Final Project Review

Team 1 (AutoUmp)
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The Team

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The Setting
Current Solutions

- Prohibitively expensive
- Extensive set-up required
- Inaccurate
- Biased
Our Solution

- A self-contained, autonomous home plate that detects balls and strikes
- Cheaper than traditional technology
- Not subject to human error
Requirements

- Detect balls/strikes accurately (>= human ump)
- Detect fastball of average little league player
- Real-time use
- Self-standing
- Battery life lasts duration of game
- Robust against physical impacts, changing weather
- Allow for different height batters
Key Challenges

- Detect and track ball with cameras
- Embedded hardware
  - Image processing on an embedded system with power/size constraints
- Design of robust, self-enclosed system that still allows for user notification and feedback
  - Enclosure
  - App, 2-way communication
Block Diagram - Hardware

- OV07740 Camera
- Xmos Processor (Slave)
- Xmos Processor (Master)
- LiPo Battery
- Power supplies
- LEDs
- Bluetooth
- GUI
Specifications

- 16.7ms throughput for image processing tasks
- 60fps with 110 degree field of view in flight direction
- Maximum 1 second delay
- Self-standing
- Can withstand physical conditions at baseball field
- Battery life > 3 hours
- Adjustable height of strike zone from app
Ball Detection

- Interpolate path of ball using a ball on either side of the strike zone
- Calculate pixel location of strike zone intersection
Ball Detection

- Use pixel location from each camera to calculate (x,y) position of baseball in strike zone plane
Ball Detection

- Tilt cameras in order to see entire strike zone
Dealing with Bottlenecks

XMOS

Game Master → Bluetooth TX

Object Tracker → Bluetooth Rx

Flood Fill 1 → Flood Fill 2

Flood Fill 3 → Flood Fill 4

Processing Master → Camera 1

Camera 2

Flood Fill 5

Flood Fill 6
Camera Protection

- Baseball fields made up of dirt
- Polycarbonate: (Mohs)
- Glass: 5.5 (Mohs)
- Quartz: 7 (Mohs)
- Sapphire: 9 (Mohs)
Requirements

- Detect balls/strikes accurately
- Detect fastball of little league player ~35mph
- Real-time use: Yes, no perceptible delay
- Self-standing: Yes
- Battery life lasts duration of game: Yes
- Robust against physical impacts, changing weather: Yes
- Allow for different height batters: Yes, via app
Costs

- Initial Prototype Development: $380.26
- Final Prototype Development: $677.25
  - PCBs: $478.28
  - Enclosure: $198.97
- Miscellaneous: $185.69

- Development Cost: $1242.94
- Final Prototype Actual Cost: ~$200.00