



**RoboJackets**  
FIRST - IGVC - BATTLEBOTS - ROBOCUP

IGVC Presentation  
June 4, 2011

[www.robojackets.org](http://www.robojackets.org)



# Team Members

- Joe Hickey
  - BS ME / Sophomore
  - Mechanical design and build
- John Madden
  - BS ME and CS/ Senior
  - Project Manager, Mechanical build, Software
- Kenneth Marino
  - BS EE / Sophomore
  - Software, Electronics
- Paul Foster
  - BS ME / Senior
  - Software
- Stefan Posey
  - BS AE / Senior
  - Mechanical build
- Jacob Schloss
  - BS AE / Senior
  - Software, Electronics
- Akshay Srivastava
  - BS AE / Junior
  - Electronics
- Peter Quick
  - BS ME, Junior
  - Mechanical Build

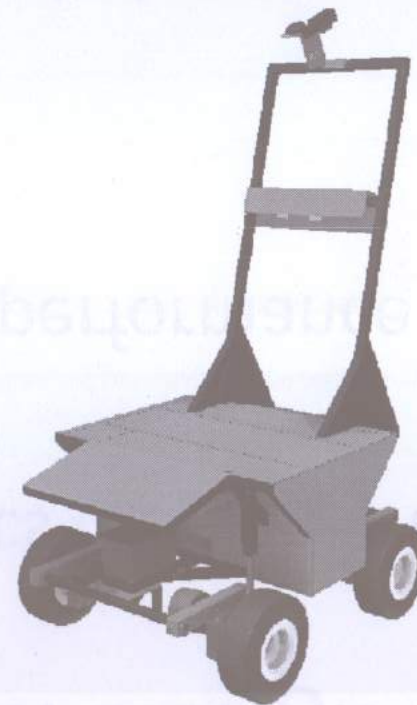


# Mechanical Overview

**Jeanni, the 2010 Base**



**Roxi, the 2011 Base**



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# Improvements on Design

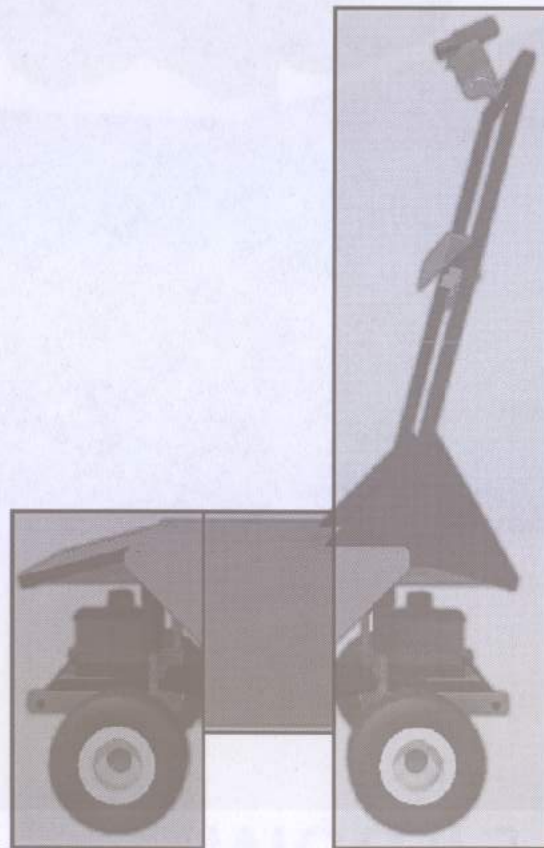
- Enhanced ride characteristics for higher top speed
- Increased adverse weather performance
- Outer panel simplification
- Reduction in overall mass
- Improved payload accommodation
- Ability to accommodate electronics and computer

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# Robot Zones

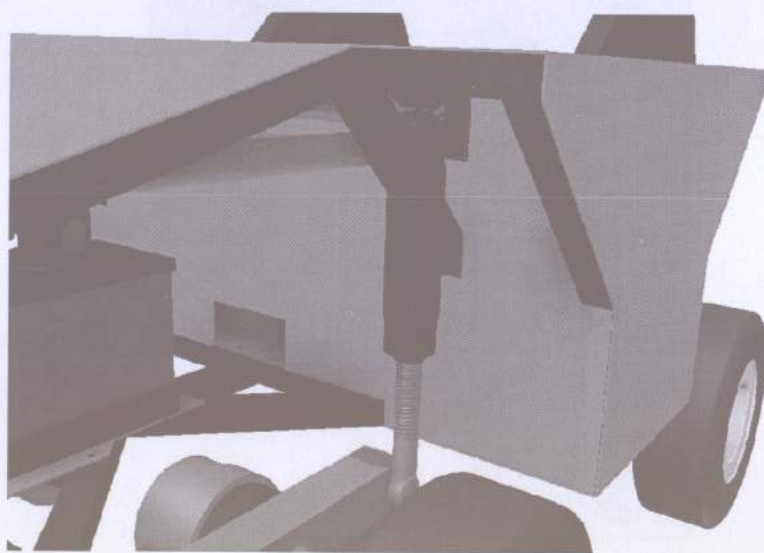


1. **Front:** Forward LIDAR, Motors, GPS, & Power Distribution / Supply
2. **Middle:** Main Batteries, Motor Drive Electronics,
3. **Rear:** Laptop, Camera, Rear LIDAR, Motors, GPS, Button Panel, & Safety Light





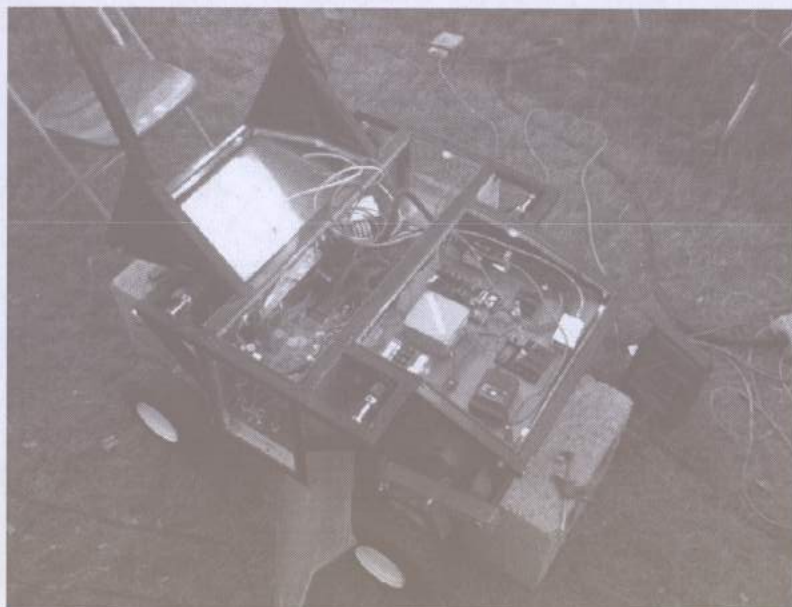
# Motors & Suspension



- Independently suspended 4 wheel drive system
- Custom shocks
- 4x NPC T64 brushed motors
- Custom adapter plate and rear shaft mount for encoders



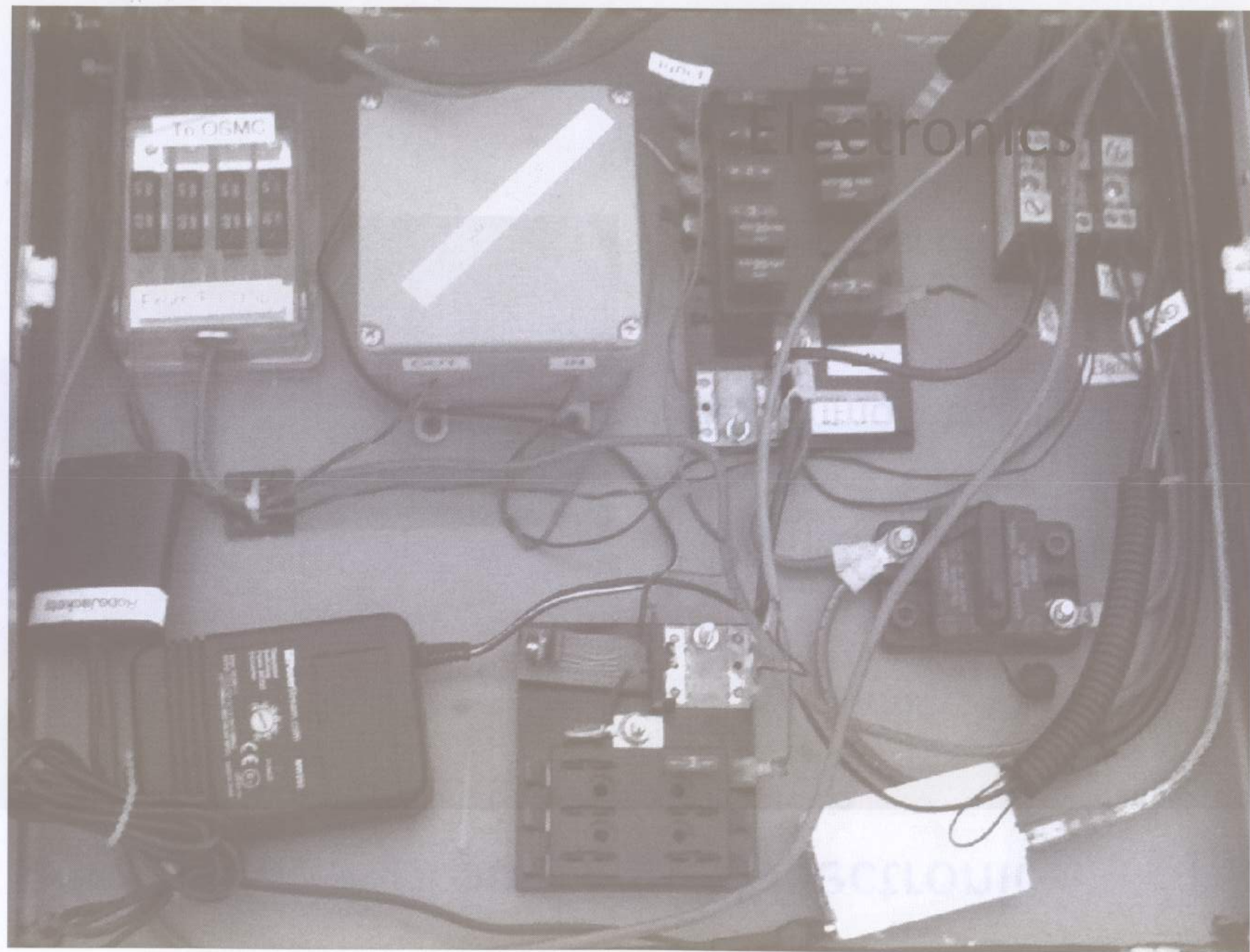
# Water-proofing and Electronic-Accommodation



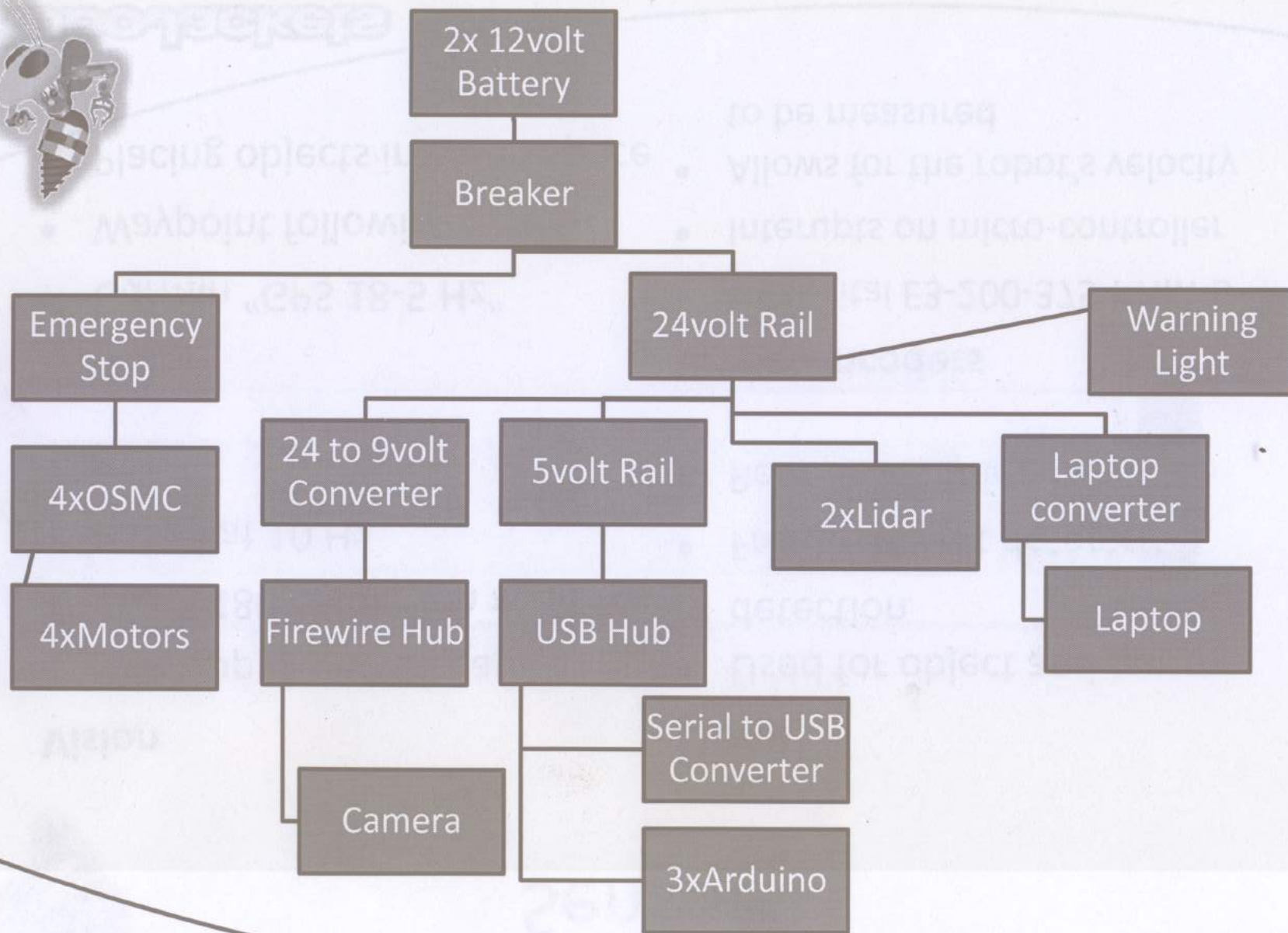
- Polycarbonate removable access panels
- Weather stripping and silicon based caulk
- Accommodates larger laptop
- SICK LIDAR in front and rear with unobstructed view and overhangs

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# Sensors

## Vision

- AVT Guppy F-036C camera
- 752 X 480 resolution at 64 fps
- Polled at 10 Hz

## LIDAR

- Used for object and ramp detection
- Front – object detector
- Rear – safety feature

## GPS

- Garmin “GPS 18-5 Hz”
- Waypoint following
- Placing objects in world space

## Wheel Encoders

- US Digital E3-200-375-I-HM-B
- Interrupts on micro-controller
- Allows for the robot's velocity to be measured





# Computers

- Main computer
  - msi laptop, Intel Core i7 cpu, cuda enabled NVIDIA 285M gpu, 6 GB RAM
  - Responsible for data processing, path planning and control algorithms
  - Forms core of sensor interconnect
- MCU
  - 6 ATmega328p based Arduino Duemilanove boards
  - Data acquisition from wheel encoders
  - Motor control boards



# Safety Features

- Emergency Stop
  - Physical button and remote
  - Disconnects power to the motors
- Safety Light
  - Turns on with power
  - Flashes in autonomous mode
- Rear-facing LIDAR
  - Detects movement behind the robot





# Software Architecture

- Split between
  - Laptop → algorithms and control
  - Microcontrollers → Data acquisition
- Primary language C++
- Uses Boost and OpenCV external libraries



# Algorithms - Vision

- Color segmentation to determine danger map
- Optical flow with SIFT feature tracking.
- RANSAC on SIFT features finds most consistent 2D affine transform.
- Local maps projected onto global map using affine transform





# Algorithms - Others

- Path Planning
  - Potential fields algorithm
- Sensor Filtering
  - Averaging filter to reduce GPS error
- LIDAR
  - Running average filter for noise
  - Erosion dilation filter



## Sponsors

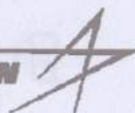
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