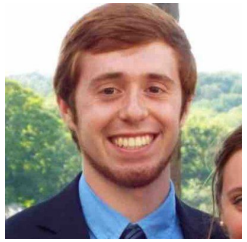
Step

A Step Forward in Virtual Reality

Team Step



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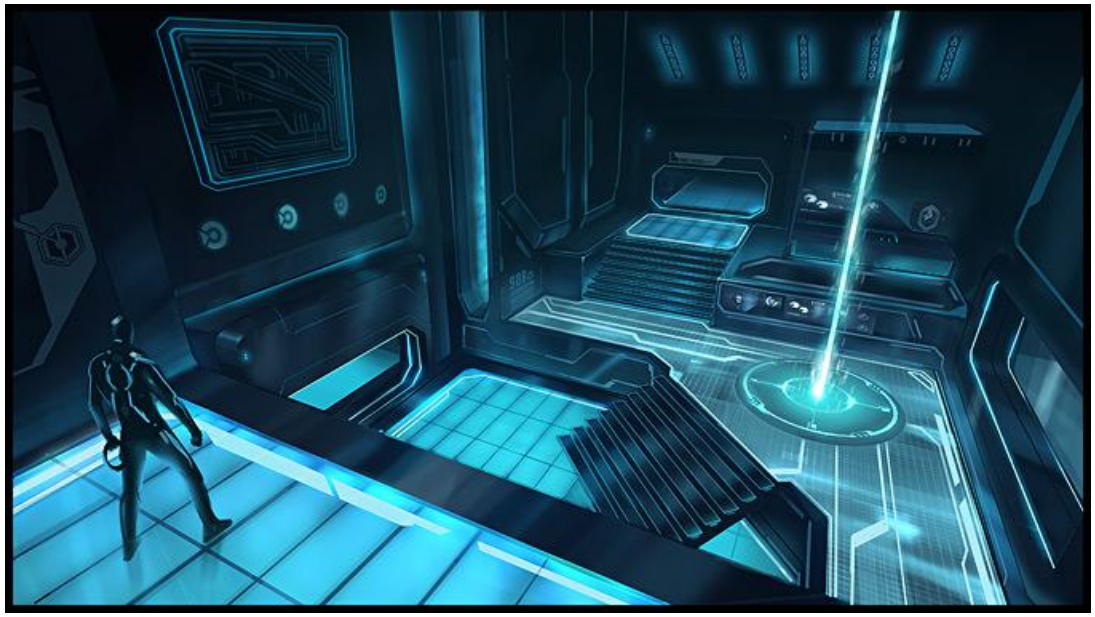
Motivation

- Current Virtual Reality has lacked the REALITY aspect
- The market is pushing smartphone VR; peripherals can make the experience better
- Users do not feel immersed in the environment
- VR hasn’t reached its full potential

Introduction

- Step is a new virtual reality environment that will immerse the user with no added hardware
- The user will be able to interact, move, and feel the environment



Our Solution

- Create a 360 degree, 3 dimensional virtual environment on a smartphone
- Create a system that will detect the user's movement such as walking, running, and arm motions
- Create a structure in which the virtual world can be emulated

Overall Requirements

- User is able to freely move in virtual environment and control movement speed
  - Speed Accuracy within .5 MPH
- Hand and arm motion is translated to in-game action
  - Depth Accuracy, standard deviation within 1 inch
- Control latency less than 200 ms[1]
- User does not have to wear any sensing equipment beyond VR headset
- Maintain framerate at 60 FPS[2]

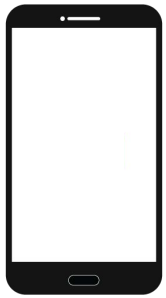
[1] Leadbetter, Richard. "Console Gaming: The Lag Factor." Eurogamer.net. Eurogamer, 09 May 2009. Web. 01 Dec. 2016. http://www.eurogamer.net/articles/digitalfoundry-lag-factor-article.
[2] Hall, Charlie. "Sony to devs: If you drop below 60 fps in VR we will not certify your game" Polygon, 17 Mar. 2016. Web 18 Apr.l 2017. http://www.polygon.com/2016/3/17/11256142/sony-framerate-60fps-vr-certification

Visual Overview


Elliptical


Raspberry Pi


Fan


Smartphone


Router

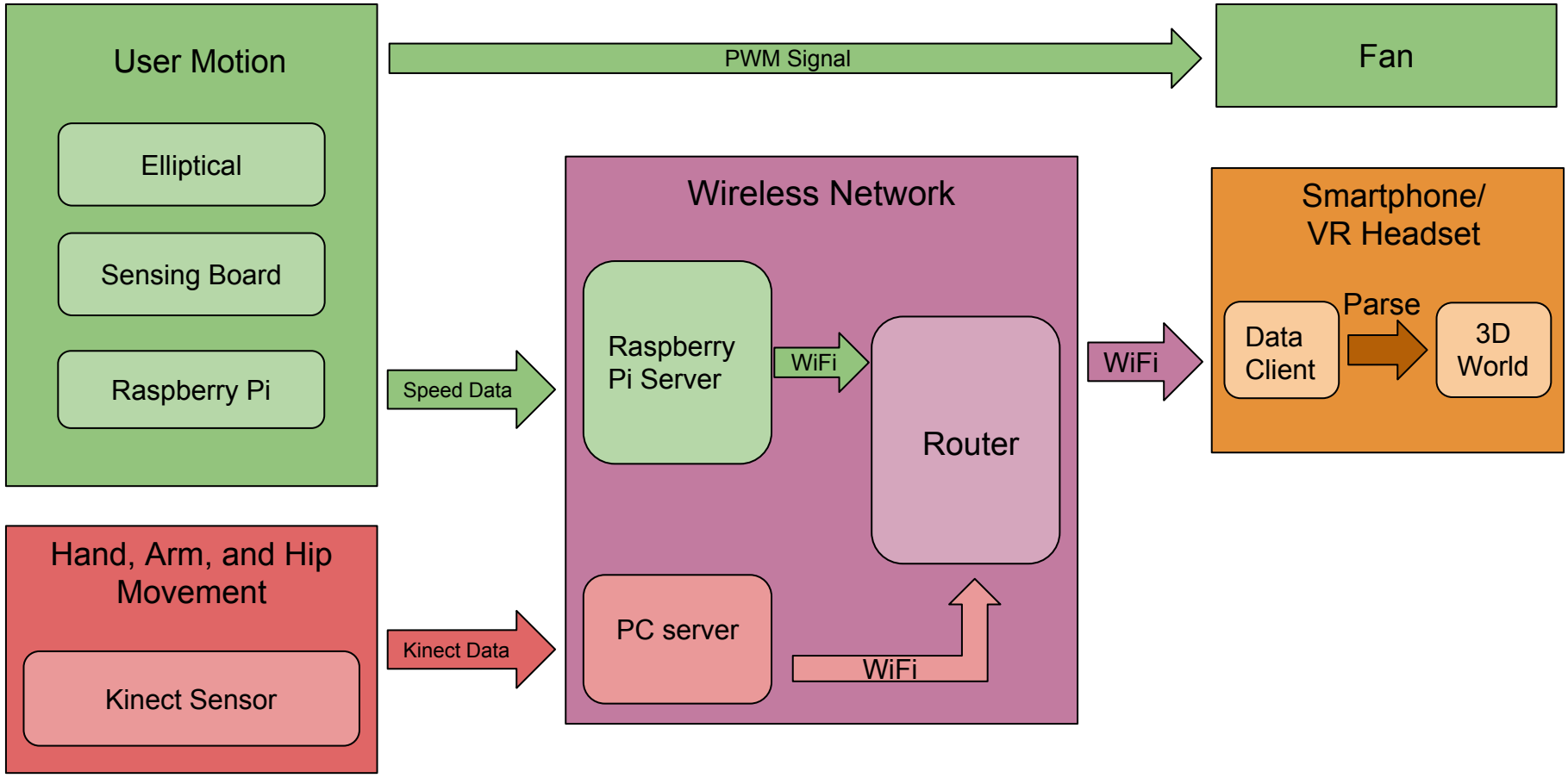

Kinect


PC


Raspberry Pi


Motor

FPR Block Diagram



FPR Deliverables

- Aesthetics on the structure
  - Better wood for mounting
  - Painted structure
  - Backdrop for structure
  - Kinect and fan mount
- Completed PCB
- Tutorial menu environment

FPR Deliverables

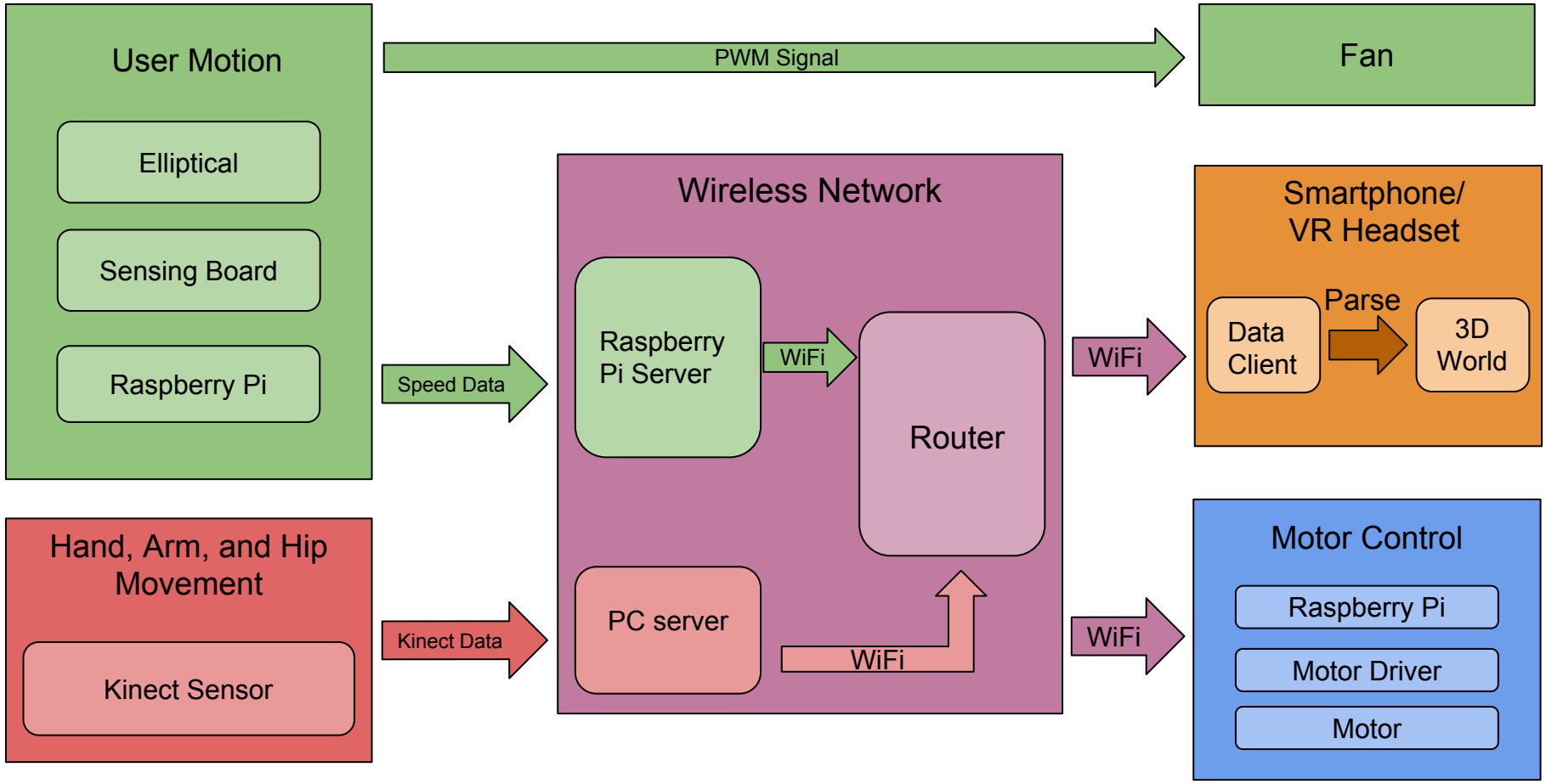
- Aesthetics on the structure
  - Better wood for mounting
  - Paint the structure
  - Backdrop for structure
  - Kinect and fan mount

- Completed PCB

- Tutorial menu environment

- Rotating platform

FPR Block Diagram

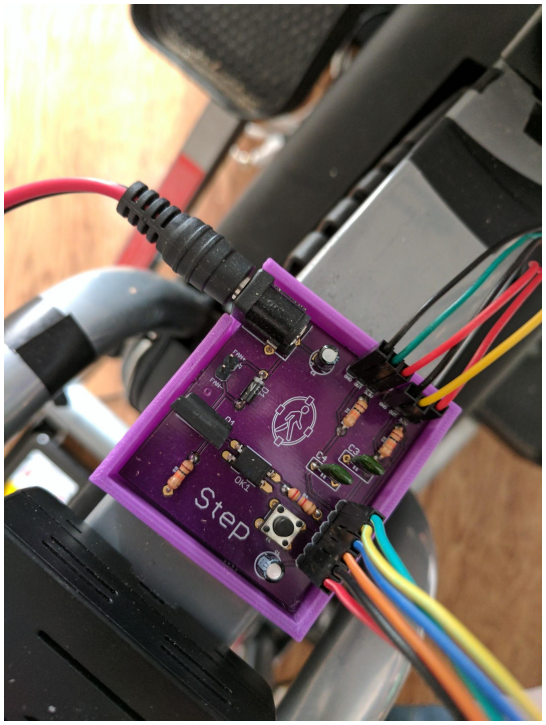


Demonstration of End-to-End Functionality

- Forwards and backwards movement
- Fan control
- Functional PCB
- Game refinement
- Reset button
- Safety structure and harness
- Turn sensing and virtual turning

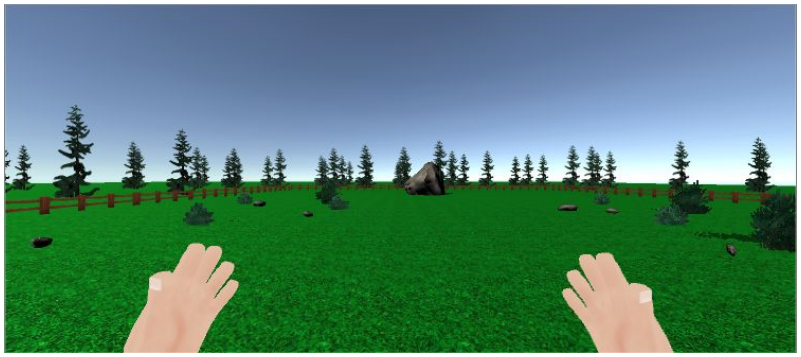
Demonstration

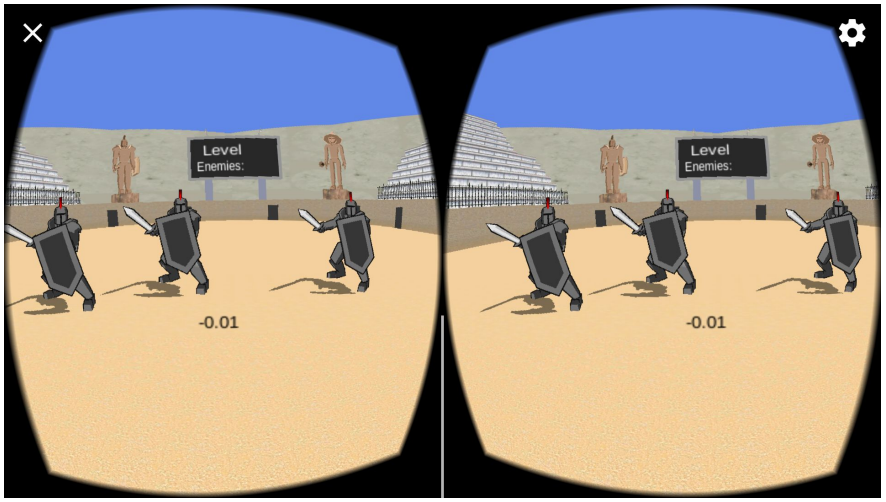
- Forwards and backwards movement
- Fan control
  - User's speed correlates to fan speed
- PCB
  - PCB is functional and mounted



Demonstration

- Game refinement
  - New and improved game with tutorial
- Reset button
  - Button automatically resets subsystems



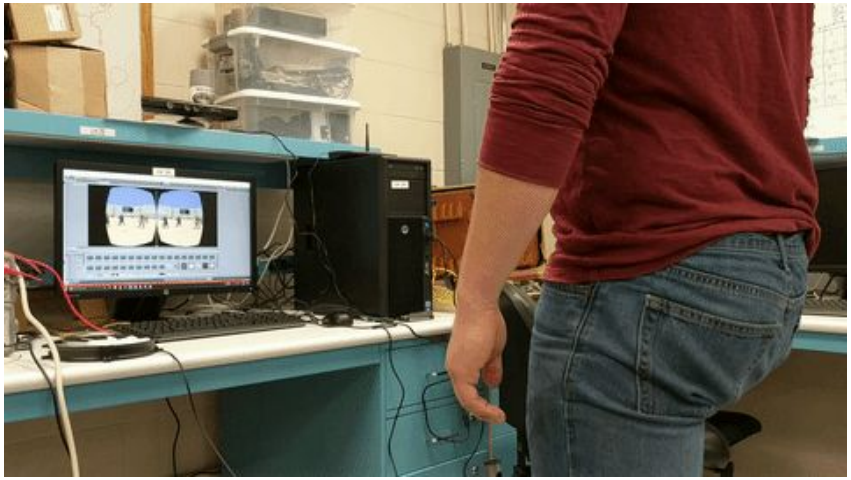


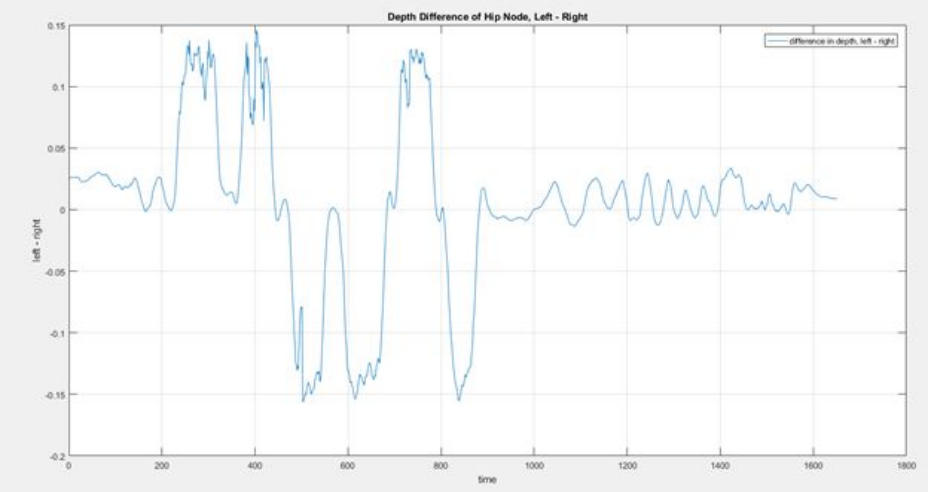
Demonstration

- Safety structure and harness
  - Structure welded, supports weight, stability improvement
- Platform
  - ¾” oak plywood
  - Center axle of telescoping pipes
  - Castors carry weight of system

Turn Sensing

- Turn sensing
  - Tracked hips allow user to turn
- Depth of hip nodes recorded in C# script, analyzed with MatLab
  - Graph indicates (depth of left hip) - (depth of right hip)
  - Positive values indicates a left turn





Demonstration

- Motor
  - Stepper motor with PWM control
  - PWM from Pi with data from Kinect
- Friction drive
  - Motor drive shaft turns drive plate that spins tire
- Enhances the immersion

Overall Requirements

- User is able to freely move in virtual environment and control movement speed
  - Speed Accuracy within .5 MPH, Std Dev = .152 MPH
- Hand and arm motion is translated to in-game action

Tape Measured	Calculated Kinect mean (n=100)	Standard Deviation (m)	Standard Deviation (in)	Performance <inch (=0.0254 m)	Performance <4cm
1.0 m	1.0021 m	0.0214	0.844	80%	93%
2.25 m	2.2452 m	0.0218	0.859	77%	96%

- Control latency less than 200 ms, ours is ~163ms[1]
- User does not have to wear any sensing equipment beyond VR headset
- Maintain framerate at 60 FPS[2]

[1] Leadbetter, Richard. "Console Gaming: The Lag Factor." Eurogamer.net. Eurogamer, 09 May 2009. Web. 01 Dec. 2016. http://www.eurogamer.net/articles/digitalfoundry-lag-factor-article.
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Demo