



CSE 165: 3D User Interaction

Lecture #20:
Marker-Based Interaction

Upcoming Deadlines

- CAPE + TA evaluations
- Sunday, March 14th at 11:59pm:
 - Homework project 4 late deadline
- Final Exam
 - 3 hour exam, **no interruptions**
 - To be taken in 24 hour window between 6pm Wed 3/17 and 6pm Thu 3/18

Marker Based Tracking

Tracking in AR Environments

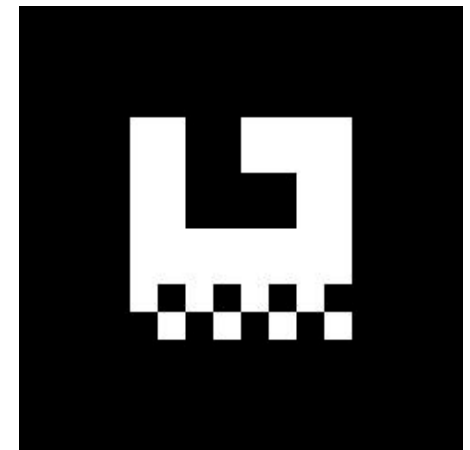
- Inside-out camera tracking (SLAM-based) is not 100% stable
- Markers in environment can anchor virtual in real coordinate space

Optical Tracking: ARToolkit

- Developed in 1999 by Hirokazu Kato, HITLab, University of Washington
- Printable square b/w markers
- Camera pose estimation: single camera tracks in 6 DOF
- Flexible marker design



ARToolKit



ARToolKit marker

ARToolkit Video

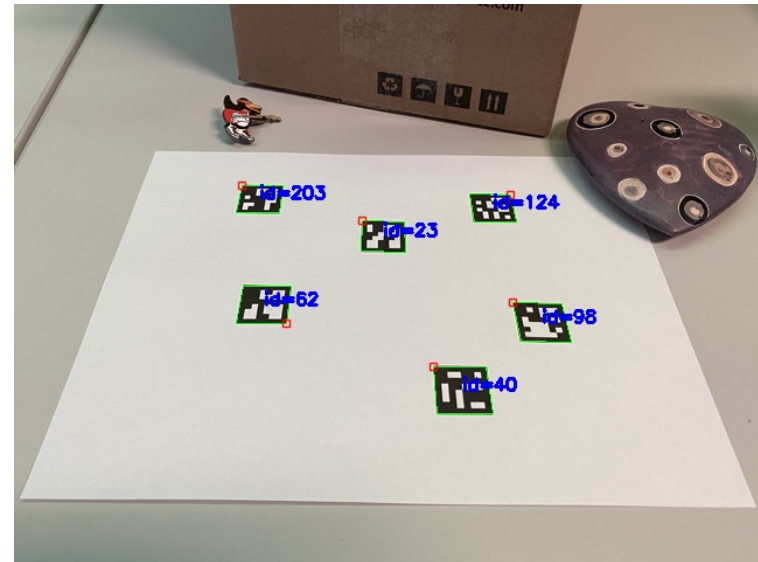
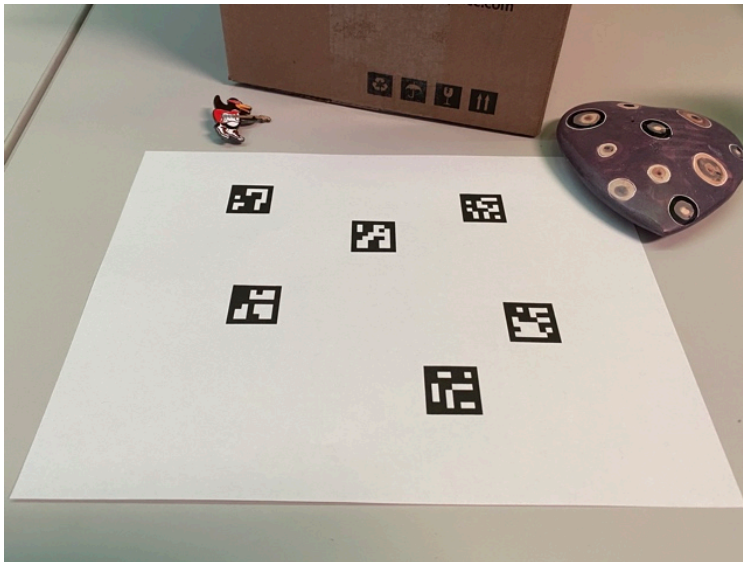
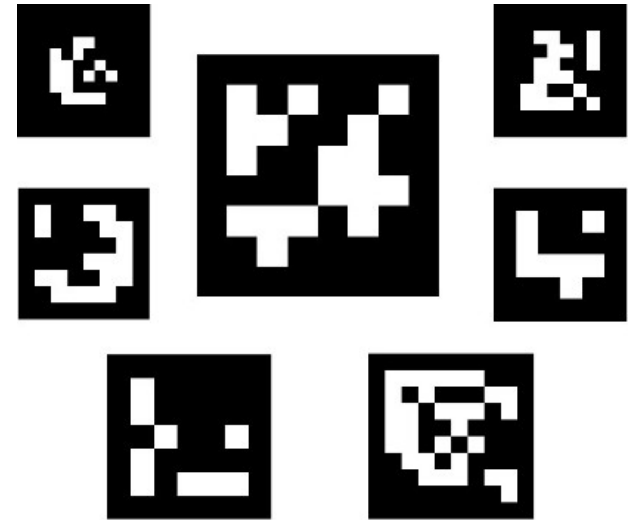


Ikea Catalogue with AR

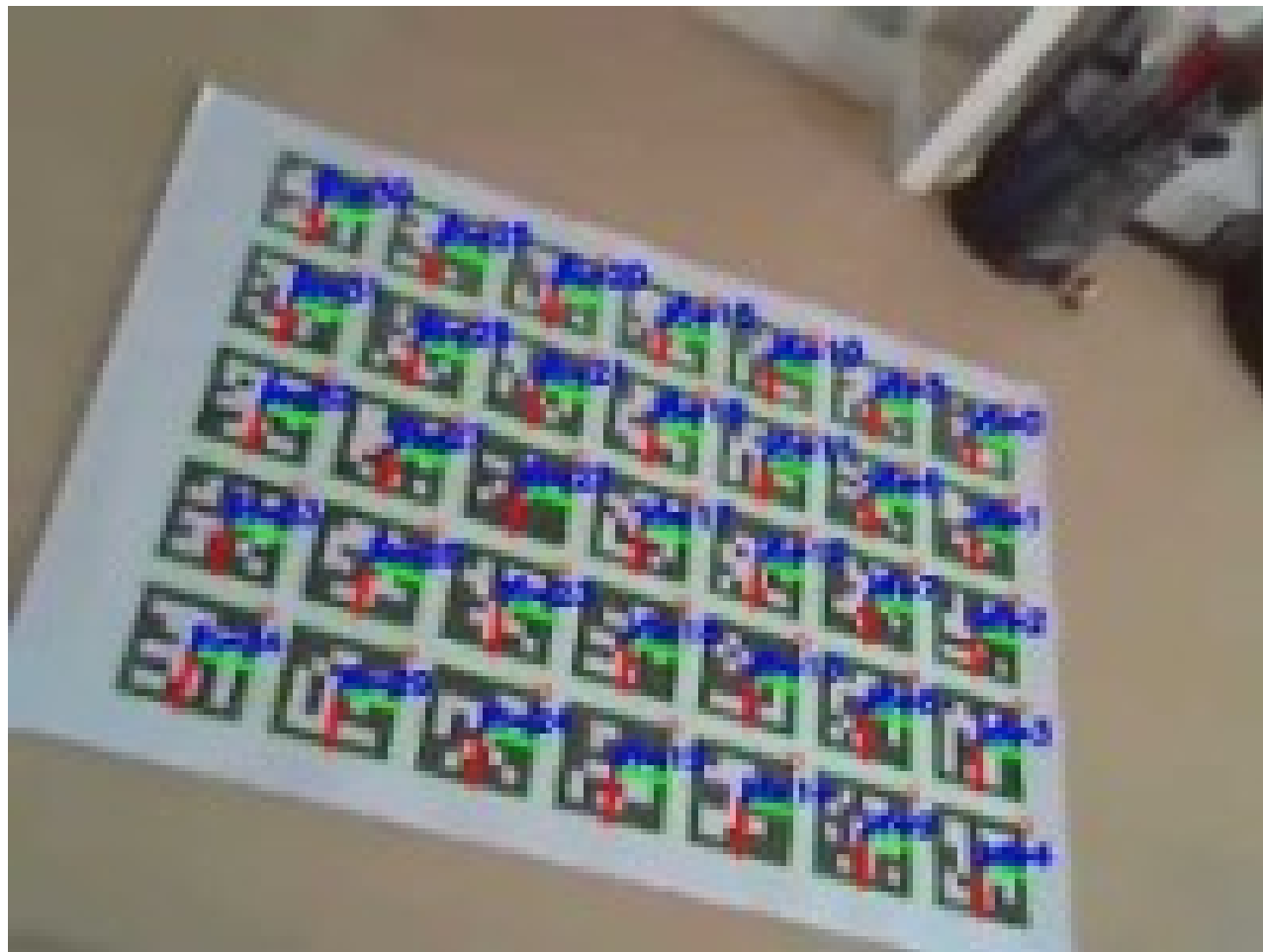


OpenCV

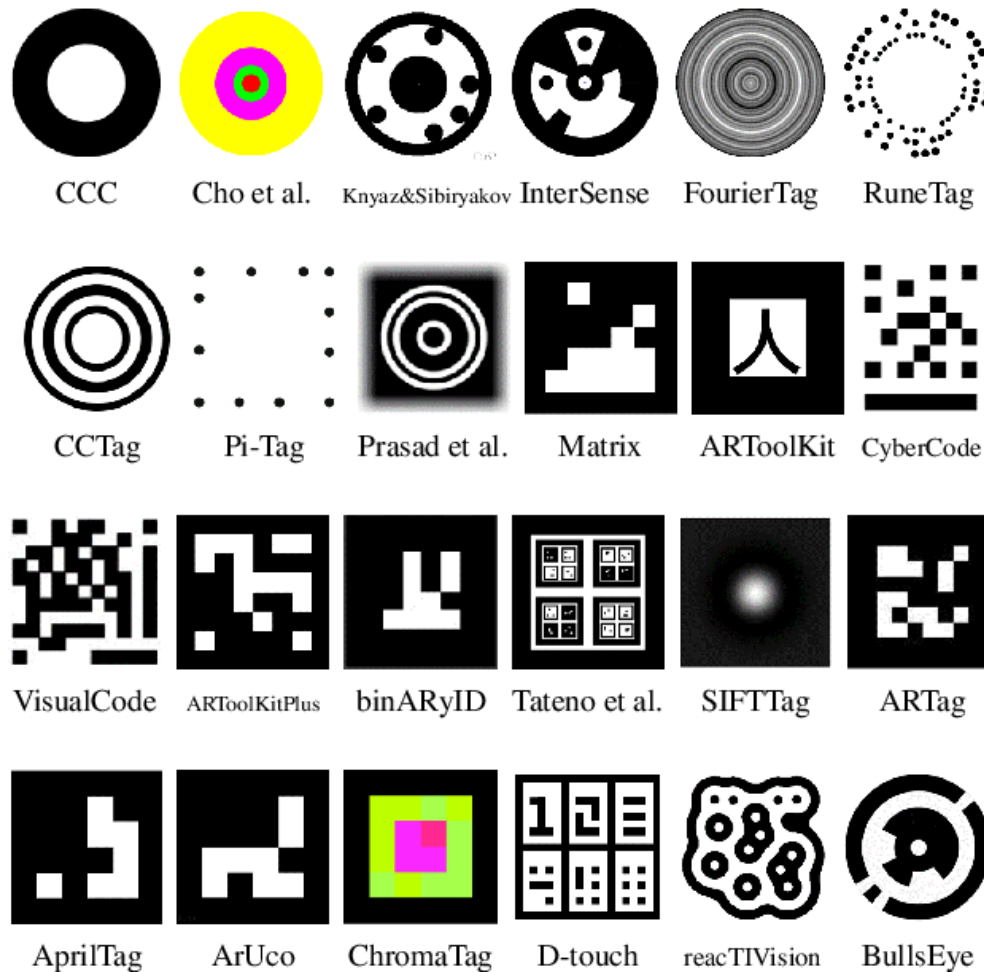
- OpenCV uses markers from ArUco library
- Procedural creation of markers



OpenCV/ArUco Marker Demo



Other Marker APIs



PTC Vuforia

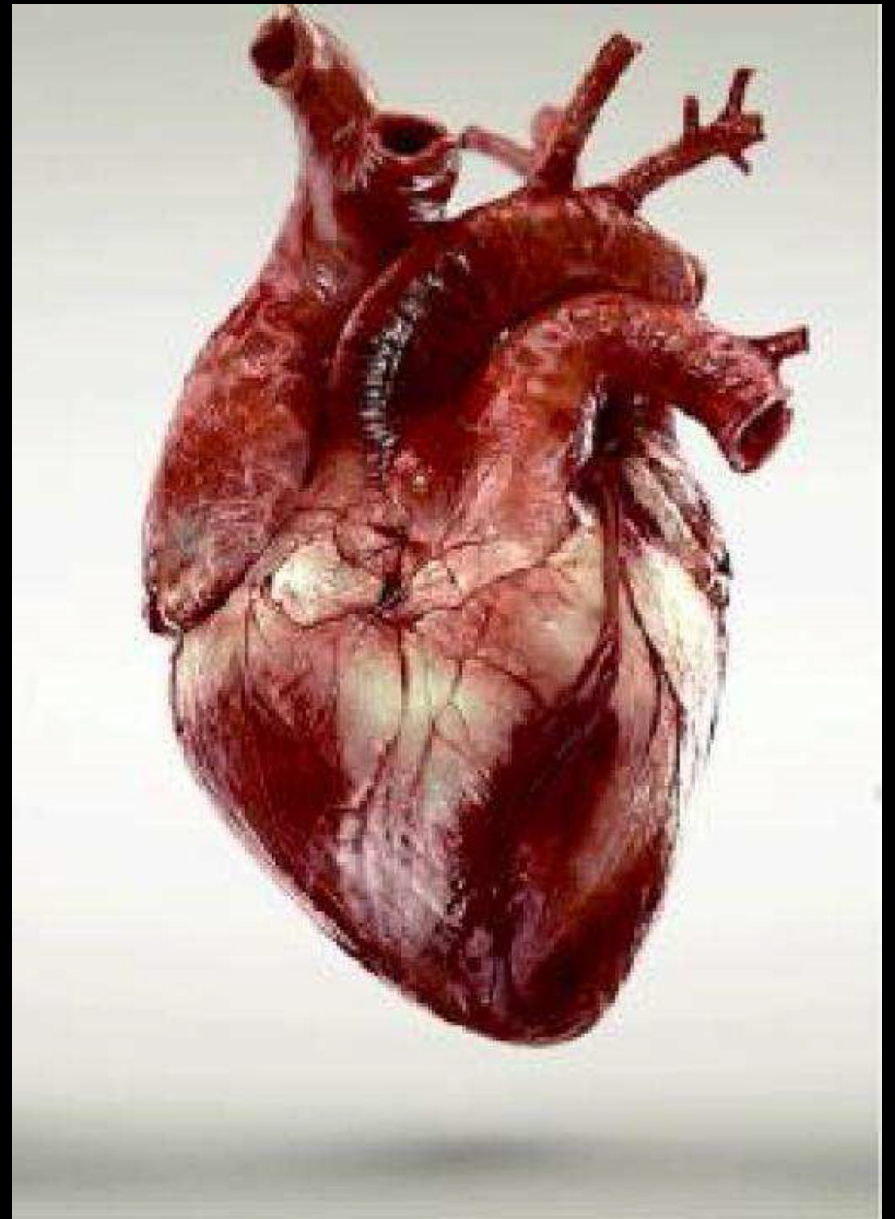
- One of the most advanced AR software development kits (SDK) for mobile devices
- Uses computer vision to track 2D markers and 3D objects in real time
- Allows for regular images to be treated as markers
- Was initially created by a Qualcomm company
- Acquired by PTC Inc. in 2015

PTC Vuforia AR Features



Augmented Reality Demo

- Android app:
 - Download “Augmented Reality EdTech Tryit” by CreativiTIC from Google Play Store
 - <https://tinyurl.com/y43emzw4>
 - App uses Vuforia SDK for image recognition
- For testing point at images on next slide



Android app: <https://tinyurl.com/y43emzw4>

The Future of 3D UIs

UIST 2020 Teaser (3:34)



A Day Made of Glass Extended Montage from 2013 (5:11)



Microsoft's Concept of 2020 (5:45)



Good luck with your final exams!