

Moving Human Electromagnetic Scattering Simulator

Design Presentation

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Agenda

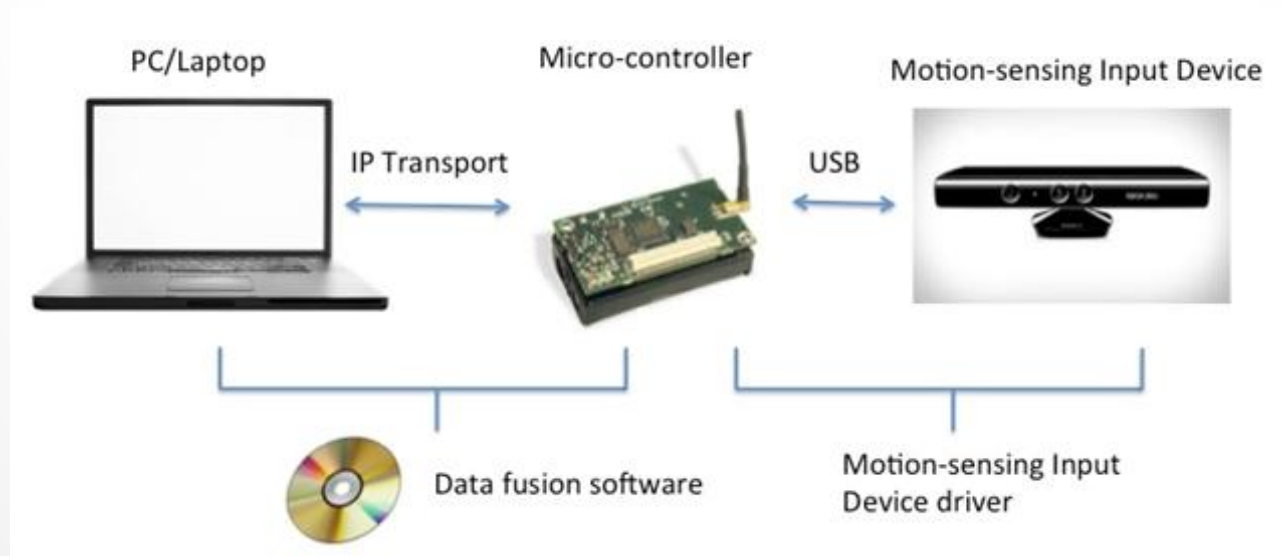
1. Motivation and Specifications
2. Design
 - a) Hardware
 - b) Software
3. Results
4. Future
5. Demonstration
6. Questions

Motivation

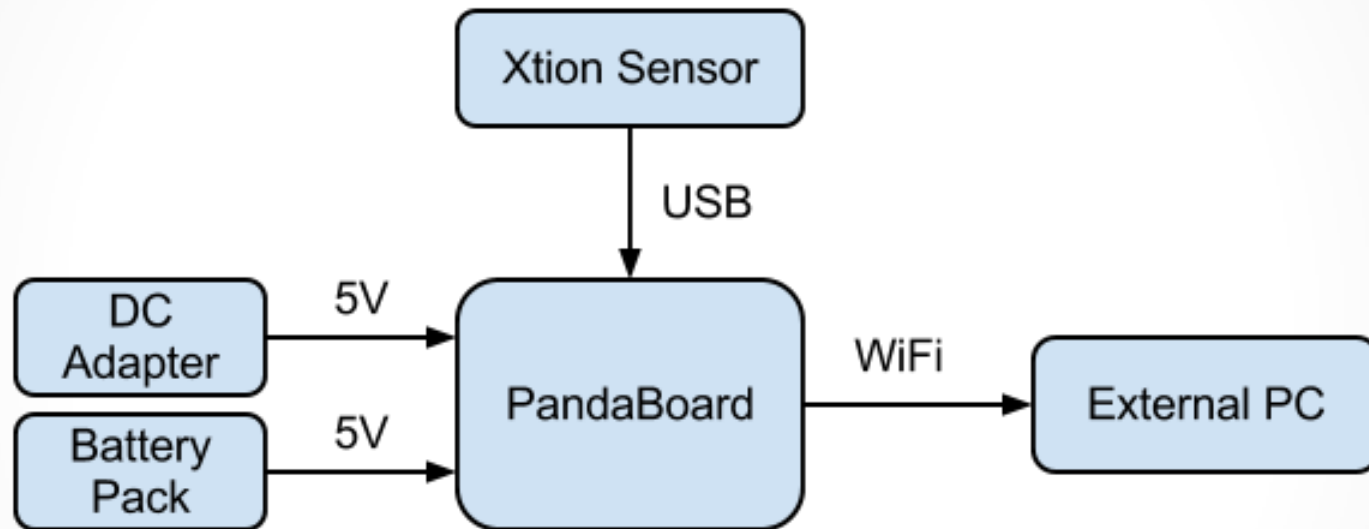
- Electromagnetic (EM) software needs parameters to run
 - Arm Length
 - Leg Length
 - Head Radius
- Manual input can be inaccurate and time consuming
- New sensors including Microsoft's Kinect are cheap and capable of human detection
- Build a portable device in order to utilize one of these sensors
- Speed up EM simulation tests
- Create a platform for future applications

Specifications

- Motion-sensing input device/micro-controller in a light-weight box
- Parsing should be done on microcontroller
- Automatic detection
- Must connect to AFRL software



Design



- Simple
- Intuitive

- Portable
- Robust

Hardware

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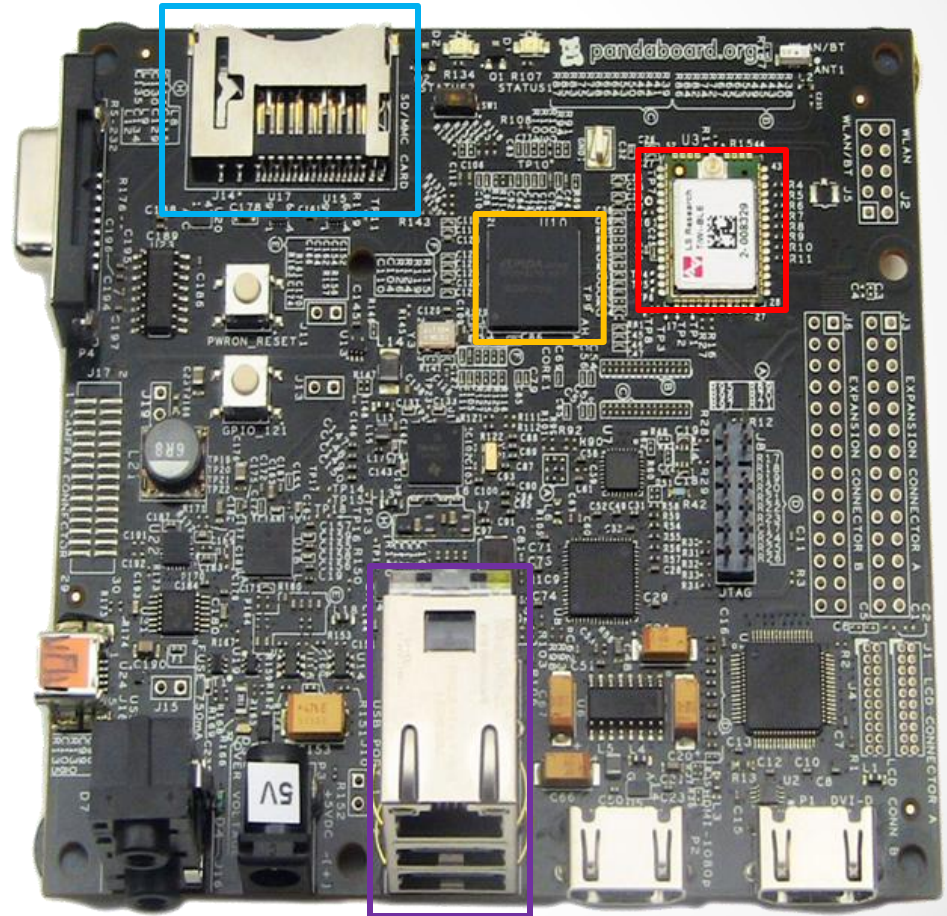
PandaBoard ES

SD Expansion Slot (16 GB)

1.2GHz Dual-Core
ARM Cortex-A9
1GB DDR2 RAM

WLAN
Bluetooth

10/100 Ethernet
2x USB 2.0



Kinect



KINECT™
for  XBOX 360.

- Launched in 2010
- VGA and infrared cameras
- Uses structured light to collect depth information
- No calibration needed
- Can differentiate between multiple people
- Skeleton overlay for parameter extraction

Why Kinect doesn't work

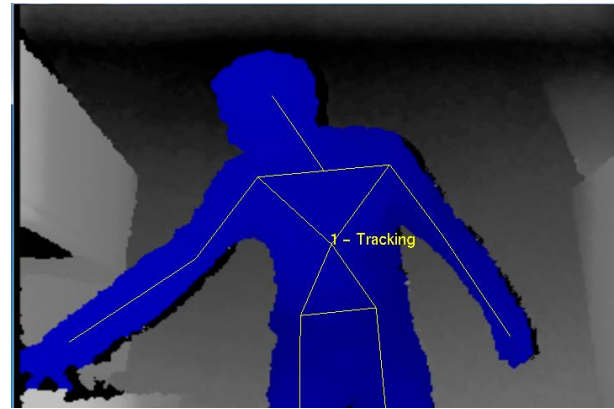
Kinect ARM-compatible Drivers



PrimeSense



- Basic depth map



NITE



- User tracking
- Skeleton model

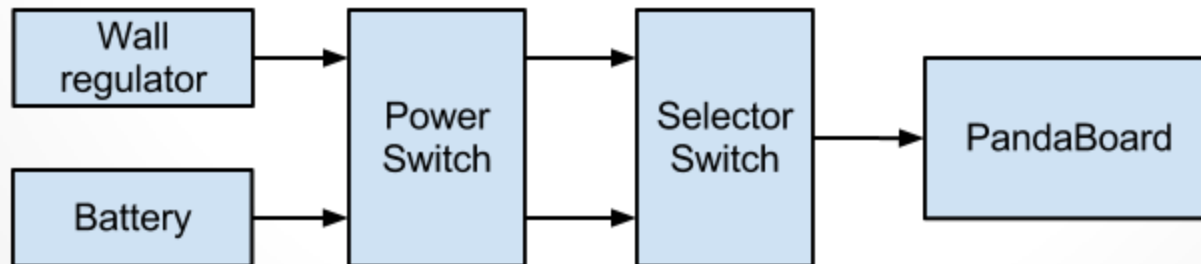
Asus Xtion Pro Live

- Stripped down Kinect
 - Less power – USB only
 - Shorter range
 - No motor in base
- Uses the same libraries
 - OpenNI
 - NITE
- Arm compatible drivers!
- More expensive (\$160 vs. \$110)



Battery

- Anker Astro2 – 8400mAh
- Battery pack charger for iPad/iPhone
- 5V 2A regulated USB output
- Provides several hours of portable operation

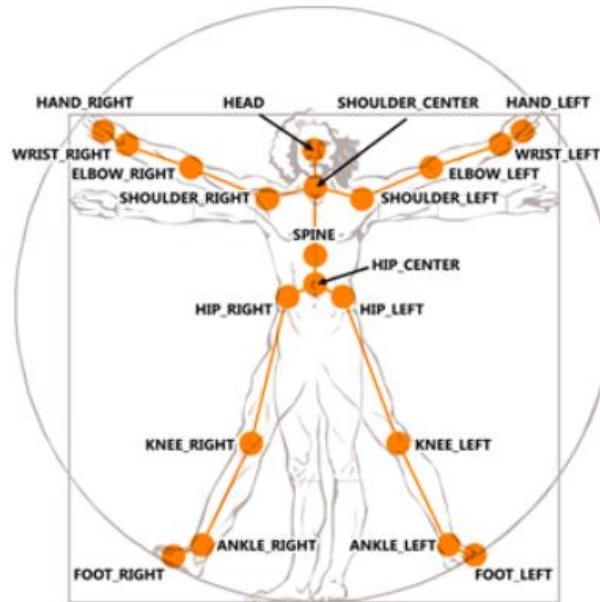


Software

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Joint detection

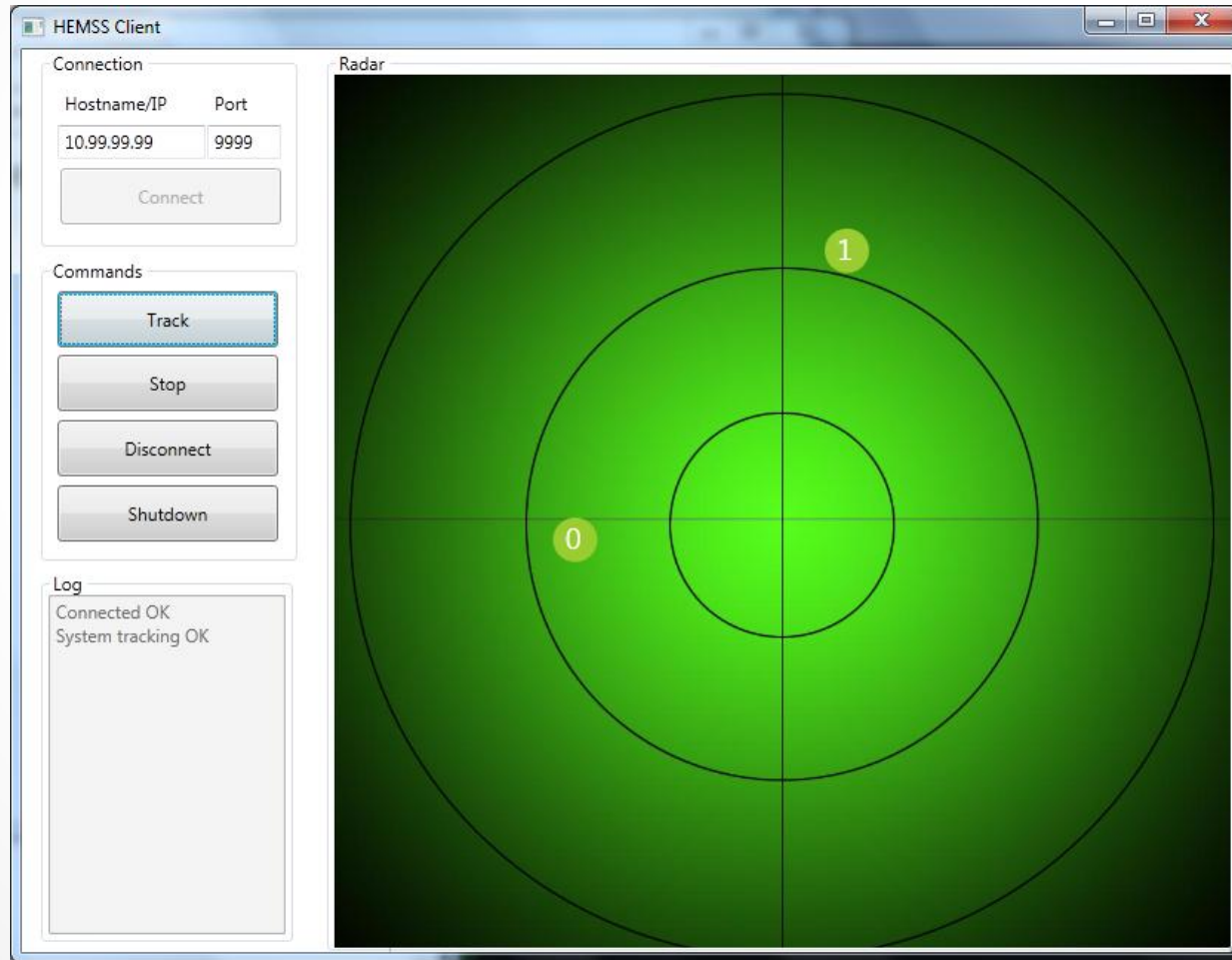
1. Utilize OpenNI skeleton detection library
2. Request parameters
 - a) Joint coordinates (x,y,z)
 - b) Center of mass
3. Compute length as the distance between joints



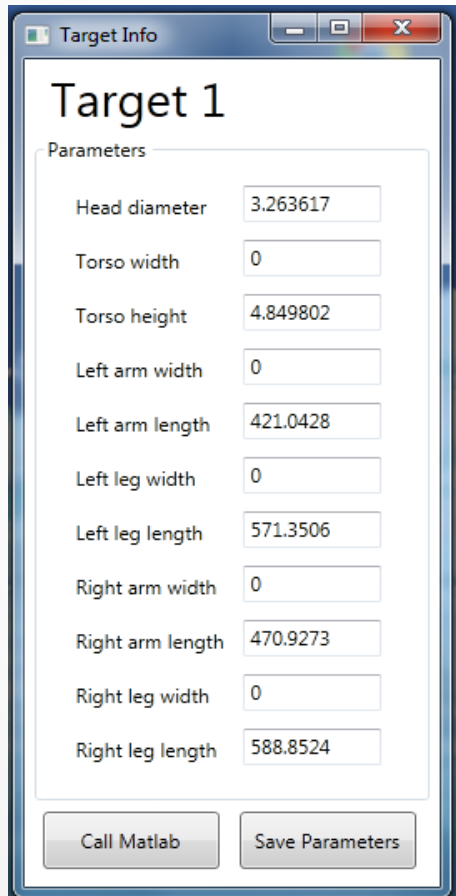
Communication

- Program developed using C++
 - Low level socket class
 - Network controller class
- PandaBoard configured as a WiFi access point
 - Can relay to multiple clients at once
 - Creates encrypted network for devices to connect to
- SSH for advanced system control through PC terminal

PC Application



PC Application

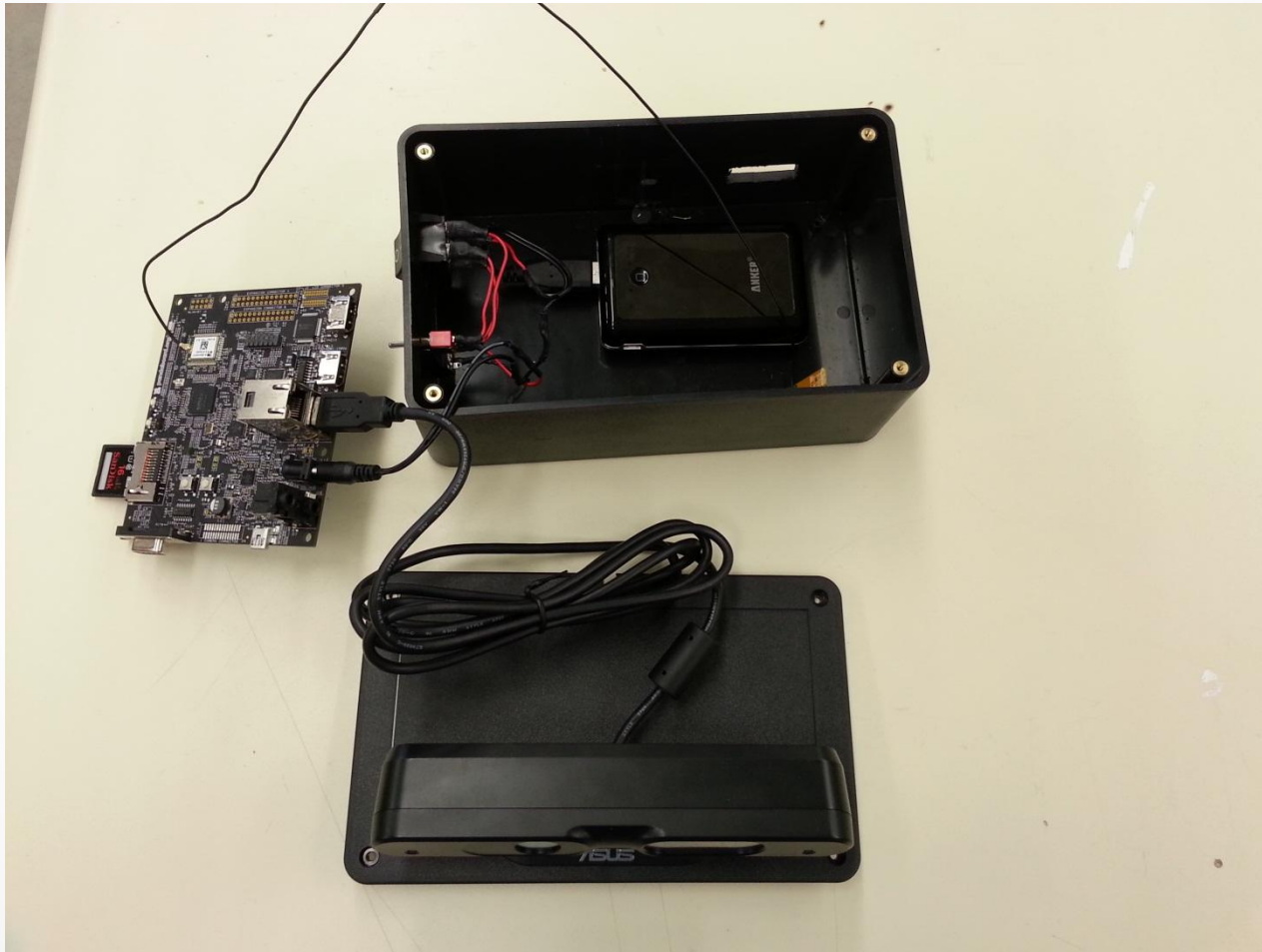


The screenshot shows a Windows-style application window titled 'Target Info'. Inside, there's a section for 'Target 1' with a 'Parameters' group box. This group box contains ten input fields, each with a label and a numerical value. At the bottom of the window, there are two buttons: 'Call Matlab' and 'Save Parameters'.

Parameter	Value
Head diameter	3.263617
Torso width	0
Torso height	4.849802
Left arm width	0
Left arm length	421.0428
Left leg width	0
Left leg length	571.3506
Right arm width	0
Right arm length	470.9273
Right leg width	0
Right leg length	588.8524

- Developed using Microsoft's C# and .NET platform
- Configured to communicate with PandaBoard server
- Provides the user with a detailed GUI
- Can launch Matlab from the target window

Enclosure



Putting it all together...

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Results

- Our system is able to successfully retrieve human parameters and send them to a PC for analysis
- Lightweight and highly portable
- Great at tracking multiple people at once
- Has a few issues
 - Parameter values can be inconsistent
 - Instability in PrimeSense software

Final Budget

Item	Supplier	Base Price (USD)	Shipping	Final Price (USD)
PandaBoard ES	DigiKey	\$161.64	-	\$161.64
Asus Xtion Pro Live	Newegg	\$159.99	-	\$159.99
Anker Battery	Amazon	\$39.99	-	\$39.99
SD Card	?	?	-	?
Enclosure	PolyCase	\$11.93	\$9.52	\$21.45
Web Camera	Amazon	\$19.99	-	\$19.99
USB-DC Cable (2)	DigiKey	\$9.10	-	\$9.10
Switch - Rocker	DigiKey	\$2.68	-	\$2.68
Switch - Toggle	DigiKey	\$2.11	-	\$2.11
Power Jack	DigiKey	\$1.18	-	\$1.18
AC/DC adapter	-	-	-	-
Total				\$1,000,000,000

Future Considerations

- Using Microsoft Kinect
 1. Switch to an X86 based microcomputer
or
 2. Wait for new drivers to be released
- Permanent battery
 - Automatic power path selection
- Improved parameter consistency
 - Highly dependent on what PrimeSense is willing to support
- Other applications

Demonstration

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Questions

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