

Penn State Abington "Campus Tour"
Autonomous Outdoor Robot Challenge

Mini Grand Challenge 2009

Mini Grand Challenge

- An Outdoor “DARPA Grand Challenge-like” competition
- Navigate two-part course for 6 waypoints
 - **Part 1:** Paved path (sidewalk) navigation (7-8 feet wide), 5 GPS waypoints, with branched paths coned-off
 - **Part 2:** Unpaved grass and dirt field, stop within 30 feet of the final waypoint
- Total Distance \leq **0.5 Miles**

Mini Grand Challenge

- No pre-recorded data is allowed (except GPS of waypoints which is a given file)
- The winner is based on a scoring system of 100 points: Completion, proper avoidance, and personality
- Penn State Robotics Club has competed twice before in 2006/07 and 2007/08
- Rich, at the time an Abington student, won the 2007/2008 competition

Goals This year

- Keep things **simple**
- Rebuild hardware
- Build failure resistant hardware
- Redevelop parts of software
- Automate software testing
- Test on-campus and at Abington
- Complete Part 1 and 2 of course
- Finish within the semester

Hardware Requirements

- Stay within 1 to 5 MPH
- Prevent hardware failures
- Handle steep gradients
- Handle effective turns and speeds
- Re-interface with the Arduino controller
- Carry \leq 50 pounds of equipment

Software Requirements

- Interface sensors and controllers:
 - Front/back sonar, vision, GPS, compass, laser, movement/turn, wheel encoder
- Handle obstacles
 - Differentiate between a cone and a road-obstacle
 - Appropriately handle a non-impassible obstacle
- Error recovery
 - Implement error recovery such as GPS data loss
- Use Player/Stage
- Employ automated testing tools

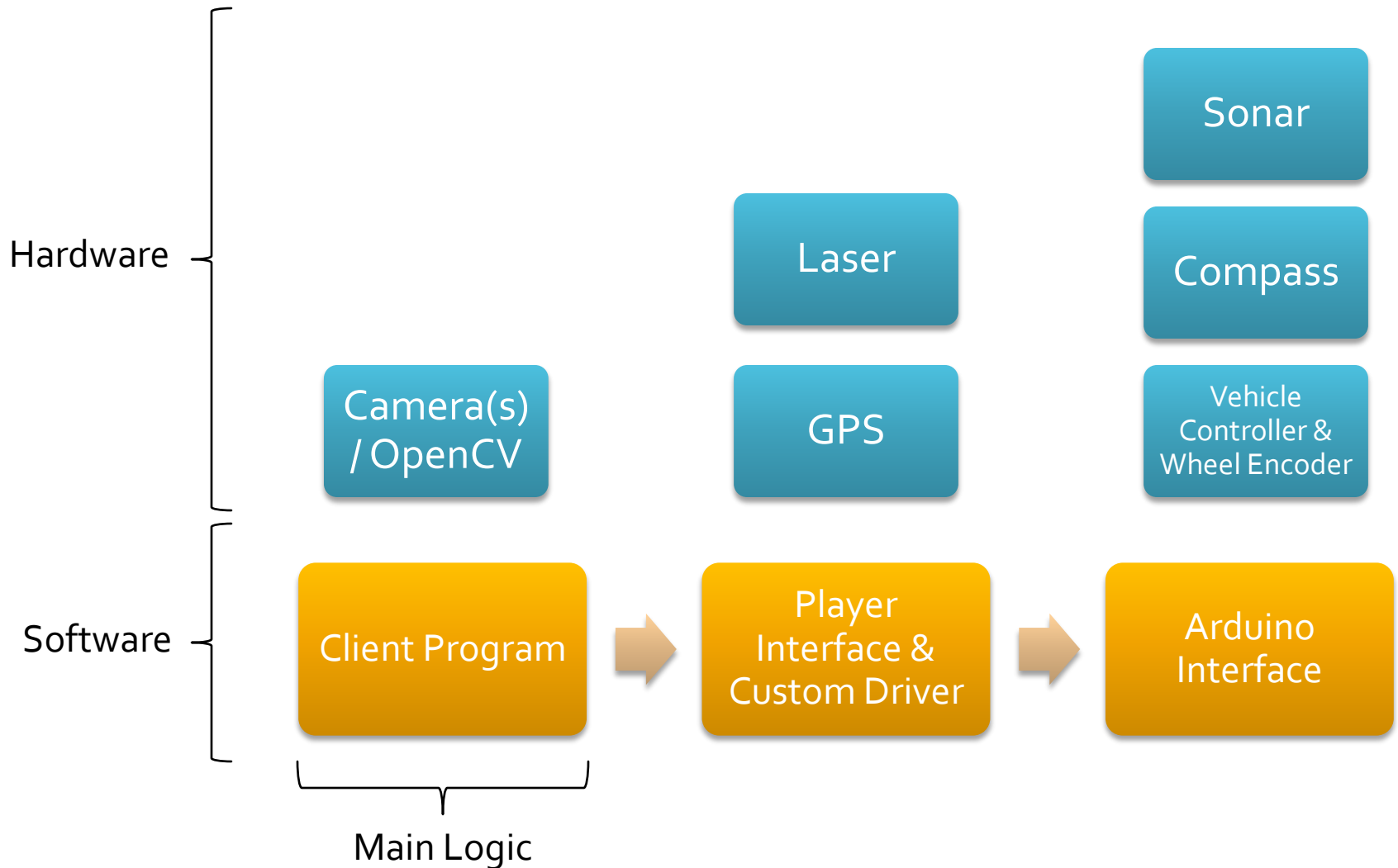
General Solution

- **Hardware Platform:** F-150 Robot /w Sensors
- **Software Platform:** Player/Stage on Linux
 - **Local path planning:** Custom/extended (*VFH/ND*) Driver
 - **Global path planning:** Simplistic GPS waypoint checking
 - **Extra Features:** Crowd Interaction, LIDAR + vision

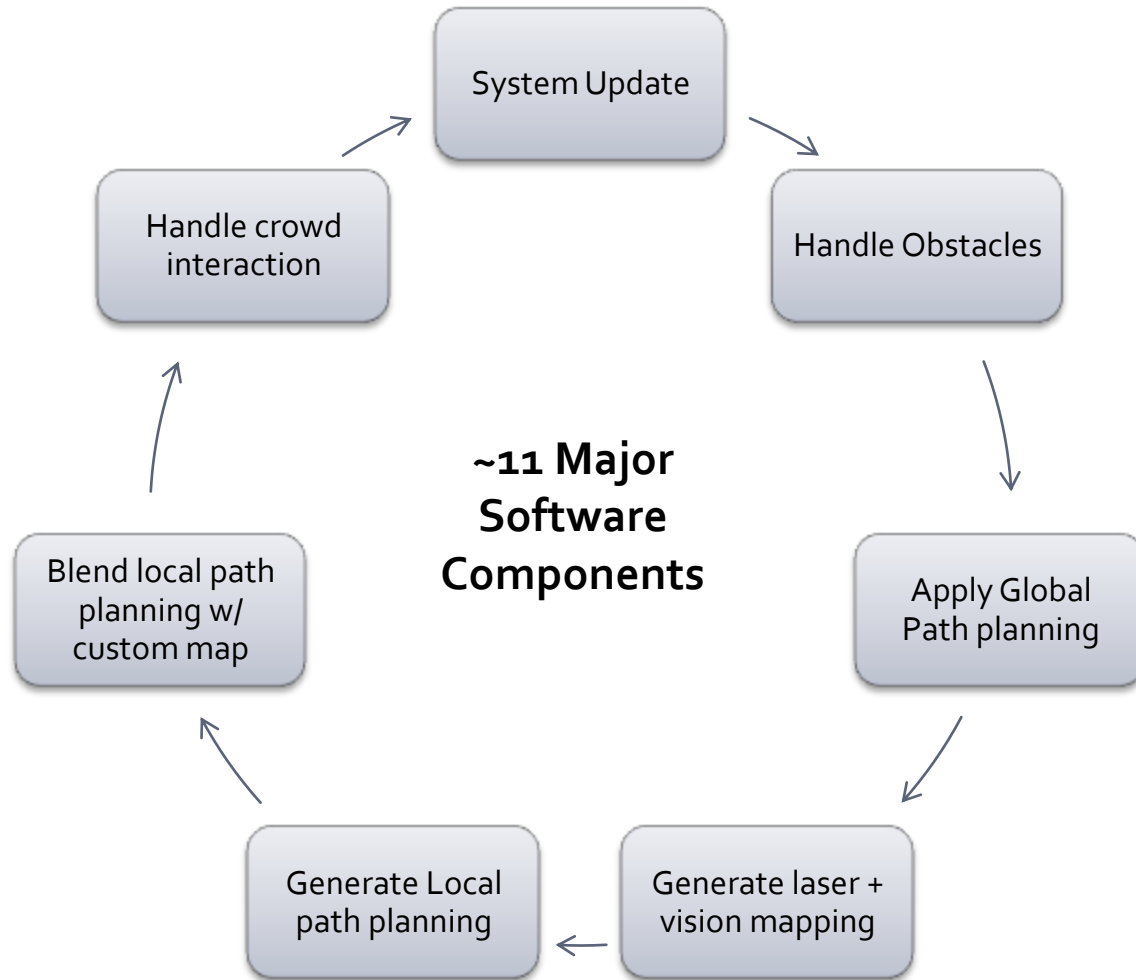
Read in detail on the Mini Grand wiki articles

http://psurobotics.org/wiki/index.php?title=Mini_Grand_Challenge

Software/Hardware Interface

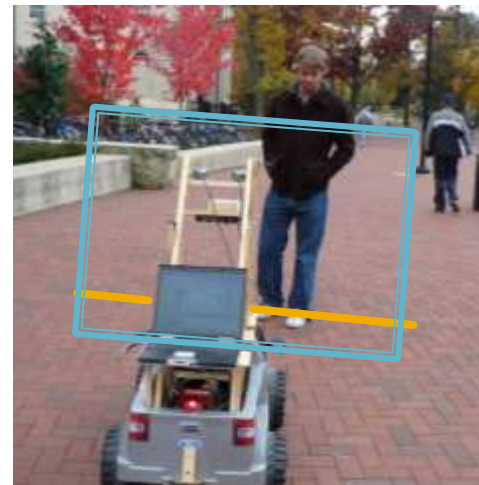
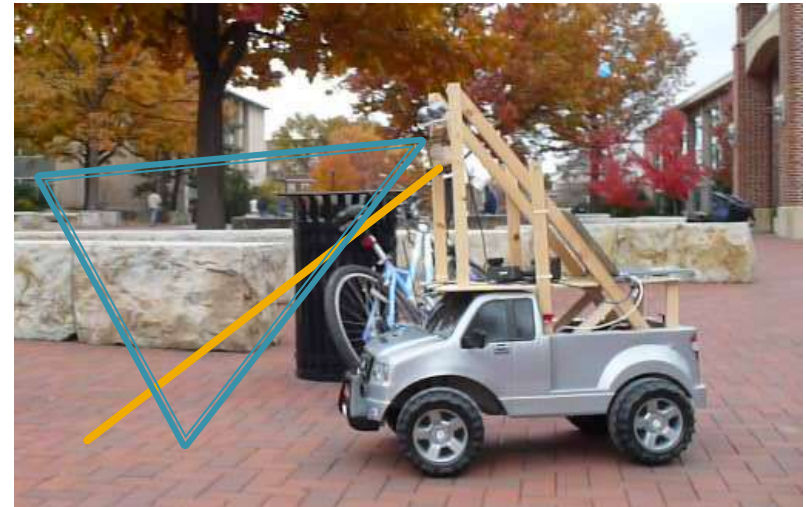


Run-time Cycle



Sample Run-time Cycle

- Query/Refresh Data
- Detect obstacles with laser and sonar
- Apply laser data onto vision to define road-color range
 - Laser finds a continuous line (Drivable surface)
 - The color range of the laser-to-vision map is saved
 - The total drivable path is defined by color profiling
- Apply global path planning rules
- Apply local path planning rules w/ blend of laser + vision data
- Update crowd interaction



Supporting Tools

- SVN tools
- Fedora 9 as host OS
- Arduino Microcontroller
- Wiki documentation
- Automated nightly builds
- Automated software testing

Questions?

