TECHNOLOGICAL IMPLEMENTATION PLAN
(Deliverable No 22)

Description of project

EC PROGRAMME:	**IST**
PROJECT TITLE:	System for European Water monitorING
ACRONYM:	**SEWING**
PROGRAMME TYPE:	5th FWP (Fifth Framework Programme)
CONTRACT NUMBER:	IST-2000-28084
PROJECT WEB SITE (if any):	http://www.sewing.mixdes.org
START DATE:	01 Sep 2001
END DATE:	31 Dec 2004
COORDINATOR DETAILS:	**Name:** Andrzej Filipkowski **Organisation:** Politechnika Warszawska **Address:** Nowowiejska 15/19, 00-665 Warszawa, Poland **Telephone:** +(48-22)6607744 **E-mail:** filip@ise.pw.edu.pl

PARTNERS NAME:
Valtion Teknillinen Tutkimuskeskus (VTT), Markku Aberg **Systea-Systems Technology Advance,** Luca Sanfilippo **Universitaet fuer Bodenkultur Wien (BOKU),** Roza Allabashi **Politechnika Lodzka (TUL),** Andrzej Napieralski **Universitat Politecnica de Catalunya (UPC),** Joan Cabestany **Centre National de la Recherche Scientifique (CNRS),** Pierre Temple-Boyer **Microsens Products Sa (MS),** Carine BERIET **Instytut Technologii Elektronowej (ITE),** Andrzej KOBUS

Commission Officer Name:	Antonios Barbas

Executive summary

Original research objectives

As the deficit of clean water becomes more of a problem in Europe, there is a need to develop easily accessible, cheap and reliable Microsystems, which could be used for water pollution monitoring and early warning of many water European resources. The equipment available so far is mostly of laboratory type and measures water samples inserted to the measuring device. The objective of this proposal is to create a system of continuous water pollution monitoring in real time. Portable equipment will be developed,

which when inserted in water resources, will collect data about pollution. "Ion Selective Field Effect Transistors" (ISFET) will be used as sensors. Hydraulic system, data processing, coding, storing and transmitting circuits will be integrated in one unit. Software for visualisation of the results will also be developed. Objectives: 1. Development of methods for design and realisation of prototypes of flexible and reliable Microsystems, based on new types of ISFETs, selectively sensitive to various polluting ions, and immune to interference, temperature and deterioration over time; 2. Development of sensors suitable for detection of selected choice of non-organic polluting ions, with a broad range of sensitivity for ion concentrations and for all types of water resources and waste water in high-risk industrial regions; 3. Development of a cheap and easily accessible system for monitoring and early warning of water pollution. Work description: The project combines partners in electronics, information, environmental and chemical engineering and involves end-users, e.g. institutions responsible for water management. The following tasks will be carried-out during the project: 1. Choice of the most important areas, where the Microsystems will be used. Creation of ion-selective materials for sensors, sensitive for monitoring of the relevant ions; 2. Production of Ion Selective Field Effect Transistors (ISFETs) sensors, sensitive to the selected ions (CHEMFETs) and having the requested range of selectivity and sensitivity. The sensors will be assessed from the point of view of selectivity, sensitivity, temperature dependence, hysteresis, and stability on time; 3. Computer simulation of the whole system; 4. Development of software and hardware for data from sensors coding, transmission, collection, storing and processing; 5. Assembling all the parts into one smart Microsystems, optimised from the point of view of cost, reliability, accuracy and lifetime. Lifetime is particularly important as most existing ISFETs can be now used continuously for not longer than days or a few weeks; 6. Testing the prototypes of the Microsystems in a real environment by institutions responsible for water management; 7. Industrialisation of the prototypes by industrial partners. Milestones: 1. Creation of sensors based on ISFET technology that are selective for a wide range of ions. Sensors will be capable for combining with data processing circuitry; 2. Completion of software and hardware for data processing and storage; 3. Final optimisation of Microsystems final prototype, with coding and data transmission facilities; 4. Final applications and preparation for industrial implementation.

Expected deliverables

The following deliverables were planned in Annex 1 of the contract and regularly implemented during realisation of the project. They all together create the whole system and give the possibility of reaching the objectives. 1. Reports, summaries - During the whole duration of the project co-ordinator took care about reporting and dissemination. 2. Plan of work - Duties were attached to particular partners. 3. Fixing technical data for the system - Studies concerning ranges of pollution to be monitored according to European standards were performed. 4. Project Presentation - Text for the Commission, describing the project SEWING was presented. 5. Dissemination & Use Plan - Preliminary vision of project usefulness was elaborated. 6. Preparation of polymer materials for optimal ionophore membranes - One of the most essential works: finding materials for realisation of ISFETs selective for chosen ions. 7. Realisation of CHEMFETs selective for different pollutants - Depositing membranes and obtaining first approach of CHEMFETs. 8. Measurements of sensors - Verification of these sensors through measurements in specially prepared measuring system. 9. Encapsulated and optimised sensors for use in microsystems - After measurements upgraded sensors were done. 10. Physical models of CHEMFETs - Mathematical models, to be used later in software in the system. 11. Behavioural models of CHEMFETs - The same, but concerning models identified through measurements. 12. Optimisation and parameter extraction software - First approach to use the model parameters in software. 13. Computer simulation of analogue interface - First approach to design interface between sensors and DSP circuits. 14. Software for digital & analogue data processing - First approach to Data Fusion and Data Acquisition software. 15. Simulation of the overall system - Use of advanced simulation programmes for the whole system. 16. Design and partitioning of the system - Theoretical approach to

combining all elements into one system. 17. Functional prototypes of particular chips - Final hardware realisation of particular parts of the system. 18. Realisation of prototypes - Realisation of prototypes of particular parts of the system and of the whole system. 19. Measurements of prototypes - Verification of prototype through measurement. 20. Evaluation of the whole system through measurements - Stating usefulness of the whole system. 21. Dissemination of the results, exploitation plan - Work conducted continuously during the whole project to disseminate partial and final results. 22. Technology Implementation Plan - Preparation of this document. 23. Assessment and evaluation of partial results - Internal assessment of the project results. 24. Final report - Final document for the Commission.

Project's actual outcome

The following results are obtained during the project: 1. Creating the theoretical basis for modelling of ISFET sensors, - The models of ISFETs met in literature were not adequate for SEWING purpose. New models and their libraries have been created. 2. Creating technology and production of two kinds of ISFET sensors: BSC (Back-Side-Contact) and FSC (Front-Side-Contact), - Sensors are the crucial elements of the system. They were subject of several deliverables and their final version was made available near the end of the project. Their behaviour is now fully satisfactory. Two versions of sensor allow choosing one of them for a given application. 3. Measurement and extracting model parameters of sensors, - Based on the theoretical models of CHEMFETs and their measurements the model parameters could be extracted and be used in further software works. 4. Creating the software for acquisition of data obtained from sensors sensitive for different ions in presence of interferences (three versions), - Adequate processing of signals obtained from the sensors give the final information about the concentration of polluting ions in measured water. Model parameters are essential for this stage of work. Digital, analogue and neural versions of data processing was created, to use the best for given application. 5. Creating the hardware for realisation of this software in the final instrument, - The algorithms created for data processing are then introduced in hardware. This can be a commercial chip or ASIC produced specially for that purpose. The choice depends on application. 6. Creating the hydraulic system for water measuring, sensor calibration and maintenance, - This very crucial part of the project allows making a programmable hydraulic system for automatic taking of measured samples, sensor calibrating and washing. 7. Creating the system for data transmitting and visualisation, - Several solutions are theoretically prepared, but in the prototype typical versions are used. 8. Assembling selected elements of the project in one final prototype, - The prototype uses selected versions of particular parts of the system prepared during running the project. It shows that the idea of SEWING was well invented and useful. 9. Verification of the prototype in real-time measurement, - The numerous measurements show, how the prototype behaves in different real-life conditions. 10. Creating the vision of future industrialisation of the system, - On the basis of these results vision of different versions of the system, depending on end-user demand, is created.

Broad dissemination and use intentions for the expected outputs

During the whole duration of the project contributions on conferences, publishing articles, organising stands on professional conferences, participating in thematic EU Commission meetings, giving materials on CORDIS pages and organising the SEWING WEB page took place. Contacts with other institutions, being interested in the results of SEWING, were also done. All contributions are available on SEWING WEB page http://www.sewing.mixdes.org. During 40 months of SEWING realisation 42 international and national conferences were attended by partners and 67 contributions were presented. Conferences EUROSENSORS, MIXDES and AutMoNet were attended regularly. During AutMoNet 2002, AutMoNet 2004 and Eurosensors 2004 conferences an exhibiting booth was organised to promote to the international scientific community and to any potential commercial partner the results of the project, with the support of a commercial flyer describing the aim of the project and prototype devices. In the home page of Systea's SME partner a link to the project's home page was inserted; Systea's main

scientific customers and commercial partners were regularly updated about the developments done in the research project. During other exhibitions, where Systea attended, a preliminary market survey was done to identify the main technical specification, price target and main application areas of the forthcoming new industrialised product coming out after the end of the project. Six papers were published in international journals, presenting partial results of SEWING project. Other interesting ways of disseminations: two notes in bulletins edited by FP5, information on CORDIS page (No 60437) and a lecture (in Polish) on the academic WEB page ATVN. On seven seminars or meetings organised by the Commission or other FP5 or FP6 projects contributions about SEWING were presented. Cluster and concertation meetings and IST-Event'04 were the most important. On a Polish-Italian seminar near Warsaw, on governmental level, SEWING was presented to potential end-users. The SEWING WEB page, with the address http://www.sewing.mixdes.org, consists of two parts. One open for public with the following topics: home, what is SEWING, research partners, project presentation, conferences, papers, selected deliverables and final results. Reports and minutes of meetings are under a password, available to all partners, PO and reviewers. Many contacts with potential end-users were done thanks to that WEB page. 22400 persons visited this page. This page is permanently updated. Two unsuccessful FP6 NoE projects were submitted on the basis of SEWING, disseminating SEWING information among about 50 partners of these projects. The exploitation plan in some most important statements is given in other parts of this TIP. Concerning the Exploitation Plan the following assumptions were done: • In the prototype built in SYSTEA, the SEWING industrial partner, the selected versions of particular solutions of parts of the system were used. The choice has been made on the basis of availability of final solutions and on the simplicity and flexibility of the whole system. • Other versions are ready for eventually using them in industrial versions of SEWING, depending of the customer's demand. This idea concerns mainly the following parts: - The Front-Side-Contacts sensors, including the Ca sensor. - The voltage based interface circuit and ASIC solution of it. - More sophisticated solutions of Digital Signal Processing of information got from sensors. - More sophisticated data transmission from the sensor to the main computer. At the beginning of the year 2005 a promoting seminar is planned, showing to interested end-users the possibilities of industrialisation of SEWING. The prototype made as the final version of the project SEWING is flexible enough to become basis for industrialised version of the system. To do that, long-term investigation of industrially made sensors is necessary to obtain long life-time (at least 3 months), low dispersion, high yield, more ions detected and low price. Also one-chip interface, DSP and controlling integrated circuit should be designed in industrial way. This will allow entering with the system on the market. It is planned to apply for a STREP project having as the objective R@D activities solving the technical and economic aspects of the sustem for industrial implementation. A spin-off SME should be eatablished for fabricating CHEMFETs in industrial way on the basis of know-how created by SEWING.

Overview of all your main project results

No.	Self-descriptive title of the result	Category A, B or C*	Partner(s) owning the result(s) (referring in particular to specific patents, copyrights, etc.) & involved in their further use
1	Creating the theoretical basis for modelling of ISFET sensors	A	Politechnika Warszawska Politechnika Lodzka (TUL)
2	Creating technology and production of two kinds of ISFET sensors: BSC (Back-Side-Contact) and FSC (Front-Side-Contact),	A	Centre National de la Recherche Scientifique (CNRS) Instytut Technologii Elektronowej (ITE) Politechnika Warszawska

			Microsens Products Sa (MS)
3	Measurement and extracting model parameters of sensors	A	Politechnika Warszawska
4	Creating the software for acquisition of data obtained from sensors sensitive for different ions in presence of interferences (three versions)	A	Universitat Politecnica de Catalunya (UPC) Politechnika Warszawska Politechnika Lodzka (TUL)
5	Creating the hardware for realisation of this software in the final instrument	A	Systea-Systems Technology Advance Valtion Teknillinen Tutkimuskeskus (VTT) Politechnika Lodzka (TUL)
6	Creating the hydraulic system for water measuring, sensor calibration and maintenance	A	Systea-Systems Technology Advance
7	Creating the system for data transmitting and visualisation	A	Systea-Systems Technology Advance Politechnika Lodzka (TUL)
8	Assembling selected elements of the project in one final prototype	A	Systea-Systems Technology Advance
9	Verification of the prototype in real-time measurement	A	Universitaet fuer Bodenkultur Wien (BOKU)
10	Creating the vision of future industrialisation of the system	A	Systea-Systems Technology Advance

*A: results usable outside the consortium / B: results usable within the consortium / C: non usable results

Quantified Data on the dissemination and use of the project results

Items about the dissemination and use of the project results (consolidated numbers)	Currently achieved quantity	Estimated future* quantity
Product innovations	1	3
Process innovations	3	4
New services (commercial)	0	3
New services (public)	0	0
New methods	3	4
Scientific breakthrought	3	3
Technical standards to which this project has contributed	0	0
EU regulations/directives to which this project has contributed	0	1
International regulations to which this project has contributed	0	0
PhDs generated by the project	4	2
Grantees/trainees including transnational exchange of personnel	0	0

** "Future" means expectations within the next 3 years following the end of the project*

Comment on European Interest

Community added value and contribution to EU policies

European dimension of the problem

The problem of water pollution monitoring is of European meaning and in this respect the

project SEWING brings valuable results on the European level. The project made contribution to all elements of a monitoring system, that is sensors, their mathematical presentation, software and hardware implemented in the system and the final prototype with all these elements included. The industrial partner of the project, a European SME, created a prototype of the system. This can be used for real-time monitoring in the field, thus giving the possibility of maintaining the quality of water in Europe on sustainable level. The exploitation plan expects production of the system in quantities enabling to solve water problems on the European level.

Contribution to developing S&T co-operation at international level. European added value

The system has been developed within broad European co-operation. Nine partners from 7 countries contributed in this project. Specialists in chemistry, electronics, semiconductor technology, informatics, environmental engineering and industrial technology co-operated in creating integrated and functional system for water pollution monitoring. The number of partners and specialists was well chosen to reach the critical mass for this interdisciplinary project. Existing of the system with possibilities of its broad production brings to Europe a significant added value, both in technological and scientific respect, but also from the social point of view. The SEWING system is innovative and its future industrial production will be significant for European economical competition. The achievements of particular partners created a variety of solutions. Some are implemented in the prototype, some are ready for implementing in future industrial applications, according to end-user demand.

Contribution to policy design or implementation

The main objective of the project: creating a relatively cheap and generally accessible system for monitoring and early warning of water pollution has been reached. This objective was based on the European policy expressed in the IST Work-programme in the FP5. Standards concerning the drinking, surface and waste waters pollution were taken into account in fixing the ranges of monitoring. So-far sensors selective for 4 ions are used in the prototype (NO3, NH4, Na, K). But there is a potential to extend this choice in the further implementations. Methods of measurements and monitoring, if accepted broadly by end-users, can contribute significantly to European standards in real-time water measurements.

Contribution to Community social objectives

Improving the quality of life in the Community:

Although the project SEWING is in the IST Programme, its usefulness is in the Sustainable Development area and therefore it is very important for the quality of life. The possibility of broad and easily accessible water monitoring all over Europe can bring significant improvement in health and comfort of life. The prototype of the system has positive properties, showing that it can be used broadly "in the field" and monitor the water quality in real time, sending the information wireless to the central computer of environment protection authorities. The number of institutions interested to be end-users of the system will decide on the final influence of the project on the quality of life in Europe.

Provision of appropriate incentives for monitoring and creating jobs in the Community (including use and development of skills):

The system will be promoted on a seminar for all potential users in the first half of the year 2005. If this promotion is effective, the production of thousands of the SEWING probes will be necessary. This will give jobs for employees in the producing institutions, as well as for the SEWING partners, who will be responsible for further improvements and development of the system. If the broad water monitoring becomes a standard in Europe, the local and regional authorities will be responsible for implementation of this policy and therefore employment will rise.

Supporting sustainable development, preserving and/or enhancing the

environment (including use/conservation of resources):
The impact of SEWING project on preserving the environment in Europe is evident. A system for water pollution monitoring and early warning, if broadly implemented, will give generally accessible information about risks concerning water quality. In particular, thanks to "in the field" and in "real-time" measurements sudden pollution is immediately detected and finding the responsible is easy. To get all benefits of the project the following should be done in the near future: 1. Getting the information from potential end-users, what version of the final equipment should be implemented industrially, 2. Fixing European standards for broad and general water monitoring.

Expected project impact (to be filled in by the project coordinator)

EU Policy Goals	I SCALE OF EXPECTED IMPACT OVER THE NEXT 10 YEARS -1 0 1 2 3	II other	
		Not applicable to project	Project Impacttoo difficult to estimate
1. Improved sustainable economic development and growth, competitiveness	3		
2. Improved employment	1		
3. Improved quality of life and health and safety	3		
4. Improved education	0		
5. Improved preservation and enhancement of the environment	3		
6. Improved scientific and technological quality	1		
7. Regulatory and legislative environment	1		
8. Other	3		

1. Economic development and growth, competitiveness	Scale of Expected Impacts over the next 10 years (2)	
	By Project End -1 0 1 2 3	After Project End -1 0 1 2 3
a) Increased Turnover for project participants - national markets	0	2
b) Increased Turnover for project participants - international markets	0	2
c) Increased Productivity for project participants	0	1
d) Reduced costs for project participants	0	0
e) Improved output quality/high technology content	0	3

2. Employment	Scale of Expected Impacts over the next 10 years (2)

	By Project End -1 0 1 2 3	After Project End -1 0 1 2 3
a) Safeguarding of jobs	0	1
b) Net employment growth in projects participants staff	0	0
c) Net employment growth in customer and supply chains	0	2
d) Net employment growth in the European economy at large	0	1

3. Quality of Life and health and safety	**Scale of Expected Impacts over the next 10 years (2)**	
	By Project End -1 0 1 2 3	**After Project End** -1 0 1 2 3
a) Improved health care	0	2
b) Improved food, nutrition	0	0
c) Improved safety (incl. consumers and workers safety)	0	3
d) Improved quality of life for the elderly and disabled	0	0
e) Improved life expectancy	0	1
f) Improved working conditions	0	1
g) Improved child care	0	0
h) Improved mobility of persons	0	0

4. Improved education	**Scale of Expected Impacts over the next 10 years (2)**	
	By Project End -1 0 1 2 3	**After Project End** -1 0 1 2 3
a) Improved learning processes including lifelong learning	0	0
b) Development of new university curricula	0	0

5. Preservation and enhancement of the environment	**Scale of Expected Impacts over the next 10 years (2)**	
	By Project End -1 0 1 2 3	**After Project End** -1 0 1 2 3
a) Improved prevention of emissions	0	3
b) Improved treatment of emissions	0	0
c) Improved preservation of natural resources and cultural heritage	0	1

d) Reduced energy consumption	0	0

6. S&T quality	Scale of Expected Impacts over the next 10 years (2)	
	By Project End -1 0 1 2 3	After Project End -1 0 1 2 3
a) Production of new knowledge	2	1
b) Safeguarding or development of expertise in a research area	1	1
c) Acceleration of RTD, transfer or uptake	1	2
d) Enhance skills of RTD staff	1	1
e) Transfer expertise/know-how/technology	0	2
f) Improved access to knowledge-based networks	0	0
g) Identifying appropriate partners and expertise	0	0
h) Develop international S&T co-operation	0	1
i) Increased gender equality	0	0

7. Regulatory and legislative environment	Scale of Expected Impacts over the next 10 years (2)	
	By Project End -1 0 1 2 3	After Project End -1 0 1 2 3
a) Contribution to EU policy formulation	0	1
Contribution to EU policy implementation	0	1

8. Other (please specify)	Scale of Expected Impacts over the next 10 years (2)	
	By Project End -1 0 1 2 3	After Project End -1 0 1 2 3
	0	3

Description of Results

No.	Title
1	Creating the theoretical basis for modelling of ISFET sensors

CONTACT PERSON FOR THIS RESULT

Name	Jan Ogrodzki

Position	Head of research group
Organisation	Politechnika Warszawska
Address	Nowowiejska 15/19 00-665, Warszawa Poland
Telephone	+(48-22)6607382
Fax	+(48-22)8252300
E-mail	jogr@ise.pw.edu.pl
URL	
Specific Result URL	

SUMMARY

As one of scientific results of SEWING project a theory of ISFET ion-sensitive sensors has been developed. This theory was so far presented in a variety of conference proceedings and now it is being prepared for a final publication in one of the sensor magazines. This theory of ion-selective sensors has become a base of innovative computer models of chemical sensors. These models have found wide application in practice of computer-aided design of sensor systems. The practical results consist of two parts: a model of the internal depletion FET of the ISFET sensor and a model of a ion-selective membrane working as a chemo-electrical transducer. The electrical model was developed in two versions: compatibile with SPICE and dedicated to HDL simulators (based on Merckel theory of FET). Both versions are physical. The model of the chemo-electrical transducer was elaborated for pH sensitive ISFETs and for arbitrary ion-selective CHEMFETs. The latter takes the form of a new, so called, super-Nikolski model not known so far in literature. Elaborated scientific results are fundamental, they are of wide interest and have broad applications in chemical sensor systems. They have been implemented in the software controlling the final demonstrator in SEWING project and will be disseminated also in literature. Especially super-Nikolski model is useful for CHEMFET characterization, simulation and data-fusion software. Different models created in this project are available in model libraries and on different software platforms. These models will be developed in the future by erxtension to other types of sensors. They will be used in new, industrial versions of the SEWING system.

SUBJECT DESCRIPTORS CODES
400 MODELLING/MODELLING TOOLS, 3-D MODELLING 192 ELECTRONICS, ELECTRONIC ENGINEERING

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: PU=Public CO=Confidential**
Publication	L.Opalski: Electrochemical modeling of CHEMFET sensors, Proc. ICSES, Swieradów, Poland, 2002, pp. 275-280	Public
publication	M. Szermer, M. Daniel, A. Napieralski: Design and modelling of smart sensors dedicated for water pollution monitoring, Proc. Int. Conference on Modelling & Simulation of Microsystems, San Francisco, USA, Feb. 2003.	Public
Publication	A. Filipkowski, J. Ogrodzki, L. Opalski, A. Goralski: Software for the system of European water monitoring, Proc. ISESS, Semmering, Austria, May	Public

	2003.	
Publication	J.Ogrodzki: Modeling of CHEMFET sensor in SPICE, Proc. ECCTD, Kraków, Poland, September 2003.	Public
Publication	A. Napieralski et al: Modelling of temperature phenomena in ion sensitive transistors, Proc. THERMINIC, Toulouse, France, Sept. 2003.	Public
Publication	Simulation of ion sensitive transistors using SPICE compatible model, Proc. IEEE Intern. Conf., Toronto, Canada, Oct. 2003.	Public
Publication	M.Daniel, M.Szermer, A.Napieralski: Modelling and practical verification of the ionophore based CHEMFET, Proc. MSM, Boston, USA, March 2004.	Public
Publication	M. Daniel, M. Janicki, W.Wrobleski, A. Dybko, A. Napieralski: Ion selective transistor modelling for behavioural simulations, Proc. AutMoNet 2004.	Public
Publication	J. Ogrodzki, W.Wroblewski: Computer modelling of CHEMFET sensors for data fusion in environmental water monitoring, Proc. AutMoNet, April 2004.	Public
Publication	M. Janicki, A. Napieralski: Estimation of Ion Mixture Composition with Chemically Modified Field Effect Transistors, Proc. 24th International Conference on Microelectronics, MIEL, Nis, Serbia, May 2004.	Public
Publication	M. Janicki, M. Daniel, A. Napieralski: Temperature dependent model of ion selective transistor for multidomain simulations, Proc. 10th THERMINIC, Sophia Antipolis, France, Sept. 2004.	Public
Publication	M. Janicki, M. Daniel, A. Napieralski: Wielodomenowe modelowanie i praktyczna weryfikacja tranzystorów jonoczu³ych ISFET, Elektronizacja, 10/2003, pp. 3-7 (in polish).	Public
Publication	L.Opalski: On modelling temperature dependence of CHEMFETs response curves, Proc. MIXDES, Lodz, Poland, June 2003.	Public
Publication	A. Napieralski et al: Parameter extraction for electro-chemical simulations of ion sensitive transistors, Proc. MIXDES, Lodz, Poland, June 2003.	Public
Publication	M.Daniel, M.Szermer, A.Napieralski, J.J.Charlot: CHEMFET modelling for hardware description languages, Proc. TCSET, Lviv-Slawsko, 2002.	Public
Publication	M.Daniel, M.Szermer, A.Napieralski, W.Wroblewski, A.Dybko: Ion-Selective Sensors Modelling for CAD, Proc. MIXDES, Wroclaw, Poland, June 2002.	Public
Publication	J.Ogrodzki: ChemFET Sensors Modeling for Water Monitoring Systems Design, Proc. MIXDES, Wroclaw, Poland, June 2002.	Public
Publication	L.J.Opalski, Z.Gniewinski, W.Wroblewski: On Dependence of ChemFET Sensor Response on Operating Point, Proc. MIXDES, Wroclaw, Poland, June 2002.	Public
deliverables	Deliverables Nos 10 and 11 describing physical and behavioural models of CHEMFETs	Public

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE:** **Tick a box and give the corresponding details(reference numbers, etc) if appropriate**					**Pre-existing know-how** **Tick a box and give the corresponding details(reference numbers, etc) if appropriate**	
	Current				**Foreseen**	**Tick**	**Details**
	Tick	**NoP[1)]**	**NoI[2)]**	**Details**	**Tick**		
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights	√			papers	√	√	papers
Secret know-how							
Other - please specify:							

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors
72 Computer and related activities 73 Research and development 80 Education

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Software code
Other:	Software is a final form, tested and ready to use.

Quantified data about the result

Items (about the results)	**Actual current quantity**	**Estimated (or future) quantity**
Time to application / market (in months from the end of the research project)	6	36
Number of (public or private) entities potentially involved in the implementation of the result:	2	3
of which: number of SMEs:	1	2
of which: number of entities in third countries (outside EU):	0	1

Targeted user audience: of reachable people	1	1
S&T publications (referenced publications only)	18	10
publications addressing general public (e.g. CD-ROMs, WEB sites)	1	2
publications addressing decision takers / public authorities / etc.	1	1
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development	√	**FIN**	Financial support	√
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing agreement		**INFO**	Information exchange/training	√
JV	Establish a joint enterprise or partnership		**CONS**	Available for consultancy	
Other	(please specify)	√			
Details:	Collaboration in domain of chemical sensors modeling and optimization, sensors systems development, development of stable technology,				

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Knowledge in domain of mathematical modeling of chemical sensors, experience, software for simulation and the models identification.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

A research group at a university working on chemical sensors modeling, applications, a small company designing analytical equipment.

No.	Title
2	Creating technology and production of two kinds of ISFET sensors: BSC (Back-Side-Contact) and FSC (Front-Side-Contact),

CONTACT PERSON FOR THIS RESULT

Name	Zbigniew Brzózka
Position	Head of Research Group
Organisation	Warsaw University of Technology, Faculty of Chemistry
Address	Noakowskiego 3 00-664, Warsaw Poland
Telephone	+48-22-6605427
Fax	+48-22-6605631
E-mail	brzozka@ch.pw.edu.pl
URL	www.ch.pw.edu.pl/~brzozka
Specific Result URL	

SUMMARY

New structures of miniaturized solid-state potentiometric transducers i.e. back-side contact (BSC) and front-side contact (FSC) ion-sensitive field effect transistors (ISFETs) were manufactured by the Institute of Electron Technology+PW (Poland) and LAAS-CNRS (France)+ Microsens (Switzerland), respectively. The performed tests proved good performance and excellent linearity of the pH responses of the ISFETS, which enables the accurate determination of pH. Further deposition of the polyHEMA layer on the gate surface and the chemical modification of the ISFETs i.e. the deposition of ion-selective polymer membranes allowed obtaining sensors – CHEMFETs – sensitive to target ions (NH4+, K+, Na+, NO3-). The procedure of the polyHEMA layer deposition is compatible with the IC technology and is realized using spin-coating technique (industrial method) in the Institute of Electron Technology. Two types of ion-selective membranes (of optimised composition) based on plasticized poly(vinyl chloride) (PVC) and polysiloxane derivative were applied. The method of membrane deposition using an automated dispensing unit (semi-industrial method, PW) and the technology of UV-polymerizable membrane deposition on ISFET wafer using spin-coating set-up (industrial method, LAAS-CNRS and Microsens) were developed, enabling the production of cheap sensors sensitive to: NH4+, K+, Na+ and NO3- ions. Ca+2-sensitive FSC-CHEMFETs have been also prepared by Microsens using the spin-coating industrial technology (these sensors are not yet implemented in the prototype). The working range of the CHEMFETs (linear range of the calibration curves at least 1-4 pX) is appropriate to perform ion monitoring in environmental analysis. An examplary prototype of a portable multisensor analyzer for water quality monitoring based on BSC-CHEMFETs was fabricated by Systea (Italy). Also ion-sensitive FSC-CHEMFETs are ready to be implemented in the measuring system. The multisensor analyzer will be dedicated to the environmental pollution survey of wastewater and natural water resources.

SUBJECT DESCRIPTORS CODES
670 WATER: MONITORING / QUALITY / TREATMENT 211 ENVIRONMENTAL INDICATORS/MONITORING/RISK ASSESSMENT 385 MEMBRANE TECHNOLOGY 412 MULTISENSORY TECHNOLOGY, MULTI-SENSING 560 SENSORY SCIENCE, SENSORS, INSTRUMENTATION

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: PU=Public CO=Confidential**
Publication	Wróblewski W., Dybko A., Chudy M., Brzózka Z., New ion-sensitive field effect transistors (ISFETs) with back-side contacts for flow analysis, Proc. SPIE, Vol. 5124, 74 (2003).	Public
Publication	Ciosek P., Wróblewski W., Brzózka Z., Reducing of total number of ion-selective electrodes in sensor array for liquid analysis, Proc. of Eurosensors XVII, Guimaraes 2003, 157.	Public
Publication	Brzozka Z., Cabestany J., Filipkowski A., Jachowicz R.S., Moscetta P., Sanfilippo L., Weremczuk J., Wróblewski W., An innovative automated flow measuring probe for the measurement of chemical parameters in water based on CHEMFET sensors, Proc. of IWA Conference AutMoNet 2004, Vienna, 283.	Public
Conference presentation	Wroblewski W., Chudy M., Dybko A., Brzózka Z., Flow-cell system based on chemically modified field effect transistors, International Conference on	Public

	Automation in Water Quality Monitoring – AutoMoNet 2002, Vienna 2002.	
Conference presentation	Chudy W., Wróblewski W., Dybko A., Brzózka Z., Natural water analysis based on multisensor system, 9th International Conference MIXDES 2002, Wroclaw 2002.	Public
Conference presentation	M. Chudy, Z. Brzozka, W. Wroblewski, Ion-sensitive transistors baesd on polysiloxane matrice RMS 033, VIIIth National Conference on optoelectronic and electronic sensors, Wroclaw 2004.	Public
Invited lecture	Z.Brzozka, Modification of polymer membranes towards advanced chemical sensors, Int. Conf. on Electrochemical Sensors, Matrafured, Hungary 2002.	Public
Publication	P. Temple Boyer, J. Launay, I. Humenyuk, T. Do Conto, A. Martinez, C. Bériet, A. Grisel: "Study of front-side connected chemical field effect transistor for water analysis", Microelectronics Reliability, 44 (2004), p.443-447	Public
Conference presentation	I. Humenuyk, B. Torbiéro, S. Assié, X. Dollat, B. Franc, A. Martinez, P. Temple Boyer: "Development of pNH4-ISFET microsensors for water analysis", Proceedings of the 18th European Conference on Solid-State Transducers, EUROSENSORS XVIII, september 13-15 2004, Roma, ITALY, p.81-82	Public
Conference presentation	I. Humenyuk, B. Torbiéro, D. Lagrange, S. Assié, B. Franck, P. Marcoul, D. Médale, A. Martinez, P. Temple Boyer: "Development of a measurement interface for ChemFETs microsensors", Proceedings of the 11th International Conference on Mixed Design of Integrated Circuits and Systems, MIXDES 2004, june 24-26 2004, Szczecin, POLAND, p.369-372	Public
Conference presentation	P. Temple Boyer, J. Launay, I. Humenyuk, T. Do Conto, A. Martinez, C. Bériet, A. Grisel: "Study of front-side connected chemical field effect transistors for water analysis", Proceedings of the 10th International Conference on Mixed Design of Integrated Circuits and Systems, MIXDES 2003, june 26-28 2003, Lodz, POLAND, p. 282-285	Public
Publication	J. Lysko, B. Latecki et al., Element of silicon TCD design and technology, 6th International Symposium on Microelectronic Technologies and Microsystems, Lviv, Ukraine 2002.	Public
Publication	B.Jaroszewicz, P.Grabiec, J.Koszur, A.Kociubinski, Z.Brzózka, Technology and measurement of backside contacted ISFETS, Proc. 9th Intern. Conf. "Mixed Design of Integr. Circ. and Systems", Wroclaw, 2002, pp.139-141.	Public
Deliverables	Deliverables 6,7, and 9 describe technology of fabrication of CHEMFETs	Confidential

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE:**	**Pre-existing know-**

	Tick a box and give the corresponding details(reference numbers, etc) if appropriate					how Tick a box and give the corresponding details(reference numbers, etc) if appropriate	
	Current				Foreseen	Tick	Details
	Tick	NoP[1)]	NoI[2)]	Details	Tick		
Patent applied for							
Patent granted							
Patent search carried out							
Registered design					√	√	ISFET fabrication
Trademark applications							
Copyrights	√			papers	√	√	papers
Secret know-how							
Other - please specify:							

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors
01 Agriculture, hunting and related service activities 73 Research and development

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Prototype/demonstrator available for testing
Other:	

Quantified data about the result

Items (about the results)	Actual current quantity	Estimated (or future) quantity
Time to application / market (in months from the end of the research project)	0	6
Number of (public or private) entities potentially involved in the implementation of the result:	10	20
of which: number of SMEs:	5	10
of which: number of entities in third countries (outside EU):	2	3
Targeted user audience: of reachable people	100	500
S&T publications (referenced publications only)	13	20
publications addressing general public (e.g. CD-ROMs, WEB sites)	1	1

publications addressing decision takers / public authorities / etc.	3	5
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development	√	**FIN**	Financial support	√
LIC	Licence agreement	√	**VC**	Venture capital/spin-off funding	√
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing agreement	√	**INFO**	Information exchange/training	√
JV	Establish a joint enterprise or partnership	√	**CONS**	Available for consultancy	√
Other	(please specify)				
Details:	The implementation of the results requires the collaboration of SMEs to create new complex analytical devices or single measuring probes for different applications (e.g. laboratory or industrial devices, clinical analyzers). Additional financial resources and the participation of other research teams are needed to undertake further research to develop new potentiometric sensors of enhanced performance and sensitivity to other analytes. Further studies are especially necessary to construct a reliable miniaturized reference electrode for potentiometric measurements.				

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Development and production of Ion Selective Field Effect Transistors (ISFETs) sensors, sensitive to the selected ions (CHEMFETs) suitable for detection of selected inorganic ions in water resources and waste water in high-risk industrial and agriculture regions. Possibility of the design of sensors based on ISFET technology that are sensitive to other analytes for environmental, industrial and clinical purposes. The sensors can be used as individual measuring probes or/and implemented in multiparameter analytical devices. Further development involves the application of novel membrane materials providing new sensors of enhanced stability, fulfiling specific target needs.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Additional partners to build new analytical devices, to test prototypes and perform market research are expected. In particular a SME able to produce CHEMFETs in industrial way according to SEWING know-how is needed. The profile of the external partners: environmental/industrial/clinical laboratories and/or SMEs working on wide areas of chemical analysis and especially analytical monitoring.

No.	Title
3	Measurement and extracting model parameters of sensors

CONTACT PERSON FOR THIS RESULT

Name	Jan Ogrodzki
Position	Head of research group
Organisation	Politechnika Warszawska
Address	Nowowiejska 15/19 00-665, Warszawa Poland
Telephone	+48-22-6607382
Fax	+48-22-8252300
E-mail	jogr@ise.pw.edu.pl

URL	
Specific Result URL	

SUMMARY

A dedicated automatic, computer-controlled stage for measurement of chemical ISFET sensors has been improved, based on standard firmware used in the SYSTEA's LFA analyzers. It provides the following procedures: programmable dosage of chemicals, computer-controlled hydraulic system providing the flow of solutions through sensors mounted in flow-cells, programmable supply-measurement equipment for sensor biasing. Results of measurment are generated in XML files and stored in a dedicated database. A dedicated software has been developed for processing the database. Another set of applications has been developed for extracting parameters of the sensor models. It contains a preextraction procedure providing rough values of electrical and chemical model parameters. These parameters are further adjusted by means of optimisation procedure. Two versions of the software have been developed: a prototype software dedicated to Matlab environment, where new algorithms have been implemented, tested, improved and a final C application implemented as a firmware in the final demonstrator. Developed electrical and chemical models appeared to have good numerical properties, were well conditioned, easy in preextration and final optimization.

SUBJECT DESCRIPTORS CODES
101 CHEMICAL METROLOGY 150 DATABASES, DATABASE MANAGEMENT, DATA MINING 186 ELECTRICAL ENGINEERING/TECHNOLOGY 390 METROLOGY, PHYSICAL INSTRUMENTATION 670 WATER: MONITORING / QUALITY / TREATMENT

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: PU=Public CO=Confidential**
Publication	M. Szermer, P. Pietrzak, M. Daniel, A. Napieralski: Laboratory Measurement Stand of Analgue to Digital Converters with Application of LABVIEW Environment, Proc. MIXDES, Szczecin, Poland, June 2004.	Public
Publication	R.Jachowicz, J.Weremczuk, J.Sochon: Automatic Stand for IS-FET Sensors Parameters Identification, Proc. MIXDES, Wroclaw, Poland, June 2002.	Public
Publication	M. JANICKI, M. DANIEL, A. NAPIERALSKI: PARAMETER EXTRACTION FOR ELECTRO-CHEMICAL SIMULATIONS OF ION SENSITIVE TRANSISTORS, Proc. MIXDES, Lodz, Poland, June 2003	Public
Publication	M.Badowski, L.J. Opalski: Software for CHEMFET sensor data processing and visualisation, Proc. MIXDES, Szczecin, Poland, June 2004.	Public
Deliverable	Deliverable No 8, describing the measurement system for sensor verification	Confidential
Deliverable	Deliverable No 12, describing the parameter extraction software and its optimisation	Public

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE:** **Tick a box and give the corresponding details(reference numbers, etc) if appropriate**					**Pre-existing know-how** **Tick a box and give the corresponding details(reference numbers, etc) if appropriate**	
	Current				**Foreseen**	**Tick**	**Details**
	Tick	**NoP[1)]**	**NoI[2)]**	**Details**	**Tick**		
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights	√			paper	√	√	paper
Secret know-how							
Other - please specify:							

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors
73 Research and development 80 Education 90 Sewage and refuse disposal, sanitation and similar activities

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Results of demonstration trials available
Other:	All results are in an implemented form

Quantified data about the result

Items (about the results)	**Actual current quantity**	**Estimated (or future) quantity**
Time to application / market (in months from the end of the research project)	6	36
Number of (public or private) entities potentially involved in the implementation of the result:	1	4
of which: number of SMEs:	1	3
of which: number of entities in third countries (outside EU):	1	1
Targeted user audience: of reachable people	1	2
S&T publications (referenced publications only)	4	2

publications addressing general public (e.g. CD-ROMs, WEB sites)	1	2
publications addressing decision takers / public authorities / etc.	1	2
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development	√	**FIN**	Financial support	
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing agreement		**INFO**	Information exchange/training	√
JV	Establish a joint enterprise or partnership		**CONS**	Available for consultancy	
Other	(please specify)	√			
Details:	Cooperation with small enterprises. Industraialization of results.				

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Knowledge in domain of mathematical modelling of chemical sensors, experience, software for simulation and the models identification.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Experienced research groups at universities, small enterprises manufacturing ion-sensitive sensors.

No.	Title
4	Creating the software for acquisition of data obtained from sensors sensitive for different ions in presence of interferences (three versions)

CONTACT PERSON FOR THIS RESULT

Name	Leszek Opalski
Position	Head of Circuits and Systems Division in the Institute of Electronic Systems
Organisation	Politechnika Warszawska
Address	Nowowiejska 15/19 00-665, Warszawa Poland
Telephone	+48-22-6607989
Fax	+48-22- 8252300
E-mail	lopalski@elka.pw.edu.pl
URL	
Specific Result URL	

SUMMARY

One of the key results of the project is software for processing of raw measurement data from several CHEMFET sensors and a temperature sensor. Usage of such software is a must, as real CHEMFET sensors are not sufficiently specific (i.e. they respond not only to

their "main ion" but also to some interfering ions), their response curve is nonlinear and temperature dependent. There were 3 approaches to design of data processing algorithms. The PW group assumed availability of steady state (current or voltage) readouts from CHEMFETs and a temperature sensor - all located in the reactor of the probe. Initially sensor calibration - water sample measurement cycle was investigated. Finally an original multistep standard addition type measurement technique was developed, that combines calibration and measurement phases. For NO3, NH4, K and Na sensors (as used in the final demonstrator probe) the first of four steps consists of complete readout from CHEMFETs and a temperature sensor, after water sample (pre-treated with Ionic Strength Adjuster) was placed in the reactor of the probe. Next measurement set is performed after injecting low level of standard liquid (with all the main ions). Then follows injection of high level of the main (most troublesome) interfering ion, i.e. K, and measurement. Finally injection of high level of the remaining main ions and measurement -complete the cycle. A special purpose optimisation based algorithm has been developed that uses measurement from all sensors in all steps of the measurement cycle and sensor models (also new ones - developed in this project) to perform estimation of main ion concentration in the sample. The algorithm and the software that implements it is data driven, and so it can accept arbitrary number of main ions, sensors (can be redundant if available) if requested via configuration files. The software library has been integrated with the dedicated measurement unit control firmware made by Systea, to provide on-line estimates of ion concentration. Stand-alone off-line processing program has been also provided. The TUL group assumed availability of time responses from the sensors, and used inverse problem solution algorithms to estimate of ion mixture composition. The approach aimed at reducing estimation uncertainty due to CHEMFET measurement inaccuracy. The work ended at the research state, with some publication documenting the results. The UPC group also considered a time evolution of responses from a redundant array of sensors. Using ideas from signal processing (multiple interference cancellation) the group aimed at decreasing of ion content estimation inaccuracy due to sensor non-specifity and measurement error, making some assumptions about statistics of the two sources of inaccuracy. The work ended at the research state with numerous publications documenting acheivements.

SUBJECT DESCRIPTORS CODES
101 CHEMICAL METROLOGY
560 SENSORY SCIENCE, SENSORS, INSTRUMENTATION
390 METROLOGY, PHYSICAL INSTRUMENTATION
400 MODELLING/MODELLING TOOLS, 3-D MODELLING
28 ANALYTICAL CHEMISTRY
129 COMPUTER SCIENCE/ENGINEERING, NUMERICAL ANALYSIS, SYSTEMS, CONTROL
186 ELECTRICAL ENGINEERING/TECHNOLOGY
192 ELECTRONICS, ELECTRONIC ENGINEERING
207 ENVIRONMENT, ENVIRONMENTAL SCIENCE
397 MICROSYSTEMS
412 MULTISENSORY TECHNOLOGY, MULTI-SENSING
563 SIGNAL PROCESSING
565 SIMULATION, SIMULATION ENGINEERING
670 WATER: MONITORING / QUALITY / TREATMENT

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: PU=Public CO=Confidential**
Publication	L.J. Opalski, "Data Fusion for CHEMFET Arrays", Bul. of the Polish Academy of Sci., Technical Sci., Vol. 50, No. 4, 2002, pp. 287-293	Public

Conference paper	G. Bedoya, S. Bermeio, V. Parisi, J. Cabestani,"An on-line water monitoring system using a smart ISFET array", IECON'02 28th Annual Conf. of the IEEE Industrial Electronics Society, Sevilla, Spain	Public
Conference paper	G. Bedoya, S. Bermejo, J. Cabestany, "Comparison of neural algorithms for blind source separation in sensor array applications", ESANN European Symposium on Artificial Neural Networks, 23-25 April 2003	Public
Conference paper	G. Bedoya, S. Bermejo, J. Cabestany, "Hybrid Neural Networks for ISFET Source Separation", SPIE's Int. Symposium on Microtechnologies for the New Millenium 2003, 19-21 May 2003	Public
Conference paper	A. Filipkowski, J. Ogrodzki, L. Opalski, A. Goralski "Software for the system of European water monitoring", ISESS International Symposium on Environmental Software Systems, Semmering, AT, 27-30 May 2003	Public
Conference paper	G. Bedoya, S. Bermejo, J. Cabestany, " ISFET source separation based on linear ICA", IWANN2003 Int. Work-Conference on Artificial Neural Networks, 3-6 June 2003	Public
Conference paper	L.J. Opalski, "On modelling temperature dependence of CHEMFET response curves", Proc. MIXDES'2003, Lodz, Poland, 26-28 June 2003, pp. 446-449.	Public
Conference paper	M. Janicki, M. Daniel, A. Napieralski, "Parameter extraction for electro-chemical simulations of ion sensitive transistors", Lodz, Poland, 26-28 June 2003, pp. 450-455	Public
Conference paper	L.J. Opalski, Z. Gniewinski, W. Wroblewski, "On dependence of CHEMFET sensor response on operating point", Proc. MIXDES'2002, Wroclaw, Poland, 20-22 June 2002, pp. 157-160	Public
Conference paper	L.J. Opalski, "Electro-chemical modeling of CHEMFET sensors", Proc. MIXDES'2002, Wroclaw, Poland, 20-22 June 2002, pp. 275-280	Public
Conference paper	M. Daniel, M. Szermer, A. Napierakski, W. Wroblewski, A. Dybko, "Ion-selective sensors modeling for CAD", Proc. MIXDES'2002, 20-22 June 2002, Wroclaw, Poland pp. 147-150	Public
Conference paper	J. Ogrodzki, L.J. Opalski, K. Zam³yñski, "Modeling of CHEMFET sensor in SPICE", Proc. ECCTD'03, Krakow, Poland, 1-4 September, 2003	Public
Conference paper	Z. Brzózka, "Reducing of total number of ion-selective electrodes in sensor array for liquid analysis", 17th European Conference on Solid-State Transducers Eurosensors XVII, Porto, Portugal, 22-24 September 2003	Public
Conference paper	TUL presented a paper "Simulation of ion sensitive transistors using SPICE compatible model", IEEE Intern. Conference, Toronto, Canada, October 2003	Public
Conference paper	UPC presented the paper "Improving Semiconductor-based Chemical Sensor Arrays Using Advanced Algorithms for Blind Source Separation", IEEE	Public

	SIcon/04, Sensors for Industry Conference, January 2004	
Conference paper	M. Daniel, M. Szermer, A. Napieralski: „Modelling and practical verification of the ionophore based CHEMFET", MSM'2004, Boston, USA, March 7-11, 2004	Public
Conference paper	M. Daniel, M. Janicki, W.Wrobleski, A. Dybko, A. Napieralski: "Ion selective transistor modelling for behavioural simulations", AutMoNet'2004 Conference, Vienna, AT, 19-20 April 2004	Public
Conference paper	Z.Brzozka, J. Cabestany, A. Filipkowski, R.S. Jachowicz, P.Moscetta, L. Sanfilippo: "An innovative automated flow measuring probe for the measurement of chemical parameters in water based on CHEMFET sensors", AutMoNet'2004 Conference, Vienna, AT, 19-20 April 2004	Public
Conference paper	G.Bedoya, S.Bermejo, J.Cabestany, V.Parisi: "On-line Water monitoring using smart array of solid-state chemical sensors", AutMoNet'2004 Conference, Vienna, AT, 19-20 April 2004	Public
Conference paper	J. Ogrodzki, W.Wroblewski: "Computer modelling of CHEMFET sensors for data fusion in environmental water monitoring", AutMoNet'2004 Conference, Vienna, AT, 19-20 April 2004	Public
Conference paper	M. Janicki, A. Napieralski: "Estimation of Ion Mixture Composition with Chemically Modified Field Effect Transistors, 24th International Conference on Microelectronics, MIEL, ", Nis, Serbia, 16-19 May 2004	Public
Conference paper	L.J.Opalski, "Data fusion for CHEMFET-based Measurements", Proc. MIXDES'04, Szczecin, Poland, 24-26 June 2004, pp. 357-362.	Public
Conference paper	M. Badowski, L.J. Opalski, "Software for CHEMFET sensor data processing and visualisation", Proc. MIXDES'04, Szczecin, Poland, 24-26 June 2004, pp. 357-362.	Public
Conference paper	M. Janicki, M. Daniel, A. Napieralski: "Application of Inverse Problem Algorithm for Estimation of Ion Mixture Composition", Proc. MIXDES'04, Szczecin, Poland, 24-26 June 2004, pp. 337-342.	Public
Conference paper	G. Bedoya, S. Bermejo, J. Cabestany "Information-theoretic Approach to multi-channel Signal Extraction by Multiple Interference Cancellation in Electrochemical Array data", Int. Joint Conference on Neural Networks (IJCNN-2004), July 2004	Public
Conference paper	S.Bermejo, "Blind source separation for solid-state chemical sensor arrays", Third IEEE Sensor Array and Multichannel Signal Processing WorkshopSitges (Barcelona), Spain, 18 – 21 July 2004	Public
Deliverable	Deliverable 18: Realisation of prototypes	Confidential
Article	S. Bermejo, J.Cabestani, "Ensemble Learning for Chemical sensor Arrays", Neural Processing Letters, vol. 19, No1, pp. 25-35, 2004, Kluwer	Public

Deliverables	Deliverables Nos 13, 14, 15 and 16 describe the works on software for data processing and software describing behaviour of particular parts of the system.	Confidential

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE:** **Tick a box and give the corresponding details(reference numbers, etc) if appropriate**					**Pre-existing know-how** **Tick a box and give the corresponding details(reference numbers, etc) if appropriate**	
	Current				**Foreseen**	**Tick**	**Details**
	Tick	**NoP[1)]**	**NoI[2)]**	**Details**	**Tick**		
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights	√			papers	√	√	papers
Secret know-how							
Other - please specify:							

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors
73 Research and development

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Software code
Other:	other solutions ready for implementation

Quantified data about the result

Items (about the results)	**Actual current quantity**	**Estimated (or future) quantity**
Time to application / market (in months from the end of the research project)	6	36
Number of (public or private) entities potentially involved in the implementation of the result:	1	2

of which: number of SMEs:	1	2
of which: number of entities in third countries (outside EU):	0	0
Targeted user audience: of reachable people	2	2
S&T publications (referenced publications only)	28	10
publications addressing general public (e.g. CD-ROMs, WEB sites)	1	1
publications addressing decision takers / public authorities / etc.	0	0
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development	√	**FIN**	Financial support	√
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement	√	**PPP**	Private-public partnership	
MKT	Marketing agreement	√	**INFO**	Information exchange/training	
JV	Establish a joint enterprise or partnership		**CONS**	Available for consultancy	√
Other	(please specify)				
Details:					

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Software for data extraction from multiple sensors

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Universities, SMEs

No.	Title
5	Creating the hardware for realisation of this software in the final instrument

CONTACT PERSON FOR THIS RESULT

Name	Luca Sanfilippo
Position	Project Manager
Organisation	Systea-Systems Technology Advance
Address	Via Paduni, 2A 03012, Anagni (FR) ITALY
Telephone	+39-07705776058
Fax	+39-07705772204
E-mail	luca.sanfilippo@systea.it
URL	www.systea.it
Specific Result URL	

SUMMARY

Two different types of hardware were developed to manage the signal acquisition from

Chemfet sensors: - a measuring system developed by Systea based on commercial A/D and D/A boards. This system is applied on the three prototypes developed during the research project (LFA test unit, probe demonstrator and final prototype) and it manages the Chemfet sensors by a specific software procedure developed with PW partners in order to measure the drain current response of voltage driven Chemfets. - a voltage sensing board developed by VTT partner, which will be managed by new dedicated software module developed by UPC partner, using a second parallel board connected through the PC-104 bus to the main CPU unit. The first one is able to measure the drain currents coming from the polarized sensors, while the second one reads directly the drain voltages. The first solution was found most suitable to use it in the final prototype.

SUBJECT DESCRIPTORS CODES
192 ELECTRONICS, ELECTRONIC ENGINEERING

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: PU=Public CO=Confidential**
Conference paper	K. Tukkiniemi: "Study of CHEMFET interface electronics", MIXDES-2002	Public
Deliverable	Deliverable No 17, describing the behaviour of particular parts of the system.	Confidential

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE: Tick a box and give the corresponding details(reference numbers, etc) if appropriate**					**Pre-existing know-how Tick a box and give the corresponding details(reference numbers, etc) if appropriate**	
	Current				**Foreseen**	**Tick**	**Details**
	Tick	**NoP[1)]**	**NoI[2)]**	**Details**	**Tick**		
Patent applied for						√	LFA circuit
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - please specify:							

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors
73 Research and development d2 Others

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Prototype/demonstrator available for testing
Other:	

Quantified data about the result

Items (about the results)	**Actual current quantity**	**Estimated (or future) quantity**
Time to application / market (in months from the end of the research project)	12	8
Number of (public or private) entities potentially involved in the implementation of the result:	4	6
of which: number of SMEs:	2	2
of which: number of entities in third countries (outside EU):	0	0
Targeted user audience: of reachable people	100	200
S&T publications (referenced publications only)	2	2
publications addressing general public (e.g. CD-ROMs, WEB sites)	1	1
publications addressing decision takers / public authorities / etc.	0	0
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development	√	**FIN**	Financial support	
LIC	Licence agreement	√	**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing agreement		**INFO**	Information exchange/training	
JV	Establish a joint enterprise or partnership		**CONS**	Available for consultancy	
Other	(please specify)				
Details:					

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

The hardware solutions of particular parts of the SEWING system can be used in other similar devices. It will be up-dated when creaing the commercial version of the system

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Co-operation in industrialising the hardware solutions of SEWING system will be welcome.

No.	Title
6	Creating the hydraulic system for water measuring, sensor calibration and maintenance

CONTACT PERSON FOR THIS RESULT

Name	Luca Sanfilippo
Position	Project Manager
Organisation	Systea-Systems Technology Advance
Address	Via Paduni, 2A 03012, Anagni (FR) ITALY
Telephone	+39-07705776058
Fax	+39-07705772204
E-mail	luca.sanfilippo@systea.it
URL	www.systea.it
Specific Result URL	

SUMMARY

During the research project three diferrent prototypes of measuring systems were developed: - LFA test unit - probe demonstrator - final prototype. Each of them was practically used in different stages of research to test the results coming from other goups and to perform measurements on water samples. LFA test unit: The LFA test unit is based on a standard SYSTEA MICROCHEM benchtop analyser, which is able to manage automatically a complete measuring sequence using the patented Loop Flow Reactor (LFR) analytical technology. The unit is divided into four main sections: - Hydraulics, mounted in the front view panel - Electronics and actuators, mounted inside the back panel - Internal reagents compartment, accessible from the right side of the unit - Alphanumeric display and membrane keyboard and a printer, mounted at the top front of the instrument. The standard LFR hydraulic manifold unit was modified to integrate: - the two-sides back-planed ISFET measuring flow-cell already developed by Warsaw University - an Ag/AgCl reference electrode, mounted in the centre of the same measuring head - n.2 CHEMFET sensors, referenced to the same Ag/AgCl electrode, with standard MOSFET output. Modified Front Side contact Sensors from LAAS partner technology, mounted on a PCB board with rear electrical connectors, were integrated and tested too, using a special customized bigger flow cell already developed by SYSTEA. The LFA test unit is a complete CHEMFET LFA bench-top analyser, which will be used to perform automatic measurement, drifts tests, comparisons on single CHEMFET sensors; the internal electronics and software provide directly output data in concentration unit, with the capability to manage the signal acquisition from two CHEMFET sensors, typically to measure NO3- and NH4+. The measuring unit is fully configurable and open to operator's modification of the analytical sequence which manages the hydraulic reactor; using the local keyboard and LCD display, as any other standard SYSTEA's LFA analyser; as an example, it allows: - to polarize the reference electrode and CHEMFETs drain inputs with single predefined voltages - to modify any interval time of the analytical sequence which manages the two CHEMFETs measurement - to program the opening and closure of any valve included in the loop - to turn on or off the peristaltic pump in both versus, at two different speed (low and high) - to modify the quantity of solutions which can be injected in the loop reactor - to perform automatically the standard addition method on each measurement cycle. The unit is configured to manage n.2 injection valves, to perform: - programmable addition of ISA (Ionic Strength Adjuster) stock solution to the sample, before and after the measurement - programmable addition of a stock calibrant solution to the sample, after the sample measurement, to perform "standard addition" method with CHEMFET sensors. The unit performs after each measurement the automatic

calculation of measured concentration; as standard the firmware provides logarithmic calculation, using known addition method, for two CHEMFET chemical sensors choosing between two different algorithms. Another firmware version is available to perform linear calculation using two standard (low, high), for pH ISFET sensors or CHEMFET sensors which already includes built-in electronic for linearized standard output. The calibration is performed using low and high standard solutions, in order to calculate the CHEMFET sensor's slope by the sequential measure of two external standard solutions (low, high), which have to be always chosen divided by a decade (i.e. low 2 ppm, high 20 ppm). The unit is fully programmable to set any configuration parameter (like added standard solution concentration, volume of added standard or Chemfet's polarization electrical parameters). The measured data are shown after the end of the measurement using the LCD display and then automatically printed using the printer mounted on the front panel. Probe demonstrator: The probe demosntrator is a prototype designed to be specifically deployed in water as a probe. The analytical part of the device is based upon a novel patented technology named micro Loop Flow Analysis (uLFA); the main characteristics of this new technology is the extreme compactness (the analytical reactor volume is 5 ml only) and the compatibility to be integrated in submergible measuring devices. The probe is able to mount both types of BSC and FCS CHEMFETs, using the linear modular flow-cell already tested in the measuring stand and in LAAS laboratory.

SUBJECT DESCRIPTORS CODES
670 WATER: MONITORING / QUALITY / TREATMENT 412 MULTISENSORY TECHNOLOGY, MULTI-SENSING 213 ENVIRONMENTAL TECHNOLOGY/ENGINEERING, POLLUTION CONTROL

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: PU=Public CO=Confidential**
LFA test unit User manual, v.1.1	User manual for this prototype measuring device	Public
LFA test unit flyer	Brochure which describes the main charactersitics of this prototttype measuring device	Public
AutMoNet 2004 paper	Paper which describes the technical charactersistics of the probe demonstrator	Public
Deliverable	In deliverable 18 the hydraulic system is described (among other items).	Public

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE: Tick a box and give the corresponding details(reference numbers, etc) if appropriate**					**Pre-existing know-how Tick a box and give the corresponding details(reference numbers, etc) if appropriate**	
	Current				**Foreseen**	**Tick**	**Details**
	Tick	**NoP[1)]**	**NoI[2)]**	**Details**	**Tick**		
Patent applied for						√	LFA circuit
Patent granted							

Patent search carried out						
Registered design						
Trademark applications						
Copyrights					√	Internal firmware
Secret know-how						
Other - please specify:						

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors
01 Agriculture, hunting and related service activities

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Experimental development stage (laboratory prototype)
Other:	

Quantified data about the result

Items (about the results)	**Actual current quantity**	**Estimated (or future) quantity**
Time to application / market (in months from the end of the research project)	6	12
Number of (public or private) entities potentially involved in the implementation of the result:	3	4
of which: number of SMEs:	1	1
of which: number of entities in third countries (outside EU):	0	1
Targeted user audience: of reachable people	500	20000
S&T publications (referenced publications only)	1	5
publications addressing general public (e.g. CD-ROMs, WEB sites)		20
publications addressing decision takers / public authorities / etc.		10
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development		**FIN**	Financial support	
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	√

MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing agreement	√	**INFO**	Information exchange/training	
JV	Establish a joint enterprise or partnership	√	**CONS**	Available for consultancy	
Other	(please specify)				
Details:	Systea needs some funding to industrialize the the measuring technology developed under the SEWING project, in order to achieve the objective of a much more competitive measuring unit to be placed in the international market				

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Systea is able to commercialize the new industrualized product using its won network of international distriutors, but we can evaluate the possibility to cooperate with a third commercial partner which is able to speed-up the marketing and commercialization of the new product.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

We need a partner which will provide us the Chemfet sensors already characterized and tested in lab, in order to be integrated in the new industrialized device. A spin-off commercial coming from Warsaw University will be the best solution to achieve the necessary support by a technological point of view. The computational algorithm developed during the project will be paid to the partner who developed it using a license fee for each unit sold.

No.	**Title**
7	Creating the system for data transmitting and visualisation

CONTACT PERSON FOR THIS RESULT

Name	Luca Sanfilippo
Position	Project Manager
Organisation	Systea-Systems Technology Advance
Address	Via Paduni, 2A 03012, Anagni (FR) ITALY
Telephone	+39-07705776058
Fax	+39-07705772204
E-mail	luca.sanfilippo@systea.it
URL	www.systea.it
Specific Result URL	

SUMMARY

The prototypes developed are capable to be managed by a local display and keyboard (LFA test unit and final prototype), a printer (LFA test unit) or to provide data to an external PC (probe demonstrator and final prototype) using a RS-232 serial port. The final prototype is equipped with a special application program developed in Viau Basic under Windows XP operating system which could perform the following main function: - start of analysis - wash of the circuit - stop the analysis - display of the results - record displayed data on a file of the PC. The program can be used locally with the PC directly connected to the measuring device, but it can be also equipped with a set of 2 GSM devices to have the same functionality done remotely. In the future industrialized program other communication devices of higher generation (GPRS, UMTS) will be used. his possibility is developed in laboratory version by TUL partner.

SUBJECT DESCRIPTORS CODES

120 COMMUNICATION ENGINEERING/TECHNOLOGY

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: PU=Public CO=Confidential**
Internal Report	M. Grecki: Data transmission in SEWING project. The document describes several solutions for wireless transmission of data from the probe.	Confidential

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE: Tick a box and give the corresponding details(reference numbers, etc) if appropriate**					**Pre-existing know-how Tick a box and give the corresponding details(reference numbers, etc) if appropriate**	
	Current				**Foreseen**	**Tick**	**Details**
	Tick	**NoP[1)]**	**NoI[2)]**	**Details**	**Tick**		
Patent applied for							
Patent granted							
Patent search carried out							
Registered design					√		
Trademark applications							
Copyrights						√	PC control Panel SW
Secret know-how							
Other - please specify:							

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Results of demonstration trials available
Other:	

Quantified data about the result

Items (about the results)	Actual current quantity	Estimated (or future) quantity
Time to application / market (in months from the end of the research project)	12	18
Number of (public or private) entities potentially involved in the implementation of the result:	3	4
of which: number of SMEs:	1	1
of which: number of entities in third countries (outside EU):	0	0
Targeted user audience: of reachable people	200	400
S&T publications (referenced publications only)		
publications addressing general public (e.g. CD-ROMs, WEB sites)		
publications addressing decision takers / public authorities / etc.		
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development	√	**FIN**	Financial support	
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing agreement		**INFO**	Information exchange/training	
JV	Establish a joint enterprise or partnership		**CONS**	Available for consultancy	
Other	(please specify)				
Details:					

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

The interactive software developed for the final prototype can remotely manage the measuring device using a GSM, it can start the measurementa and download the results.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Sysmedia company, who developed as subsupplier for Systea the interactive software to manage remotely the final prototype, is the main partner for any further improvement for industrialization use of our research.

No.	Title
8	Assembling selected elements of the project in one final prototype

CONTACT PERSON FOR THIS RESULT

Name	Luca Sanfilippo
Position	Project Manager
Organisation	Systea-Systems Technology Advance
Address	Via Paduni 2A 03012, Anagni (FR) ITALY
Telephone	+39-07705776058

Fax	+39-07705772204
E-mail	luca.sanfilippo@systea.it
URL	www.systea.it
Specific Result URL	

SUMMARY

The final prototype is divided into five main sections: - Hydraulics, mounted on the front side of the internal slid - Sensors mounted in dedicated flow cell, placed on the right side of the internal slid - Electronics and actuators, mounted on the right side of the internal slid - Internal reagents compartment, accessible from the upper side of the unit - Display and keyboard and printer, mounted on the front panel which is can be opened to access the hydraulics and the electronics. The external compartment is IP-55 proof and the unit is designed to be used as a portable and on-line field system, easily powered by an external 12 Vdc power supply. The unit is equipped with a standard RS-232 serial port to manage the analyzer using a local or a remote device, like a PC or a data-logger. The LFA (Loop Flow Analysis) technology is able to manage automatically a complete measuring sequence using the patented Loop Flow Reactor (LFR) analytical technology. The LFA unit contains as main parts the sensors, the conditioning part electronics and the main processing subsystem. The final prototype integrates: - up to n.7 Chemfet sensors + Ag/AgCl reference electrode + temperature sensor integrated in a dedicated linear flow-cell or two linear flow-cells connected in series (one for BSC and one for FSC sensors) - the specific A/D acquisition boards developed under the project to manage and read the signals from Chemfets and temperature sensor. It automatically manages the measurement sequence under the specific procedures used by LFA based units and the new computation software developed by SEWING partners.

SUBJECT DESCRIPTORS CODES
28 ANALYTICAL CHEMISTRY 213 ENVIRONMENTAL TECHNOLOGY/ENGINEERING, POLLUTION CONTROL 412 MULTISENSORY TECHNOLOGY, MULTI-SENSING 560 SENSORY SCIENCE, SENSORS, INSTRUMENTATION 670 WATER: MONITORING / QUALITY / TREATMENT

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: PU=Public CO=Confidential**
Deliverable n.18	This document describes the technical characteristics of the final prototype.	Public
Deliverable23	Deliverable 23 is an internal assessment of the whole project.	Confidential
Deliverable 24	Deliverable 24 is the final report describing the final realistion of the project.	Confidential
Report	Final Results of the project are described and diseminated through WEB and CORDIS	Public

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE:** **Tick a box and give the corresponding details(reference numbers, etc) if appropriate**	**Pre-existing know-how** **Tick a box and give the corresponding**

						details(reference numbers, etc) if appropriate	
	Current				**Foreseen**	**Tick**	**Details**
	Tick	**NoP[1)]**	**NoI[2)]**	**Details**	**Tick**		
Patent applied for						√	LFA circuit
Patent granted							
Patent search carried out							
Registered design							
Trademark applications						√	Micromac-1000
Copyrights							
Secret know-how							
Other - please specify:							

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors
33 Manufacture of medical, precision and optical instruments…

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Prototype/demonstrator available for testing
Other:	

Quantified data about the result

Items (about the results)	**Actual current quantity**	**Estimated (or future) quantity**
Time to application / market (in months from the end of the research project)	8	12
Number of (public or private) entities potentially involved in the implementation of the result:	4	6
of which: number of SMEs:	1	1
of which: number of entities in third countries (outside EU):	0	1
Targeted user audience: of reachable people	200	500
S&T publications (referenced publications only)		
publications addressing general public (e.g. CD-ROMs, WEB sites)	1	2
publications addressing decision takers / public authorities / etc.		
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development	√	**FIN**	Financial support	
LIC	Licence agreement	√	**VC**	Venture capital/spin-off funding	√
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing agreement		**INFO**	Information exchange/training	
JV	Establish a joint enterprise or partnership	√	**CONS**	Available for consultancy	
Other	(please specify)				
Details:					

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

The potentiality of the final prototype is now to manage and read the measured signals from up to 8 different sensors integrated in one single measuring unit. It gives a strong potentiality to allow future enhancements to other sensors technologies like potentiometric sensors or biosensors.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

We need to improve the final prototype to grow it to a new industrialized and commercial product which will be cheaper than the actual commercial LFA analyzers manufactured by Systea. Any other partner who has a reliable sensor technology to be mounted in a flow cell inside the LFR circuit could be a potential partner for any further improvement and use of the developed technology.

No.	Title
9	Verification of the prototype in real-time measurement

CONTACT PERSON FOR THIS RESULT

Name	Roza Allabashi
Position	Head of laboratory
Organisation	Universitaet fuer Bodenkultur Wien (BOKU Wien)
Address	Muthgasse 18 1190, Vienna Austria
Telephone	+43-1-360068/5804
Fax	+43-1-3689949
E-mail	roza.allabashi@boku.ac.at
URL	http://www.wau.boku.ac.at/sig.html
Specific Result URL	

SUMMARY

One of the instruments made available from the project parners - the LFA test unit - is tested at our lab for a period of 7-8 months, concerning the parameters NH4-N and NO3-N, using the respective backside contacted ISFET sensors. The results obtained are compared with reference methodes used at our lab, according to the german standard methods (DIN). These are: for NO3-N the ion chromatography (IC) and for NH4-N the photometric method. During the testing time the following characterictics are validated: *)sensor conditiong time *)measuring stability of sensor/system *)the lowest limit of quantification (LOQ) *)Accuracy (by means of control and real samples) *)Presicion /

Uncertainty of the system *)Sensor life time *)Sensor homogeneity The results are very satisfactory, special for the nitrate measurement, concerning the stability and life time of the sensors. Also the accuracy and precision of the determination are very good even for real waters, except for effluents from waste water treatment plants. The final improved prototype based on Micromac-1000 device, able to measure four ions simultaneously (NH4+, NO3-, K+ and Na+), was also thoroughly measured and the results are highly satisfactory.

SUBJECT DESCRIPTORS CODES
211 ENVIRONMENTAL INDICATORS/MONITORING/RISK ASSESSMENT 213 ENVIRONMENTAL TECHNOLOGY/ENGINEERING, POLLUTION CONTROL 607 TECHNOLOGY TRANSFER 666 WATER RESOURCE MANAGEMENT/ENGINEERING 670 WATER: MONITORING / QUALITY / TREATMENT

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: PU=Public CO=Confidential**
Deliverables	Deliverables Nos 19 and 20 describe in details the results of measurements of sensors and of the final prototype.	Confidential
Report	In the Final Results report available on WEB and CORDIS the measuremnts of the prototype are described.	Public

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE: Tick a box and give the corresponding details(reference numbers, etc) if appropriate**					**Pre-existing know-how Tick a box and give the corresponding details(reference numbers, etc) if appropriate**	
	Current				**Foreseen**	**Tick**	**Details**
	Tick	**NoP[1)]**	**NoI[2)]**	**Details**	**Tick**		
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - please specify:							

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors
37 Recycling 41 Collection, purification and distribution of water 73 Research and development 80 Education 90 Sewage and refuse disposal, sanitation and similar activities

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Experimental development stage (laboratory prototype)
Other:	

Quantified data about the result

Items (about the results)	**Actual current quantity**	**Estimated (or future) quantity**
Time to application / market (in months from the end of the research project)	12	36
Number of (public or private) entities potentially involved in the implementation of the result:	3	6
of which: number of SMEs:		
of which: number of entities in third countries (outside EU):		
Targeted user audience: of reachable people		
S&T publications (referenced publications only)	1	3
publications addressing general public (e.g. CD-ROMs, WEB sites)	1	1
publications addressing decision takers / public authorities / etc.	1	3
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development	√	**FIN**	Financial support	√
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing agreement		**INFO**	Information exchange/training	√
JV	Establish a joint enterprise or partnership		**CONS**	Available for consultancy	
Other	(please specify)	√			
Details:	Our institute has tested the developed instruments including the sensors for a certain period of time within the project SEWING. From our point of view, the developments in this topic are very interesting and are much in demand for				

	monitoring purposes, specially for water monitoring. Because of the big variety of the monitoring parameters, the need on research and development concerning available techniques is beyond controversy.

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

The methods of water pollution measurements are available.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Partners interestedc in water pollution monitoring are expected.

No.	Title
10	Creating the vision of future industrialisation of the system

CONTACT PERSON FOR THIS RESULT

Name	Luca Sanfilippo
Position	Project Manager
Organisation	Systea-Systems Technology Advance
Address	Via Paduni, 2A 03012, Anagni (FR) ITALY
Telephone	+39-07705776058
Fax	+39-07705772204
E-mail	luca.sanfilippo@systea.it
URL	www.systea.it
Specific Result URL	

SUMMARY

According to the prototype devices developed under the project, the industrialization phase will be based on the following main points: - design of a compact and portable on-line analyzer, to be powered by low voltage and with the lowest consumption of solutions and washing liquids - identification and development of a low cost and compact hydraulic to manage the measuring system - identification and development or a more compact and cheaper electronic to manage signal measurement and system management - design, development and field test of the industrialized product. The industrialized product will be based on a miniaturized version of the standard SYSTEA's LFA technolgy. The target of price will be to stay lower of 10.000 euro as list price for the on-line multiparametric device equipped with 6 measuring sensors. The market target will be: environmntal and agricultural Authorities, public and private enthities who have the need to take under control surface water and groundwater.

SUBJECT DESCRIPTORS CODES
213 ENVIRONMENTAL TECHNOLOGY/ENGINEERING, POLLUTION CONTROL 211 ENVIRONMENTAL INDICATORS/MONITORING/RISK ASSESSMENT 412 MULTISENSORY TECHNOLOGY, MULTI-SENSING 670 WATER: MONITORING / QUALITY / TREATMENT

DOCUMENTATION AND INFORMATION ON THE RESULT

Documentation type	Details (Title, ref. number, general description, language)	Status: PU=Public CO=Confidential
Deliverable 21	Deliverable 21 lists the whole documentation created	Public

	during the project and gives the vision of future development.	

INTELLECTUAL PROPERTY RIGHTS

Type of IPR	**KNOWLEDGE:** **Tick a box and give the corresponding details(reference numbers, etc) if appropriate**					**Pre-existing know-how** **Tick a box and give the corresponding details(reference numbers, etc) if appropriate**	
	Current				**Foreseen**	**Tick**	**Details**
	Tick	**NoP[1)]**	**NoI[2)]**	**Details**	**Tick**		
Patent applied for					√		
Patent granted							
Patent search carried out							
Registered design							
Trademark applications					√		
Copyrights							
Secret know-how							
Other - please specify:							

1) Number of **P**riority (national) applications/patents
2) Number of **I**nternationally extended applications/patents

MARKET APPLICATION SECTORS

Market application sectors
33 Manufacture of medical, precision and optical instruments…

CURRENT STAGE OF DEVELOPMENT

Current stage of development	Prototype/demonstrator available for testing
Other:	

Quantified data about the result

Items (about the results)	**Actual current quantity**	**Estimated (or future) quantity**
Time to application / market (in months from the end of the research project)	12	18
Number of (public or private) entities potentially involved in the implementation of the result:	4	6
of which: number of SMEs:	1	2

of which: number of entities in third countries (outside EU):	0	1
Targeted user audience: of reachable people	200	1000
S&T publications (referenced publications only)		
publications addressing general public (e.g. CD-ROMs, WEB sites)	1	2
publications addressing decision takers / public authorities / etc.		
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT

R&D	Further research or development	√	**FIN**	Financial support	
LIC	Licence agreement	√	**VC**	Venture capital/spin-off funding	√
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing agreement		**INFO**	Information exchange/training	
JV	Establish a joint enterprise or partnership	√	**CONS**	Available for consultancy	
Other	(please specify)				
Details:					

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

The SEWING system, being developed and industrialised in the future will offer excellent opportunities for all end-users interested in water pollution monitoring.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

SME able for industrial producing of CHEMFET sensors on the basis of SEWING know-how is necessary.

I am the Co-ordinator of the above project, and confirm on behalf of the contracted Partners the information contained in this Technological Implementation Plan, and I authorise its public dissemination.

Signature: **Name: Andrzej Filipkowski**

Date: January 24, 2005 **Organisation: Politechnika Warszawska**