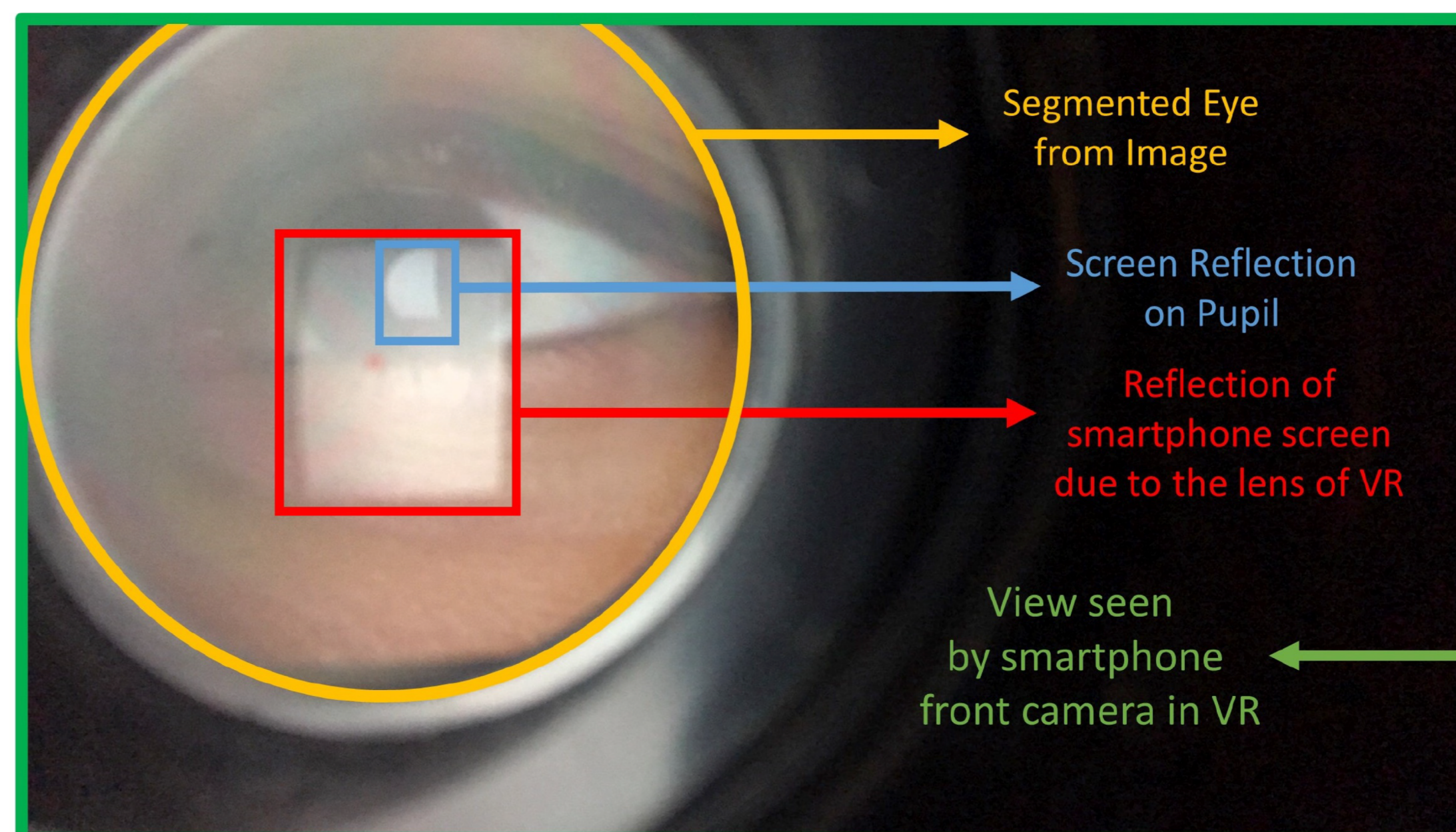


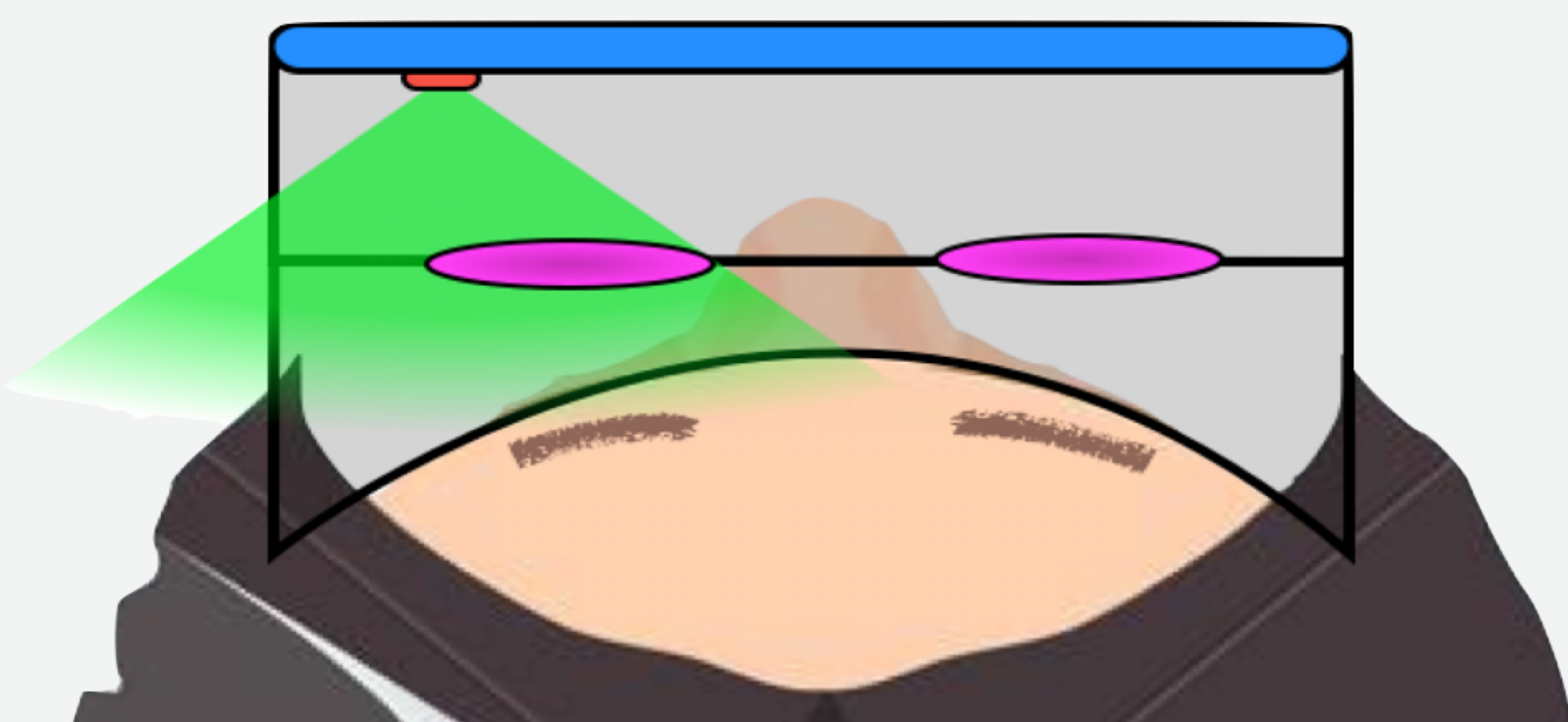
EyeSpyVR: Interactive Eye Sensing using Off-the-Shelf Smartphone-Based VR Headsets

Karan Ahuja, Rahul Islam, Varun Parashar, Kuntal Dey, Chris Harrison and Mayank Goel

Low cost virtual reality (VR) headsets powered by smartphones are becoming ubiquitous. Their unique position on the user's face opens interesting opportunities for interactive sensing. In this paper, we describe EyeSpyVR, a software-only eye sensing approach for smartphone-based VR, which uses a smartphone's front facing camera as a sensor and its display as a passive illuminator. Our proof-of-concept system, using a commodity smartphone, enables four sensing modalities: detecting when the VR head set is worn, detecting blinks, recognizing the wearer's identity, and coarse gaze tracking - features typically found in high-end or specialty VR headsets. We demonstrate the utility and accuracy of EyeSpyVR in a series of studies with 70 participants.

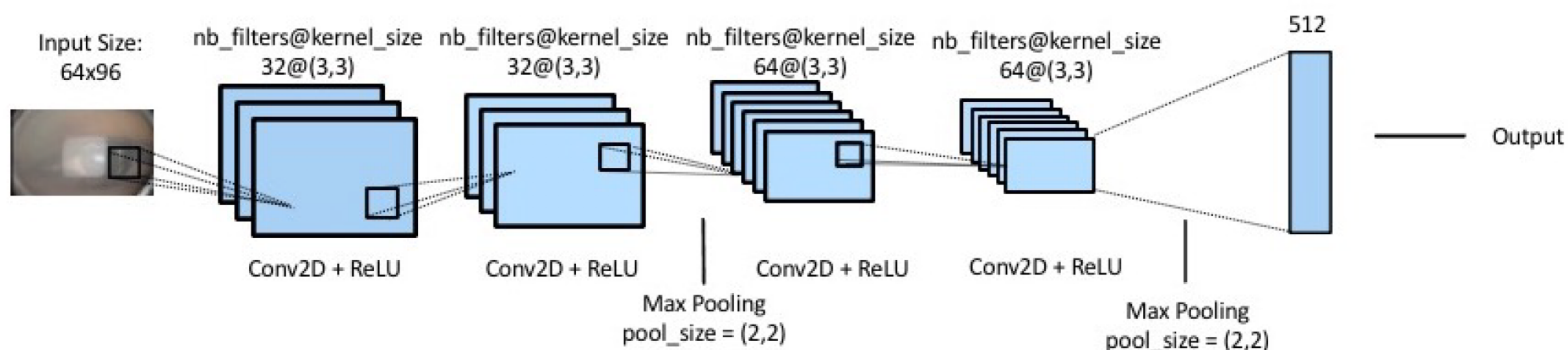


View from a smartphone's front facing camera.



Top down view of VR headset when worn

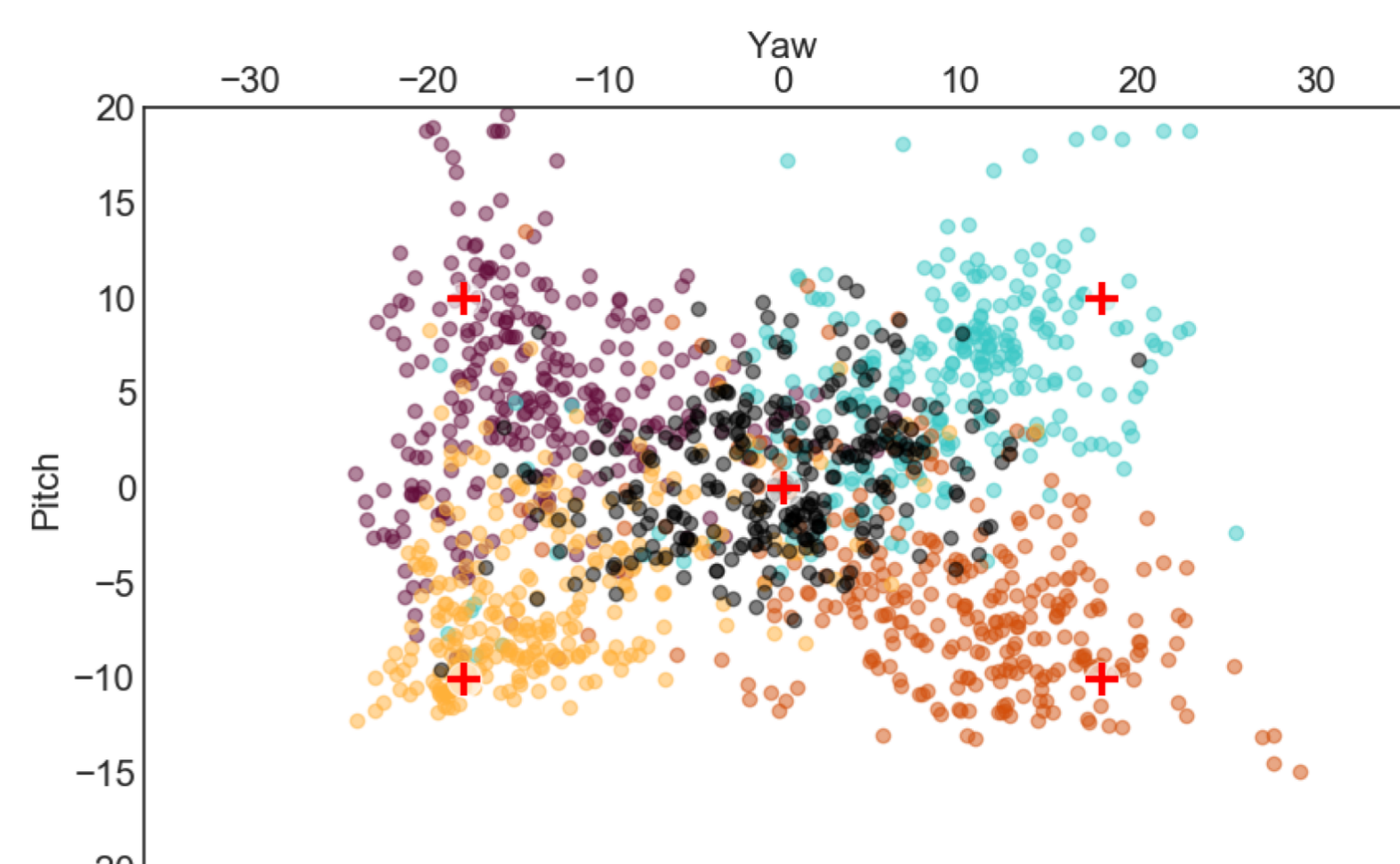
- Smartphone in blue
- Camera in red
- Field of view of camera green
- Headset lenses in pink



Convolutional networks used to train models for blink, gaze location and user identification

Results

- Worn detection: 100%
- Blink Detection: 95.3% (S.D. = 0.11)
- Simulated family Biometric across 4 users: 81.4 %
- Gaze Estimation:
 - Person independent (no calibration): 12.9°
 - Person dependent (with calibration): 10.8°



Per user gaze calibrated accuracy across five points. Red cross-hairs showcase ground truth