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REPORT OF THE ACTIVITY OF SPES IN WP3

FOR THE PERIOD FROM NOVEMBER 2003 TO OCTOBER 2004

**THE WORK PLANNED FOR THE SECOND YEAR OF THE PROJECT IS
FOCUSED ON THE DESIGN, DEVELOPMENT AND FULL IMPLEMENTATION
OF THE ON-LINE VERSION OF THE MARTINA TITRATOR.**

**AN IMPORTANT ISSUE OF THIS ACTIVITY IS THE FIELD TEST OF THE
INSTRUMENT AT A PILOT PLANT IN STRICT CO-OPERATION WITH POLIMI
AND ENEA.**

**THE TIMETABLE OF THE EFFORT SPENT AND OF THE ACTIVITY
IMPLEMENTED DURING THE THE SECOND YEAR IS REPORTED.**

EOLII SECOND YEAR PLENARY MEETING

NOVEMBER 2004

NOVEMBER – DECEMBER 2003



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- **ELECTRIC SCHEMES DESIGN COMPLETION**
- **FIRMWARE DESIGN BEGINNING**

THE DESIGN OF THE ELECTRIC SCHEMES AND OF THE FIRMWARE WAS BASED ON THE REQUIREMENTS ASSESSED FOR THE ON LINE VERSION OF THE TITRATION BIOSENSOR.

THE INSTRUMENT IS ABLE TO PERFORM THE FOLLOWING TASKS:

- 1. WITHDRAW THE SAMPLE TO BE ANALYSED;**
- 2. EXECUTE THE TITRATION EXPERIMENT;**
- 3. DISCHARGE THE SAMPLE;**
- 4. ELABORATE DATA COLLECTED DURING THE EXPERIMENT;**
- 5. PROVIDE ELABORATED DATA AVAILABLE FOR MONITORING AND CONTROL SYSTEMS.**

TO IMPLEMENT, MONITOR AND CONTROL THESE FEATURES, A MODULAR HARDWARE CONFIGURATION WAS DEVELOPED, BASED ON FOUR ELECTRONIC EMBEDDED BOARDS.



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THE ANALOG INTERFACE

16 BIT MICROCONTROLLER ARCHITECTURE

8 CHANNELS

16 BIT RESOLUTION

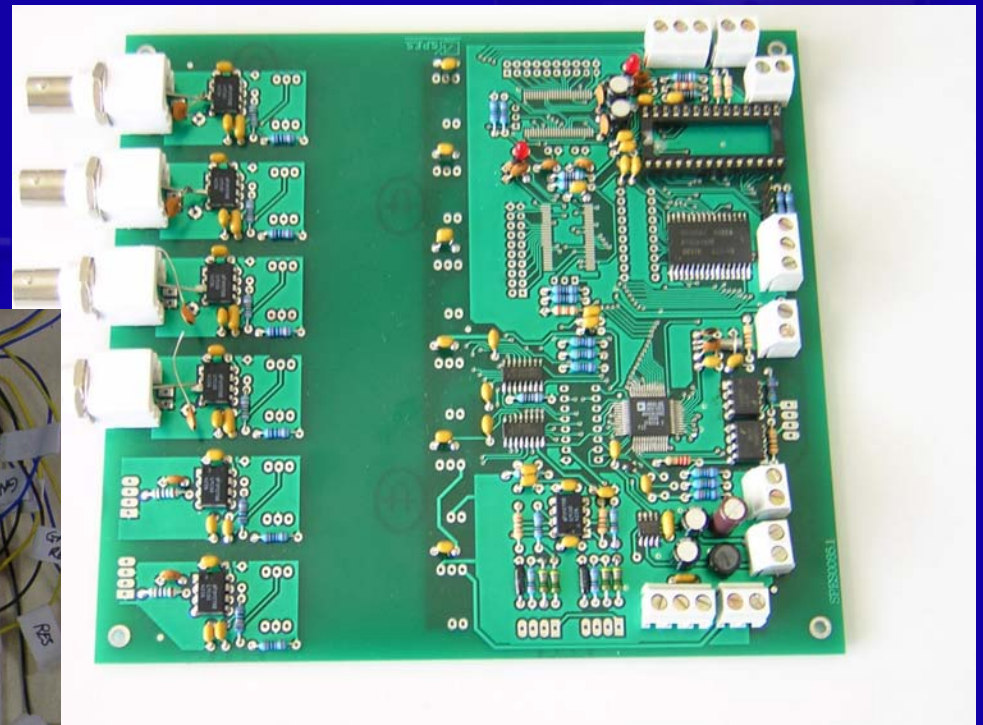
GALVANIC ISOLATION



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THE ACTUATORS INTERFACE



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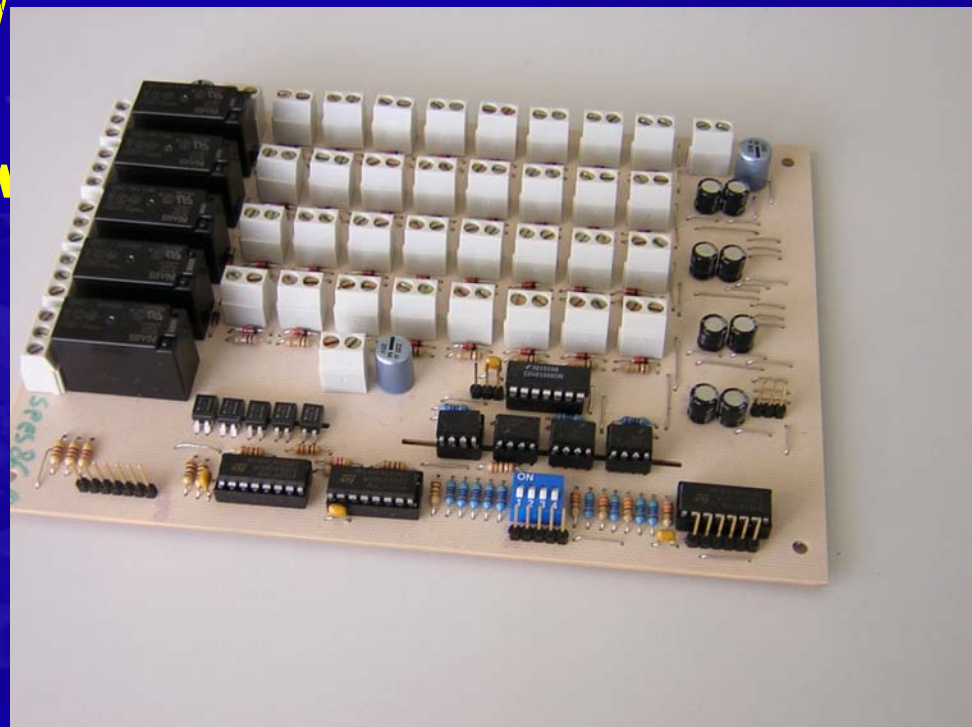
4 PERISTALTIC PUMPS 24V DC 6W

20 SOLENOID MICROVALVES 24V DC 6W

6 STIRRERS 24V DC MAX 50W

2 HEATERS 24V DC MAX 50W

2 AERATORS 24V DC MAX 50W



THE MAIN BOARD



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32 BIT MICROCONTROLLER ARCHITECTURE WITH EMBEDDED OS ONBOARD

HUMAN INTERFACE:

- TOUCH SCREEN

LOCAL AREA LINKS AND CONNECTIONS:

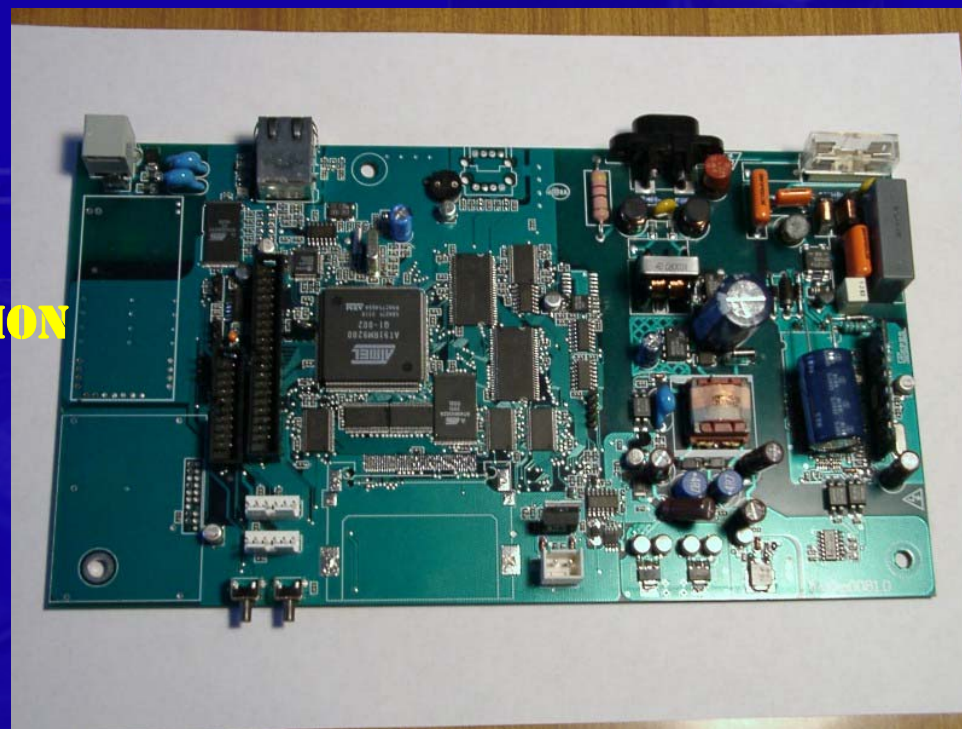
- RS232 SERIAL LINK FOR PC CONNECTION
- RF (DECT STANDARD) WIRELESS LINK

REMOTE LINKS:

- PSTN MODEM LINK

DATA STORAGE:

- COMPACT FLASH CARD



JANUARY 2004

ELECTRIC SCHEMES DESIGN COMPLETION



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FEBRUARY 2004

MANUFACTURING OF THE FOUR EMBEDDED ELECTRONIC BOARDS

PC SOFTWARE DESIGN BEGINNING

MARCH 2004

**IN-CIRCUIT TEST AND DEBUG OF THE EMBEDDED ELECTRONIC
BOARDS**

FIRMWARE DESIGN COMPLETION

APRIL 2004

PC TEST SOFTWARE DESIGN COMPLETION

SYSTEM SET UP

LAB TEST AND DEBUG

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NOVEMBER 2004



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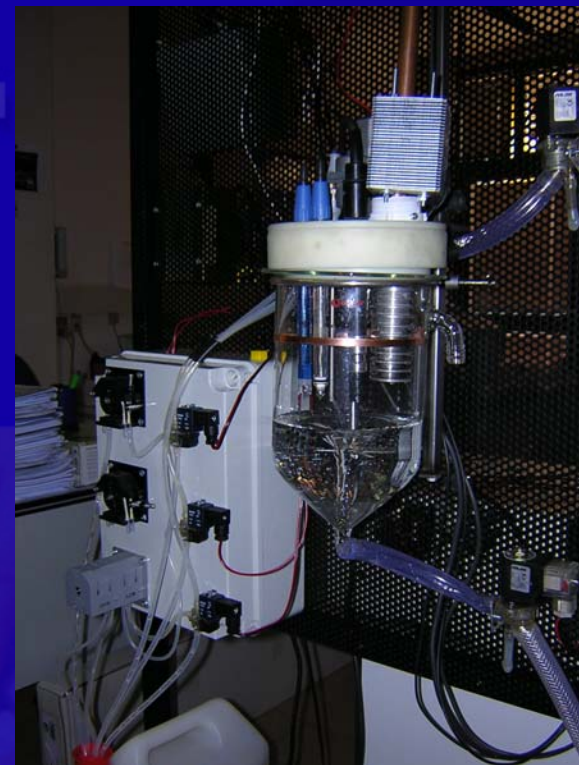
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**FOR THE SYSTEM SET UP A LOT OF PRELIMINARY TESTS WERE PERFORMED
TO DESIGN THE HYDRAULIC CIRCUITS AND TO SELECT THE COMPONENTS.**

**TWO PICTURES OF THE TESTS OF THE HYDRAULIC AND MECHANICS
COMPONENTS**



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MAY 2004

- **LAB TEST AND DEBUG**

JUNE 2004

- **FIRST PROTOTYPE SET UP**

SET UP OF THE CABINET, ELECTRIC COMPONENTS AND CONNECTIONS.

SEPTEMBER 2004

- **LAB TEST AND DEBUG COMPLETION**

OCTOBER 2004

- **DELIVERY**
- **START OF THE FIELD TEST**

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ALL THE ROUTINES AND ALGORITHMS FOR DIGITAL SIGNAL ACQUISITION AND PROCESSING, FOR THE EXPERIMENT CONTROL AND FOR DATA ANALYSIS ARE IMPLEMENTED INTO THE FIRMWARE ON BOARD.

THE INSTRUMENT CAN BE FULLY CONFIGURED USING A GRAPHICAL HUMAN INTERFACE DEVELOPED ON PURPOSE AND IMPLEMENTED USING A TOUCH SCREEN; THE DATA CAN BE PROCESSED IN REAL TIME AND STORED IN EXCEL FORMAT INTO THE COMPACT FLASH CARD.

ADDITIONALLY THE FIRMWARE ON BOARD WILL ALSO ALLOW TO SET AND MANAGE SAMPLE COLLECTION AND DISCHARGE, ROUTING FOR THE IDENTIFICATION OF THE DIFFERENT PHASES OF THE EXPERIMENTS AND FOR THE ACTIVATION OF THE REAGENTS' ADDITION AT THE APPROPRIATE TIME, IDENTIFICATION OF KNEES IN THE TITRATION CURVE AND FOR THE AUTOMATIC IDENTIFICATION OF THE END OF THE TITRATION EXPERIMENTS.

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TEST AND DEBUG ACTIVITY



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THE FIRST STEP OF TEST AND DEBUG OF THE PROTOTYPE WAS PERFORMED AT SPES LAB.

MAJOR PROBLEMS THAT WERE POINTED-OUT AND REPORTED:

- **UNRELIABLE WORKING OF THE COMMUNICATION BETWEEN THE SEVERAL BOARDS, DUE TO ELECTRICAL NOISES AND INTERFERENCES ON THE INTERNAL BUS;**
- **OCCASIONAL MALFUNCTIONING OF THE OPENING/CLOSING CYCLE OF THE MICRO-SOLENOID VALVES FOR TITRANT DOSING.**

ON THE BASIS OF THIS FIRST STEP OF THE TEST AND DEBUG ACTIVITY, SPES DESIGNED AND IMPLEMENTED A SECOND VERSION OF THE EMBEDDED CONTROL BOARDS: THE BUS FOR THE COMMUNICATION BETWEEN THE BOARDS WAS COMPLETELY RE-DESIGNED TO IMPROVE THE EFFICIENCY, THE RELIABILITY AND THE HARDWARE FILTERING FOR NOISE REDUCTION. ALSO THE ACTUATORS INTERFACE WAS COMPLETELY REDESIGNED.

THE FIRMWARE WAS REVISED AND A SECOND RELEASE WAS IMPLEMENTED.

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PLANNED ACTIVITY

FEBRUARY 2005

- **FIELD TEST COMPLETION**

APRIL 2005

- **INTEGRATION WITH THE EOLI DIGITAL PLATFORM**

MAY 2005

- **SHIPPING TO LBE IN NARBONNE**

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