Senior Design Project

3D Perspective-Based Touch Screen Environment

Team Touch Screen

RICE ece — redefining limits

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Motvation

- 3D and touch technology is growing in popularity
- This has the potential to transform user interfaces
- *We have created a novel desktop environment that leverages 3D and a touch screen to attain a new level of interactivity*
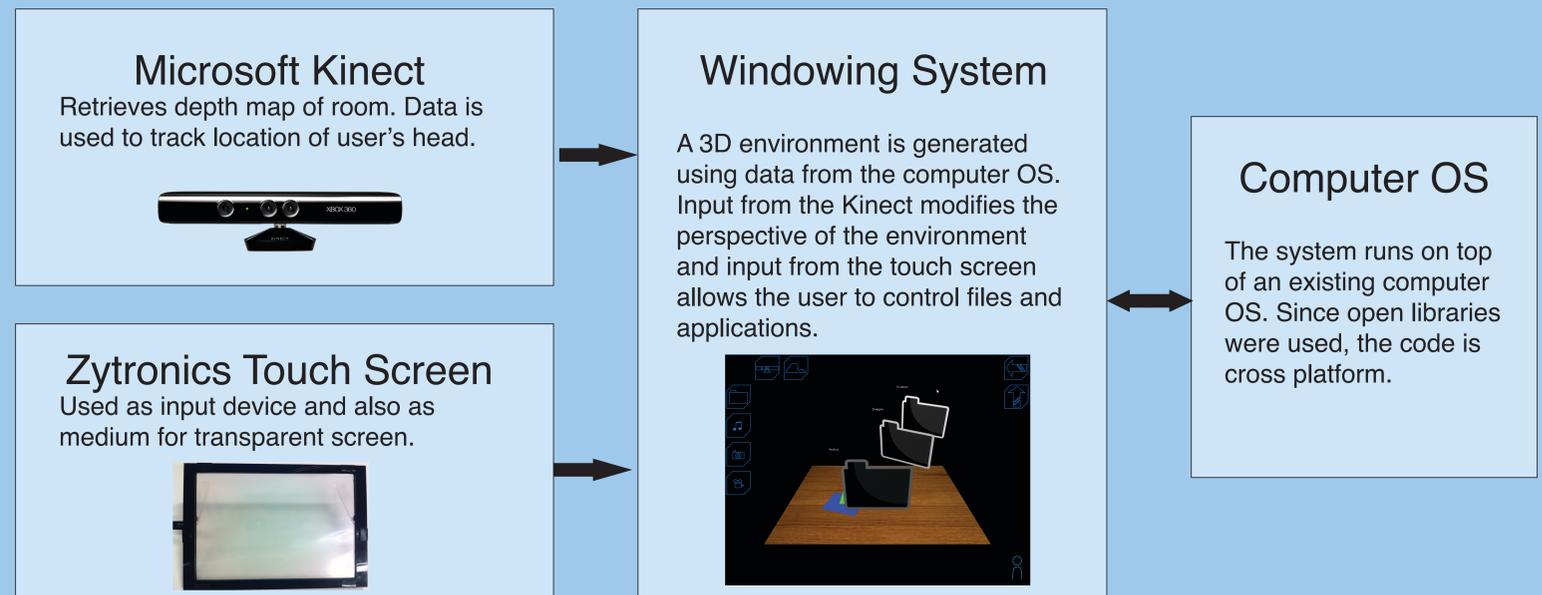
Design Goals

- Develop 3D environment that simulates a physical desk
- Environment's perspective responds to user's physical position
- User interacts with objects directly through a touch screen
- Create applications to demonstrate this new level of interactivity
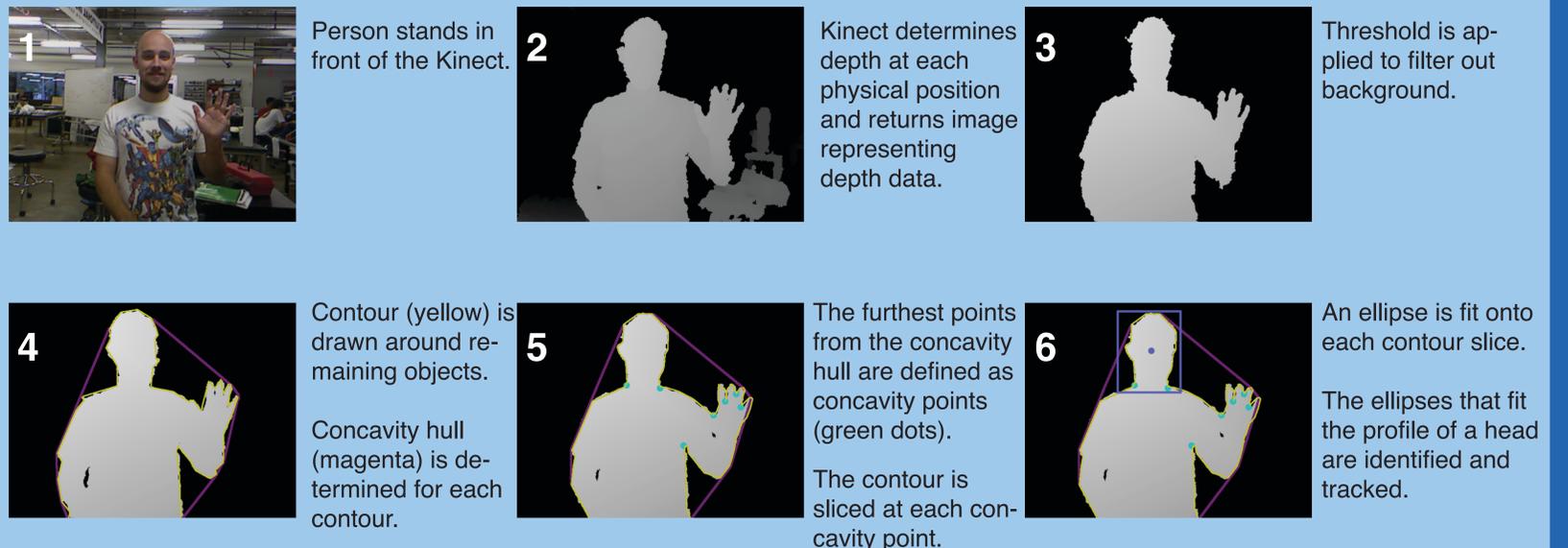- Open source and cross platform

Approach

- Render environment using OpenGL
- Project environment onto scattering film behind touch screen
- Use depth information from Microsoft Kinect to determine head position
- Update perspective of environment based on tracked head position
- Obtain user input from touch screen to navigate system

Design

System Components

Microsoft Kinect
Retrieves depth map of room. Data is used to track location of user's head.

Windowing System
A 3D environment is generated using data from the computer OS. Input from the Kinect modifies the perspective of the environment and input from the touch screen allows the user to control files and applications.

Computer OS
The system runs on top of an existing computer OS. Since open libraries were used, the code is cross platform.

Zytronics Touch Screen
Used as input device and also as medium for transparent screen.

Head Tracking Algorithm

1. Person stands in front of the Kinect.

2. Kinect determines depth at each physical position and returns image representing depth data.

3. Threshold is applied to filter out background.

4. Contour (yellow) is drawn around remaining objects.

   Concavity hull (magenta) is determined for each contour.

5. The furthest points from the concavity hull are defined as concavity points (green dots).

   The contour is sliced at each concavity point.

6. An ellipse is fit onto each contour slice.

   The ellipses that fit the profile of a head are identified and tracked.

Reference

Parvizi, E.; Wu, Q.M.J.; , "Real-Time 3D Head Tracking Based on Time-of-Flight Depth Sensor," Tools with Artificial Intelligence, 2007. ICTAI 2007. 19th IEEE International Conference on , vol.1, no., pp.517-521, 29-31 Oct. 2007

Open Source Libraries

OpenFrameworks, OpenKinect, OpenGL, OpenCV, FFMpeg