
I²PRO 316: Robotics Initiative at Illinois Institute of Technology



Fall 2004

Goals

- Explore Robotics Technology Applications
 - Unmanned Aerial Vehicles
 - Dr.Todd Kuiken's Robotic Prosthetics
 - Advanced Robotics Platform at IIT
 - Peppy the Robot
 - Roomba Modified into a E.R.M.bot
 - Spread the Robotics Interest to Other Students
 - Pyro
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Python Robotics: What is Pyro?

- Python is an interpreted, interactive, and object oriented language. It is freely usable and distributable.
 - Libraries for Python
 - A programming environment
 - A graphical user interface
 - Low level drivers designed to program and use with robotics and robot AI.
 - Goal
 - Further robotics here at IIT by providing an easily accessible means of study in the subject
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Advantages of Pyro

- Clear syntax
 - Open source
 - Designed for students and researchers
 - Universal robot programming
 - Powerful
 - Simulations can be run without actual robot hardware
 - Simulations provide many objects with which to interact
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Assignments

- Investigate more accessible means of using Pyro
 - Gain familiarity with Pyro and its operations
 - Order microcontroller
 - Create pseudo code of E.R.M.bot
 - Create operational Pyro code from pseudo code
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Obstacles / Bugs Encountered

- Still in development stage
 - Not all simulations work with all robots
 - Roomba controller did not interface with software
 - Able to input improper values in movement commands
 - Runs in a Linux environment
 - Most computers are Microsoft windows based
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Future Plans

- Help Pyro become a more mainstream robotics software
 - Distribute Pyro to the IIT campus
 - Develop a Pyro program that high school robotic clubs can use
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Peppy™ Project

■ Objectives

- Autonomous Domestic Robot
- Voice Recognition
- \$500 Selling Price

■ Spring IPRO

- Implemented Voice Functionality
- Initial Project Idea

■ Summer IPRO

- Sonar Array
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E.R.M.bot: A Programmable Robotics Platform

Picture?

Introduction and Overview

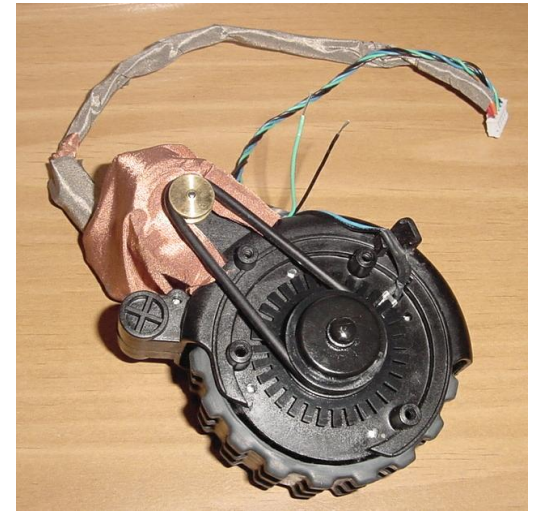
Unmodified Roomba:



- Roomba as a robotics platform
- Initial goal was restoration to stock condition
- Pyro as the development environment

Obstacles

- Pyro and Microcontroller Compatibility
 - Microcontroller acts as the 'brains' of the robot
 - Technical difficulties with Pyro
- Repairs (11 major repairs documented)
 - Wheel assemblies
 - Sensors
 - Roomba's controller



Project Development

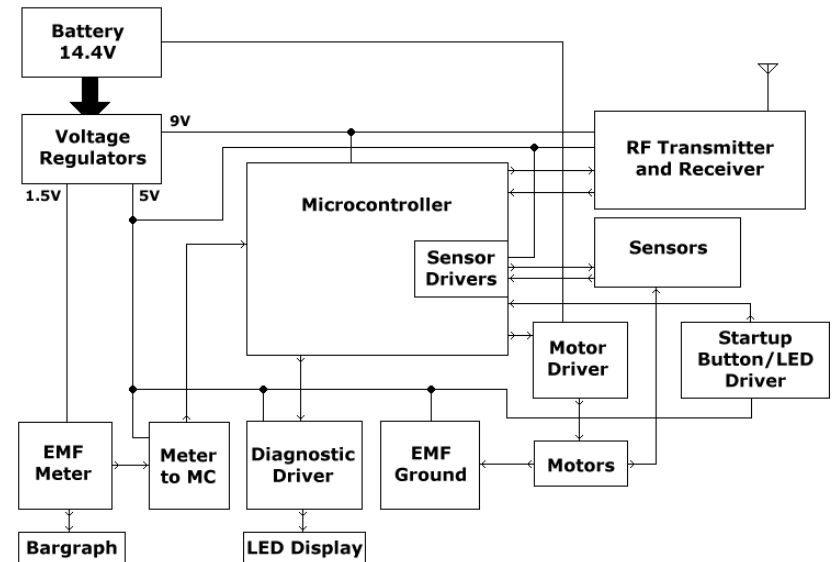
- EMF Room Mapping (E.R.M.)
- Circuits
- Physical modifications
- Software development
- Platform suitability and testing
- Why EMF?



Circuits and Electronics

- Tasks Selected by Members
- Extensive Design and Testing Phase
- Specialized Circuits
 - ❑ EMF meter
 - ❑ EMF ground
 - ❑ Wireless capability

Electronic Block Diagram:

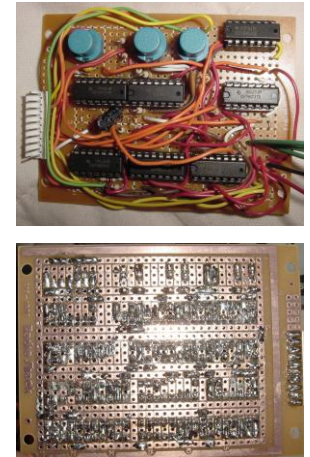
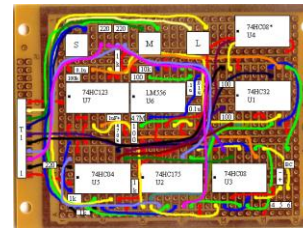
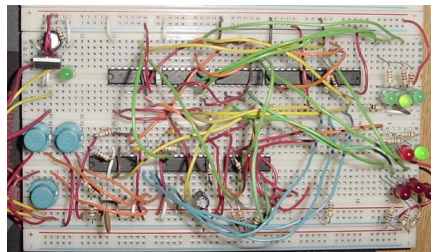
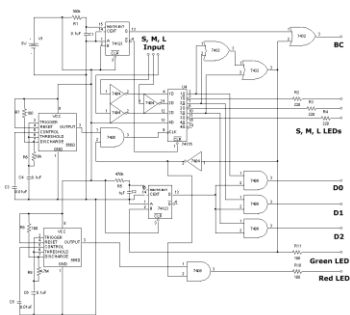


Physical Modifications

- Attempted to Keep Most of the Roomba in Stock Condition
 - Modular Design
 - Circuits Mounted to Physical Platform (Picture)
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Electronics Platform Testing

- Circuits Designed, Debugged, Built, Then Tested Again
- Development Cycle: (Sample Circuit)



Software Development

- Pseudocode For EMF Room Mapping
 - Microcontroller Programmable in C/C++
 - Wireless Protocol
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Future Recommendations

- Develop Microcontroller Software
 - Swarm Capability
 - Improve EMF Grounding
 - Add Sensors and Functionality
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Results and Conclusion

- Stable, Capable Robotics Platform Created

(Picture)

- Endeavors Were Successful, Despite Many Setbacks and Challenges
 - Other Robotics Platform
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Guest Lecture

Dr. Todd Kuiken

MTCC auditorium, IIT

4PM, November 9th, 2004

Why a Guest Lecture?

- To promote Robotics in a campus-wide way by showing one of its practical applications
 - To bring an interesting, accomplished professional to IIT
 - To gain experience in organizing real-life events
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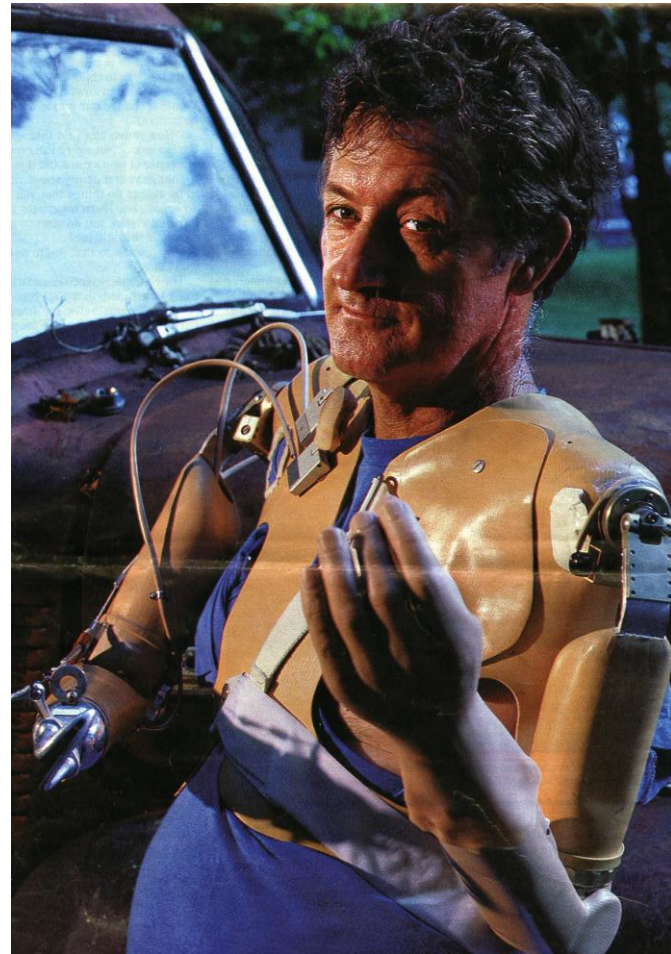
Dr. Kuiken: Bio



- Education:
 - MD/PhD from Northwestern University
 - Employment
 - RIC since 1997
 - Chief of Staff, Director of Amputee Services
 - Northwestern University
 - Associate Professor
 - Awards, Grants, Speaking & Writing
 - “Best Doctor in Chicago”
 - Over \$3 Million as principal investigator
 - Most recent speaking engagement: Hong Kong
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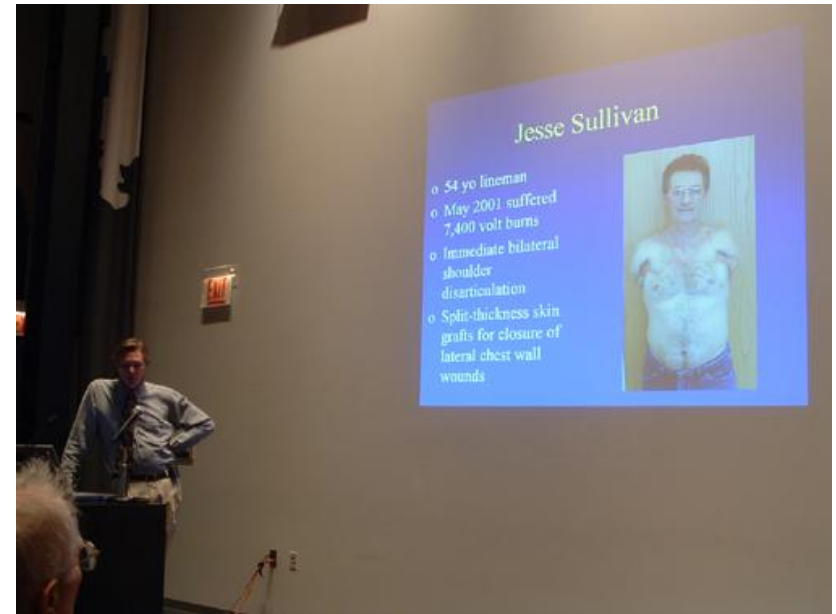
Dr. Kuiken: In the news

- Achieved amazing results with Jesse Sullivan
- Featured on CNN.com, the Newshour with Jim Leher, and in the Chicago Tribune



Dr. Kuiken: Talk at IIT

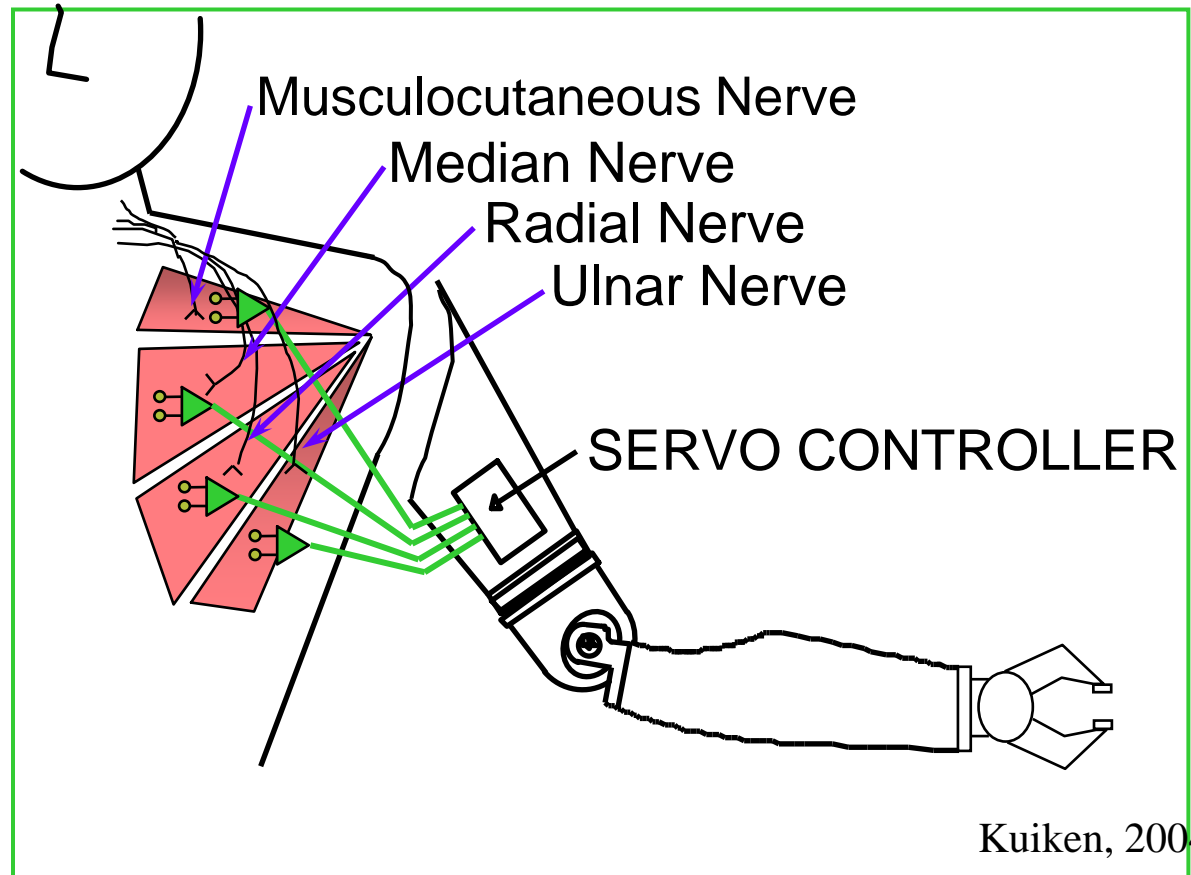
- Dr. Kuiken generously agreed to come to IIT



- The campus responded well

Dr. Kuiken: Talk at IIT (Continued)

- Topic for Talk at IIT:
 - Neuromuscular Reorganization for Improved Control of Artificial Arms
 - Q & A followed



Conclusion

- The lecture was a success
- We accomplished all of our goals for the event
- We recommend more lectures to future sections of the IPRO

Next up...

Unmanned Aerial Vehicles

- Objectives
 - Examine a practical application of robotics technology
 - Tasks
 - Compile info on already existing hardware
 - Research experimental aircraft programs
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Unmanned Aerial Vehicles

- Obstacles
 - Expense
 - Accident Rate
 - Operations in Controlled Airspace

 - These Obstacles Can Be Overcome
 - Compare to Accident Rate of Manned Aircraft
 - Access5: NASA, FAA, DoD, Industry
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Conclusion
