bring IT on! 2012 Catalog

tomorrow is already here
Bring IT on! – 2012 - an event organized by:

Faculty of Computer Science
of the "Alexandru Ioan Cuza" University of Iași

Faculty of Automatic Control and Computer Engineering
of the Technical University “Gheorghe Asachi” of Iași

Institute of Computer Science of the Romanian Academy, Iași branch

Intelinvest Consulting
New, cutting-edge technologies will always change the way of doing business. Organizations use every day the technological innovations, to better manage their activities and become more competitive. Bring IT on! – 2012, an event organized by the Faculty of Computer Science of the “Alexandru Ioan Cuza” University of Iași, in partnership with the Faculty of Automatic Control and Computer Engineering of the Technical University “Gheorghe Asachi” of Iași, the Institute of Computer Science of the Romanian Academy, Iași and Intelinvest Consulting – is being expected to create a bridge between the business world and the Romanian academic IT-research units, by providing the former with investment opportunities generated by IT-research developed by the later.

The event took place on May 17 and 18, 2012, in the The Hall of the Lost Steps of the University Palace from Copou.

This Catalog presents a selection of the most significant projects presented during Bring IT on! – 2012. The organizers hope that it will be the first in a series of similar publications which will spread the seeds of a much wanted crop: good and productive collaboration between the academic research and the industry, out of which, when ripe, robust and thriving business partnerships could be born. The outcomes of these spin-offs should sometimes return into the University to support other fresh ideas.

The projects presented at Bring IT on! – 2012 fall into the following topics:

1. Biotechnologies
2. Embedded Systems
4. Image and Video Processing
5. Information Security
6. Intelligent Agents and Robotics
7. Intelligent Data Analysis
8. Natural Language Processing
9. Intelligent Data Analysis
10. Networking & Communication
11. Soft Computing
12. Software System Engineering
13. Software Verification and Analysis
14. Web and Mobile Technologies
## Contents

<table>
<thead>
<tr>
<th>Pages</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-9</td>
<td>Remote Diagnostics and Services</td>
<td>Daniel ANECHITEI, Radu IONESCU, Adrian IFTENE</td>
</tr>
<tr>
<td>10-11</td>
<td>Formal model-based language engineering in K</td>
<td>Andrei ARUSOAE, Dorel LUCANU</td>
</tr>
<tr>
<td>12-13</td>
<td>Java Language Semantics in K Framework</td>
<td>Denis BODÁNÁS, Dorel LUCANU</td>
</tr>
<tr>
<td>14-15</td>
<td>Power-aware software framework for securing embedded systems</td>
<td>Nicolae BOTEZATU</td>
</tr>
<tr>
<td>16-17</td>
<td>The Self-Driving Car</td>
<td>Marius BURDIUN, Valentin GRIGOROVICI, Alexandru BARLEANU, Florin PANTELIMONESCU</td>
</tr>
<tr>
<td>18-19</td>
<td>Networked Predictive Control for Fast Automotive Systems</td>
<td>Constantin F. CĂRJUNTU, Corneliu LAZĂR</td>
</tr>
<tr>
<td>20-21</td>
<td>SunScreen</td>
<td>Emanuel COSTEA-CĂPUŞNEAC, Amalia Raluca GÎMBUŢA, Lakatos ISTVÁN, Francesca POPA</td>
</tr>
<tr>
<td>22-23</td>
<td>Gesture Based Human Computer Interface for Simulation of Assembly Operations</td>
<td>Elena-Gina CRĂCIU, Ștefan-Gheorghe PENTIUC, Laurent GRISONI</td>
</tr>
<tr>
<td>24-25</td>
<td>ATLAS Project – the Romanian Component</td>
<td>Dan CRISTEA, Eugen IGNAT, Daniel ANECHITEI</td>
</tr>
<tr>
<td>26-27</td>
<td>Processing of 3D Medical Data using Volume Visualization techniques</td>
<td>Marius GAVRILESCU, Vasile MANTA</td>
</tr>
<tr>
<td>28-29</td>
<td>Cityquest - 3D Mobile Game for Windows Phone 7</td>
<td>Alecsandru GRIGORIU, Victor POROF, Sabin-Corneliu BURAGA</td>
</tr>
<tr>
<td>30-31</td>
<td>Android Remote</td>
<td>Cristina ŞERBAN, Irina GROSU, Alexandra SIRÎTEANU, Alexandru AVERESCU, Diana POJAR, Alexandru PAICU, Bogdan GĂZA, Victor POROF, Claudia DONEA, Adrian IFTENE</td>
</tr>
<tr>
<td>32-33</td>
<td>Integrated System for Remote Monitoring of Physiologic Vital Parameters</td>
<td>Paul HERGHELEGIU, Vasile MANTA</td>
</tr>
<tr>
<td>34-35</td>
<td>Early Crisis Detection from Text Streams</td>
<td>Adrian IFTENE, Alexandru-Lucian GÎNŞCĂ</td>
</tr>
<tr>
<td>36-37</td>
<td>Eye Tracking Based Communication for Patients with Neuro-Locomotor Disabilities</td>
<td>Robert G. LUPU, Valentin SIRITEANU, Daniel LEON</td>
</tr>
<tr>
<td>38-39</td>
<td>K-Framework</td>
<td>Radu MEREUŢĂ, Emilian NECULA, Raluca NECTULA, Dorel LUCANU</td>
</tr>
<tr>
<td>40-41</td>
<td>Automatic Visual Annotation Services</td>
<td>Sergiu NEDEVSCHI, Arthur COSTEA, Robert VARGA</td>
</tr>
<tr>
<td>42-43</td>
<td>Intelligent system for trajectory detection</td>
<td>Sorin CRĂCĂNA, Gabriel FELIU, Gheorghe PANAGHIU, Alexandru BĂRLEANU</td>
</tr>
<tr>
<td>44-45</td>
<td>Developing An Intelligent Manufacturing Architecture Under The Holonic Concept</td>
<td>Carlos PASCAL, Doru PANESCU</td>
</tr>
<tr>
<td>46-47</td>
<td>Romanian Language Processing Chains in U-Compare</td>
<td>Ionuţ Cristian PISTOL</td>
</tr>
<tr>
<td>50-51</td>
<td>Adaptive Car Embedded System</td>
<td>Vlad SANDULEAN, Dan GAVRILI, Marius IACOB</td>
</tr>
<tr>
<td>52-53</td>
<td>Automatic Morphologic Classification System for Romanian Texts</td>
<td>Radu SIMIONESCU, Dan CRISTEA</td>
</tr>
<tr>
<td>54-55</td>
<td>The usage of FPGA technology in embedded systems design</td>
<td>Andrei STAN, Sorin GABOR, Marius IACOB</td>
</tr>
<tr>
<td>56-57</td>
<td>Efficient Use of HPC Resources Provided by a Supercomputer Based on CBEA Processors</td>
<td>Ioan UNGUREAN, Ștefan-Gheorghe PENTIUC</td>
</tr>
</tbody>
</table>
Remote Diagnostics and Services

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1. OBJECTIVES

Mobile Equipment Industry grew really fast in the last decade covering a lot of human necessities. There are tens of millions of mobile equipment built every year, while the number of technicians cannot cover all the maintenance of such an amount of devices, especially when most of them are always on the road. Here comes the need of a specialized device that can help humans spare the diagnosis costs and time. Through our solution, mobile equipment could be remotely checked by a specialist or even automatically.

2. TECHNICAL DESCRIPTION

OBD acronym comes from On-Board Diagnostics, which is a generic term referring to a vehicle’s self-diagnostic and reporting capability. OBD systems give the vehicle owner or a repair technician access to state of health information for various vehicle sub-systems. The ELM¹ integrate controller is a chip which helps you connect to the ECU of your mobile equipment and communicate with it through a standard serial connection (e.g. ELM327 communicates through a standard RS232 serial connection). It interprets sent ASCII commands and passes them to the OBD.

The architecture of our system consists of two parts: the client mobile device and the server (or remote host). In the figure we have displayed the system architecture in a graphical manner for a better understanding.

A. THE CLIENT (MOBILE DEVICE)

This device should be placed inside the vehicle (or in range of the Bluetooth) and its main responsibility is to communicate with the OBD through the ELM device, by sending it specific ASCII commands via Bluetooth, collect data and send it to the server via an internet connection.

B. THE REMOTE HOST (WEB SERVER)

This is the part where all the data is collected and processed automatically. Its responsibility is to store the results in a larger database. Also, the remote host can start or stop any of the client devices on demand by sending the “stop” or “start” command. Information collected from clients must also be displayed in a human readable format so that a real person can interpret the results.

3. USE CASES

Our solution has many advantages and can be applied to any equipment containing an engine control unit (ECU). For example, instead of having our car checked up by a technician/mechanic in a service it can be automatically checked and diagnosed remotely without any physical intervention. In case of any turbulences produced inside the car we can get warned about, before causing accidents because of it. Another situation in which it could be very useful would be the case of motor boat, placed during the winter in a dry dock. If the engine’s boat is equipped with an OBD2 interface, the diagnosis could be done without transporting the boat to a service. The same for an oil platform: the diagnosis of equipment that has also an OBD2 interface can be performed remotely without large expenses.

4. INFORMATION FOR INVESTORS

The system was tested and works on OBD II simulators.

5. REFERENCES

¹ ELM 327: http://www.elmelectronics.com/DSheets/ELM327DS.pdf
² OBD II Ecu: http://www.4x4wire.com/toyota/6Runner/tech/OBD-DII_ECU/
Formal model-based language
engineering in K
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1. OBJECTIVES
This project aims to design and implement a framework in which Domain Specific Modeling Languages (DSMLs) can be defined formally by giving their operational semantics. The first main objective of it is to create an easy-to-use framework (from a software engineer perspective) which is still a powerful formal tool for defining DSMLs. The second main objective is to provide tools for analysis and verification bundled in the framework, which will operate on the same semantics – assuring this way the correctness of the proofs.

2. TECHNICAL DESCRIPTION
Domain-Specific Modeling Languages (DSMLs) are languages dedicated to modeling in specific application areas. Recently, the design of DSMLs has become widely accessible to engineers trained in the basics of Model-Driven Engineering (MDE): one designs a metamodel for the language’s abstract syntax; then, the language’s operational semantics is expressed using model transformations over the metamodel. The freedom of DSM design in MDE context leads to a big number of languages, and in most of the situations to a big number of errors in those languages. Indeed, getting a language right (especially its operational semantics) is hard, regardless of whether the language is defined in the modern MDE framework or in more traditional ones.

Formal methods can help detect or avoid errors in DSM definitions. However, the history of formal methods offers many examples of valorous methods that could not be transferred outside a circle of specialized users, because software engineers do not have the time or the background required for learning them. The lesson learned from these failures is that, in order to be accepted by software engineers, formal approaches have to operate with notions familiar to them. We propose here such an approach where users can define their DSMs using familiar MDE ingredients (metamodels for syntax, OCL constraints for static semantics, model transformations for operational semantics). In the implementation we rely on K, which is a framework designed for giving operational semantics for programming languages which also provides an execution engine and some analysis tools. The major contributions of this approach is providing a formal semantics to the MDE notions employed in DSML definitions:

• metamodels, together with well-formedness OCL constraints and models;
• model transformations for operational semantics. We have designed a language called KMRL (K-based Model-Rewrite Language) which is composed of model-rewrite rules, where each rule consists of a model pattern similar to MDE models, an optional condition written in OCL, and an optional piece of imperative code also based on OCL.

3. USE CASES
The framework we want to create will be useful anywhere were DSMLs are useful. To be more specific, the framework can be used anywhere where a formal definition of DSMLs is required. It will be able to generate parsers for the language and code parameterized by OCL constraints such that these are valid at runtime. We also want to focus on test case generation. More examples and use cases can be found in [1] and [2].

4. INFORMATION FOR INVESTORS
This project already started and the results we have for now are quite promising. We can define metamodels, OCL constraints and model transformations and we can also test them using the K framework – a framework designed for giving operational semantics for programming languages. We can also do analysis/verification using model checking based on “search” command from Maude. All these features are available online at https://fmse.info.uaic.ro/tools/dsml – where the formal definition of SPEM (actually a subset of it – xSPEM) is given.

REFERENCES
1. OBJECTIVES
In this project we present ongoing work on the formal specification of Java language. It is a useful tool for both software research and software engineering. In software research the tool might be used for program verification. In software engineering it is useful to design a new language heavily influenced by Java, to implement a novel technique for code inspection or refactoring, or to use Java as a scripting language.

2. TECHNICAL DESCRIPTION
The Java runtime semantics was developed in K Framework paired with an external parser. The compilation result of this semantics is an interpreter for java. The first obvious benefit of having an interpreter is that java now can be used as a scripting language. Small, one-file Java programs may be run from command line without being compiled first. Right now the only interface with operating system is console input/output. We are also considering to add support for external programs execution and file operations, so that scripting in Java could be really useful.

Below we highlight the completion status of the language itself. We have support for all primitive types except floating point, and reference types. The following chapters of Java Language Specification (JLS) are completely implemented, (except floating point related features): Literals, Conversions and Promotions, Arrays, Expressions, Statements. All basic features of OOP programming are also working – classes, members, encapsulation, inheritance and polymorphism. Right now they are implemented in a simplified form, and in future we will continue working on them so that we will reach full conformance with JLS.

The parser upon which semantics is based is implemented in SDF formalism. It has two parts. First is formal specification of Java syntax in SDF formalism - the project Java-front. Second is a parser generator written in Stratego program transformation language. The parser generator is language independent, thus it may be used to give formal semantics to any language, provided we have a SDF syntax for it.

The semantics part is implemented in K Framework. K Framework itself might be regarded as a programming language specifically designed for implementing compilers and interpreters for other languages. A language definition in K Framework consists of a configuration and a set of rewriting rules. The configuration is the “data” part of the language interpreter – it represents the state of the executed program. The set of rules is the “algorithm”. Each rule rewrites a specific part of the configuration into a new form.

Using this rewriting paradigm, a language may be defined in much shorter format than using a conventional programming language. For example current Java semantics source code have 55 KB, 1800 lines of code (including whitespaces and comments), and 240 rules.

3. USE CASES
A good source of example programs, currently supported by the project is the automatic test suite. It has more than 100 programs at the moment of writing, and continues to grow. All programs may be run by both Java semantics interpreter, or by JDK, 1.4 and above.

4. INFORMATION FOR INVESTORS
The ability to run Java as a scripting language may facilitate integration with other scripted tools. In particular, it might eliminate the need to use other languages, such as Perl, as a scripting tool. This in turn, may reduce the amount of different programming languages used in a project, leading to reduced maintenance costs.

A company interested in developing a novel programming language inspired by Java can reuse a great part of existing Java semantics. This, in turn, will lead to faster new language prototyping.

5. REFERENCES
Power-aware software framework for securing embedded systems

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1. OBJECTIVES
The software framework is intended for use in resource constrained embedded systems, for deployment and evaluation of adaptable security mechanisms. It was designed to act as a bridge between an embedded software application or real-time operating system (RTOS) and the underlying communication or storage hardware in order to secure data with respect to the power and security constraints of the system.

2. TECHNICAL DESCRIPTION
The following characteristics are relevant concerning the architecture:

- the framework links to a communication interface in order to secure (i.e. encrypt/decrypt) the transferred data using one of the available security resources. The security resources are represented by symmetric encryption algorithms which are integrated within a library of the framework, which also holds the energy consumption and time performance characteristics of symmetric algorithms;
- the usage of symmetric algorithms implies the use of a shared encryption key. In order to exclude the usage of asymmetric ciphers for key management and to alleviate the system of extra processing, the framework implements two alternatives for key exchange: first, a two key, two stage mechanism that is used to deliver the encryption key through the communication medium, and, second, a key generation method, based on synchronized system time bases, that does not use the communication medium for key delivery;
- the framework is designed to work on a master-slave architecture, where the slave is a battery powered system and the master is a mains powered one. The purpose is to use the master system to log the events and parameters of the slave one, without having to worry about energy constraints;
- the framework integrates an adaptable security engine based on the Weighted Product Model (WPM) decision method which was chosen for its property of being a dimensionless analysis method, meaning it eliminates any units of measure from values describing the decisional alternatives. This is an advantage because the chosen decision criteria is based on the volume of data to secure, energy consumption and time performance characteristics of the security resources used;
- due to its high abstraction level and to the fact that it is entirely written in ANSI C, the framework is easily portable throughout different target processors and compilers. It offers standard interfaces for both application and system driver interfacing.

3. USE CASES
This software framework can be deployed in embedded systems with wireless communication capabilities, as a means to secure the data sent and received through the shared medium.

For example, consider a network of wireless sensors composed of battery powered systems used for monitoring road traffic. Such sensor nodes have limited battery capacity and the use of the software framework provides a trade-off between security and operation time. Other applications for the framework include telemedicine, e-health and patient monitoring systems. Such devices are suited because of the sensitive data they process and because they tend to become less invasive (small wireless connected devices).

4. INFORMATION FOR INVESTORS
There is a constant interest for software methodologies designed to bind low energy consumption and other performance metrics (i.e. throughput, latency).
The Self-Driving Car

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1. OBJECTIVES
The purpose of the project was to build a car that is able to drive itself on any track marked by a black line on a white background. The car follows some basic rules such as: keeping itself on the track, stop only at the finish line, and run at the highest speed possible.

The track may contain: straight lines, tight curves, intersections, start-stop line, bridges, tunnels, bumps, black spots, reflective tape.

2. TECHNICAL DESCRIPTION
Starting from a set of components that included a toy car chassis, some motors and a camera we built a car that is as competitive as a formula 1 car. We made this possible using a state-of-the-art processor that we have embedded in the car (the MPC5604B from Freescale). But this would be useless without hard work and intensive programming to fill the processor with good-operating code in order to give the car the power to take its own decisions.

As we said, programming wasn’t easy. We had to deal with successive signals from the camera (an array of 128 diodes) representing the road that had to be acquired, filtered and analysed to build a correct representation of the track in the car’s “brain”. Having this successfully done, the decisions chain moved further to controlling the motors: one servomotor for the front wheels and two DC-motors in the back, one for each wheel.

To achieve maximum accuracy with the signal from camera we controlled its acquisition time at one millionth of a second, taking 4 samples every 7μs during the acquisition time which happens every 10ms. Although the signal is quite precise, it reflects the state of the track which besides the ‘expected’ elements may itself be damaged, thus making the signal analysis a provoking task. Separating the black line from other elements of the track proved to be most challenging especially when dealing with intersections and damaged circuit. Because the car is always pushing the speed limits, it has to make quick decisions in order to keep itself on the track, but if it happens to lose the track, the algorithm helps it find the road fast by taking into account the car’s last valid position.

The found black line’s index is transferred to the servomotor’s position in order to steer the car. Steering is also assisted by the motors in the back which get into action differentially by transferring power from the wheel from the interior of the curve to the wheel from the exterior, thus allowing high speed in tight corners.

The Figure gives an idea of how the car sees the road.

3. USE CASES
Starting from account of how many great things we’ve learned about motors control, data acquisition and analysis, and wireless communication that we used for debugging our application in real time with the PC. It goes without saying that this was an amazing educational project that helped us improve our knowledge of technic. But also this could serve not only to us, but to a wide range of activities that imply industrial work (controlled vehicle driving inside fabrics), civil service and commerce (cars that safely drive themselves carrying people and goods on public roads).

4. INFORMATION FOR INVESTORS
We are now asking you to close your eyes and think of the future. What did you see with your imagination? Was it a full-sized driverless-car that was driving you to work while you were watching the stocks? If you wish this to happen, help us take our project to the next level. We intend to build a full-sized car that is able to drive itself in real traffic. And this doesn’t come cheap; we need investment to buy the equipment including an appropriate car, real accurate sensors and processing power. We might be the young enthusiasts that can realize this dream!

Signal processing
Networked Predictive Control for Fast Automotive Systems

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1. OBJECTIVES
The goal of this project is to provide a control design methodology that ensures the closed-loop performances of a physical plant, while compensating the time-varying delays introduced by the communication network that links the controller with the remote process in automotive applications.

2. TECHNICAL DESCRIPTION
All of the available control solutions for automotive applications assume that the sensors, controllers and actuators are directly connected, which is not realistic. Rather, in modern vehicles, the control signals from the controllers and the measurements from the sensors are exchanged using a communication network, e.g., Controller Area Network (CAN) (Figs. 1, 2). This brings up a new challenge on how to deal with the effects of the network-induced time-varying delays in the control loop.

As such, the problem considered in this project is to control a system through a communication network, while compensating the time-varying delays introduced by the network. Firstly, the error caused by the time-varying delays is modeled as a disturbance, which enables the usage of a disturbance bounding method considering that the input of the process is bounded. Then, a robust one step ahead predictive controller based on flexible control Lyapunov functions is applied, which explicitly takes into account the bounds of the disturbances caused by time-varying delays and guarantees also the input-to-state stability of the system in a non-conservative way. Moreover, by choosing an appropriately Lyapunov function, the predictive algorithm amounts solving a single, low-complexity linear program each sampling instant. The modeling method and control strategy were tested on a vehicle drive-train controlled through CAN, with the aim of damping drive-line oscillations – crucial in improving driveability and passenger comfort. Several TrueTime realistic simulations show that the proposed control scheme can handle both the performance/physical constraints and the strict limitations on the computational complexity (Fig. 3).

3. USE CASES
Although the case study considered in this paper is an automotive application, the theoretical results could be applied for other network-controlled applications from different industry fields: aeronautics, automated manufacturing, military unmanned vehicles, tele-robotics, tele-medicine. Moreover, the communication protocol used for the simulations and experiments is CAN. Also, the theoretical results presented could be applied for other communication protocols and even for wireless networks.

4. INFORMATION FOR INVESTORS
By controlling a fast system through a networked environment, the implementation/maintenance costs are lowered and, e.g., in the automotive industry, using networked control systems, in which controllers exchange information about the operation of the vehicle, leads to minimization of fuel consumption and lower emissions. Moreover, the proposed predictive control strategy ensures the performance/stability of a physical plant, while taking into account the network-induced time-varying delays.
1. OBJECTIVES
At the moment, there are many campaigns meant to increase self-awareness, as well as websites or mobile applications that give general information about skin cancer and ways to prevent it, but none is user-oriented as there are many factors that influence the risk of getting skin cancer. The SunScreen application is designed to help prevent skin cancer by offering relevant and personalized advice on how to protect oneself from the detrimental effects of the Sun and to keep records of UV exposures.

2. TECHNICAL DESCRIPTION
The technologies have been chosen to yield facile portability of the application as well as convenient hardware support. Hence, we use C# as programming language along with the .NET framework and Windows Azure as storage space for the multiple types of data the application collects.

- The conventional Web application (intended to be used especially on desktop computers) is based on ASP.NET and jQuery.
- The mobile application is built with PhoneGap platform which provides an important support for portability. The implementation uses JavaScript for the backend and HTML5 and CSS3 for the frontend.
- Both the mobile and Web applications invoke our developed Web service in order to retrieve the necessary data. The SunScreen project offers a public API – based on the REST paradigm – implemented in C# and based on the ServiceStack library.
- The data is stored in Windows Azure. The spatial data collected from the user’s GPS coordinates and UV level are stored in a relational database that uses the Windows SQL Server spatial data features. All other user information are stored using Table storage for easier manipulation of large amount of data.

The data used by the service to calculate radiation levels for a certain point on the globe are provided by independently running worker applications that offer hourly UV readings from specified locations on the globe, which then are returned by the service if there are readings for the queried location, or are averaged to provide an indication on what the radiation level might be. Recommendations are also made for the user using a rule-based engine which factors in age, location, skin-pigmentation, conditions, etc.

3. USE CASES
Our application targets anyone who owns a mobile device (phone, tablet, etc.) with GPS receiver and spends at least two hours a day in the sun. Our main customers are however people who present high risks of developing skin cancer, parents having small children and people with elderly relatives. Not only the application’s owner will benefit from the provided facilities. SunScreen also allows to user to help and protect an acquaintance/relative who could not use this application (e.g., children, people having special conditions).

4. INFORMATION FOR INVESTORS
SunScreen can be categorized as economically viable. It can be deployed and maintained due to the advertising of certain dermatological products/services, including specific goods of interest to our application user. We also plan having partnerships with private hospitals, private outdoor pools and parks which will help us keep up with the maintenance costs and may even allow us to offer the application free of charge to under-privileged people from around the world.
Gesture Based Human Computer Interface for Simulation of Assembly Operations

1. OBJECTIVES
The project proposes a new interface for the human interaction with 3D virtual reality environment in simulating the assembling operations. This interface, based on human gestures, provides intuitive interaction for selection, manipulation and control for any component inside the virtual model.

2. TECHNICAL DESCRIPTION
The solution we propose is based on real-time image processing techniques and on a 3D Hidden Markov Model-based classifier for gesture recognition. The interface is composed by three components:
- the input tool: the user hand is the instrument through which the user is accessing the object inside virtual reality. The hand detection is achieved by a supervised classifier based on Haar-like features and AdaBoost algorithm.
- tools for selection and manipulation: the hand posture is the instrument through which the virtual objects can be grabbed, rotate, positioned and released. The posture classifier was developed based on the Hu image moments.
- the assembly commands: the hand gestures are used for mapping the operations of assembling, replacing, deleting or disassembling the components. The gesture recognition is build based on a HMM classifier.

During assembly or disassembly the user can learn an assembly task and he will be able to find details about components and observe the relationships between them.
Advantages of this designed, implemented and experimented human computer interface (HCI):
- the user is allowed to manipulate the objects in the scene with free hands, without gloves or other devices.
- the functionality of assembly simulator systems become easier, since is avoiding the switching between the mouse action on menus and keyboard pressing for different parameters.

3. USE CASES
- Let’s build in a Virtual Educational Environment: a child has to build a virtual model starting from a real one (e.g. an airplane, etc.). In this activity the children will practice visual-spatial intelligence (the positioning of 3D objects) and the logical-mathematical skills (identify relationships between parts). Finally, the model will only work if all the pieces are placed correctly.
- Change a Wheel on a Car: inside a virtual simulator one user has to change different components of a car and validate the assembly process.

4. INFORMATION FOR INVESTORS
This interface, used to facilitate the assembly operations in virtual environments, is propitious and interesting for two reasons: first, it is in accordance with the current developments in HCI technology (we arrived at interfaces based on voice and gesture recognition, multi-touch, brain-computer, etc.); second, besides the simulation and the evaluation of the new product development process, this allows to the user to interactively learn an assembly task by simulating the real process. The importance of this interface is given by the fact that it can provide the functionality of mouse and keyboard inside an assembly simulator by intuitive interpretation of human gestures.
1. OBJECTIVES
ATLAS (Applied Technology for Language-Aided CMS) is a project co-funded by the European Commission, with the purpose to build a technology facilitating multilingual Web content development and management, in particular the authoring, versioning and maintenance of multilingual Web sites. We are referring here only to the Romanian language component.

2. TECHNICAL DESCRIPTION
The ATLAS framework employs technologically and linguistically diverse natural language processing (NLP) tools in a platform, based on UIMA2. The UIMA pluggable component architecture and software framework are designed to analyse content and to structure it. The ATLAS core annotation schema, as a uniform representation model, normalizes and harmonizes the heterogeneous nature of the NLP tools. The language processing tools are integrated in a language processing chain (LPC), so the output of a given NLP tool is used as an input for the next tool in the chain.

The baseline LPC for each of the project languages includes: sentence and paragraph splitter, tokeniser, part of speech tagger, lemmatizer, noun phrase chunker and named entity extractor. The annotations produced by each LPC along with additional statistical methods are subsequently used for the detection of key words and phrases, generation of multilingual text summarisation, multi-label text categorisation and machine translation.

The diverse content in i-Librarian requires a flexible generation of summary depending on the text length. The baseline method, used for both short and long texts, relies on shallow level language independent heuristics.

The summarisation approach used for short texts exploits cohesion and coherence properties of the text on discourse structures that resemble rhetorical trees. The short texts summarisation chain includes following the language processing chains an anaphora resolver, a clause splitter, a discourse parser and a summarizer.

3. USE CASES
i-Publisher, adds a visualization layer to ATLAS and provides a powerful web-based instrument for creating, running and managing small and enterprise content-driven web sites. i-Publisher will be freely available as an online service and also used by the ATLAS consortium to build two thematic content-driven web sites – i-Librarian and EUDocLib.

i-Librarian allows its users to store, organize and publish their personal works, to locate similar documents in different languages, and to obtain easily the most essential texts from large collections of unfamiliar documents.

EUDocLib is a publicly accessible repository of EU documents, providing enhanced navigation and easier access to relevant documents in the user’s language.

4. INFORMATION FOR INVESTORS
A wide range of technologies will be utilized to simplify the process of managing and publishing heterogeneous multilingual content, and to make content accessible both from personal computer and mobile. Language-based mechanism such as automatic categorization, summarisation and annotation, greatly enhance user experience by saving authors and editors valuable time and by improving content navigation. ATLAS simplifies the process of managing and publishing multilingual content. Collaboration with industry is searched for the exploitation of the product.
Processing of 3D Medical Data
Using Volume Visualization Techniques

1. OBJECTIVES
Within this project we aim to develop applications for the representation and visual manipulation of 3D medical data from CT and MRI scanners. Our two main objectives are to provide tools for an easier, more intuitive and efficient examination of complex medical scans, as well as to develop optimal software prototypes for research and publication purposes. Our results target medical personnel, patients, as well as research and academic staff involved in scientific visualization.

2. TECHNICAL DESCRIPTION
Our prototype takes as input 3D data from various scanning devices (mainly, but not limited to, CT and MRI). Such devices generate multiple slices which form a volume data set. Several data processing and rendering algorithms allow the precise control of colour and opacity, based on various direct, indirect and statistical properties of the data. The results are generated in the form of 2D images which show various components from within the data set, as specified by the user and according to the project workflow.

Figure 1 shows a basic network assembled from various processors involved in the prototype. Initially, the data set is sent to video memory by a Volume Loader. A Proxy Geometry processor generates a polygonal 3D object required for rendering (typically a cube). The Ray Caster then samples the data set by emitting a ray through the volume from each pixel. At each sampled point, a transfer function generated semi-automatically or manually by the user maps colour and opacity according to one or several non-optical properties of the media located at the sampled points. As an example, we consider the density of the corresponding anatomical tissue as the main property. The classified data is then projected onto a 2D image which is then displayed on an appropriately-generated widget (an on-screen render window). A result can be seen in Figure 2, where in images b) and c) various anatomical structures have been separated based on their different densities: bone, blood vessels, skin etc. We’ve also added Phong-based illumination for more realism.

Figure 2. Images generated from CT medical data: a) One 2D slice from the data set. b) direct volume rendering with classification and illumination; c) a different view of the same data using clipping geometry.

3. USE CASES
Such 3D representations are particularly useful for data comprising a very large number of slices, since it is normally tedious and time-consuming for a medical doctor to visually inspect hundreds of 2D slices per patient. A more intuitive 3D representation would also be useful to patients who lack the necessary training to interpret traditional greyscale slices. Furthermore, a 3D depiction of the data may well serve for educational purposes, where the educator would easily be able to interact and control the resulting image while providing explanations and lecturing.

4. INFORMATION FOR INVESTORS
We offer robust and functional prototypes for 3D rendering, primarily for research in scientific visualization. We are particularly interested in inter-disciplinary collaborations with specialists from the medical/IT fields willing to evaluate our results for the purposes of paper publication. However, we do not exclude the potential for the commercial application of our techniques.
1. OBJECTIVES

Our game design proposal is based on the Imagine Cup 2011 submission. The new game features around 10% of the original idea: main objectives were to accomplish all the MDGs and bring awareness on toughest world problems, through player actions and social media interaction (Twitter). An issue that is covered throughout the new game is helping friends get well and deal with diseases such as osteogenesis imperfecta. Based on the feedback we received, interesting story elements and gameplay were added.

2. TECHNICAL DESCRIPTION

This game uses the latest XNA technology for Windows Phone to provide an immersive game experience enriching the storyline. We're providing a social experience via Twitter integration, by implementing asynchronous NET REM APIS. The entire game is developed using the latest Microsoft development tools and the C# object oriented language, guaranteeing its performance, speed and optimized memory usage. The game play represents the key-component of the Cityquest proposal. It was designed so that the players will be emerged into a brand new experience. The steps are described as followed: 1. The first objectives are to accomplish all the MDGs and bring awareness on toughest world problems, through player actions and social media interaction (Twitter). An issue that is covered throughout the game is helping friends get well and deal with diseases such as osteogenesis imperfecta. 2. The story is focused on the main character adventures. Player impersonates a lion-type hero to be controlled through the 3 life stages: child, teen and adult. CITYQUEST is intended to be played by 5+ year kids. 3. Players are set to customize their hero with the help of a series of options. 4. The users can change the character gender, thus assuring gender equality from the beginning of the game. 5. At first contact with the city, the players must explore and make new friends. They do that by solving quick Millennium Development Goals. 6. Solving the quick MDGs is done by setting awareness. The player accomplishes the goals by gaining new friends. 7. Players could interact with the environment, including access to the map and the personal diary which offers the current objectives, inventory, and statistics. 8. The diary contains information regarding the current objective, level and city health, achievements unlocked and stats about our friends and citizens (which are healthy, which are not). 9. After gaining a significant number of friends, the player is introduced to the plot: the city and player friends are getting sick (their bones get fragile just like osteogenesis imperfecta). The player also advances to the next level; the character becomes a teen. 10. A cure must be found quickly. Exploring the city for help, the hero finds a strange-shaped stone carved with a message: Find a set of items and you can save the day. 11. Some items can be found by simply exploring the city. For example, the four leaf clover is just waiting to be picked up by our hero and used later to gain the antidote. 12. Other items must be earned. This is done by interacting with non-playable-characters (NPC) that have a gameplay icon. They need your help and after you complete the challenge correctly you can be awarded with an item. 13. Mini-game challenges are designed for educational and interactivity purposes. 14. Also, CITYQUEST is testing the player logical and mathematical basic knowledge. 15. Other mini-games may challenge the player intuition and creativity. One of the games require for the user to complete the sentences with the correct missing word. 16. A puzzle may include different scenarios. 17. After collecting all items, the player gains a new level – the hero is now an adult. 18. During this time, birds may fly in and out of the screen. The player could catch them for later use – the birds can help transport the antidote. 19. In the final stage of the game, the player is racing against time to distribute the cure to sick friends. 20. The city gains back its shine; at this point, the player is faced with a decision: to play again with a new character and unlock new features and/or achievements or choose a new challenge – continue to another city/map in danger.

3. INFORMATION FOR INVESTORS

The game is currently available as an alpha release (for testing bugs/inconsistency/performance issues). Soon, a public beta version will be launched as an important factor of our user testing process. Based on the player feedback, elements of the game may change or be improved.
1. OBJECTIVES

Android Remote enables the user to connect to a computer running Microsoft Windows across the Internet or Bluetooth from a mobile device powered by the Google Android platform. By receiving commands from the Android component (the client), the desktop component (the server) can control applications like Microsoft PowerPoint and Windows Media Player. The list of accessible applications and the actions supported by each of these is defined at runtime by getting this information from an .xml configuration file.

2. TECHNICAL DESCRIPTION

The system is comprised of two major parts: the Android component and the Desktop component (a Microsoft Windows computer). These two communicate by means of Bluetooth and Wi-Fi.

The Android component offers the user two screens: one that lists the available desktops and the means of communication (Bluetooth or Wi-Fi); and one that lists the applications that the user can control, together with the actions available for each of them. The Desktop component contains three main modules. The Accessible Applications module keeps a list of the applications that can be accessed by the application. It gets this information from an .xml configuration file. The Running Applications module monitors the running processes in the computer. It is its role to notify the Android whenever an application is started or exited. The Profile Manager module creates specific profiles for an application, through which it can perform various actions (e.g. run, exit, close, presentation, view show, exit show, next slide, and previous slide for a PowerPoint application; play, pause, next, previous, volume up, volume down, mute, unmute for Windows Media Player).

The communication consists of passing strings with a certain format between the client and the server.

3. USE CASES

You can use Windows Media Player sitting on your couch, listening to your favourite playlist, changing the song whenever you are bored, or increasing the volume when you feel like it. You do not have to go to your desktop to do that, but you can do it easily just with your phone’s touchscreen.

You can also use it when you try to deliver a presentation to an audience and you are tethered to a mouse or keyboard to change the slides.

4. INFORMATION FOR INVESTORS

Day by day, the numbers of phone users, especially Android ones, are increasing. Therefore, the application will be a success for those who are interested in controlling the computer applications without sitting in front of a PC.

We have created a robust, efficient and user-friendly application that can be used effectively to remotely control the Windows Media Player and the Microsoft PowerPoint applications. We would also like to point out that all of our features have been fully tested to assure smooth functioning, efficiency and effectiveness.
1. OBJECTIVES
We introduced different methods for the visualization, analysis, and validation of biopsy needle pathways [1]. Also, to provide additional preoperative planning support, we introduce the concept of a biopsy-needle stability-map [2].

2. TECHNICAL DESCRIPTION
Our system uses a multi-level approach for identifying stable needle placements which minimize the risk of hitting blood vessels. This is one of the major dangers when performing a biopsy. Our approach helps in identifying and visualizing the point on the pathway that is closest to a surrounding blood vessel, requiring a closer inspection by the neurosurgeon. An evaluation by medical experts was performed to demonstrate the utility of our system, with encouraging results.

The user feedback was acquired from five participants, forming two groups: the first group consisted of two medical experts with decades of experience in biopsy procedures; the second group consisted of one neurosurgeon and two neurosurgery residents with limited experience in biopsies, but with extensive experience in brain surgeries.

The result of the acquired feedback verifies that our system reduces the pre-planning time needed for the biopsy needle pathway selection. Both the experts and the second group of respondents agreed that the confidence level of the selected pathway is much higher using our system than using a current medical workstation. This is due to the several possibilities of validating the needle pathway.

The described application loads a volume reconstructed directly from the DICOM images obtained from different medical scans. Three volume visualization methods are implemented: direct volume rendering (DVR), maximum intensity projection (MIP) and Maximum Intensity Difference Accumulation (MIDA). Different cutting planes and multiple transfer functions can be used for facilitating the 3D visualization process. Also, a series of 2D views are provided. For the validation and the identification of one specific needle pathway we have introduced a series of graphical elements to ease the pre-operative planning (see Figure): an entry points stability map for the biopsy needle; a needle pathway distance graph; an augmented 2D slice view normal to the needle direction.

3. USE CASES
Possible usage scenarios for the described application are mostly focused on medicine procedures that involve the insertion of a needle for different purposes. Our system requires that the needle insertion process does not cause significant tissue deformations. As possible applications, we mention: biopsies of brain or liver tumors (both require special attention for avoiding blood vessels); insertion of electrodes in Parkinson disease treatment; ablation of brain clots or of hepatic tumors.

4. INFORMATION FOR INVESTORS
One potential investor should manage the interaction with hospitals and other medical workstations developers in order to integrate the capabilities of the presented system into current medical workstations. The workload required to accomplish this, from the programming point of view, is minimal once we are permitted to interact with the existing software.

5. RESOURCES

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Early Crisis Detection from Text Streams

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1. OBJECTIVES

We present a system that monitors online news articles, blogs, RSS feeds, detects and classifies events and, using an altered opinion mining workflow, detects geographical entities related to these events and the sentiments expressed towards them. The results are displayed in customized GoogleMaps views, indicating areas with a potential risk, such as natural disasters, unfavourable weather or threatening protests. In Figure 1, we present the most important components of our system. In order to test it, we have monitored protests that took place in Romania between 13 to 25 January, 2012.

Newspaper monitoring: A number of newspapers are monitored using RSS feeds and the articles are gathered using a crawling component. For our case study, we monitored five newspapers Adevarul, Hotnews, Jurnalul, Puterea and Romania Libera. This data was stored locally and it was pre-processed (from html pages were removed links, photos, menus, special characters).

Identification of potential risk events: After the initial processing step, we identify news articles containing a higher frequency of mentions of potential risk events. We also use a topic model approach to detect the main topics of the news articles. This component is designed to filter news and to select only relevant information for our current task.

Data processing: Identifying locations, regions, keywords. Named entity identification is a crucial component of our application. The correct identification of “islands” with potential risks on a map depends on the accuracy of this component. For this, we use the Romanian language specific resources that contain cities, small regions or larger regions. Additionally, we have added a new type of named entity, “street”, for which we have created specific resources and specific rules to identify streets.

Identification of opinions: We use manually built resources to identify opinions keyword signals the feelings, amplifiers, diminisers and negation. Additionally, we added resources using specific words for conflict. We calculate the valences for groups of feelings and pairing named entities with scores based on the distance, punctuation and context. Based on these values we are able to classify named entities previously identified based on the opinion expressed towards them. Although obtaining a general opinion, as defined by the opposites positive/negative still can provide valuable clues concerning a potential threat, by adapting the context to a specific issue (protests, weather etc.) and introducing a relevant seed vocabulary, we can shift the semantics of the opinion towards the problem in hand. For example, we will be able to present the results in terms of degrees of danger.

Building a customized GoogleMaps map for events: The purpose of this component is to create a map based on GoogleMaps, in which the locations and critical values calculated for them will be placed. Depending on these “islands”, we will inform concerned people of the potential risks that appear. In Figure 2, such visualization can be seen.

3. USE CASES

All the processing is done in real time and, depending on the monitored sources, our work could be of use as a population warning system, but it could also be useful for regional or local authorities in managing intervention time and resources by prioritizing the situations for which they have to act. Also, the system provides alternative routes that bypass potential dangerous areas.

4. INFORMATION FOR INVESTORS

Although the system was built to be used for crisis scenarios, its design allows it to be easily adapted, with minimum human intervention, to track any event that may appear in online news articles. More than that, its components can be used individually. For example the topic detection component can be successfully used to track emerging trends or important events in online media.

Figure 1. The main components of the system

Figure 2. Alternative route visualization
1. OBJECTIVES
This project presents a new technology used for communicating with people with major neuro-locomotor disability. The technology is based on eye tracking to select a keyword and send it to a caretaker through a communication system. This is useful for patients who cannot communicate verbally, through signs or in writing and is based on their ability to control eye movement.

2. TECHNICAL DESCRIPTION
The communication system that offers the patient the possibility to express his needs whenever he wants even he is alone, is depicted in Figure.

- AsistsysPatient - a computer based device assisting the patient in keyword selection process and ensures the communication with the server;
- AsistsysServer - manages all the information received/forwarded;
- AsistsysCaretaker - identified as a PDA or smartphone announces the caretaker about patient request.

In front of the patient’s eyes, a computer based unit displays keywords on a screen together with a suggestive icon and background colour. Whenever the cursor floats over a certain group (keyword – image) the area is highlighted and the keyword is heard into the headphones. The selection is made detecting a voluntary blink. The selected keyword is sent via Ethernet to the server. There, based on the information in the database, is selected the caretaker who has to answer and the keyword is sent wireless to his/her PDA. The caretaker’s answer is sent back to the server and from there to the patient’s device screen. The major advantage of the proposed system is that it replaces the traditional manner of communicating, which relies on the constant presence of a caretaker at the patient’s bedside, raising thus the cost of patient care taking.

The patient gaze direction is determined by the eye tracking technique. To perform this, a video cam is placed very close to the eye right underneath avoiding to obstruct the patient’s frontal visual field. The camera was modified to take images only in infrared light. To track eye movements a proposed algorithm named binarization has been implemented. The algorithm is feature-based, assuming that the darkest region in the image is the pupil. Applying an inverse binarization threshold the corresponding pixels of pupil are evidenced. To map the gaze position on screen a second order polynomial function is used.

3. USE CASES
The proposed communication system for patients with neuro-locomotor disabilities is based on eye-tracking and can be used by patients with no controlled movement except eye movement. This system assists and offers to the patients a way of expressing their needs or desires in the absence of the caretaker. Once the patient accustoms himself with the system, a more complex list of keywords should be used. The system can be used in hospitals or at homes.

4. INFORMATION FOR INVESTORS
Future work is to improve the eye tracking algorithm to run on mobile devices like smartphones. That could be very useful for patients with neuro-locomotor disability to communicate. Connecting video glasses to smartphones will allow people to use their smartphones with their eyes while they drive a bicycle, a motorcycle or a car and not only.

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1. OBJECTIVES

K is an executable semantic framework in which programming languages, calculi, as well as type systems or formal analysis tools can be defined, making use of configurations, computations and rules. The aim of K is to demonstrate that a formal specification language for programming languages can be simultaneously simple, expressive, analyzable and scalable. K is particularly suitable for defining control-intensive language features such as abrupt termination, exceptions, or call/cc. Using the tool one can easily experiment with language design by means of testing and exhaustive behavior exploration.

2. TECHNICAL DESCRIPTION

The K framework consists of two components: K rewriting and the K technique. Like a term rewrite system, a K-system consists of a signature for building terms and of a set of rules for iteratively rewriting terms. Like in rewriting logic, K rules can be applied concurrently and unrestricted by context. Moreover, K rules contain information about what part of the matched term is left unchanged by the rule (called the read-only part), similar to interfaces in graph rewriting. Besides offering a more compact notation for the rewrite rules, identifying the read-only part can also potentially enhance the concurrency: now two overlapping rules can be applied in parallel if they only overlap on their read-only part, similar to the concept of parallel independence in graph rewriting. However, if one is not interested in the degree of concurrency allowed by a K definition, one can safely ignore the information regarding the read-only part, and view K rules as an alternative notation for rewrite rules. Our implementation takes this approach, to benefit from the existing infrastructure and analysis tools provided by the Maude rewrite engine. A rewriting formalism, be it rewriting logic or K rewriting, can be very general and flexible, but it does not tell how one can define a programming language or a calculus. In particular, even though the underlying framework might offer support for concurrency, a bad definition may partially or totally inhibit the framework’s concurrency potential. The K technique proposes an approach and supporting notation to make the use of K rewriting, or even rewriting in general, convenient when formally defining programming languages and calculi.

3. USE CASES

K definitions are written in machine-readable ASCII, which the K tool accepts as input. For execution and analysis purposes, the definitions are translated into Maude rewrite theories. For visualization and documentation purposes, definitions are typeset into their LaTeX mathematical representation. The K tool provides modules for grouping language features. A module is defined by the syntax. Once the K definition of a language was written in the K tool and compiled successfully (using the kompile command), the krun command can be used to execute/interpret programs written in the defined language.

4. INFORMATION FOR INVESTORS

We presented the K semantic framework, consisting of a general-purpose concurrent rewriting approach together with a definitional technique specialized for concurrent programming languages or systems. We hope that we presented compelling arguments that K brings together the advantages of the existing language definitional frameworks and avoids some of their limitations. Although introduced relatively recently, K has already generated a consistent body of research projects and publications. Even from its incipient stages, K aimed at scalability: to define and analyze real life programming languages.
Automatic Visual Annotation Services

1. OBJECTIVES

The objective of the Automatic Visual Annotation Services is to provide a tool for semantic annotation of general images or video data. The services identify and annotate the image content using: context recognition, concept recognition, face detection, macro/close-up detection and text detection. The web services have a simple interface and can be used efficiently in the semantic web.

2. TECHNICAL DESCRIPTION

The Automatic Visual Annotation Services were developed in the context of the INSEMTIVES FP7 project as a tool for providing automatically extracted semantic annotations for images and video.

Image annotation task

The first step consists of basic image properties extraction (e.g. size, dominant colour) and EXIF data extraction (aperture, exposure, GPS coordinates are also provided). The quality of the image is checked in order to reject bad quality images.

The image context is recognized using a two level classification. First the image is classified as indoor or outdoor, and then it is classified further as an indoor sub-context (e.g. bedroom, kitchen, office) or outdoor sub-context (e.g. urban, forest, coast). An improved Bag of Words (BoW) type approach, outperforming the state of the art methods, was used for image annotation. For the recognition of macro or close-up images a novel matching technique based on SIFT features and compactness is used. Face detection was used in order to recognize group photos or portraits. An extension was proposed for the classical Viola-Jones face detector, resulting in a significant improvement in detection precision. Text detection methods are also included.

The average image annotation time is of 3 second. The image annotation is extended to video annotation by annotating individual key frames of video shots.

Annotation web service

The annotation of images is available as web service. The URL address of an image has to be provided as input and the annotation result is returned in JSON format. For more efficient use in the semantic web, a web service is available that returns annotation in RDF format. DBpedia concepts are used as annotation and ontology was created for specifying the relations.

A demonstrator is available at http://insemtives.utcluj.ro (user: demo; password: demo1234).

3. USE CASES

The main use case of the annotation services is Content Based Image Retrieval (CBIR). The services can be used to annotate semantically large image databases. This way it is possible to do complex image queries (e.g. request outdoor images with at least 4 people).

4. INFORMATION FOR INVESTORS

The annotation services can be easily extended to recognize new types of image contents and image concepts. This way the services can be adapted to various application domains (e.g. medical images, traffic images, management of large collections of pictures and movies).
1. OBJECTIVES
The aim of the project is to build an intelligent self-driven vehicle capable of navigating a marked road with different elements such as: bumps, hills, crossroads, winding or serpentine road, as fast as possible and without exiting the road course. This project is an excellent starting point for students to develop their embedded systems knowledge and to deal with electronics, sensors, actuators and artificial intelligence.

2. TECHNICAL DESCRIPTION
The project involved building a small scale car starting from a body kit with four wheels, a chassis, two DC motors, a servo motor, a linear camera and using a TRK-5604B platform from Freescale Semiconductor together with an H-bridge board for control and processing.

A sensitive part of the project revolved around analyzing the signal from the camera. An amplifier was used to improve the signal for an easier/safer acquisition. The signal was translated in a more intuitive representation containing stripes of black and white and their limits thus facilitating the identification of the black line the robot follows.

Once the position of the black line was known decisions regarding the direction for the front wheels and the differential on the traction wheels could be made. Based on fuzzy control, various differentials were implemented and tested to get a better response at variable speed levels and curve difficulties. At average speeds this proved to be sufficient, but as the base velocity increased and the robot accelerated the behaviour of the car on the track degraded. This pointed out the necessity of better controlling the speed of the car in curves.

Hall sensors were used to determine the speed of both traction wheels. This implied a realistic approach towards making tight turns without going off course. A braking mechanism was used to limit the speed when encountering curves at high speed.

A serial communication was used for debugging and for a better understanding of what the robot “sees” and the decision it makes on the track.

3. USE CASES
One important application of this project is automotive. Given a marked road, a camera can be used to identify the markings and signal the driver if he is going off road and even return the car to safety in case the driver has fallen asleep.

Other applications include industrial robots required to move things around along an assembly line or a variable path. Smaller versions can be used to navigate tight spaces like air vents or pipes and to measure temperature, humidity, chemical substance concentration or other environment parameters.

4. INFORMATION FOR INVESTORS
This is an easy to implement solution, cross-platform and with numerous applications, that requires a small development/deployment team. It can also be a start-up project for inexperienced people/students to get familiar with real time systems, intelligent agents and embedded products in order to expend their horizon before addressing a larger project.
Developing An Intelligent Manufacturing Architecture Under The Holonic Concept

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1. OBJECTIVES
The project goal is to develop a new architecture for manufacturing systems, which must provide the features requested by the present markets: flexibility, adaptability and agility, both in terms of operation and implementation/reconfiguration. The control structure should be accompanied by a methodology enabling the analysis and validation of the resulted scheme. Thus, the project output is addressed to those involved in designing and deploying manufacturing control systems.

2. TECHNICAL DESCRIPTION
The proposed solution mainly exploits the holon and holarchy concepts of intelligent control architectures and the BDI reasoning mechanism used in agent-based structures. Conceptually, a holon is an autonomous, independent entity operating according to its environment, but at the same time, it is a part of another entity, in a larger context that takes into account the manufacturing process evolution. In our approach, a holon contains two main parts: a deliberative component based on the BDI architecture and a structural component. The last one is the actuator part, being a proper physical device (e.g. a robot) or an aggregated group of holons, resulted from a planning process for a manufacturing goal. This is a hierarchical structure temporally formed, namely a holarchy (see figure). The main points that control the holarchy formation are: a planning process conducted in the plan space, the negotiation between several holons according to an adapted form of the contract net protocol and a proper application of the BDI approach for holonic agents. Each component of the control scheme gets a model, conceived as a coloured Petri net (CPN).

Thus, the complex model of the entire solution was obtained as a hierarchical CPN, being close to a prototype solution of the desired control application. This allows an analysis of several important characteristics: the absence of deadlocks, the results provided for each manufacturing goal, the consistency of holonic agents’ beliefsets. The original aspects of this project consist in the way the already mentioned concepts are integrated and the provided guiding elements for all the phases of the manufacturing control scheme carrying out, from design until final validation. The solution is to be tested in a laboratory with real industrial devices (robots, storage devices, a machine tool, a computer vision system and a conveyor), the holons being constructed under the JAC intelligent agents platform.

3. USE CASES
The resulted prototype can be applied in manufacturing scenarios that involve assembly and palletize goals, by using the above mentioned equipment. As shown in the figure, more types of holons contribute in getting a solution. The resource holons are devoted to the physical manufacturing elements (e.g. the robots), the product holons contain the knowledge about processing a specific product (e.g. an assembled object) and the order holons manage the manufacturing commands (e.g. a set of products to be obtained). Because these holons possess partial knowledge on the environment, the staff holons are introduced and endowed with global information. Thus, the trade off between distributed and hierarchical solutions is obtained, even for cases that imply the cooperation of several holons.

4. INFORMATION FOR INVESTORS
The holonic approach potential is high, due to the advantages it brings about (one example: the changes requested by new products or the introduction of new equipment become easy to handle). Nevertheless, there is a gap between the theoretical issues on intelligent control and its real application. Our project reduces this inconsistency. Through the proposed formalism covering all the phases (design, analysis/validation and implementation), a manufacturing environment becomes similar with a “Lego” game: various devices and procedures turn into easy to be coupled holons. An investor can help us in completing our holonic modules and in making the final tests.

The holarchy formation for a manufacturing scenario
The main goal of the METANET4U project is to collect language resources for seven European languages and distribute them using a platform called METASHARE. The contributed resources can have many forms, from annotated corpora to complex processing systems and from open-source tools to pay-per-use web services. As part of METANET4U, work has been carried out on the WPS Workpackage, whose main goal is to show if and how processing tools originating in various sources and usable for various languages can be combined to build complex processing workflows using the U-Compare linguistic workflow management system.

As part of UAIC’s contribution to METANET4U (and the WPS Workpackage), we selected 18 processing tools developed at UAIC to be contributed to METASHARE (14 of which will be integrated in UIMA and U-Compare). The benefits for the Romanian language are most of all of visibility, the large set of language processing components contributed by the Romanian partners (second largest in METANET4U, after English) proves again that Romanian is on the leading edge of NLP development.

### 2. TECHNICAL DESCRIPTION

The first stage involving UAIC required us to select tools we can contribute to METASHARE. We selected 18 processing tools developed at UAIC (and all available for free, either as open source or web service). Of them, 14 were selected for integration in UIMA and U-Compare. We kept the tools relevant in multilingual contexts, performing tasks relevant for other languages if the required resources are provided. The Table shows the 14 UAIC tools to be integrated, together with the selected U-Compare Type System input and output format.

#### 3. USE CASES

The benefits of collecting NLP resources from multiple developers and many languages and showing how they can be combined and compared is significant, both for application developers and the uninformed user of NLP techniques. The developer benefits knowledge of other similar tools, independent comparison of the results and guaranteed compatibility with relevant other components. The uninformed user can select available workflows without knowing their internal architecture, and can be assured that the components selected are compatible and working with the efficiency provided by the UIMA integration.

<table>
<thead>
<tr>
<th>Tool name</th>
<th>Input</th>
<th>Output</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splitter</td>
<td>org.u_compare.shared.document.Text</td>
<td>org.u_compare.shared.document.segment (new type added by UAIC)</td>
<td>Splits to discourse units</td>
</tr>
<tr>
<td>Tokenizer</td>
<td>org.u_compare.shared.document.Text</td>
<td>org.u_compare.shared.syntactic.token</td>
<td></td>
</tr>
<tr>
<td>Lemmatizer</td>
<td>org.u_compare.shared.syntactic.POSToken</td>
<td>org.u_compare.shared.syntactic.RichToken</td>
<td>Two versions with different input types</td>
</tr>
<tr>
<td>POS-splitter</td>
<td>org.u_compare.shared.syntactic.POSToken</td>
<td>org.u_compare.shared.syntactic.Dependency</td>
<td></td>
</tr>
<tr>
<td>RARE</td>
<td>org.u_compare.shared.syntactic.Chunk</td>
<td>org.u_compare.shared.semanticCoreference Annotation</td>
<td>Performs anaphora resolution</td>
</tr>
<tr>
<td>Discourse Parser</td>
<td>org.u_compare.shared.syntactic.Conference Annotation</td>
<td>org.u_compare.shared.syntactic.Conference Annotation</td>
<td>Performs semantic role labelling</td>
</tr>
<tr>
<td>NER</td>
<td>org.u_compare.shared.syntactic.RichToken</td>
<td>org.u_compare.shared.semantic.SemanticClassAnnotation</td>
<td>Builds an ontology from keywords and definitions</td>
</tr>
<tr>
<td>Ontology Builder</td>
<td>org.u_compare.shared.syntactic.RichToken</td>
<td>org.u_compare.shared.semantic.Ontology (new type added by UAIC)</td>
<td>Output is a different UIMA view of the same document</td>
</tr>
<tr>
<td>QA</td>
<td>org.u_compare.shared.document.Text</td>
<td>org.u_compare.shared.document.Text</td>
<td>Outputs QAs to the input questions</td>
</tr>
<tr>
<td>TE</td>
<td>org.u_compare.shared.document.Text</td>
<td>org.u_compare.shared.document.Text</td>
<td>Checks entailment between two input fragments</td>
</tr>
<tr>
<td>Document Finder</td>
<td>Any</td>
<td>org.u_compare.shared.document.Category (new type added by UAIC)</td>
<td>Keeps original format</td>
</tr>
<tr>
<td>Categorizer</td>
<td>org.u_compare.shared.document.Text</td>
<td>org.u_compare.shared.document.Category (new type added by UAIC)</td>
<td>Finds occurrences of an annotation pattern</td>
</tr>
</tbody>
</table>

Romanian resources in U-Compare

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**Romanian Language Processing Chains in U-Compare**

Ionut Cristian PISTOL

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Integrated System for Remote Monitoring of Physiologic Vital Parameters

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1. OBJECTIVES

The proposed system is able to measure and transmit to a central monitoring station the following patient’s vital parameters: blood oxygen saturation level (SpO2) and heart rate (HR). The system can be used for long-time continuous patient monitoring, as medical assistance of a chronic condition, as part of a diagnostic procedure, or recovery from an acute event.

Monitoring patient’s SpO2 and HR within hospital or his home requires the use of sensors attached by wires to the medical devices, which limits the patient’s activity. As an alternative, wireless devices are suitable for remote patient monitoring, giving him the freedom of movement.

2. TECHNICAL DESCRIPTION

A conceptual view of the proposed system (depicted in the Figure) consists of the following components: a wireless sensor network (WSN) used to measure SpO2 and HR from the patient, each sensor node has a wireless pulse oximeter attached on the patient, several repeater nodes distributed in WSN at fixed location, their number and density depending by the coverage requirements, and a central monitoring station running a patient monitor application that receives SpO2 and HR from WSN, displays them as temporal waveforms, and activates the alarms when these values exceed the preset limits.

The wireless pulse oximeter contains a commercially available Micro Power Oximeter Board from Smiths Medical connected to an eZ430RF2500 RF module from Texas Instruments. The Oximeter is used to collect the SpO2 and HR from the patient and has the following specifications: measurement range of 0–99% SpO2 with ±2% accuracy for 70–99% SpO2, and pulse rate measurement range of 30–254bpm with ±2bpm or ±2% accuracy.

A user-friendly Graphical User Interface (GUI) was developed for the patient monitor application, to display the received measurements and alarms from monitored patients. The GUI running on the central monitoring station displays the temporal waveform of SpO2, HR, Plethysmographic signal, and the status of wireless pulse oximeter (the battery voltage and distance from the nearby RE or AP – measured by using the power present in the received radio signal (RSSI)).

The physiological conditions that may cause alerts are: low SpO2 if SpO2<93%, bradycardia if HR<60bpm, tachycardia if HR>150bpm, HR arrhythmia if ΔHR/HR over last 5 min>20%, low battery voltage if VBAT<1.9V, or low value for RSSI if measured RSSI<30%.

3. USE CASES

Millions of people around world suffer from chronic diseases, and many of them could benefit from constant monitoring of their vital signs, even they are at home. The elderly people may also be monitored within their home, as an alternative to medical supervision in hospitals. A new concept in healthcare, aimed to providing continuous remote monitoring of user vital signs, is emerging. Integrated System for Remote Monitoring of Physiologic Vital Parameters increases efficiency of the emergency services, helping to save lives of critical ill patients. Our system allows doctors and patients to keep their health records for a long period of time. These are some of the reasons for our system to move from an expensive way of monitoring patients to a reality.
Adaptive Car Embedded System
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1. OBJECTIVES
We wanted to develop a "smart car" that can follow a track without human intervention and track foresight. The car was built to participate in the European finals of "The Freescale Cup: Intelligent Car Racing 2012".

2. TECHNICAL DESCRIPTION
The MicroC OS II operating system was used to drive the logic of our car. Because this O.S. was not supported by the MPC5604B processor, we decided on porting it. Configuration Drivers had to be written for the peripherals we used (USART, ADC, PIT, EMIOS, ST, etc.).
Several circuits have been added to the original development kit in order to adjust to various necessities. With an amplifier we shortened the camera acquisition time. Optical sensors were used to detect the car speed. An accelerometer was used to detect slopes.
Data acquired from the linear camera is corrected with several types of software filters in order to remove noise and add a degree of adaptability to various lighting conditions. Line detection is based on a conditional algorithm, while the car position is controlled by a simple closed loop feedback regulator.
Forward speed is determined by two DC motors. We use this at turns to control the wheel speeds in a differential manner and even make them turn in different directions when sharp turns are detected. Basically the speed of the motors is described by a 3rd degree polynomial with a negative lower limit.
Additional software was written for Matlab in order to make our work easier. With it we had live information about camera data, car status (voltage, motors, servo) and the status of the control algorithm. This information was used later on to test the algorithm offline, without the need of starting the car.

3. USE CASES
Computer aided steering
From the moment a driver sees an obstacle to the car stopping is a long way...
A car with a speed of 60Km/h travels about 16 meters while the driver reacts to the obstacle and another 16 for the actual stopping. Average human time reaction is roughly 1 second. A computer might help. A computer could react, given the proper "brain" and "power" in less than 1 millisecond or in less than 1 meter.

4. INFORMATION FOR INVESTORS
Be the first to invest in the future of transportation! Self driving cars can take you anywhere faster and safer. You just sit back and relax! By using video cameras and different sensors they can handle even the busiest streets. No needs for infrastructure changes or heavy maintenance. We bring the brains you bring the resources.
Automatic Morphologic Classification System for Romanian

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1. OBJECTIVES
This project consists of a system which analyses Romanian text from a morpho-
logical point of view. The system establishes for each word of a given Romanian text,
its part of speech including its morphological features (gender, number, tense etc.).
What is the usability of such a system? A large amount of the efforts driven in the
natural language processing are aimed towards extracting structure out of text (which
is by default interpreted as sequence of de characters and nothing more). Such a
structure can be used to conduct various automatic analyses on the text. Morpho-
logic classification represents a first component of a processing chain which extracts
such structure.

2. TECHNICAL DESCRIPTION
Morphologic classification might seem a trivial task, a simple high school exercise,
yet the problem of automatic morphologic classification is a complex task. Access
to a morphologic dictionary is not enough, because ambiguity is quite high. In fact,
in Romanian, approximately 50% of the words, when placed in different contexts,
can have different parts of speech or morphologic features. Even more, summing
up all the recognized parts of speech, in combination with all the values which their
morphological features can take, a total of 406 possible classifications are
obtained.
The process of part of speech tagging is a statistic guessing. No mor-
phological classifier is 100% accurate. The presented system has a preci-
sion of 97.05%. It works based on a statistic model which was trained on
manually annotated text. Even more, rules can be written to alter the classi-
fying manner with the aim to improve it and adapt it to a particular text type (medical,
political etc.).

3. USE CASES
As a standalone tool, the morphological classifier probably doesn’t present much
interest to the common user. Its main utility consists in the integration within vari-
ous processing chains. Almost any automatic text analysis tool uses a morphologic
classifier as one of its first components. Below is an enumeration of natural language
processing applications and projects which present potential investor interest and
which could never work without such a part of speech tagger:

• question answering systems;
• automatic summarization;
• automatic opinion extraction (from blogs and forums);
• machine translation;
• extraction from the internet (mainly from the blogosphere) of sentiments
related to certain personalities, products, cities etc. (sentimatrix);
• automatic extraction of the genealogic tree of the characters in a novel;
• show a map of the places in which the action takes place, in a novel.

4. REFERENCES
The usage of FPGA technology in embedded systems design

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1. OBJECTIVES
The system (named HILS – Hardware In the Loop System) is designed to ease the development process (mainly the test and validation phases) of complex real-time embedded systems. It has three main modules: a logic analyser, a stimulus generator and a processing core which makes a link between the first two modules. The logic analyser module provides a number of probes to collect the digital signals from the system under test (or target device), and the stimulus generator module provides a response using a highly configurable logic.

2. TECHNICAL DESCRIPTION
The main purpose of this device is to reproduce the environmental states in which the target system is meant to be placed, including exceptional events. In order to achieve this feature, the HILS can follow a specific test case defined by the user through rules and equations.
For HILS project implementation a FPGA (Field Programmable Gate Array) platform is used. This choice is based on the following arguments:
- it allows a high degree of parallelism in the implementation; this feature is needed in order to assure independent functional modules: analyser, stimulus generator and processing core;
- it enables customization: embedded microcontroller with custom peripherals modules (SPI, PWM, DMA);
- it allows a high degree of flexibility: may choose an appropriate computing architecture;
- it is a modern design approach.
There are three operating modes for this platform: simple analyser mode, analyser and stimulus generator mode, and hardware in the loop mode. In simple analyser mode the device works as an instrument which displays signals in a digital circuit. Data is captured through several probes connected to the target circuit, with a specific sampling rate, and stored into a buffer. In analyser and stimulus generator mode of operation the device works as a simple analyser, like in the previous description, but also as a stimulus generator. Essentially, the device under test gets its inputs from the platform and its output signal will be connected and monitored with the same instrument.

3. USE CASES
The system was used in validating the operation of a line follower vehicle. This vehicle uses a camera for line detection and a servo-motor for the steering mechanism. To ease the development of this project we used the HILS device. A specific PC application allows easily generation of various camera images. These images are sent to HILS where the stimulus generator module reproduces them as an analogic signal. This signal is interpreted by the application from the car as an image from the camera and the steering response is read back by HILS through logic analyser module and sent to the PC application for the user to evaluate.

4. INFORMATION FOR INVESTORS
The FPGA technology is very well fitted for this kind of design challenges: measurement and stimulus generation devices. There is a constant interest for the usage of this technology and also there is a good level of know-how. An automated method for validating the operation and implementation of embedded real-time systems is of great interest for automotive industry (for example). A commercially viable prototype of this proposed product may be built with approximately 3 man-year works.
Efficient Use of HPC Resources Provided by a Supercomputer Based on CBEA Processors

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1. OBJECTIVES

“Ștefan cel Mare” University of Suceava has completed the computing capacity from HPC laboratory with a cluster, within the GRID-NORD project of the IInd National Plan, the Capacities Programme. The cluster, named USV-RoadRunner, was manufactured by IBM and has the same architecture as the RoadRunner cluster of the National Los Alamos Laboratory in New Mexico, USA. The main objective of this project is represented by increasing the use of computing resources of the high-performance computing laboratory at the “Ștefan cel Mare” University.

2. TECHNICAL DESCRIPTION

The cluster purchased by USV was built of PowerXCell 8i processors (which contains a PowerPC processor named PPE, and eight acceleration cores named SPE). After installing this supercomputer, the performance tests were accomplished in the same conditions used as for the homologation in www.top500.org (with HPL – High Performance Linpack). The result achieved (after the optimization of the input parameters of HPL test) was 6.53TFlops (the theoretical peak performance is 9.83TFlops).

The parallelization of algorithms for this system is performed on two levels. On the first level of parallelization, the distribution of computing tasks to compute nodes is performed using MPI standard. The second level occurs on each PowerXCell 8i processor, through the distribution of computing tasks to SPE cores (eight acceleration cores on each processor). This section presents the results obtained by running a variant of the hierarchical ascendant classification algorithm which has been optimized for the supercomputer with Roadrunner architecture (based on PowerXCell 8i processors). The total execution times and communication times for the case in which we use only PPE cores from the PowerXCell 8i processors are presented in Figure 2. The total execution times for the case in which we use all eight SPE cores from each PowerXCell 8i processor are presented in Figure 3. It can be noticed that the running time for the case in which all eight SPE are used is much smaller than in the case in which only PPE cores are used.

3. USE CASES

The supercomputer can be used for complex applications in pattern recognition and artificial intelligence, stochastic processes, simulation and modelling using the Monte Carlo method (e.g. simulation of molecular dynamics, simulation of transport photons).

4. INFORMATION FOR INVESTORS

We can provide the following services: complex computing for applications related to pattern recognition and artificial intelligence, a highly complex computing environment to solve acute problems concerning environment and natural resources, as well as resources for simulation of complex stochastic systems.

Figure 1. The USV-RoadRunner supercomputer

Figure 2. The total execution times and communication times (only PPE cores)

Figure 3. The total execution times and communication times (all 8 SPE cores)