

Introduction to Game Programming and Robotics

Unit # 1

Tentative Course Outline

- Theory
 - Different types of sensors and their characteristics
 - Behavior-based robotics
 - Reactive and hybrid robot systems
 - Localization (particle filters and triangulation methods)
- Microsoft Robotics Developer Studio
 - Robot programming using VPL/MRDS
 - Sumo Competition
- Simple Programming Language*
 - Maze Solver and Line Tracing
- RoboCup Soccer
 - Building a team of autonomous agents having good enough locomotion, localization and strategy building capabilities
- Kinect Programming
 - Skeleton tracking programming
- PacMan Programming
 - Building an autonomous game controller

Useful Information

- Course Website
 - <http://cse460fall2013.wikispaces.com>
- Books
 - Johns and Taylor, Professional Microsoft Robotics Developer Studio, 2008
 - Kang, Chang, Cu and Chi, Robot Development Using Microsoft Robotics Developer Studio
- Microsoft Robotics Studio Website for tutorials and discussion forums
 - <http://msdn.microsoft.com/en-us/robotics/default.aspx>
 - <http://social.msdn.microsoft.com/Forums/en-US/category/robotics>
 - <http://msdn.microsoft.com/en-us/robotics/bb383569.aspx>

Grading Policy (Tentative)

- | | |
|-----------------------------------|-----|
| • Midterms (15% each) | 30% |
| • Final | 40% |
| • Project/Competition/Assignments | 30% |

History of Robotics at IBA

- Lego Mindstorms were introduced in the AI course (Spring 09)
- Students made many projects/videos using Lego Mindstorms.
- The first offering of this course was in Fall 09 - Sumo competition was organized among the class participants.
- Robo Workshop initiated in January 2010. So far 5 workshops have been organized.
- Karachi Koalas, the first ever RoboCup Soccer team from Pakistan, was established in Fall 2010 in collaboration with University of Technology, Sydney.
- Karachi Koalas participated in 2011, 2012 and 2013 World RoboCup competitions and is currently ranked 5th in the world.
- This course has been redesigned and is aimed to offer to sophomores on regular basis.

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Future of Robots Programmer

CNN Money
A Service of CNN, Fortune & Money

FORTUNE **Money**

Home Video Business News Markets Term Sheet Economy Tech Personal Finance

FULL REPORT
The new new careers

The United States may keep shedding jobs to foreign countries, but it cranks out new occupations like no one else. Here are just five of the hottest you can get into now.
By Michael Copeland and Kevin Kelleher

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Robot Programmer

Salary range: \$40,000-\$100,000

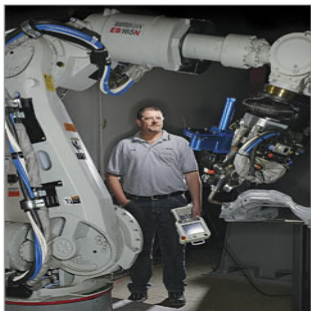
Experience/skills: Associate degree in a technical field and extensive training. People skills also come in handy.

Perks: Lots of travel, helping clients customize each machine to a particular task

Who's hiring? ABB, Fanuc, Motoman, Panasonic, Toyota

Back in 1990, Matt Zeigler was pulling 12-hour shifts as an arc welder for a forklift manufacturing firm in Indiana when a technician in a white lab coat came into the factory to work on a new \$85,000 robotic welder. "I said, 'Why aren't I doing that?'" Zeigler recalls. Self-training eventually got him out of blue-collar work and into a top robot programming position

BUSINESS 2.0



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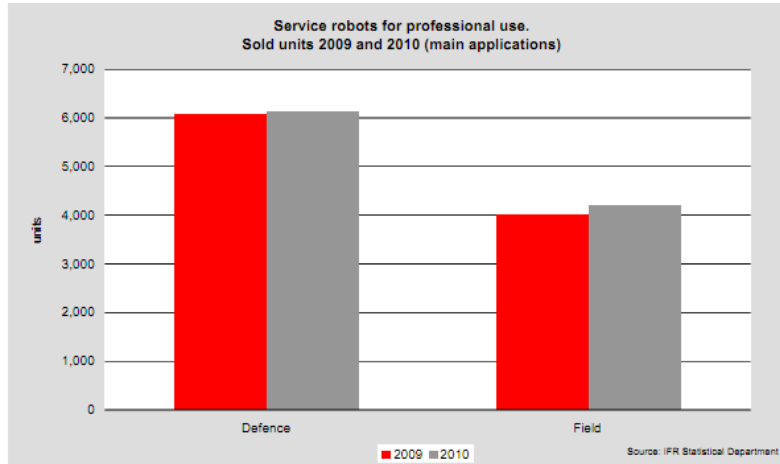
Statistics of Robots

- In 2010, about 2.2 million service robots for personal and domestic use were sold, 35% more than in 2009. The value of sales increased by 39% to US\$538 million.
- So far, service robots for personal and domestic use are mainly in the areas of domestic (household) robots, which include vacuum cleaning, lawn-mowing robots, and entertainment and leisure robots, including toy robots, hobby systems, education and research.

New

- In 2011, about 2.5 million service robots for personal and domestic use were sold, 15% more than in 2010.
- The value of sales increased by 19% to US\$636 million.

Statistics of Robots (Cont'd)

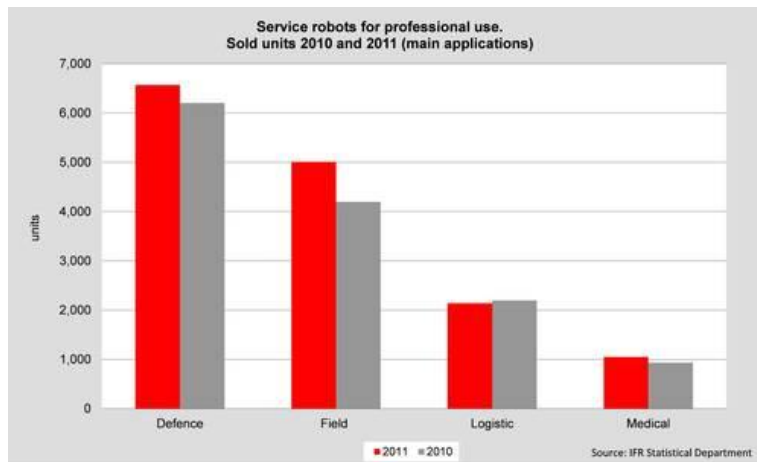


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New

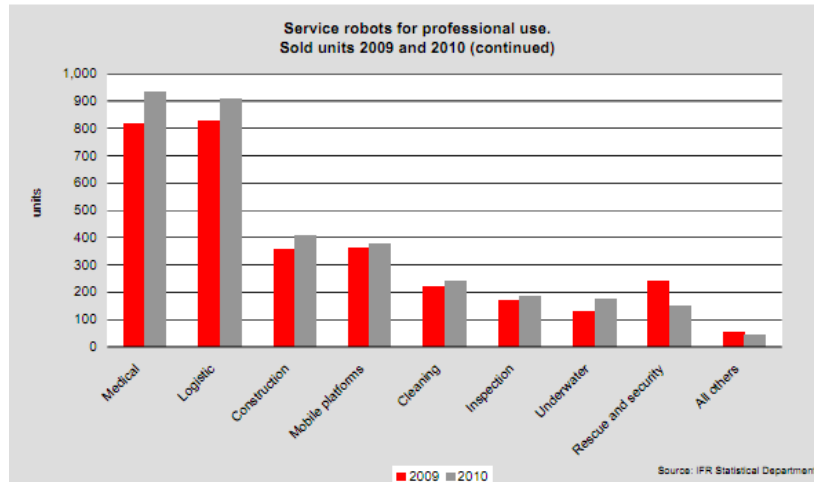


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Statistics of Robots (Cont'd)

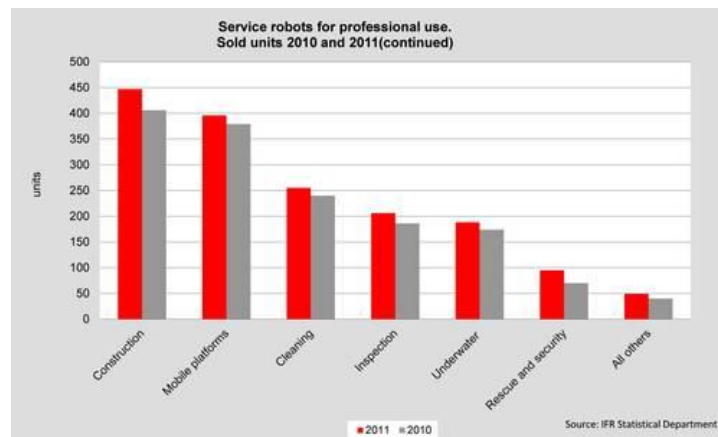


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New

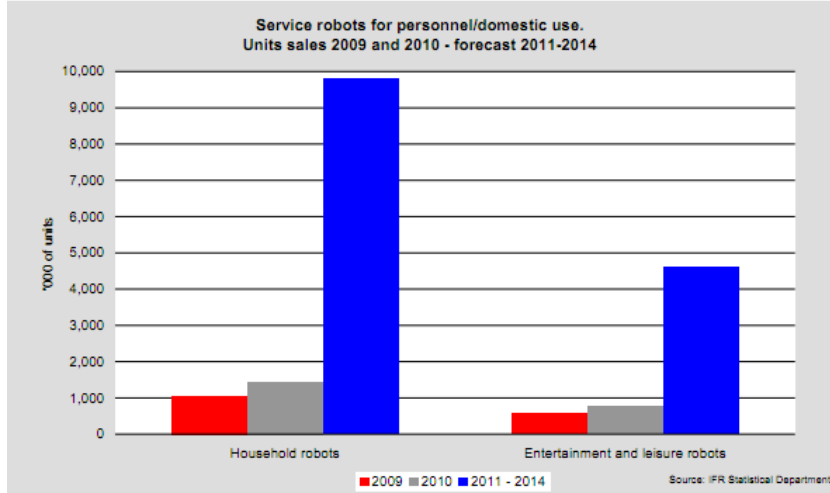


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Statistics of Robots (Cont'd)

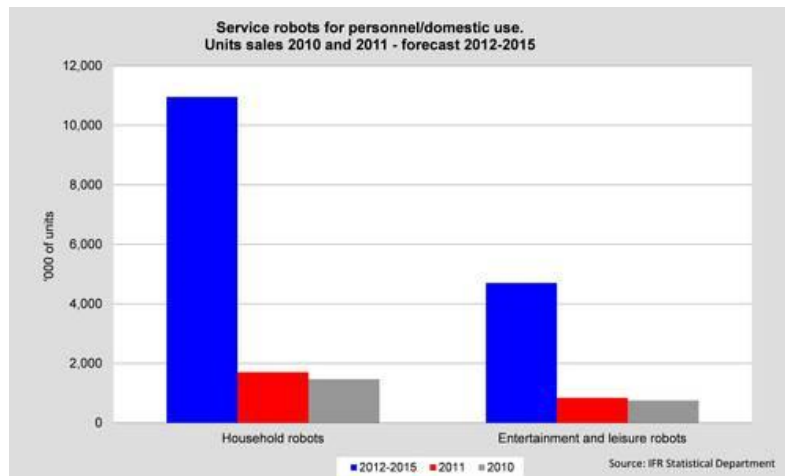


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New



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A Robot in Every Home by Bill Gates (December 2006)

- Robotics industry is developing in much the same way that the computer business did 30 years ago.
- All of us are fascinated by machines in popular culture (Asimov, I-Robot, Star Wars, Star Trek, etc.)
- DARPA Grand Challenge was a big success
- Almost all the top universities have at least one major project involving robotics.
- But we still have a long way to go before real robots catch up with their science-fiction counterparts.

A Robot in Every Home by Bill Gates (Cont'd)

- It has been much harder than expected to enable computers and robots to sense their surrounding environment and to react quickly and accurately.
- It has proved extremely difficult to give robots the capabilities that humans take for granted – for example, the abilities to orient themselves with respect to the objects in a room, to respond to sounds and interpret speech, and to grasp objects of varying sizes, textures and fragility.

Roomba Video

- <http://www.youtube.com/watch?v=CLiPLiQDIk0>



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Lawn Mower

- <http://www.youtube.com/watch?v=-19jNcOI8Lc>



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Wakamaru

<http://www.youtube.com/watch?v=IJ4M1AHj40o>

- A Japanese domestic robot made by Mitsubishi Heavy Industries, primarily intended to provide companionship to elderly and disabled people.
- The robot is yellow, 1m tall, and weighs 30 kilograms. It has two arms and its flat, circular base has a diameter of 45 cm.
- The first hundred went on sale in September, 2005, for USD \$14,000.



Robot Maid

- <http://www.youtube.com/watch?v=---wEgmNzs0w&feature=related>



Robotics Deployment

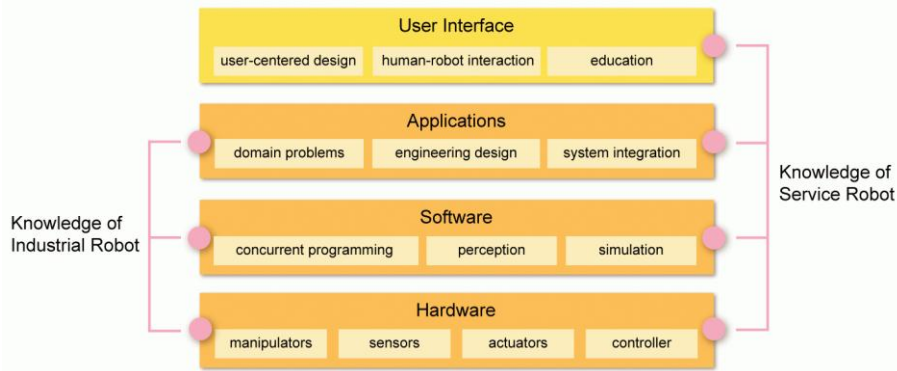
<http://www.ifr.org/robots-create-jobs/>

- Three critical areas of growth in robotic deployment where:
 - robots carry out work in areas that would be unsafe for humans
 - robots carry out work that would not be economically viable in a high wage economy
 - robots carry out work that would be impossible for humans.

Origin of the Word “Robot”

- The Term “Robot” originates from the fictional novel titled Rossum’s Universal Robots published in 1921 by Czechoslovakian writer Karel Capek.
- In the novel, an R.U.R is described to be composed of a collection of components and is smart enough to replace the humans working in a designed area.

Knowledge Required for Robot Development



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Knowledge Required for Robot Development (Cont'd)

- Hardware Layer
 - Analogous to the bodily function of a human being
- Software Layer
 - Analogous to the senses and reaction of a human being
 - Requires concurrent programming and software and communication protocols
- Application Layer
 - Analogous to a human being's specialization and profession
 - Concerns with engineering design and system integration
- User-Interface Layer
 - Primarily used in service robots

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Industrial vs. Service Robots

- Industrial Robots
 - An industrial robot's design goal is focused on precision control, rather than on goals such as artificial intelligence.
 - The industrial robot need only repeat the execution of a single task.
- Service Robots
 - The goal of a service robot is to provide a service to address the human needs.
 - Being closer to human habitats, the environment to which service robots are deployed is unknown and there is a need for reactions to sudden changes.

Applications (IEEE TC on Service Robots)

- Cleaning & Housekeeping
- Humanoids
- Inspection
- Lawn Mowers
- Surveillance
- Medical Applications
- Mining Applications
- Guides and Office
- Fire Fighters
- Food Industry
- Search & Rescue

Technologies Used

- Sensing
- Mobility
- Manipulation
- Design
- Control
- Planning
- Components

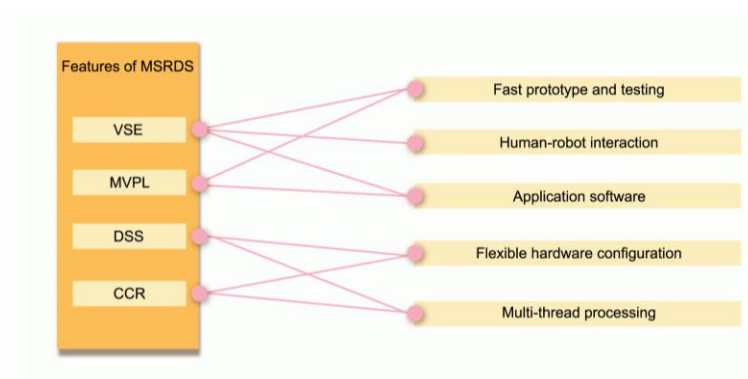
Lego Mindstorms

- Lego Mindstorms Education NXT Base Set was released in September 2006.
- It incorporates sensing, motion and control components.
- The building block concept to break down hardware structure equips robots with high degree of flexibility and rapid prototyping.

Microsoft Robotics Development Studio

- Microsoft introduced MRDS in 2006. It has the following features:
 - Concurrency and Coordination Runtime (CCR) and Decentralized Software Services allows users to easily and flexible control concurrent operations.
 - Microsoft Visual Programming Language (MVPL) provides a high-level graphical interface.
 - Visual Simulation Environment (VSE) allows designed to test and develop algorithms at time when no robots are available for testing.

Microsoft Robotics Development Studio (Cont'd)



Kinect



- A motion sensing input device by Microsoft.
- It enables users to control and interact with the Xbox 360 without the need to touch a game controller, through a natural user interface using gestures and spoken commands.
- After selling a total of 8 million units in its first 60 days, the Kinect holds the Guinness World Record of being the "fastest selling consumer electronics device".

RoboCup Soccer

- **RoboCup** is an international robotics competition founded in 1997. The aim is to develop autonomous soccer robots with the intention of promoting research and education in the field of artificial intelligence.
- The official goal of the project:
 - *By mid-21st century, a team of fully autonomous humanoid robot soccer players shall win the soccer game, complying with the official rule of the FIFA, against the winner of the most recent World Cup.*

RoboCup Soccer Leagues

- Humanoid League
- Middle Size League
- Small Size League
- Standard Platform League
- 3D Simulation League



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Course Objectives

- To study a futuristic and fascinating technology (technologies)
- To enhance your problem solving and programming skills
- To attract great minds towards this exciting field
- To make IBA a leader in Educational/Cognitive Robotics within Pakistan
- To find future stars of Karachi Koalas
- To initiate new teams in Virtual Reality League, Rescue Simulation League and RoboCup@Home

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