To:	Professor Merz
From:	Benjamin Nitkin
Subject:	IGVC Progress Report
Date:	September 11, 2013

The past week has been dedicated to research and orientation. Research focused on three main topics. First, how have other teams approached the IGVC? What do their electrical configurations look like, what types of sensors did they use, and how do their robots locate themselves in the course? Second, how will our costs break down? What are the most expensive electrical components, and how can we save money on them? Third, an inventory of leftovers from the BattleBot project identified many parts applicable to IGVC.

How have other teams approached the IGVC?
The IGVC website hosts reports from every team for all past competitions. These reports describe the robot in terms of hardware, power systems, sensors, and software. Most vehicles were similar: almost all ran on two wheels with a third caster for stability. The electrical designs were fairly similar, too.

They all ran on a 12- or 24- volt supply, with 24v being more common. Most used a suite of sensors designed to locate the vehicle both in absolute space and relative to the course. GPS provides absolute positioning. This suite included wheel encoders to measure velocity, an inertial measurement unit (IMU) to track heading and acceleration, light detection and ranging (LIDAR) to map obstacles, a camera to watch for white lines, and a laptop to handle all of the heavy-duty processing.

The vehicles possessed very robust mapping abilities. Their onboard sensors were used for simultaneous location and mapping (SLAM), a technique used to generate a map of an unknown environment and locate the robot within it. Mapping and obstacle detection will be the most difficult part of the robots' software design.

How will our costs break down?
As generous as our budget is, most IGVC robots cost $12,000 or more, so our vehicle will be sparse compared to competitors. The single largest expense is the LIDAR sensor, which retails at around $5000. Our robot will omit LIDAR and attempt depth mapping using stereo cameras. Laptops will be another major expense – the robot needs one on-board for navigation, and a second laptop for provide telemetry and teleoperated control. Borrowing laptops from ITS or elsewhere on campus will considerably cut costs.

Electronics and other sensors are inexpensive compared to the items above. A rough budget is provided in Attachment 2. The table provides two choices for radio communication and three for sensor packages.

What parts do we have?
In past years, ME seniors have designed a BattleBot, and the parts are still available. Attachment 1 lists electronics we could salvage from the BattleBot. Electronic speed controllers (ESC's) are among the most valuable parts: reusing them would save our team hundreds of dollars.

Attachment 1: Inventory of Electric BattleBot parts

Quantity	Value (est.)	Total value	Name	Description
3	$190	$570	Victor 885	Motor controller; 120A continous, 300A surge
1	$90	$90	Victor 884	Motor controller; 40A continous
1	$220	$220	Thor SC	Motor controller; 150 A cont. 300A surge
2	$20	$40	Buss bars	Beefy metal bars for connecting high-current loads
2	$30	$60	Keyed switches	Switches with removable key; useful for main robot power. 300A max, cont.
1	$20	$20	Killswitch	Large red button connected to a 10A microswitch. Useful for switching relays to cut main power.
1	$30	$30	Large relay; unmarkec	Looks like it goes with the killswitch, across the main voltage feed. Need to look closer.
1	$14	$14	Opto 22 DC60MP	60 volt, 3 amp solid state relay. Probably not helpful.
1	$110	$110	Bussman T30100-2CF	Fusebox (up to 600A fuses)

Attachment 2: Estimate for Electronics

(Note that neither *R/C* nor *Obstacle Avoidance* are suitable for the competition. They're provided for price reference.)

			Power	Communication		Sensor Suites		
Item name	Mfr	Price	Base	R/C	Base Station	Obstacle avoidance	Pathfinding	All-out
Power								
Deep Cycle battery (marine/rv)	sears.com	$75	1					
Breakers	mcmaster.com	$3	5					
Motor	mcmaster.com	$50	2					
Electronic Speed Control	castle creations	$100	2					
Safety light	anywhere.	$15	1					
Radios								
Spektrum Radio (1-way radio)	Spektrumrc.com	$100		1				
XBee (2-way serial radio)	sparkfun.com	$22			2			
XBee-computer bridge	sparkfun.com	$25			1			
Brains								
Arduino	digikey.com	$20			1			
Laptop	??	$1,500					1	1
Joystick	??	$20			1			
Base Station laptop	??	$0			1			

Sensing								
GPS	https://www.sparkfun.com/products/8975	$60				1	1	1
Encoder	digikey.com	$25				2	2	2
IMU	https://www.sparkfun.com/products/10121	$60					1	1
Range sensor	https://www.sparkfun.com/products/8502	$25				5	3	3
LIDAR		$5,000						1
Line RADAR								
Webcam, 2x	staples.com	$60				1	1	
Totals			$405	$100	$109	$295	$1805	$6745