80C537 MICROCONTROLLER REMOTE LAB FOR A COMPLETE E-LEARNING TEACHING

M. Gilibert[1], J. Picazo[1]; M.E. Auer[2], A. Pester[2]; J. Cusidó[1], J.A. Ortega[1]

[1]Technical University of Catalonia
[2]Carinthia University of Applied Sciences

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Introduction

Microcontrollers:

- Basic subject in electronic engineering degrees
- Practical programming exercises
- Presence laboratory mock-ups

Higher educational trends:

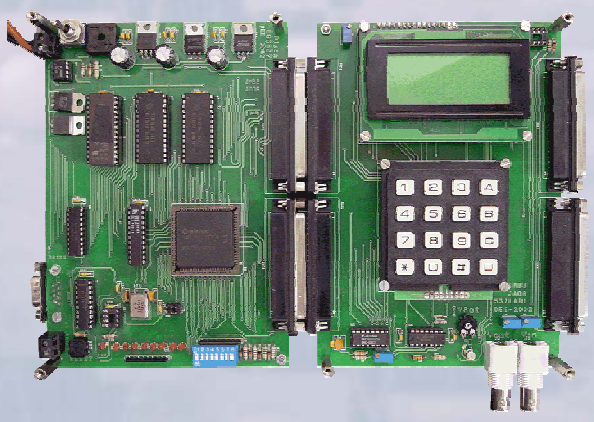
- Problem Based Learning approach
- Further accessibility to laboratory resources
- Facility to work avoiding displacements

Remote Labs:

- Help to improve the learning process

Development hardware: µDEE537

MAIN BOARD EXPANSION BOARD



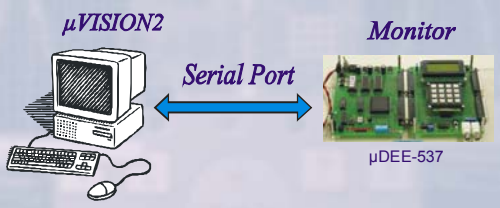
Main board:

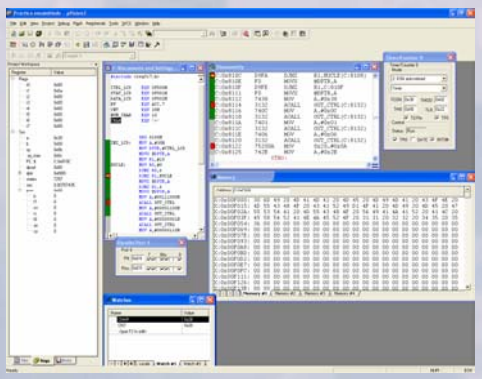
- Microcontroller 80537
- Memories
- Leds
- Switches

Expansion board:

- Keyboard
- Display
- Temperature sensor
- Position sensor
- Analogue I/O

Development software: µVision2





- Edit
- Assemble
- Debug
  - Simulator
  - Target

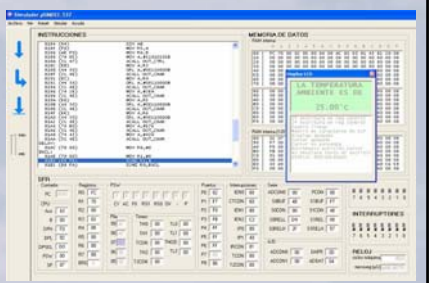
Virtual learning environment

e-Learning Platform:

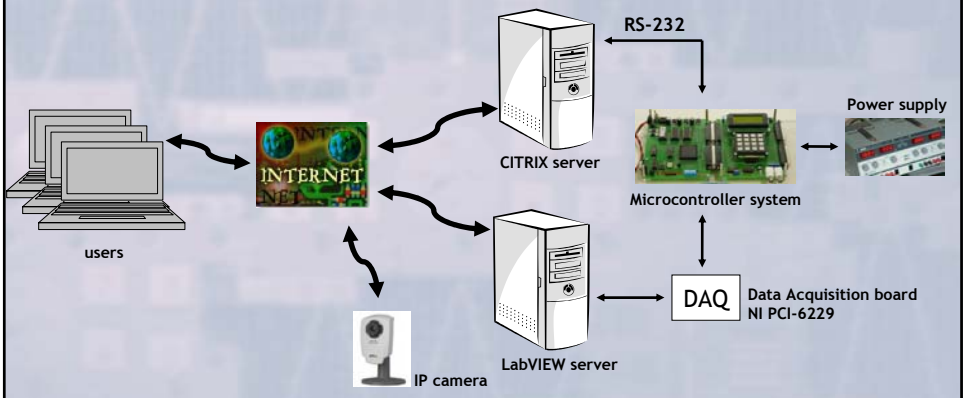
- Telematic communication environment
- Container for theoretical contents
- Accessible by means of a standard web browser: http://micros-ct.upc.es

Simulator µSim537:

- Practise without expensive equipment
- Use from home via Internet



Remote laboratory approach



- **CITRIX server** → debug information remotely
- **LabVIEW server** → remote human board interaction

Remote lab software

LabVIEW server:

- National Instruments (NI) LabVIEW 8
- NI DAQmx driver

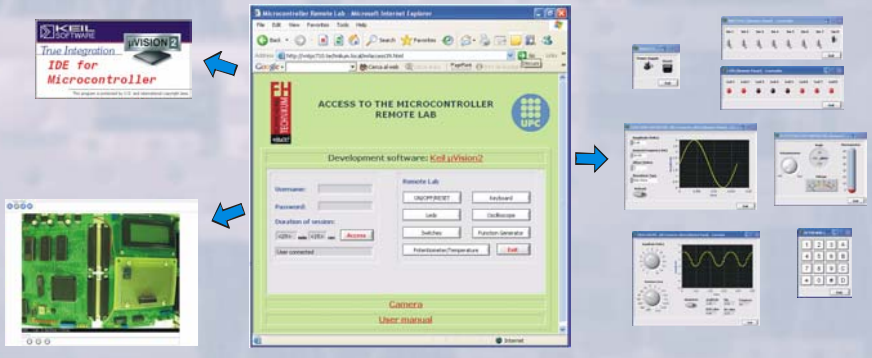
CITRIX server:

- Keil µVision 2
- Citrix MetaFrame

Client computer:

- NI LabVIEW Run-Time engine 8
- Web browser

Human board interface



User access control to permit the access to the physical system

Human board interface

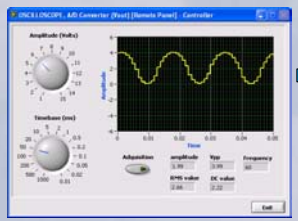
Switch on the board and reset the microcontroller

Value change of position and temperature sensor

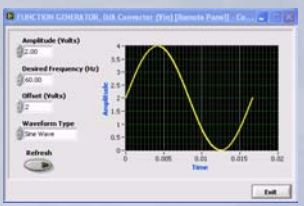
To monitor the state of the leds

Virtual keyboard to replicate the pressed key

Switch control to change the state of the switches

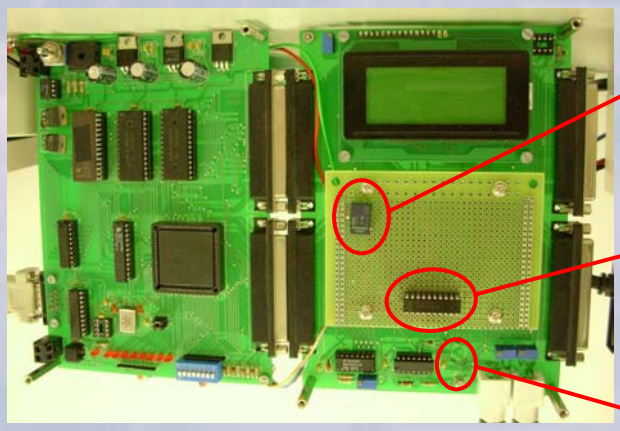


To visualise and measure the signals of the A/D converter



To generate a signal to feed the analogue input

Hardware mock-up modifications



Relay remotely controlled, to switch on and off the board

Buffer 3-state required for the correct function of the remote keyboard

Temperature and position sensor removed

Conclusions

- New self made remote lab for the 8051 microcontroller family has been presented, including successful practical results
- New changes in the learning process
  - Useful tool in PBL approach
  - Lab resources available 24 hours per day
- Improvement of the students satisfaction
  - Flexible schedule
  - Minimum displacements
- A complete e-learning teaching is achieved combining the virtual environment with the Microcontroller Remote Lab

Future work

- The user access has to be more secure and tough
- The VIs could be putted on the web in a way that avoids the user to download any extra software to run the application
- The possibility of contemplating more than one user working at the same time