Mirror

Team 08

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The Problem

Phantom Limb Pain
Phantom Limb Pain (PLP):
The sensation of feeling pain in an amputated limb

It happens when nerves that would normally innervate the missing limb cause pain

The Problem

~80%

~20%
The Motivation

- Mirror box therapy reflects the intact limb

- **Limitations:**
  - Position of missing limb (e.g. shoulder)
  - Size of the mirror
  - Psychological resistance (40% of the PLP do not benefit from it)
We will cover...

- Our Solution
- How it works
- Technologies used
- Limitations
- Testing and Evaluation
- Team Dynamics
- Future Work
The Solution

Mirror

Create an intuitive and immersive solution for mirror box therapy

Ubiquitous Devices

Kinect

Virtual Reality
How it Works...

Calibration

Tracking

Mirroring

KINECT™

Visual Studio®

Visual C#
Prototypes
The Limitations

Anything that can go wrong, will go wrong.

- Murphy’s Law
Limitations

Hardware

**Kinect**
- Misclassification of skeletal joints
- Physical factors such as light and distance from the kinect tends to affect the skeletal tracking

**Google Glass**
- not immersive enough
  (Augmented Reality)
## Limitations

<table>
<thead>
<tr>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Highly Joint Dependent</td>
</tr>
<tr>
<td>● Person’s orientation change will create issues while mirroring</td>
</tr>
</tbody>
</table>
Limitations

Users

- Is our system as good or better than current solution?
- Finding an actual patient
Testing

Please stand with your arms at each side until the calibration is done

Calibration Result

Are you trying to mirror ElbowRight?

Yes  No
Team Dynamics

None of us is as smart as all of us

--Ken Blanchard
Agneev Ghosh, Grad CSE
Skeleton tracking developer
Missing joint recognition

Wendy Vasquez, Undergrad CSE
Google glass technology
Background removal

Raissa De Souza, UPS CSE major
GUI developer
Background removal

Alvin Yan, Undergrad CSE
Website developer
Google glass technology

Rahul Ramath, Grad CSE
Skeleton tracking developer
Missing joint recognition
Project management

Vinita Murthi, Grad CSE
Background removal
RGB and mirroring limb
Project management
## Development Plan

<table>
<thead>
<tr>
<th>M</th>
<th>Tu</th>
<th>W</th>
<th>Th</th>
<th>F</th>
<th>Sa / Su</th>
</tr>
</thead>
<tbody>
<tr>
<td>W.V V.M</td>
<td>The guys</td>
<td>The girls</td>
<td>A.Y R.R R.S</td>
<td>Weekly Meeting</td>
<td>All hands on deck</td>
</tr>
</tbody>
</table>

### Task Table

<table>
<thead>
<tr>
<th>Week</th>
<th>Task</th>
<th>Priority</th>
<th>Assignee</th>
<th>Estimate (Hr)</th>
<th>Deadline</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 5 (Missing Limb Identification and RGB Combination)</strong></td>
<td>Use the Skeletal tracking to find inferred bones</td>
<td>Critical</td>
<td>Agneev/Rahul</td>
<td>2</td>
<td>10/30/2015</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Remove the inferred limb from the skeleton track detected by Kinect</td>
<td>Critical</td>
<td>Agneev/Rahul</td>
<td>1</td>
<td>10/30/2015</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Calibrate the application for the user and verify the missing limb</td>
<td>Critical</td>
<td>Vinita/Wendy</td>
<td>1</td>
<td>10/30/2015</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Background Subtraction of the user RGB feed</td>
<td>High</td>
<td>Vinita/Wendy</td>
<td>1</td>
<td>10/30/2015</td>
<td>Moved (Week 6)</td>
</tr>
<tr>
<td></td>
<td>Superimposition of RGB and Skeletol</td>
<td>High</td>
<td>Raissa/Alvin</td>
<td>0.5</td>
<td>10/30/2015</td>
<td>Moved (Week 6)</td>
</tr>
<tr>
<td></td>
<td>User Interface Design</td>
<td>Stretch</td>
<td>Raissa</td>
<td>0.5</td>
<td>11/25/2015</td>
<td>Partially Completed</td>
</tr>
<tr>
<td></td>
<td>Website Update</td>
<td>Stretch</td>
<td>Alvin</td>
<td>0.5</td>
<td>NA</td>
<td>Partially Completed</td>
</tr>
<tr>
<td><strong>Week 6 (Mirroring Skeletal Image)</strong></td>
<td>Background Subtraction of the user RGB feed</td>
<td>Critical</td>
<td>Vinita/Wendy</td>
<td>1</td>
<td>11/4/2015</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Superimposition of RGB and Skeletol</td>
<td>Critical</td>
<td>Vinita</td>
<td>1</td>
<td>11/4/2015</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Testing the Calibration Window</td>
<td>Critical</td>
<td>All</td>
<td>1</td>
<td>11/4/2015</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Calculate joints coordinates of missing limb</td>
<td>Critical</td>
<td>Agneev/Rahul</td>
<td>1</td>
<td>11/5/2015</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Mirroring the good limb to the missing limb</td>
<td>Critical</td>
<td>Vinita/Rahul</td>
<td>2.5</td>
<td>11/5/2015</td>
<td>Partially Completed</td>
</tr>
<tr>
<td></td>
<td>User Interface Design</td>
<td>Stretch</td>
<td>Raissa</td>
<td>1</td>
<td>11/25/2015</td>
<td>Partially Completed</td>
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<td></td>
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<td>Alvin</td>
<td>0.5</td>
<td>NA</td>
<td>Partially Completed</td>
</tr>
<tr>
<td></td>
<td>Google Glass Live Stream</td>
<td>Medium</td>
<td>Wendy</td>
<td>2</td>
<td>2/12/2015</td>
<td>Moved (Week 8)</td>
</tr>
</tbody>
</table>
The Good
● Reached the goal
● Dynamic of the teamwork
● Newfound respect for graphics developers (it’s HARD)

The Bad
● Reduced ability to parallel development
● Lack of interaction with patient
● Limited expertise

The Ugly
● 8 weeks. Are you serious?
What Next?

- Better performance of mirroring
- Mobile application for patient check in (with QR codes)
- Facilitate interaction between patients using games
- Improve immersion of the solution using HoloLens
- Bring in patients to gauge the psychological benefit
Questions?