

Team P13375: Computer Controlled Hydraulic Nanomanipulator



Member	Role	Contact
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Customer: Dr. Michael Schrlau

Guide: Bill Nowak



Mission Statement

Nanomanipulators: High-precision positioning instruments used with high magnification microscopes to interact with objects on the nanometer scale.

Project Goal

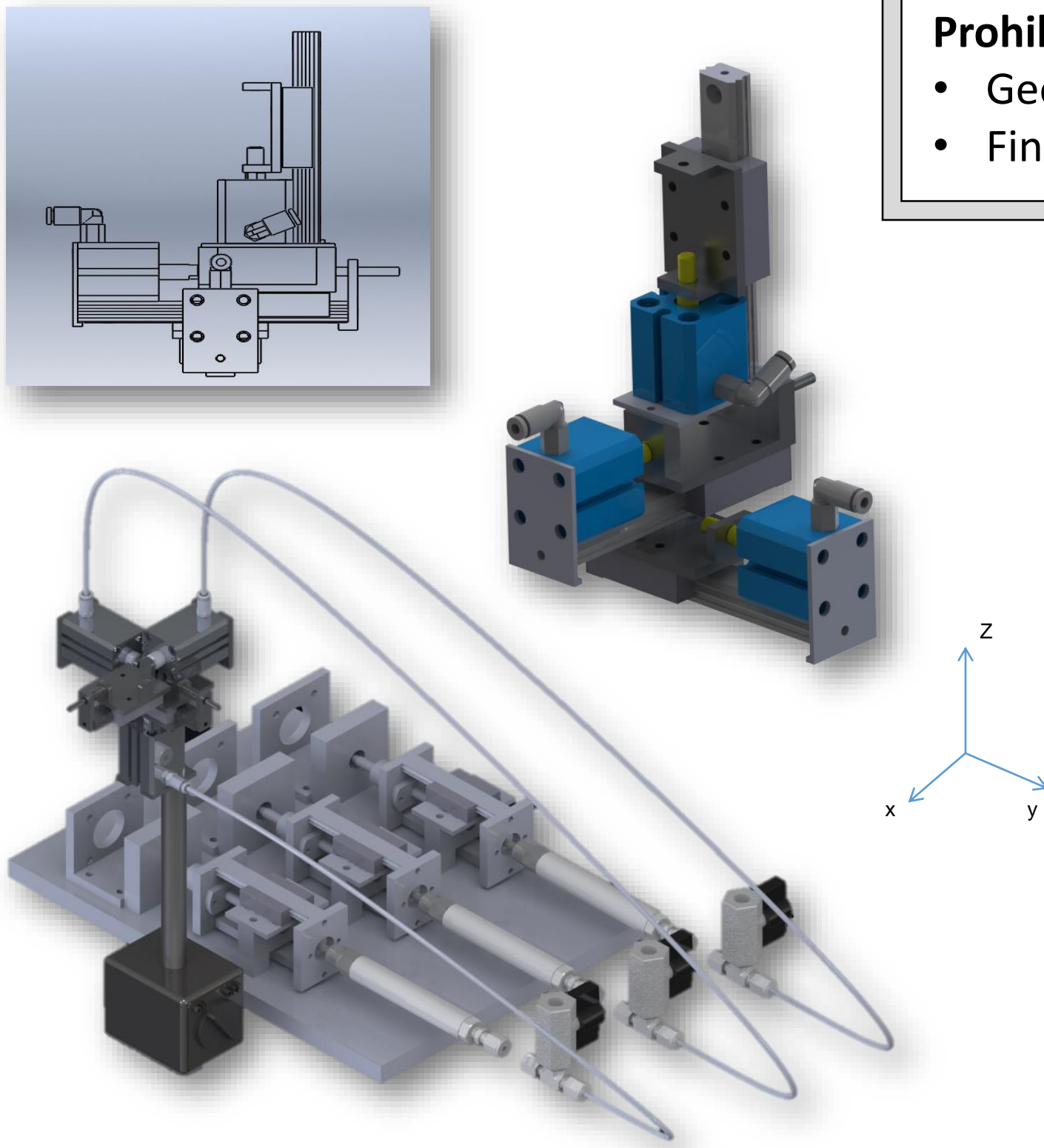
To construct a cost-effective nanomanipulator of comparable performance to those commercially available, with remote computer control capability.

Use Cases

- Biomedical science: Elucidate the behavior of individual living cells.
- Remote collaboration: Provide equipment access and control to researchers not physically present in a laboratory.
- Further education: Increase opportunities for access to high magnification microscopes in secondary schools and research environments.

Prohibitive Factors

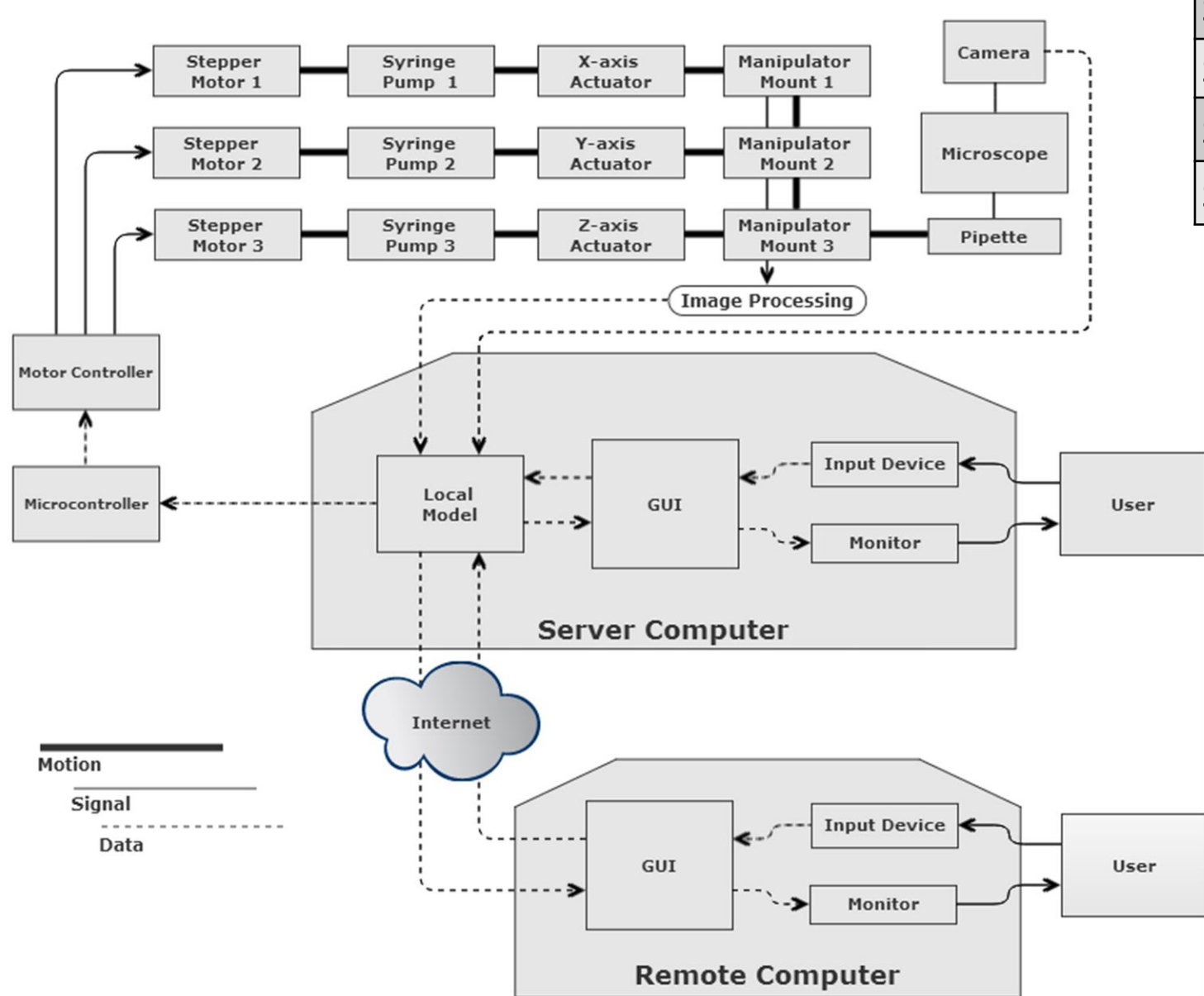
- Geographical location.
- Financial limitations.



#	Specification (metric)	Unit of Measure	Target Value	Theoretical Value	Actual Value	Previous System
S1	Manipulator size	Cm (H x W x L)	8 x 8 x 8	13 x 12 x 12	13 x 12 x 12	13 x 13 x 13
S2	Weight of manipulator	grams	550	400	400	689
S3	Development cost	\$	1,352	1,441.81	1,441.81	
S4	Manufacture cost post-dev.	\$	1000-1500	1,413.01	1,413.01	
S5	Limit of travel per axis	cm	> 0.25	0.5	0.5	1.10
S6	Speed of travel	mm/sec	0.5	.088	0.0392	0.04
S7	Observed Resolution	nm	< 100	86.74	1601	Eppendorf 500
	Theoretical Resolution form Speed	nm	<100	86.74	14	56
S8	Sampling rate	Hz	60	0	60	N/A
S9	Level of difficulty of use	Binary	Easy	Easy	Easy	Medium
S10	Supported control software	Binary	Yes	Yes	Yes	Yes
S11	Visual feed sampling rate	Hz	60	60	60	N/A
S12	System control via input device (remote, local)	Binary	Yes	Yes	Yes	Locally
S13	Additional system feedback	Subjective	Yes	Yes	Yes	No
S14	System provides calibration	Binary	Yes	Yes	Yes	No
S15	System backlash	revolutions	< 3	0	2.27	25
S16	Video image frame rate	frames/sec	>30	30	30 ^[1] [2]	N/A
S17	Remote control latency	ms	< 200	< 200	~100 ms ^[2]	N/A

1. Varies depending on video configuration. Tested with 720 x 480 color image.
2. Measurements dependant upon Internet connection and location.

System Overview



Main Improvements

- Reduced backlash.
- Provide remote control capability.
- Increase speed of movement.
- Streamlined system setup and usage.

Highest Priority Needs

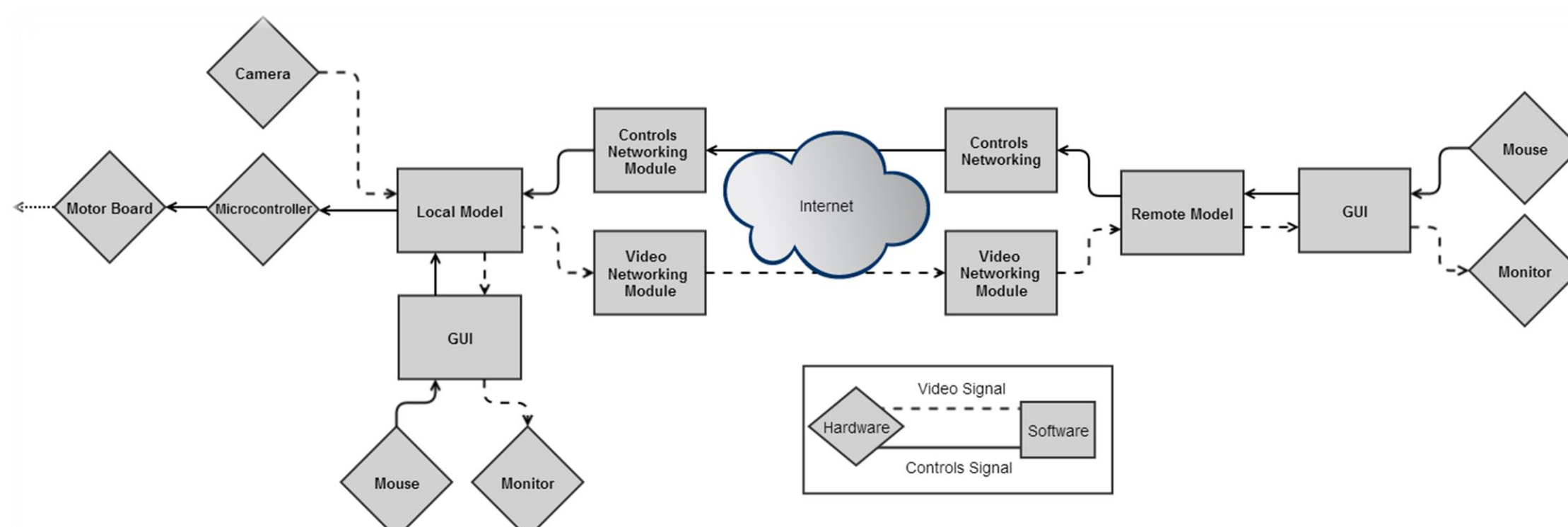
- Ease of Use
- Calibration
- Limit of Travel in each Direction
- Resolution
- Input Device Control
- Speed of Travel

Above list meets 60% of customer requirements.

Acknowledgements

- Bill Nowak
- Charlie Tabb
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- Nicholas Hensel
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Remote Control Subsystem



SMC Cylinders from
Component Supply

