identified
  - Ball location error increases drastically towards middle of table
- Rec center table
  - Poor results
  - No edge markers detected
  - Fewer balls detected

Middle Error



Future Work

Possible Improvements

- Increase picture size
- Constant lighting
- New classification algorithm
- Require more edge markers in each picture
- Ray trace uniquely identified balls