

# Hydraulic Nanomanipulator

## Senior Design Project P13371

Primary Customer: Dr. Michael Schrlau

Team Guide: William Nowak

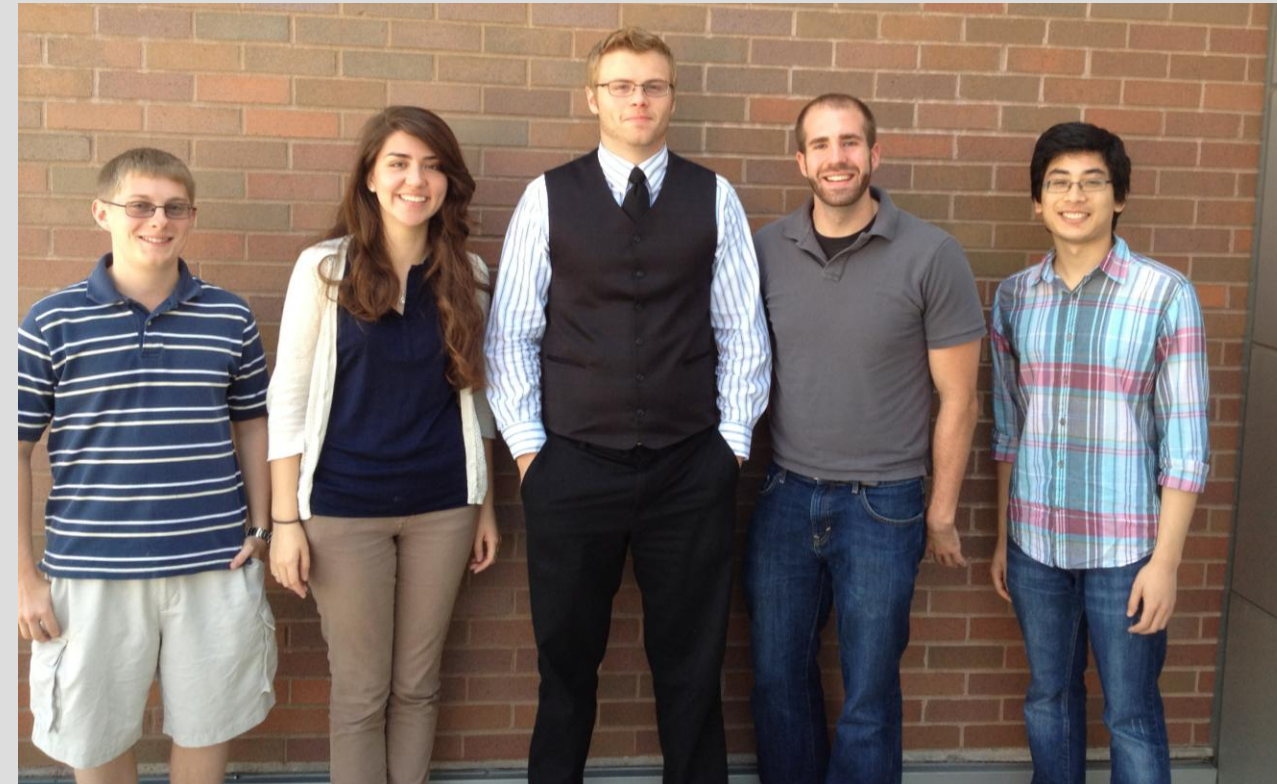
### Mission Statement

- Broaden participation in nanoscience for students in secondary education by lowering the manufacturing cost of the system to below \$1000
- Improve the design and implementation of a computer controlled hydraulic nanomanipulator executed by team P12371
- Meet competitive operational specifications and reduce cost compared to commercially available product (\$10,000+)

### Background

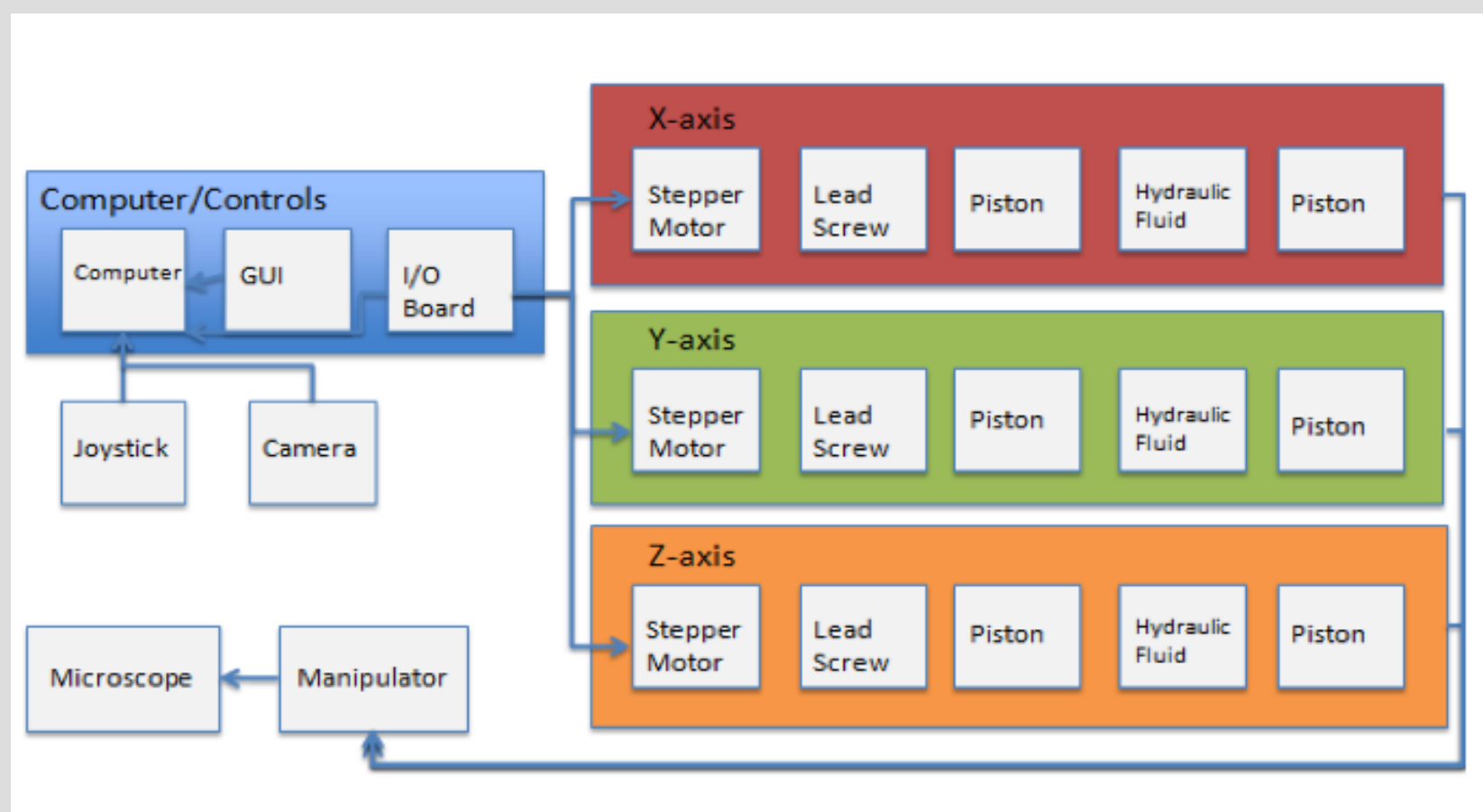
- A nanomanipulator is an ultra-high precision positioning instrument that is used to maneuver objects under high magnification
- Primary use is to study cell behavior

### Team Members

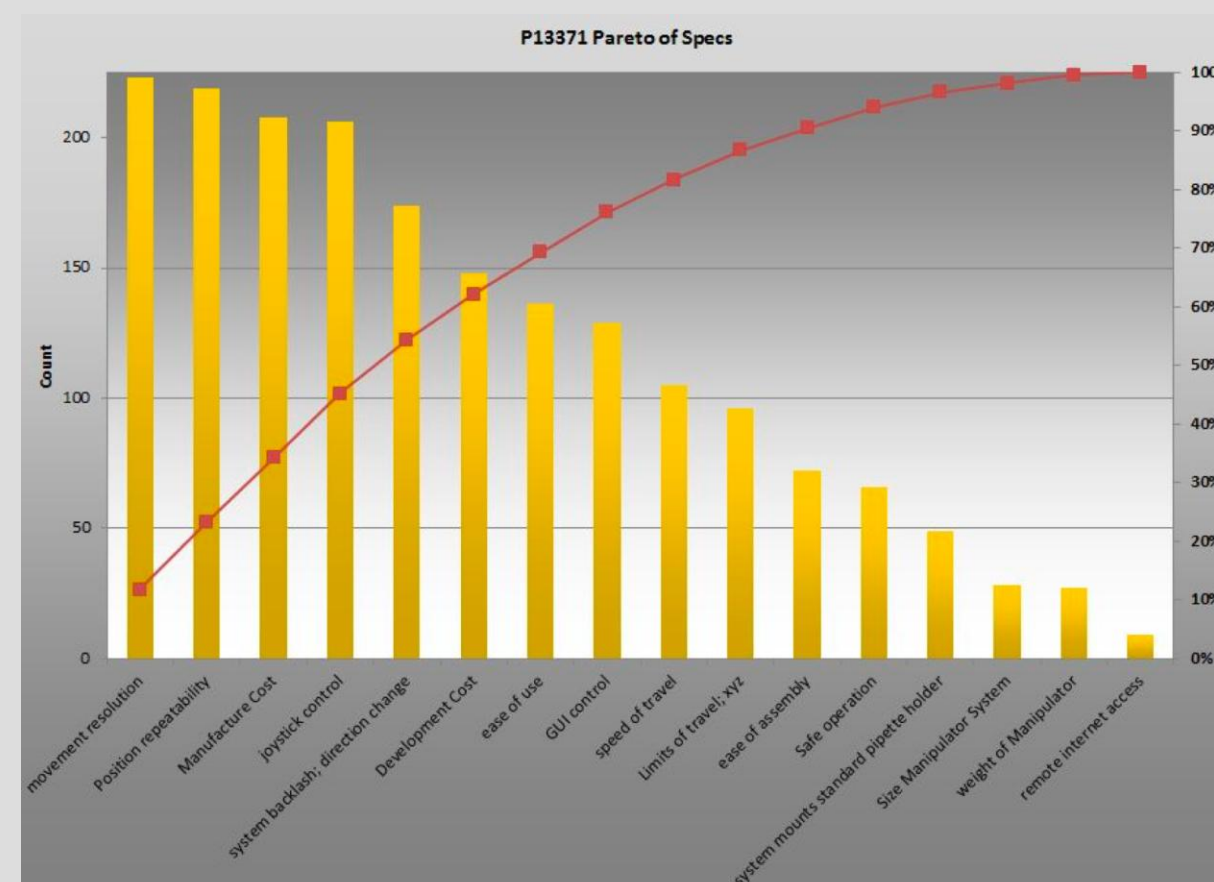


From left to right: Keith Slusser (ME), Bridget Lally (EE), Jacob Bertani (ME), Nick Matson (EE), and Avash Joshi (ME).

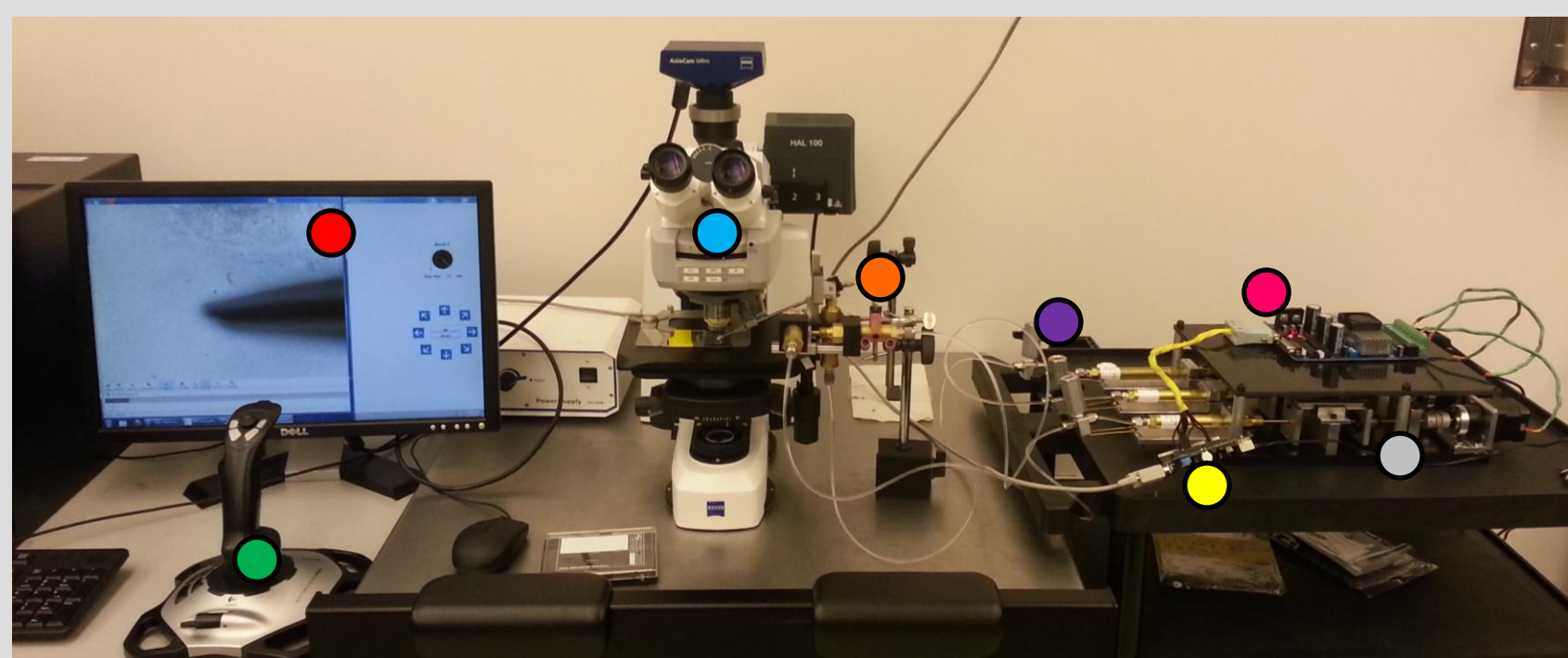
### System Architecture



### Customer Needs and Specifications



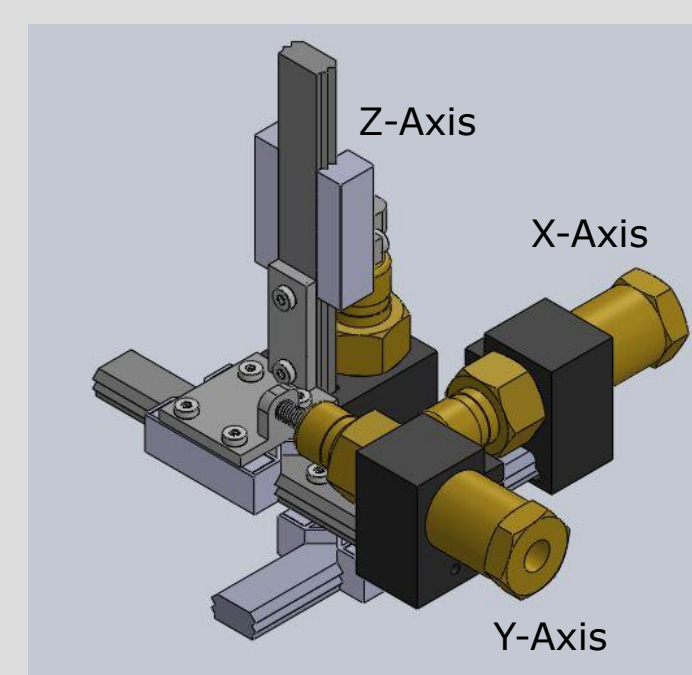
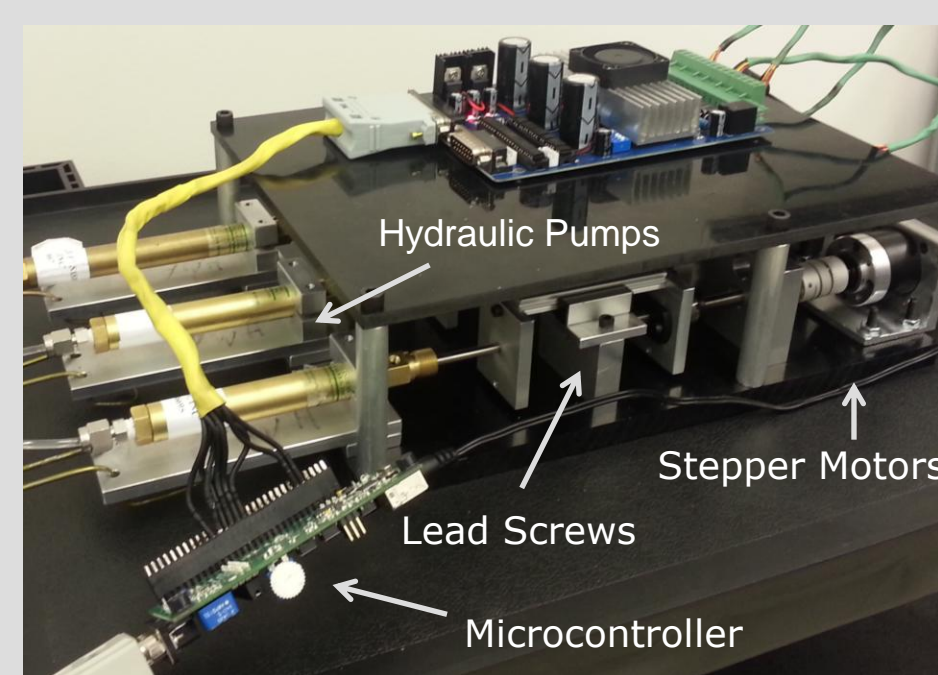
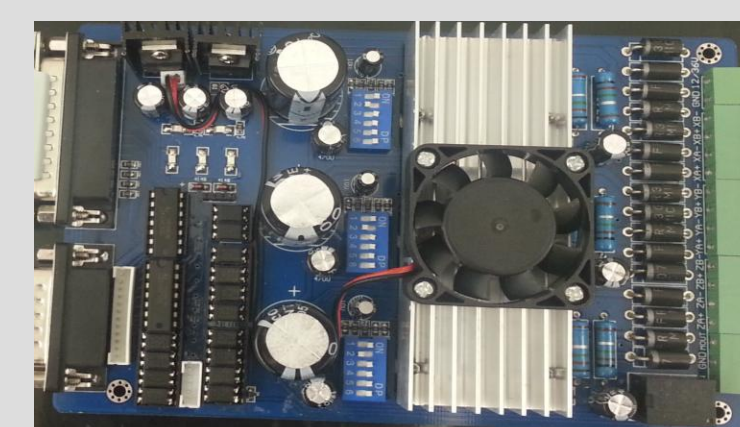
### System Assembly



- GUI
- Microscope
- Hydraulics
- Motor Control
- Joystick
- Manipulator
- Microcontroller
- Pump Assembly

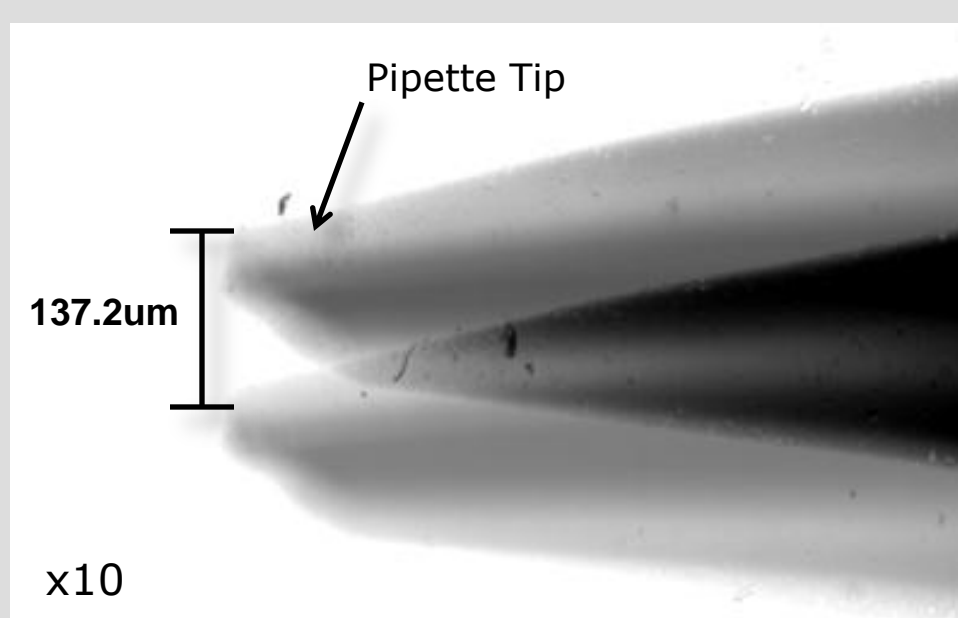
### Sub-Assemblies

- Bottom Right: Manipulator Solid Model
- Bottom Left: Pump Actuator
- Top Right: Motor Control Board



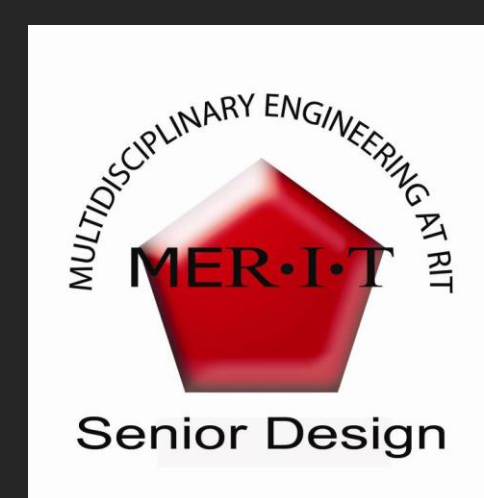
### Conclusions

- One revolution of the stepper motor results in 137.2  $\mu\text{m}$  of linear movement
- Results in a resolution of 50nm/step
- Backlash reduced from 14 revolutions to 3 revolutions



### Acknowledgements

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Customer and Sponsor
- William Nowak**  
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- Sabine Loebner**  
P12371
- Jan Maneti & Rob Kraynik**  
ME Machine Shop
- RIT Office of Sponsored Research**



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