OAMK

An active attitude and the spirit of doing

HANDS-ON WORK AND RESULTS AT THE INFORMATION TECHNOLOGY DEPARTMENT OF OULU UAS

ePOOKI 4/2014 – THE PUBLICATIONS OF RESEARCH AND DEVELOPMENT WORK OF OULU UNIVERSITY OF APPLIED SCIENCES

Contents

Jussi Tuokkola

Foreword

Oulu UAS educates professionals for the needs of Northern Finland, whose competence corresponds to the needs and development of working life in the region. Our teaching is developed in close co-operation with working life, industry and commerce. We react quickly to the changes occurring in working life and the requirements of new competence. Companies and private individuals can benefit from the services we provide. Even though from now on, you will know us as Oulun ammattikorkeakoulu, the name change will not affect our daily operations.

At the degree programme of Information Technology we aim to develop our teaching to include more real-life project work: our curricula include increasingly more company-related projects. This way we are able to provide our students with a more realistic view of the everyday work at companies, and also improve their employment opportunities.

The purpose of this publication is to spread the word about the projects and results achieved by the students and staff of the Information Technology department. In addition to student projects, our department is also involved in many domestic and international projects well worth mentioning. Yearly, our students complete hundreds of thesis and project work. This publication also presents good examples of our successful projects. I hope that this first publication will be followed by many new editions covering not only IT, but also the accomplishments of the entire School of Engineering.

Jari-Pekka Rontu

Deputy Director

Studies are strongly oriented towards employment and aim to support students' professional growth.

Jussi Tuokkola

School of Engineering

We train professionals for demanding tasks in the service of business and the public sector. The School of Engineering awards bachelor's degrees for Bachelors of Engineering and Bachelors of Construction Management. It is also possible to study for the degree of Master of Engineering in Finnish.

Studies are strongly oriented towards employment and aim to support students' professional growth. Special attention is paid to the learning of skills that apply theory to practice. This is enabled by close co-operation with employers and provides the students with the possibility to network with the employment sector even before graduation. We have a diverse international co-operation network and offer a number of internationally-oriented degree programmes.

Oulu UAS profiles itself

1. as an expert using diversity and strong regional information and communications technology know-how,
2. as the active developer of regional innovation activities and
3. as the venue for vocational teacher training in Northern Finland.

Information technology

In the field of IT, there are two degree programmes leading to a Bachelor's degree. Optional lines of study in the degree programme are the hardware and product design and software development. The English degree programme focuses on the design and implementation of web services.

Studies in all degree programmes include close co-operation with local companies. Students in all study options complete company-oriented development projects as part of their studies. These projects are principally based on the needs of companies and often completed on the companies' premises. This also enables students to carry out their own innovative product development projects.

Development projects aim at educating the students to use the theory in practice, to understand the different parts and stages of the project work, to work in a project team and with different project tools as well as to communicate fluently with the different internal and external customer groups involved in project work.

Students doing their development projects are mainly third or fourth year students and have basic skills in languages and communication, natural sciences, computer technologies, software and hardware development, networks and business.

In information technology one focus area is future health and well-being. Within this focus area we develop user-oriented, innovative services and operating models. New services are created and applied to promote health and well-being and to develop service processes, especially with the help of skills related to well-being, information and communications technology and the culture sector. Our objective is to understand the determinants of health and well-being, and the role that public policy plays in shaping the quality of people's lives.

Eero Nousiainen
Head of ICT Department

For the companies, thesis work is a good way of testing the students and their competence.

Jussi Tuokkola

Thesis

A thesis is the final work for the students of engineering. It is a tangible proof of capability to independent work. Usually, it is done during the last year of the four-year studies. However, in some cases it can be started earlier. In any case, the work cannot be started until a majority of studies have been completed.

Generally, students complete their theses individually or as a member of a project team. These projects can be located in different kinds of companies and institutions, as well as at the school. The thesis work should have some connection to working life. Thus, most of the subjects deal with practical problems, which have been presented by the customer of the thesis.

The actual work is done in tripartite co-operation. The student is responsible for the thesis project, the schedule and project planning. The representative of the customer specifies the requirements for the work and gives support and the tools for the student. The tutoring teacher gives also support, but concentrates mostly on guiding the writing process. The actual guidance in everyday work should be arranged by the customer.

For most of our students, the thesis is a gateway to the working life. This is why we prefer that the theses are done in real environments, such as IT companies. For the companies, thesis work is a good way of testing the students and their competence. Many students have continued working in the same companies after graduation.

We hope that the thesis posters give you a good idea of what kind of theses are done at our department. We chose some of the best work that also represent the different branches of the department.

Riitta Rontu
Senior Lecturer
Head of Degree Programme

Design and implementation of a web-based questionnaire tool

Päivikki Honkanen

Introduction

The baseline for this thesis work was the client's need for a web based tool which the educational organizations can use for creating their development plans.

The tool will be used for instance by consultants who survey the current situation of educational organizations.

The software implemented in this thesis work is a part of the questionnaire tool which will be implemented later.

Methods

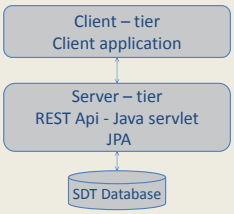
REST - Representational State Transfer – an architectural style for distributed hypermedia systems

JSON - JavaScript Object Notation - a lightweight data-interchange format which is easy for humans to read and write and for machines to parse and generate

JPA - Java Persistence Api - a Java programming language framework managing relational data in applications

Results

Working software system
-Database
-Server component
-User interface application



The implemented service interface enables further software development of a mobile survey tool, a survey control interface and a reporting and analyzing tool.

Objectives

Planning and implementing a database for the survey tool

Planning and implementing a Web application interface for the survey tool.

Implementing a method for reading question forms from an Excel-file and save them to database

Implementing a user interface which a survey respondent can use to register as a user in a school organization, download a survey from the database, answer the questions and save the answers.

Basics

The user registers in the system by giving his/her username and password.

A list of the organisations surveys is shown on the display and the user chooses one of them.

After that he/she can pick up a questionaire form to get a list of question groups. The user chooses a question group one at a time and answers the questions.

The saved answers will be shown again when the user returns to the same question form later and he/she can continue answering or change the previous answers.

Conclusions

The implemented software system fullfills the given requirements.

The software has been installed on client's computer and used in demonstrations.

The implemented service interface enables further software development of a mobile survey tool, a survey control interface and a reporting and analyzing tool.

References

1) Honkanen, Päivikki 2012. Nettipohjaisen kyselytyökalun tietokannan ja web-rajapinnan suunnittelu ja toteutus

OULU UNIVERSITY OF APPLIED SCIENCES

Tester for Battery Interface Master

Design and integration of a test environment for MIPI Alliance's Battery Interface Master

MIPI Battery Interface

- MIPI Alliance's specification for battery interface (BIF) (figure 1)
- BIF supports two types of battery packs
  - Smart battery packs that use digital communication for identification
  - Low cost battery packs that use a resistor for identification

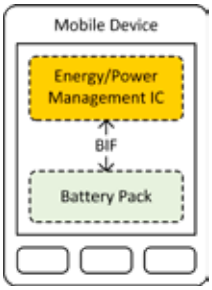


Figure 1. BIF in a mobile device

- BIF reduces development costs throughout the battery pack's lifespan with IP reusability.
- Smart battery packs can use digital communication for practically anything, for example GPIO.

Tester for BIF Master

- Standalone test environment for a BIF Master (figure 2)
- Used to test electrical/timing parameters and to recreate real world use cases to help with debugging

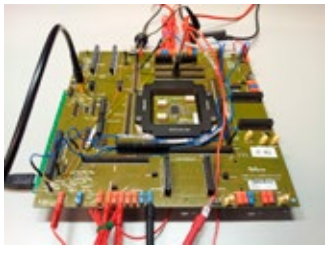


Figure 2. The test environment

- Tester for BIF Master consists of three parts (figure 3)
  - 1. Wrapper for BIF SW Engine
  - 2. Simulated BIF Slave
  - 3. Measurements

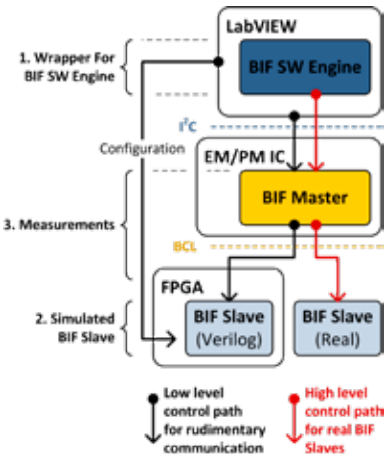


Figure 3. Block diagram for the Tester for BIF Master

1. Wrapper for BIF SW Engine

- The BIF SW Engine provides high level control for the BIF system.
- The wrapper wraps the BIF SW Engine (C/C++) into a DLL which can be used with LabVIEW.

2. Simulated BIF Slave

- A BIF Slave synthesized into an FPGA running a Nios II system (figure 4).
- Provides time base skewed responses for the BIF Master

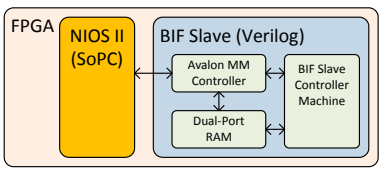


Figure 4. The BIF Slave in the FPGA

- Can be used to create custom data packets for the BIF Master

3. Measurements

- Measurements demonstrate the operation of both the Simulated BIF Slave and the wrapped BIF SW Engine.
- The Simulated BIF Slave is demonstrated with a response time base sweep (figure 5).

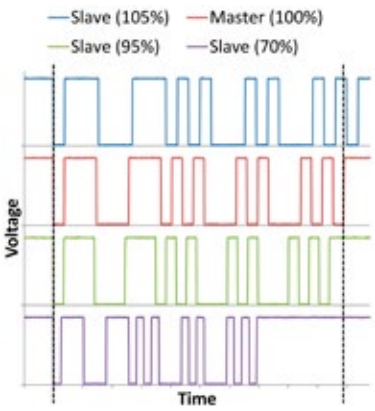


Figure 5. Time base skewed responses

- BIF SW Engine's integration into LabVIEW is demonstrated with a live temperature plot measured concurrently from three real BIF Slaves (figure 6).

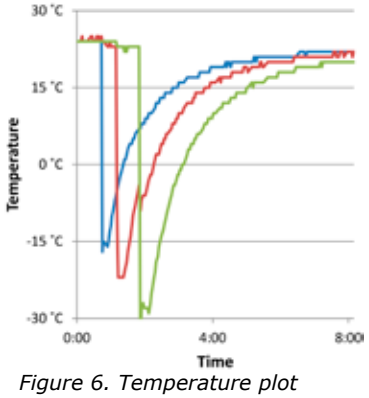


Figure 6. Temperature plot

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An Example of a Synergistic Relationship Between Software Architecture and a Domain-Specific Language

David Narraway, G9097
School of Engineering, Information Technology, Software Engineering

Introduction

The EXFO M5 Network Analyzer (FIGURE 1) is a wireless network analyzer. It can be used to monitor 2G, 3G and 4G wireless networks.

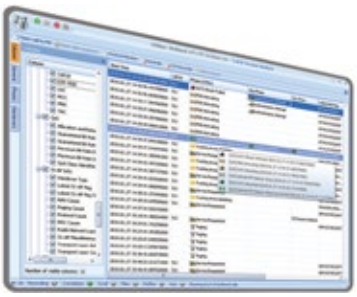

FIGURE 1. M5 Network Analyzer

The main software partitioning paradigm uses a form of the MVC concept (Reenskaug, 1979) to split the functionality into “applications” and their user interfaces. The application and UI parts of the system serialize information into messages for sending and de-serialize messages when receiving information.

Objectives

The thesis sets out to describe how internal messages passed between the cooperating parts of the M5 Software Architecture are specified in a Domain Specific Langauge developed for that purpose and how code generators produce code from the specifications that plugs into the Software Architecture.

Thesis

ECTS credits: 30

Date of publication: 2013, Spring

Dr. Kari Laitinen

Methods

A number of simple tools were used to identify and extract useful information from the codebase and this information was extended during development. The new UI software Architecture was influenced by the generative programming approach, with interface message readers and writers produced by code generators, as well as the storage components used to hold the message contents (FIGURE 2). Support tools also took advantage of the generative programming approach.

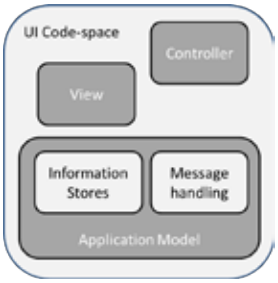

FIGURE 2. UI Architecture

Results

The use of a domain specific language to describe the message interface between cooperating entities in the M5 Network Analyzer has been a success. The language evolved as requirements and opportunities for optimization became clear, but has been stable for several years. The supporting code generators also proved very useful, providing the ability to make large scale corrections to code with a minimum of effort. Browser based documentation is easily derived from the specifications (FIGURE 3).

FIGURE 3. Example specification

Conclusions

Given the availability of certain pre-requisites, e.g. readily available domain expertise and management support, Domain specific languages and supporting tools can be an excellent approach to formally capture knowledge that might otherwise not be expressed so clearly.

References

Reenskaug, T. (1979)
1979-12-MVC.pdf

Qt Quality Visualization

Juha Sippola, TTE3KA
School of Engineering, Information Technology, Software Engineering

Introduction

Qt is a cross-platform application and UI framework for software developers. It is developed by Digia together with the Qt Project, a meritocratic consensus-based open source developer community. Digia owns all Qt trademarks and is responsible for the commercial and open source licensing of Qt.

Objectives

The main objective was to improve the visualization and communication of the Qt quality and its progress by creating a web portal to collect and display metrics on Qt process areas, focusing on continuous integration.

The target audience includes the Qt teams in Digia and the global Qt developer community, i.e. those individuals and teams that develop the Qt library components and the Qt tools.

The Qt Metrics System

The implemented Qt metrics system consists of three main components: the parser, the report builder and the database.

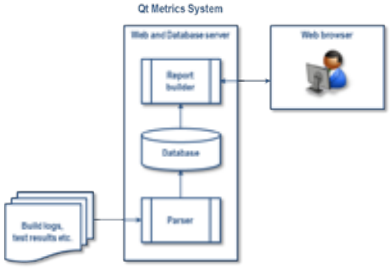

FIGURE 1. System architecture

The parser reads the build logs, test results or other files that are created in the development process, and pushes the data into the database. The report builder reads the data from the database, and shows predefined metrics and reports on a web interface where the user is able to scope and filter the information based on his or her interests and needs.

FIGURE 2. Qt metrics system portal

Methods

The selected technical solutions were Perl for the parser, MySQL for the database, and combination of HTML, CSS, PHP and AJAX for the report builder. The solutions are open source like the Qt itself.

The thesis project used the same contribution practices and tools that are used for the actual Qt software implementation.

Results and Conclusions

The Qt metrics system was launched and taken into public use as planned. The user feedback, both before and after the launch, has been positive.

The development proposals are related to adding new content and functionality to the current metrics page, adding new metrics pages for other process areas, and improving the overall performance of the system still further.

The schedule and the effort used in the project were kept well compared to the original estimates set in the beginning of the project.

References

The Qt metrics system:
http://testresults.qt-project.org/qtmetrics/
The documentation of the system:
http://qt-project.org/wiki/Qt_Metrics_Page_Description

Thesis
ECTS credits: 15
Date of publication: 2013, Autumn
Instructor: Timo Vainio

OULU UNIVERSITY OF APPLIED SCIENCES
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Author: Miikka Keski-Säntti (Oulu UAS)
Supervisor (Oulu UAS): Jukka Jauhiainen
Supervisor (TAUH): Juha Aalto

CENTRICITY ANESTHESIA

Representation of implementation project and interfaces

Centricity Anesthesia

Centricity Anesthesia (CA) is a clinical information system, which covers all the documentation needs during anesthesia. CA receives data from the medical devices and displays it in CA-client software.

With CA, clinical personnel can search, input, save, move and overview patient information. CA also improves the patient treatment by offering detailed patient data for the researchers. End users of the CA are the personnel, who carry out preoperative evaluation, intra- and post-operative treatment.

Implementation

Implementation of Centricity Anesthesia IT-system was carried out in the Pirkanmaa Hospital District during the years 2012 - 2013. Over 500 medical devices were connected in the Centricity Anesthesia data collecion system.

Thesis was done for the department of biomedical engineering in Tampere university hospital. The purpose of the thesis was to create an information document about the CA and its interfaces to other IT-systems and medical devices.

Functioning

Physical stucture of Centricity Anesthesia consists of medical devices, ethernet box connection units, CA-workstations (Medical PC), switches and WMware ESXi5 servers. The medical devices connected in the Centricity Anesthesia mainly consist of infusion and syringe pumps, patient monitors and anesthesia workstations. Topology of CA is described in the upper picture.

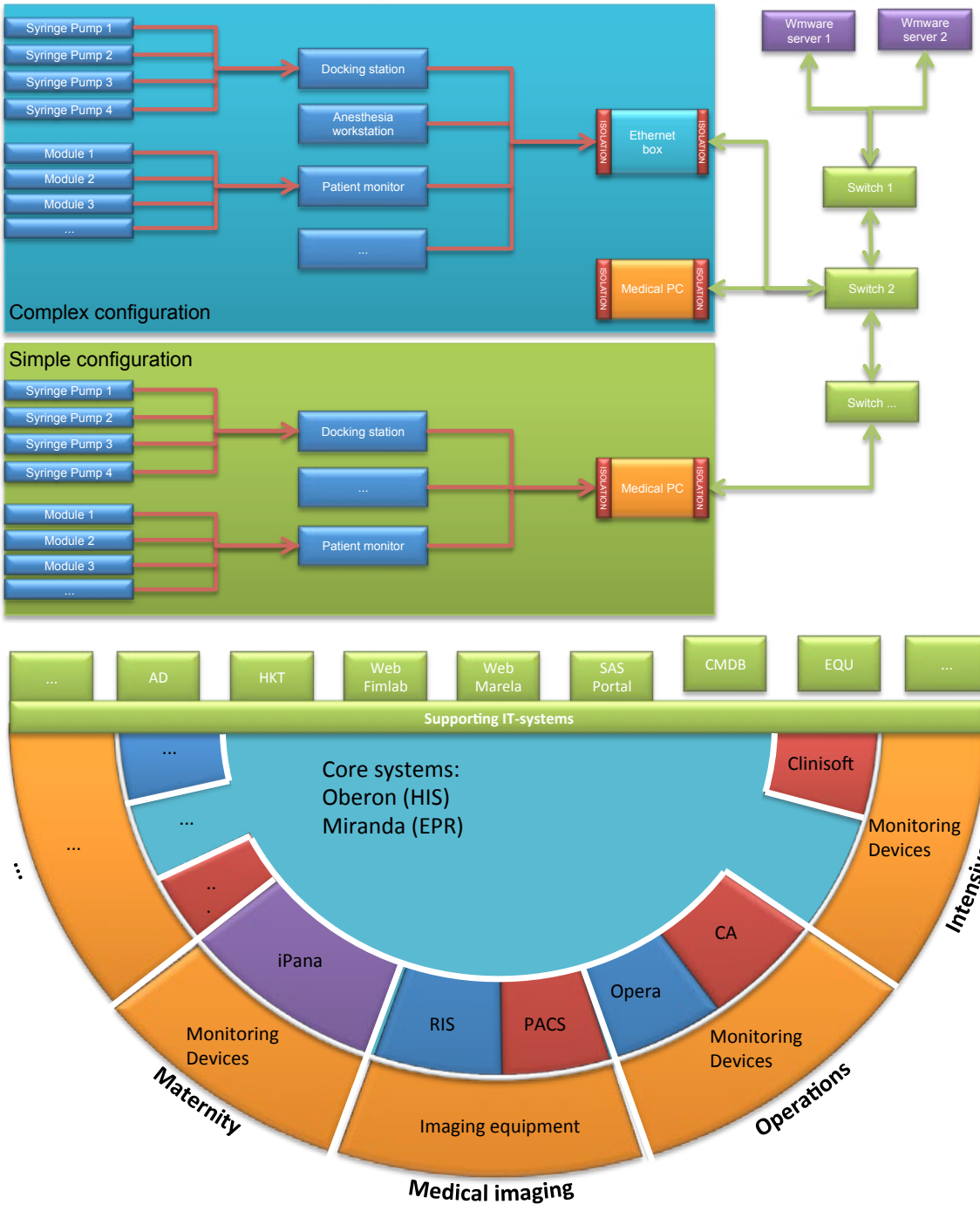
CA contains multiple interfaces to other IT-systems in the hospital. The hierarchy of clinical IT-systems is explained in the picture below.

Environment

Recently the IT-projects have been a widely discussed phenomenon in the media. The public opinions haven't always been positive. IT-projects have often been delayed and the costs have been larger than expected.

The reason for the problems has often been found in the diversity and fragmentation of healthcare IT-systems. The fragmentation is mostly caused by the different IT-systems between healthcare sectors. The problem also exist inside the hospitals: many units in the special health care have their dedicated IT-systems, which are not always compatible with other systems.

From the technical point of view the field of health care is strictly regulated. Medical devices must meet the requirements of MD-directive (93/42/EEC), which is often fullfilled with complex EN 60601-1 standard series which contains requirements for performance and risk management along with electrical safety.


Syringe Pump 1
Syringe Pump 2
Syringe Pump 3
Syringe Pump 4
Module 1
Module 2
Module 3
...
Docking station
Anesthesia workstation
Patient monitor
...
ISOLATION
Ethernet box
Medical PC
Wmware server 1
Wmware server 2
Switch 1
Switch 2
Switch ...
Complex configuration
Simple configuration
Core systems:
Oberon (HIS)
Miranda (EPR)
Clinisoft
iPana
RIS
PACS
Opera
CA
Monitoring Devices
Intensive care
Maternity
Imaging equipment
Operations
Medical imaging
AD
HKT
Web Fimlab
Web Marela
SAS Portal
CMDB
EQU
Supporting IT-systems

Projects done for companies are a good way of getting valuable working experience.

Juha Räty

Company-oriented product development projects

Company-oriented product development projects are included in the option of Software Development. Projects are started on both terms, and they always last for one semester. These courses aim to take into account real conditions, under the guidance of the teachers.

The projects are business-oriented and controlled primarily by the customer companies. The objective is that the students get an idea of how to work in real-life projects.

All three projects (10 ECTS each) can include several development assignments or one development project. As a whole, a project takes about 1–1.5 years to complete. The projects may be in connection with normal training (a total of 30 ECTS). Thesis work (15 ECTS) can be carried out after or between the project. Financial compensation is not usually paid.

Contents

The students become acquainted with specification, design and implementation in practice. The objective is to deepen the skills needed, and at the same time acquire hands-on technical competence. The contents are determined in more detail in the project.

The project work may be related to the following:

- Information charting
- A feasibility study and specification of software
- Software design and implementation
- Software testing.

Scope

Projects are usually completed during the third year. The amount of work is about 200 hours (± 10%) per student. The recommended size of the project team varies, but is normally 2–4 students.

Organisation

The projects are started together with Oulu UAS and the customer, who also form the steering group. The steering group decides on the aim and controls all the objectives. If needed, the steering group will also restrict the scope of the project if all objectives will not be realised with the available resources. The primary aim of the guiding teacher (who also belongs to the steering group) is to monitor the educational objectives, and to guide the project in a way that it supports these objectives.

How to place an order for a project?

Orders can be submitted throughout the year. However, we recommend that spring projects are ordered well in advance in the autumn, and vice versa. The project should have preliminary specifications ready before the actual start.

The following information is appreciated when placing the order:

- A brief description about the project, the tasks and the objectives
- The schedule and the number of students needed
- A description of the tools used in the project
- A contact person and contact details of the customer's representative.

Pertti Heikkilä
Lecturer

Lasse Haverinen
Lecturer

Solution One Holding
www.s-onetelecom.com

Software development

Hello Kitty Widgets

Widgtes for Hello Kitty Launcher

- Project includes five different widgets for Hello Kitty Launcher which is made by Solution One Holding. All widgets has Hello Kitty theme.

1. Favorite app widget
2. Recommended app widget
3. Clock & Calendar widget
4. Music Player widget
5. Calendar widget

Image 1 Clock & Calendar

Widget fuctions

- Favorite app widget is editable and you can put your favorite applications on it. You can choose applications from application list.
- Recommended app widget recommends very usefull applications
- Clock & Calendar widget shows the time and date. It opens the Android calendar by clicking it.
- Music Player widget controls the Androids default music player.
- Calendar widget show calendar. Month can be changed.

Techincal information

- Widget works on Android version 2.1 and above that.
- Widget is developed for Hello Kitty launcher which work on every android version.

Image 2 Music Player widget

Development of the Widget

- This project is part of practical training for studies. Project was made in Bangkok, for Solution One Holding and their Hello Kitty launcher on Android.
- Project management was dealt with using Scrum-process model.

Sprint 1

- First Layouts to all the widgets
- Functionality for them
- Set the graphics
- Testing

Image 3 Calendar widget

Used tools

- Widget was developed in Eclipse using Android SDK.
- Graphics was made by Solution One Holdings graphical team. They used Photoshop and Adobe Illustrator.

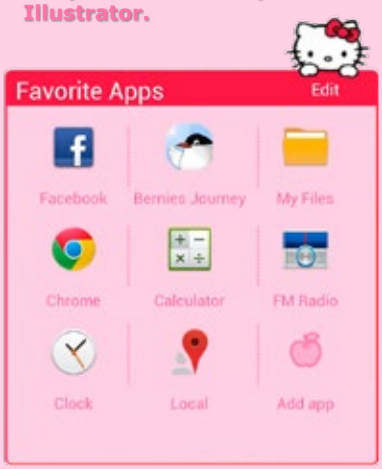


Image 4 Favorite app widget

Testing

- Testing was performed threw whole project.
- Tester in this project was Antti Haukipuro

Hello Kitty Launher

- Hello Kitty launcher is made by Solution One Holding and it can be found on Google Play market.
- These widget will be attached to launcher in future, so widgets are not in Google Play market separately.

Get the Hello Kitty Launcher from Google Play

GET IT ON Google play

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OULU UNIVERSITY OF
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SOFTWARE DEVELOPMENT

Zombie Cruise - game prototype for iPhone and iPad

Game

- Zombie Cruise is a romantic action adventure game for iOS-mobile platform. The game is set on a Caribbean-cruiseship hit by a zombie-infection.
- The players mission is to guide the main character to survive and find out the reason for the situation.
- The zombies are aggressive so the the player must avoid or distract them using whatever is available.
- There are other survivors aboard the ship that the player can interact with in the story missions.

Image *2. In-game screenshot*

Tools

- The game was developed using the Unity-game engine, which allowed to develop the game for multiple platforms simultaneously (Windows, Mac and iOS).
- Unity can be scripted with several different languages, C# in MonoDevelopment environment was used for this project.
- The game was tested mainly on Mac OSX, but the touch screen features and performance was tested on actual hardware (iPhone 3GS, iPhone 4 and iPad 2).

Image 1. Zombie Cruise - logo

Development

- The development began in the summer of 2011.
- There have been several subsequential prototypes based on the observations made from previous ones.
- All requirements were not clear in the beginning of the project so agile development methods were required.
- The project was managed using SCRUM-methods.
- During the projects, 5 sprints were made with total duration of 4 months.

Image 3. Unity game engine -logo

Features

- 3D game world
- Touchscreen-controls
- Scripted storyscenes
- 10 game levels

Tuonela Productions

- The projects owner was a game company from Oulu called Tuonela Productions Ltd.
- The development team consisted of a producer, game designer, programmer, writer and two graphic artists.

Testing

- During development the game was tested internally in the company.
- Finished prototypes were tested by OAMK students and volunteer testers.

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Instructor: Pertti Heikkilä, e-mail: Pertti.Heikkila@oamk.fi, tel. 010 27 22145

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Platform HAL's test system

Platform HAL Test Coverage Increase for MP5232 Smartphone Platform

MP5232 platform

- The platform delivers a no-compromise user experience with 1.5GHz dual-core computing power, industry-leading graphics, video and imaging capabilities
- MP5232 supports differentiating features including multi-camera and multi-display support, full HD 1080p multi-format video encoding/ decoding, stereoscopic 3D (S3D) video and advanced graphics to deliver a console-like gaming experiences and engaging user interfaces
- MP5232 platform with its high perfomance capabilities provides a high quality basis for the LTE – devices manufacturing.

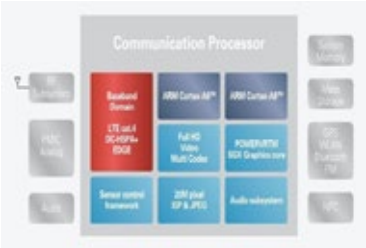

Fig. 1. Communication processor

- Platform HAL software is located in the modem part (Fig. 1), which supports 2G, 3G and LTE – interfaces.
- The main purpose of this project was the Platform HAL software testing coverage improving by implementing new test cases and challenging already existing solutions.

Testing & debugging environment

- Platform HAL software testing environment consists of following items:
  - MP5232 platform's device prototype
  - NTRACE PC software
  - FIDO device(more information about this device could be found here http://www.liewenthal.ee/)
- NTRACE software is the main tool for debugging and analysis the Platform HAL 's functionality. The software allows to send a test messages based on the terms of the license, the subsystem type and the test cases collection implemented.
- All transactions between MP5232 platform and NTRACE PC are managed with FIDO device. This allows to send a request (test message) and to recieve a response (test result)

Fig. 2. Testing environment

- In addition, for the advanced debugging and analysis Latte and TRACE32 software can be used.

Implementation

- All test cases are implemented in C programming language
- The processor environment used in the test device prototype is ARM Cortex R4
- During the test cases implementation both Standard and Modem APIs are used.
- Test system includes partially an automatic test system's implementation.

Verification

- Test cases were implemented according to the internal documentation and manuals
- All mandatory checks and verifications were done by the senior software developers, testing team and a solid manager
- New test cases were successfully integrated into the Platform HAL software and released.

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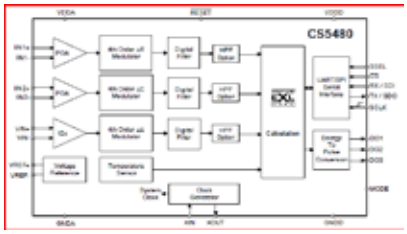
OULU UNIVERSITY OF APPLIED SCIENCES

ENERGY METER EM-12

Juha Nord, t0noju00@students.oamk.fi

Introduction

- Project was to design and manufacture cheap energy meter, which can measure from connected devices they voltage, current and power factor.
- Measurement are carried out from connected power supply and current sensors.
- Measurements are carried out every second and from them average is calculated in 6 second intervals to the packet to be sent.
- Meter sends data packets via ethernet to data collecting server, where they can be edited to visual form.
- Meter is based on Cirrus Logic's CS5480 -chip.



PICTURE 1. Block diagram of CS5480

- Used current sensors are split-core type current transformers, which are easy to install on the measured line by pressing.

PICTURE 2. Current transformer

Objectives

- The goal was to manufacture working prototype from meter and documents which allow further development and to manufacture them.

Methods

- PCB was designed by using CadSoft EAGLE software.
- Atmel AVR Studio was the tool to design and compile embedded software.
- Microsoft Visual Studio 2010 Professional was used to make testing tools and electricians configuration software.

Results

- At the end of project version 2 of PCB was ready.
- Device send UDP packet which includes XML-formatted data with ID and measurements.
- Because device will be installed in electric main center, enclosure was chosen utilizing automated circuit breaker profile of 9 fuses.

PICTURE 3. Energy meter EM-12 and current sensor

Conclusions

- Project was interesting, but problems with tools slowed the progress.
- One of the further development area is to change communication card from ethernet to radio modem or PLC (Power Line Communication).
- Another further development area is to integrate controls to device, so it can turn devices on and off.

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Euroopan unioni Euroopan sosiaalirahasto
Elinkeino-, liikenne- ja ympäristökeskus
OULUN SEUDUN AMMATTIKORKEAKOULU
Vipuvoimaa EU:lta
2013

The purpose of the project work is to deepen the knowledge and to integrate the pieces together.

Juha Räty

Project work

Some studies are arranged as project work. The project course arranged during the last period of the first and second years extends to five ECTS. The courses are intended as a summary of the topics learned. During the course, students work in groups of 2–4. The course has more than one teacher to guide the work. In most cases the projects do not include new issues. The purpose is to deepen the knowledge and to integrate the pieces together. We also arrange optional studies for the third-year students as a project. This project is larger (15 ECTS), and the students will study also new topics based on new technologies.

The students work on the campus and the teachers monitor their presence. The student groups also hold regular meetings with the teacher. At the end of the course, a seminar is arranged, where the achievements are presented. The work is evaluated both by the students and the teachers. Each student completes a self-evaluation and evaluates also the other students in the same group. In addition, teachers evaluate the students' performance and give final grades.

Our experience has been mainly positive. Students like this type of work and they work hard in the projects. A successful project requires good planning, and the best results are achieved when the teacher has good knowledge of the theme. However, this study method is not best suited for new case studies for first and second year students. It requires too much information gathering, and one teacher can use only little time in one student group.

The students can either choose their subjects freely or from a ready-made list provided by the teacher. If the subject is freely chosen, the teacher should carefully consider that the subject is realistic and the group is able to complete the work successfully.

Projects in medical engineering have been an integral part the studies for almost 15 years. Projects typically start in the beginning of the third year. There are three separate projects in the ongoing curriculum, four ECTS credits each. The students can choose the topic of the project freely.

The topics are gathered from the local companies, EU and TEKES funded R&D projects and from clinical environments. Typically, the students work in teams of 3–5. One ECTS corresponds to 27 hours of work. One team member is the project manager and another is the secretary. The steering group typically consists of one or more teachers and customers. The time span of a project is typically one semester.

The projects may contain, for example, electronics design, microcontroller programming (e.g. Arduino, Raspberry Pi), UI or database programming, data analysis as well as prototype design and testing. Prototypes can be manufactured using rapid prototyping technologies. Some projects also relate to usability and user interface design of various devices, software and facilities. The usability laboratory equipment can be utilised.

Comments on the project studies

- Projects should be monitored closely and ensured that the students receive the necessary support.
- The assessment is in general difficult because projects can be very different.
- The design documentation should have clear and identical instructions for all projects.
- Planning and tracking of projects is the practice used in the scrum process model.

Pekka Alaluukas
Senior Lecturer

Jukka Jauhiainen
Principal Lecturer

SARA

Jaakko Korva, HYV1SN
Tekniikan yksikkö, Hyvinvointiteknologia, Opiskelijakoordinaattori

The Starting Point

The project "Sara" (abbreviation of Finnish word “pisara”) started in January 2013. The goal was to study printed biosensors and their applications as measurement devices. Sensors provided by the PrinLab were tested in spring. During the summer of 2013, first prototypes were built. It was then possible to read the biosensor data and to analyze small quantities of various substances from liquid samples.

The Goal

The goal of the project is to develop a measurement device that can be used to measure different kinds of samples with various sensors. The possibility of mobile application will be kept in mind for the sake of future commercialization purposes.

Methods

Project Sara will be done by the medical engineering students utilizing project courses, practical training and BSc theses. There is a dedicated working place for the project.

Devices like a 3D printer and circuit board manufacturing system have been utilized in the project.

Figure 1. The prototype

The Results

It is now possible to make an amperometric measurement that provides information about the concentration of the studied substance in a liquid sample. Only one type of sensor has been used so far. We are intending to expand the measurements to different sensor types in 2014.

The prototype can be operated by a dedicated touch-screen application which was developed in the project.

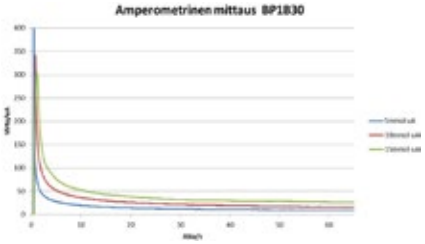

Figure 2. The amperometric measurement.

The Future

There are still many development steps ahead. Our aim is to recruit new students to advance the project in the near future.

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HYTKE http://www.oamk.fi/~manneha/

PrintLab http://www.oamk.fi/hankkeet/prinlab/

As a part of his studies, Veli-Matti Jaakola designed a 3D game.

Anne Peltola

Oulu UAS has excellent possibilities in solving pragmatic problems and developing new solution models.

Anna Timonen

Research & Development

Higher education is based on the requirements of internationalisation and developing the working life, on research as well as on artistic and cultural bases. The applied research, development and innovation work of universities of applied sciences as well as the development of entrepreneurship serve and support not only the teaching, but also the development of the entire Northern Finland and renew its economic and business life. Oulu UAS's operations support the university community's and especially its students' readiness to operate in international duties.

Oulu UAS pursues jointly outlined development targets as part of an internationally renowned regional innovation cluster with a particular emphasis on the following focus areas:

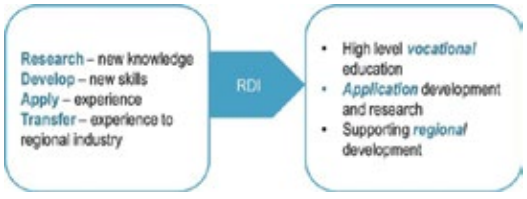
1. Future health and well-being
2. Energy, natural resources and the environment

In addition to focus areas, shared themes in the higher education community are

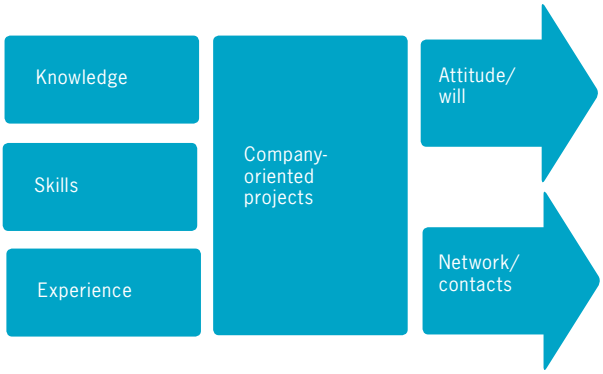
– Intelligent learning
– Innovative products and services
– Entrepreneurship and new business operations

R&D has a special role in enabling working life based learning and building learning-based national and international networks. The R&D operations at the School of Engineering focus on applied research and applying technologies in order to solve working life based problems. As a diversified university of applied sciences Oulu UAS and the School of Engineering have excellent possibilities in solving pragmatic problems and developing new solution models.

The objective of the research is to acquire information on new technologies and the required areas of expertise for the future teaching needs. These activities are based on the co-operation with the universities and research centres.



R&D operations are implemented both within the limits of the basic funding of teaching as well as in national and international projects executed with outside funding. The objective is to integrate R&D naturally to the learning objectives. Development projects implemented in co-operation with the business life deepen the mutual co-operation and provide the students an excellent opportunity to apply the acquired competence to practice. At the same time, the development co-operation provides the companies an opportunity to train potential, future employees to their own expertise and application area. For the students, working in a real environment provides an opportunity to network and motivates in finding new skills and knowledge.



In the future working life, the meaning of networks grows both nationally and internationally. Through R&D operations the students have a possibility to understand the meaning of networks in working life and to learn how to utilise the networks in their own work.

Sakari Kauppinen
Director of Research

CASE: Building a Modern 3D Virtual Laboratory for User-Centric Design Approaches

The modern 3D virtual laboratory at Oulu University of Applied Sciences (Oulu UAS) brings new kind of efficiency to design and engineering. In a virtual environment the models are in the same scale as in the final building, which helps to understand and perceive details in a concrete way. The virtual lab creates experiences that also promote product sale and marketing.

Introduction

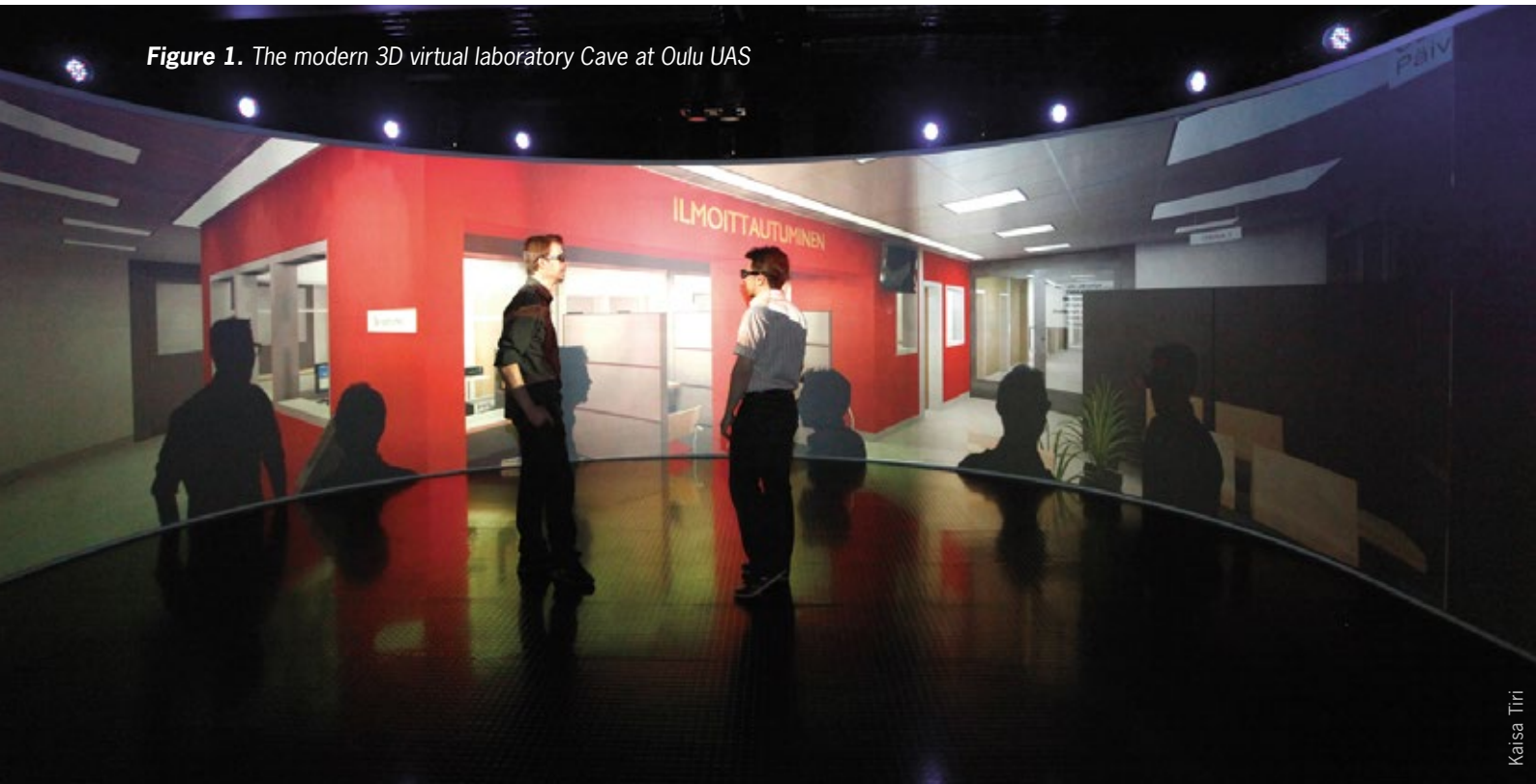
Immersive environments using 3D visual output have become a well-known tool for virtual reality. Research has studied their use and potential from various angles. At Oulu University of Applied Sciences (Oulu UAS) we are interested in Cave environments, where the user is surrounded with large projected screens providing a 3D immersion. Cave was first introduced in 1992 as a SIGRAPG'92 Showcase. Since then, large scale set ups for virtual environments have been used to demonstrate and investigate various kinds of concepts, for example, in the area of gaming, architecture and interaction research.

Virtual environments offer an interesting tool for design, and have been utilised as a design space for domains benefitting from spatial and 3D presentations, architecture and building interiors being often mentioned examples. Methodologically, participatory design using virtual environments has provoked encouraging results. As an industrial example, Jaguar Landrover promotes its design space, where engineers can see and interact with 3D components within a virtual design environment. Virtual environments provide a strong means for visualising the designs in a reasonable level from the user or designer point of view.

Approaches on immersive environments have typically concentrated on interactive virtual environments from the engineering point of view or been targeted to some rather pragmatic objective. We at Oulu UAS are interested in augmenting the immersion in order to create rich, even artistic representations that encourage user participation to the design process. For this purpose, the virtual environment should be rich enough to hold artistic interest and combine both immersive virtual reality applications and multi-layered creative content production.

In this application report, we describe our project of building a modern cave 3D virtual lab, the motivations behind the selected virtual environment solution, the faced challenges and results.

Figure 1. *The modern 3D virtual laboratory Cave at Oulu UAS*



Kaisa Tiri

Figure 2. *A HVAC design*

Jussi Tuokkola

Constructing the set-up for a 3D virtual lab

Technical set-up

A room with 8 x 8 x 3.5 metres (width x length x height) was allocated for the project to set up the 3D virtual environment. Instead of a typical wall set-up, a curved optical projection screen is used with three front projection stereo channels and a floor with a front projection stereo. The limited space was the first challenge, invoking questions about the efficient use of space and money. Front projections were chosen for

a) reducing installation space

b) achieving shaper images and

c) avoiding discontinuity (for example, hot-spots, seams, shadows from the supporting structure), which is present on non-overlapping (rear projected) multi-projector technologies.

By choosing the optical projection surface instead of a white or a silver screen, we are approaching the optimum viewing angle and stereo separation combination. In addition, a better contrast ratio was achieved compared to the non-optical solutions. It is known that the contrast is crucial for an outstanding image quality.

Eight high-resolution projectors display images on the screen area with the light output of approximately 50 000 ANSI lumens. A screen with the length of 13.5 and the height of 2.5 metres is used to provide an opening angle of 180 degrees with the radius of 3.5 metres. High quality filters are used for stereo separation eliminating the ghost images effect and achieving adequate viewing positions. There are twelve DMX-controlled ambient lights for projecting rich, saturated colours and colour-changing effects as well as channels for fog machines or any other auxiliary devices or actuators.

User tracking is planned with an optical tracking system instead of an electromagnetic one. A controlling device, often called as a magic wand acts also as an interaction metaphor.

Image quality and 3D media

A curved screen requires the images to be warped before being projected onto the screen. Therefore, advanced video server software and video projectors with adjustable geometrics are used for image correction. A novel approach strategy for handling the image corrections (warping, edge blending) in our environment was developed. We use a specific virtual reality application to render the virtual environment images and for interactions.

A real video is played over a specific application utilising a video server. The video server allows an effective and secure way for media positioning on the screen in one pixel level and time-line based layering of the media assets for multiple independent layers. Furthermore, the video server executes image corrections independently from the image source. Auxiliary timelines are included for external controls (lightning, fog machines, etc.). For the audio, we use a 7.1 surround system with active monitor loudspeakers and an active subwoofer.

User participation and design process

The virtual lab was constructed in order to

a) enable and encourage user participation to the design process and

b) to facilitate the collaborative model- assisted decision-making.

By participating in the design process, end-users can discover better functionality for work and living spaces. This also reduces

Figure 3. *An iterative decision-making meeting takes place at virtual lab.*

Jussi Tuokkola

the costs during the building's lifetime and supports sustainable development. All in all, virtula lab increases customer satisfaction, which is crucial for successful business.

User participation in the design process can be applied to many fields, such as architecture, urban planning, factory site design, simulation, engineering, industrial design, culture, history as well as entertainment.

Our partners, in addition to the academic players, are large and medium-sized architect, designing and engineering companies from a variety of engineering and designing fields. We help them to adapt techniques as evidence based design (EBD) and user-oriented design (UOD) to fully match the project goals.

In practical problems, design decisions are often affected by a large number of parties, in many times representing varying fields of expertise.

The advantage of installations such as the virtual lab lies in their ability to simplify and hasten the process of iterative decision making, as a large number of scenarios can be studied within the timeframe of one meeting.

The virtual lab may also be used to simulate real life situations that would otherwise be too dangerous to achieve. For example, there have been ideas of simulating the feeling inside a burning building to give common people the feeling how fast the situation actually turns to fatal. Another example is to educate people working at a construction site in a game like environment simulating the hazards, and while doing so hopefully giving a better understanding of the dangers and in the best case saving lives while doing so.

For educational use, the virtual lab offers students rather a rare opportunity to see their designs and ideas in a real life scale, giving the opportunity to gain the experience in design they otherwise would not. Being a multi-use environment, the lab also offers a rare opportunity for widescreen media installations that may be used to educate content creation for a large venue installations.

The virtual lab combines the means for high quality immersion and presentation. Models designed with 3D design programs such as CAD come to life in the virtual space. They are in the same scale as in the final building, and this helps to understand and perceive details in a very concrete way.

Designing, whether architectural, mechanical or other, is inherently creative producing. The modern 3D virtual lab is a tool that is rather encouraging than stifling creativity.

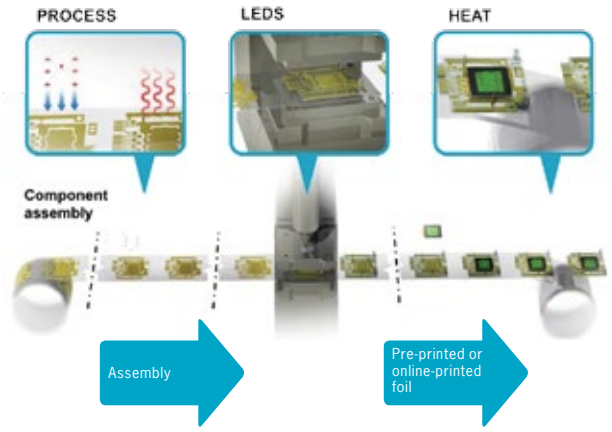
Janne Kumpuoja
Laboratory Engineer

Jussi Kangasoja
Planning Officer

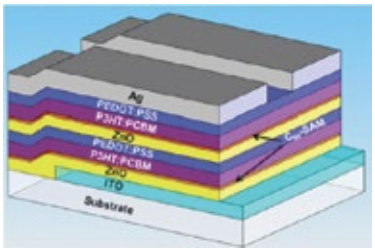
CASE: Autonomous R2R systems (Autosys)

The objective of Autonomous R2R (Roll-to-Roll) systems is to extend the capabilities of R2R manufacturing from single component manufacturing and integration of functional systems to the pilot production level. Running the pilot lines continuously, the PrintoCent community and companies learn about the capabilities, bottle necks and design guidelines of a real production environment.

Understanding the yields and tolerances of the production, the most optimised process sequences, process tack times, design guidelines as well as manufacturing standards and cost calculations requires not only current laboratory-scale research, but also test runs in a larger scale and volume.



The project develops multi-junction organic solar cells R2R processing including ITO (Indium Tin Oxide) replacement materials, ALD-processed (Atomic Layer Deposition) barriers and in-line thin film measurements.



Pre-assembly

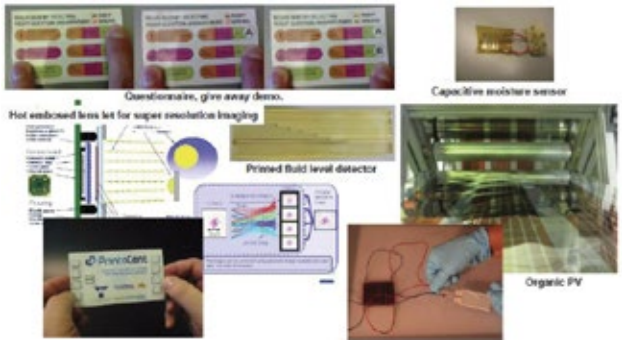
The integration of new user interface concepts will also be developed. These user interfaces will also act as system demonstrations for all the work developed in the project. The first demonstrator is an active poster, where electrical functionality has been utilised in a large, flexible area including functionalities such as an electrochrome display, capacitive touch controls as well as new power source technologies such as organic photovoltaics or wireless power transfer via NFC (Near Field Communication).

Another demonstrator concept is a 3D-formed user interface embedded in a plastic product cover in order to create a

seamless user interface, which looks nice and is easy to keep clean. The manufacturing of the user interface requires integration of several functionalities such as a display or indicators, a keyboard, a power source, control electronics, touch buttons and back lighting.

Conclusion

The PrintoCent partners are conducting active research and development in the field of printed electronics and hybrid manufacturing of integrated smart systems. The research focuses on combining manufacturing technologies such as roll-to-roll printed functionalities, injection moulding and traditional component assembly to enable seamless integration of the new technology into traditional products at comparatively low costs. This approach is called printed hybrid systems. Through the hybrid manufacturing approach, the printed electronics industry also benefits from a faster time-to-market compared with fully printed products.



PrintoCent is actively building a globally unique pilot production facility to enable proof of concept demonstrations and small-scale production ramp-up for customers.

By combining the expertise of this low-cost electronics manufacturing technology with the efficient 3D shaping technology of injection moulding, there is great potential to build a new high-throughput manufacturing technology platform that can deliver complex optical, electrical and mechanical functions with relative ease.

New printed components, roll-to-roll processing and the integration of post-printing assembly techniques offer unique potential for new types of products. They also enable leaner logistics and value chains with less material loss and fewer mechanical parts. This all leads to more compact and environmentally friendly products with new functionality, appealing design and an intuitive user experience.

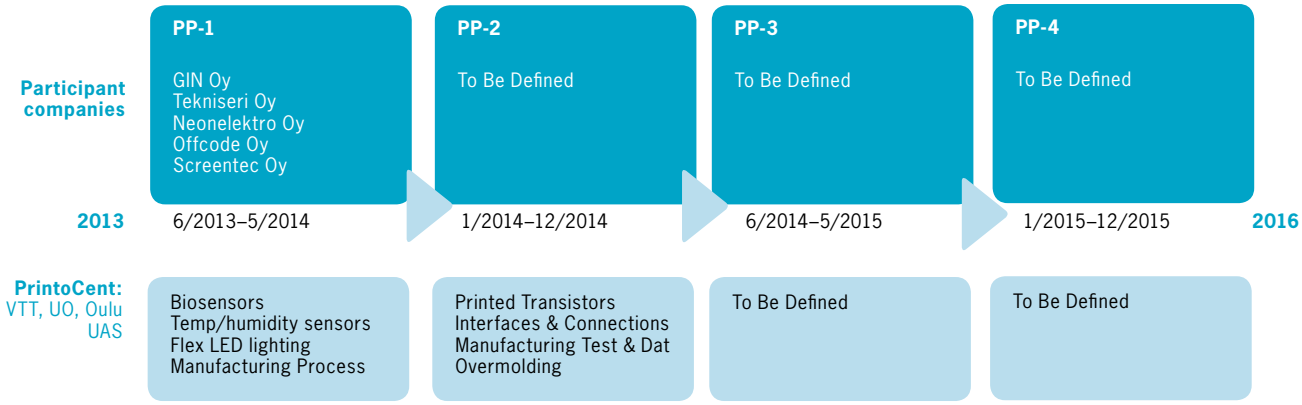
PrintoCent's partners competence and the broad capability set covers the entire value chain from materials, component design and processing to system integration, concept demonstrations, process control instrumentation and pilot manufacturing. With active industrial designer involvement, this development leads to novel product ideas, and product developers are rapidly finding new product opportunities with printed hybrid systems.

The main objective of system integration development is to enable multifunctional plastic foils with high compactness, a high degree of autonomy, overall integration of several functionalities and reduced installation costs. System performance, reliability and a cost optimum will be sought for the specified application requirements. This will be done by hybrid integration of the best suited combination of functionality building blocks, such as lighting elements, photovoltaics, batteries, sensors, RF and CPUs, as well as high-throughput and high-yield manufacturing processes such as lamination, printing, bonding and encapsulation. The integrated manufacturing vision is combined with roll-to-roll compatible, stop-and-go post-processing or component assembly on flexible foil and injection moulding.

Harri Määttä
Special Researcher

CASE: Printed to Products

Printed to Products is a set of projects. One project is already going on, the second is under preparation. In total, there will be four projects, each with a different focus and different companies involved.



Printed to products and business value chains – a one year development frame with Tekes funding

As a part of the PrintoCent 2013–2015 programme, the overall objective of the Printed to Products project is to boost printed and flexible electronics/functionality based products, services and business to be established in Finland. The project primarily supports the first phase participating companies' (i.e. Tekniseri, Neonelektro, Screentec, GIN and Offcode) own projects' generic needs, which have been identified to be under the following three themes:

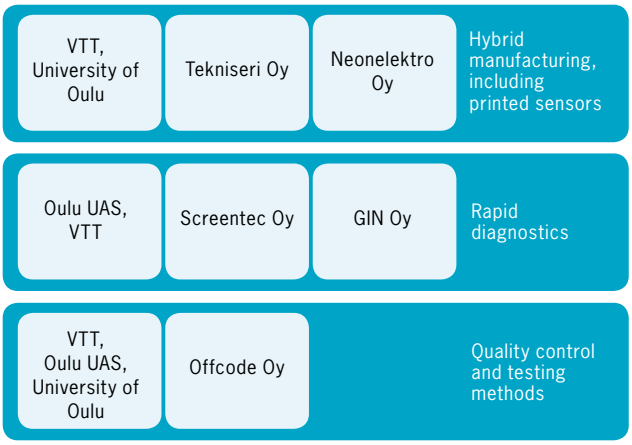
i) Hybrid manufacturing, in which printed components, like sensors (e.g. temperature, humidity, pressure/force), will be combined with traditional components (processors, power, LED, etc.) at flexible substrates.

ii) Rapid diagnostics and biosensors, which enables new kinds of product and service innovations.

iii) Improving printing registration accuracy, quality control and testing methods.

In rapid diagnostics the manufacturing methods of biosensor and electrode structures will be developed. The overall focus is towards the mass manufacturing capability. One of the main points is to develop a suitable method for biomaterial dispensing. Several different component and manufacturing related special techniques, testing and quality control methods will be developed, and de facto standards for application design will be made.

In the sensor development, printed sensors will be made and integrated into the measurement platform developed in the project. The multiple variable measurement system concept will be demonstrated this way. The measurement platform can



Project partners

be applied in several different applications with different sensor combinations. The sensor from the rapid diagnostics can also be integrated into the platform.

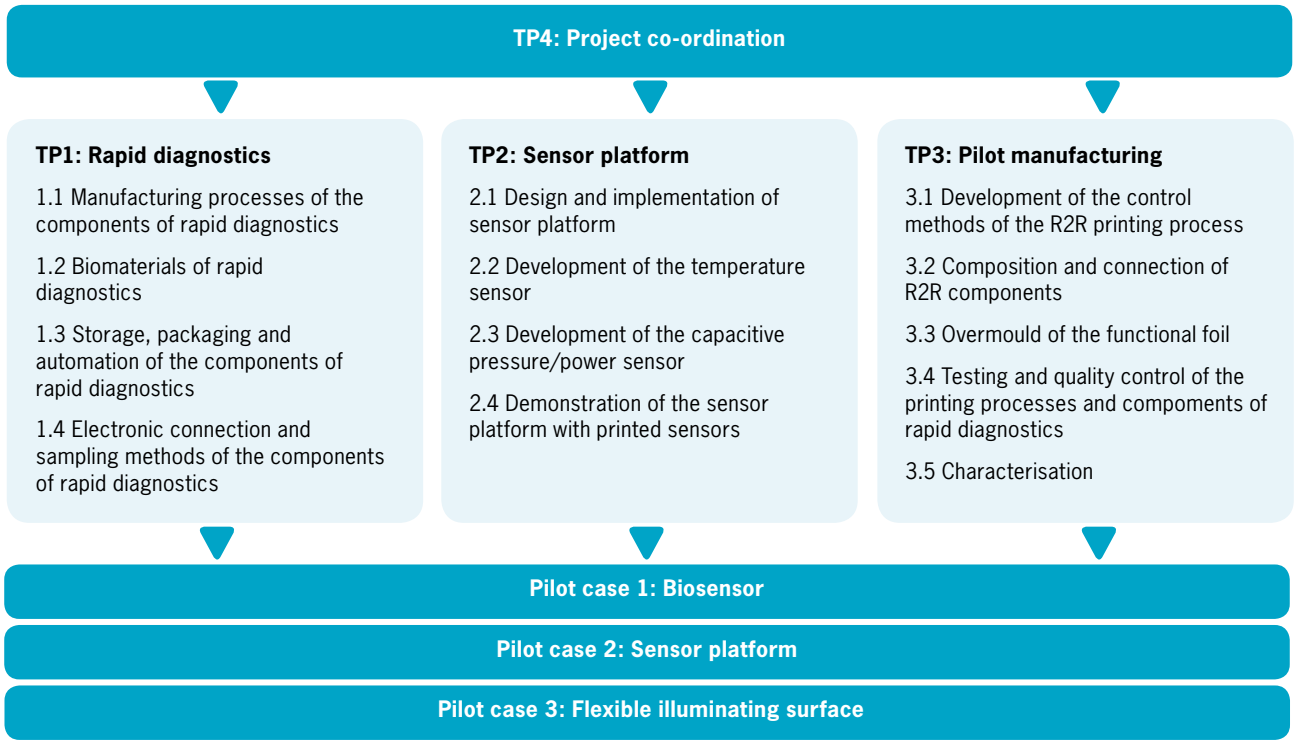
In pilot manufacturing, the pilot-level manufacturing capability of printed hybrid systems will be improved as follows:

i) R2R printing process controlling, registration accuracy, quality control, process and test methods

ii) R2R component assembly and attachment to flexible substrates

iii) Overmoulding of functional foils

iv) Rapid diagnostic process quality control and characterisation



Project structure

There will be three pilot cases

i) Rapid diagnostic

ii) Sensor platform

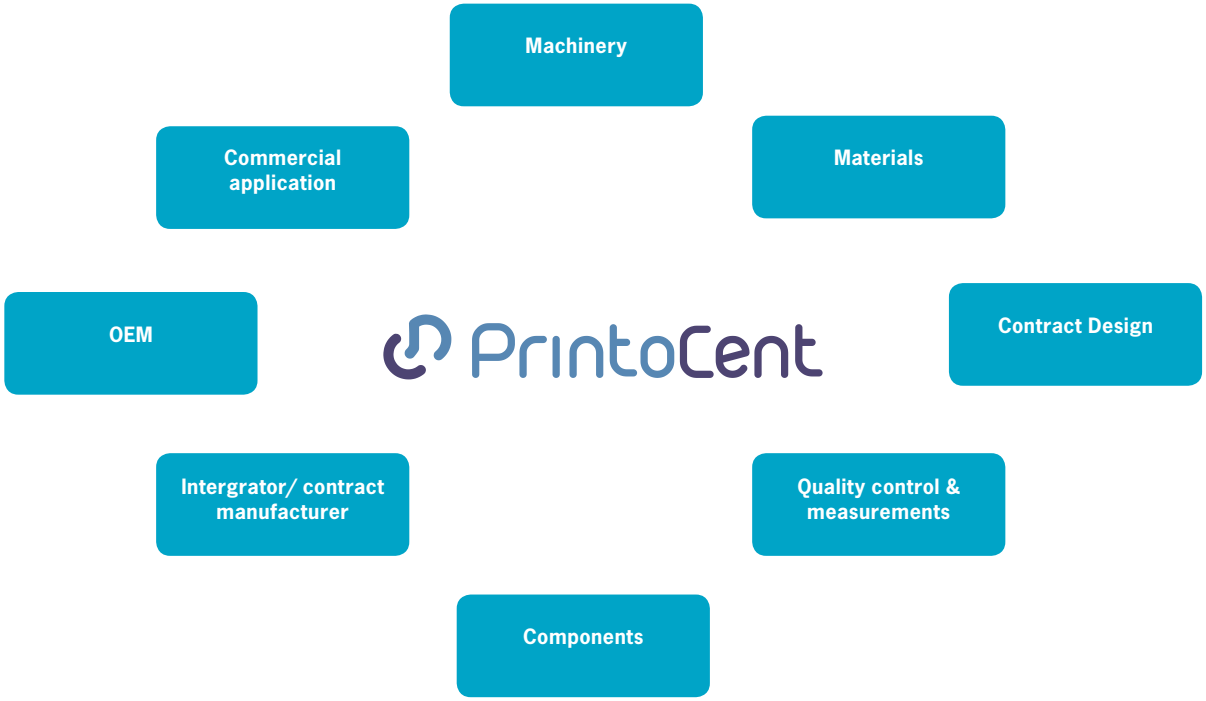
iii) Flexible illuminative surface

Even though the pilot cases are generic, on the system level they are sufficiently product like so that the design and manufacturing piloting process including documentation, milestones, product verification runs, production verification runs and characterisation can be run in the PrintoCent infrastructure. A tested and verified process helps the actual product concept design and implementation to be faster, less risky and more cost-efficient.

Harri Määttä
Special Researcher

CASE: PrintoCent Start & RunCent – At the core of printed intelligence

The PrintoCent Start & Run project builds a centre of printed intelligence activity in Oulu. The centre offers product development and production services to companies. PrintoCent creates a centre for companies, where they can utilise a high-level production environment and the related services located in the neighbourhood. By utilising the services created by PrintoCent, the companies can start the printed intelligence based business more quickly and with less risk.



On the early stages, the companies can utilise the services of the PrintoCent pilot factory as purchased services in their own product development and production, and integrate to the business community and the utilisation of the region's strong research. Domestic and foreign corporate offices are sought into PrintoCent, and through product development and production new supplier networks and jobs will be established. The project also identifies the training needs of companies.

Conclusion

1. The development of PrintoCent's operation and administration model

An operation and administration model will be built in order to enable permanent operations of PrintoCent. The objective is to enable self-financed operations for the innovation centre in 2014. The key factors include

- Identifying interest groups
- Strategy
- Product portfolio
- Deepening the co-operation between VTT Technical Research Centre of Finland, University of Oulu and Oulu UAS on the practical level.

The objective is to gradually generate an operation model to the PrintoCent innovation centre.

The model will be based on

- The development and production services of PrintoCent Pilot Factory

– The development of the regional co-operation between companies and research facilities
– Continuous presentations of the PrintoCent community to potential international customers and partners
– Organising different types of networking events both in Oulu and internationally

2. Building and internationalising the PrintoCent community

The project will create an operation environment and provide a service package to the companies located at PrintoCent. It will also find customers and partners to the PrintoCent community both in Finland and internationally. Partner programmes, which create value chains for companies will be built for the selected fields. The programmes will include both regional and international companies.

In co-operation with BusinessOulu the partners will create fluent models for guiding visitor groups within the PrintoCent community: VTT Technical Research Centre of Finland, University of Oulu, Oulu UAS and the companies. The organisation of further education aimed at the needs of the companies will be promoted, for instance, on the following areas: business, technology, producation and business idea.

3. Building the PrintoCent brand and an international co-operation network

The project will promote the PrintoCent brand, provide regional companies a contact network for international markets and build inter-company projects. PrintoCent has built an international brand and a co-operation network in Germany and the Great Britain, which the companies of the competence community can utilise in their business. The project will implement 3–5 market-oriented competence demonstrators.

The project promotes the company-oriented R&D services of research institutions and universities of applied sciences. The project also strengthens the mutual networking of VTT Technical Research Centre of Finland, University of Oulu and Oulu UAS as well as with the companies and public organisations. The project ensures that the already financed research and development environment and the hardware will be utilised in the development of the regional business life.

The competence and broad capability of PrintoCent's partners covers the entire value chain from materials, component design and processing to system integration, concept demonstrations, process control instrumentation and pilot manufacturing. With active industrial designer involvement, this development is leading to novel product ideas, and product developers are rapidly finding new product opportunities with printed electronics.

Harri Määttä
Special Researcher

PrintoCent industry cluster members (October 2013)

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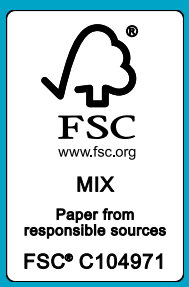

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