TCU
Computer Science Department

TouchCU

Enabling Touch, Anywhere!

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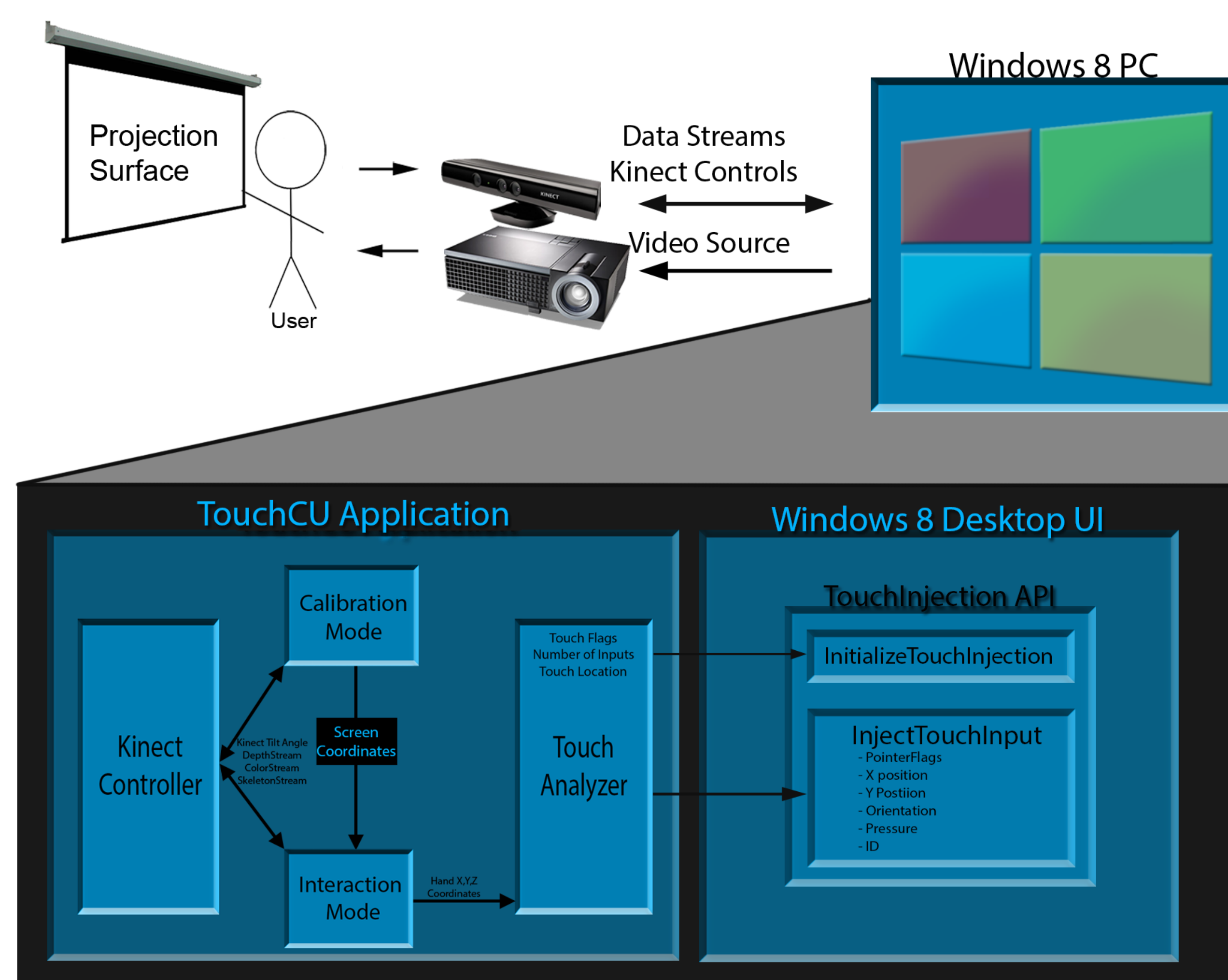
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What is TouchCU

2013-2014 capstone project geared toward turning any flat surface into a multi-touch screen; utilizing the Microsoft Kinect for Windows, a standard projector, a Windows 8 PC, and a flat non-reflective surface.

Microsoft supported Ubi-Interactive in developing a similar product that is available commercially. TouchCU, while similar in concept, allows for a greater operating range and implements voice interaction.
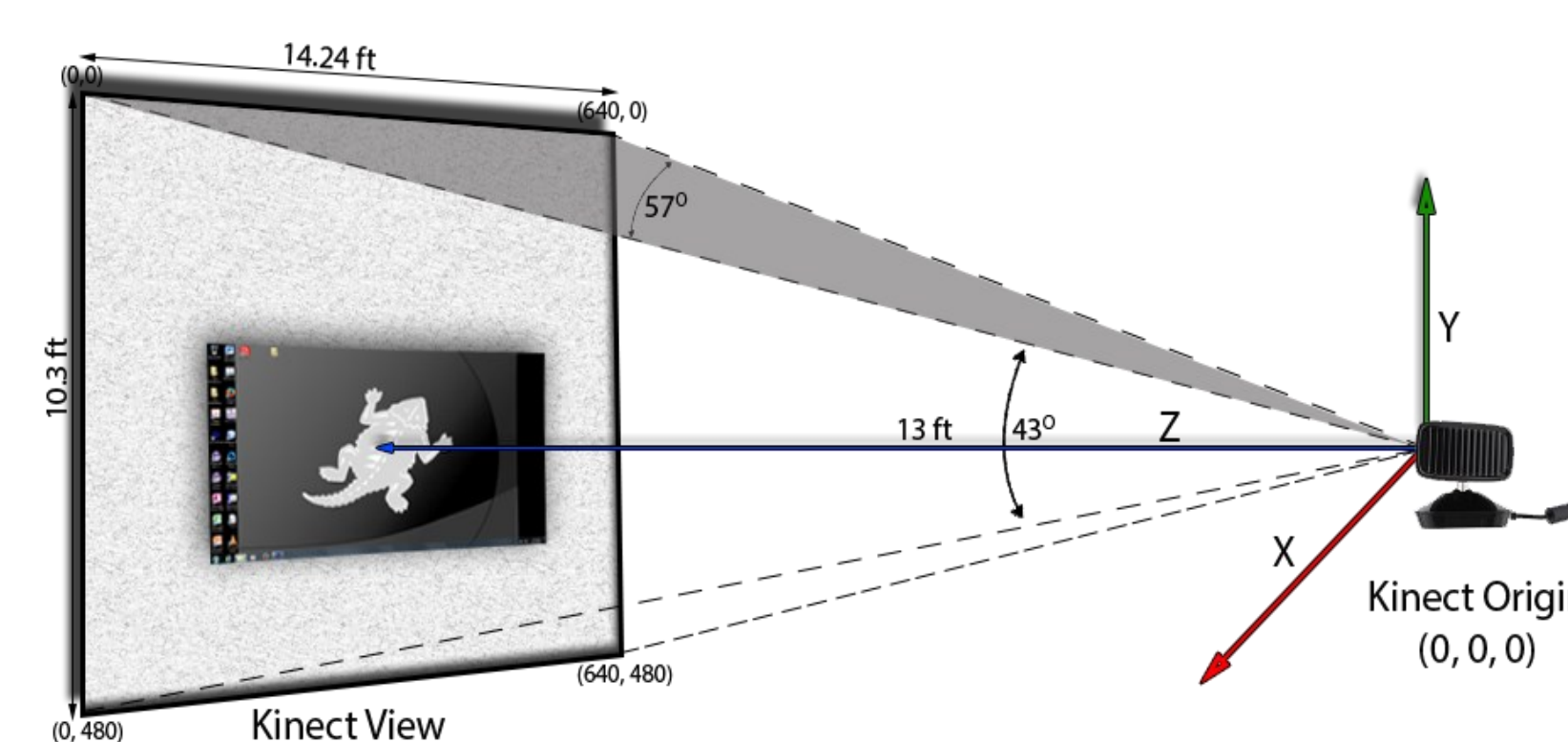
Background

- Massive growth of touch technology integration into our every day devices

- Created an increase in demand by users for new and innovative ways to interact with their devices

- Users are looking for easier ways to interact with their personal computers

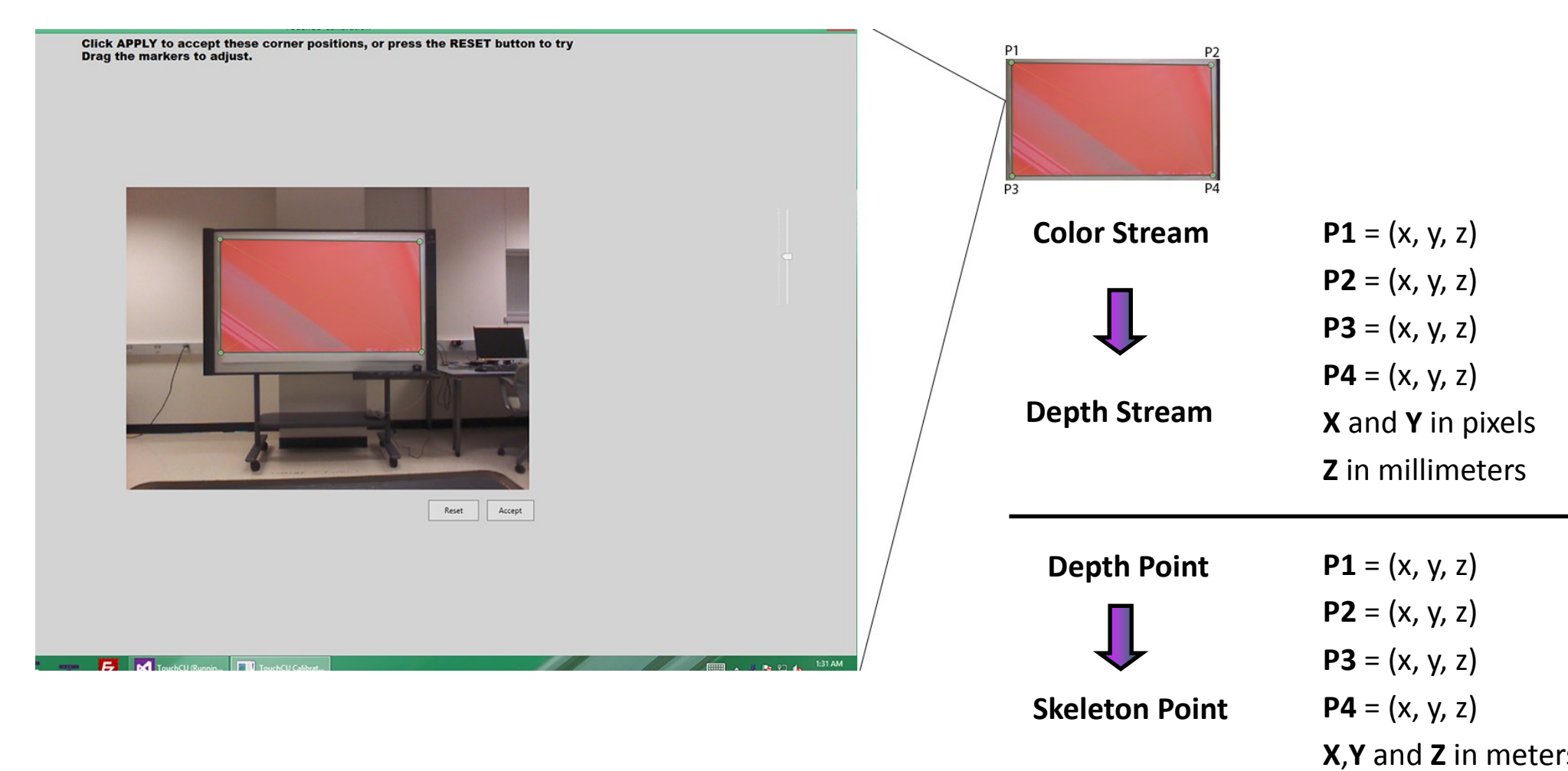- Current solutions limit operating range and do not include voice commands

System Design

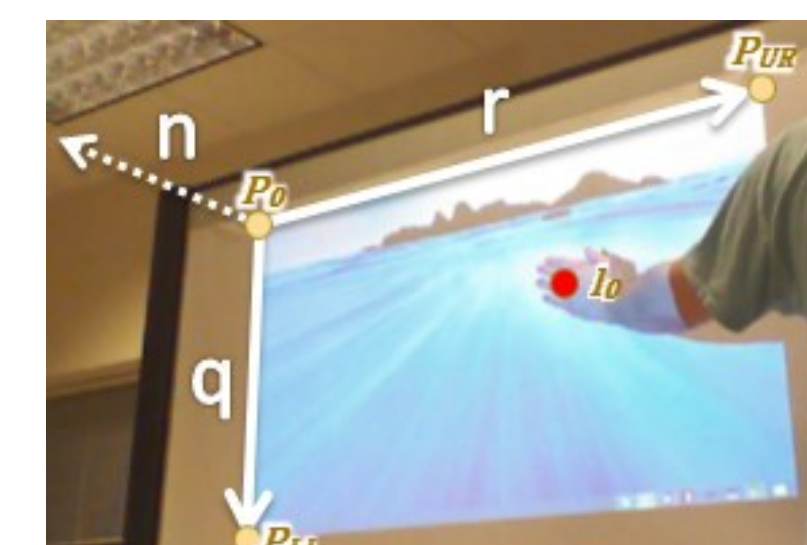

Obtaining Windows Screen Position

Step 1: Setup

Step 2: Calibrate

Color Stream
P1 = (x, y, z)
P2 = (x, y, z)
P3 = (x, y, z)
P4 = (x, y, z)
X and Y in pixels
Z in millimeters

Depth Stream

Depth Point
P1 = (x, y, z)
P2 = (x, y, z)
P3 = (x, y, z)
P4 = (x, y, z)

Skeleton Point
X, Y and Z in meters

Step 3:
Determine Hand Position On Projection Screen

Every point in Kinect's 3D space can be represented by: (X_k, Y_k, Z_k)

- For any hand position, its pixel location x, y, and its distance from the screen z, can be calculated by:

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = (\vec{r} \quad \vec{q} \quad \vec{n})^{-1} (\vec{l_0} - \overrightarrow{OP_0})$$

- Touch Injection Screen Point: $(X_0, Y_0) = (width * x, height * y)$

- Distance from Hand to Screen: $d = z$

User Interaction

Touch - 1 Hand

Tap   Hold   Drag

Voice

Addie

Open / Close

Start Menu
Window
My Documents
Settings
Debug

Touch - 2 Hand

Rotate   Zoom

Air

Swipe Left   Swipe Right

The Microsoft Kinect

- Motion sensing device developed by Microsoft for Windows PC and Xbox

- Data Streams: Color, Depth, Skeleton, Audio

  - Tracks up to 20 joints (Default); 10 joints (Seated)

  - Maximum capture rate of 30fps

  - Contains an IR sensor, microphone array, and color camera

- Used in speech and gesture recognition applications
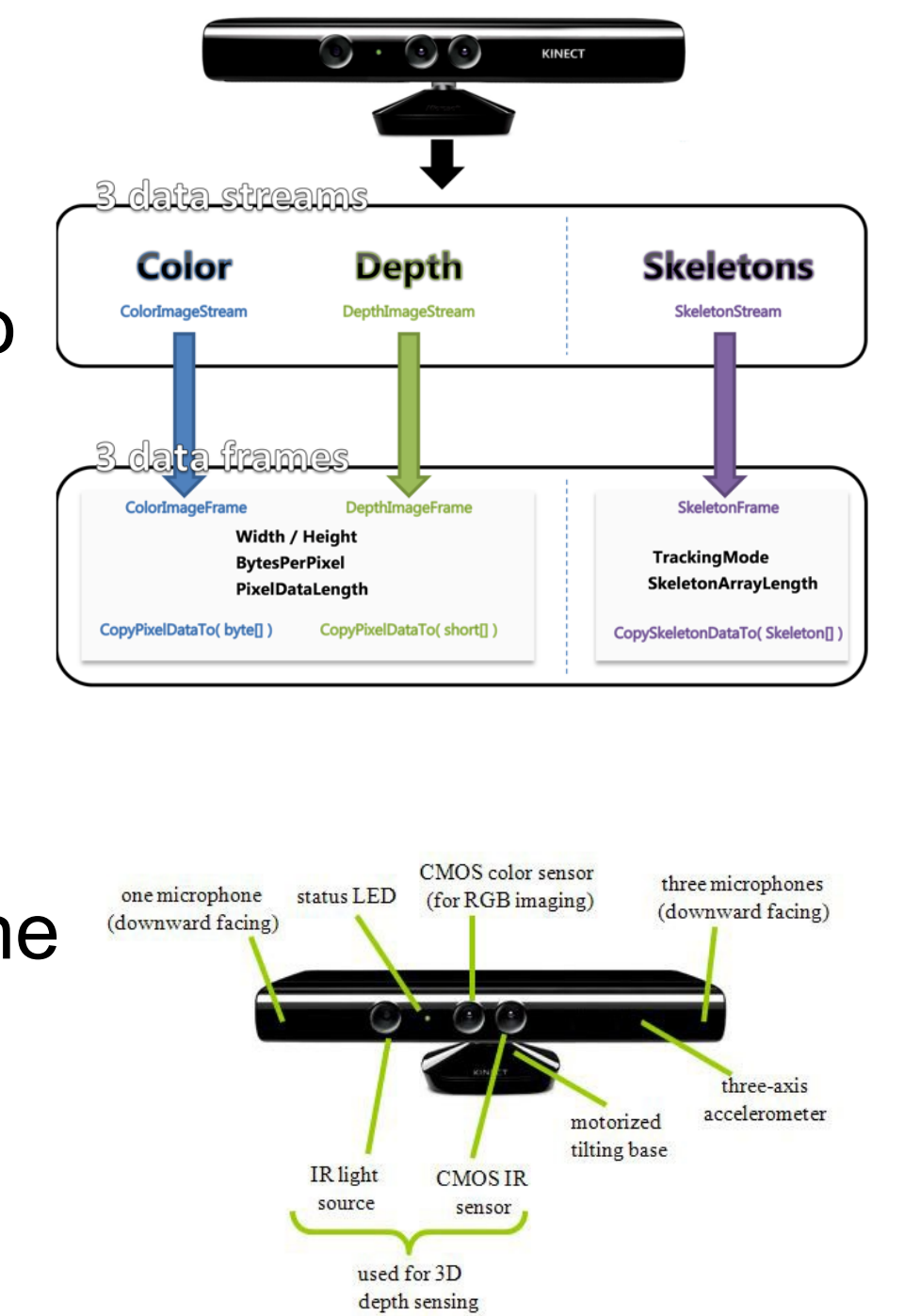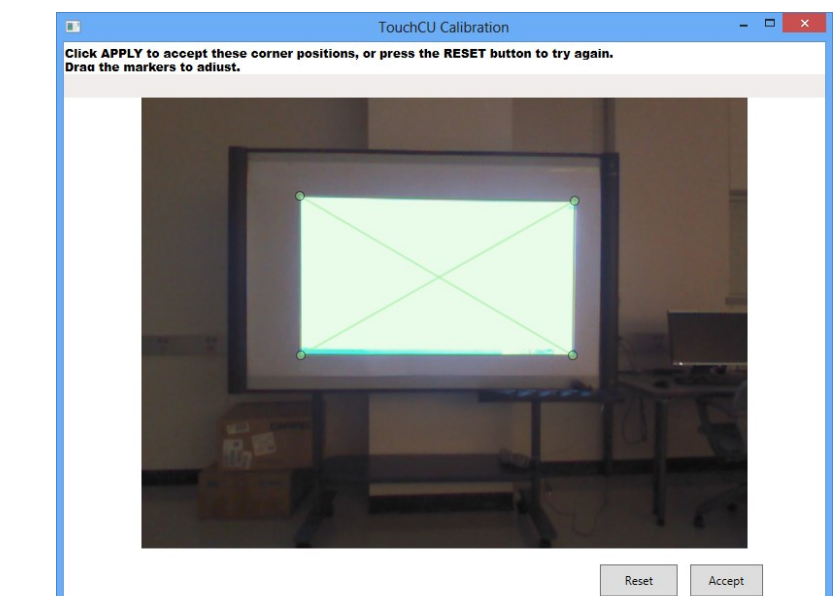
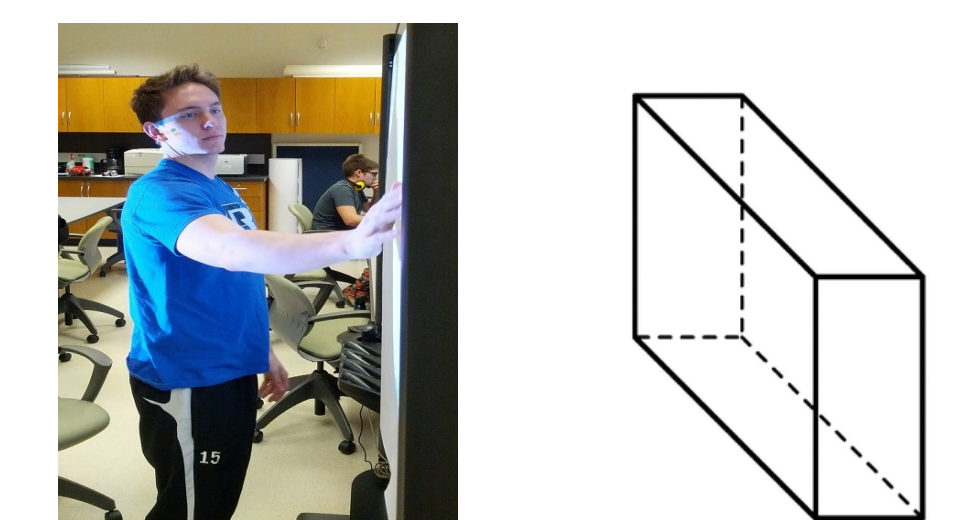## Using TouchCU

Place Kinect and projector accordingly
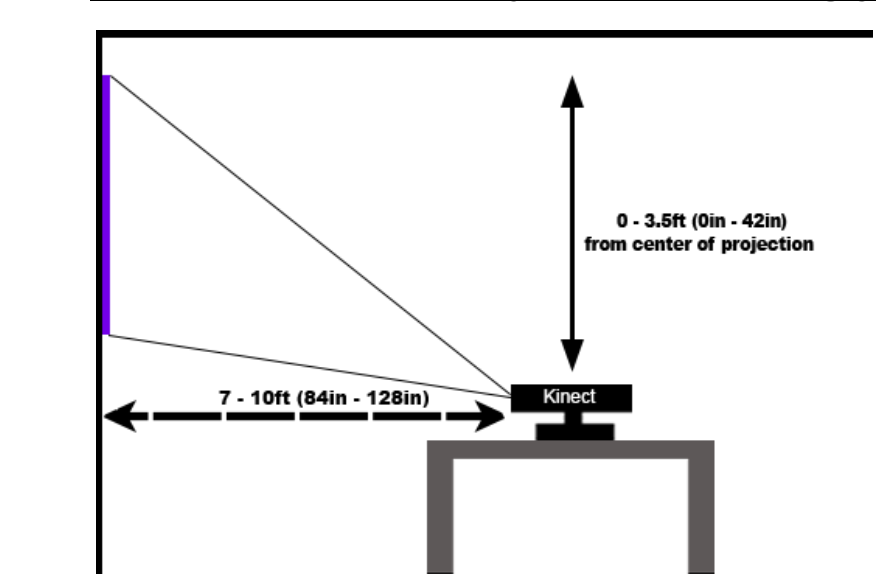
Make sure hands are clearly visible to the Kinect

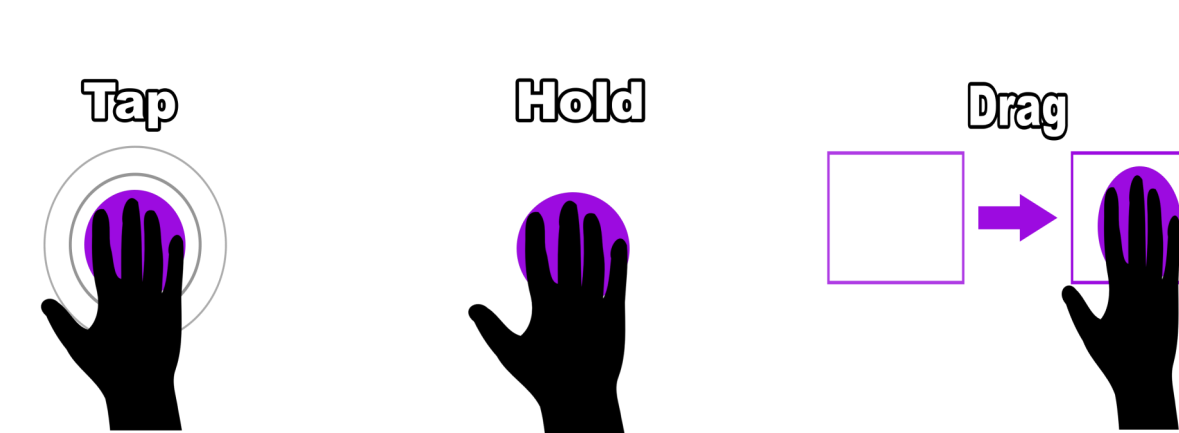Select the corners of the projection in calibration mode

Make sure hands enter/leave interaction zone completely, and that you interact using well-defined, and fluid motions
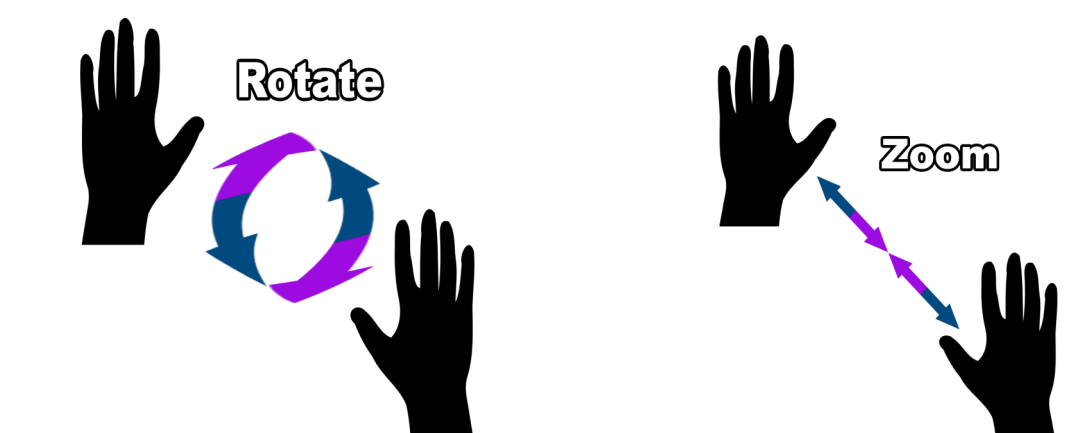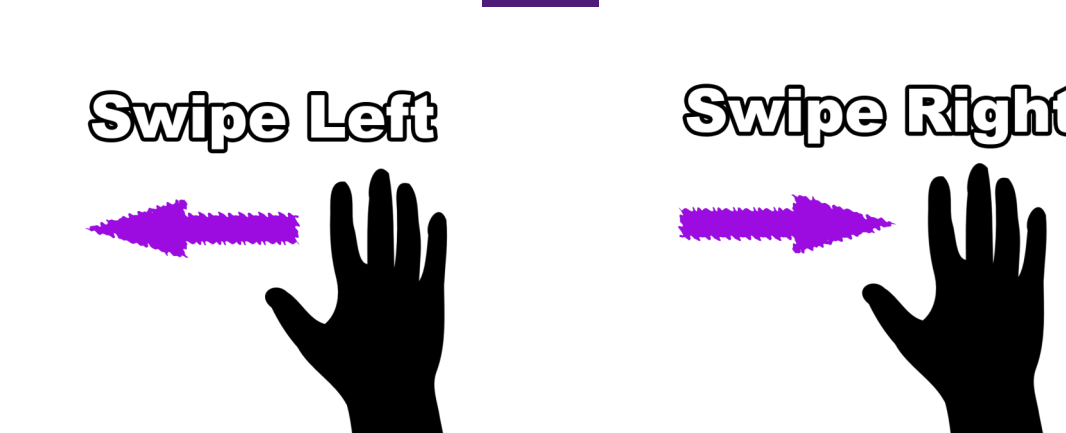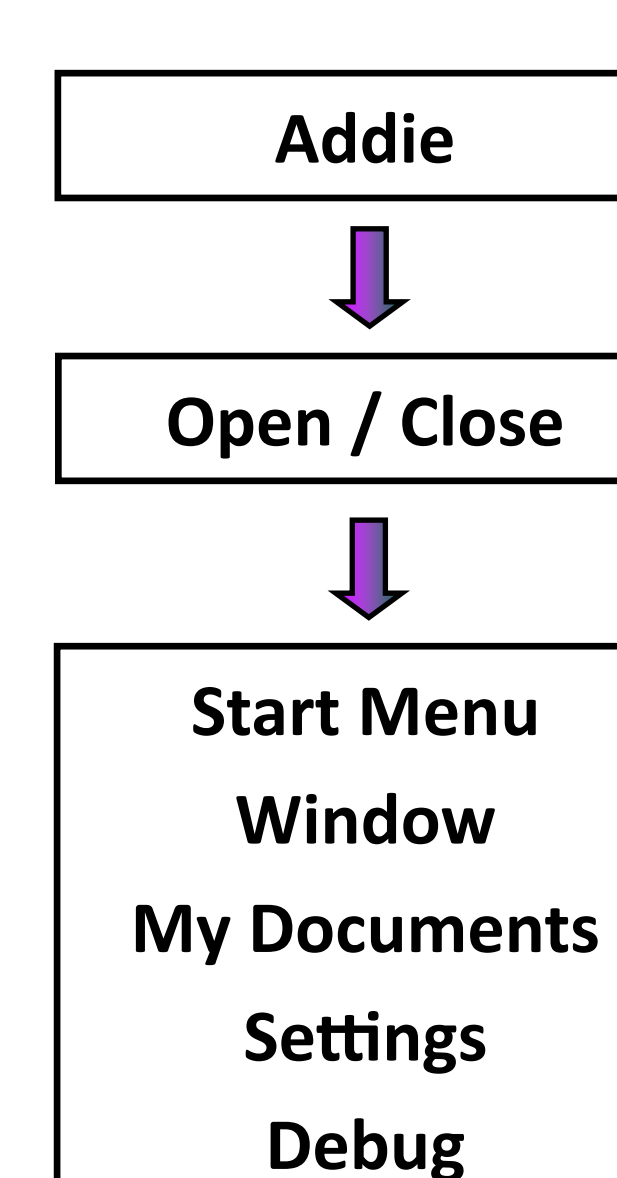
Results and Conclusions

. TouchCU converts Kinect output data into Windows touch input data within 500 ms

. TouchCU supports 4 one-handed touch specific gestures, 2 two-handed touch specific gestures, 2 air gestures, and 10 voice commands to efficiently control Windows 8

. The Microsoft Kinect performs best when the user is facing the sensor

. TouchCU is optimized to have the Kinect placed 7-10ft from the screen

. To interact with Windows 8 using TouchCU effectively, the user must keep both hands visible to the Kinect at all times

References

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Microsoft Kinect for Windows SDK http://www.microsoft.com/en-us/kinectforwindows/

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Ubi Interactive http://www.ubi-interactive.com/