INTRODUCTION TO ROBOTICS

(Kinematics, Dynamics, and Design)

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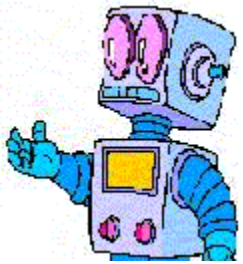

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TEXT BOOK

Introduction to Robotics: Mechanics & Control

By: J. J. Craig, Prentice Hall, 3rd Edition 2005, 2nd/3rd Edition, Translated to Farsi; By A. Meghdari & F. Mirfakhraei, et.al. SUT Press, 1374, 1377, 1384, 1388.

REFERENCE BOOKS

- **Intelligent Robotics Systems; by Mohsen Shahinpoor, ERI Press, 1994.**
- **Fundamentals of Robotics; by R. J. Schilling, Prentice Hall, 1990.**

COURSE OBJECTIVES

At the end of this course, you should be able to:

- Describe and analyze rigid body motion…
- Write down manipulator kinematics/dynamics and operate with the resulting equations…
- Solve inverse kinematics/dynamics problems...
- Design and select robots for performing various robotic tasks…
- Solve trajectory and motion planning problems…
- Program manipulators to perform various motions…

TOPICS

- Introduction to robotics terminologies & applications
- Review of current robotics research (Videos)
- Robot arm mechanism's designs & grippers
- Mathematical tools: spatial descriptions & transformations
- Robot manipulator kinematics
- Inverse manipulator kinematics/workspace
- Jacobians: velocities & static forces, singularities
- Robot manipulator dynamics: Newton-Euler & Lagrangian equations of motion
- Robot trajectory and motion planning/generation
- Robot Design, and Robot Programming Languages
- Laboratory robot's motion programming & task planning

GRADING POLICY

- **Mid-Term Exam: 30%**
- **Final Exam: 30%**
- **Homework*& Quiz(Weekly): 15%**
- **Lab/Seminar Projects: 25%**

OFFICE HOURS

- **Tuesdays: 3:00 to 4:30 PM**
- **Tel: (021) 6616-5541, 5548**
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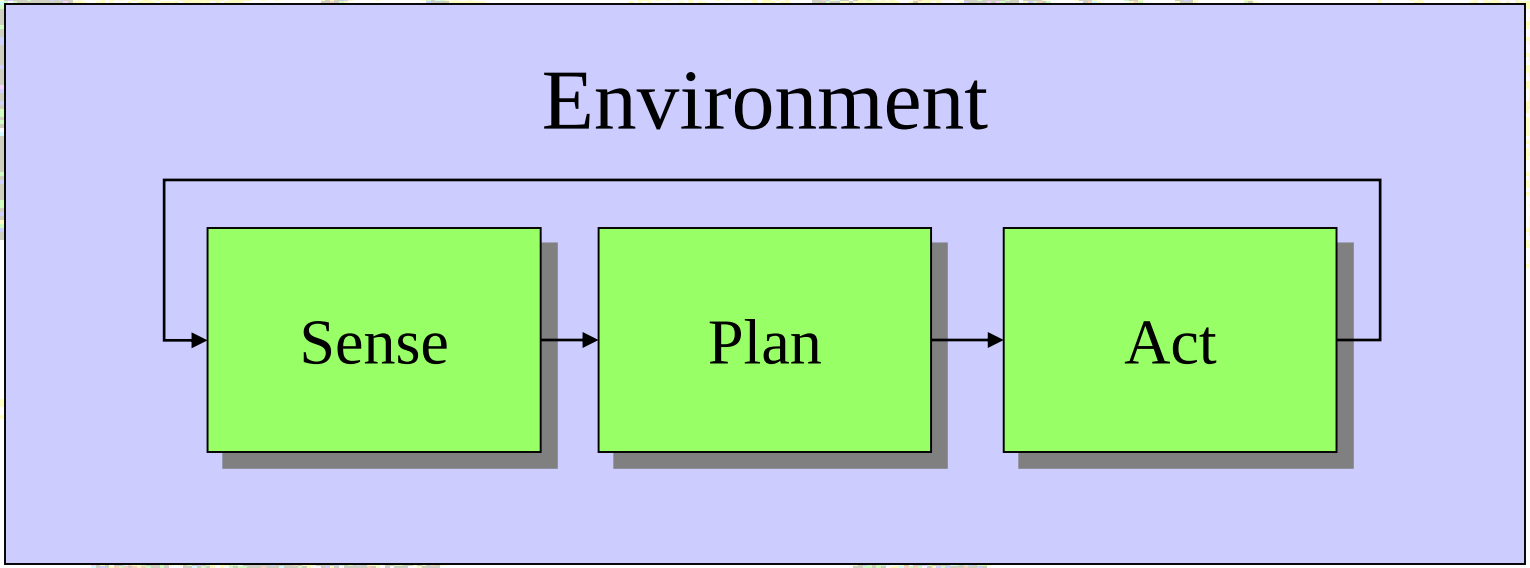
Basic Issues in Robotics

A Robot is an entity that can sense, think and act!



- ***How to SENSE?***
- ***How to PLAN?***
- ***How to ACT?***

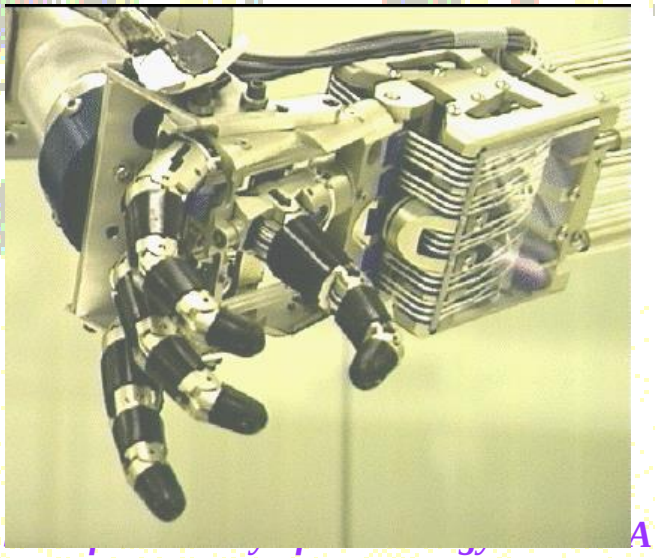
Primitive Robotic Functions

- ***SENSE***
  - The function of acquiring information from the environment (i.e. bump sensors, optical sensors, …).
- ***PLAN***
  - The function of determining high-level tasks to accomplish Various AI techniques.
- ***ACT***
  - The function of producing low-level actuator commands (i.e. Turn on motor one for a few seconds).

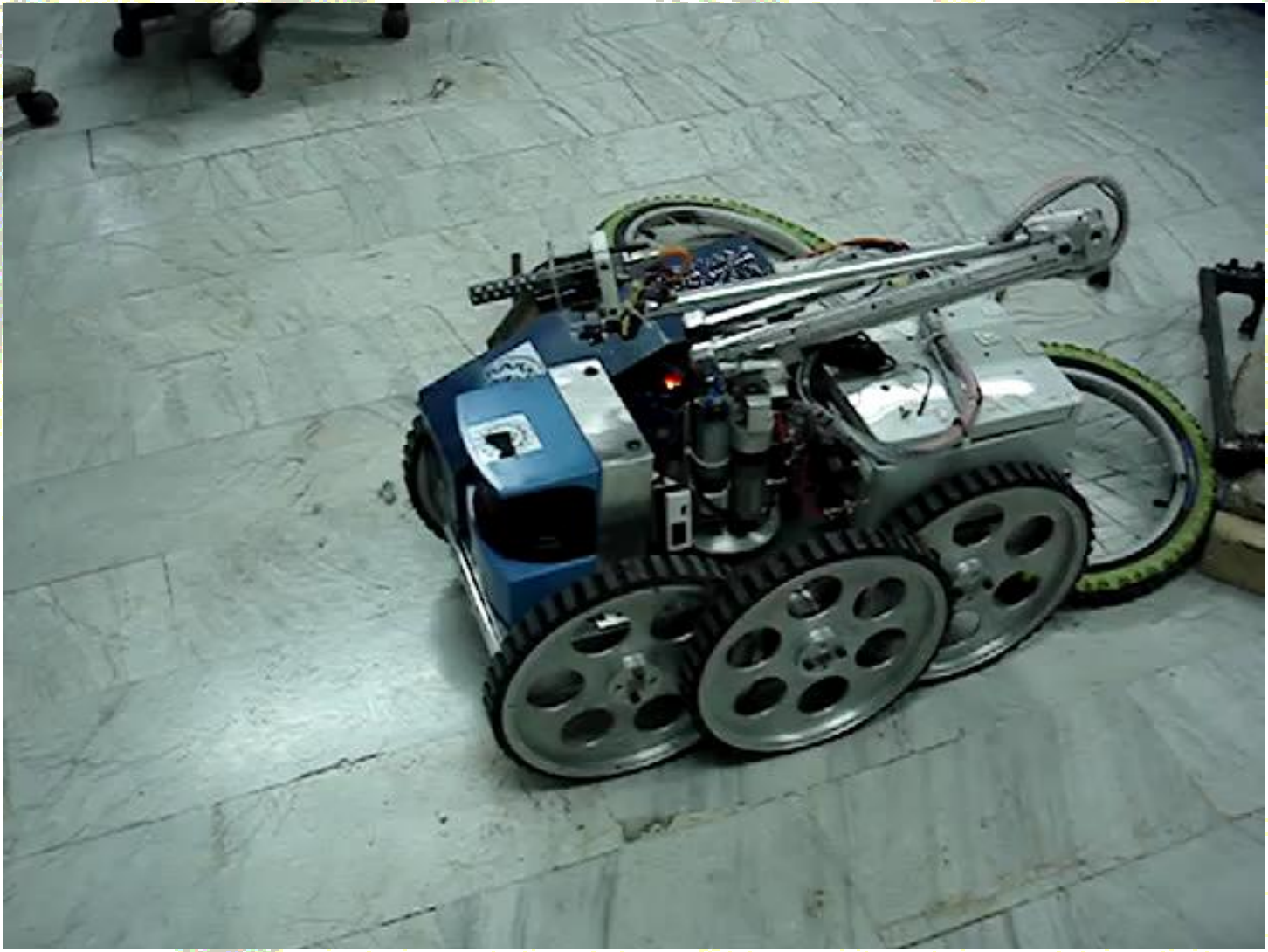
What are Robots Made of?

- Sensors
  - cameras
  - ranged finders
  - touch sensors
- Computer
  - embedded controller and microprocessor
- Actuators
  - wheels or legs
  - manipulators (gripper or hand)

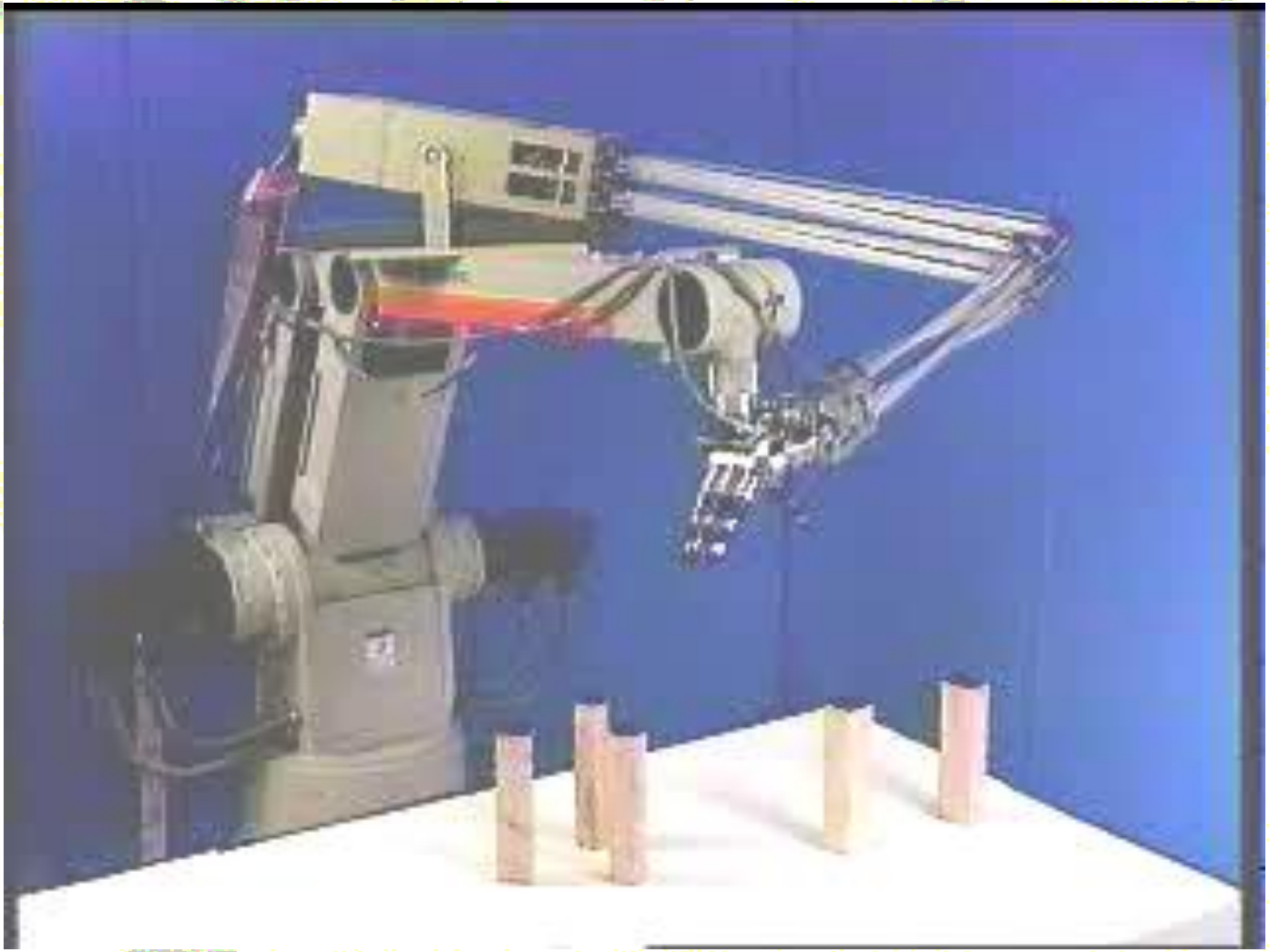
Robot Samples



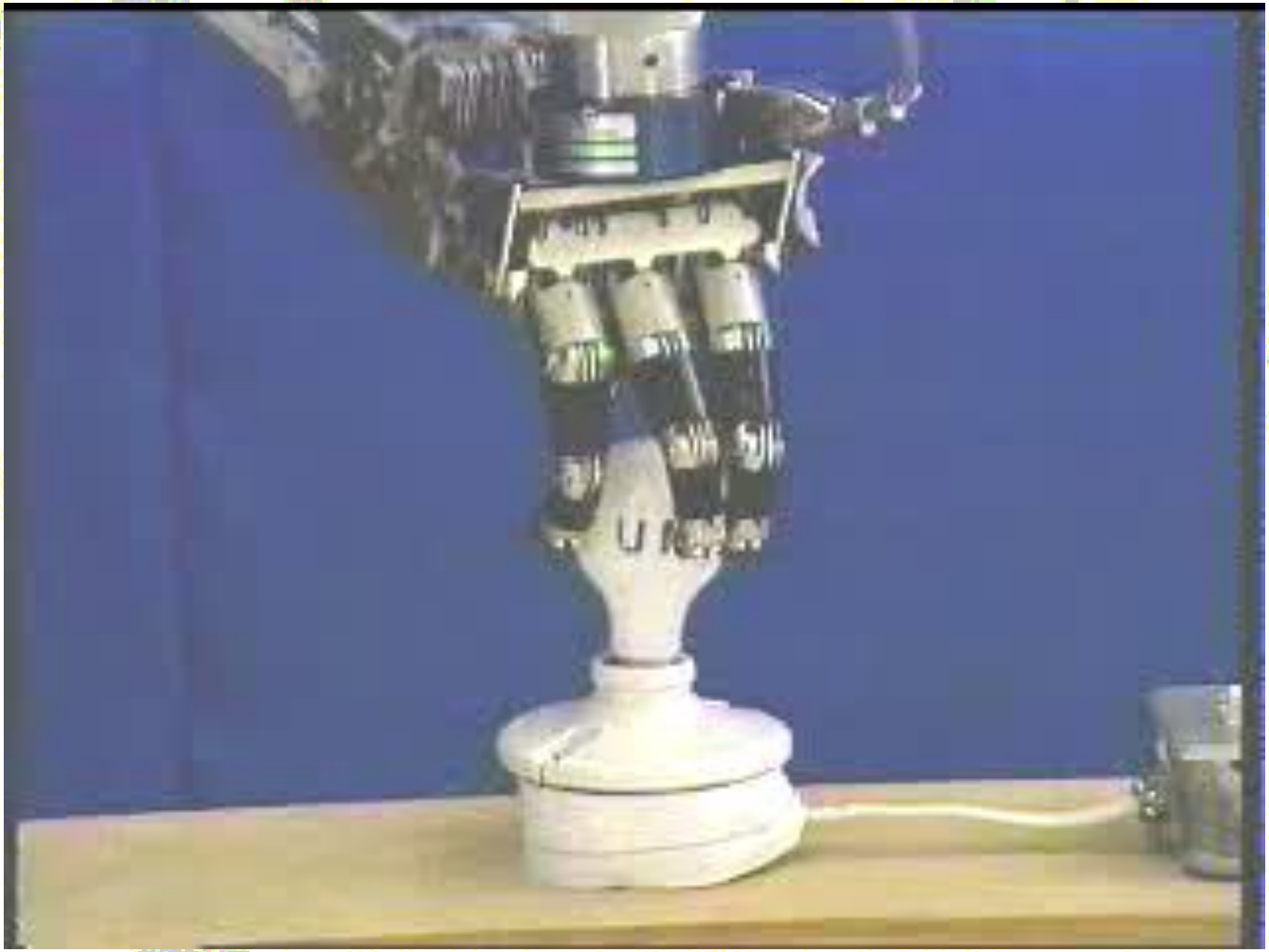
Robot Demos - Rescue



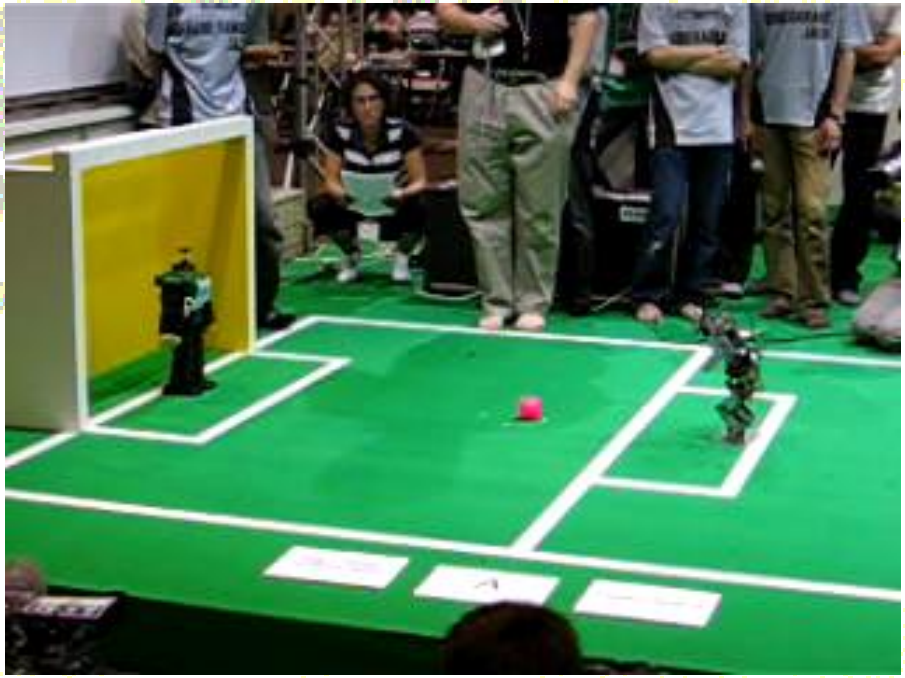
Robot Demos – Pick & Place



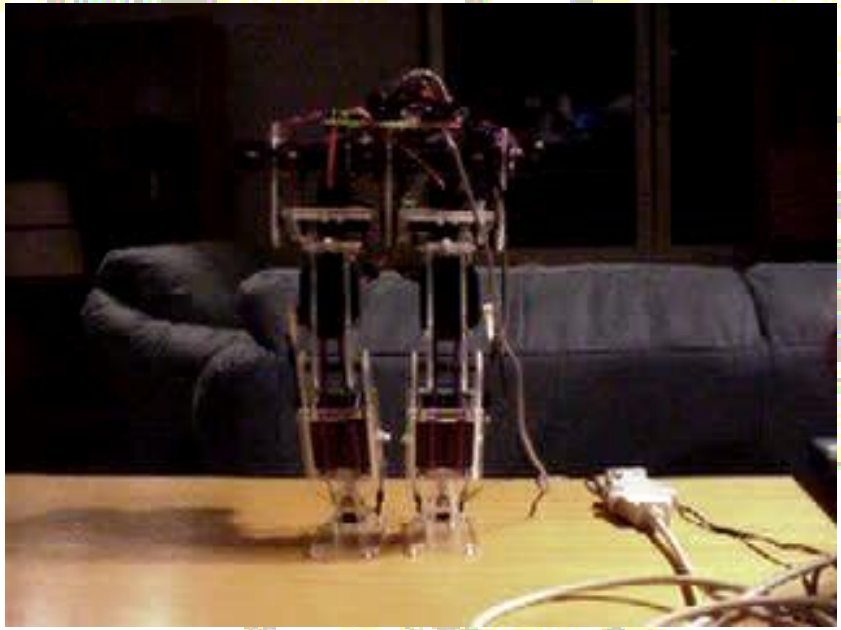
Robot Demos



Robot Demos - Humanoid

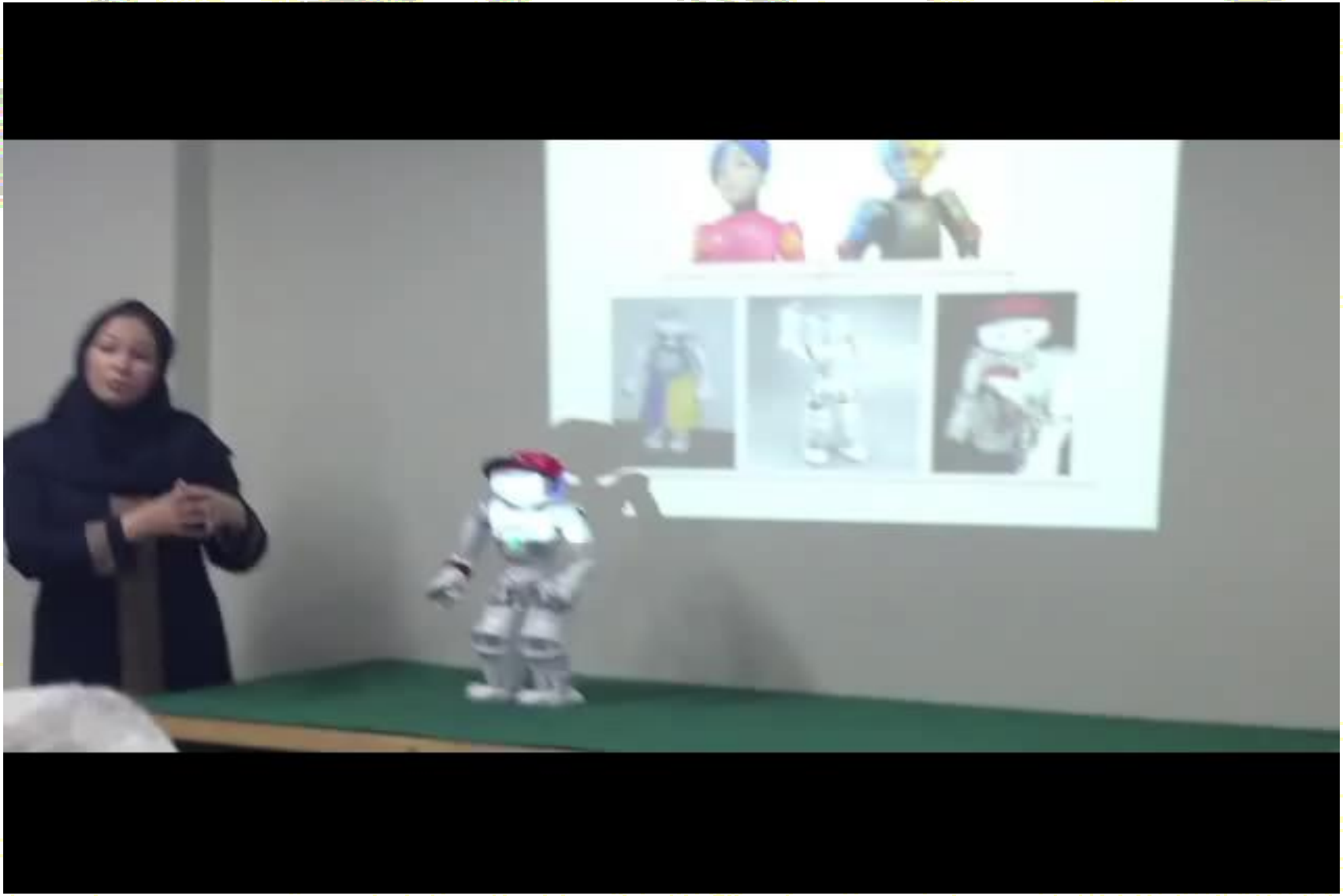


Robot Demos

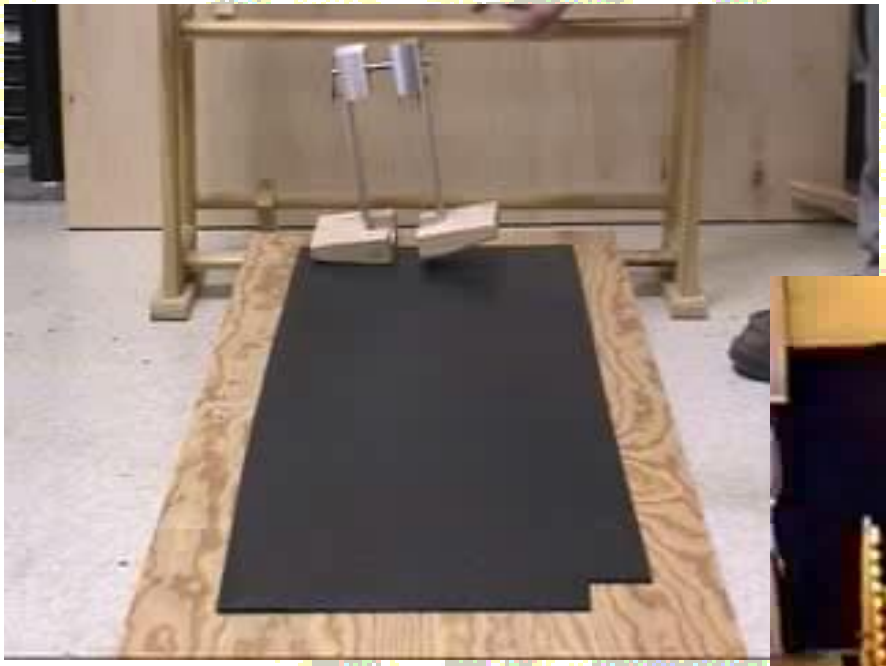


Walking.avi

Applying Robots as Teaching Assistants in EFL Classes …

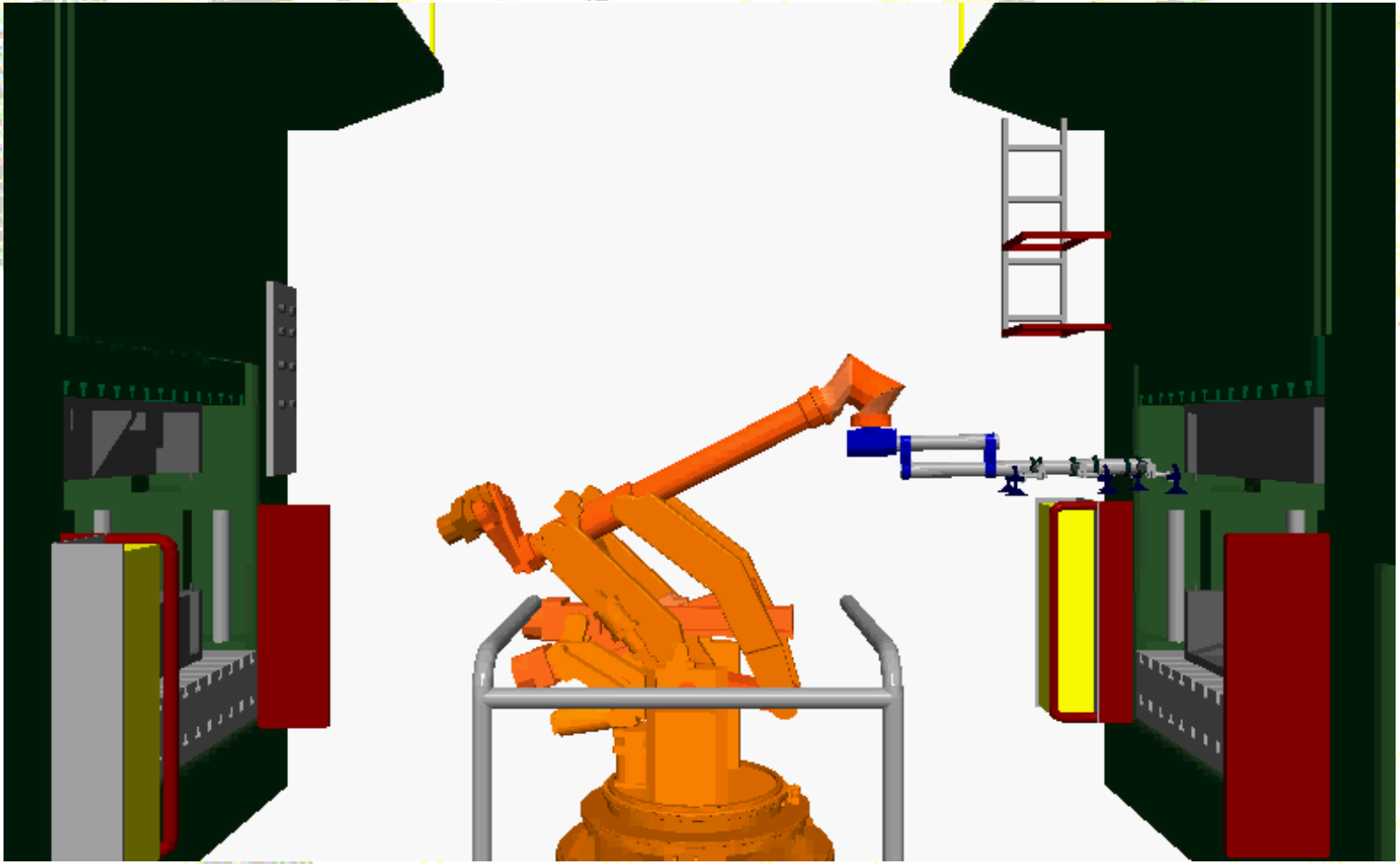


Passive Robots - Humanoid



Robot Demos

Robot Demos



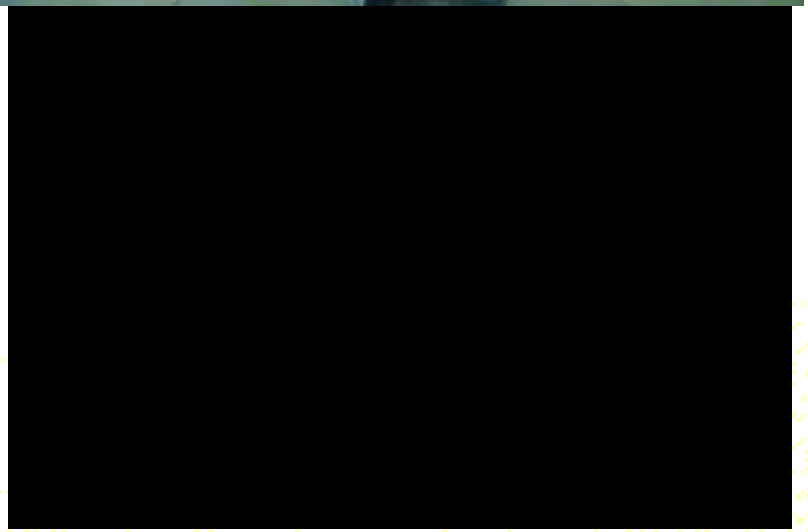
Robolens: A Clinical Surgery Assistant RobotBird, 1386 (2007), A. Mirbagheri, F. Farahmand, A. Meghdari

Laparoscopic surgery is a specific branch of Minimally Invasive Surgery (MIS) that is performed in the abdominal cavity. In this method "ROBOLENS" helps the surgeon by holding and moving the laparoscopic lens (camera) under his/her supervision during the surgical operation and acquires a stable view from the surgical site. It can be controlled by Voice commands or by a smart foot switch system.

The project is accomplished and the robot has passed technical and clinical tests at the Imam Khomeini Hospital Complex, Tehran, Iran.

Animal Like Robots

A Flying Insect



Animal Like Robots

Swarm Robots (توده رباتها)

Animal Like Robots

Animal Like Robots