

climbAR

Augmented Reality Climbing, a CS98 Project

What is climbAR?

ClimbAR is an augmented reality framework for developing interactive rock climbing games.



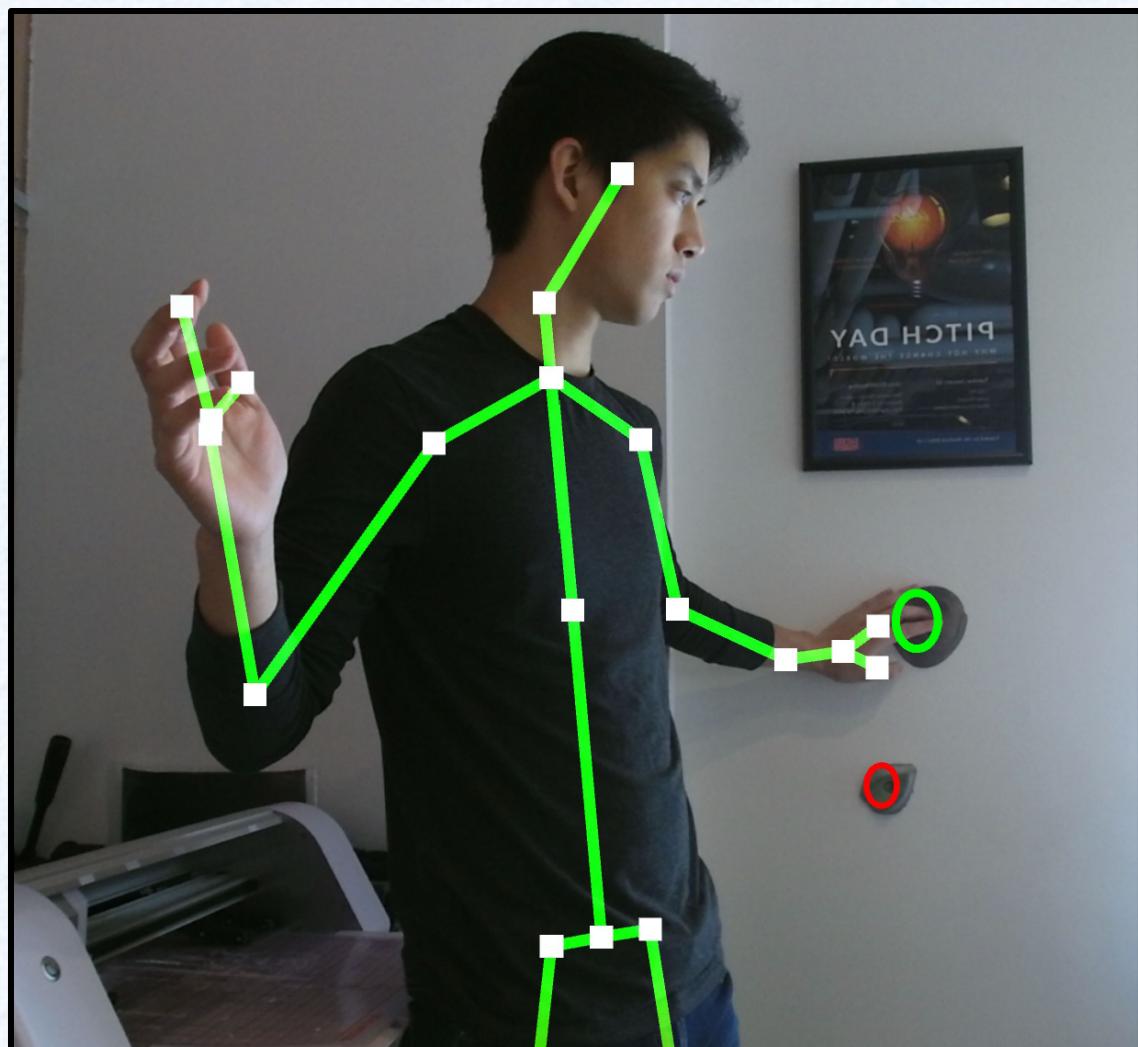
Example Games

Music Game

Touch a hold to mute/unmute an instrument from our upbeat jazz song!

Rocman

For this multiplayer game, one person controls a Pacman-style ghost with the arrow keys, and the other has to avoid it while climbing on the wall!

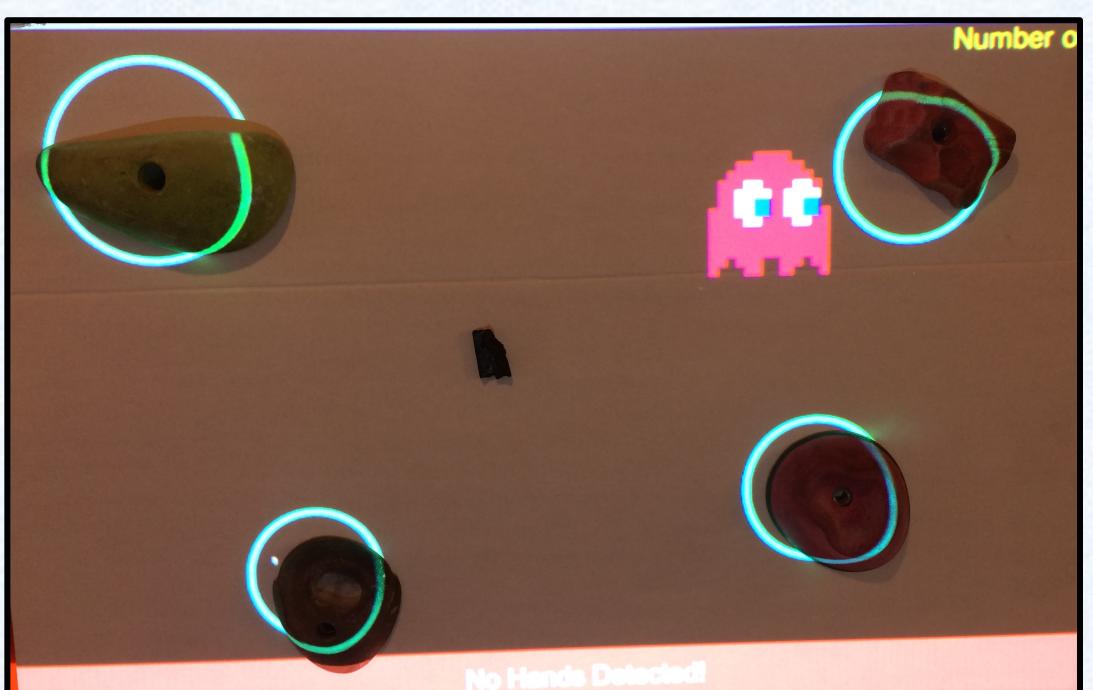


climbAR SDK

Our final product is not the demo games themselves, but an SDK that makes it easy for other developers to create fun Augmented Reality games for climbing walls!

We provide functions that make it super easy to track the user's body, identify where the holds are, detect when the user interacts with holds, add custom functionality to holds, and much more.

We also provide a framework for developing games using the climbAR SDK, as well as a demo menu scene and games as examples to start with.



How to play climbAR games

- Start facing the projector
 - The Kinect is picky and might not track your body if you don't look at it first
- Climb on the wall like you normally would. As long as you stay within the projection area, the Kinect will track your body.
- You can only use your hands to trigger the holds - while we track your entire body, we only let you use your hands to interact with the game.
- If you grab a hold out of the Kinect's field of vision, it will not be tracked. That includes blocking the field of vision with your body (i.e. grabbing a hold right in front of your body).

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Components

Unity Game Engine

Unity is a cross-platform game engine. We use Unity to create all the graphics displayed on the climbing wall, and program all the interaction between the graphics and the user.



Microsoft Kinect

We use a Kinect and the Kinect SDK to identify climbing holds and track the user's body.

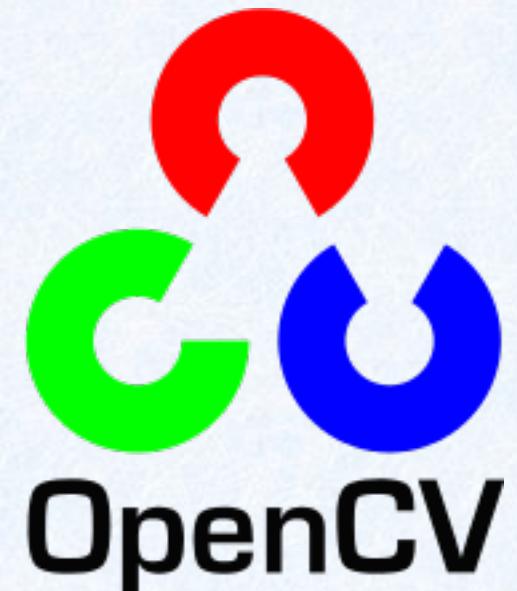
The Kinect uses an array of sensors to track the user's body in real time, and gives us access to the tracked skeleton through the Kinect SDK.

We also use a frame from the Kinect to identify climbing holds, using an OpenCV Computer Vision classifier.

OpenCV

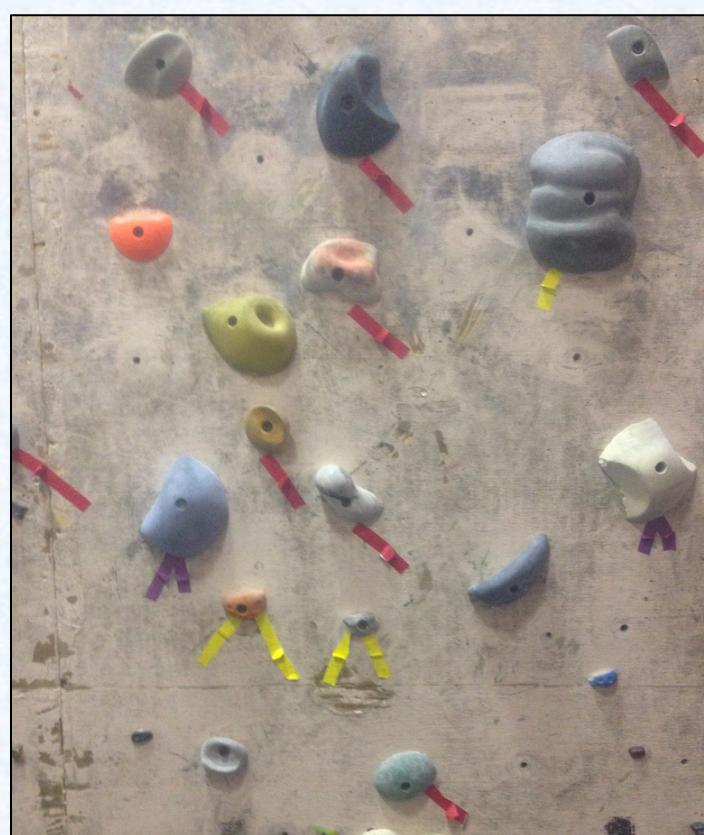
OpenCV (Open Source Computer Vision) is a library of functions aimed at real time computer vision, i.e. enabling computers to “see”.

- OpenCV exists in C++ but not in C#, so we built it as a DLL (Dynamic-Link Library, for Windows)
 - We wrote a wrapper to import it in Unity, to avoid buying an expensive Unity asset.



OpenCV Climbing Hold Detector

- We use OpenCV to “see” the holds in the wall, so that our software automatically knows where the holds are, in any climbing gym, just like you do when you see a climbing wall!
 - Start with ~500 positive & negative up close images of climbing holds and train an OpenCV custom object detection classifier (Haar classifier) to detect climbing holds
 - Each image needs a bounding box to indicate the object we are targeting. In our case, the entire image is the bounding box since we took close up images.
 - We pass a frame from the Kinect to the classifier, which returns the positions of all the holds. We can now use this information to build games based on the climbing wall!



X3000 Infinite Precision Quantum Projector

Just kidding, it's a regular projector.



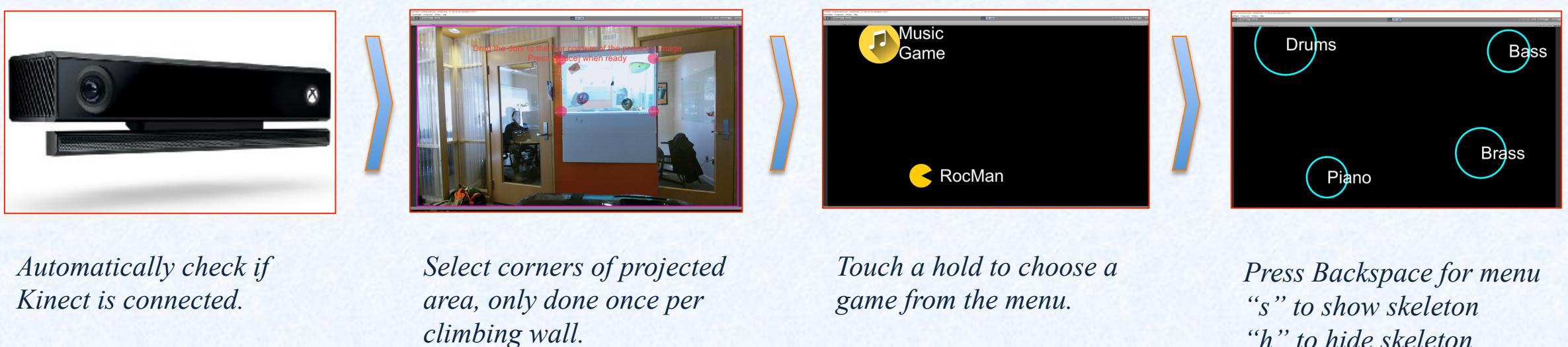
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Hold Classification



Setup and gameplay



The Team



Left to Right: Orestis Lykouropoulos, Charley Ren, Pat Xu, David Bain, Jon Kramer

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