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)

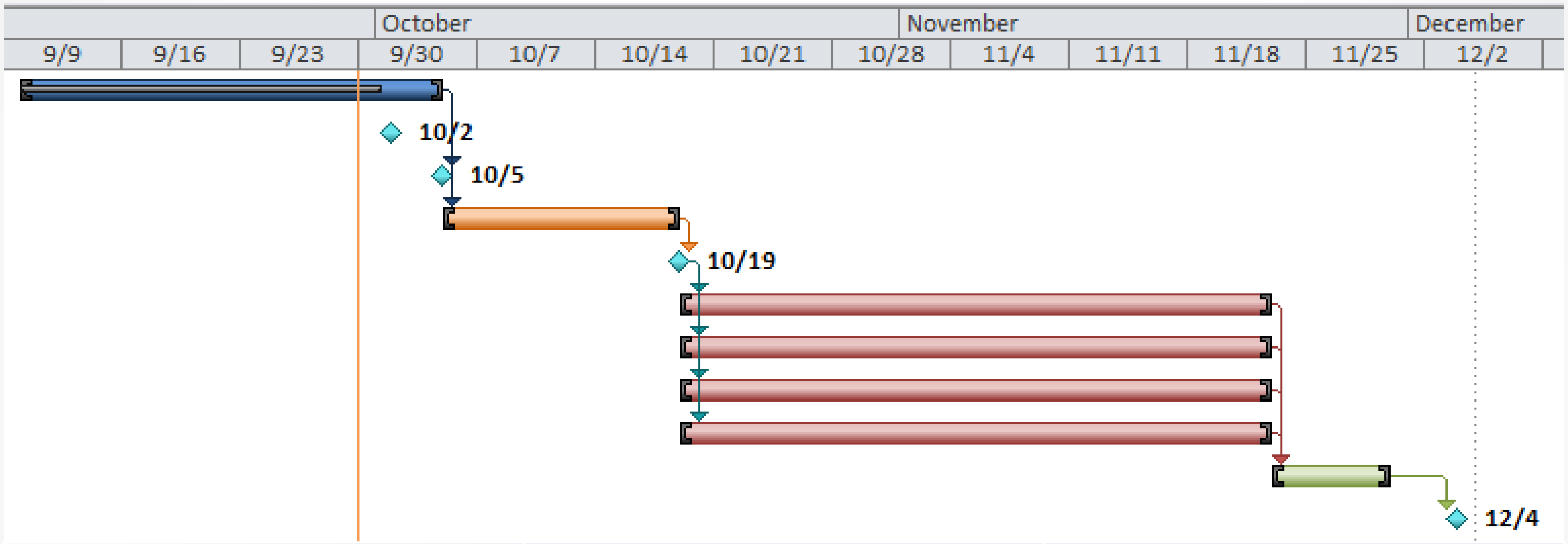
Development Approach

- 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

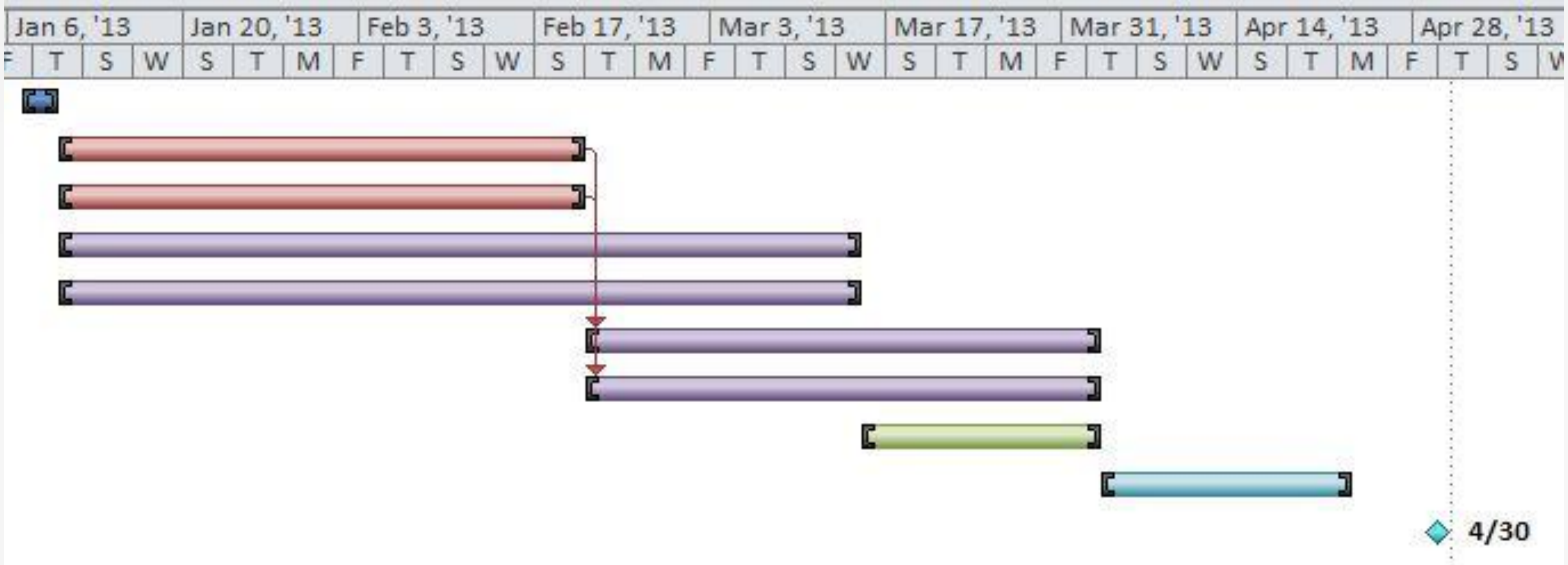
- Combined all modules into a single product

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	

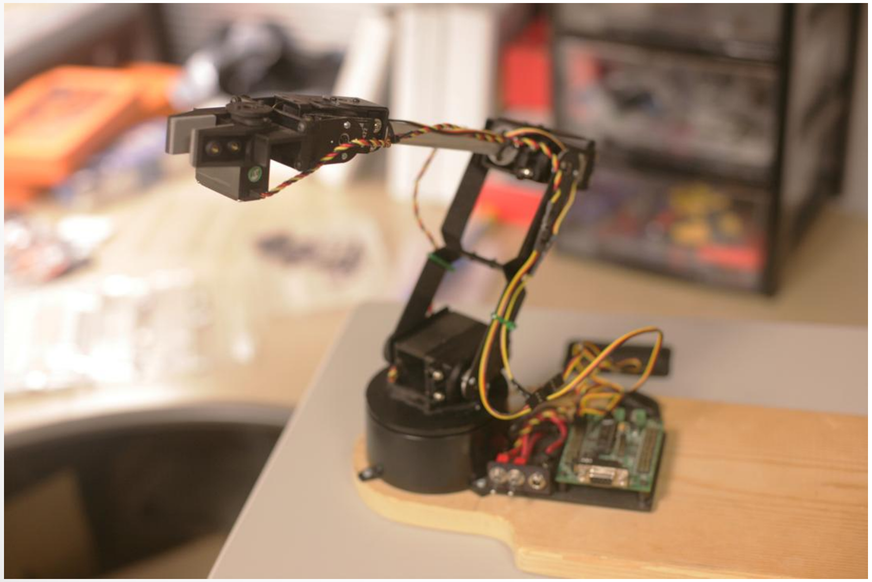
Project Plan Spring 2013

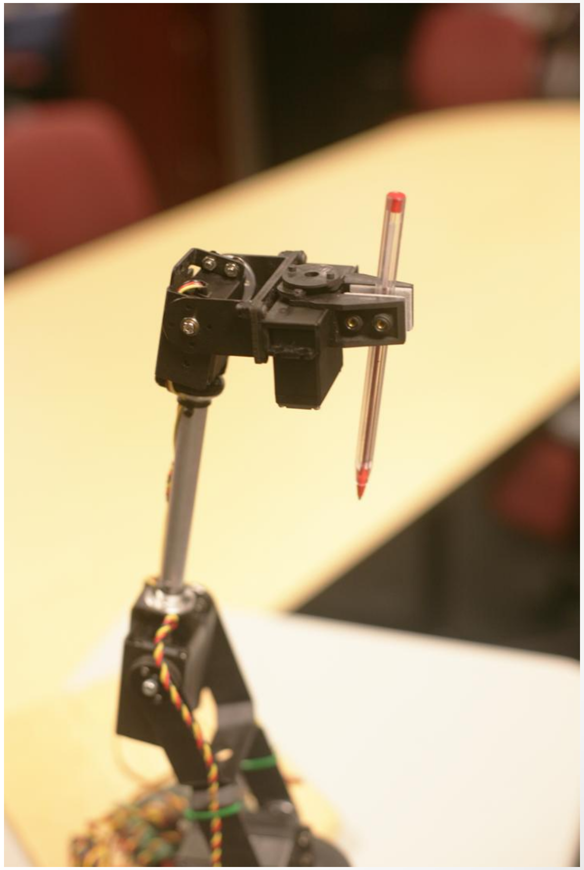


	Scheduled
Project Review	Jan 9
Development	Feb 20
Refinement	April 2
Integration	April 2
Testing	April 22

Technology and Tools Used – Robot Arm

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



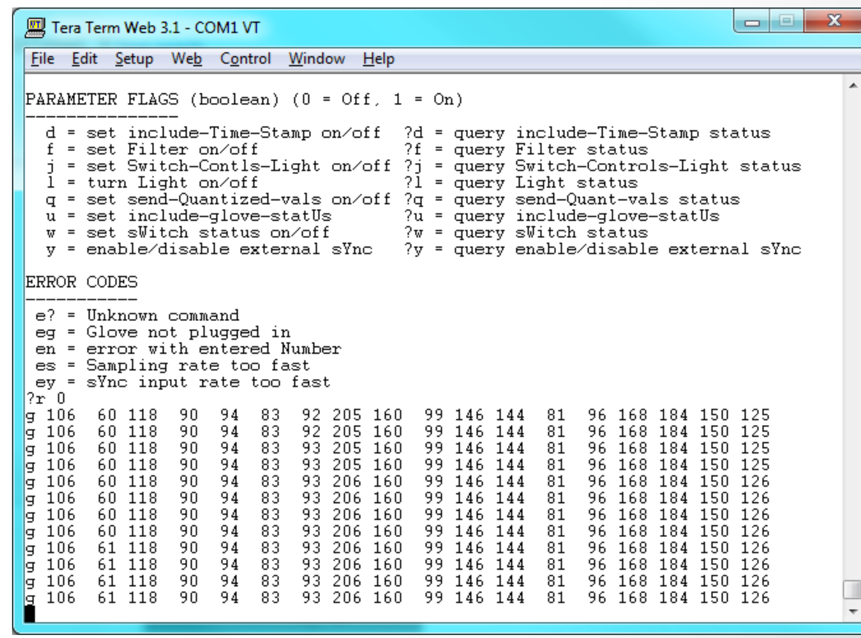


Technology and Tools Used -- Kinect

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

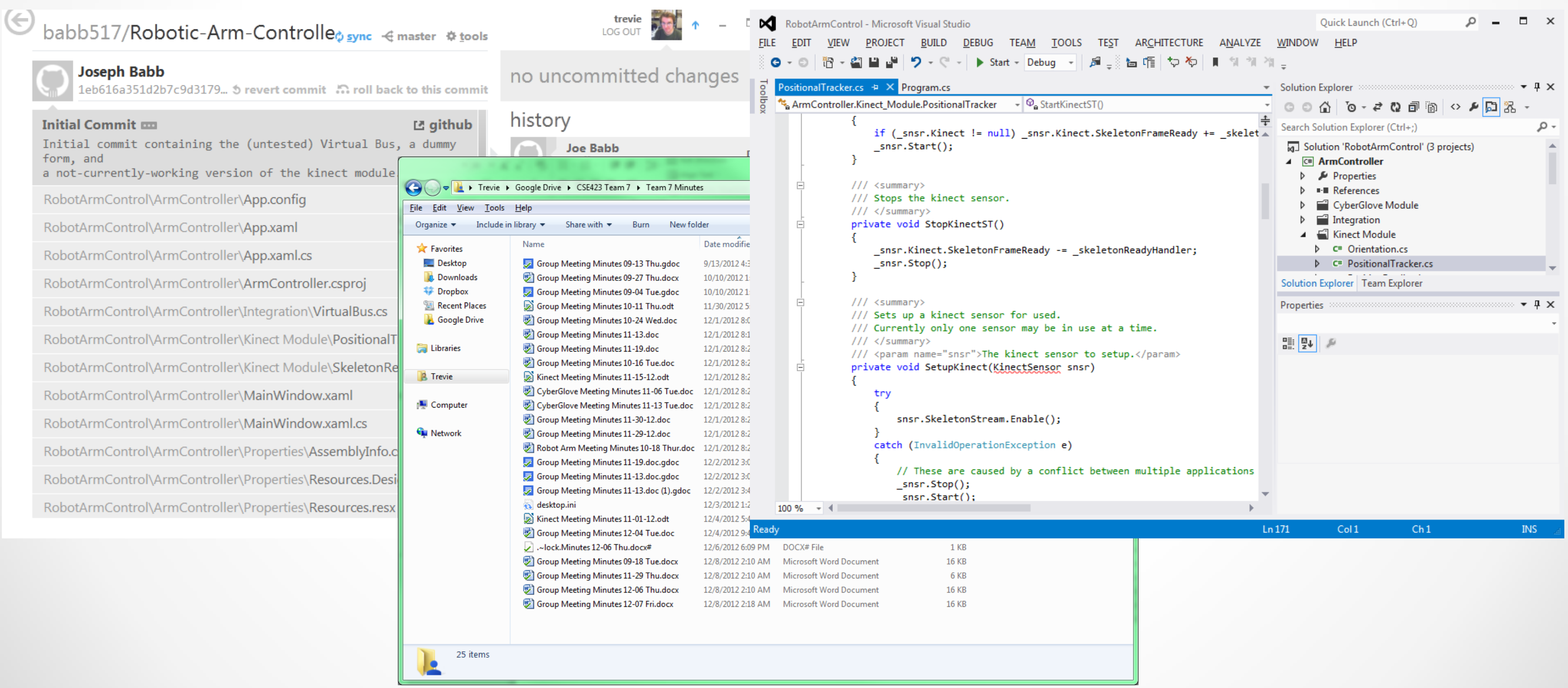
Technology and Tools Used -- CyberGlove

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



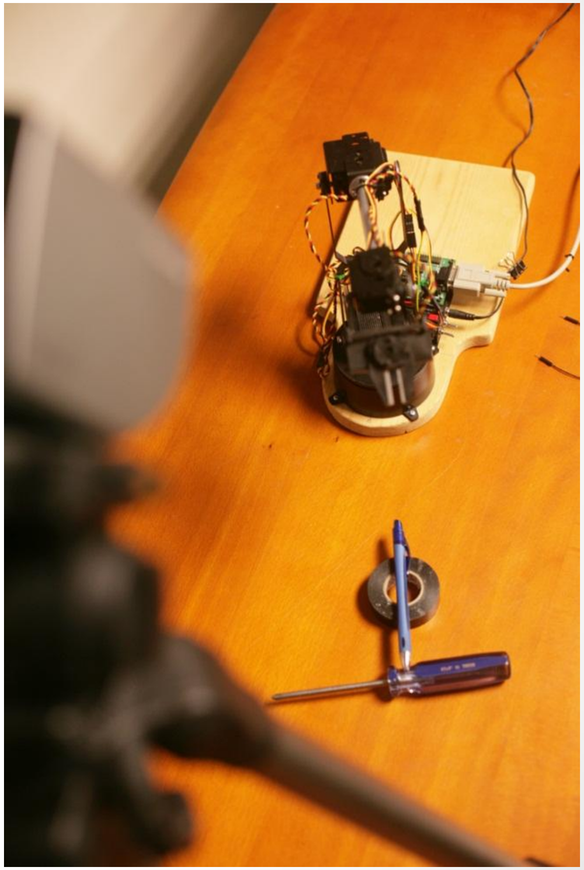
Software Used

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



Technology and Tools Used – Video (Planned)

- Single POV
- No audio

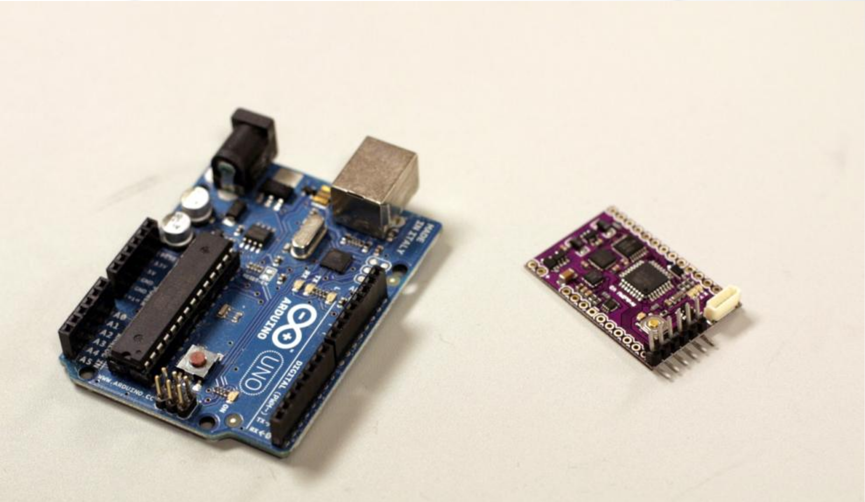


Technology and Tools Used – IMUs (Planned)

- Inertial Measurement Unit
  - Accelerometer
  - Gyroscope
  - Magnetometer

- 3 linked to Arduino

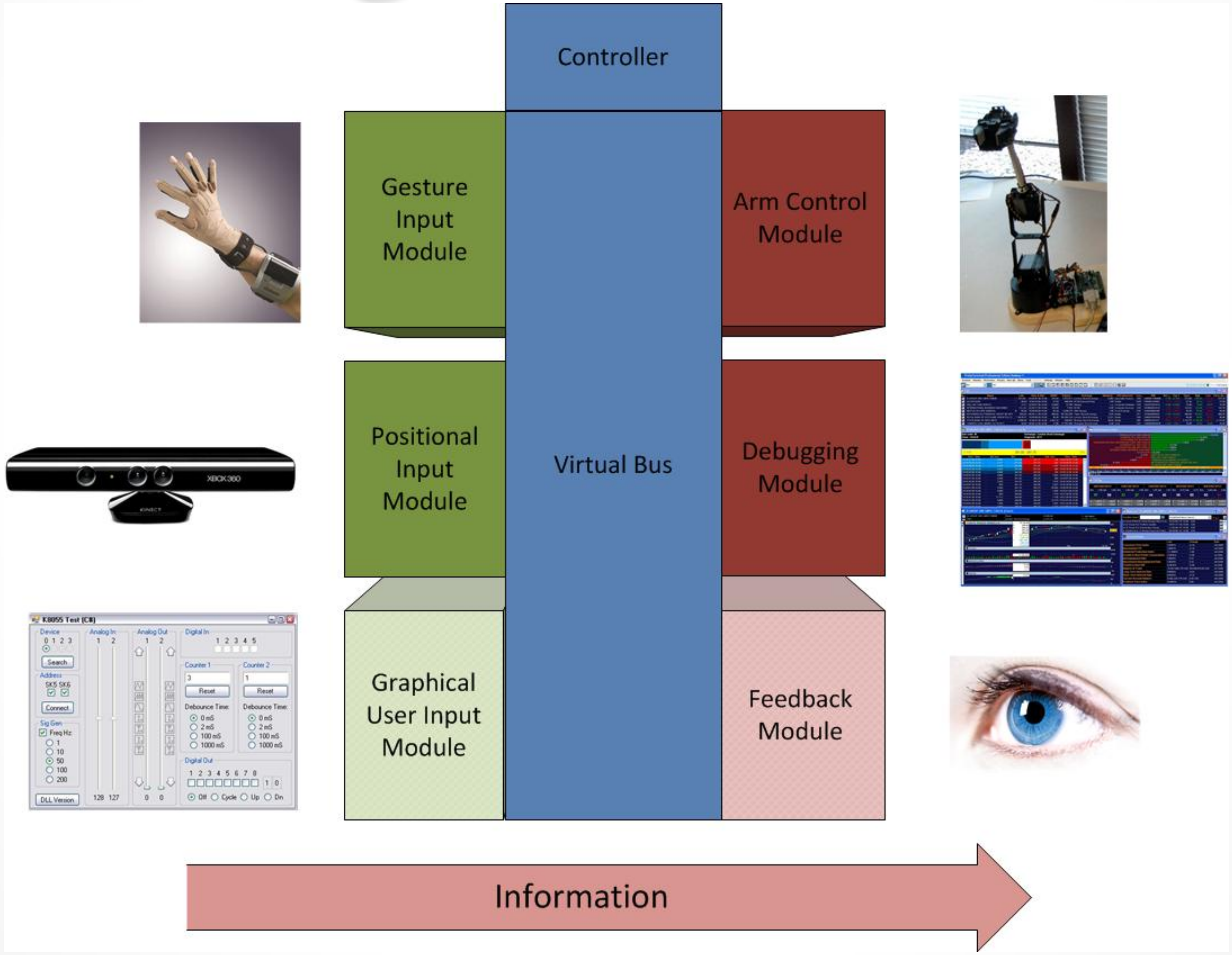
- Collaboration with Dr. Troy McDaniel



Design Decisions

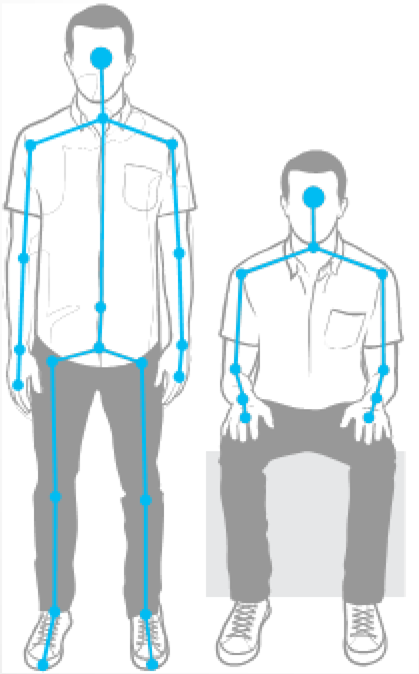
- Design is modular
  - Central controller
  - Focus on extensibility
  - Shared data medium (virtual bus)
  - Publish / subscribe architecture
- Initially Kinect was chosen over IMUs
  - Next semester IMUs will replace Kinect
- Wrist data is obtained from CyberGlove
  - The Kinect is unreliable when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

Design Overview



Problems and Risks

- Kinect motion tracking is not accurate



http://msdn.microsoft.com/en-us/library/hh973077.aspx

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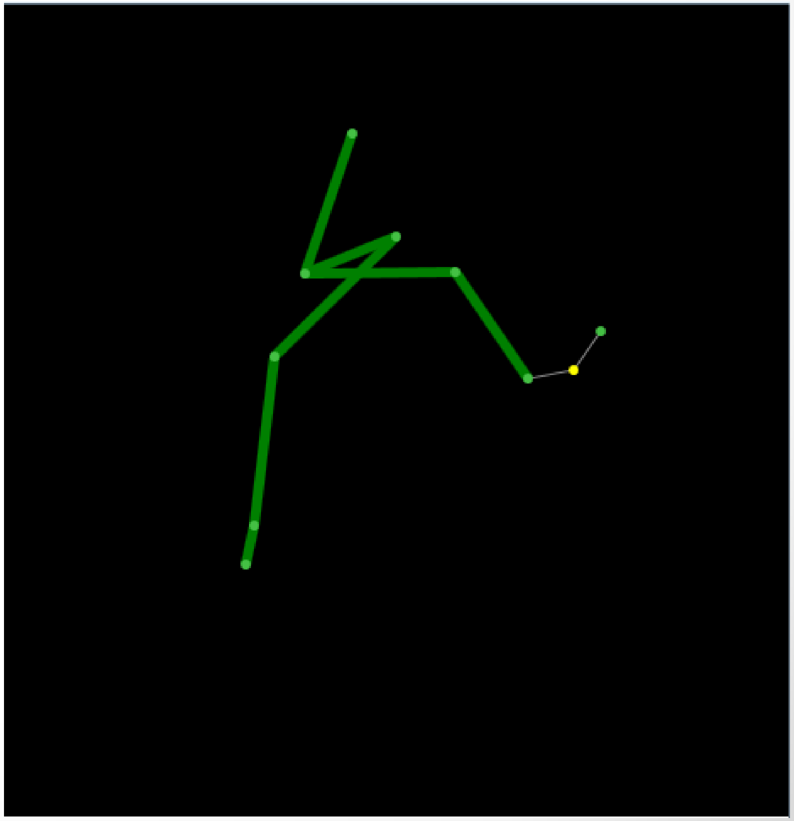

Problems and Risks

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

http://www.lynxmotion.com/images/product/medium/wruhd.jpg

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