

Smart Robots, Inc.

The Open Source Path to Autonomous Robots

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- Business and systems analyst and computer software engineer – in banking, insurance, engineering, local and state government, nuclear power generation, solar energy, defense logistics, health care, energy distribution, plastics
- Founder and President of RB Robot Corporation (publicly traded company - NASDAQ)
- Co-founder and Chairman of the National Personal Robot Association (NPRA)
- Chairman of the first International Personal Robot Congress (IPRC) in April, 1984 in Albuquerque, NM
- Founder and CEO of Smart Robots, Inc.

Joe Monti, Software Engineer, Smart Robots, Inc. (Monti@smartrobots.com)

- Computer Science major at University of Massachusetts, Amherst
- Co-president of the Berkshire Linux Users Group
- Developer of the SR4 Robot operating system

## The Open Source Path to Autonomous Robots

- What is an autonomous robot?
- How soon are we going to see them in our lives?
- How do we get there from here?
- Smart Robots' SR4 Robot
- Open Robot Network
- Robot Application Engineering
- The open source path to autonomous robots
- Q & A and Discussion

## What Is an Autonomous Robot?

- Not remote control
- Not a showbot
- A fusion of sensors, computing and affective capabilities
- A cybernetic feedback loop in the flesh (metal, plastic, etc.)
- Intentional existence, not random
- Connected (when it needs or wants to be), but independent (when it needs or wants to be): A wireless peripheral or an independent node to a PC, a local area network, or the web
- A device that makes its own way in the world – or, at least in defined domains

- Roomba



- Smartcarpet (RFID)



- SR4 (Map-tracker)



## How Soon Are We Going to See Them in Our Lives?

- Now
- As soon as you want to
- Depends on the capability and the level of autonomy you wish to see
- Autonomous robots are an evolutionary phenomenon
- It takes a village (or at least a concerted effort by a closely knit and well-supported cadre of open source developers)

## How Do We Get There From Here?

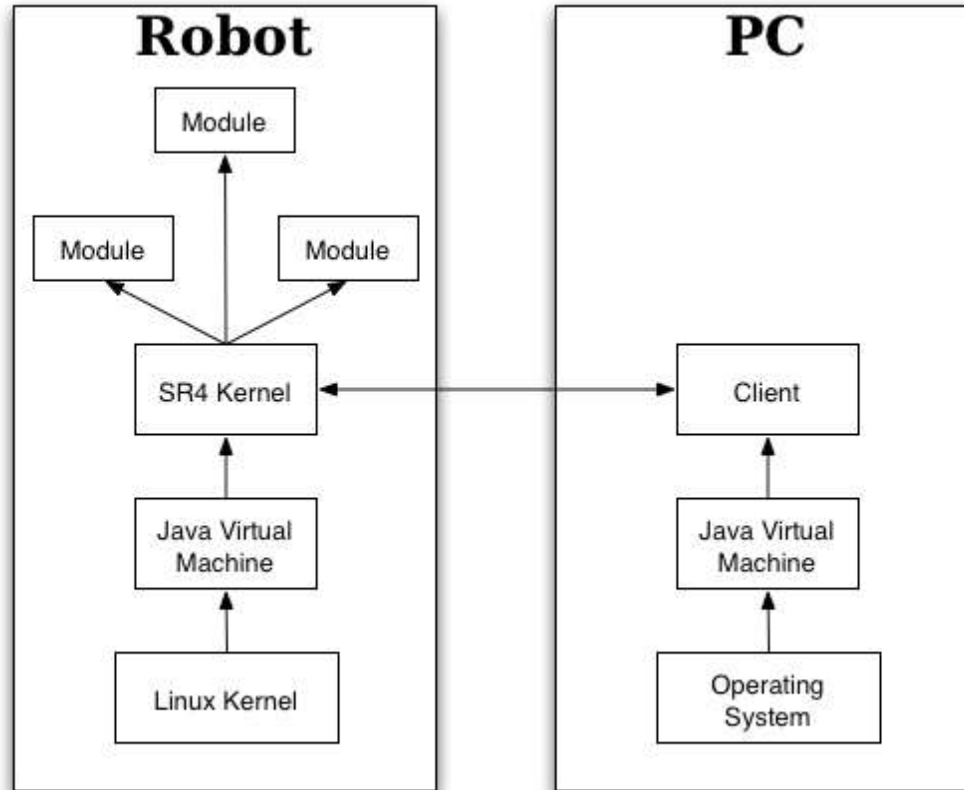
- It is just a matter of going
- David Heiserman – Kindergarten for robots
- Software that enables robots to learn from their own experiences
  - Databases
  - In time, modifying and adding to its own code (and/or restructuring underlying code via changing configuration variables, all driven by feedback, analysis, decisions/choices)
- Bicentennial Man / I Robot (Asimov) approach
  - Positronic brain – does it all
- Evolution Approach
  - Build it as we go
  - Massively collaborative effort
    - Closely couple what is currently already happening in general – and focus it and speed it up
- Collaborative application projects (Application engineering – later)



## Smart Robots' SR4 Robot

- Hardware
  - Architecture
    - Sensors, computing, affective capability
    - Cybernetic feedback loop – in the physical world
    - Graphic on SR4 architecture
    - Photos
  - Components
- Software (It's the software stupid)
  - Architecture
    - Linux, Java, Apache, SSH, (XML parser, My\*SQL, Derby
    - Kernel, Modules and Clients
      - Linux-like
    - Robot Desktop

## SR4 Software Architecture



## Smart Robots, Inc. Summary: SR4 Series Robot

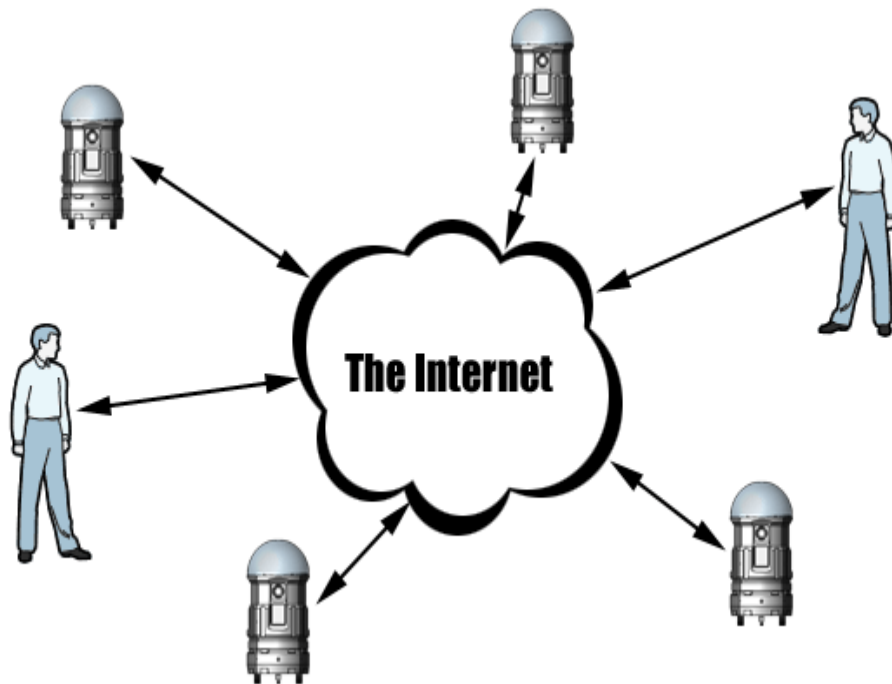
### Technology

- Software
  - Linux
  - Java
  - MySQL / Derby
  - XML
  - SSH
  - Apache
- Electronics
  - Single-board computer (ARM 7)
  - Power board
  - Sensor board (Object-oriented firmware - OOPic)
  - Motor controller and motor driver boards
  - User-panel
  - Voice
- Connectivity
  - 802.11b and g wireless
  - Ethernet cable
  - USB
  - Serial
  - I<sup>2</sup>C
- Sensors
  - Polaroid Sonar
  - Wheel encoders (industrial grade)
  - Eight-zone bumper belt (membrane)
  - RF/Sonar position triangulator (experimental)
  - Temperature
- Motor-wheel base
  - 8" wheels
  - 100 lb rated carry-weight, of which robot itself weighs 50 lbs w/batteries (including over door-jams and up ramps)
  - Mabuchi motor
  - Speed: 2 Mph ±
- Voice synthesis
- Motor-amperage sensors (real-time monitoring and response)
- Planned in 2006
  - Vision-arm
  - Video over IP
  - Introduction of first commercial application (Office)

## The Open Robot Network

- The APIs
- The network [diagram]
  - Robot to Robot / Robot to User / User to Robot
  - Trinity and Neo

**Robots talking to robots and people over the internet**





Trinity: Tank, I need a pilot program for a B-212 helicopter

**Toshiba adapts the SR4 to promo its wireless products in Spain**





[NTS Mobile](#), of Bilbao, Vizcaya, Spain, specialists in PDA and other wireless and computing technologies, performed the adaptation, adding a Toshiba Tablet PC, two Dlink wireless digital cameras to an SR4-P robot.

## Robot Application Engineering

No	Robot Tasks	Full Computer & Electronics	Point to Point Navigation	Arm and Manipulator
1	Smart-random vacuum cleaner	—	—	—
2	Pt. to pt. navigating vacuum cleaner	X	X	—
3	Roving speaker-phone	X	X	—
4	Office delivery assistant	X	X	—
5	Water the floor plants	X	X	X
6	Empty the dishwasher	X	X	X
7	Clean the toilet	X	X	X
8	Serve and replenish the party food	X	X	X
9	Mop the kitchen floor	X	X	X

## Robot Application Engineering

(continued)

Examples of robot skills that might be available from a downloadable Web Service (Robot Network) include:

- How to handle a cup
- How to handle a glass
- How to handle a plate
- How to handle a soup bowl
- How to handle a cereal bowl
- How to handle a spoon
- How to handle a fork
- How to handle a knife
- etc.
- How to organize the unloading of a Kenmore model Sears # 16514 dishwasher
- How to organize the unloading of a Westinghouse model ebuild Ref. No. GU1100XTLT dishwasher
- How to handle small sized odd items (wine bottle plugs, turkey skewers, etc.) [or medium sized, or large sized]
- How to decide when not to handle something and call for help

## The open source path to autonomous robots

- How it might work
  - ORN
  - Collaborative development and testing
  - Future 3<sup>rd</sup> party components/peripherals
  - Future application engineering and support enterprises (Value added resellers – VARS)
- ORN Infrastructure needed
  - Simulation
  - Project leaders/moderators
- Immediate ORN Projects
  - Voice-Sounds
  - Vision-Arm
  - Others
- Your ideas

[Allophones](#)  
[Base64](#)  
[BasicNavigationException](#)  
[BasicNavigationMethod](#)  
[Beacon](#)  
[Beacon](#)  
[BeaconBase](#)  
[BeaconMap](#)  
[Broadcast](#)  
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[DefaultButtonFunction](#)  
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[SMBusOutputStream](#)  
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[SRIEllipse](#)  
[SRIMath](#)  
[SRISocket](#)  
[SRISocketException](#)  
[SRISocketReader](#)  
[SRISocketSRMLException](#)  
[SRML](#)  
[SRMLBattery](#)  
[SRMLBeacon](#)  
[SRMLBeaconBase](#)  
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[SRMLButton](#)  
[SRMLCronJob](#)  
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[SRMLLcd](#)  
[SRMLLocator](#)  
[SRMLMCDrive](#)  
[SRMLMCHalt](#)  
[SRMLMCMODE](#)  
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[SRMLMCRotate](#)  
[SRMLMCRunningSpeed](#)

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[SRUPHandler](#)  
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[SRUPReader](#)  
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[Scheduler](#)  
[Serial](#)  
[SerialDevice](#)  
[SerialException](#)  
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[Servo8](#)  
[ServoException](#)  
[Speech](#)  
[StringStream](#)  
[TTPEXception](#)  
[TextToPhonetics](#)  
[Triangulator](#)  
[UserPanel](#)  
[UserPanelPage](#)



Give us 10 open source developers, nay 100, nay 1,000 and we will give you the collective skills and vision and experience of all those participating, shaping and equipping and teaching the intelligent machine forms that lay just ahead.

## Analogy:

- the digital computer – to placing a man on the moon
- the open source movement – to the emergence of integrated autonomous intelligent machines

Ideas, suggestions, comments, inquiries to:

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OSCON 2005 Slides:

<http://www.smartrobots.com/oscon2005/autonomousrobotsoscon2005.doc>

<http://www.smartrobots.com/oscon2005/autonomousrobotsoscon2005.pdf>

## Q & A and Discussion