INTERFACE ANYWHERE

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Development of a Voice and Gesture System for Spaceflight Operations

INTERFACE ANYWHERE PROJECT

- The Interface Anywhere Project was funded through Innovation Charge Account (ICA) at NASA JSC in the Fall of 2012.
- The project was collaboration between human factors and engineering to explore the possibility of designing an interface to control basic habitat operations through gesture and voice control.
  - Current interfaces require the users to be physically near an input device in order to interact with the system.
  - By using voice and gesture commands, the user is able to interact with the system *anywhere* they want within the work environment.

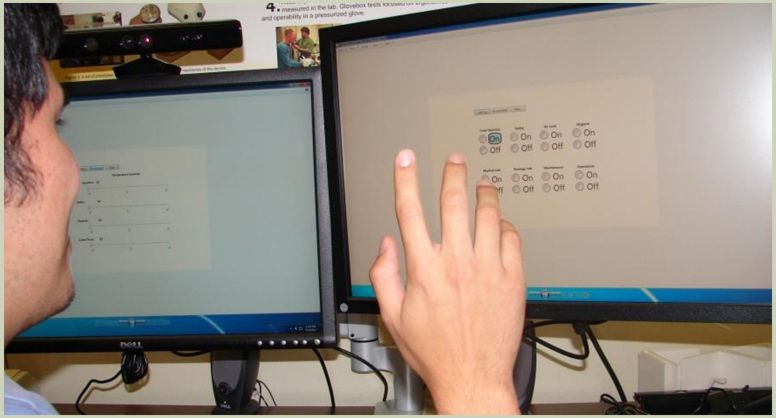
NATURAL USER INTERFACE

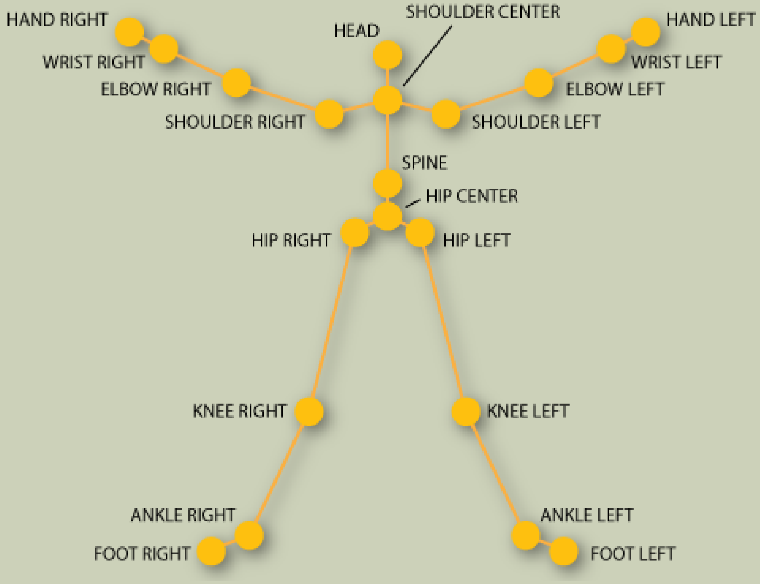
- Natural User Interface (NUI) is a term used to describe a number of technologies such as speech recognition, multi-touch, and kinetic interfaces.
- the NUI is the next step forward from the traditional graphical user interface (GUI), which employs a mouse and keyboard as the primary means of input.
- The goal of NUI is to develop interfaces that do not have a steep learning curve and the interaction with these interfaces that are “natural” and intuitive to the user.

MICROSOFT KINECT SYSTEM

- Our NUI system of choice is the Microsoft Kinect sensor.
- The Kinect contains an infrared projector and receiver, a normal RGB camera, and an array of four microphones.
- The system tracks multiple users in x-, y-, and z-space. Based on the depth information, the Kinect generates a skeleton using joint positions.
- It is the skeleton tracking ability that makes gesture recognition possible.

MICROSOFT KINECT SYSTEM

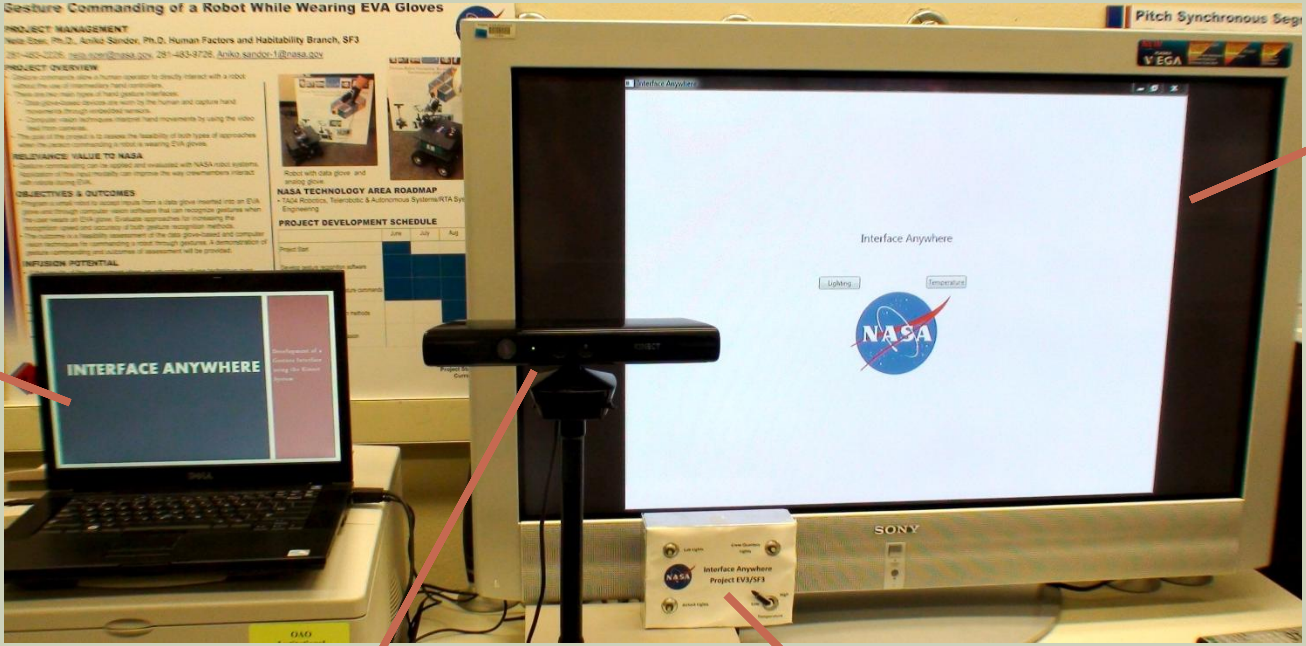




THE INTERFACE ANYWHERE SYSTEM

- The system utilizes a Kinect for Windows sensor, a computer running Windows 7, in-house developed software, microcontroller with end effectors, and large monitor for testing purposes.
  - To illustrate control of an external system, the Arduino development platform was used in conjunction with LED lights and a servo.
- The Kinect system tracks user movements.
  - When a predefined movement (or gesture) is completed an action occurs on the interface.
- To complement the repertoire of gestures, voice commanding was also implemented to illustrate the flexibility of the system by allowing a truly hands-free mode of interaction.

THE INTERFACE ANYWHERE SYSTEM



Windows 7 CPU

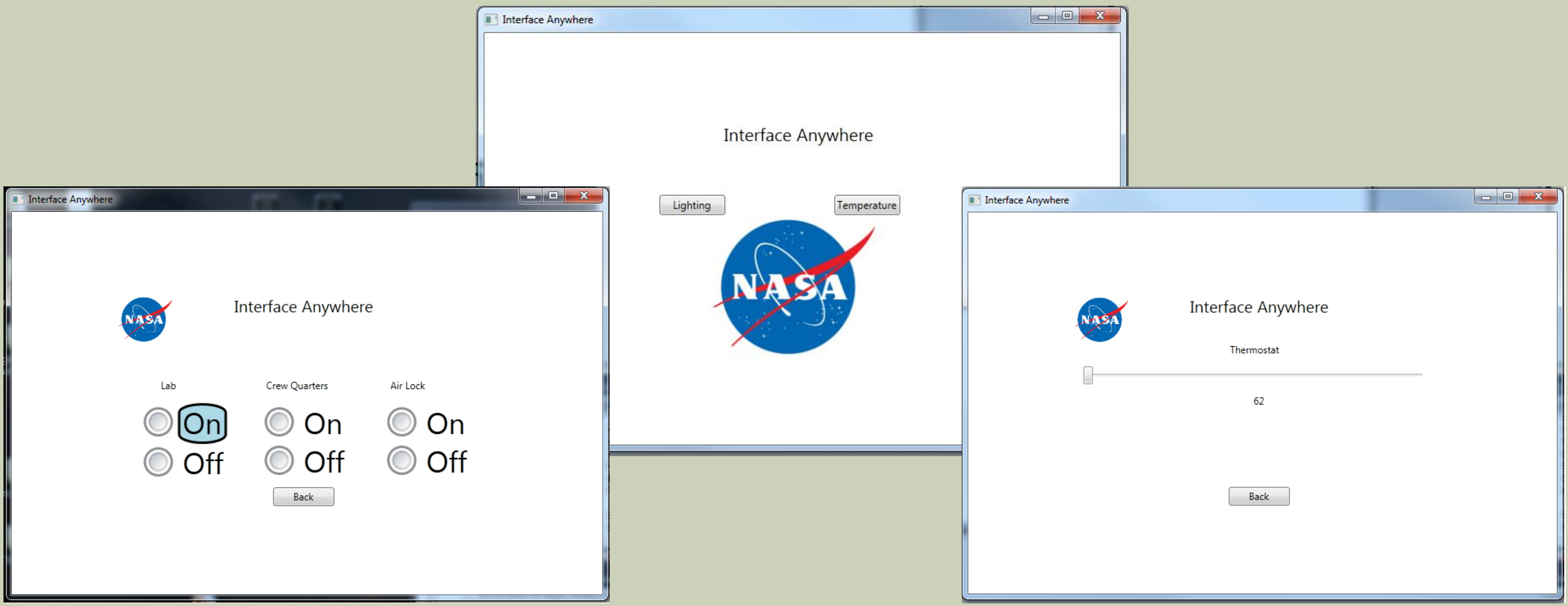
Monitor

Kinect Sensor

Arduino Box

THE INTERFACE ANYWHERE INTERFACE

- The interface consisted of three screens:
  - A main menu leading to either a lighting or thermo control interface. These two systems were meant to reflect interfaces that could be found in a habitat operations system.



EVALUATION PROCEDURES

- A heuristic evaluation was conducted on the Interface Anywhere in which participants followed a sequence of tasks and provided comments as to the usability of the system and suggestions for improvement.
- Participants used voice control to move from the Main Window to each control screen.
  - Lighting Screen: Using voice commanding, the user could control on-off of the lights in each habitation area (e.g., “lab off” would select the off button). For gesture commanding, the left hand controlled a focus box. When the focus box was over the desired radio button and wave of the right hand activated the button.
  - Thermostat Screen: With voice commands, the user named the desired temperature and the slider moved to that position. Using tracking of the right hand, the user could control the location of the slider. Once at the desired location the user verbally cut off arm tracking.

PARTICIPANT COMMENTS

- All participants said they would want to use the system. However, some felt that utility would be application specific.
- Most thought the system added flexibility to human-computer interaction, especially if multitasking or far away from a control device.
- People liked not being confined to an input device, but were concerned with accuracy using voice commands and/or gestures. However, most felt accuracy would increase with training, time, and/or better software.
- Participants felt the systems greatest benefit was the increased mobility and flexibility through the use of voice and gestures afforded in the work environment because they were not connected to hardware.

PARTICIPANT COMMENTS (CONTINUED)

- Most felt that the voice commands and gesture were intuitive and easy to use (e.g., moving the slider or focus box with the hand), but there was a slight learning curve with how to make the gesture properly. All participants figured it out within minutes.
- Given the amount of time and resources that could be devoted to the development, there were some false positives both for voice commands and gestures. Even though this was a concern for participants, they felt that the issues could be worked out with more time to improve the software.

CONCLUSIONS

- The current work with gesture and voice commanding has shown that both are viable options to interface design.
- Further work needs to be accomplished in order to refine the interactions, for example what types of gestures control certain aspects of the interface.
- As technology and funding become available, future efforts will examine the miniaturization of the sensors, use of multiple sensors, and software development.
- In addition, as new interfaces are developed and evaluated, requirements, lessons learned, and standards will be documented for future use and added to the body of knowledge with respect to gesture and voice commanding and interface design.