IC Chipz

Team: sdmay20-40
Members: Nicholas Dykhuizen, Justin Elsbernd, Joshua Heiser, Andrew Kicklighter, Paul Kiel , Alexander Weakland

Adviser/Client: Dr. Henry Duwe
**Website:** https://sdmay20-40.sd.ece.iastate.edu

Problem Statement

Skeet shooting should be automatically judged and scored accurately for all tournaments and events. In today's world, there is becoming a shortage of reliable skeet shooting judges. If this problem continues to be ignored, the sport of skeet shooting will eventually be out of options for judges. To solve this issue, the team will use the implementation of an automatic scoring systems to fairly judge skeet shooting events.

Solution

Using a Nvidia Jetson board with a E-Con Systems camera recording 60FPS at 1080p to automate the the judging process by using YOLO image recognition that is able to communicate via. WiFi or Bluetooth with our mobile application to successfully and accurately score any number of skeet shooting rounds for the user.

Design Approach
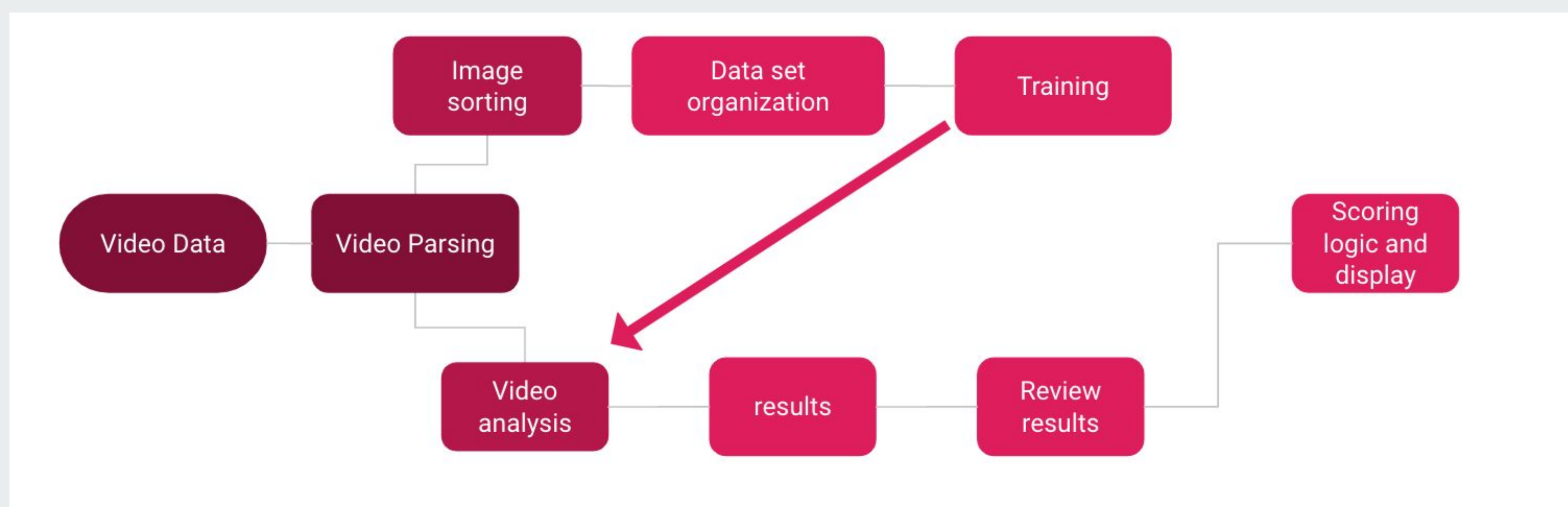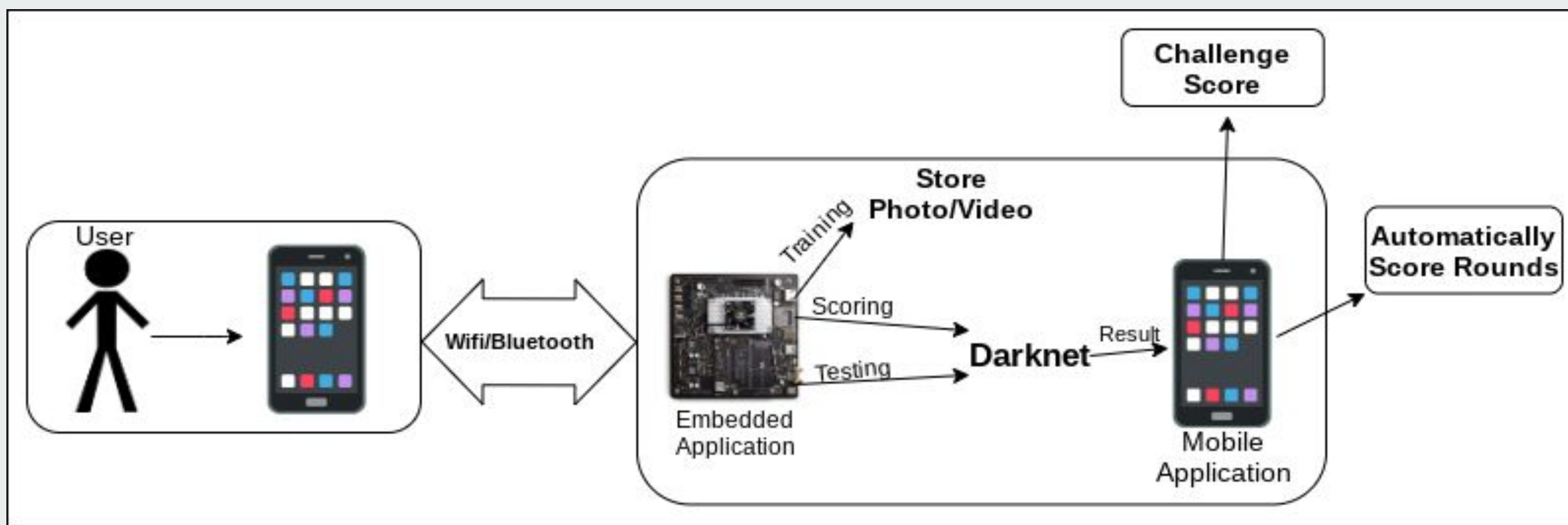
Testing

- **Mobile Testing**
  - Ensure that all functionalities required for the mobile app works as expected
  - Used Apple's Test Flight so that other team members were able to utilize the application to ensure the application was bug and error free
- **Integration Testing**
  - Made sure that the mobile app and the embedded board can communicate as needed
  - Ensured that file transfers are successful
  - Confirmed that file storage is done correctly based on inputs
- **Embedded Testing**
  - Confirmed that the scoring algorithm works
  - Created proper test and training sets
  - Added the training sets to Darknet to increase its accuracy
  - Used Python scripts to test the accuracy meets the requirements set out at the beginning of the semester (95+ percent)
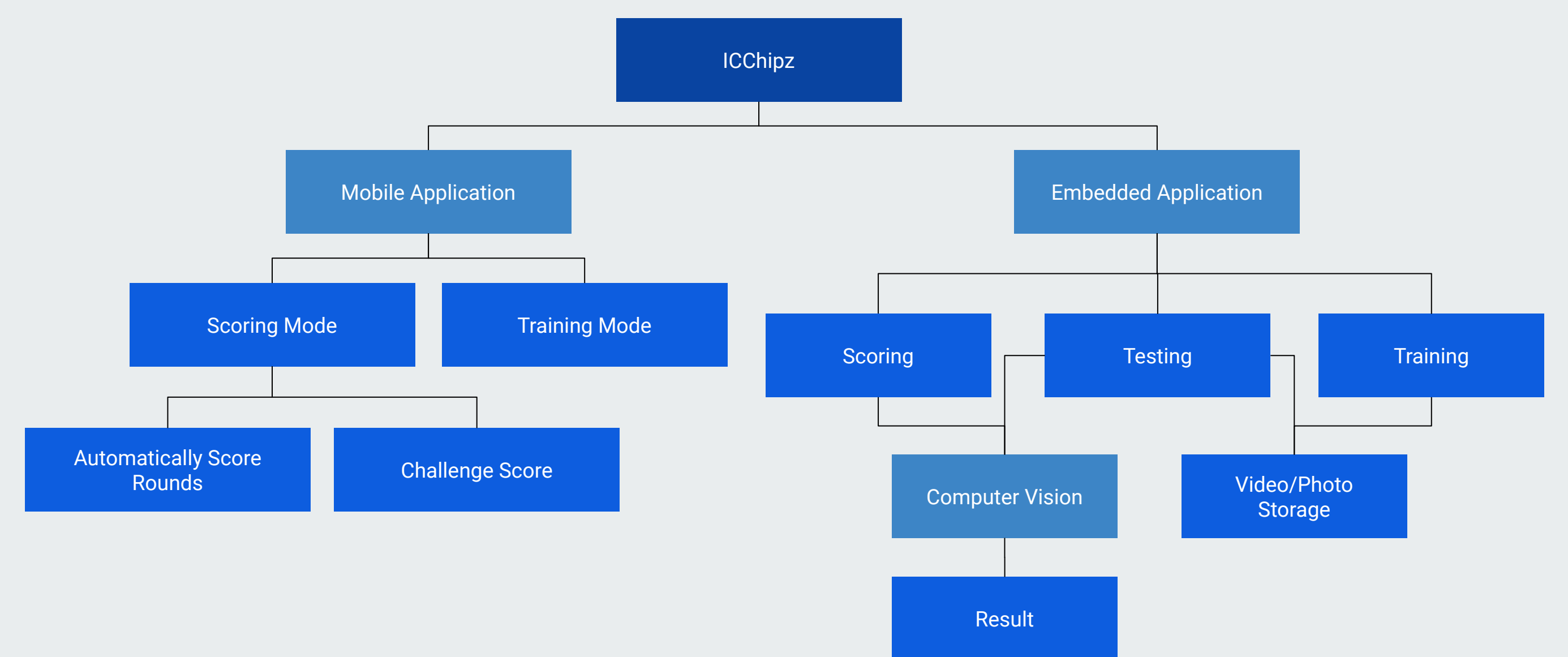
Final Product
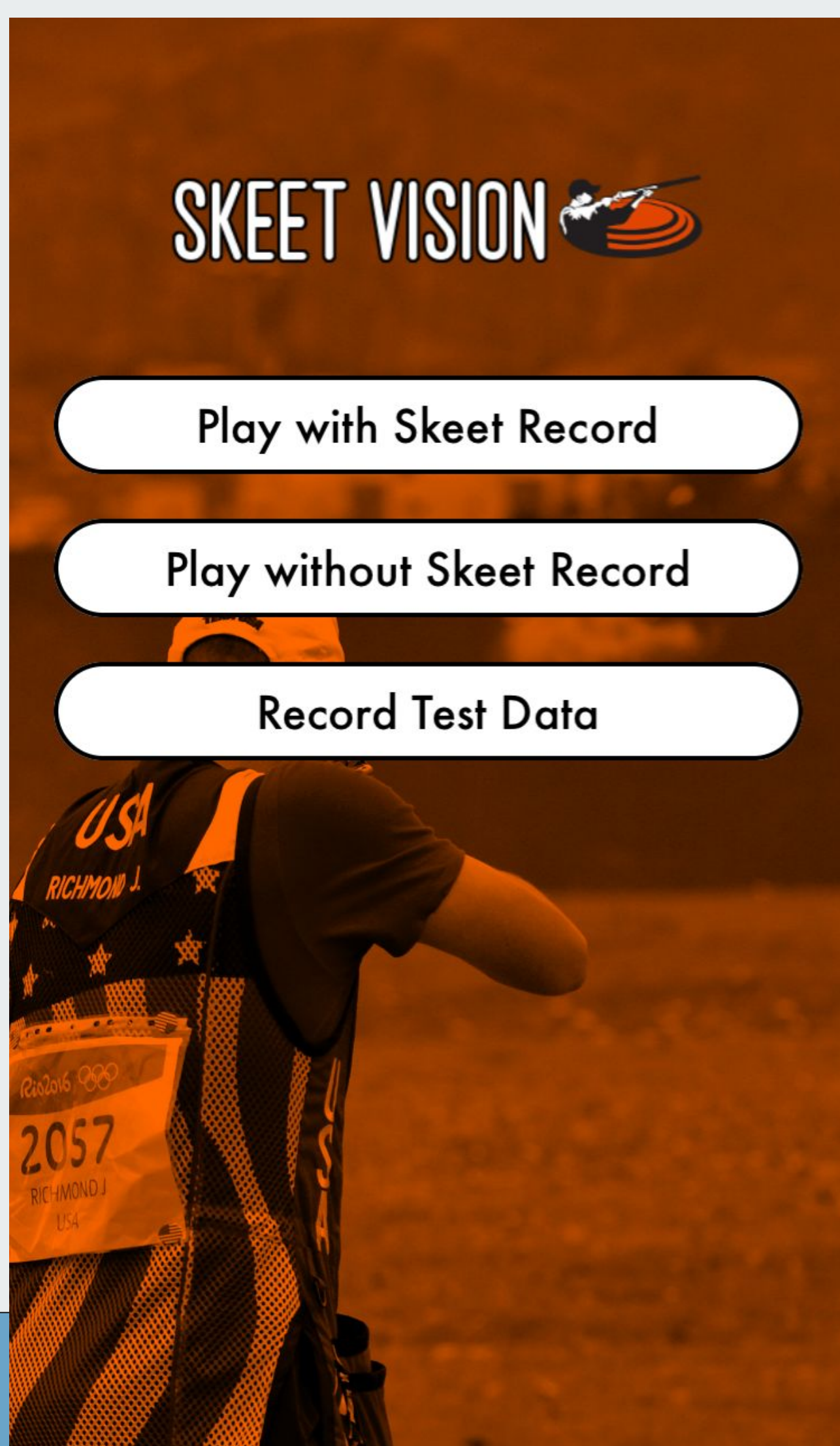
Mobile Application

Nvidia Jetson Board w/ E-con Systems Camera

Functional Decomposition

Design Requirements

Functional Requirements
- Mobile application to monitor video, keep records, and show scoring and save rounds
- Program which uses image processing to decompose video to determine scoring
- Low error rate
- Product functions at a 95%+ success rate given night time conditions
- Automated data collection and flow into analysis systems.
- Automated data labeling

User Interface Requirements
- Track the score of the round
- Display whether the clay pigeon is dead or alive after a shot
- The application should output a final scorecard when the round is over
- The ability to review video to dispute a call
- The UI should be organized and easy to use
- The application should store past rounds in a database

Environmental Requirements
- Machine vision model should work in any weather condition
- Machine vision model's accuracy for unique conditions should still be relatively high
- Model should have the same desired accuracy for detecting both live and ead clay pigeons

Market Requirements
- Hardware should be relatively cheap
- No large purchases should be required unless a functional requirement is involved

Technical Details

Hardware:
- Nvidia Jetson board
- E-Con Systems TX130 camera

Software:
- Darknet
- YOLO Image Recognition API
- OpenCV
- C++ and Python
- Xamarin Forms (XAML and C#)

Intended Users

There are two main intended users of this product. The first users are referees who are judging the skeet shots. They will use this product because it will help them accurately check and see if a clay pigeon has been successfully shot or not, both through the computer vision and through the video feedback through the mobile application.

The second user of this product is the players doing the skeet shooting. They will use this product because it will help them keep track of their score without the need of always having a referee and use the video feedback in order to study their shots.

Engineering Standards and Design Practices

- IEEE 829 - Documentation Standards
- IEEE 1220-2005 - Standard for Application and Management of the Systems Engineering Process
- IEEE 1012-2016 - Standard for System, Software, and Hardware Verification and Validation