



IPRO 316

Creating an Interdisciplinary Robotics Initiative @ IIT

Spring 2003

Advisor:

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Team Members

- Ali Zenfour, CHE, Senior, Hardware
- Aric Harris (Team Leader), ME, Graduate, PR
- Chance Yohman (Team Leader), CS, Junior, Software
- Chen Teng, CPE, Junior, Software
- Mayank Brahmabatt, CPE, Senior, Hardware
- Michael Carter, CS, Senior, Software
- Rajesh Kurra, CS, Senior, Software
- Shirali G. Patel, EE, Junior, Hardware
- Syed Husain, CPE, Junior, Software
- Tiana Washington, EE, Junior, PR
- Yu Zhang, CPE, Senior, Hardware

Objectives

- 1) Hands-on experience with a robot, i.e. **The Roomba or Micromouse.**
- 2) Organize an IIT special interest group that focuses on topics related to Robotics.
- 3) Review literature in the Robotics field .
- 4) Take field trips to institutions involved with Robotics.
- 5) Explore opportunities for IIT to participate in the FIRST robotics competition.

Team Organization & What We Accomplished

- Three Groups
 - Hardware
 - Handled disassembly and reverse engineering of the Roomba.
 - Software
 - Handled code extraction from the Roomba and exploration of the Micromouse competition.
 - Public Relations
 - Explored applications of Robotics, interest in Robotics @ IIT, and organized a Robotics Day.

The Hardware of Roomba



Objectives

- What is Roomba and is it Worth the Hype?
- Testing
- Disassembling

What is Roomba and is it Worthwhile?

Roomba is a commercially-available robotic vacuum cleaner from iRobot. Unlike other robotic vacuum cleaners on the market like RoboKing that cost \$2,000, Roomba comes at a fraction of the price at \$200. We wanted to know if Roomba was worth paying for.

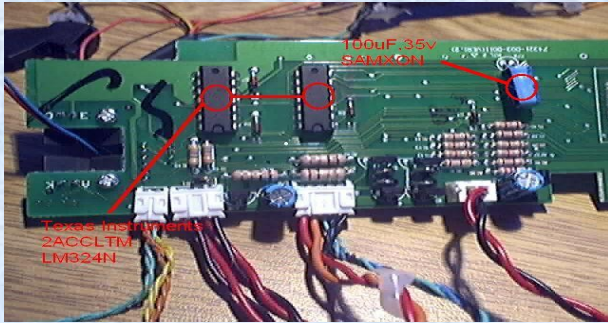
Testing Tasks

- Effectiveness of Picking Up Different Materials
- Reacting to Environmental Hazards
- Performance as a Vacuum Cleaner

Testing Results

- Does well with small materials (<2" x <2").
- Does not do well with large , sticky, or elongated items.
- Roomba works efficiently on inclines of $\leq 10^\circ$.
- Can detect drop-offs (e.g. along the top of stairs), but stops if one of the wheels drops off the edge.
- Gets itself out of tight corners, by calculating rotation angle and recalculates its path.
- Virtual wall had only $\frac{1}{2}$ the range advertised.
- **Roomba serves better as a maintenance vacuum to be run daily to pick up small items.**

Disassembly- Parts of Roomba



Motherboard



Tray



Brush



Miscellaneous Parts

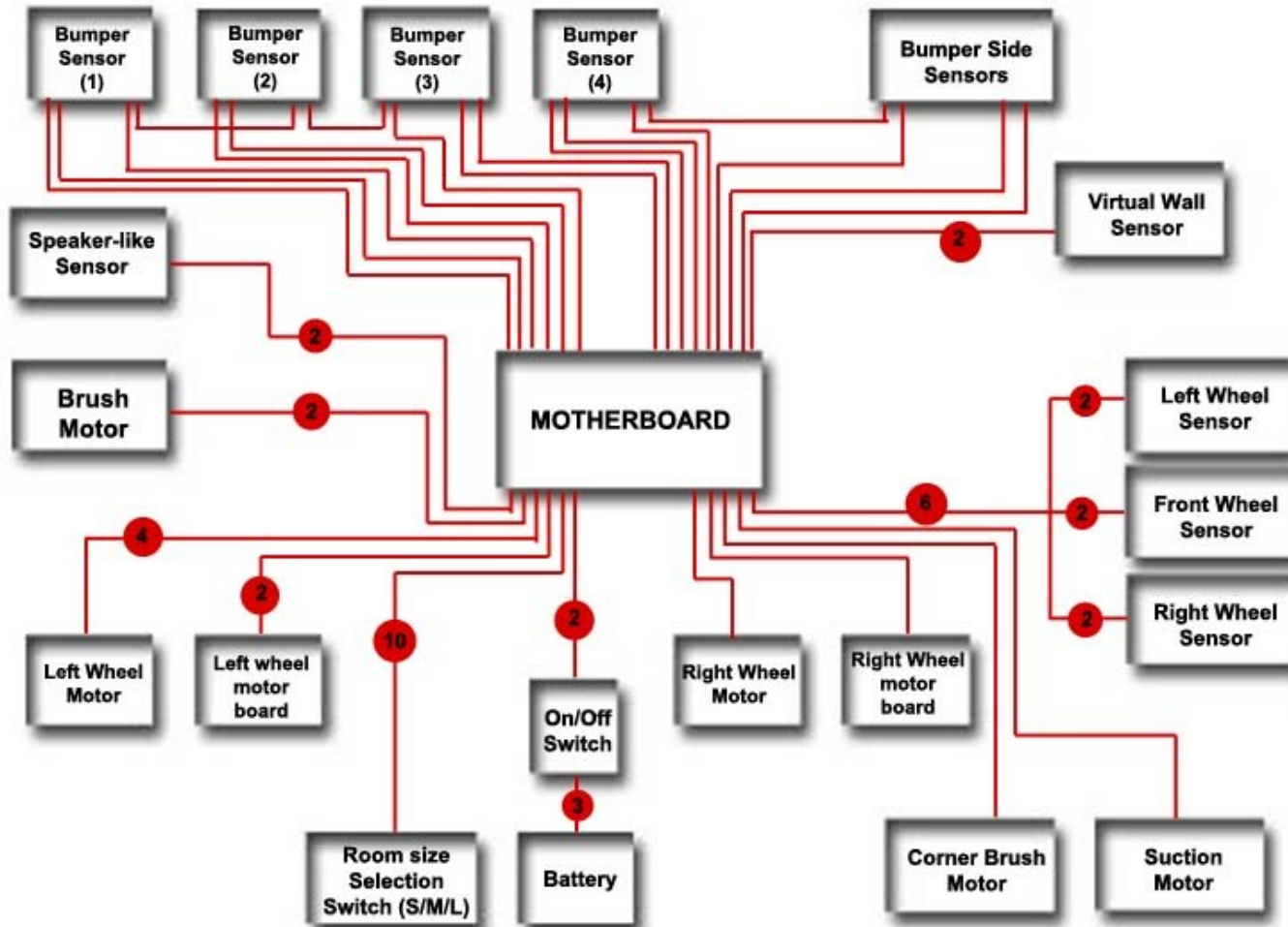


Battery



Virtual Wall

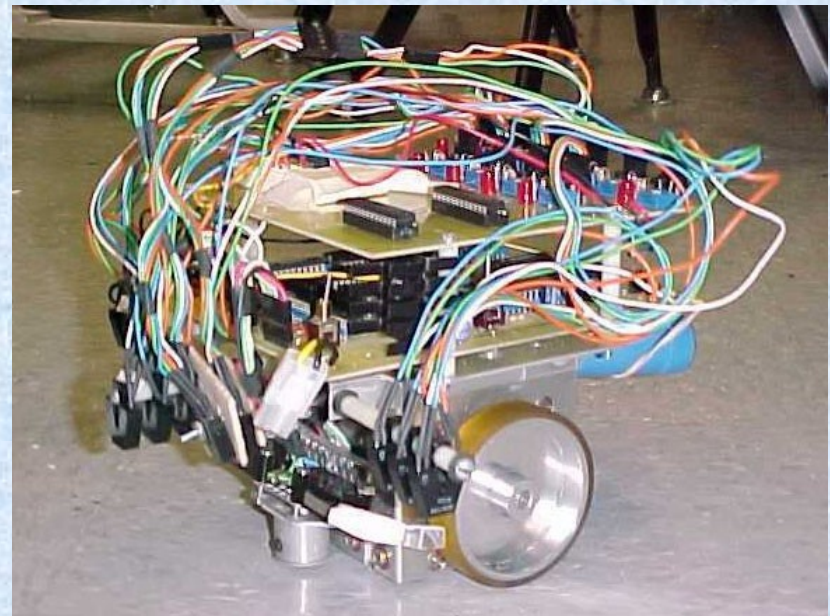
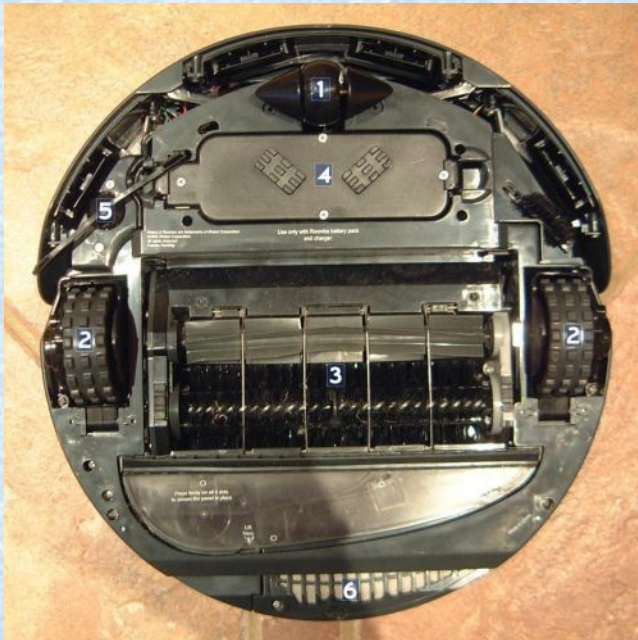
A Closer Look @ the Control System



Conclusions from the Disassembly

- Main motor attached to main brush by gear box.
- Aside from mobility, wheels detect the presence of the floor.
- Eight touch sensors on the bumper determine which way to go.
- Aside from novel features, the Roomba was constructed of cheap plastic and large amounts of glue.
- **While saving on cost, cheaper materials could shorten the life span of the Roomba.**

The Software of Roomba and Other Robots



Patent Issues with Roomba

1. iRobot has the patent for the Roomba for 17 yrs
2. Is it legal to examine code from the Roomba?
3. Consulted Director of Technology Transfer and Intellectual Property @ IIT.

Conclusion: Legal to examine code, but can not commercialize.

Reverse-Engineering Issues with Roomba

- Issue of Downloading Source Code
- Lack of Hardware to Download Source Code With
- Lack of Technical Expertise

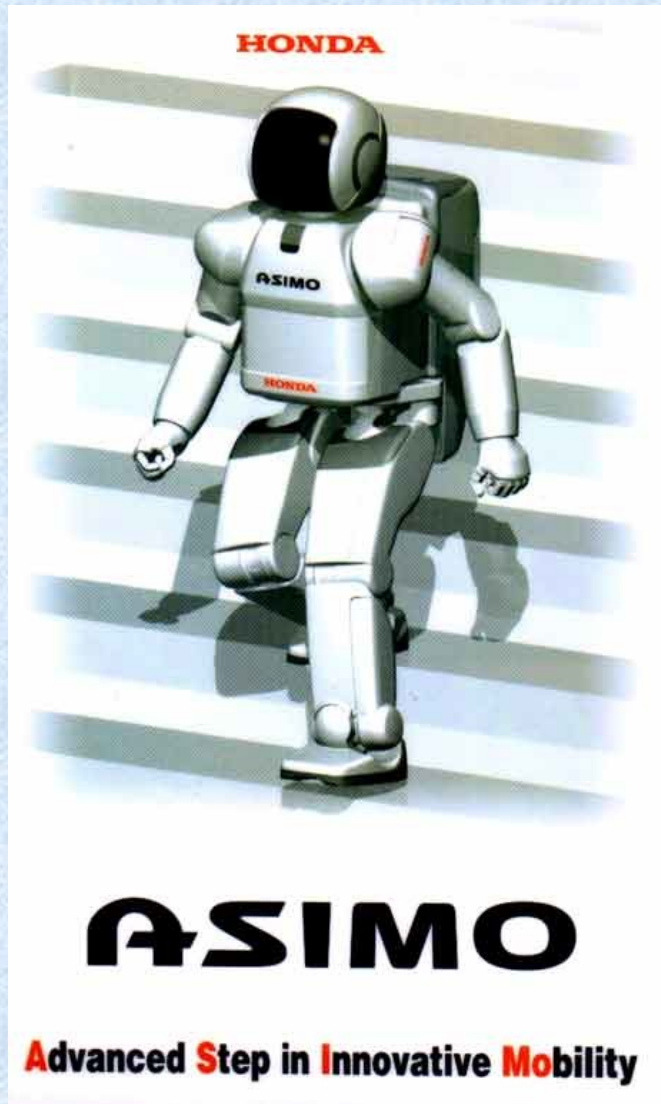
RESULT: No Source Code. ☹

Other Options

- Micromouse Competition
 - Lego Mindstorms Competition
 - NQC Language
 - Technical Issues
 - Lack of Array Support
- A New Vision



Public Relations



ASIMO- February 22-23, 2003

- Honda's Humanoid Robot
- Most Advanced Walking Robot
 - Can even walk up and down stairs!
- Provided insight into the current status of Robotics.
 - Commercially applied as a tour guide and greeter.

Survey & Results

Questions:

YES %

Number of Surveys Filled Out: 86

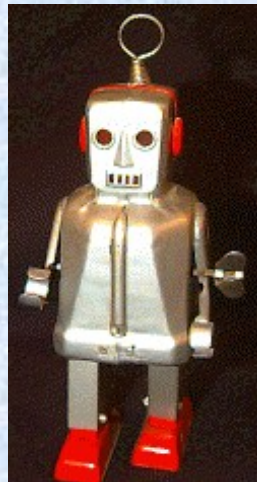
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|---|--|-----|
| 1 | Are you interested in robotics? | 80% |
| 2 | Would you be interested in seeing robotic demonstrations? | 86% |
| 3 | Would you like to see IIT add more robotic electives? | 77% |
| 4 | Do you know about the student organization SMURFS here at IIT? | 61% |
| 5 | Would you be interested in attending robotic events? | 77% |
| 6 | Would you be interested in helping students from the Chicago-land area High Schools and Liberal Arts Colleges develop a robotics initiative with IIT as the HUB? | 65% |

Robotics Day (April 28th)

- Two Speakers- Dr. Peter Greene & EDT
- Robotics Demonstrations
 - Robots designed by EDT
 - 30 Ft. SMURFS Demonstration
- Introduction of the International Robotics Student Interest Group
 - www.irsig.org (currently hosted at www.iit.edu/~irsig)

Conclusions

- There is an interest in Robotics here!!!
- Need to bring more Robotic Demonstrations here.
- Need to offer more IPROs and courses with hands-on experience in Robotics.



Thanks!!!

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 - Professor Peter Lykos
 - Aaron Van Tassle from UC-Berkeley
 - Robert Anderson, Director of Technology Transfer and Intellectual Property @ IIT
 - EDT
 - Dr. Peter Greene
 - All Other Participants @ Robotics Day

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