Cornhole Robot

Brent Brisbois, Haihan Gao, Noah Hicks, Yiming Liu, Shinjo Satoh

{brentbri, hhgao, nhicksn, liuym, ssatoh}@umich.edu

WHY a Cornhole Robot?
Idea & Use Case

- **Use Case**
  - Solo play and practice
  - Ideal for:
    - Training
    - Skill improvement
    - Entertainment
- **Target Audience**
  - Cornhole enthusiasts
  - Event organizers
  - Sports equipment retailers
- **Features**
  - Various difficulty levels
  - LCD display for instructions and scoreboard

HOW does it work?
General Implementation

- **Computer Vision**
  - PixyCam for object detection and scorekeeping
- **Software Algorithm**
  - Controls robot behavior
  - Aiming and throwing strategy based on real-time data
- **Aiming Launcher**
  - Stepper motors controlling the angle of the throw
- **Physical Launcher**
  - Mechanical system with a slingshot mechanism

WHAT is Cornhole?
Game Introduction & Rule

- **Game Intro**
  - Outdoor game where players throw bags at a board with a hole
- **Game Rules**
  - Players take turns throwing bags
  - First to reach 21 points wins
- **Scoring Details**
  - 3 points for bags in the hole
  - 1 point for bags on the board
  - The player who scored more gains the difference in points
  - Scoring over 21 points results in going back to 13 points

Embedded System Solution

Pixy Cam Monitoring →

- Object detection
- STM32 Microcontroller
- SPI Serial Communication
- Detects…
  - 8 bags for score keeping
 - board vertices & hole for moveable board position
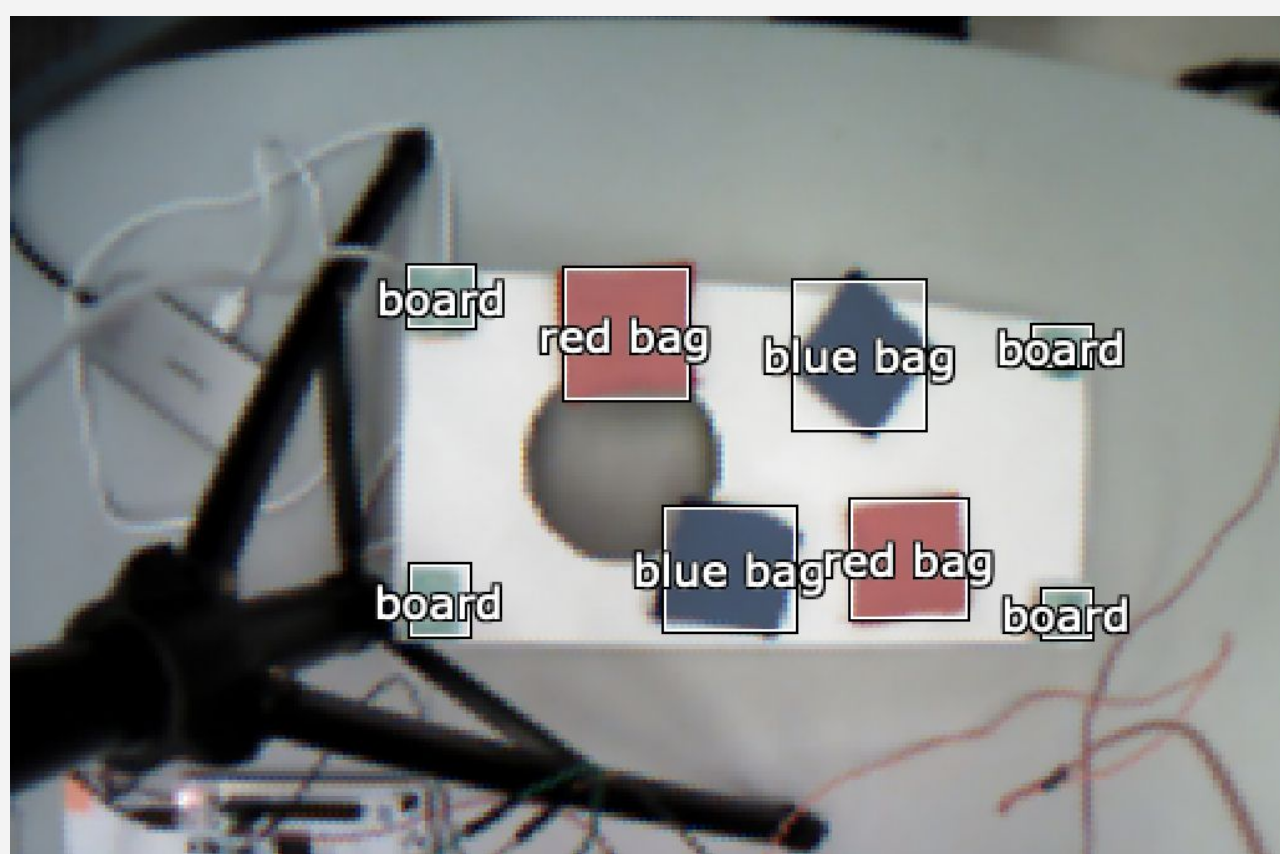
Challenges

- Sensitivity to light conditions
- Object detection accuracy
  - Overlapping object detection
  - Inside-the-hole bag detection

Pre-Aiming & Launching ←

- Direction Adjustment
  - NEMA 17 stepper motor
  - Lazy susan bearing
  - Gear ratio reduction for precision
- Vertical Angle Adjustment
  - NEMA 23 stepper motor
  - Drawbridge style
- Launching
  - 3D printed piston with latex tubes
 - Archery release triggered by servo
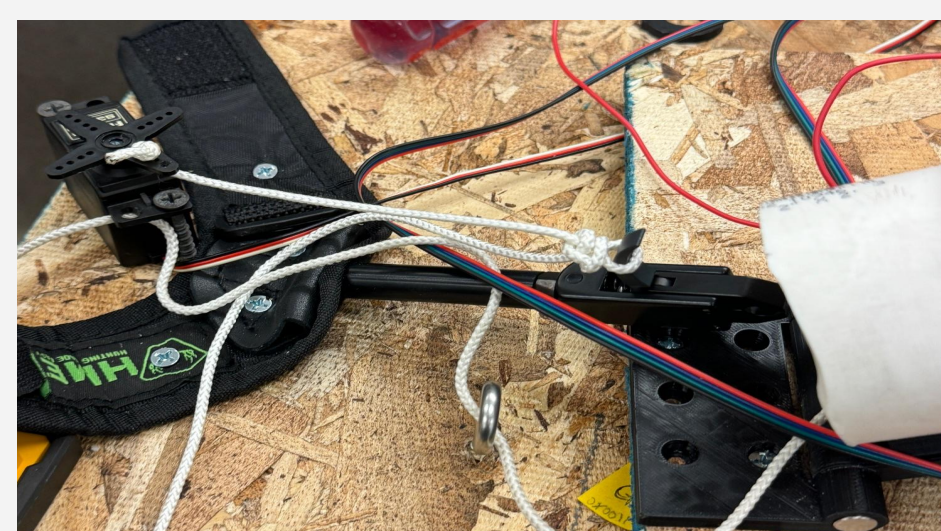
Challenges

- Limited stepper motor torque
- Calibration and Initialization
- Launching mechanism

Score Keeping & Strategy

- Sections off board
- Categorizes bags on the board with a column and row
- Selects throw based on position of bags and current score
- 3 difficulty levels

- Displays score, current game state, and use instructions on LCD screen
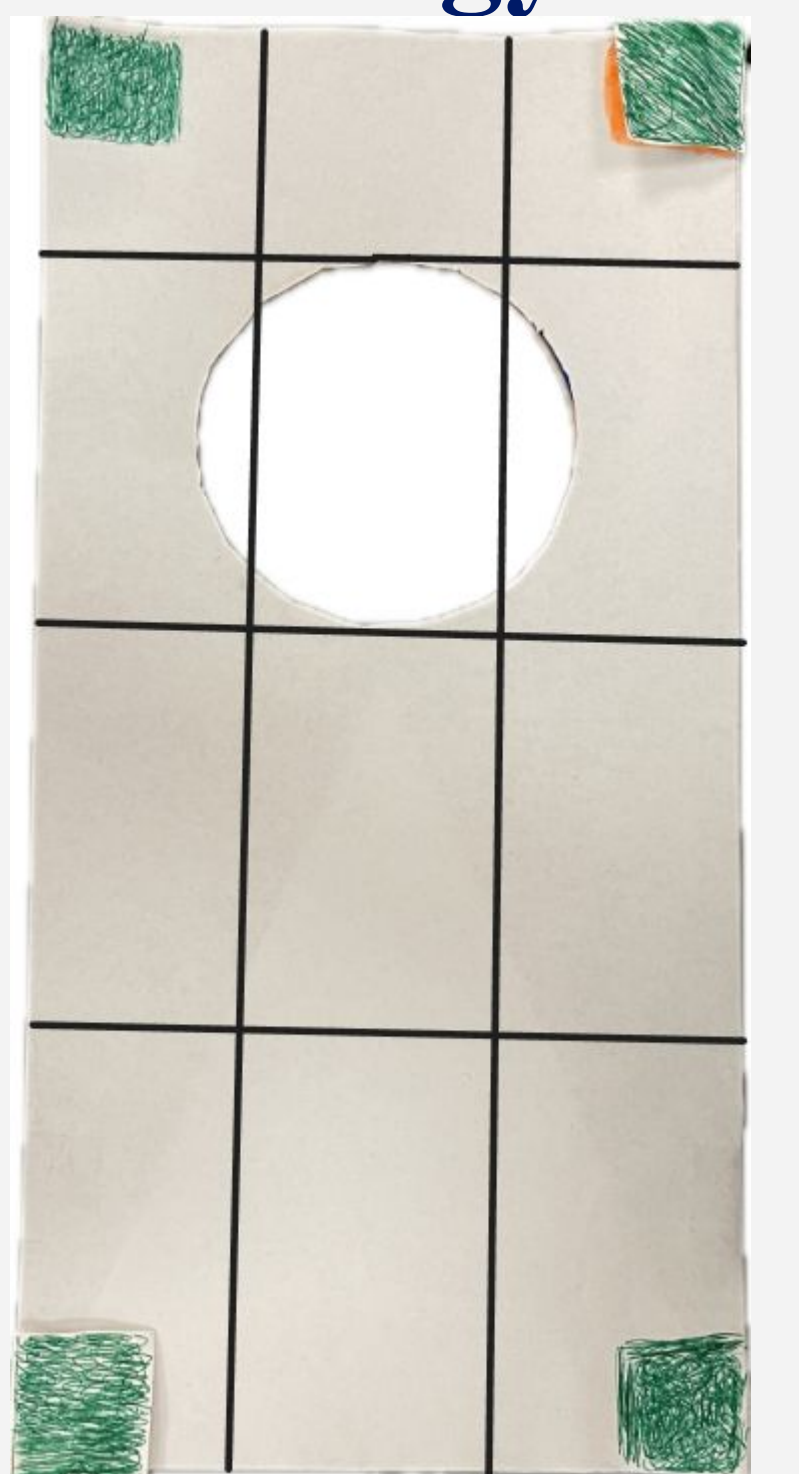
Challenges

- LCD screen format
- Throw precision
- Selecting board sections

Next Steps & Improvement

- Automatic Loading & Launching
- Real-scale board and bags
- Safety measures

Previous Attempts & Alternative Designs

- Flywheel launching mechanism (shown right)
- Turret style vertical angle adjustment (shown left)
- Arm launching mechanism (closer to real game)