Point-to-point Autonomous Collision and Obstacle-avoidance Robot

Arthur Rudnick  
Dan Dosch  
Derek Spadaro  
Nhat Le

Professor John Johnson  
ECE 189A-B 2004-2005

http://www.AtotheR.com/robotics/pacobot
PACObot utilizes Global Positioning System technology, a digital compass, and both infrared and ultrasonic sensors to travel to preprogrammed waypoints while avoiding unplanned obstacles in its way.
Scientific: Topological mapping, mapping of other planets, regular distance soil and water sampling.

Military: Automated reconnaissance, unmanned convoy control, robotic sentry, mine field charting.

Public Utility: Automated lane line painting, lot line adjustment, spill clean up, parking lot layout.

Homeland Security: Automated border patrol, airport parking lot and loading area monitoring.

Household Consumer: Automated dog walking, intelligent large area lawn mower.
Arthur Rudnick: Group Leader
Inter-Processor Communication
Power Management and Distribution
System Level Design and Integration
Control Processor Software
Crisis Management

Dan Dosch: Object Detection
Infrared Sensors
Ultrasonic Sensor
Digital Compass
Navigation Processor Software

Derek Spadaro: Navigation
Global Position Satellite Module
PC User Interface
Navigation Processor Software

Nhat Le: Vehicle Control
Motor and Servo Control
Chassis Design and Fabrication
Design Plan (Fall)

**Project PACObot**

**No Risk Systems**

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**PACObot**

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<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
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<td>Refined Project</td>
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<td>Establish Purchase Orders</td>
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**Proposed Project Schedule**

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**Task**

- **Split**
  - Project Idea and Team Formation
  - Refined Project
  - Initial Design Review
  - System Level Design
  - Preliminary Design Review
  - Detailed Design
  - Critical Design Review
  - Implementation of Hardware Design
  - Establish Purchase Orders
  - Contact Free Part Contacts
  - Obtain Parts
  - Basic Microcontroller Unit Test
  - Servo Control Unit Test
  - Motor Control Unit Test
  - IR Sensor Unit Test
  - Sonic Sensor Unit Test
  - Digital Compass Unit Test
  - RS-232 Unit Test
  - GPS Unit Test
  - Integration Testing
  - Schematic Layout
  - System Prototype
  - PCB Layout

**Milestone**

- Arthur
- Nhat
- Dan
- Derek

**External Tasks**

- Arthur
- Nhat
- Dan
- Derek

**Summary**

- Project Summary

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**Page 1**
Testing and Development Plan (Spring)

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<td>Digital Compass and GPS to Nav Proc Integration</td>
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<td>Final Shakedown and Testing</td>
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System Overview

- Microchip PIC18F4331
  - Running on 8MHz Internal Clock
  - 40 MHz Capable with External Clock
  - 40 I/O Pins
  - 2 PWM Modules (8 & 2 Channel)

- Dual Processors
  - Faster Response Times
  - Task Modularization
  - Parallel Development Process

- Robust and Testable Design
  - Highly Modular
    - Pin Headers
    - Socket Mount Components
    - Off Board Modules
  - Diagnostic LEDs
  - Test Points
Vehicle Control (Motor & Servo Subsystems)

- 4 HOB-10 Gearhead Motors (12v)
  - Speed: 500 RPM
  - Stall Torque: 105 oz/in
  - Stall Current: 4.7 Amps

- 2 KCMD L298 Motor Control Modules
  - Voltage Range 6v – 26v Operation
  - Thermal Overload Shutdown
  - Regenerative Braking

- 2 GWS S-19CLMG Servo Motors (6v)
  - Stall Torque: 100 oz/in
  - Stall Current: 1.5 Amps
Object Detection (Sensor Subsystem)

- 1 SRF08 Ultra Sonic Range Finder
  - I2C Interface
  - 56 ms Average Response Time
  - 11 Meter Range

- 5 Sharp GP2D05 Infrared Sensors
  - Binary Interface
  - 30 ms Average Response Time
  - 1.5 Foot Range
Navigation (GPS & Digital Compass Subsystems)

- Devantech CMPS03 Digital Compass
  - I²C Interface
  - 8 Bit Precision

- Motorola Oncore FS GPS Eval Board
  - RS-232 Interface
  - 12 Channel Receiver
  - 1 Hz Refresh Rate
Software (Navigation Processor)

USR_MODE
RUN

Disable NAV_DEST Signal

Check Waypoint Queue

Enable NAV_DEST Signal

Is Queue Empty?

YES

NO

Disable NAV_RIGHT Signal

Disable NAV_LEFT Signal

Pop Waypoint

Poll GPS Module

Parse GPS String

Near Waypoint?

YES

NO

Compute Bearing to Waypoint

Poll Digital Compass

Compute Heading Adjust

Update NAV_LEFT

Update NAV_RIGHT

Possibility for increased responsively by skipping GPS polling step N times (determined by empirical testing in the spring)
Power Distribution Specifications

- 12v Capacity: 1.3 AH Sealed Lead Acid
- 12v Peak Current Draw: 10 Amps
- 12v Average Current Draw: 1 Amp
- Protected by 10 Amp Quick Blow Fuse

- 6v Capacity: 1.3 AH Sealed Lead Acid
- 6v Peak Current Draw: 6 Amps
- 6v Average Current Draw: 0.5 Amps
- Protected by 6 Amp Quick Blow Fuse

- 5v Capacity: 700 mAH NiCad
- 5v Peak Current Draw 40 mA

Chassis Specifications

- 4 Wheel Steering
- 4 Wheel Independent Suspension
- Top speed 5 MPH
- Turning Circle 2 Feet
- 1 Hour Average Run Time
Finished Product

- Autonomous Point to Point Navigation
- Autonomous Obstacle Avoidance
- Highly Adaptable and Extensible
Video

DIVX Medium Quality

Microsoft DV Super HQ
End of Presentation

Questions?

http://www.AtotheR.com/robotics/PACObot/