UB Robotics

An Undergraduate Club of the University at Buffalo

IGVC

(Intelligent Ground Vehicle Competition)

An entry for IGVC is UBR's main project. It involves creating a vehicle that can run without human operation. The competition is split into the Autonomous and Navigation Challenges.

Autonomous Challenge: The robot must navigate along a course, staying between white lines and avoiding obstacles.

Navigation Challenge: The robot must navigate to certain GPS waypoints while avoiding obstacles

Navigating autonomous course

Setting up for next competition

UB Robotics (UBR) is a club that designs and builds intelligent vehicles that perform various tasks. The club is comprised primarily of mechanical, electrical, and computer engineers. The focus this year has been on the Intelligent Ground Vehicle Competition but other creations include a battlebot for UB's Engineers Week competition and other small demos for the community.

2008 IGVC Vehicle and Team

2009 IGVC Vehicle Design

Mechanical Design

This year's design was built from the ground up using a four wheel direct-drive system. It is meant to be able to handle moderately tough terrain. The frame houses all of the electronics, batteries, laptop, motors, and sensors. Special consideration was taken for accessibility; the battery boxes and laptop are designed to be easily removed.

2009 Design: Lower Half of Frame

System Integration

The computer receives information about the world through five sensors which collect two types of information

Sensors that find the location of obstacles relative to the robot:

- 3CCD color video camera
- Scanning laser range finder

Sensors that are fused using an Extended Kalman Filter to estimate the vehicle's location:

- Differential GPS
- Digital compass
- Optical wheel encoders

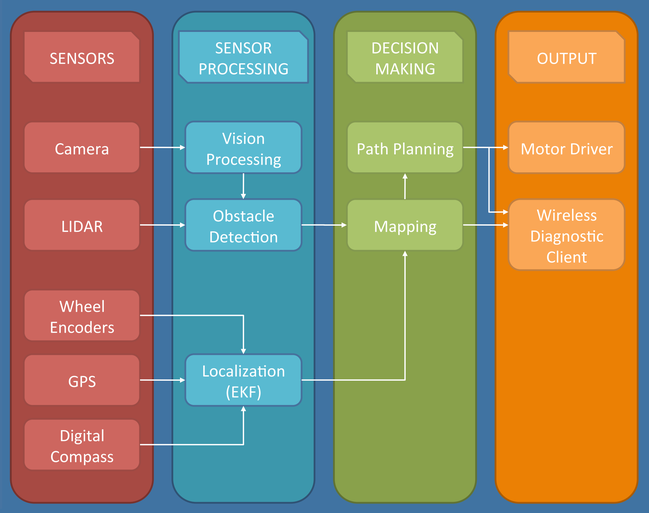


Image Processing (Vision)

The vision software detects lines and obstacles using a 3CCD color video camera. Images are processed using a series of algorithms implemented with the OpenCV API and functions created by the team. Features are extracted and used to create a local map for path planning.

Algorithms include:

- Grey scale conversion
- Threshold operation
- Canny edge detection
- Noise masking operation
- Hough transform line detection

Path Planning

Mapping algorithms used in our robot include:

Dijkstra Algorithm

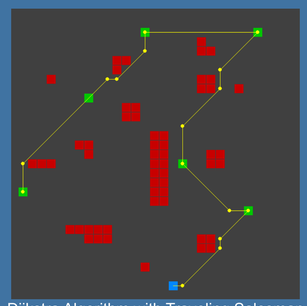
- Finds paths from start to each waypoint, and from waypoint to waypoint, while compensating for obstacles.

Traveling Salesman Algorithm

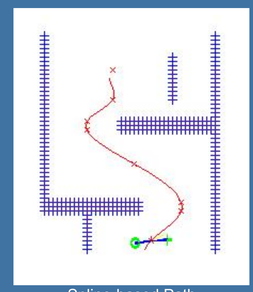
- Determines the optimal order in which to travel to the GPS waypoints in the Navigation Challenge

Spline path creation

- Used for autonomous challenge to determine trajectory while staying in the middle of designated boundaries



Dijkstra Algorithm with Traveling Salesman



Spline-based Path

Electronics

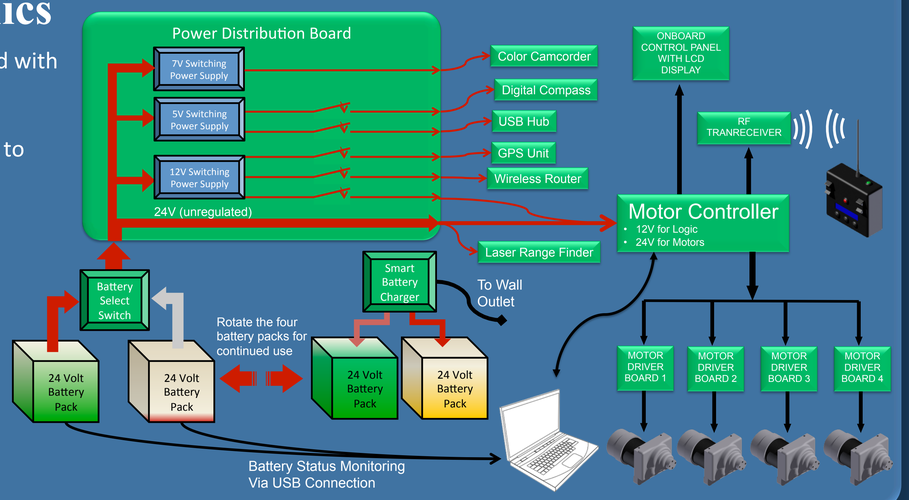
24V System powered with dual battery packs

Remote changeover to manual control

High efficient switching power supplies

Modular H-bridge circuits

PID feedback on motor speed



UB Robotics Club Members

Hardware

Daniel Muffoletto, Tim Montgomery, Colin Lea, Ben Deuell, Mike DiSanto, Chris Nugent, Matt Pivarunas, Chih Yong Lee, Darwin Yip

Software

Mark Tjersland, Jake Joyce, Doug Calderon, Pradeep Gollakota, Dominic Baratta, David Berquist, Ashish Kulkarni, Matt Mott, John-Paul Sitarski, Andrew Puleo, Don Monheim

Advisor Dr. Jennifer Zirnheld

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