Robots: Everywhere around us

[A Dream Coming True]

Prepared by: Dr. Alaa Khamis, Egypt Chapter Chair

Presented by: Eng. Omar Mahmoud

http://www.ras-egypt.org/

Outline

- IEEE RAS – Egypt Chapter
- What is a Robot?
- What is Robotics?
- Science Fiction
- Science Facts
- Robots Today
- Robots' Future

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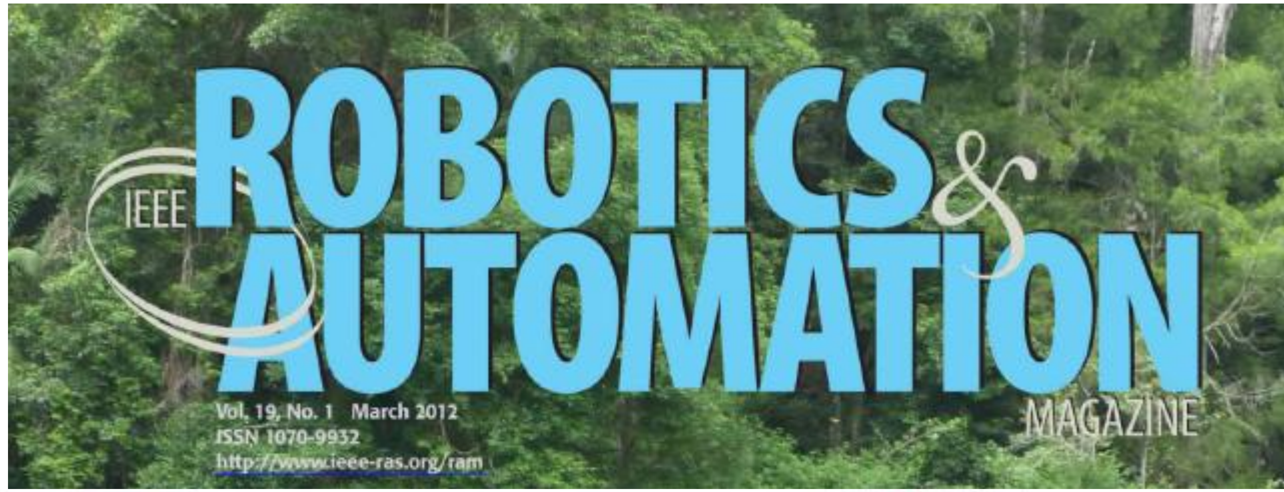
IEEE RAS – Egypt Chapter

Established in Sept. 2011 to become the meeting place of choice for the robotics and automation community in Egypt.



The launch event of the new RAS Egypt Section Chapter took place on 18 September 2011. A Distinguished Lecture "Networked Robot Systems" was presented by Klaus Schilling of the University of Würzburg, Germany, and Stanford University, United States.

114 • IEEE ROBOTICS & AUTOMATION MAGAZINE • MARCH 2012

IEEE RAS – Egypt Chapter

- Conferences & Workshops
- Seminars & Webinars
- Free Courses
- Robotic Competitions

Conferences & Workshops

ICET 2012

http://www.icet-guc.org/2012/

Seminars & Webinars

Networked Robot Systems: Invited Talk

Lecture about **Networked Robot Systems** by Prof. Dr. rer. nat Klaus Schilling, Professor and Chair of Robotics and Telematics Lab, Julius-Maximilians-University Wurzburg, Germany and Consulting Professor at Stanford University, Department of Aeronautics and Astronautics, USA. 19 September 2011

IEEE Distinguished Lecturer

Distinguished lecture entitled **Pico-Satellites for Education and Research in Networked Space Systems** by: Prof. Dr. rer. nat Klaus Schilling, Professor and Chair of Robotics and Telematics Lab, Julius-Maximilians-University Wurzburg, Germany and Consulting Professor at Stanford University, Department of Aeronautics and Astronautics, USA.

More info: http://icet-guc.org/2012/index.php/invited-talk-pico-satellites-for-education-and-research-in-networked-space-systems/

Slides available at: http://ras-egypt.org/reading/IEEE%20RAS%20Egypt%20Schilling%20Handout.pdf

Panel Discussion: Robotics Education

Panel Session: Robotics Education: From Schools to Academia and Industry

- Robotics at school initiatives
- Robotics at University initiatives
- School to University linkage through robotics programs
- Research to industry linkage programs
- The impact of robotics education on research and industry

IDEAS GYM Raise your mind fitness

More info: http://icet-guc.org/2012/index.php/panel-session-robotics-education/

Cooperative Multirobot Systems Seminar

This seminar has been organized by IEEE RAS – Egypt chapter and given by Dr. Alaa Khamis, associate professor at German University in Cairo and Egypt chapter founder and chair, in Faculty of Computer and Information Sciences, Ain Shams Uni.

Robots Moving Closer to Humans Seminar

IEEE RAS – Egypt Chapter organizes the an IEEE Distinguished Ambassador seminar at Nile University in January 2, 2013.

Bruno Siciliano, Professor of Control and Robotics, and Director of the PRISMA Lab in the Department of Computer and Systems Engineering at University of Naples Federico II. He is the Past-President of the IEEE Robotics and Automation Society

Robotics between Fact and Fiction Seminar

IEEE RAS – Egypt Chapter in collaboration with Hadath for Innovations & Entrepreneurship organized the following seminar at Ain Shams University, Egypt:

When: February 2, 2013 at 12:00PM

Where: Palestine Hall, Faculty of Engineering, Ain Shams University

Title: Robotics between Fact and Fiction

Speaker: Alaa Khamis, IEEE RAS Egypt Chapter founder and chair

RAS Talks

- **Theme of talks:** Informal, wide range of topics but must be related to robotics and automation. Talks to be pitched at a level that could be understood by a non-specialist. We are not looking for proofs or slides filled with equations.
- **Format of talks:** Can be very varied in nature, normally a 30min presentation followed by 10 to 20 minutes of question period at the end.

More info: http://msm.guc.edu.eg/RAS/talks.html

Robotics and Autonomous Systems
RAS TALKS
Open Research Forum

Webinars

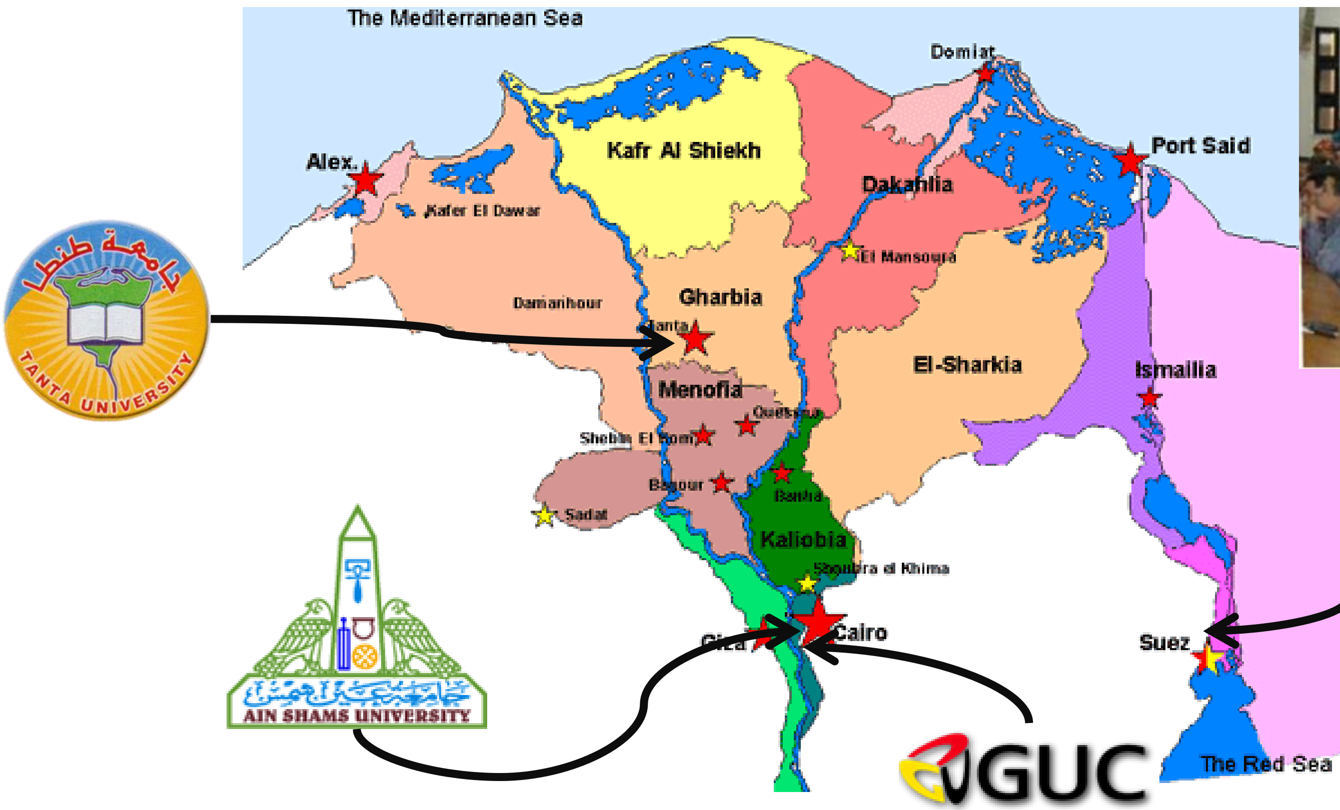
- **Mobile Robot Locomotion and Positioning Systems** by Dr. Alaa Khamis, IEEE RAS Egypt Chapter Chair.
- **Buried Mine Detection** by Dr. Hisham El-Sherif, German University in Cairo.
- **Machine Vision** by Dr. Mohamed Salem, Ain Shams University.
- **Perception and Navigation of Autonomous Vehicles** by Prof. Dr. Howard Li, Director of COllaboration Based Robotics and Automations (COBRA) Group, University of New Brunswick, Canada.
- **Wireless Communication for Teleoperated/Autonomous Vehicles** by Dr. Ahmed Madian, Egyptian Atomic Energy Authority.
- **Construction and Control of an Unmanned Quadrotor** by Amr Nagaty, University of New Brunswick, Canada.

Download: http://landminefree.org/webinars

Free Courses

“How to build a real robot” Course

The objective of this course is to teach students without any background in robotics how to build a real robot that can perceive the environment and acts accordingly in autonomous way.



Available at: http://www.ras-egypt.org/course/index.html

Optimization with Engineering Applications

- Optimization Theory
- Deterministic Optimization
- Trajectory-based Stochastic Optimization
- Population-based Stochastic Optimization
- Project Presentation and Discussion

Suez Canal University
Faculty of Petroleum and Mining Engineering
Control Technology Unit (CTU)

Institute of Electrical and Electronics Engineers (IEEE)
Robotics & Automation Society
Egypt Chapter

Optimization with Engineering Applications

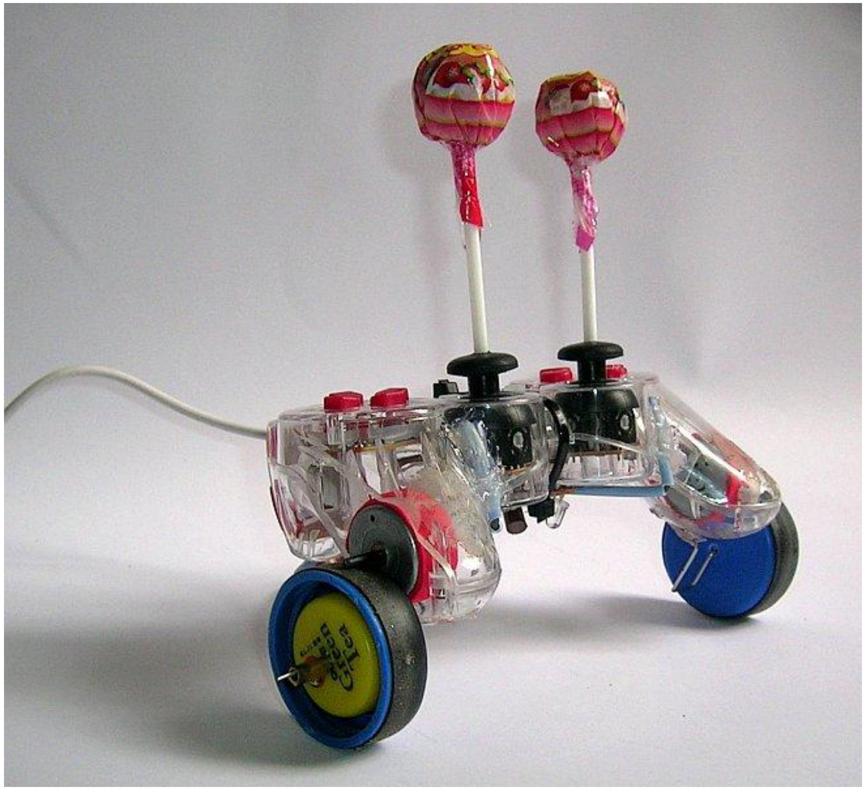
Free Intensive Course for Postgraduate Students

Robotic Competitions

AFRON: Africa Robotics Research Network

IEEE RAS - Egypt Chapter has joined African Robotics Network (AFRON) in May 8, 2012 .

Dr. Alaa Khamis, chapter chair served as a juror in African Robotics Network (AFRON) "$10 Robot" Design Challenge (http://spectrum.ieee.org/automaton/robotics/diy/winners-of-10-robot-challenge-announced).

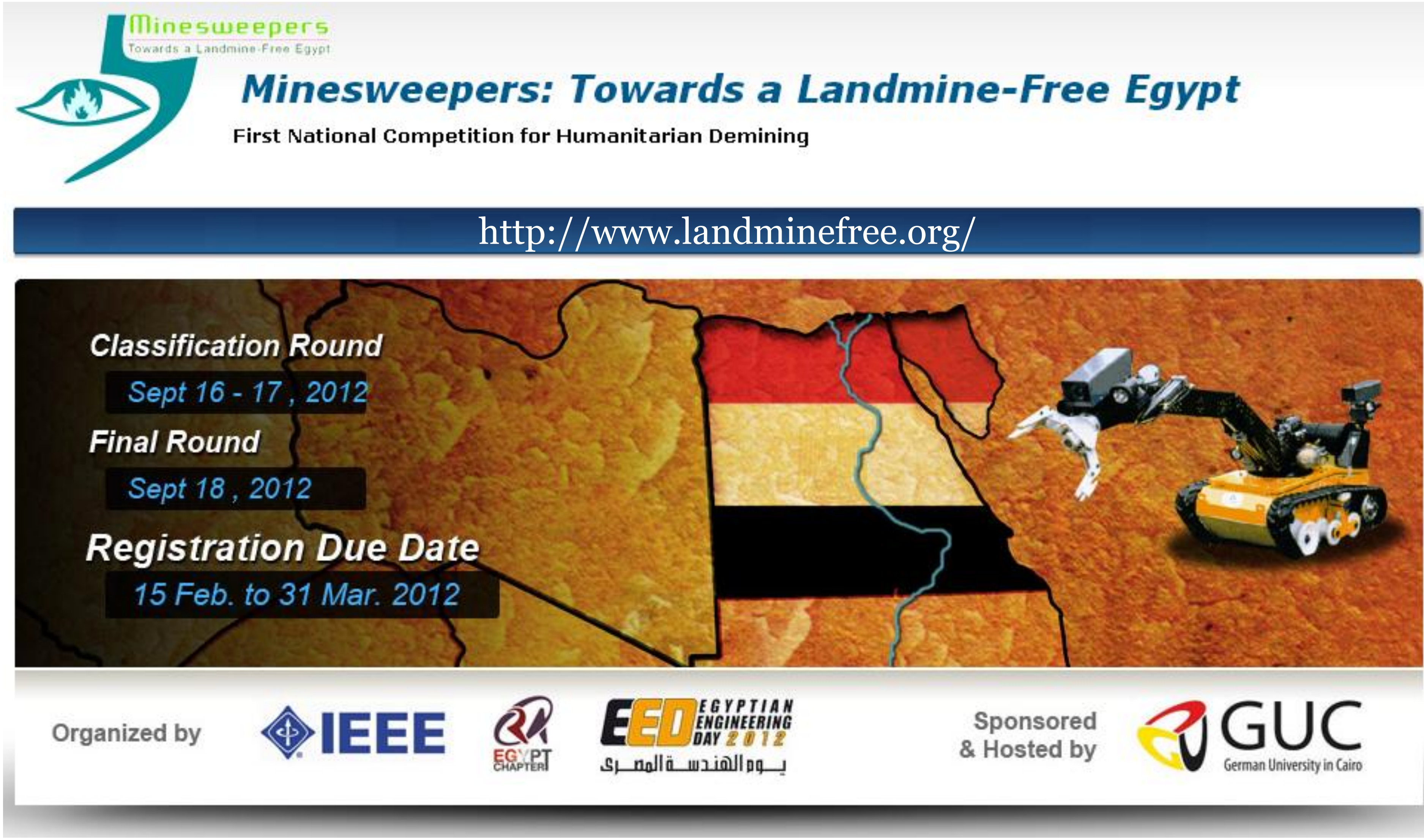


The Suckerbot, one of the winners

Remotely Operated Vehicle (ROV) Egypt

IEEE RAS – Egypt Chapter sponsors the ROV Egypt Competition (http://www.rovegypt.org/).

Towards a Landmine-free Egypt



Executive Secretariat for the Demining & Development of the North West Coast, Ministry of International Cooperation.

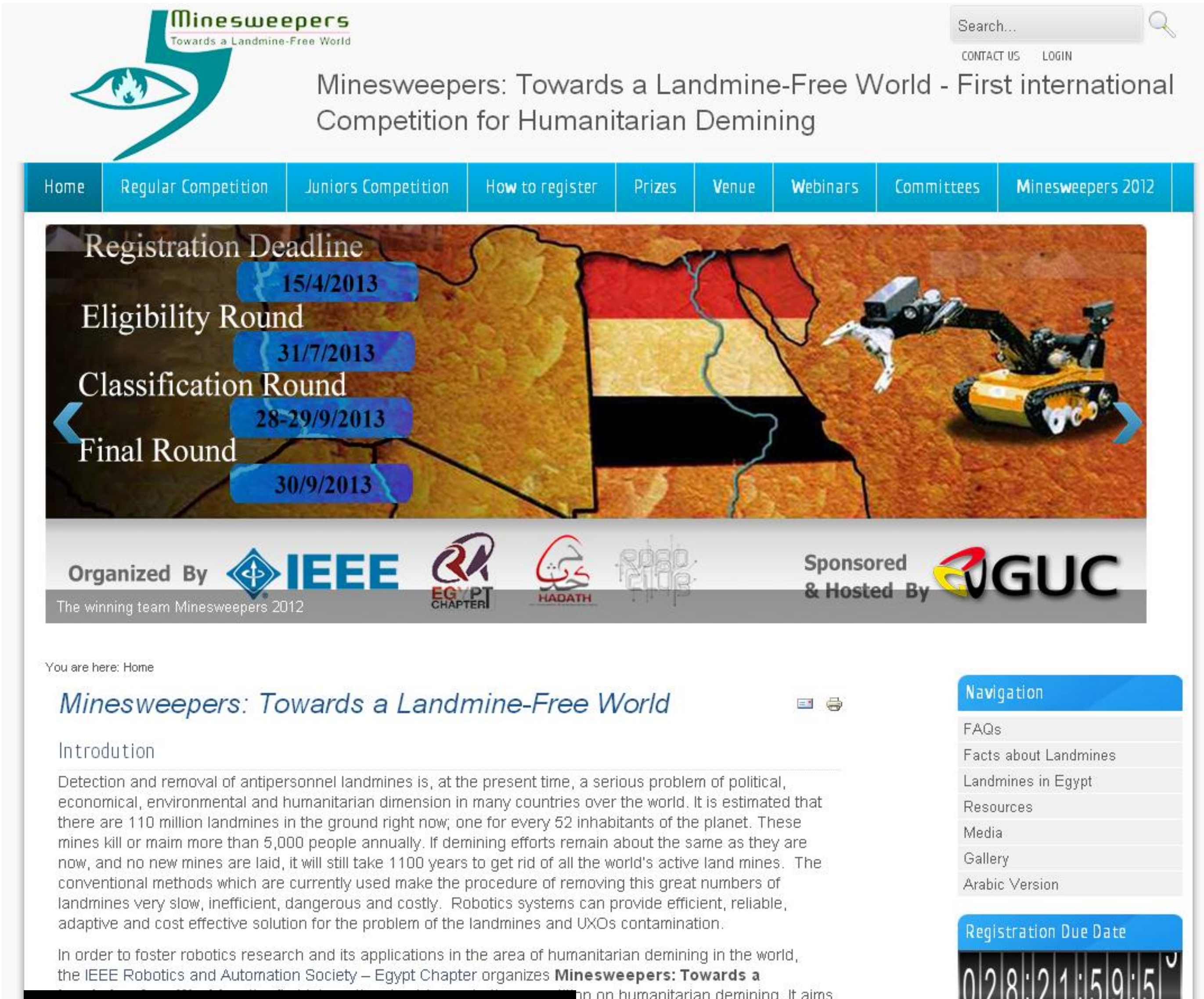
Mines Action & Human Rights Foundation

Towards a Landmine-free Egypt

Competition arena with surface and buried mines

EMAR Ain Shams Team, 4-wheel drive unmanned ground vehicle winner of the first place in the competition

Towards a Landmine-free World



http://www.landminefree.org/

IEEE RAS – Egypt Chapter

For more information about Chapter activities, visit:

http://www.ras-egypt.org/

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- **<u>What is a Robot?</u>**
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What is a Robot?

What is a Robot?

- **What is the difference between these two VW?**

Stanley, Stanford Racing Team The winner of the 2005 DARPA Grand Challenge

This is a Robot

Original Volkswagen Touareg

This is not a Robot

Why!?

What is a Robot?

- **DARPA Grand Challenge**

The DARPA Grand Challenge is a prize competition for **driverless cars**.

- **First Grand Challenge:**

Date: March 13, 2004

Task: desert course stretching from Barstow, Cal. to Primm, Nev. (142 mile)

Winner: did not produce a finisher .

Only 7.4mile

- **Second Grand Challenge:**

Date: October 8, 2005

Winner: Stanford Racing Team completed the 132-mile course in just under 7 hours to win a US$2M prize. (2nd place in 2007 Urban chanllenge)

What is a Robot?

- **DARPA Grand Challenge**
  - **Urban Challenge:**

    Took place on November 3, 2007 The course involved a 96 km (60 mi) urban area course, to be completed in less than 6 hours. Rules included obeying all traffic regulations while negotiating with other traffic and obstacles and merging into traffic.

  - **Google driverless car**

    The Google driverless car is a project by Google that involves developing technology for driverless cars.

What is a Robot?

EGYPT CHAPTER

- **What is the difference between these two VW?**

A robot is a machine that **imitates** the actions and sometimes appearance of an intelligent creature, usually a human

Perceiving Environment: getting information from its surroundings

Doing something physical: such as move or manipulate objetcs, based on environmental information

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What is Robotics?

- Robotics is the intelligent connection of perception to action.

M. Brady, "Artificial Intelligence and Robotics," Artificial Intelligence, 26, pp.79-121, 1985.

- Robotics is the discipline which involves:

a) The design, manufacture, control, and programming of robots;

b) The use of robots to solve problems;

c) The study of the control processes, sensors, and algorithms used in humans, animals, and machine; and

d) The application of these control processes and algorithms to the design of robots.

MP. J. McKerrow. *Introduction to Robotics*. Addison-Wesley, 1992.

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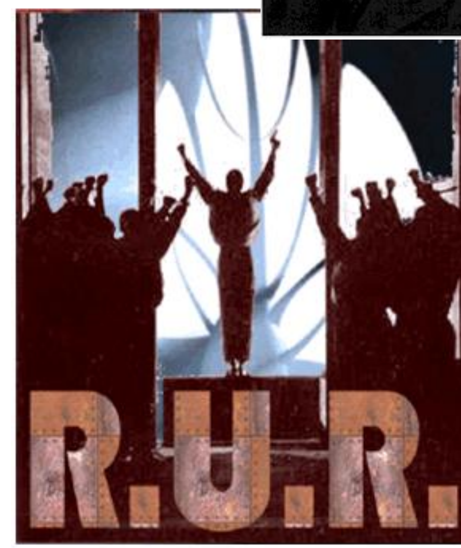
Science Fiction

- **Rossum's Universal Robot (R.U.R)**

Karel Capek (1890-1938) was a Czech novelist who introduced the word `robota' in a 1920 play titled Rossum's Universal Robots (RUR).

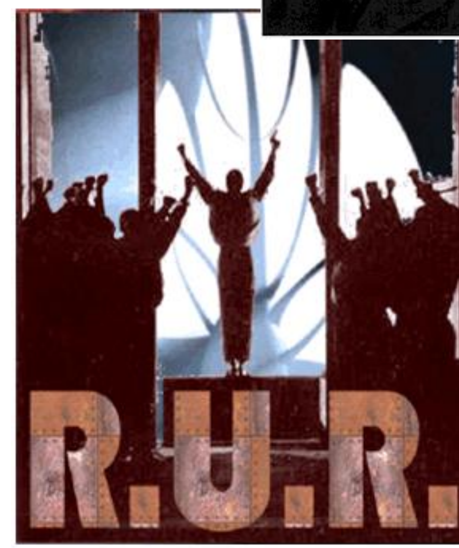


Robota in Czech (Robot in English) is a word for **worker or servant or subordinate work**.

The word Robot displaced older words such as **automaton or android** in languages around the world.

Science Fiction

- **Rossum's Universal Robot (R.U.R)**



The play RUR featured robots that nearly took over the world.
They stopped only when they could not answer the question:

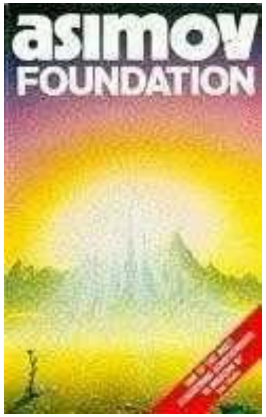
"What do we do after we have destroyed all of the humans?"

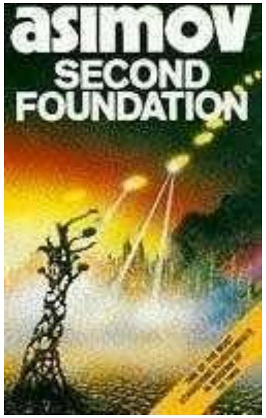
Science Fiction

- **Laws of Robotics - Isaac Asimov**

Law 1:

A robot may not injure a human being or through inaction, allow a human being to come to harm.



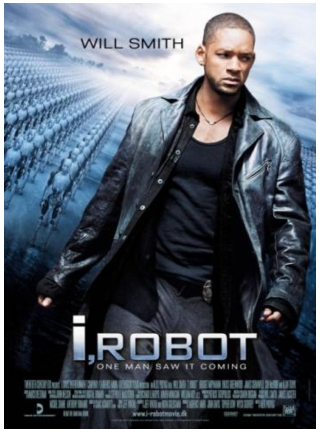


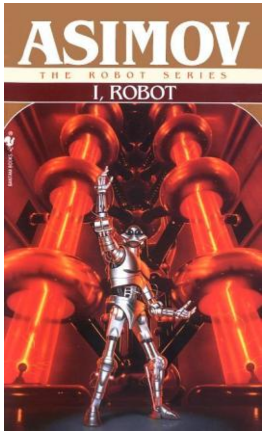
Law 2:

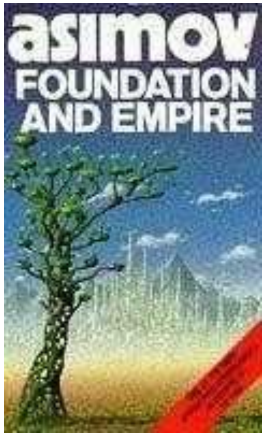
A robot must obey the orders given it by human beings, except where such orders would conflict with the 1st Law.

Law 3:

A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.





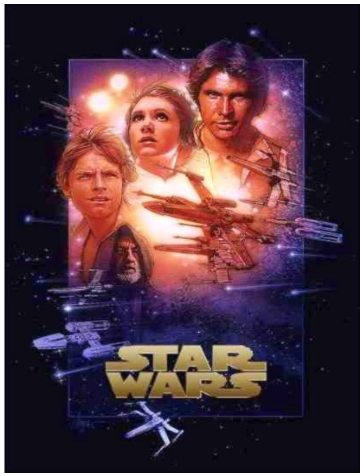


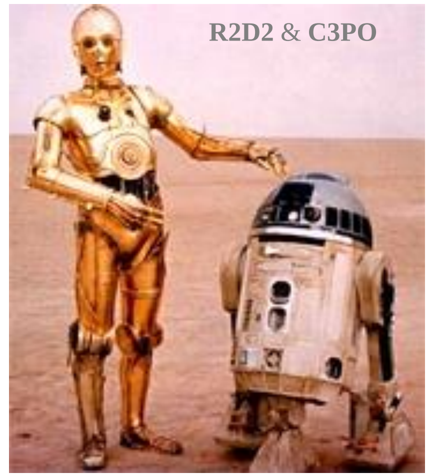
Zeroth Law:

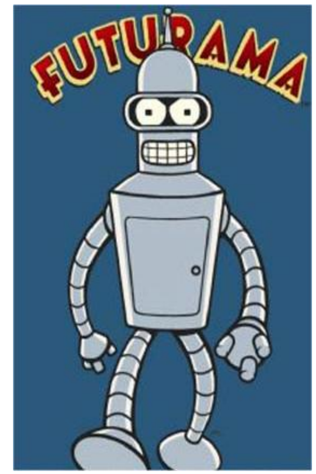
A robot may not injure humanity, or, through inaction, allow humanity to come to harm.

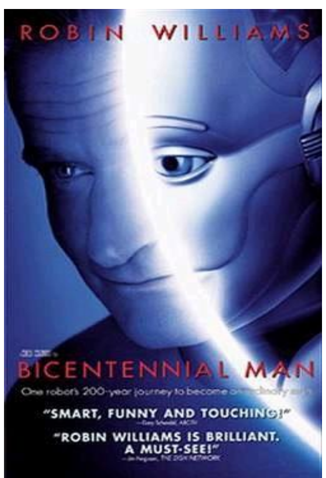
Science Fiction

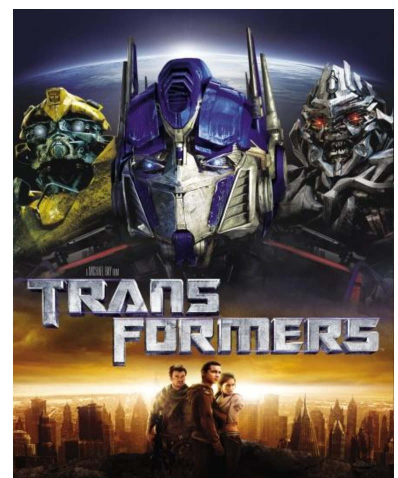
- **Science Fiction Classics & Movies**











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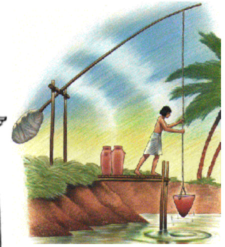
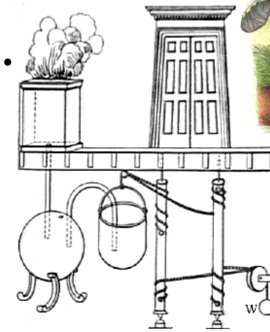
Science Facts

- **Mechanical Automata**

  - Ancient Greece & Egypt Water powered for ceremonies.



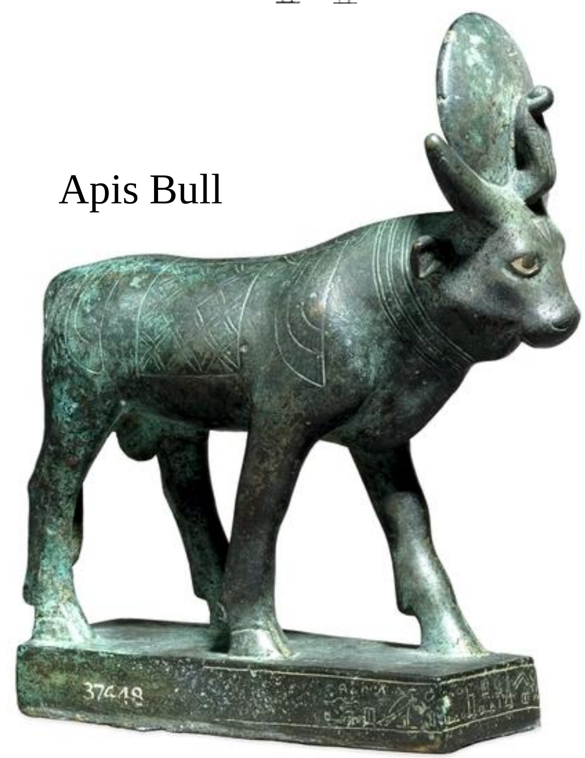


  - Apis Bull God

    “Then he brought out (of the fire) before the (people) the image of a calf: It seemed to low: so they said: This is your god, and the god of Moses, but (Moses) has forgotten!”, Holy Qur’an, Surat Ta-ha verse 88.

    “And all the people brake off the golden earrings which were in their ears, and brought them unto Aaron. And he received them at their hand, and fashioned it with a graving tool, after he had made it a molten calf: and they said, These be thy gods, O Israel, which brought thee up out of the land of Egypt.” – Holy Bible, Exodus 32:3,4

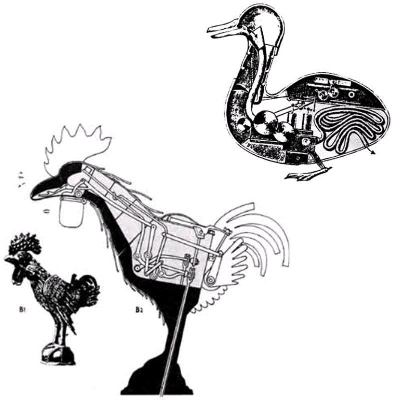
Apis Bull



Science Facts

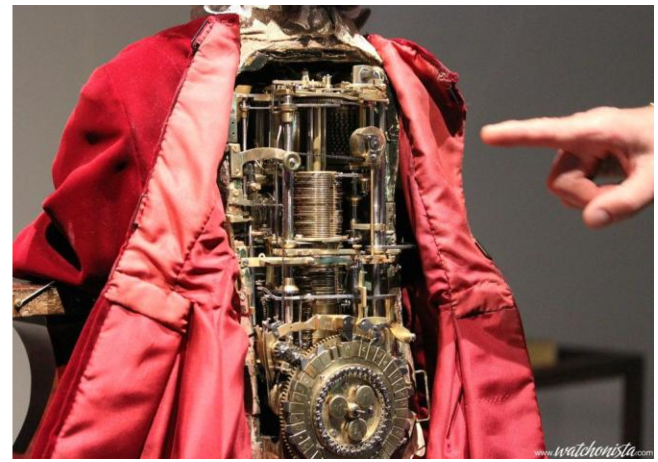
- **Mechanical Automata**
  - ➢ The Elephant Clock: Leaf from The Book of Knowledge of Ingenious Mechanical Devices by Al-Jazari (1206 AD).

  - ➢ 14th – 19th century Europe Clockwork driven for entertainment.



Science Facts

- **Mechanical Automata**
  - ➢ Mechanical Dolls – Droz Family (1770)



  - ➢ Maillardet (1805)

Science Facts

- **History of Robots**
  - 1928: First motor driven automata
  - 1961: First industrial robot (Unimate)
  - 1962: First robot company (Unimation)
  - 1967: Shakey Autonomous mobile research robot

George Devol

Joseph F. Engelberger

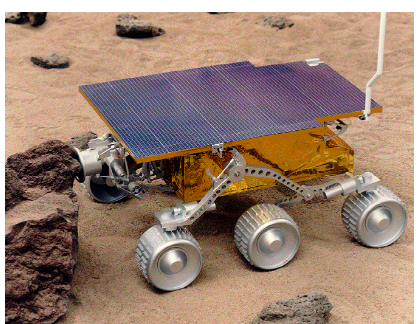
Shakey

  - 1969: Stanford Arm Dexterous, electric motor driven robot arm.

Unimate

Science Facts

- **History of Robots**
  - 1978: The PUMA (Programmable Universal Machine for Assembly) robot is developed by Unimation with a General Motors design support.
  - 1980s: The robot industry enters a phase of rapid growth. Many institutions introduce programs and courses in robotics. Robotics courses are spread across mechanical engineering, electrical engineering, and computer science departments.



SCARA (Selective Compliance Assembly Robot Arm) invented by Makino in 1982.

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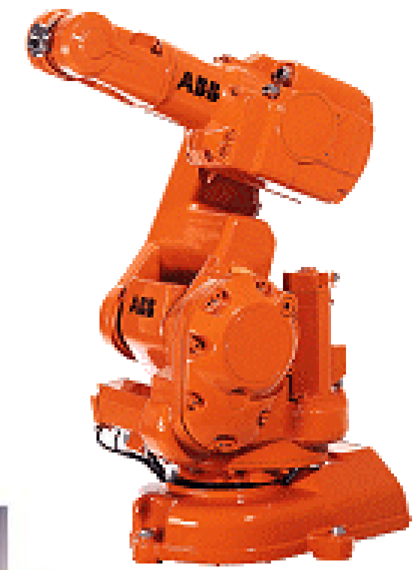
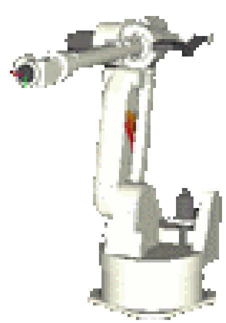
Robots Today

- **Industrial Robots or Manipulators**

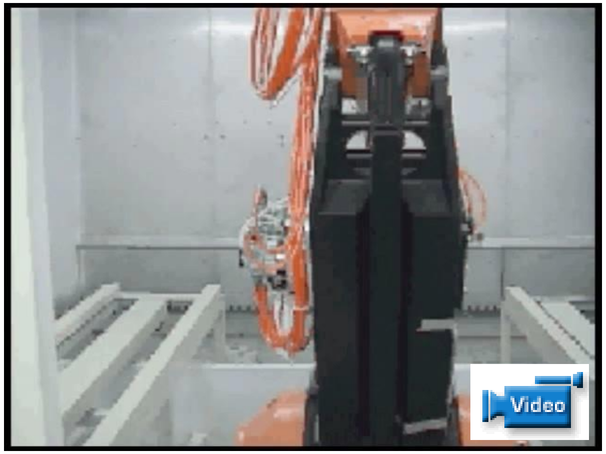


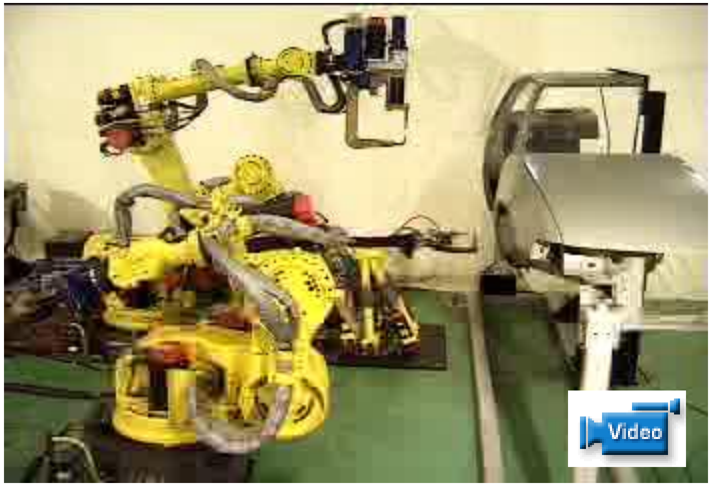


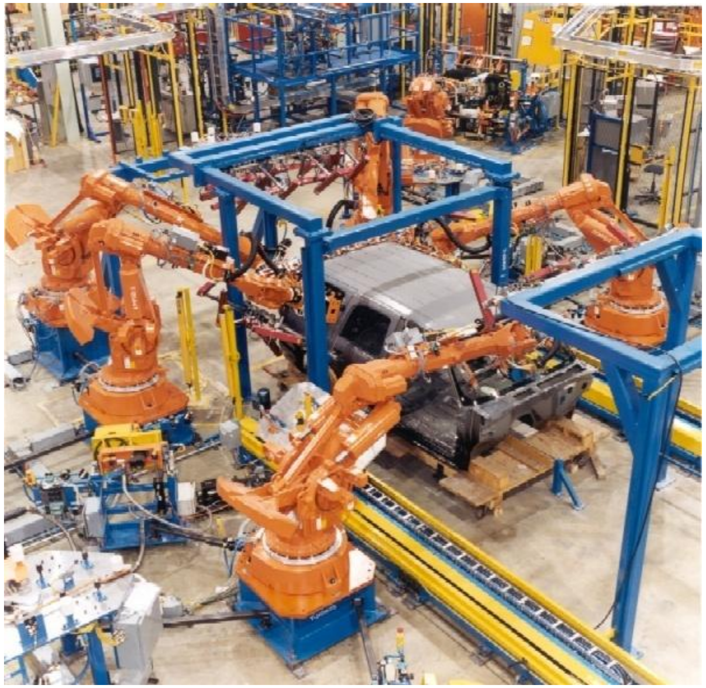
Robots Today

- **What Can Industrial Manipulators Do?**

  - Material handling
  - Material transfer
  - Machine loading and/or unloading
  - Spot welding
  - Continuous arc welding
  - Spray coating
  - Assembly
  - Inspection



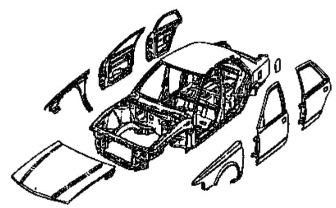




Robots Today

Advantages:

- Repeatability
- Tighter quality control
- Waste reduction
- Working in hostile environment
- Increased productivity.



Disadvantages

- high initial costs
- increased dependence on maintenance.

Advantages/ Disadvantages?!

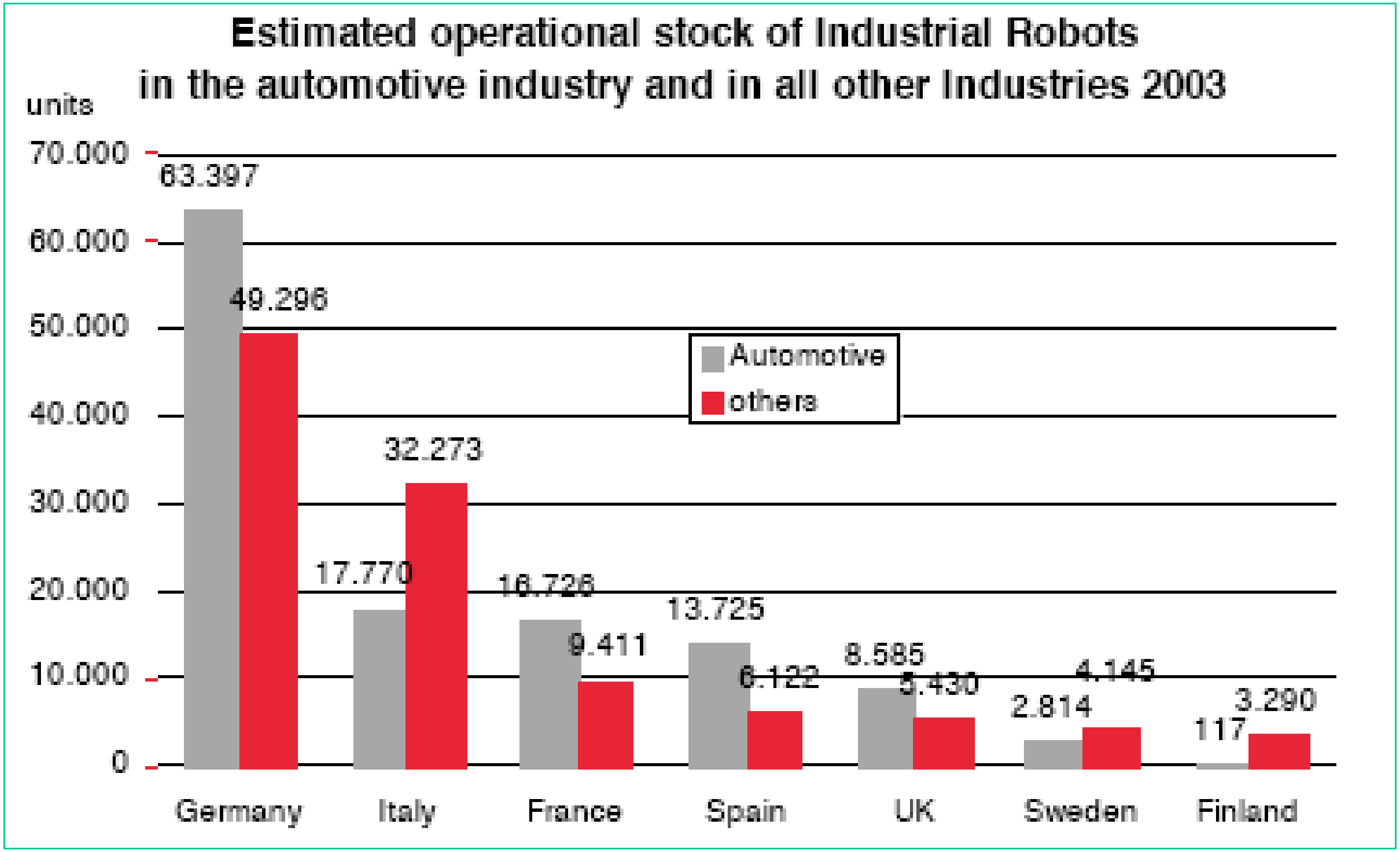
- Impact on employment

Country	Robot Density	Unemployment Rate %
Japan	280	4.7
Germany	135	10.5
Italy	67	11.5
Spain	41	16

IFR, October 2002

Robots Today

- **Industrial Robots in Automotive Industry:**



Source: Industrial Robot Automation. DR.14.1 White paper, European Robotics Network (EURON), 2005.

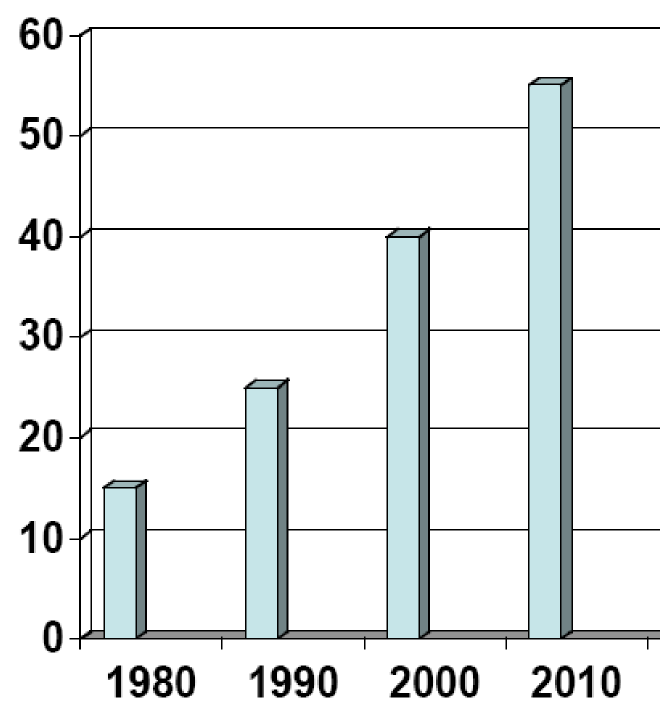
Robots Today

- **Industrial Robots in Automotive Industry:**

Origin of robot supplier in the automotive industry

Robots in the automotive sector			
Make	Japan	Europe	Other
Honda	100 %		
Toyota	100 %		
Nissan	100 %		
Mazda	100 %		
VW	10 %	90 %	
BMW	20 %	80 %	
DC	20 %	80 %	
Renault	50 %	50 %	
PSA	50 %	50 %	
Ford	50 %	50 %	
GM	80 %	20 %	
Korean	60 %	20 %	20 %

Increasing investment portion of robotics by car industry and 1st tier suppliers.



Source: Industrial Robot Automation. DR.14.1 White paper, European Robotics Network (EURON), 2005.

Robots Today

- **Mobile Robots**

A mobile robot is a robot that can move in the real world and can be completely autonomous

The main features:

- ➢ Reprogrammability
- ➢ The ability to navigate
- ➢ Autonomy






Robots Today

- **Mobile Robots: Indoor Robots**

B21

Koala

Magellan Pro

Cybor

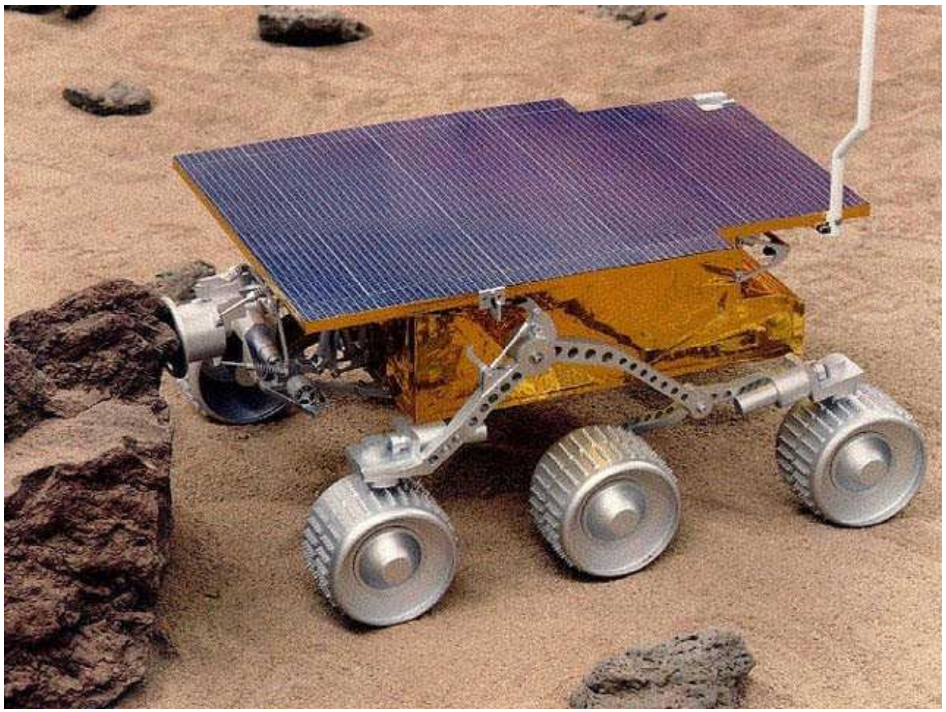
Hemisson

Khepera

Robots Today

- **Mobile Robots: Outdoor Robots**

PackBot Explorer

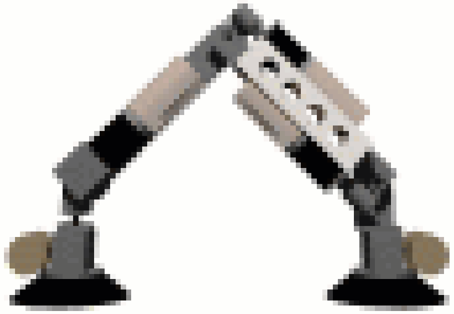


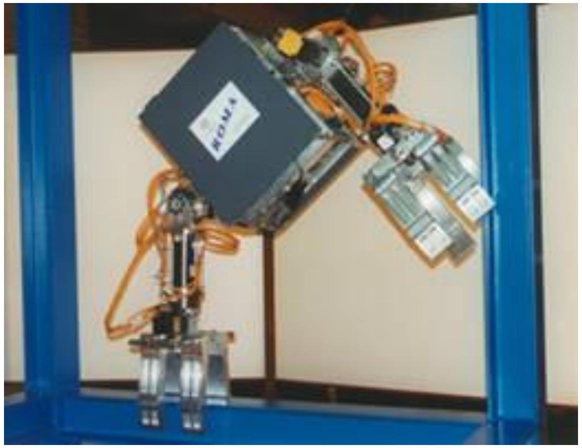
Sojourner

ROCA (UC3M)

Robots Today

- **Climbing Robots**





ROMA-I (UC3M)

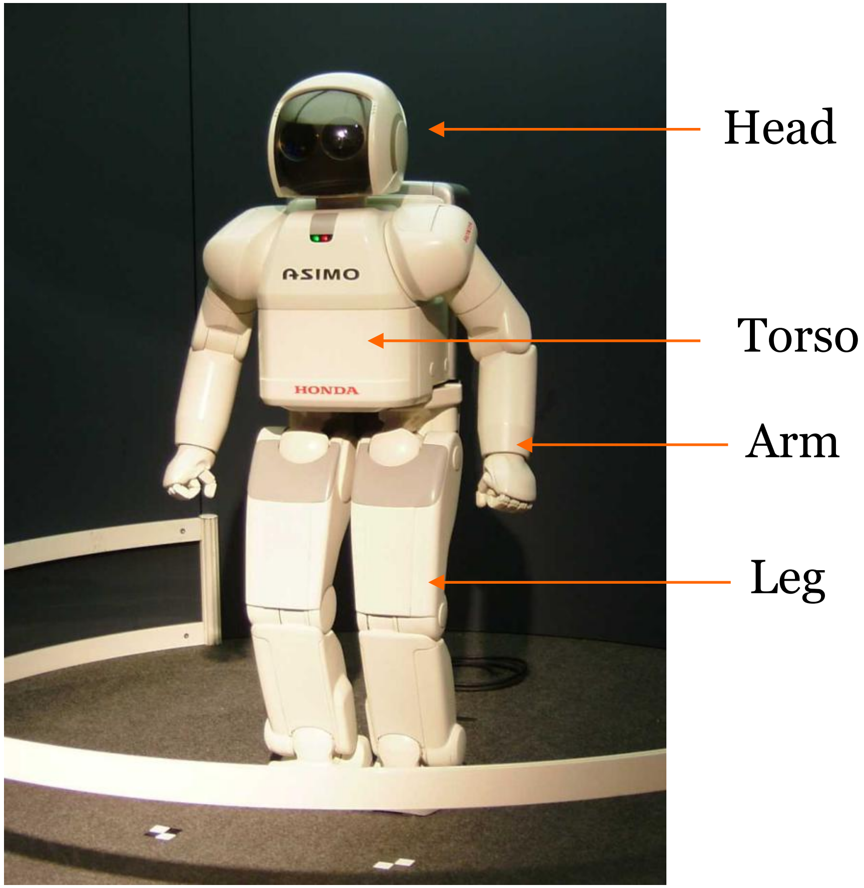
Robots Today

- **Humanoid Robots**

A humanoid robot is a robot with its overall appearance based on that of the human body. In general humanoid robots have a torso with a head, two arms and two legs, although some forms of humanoid robots may model only part of the body, for example, from the waist up.

male ➢ Androids

female ➢ Gynoids



Robots Today

- **Humanoid Robots**

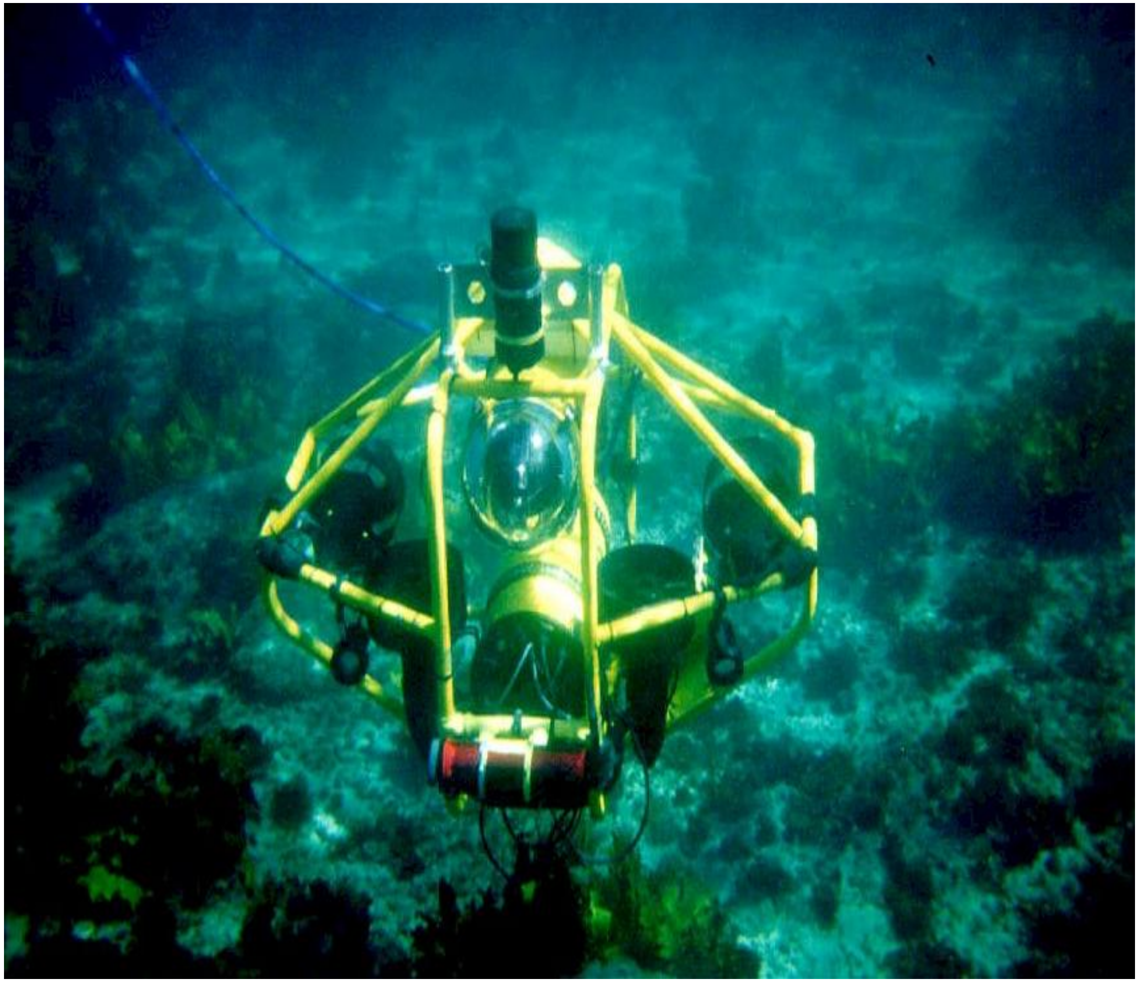
Physically anthropomorphic

ASIMO

QRIO

RH-1 (UC3M)

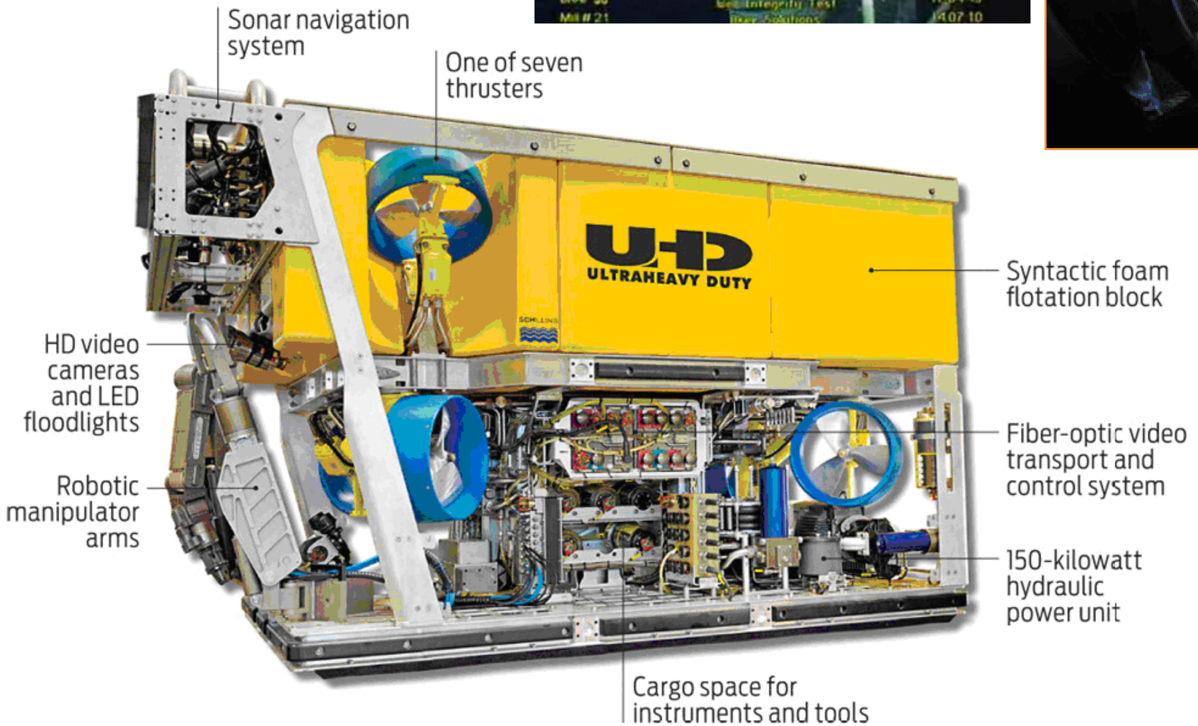
- **Underwater or Submarine Robots**



- **Underwater or Submarine Robots**

BP's Deepwater Horizon oil rig problem in the Gulf of Mexico

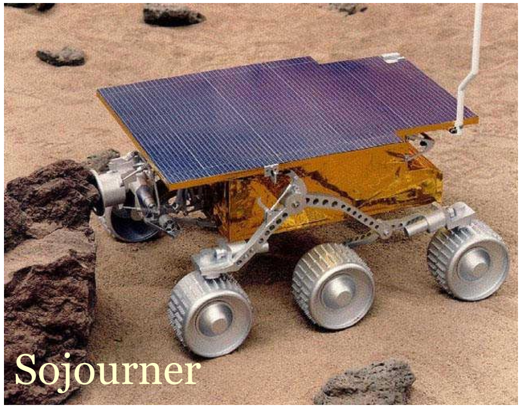
U.S. Coast Guard

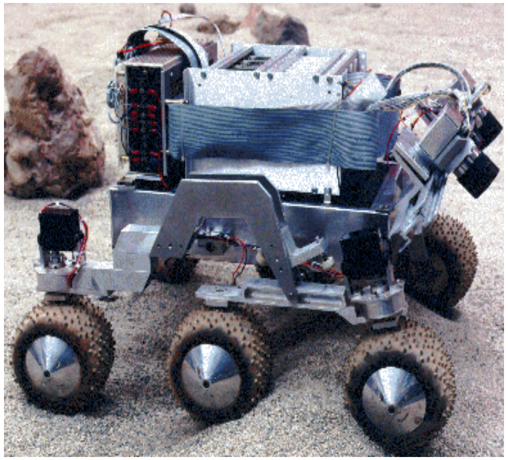


Work-class ROVs are designed by Schilling Robotics to do power-intensive work hundreds of meters below the surface

Robots Today

- **Space Exploration Robots**





Robots Today

- **Space Exploration Robots**

NASA Mars mission

The Curiosity rover is designed to travel Mars studying climate and geology. The rover is looking for signs of carbon, the building blocks of life. Some of the rover's features:

Robotic arm
Used to examine and manipulate soil and rocks; it also has two scientific instruments, one uses X-rays to determine materials' composition and the other is a magnifying camera

Laser
Burns small holes in rocks and soil up to 23 feet away and identifies chemical elements

Color cameras
Stereo mastcams on either side of the rover's mast take color pictures and movies in 3-D

UHF antenna
Primary transmission antenna

Plutonium power source
A nuclear battery that converts heat into electricity

Neutron detector
Detects water in rocks and soil

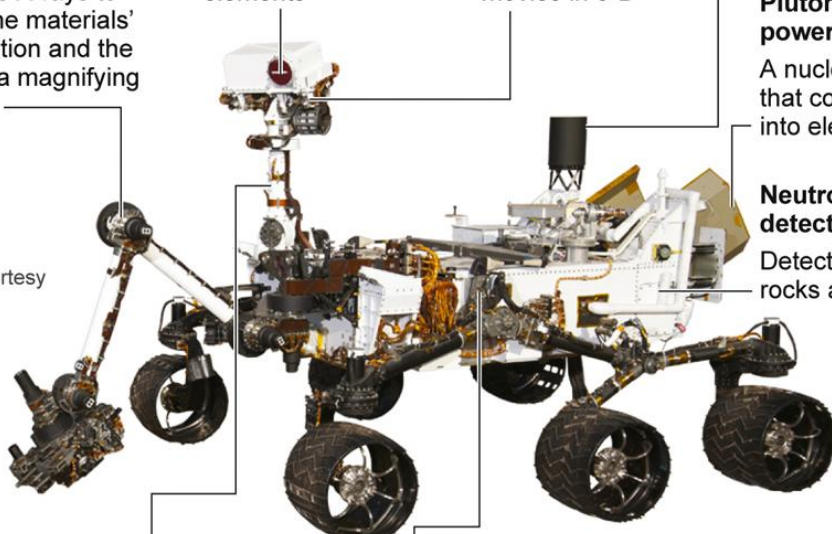


Photo courtesy of NASA

Weather station
Records wind speed/ direction, air pressure, humidity, temperature and UV radiation

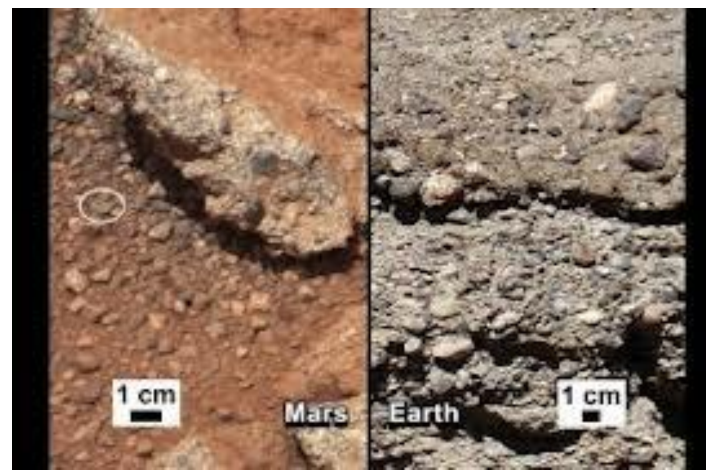
Radiation detector
Measures radiation from the sun, supernovae and other sources

Inside:
Chemistry lab
Analyzes rock and soil samples for organics

Mineral detector
Shines an X-ray beam at a rock or soil sample to identify types of minerals

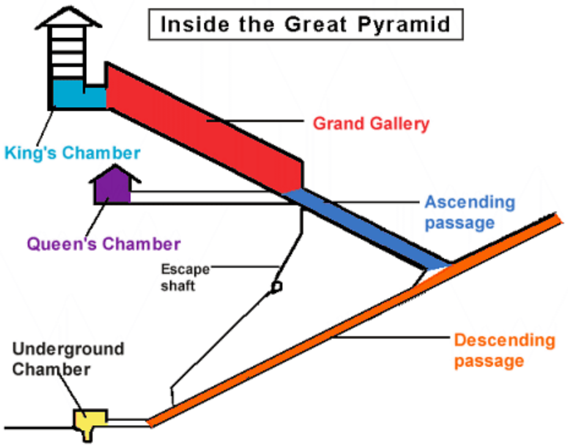
SOURCE: NASA — AP

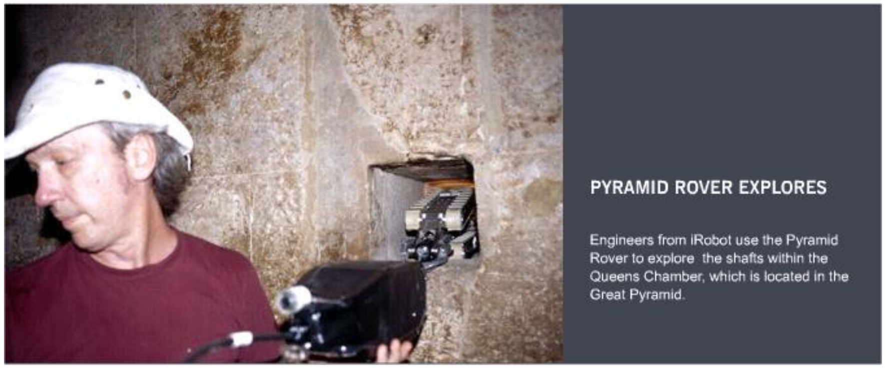
Curiosity

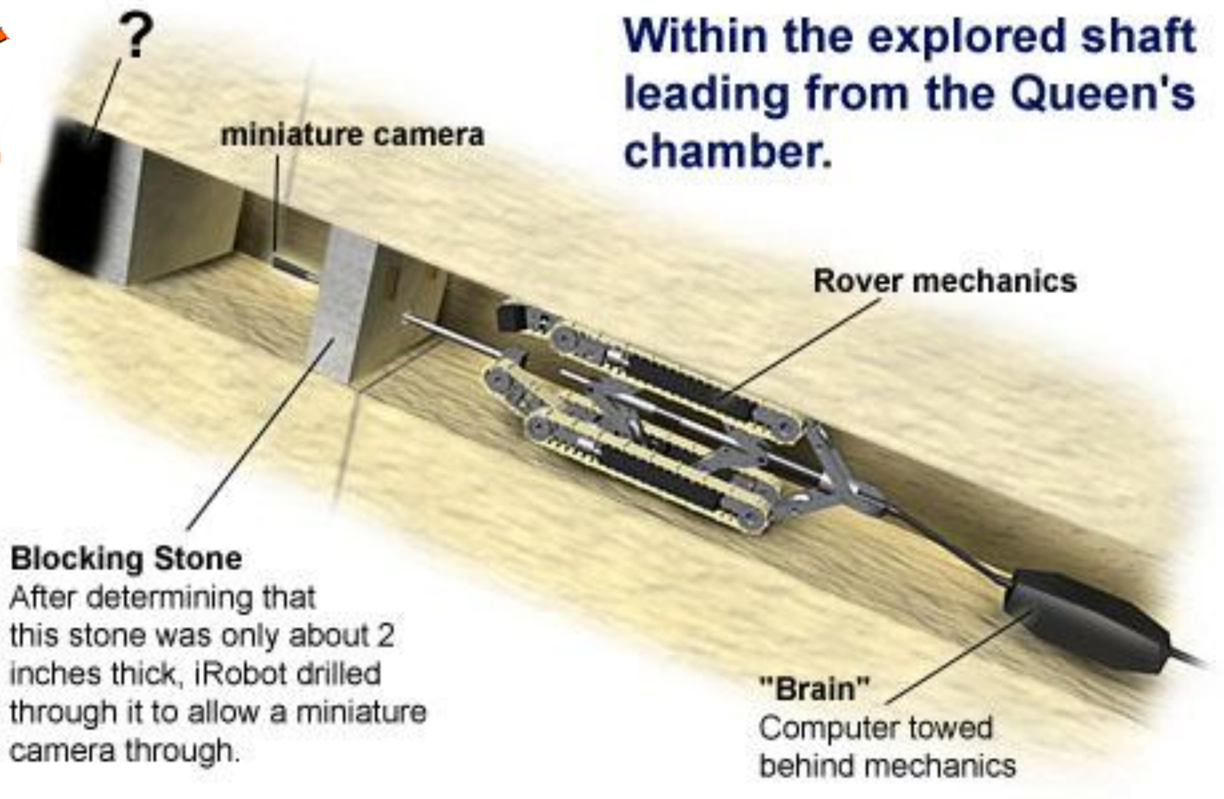


Robots Today

- **Exploration Robots**







Robots Today

- **Military Robots**

"Future Combat System is a major program for an entire System of Systems to transform the U.S. Army to be strategically responsive and dominant at every point on the spectrum of operations, through real-time network-centric communications and systems for a family of manned vehicles and unmanned platforms by the next decade".

R-Gator: Autonomous Unmanned Ground Vehicle

Robots Today

- **Unmanned Vehicles**

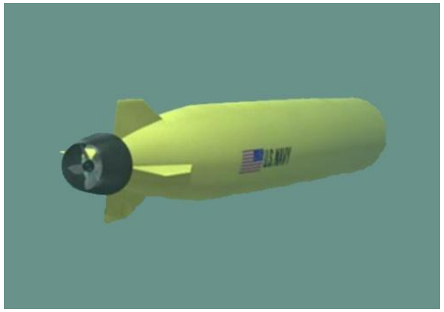
UXVs

Unmanned Ground Vehicles (UGV)

Unmanned Aerial Vehicles (UAV) & Micro Aerial Vehicles (MAV)

Unmanned Surface Vehicles (USV)

Unmanned Underwater Vehicles (UUV)



Robots Today

- **Unmanned Ground Vehicles (UGVs)**

Boston Dynamics BigDog
Robot The Army mule

YouTube

Boston Dynamics
RHex

YouTube

Robots Today

- **Unmanned Aerial Vehicles (UAVs or Drones)**
  - There are 17,300 drones in the US army inventory.
  - These drones can carry up to 3000 pounds of weapons.
  - Fabricated by Boeing

UAV carrying Viper
Strike Weapon System

A forward looking infrared (FLIR)
camera mounted on the side of an UAV

Robots Today

- **Unmanned Aerial Vehicles (UAVs or Drones)**

109,534 Total Hours: 01 Feb 03 – 15 OCT 05

Source: Brigadier General E.J. Sinclair, 2005 UAVS Symposium

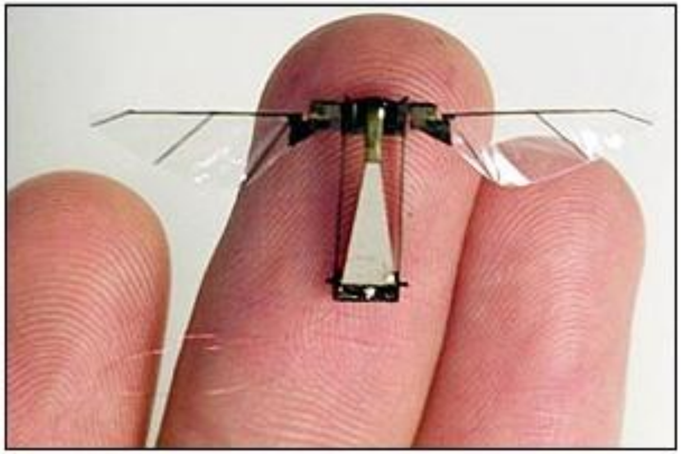
Robots Today

- **Micro Aerial Vehicles (MAVs)**

Micro Aerial Vehicles (MAV) are used in **spying missions**, where they quite literally serve as a "**fly on the wall**" - recording and transmitting audio-visual information.

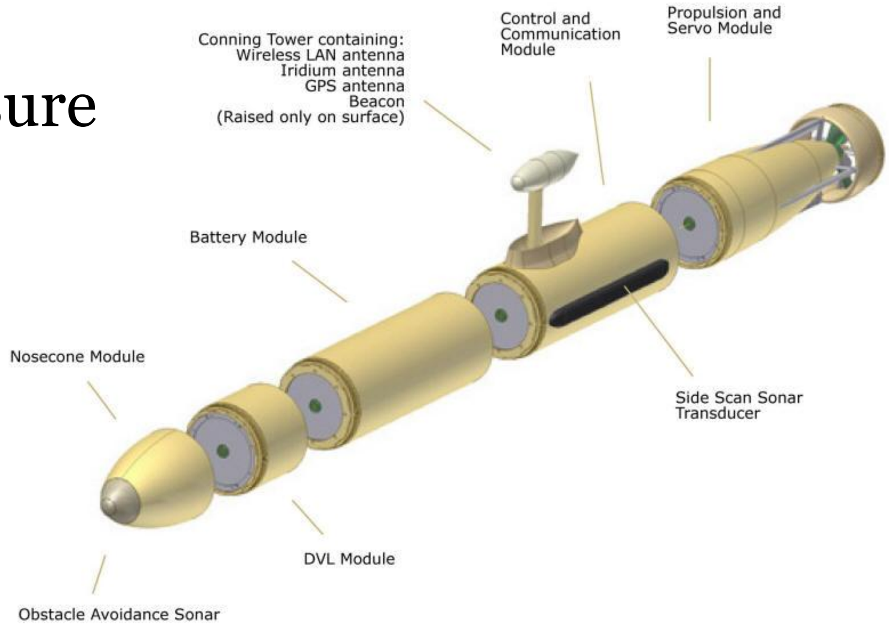
An individual robot is equipped with **miniature cameras, microphones, modem** and **GPS**.

A number of terrorist cells are being infiltrated thanks to this new technology.



Robots Today

- **Unmanned Underwater Vehicles (UUVs)**
  - CIA's Office of Advanced Technologies and Programs developed the Unmanned Underwater Vehicle (UUV) **fish** to study aquatic robot technology.
  - The **UUV fish** contains a pressure hull, ballast system, and communications system in the body and a propulsion system in the tail.

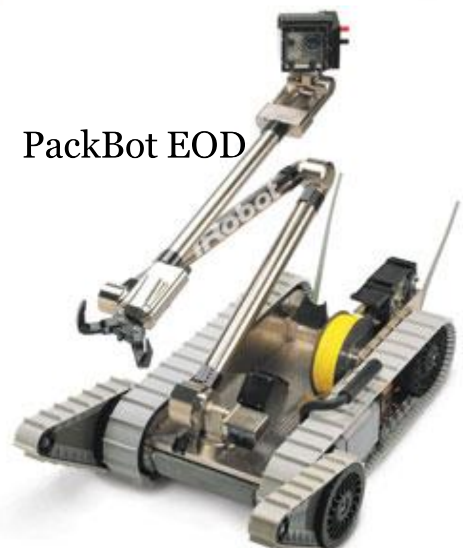


Robots Today

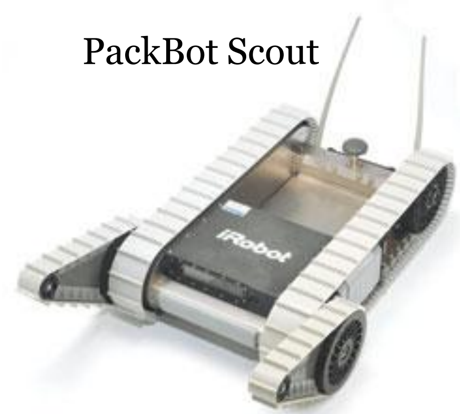
- **Surveillance and Reconnaissance Robots**

PackBot Explorer

PackBot EOD

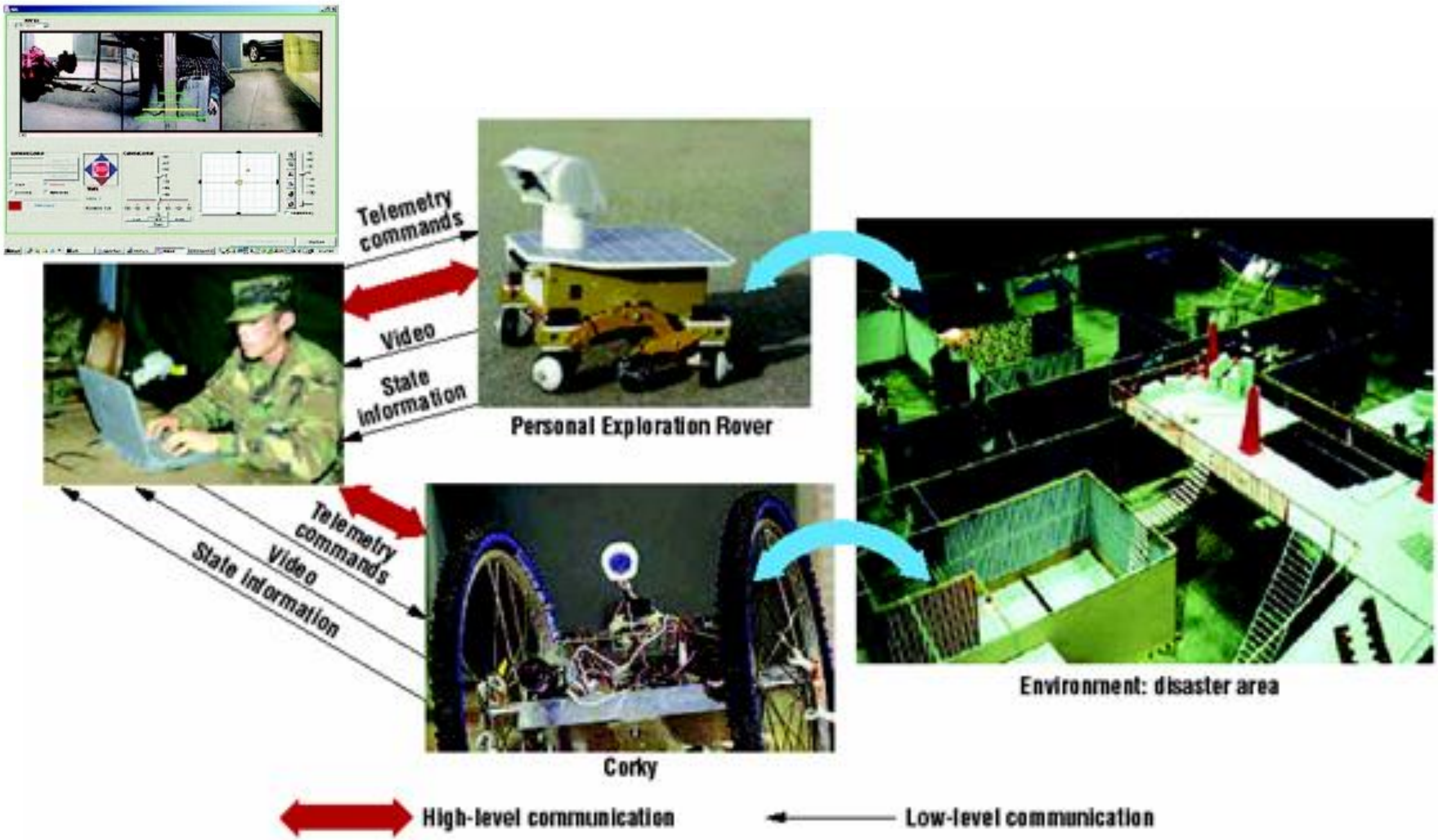


PackBot Scout



Robots Today

- **Search and Rescue**



- **Fire Fighting Robots**

SACI 2.0 is a firefighting robot presented in July 2006 with the following features:

-It has Fault Tolerant Architecture with redundancy in its moving system;

-It has lighting system; -It is modular; -It has at least 100% more autonomy, with a full load capacity up to a minimum of six hours; - It can have infrared or common video cameras and be controlled by wireless remote control.

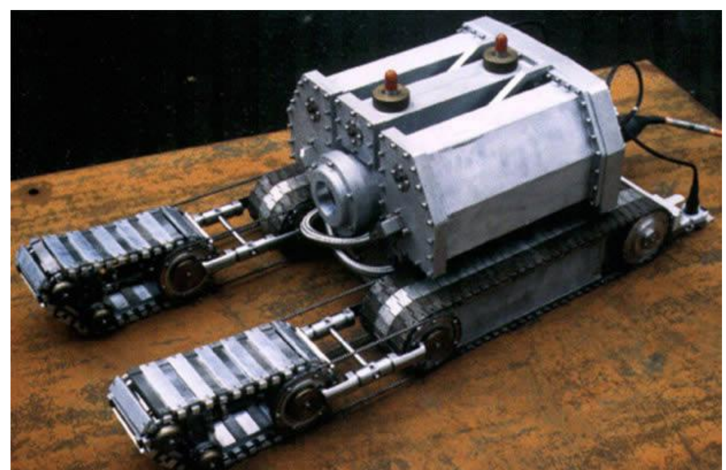
Robots Today

- **Inspection Robots**

Pipeline Inspection

Neptune: A Robotic Inspection System for Oil Storage Tanks

Pioneer



Robots Today

- **Agriculture Robots**

Ag-robots Farm Robots

Illinois University

National Robotics Engineering Consortium

http://www.rec.ri.cmu.edu/projects/demeter/demeter.shtml

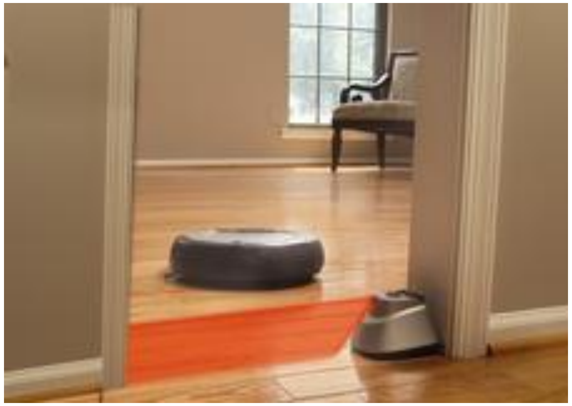
Robots Today

- **Cleaning and Mowing Robots**

Roomba - Making money with autonomous robots

Since the Roomba retails for about $300 in 2003, it's been able to sell 1.5 million of them in three years.

Price now is about $150



Robots Today

- **Personal Assistant Robots**

Nursebot

Wakamaru

RI-MAN

Maggie (UC3M)

Robots Today

- **Entertainment Robots**

Anaconda

AIBO

QRIO

Robots Today

- **Soccer Robots**

FIRA
Federation of International Robosoccer Association

RoboCup

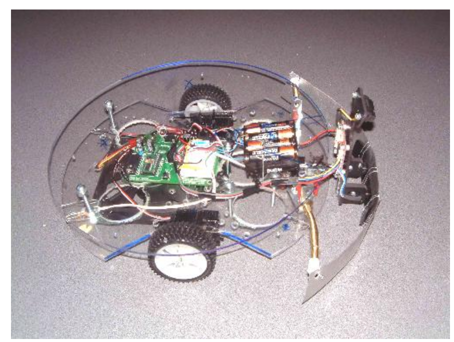
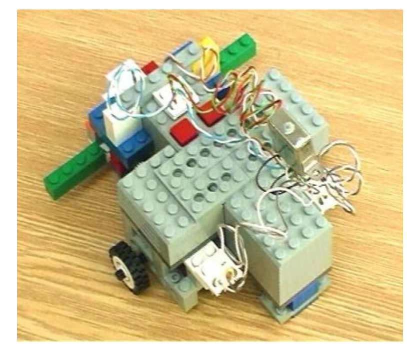
Robots Today

- **Hobby Robots**







eurobot http://www.eurobot.org/

Hands On!!! http://www.handson.org.tw/

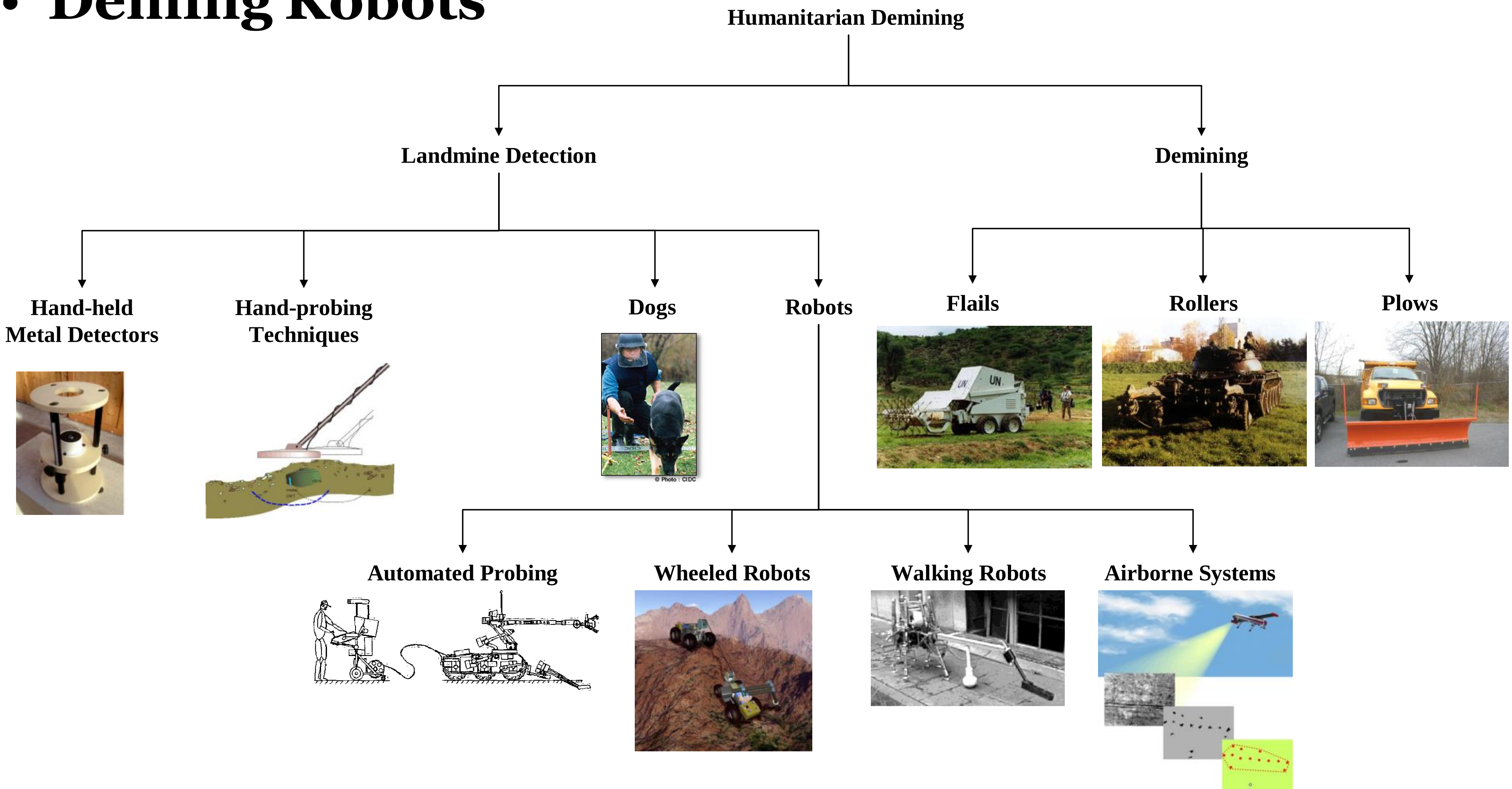
FIRST http://www.usfirst.org/robotics/

worldskills international http://www.worldskills.org/

HISPABOT http://www.depeca.uah.es/alcabot/hispabot/index.html

Robots Today

- **Deming Robots**



Egypt, Angola, and Iran account for more than 85 per cent of the total number of mine-related casualties in the world each year.

Egypt has 23 million mines mostly in border regions.

Robots Today

- **Deming Robots**

Mini Flail

Tempset

Mini-Deminer

Mini Flail -TECHNOPOL

Bozena

TODS

AARDVARK MK4

UOS-155 BELARTY

ARMTRAC-325

HYDREMA 910 MCV

RA-140 DS

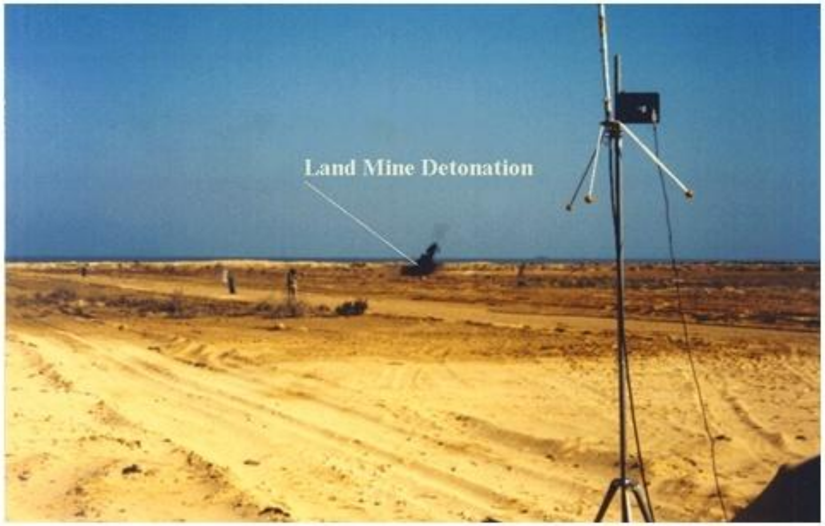
ARMTRAC-100

Robots Today

- **Deming Robots**

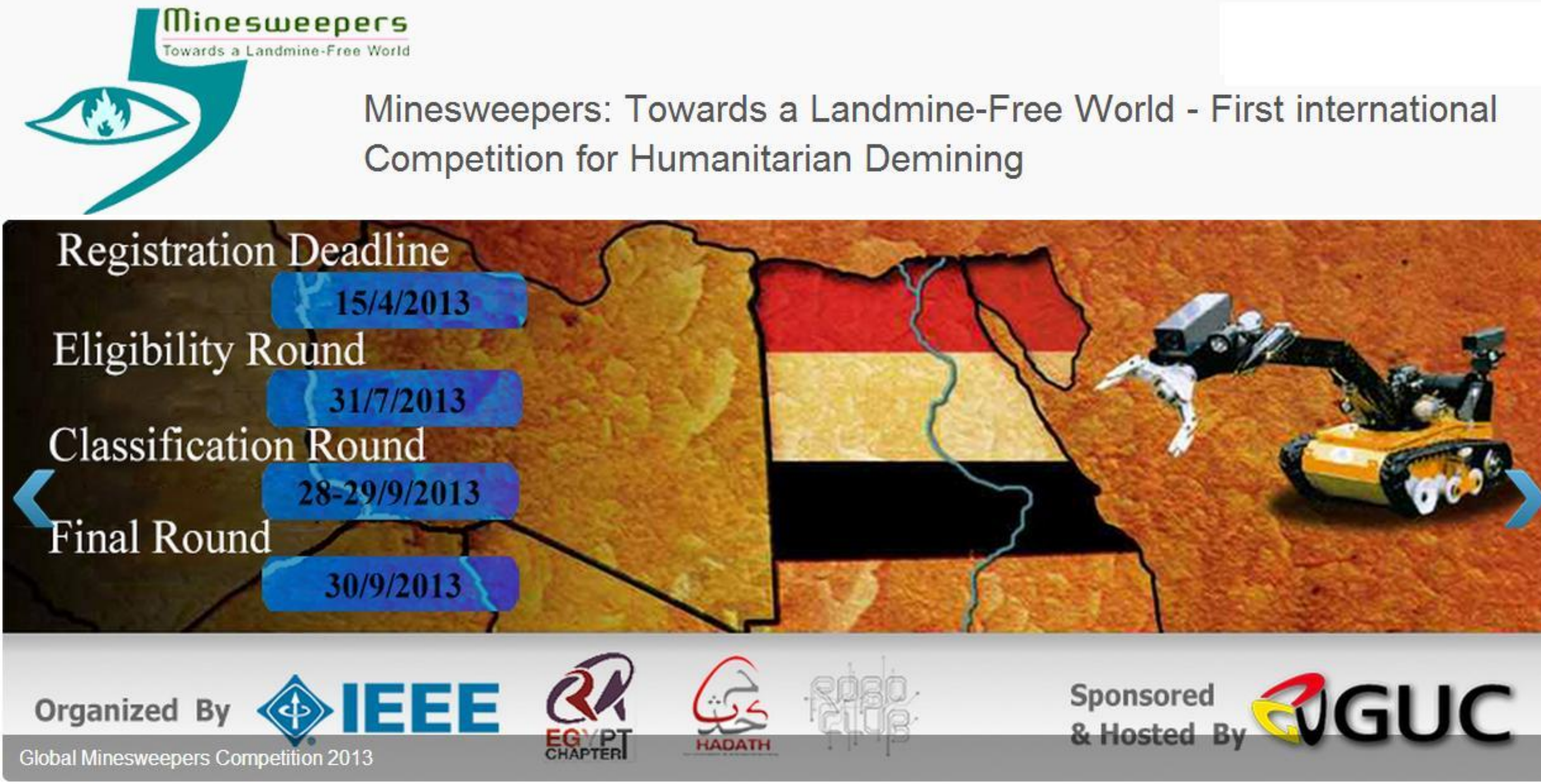
Teleoperated Ordnance Disposal System (TODS) provides safe, effective and efficient delivery of tools necessary for the clearance of landmines. TODS was developed for and tested by the US DoD Humanitarian Demining Research and Development Program.

The ETODS system was developed by the US Department of Defense to Egypt during the month of September 1999. This was an effort supported by OAO Robotics to demonstrate the mine clearance capabilities of the ETODS system to the Egyptian Ministry of Defense.



ETODS at Work near the Red Sea

Source: http://www.manitgroup.com/oao.htm



Minesweepers: Introduction

Outline

- About Minesweepers
- Competition Rules
- Procedure

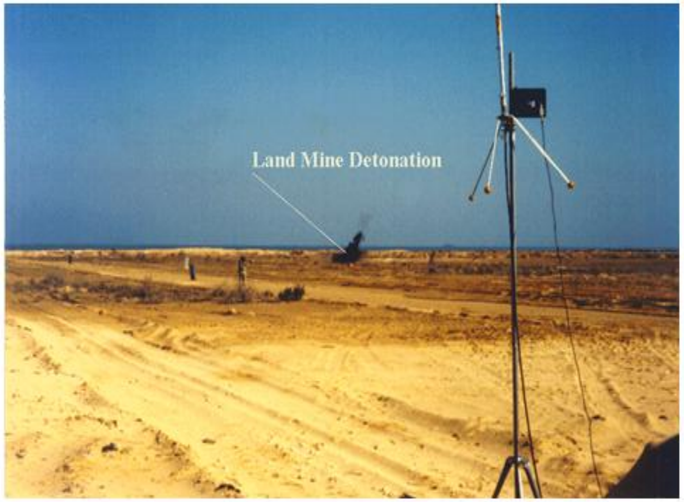
Outline

- **About Minesweepers**
- Competition Rules
- Procedure

About Minesweepers

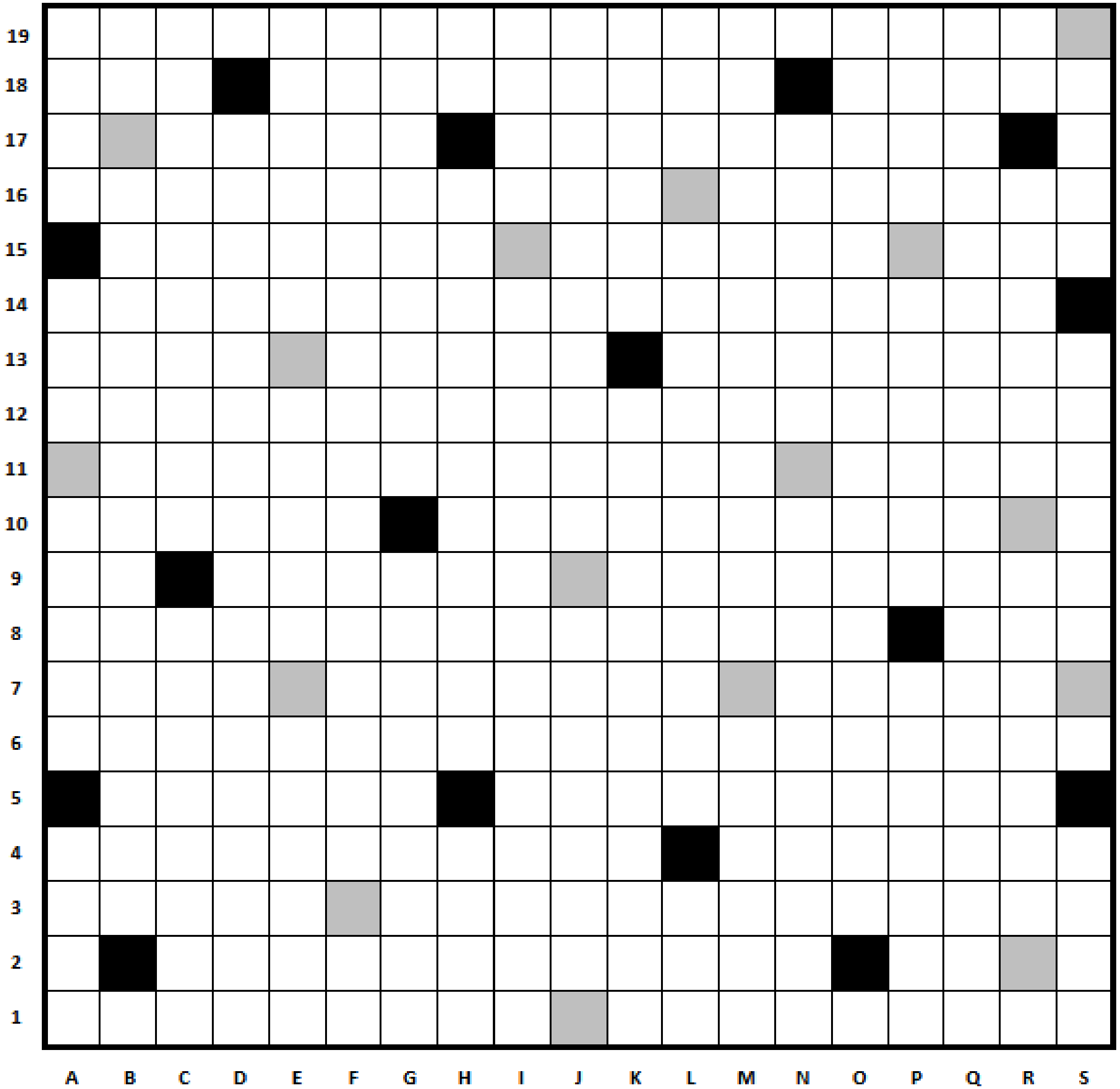
- Minesweepers: Towards a Landmine-free Egypt is a national robotic competition aimed at fostering robotics research and its applications in the area of humanitarian demining in Egypt.

- In **Minesweepers** each participating team will construct a teleoperated or an autonomous robot that should be able to search for underground and aboveground anti-personnel mines and produce a map of the detected mines.



- The robot has to be able to navigate through rough terrain.

About Minesweepers



Rough Terrain

Buried and Surface Mine
10x10x10 (LxWxD)

Mine Map

About Minesweepers

- **Organizers**

IEEE Robotics and Automation Society (RAS)

Egypt Chapter

HADATH

for innovation & entrepreneurship

ROBO CLUB

About Minesweepers

- **Sponsors**

GUC
German University in Cairo
الجامعة الألمانية بالقاهرة

Executive Secretariat for the Demining & Development of the North West Coast, Ministry of International Cooperation.

Mines Action & Human Rights Foundation

About Minesweepers

- **Prizes (Regular Competition)**
  - ◇ 1,000 USD for the *First* Winner
  - ◇ 750 USD for the *Second* Winner
  - ◇ 400 USD for the *Third* Winner
  - ◇ Executive Secretariat for the Demining & Development of the North West Coast, Ministry of International Cooperation. IEEE Robotics and Automation Society (RAS) Egypt Chapter and Mines Action & Human Rights Foundation will provide certificates of merit for the first three winners.
  - ◇ IEEE Robotics and Automation Society (RAS) Egypt Chapter will provide a certificate of recognition for all participants.

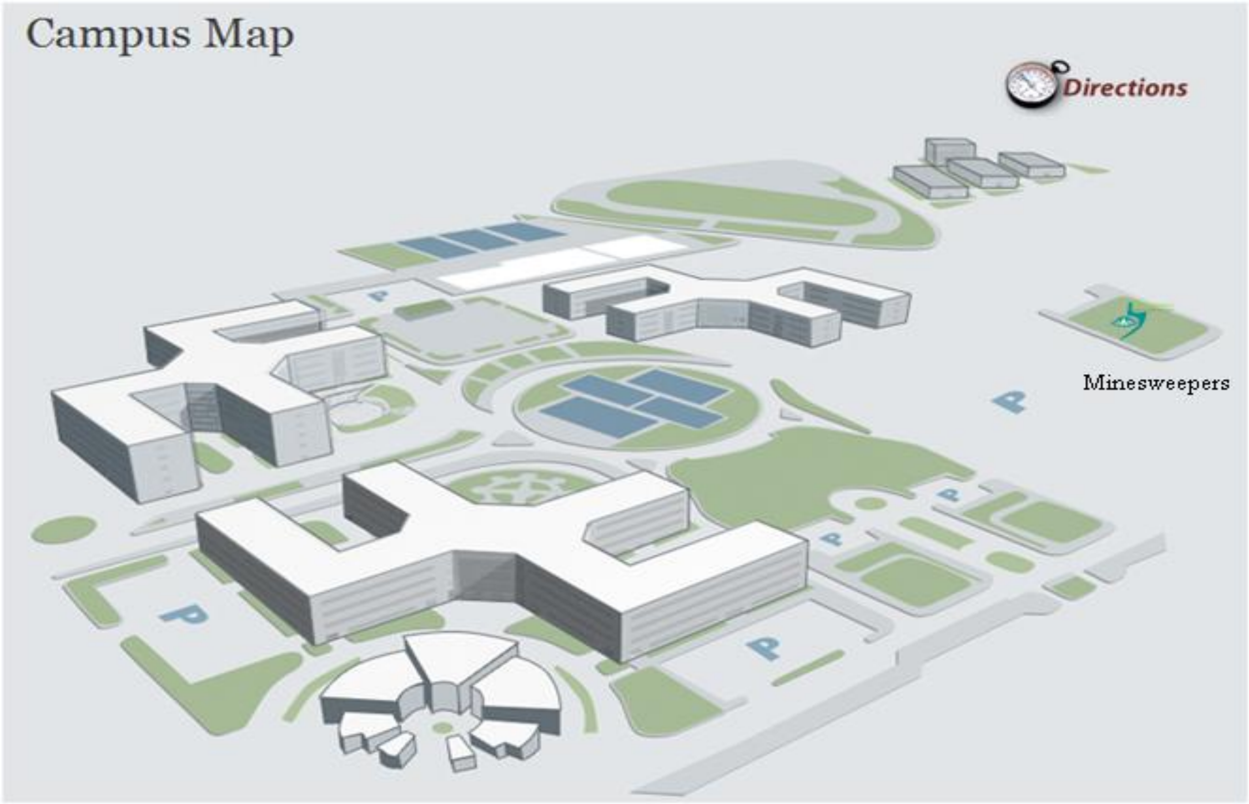
About Minesweepers

- **Prizes (Junior Competition)**
  - ◇ 300 USD for the *First* Winner
  - ◇ 200 USD for the *Second* Winner
  - ◇ Executive Secretariat for the Demining & Development of the North West Coast, Ministry of International Cooperation. IEEE Robotics and Automation Society (RAS) Egypt Chapter and Mines Action & Human Rights Foundation will provide certificates of merit for the first three winners.
  - ◇ IEEE Robotics and Automation Society (RAS) Egypt Chapter will provide a certificate of recognition for all participants.

About Minesweepers

- **Venue**

  Minesweepers 2013 will take place this year at the German University in Cairo located in the Main Entrance El Tagamoa El Khames, New Cairo City, Egypt.



Rough Terrain

Outline

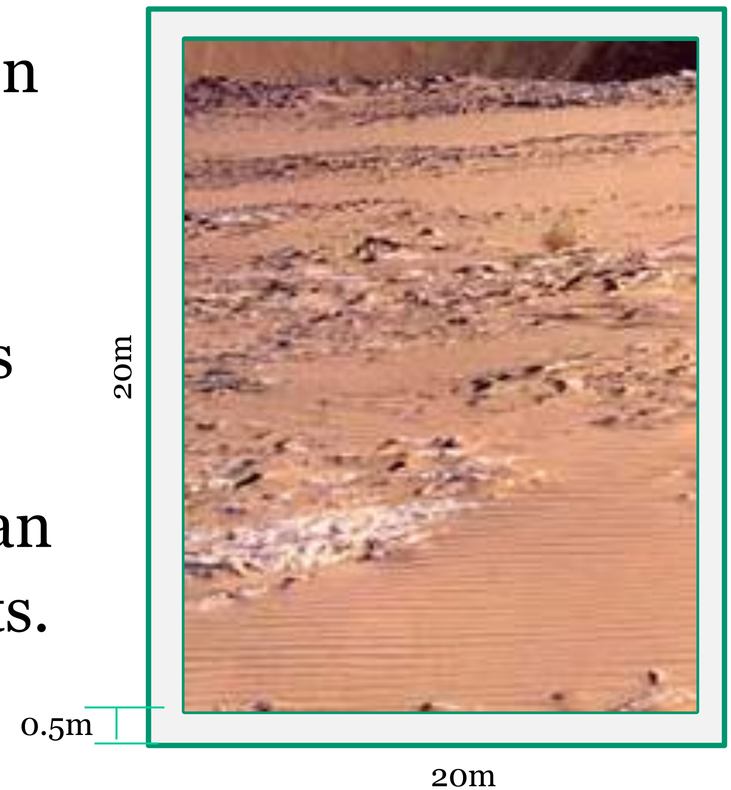
- About Minesweepers
- **Competition Rules**
- Procedure

Competition Rules

- In **Minesweepers** each participating team will construct a teleoperated or an autonomous robot that should be able to search for underground and aboveground anti-personnel mines and produce a map of the detected mines.
- The robot has to be able to navigate through rough terrain

Competition Rules

- **Minefield**
  - ◇ The competition arena will be an open desert area with dimensions 20x20 meters.
  - ◇ The field will be surrounded by a wall with 50 cm height.
  - ◇ The landmine contaminated zones in the arena start 50 cm from each the boarders.
  - ◇ Most of the arena will be sandy soils or rocky with obstacles, some steep inclines, ditches and culverts that can be difficult to negotiate by the robots.



Competition Rules

- **Mines**
  - ◇ **Buried Mines:**
    - made from a metallic cube.
    - dimensions of 10 x 10 x 10 (L x W x D).
    - mines are buried underground with maximum depth 10 cm.
  - ◇ **Surface Mines:**
    - made from a metallic cube.
    - dimensions of 10 x 10 x 10 (L x W x D).
    - labeled in black color.
    - These mines are visible and are located on the surface of the competition area.

Buried and Surface Mine
10x10x10 (LxWxD)

Competition Rules

- **Robots**
  - ◇ The robot has to be made by team members.
  - ◇ Teleoperated robot must be operated remotely from a base station located outside the minefield. Wireless controller based on ZigBee for example.
  - ◇ In case of autonomous robots, all the actions of the robot must be completely autonomous without human intervention.
  - ◇ Careful attention must be paid to the robot locomotion systems as the roughness of the terrain is very high.

Competition Rules

- **Robots (cont'd)**
  - ◇ Robots can be wheeled, legged or hybrid.
  - ◇ Wheeled robots include but are not limited to differential drive, tricycle drive, Ackerman steering, synchro drive, omnidirectional drive, Multi-Degree-of-Freedom (MDOF) vehicles, MDOF vehicle with compliant linkage or tracked vehicles.
  - ◇ Legged robot can be uniped, biped, tripod, pentapod, quadruped or hexapod robot.
  - ◇ Robot can also be an unmanned aerial vehicle or a quad-rotor.

Competition Rules

- **Robots (cont'd)**
  - ◇ Robot can be actuated using:
    - electric,
    - pneumatic or
    - hydraulic actuation system,
    - Diesel/Petrol engine or
    - using solar energy.

Competition Rules

- **Sensors**
  - ◇ Each team can select their own set of sensors for localization of mines.
  - ◇ Although teams can install cameras on robot or install them on the sides of the field
  - ◇ No camera or sensors is allowed to hangover the competition area.

Competition Rules

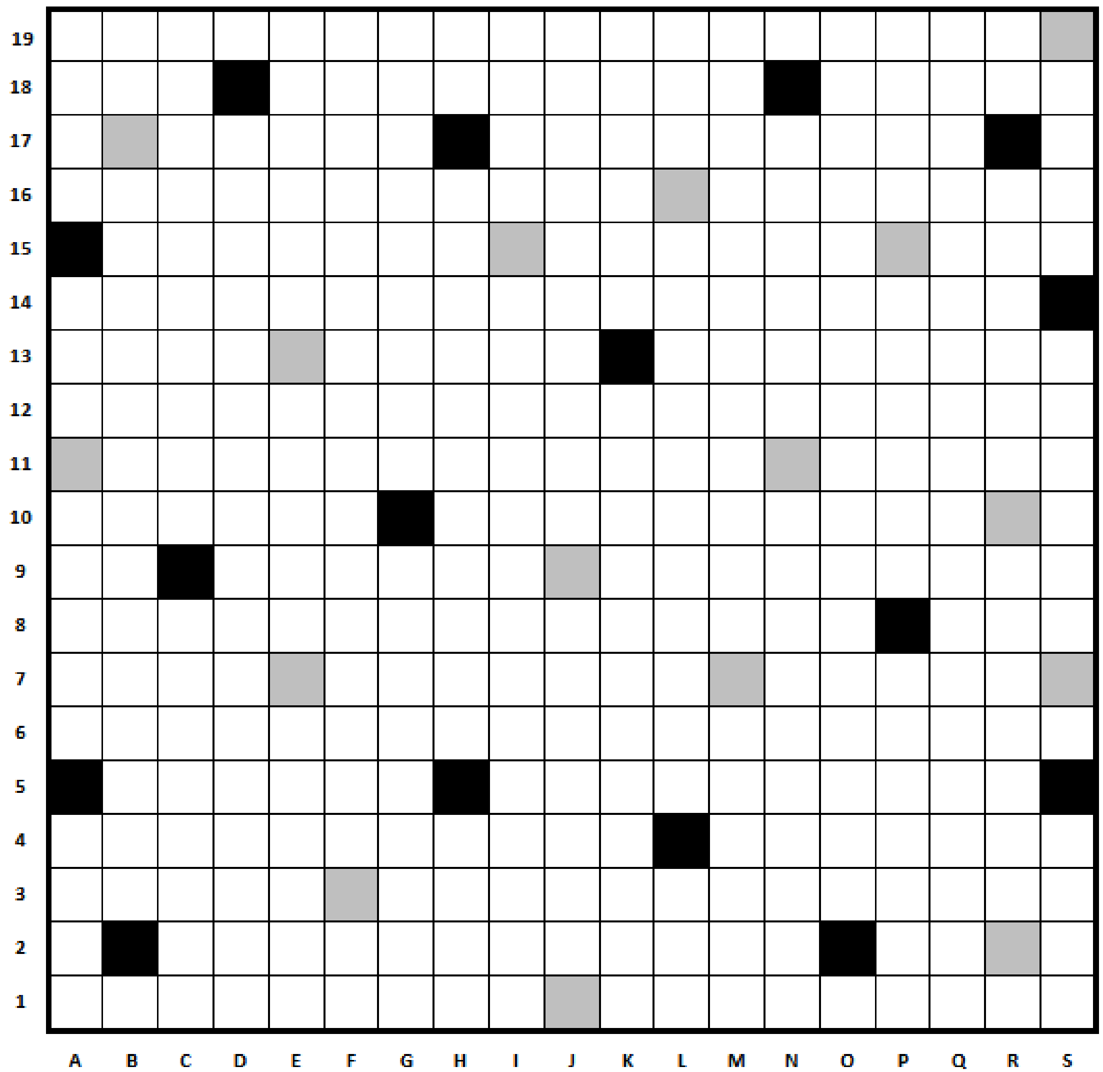
- **Mine Detection**
  - ◇ When a robot detects a mine, it has to report this event using a light **blinking signal and a warning siren** for at least **5 seconds**.
  - ◇ Teams have to correctly position the alarm device on their robot.

Competition Rules

- **Mine Map**
  - ◇ Each deminer robot has to provide map of the detected mines when its competition time slot finishes.
  - ◇ This map can be simply a text file or text shown on the display of the robot. The sequence of the positions has to be the same as the detected mines.
  - ◇ This mine map can be represented graphically or using vector format.

Competition Rules

- **Mine Map (cont'd)**



Graphical Representation of the Mine Map [Black: buried mine, Gray: Surface Mine]

Competition Rules

- **Mine Map (cont'd)**

Surface mines found at:	
A	11
B	17
E	7
E	13
F	3
I	15
J	1
J	9
L	16
M	7
N	11
P	15
R	2
R	10
S	7
S	19

Buried mines found at:	
A	5
A	15
B	2
C	9
D	18
G	10
H	5
H	17
K	13
L	4
N	18
O	2
P	8
R	17
S	5
S	14

Vector Representation of the Mine Map

Outline

- About Minesweepers
- Competition Rules
- **Procedure**

Procedure

- Each robot starts the game from a different randomly selected location marked in the map.
- Team members will bring the teleoperated or the autonomous robot to this location.
- Then robot has to search the field to find buried mines or the mines scattered on surface.
- When the robot detects any kinds of mine it should register the location of the mine in the map and produce a light signal and siren and also report the mine location to update the mine map.

Procedure

- All the detected mines will be removed from the field before a new team enters the arena.
- Robots must avoid surface mines else the team will be penalized.
- During competitions only one of team members (**team representative**) can attend the field.

Procedure

- Team representative can request a "**Reset Time**" which means he/she can stop the game and take out robot for repair or adjustment.
- The time spends for this repair will be included within the competition time and there would be a penalty for each resent time. The competition time allowed for each team is 15 minutes.

Procedure

- The competition will end with one of the following conditions:
  1. The dedicated time finishes,
  2. Team dismiss the game,
  3. Any cheating happens.

Procedure

- **Scoring**
  - ◊ 100 Positive score for detecting every buried metallic mine.
  - ◊ 50 Positive score for detecting every surface metallic mine.
  - ◊ 300 Positive score for complete surf of field if 80% of mines are detected correctly.
  - ◊ 50 Negative score for wrong detection.
  - ◊ 100 Negative score for passing over a buried mine without detecting it.
  - ◊ 50 Negative score for touching a surface mine. Game terminates.

Procedure

- **Scoring (cont’d)**
  - ◊ 30 Negative score failure in producing a light signal and/or a siren for a detected mine.
  - ◊ Maximum duration of every “Reset Time” is 20% of the allowed time. Every “Reset Time” will reduce 10% of the subsequent scores (they will be multiplied by 0.9 for first reset, 0.8 for second and so on).
  - ◊ Autonomous robot’s total score will be multiplied by 1.4.

Procedure

- **Scoring Sheet**

<table>
<tr><th>Action</th><th colspan="2">Count</th><th>Score/Unit</th><th>Subtotal</th></tr>
<tr><td>Detected Surface Mines</td><td colspan="2">10</td><td>50</td><td>500</td></tr>
<tr><td>Detected Underground Mines</td><td colspan="2">50</td><td>100</td><td>5000</td></tr>
<tr><td>Completely Scan the field and 80% of Mines Detected</td><td colspan="2">1</td><td>300</td><td>300</td></tr>
<tr><td>Wrong Detection of a Mine</td><td colspan="2">3</td><td>-50</td><td>-150</td></tr>
<tr><td>Pass over Buried Mine without Detection</td><td colspan="2">10</td><td>-100</td><td>-1000</td></tr>
<tr><td>Touching Surface Mine</td><td colspan="2">1</td><td>-50</td><td>-50</td></tr>
<tr><td>No light signal and/or a siren</td><td colspan="2">0</td><td>-30</td><td>0</td></tr>
<tr><td colspan="4">Total Score</td><td>4600</td></tr>
<tr><td rowspan="5">Reset Time</td><td>☑</td><td>1st</td><td colspan="2">Multiply Score by 0.9</td></tr>
<tr><td>☑</td><td>2nd</td><td colspan="2">Multiply Score by 0.8</td></tr>
<tr><td>☐</td><td>3rd</td><td colspan="2">Multiply Score by 0.7</td></tr>
<tr><td>☐</td><td>4th</td><td colspan="2">Multiply Score by 0.6</td></tr>
<tr><td>☐</td><td>5th</td><td colspan="2">Multiply Score by 0.5</td></tr>
<tr><td colspan="4">Total Score (Updated)</td><td>3680</td></tr>
<tr><td>Autonomous Robot</td><td colspan="3">☑ YES (Multiply by 1.4)</td><td>☐ NO</td></tr>
<tr><td colspan="4">Final Score</td><td>5152</td></tr>
</table>

Procedure

- **Competition Rounds: Eligibility Round**
  - ◇ All the registered teams must send by email (world@landminefree.org) a technical report and a 3-minutes video showing the design and the operation of their robot.
  - ◇ Deadline to submit the report and the video is July 31, 2013.
  - ◇ The accepted teams to participate in the classification round will be notified by email in the first week of August 2013.
  - ◇ More details at the Competition Website.

Procedure

- **Competition Rounds: Classification Round**
  - ◇ All the ready robots will participate in order established by gambling.
  - ◇ The team with highest number of accumulated points will win.
  - ◇ In case of equality in number of points, the robot that finished the course in minor time will win.
  - ◇ The best teams will be classified for the eliminatory round.
  - ◇ If insufficient number teams have finished the classification round, the judge committee can select some of the unclassified teams to participate in the final round.

Procedure

- **Competition Rounds: Final Round**
  - ◊ The classified team will have to realize a final course, being winning the best classified one according to the same guidelines.
  - ◊ If a team or several teams don't finish the course, the judge committee must decide the order of the final classification, based on different arguments such as:
    - Minimum time of finishing the course in this rounds.
    - Minimum number of wrong detections.
    - Being the unique team that keeps operating.

Outline

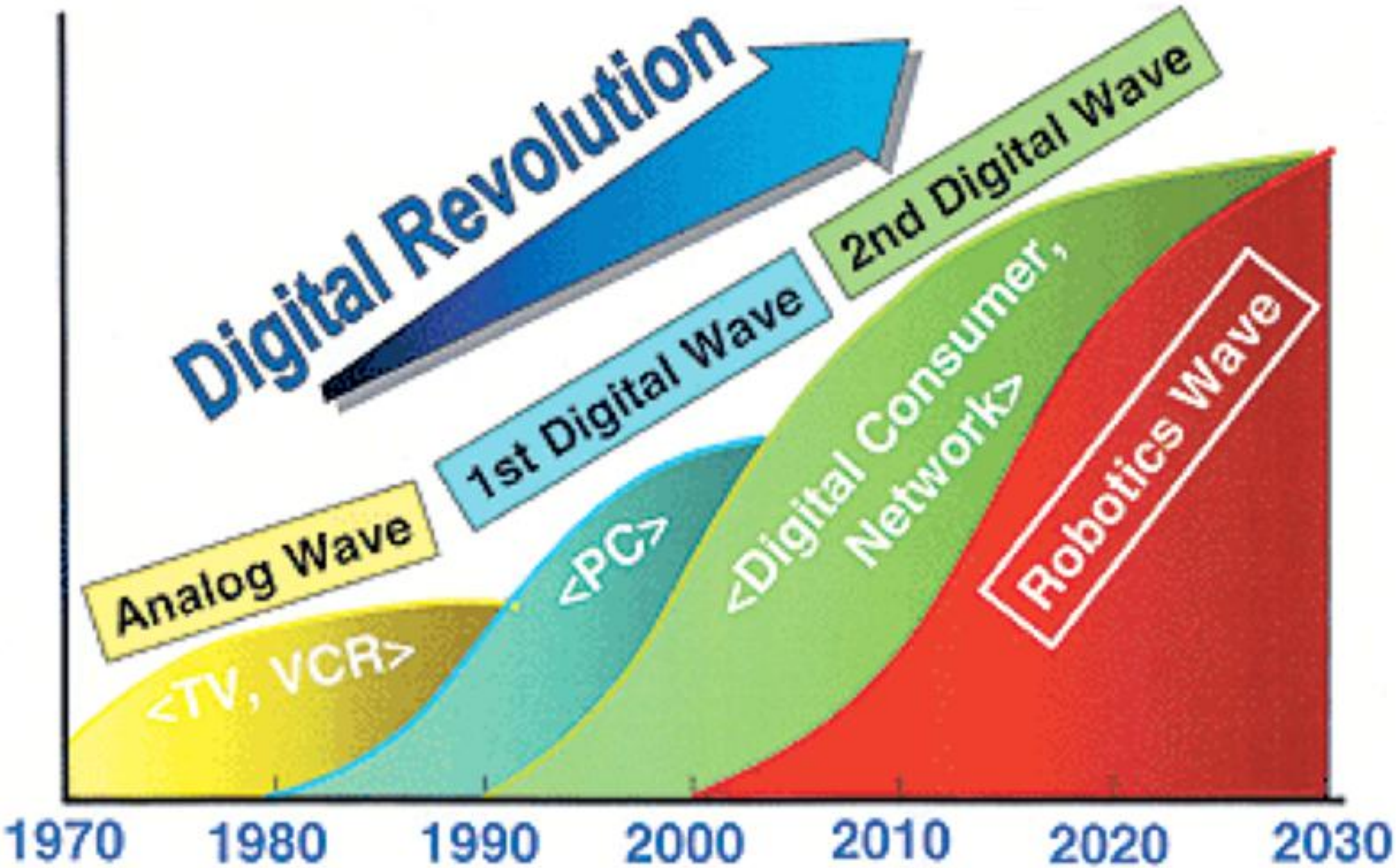
- About Minesweepers
- Competition Rules
- Procedure

Back to the Future =)

Outline

- IEEE RAS – Egypt Chapter
- What is a Robot?
- What is Robotics?
- Science Fiction
- Science Facts
- Robots Today
- **Robots' Future**

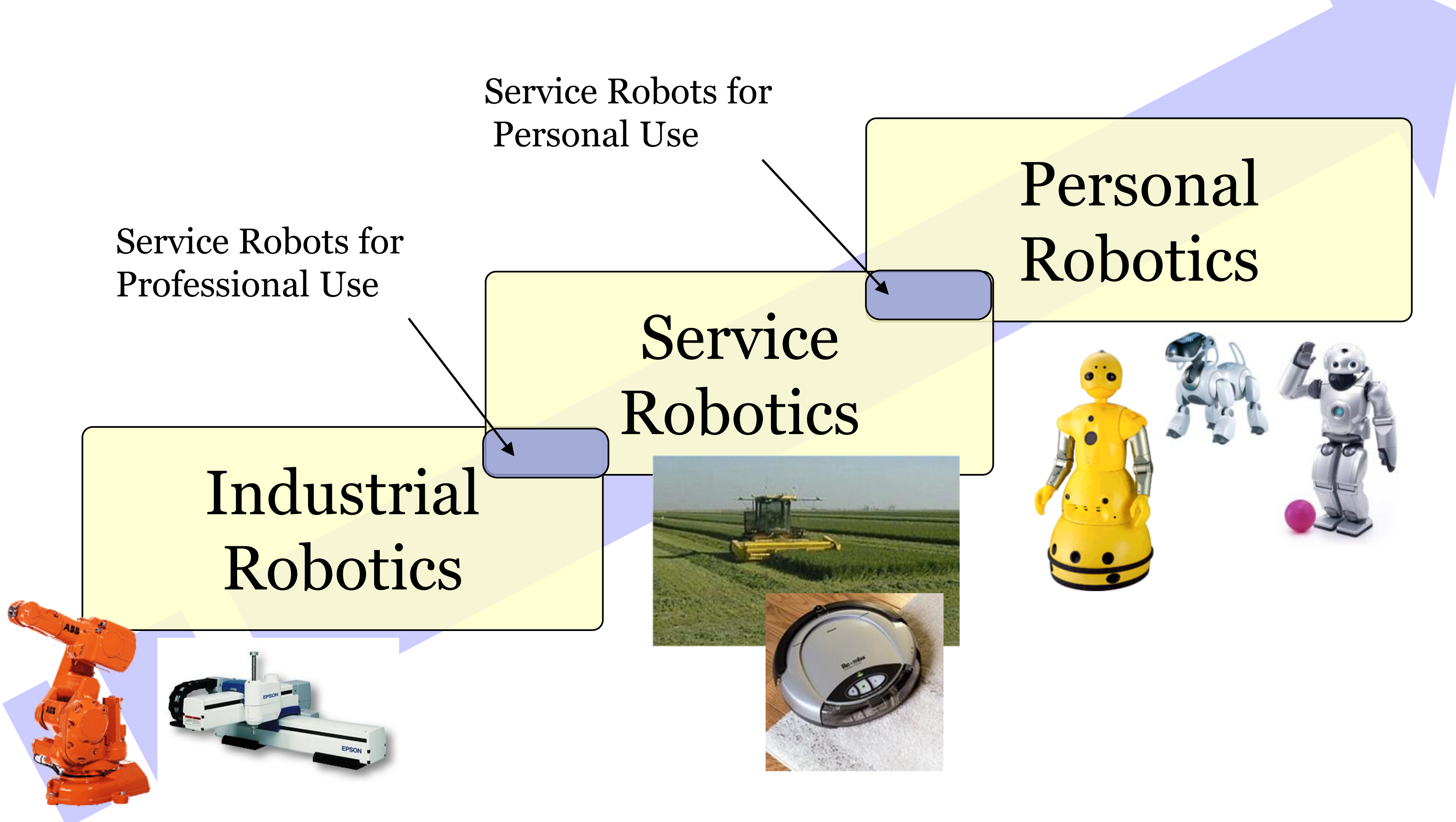
Robot's Future



Source: Bruno Siciliano. Robots Moving Closer to Humans. IEEE Distinguished Ambassador Seminar. Available at: http://ras-egypt.org/activities.html

Robot's Future

The Evolutionary Stages



Robot's Future

- **A robot in every home**

"As I look at the trends that are now starting to converge, I can envision a future in which robotic devices will become a nearly ubiquitous part of our day-to-day lives. The challenges facing the robotics industry are similar to those we tackled in computing three decades ago."

Bill Gates, 2007
Scientific American

Robot's Future

- **Service Robots**

Service robots assist human beings, typically by performing a job that is dirty, dull, distant or dangerous.

Service Robots

Service Robots for Professional Use

(Construction robots, demolition, medical, space robots, underwater expoloration, cleaning, demining, inspection, fire fighting,...

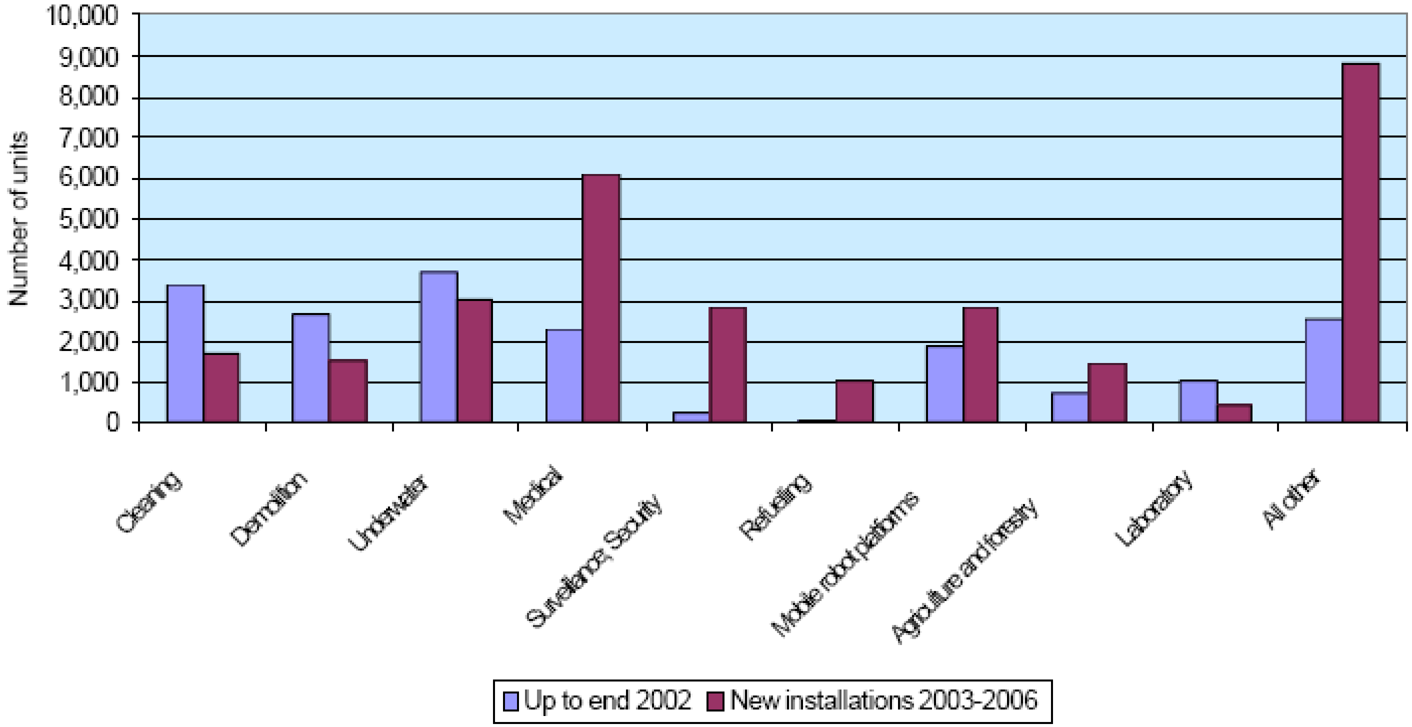
Service Robots for Personal Use

(domestic, personal assistant, entertainment robots, vacuum cleaners, etc.)

Robot's Future

- **Service Robots**

Service robots for professional use. Stock at the end of 2002
and projected installations in 2003-2006

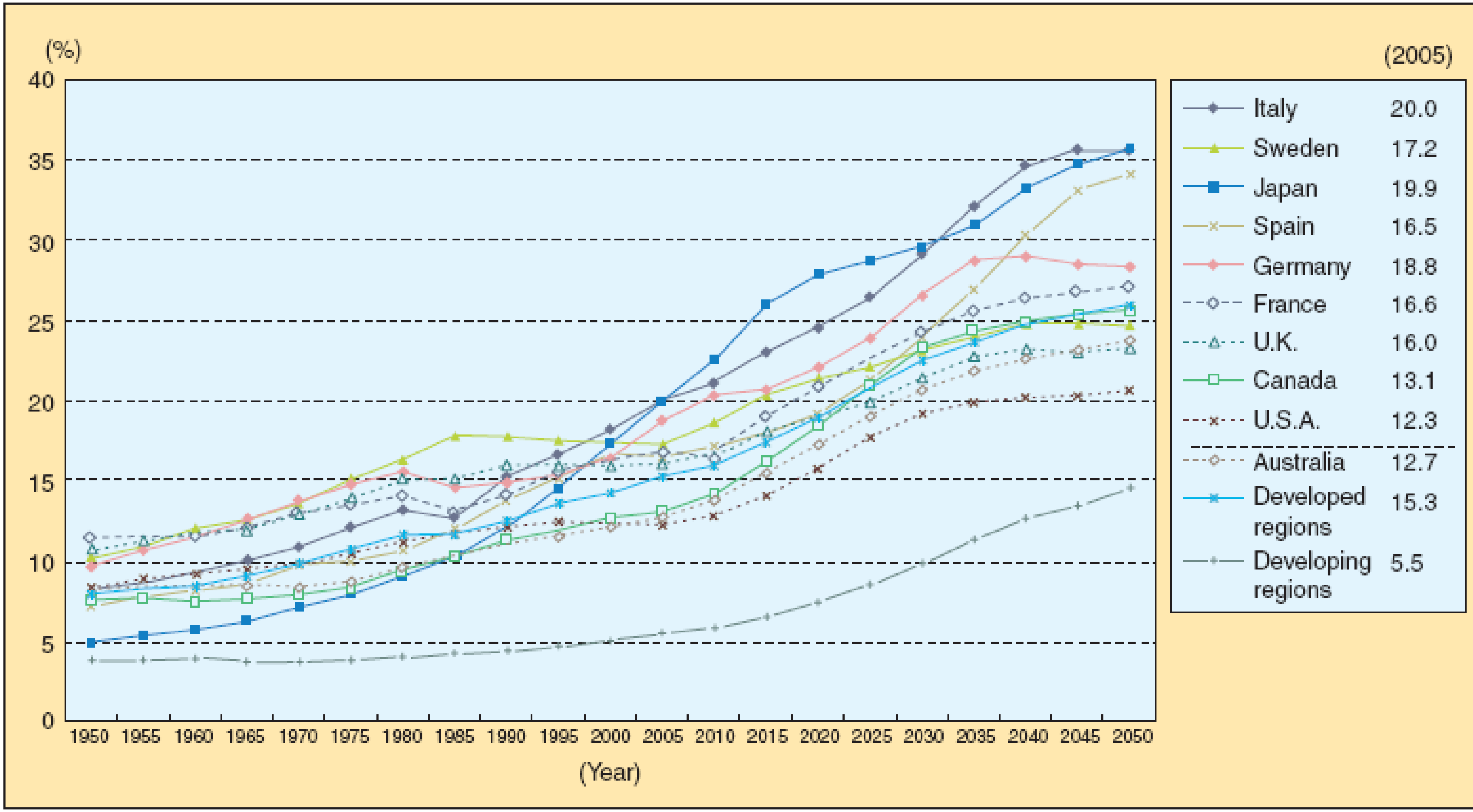


IFR, October 2002

Robot's Future

- **Service Robots**

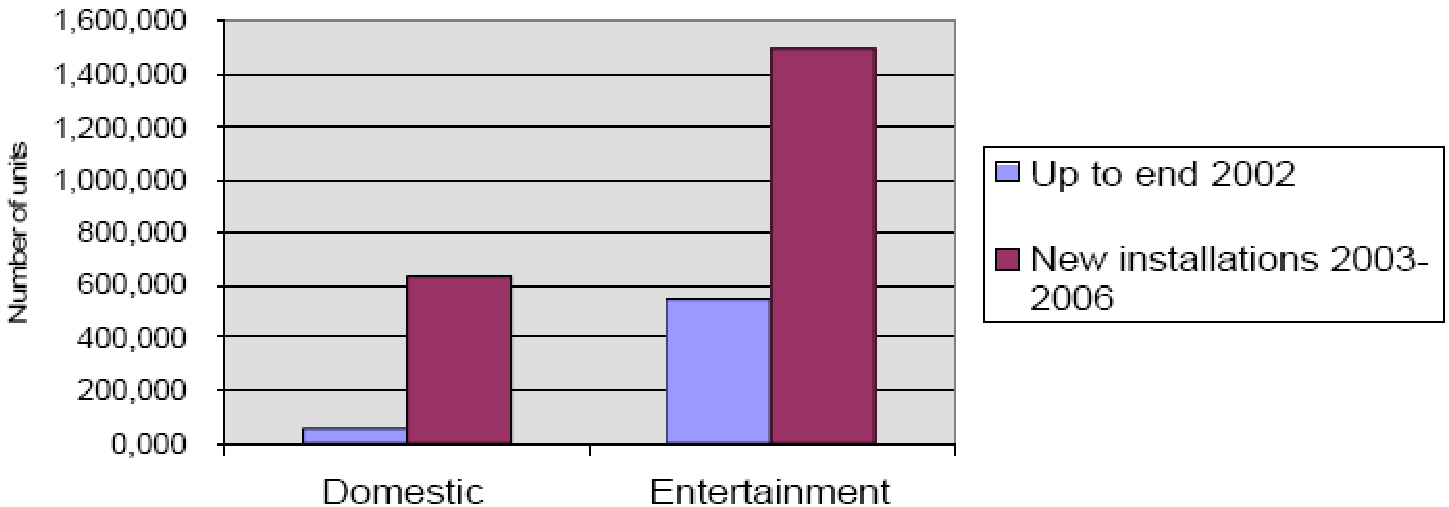
Trends in percentage of the elderly (over age 85) in the world



Source: ADRIANA TAPUS,MAJA J. MATARIC´, AND BRIAN SCASSELLATI, "Socially Assistive Robotics: The Grand Challenges in Helping Humans Through Social Interaction," IEEE Robotics & Automation Magazine, MARCH 2007

- **Service Robots**

Service robots for private use. Stock at end 2002 and projected installations 2003-2006

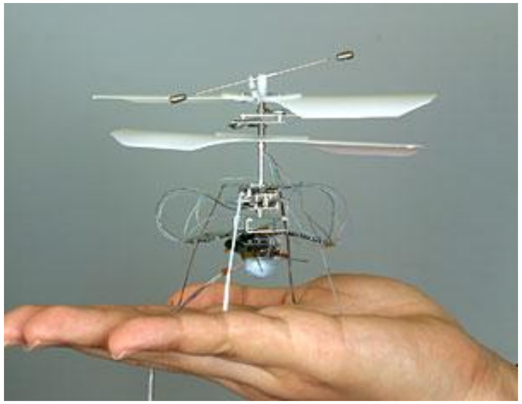


IFR, October 2002

Robot's Future

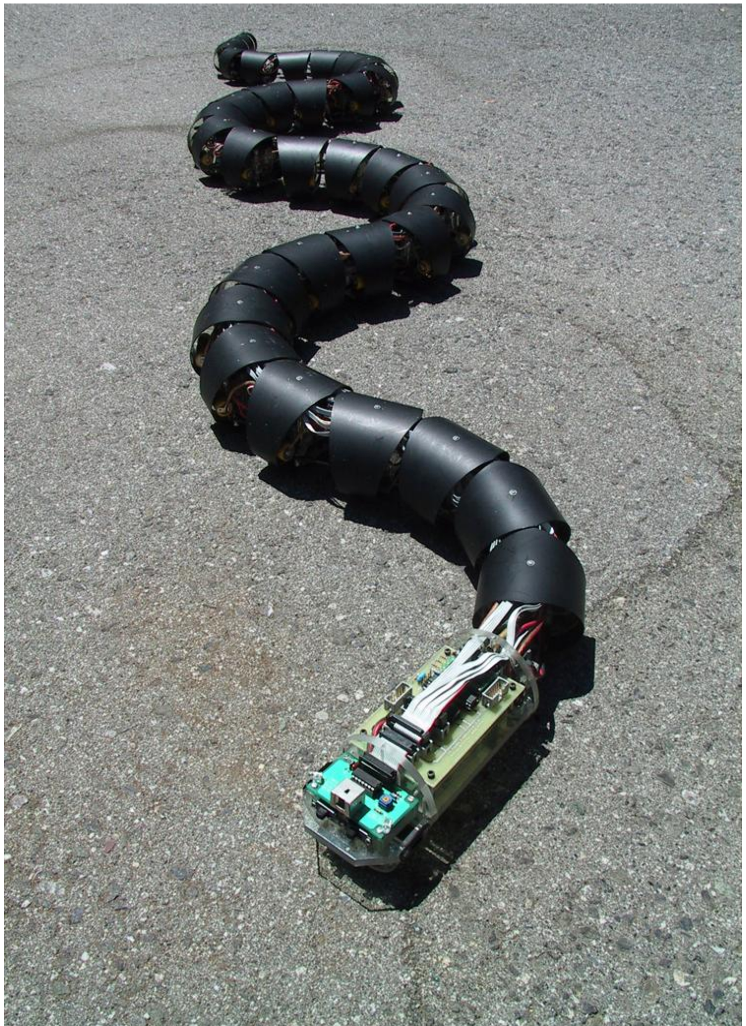
- **Nanorobots or Nanobots**

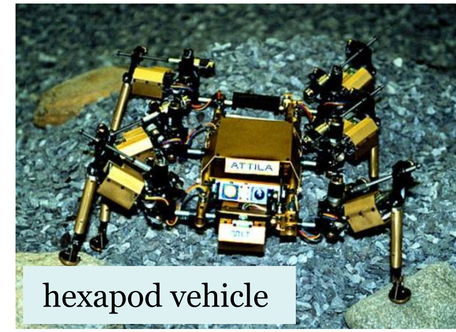
  Nanorobotics is the technology of creating robots at or close to the scale of a nanometre (10^{-9} metres). The first useful applications of nanorobots will likely be in medical technology. Another application is the detection of toxic chemicals, and the measurement of their concentrations, in the environment.



Robot's Future

- **Biologically-inspired Robots**





hexapod vehicle

OmniTread Robot

Genghis II

Cybor

Robot's Future

- **Emotional Robots**

Albert HUBO – Hanson Robotics

Robot's Future

- **Emotional Robots**

Ibn Sina Robot

Interactive Robots and Media Lab - UAE University

YouTube http://www.youtube.com/watch?v=OIOtOmyySQo

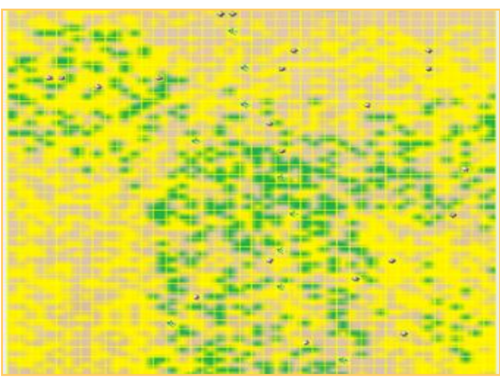
Robot's Future

- **Multirobot Systems**

Urban Surveillance

Net-centric Warfare

Search and Rescue



Minefield Mapping

Intelligent Carts

Nano and Pico Satellites

More info: Alaa Khamis, Cooperative Multirobot Systems. Available at: http://ras-egypt.org/activities.html

Thank you for your attention

Questions?