

# Blackjack Master

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CS 131

# Problem Statement

- **Summary**
  - Automating playing card recognition using computer vision
- **Challenges**
  - Lighting
  - Rotations
  - Background complexity
  - Low resolution
  - Etc.
- **Goals**
  - Detect and classify playing cards from images
  - Build HUD with card counting functionality

# Experimentation

*Example 1*

## Full Card Template Matching



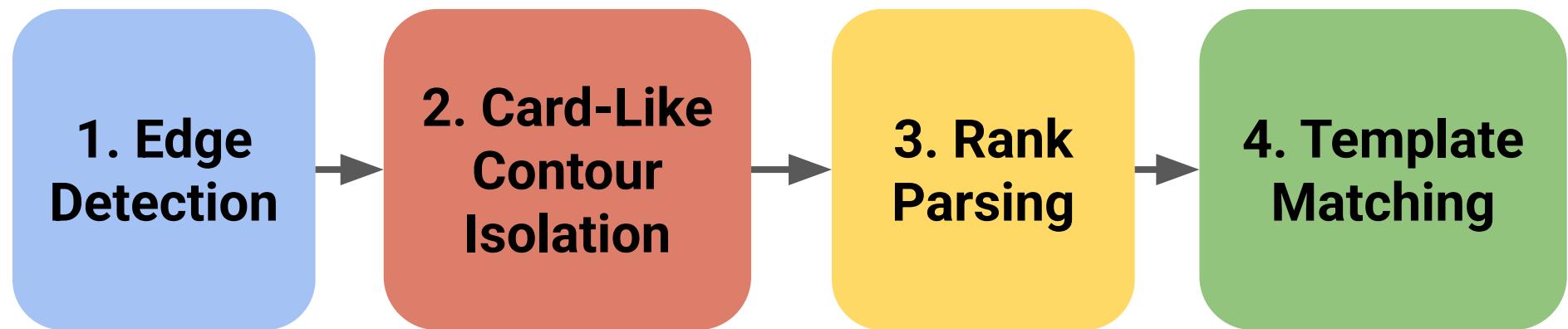
*Example 2*

## Card Detection With PCA



# Methods

# Methods

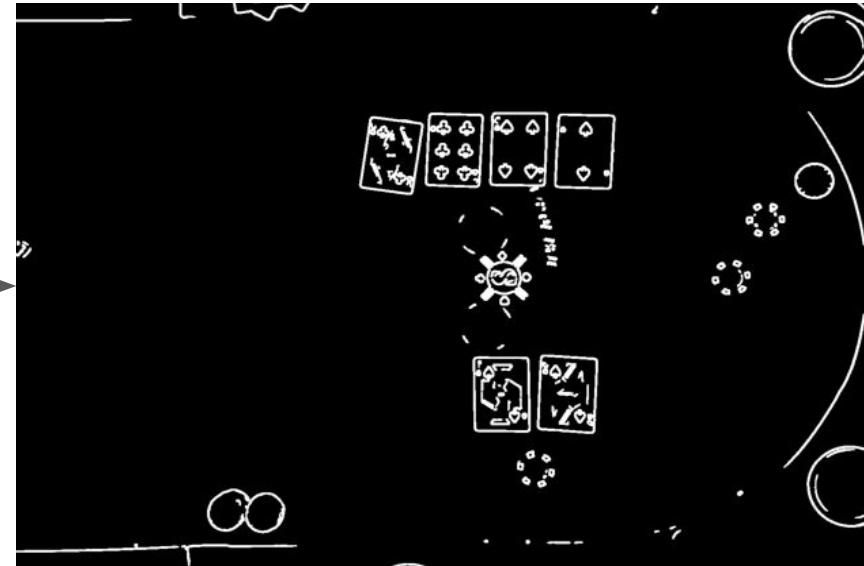


# 1. Edge Detection

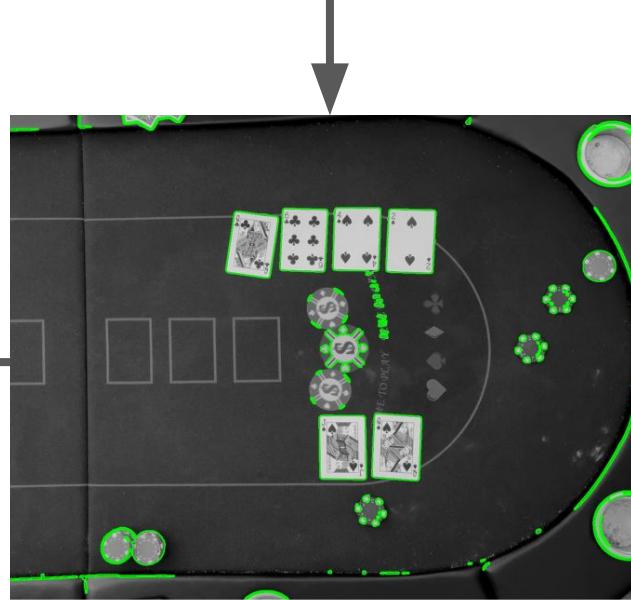
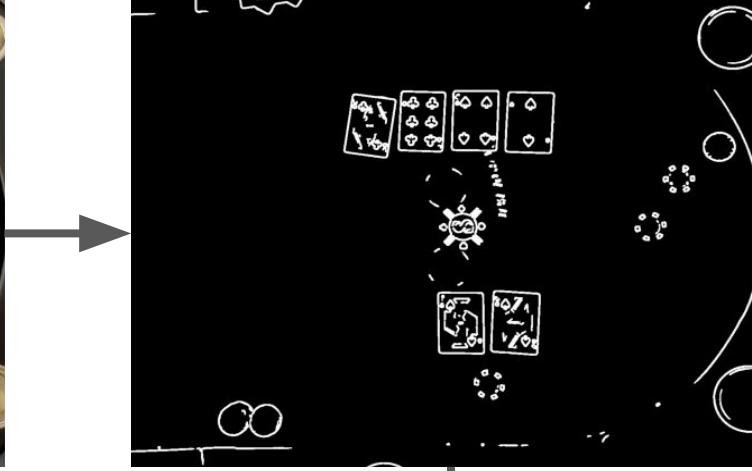
Raw Image



Edges

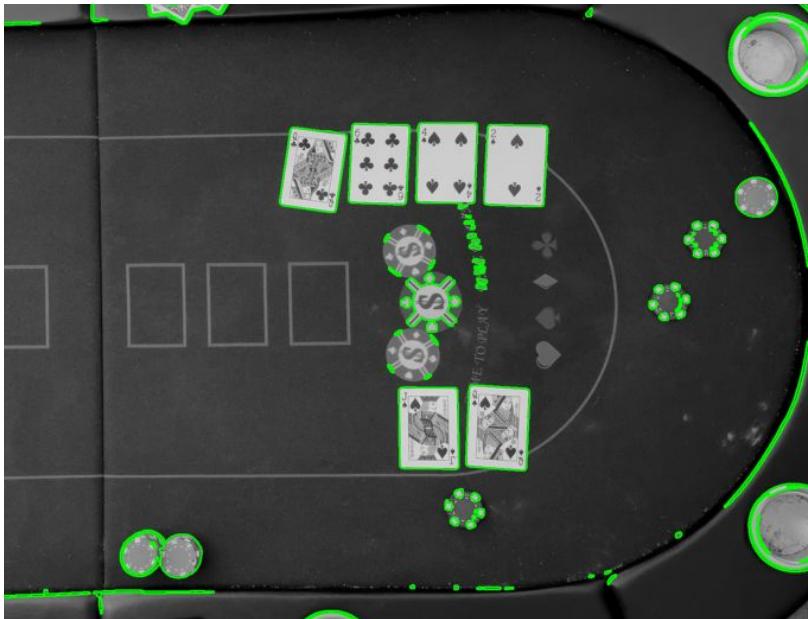


*Detect edges using **canny edge detection** from homework.*

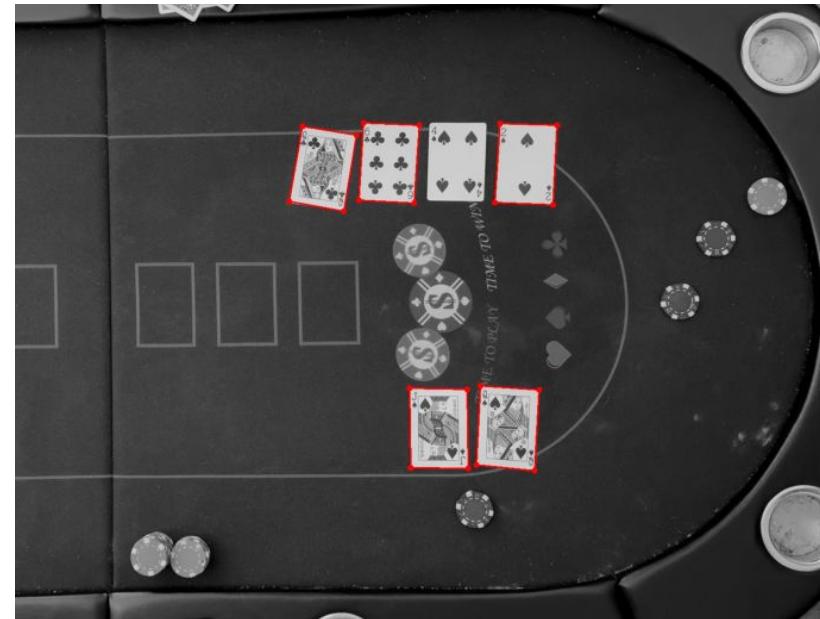


## 2. Card-Like Contour Isolation

Contours

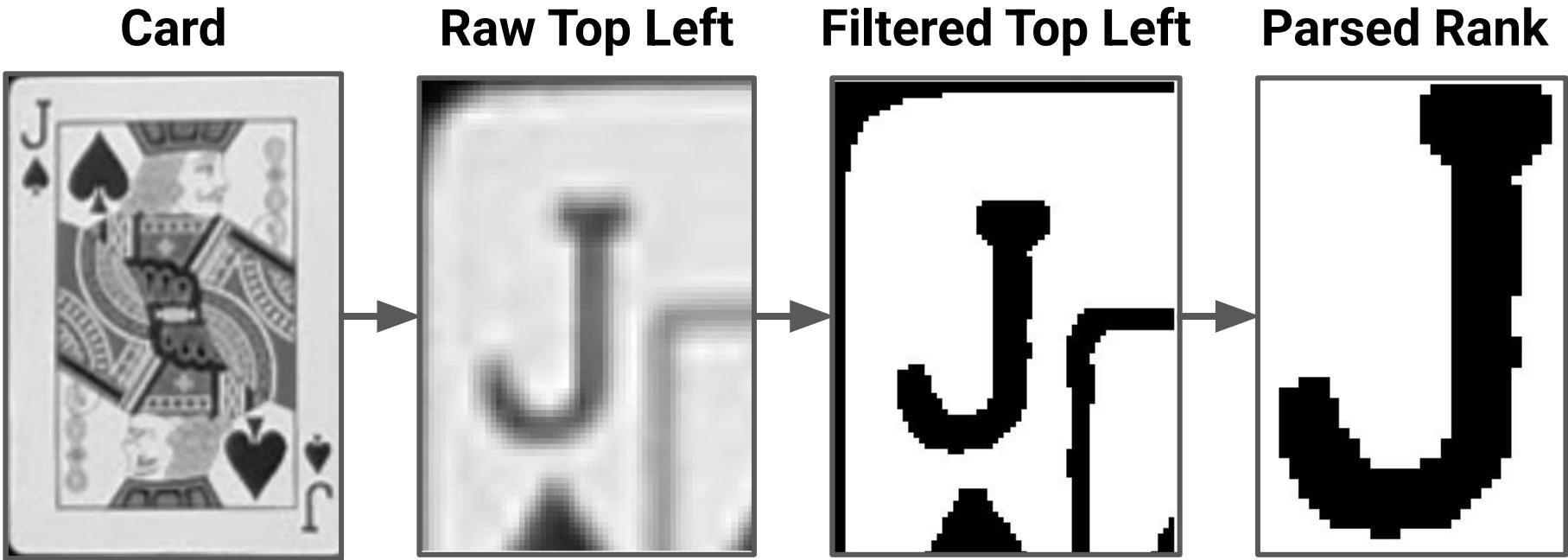


Detected Cards



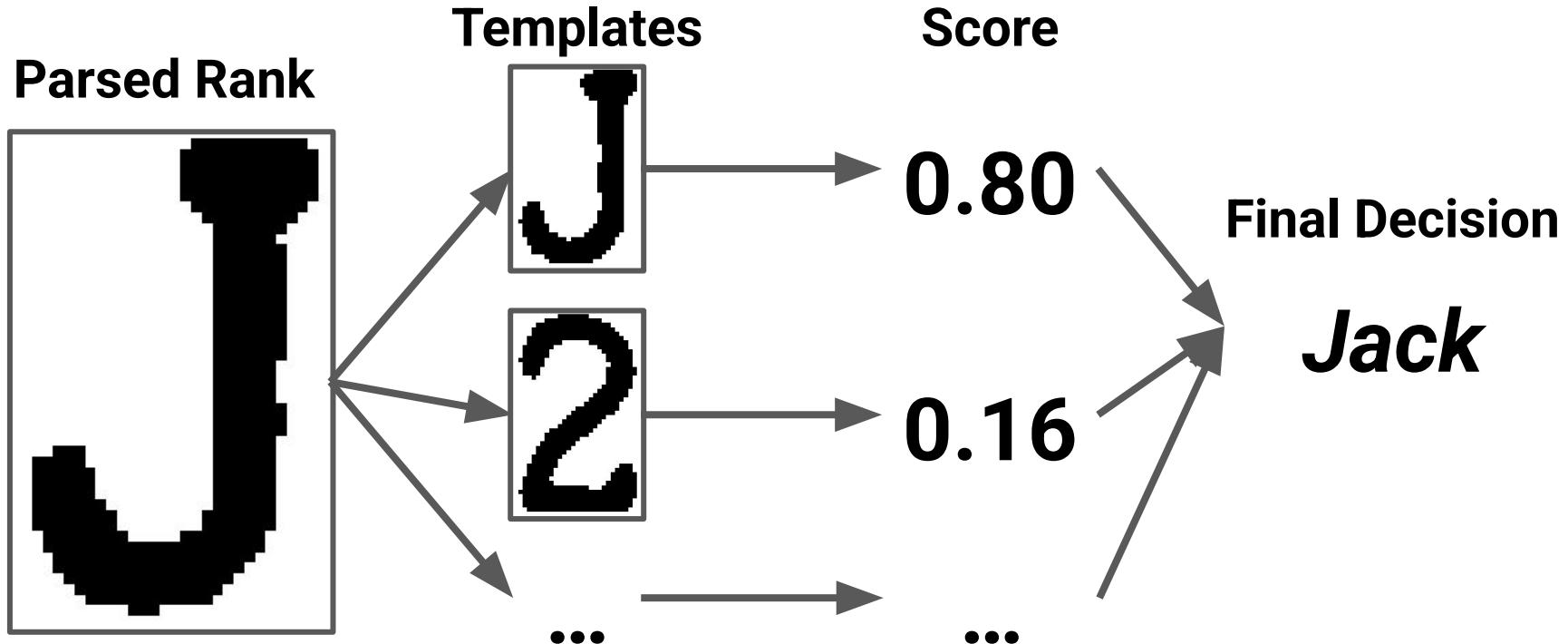
**Detect contours** then determine if contours are card like by **smoothing, fitting polygon**, and determining if the fit polygon is a **parallelogram of adequate size**.

### 3. Rank Parsing



Extract **top left corner, filter** into binary image, use **canny edge detection**, determine **contours**, parse **contour not touching edge of the image** as the rank.

# 4. Template Matching

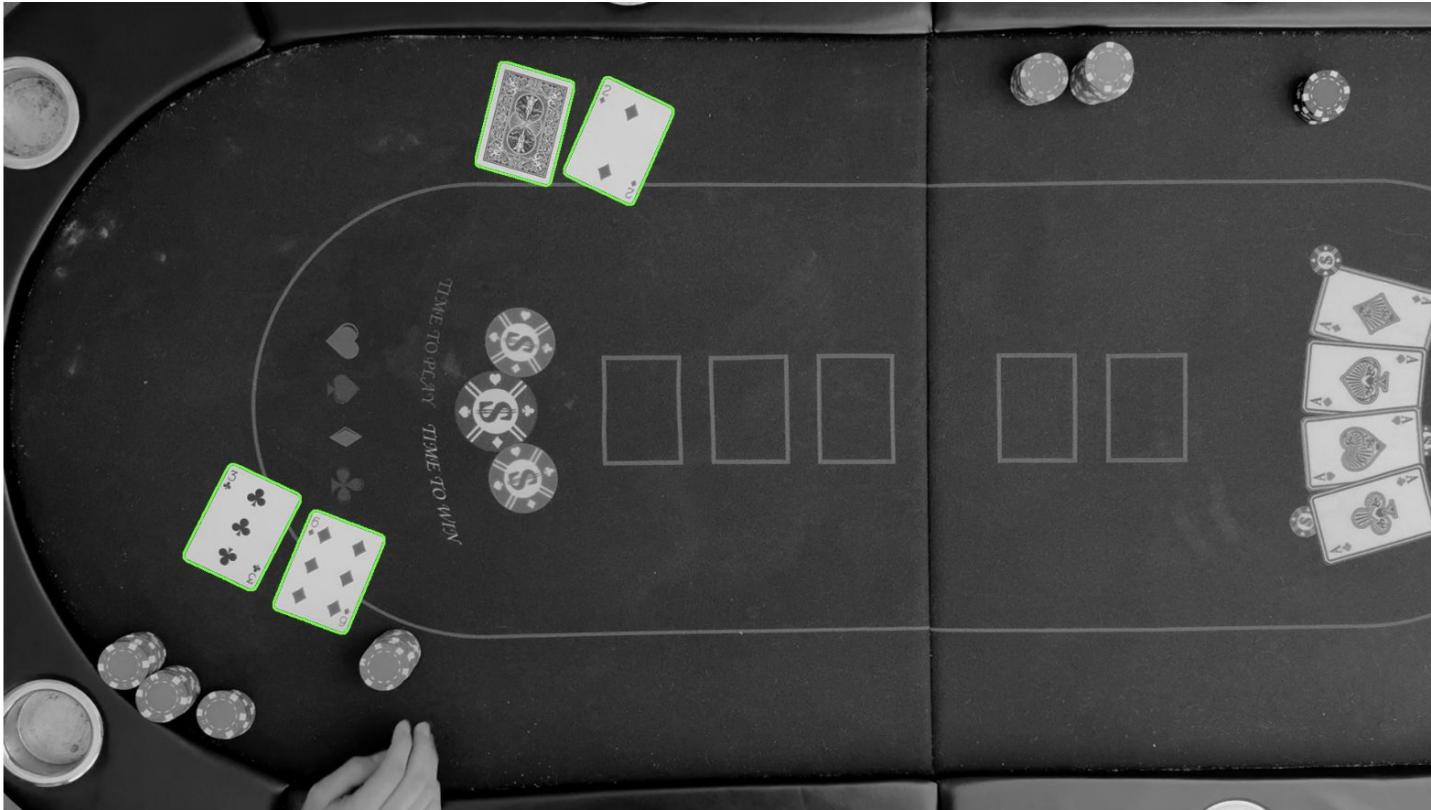


***Match parsed rank with template extracted from random training example, determine max score over given threshold, use this label.***

# Results

# Hand #1

## Hand Analysis



Dealer hand: 2

Player hand: 6, 3

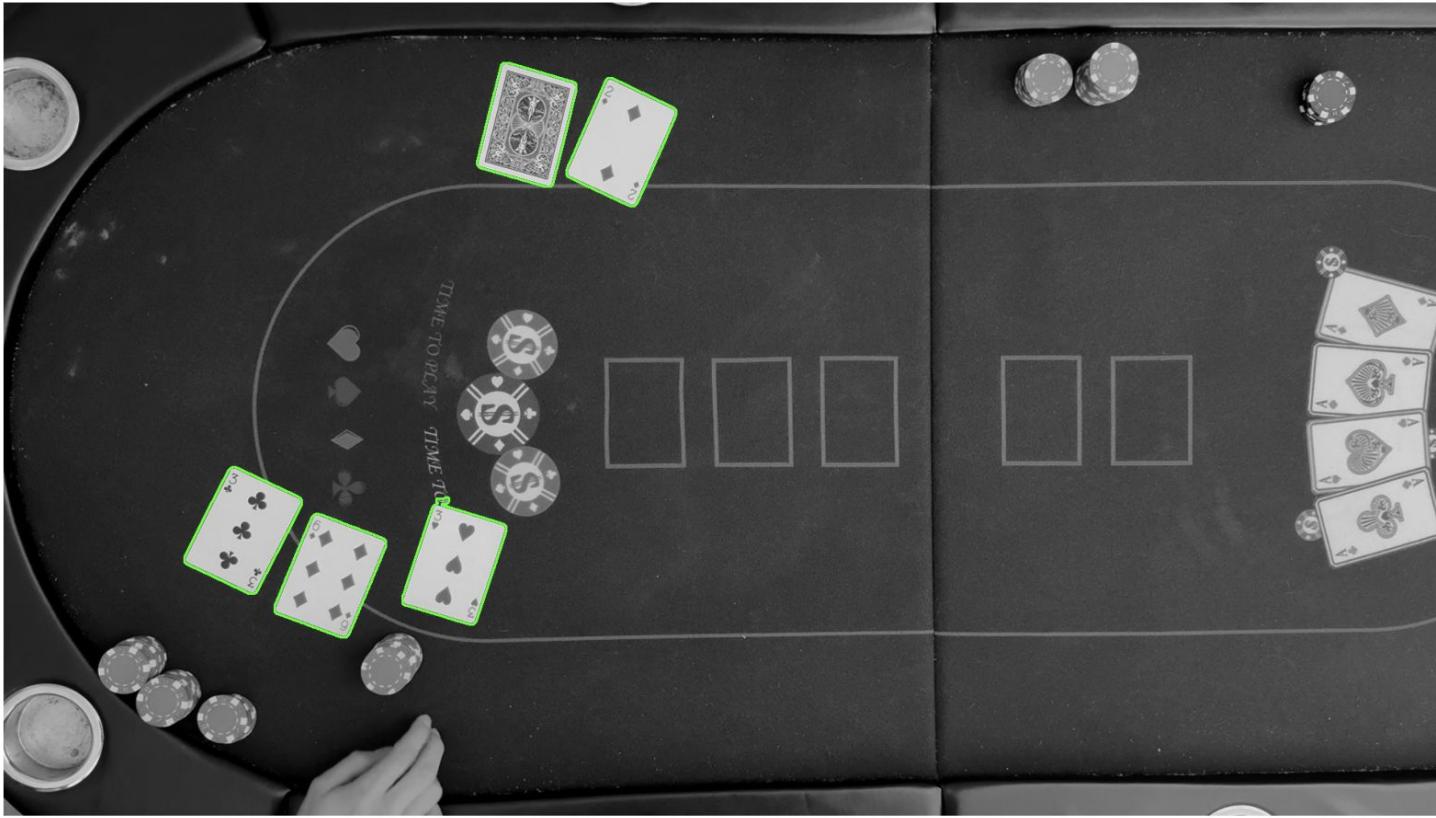
Strategy: Hit

Running Count: 0

True Count: 0.0

# Hand #1

## Hand Analysis



Dealer hand: 2

Player hand: 3, 6, 3

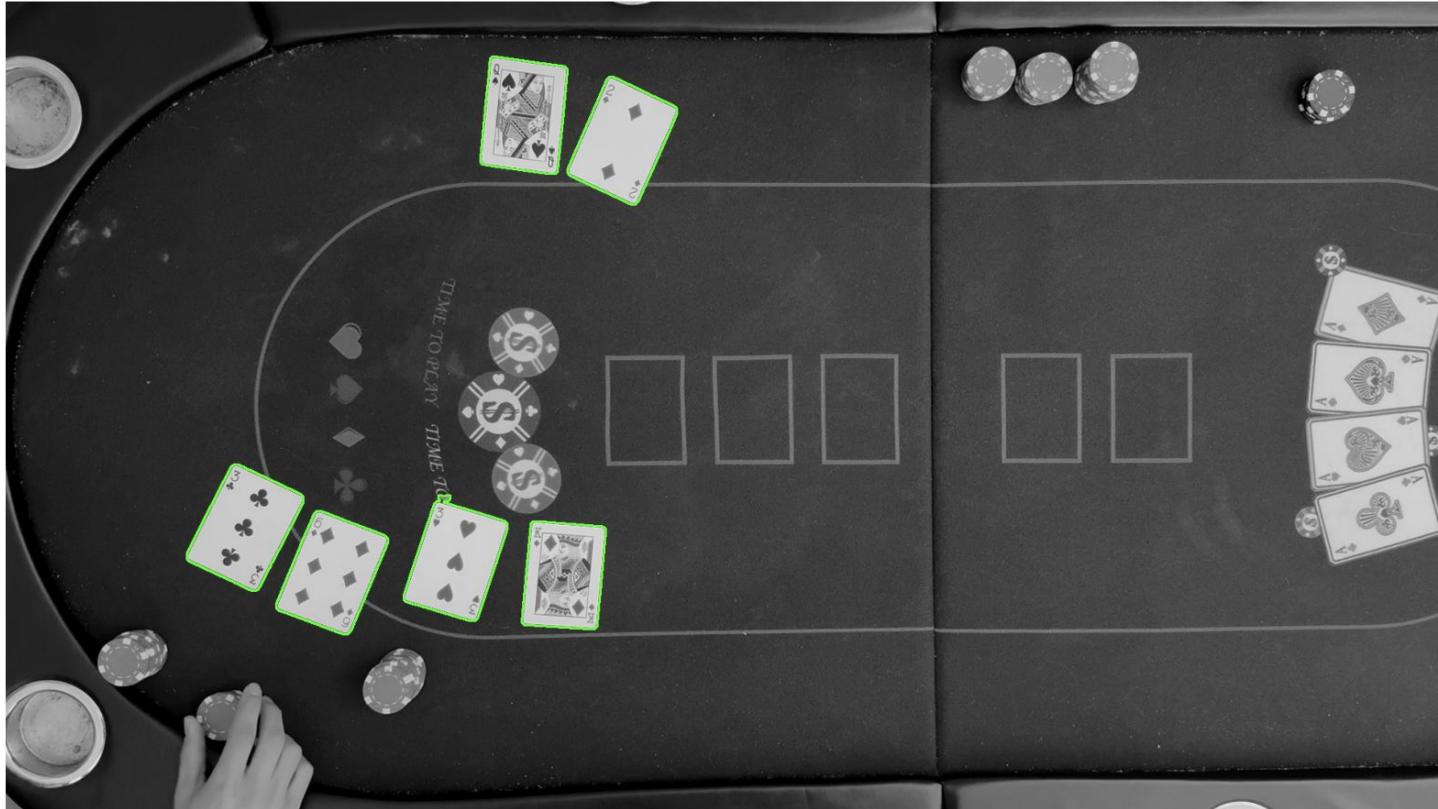
Strategy: Hit

Running Count: 0

True Count: 0.0

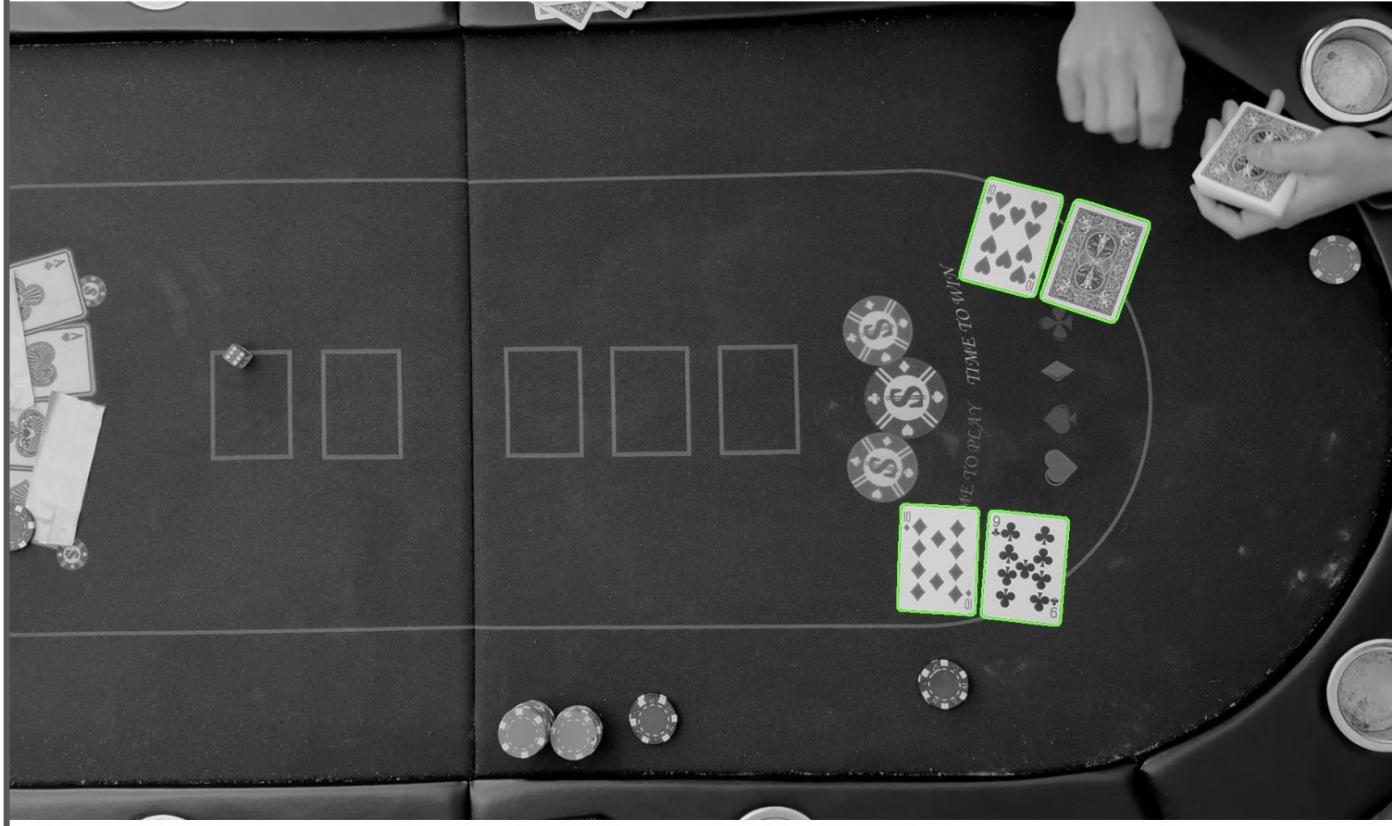
# Hand #1

## Hand Analysis



# Hand #2

## Hand Analysis



Dealer hand: 10

Player hand: 9, 10

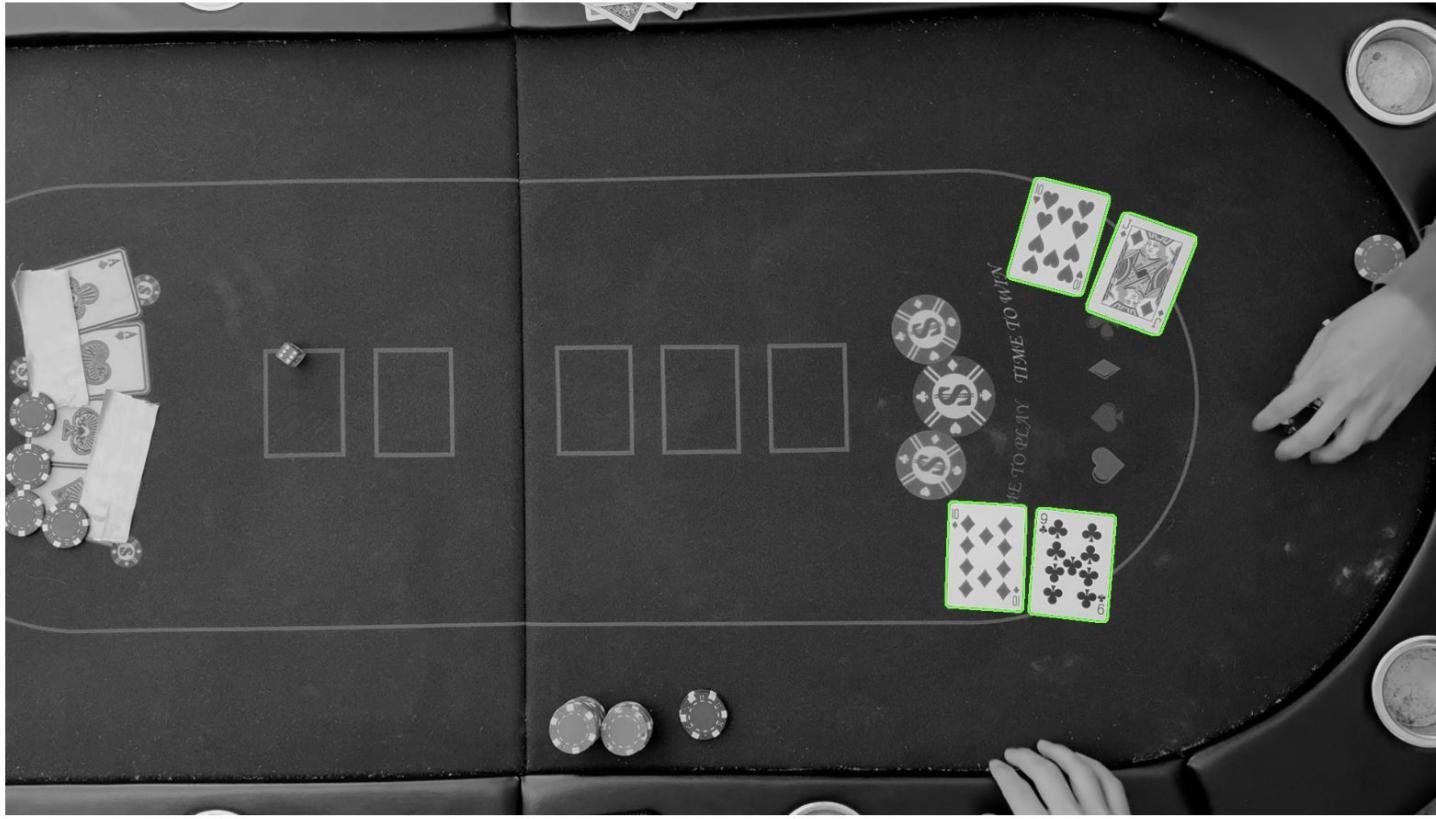
Strategy: Stand

Running Count: 2

True Count: 2.0

# Hand #2

## Hand Analysis



Dealer hand: J, 10

Player hand: 9, 10

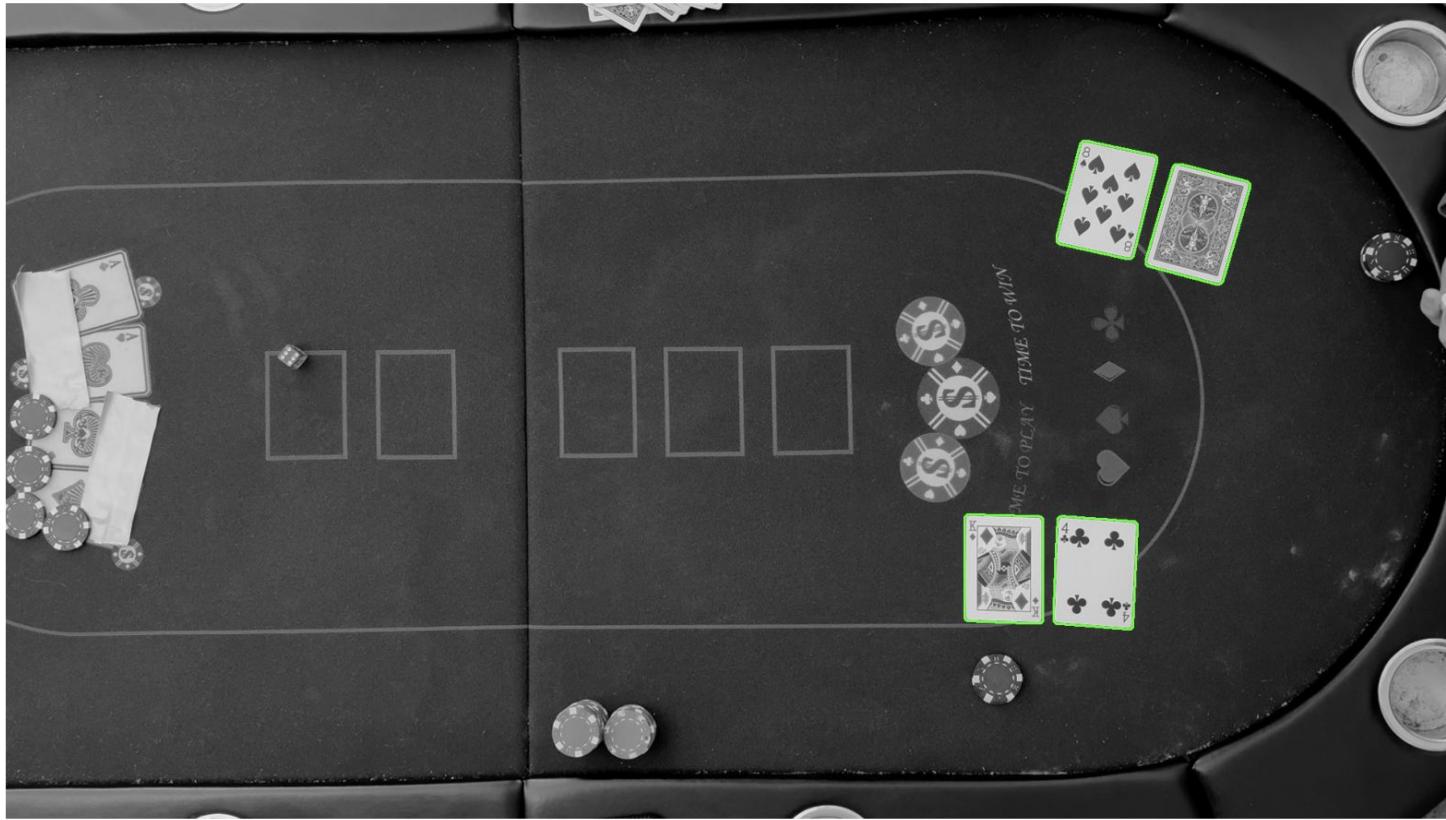
Running Count: -1

True Count: -1.0

Bet Suggestion: Min bet

# Hand #2

## Hand Analysis



Dealer hand: 8

Player hand: 4, K

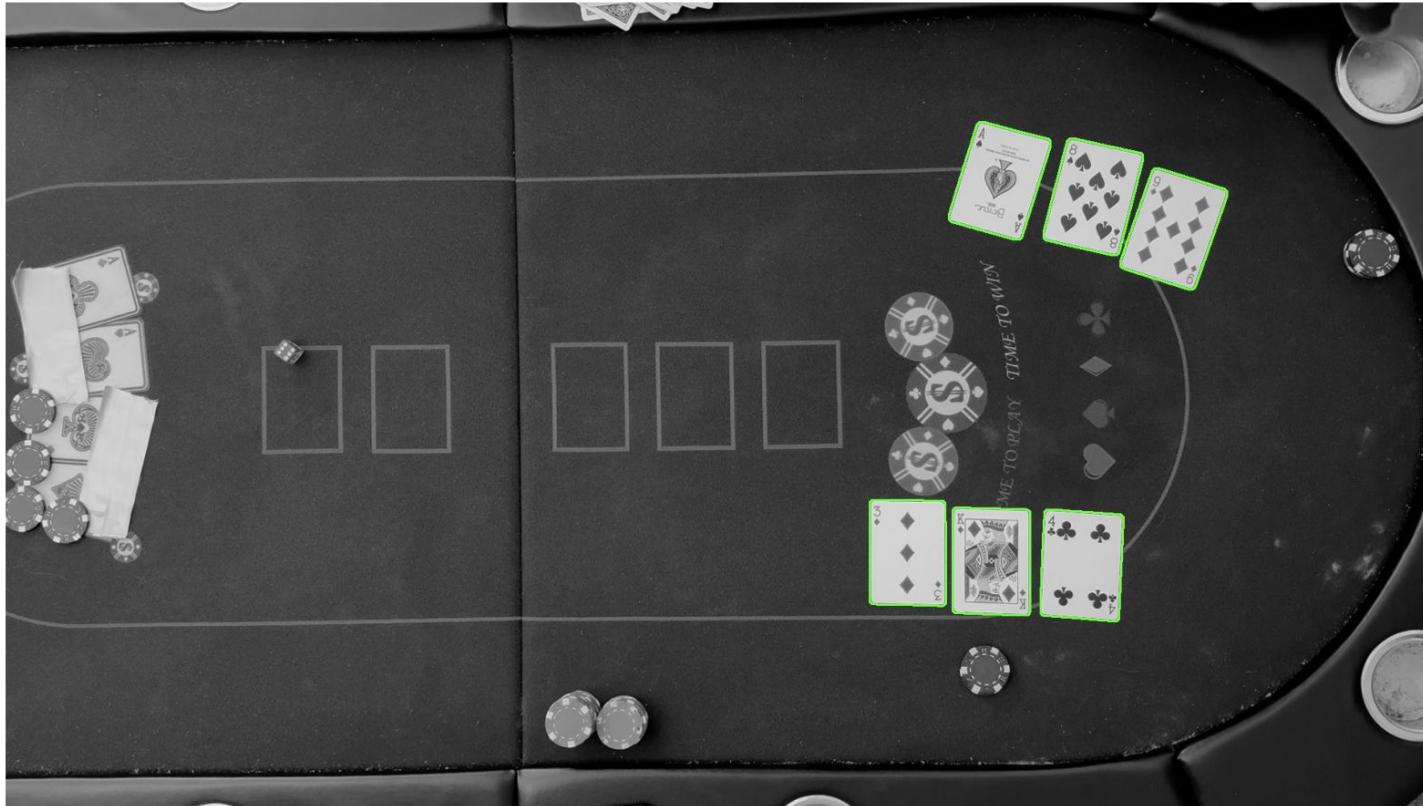
Strategy: Hit

Running Count: -1

True Count: -1.0

# Hand #2

## Hand Analysis



Dealer hand: 9, 8, A

Player hand: 4, K, 3

Running Count: -1

True Count: -1.0

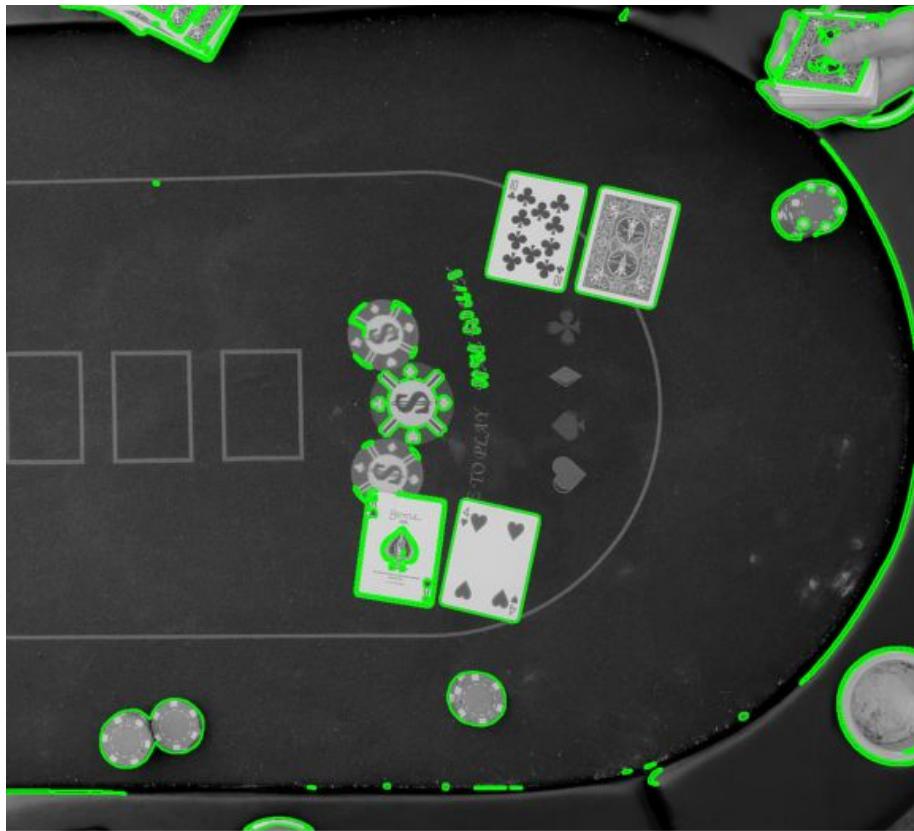
Bet Suggestion: Min bet

# **Results (97 Cards Between 25 Images)**

	<b>Precision</b>	<b>Recall</b>
<b>Card Detection</b>	0.979	0.948
<b>Rank Detection</b>	0.978	0.928

# Limitations + Next Steps

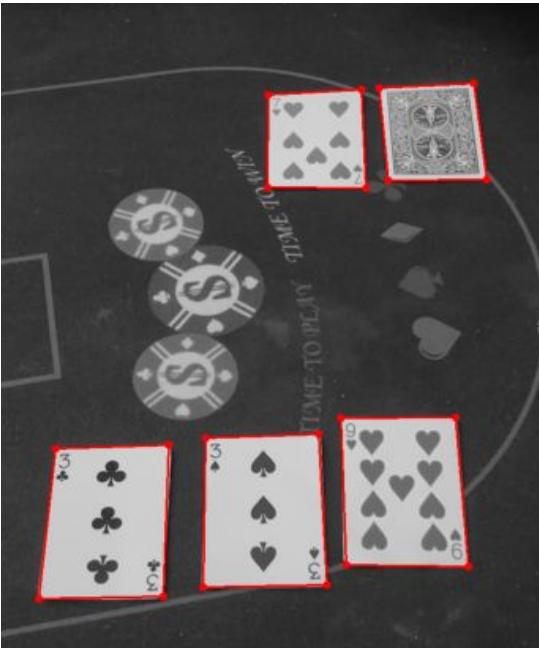
# General Robustness



An **example of error** where **background patterns disrupt card detection.**

# Point-of-View

Detected Cards



Cards



Parsed Rank

9  
3  
3  
7

Match

9  
3  
3  
K

✓  
✓  
✓  
✗

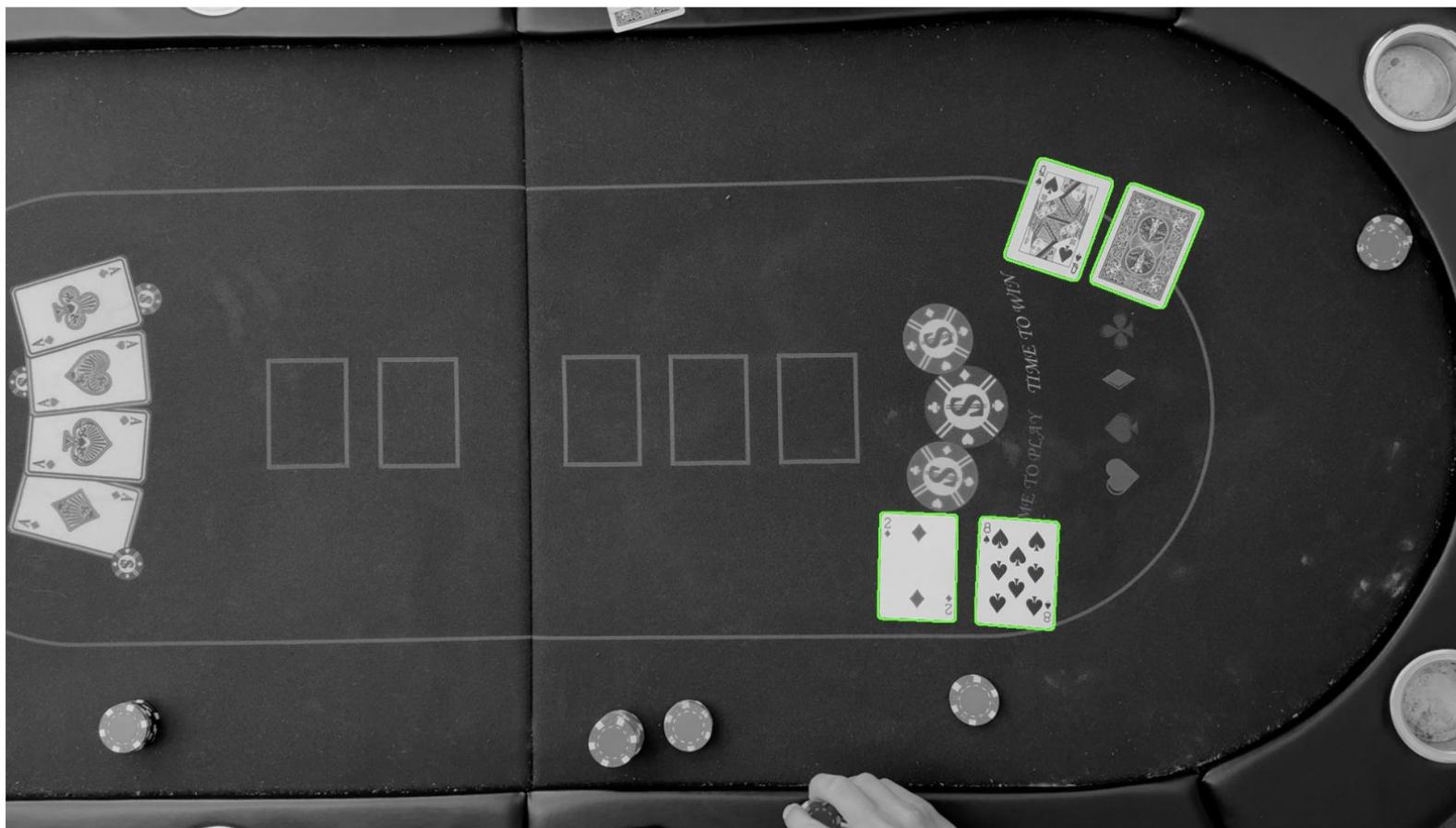
Trouble with **low definition** resulting from **perspective transform**.

**Thank you!**

# Q&A

# Appendix

# Hand Analysis



Dealer hand: Q

Player hand: 8, 2

Strategy: Hit

Running Count: -1

True Count: -1.0

# Hand Analysis



Dealer hand: A, Q

Player hand: 8, 2, K

Running Count: -3

True Count: -3.0

Bet Suggestion: Min bet

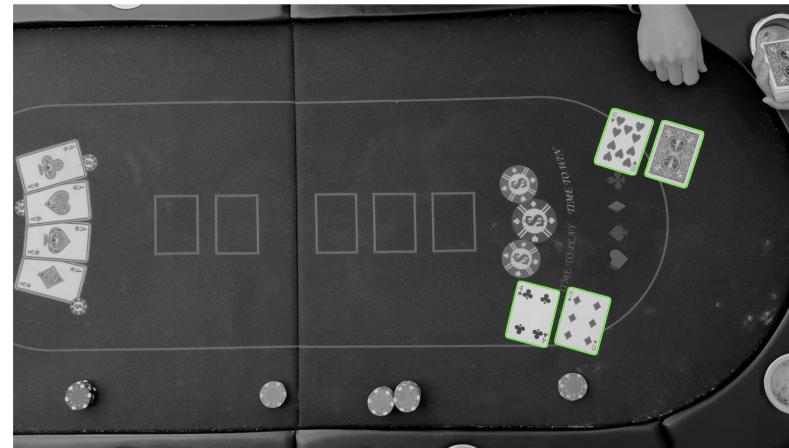
Hand Analysis



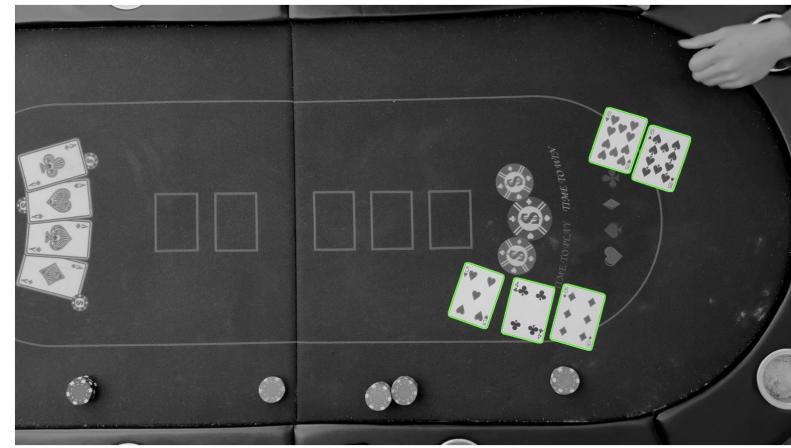
Hand Analysis



Hand Analysis



Hand Analysis



Dealer hand: K, Q

Player hand: 6, 5, 6

Running Count: -2

True Count: -2.0

Bet Suggestion: Min bet

Dealer hand: 10, 10

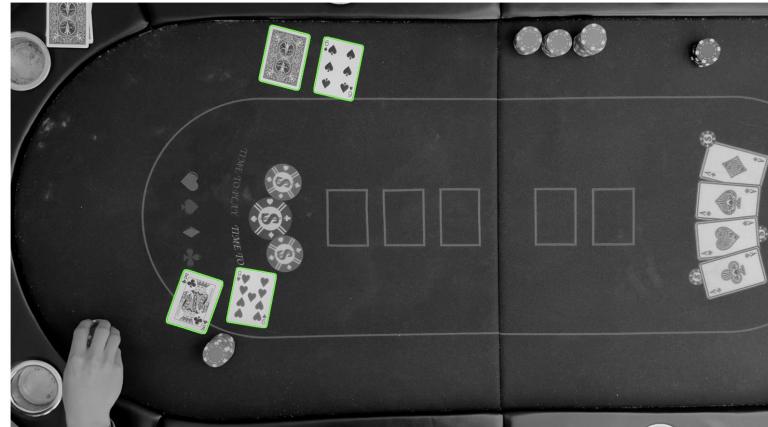
Player hand: 6, 4, 5

Running Count: -1

True Count: -1.0

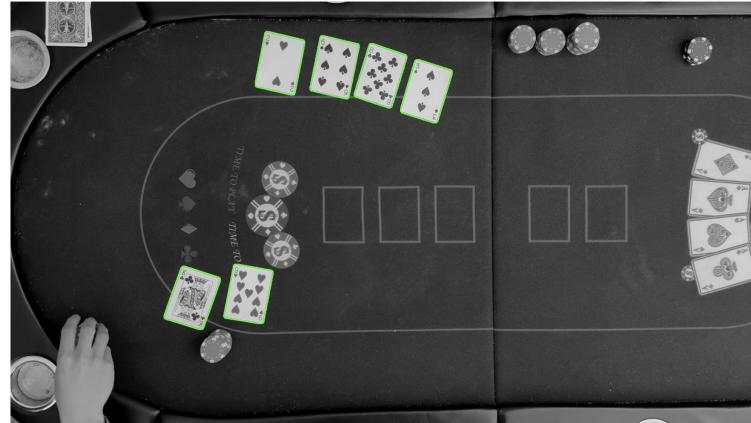
Bet Suggestion: Min bet

Hand Analysis



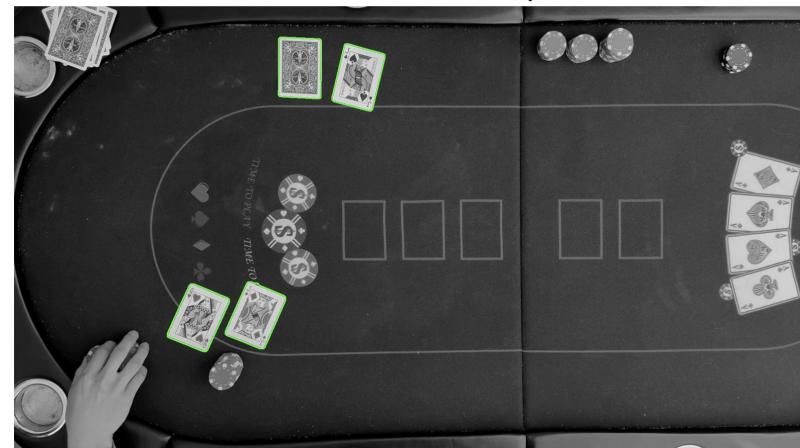
Dealer hand: 6  
Player hand: 9, K  
Strategy: Stand  
Running Count: -1  
True Count: -1.0

Hand Analysis



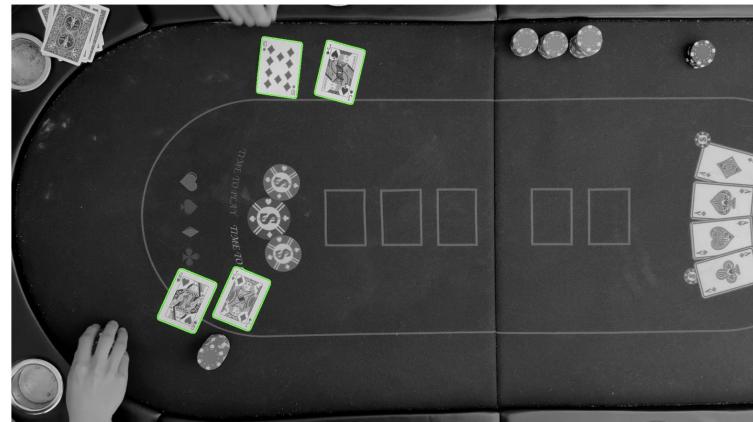
Dealer hand: 3, 8, 6, 2  
Player hand: Q, K  
Running Count: 0  
True Count: 0.0  
Bet Suggestion: 1x bet

Hand Analysis



Dealer hand: J  
Player hand: J, Q  
Strategy: Stand  
Running Count: 0  
True Count: 0.0

Hand Analysis



Dealer hand: J, 10  
Player hand: J, Q  
Running Count: -4  
True Count: -4.0  
Bet Suggestion: Min bet