



# LAGR Robot



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# LAGR Robot



## Objective:

*Provide a uniform and easy-to-use robotic platform to facilitate the development of learning algorithms applied to ground robots.*

## Features:

- *Complete robotic system with all the necessary hardware and software for autonomous operation*
- *Modular design to allow for partial or total swap of the autonomy software modules*
- *Developer friendly design: long battery life, standard development environment, flexible teleoperation modes, extensive data logging capabilities and system simulator*



# LAGR Robot





# LAGR Robot Without the Body Shell





# Performance Characteristics



Parameter	Values	Notes
Dimension (W x L X H)	74cm x 120cm x 102cm	Height = 78cm with the sensor head removed for transportation
Ground clearance	14 cm	
Battery life	2-4 hours	Depends on the usage pattern
Recharge time	2-3 hours	
Max speed	~2 meters/second	Depend on battery condition, currently controller limited to 1m/s
Payload	>100lbs	
Weight	~240 lbs	With both battery banks installed
Max slope	> 20 degrees	Traction limited, so the actual figure is terrain dependent.
Weatherproofing	Splash/rain proof	Exposure to rain should be reserved for emergency
Computing	1GHz C3 & 3 x 2.0GHz Pentium-M	Equivalent to Three 2.8GHz P4



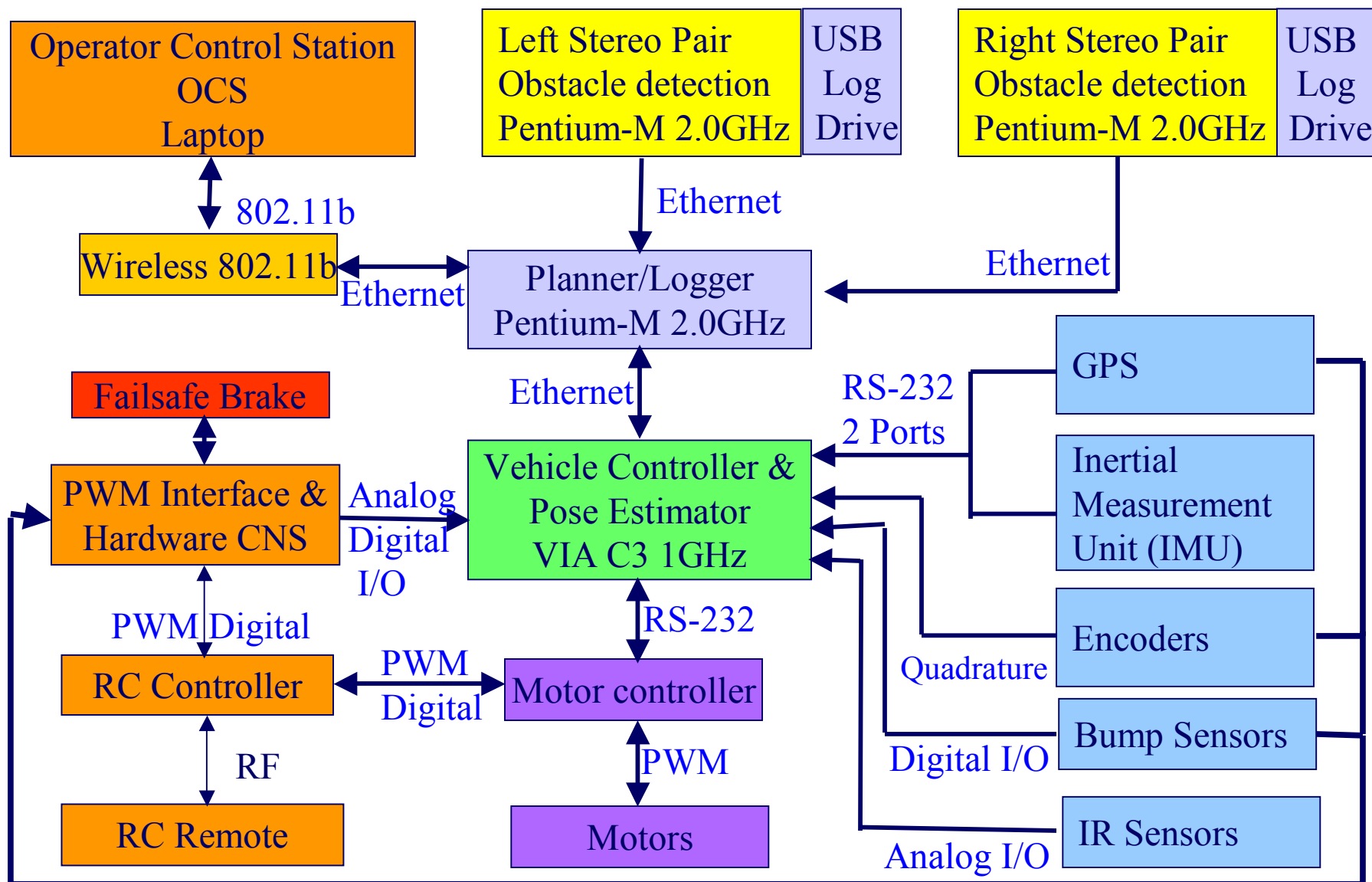
# Payload



- **Sensors:**
  - Stereo cameras: Dual Point Grey megapixel Bumblebee stereo cameras
  - WAAS GPS
  - 3 axis gyro/compass/accelerometer
  - Bumper activated switches and IR rangefinders
- **Computers:**
  - Low Level Controller/Interface Computer: 1GHz VIA C3 low power embedded board, 512MB ram, 1GBytes flash drive running Linux
  - 2 Sensor processing computer: 2.0GHz Pentium-M (equivalent to about 2.8GHz Pentium 4 but with a much lower power consumption), 1GB ram, 512MBytes flash drive for system software and 40GB USB drive for logging.
  - Planning and logging computer: 2.0GHz Pentium-M, 1GB ram, 2GBytes flash drive, 1Gbytes USB Flash Drive
- **Communication:**
  - Gigabit ethernet for on-board communication
  - Wireless ethernet comm link (802.11b)
  - Remote monitoring software can be run on a laptop
  - Standalone RF remote
- **Hardware monitoring and safety board**
- **Power subsystem: 24V input power supply outputting 5V and 12V.**

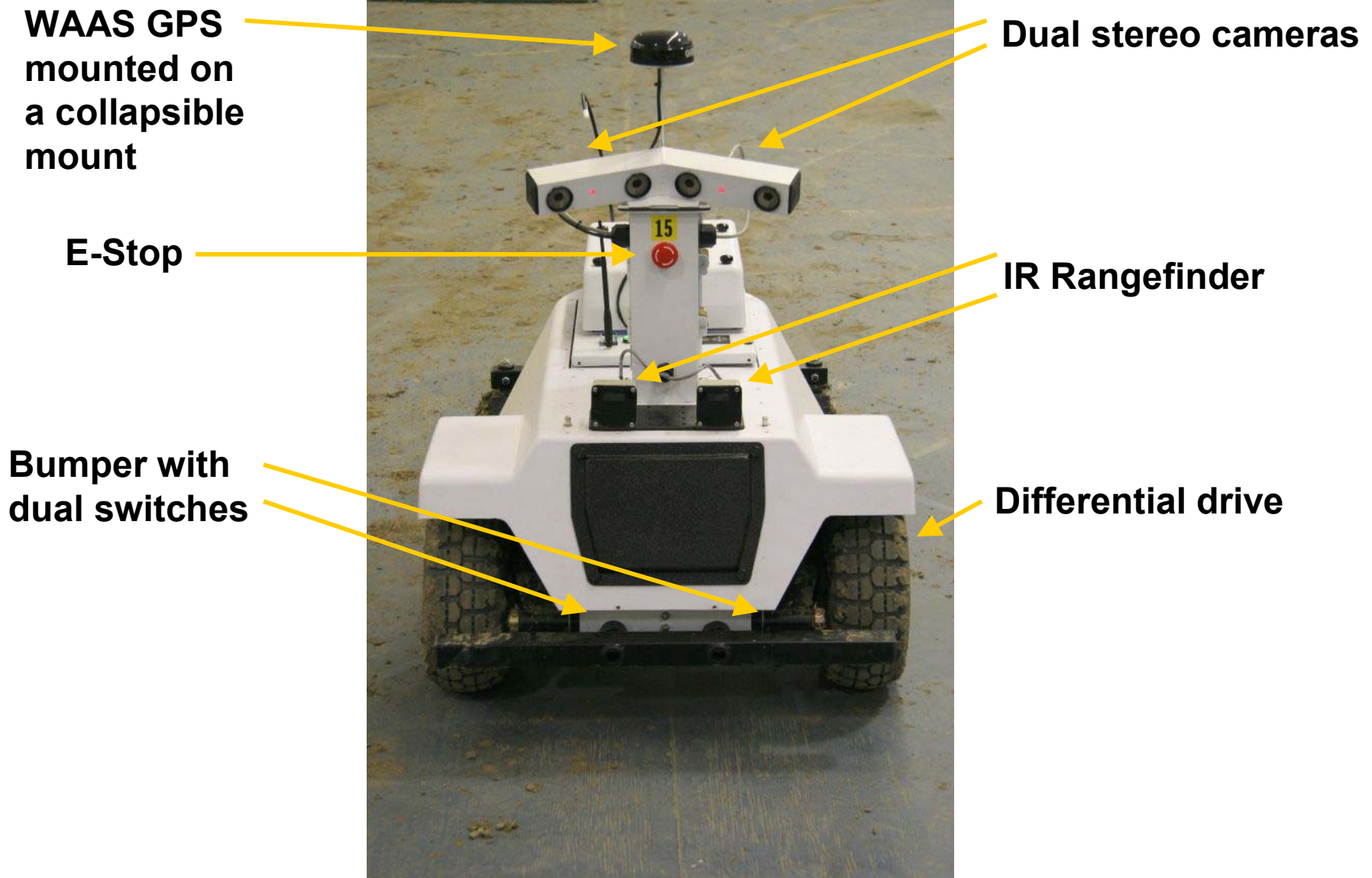


# LAGR Hardware Architecture



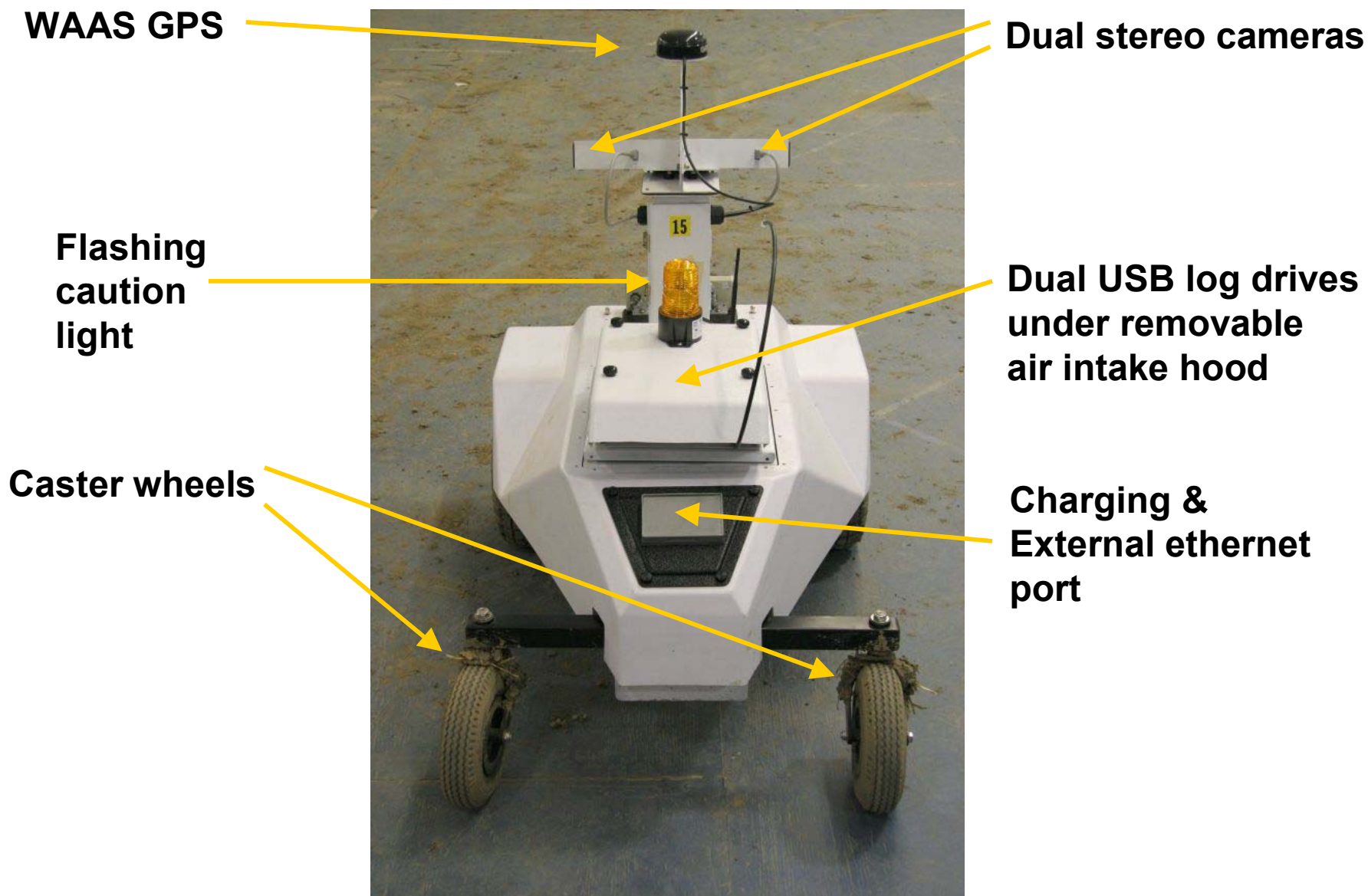


# LAGR Robot Front View





# LAGR Robot Rear View





# Power Switches, Antenna and LCD Display

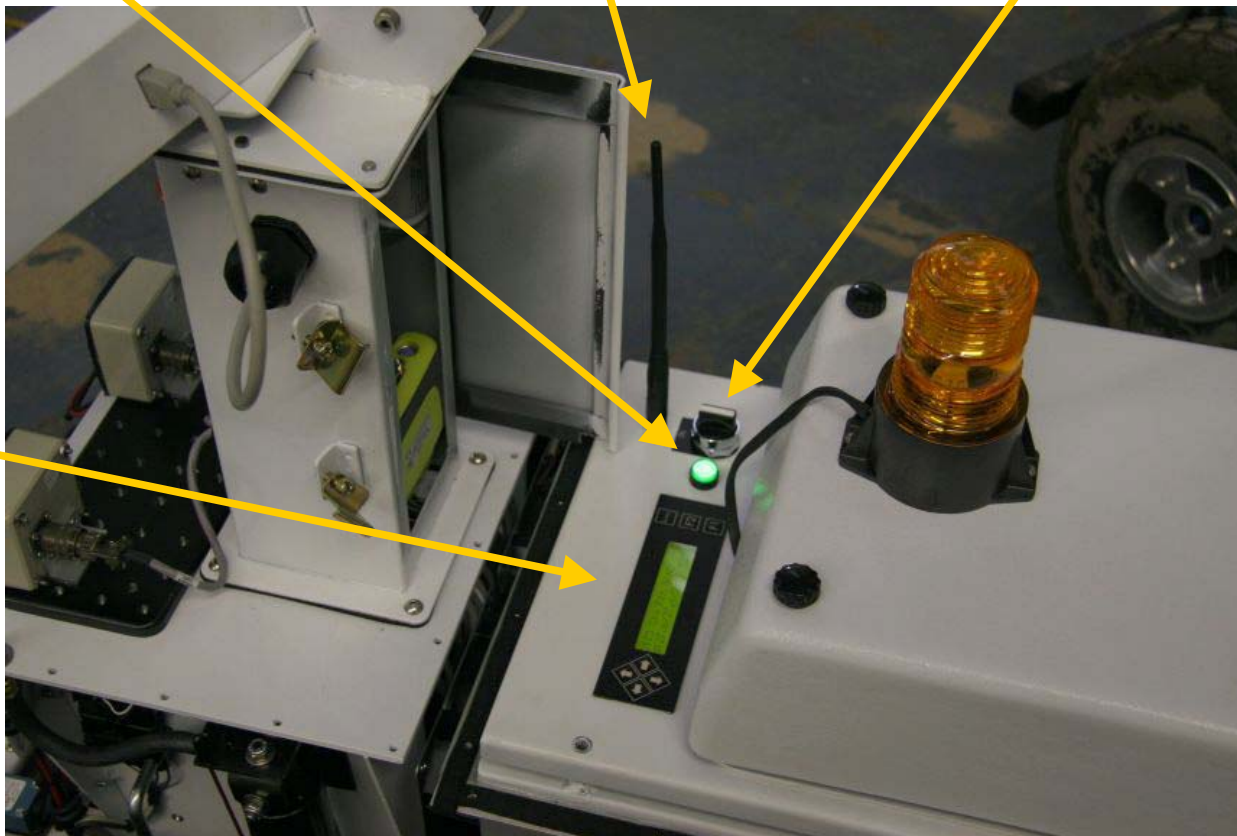


Soft power switch

Ethernet antenna

Main power switch

LCD  
Display



- Main power switch connects and disconnects the battery packs to the E-box
- Soft power switch turns on and off the computers. During shutdown, it will deliver the shutdown signals to all the computers and wait 45s before shutting off power.



# LCD Display Information



**Serial number**    **Controller Status**    **Pose Status**    **GPS Status**



**Primary  
battery  
voltage**

**Secondary  
battery  
voltage**

**Combined  
battery  
voltage**

**E-box  
temperature  
(celcius)**



# Modes of Operation



- **Computer control/autonomous mode: computer sends rotation and translation velocities to the controller**
- **Remote mode: the RF remote sends driving commands to the controller**

**And if everything else fails:**

- **Manual: deactivate the clutch and push the robot**



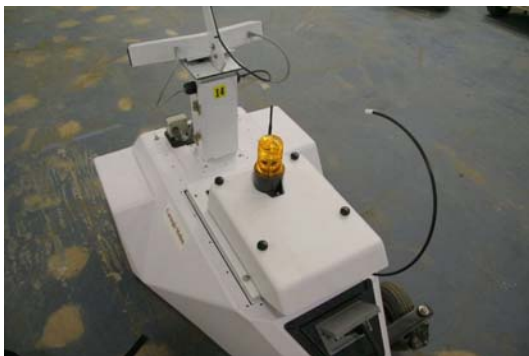
# Radio Remote



**DO NOT MODIFY ANY SETTING ON THE RF REMOTE!!!**  
**MODIFICATIONS CAN RESULT IN UNSAFE OPERATION!!!**



# USB Logging Drive



**2 removable USB Drives: 40gb capacity, Hitachi Travelstar 5K80 model (5400rpm)**



# Robot API



- **Low level interface:**
  - Direct control of drive motors, brakes, and sensors
  - Access to raw data from all the sensors (time tagged): vehicle sensors (encoders, voltages, etc.) and perception sensors (images)
  - Self-diagnostic command and status
- **Mid-level interface:**
  - Translation and rotational velocity command
  - Filtered data from the pose server (local and global pose)
  - Processed sensor data, such as range image and the associated raw data (especially colorized range image)
  - General vehicle and sensors states
- **High-level interface:**
  - Demonstration software (comes with the source code)
- **Multi-client capability for sensor data, shared memory interface**

**The API comes as a set of library without source code, but the source code for the demonstration or example programs will be provided to serve as templates for the user programs.**