

Armed and Dangerous

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Agenda

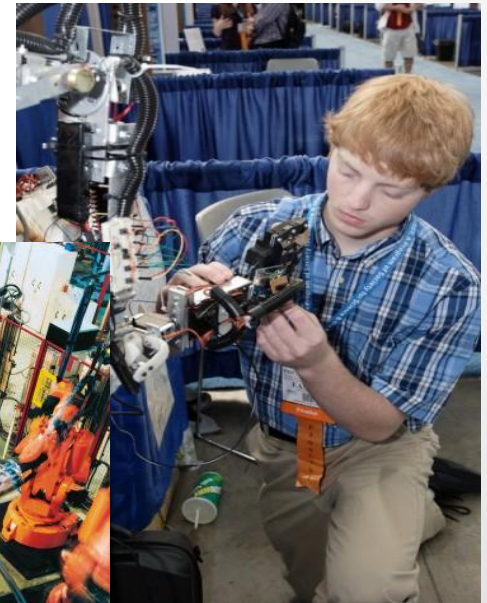
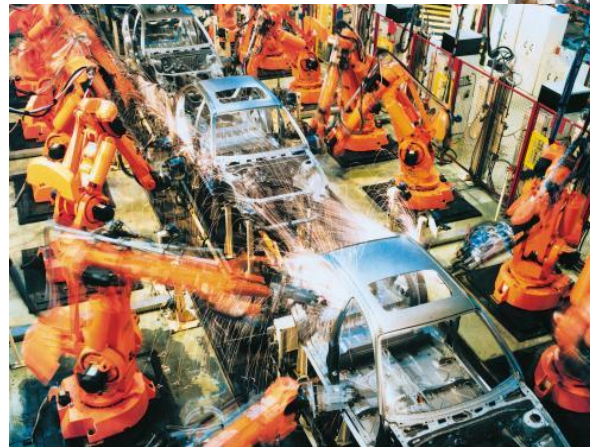
- Description
- Purpose of Project
- Scope
- Development Approach
- Project Plan
- Technology and Tools
- Design Decisions
- Problems and Risks
- Achievements
- Lessons Learned

Project Description

- Controlling a robotic arm to mimic arm and hand movements
- Sponsored by CUBiC (Center for Cognitive Ubiquitous Computing) Lab at Arizona State University and Dr. John Black
- Implemented with a CyberGlove and a Microsoft Kinect
- All operations occur in real time

Purpose and Users

- The robot arm can be used for entertainment and educational purposes by children
- Robotic arms are a great option in dangerous situations
- Auto arms in manufacturing industry



Science Daily,

<http://www.sciencedaily.com/releases/2012/05/120516140000.htm>

Scope

Original Definition

- Develop a user-friendly interface to control the motion of a robotic arm
- Allows remote user control of the arm through use of a webcam

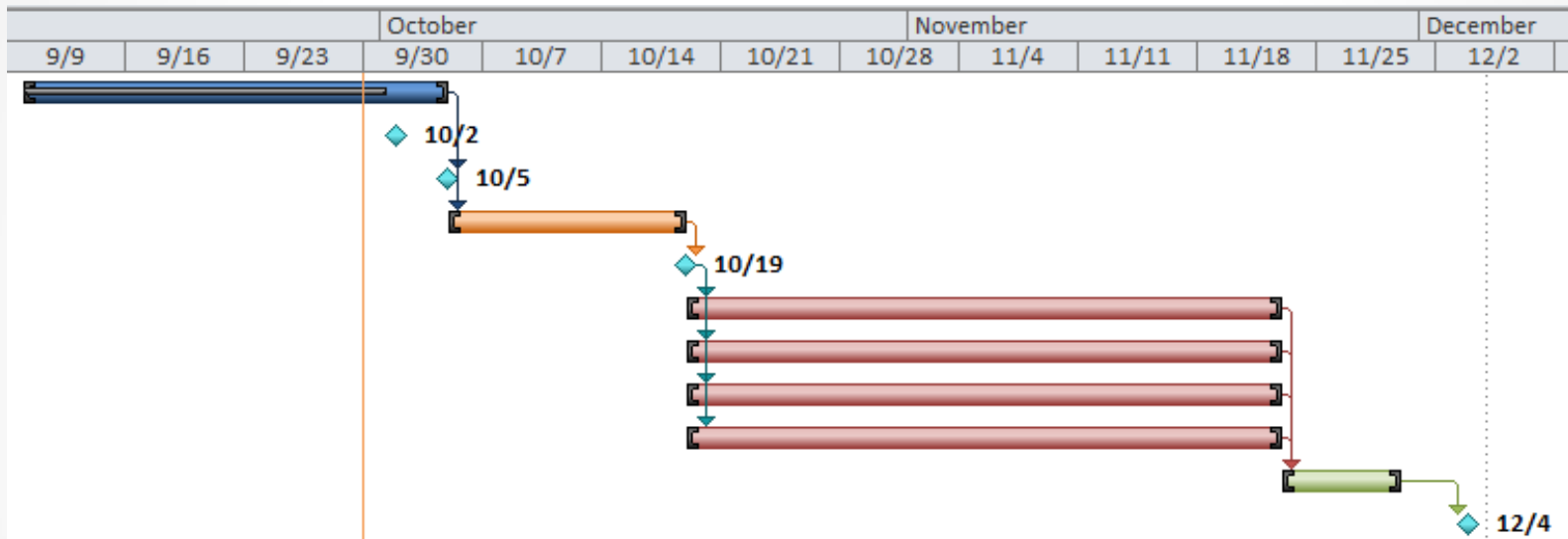
Scope Changes

- Added gesture control
- Graphical interface for configuration
- Allow multiple methods of motion tracking
 - Kinect
 - Inertial Measurement Units(IMUs)

Development Approach

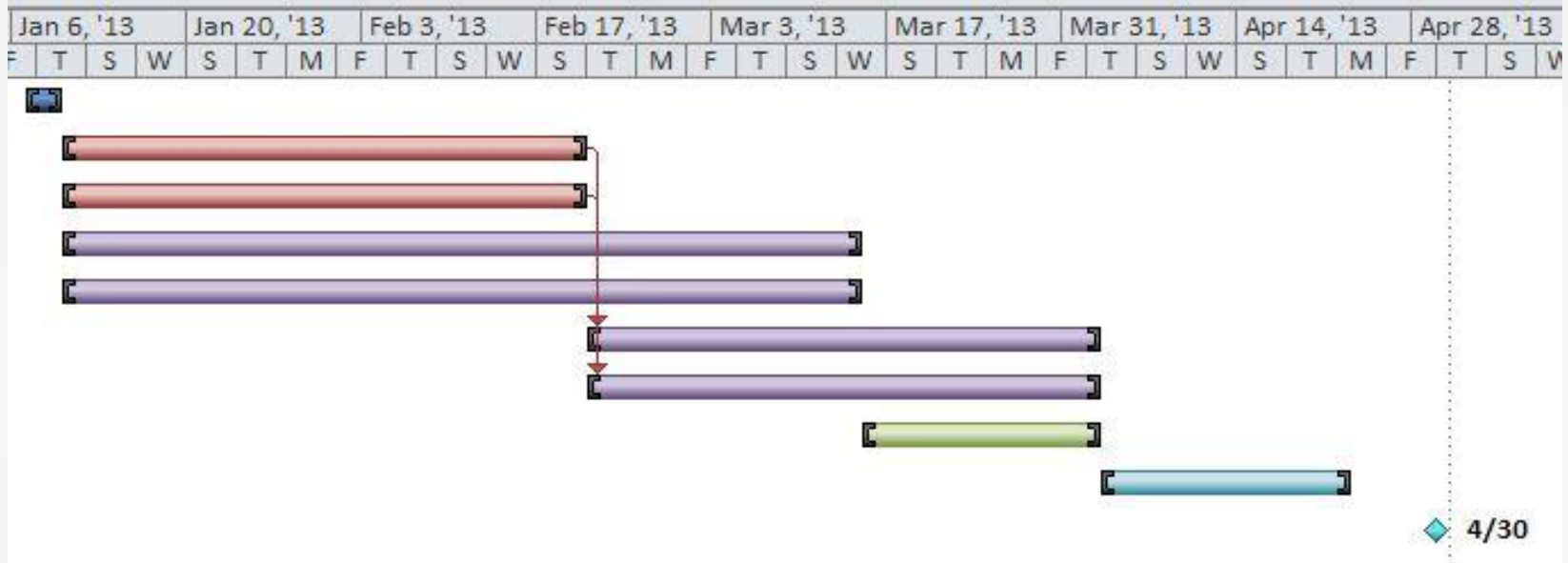
- Divided into four sub-components (teams)
 - CyberGlove - Michael and Craig
 - Kinect - Joe and Scott
 - Robot Arm - Max and Ash
 - Integration and Control System – full team
- All modules were developed in parallel
- Combined all modules into a single product

Project Plan Fall 2012



	Scheduled	Completed
Project Initiation	Oct 4	Oct 4
Design	Oct 18	Oct 28
Development	Nov 22	Nov 29
Integration	Dec 10	Dec 7
Refinement	Spring 2013	

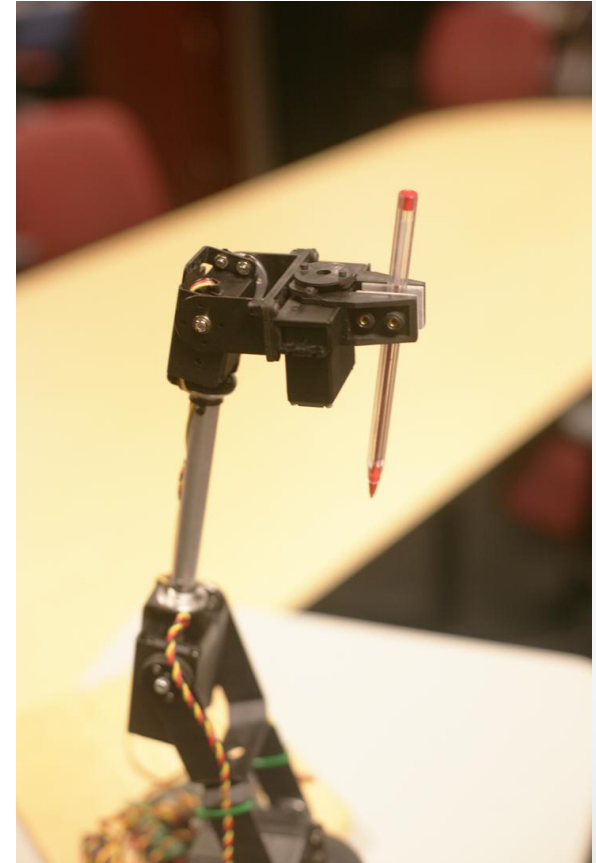
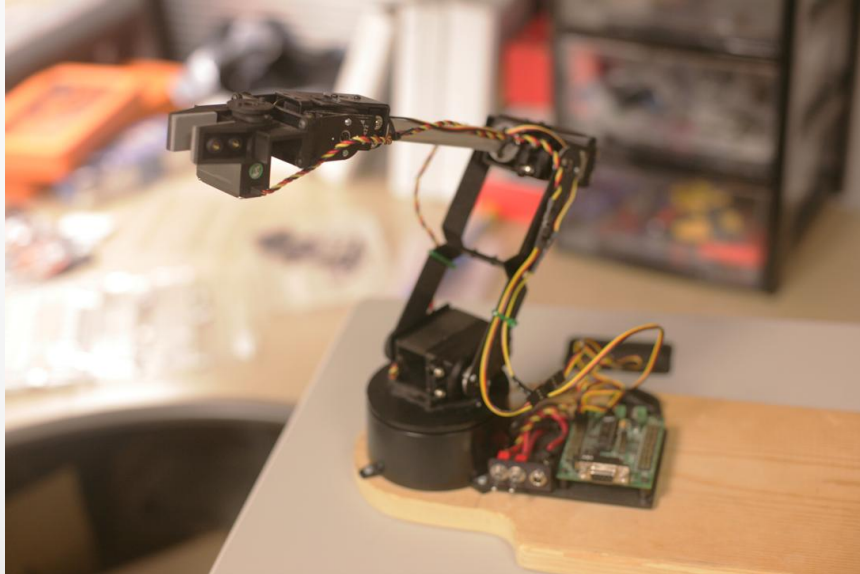
Project Plan Spring 2013



Scheduled	
Project Review	Jan 9
Development	Feb 20
Refinement	April 2
Integration	April 2
Testing	April 22

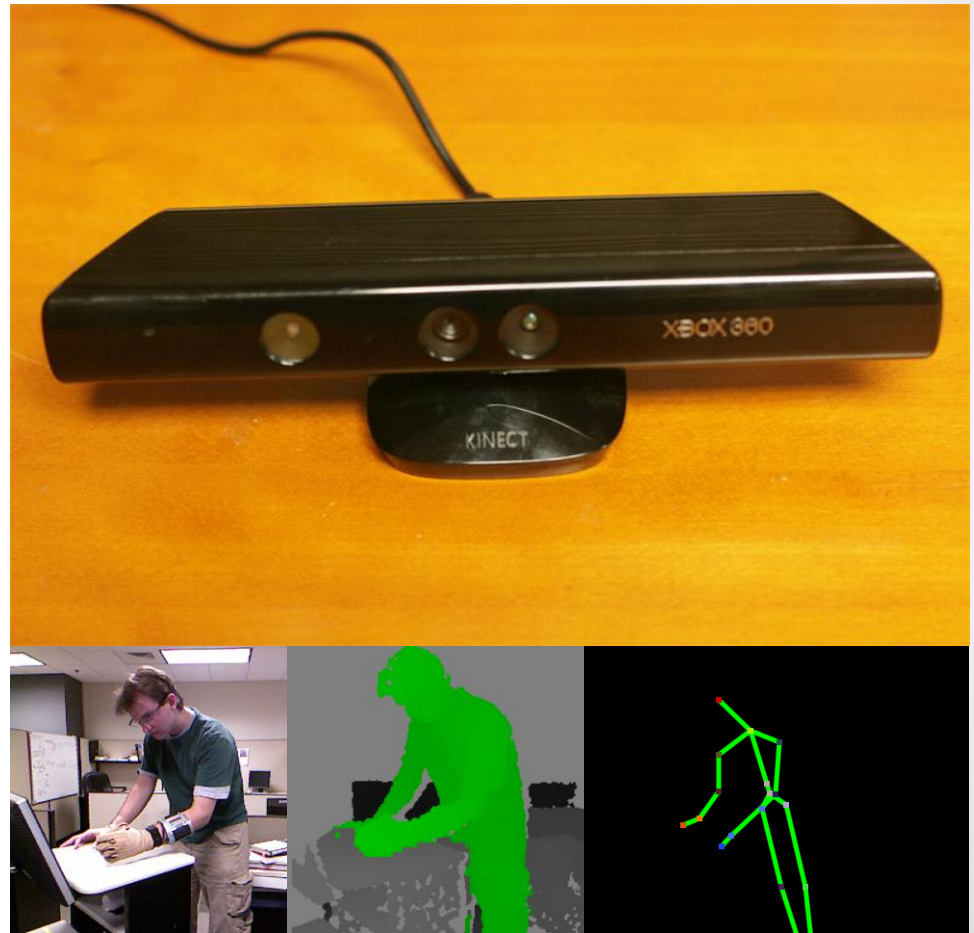
Technology and Tools Used – Robot Arm

- Lynxmotion AL5D
- 5-axis
- 13 oz. capacity



Technology and Tools Used -- Kinect

- Provides joint positions for right arm in 3D space
- Data is noisy
- Tracking of wrist/hand movements unreliable



Technology and Tools Used -- CyberGlove

- 18 flex sensors
- Wrist flexion/extension
- Serial protocol



```
Tera Term Web 3.1 - COM1 VT
File Edit Setup Web Control Window Help

PARAMETER FLAGS (boolean) (0 = Off, 1 = On)
d = set include-Time-Stamp on/off ?d = query include-Time-Stamp status
f = set Filter on/off ?f = query Filter status
j = set Switch-Contls-Light on/off ?j = query Switch-Controls-Light status
l = turn Light on/off ?l = query Light status
q = set send-Quantized-vals on/off ?q = query send-Quant-vals status
u = set include-glove-status ?u = query include-glove-status
w = set sWitch status on/off ?w = query sWitch status
y = enable/disable external sYnc ?y = query enable/disable external sYnc

ERROR CODES
e? = Unknown command
eg = Glove not plugged in
en = error with entered Number
es = Sampling rate too fast
ey = sYnc input rate too fast
?r 0
g 106 60 118 90 94 83 92 205 160 99 146 144 81 96 168 184 150 125
g 106 60 118 90 94 83 92 205 160 99 146 144 81 96 168 184 150 125
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Software Used

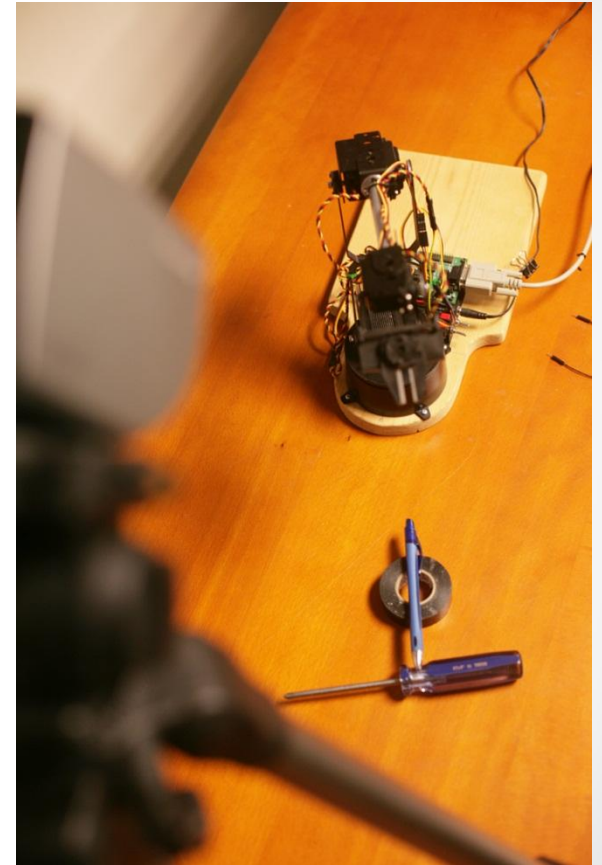
- Visual Studio 2012 for software development
- Git and github as code repository
- Google Drive for document sharing

The image is a collage of three screenshots illustrating the software used in the project:

- Top Left:** A screenshot of a GitHub repository page for 'babb517/Robotic-Arm-Controller'. It shows the commit history, including an 'Initial Commit' and a commit by 'Joe Babb'. The repository is linked to a Google Drive folder.
- Bottom Left:** A screenshot of a Google Drive interface showing a folder named 'Trevie' containing various documents, including meeting minutes and project files.
- Right:** A screenshot of the Visual Studio 2012 IDE. The main window displays the 'PositionalTracker.cs' file, which contains C# code for handling Kinect sensor data. The Solution Explorer on the right shows the project structure, including 'ArmController', 'CyberGlove Module', 'Integration', 'Kinect Module', 'Orientation.cs', and 'PositionalTracker.cs'.

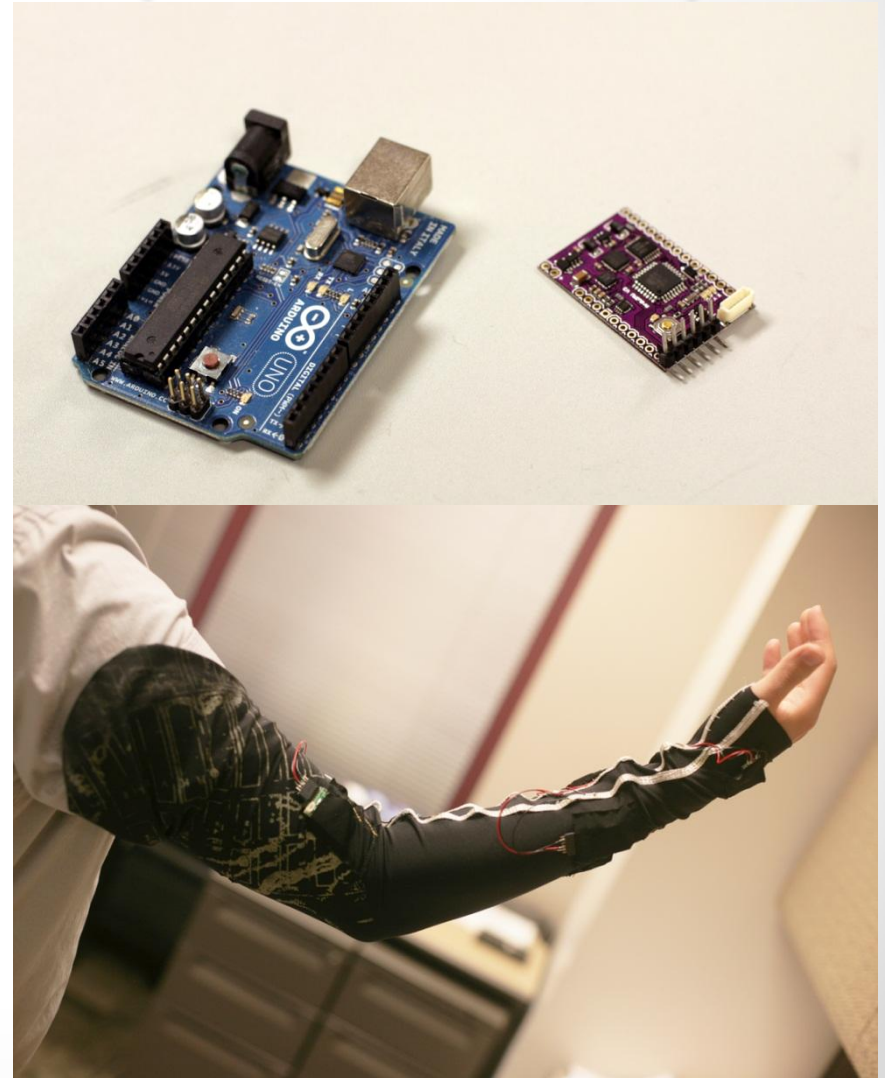
Technology and Tools Used – Video (Planned)

- Single POV
- No audio



Technology and Tools Used – IMUs (Planned)

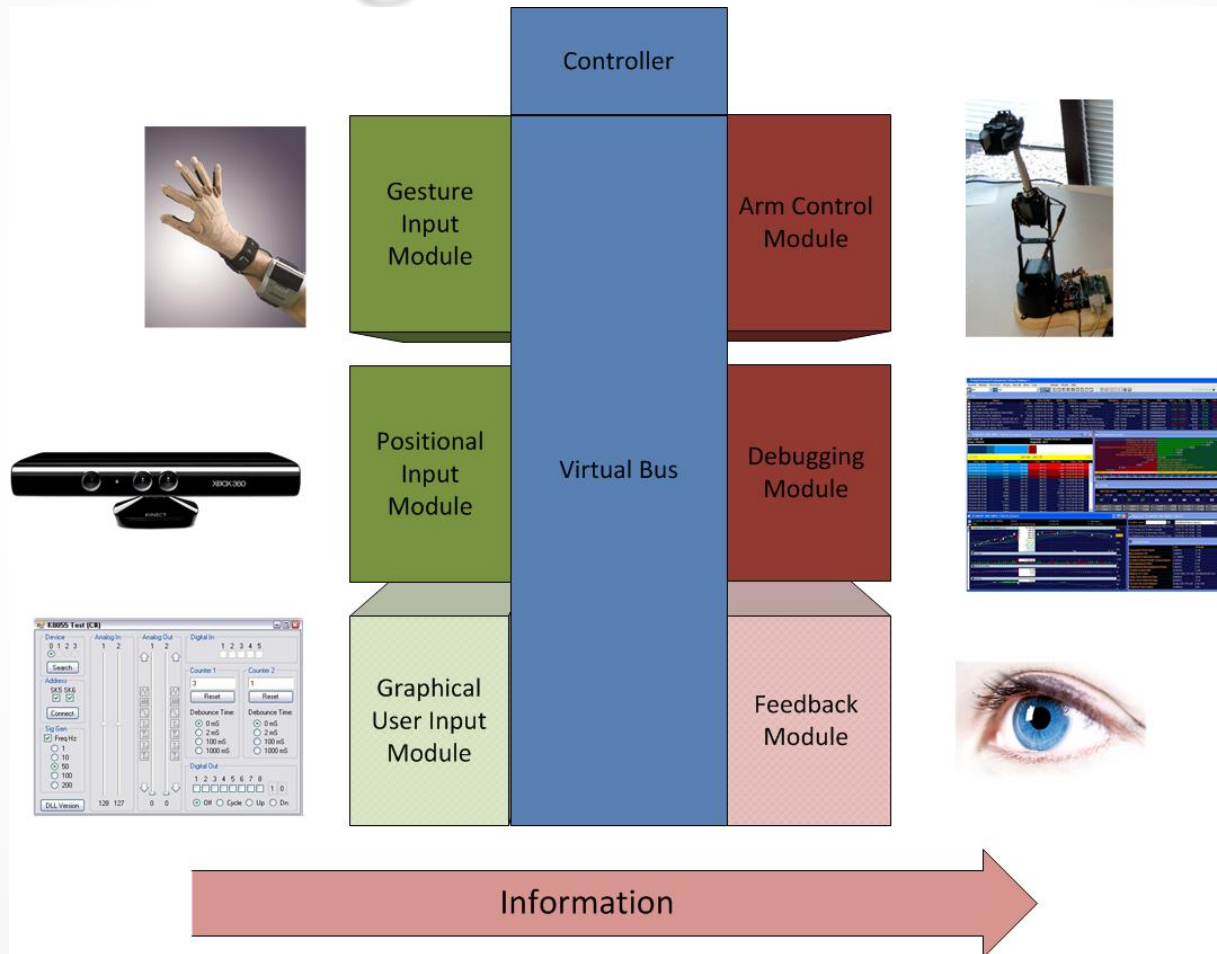
- Inertial Measurement Unit
 - Accelerometer
 - Gyroscope
 - Magnetometer
- 3 linked to Arduino
- Collaboration with Dr. Troy McDaniel



Design Decisions

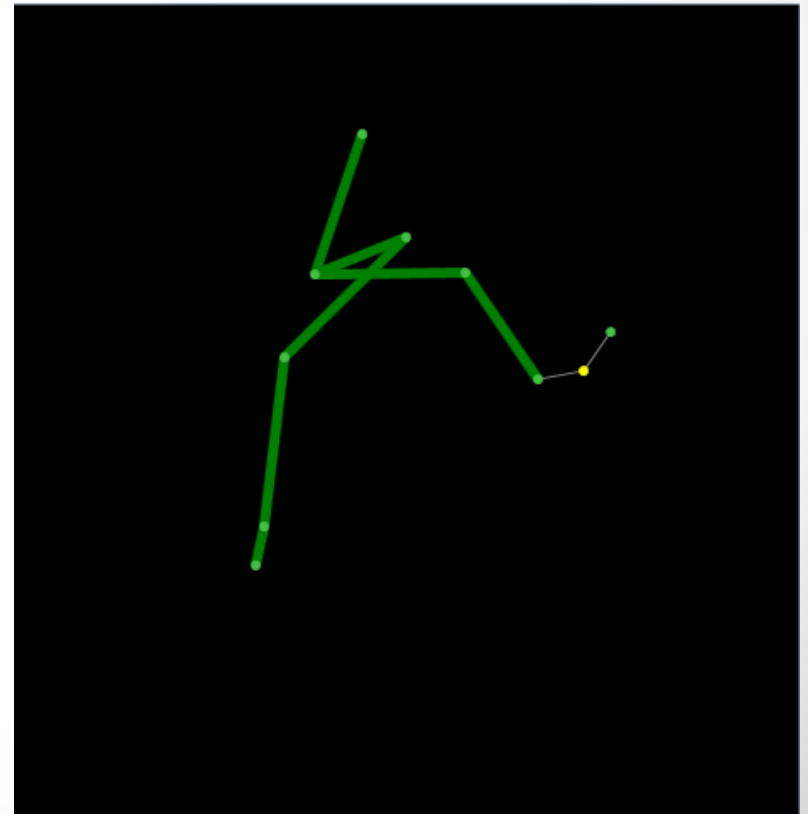
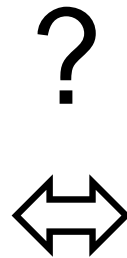
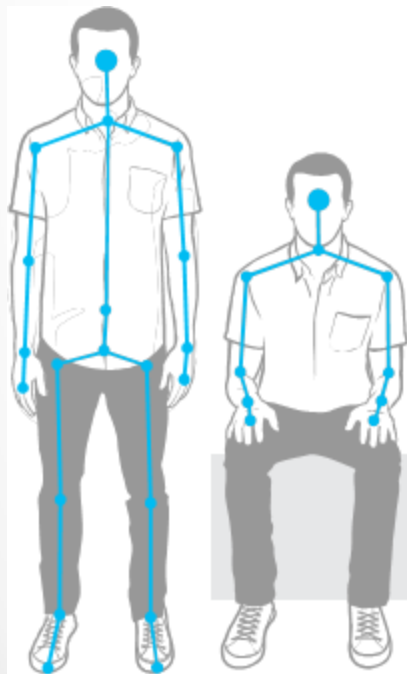
- Design is modular
 - Central controller
 - Focus on extensibility
 - Shared data medium (virtual bus)
 - Publish / subscribe architecture
- Initially Kinect was chosen over IMUs
 - Next semester IMUs will replace Kinect
- Wrist data is obtained from CyberGlove
 - The Kinect is unreliable when tracking the wrist.

Design Overview



Problems and Risks

- Kinect motion tracking is not accurate



Problems and Risks

- Servos can overheat and fail
- Additional hardware is required for further refinement



Video

Achievements

- All sub-teams have successfully completed and integrated their modules
 - Kinect Module
 - CyberGlove Module
 - Arm Control Module
- All existing code has been well documented
 - Ambiguity in some sections of code has been removed
- The robot arm can mimic basic arm movement
 - Objects such as pens can be picked up and moved around

Lessons Learned

- Robot arm testing must be carried out with caution
 - Gears have been stripped due to uncontrolled robot arm movement
- We must be ready to replace parts at any time
 - We now have a much better understanding of the mechanical workings of the robot arm
- The data provided by the Kinect is unreliable
 - The Kinect must be replaced to perform finer human arm movements

Conclusion

- The robot arm can mimic basic arm movement
- Various peripherals are used to gather input
 - Kinect
 - CyberGlove
- Publish/subscribe architecture used for our code
- Future Plans include:
 - Phase out Kinect
 - Add visual feedback module
 - Add graphical interface

Questions