Project no.	**COOP-CT-2004-508231**
Project acronym	**PICO**
Project title Paraendoscopic	**Intuitive Computer Assisted Operating System**
Instrument	**Cooperative Research**
Thematic Priority	**FP6-2002-SME-1**

Publishable Final Activity Report

Period covered: **from 01.12.2004 to 28.02.2007**

Date of preparation: **14.04.2007**

Start date of project: **01.12.2004**

Duration: **27 Months**

Project coordinator name **Dr. Ludger Schnieder**

Project coordinator organisation name

Revision: **FINAL**

Kompetenzzentrum MITT e.V.

Project objectives

Endoscopic interventions have been performed in growing numbers in Neurosurgery for the last years. Compared to microscopic interventions the use of an endoscope has significant advantages mainly resulting from an improved view of the object field and a reduced trauma. Yet, limitations of the endoscopes and auxiliary tools available exclude most of the indications in Neurosurgery from Endoscopic interventions.

In addition, endoscopic interventions offer significant benefits to the patients. The reduced trauma leads to a reduced stay at hospitals and a faster convalescence. Especially in Neurosurgery, a reduced trauma is directly associated with a reduced impact on the brain's functions and shows immediate improvements.

The availability of an endoscopic system integrated with mechanical components and characterized by improvements concerning optical properties and handling concept would have the power to transform today's microscopic interventions into endoscopic interventions in Neurosurgery.

The **objective of PICO** was the development of an integrated Neurosurgical system to create the technical preconditions for a basic change from microsurgical to endoscopic interventions in Neurosurgery. The developed system is consisting of

- a holding device for accurate positioning of an endoscope,
- an ergonomic, robust and reliable man-machine interface for remote control of system functions, integrated in a safe overall system control,
- a set of micro mechanical instruments adapted for use in stereo-endoscopic Neurosurgery and
- a specially adapted stereo-endoscope for Neurosurgery.

The **vision of PICO** is to combine the benefits of microscopic systems – mainly 3D-visualisation and well-suited holding concepts – with the benefits of endoscopic systems thus overcoming the drawbacks in today's Neurosurgery.

At present the major part of all neurosurgical operations rely on the surgical microscope. An improved endoscopic instrumentation for the operating room resulting from a coordinated development of the relevant components should enable neurosurgeons to use endoscopic rather than microscopic sight for their interventions. Following the research results from leading neurosurgical departments during the last years it's quite obvious that the future of less or minimally invasive Neurosurgery is based on the use of endoscopes either to assist the microsurgical procedure or more favourably to completely replace the microscope. From the view of the patients this is a most desirable development as it helps to reduce the operative trauma and post-operative problems or losses of brain functionality.

The system developed in the PICO project is a first step towards performing an important part of all neurosurgical interventions endoscopically thereby achieving a significantly improved view on the situs and a reduction of the operative trauma at the same time.

Contractors involved

Contractor	Role in Project
Kompetenzzentrum Minimal Invasive Medizin & Technik Tübingen-Tuttlingen e.V. Frondsbergstr: 23 D 72070 Tübingen Germany	Coordination System architecture Integration / Interface issues among individual modules
Silicon Software GmbH Schildkrötstr. 17 D-68199 Mannheim Germany (accession to the contract 01.01.2006)	Video Processing for 2D and 3D-Visualisation FPGA development and programming Hardware development for video processing
Ing. Werner Fuchs GmbH Hauptstrasse 41 A 2443 Loretto Austria	Research & Development for mechanical parts System Integration mechanical components
Medin a.s. Vlachovická 619 59231 Nové Město na Moravě Czech Republic	Research & Development for designing and manufacturing a neurosurgical instrument set Enabling partner
Nouvag AG St.Gallerstrasse 23-25 CH 9403 Goldach Switzerland	Development of Motors and motor drives
University Hospital in Hradec Králové, (Fakultní nemocnice, Hradec Králové) 50005 Hradec Králové Czech Republic	End-user; Clinical Tests
Department of Neurosurgery Katharinenhospital, Klinikum Stuttgart Kriegsbergstrasse 60 D 70174 Stuttgart Germany	End-user; Clinical Tests
Department of Neurosurgery, University Medical Center Nijmegen Reinier Postlaan 4 NL 6500HB The Netherlands	End-user; Clinical Tests
Klinik und Poliklini für Neurochirurgie Klinikum der Ernst-Moritz-Arndt-Universität Greifswald Fleischmannstrasse 8 D 17487 Greifswald Germany	End-user; Clinical Tests
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (IPA) Hansastrasse 27C D 80686 München	Development of adjustment components and holding device System Integrator
Swiss Federal Institute for Technology - Lausanne ISR-LSRO (VRAI Group) CH 1015 Lausanne Switzerland	Development of User Interaction Appliance (User Interface)
Universität Stuttgart Keplerstrasse 7 D 70049 Stuttgart Germany	Development of Control Software
Richard Wolf GmbH Pforzheimer Strasse 32 D 75434 Knittlingen Germany	Adaptation of endoscopes Marketing, Product Dissemination Enabling Partner

Co-ordinator contact details

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End results

In this R+D-Project 13 partners from 5 european countries developed in a total time of 27 months **a fully functional demonstrator** for a neurosurgical, para-endoscopic operating room system containing the following components:

1. **A balanced mechanical endoscope holding and motion system** with

- sufficient stiffness
- motors / breaks avoiding a stick-slip-effect on release of the breaks
- a fixing to the operating table to pivot the endoscope around the point of trepanation
- a motor driven fine adjustment
- the possibility to fix the holding and motion system to the fixation of the patients head (Mayfield-clamp)

Figure 1: PICO Demonstrator hardware (stand, drives, endoscopes)

2. **A control system and a user interface** enabling the surgeon to control the endoscope position intuitively, including

- steering of the endoscope directly by the surgeon without the need to take his hands from the instruments
- a suitable input device
- a control software as well as
- the necessary hardware to provide the drives with the necessary energy and control signals

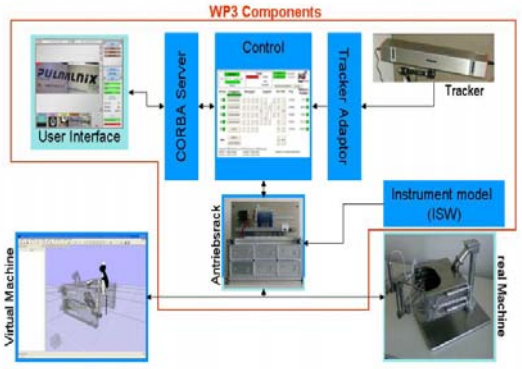
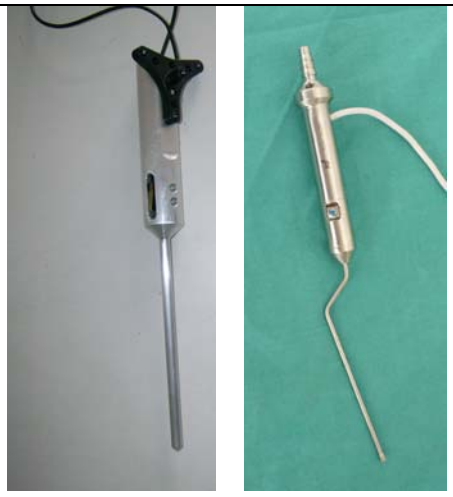


Figure 2: Concept for Control System

3. **A 3-D visualization system** with - the additional feature of voice controlled delivery of surplus information (preoperative data, ultrasound images …), including - the possibility of a three-dimensional (3-D) representation - a suitable monitor or alternatively a head mounted display for visualization - a voice control system for the surgeon	 **Figure 3: PICO User Interface**
4. A **set of instruments for para-endoscopic sugery** including - instruments that enable the surgeons to perform complex manipulations endoscopically - important functions like suction, rinsing, dissection, cutting, grasping, sample taking - multifunctional instruments energized by bipolar high frequency current or, radio frequency current	 **Figure 4: Demonstration instruments containing control buttons for the user interface**
5. **Suitable endoscopes for mono- or stereoscopic sight** on the situs, including an Exoscope camera to visualize the exterior surgical field	 **Figure 5: PICO Endoscope with exoscope camera mounted on motor driven adjustment unit**

Publishable Final Plan for Dissemination and Use

During the project, actual results were disseminated in numerous events, including courses for medical experts, presentations on conferences and fairs, books and diploma resp. master thesis. A central point for information to the public was the PICO-website www.pico-endoscopy.org hosted since 2005 and regularly updated by the coordinator.

A detailed exploitation plan was discussed with the SME partners and the enabling partners as well as with the R&D performers. Several measures are planned for the next two years until the end of 2008. The system demonstrator will be presented to medical and technical experts to get a broad feedback on its potential and the necessary changes for further development steps.

Essential for the dissemination plan is the possibility to have the demonstrator system running for at least six months at the Katharinenhospital in Stuttgart. Interested medical experts are invited to test the system, give feedback and propose necessary improvements. The technical partners agreed to support that test period as far as possible.