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## Index (Authors, Titles)



Francesco Anwander, Raimund Stampa:

***Design Considerations for Embedded Sensor Systems in Industrial Applications.***

Achim Boll, Thorsten Knutz, Christoph Witthandt, Helmut Dispert:

***Wireless Sensors for the measurement of dissolved oxygen in aquaculture plants.***

Rainer Bollmann, Gerd Stange:

***Magnetic inductive flow meters (MIF), capacitive sensors, ion sensitive sensors.***

Bert Bonroy, Greet Leysens, Dragana Miljkovic, Pieter Schiepers, Eric Triau, Maartje Wils, Daniel Berckmans, Patrick Colleman, Lieven De Maesschalck, Stijn Quanten, Bart Vanrumste:

***A Video Acquisition System to Develop a Real-Time Discomfort Recognition Algorithm.***

Stefan Buschner:

***Data protection vs. access convenience card-to-card-authentication: the approach of choice.***

K. Cuppens, L. Lagae and B. Vanrumste:

***Towards automatic detection of movement during sleep in pediatric patients with epilepsy by means of video recordings and the Optical Flow algorithm.***

Johan Dams:

***Portable Elliptic Curve Cryptography for Medium-Sized Embedded Systems.***

Helmut Dispert, Johannes Bönniger, Alkje Kalies, Jonas Kaufmann, Jan Küting, Sebastian Lampe, Michael Lodemann, Justus Rogowski, Benjamin Widmann:

***A Lightweight Web Service Approach for Querying Sensor Networks using the example of ZigBee.***

Margus Ernits, Kalle Tammemäe:

***Environment for distance study of embedded system programming.***

Alexander Friedel:

***The Challenge of Internationalization Can you handle Prapawadee Jaroenrattanatarakoon?***

Stephan Hüttmann:

**Applying Sensor Technology to Groundwater Monitoring and Environmental Rehabilitation.**

Nils Kannengießer, Helmut Dispert:

**Implementation of a Security System based on RFID and WSN technology.**

Stefan Koss, Thorsten Knutz, Helmut Dispert:

**Development of a ZigBee-based wireless sensor network node for automatic data acquisition and transfer.**

Jan Küting, Joseph Morgan, Jay Porter, George Wright, Helmut Dispert:

**Client-Based Adaptive Load Balancing in Service-Oriented Systems**

Yin Li, Xin Chen, Dongjian He, Liling Tang:

**Research on GEP Algorithm and its Applications in Foodstuff Yield Prediction from Shaanxi Province.**

Smail Menani, Liu Yang, Jani Ahvonen, Johan Dams:

**Enhancement of the Botnia RoboCup Soccer Team.**

Joseph A. Morgan, George B. Wright:

**Embedded System Product Design: An Educational Program in Applied Engineering.**

Ali Asghar Nazari Shirehjini:

**An Approach to Mixed Initiative Control of Adaptive Multimedia Environments.**

Rainer Neumann, Hartmut Rehling:

**MPLAB Integrated Development Environment.**

George Palamas, Manolis Kavoussanos, George Papadourakis:

**Unsupervised Texture Segmentation via Adaptive Gabor Filters.**

Panagiotis Palantas, George Palamas, Manolis Kavoussanos, George Papadourakis:

**Monocular Omnidirectional Vision Simulator for Robot Navigation.**

Heikki Palomäki:

**The teaching principles of the embedded systems at School of Technology of Seinäjoki University of Applied Sciences.**

Heikki Palomäki:

**Wireless research projects at School of Technology of Seinäjoki University of Applied Sciences.**

Rafael Pereira Pires and Antônio Augusto M. Fröhlich:

**A Framework for Configuration and Assembly of Routing Protocols for Wireless Ad Hoc Networks.**

Hauke Schramm, Ana Belén Martín Recuero, Peter Beyerlein:

**Discriminative Optimization of 3D Shape Models for the Generalized Hough Transform.**

Andy Walter:

**Multicore Support for Realtime Java.**

Claudius Zelenka:

Eye Tracking.

## Abstracts



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### Design Considerations for Embedded Sensor Systems in Industrial Applications

- **Authors:**

Francesco Anwander, Raimund Stampa.

**Renesas Technology Europe**

**Ratingen, Germany**

- **Keywords:**

Microcontrollers, industrial network applications, hybrid communication protocols, university programme

Embedded sensor systems for industrial applications require high reliability over long lifetime under tough environmental conditions. This can only be realized by a careful selection and design of all components from the microcontroller up to the communication protocol. Here design examples from real practice are given for the typical critical areas like low power consumption, easy connectivity, tiny size and high sensor resolution. Some typical candidates from the vast multitude of sensor network protocols are analyzed against the key requirements of embedded industrial applications. In contradiction to the gateway approach the Renesas network protocol for metering applications RUN-M favors a hybrid network approach with seamless connectivity between wired and wireless devices within one network.

Finally an update about the Renesas university programme including recent examples of student works and proposals of new topics for co-operation will be given.

#### Index

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### Wireless Sensors for the measurement of dissolved oxygen in aquaculture plants



- **Authors:**

Achim Boll<sup>1</sup>, Thorsten Knutz<sup>2</sup>, Christoph Witthandt<sup>2</sup>, Helmut Dispert<sup>1</sup>.

<sup>1</sup>Kiel University of Applied Sciences, Kiel, Germany

<sup>2</sup>GO Systemelektronik, Kiel, Germany

- **Keywords:**

Wireless Sensors, Sensor Networks

Network topologies for the connection of up to 24 external sensors on one point will be shown. Address and serial number patterns administration using 16 bit address field. The system can run by low energy technology for one year without exchange of sensor elements and batteries. The benefit of the new wireless technology will be shown in a number of conventionally realised aquaculture plants.

### Index

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## **Novel design principles for electromagnetic flow metering (MIF), based on permanent magnets**

- **Authors:**

Rainer Bollmann, Gerd Stange.

**Kiel University of Applied Sciences**

**Kiel, Germany**

- **Keywords:**

Magnetic inductive flow meters (MIF), capacitive sensors, ion sensitive sensors

In contrast to the well known principle of electromagnetic flow metering with time dependent magnetic fields, here the possibilities of applying permanent magnets will be studied. That means (almost) zero energy consumption. It also means that galvanic contacts have to be replaced by some other components for signal coupling. The presentation will show the new principle in combination with several designed sensor-types and the sensitivity and accuracy of the system.

### Index

---

## **A Video Acquisition System to Develop a Real-Time Discomfort Recognition Algorithm**

- **Authors:**

Bert Bonroy<sup>1</sup>, Greet Leysens<sup>1</sup>, Dragana Miljkovic<sup>2</sup>, Pieter Schiepers<sup>2</sup>, Eric Triau<sup>3</sup>, Maartje Wils<sup>3</sup>, Daniel Berckmans<sup>2</sup>, Patrick Coleman<sup>1</sup>, Lieven De Maesschalck<sup>1</sup>, Stijn Quanten<sup>2</sup>, Bart Vanrumste<sup>1</sup>.

<sup>1</sup>Katholieke Hogeschool Kempen.

<sup>2</sup>Katholieke Universiteit Leuven.

<sup>3</sup>Woon- en zorgcentrum De Wingerd.

- **Keywords:**



This project contains three aims. The aim-A is to develop the video acquisition system, to obtain a high-quality data set of video images of demented elderly labelled with respect to discomfort. Aim-B is to develop the digital discomfort label tool to label the recorded images with respect to discomfort and calculates the discomfort score immediately after an assessment session. The last aim, Aim-C, is to show the first results on the use of the digital discomfort label tool.

## Index

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### **Data protection vs. access convenience    card-to-card-authentication: the approach of choice**

- **Authors:**

Stefan Buschner.

gematik Gesellschaft für Telematikanwendungen der Gesundheitskarte mbH

Berlin, Germany

- **Keywords:**

Health card, card-to-card-authentication

The German health card project is the biggest smart card project in the world and hence one of the biggest projects for embedded systems. It will introduce 80 million health cards, 500,000 health professional cards, 1 million SMC A/Bs and about 500,000 net based card terminals. The health cards are designed to carry data and, in addition, to hold keys for the access to the telematic infrastructure that will be introduced together with the cards in order to connect physicians, pharmacists and hospitals with each other.

The typical approach to protect the data on a smart card, is to have a PIN-verification of the user. For our purpose, it would not only be inconvenient to ask the patient for his PIN when he enters a physician's office but even impossible if he was unconscious. Especially in situations like this, the health card has its benefits because it carries an emergency data set. The card is able to detect its own location in a secure environment and then gives access to its data. This is done by card-to-card-authentication with a health professional card. Using CV-certificates to introduce detailed access rules, allows convenient but strong data protection of medical patient data.

## Index

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### **Towards automatic detection of movement during sleep in pediatric patients with epilepsy by means of video recordings and the Optical Flow algorithm**

- **Authors:**

K. Cuppens<sup>1</sup>, L. Lagae<sup>2</sup> and B. Vanrumste<sup>1</sup>.

<sup>1</sup>MOBILAB, K.H.Kempen, Geel, Belgium.

<sup>2</sup>Kinderneurologie, UZ Gasthuisberg, Leuven Belgium.

- **Keywords:**

Epilepsy, optical flow, movement detection



*Introduction:* The detection and analysis of epileptic seizures is typically done by video-encephalogram monitoring. Although it is considered as the Golden Standard, it has disadvantages: the electroencephalogram electrodes are uncomfortable to wear for a longer period of time and hospitalization is often required. The aim of our work is to investigate whether the optical flow algorithm applied to video recordings can be used to detect movement during sleep in pediatric patients with epilepsy.

*Methods and data:* The optical flow algorithm allocates intensities to pixels proportional to their involvement in movement of object in a scene. The average of the 0.06% highest of these intensities was plotted as a function of time ( $R(t)$ ). As dataset we used simulated video recordings (640x480 30fps) consisting of normal sleep movement and seizure like movement.

*Results:* We investigated  $R(t)$  as a function of the acquisition parameters (such as spatial resolution and frame rate). We found that we still could make a distinction between a movement and noise, when we spatially downsampled to 320x240. When we further decreased the resolution, we found  $R(t)$  to be of the same order of noise especially for small movements (e.g. finger movements). Furthermore we found that we could reduce the frame rate but this reduction yielded aliasing artifacts especially for jerks (sudden movement of limbs). The reduction in spatial and temporal resolution eases the computational load of the algorithm which puts future real-time applications in reach.

*Discussion:* From our findings above we extracted the optimal acquisition parameters which guaranty clear distinction between movement (high  $R(t)$ ) and non-movement (low  $R(t)$ ). We have set an ideal threshold which can detect movement in most video sequences, even under sub-optimal circumstances as compressed video data, a varying luminance and a change in camera point of view.

## Index

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## Portable Elliptic Curve Cryptography for Medium-Sized Embedded Systems

- **Authors:**

Johan Dams.

**Vaasa University of Applied Sciences and Vaasa University**

**Vaasa, Finland**

- **Keywords:**

Cryptography, ECC

In general, cryptographic methods are very intensive on memory and computing power. The reason for this is are the mathematical operations necessary on really big numbers. While these operations don't pose any major issues on the latest consumer personal computer, embedded systems often only have a fraction of this raw power available. The goal of this paper is to come up with a way for these devices to communicate with other such devices in a secure way, that is, with all the communication of data between these devices encrypted.

From the beginning, Elliptic Curve Cryptography (ECC) has been the most favoured method to achieve this goal. ECC promises the same level of security for smaller key sizes (and thus smaller numbers), but the trade-off is an increase in mathematical complexity. Through optimisation and careful selection of algorithms, this form of cryptography has become feasible for embedded systems as well.

The research in this paper is focused on the development and implementation of an elliptic curve based cryptographic system for embedded devices which can provide digital signatures, key generation/storage and



encryption/decryption of data. The main aspects to achieve this goal are the selection and implementation of a suitable elliptic curve, a cryptographic hash function and a strong block cypher.

It should be noted that the focus of this paper lies on the implementation of ECC for medium sized embedded systems. This means that low end 8 or 16 bit devices are not considered, but that low power 32 bit devices (typically sub 1 Watt range) are the focus of the work. The reason for this is the anticipation of better battery life for these devices while developments towards low power consumption for these chips is making incredible headway. Typical applications for these kinds of chips with the need to encrypt data are point-of-sale terminals, HVAC building and control systems, medical instrumentation and monitors, fire/security control and monitoring systems and factory and automation systems.

## Index

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## **A Lightweight Web Service Approach for Querying Sensor Networks using the example of ZigBee**

- **Authors:**

Helmut Dispert, Johannes Bönninger, Alkje Kalies, Jonas Kaufmann, Jan Küting, Sebastian Lampe, Michael Lodemann, Justus Rogowski, Benjamin Widmann.

**Kiel University of Applied Sciences**

**Kiel, Germany**

- **Keywords:**

ZigBee, Wireless Sensor Networks, Web Service

We present the design and implementation of a unified access platform to sensor networks based upon Web Services.

This allows other systems in heterogeneous environments to easily consume and process sensor network data transmitted by the sensor nodes. Clients can subscribe to different node or value types, while data filtering is done on the server side. The system design is modular and all components are exchangeable. The prototype version uses ZigBee as an example wireless communication technology. It is implemented in Microsoft .NET. To demonstrate the capabilities of the system, four different clients were developed that demonstrate different access strategies in homogeneous and heterogeneous environments.

## Index

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## **Environment for distance study of embedded system programming**

- **Authors:**

Margus Ernits, Kalle Tammemäe

**Estonian IT College**

**Tallinn, Estonia**

- **Keywords:**

Distance training, Embedded systems

Modern education needs distance learning and e-learning as an alternative to classical approach, and study of embedded systems is no exception. Current article focuses on specific aspect of distance study of



embedded systems. Possible solutions include lendable home-lab kits, virtual labs and distance labs. Functional and non-functional requirements for usability, deployability and manageability are developed for experimental distance-lab. Methods and problems in distance study of embedded system using particular distance-lab are briefly described.

To use this lab student needs Internet-connected computer with Java capable web browser. Student receives assignment through web and solves it using their own editor or IDE, then uploads C source code to lab system web page. System compiles source code and gives feedback to student. After successful compiling student loads binary code to embedded system and executes it. User gets visual feedback from lab's LCD screen and LED's through web-camera.

Distance lab is designed using GPL'ed and free software to give possibility for deploy copy of system in other universities.

This particular lab uses virtualization technologies to simplify manageability and installation process.

Article describes unfinished areas such as distance debugging, better feedback and automatic personalization of assignments.

Experiments have proved correctness of the concept and user fidelity of running the remote labs.

## Index

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## **The Challenge of Internationalization Can you handle Prapawadee Jaroenrattanatarakoon?**

- **Authors:**

Alexander Friedel,

**macio GmbH**

**Kiel, Germany**

- **Keywords:**

Internationalization, Software Engineering, GUI, Embedded-System

### **Problem**

More and more usability is a key factor for the market success of embedded-systems. Defining usability as depending on the fit to the customer needs and knowing that these differ a lot in the global market, it is a challenging task for the software engineer to develop graphical user interfaces in time and in budget for a variety of markets.

Foreign characters, different attitudes towards colours and forms - last but not least different reading orders and text lengths are challenges a software engineer and designer must consider. The goal is to develop a user interface that flexibly adapts to the desired country and language while being based on the same software architecture.

### **Software development process and a practical guide**

We show, from real-life projects in the machine construction industry and embedded-systems, how to integrate the task internationalization in to the software development process. We will point out that internationalization is more than switching a language and present different methods how to handle these issues for developing software. A practical guide with the most important questions you have to answer for internationalization will give you hints for your own work.

## Index



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## Applying Sensor Technology to Groundwater Monitoring and Environmental Rehabilitation

- **Authors:**

Stephan Hüttmann,  
**Sensatec GmbH**  
**Kiel, Germany**

- **Keywords:**

Environmental Monitoring, online data acquisition, sensor systems

Reactive biological and chemical methods have been used for many years, in order to in-situ reclaim contaminated areas. All treatment processes have in common that active agents have to be distributed in the ground water. The efficient distribution of these agents is of prime importance and has to be determined empirically through adequate field measurements. Relevant process parameters can change within minutes or hours, so that their values cannot be measured using traditional methods taking groundwater probes.

Today methods and sensors are available for in-situ data acquisition, applying modern sensor and communication technologies.

In this paper we will present state-of-the-art online sensor systems that can be used to measure environmental parameters like redox potential, temperature, pressure, oxygen content, pH value, and water conductivity. Furthermore selective ion sensors to determine chloride, bromide and nitrate content will be discussed. In a summary we will give a systematic overview of typical online sensor systems, showing their benefits in reactive processes.

### Index

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## Implementation of a Security System based on RFID and WSN technology

- **Authors:**

Nils Kannengießer, Helmut Dispert.  
**Kiel University of Applied Sciences**  
**Kiel, Germany**

- **Keywords:**

Wireless Sensor Networks, RFID, Sun Microsystems SunSpot

Over the last few year we have observed a convergence of wireless sensor networks (WSNs) and RFID systems. In the next generation "Super RFID technology" traditional passive tags will be replaced using dedicated WSNs that extend standard tags to allow data acquisition and data storage, e.g. for monitoring purposes.

In this paper we suggest a new application for Super RFIDs in security systems with an emphasis on theft control and prevention.



A standard Sun Microsystems SunSpot WSN system is used to detect the illicit removal of objects. The WSN nodes are equipped with a three-axis linear accelerometer capable of precisely measuring motion. A master WSN-node in combination with an RFID reader allows to control and supervise a group of slave-nodes that are attached to the objects under surveillance.

We will introduce the SunSpot technology, demonstrate the effectiveness of the complete system and discuss future application scenarios.

## Index

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## **Development of a ZigBee-based wireless sensor network node for automatic data acquisition and transfer**

- **Authors:**

Stefan Koss<sup>1</sup>, Thorsten Knutz<sup>2</sup>, Helmut Dispert<sup>1</sup>.

<sup>1</sup>Kiel University of Applied Sciences, Germany

<sup>2</sup>Go Systemelektronik, Germany

- **Keywords:**

Wireless Sensor Networks, Embedded Systems, Microcontrollers, ZigBee, Smart Environmental Monitoring

In this paper we describe the development of an IEEE 802.15.4 compatible wireless sensor network (WSN) node. The sensor node will acquire and internally store data periodically. Starting times as well as the time intervals for the measurements can be freely programmed over the network system. As soon as a mobile network is detected in its proximity the node will automatically transfer data. Optionally sensor data can be delivered on demand.

When in its idle state the node remains in power-down mode in order to minimize consumption.

The system is based on a Renesas microcontroller coupled to an RF-transceiver.

In a sample application the system is interfaced to a piezoresistive pressure sensor, typically used to determine water levels in closed tanks or open aquaculture systems. Possible applications in the area of environmental monitoring will be presented (including tidal range measurements).

## Index

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## **Client-Based Adaptive Load Balancing in Service-Oriented Systems**

- **Authors:**

Jan Küting<sup>1</sup>, Joseph Morgan<sup>2</sup>, Jay Porter<sup>2</sup>, George Wright<sup>2</sup>, Helmut Dispert<sup>1</sup>.

<sup>1</sup>Kiel University of Applied Sciences, Kiel, Germany

<sup>2</sup>Texas A&M University, College Station, Texas, U.S.A.

- **Keywords:**

Network Systems, Load Balancing, Traffic Distribution

In computer networks load balancing (or load distribution) has developed into a highly important subject, with the ultimate objective of evenly distributing the traffic and work load (e.g. in multi-server Internet-based systems).



In this publication we consider the problem of sender-initiated adaptive load balancing in service-oriented distributed systems. We investigate an approach that is based on local observation of response-times. Since in this system the balancing decision is not based on remote state observation and information exchange, the new approach allows to decouple the load balancing mechanism from any concrete technology platform. First tests and comparisons with shortest queue scheduling are very promising. The results indicate that response-time-based load balancing performs surprisingly well under circumstances where the variation of the observed response-time is not caused by variation in message size or request type.

The presentation will be accompanied by a live demonstration of the system, evaluation measurements will be discussed.

## Index

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## Research on GEP Algorithm and its Applications in Foodstuff Yield Prediction

- **Authors:**

Yin Li<sup>1</sup> Xin Chen<sup>2</sup>, Dongjian He<sup>1</sup>, Liling Tang<sup>3</sup>

<sup>1</sup> College of Information Engineering, Northwest A & F University, Yangling, Shaanxi, 712100, China

<sup>2</sup> Department of General Design, Northwest Institute of Mechanical-electronic Engineering, Shaanxi, 712099, China

<sup>3</sup> Department of Foreign Language, Guilin College of Aerospace Technology, Guilin, Guangxi, 541004, China

- **Keywords:**

Gene Expression Programming; Foodstuff Yield Prediction; Data Mining

In order to synthetically solve economic and risk issues for food production, researching optimization algorithm of food production's forecast based on the gene expression program. Taking Shaanxi province's food production as an example to solve some key issues in food production which are the uncertainty information processing, reliability criteria analysis, mathematical model of food production and the model's solving algorithm. The emphasis was starting from the food production research which based on the GEP algorithm, validating the availability of building

food production model which based on GEP through the uncertainty information processing. This study based on GEP algorithm established a mathematical model of food production and realized the application by using the optimization methods of solving general multi-objects and non-linear issues. The study had important theory and application values in research on facilitation of food production algorithm and promotion of economical efficiency and reliability in food production.

## Index

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## Enhancement of the Botnia RoboCup Soccer Team

- **Authors:**

Smail Menani, Liu Yang, Jani Ahvonen, Johan Dams



**Vaasa University of Applied Sciences  
Vaasa, Finland**

• **Keywords:**

This paper describes the development phases, design processes and the significant improvement of the Botnia Robocup Soccer team over the past five years. The Old design of the Botnia soccer robot team showed many design and implementation errors and weaknesses. An assessment of the Botnia old design is carried out to study the possibilities of improvement. In the previous design, the global vision was not reliable and the motion control of the robot was poor. Other important technical problems were also taken into consideration such as loss of power, dribbling and kicking systems as well as safety issues. In the new design a robust high precision global vision system is implemented and the PID Motion Control System is improved. A new PCB is designed and better electronic components are used to reduce the power consumption and extend the life of the batteries. In the new model, a second RF channel is added and the communication protocol is improved to increase the communication reliability and reduce transmission delays. The new design has been proven to be efficient and good results were obtained during the 2008 RoboCup word championship.

**Index**

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## **Embedded System Product Design: An Educational Program in Applied Engineering**

• **Authors:**

Joseph A. Morgan, George B. Wright  
**Texas A&M University  
College Station, Texas, U.S.A.**

• **Keywords:**

The Embedded Systems business has grown significantly since the introduction of the first microcontrollers. The complexity of state of the art embedded systems continues to increase. There is significant demand for graduates that understand the various aspects of electronics and telecommunications embedded system product development. This paper will describe the undergraduate program at Texas A&M University that focuses on embedded system product design and development and provide examples of products that were completed as part of student s capstone design course sequence.

**Index**

---

## **An Approach to Mixed Initiative Control of Adaptive Multimedia**

• **Authors:**

Ali Asghar Nazari Shirehjini.  
**Interactive Graphics Systems Group (GRIS)**

**Darmstadt University of Technology (TUD)****Fraunhoferstr. 5, Darmstadt, Germany****• Keywords:**

Ambient Intelligence, Human-Environment-Interaction, mixed-initiative, interaction synchronization, conflict management metaphors

This paper describes an approach for accessing Ambient Intelligence Environments (Aml-E) based on mixed-initiative interaction. Our approach combines mobile interaction appliances with situation-aware interaction. By doing so, we address some major challenges of Human-Environment-Interaction such as loss of user control, missing system image or over-automation. Significant contributions are mechanisms and metaphors for interaction management which avoid and solve conflicts between the user initiated interaction and the actions performed by the adaptive environment. Especially, we describe a generic interaction model and an architecture for mixed-initiative environment control.

Within this paper we first analyze the challenges of existing interaction approaches and argue for a mixed-initiative approach to overcome identified challenges. We provide a novel interaction model and describe a prototype realizing this approach.

**Index**

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**MPLAB Integrated Development Environment****• Authors:**

Rainer Neumann, Hartmut Rehling.

**Microchip Technology GmbH****Karlsruher Strasse 91, Pforzheim, Germany****• Keywords:**

Integrated Toolset for the Development of Embedded Applications

MPLAB Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded applications employing Microchip's PIC<sup>®</sup> and dsPIC<sup>®</sup> microcontrollers. MPLAB IDE runs as a 32-bit application on MS Windows<sup>®</sup>, is easy to use and includes a host of free software components for fast application development and super-charged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools.

Choose MPLAB C Compilers, the highly optimized compilers for the PIC18 series microcontrollers, high performance PIC24 MCUs, dsPIC digital signal controllers and PIC32MX MCUs. Or, use one of the many products from third party language tools vendors. Most integrate into MPLAB IDE to function transparently from the MPLAB project manager, editor and debugger.

**Index**

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## Unsupervised Texture Segmentation via Adaptive Gabor Filters

- **Authors:**

George Palamas, Manolis Kavoussanos, George Papadourakis.

**Technological Educational Institute of Crete**

**Heraklion, Crete, Greece**

- **Keywords:**

Partitioning of an image into regions, each of which contains a single texture distinct from its neighbors is a well defined problem in the machine vision discipline. Humans are capable of discriminating perceptually different textural patterns although it is difficult to reproduce with machine vision principles due to the lack of an acceptable definition for texture models. Gabor filter banks are a common choice for texture feature detection. A particular set of Gabor filters used for extracting the features is usually designed for optimal signal representation. This report presents a hybrid method for pixel based texture segmentation based on a statistical sub-feature extraction technique from gabor filter responses. We propose an optimization technique of Gabor filter kernels through a genetic algorithm which aims at maximizing the discrimination between multi-textured images. Since we choose to make no assumptions about the type of textures to be presented to the system, derived pixel characterization vectors are automatically classified with K-means algorithm. Experimental results demonstrate the effectiveness of the proposed approach with a variety of synthetic and real texture patterns.

### Index

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## Monocular Omnidirectional Vision Simulator for Robot Navigation

- **Authors:**

Panagiotis Palantas, George Palamas, Manolis Kavoussanos, George Papadourakis.

**Technological Educational Institute of Crete**

**Heraklion, Crete, Greece**

- **Keywords:**

Environmental awareness and thus navigation are essential for autonomous mobile robots. Among the sensors used for navigation purposes, vision sensors provide the richest source of information. A special issue of vision sensor is the panoramic or omni-directional vision system with a single camera. These systems provide a 360° view of the robots environment around the vertical axis within a single view-port. They have becoming popular over the last number of years and are now cutting edge practice for vision based autonomous navigation. Today, most of the work that is carried out for omni-directional robot vision is done on real hardware with expensive concave mirrors. In addition, precise mounting and calibration is required and in case of multi-agent systems the cost can be prohibitive. Simulators are important tools to quickly obtain meaningful results from complex architectures and verify algorithms. In this report we present a mobile robot simulator with monocular omni-directional vision. In order to demonstrate the capabilities of the system, a visual way finding task was designed which required the simulated agent to navigate from place to place towards a number of visual cues.

### Index

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## The teaching principles of the embedded systems at School of Technology of Seinäjoki University of Applied Sciences

- **Authors:**  
Heikki Palomäki  
**Seinäjoki University of Applied Sciences**  
**Seinäjoki, Finland**

- **Keywords:**

Seinäjoki is a growing rural city. The large and varied small-scale industry gives a specific feature to teaching of the embedded systems as well. First the teaching serves the engineering automation and secondly it serves the small hi-tech companies, which are investing in the developing projects. The focus of teaching the embedded systems is on developing the new smart small-scale electronics. The basic skills are the digital technique, hardware-oriented programming, PCB layout planning and electronic production. The goal for every first-year-student group is to make practical projects and for the last-year-student to develop something new.

### Index

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## Wireless research projects at School of Technology of Seinäjoki University of Applied Sciences

- **Authors:**  
Heikki Palomäki  
**Seinäjoki University of Applied Sciences**  
**Seinäjoki, Finland**

- **Keywords:**

The research of the embedded systems at School of Technology of Seinäjoki University of Applied Sciences is based on the non-standard light short range wireless technology. In various different projects we develop minimized hardware for the radio buttons and modules, drivers, low-power features and simple routing methods. To continue the development we simulate the positioning and multi-hop routing methods and make some tests to implement the radio buttons. The research and development is made in projects led by the lecturers and in the project studies and during the practical training periods by the students.

### Index

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## A Framework for Configuration and Assembly of Routing Protocols for Wireless Ad Hoc Networks



- **Authors:**

Rafael Pereira Pires and Antônio Augusto M. Fröhlich.

**Laboratory for Software and Hardware Integration LISHA**

**Federal University of Santa Catarina UFSC**

**Florianópolis, SC, Brazil**

- **Keywords:**

Routing Algorithms, Wireless Networks, Ad Hoc

Networks, Embedded Systems

A great number of routing algorithms for wireless ad hoc networks were proposed. Each one shows some advantages in specific situations. In this work, we present a system where is possible to assemble a routing protocol by choosing and configuring some of the many proposed strategies. We draw two distinct scenarios with different parameters and predefined requirements. Then we analyze the choice and configuration of the routing algorithm over the framework based on the expected results from the application's point of view. Our results show that our system and strategy bring benefits in the sense of producing personalized protocols, that adequately fits in the target deployment environment.

### Index

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## **Discriminative Optimization of 3D Shape Models for the Generalized Hough Transform**

- **Authors:**

Hauke Schramm<sup>1</sup>, Ana Belén Martín Recuero<sup>2</sup>, Peter Beyerlein<sup>3</sup>

<sup>1</sup>**Kiel University of Applied Sciences, Germany**

<sup>2</sup>**Philips Research Europe - Aachen, Germany**

<sup>3</sup>**Wildau University of Applied Sciences, Germany**

- **Keywords:**

Generalized Hough Transform, Medical Image Analysis, Object Detection, Shape Model, Minimum Classification Error Training, Maximum Entropy Distribution

To achieve a high level of automation in medical image processing, techniques for automatic detection of anatomical objects are required. Recently, it has been shown that the Generalized Hough Transform (GHT), a technique widely used for 2D object detection, can also be successfully applied to 3D images. The central knowledge source of the GHT is a usually manually generated shape model, describing the shape of the considered object as a set of points. In this work we outline an automatic procedure for generating efficient and discriminative shape models for usage in GHT-based object detection. The technique (1) splits the N shape model points into N individual knowledge sources, (2) recombines them into a Maximum Entropy Distribution and (3) optimizes their individual weights in this distribution using Minimum Classification Error Training (MCE). By this, an individual weighting of model points with respect to their importance for the object detection task is achieved. Since the technique estimates positive and negative weights, the resulting shape model captures both the shape of the considered object (points with positive weights) as well as the shape of confusable structures or anti-shapes (points with negative weights). Since unimportant points can be identified by their low absolute weight and removed from the shape model, it is possible to learn shapes from scratch, e.g. an initial random point cloud. First results with this technique will be presented, showing that an efficient 100 point shape model for femur detection can be learned from scratch by using only three training images.



## Index

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### Multicore Support for Realtime Java

- **Authors:**  
Andy Walter.  
**aicas GmbH**  
**Karlsruhe, Germany**
- **Keywords:**

Realtime Java is getting more and more popular in Embedded Systems. The objectoriented approach significantly increases the productivity of developers. The open standard RTSJ (Realtime Specification for Java) extends the Java paradigm "write once, run everywhere" to realtime Java applications. At the same time, multicore technology is finding it's way into Embedded Systems as well: The number of CPUs and CPU cores per Embedded board is steadily increasing. To achieve maximum advantage of those new devices, RTSJ alone is not sufficient.

The Jeopard project makes realtime Java suitable for multicore applications: The Garbage Collector needs to be extended, the existing Standard classes and RTSJ API needs to be checked for possible problems in multicore environments. Even ordinary Java applications using several threads should benefit when running on a multicore device.

The Jeopard team is also working on an extended API to support developers who actively want to write applications for a multicore device. In many cases, the load balancing can be done automatically, but in some cases, developers may want to control it explicitly. Some programming techniques which are considered bad style in a single core device can cause severe problems in a multicore environment. While in a single core system, wrong synchronisation usually causes race conditions which are hard to find, but possibly never occur a missing synchronisation most definitely causes a multi core system to either crash or at least to return the wrong results. Therefore, the Jeopard project is also working on style guides for multicore developers.

## Index

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### Eye Tracking

- **Authors:**  
Claudius Zelenka.  
  
**Christian-Albrechts-University Kiel**  
**Kiel, Germany**
- **Keywords:**  
Eye Tracking, Embedded Linux

Methods for detection of the eye and the line of sight have been developed for more than twenty years. Despite this long history, commercial devices have found only a limited range of applications mainly in the medical and military field. They are not suited for applications in the office or in the vehicle, as they are

sensitive to optical reflections and changing illumination.  
Available systems are also too complicated and expensive for wide use.

In this contribution a low cost system for eye recognition, which works reliably even in bright sunlight, will be presented. The low sensitivity against optical interference has been achieved by a novel optical illumination and a proprietary computer algorithm. The cost of the system could be reduced by using a Nano-ITX Board from VIA, and the operating system embedded Linux.

This approach opens a wide range of practical applications as new interface between man and computer or machines. Another important application is detection of micro sleep in vehicles, which will make car driving much safer.

## **Index**

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