In the Slot – Umpire Training Tool

STUDENTS: ANDREW CHENG, ZACH DANIEL, GILBERT LIN, JUDY LU, ARVIN NUSALIM, SAMANTHA REKSOSAMUDRA

Motive / Objective

- Status Quo: No tool available for umpires to learn the strike zone from personal perspective
- Goal: Develop a training system that allows umpires to be done from the umpire’s perspective
- MVP: Create a model that can determine whether a pitch is strike/ball from an uploaded video

Requirements

- System will provide an end-to-end user experience where an umpire will upload a video of a pitch, and then be returned a visualization of their strike zone.
- System will detect whether a pitch is a ball or a strike based on video captured from the umpire's perspective.
- Minimum 50% accuracy
- System will provide an interactive visualization of an umpire's accuracy

ML Ball Detection

- Machine learning based object detection is used to detect the baseball over the course of its trajectory during a pitch.
- A custom model was trained to detect baseballs, and ping pong balls based on the YOLOV6 algorithm.
- Captured videos under different lighting conditions to compile a baseball and ping pong ball custom dataset ~5.7 GB.

3D Strike Zone

- Photogrammetry is used to estimate the position of balls in the frame relative to camera
- Ping pong balls are used to mark the boundaries of the strike zone
- Algorithm is run at each frame to check if a baseball has entered the strike zone

Web Application

- Our primary objective in this project is to develop a user-intuitive platform interface, ensuring accessibility for both new and experienced users.
- Users can upload media files meeting pre-defined parameters, such as .mov and .mp4 formats
- Upon selecting ‘Predict’, uploaded media undergoes processing through our model
- A sample image at the bottom right shows a sample result page

Results

- Custom object detection model: Detect baseballs and ping pong balls in varying lighting and pitching speeds
- High detection accuracy: Detect baseballs within 10 feet of the camera in 85% of frames
- 3D strike zone calculation: Determine if a pitched ball is within the strike zone.
- Web app: Users can upload videos to analyze pitch results
- Interactive 3D visualization: Display the strike zone and overlay detected ball positions

Future Work, References, and Acknowledgments

- Improve UI/UX design to enhance usability, integrate login and data management, and simplify video uploads.
- Enhance the object detection system’s accuracy and reliability under challenging lighting, for consistent performance.
- Acquire cameras and sensors with higher resolution to improve the system’s accuracy and performance.
- Train LLM to automatically demarcate each pitch from an umpire training session
- Integration with wearable sensors to capture biometric data.
- Real-time analytics and insights to provide instant feedback to players and teams as well as actionable insights

ADVISERS: Jai Jaisimha, Atharva Mattam
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