Autonomous Sumo Robot

By Scott Skousen

Agenda

- Brief description of sumo robot contest
- Robot specifications
- Project goals
- Hardware design
- Software design
- Preliminary cost estimate
- Schedule for completion
- Questions

What is Robot Sumo?

- International competition
- Objective is to remain inside the ring while attempting to push or trick your opponent out of the ring

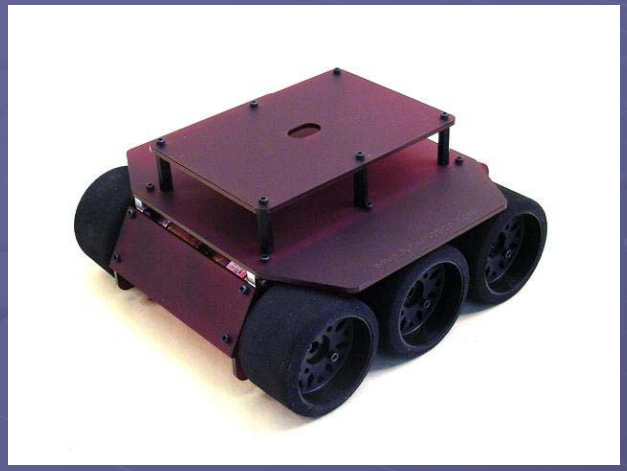
Robot Specifications

- Autonomous
- 20cm x 20cm size limit (L x W)
- Mass less than 3kg
- Must start operation 5 seconds after beginning of match
- Must not damage ring
- Not designed to damage other robot

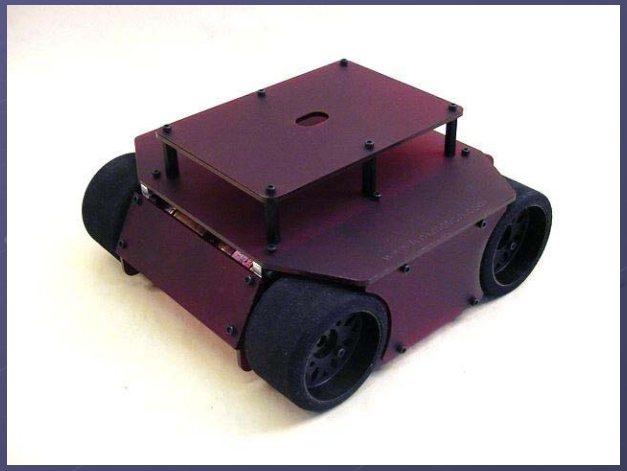
Goals for Project

- Robot must not go outside of the ring on its own
- Must actively seek out opponent
- Tough enough to survive competition
- Able to win reasonable pushing contest
- Built as cheap as possible while remaining competitive

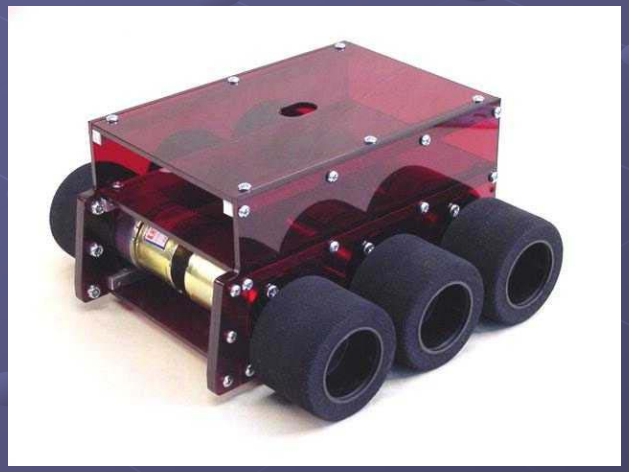
Robot Chassis



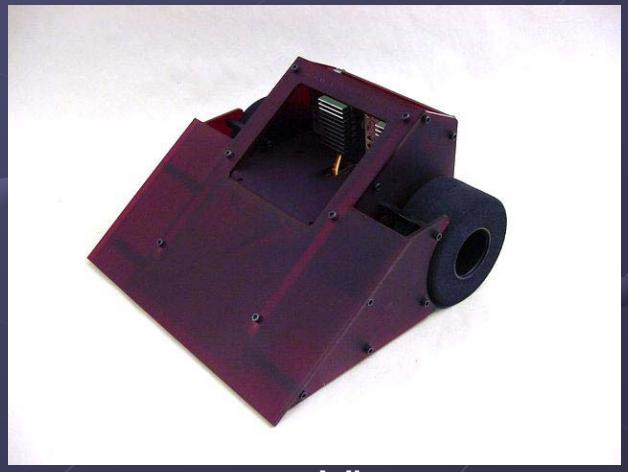
Predator



Terminator

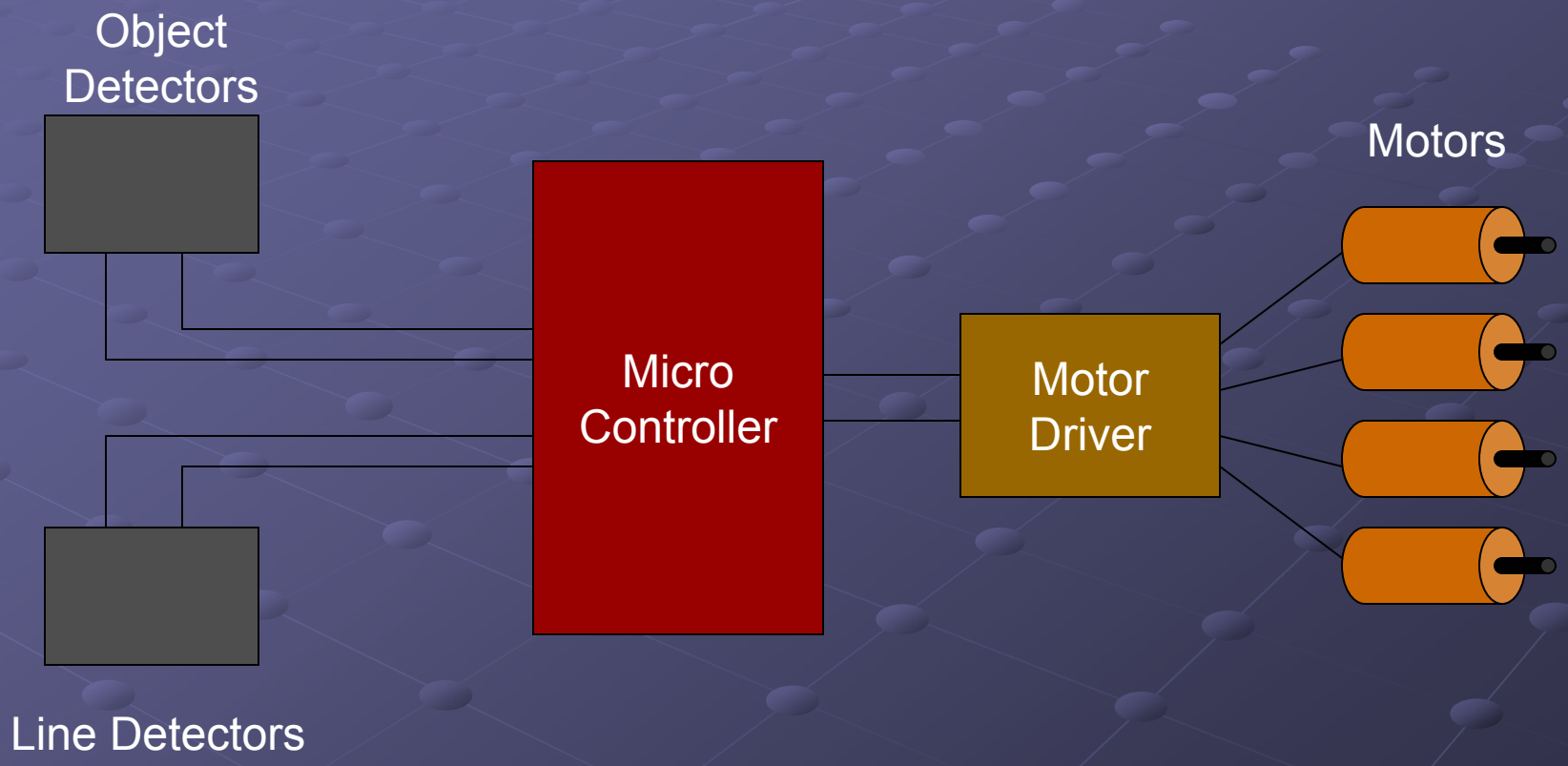


Stomper



Viper

Basic Hardware Block diagram



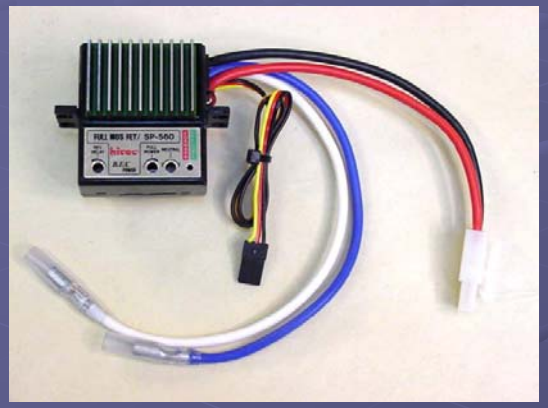
Motors and Wheels

- 6V gear head motor
- 100mA – 2.0 Amps
- 186 rpm

- Green dot compound that sticks to the ring like glue
- Great traction

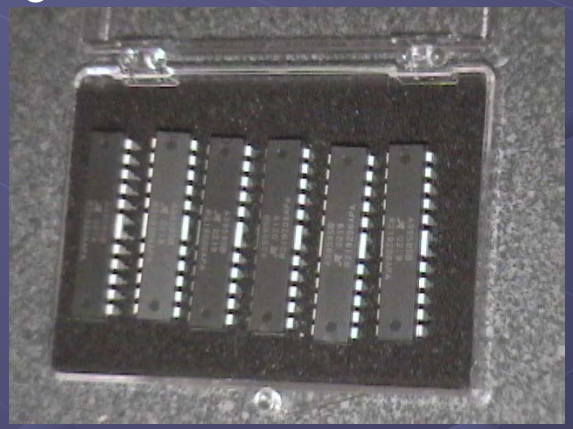
Motor Drivers

Hitec SP-560



- 24 Amps
- Very easy to use
- Expensive ($69.95)
- Need two of them

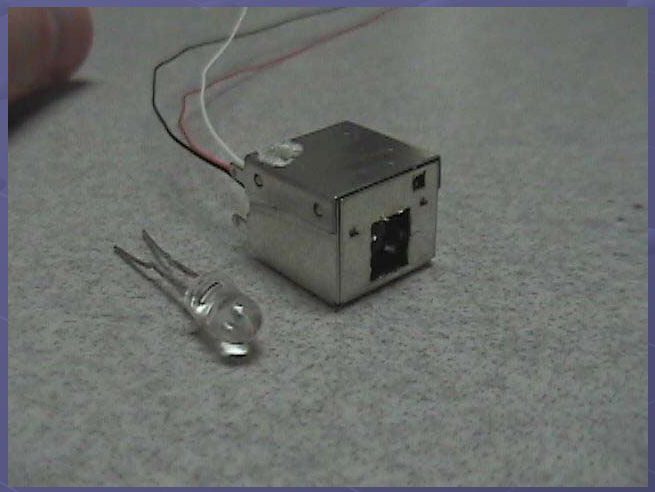
Allegro 3959 PWM Motor Driver



- 3 Amps
- PWM control
- Cheap (free)
- Need six of them

Object Detection

Infrared



Ultrasonic

IR Object Detection

Pros

- Cheap
- Easy to use
- Good range (4 feet)

Cons

- Sensitive to changes in ambient light
- Readings vary with color of object
- Affected by heat of object
- Main regret of previous designers

Ultrasonic Object Detection

Pros

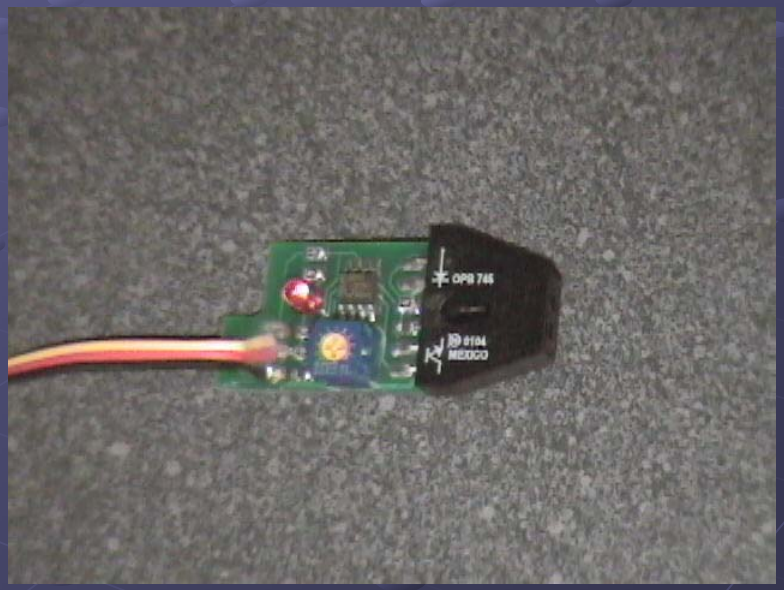
- Reliable
- Good range (9 feet)
- Easy to use

Cons

- Expensive
- More programming involved
- Not great with “fuzzy” objects

Line Detection

- Extremely accurate
- Adjustable for varying light conditions
- Easy to use

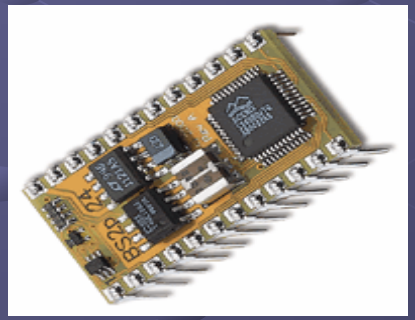


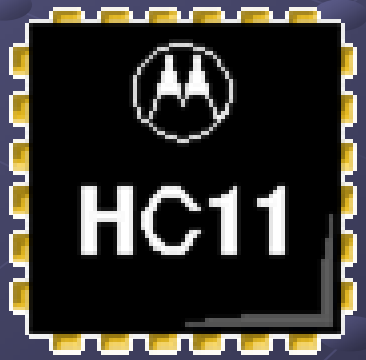
Microprocessor Requirements

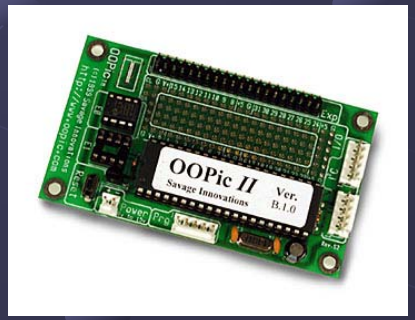
- Needs at least 16 I/O pins
- Enough memory for program storage
- PWM output for motor control
- Easy to program (no special programming devices)
- Inexpensive

Microprocessors Considered

- Pic
- 68HC11
- Basic Stamp 2p



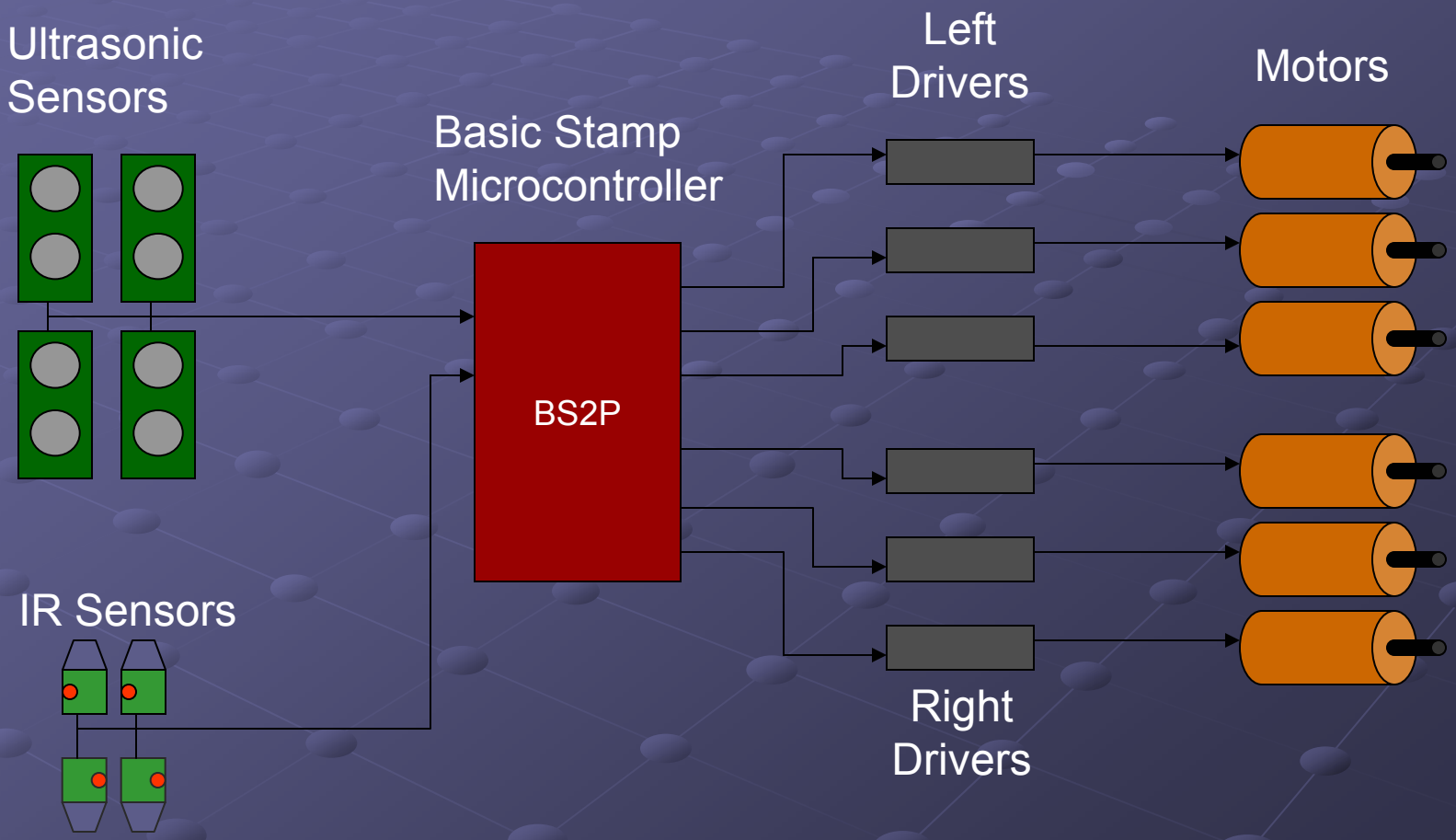




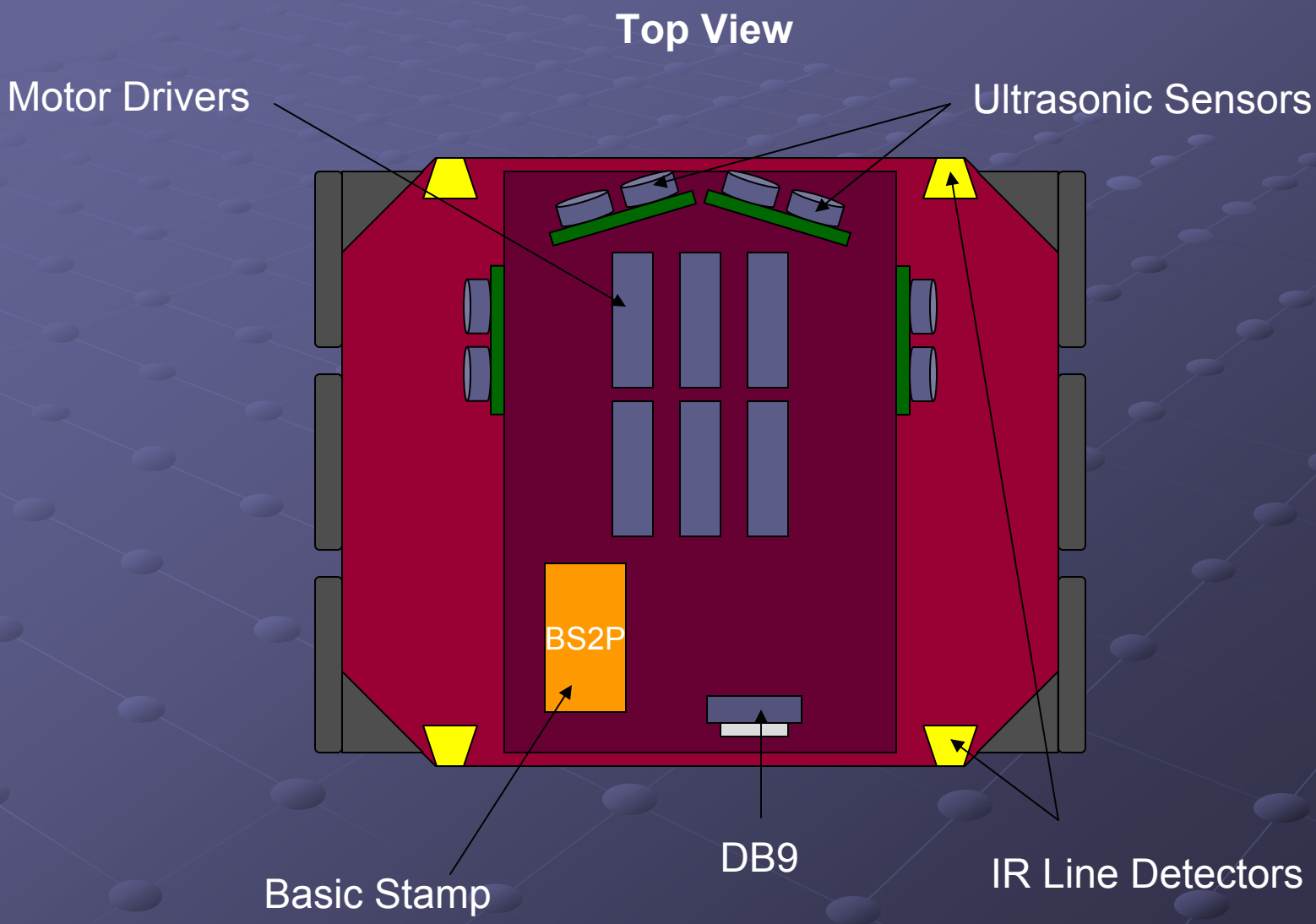
Basic Stamp 2p24

- Has 16 I/O pins
- PWM output for motor control
- Plenty of program memory (16K)
- Only need a serial cable for programming
- Polling capabilities
- Already have one

Hardware Block Diagram

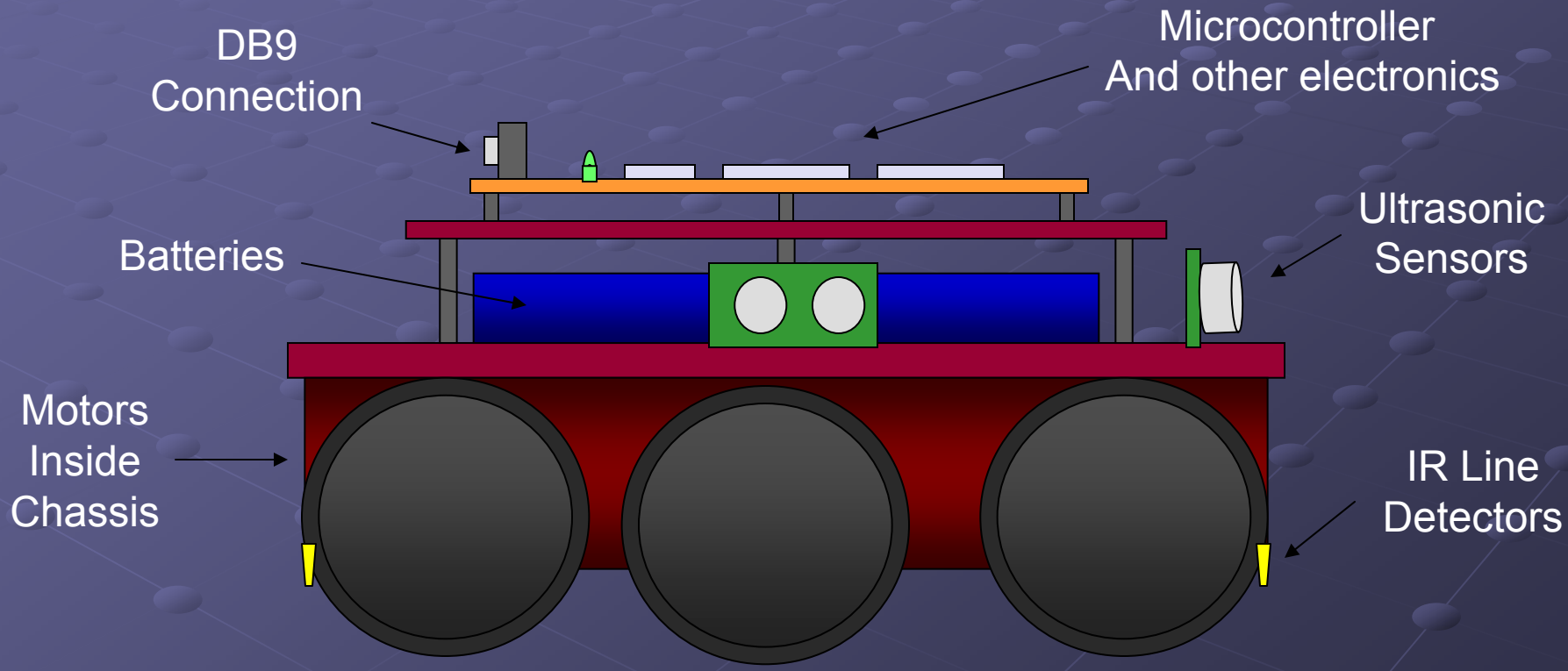


System Layout

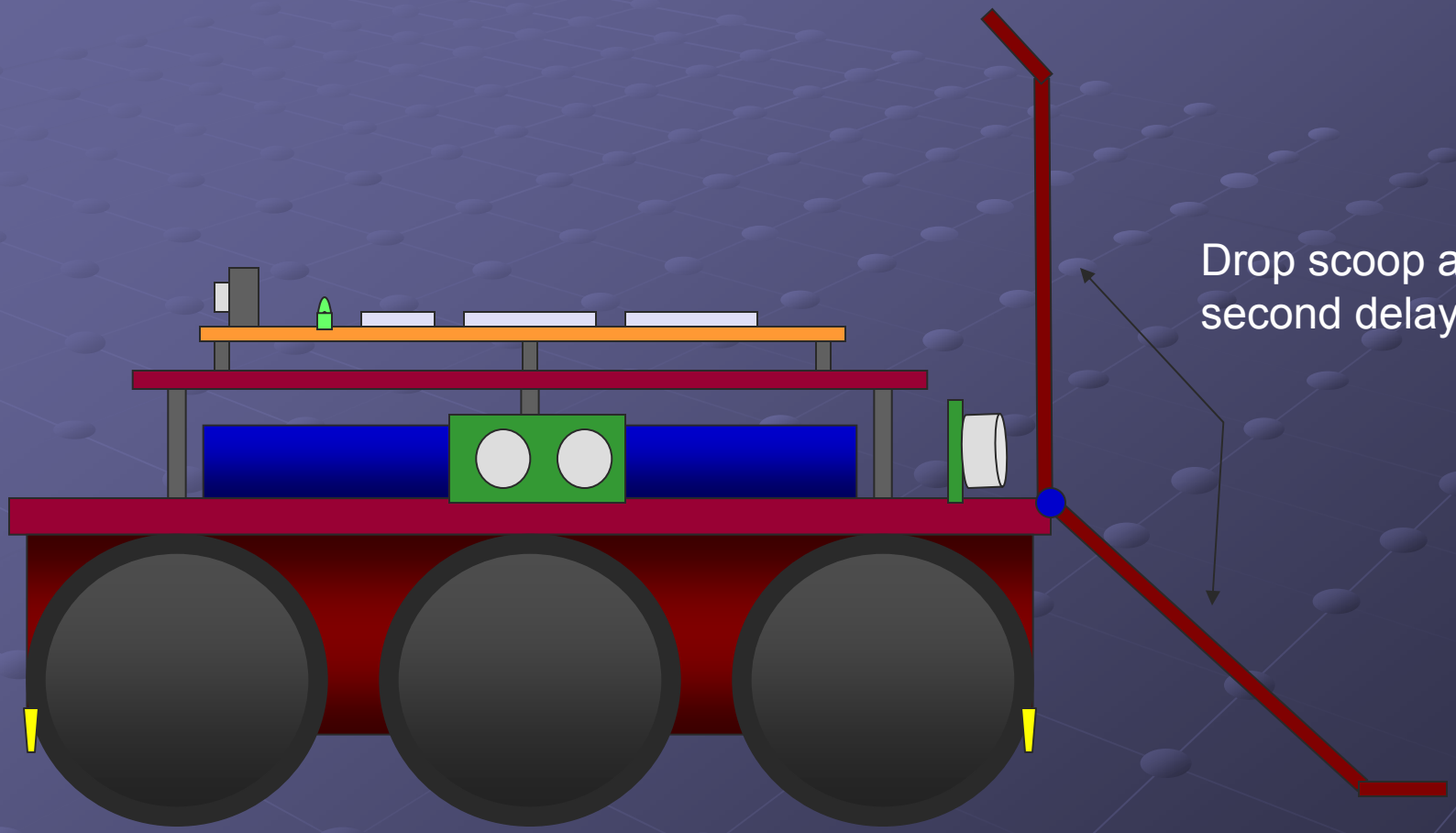


System Layout

Side View



Scoop



Drop scoop after 5 second delay

Software Algorithms

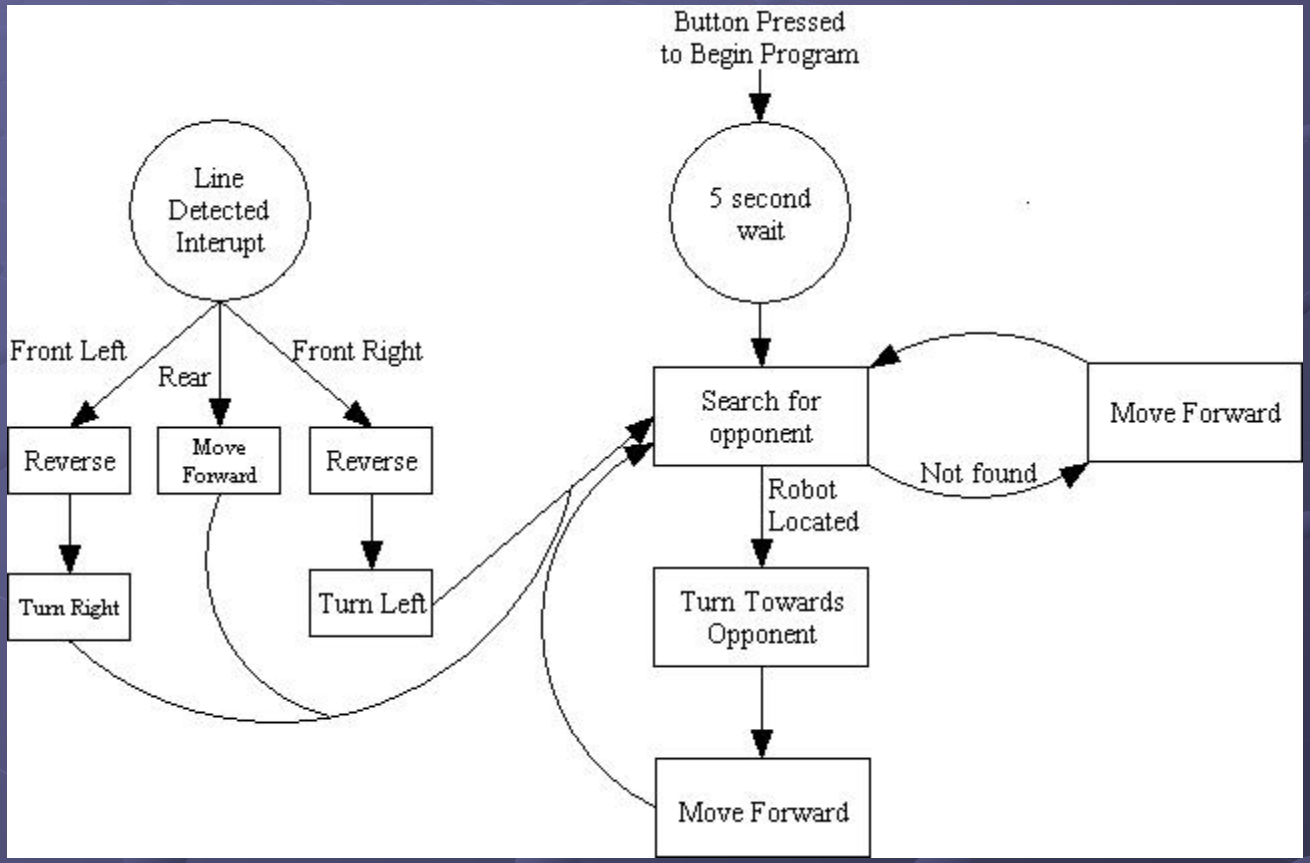
- Search and attack
- Search and run
- Random movement

Search and Attack

Useful when opponents robot is weak

- Locate opposing robot
- Charge robot
- Attempt to push out of ring

Search and Attack Flow Chart

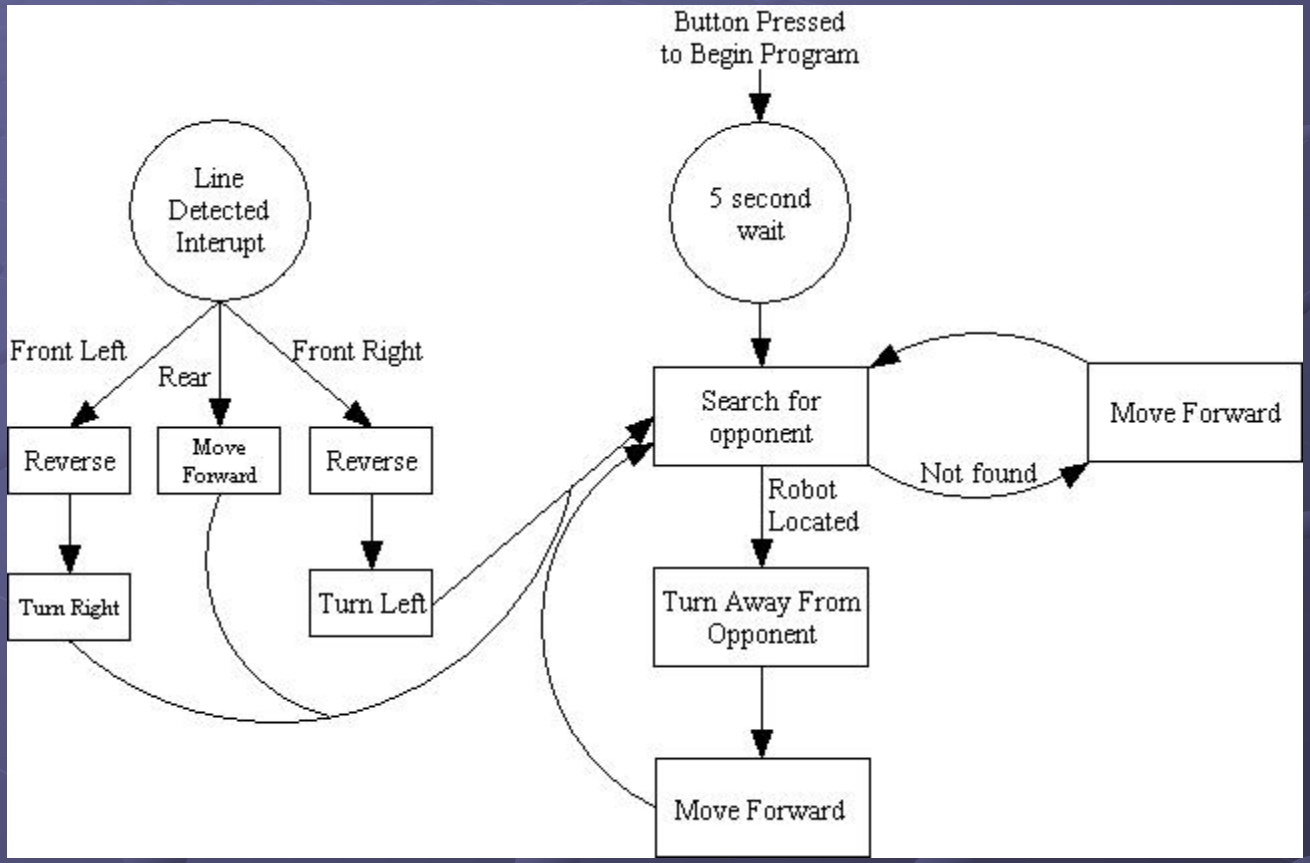


Search and Run

Useful when overpowered by other robot

- Locate opponent
- Run away
- Hope that other robot makes a mistake and falls out of ring

Search and Run Flow Chart

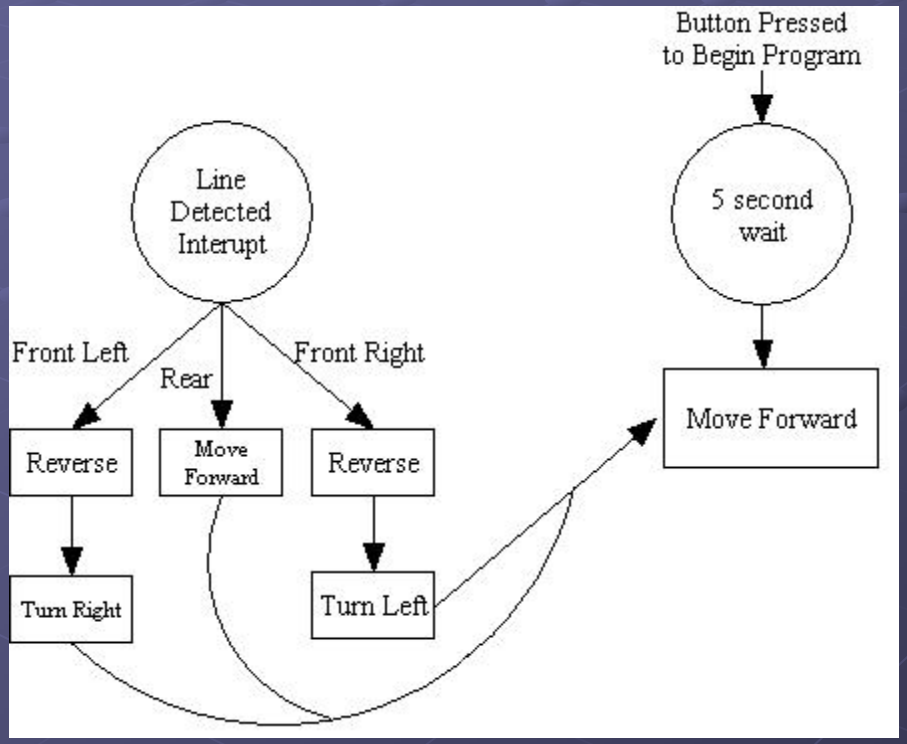


Random Movement

Used when object detectors aren't working

- Move forward until line is detected
- Turn predetermined amount
- Move forward until line is detected

Random Movement Flow Chart



Which Algorithm?

- Decided to use all three
- Will load program based on opponent

Preliminary Cost Estimate

Description	Part Number	Manufacturer	Vendor	Qty	Cost	Total
Predator Chasis	CP-01	Lynxmotion	Lynxmotion	1	$25.00	$25.00
Gearhead Motors	GHM-01	Hsiang	Lynxmotion	6	$19.00	$114.00
Delux Sumo Tires	TSR-01	Lynxmotion	Lynxmotion	3	$18.00	$54.00
Hubs	HUB-01	Lynxmotion	Lynxmotion	3	$6.00	$18.00
Ultrasonic Sensor	SRF04	Devantech	Acroname	4	$26.95	$107.80
IR Line Sensor	SLD-01	Optek	Acroname	4	$14.95	$59.80
Motor Drivers	A3959	Allegro Micro.	Allegro Micro	6	$3.25	$19.50
Basic Stamp BS2P	BS2P24	Parallax	Parallax	1	$79.00	$79.00
24 pin socket for Basic Stamp	ED58246-ND	Mill-Max	Digikey	1	$1.73	$1.73
24 pin sockets for motor driver	ED58243-ND	Mill-Max	Digikey	6	$1.46	$8.76
4 pin headers for ultrasonics	WM-2002-ND	Molex	Digikey	4	$0.33	$1.32
4 pin connectors for ultrasonic	WM-4202-ND	Molex	Digikey	4	$0.76	$3.04
3 pin header for IR sensors	WM-2001-ND	Molex	Digikey	4	$0.27	$1.08
3 pin connectors for IR sensor	WM-4201-ND	Molex	Digikey	4	$0.61	$2.44

Preliminary Cost Estimate

Description	Part Number	Manufacturer	Vendor	Qty	Cost	Total
DB9 connector	A23305-ND	AMP	Digikey	1	$1.94	$1.94
PC mount LED	67-1316-ND	Lumex	Digikey	2	$0.84	$1.68
PC Board	276-150	Radio Shack	Radio Shack	2	$1.99	$3.98
Plexiglass 1'x1'	N/A	N/A		1	$2.99	$2.99
Wire	N/A	N/A	Radio Shack	1	$3.89	$3.89
Misc screws	N/A	N/A	Home Depot	1	$5.00	$5.00
7.2 Volt Battery	23-331	Nikko	Radio Shack	2	$13.99	$27.98
Battery Charger	23-440	Radio Shack	Radio Shack	1	$18.99	$18.99
Total						$561.92

Gantt Chart

			Week of Dec 16					Week of Dec 23					Week of Dec 30				
ID	Task Name	Hours	M	T	W	TH	F	M	T	W	TH	F	M	T	W	TH	F
1	Detailed HW design	40															
2	Purchase parts	3															
3	Assemble test circuits	15															
4	Write test code	3															
5	Test IR sensors	2															
6	Test ultrasonics	2															
7	Test motor drivers	2															
8	Mount HW to chassis	30															
9	Retest after mounting	2															
10	Complete final code	40															
11	Test and debug	30															

Gantt Chart

			Week of Jan 6					Week of Jan 13					Week of Jan 20				
ID	Task Name	Hours	M	T	W	TH	F	M	T	W	TH	F	M	T	W	TH	F
1	Detailed HW design	40															
2	Purchase parts	3															
3	Assemble test circuits	15															
4	Write test code	3															
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??Questions??