

# DI.SY.RE

## A Demonstrator for Distributed Industrial Systems Remotely Controllable

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# *Presentation Agenda*

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- **Objectives**
- **Overview**
- **The local infrastructure**
- **The Remote access infrastructure**
- **Current status of development**
- **Work in progress**
- **Conclusions**

## **Development of an experimental setup:**

- easy to use in classes and exhibitions
- challenging for teaching and research
- to be used in distance learning

# *Objectives*

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## ➤ **Teaching Domains**

- Industrial fieldbuses
- Real-time systems
- Control / distributed control systems

## ➤ **Main Research Applications**

- Medium access protocols for real-time systems
- Synchronisation

## ➤ **Demonstration Capabilities**

- Portable
- Visual inspection of correct operation
- Capable of supporting operational failures without personal or material damage

# *Presentation Agenda*

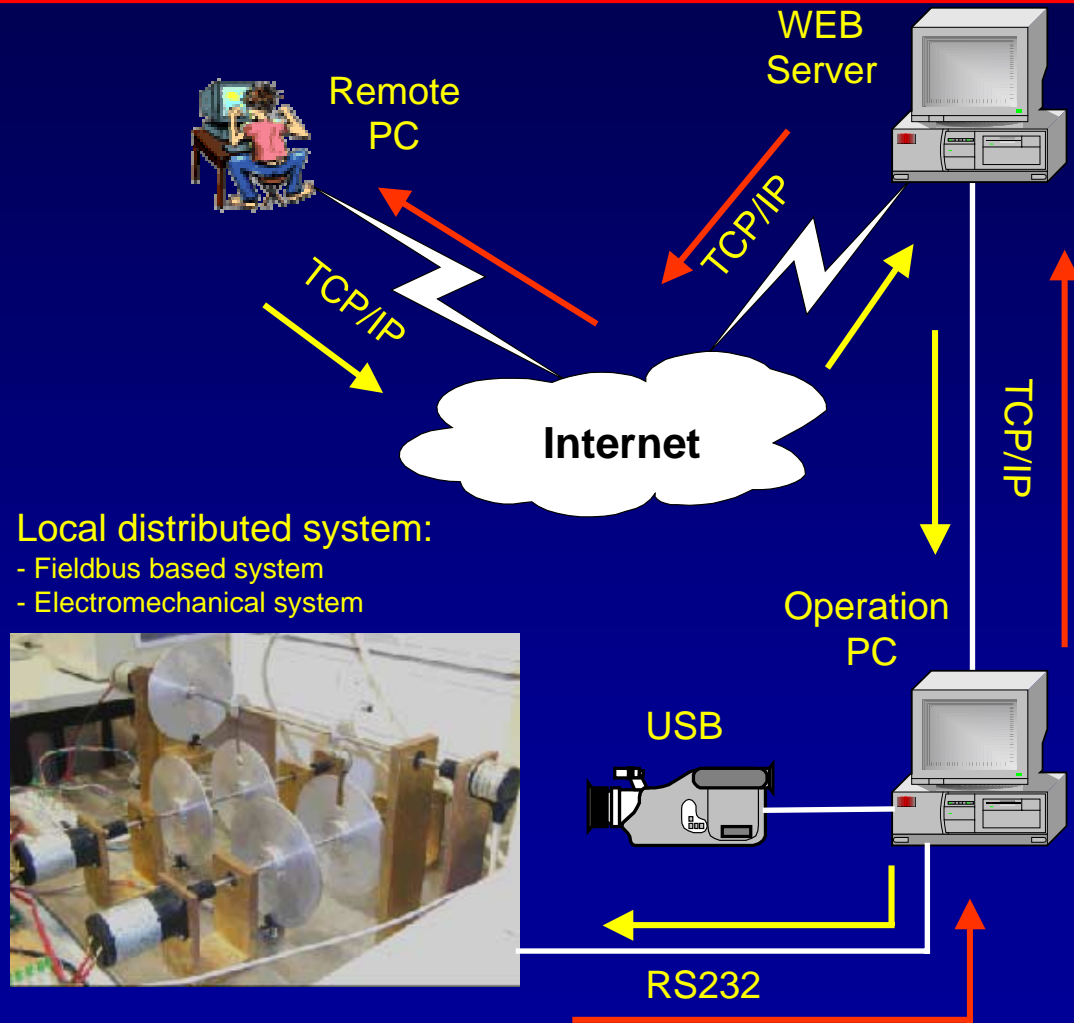
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## The DI.SY.RE system includes:

- **A local infrastructure** (standalone operation possible)
  - Electromechanical part
  - Local distributed system
- **A remote access infrastructure**
  - Client/Server architecture
  - Web Server
  - A set of tools to enable remote control

# Overview



Global system architecture

# *Presentation Agenda*

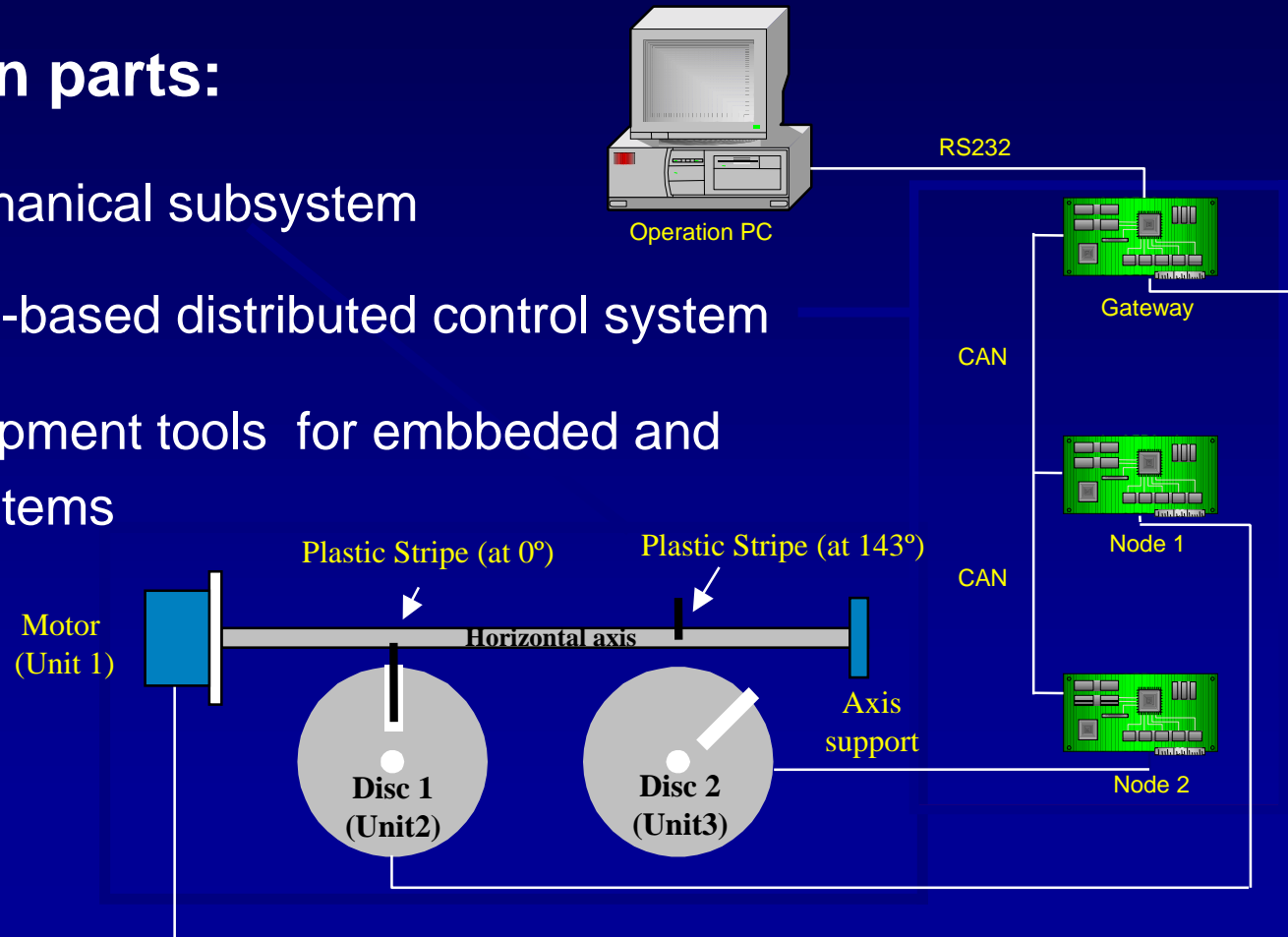
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# The local infrastructure

## Integrates 3 main parts:

- An Electromechanical subsystem
- A local fieldbus-based distributed control system
- A set of development tools for embedded and distributed systems



# *The local infrastructure*

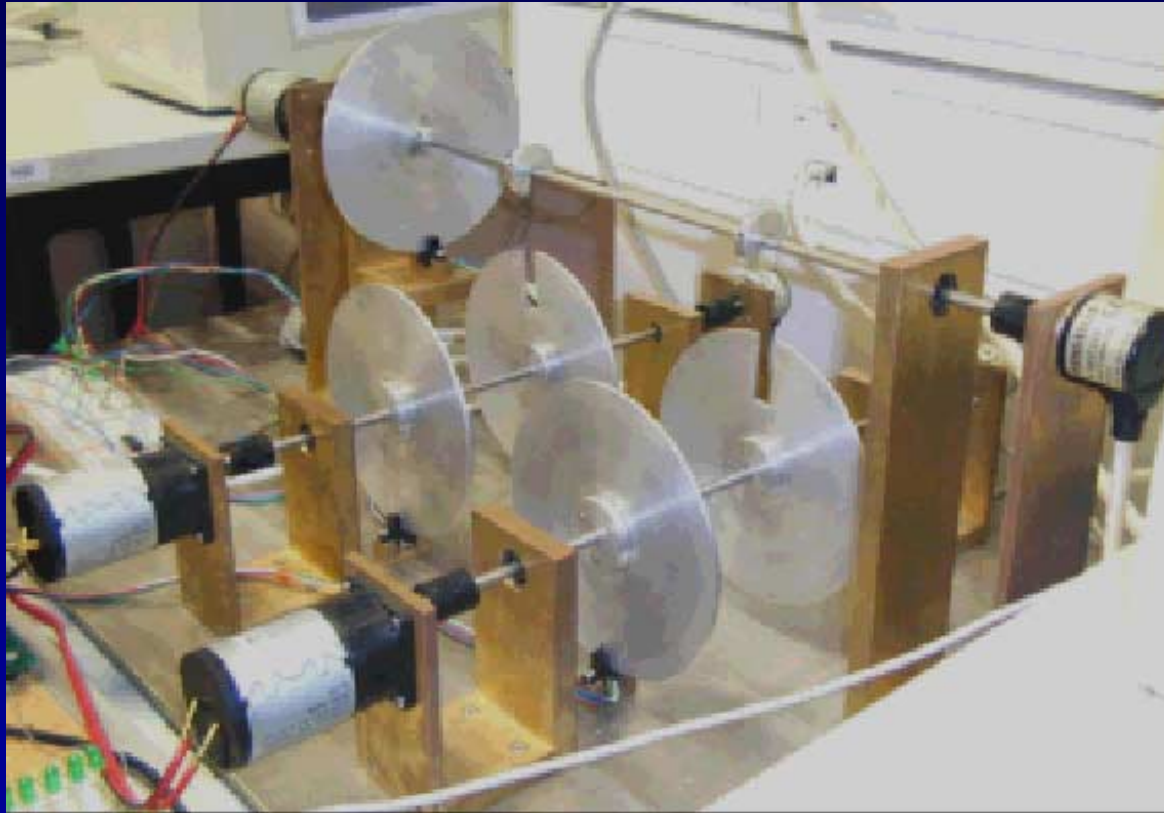
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## **Electromechanical Part:**

- 3 Axes with Motor / Encoder pairs.
- Speed / position control of each axis.
- Synchronisation between axes (plastic stripes must pass in disc slots).
- Easy to verify synchronisation.
- Portable (small and light).

# *The local infrastructure*

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A view of the electromechanical part

# *The local infrastructure*

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## **Local distributed system:**

- A PC that acts as an operation interface or development station (IDE - integrated development environment, loader, ...).
- A fieldbus (CAN- Controller Area Network).
- A gateway: connects the PC to the fieldbus.
- A set of microprocessor-based nodes.

NOTE: Special tools and procedures developed locally can be used to download programs from the PC to every node of the distributed system.

# *The local infrastructure*

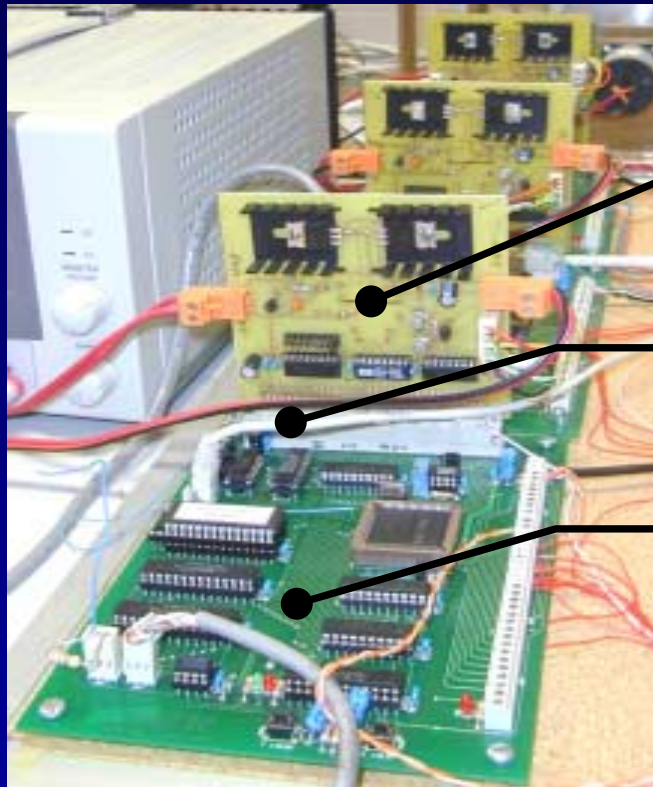
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## **Why the CAN (Controller Area Network) fieldbus:**

- CAN is currently under intensive research.
- Many applications in industry (automotive, process control, ...)
- Low-cost and availability of CAN controllers and of micros with CAN interface (due to automotive industry).
- Interesting MAC (medium access control) characteristics.

# *The local infrastructure*

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**Motor Drivers**

**CAN Bus**

**CANivete Board**

Microcontroller based boards and  
Interface electronics

# *The local infrastructure*

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## Summary:

- No damage if not operating properly.
- Similar to an industrial machine (machine-tool, robot).
- CAN bus
- A set of tools to enable local control

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# *The Remote Access Infrastructure*

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**A set of tools that enable a remote access to the local infrastructure, in order:**

- To illustrate the potentials and problems of accessing automation systems through Internet.
- To increase the accessibility to a distributed real-time system demonstrator (teaching, demonstration, research).
- To provide an infrastructure for distance learning by means of remote controlled experiments in fields such as:
  - Control algorithms
  - Distributed control systems
  - Distributed embedded systems

# *The Remote Access Infrastructure*

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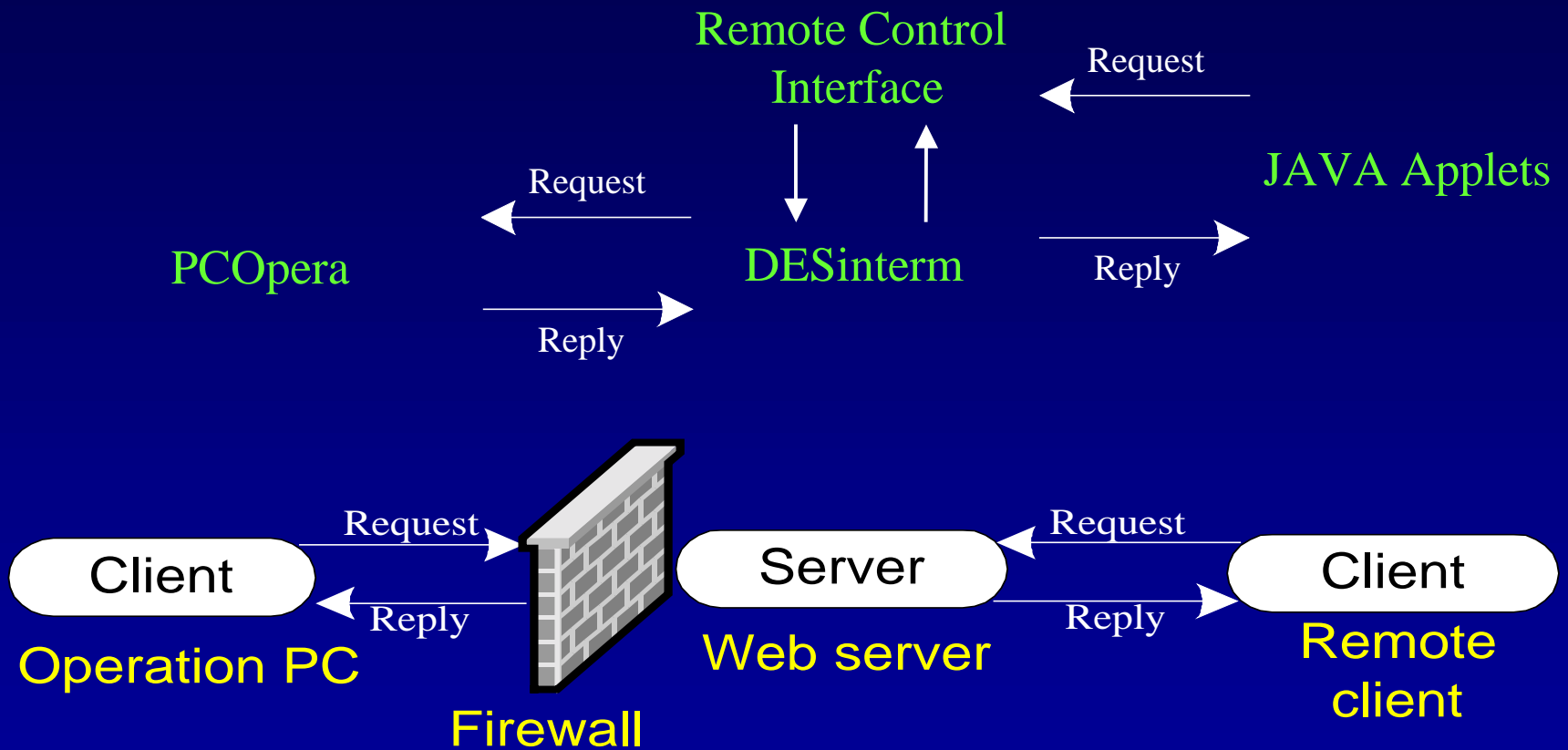
## **Remote access elements:**

- The operations PC (acts as an interface with the local infrastructure).
- A Web server.
- One or several remote clients (only one with control capabilities in each instant).

## **Additional elements:**

- A webCAM

# The Remote Access Infrastructure



Implemented communication scheme

# *The Remote Access Infrastructure*

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**The main characteristics of the implemented communication model are:**

- **Portability** – The operation PC and the web server can be easily replaced.
- **Flexibility** – It is possible to operate inside firewall or proxy server protected intranets.
- **Security** – A domain is used to access control.

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# *Current Status of Development*

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## **Operations in the local infrastructure** (also available in standalone mode):

- Turn on/off the system
- Change the motor's speed
- Select disc positions
- Select the control type (Local/Remote)
- Continuous operation with synchronisation at different speeds (under development)

## **Remote operation and monitoring**

- Remote speed programming
- Observation through Real Video
- Operation parameters visualisation (charts and tables)

# *Current Status of Development*

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## **Already implemented:**

- Electromechanical part, and associated electronics
- A set of tools for local/remote access and control

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# *Some of the Work in Progress*

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- **Enhancing the program download capabilities:**
  - Remote program download
  - Broadcast / multicast
- **Development of a test bed for studies on control algorithms, including distance learning:**
  - Remote experiments with download of control algorithms

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- **The DISYRE demonstrator can be a useful tool for education and research.**
  
- **Relevant characteristics:**
  - Remote access capabilities
  - Portability and robustness of the local electromechanical equipment
  - Similarities with real industrial systems
  - Easy verification of performance

# *Conclusions*

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Currently the system is not always available, since it is being used by final year students in their projects.

Some demonstrations can be scheduled, if someone is interested!!

[www.est.ipcb.pt/laboratorios/ari/projectos/19992000/desire/sim/default.html](http://www.est.ipcb.pt/laboratorios/ari/projectos/19992000/desire/sim/default.html)

# Questions ?

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