智能設計、自動化及製造研究中心
Centre for Intelligent Design, Automation & Manufacturing

City University of Hong Kong

Professor SK Tso

Director of Centre

Mission

- to advance engineering application and development of machine intelligence
- to integrate machine intelligence harmoniously with human intelligence

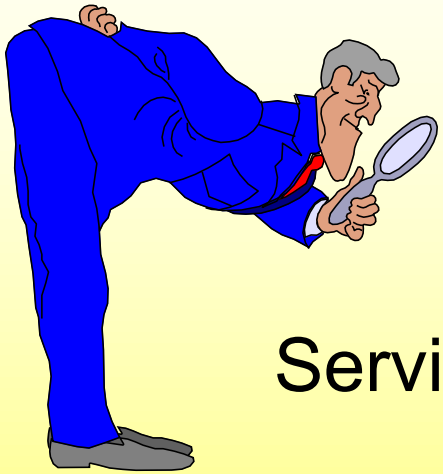
Focus

- Intelligent design
- Intelligent automation
- Intelligent manufacturing

CIDAM Objectives

- Increase applied research output in terms of application-specific development and creative system integration
- Facilitate technology transfer in area of intelligent automated systems
- Steer industry-funded projects to more independent operation
- Foster academic and research links and collaboration with institutions with similar interests
- *Organise regional and International conferences, workshops and seminars*

A key R & D Area



Service Automation & Robotics

What Service Robots?

- Exist in many forms, shapes and sizes, not usually man-like
- Provide a wide range of services
- Typical examples
  - glass curtain wall cleaning, pipe inspection, surgical aid, nursing and entertainment
- Often coexist and cooperate with human beings, as assistants, as friends

Why Service Robots?

- Provide good, consistent and reliable services unaffected by the problem of fatigue
- Improve productivity and quality of services
- Assist daily routine but essential work
- Enhance the quality of life for the elderly and the handicapped
- Operate in hazardous or unpleasant environments
- Provide educational or stimulating entertainment

Opening of the Workshop on Service Automation and Robotics

The Workshop on Service Automation and Robotics

Keynote Speakers

Prof. Tso, Prof. Dillmann, Dr. Engelberger, Prof. Schraft, Prof. Fukuda

Service Robotics Research Laboratory

Officially opened by Dr. Joseph Engelberger, Father of Robotics

Service Robotics Research Laboratory

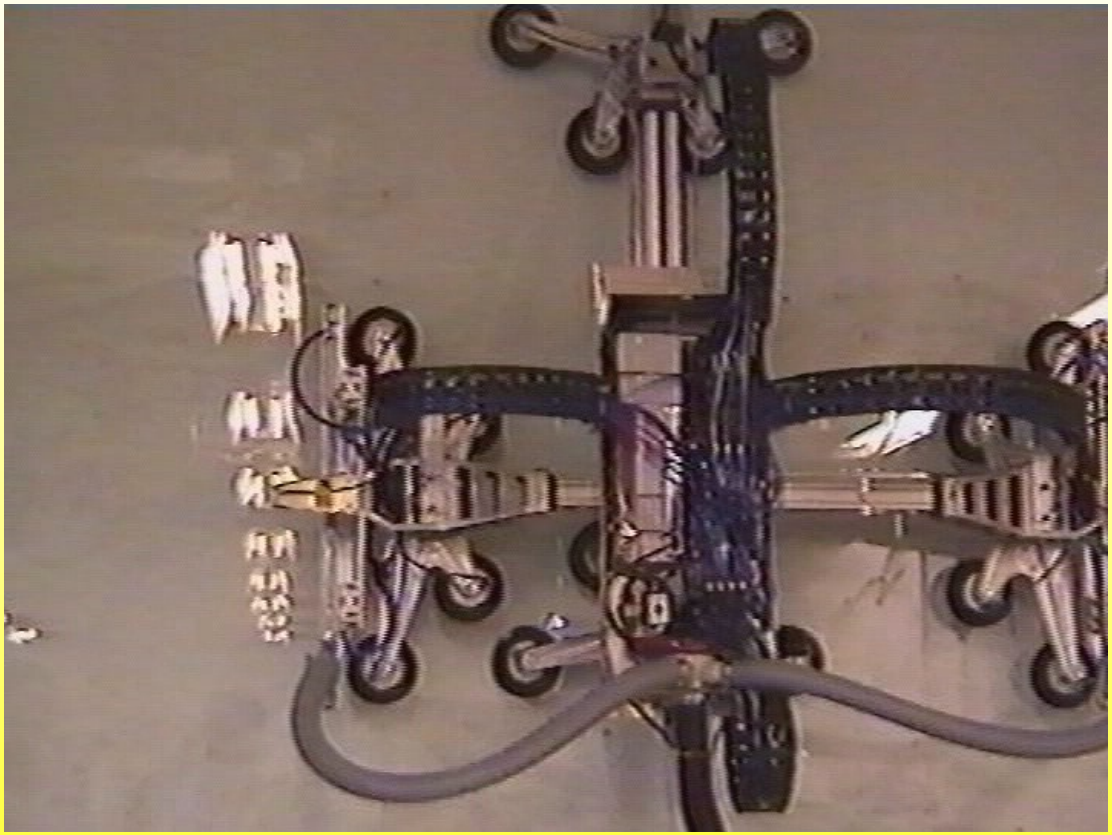
Service Robotics Research Laboratory Opening Plaque

智能設計、自動化及製造研究中心
Centre for Intelligent Design, Automation & Manufacturing

Examples of CIDAM Service Automation & Robotics Projects

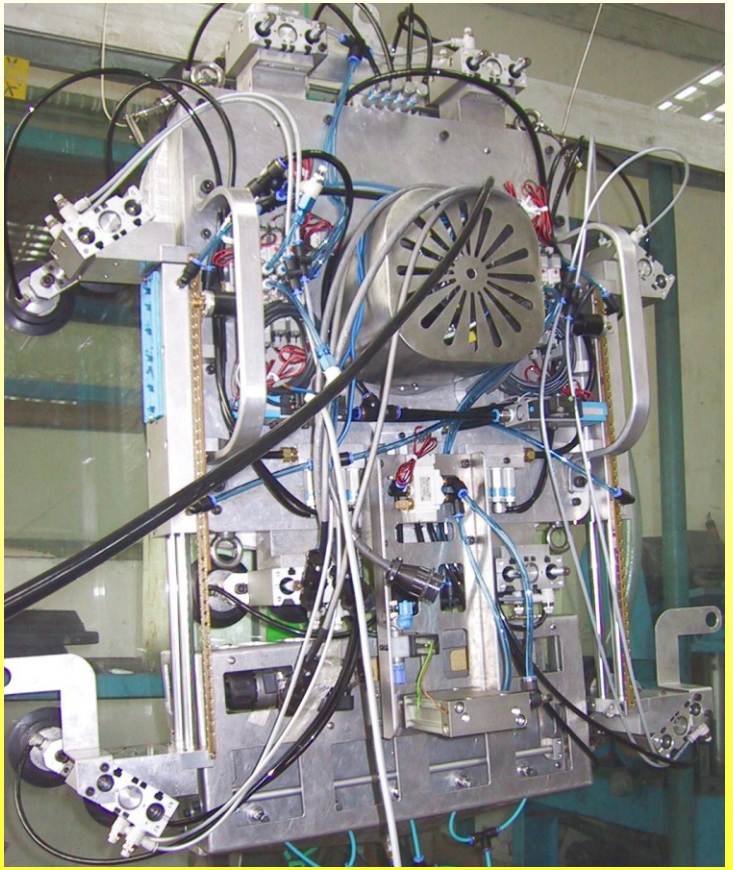
Cleanbot I Glass-Wall Cleaning Robot

- A glass curtain wall cleaning robot for high-rise buildings
- Inspecting tall structures
- Mobile advertising board
- Vacuum grippers for climbing walls
- Replacing expensive gondola systems



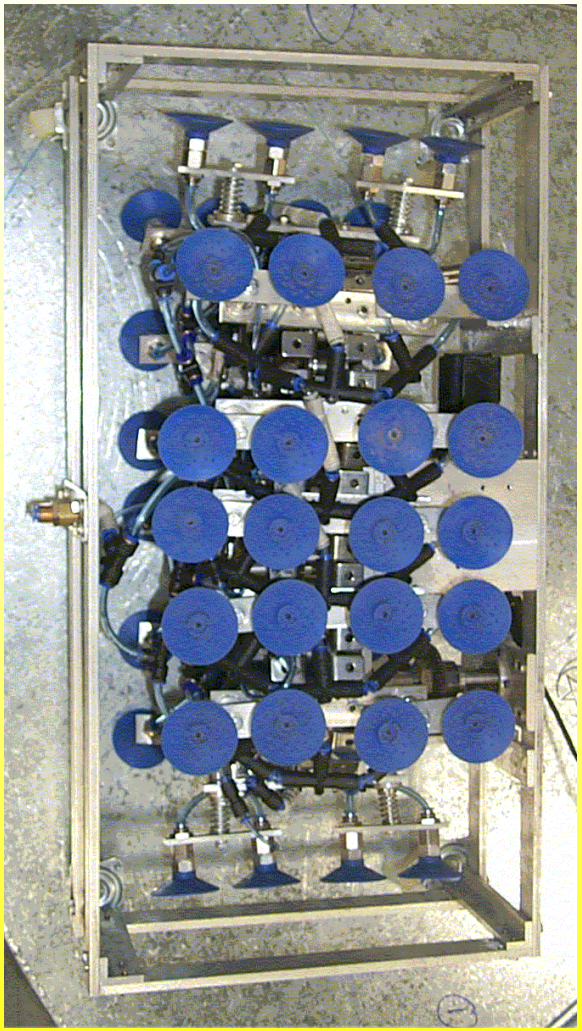
Cleanbot II Glass-Wall Cleaning Robot

- Fast moving robot for cleaning glass-curtain walls
- Single large gripper with wheels underneath for continuous climbing motions
- Legs for stepping over window ledges



Cleanbot III Glass-Wall Cleaning Robot

- A glass curtain wall cleaning robot for high-rise buildings
- Multiple vacuum grippers for secure climbing
- Track mechanism for continuous motions

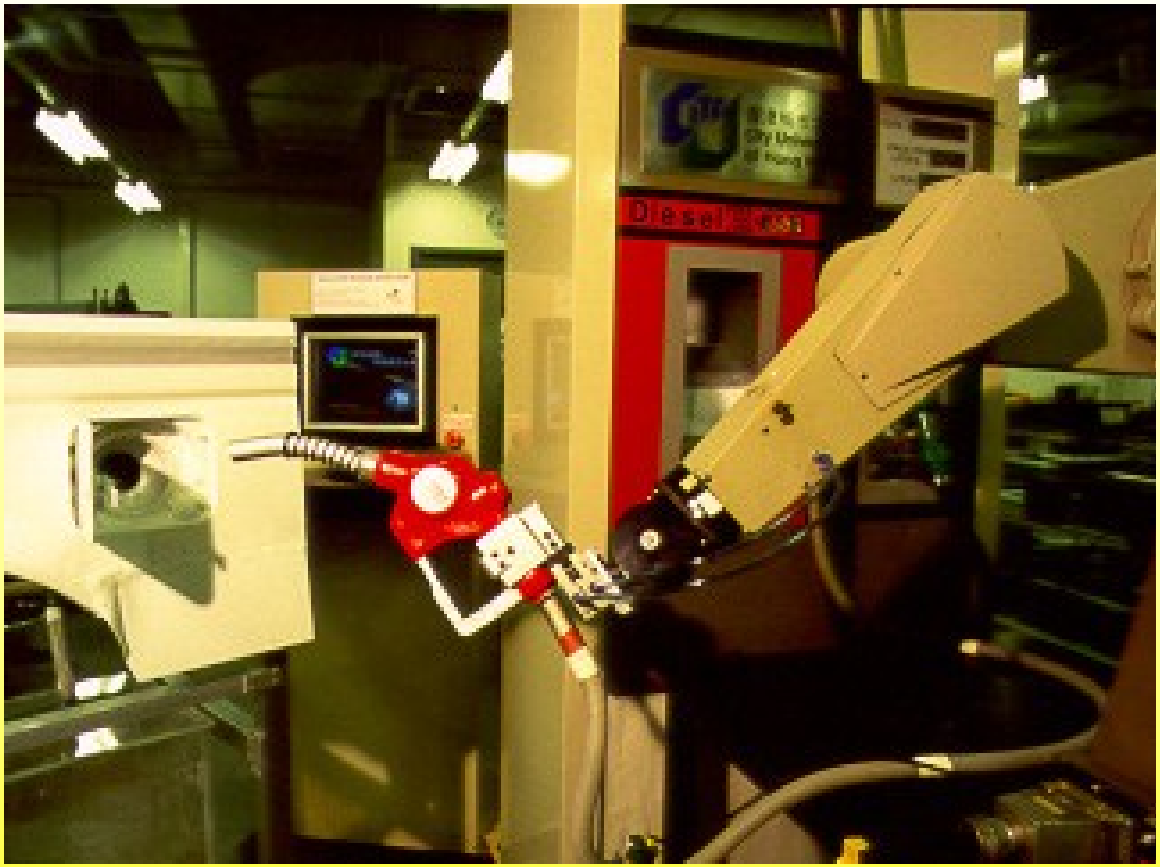


Ventilation Duct Inspection Robot

- A wireless tele-operated climbing robot for inspecting ventilation duct
- Magnetic gripper for climbing vertical surfaces inside ventilation ducts
- Carrying camera and small cleaning tools
- Track mechanism for climbing obstacles

Automatic Petrol Filling System

(First generation)



Automatic Petrol Filling System
(Second generation)

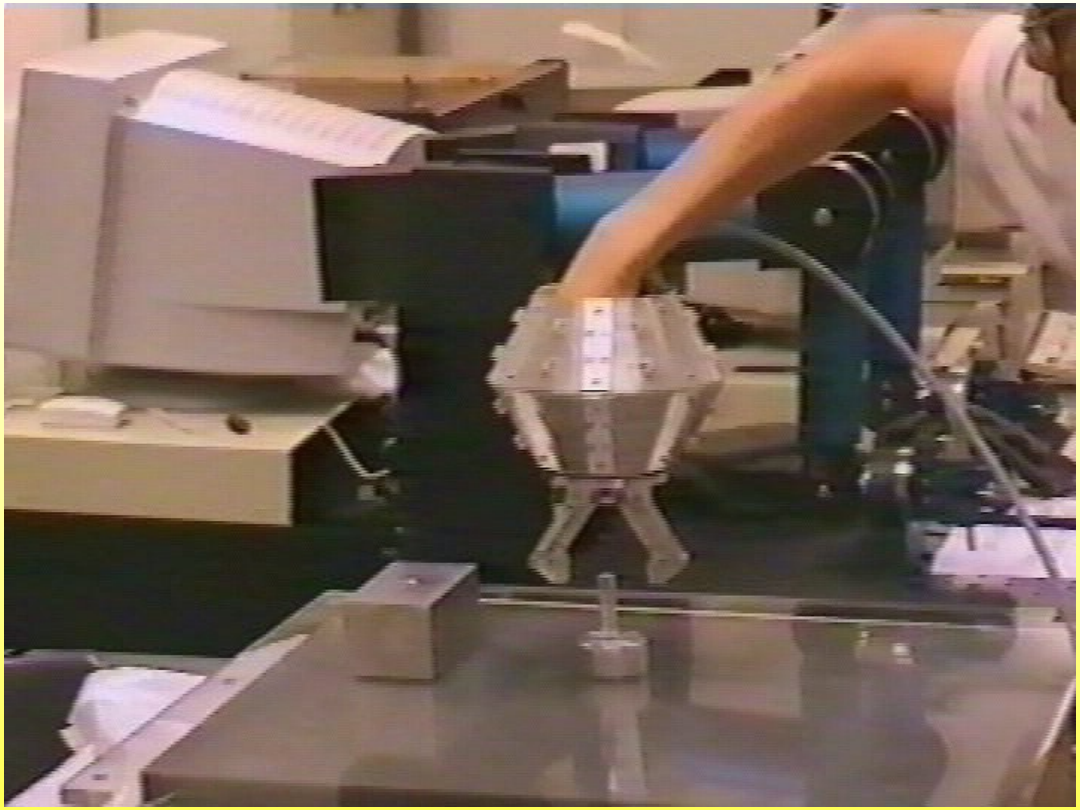
- Automatic petrol filling in unmanned stations
- A specially designed overhang robot
- Machine vision for accurate positioning
- Force sensing wrist for contact-free gun insertion
- Smart card system for all transactions

Baggage-carrying Robot

- An autonomous mobile robot for carrying baggage
- Special fibre-optic tactile sensors for collision detection
- RF and ultrasonic technology for tracking the baggage owner

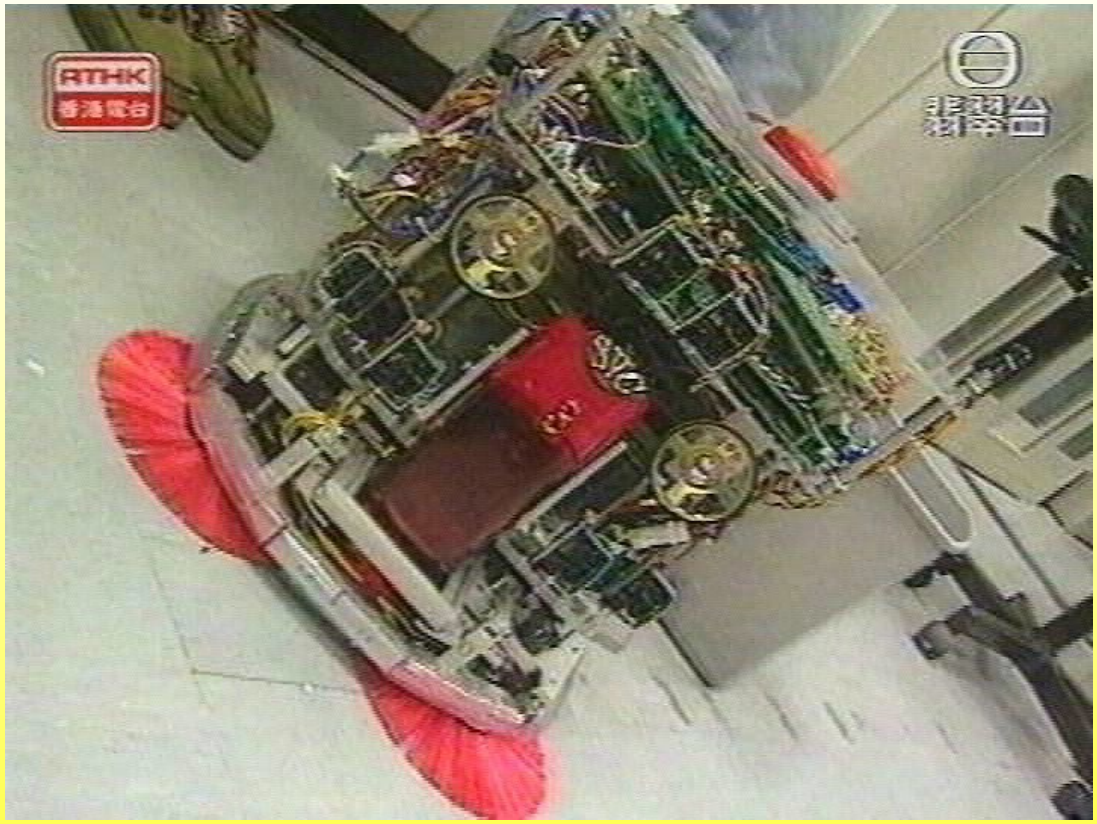
Automatic Robot Programming System

- Robot programming through human demonstration
- Transfering human intelligence to robot
- Hidden Markov Model for modelling service tasks



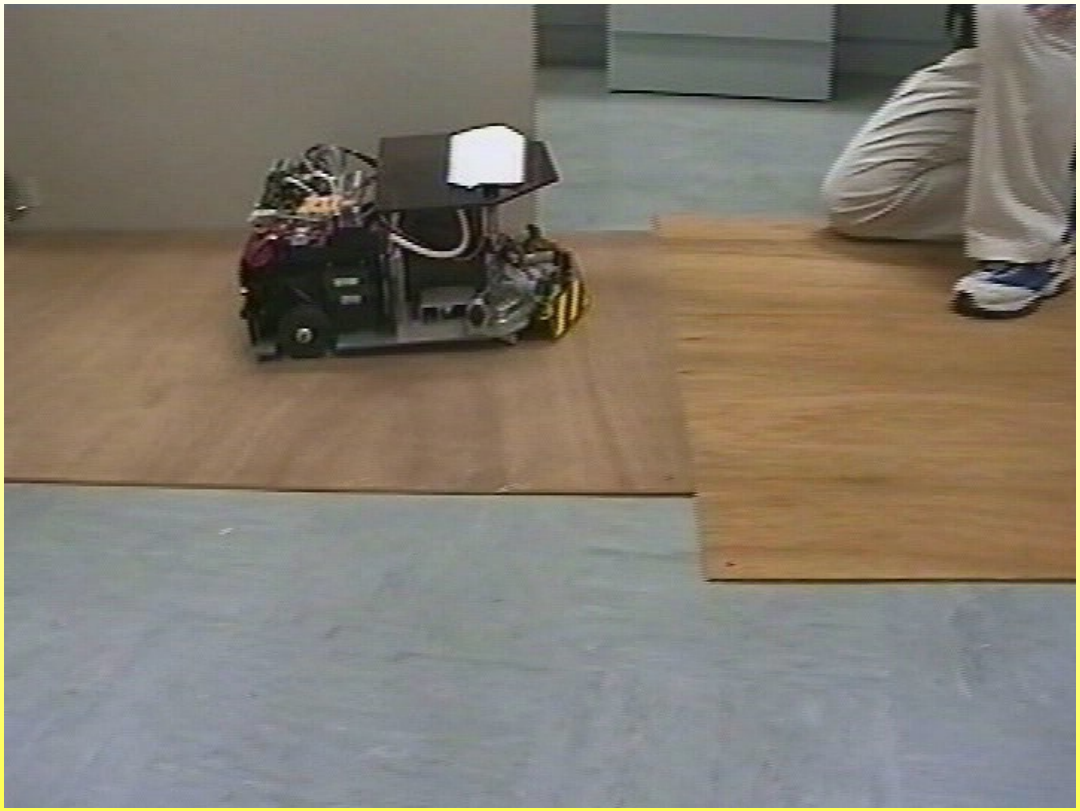
Automatic Floor Cleaning Robot I

- Cleaning in hot or contaminated environments
- Self navigation
- Obstacle avoidance using infrared sensors
- Suitable for cleaning large floor areas, e.g. in offices and shops, after working hours



Automatic Floor Cleaning Robot II

- Designed for cleaning areas under bed
- Self navigation
- Obstacle avoidance using infrared sensors
- Lowering risk of back injuries of human workers
- Reducing unnecessary contact between patients and non-medical staff

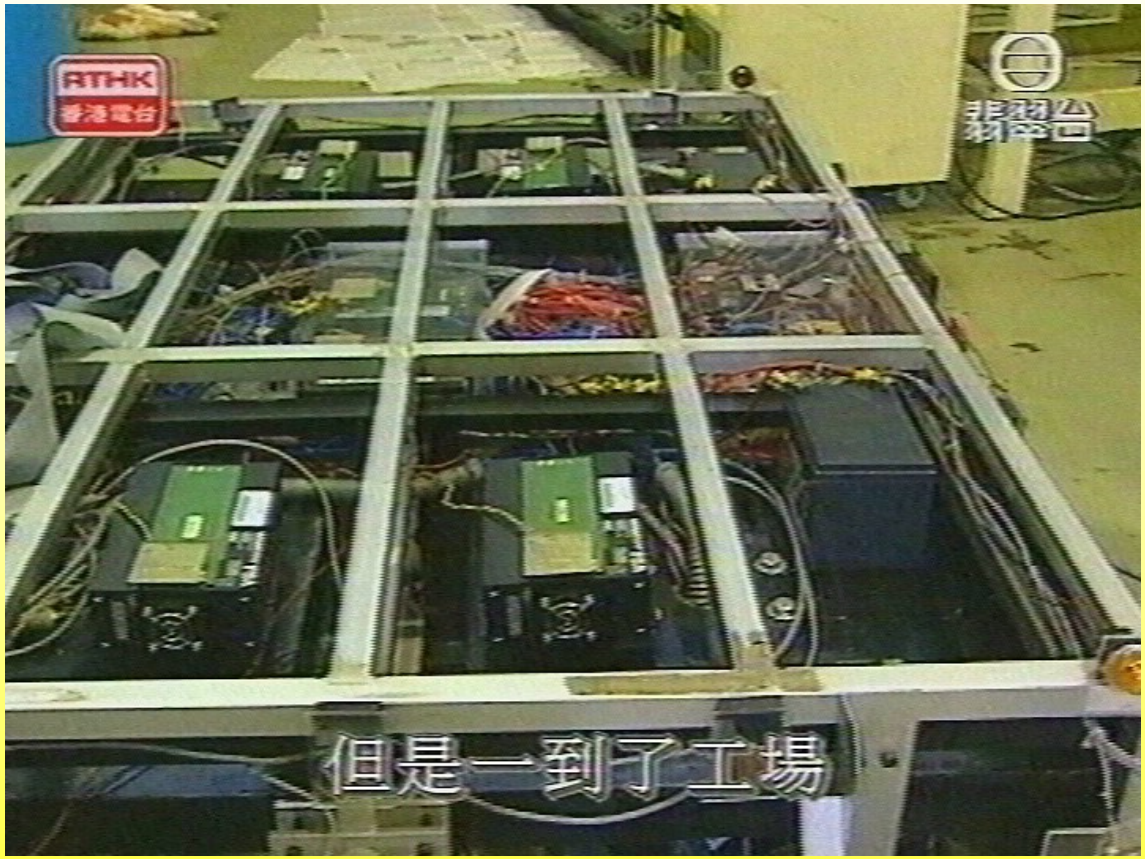


Multi-purpose Autonomous Robust Carrier for Hospitals

- An autonomous courier for hospital applications
- Moving trolleys or carrying heavy loads
- Operating lifts unassisted
- 2.4 GHz Wireless LAN for central communication
- Local navigation using beacons

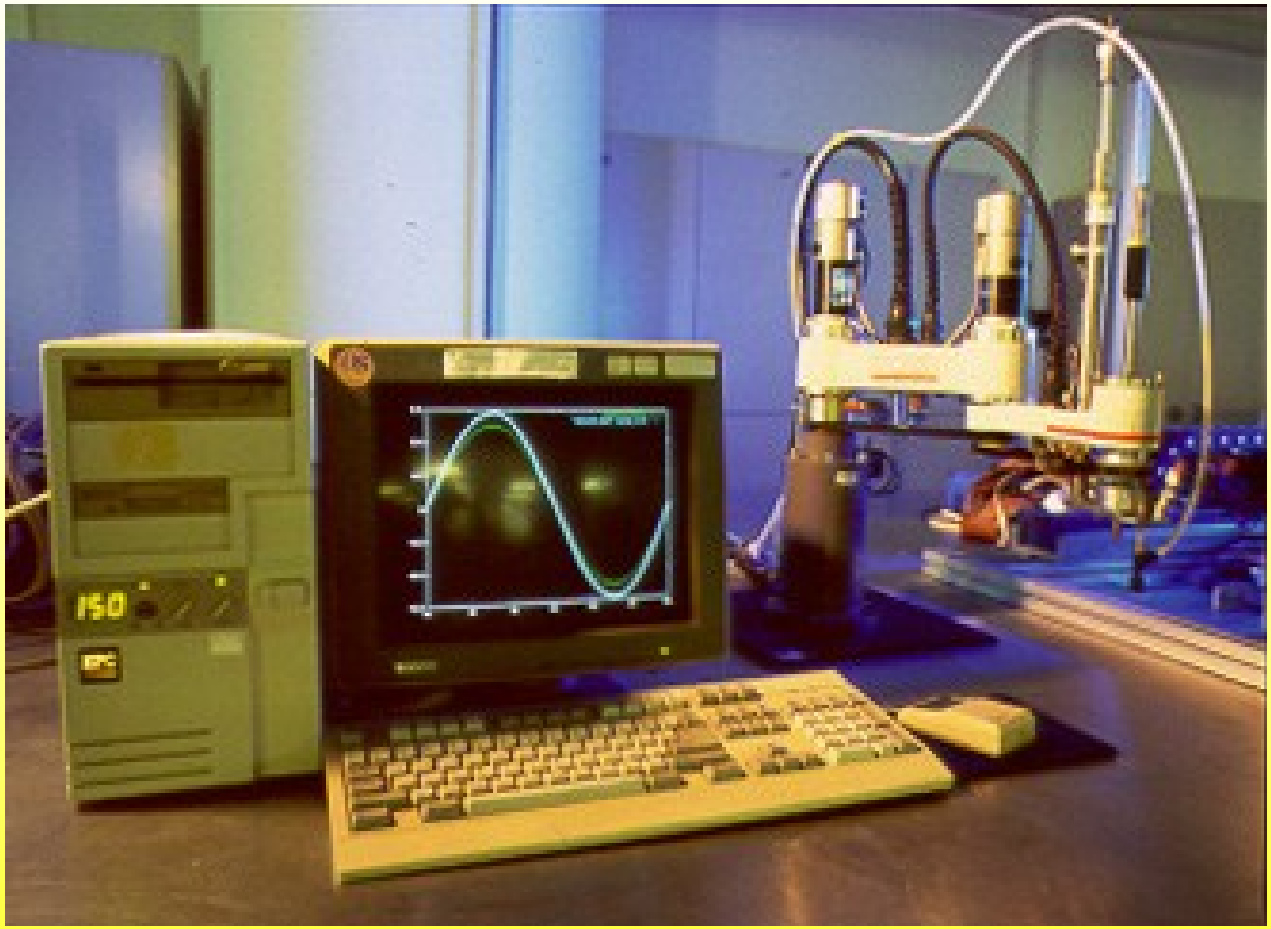
Autonomous Robot Carrier

- Self navigation
- Obstacle avoidance
- Driving with four steerable wheels
- 1-tonne load-carrying capacity
- Suitable for congested factory, airport, cargo terminal and warehouse applications



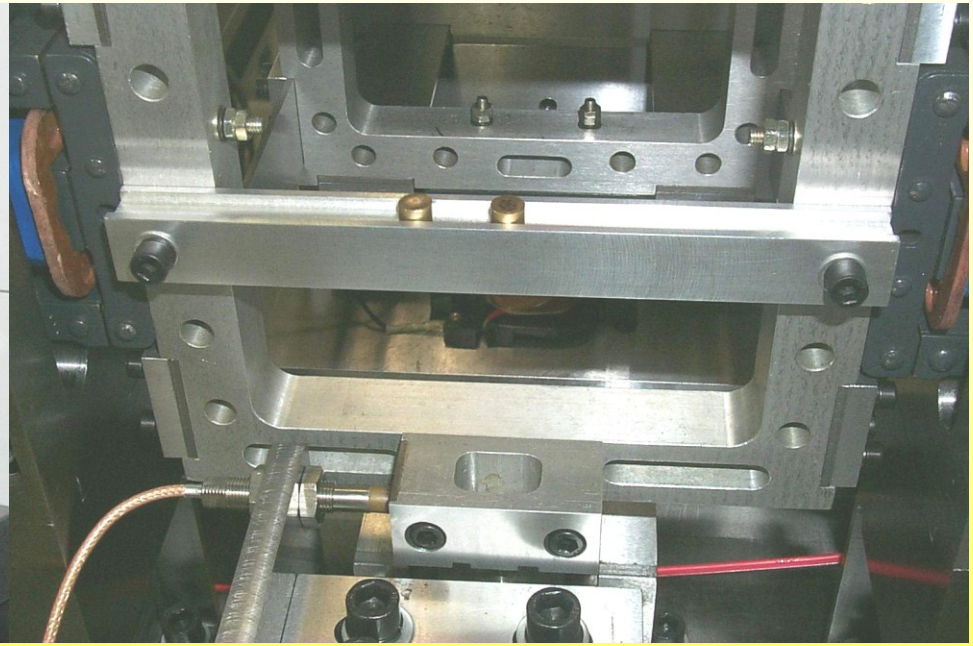
Virtual reality experiments

High-performance intelligent control of robots



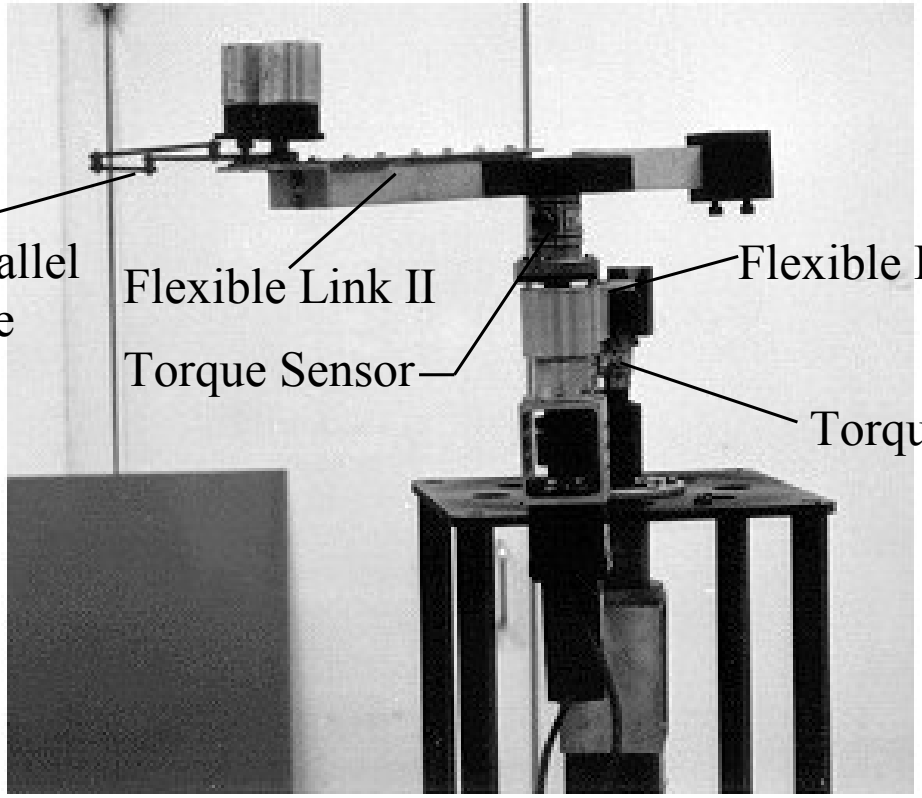
Sensor-based Flexible Vibratory Feeding System

Overall system



Feeding mechanism

Macro-micro flexible manipulator



Service Automation Projects for Power System Operation

- Power system stability, assessment and enhancement
- Data-mining for large power station databases
- System fault diagnosis
- Discovery of conflicting data for stability classification
- Reactive power optimisation