VIRGINIA TECH

Wearable and Ubiquitous Computing

Project Anywhere User Guide

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Project Anywhere User Guide

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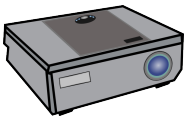
Introduction to Project Anywhere System

Project Anywhere is a key aspect of the Virginia Tech's Mirror Worlds project, which is funded by the National Science Foundation. The goal of the Mirror Worlds project is to create an interactive shared space between the physical, real world and the virtual. It incorporates human interaction with the study of human behavior and emotions in both worlds, physical and virtual. Project Anywhere is an essential component of Mirror Worlds, meant to provide the capability of projecting an image from the virtual world into the real world. It can either serve as a way to provide notifications between the two worlds or as a portal to share interactive information between users in the virtual and those in the physical.

Brief Overview of the System



This Project Anywhere prototype implementation provides the functionality to give a virtual user a simple way to project an image into the real physical world where the real world user can be notified.

The prototype system uses a user interface designed in Unity3D to serve as a simple and easy to use program for the virtual user to select a position in a room to project a laser pointer or real projector image at. This prototype however specifically uses a laser pointer for its projections. The system rotates a mirror at corresponding angles in order to reflect the light beam of the laser pointer to a desired location.

The System at a Glance

The system has the following components:

1. XBee wireless radio modules to provide communication between the physical prototype and user interface

    - XBee Shields are used to connect the XBee radios to the Arduino Uno boards

2. The Rotation Harness that is attached to the cardboard box housing to hold the mirror and motors

3. Arduino Uno micro-controller to control the motors

4. User interfaces to interact with the system

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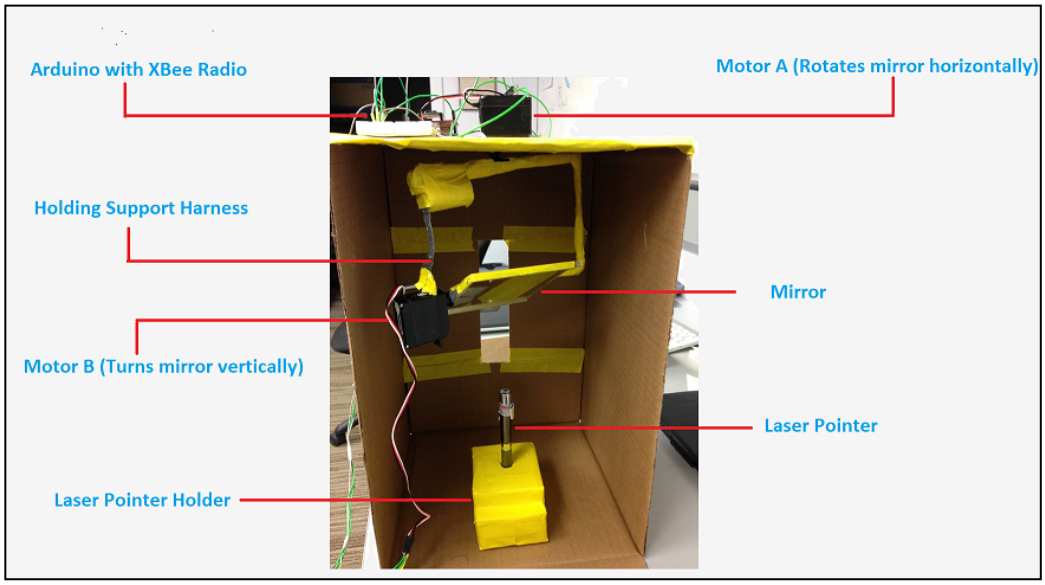


FIGURE 1 A diagram showing the overall prototype system (not including the Unity3D user interface). As shown, the system consist of the follow materials and items: Two Arduino Uno boards (the one that controls the motors is shown and the other one that is connected to the computer which runs the Unity3D interface is not shown), two Servo motors (torque of 16.6/20.8 oz-in), a hand size plane mirror, a rotation harness to hold the mirror (built using wooden dowels, metal, and tape), a laser pointer, and a Styrofoam laser pointer holder.

System Setup

I. Setting up the Arduino –Motor connections

1. Attach the XBee shield to the Arduino Uno board.

2. Connect the red wire of both the servo motors to the +5V pin of the Arduino.
3. Connect the black wire of both the servo motors to the GND pin of the Arduino.
4. Connect the white wire of Motor A to pin 9 of the Arduino.
5. Connect the white wire of Motor B to pin 10 of the Arduino.
6. Connect the Arduino to a power source using a USB cable.

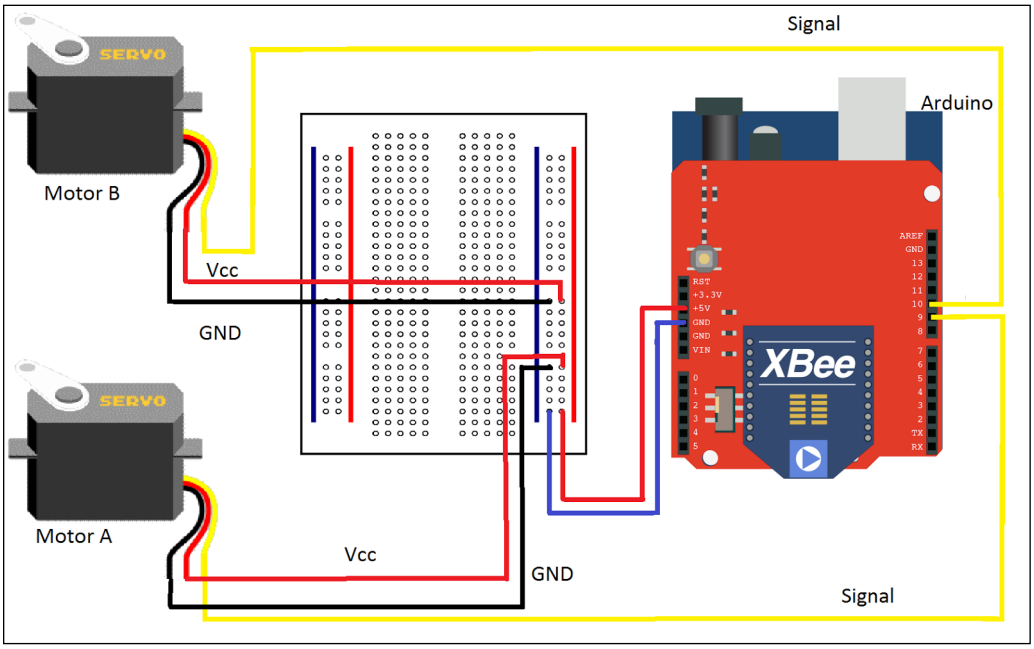
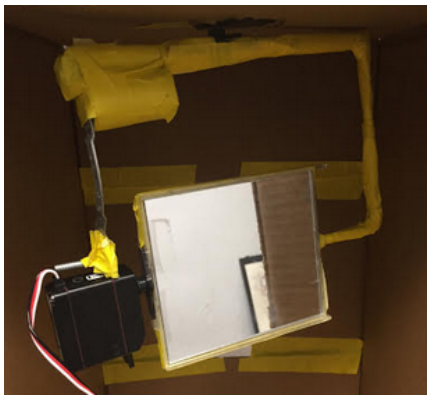


FIGURE 2 Circuitry diagram showing the connections of the two motors with the Arduino Uno board and XBee radio.

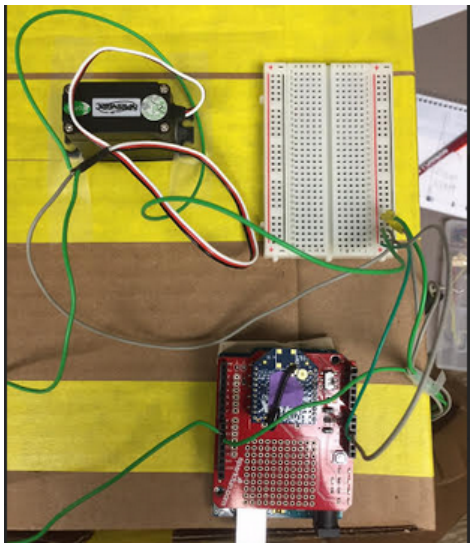
II. Setting Up the Overall System:

1. Check that the rotation harness is attached to the motor at the top of the cardboard box. If not, then firmly attach the harness to the shaft of the motor. Rotate a few times manually to check.



2. Attach the laser pointer to the holder at the bottom of the cardboard box.

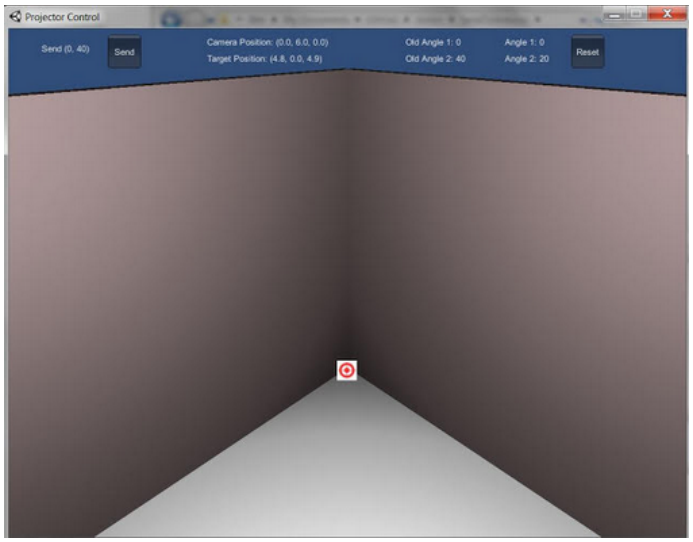
3. Connect the Arduino attached to the cardboard box to a power supply via USB cable. Ensure that all the wire connections are secure. If not, follow the instructions given in System Setup Section I. The red LED should be ON at all times after connecting the power.



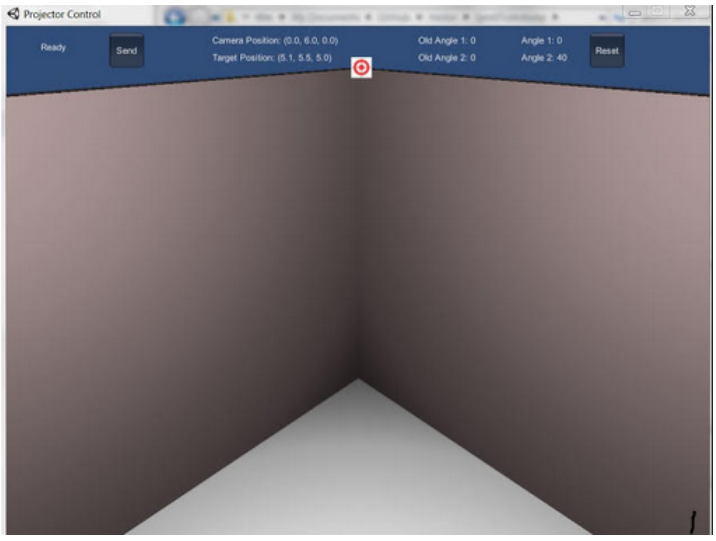
4. Connect the second Arduino board to the laptop via USB cable and open the Unity 3D user interface ProjectControl.exe file.

5. Initially, adjust the mirror so that it is parallel to the floor. The reflection of the laser should exactly align with the tip of the laser pointer.

6. On the user interface, select the bottom most point of the center corner where the two walls join. The motors will rotate the mirror accordingly to project the point of the laser pointer point to this location.



7. To calibrate the lowest position, manually adjust the mirror so that the laser points to the location the user wants to consider as the bottom most point. Ensure that the angle of the mirror is not more than approximately 20 degrees. If it is greater, then move the system slightly closer to the wall.



8. Now click on the top most point on the center corner where the two walls are joined. The motors will rotate the mirror to project the laser to this top-most point. This is the highest point where the laser projection can be aimed.

Using the System

I. Using the Unity3D User Interface

The Unity3D user interface purpose is to serve as an easy to use, simple interface that allows the virtual user to select a position in the room to project an image. Below are the steps that detail a walkthrough for using the user interface.

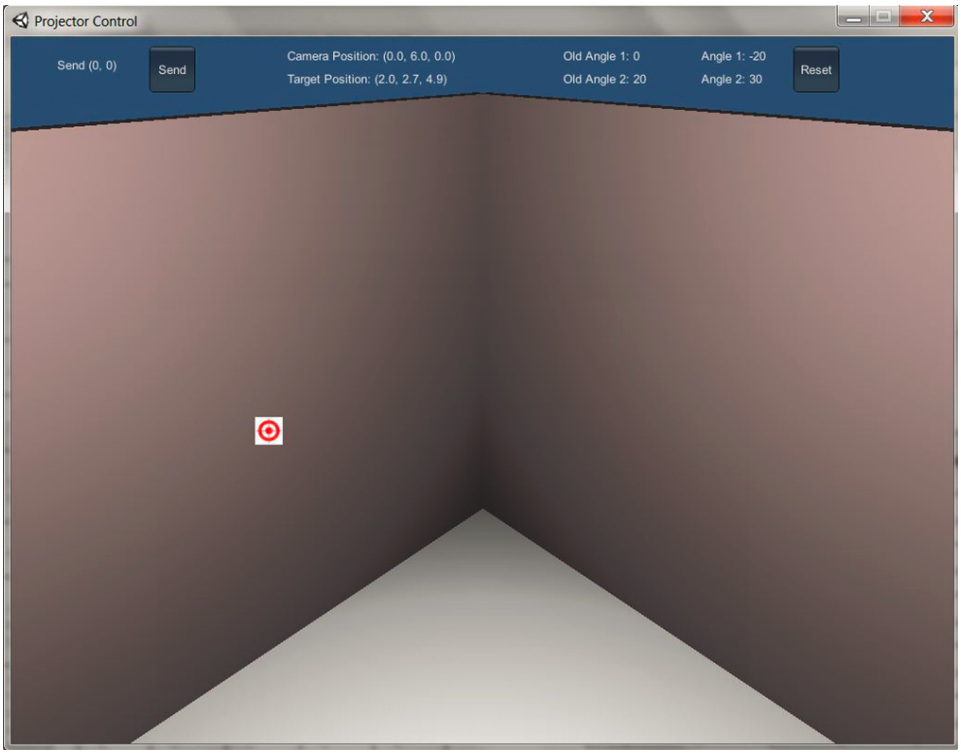


FIGURE 3 Screenshot of the User Interface that is designed using Unity3D

Buttons & Labels

- Bullseye-Target Selector- This button is clicked by the user to specify the desired location of new projection
- Send - This button sends the calculated angles that would rotate the motors horizontally and vertically to adjust the mirror reflected image to project the newly desired location
- Reset - This button allows the user to reset the values for the angle calculations back to the initial position
- "Angle 1" - This parameter shows the angle calculation of the rotation in the horizontal direction

- "Angle 2" - This parameter shows the angle calculation of the rotation in the vertical direction

User Interface Steps

1. Open the User Interface program to run on your computer

2. Once the program is running, use the target bulls eye mouse to select the desired position to project the image

3. Once the desired position is selected, click the "Send" button to have the program send the calculated angles through the XBee radio to the Arduino that controls the motors

4. Repeat Steps 2-3 to make a new selection for the desired projection position