



Software Technology

Eindhoven University of Technology

PEng projects 2010



3TU.School for Technological Design,
Stan Ackermans Institute offers eleven
two-year postgraduate technological designer
programmes. This institute is a joint initiative
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Netherlands: Delft University of Technology,
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University of Twente. For more information
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Prof.dr. J.J. Lukkien

Methods and Tools

The group of Software Technology PDEng candidates graduating in 2010 is an unusually small group. Two years ago it was apparently difficult to attract students for the programme as the market was pulling strongly. Fortunately, a better balance has been reached since then; currently, we have two full year-groups. At the time of writing there are no indications that the programme might get hurt by the economic slowdown.

In the period January through September 2010 our candidates have done their final projects, which turned out, as always, to be a very interesting and diverse collection of undertakings. Though diverse, all projects have in common that there is a real design challenge that requires skill and training and that the result is relevant and needed by the organization hosting the project.

This year's collection of projects may be characterized by 'methods and tools'. Many projects aim at supporting a professional in her work, be it a medical specialist, a system or a software engineer, a physicist or a laboratory worker. Making processes and structures visible in an understandable way such that a professional can work more efficiently was a key element. In addition, there are also projects aiming at creating a product or the architecture thereof.

All projects are typical for our programme and I am proud of the results as shown in this booklet. They serve as an advertisement for our programme. I wish our candidates all the best and a successful career.

Johan Lukkien
Scientific Director

The Software Technology PDEng (Professional Doctorate in Engineering) degree programme is an accredited and challenging two-year doctorate-level engineering degree programme. During this programme trainees focus on strengthening their technical and non-technical competencies related to the effective and efficient design and development of software for resource-constrained software-intensive systems, such as real-time embedded systems, in an industrial setting. During the programme our PDEng trainees focus on systems architecting

and designing software for software-intensive systems in multiple application domains for the High Tech Industry.

The programme is provided by the Department of Mathematics and Computer Science of Eindhoven University of Technology in the context of the 3TU.School for Technological Design, Stan Ackermans Institute.

For more information, visit the website at www.3tu.nl/sai/st.



Challenges

Provide insight into the requirements and feasibility aspects of an IP-to-Zigbee bridge (IP Bridge) that is both low cost and easy to use. Define the hardware and software architecture of the IP Bridge based on the application-gateway approach and work out the installation use cases and related interfaces, for the entire end-to-end system.

Results

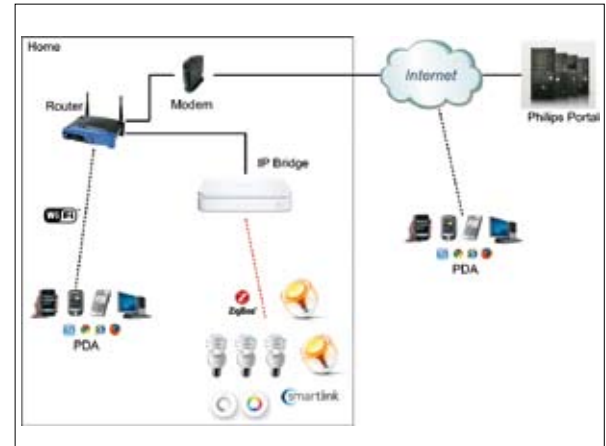
An analysis showed the SW/HW platform choices and alternative solutions for the IP Bridge's service discovery and remote control functions. The system that consists of the IP Bridge and a Portal prototype was designed and implemented together with measurements on command rates and response times. The system enables the users to set up the IP Bridge easily and to control lights locally or remotely through web applications on their smartphones. The IP Bridge also provides a basic API that allows developing lighting controlled applications in the IP domain.

Benefits

The developed prototype is low-cost and easy to set up and hence shows the high chances of success of an actual product for new lighting applications in the IP domain. The project enabled the group to gain valuable knowledge of HW/SW platform choices, as well as technical solutions for installation, remote control, and software upgrade. The results were also adopted in a project of developing an actual product.

The Vinh Bui

IP-to-Zigbee Bridge for Home Lighting Applications



“Vinh has addressed every one of the ambitious goals we set and has excelled at it. The results can seamlessly be adopted in the trail project to move forward with the next step towards an actual product.”

*Dr.ir. E.D.L.M. Frimout
Philips Lighting*

Philips Lighting develops a number of radio frequency controlled lighting products, both for the office and home domains. Inter-operability among these devices is achieved through a standard based upon Zigbee Pro. For example, a Smartlink network consists of lights and remote controllers, where remote controllers are used to change the appearance of lights.

IP-to-Zigbee Bridge from controlled lighting systems to the IP domain

Besides the integrated control use cases developed by Philips, a large diversity of use cases have been identified that require opening up the lighting control system to devices outside the control domain. An IP-to-Zigbee bridge from the lighting system to the IP domain can provide such an open interface and can enable a wide scale of “long-tail” use cases. Such the IP-to-Zigbee bridge can however only be adopted by the users on a broad scale if it is both low cost and easy to use, both in the Zigbee domain and in the IP domain.

To achieve the goal of developing the IP-to-Zigbee bridge product, an IP Bridge prototype based on the application-gateway approach was designed and implemented. Two access levels for bridging: an API, which mainly translates the protocol and allows integration in arbitrary networked environments, and an HTTP interface that gives access to an embedded web application for direct control and configuration purposes were defined. In order to guarantee the requirements of low cost and future extensibility, investigations and choices of the HW/SW platform were made. In addition, several technical solutions for the use cases like installation, service discovery, software upgrade, and remote control via a Portal had feasibility analyzed and were implemented. The realization of the IP Bridge and Portal design was successfully shown together with measurements on command rate and response times.

The project provided valuable insight into selecting, setting up and developing of the IP Bridge and the Portal. The results can seamlessly be adopted in the development project to move towards an actual product.

Challenges

The ROSE project aims at building commercial personal robots. The ROSE project is at an early stage, a lot of critical design decisions are left to be made. Analyzing short and long term requirements, a vision system was defined. This vision system would help the robot navigating and interacting with objects in a daily human environment.

Results

Through a survey of existing robotic software solutions ROS (Robot Operating System) was chosen. Two sensors were also selected: a stereo camera and a laser range finder. This software solution and these sensors made it possible to quickly design and implement demonstrators that showed the feasibility of the above challenges.

Benefits

It is now easier for the ROSE project to implement the domestic tasks described in the use cases. As more features are added to ROS, the project can integrate these into the robot, speeding up development even more.





Challenges

The project can be characterized by two challenges. One challenge was getting familiar with the vast clinical domain, especially with the pathology of breast cancer. From technology point of view DICOM structured reporting represented a major challenge.

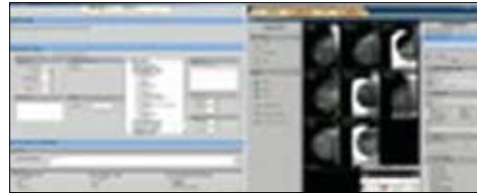
Results

A breast cancer reviewing workstation was extended with a plug-in that gathers the input from the pathologist, facilitates the consensus between the radiologist and pathologist and contributes in the next step of the treatment plan.

Benefits

A prototype was built, creating insight in the user requirements, including how to represent a complete histological classification of breast cancer. The project demonstrated how to extend the workstation with plug-ins.

Paul-Robert Marcu



Mini Tumor Board plug-in for a breast cancer reviewing workstation

"Paul-Robert did not only solve the technical problems but also got to understand the clinical domain, which he demonstrated in review sessions with clinicians."

Dr.ir. J. Buurman
Philips Healthcare

Globally, breast cancer is one of the leading causes of cancer related death among women. Seventy-eight percent of all women – one in eight women – will get breast cancer in their life. In the treatment of breast cancer, there are various moments where a decision is made about the diagnosis or treatment of the patient. Increasingly, the responsible physician no longer makes these decisions in isolation. Rather, a multidisciplinary team is consulted.

Mini Tumor Board (MTB)

Such a team is the Mini Tumor Board. The Mini Tumor Board could consist of a radiologist, a surgeon, a pathologist and a nurse practitioner. A breast cancer reviewing workstation is a collection of applications that supports MTBs by facilitating the review and diagnosis of cases at a single work spot. Currently the workstation is used mainly by radiologists. As the workstation is being used in the multidisciplinary MTB meetings where pathologists are also present, the integration of pathology data with the workstation improves the diagnostic process by facilitating the communication across disciplines and reviewing the reports of older cases.

For this scope the workstation was extended with a prototype MTB plug-in. The role of this plug-in is to gather the input from the pathologist, to facilitate the consensus between the radiologist and pathologist and to contribute in the next step of the treatment plan.



Challenges

The first challenge was to learn the new fields of cardiovascular disease, quantitative flow magnetic resonance imaging, and flow visualization. The biggest challenge, however, was to design and implement the 4D flow application integrated with Philips' ViewForum platform, which required a detailed understanding of this complex software platform.

Results

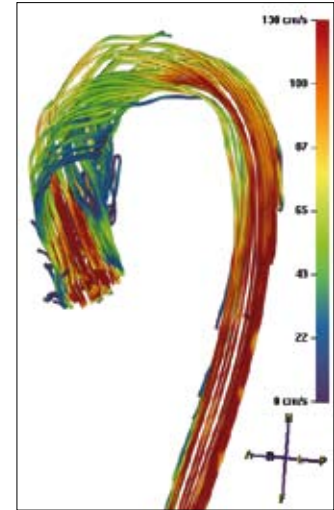
First, the 4D flow application offers a convenient means to select flow measurement locations on a 3D rendering of a vessel. It can determine flow velocity and several derived values, such as the total volume of blood flowing through a vessel per second. Second, the 4D flow application supports a number of flow visualization techniques, such as glyphs, streamlines, and mesh deformations.

Benefits

The 4D flow application assists clinical researchers in obtaining insight into the development of cardiovascular disease and developing tools and methods to diagnose and judge the disease. Compared to 2D flow imaging, 4D flow can improve clinical workflow by eliminating the slice selection step prior to scanning and improve analysis by interactive repositioning of measurements afterwards. Furthermore, it gives better insight into the dynamic 3D nature of blood flow.

Fred van Nijnatten

Four-dimensional blood flow quantification and visualization



“Fred designed and implemented a fantastic 4D QFlow visualization and quantification software prototype, that will be of great value in future evaluations of the clinical benefit of this new MRI technique!”

*Prof.dr.ir. M. Breeuwer
Philips Healthcare*

Cardiovascular disease is the leading cause of death in developed countries. Measuring the amount of blood flow in the vessels in the body is essential for diagnosing and monitoring this disease as well as for treatment planning. Magnetic Resonance Imaging provides pictures of the inside of the human body and can also measure blood flow velocity (so-called Qflow MRI). Qflow MRI creates a huge quantity of data that clinicians cannot interpret directly. To solve this problem, Philips Healthcare has initiated the 4D-Flow project. The goal of this project is to provide clinicians with flow analysis software.

Clinical demand

Atherosclerosis is the most frequent occurring cardiovascular disease. Atherosclerosis causes vessels to become narrower due to the settlement of fatty materials such as cholesterol. The diameter of the vessel is commonly used to judge the severity of atherosclerosis. A better criterion is the amount of blood flowing through the vessel. For understanding the disease better researchers ask questions like: does the change in geometry lead to change in flow patterns and will that lead to further problems? To measure blood flow and to answer these questions, the blood speed and direction is measured on a complete 3D grid of sample points for a series of consecutive time moments.

4D flow analysis application

The 4D flow analysis application extracts vessels and vessel boundaries from the measured velocities and displays the results. A clinician can then select points of interest, and the application will calculate the amount of blood that flows through the vessel at each point. With older 2D Qflow MRI techniques, a plane slicing a vessel of interest has to be specified before the scan MRI scan is made, which is a tedious task. In the 4D flow application, it is easy to select points of interest on a 3D rendering of the vessel and subsequently determine the resulting flow measurements. Additionally the Flow4D application incorporates a number of 2D, 3D, and 4D visualization techniques to reveal normal and abnormal flow patterns.



Challenges

The biggest challenge of this project has been to make changes to the existing development environment. This has removed the developers' dependency on emails for information related to the builds and test runs and has provided them an alternative view on this information, namely the software engineering dashboard.

Results

The dashboard information infrastructure that contains information related to builds and test runs has been integrated into the company's development infrastructure, and there are plans to provide other tools and systems with this information. Furthermore, the dashboard that visualizes the mentioned information has become part of the standard development environment used at the company.

Benefits

The main benefit of the dashboard application developed during this project over emailing build results and test results is the ability for developers to quickly get an overview of information related to builds and test runs. Additionally, it allows faster navigation through this information to improve problem analysis and solving.

Tim Paffen



Software Engineering Dashboard - Visualizing and connecting information

“From the start of the Software Engineering Dashboard project, Tim used direct input and feedback from the developers to maximize success. Now the dashboard is the primary access point for build control and status report of the automated software toolchain for most developers.”

*ir. M. Brunner
Océ Technologies BV*

The project has been performed at Océ Technologies B.V. At the start of the project, information related to build results and test results was relayed to developers in the form of emails. This has three drawbacks: the first is that developers received around thirty emails every morning related to the nightly builds and test runs. The second is that developers could not track the progress of the build process and the testing process. Finally, related information about build results and tests results was provided as separate emails, meaning developers had to connect that information manually. The main focus of the project was to remove these drawbacks by providing a dashboard. This product has been split into two components: the dashboard that visualizes information about builds and tests, and the dashboard information infrastructure that provides that information.

Dashboard information infrastructure

This information infrastructure has been developed to provide the dashboard with information about builds and test runs. Each information source (for example, one that provides build results) consists of a web service with a RESTful API, and storage. Inserting or retrieving information is done using HTTP requests to this web service. This creates a distributed system in which information sources are fully independent from one another, and changes can be made easily.

Dashboard visualizing build information and test information

The dashboard component is a stand-alone application that developers install on their workstations. It retrieves information from the information sources described above. In the dashboard, information related to builds and test runs are connected in a logical manner, allowing developers to track the progress of running builds and tests, and to navigate to files or tasks in the configuration management system directly from the dashboard.

Challenges

One of the main challenges was to redesign the Flightmap.nl portal in such a way to assure easier further development: make it easier to grow, adjust, improve and evolve. Flightmap.nl had to be made as dynamic as possible. Besides that, the portal should be responding fast and the system security is paramount.

Results

New three layer software design, made according to best design practices and experiences, has increased flexibility, reusability, maintainability, and reduced the code size of the Flightmap.nl portal. Implementation solutions made it work faster, stable and secure.

Benefits

Flightmap.nl is now a fully operational and commercial product. It is able to respond quickly to changes in requirements, new expectations and solution updates. It is able to be concurrent in a vast and growing area of software solutions. Flightmap.nl is ready to face the cruel corporate world of tomorrow.



Igor Perovic



Flightmap.nl future-proof architecture

“After a successful first release of Flightmap 1.0 in January 2010, a step change in scalability and security was needed. Igor has successfully investigated and defined the required changes as well as designed, implemented, and tested them.”

Ir. J. Goorden
BICORE

In the big business world of today, one of the most important instruments of corporate management is project portfolio management. Companies with a large number of projects need a way to keep an eye on what is happening in their backyard. They need to carefully estimate, plan and adjust the projects in their portfolio not only to keep a close look of what is currently going on in their business, but also to select and approve the future projects. In order to achieve the optimal return on investments and to later steer those projects in a best possible way.

Flightmap.nl

BICORE's Flightmap.nl is a web portal with the main purpose to provide an on-line tool for efficient project portfolio management. The portal provides to users a clear overview of the projects in their portfolio. Users can use various views to analyze and compare their projects regarding many parameters, such as the risk, the stage the project is in, value of the projects and many more.

Futureproof architecture

Flightmap.nl structure and content is specified with the user and it is based on the needs of concrete user – company. During this project, with a help of best design practices and a great deal of new solutions, it has been made completely dynamical and flexible. It can be easily modified and adjusted to meet the changes in requirements or to embrace a new user. It is now faster, more efficient, secure and robust. Currently, a company can get its own specialized and customized project portfolio management tool, in a short time. Flightmap.nl is ready to face the cruel corporate world of tomorrow.

Challenges

Design a software bridge to couple different testing frameworks in order to perform automated interactions tests on Controller and Embedded software components in PC environment and on real printer machine (engine). Controller and Embedded software teams have different approaches towards testing. Arriving at a testing architecture that would satisfy the needs of both teams in order to keep the testing productive was one of the key challenges.

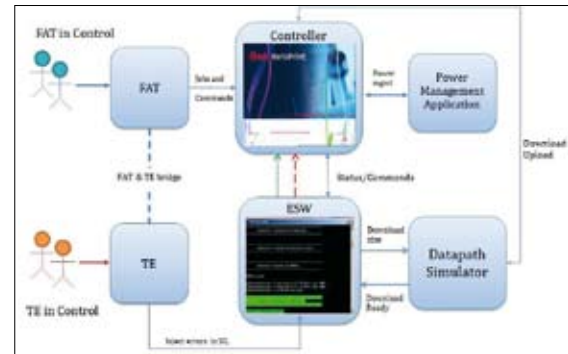
Results

The analysis showed that, the interaction between the Controller and Embedded software was feasible in PC environment. To automate interaction tests, the existing frameworks used for testing Controller and Embedded software were investigated and were bridged together. The bridged framework provided two architectural choices for testing. A decision was made to go ahead with both the choices based on usage and approach towards testing. The bridged framework was designed in a way that there is loose coupling between different automated testing frameworks. This was necessary to keep the impact of the framework crashes on the software components as minimum as possible and easy for extending and faster implementation.

Benefits

Presented bridged framework enables users discovering initial set of bugs by doing automated interaction tests in the early phase. This helps making the software components more reliable and efficient before deploying on an engine. The same framework can be used to run semi-automated tests on an engine. Semi-automated (placing papers in the tray requires manual interaction) tests will allow to perform exploratory tests, repeat tests, get consistent results. To keep the testing productive the bridged solution allows the users to write and execute scripts in the framework they are familiar with, thereby reducing the learning curve. These factors will improve the testing process and enable to achieve quality targets in time.





Automating functional tests on cut-sheet print engine

“Sunder has a high drive for making the correct balanced solution, satisfying all stakeholder needs. ...We saw our selves through the eyes of an unbiased person which provided valuable and unexpected insights.”

*ing. J. Janse en
ing. J.A.P. Janssen
Océ Technologies BV*

Océ develops high-end professional printers. As quality is an important factor for Océ, such printers are extensively tested during the development phase. These printers have two main software components, namely Controller software and Embedded software that interact with each other to perform printing, scanning or copying jobs. These software components are developed and tested (tested manually or using automated testing frameworks) independently in development PC by separate teams. The interaction between these software components is then tested on a real printer machine (also termed as engine).

Discovering software interaction bugs in early phase

Currently the interaction between Controller and Embedded is only verified on an engine. While doing tests on an engine, interaction bugs are found. Finding more bugs is affected by the limited availability of the engine during development phase. Furthermore the testing on an engine is labor intensive. These factors delay the testing process which may affect meeting the quality targets in time. In order to improve the testing process there is a need of a solution that would help users discovering errors in the early testing phase. The solution should also make testing on an engine less labor intensive.

Bridging frameworks

These challenges were met by bridging automated testing frameworks used to test Controller and Embedded software. From the feasibility study we learned that the interaction between Controller and Embedded software could be tested in PC environment. The bridged framework was designed in a way that it could be used to perform automated interaction tests in PC environment and also semi-automated tests on an engine. The framework provides two architectural solutions wherein users from Controller and Embedded domains can write and execute scripts in the framework they are familiar with, and yet have privilege of using Controller with Embedded software to do interaction tests which were not possible before.

Challenges

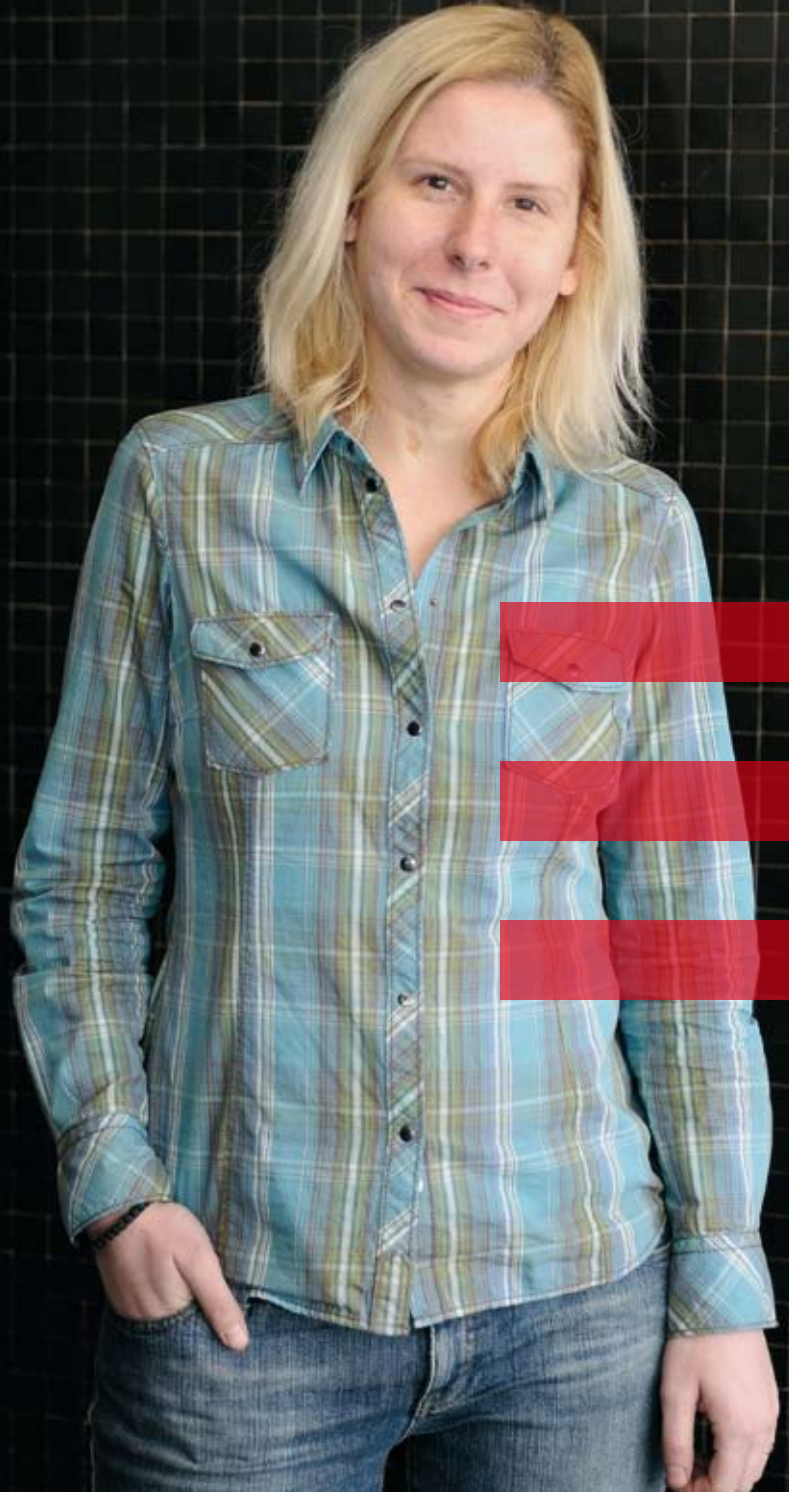
The essential difference between using the Grid and the local computing farms for analyzing physics data is in the proximity between the storage and computing resources used for this analysis, as well as their capacities, interconnections and performance characteristics. The hardware-middleware-software stack on which the LHCb analysis algorithms are built is complex and unstable because of its heterogenic and distributed nature. Achieving a robust solution in such an environment raised a challenge. Furthermore, analyzing the possible performance gains depends on many factors in the ecosystem of the LHCb analysis jobs, therefore the crucial metrics had to be carefully chosen and the feasibility tests meticulously devised for different classes of analysis jobs.

Results

The results of the feasibility study illustrate that the undertaken file staging approach is relatively insensitive to the original location of the data, and a significant gain can be achieved in terms of wall-clock times of analysis jobs, as the leading optimization criteria. An interesting result is that the presented solution also reduces the total amount of data transfer between the Grid and the local computing facility to around 60%, when compared to not using the solution in the analysis jobs at all.

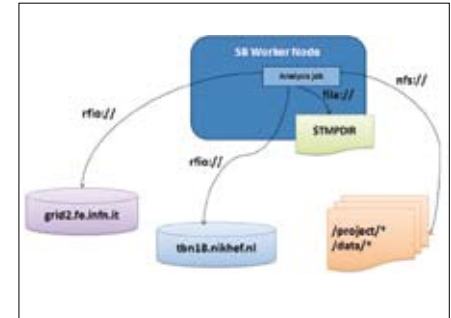
Benefits

The primary interest for a more efficient usage of the available local computing resources at NIKHEF and considerably shorter wall-clock times of the LHCb analysis jobs performed on these resources is accomplished. A negligible effort on behalf of LHCb physicists is needed to use the provided solution. The proposed design permits implementing an adaptive file staging behavior based on a set of preferred dynamic environment settings, and has the potential to scale well when adopted for usage in the LHC Grid environment.



Daniela Remenska

A File-Staging Approach to Optimizing Large Scale HEP Data Analysis



“Daniela dealt with this challenging project at much-faster-than-anticipated pace, and the result was of such quality that she was asked to come to Geneva (the home of the LHC) and present her work.”

Dr. J. Templon
NIKHEF

The LHCb physicists working at NIKHEF perform heavy physics analysis of the data collected from the Large Hadron Collider at CERN. While this analysis is mainly accomplished by submitting analysis jobs on the Grid resources, there is motivation for using the dedicated local in-house computing resources at NIKHEF as well, as a back-end for this purpose. However, this physics analysis on such a local computing facility seems inefficient for multiple reasons: the bandwidth constraints between the local and Grid resources, the protocols for access of the Grid data across the network, as well as the disk and memory space limitations of the local computing resources.

Profiling LHCb analysis jobs on a local computing farm

To investigate the main reasons behind the perceived inefficiency and identify the critical factors for achieving an improved efficiency of the local physics analysis, profiling experiments with carefully chosen metrics were devised, which showed that data access is the limiting factor in job performance on these resources, when remote access protocols (e.g. rfio, dcap) are used to access Grid-resident data. The poor CPU/runtime ratios measured indicated that the analysis jobs spend most of their time waiting on the remote Grid data to become available for processing. Furthermore, an overhead of more than 60% of the original data size is transferred through the network interface of the worker nodes. The effect is greater with non-sequential remote access, where a lot of seek operations are necessary to select certain event data.

Improving wall-clock times of the analysis on a local computing farm

To cope with the I/O bound analysis jobs, an approach of file pre-fetching based on the predictable input streams was implemented in a file stager demonstrator. Furthermore, this file staging concept was accomplished concurrently with the actual data processing, such that each subsequent file is staged at the same time that the previous file is being processed. This resulted in reduction of 20-50% (depending on the classes of jobs) in the wall-clock times of the analysis jobs, thus making them much more efficient and almost not sensitive to the physical distance of the data.



Challenges

To design and develop software that should run a process control loop, while following the CARM guidelines. Another challenge was to find out the possibility of running CARM subsystems individually which also provides separation of concerns.

Results

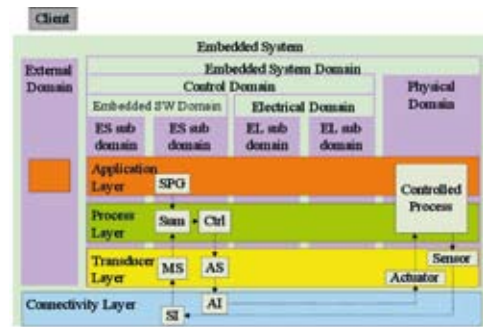
A part of CARM Light was developed as a proof-of-concept. The developed solution provides the facility to create, and execute a process control loop at a fixed frequency. The multi-threaded software allows the user to interact with the process control loop during its execution.

Benefits

The solution provides a tool to investigate the effect of various design, implementation and deployment choices with respect to the timing behavior of the platform.

Assad Saleem

CARM Light: Software for the Motion Control System



“Implementation of the system showed some particular challenges. Assad showed his professionalism and determination to solve this task at hand. Within a very limited time span, he developed a process control system...”

*Dr. W.T.M. Alberts
ASML*

ASML makes lithography machines. These machines are highly complex systems that contain mechanical, optical and electronic components. A large amount of electronics and software is used to control their dynamic behavior. ASML created a framework called CARM (Controller Architecture Reference Model) to facilitate the design of the embedded systems of these machines. CARM describes embedded systems by proposing four logical layers across various engineering domains. Each of these layers describes a different abstraction level within the engineering domain.

CARM is about designing the software for motion control systems at ASML. Mechanical engineers develop algorithms in order to design motion control systems; such an algorithm is called a “process control loop.” A process control loop calculates the output for the actuators. Actuators control the moving parts in the Lithography machine. A typical sample period consists of hardware/operating system latency, process control loop execution, and background processing. During system execution, the length of the sample period determines the frequency at which the process control loop is performed. Parallelized hardware is used to meet the high frequency demands. CARM-based subsystems use a hardware rack containing several blades, where each blade contains multiple embedded processor boards. All of the processing units work concurrently in order to meet the hard and soft real-time deadlines.

In view of the cost and complexity of this framework, the concept of CARM Light was introduced. According to this idea, the functionality of a subsystem can be deployed on less expensive hardware. This is especially beneficial for projects with a smaller budget that do not need the full complexity of a CARM-system and of sharing it with other projects. In this project, an attempt was made to develop such a lighter version of the system. Another goal of developing the CARM Light system was to investigate the real-time behavior, and whether the developed system can meet the control system’s high frequency demands.



Challenges

One of this project's main challenges was the design of a simple and extensible modeling language which nevertheless allows any realistic data path architecture to be expressed. In addition, to create a set of tools that deal with this language, each of which is to be simple and maintainable, required careful tuning of the abstract concepts involved. Finally, the large amount of stakeholders involved made some project planning non-trivial.

Results

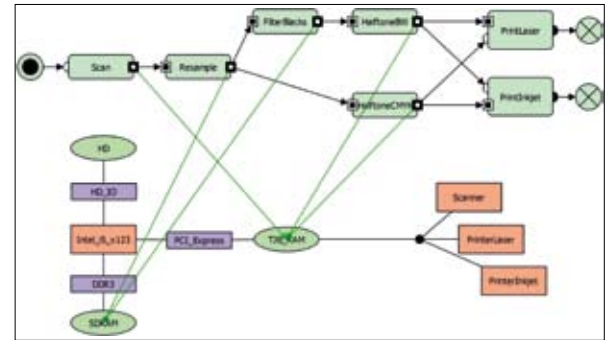
The resulting language, DPML, the Data Path Modeling Language, is simple to use, yet expressive and extensible. The associated tool chain, DPATCH, contains a custom DPML editor, as well as a set of tools that can be used to simulate DPML models. By visualizing simulation traces as Gantt-charts, architects can autonomously model, tune and analyze data path designs, front-to-back.

Benefits

Using rudimentary computation tools such as Excel sheets gives architects already some information on which architecture choices are best. With DPATCH, however, the dynamic behavior of a data path can also be analyzed, which is significantly more powerful. This way, the chance that unforeseen behavior or a changing environment requires an earlier data path design decision to be changed is significantly reduced.

Egbert Teeselink

DPATCH: A tool chain for modeling and analyzing printer data path architectures



“Egbert has created a valuable tool chain for data path modeling and analysis.

Not only was his project technically challenging, but also balancing the interests of all stakeholders was not a trivial task. It is almost needless to mention that both were carried out very well.”

*Dr. L.J.A.M. Somers
Océ Technologies BV*

Designing printer data paths

Océ is a manufacturer of high-performance multifunctional printers. An important component of such printers is the data path, which performs real-time image manipulations. Because of the large data sizes and high throughput requirements in high-performance multifunctional printers, the data path is usually implemented as a hybrid software/hardware system.

Designing the architecture of a data path is a nontrivial problem, because of the many tradeoffs involved and because it is difficult to analyze how well a design conforms to many of the important quality attributes. One quality attribute that is difficult to deduce from a data path design by hand is its throughput, typically expressed as the amount of pages that it can handle per minute. Because this is difficult to analyze by hand, it is also difficult to predict how well a data path will perform when requirements change. This limits how structured and flexible the data path design process can be.

Model-based design and analysis

In order to improve this process, a solution is needed that helps architects analyze the behavior of a model of a data path architecture, find its throughput and identify bottlenecks. The solution must be sustainable, so that support for increasingly detailed architecture models can be added and so that it can be integrated with related state-of-the-art academic results.

This challenge was met by the creation of DPATCH, for Data Path Analysis Tool CHain. This tool chain is centered around DPML, a domain-specific language for modeling data path designs. It includes a modeling environment, a transformation engine and a simulator so that architects can autonomously design, model, simulate and visualize the behavior of a data path.

Using DPATCH, architects can analyze the behavior of data path designs, which enables data path design processes to be improved.

Challenges

The goal of this project was to develop a generic training framework which allows the creation and execution of various training scenarios. One of the biggest challenges was to design and implement an execution environment for the trainings. This environment must support the execution of various trainings, which have different data and different logic, and must integrate with an augmented reality system to allow the users to perform the trainings in an augmented reality environment.

Results

The delivered framework consists of two applications, which allow the users to create and execute training scenarios. A generic format was defined for the trainings, so that variety in behavior and complexity is enabled. The functionality and the quality attributes of the framework have been proven by the creation and execution of two trainings for medical interventions.

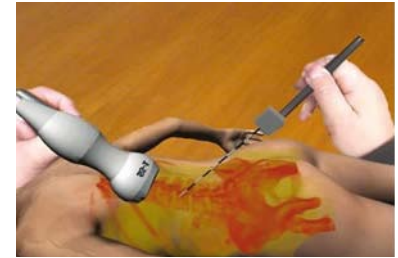
Benefits

This framework represents the starting point for building a full-fledged training solution using augmented reality, which is flexible and reliable enough to be used in a real-life situation. Virtual Proteins is now able to use the framework to create and execute training scenarios not only for medical procedures, but also for other application domains.



Ioana-Tatiana Ungureaunu

Augmented Reality to Train User Skills: Training Development and Evaluation Kit



“Tatiana’s perseverance and attention to detail have stood out in working with her.”

*Dr. B.G.B. Barenbrug
Virtual Proteins*

VP MicroLab® is a Desktop Augmented Reality System, which can be used in several domains to generate, visualize and interact with 3D models. For the medical domain, this product brings new possibilities for training and diagnostic, as it supports the generation of 3D models of real patients from CT, MRI and PET scans, and allows doctors and medical students to visualize and interact with the internals of the human body in an augmented reality environment. The goal of this project is to design and implement a generic framework which enables its users to create training scenarios and execute them in the augmented reality environment offered by VP MicroLab®.

Generic training framework

In order for a training to be effective and the student to gain skills, the learning process needs to be structured and needs to follow certain steps. The framework developed in this project allows the creation of structured training scenarios, in which the trainer defines the goal, the steps and the rules of the training, and allows the students to practice the training (medical procedure) in a safe environment, without putting the patient’s life at risk while they gain skills.

To achieve this, several activities were carried out. First, the integration of the execution environment with VP MicroLab® was investigated and designed. Second, a generic structure was created for defining trainings, which can be used to define trainings for various domains. Next, the execution environment was designed and implemented to load and execute training scenarios, and the integration with VP MicroLab® was completed. The application which allows creating new training scenarios was also designed and implemented. Finally, several trainings were created to prove the functionality of the framework.

With the outcome of this project, Virtual Proteins has the basis for creating a full fledged training solution, which can be used in healthcare, to train medical procedures, but also in other domains.

Credits

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