



Project No: **530510-TEMPUS-1-2012-RS-TEMPUS-JPCR**

Project title:

Assisting humans with special needs: curriculum for
HUman-**TO**ol interaction **Net**work

Acronym: HUTON

Deliverable 3.1:

**Development of the Laboratory facilities
that supports the new curriculum**

Due Date: **Month 6**

Submission date: **Month 6**

Start date of project: **15/10/2012,**

Duration: **36 months**

Lead beneficiary for this deliverable: **SUNP**

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Revision: **1.0**

Dissemination Level		
NL	National level	√
IL	International level (including the Commission Service)	

Deliverable 3.1: **Report and request for the purchasing of instrumentation**

This deliverable is the first action of the WP3: **Development of the Laboratory facilities that supports the new curriculum**

Introduction:

The wider objective of the project "Assisting humans with special needs: Curriculum for **HU**man-**TO**ol interaction Network (HUTON)" is the development of interdisciplinary and multidisciplinary curriculum with the laboratory educational support and the educational training network for the optimized use of technology that improves the quality of life of humans with special needs

The specific objectives in the project are:

- Development of the **new interdisciplinary and multidisciplinary accredited curriculum (MECHATRONICS FOR REHABILITATION)** leading to the master degree in the domain of technologies for humans with special needs.
 - Setup of the training **network in Republic of Serbia (RS) in the domain of mechatronics, rehabilitation engineering and medicine, and neurorehabilitation** that enables the delivery of the new interdisciplinary and multidisciplinary curriculum.
 - Training of staff for providing on-the-job education and use of appropriate technologies which increases **new employment opportunities**.
 - Training of staff for providing **better medical services** for humans with special needs.
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The project is planned with eight workpackages, where the first four are the development activities. The workpackage (WP) 3 is dedicated to the development of laboratory facilities which will optimize the training within the new curriculum.

The WP3 plan addresses the planning, purchasing and setup of the laboratory instrumentation in the clinical partners and their university partner in Belgrade, Novi Sad and Novi Pazar.

The instrumentation that is planned for HUTON needs to be the basis for the laboratory education within the courses. In parallel, the value of the instrumentation will be seen in its future exploitation by the trained professionals who receive the appropriate education through the curriculum after the program is finished.

The staff training planned in HUTON will ensure the required high skills profile assistance for the optimal use of the laboratory instrumentation. The new instrumentation was planned with the aim to integrate it into the available equipment of the participant institutions. The plan was made to allow the implementation of the curriculum, and all instruments are to be used as part of at least one course within the new curriculum. The planning was considering the expertise of EU partners in the project, and the principles of good practice in medicine. The instrumentation planning considered modern trends of the inclusion of tele-medical applications in cases where this was feasible.

The approved project proposal started from the following assumptions: 1) laboratory space is available at partners sites where the instrumentation will be installed and used and 2) staff is available at partners sites that can be trained to use new equipment. The RISKS have been envisioned in the availability of the staff; hence, the WP3 activities will provide necessary training to the staff in the cases when necessary.

The **first phase of the activities** that led to this Deliverable was the creation of **the existing lab equipment lists**. For that purpose, the WP3 responsible person visited and had productive discussions with representatives of clinical partners. In addition, the local program board had monthly meetings and several Scype and mail communications with representatives of the partners from Serbia where they expressed their needs. Finally, the kickoff meeting in Belgrade and the meeting of the Program Board in Ljubljana, Slovenia were the events where the decision was reached how to prepare the plan that is described in this Deliverable.

The discussions and review of the available equipment were the basis. However, the needs of the planned courses that will form the curriculum (activities of the WP2) and know-how of project participants on the current trends in the rehabilitation, and limited resources that are on disposal to the project to be invested in the purchasing of the new instrumentation/ rehabilitation assistive technologies influenced the plans presented in this Deliverable.

The original project plan includes the following laboratory equipment: 1) computer support for the instrumentation; 2) Movement analysis hardware and software; 4) electrical stimulation hardware; 5) robot assistant for upper extremities; 5) walking assistant for the training of the walking; 6) biofeedback for the rehabilitation based on virtual reality; and 6) hardware/software (signal processing, image processing, etc.) for biomedical signals acquisition.

The meeting in Ljubljana on March 12, 2013 was the event, where after reviewing the courses that will form the core of the Curriculum the decision was unanimously reached which instrumentation/instrumental parts will be purchased to allow optimal training of the staff:

Partners: UB & SUNP (2 x 5000€)

Robotic assistant for upper extremities rehabilitation

The robot assistant for upper extremities should be a workstation for clinical use. The workstation should allow a range of exercise games with adjustable difficulty levels and a standardized hand and arm function tests.

The workstation must include:

- Standardized upper limb exercises representing activities of daily life (ADL)
- Intensive training with motivating games
- Tracking of functional improvements with an automated, objective hand and arm function tests
- Possibility for therapists to tele-supervise clients from anywhere

Partners: UB, UNS & SUNP (3 x 5000€)

Robotic assistant for lower extremities rehabilitation

The robot assistant for lower extremities should be a motorized, body support system which secures a patient from falling and reduces a physical stress to therapists.

The system must include:

- Ground level hands-free walking indoors/outdoors (flat terrain)
- Walking speed regulation from 0m/s to 1.2m/s

- Adjustable support from partly to full body weight support by means of body contour harness
 - Remote control of speed and walking direction
 - Complete power supply independence (battery driven)
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Partners: UB & UNS (2 x 2000€)

Movement assessment system

The system must include:

- Set of small size and light weight sensors units with possibility to link up to 7 units
 - Battery operated sensors units with 3D accelerometers and 3D gyroscopes
 - Wireless communication of each unit with a host computer
 - USB receiver
 - Software running on a PC
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Partners: UB & UNS (2 x 1500€)

Ground reaction force assessment system

The system must include:

- Insole type sensors allowing analysis of ground reaction force distribution
 - Insole size adjustment mechanism
 - Battery operated sensors
 - Wireless communication with a host computer
 - USB receiver
 - Software running on a PC
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Partners: UB, UNS, & SUNP (3 x 5000€)

Biofeedback system

The system should allow mental and physical exercise feedback used for a training of the brain. The feedback system should include the recording capabilities of electrophysiological signals originating from brain and muscles. The feedback needs to provide visual/auditive/somatosensory or other modalities of interfacing with a trainee.

The system must include:

- Multi-channel (min 16 channel) amplifier for cortical and muscle signals
 - Interface to a PC/smart phone/smart TV/other and the appropriate display
 - Software for real-time processing
 - Selection of virtual reality scenarios for feedback
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Partner: SUNP (1250€)

Muscle stimulator

Required characteristics:

- minimum 4 independent channels
- recording of EMG signals
- amplitude up to 100mA, increment 1mA or less
- frequency 1-150Hz
- pulse width 30-400µs
- battery powered

Partner: UNS (4x1100€)

DAQ device

Required characteristics:

- 16 analog inputs, 500 kS/s, 16-bit resolution, ± 10 V
- Two analog outputs, 900 kS/s, 16-bit resolution, ± 10 V
- 24 digital I/O lines (8 hardware-timed up to 1 MHz)
- Four 32-bit counter/timers for PWM, encoder, frequency, event counting, and more
- Advanced timing and triggering with NI-STC3 timing and synchronization technology
- Support for Windows 7/Vista/XP
- USB connection

Partner: UNS (600€)

Electrophysiological signal simulator

System must include:

- Signal Generator: DC, sine, rectangle, ECG simulation
- Impedance Meter,
- Amplifier / Data Logger (amplitude range $5\mu\text{V} - 20\text{mV}$ ($\pm 5\%$ to $\pm 10\%$))
- DC offset $0 - 300\text{mV} \pm 10\%$
- Frequency range $0,1 - 1000\text{Hz}$
- Common mode signal simulator (frequency to 60Hz , amplitude $0 - 5 \text{V}_{\text{pp}} \pm 10\%$)
- Battery powered
- Minimum two output channels

Partner: SUNP (2x170€)

DAQ device

Required characteristics:

- 8 analog inputs (12-bit, 10 kS/s)
- 2 analog outputs (12-bit, 150 S/s); 12 digital I/O; 32-bit counter
- Bus-powered for high mobility; built-in signal connectivity
- OEM version available
- Compatible with LabVIEW, LabWindows/CVI, and Measu. Studio for Visual Studio .NET

Partner: SUNP (2x280€)

DAQ device

Required characteristics:

- 8 analog inputs (14-bit, 48 kS/s)
- 2 analog outputs (12-bit, 150 S/s); 12 digital I/O; 32-bit counter
- Bus-powered for high mobility; built-in signal connectivity
- OEM version available
- Compatible with LabVIEW, LabWindows/CVI, and Meas Studio for Visual Studio .NET

Partner: SUNP (300€)
Fixed power supply device

Required characteristics:

- Minimum two adjustable outputs and one fixed output 5V or 12V
- Output voltage 0- min 20V
- Output current 0- min 0.5A
- DC accuracy <3%
- Short-circuit proof

Partner: SUNP (2x300€)
Digital scope

Required characteristics:

- Frequency range 30MHz
- Sampling time 260MS/s
- Horizontal scale 4ns/div-10s/div
- Response time <15ns
- 2 channels
- Maximal input voltage 400V
- Vertical sensitivity 5mV/div-5V/div
- Color screen LCD, TFT
- Probe attenuation factor 1X, 10X, 100X

Partner: SUNP (450€)
Function generator

Required characteristics:

- Minimum two channels
- Waveforms: square, triangle, sine
- Frequency range 0.05Hz-min 5MHz
- Voltage 2mVpp-20Vpp
- Short-circuit proof

The financial summary is in the Table (in €)

Instruments	UB	UNS	SUNP
Arm/hand assistant	5000	0	5000
Walking assistant	5000	5000	5000
Movement assessment	2000	2000	0
GRF system	1500	1500	0
Biofeedback system	5000	5000	5000
DAQ and simulators	0	5000	2250
Muscle stimulator	0	0	1250
TOTAL	18500	18500	18500

The funds planned are the estimates based on the detailed review and contacts with possible providers of the instrumentation of the available systems that fulfill the requirements listed

above, and are 90% of the approved funds for the Laboratory instrumentation approved by the TEMPUS office.

The instruments listed are parts of the envisioned equipment for the following courses:

Core Courses: 1) Control of biological actuators, 2) Control of movement, 3) Mechatronic systems in rehabilitation, and 4) Signals and systems in rehabilitation.

Elective courses: 1) Mechanics of robots, 2) Pneumatic and hydraulic drives, 3) Sensors for mechatronic systems in rehabilitation, 4) Microcomputers, 5) Disability and rehabilitation, 6) Assessment of signals in rehabilitation and 7) Robotics for rehabilitation.