

FINAL PRESENTATION
FEBRUARY 24, 2012

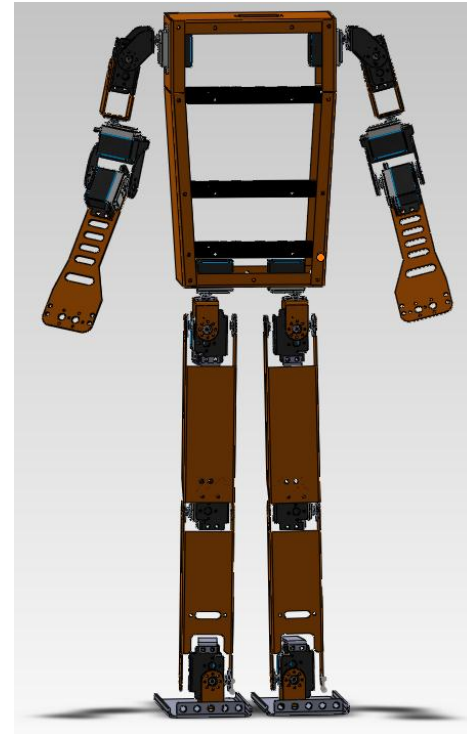
MSD II HUMANOID ROBOT P12201

CUSTOMER NEEDS

- **Electro-Mechanical**
 - 20 Degrees of Freedom
 - a) 32 DOF Servo Controller
 - Robot can balance on its feet
 - 10 hr motionless and 2 hr continuous motion battery life
- **Intelligence**
 - Embedded OS on small form factor PC or microcontroller
 - Multiple Interfaces: I2C, SPI, UART, USB (for future expansion)
 - 32-bit CPU architecture
- **Guidelines**
 - Robot must be test stand for future projects
 - Height of 20in to 3ft
 - Weight less than 30 lbs

MECHANICAL CONCEPTS

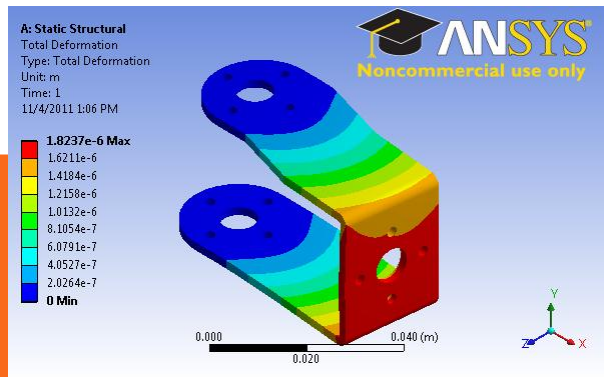
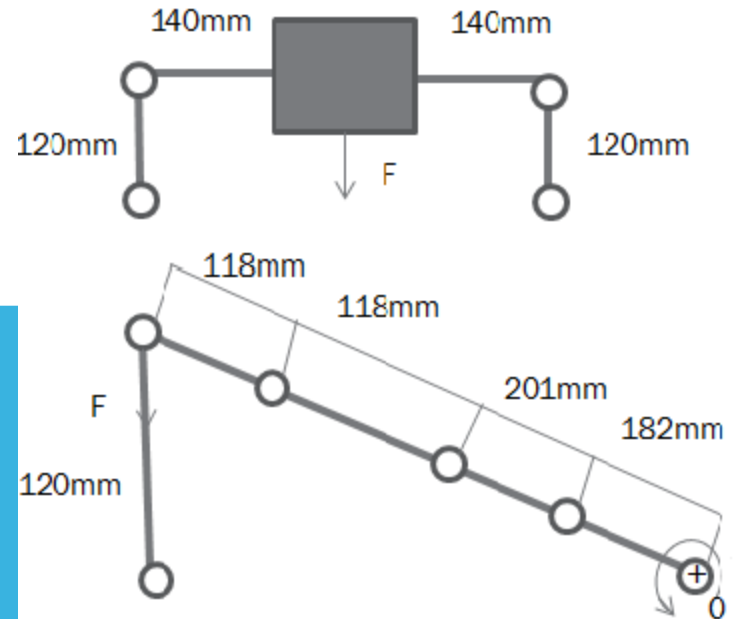
- Degrees of Freedom
- Center of Gravity
- Wire Routing
- Electronic Storage
- Robustness of Robot



MECHANICAL DESIGN

- Torque Considerations
- Space Requirements for Electronics
- Joint Design
- Integration with standard servos and brackets
- Stress Calculations

Push-up Layout



IMPLEMENTATION


- Metal Shear
- CNC machined
- Milling
- Bending



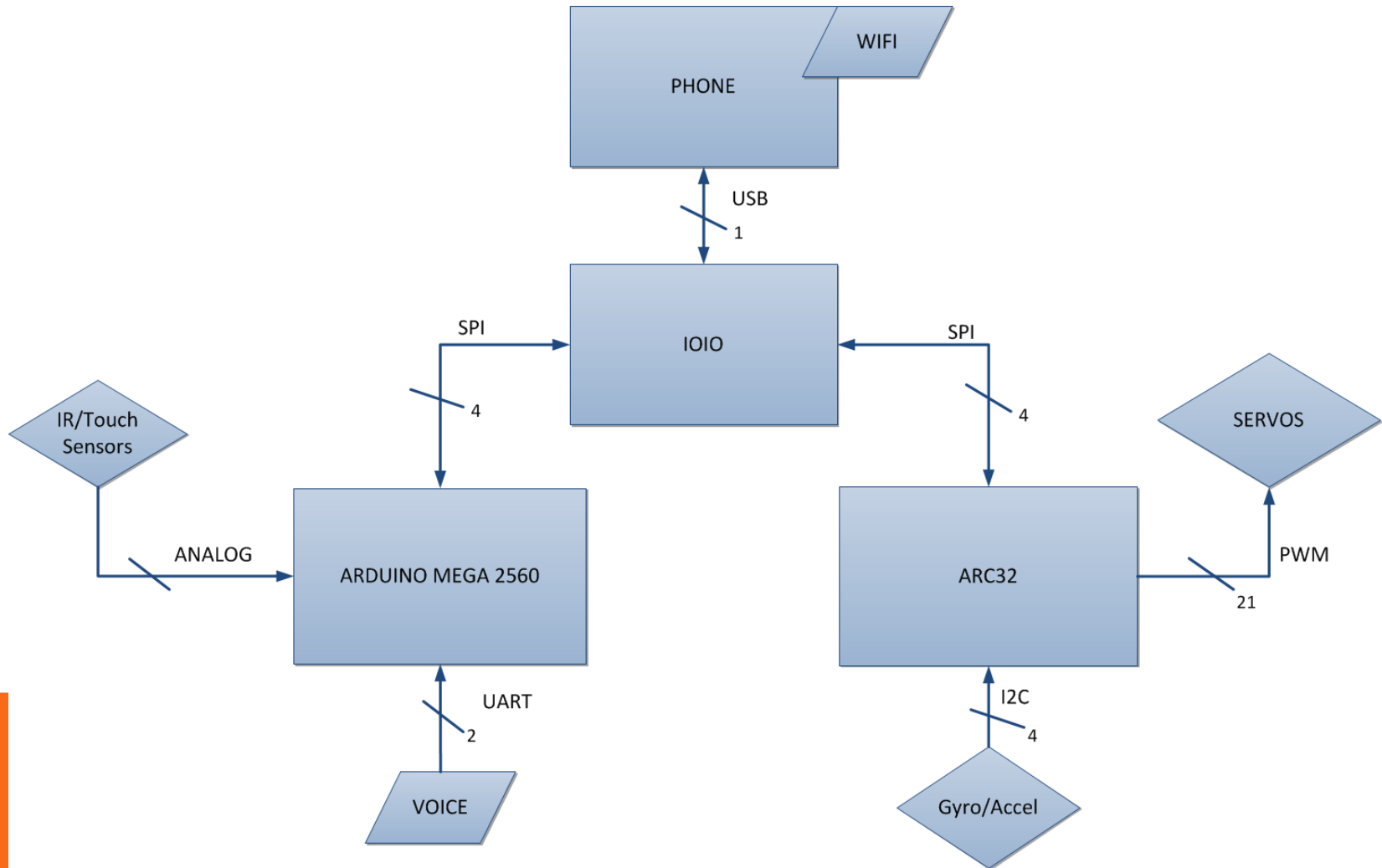
MOVEMENT CONTROL

- Servo Controller
 - ARC32
 - Movement commands
 - Look up table
 - Inverse Kinematics
 - Communication

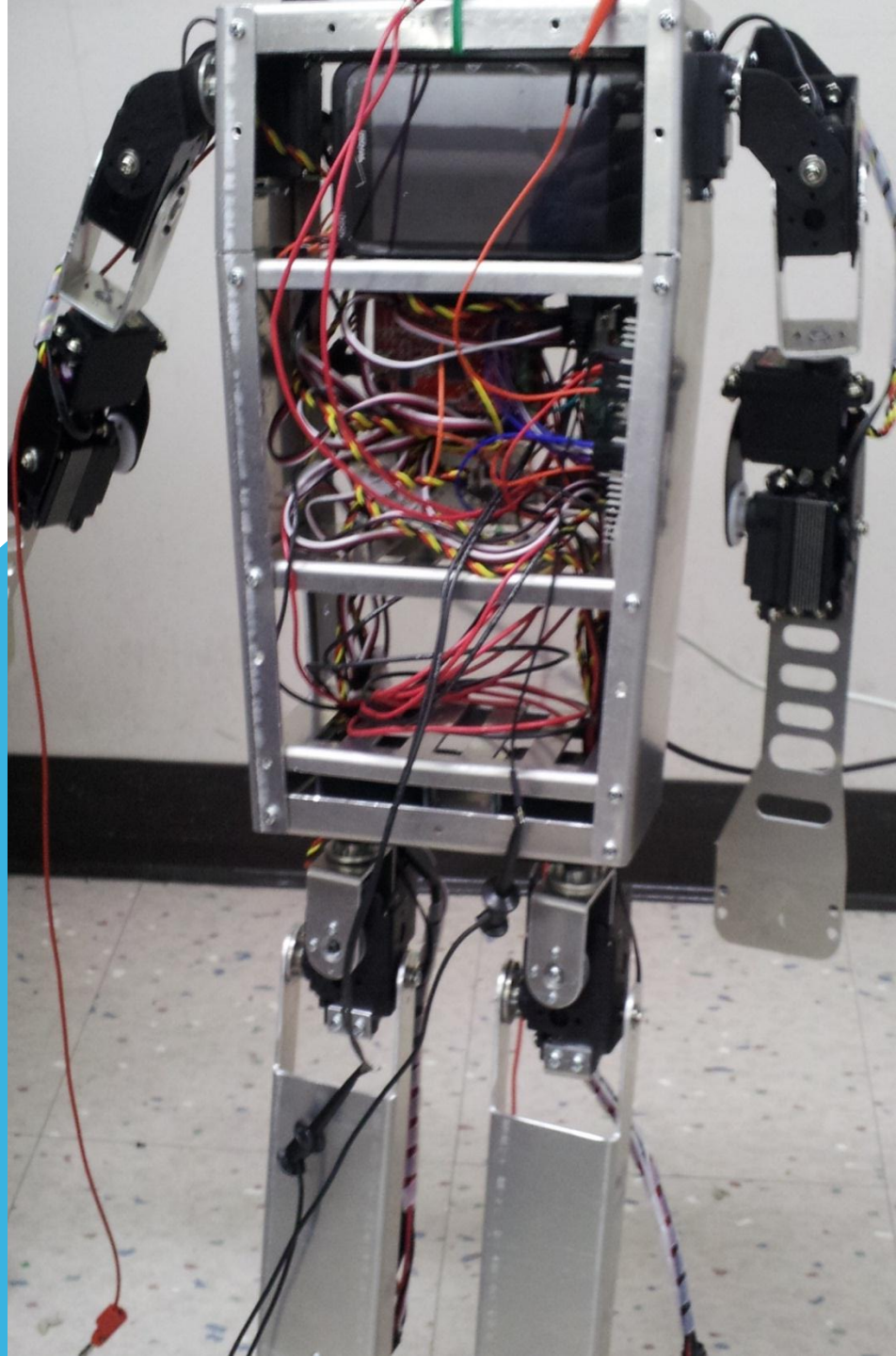
BALANCE & JOINT MOVEMENT

- Inertial Measurement Unit
 - Degrees of Freedom
 - Center of Gravity
 - Robot Stance
 - Smooth movements
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FLOW OF INFORMATION



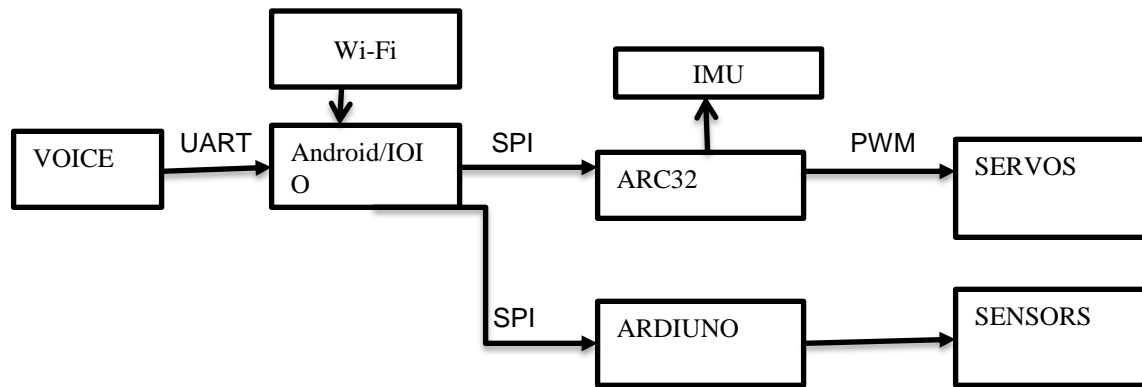
MSD II: TEST PLAN



INTELLIGENCE

	Preliminary Test (Week 3)	Mid testing(Week 7)	Final Test(Week 10)
Arc32	Yes	Yes	IP
Ardiuno	Yes	Yes	IP
Voice	Yes	Yes	IP
IOIO	yes	Yes	IP
Phone	Yes	Yes	IP

Communication Interfaces.



Interface	P/F
SPI	P
I ² C	F
UART	P

Sensor

	Forward(close/Far)	Large Object(Week 7)	Small Object(Week 7)	
Proximity	Yes	NA	NA	
	Preliminary(axis-tilting) (Week 6)	Inclination(Week 8)	Balancing(week 8)	Position(Week 8)
Gyro	Yes	NA	NA	NA
Accelerometer	Yes	NA	NA	NA
Touch	NA	NA	NA	NA

CUSTOMER TESTING REQUIREMENTS

Engr. Spec. #	Specification (description)	Unit of Measure	Marginal Value	Test Result(P/F)
S2	Voice command capable	Commands	16	Partial not integrated
S6	Operate wirelessly	Commands	5	P
S16	32-bit CPU architecture	N/A	---	P
S21	Computer Storage Space	Gigabytes	2	P
S22	Computer compatible with multiple interfaces	Interfaces	3	Partial
S37	Servo Controller	Ports	32	P
S23	Software library of functions	Functions	4	Partial

Engr. Spec. #	Specification (description)	Unit of Measure	Marginal Value	Test Result(P/F)
S7	Overall weight	Pounds	30	P
S19	Walking over small object	Inches	3	F
S36	Center of gravity	Inches	.5	22.4
S38	Will not break if it falls over	N/A	---	P

CONTINUE...

Engr. Spec. #	Specification (description)	Unit of Measure	Marginal Value	Test Result(P/F)
S1	Walk at Human Speed	kph	1	F
S8	Must support +25% of weight	%	25	F
S24	Torso Bending	Degrees	45	P (45° Inward)
S25	Torso Twisting	Degrees	45	P (45° Left & Right)
S26	Head Twisting	Degrees	90	NA
S27	Head Bending	Degrees	45	NA
S28	Shoulder Bending	Degrees	60	P (90° Outward/Limited Inward)
S29	Shoulder Rolling	Degrees	90	P (180° Inward/20° Backward)
S30	Elbow	Degrees	120	P (105° Inward/ Limited Backward)
S31	Wrist	Degrees	60	NA
S32	Hip Bending	Degrees	45	P (45° Inward/10° Outward)
S33	Hip Rolling	Degrees	45	P (90°)
S34	Knee	Degrees	120	P (140° Backward)
S35	Ankle	Degrees	45	P (45° Outward/Inward)
S39	Battery life while not moving	Hrs.	10	IP
S40	Battery life while in continuous motion	Hrs.	2	NA
S41	Fall Recovery Time	Seconds	60	F

PROJECT DIFFICULTIES

Mechanical

- Examining the robot the mechanical body is 95% complete with the exception of the legs are shaky when trying to hold itself and 25% of its own weight (10lb).

Electrical


- The wiring is a 98% complete
- The legs can stand based on the programming done but servos make a lot of noise due to the load on the legs.

Intelligence

- Several of the commands work but Arc32's I2C affects servo movements.



FUTURE IMPROVEMENTS

- More robust servos
 - Better Servo Support (thrust bearings)
 - Plastic inside coating for Body
 - Better bending processes
 - Reduce Weight
 - IMU with Microcontroller
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FINAL PRODUCT

