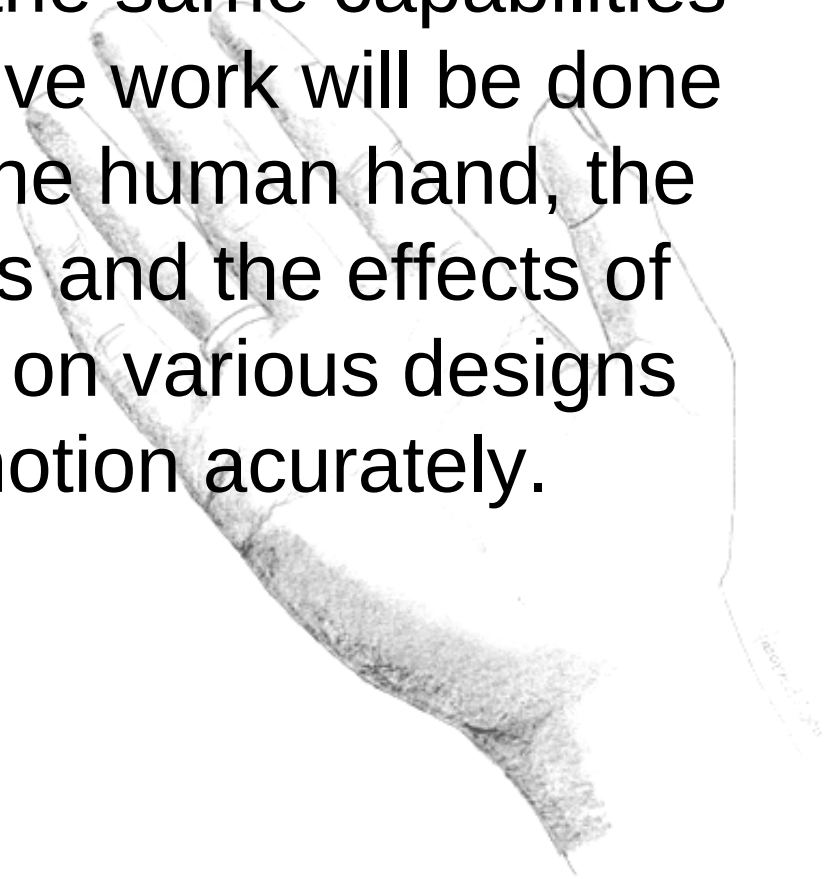
Artificial Limb Project

By Casey Dill

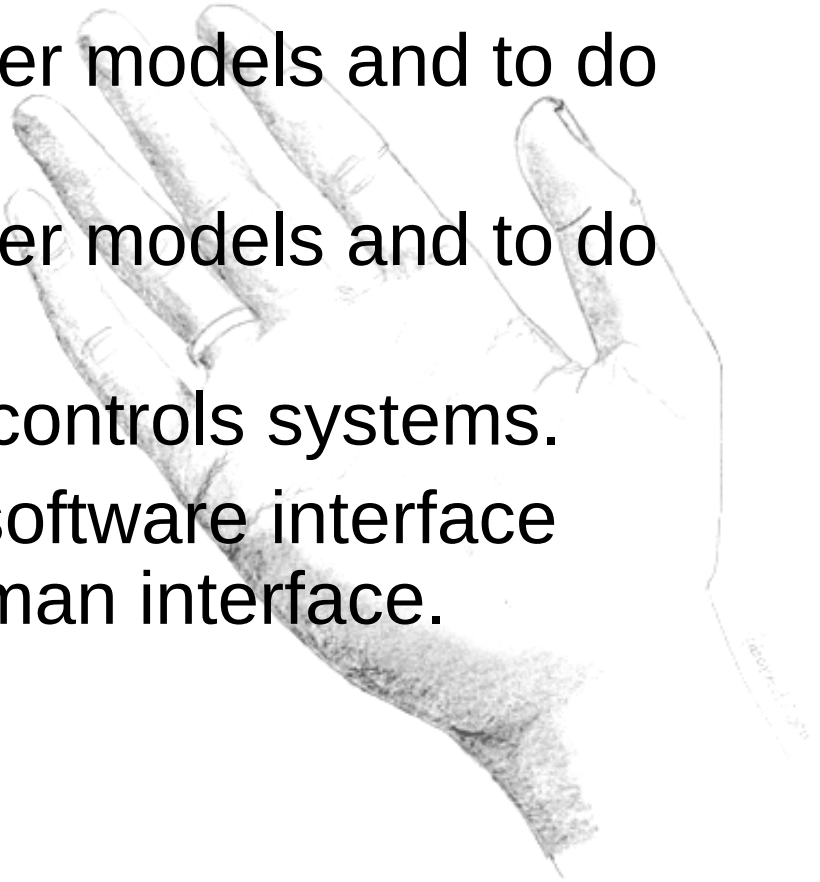
Mission Statement

- This project will improve upon existing plans for an artificial arm with the same capabilities of a human arm. Extensive work will be done to study the motions of the human hand, the forces acting on the parts and the effects of scaling up and down; all on various designs that reproduce human motion acurately.



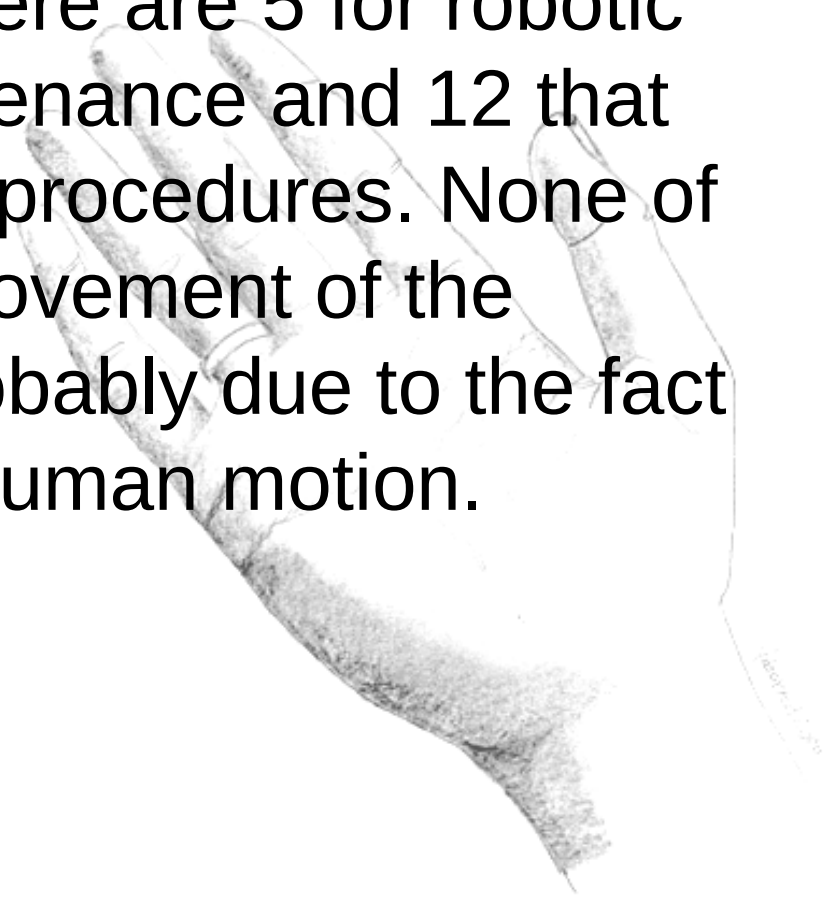
Staffing Requirements

- ME Lead – To lead the team and make sure all the goal of the project are met and on time.
- ME1 – To work on computer models and to do mechanics analyses.
- ME2 – To work on computer models and to do mechanics analyses.
- EE1/CE1 – To program a controls systems.
- EE2/CE2 – To work on a software interface package or to create a human interface.



Intellectual Property Considerations

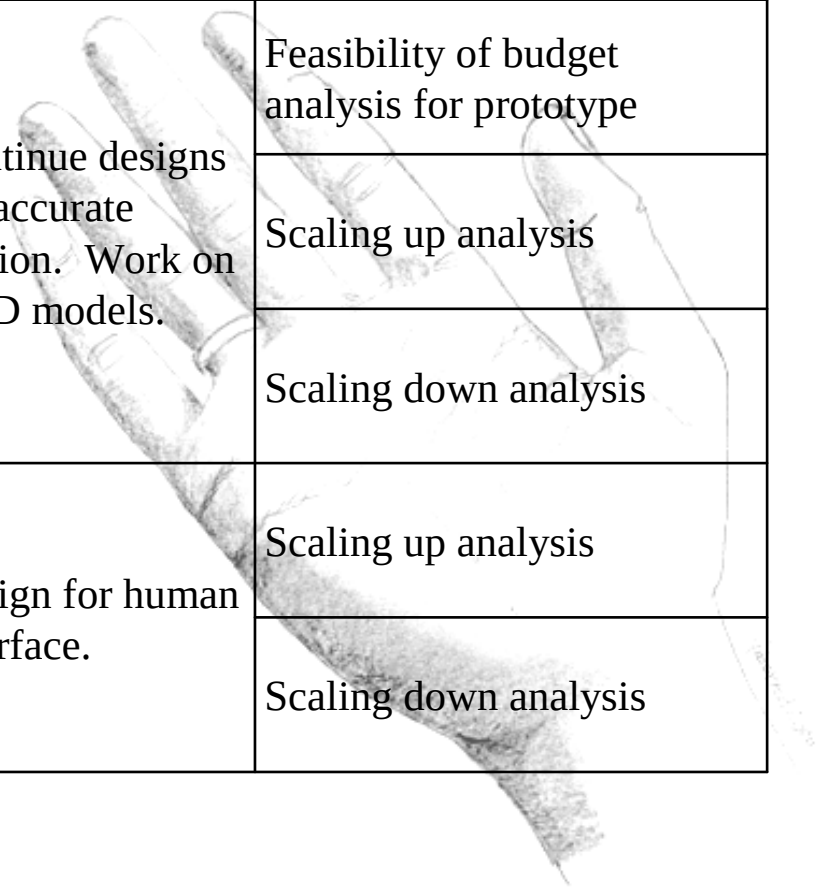
- There are many patents for robotic designs that are still in effect. There are 5 for robotic arms that perform maintenance and 12 that have to do with medical procedures. None of these arms mimic the movement of the human anatomically, probably due to the fact that no one can patent human motion.



Source: http://patft.uspto.gov/

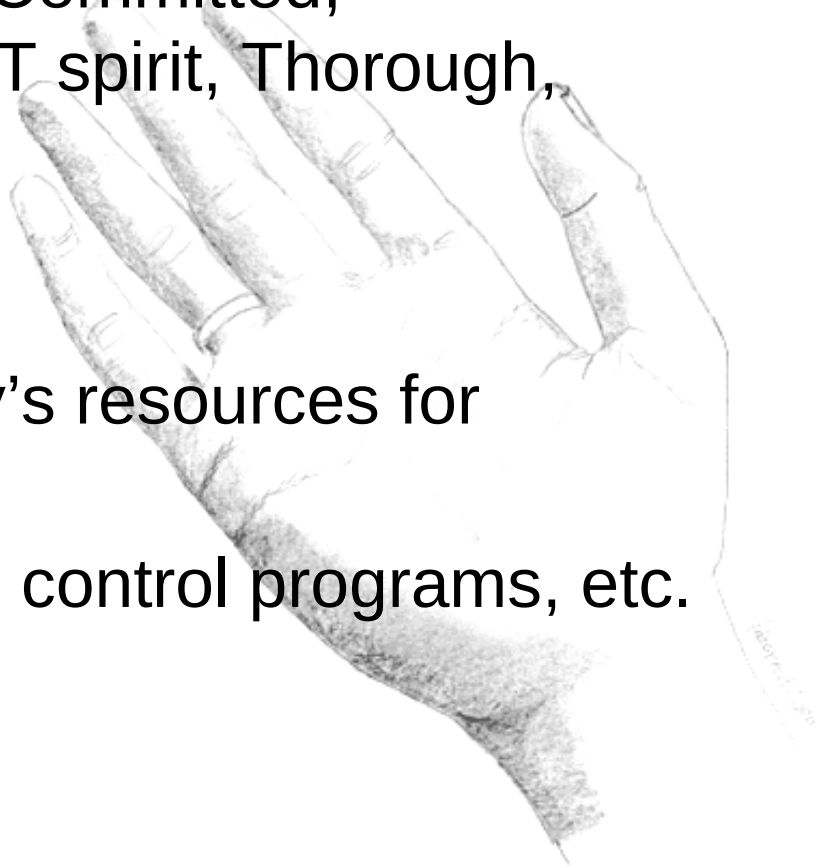
Preliminary Work Breakdown Structure

Person	Week 1	Week 2	Week 3	Week 4
ME Lead	Familiarize with past projects' accomplishments and challenges. Meet with faculty guide to talk about goals and concepts. Brainstorm concepts for development. Become a team.	Initial design concepts for the wrist and forearm.	Continue designs for accurate motion. Work on CAD models.	Feasibility of budget analysis for prototype
ME 1				Scaling up analysis
ME 2				Scaling down analysis
EE/CE 1		Design for position controls	Design for human interface.	Scaling up analysis
EE/CE 2				Scaling down analysis



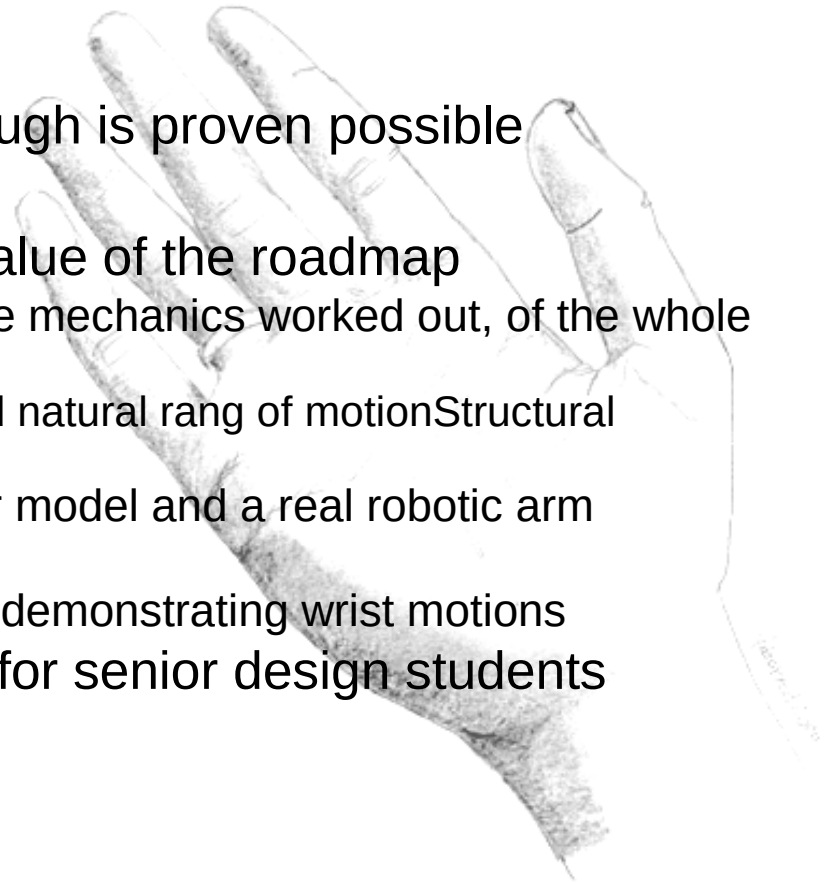
Team Values and Resources

- Team Values and Norms
  - Professional and Ethical, Committed, Demonstrates the core RIT spirit, Thorough, Accurate and Punctual
- Required Resources
  - Access to The RIT Library's resources for research
  - Access to CAD programs, control programs, etc.
  - Meeting space



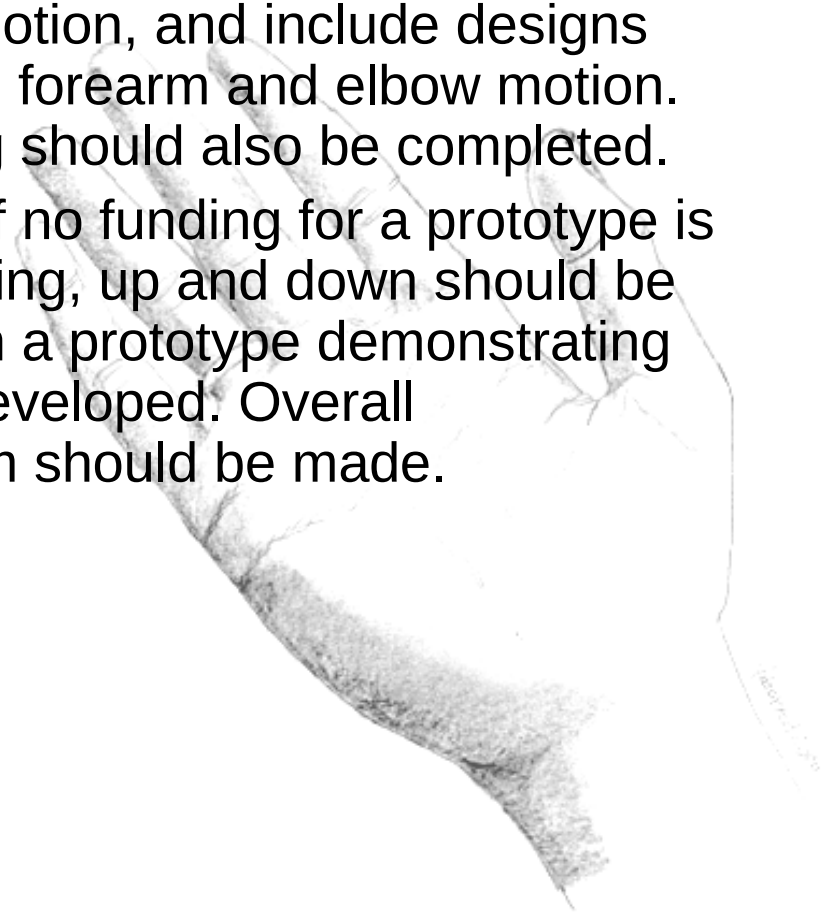
Customer Needs

- Customers:
  - Dr. Lamkin-Kennard – Faculty guide
  - Past Senior Design Team
  - Medical Industry
  - Dresser Rand in the future, if enough is proven possible
- Needs:
  - The project needs to add to the value of the roadmap
    - Proof of concept CAD model with the mechanics worked out, of the whole arm
      - Should demonstrate tool usage and natural rang of motionStructural analysis for scaling up and down
    - An interface system with a computer model and a real robotic arm
      - simple and well documented
    - (if funding is found) a prototype arm demonstrating wrist motions
  - The project should be interesting for senior design students



Target Specifications

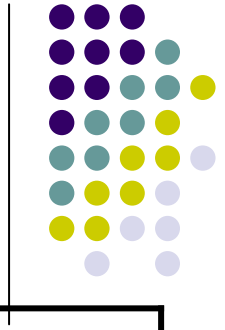
- By the end of the first quarter CAD models of several different designs for a robotic human arm are to be developed. They should be with respect to human motion, and include designs from past groups and include wrist, forearm and elbow motion. Designs to improve motion sensing should also be completed.
- By the end of the second quarter, if no funding for a prototype is found, a complete analysis for scaling, up and down should be completed. If funding is found, then a prototype demonstrating the wrist design concepts will be developed. Overall improvement to the controls system should be made.



Issues & Risks

Risk Management Table					
Description of Risk	**Possible Consequences**	**Probability of Risk (H/M/L)**	**Severity of Risk (H/M/L)**	**Overall Risk (H/M/L)**	**Contingency Plan**
Money is not found for prototyping	Not able to build prototype	H	L	L	Alternate path a for more rigorous engineering analysis is followed.
Because most of this work will be done on the computer, there is always the potential of data loss	Lost time and work	M	M	M	Daily back up on EDGE server
EDGE server has down time	Not able to retrieve work off of EDGE	L	H	M	Keep work in progress backed up on local machine
The school computer could crash with too detailed CAD work with too many parts	Model not renderable	H	L	L	Work with parts of a model at a time.
Not enough programming knowledge to support efforts	Too much work would be placed on those who do know programming	M	H	M	See help from another faculty guide able to help with the programming & teach it.

Concept Development



	Option 1	Option 2	Option 3	Option 4
Knuckle 1 DOF	Pin joint	Flexible material	Ball and socket	Floating
Knuckle 2 DOF	Ball and socket	Two pin joints	Gyroscope	Flexible connector
Wrist	Two pin joint	Ball and socket	Two ball and socket joints	Flexible connector
“Bone” material	Steel	Aluminum	Hard plastics	Titanium
Position Sensing	3D position sensing	Joint angle monitoring	Tendon length monitoring	Control system calculations
Forearm	Two “bones” that wrist	Load-bearing bearing	Rotate at elbow	

Concept Development