MAXWELL

Magazine of the Electrotechnische Vereeniging

IEC: Smart Grid

The challenges of developing a stable smart grid

Graduation report

An audio processor using partial FPGA reconfiguration

40 years EWI

A photo report on the faculty's 40th birthday

Edition 13.2

January 2010

Hier invoegen: pagina2vanderlande.pdf

From the Board

As I write this little piece for you it is already January. Almost half of our year as Board of the ETV is already over, and time went fast for all of us. The agenda was full of nice activities, especially in the month of December. The excursion to Dutch Space was a great success, twice as much people as we had room for wanted to come! Also, a select group of members visited Huisman. Besides we had lots of lectures: ASML visited us to introduce their company, an engineer from TNO explained how spectrum auctions work and the lecturer of the year, Mr. Janssen, took us with him into the world of audio. On top of that the traditional December activities like the Sinterklaaslunch and the Kerstlunch- with our famous homemade Glühwein- have taken place. These were great opportunities to meet each other outside the lecture halls, and have some informal contact. The AkCie, a committee consisting of first year Bachelor students, has organised her first activities: a pancake-eat-competition and a gnomedrink. Many enthusiastic people came and participated. Of course you can read about all these activities in this edition of the Maxwell!

We as the Board have also had some nice experiences in the last period. We went to a few proms and parties to relax from the hard work that has to be done every day. But we also visited companies and professors to maintain the relations of the ETV with several companies and people within and outside the faculty. As the Board of the ETV you get to know a lot of people, which is interesting on its own, but also offers great opportunities.

As fun as it is for us to look back and see what activities we have had in the last quarter, there is more to be done planning the new activities for the upcoming third quarter of the year. You can already subscribe for the excursion to the CeBit, a big computer fair in Hannover, Germany. There will also again be lectures, of course with a nice, homemade lunch. Another point of attention is the evaluation of the courses. Special attention of course is paid to the first year Bachelor students- the future of the student population. But this year the evaluation of the minors has been renewed, too. More Electrical Engineering students choose a minor outside the faculty, so it's interesting to see if they like it and how they perform.

If you have courses to complain about or want to take part in the evaluation of educational issues just contact us!

But also for other questions about the faculty and the study or for a cup of coffee you are invited to visit us in the board room.

On behalf of the inviting board,

Imke Zimmerling, President

Column

Thinking about sustainability

Four years ago I did not realize that I would have been confronted with sustainability during my study in Electrical Engineering. Thereby, sustainability has nothing to do with the skills a good engineer should possess. Every hour education focussed on sustainability is therefore subtracted from the valuable technical classes.

For instance, the master Electrical Power Engineering is changed into Electrical Sustainable Energy and for what? Are innovation and technology making place for policy and politics? Don't you think this is a reason why the level and thrill of our education is decreasing during the last years? Is that the reason why I am not always feeling comfortable with the way the Sterkstroomdispuut is pushed towards sustainable propaganda?

Apparently, the TU Delft is not the only educational facility on which students have to deal with the same issue. Some months ago I read the article 'Sustainability is a waste' on the website of the National Association of Scholars. The NAS is an association of academics that stands for intellectual freedom and sustaining the tradition of reasoned scholarship, something the TU Delft is far from. This article stipulates why sustainability should be avoided with regard to a certain specific educational program like Electrical Engineering. Probably a part of the American academics still has an idea of what is called 'freedom' and is willing to stick to its principles.

There is nothing wrong with an interest in sustainability. If you want to study a master in Sustainable Energy Technology (SET), it is your individual choice. Whether you want to become a member of the Energy Club or not, that is your choice. Everyone should be aware of making choices themselves and thinking of the consequences every other choice has.

Finally, I found it interesting that a discussion about sustainability often ends with "No, I think we should do something against...". Who is we? I guess we all can make choices ourselves and learn from our mistakes, which sounds more obvious than it is often applied.

The President of the Sterkstroomdispuut needs to make choices consistent with his own principles that do not offend, affect or harm anyone. Why is it sometimes not appreciated to have principles and sustain values?

Should we all become politicians?

Menno de Haas, President of the Sterkstroomdispuut

Contents

ETV MAGAZINE "MAXWELL" Year 13 – edition 2 – January 2010 **PRINTING** Thieme Media Services, Delft **NUMBER OF COPIES** 900 **EDITORS** Ben Allen, Joost van Driel, Benjamin Gardiner, Stephan Groot, Maarten Kastelein, Jeroen Ouweneel, Imke Zimmerling **CONTACT** Maxwell, p/a Electrotechnische Vereeniging, Mekelweg 4, 2628 CD Delft, phone: 015-2786189 or 015-2781989, fax: 015-27 81002, e-mail: maxwell@etv.tudelft.nl, website: www.etv.tudelft.nl **CHANGE OF ADDRESS** Please send your changes to the address above, or use the website. Alumni can change their address via the Alumni Office website: www.alumni.tudelft.nl. **ADVERTISEMENTS** Vanderlande (p.2), Technolution (p.24) **SUBSCRIPTIONS** Non-members can receive the Maxwell four times a year, against a contribution of €10,- per year. For more information, please contact the Maxwell Committee.

Smart Grid

In this article the IEC (International Electrotechnical Commission) explains the challenges, that need to be overcome in order to develop a smart grid, i.e. bringing the information age to the power grid.

40 jarig bestaan EWI

Vanwege het 40-jarig bestaan vindt u hier een fotoreportage over het gebouw waarin de opleiding Elektrotechiek is gehuisvest.

Newsflash

Flexible solar cell implant could restore vision

The first flexible retinal implant could restore some vision to people with certain forms of visual impairment. Conditions such as age-related macular degeneration occur when some of the photoreceptors in the eye stop functioning properly. But as other parts of the eye still work, it should be possible to restore vision using an implant that mimics the photoreceptor layer, says Rostam Dinyari at Stanford University in California.

To achieve this, an implant needs to convert a light signal into an electrical pulse – in other words, perform like a solar cell. But most solar cells are rigid, which makes them far from ideal for use inside the eye. "If you have a lens, the focal plane is always curved and the best picture forms on a spherical surface," Dinyari says. This is why the retina is curved.

Rigid implants

Using rigid chips, a large number of small implants must be fitted in order to approximate the curve of the retina. A flexible implant would simplify matters. "You would need a lot of surgery to implant a large enough number [of rigid implants] to cover the retina," says Dinyari. A flexible implant "would use just one surgical procedure".

While several companies are developing rigid implants, Dinyari and colleagues have designed a flexible silicon implant. They did so by carving deep grooves into the silicon between adjacent solar cell pixels that are each just 115 micrometres across. The implant would be inserted over the most damaged part of the retina. A glasses-mounted camera would capture video, convert it to near-infrared signals and project it directly onto the implant.

Projecting images

When hit by the light, the solar cells inject current patterns corresponding to the projected images into neural tissue, which ultimately arrive at the visual cortex via the optic nerve. Near-infrared signals are used as they do not interfere with the surrounding intact photoreceptor cells, which send signals to the brain as normal.

Initial trials using retinas extracted from pigs showed that the implant could be inserted without damaging the fragile solar cell array. The team hope to implant the device into a live pig soon, before testing it in humans. Jason Dowling at the Australian eHealth Research Centre in Herston, Queensland, thinks the approach is interesting. "To the best of my knowledge I think this is the first implant which is shaped to the curved surface and this [approach] makes a lot of sense," he says.

Source: Colin Barras, New Scientist

Image above: Macular degeneration occurs in the central section of the retina

Solar cell breaks efficiency record

Boeing-Spectrolab has developed a solar cell that can convert almost 41 percent of the sunlight that strikes it into electricity, the latest step in trying to drop the cost of solar power. Potentially, the solar cell could bring the cost of solar power down to around $3 a watt, after installation costs and other expenses are factored in, over the life of the panel. Current silicon solar cells provide electricity at about $8 a watt, before government rebates. The goal is to bring it to $1 a watt without rebates or incentives. The cell achieves 40.7 percent efficiency. The Department of Energy has been sponsoring research to find ways to get solar cells past the so-called 40 percent barrier.

Earlier this year, researchers at Lawrence Berkeley National Laboratories reported that cells made of a new type of semiconductor, zinc-manganese-tellurium, combined with a few atoms of oxygen, could convert around 45 percent of sunlight into electricity. That technology, also partly sponsored by the Department of Energy, has been licensed to RoseStreet Labs in Arizona. It remains to be seen whether this material can be made into solar cells economically.

Sharp Solar, one of the biggest solar companies in the industry, showed a solar cell offering 36 percent efficiency earlier this year. The Sharp cell includes a concentrator--a thin lens that focuses sunlight on the cell--but is not made of silicon. It instead is made out of III-V compounds, molecules made from elements in the III and V columns of the periodic table of elements. (The metallic element gallium-used in semiconductors and optoelectronic devices-is from this neighborhood.)

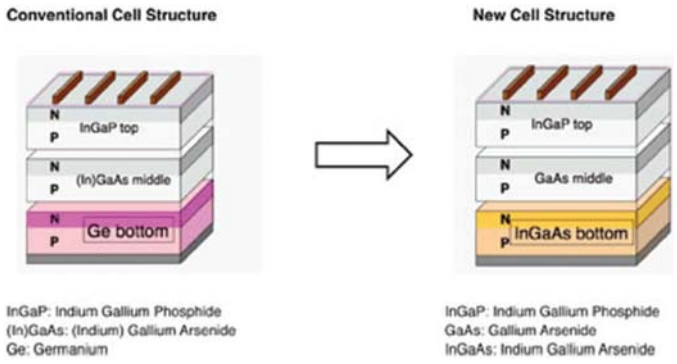


Illustration of Sharp's new solar cell structure

Currently, the best commercial silicon solar cells can convert 22 percent of the sunlight that hits them into electricity, and physics dictates that maximum efficiency for these cells will come at around 26 percent. Boeing got around that barrier by integrating two technologies. One, the solar cell, contains a layer of concentrators. From a practical point of view, using a concentrator is like adding extra surface area to the cell. The solar cell also contains more than one material. Silicon cells interact with only a limited part of the light spectrum. Additional layers of gallium arsenide or other materials can convert light in other portions of the spectrum into electricity. Making so-called multi-junction solar cells is more expensive than making single-junction silicon cells. Still, many companies believe the higher manufacturing expense can be offset by cost savings from the cells' greater electrical output. Boeing, however, did not state what materials it used in its cell.

Source: Michael Kanellos, CNET news

MIT, VW Group Team on AIDA

A collaborative effort between the Personal Robots Group at the MIT Media Lab, MIT's SENSEable City Lab and the Volkswagen Group of America's Electronics Research Lab is set to yield the Affective Intelligent Driving Agent (AIDA). AIDA is an in-car personal robot that is designed to alter the way drivers interact with their vehicles. Professor Carlo Ratti, director of the SENSEable City Lab, commented, "In developing AIDA we asked ourselves how we could design a system that would offer the same kind of guidance as an informed and friendly companion."

Professor Cynthia Breazeal, director of the Personal Robots Group at the MIT Media Lab explained, "We are developing AIDA to read the driver's mood from facial expression and other cues and respond in a socially appropriate and informative way." Over time, researchers believe that a symbiotic relationship will develop between the driver and AIDA, whereby both parties continually learn from one other and establish a strong bond. "When it merges knowledge about the city with an understanding of the driver's priorities and needs, AIDA can make important inferences," said Assaf Biderman, associate director of the SENSEable City Lab. "Within a week AIDA will have figured out your home and work location. Soon afterwards the system will be able to direct you to your preferred grocery store, suggesting a route that avoids a street fair-induced traffic jam. On the way AIDA might recommend a stop to fill up your tank, upon noticing that you are getting low on gas," added Biderman. "AIDA can also give you feedback on your driving, helping you achieve more energy efficiency and safer behavior."

Source: TMCnet blog

Concept of the AIDA user interface

Activities of the Electrotechnische Vereeniging

Lunchlezing ASML

Auteur: Lennart Klaver

De lunchlezing van ASML was een leuke en interessante blik in de componenten waar elke elektrotechnicus mee werkt, de IC's. De presentatie was meteen een aanvulling van de kennis van de vakken Elektronische Circuits 2 en het ontwerppracticum.

ASML is een bedrijf dat onder andere machines ontwerpt en produceert voor het lithograferen van wafers. Lithograferen is het belichten van de silicium wafers, zodat het ontworpen patroon op de fotogevoelige laag van de wafer terecht komt. Na het lithograferen zal de fotogevoelige laag worden ontwikkeld en zal het overtollige silicium worden verwijderd. Door deze stappen te herhalen maakt men een chip in het silicium. De machines werken met de nieuwste materialen en technieken, met een versnelling van 0 tot 100 km/h in 1,6 seconden laten ze de gemiddelde sportauto achter zich.

De machines van ASML halen een minimale afwijking van 0.3 nm op een snelheid van 100 mm/s, equivalent met 2 Boeing 747 vliegtuigen op een snelheid van 1000 km/h die met een afwijking van 0.001 mm van elkaar op gelijke route vliegen. De nieuwste machine van ASML op basis van Extreme Ultra Violet haalt zelfs een snelheid van 600mm/s. De EUV-machine is gemaakt voor het 13 nm-procédé, de toekomstige chipstandaard.

Door middel van een laser worden druppels tin tot plasma verhit. Hierbij komen fotonen vrij met een golflengte van 13,5nm die door middel van een serie spiegels naar het spiegelende masker worden geleid. De reflectie van het masker wordt daarna via een andere serie spiegels richting het silicium gestuurd. Gebruikelijk is het om lenzen te gebruiken, maar vanwege de kleine golflengte zou de straal worden geabsorbeerd en dus onbruikbaar worden.

Verder is te zien dat van ASML ondanks de slechte economische markt toch groeit. Het aandeel van ASML is in het afgelopen jaar gestegen van € 12,50 naar € 22,-, de verkoop van nieuwe machines neemt helaas dit jaar wel iets af. Het vooruitzicht is dat de verkoop komend jaar zal toenemen door de EUV machine die rond 2010 op de markt komt. Het aantal banen bij ASML is sinds 2007 gegroeid van 6582 tot boven de 6930 personen in 2009.

ASML is op zoek naar nieuwe mensen om hun team te versterken. Een groot deel van het ontwerpteam heeft een universitaire titel, ASML staat ook dicht bij het universitaire onderzoek. Om tot nieuwe technieken te komen wordt er samengewerkt met diverse onderzoektakken, van het fundamentele vlak tot het mechanische vlak. Bij ASML zijn diverse internships beschikbaar, voor meer informatie: http://www.asml.com/

Lunch Lecture: Aspects of sound reproduction - A hobby that has gotten a little out of hand

Author: Joost Kerpels

Thursday the 26th of November, Dr.ir. G.J.M. Janssen gave us the opportunity to take a look into his personal home and his hobby. As lecturer of the year, he was asked to entertain us during lunch with an interesting lecture. He chose not to elaborate on his professional field, he'd rather explain us his hobby: sound.

First we got an explanation about what sound actually is; what aspects make sound nice to listen to and what meth-

Gerard Janssen explains how his audio system works

ods there are to achieve this aim. Mr. Janssen explained the techniques he has used to upgrade his cd player, his pre-amplifier, his filters and his power amplifier. Then he continued by explaining different types of loudspeakers. The usual kind of loudspeakers is the 'closed box', in which, as the word suggests, the speakers are mounted in a box, making the sound waves travelling in forward direction only. His latest project involves a different type of loudspeaker: the dipole. In this scenario, the speakers are free to radiate both forwards and backwards. When placed near a wall, in the right position, this gives a lot more depth in the sound than the closed box system. To suppress too much bass, he mounted this speaker in a closed box. Dr.ir. Janssen finished his presentation by showing us some measurement methods, and how to use these to improve sound quality.

To illustrate this lecture, and to show off with al the hours of hard work he put in this project, he gave everyone the opportunity to experience his system later on in the Jan Anthony Snijderszaal. Lots of people were amazed by the sound quality of the beautiful music he brought with him. He brought some towels with him, to cover the backside of the dipole, thus creating a closed box system, to illustrate the difference in depth. It was a unique experience to hear this amazing difference.

Excursie Dutch Space

Auteur: Remco v/d Plaats

Op 1 december was er door de ETV weer een excursie georganiseerd. Dit maal stond een bezoek aan Dutch Space, dat gevestigd is in Leiden, op het programma. Dinsdagmiddag om 1 uur werd er verzameld op het station waarna om half 2 een groep van 20 man met de trein naar Leiden afreisde. Eenmaal in Leiden moest nog een stukje worden gelopen waarbij onze kaartlezer behoorlijk in de fout raakte waardoor we een kleine city-tour door Leiden kregen.

Eenmaal bij Dutch Space werden we hartelijk ontvangen en konden we doorlopen naar een zaaltje waar we een presentatie over de activiteiten van Dutch Space kregen te zien onder het genot van een drankje. De presentatie bestond uit een filmpje waar een vluchtig overzicht van de activiteiten werd gegeven gevolgd door een toelichtende diapresentatie waar de bijdrage aan verschillende ruimteprojecten werd getoond evenals de zonnecellen die worden gemaakt in de clean-room van het bedrijf.

Deze presentatie werd direct opgevolgd door een tweede presentatie waar de werkwijze werd uitgelegd die wordt toegepast bij het ontwikkelen van delen van een raket. Dit kwam neer op vele controles zodat eventuele fouten of haperende schakelingen niet direct fataal zouden zijn waardoor de raket neer zou kunnen storten.

Dit waren interessante presentaties maar aan het einde van de tweede presentatie bleek dat de verwarming in de ruimte niet werd teruggekoppeld en gecontroleerd want het werd steeds warmer. Na de presentatie kregen we nog een rondleiding in de productie hallen van het bedrijf. Eerst kregen we de clean-room te zien waar we dit keer helaas niet in konden omdat er niet veel boeiends was te zien maar we werden van harte uitgenodigd om een volgend jaar weer te komen en dan wel een kijkje in de cleanroom te nemen.

Wel waren er op de bovenverdieping nog enkele interessante projecten te aanschouwen. Zo was er een robot die op dat moment werd getest en uitgeprobeerd en een tussentrap die tussen de eerste twee trappen van een raket zit en door Dutch Space was ontwikkeld. Ook kregen we het een en ander te zien van de zonnecellen die door het bedrijf worden gemaakt.

Inmiddels was de tijd voorbij gevlogen en om 5 uur werden we naar de bedrijfsbar geleid waar onder het genot van een hapje en drankje nog kon worden nagepraat over deze dag en nog vragen konden worden gesteld aan de mensen van het bedrijf. Rond kwart voor werd er een einde aan deze dag gemaakt.

Drink Lecture by TNO

Author: Wyger Brink

In the afternoon of Monday the 14th of December, Thom Jansen from TNO visited the ETV to inform everybody on the current trends in spectrum auctioning. In this process, many disciplines are involved like for instance law, politics, economics and electrical engineering. It therefore forms an interesting environment for the electrical engineer.

As we all know, the electromagnetic spectrum is a limited resource. Many mobile services are being developed and these services need an appropriate part of the spectrum to be operational. To coördinate the allocation of the spectrum, several methods have been applied in the past. Procedures like centralized allocation, beauty contests, 'first come, first served' and even lotteries have determined who could transmit on certain frequencies.

Since the 90s, auctioned licensing has become a popular method. It offers a fair way to efficiently allocate the spectrum, while at the same time stimulate competition in the telecommunications market. Tremendous amounts of money are being transferred to the governments this way, with the legendary UMTS-auction in the UK topping everything in the year 2000. In total, this auction had revenue of 37 billion (10^9) €. With respect to the amount of inhabitants, a total of more than 647 €/p.p. was paid for 140 MHz of spectrum, an investment that would actually take a very long time to pay back.

On the contrary, the UMTS auction was a major flop in the Netherlands. Here, the auctioning of 120 MHz of spectrum yielded a total revenue of just 2.6 billion € (169 €/p.p.), while economists expected 10. The auctions attracted too few bidders, strange bids were placed which led to questions of whether there was collusion (secret agreements amongst companies). The auction ended in turmoil and newcomers claimed they didn't have any chance of entering the market this way.

In the future, auctioning will remain a key process in sharing the spectrum. Upcoming auctions are in the 2.6 GHz band which are being held in 2010, and the re-auctioning of the 900/1800 MHz bands in 2011. In 2011/2012, the 800 Mhz bands (which are now mainly used for television broadcasts) will be re-auctioned and in 2013-2014 the 3.5 GHz band will be re-auctioned.

After the lecture, TNO offered the participants a drink in the \Pub to discuss the topic. The drinks were luckily, in contrary to the frequency bands, acquired without the intervention of an auctioneer.

Excursion to Huisman

Author: Joost van Driel

At October 15th twelve students visited the company Huisman. It produces very large cranes that will mostly be used on ships. Huisman also has a daughter company that produces roller coasters. The company is situated all over the world, to provide service and, of course, selling.

When we arrived at the Huisman headquarters in Schiedam, we were surprised with some coffee and cake. While enjoying that, we listened to our host Fred Kofman who gave us a short introduction to Huisman and what their researchers are currently working on. The best way to talk about the research is to let a researcher tell the story. In this case that researcher was Johan Lops, Electrical Engineer. He was working on the newest product of Huisman, their 5000 Ton crane. He designed the whole electric circuit of this crane, that is currently being build in the hall next to the offices.

The electric circuit consisted of a couple of voltage rails, all DC, except for the generator. All of the devices attached to the crane are connected to these voltage rails, such as the motor to rotate the crane, the driver's control unit, the (also enormous) lights and the winches. The main winch has a very complicated system that keeps the load stable during the lift. This was the main subject of the lunch lecture Huisman gave in the first quarter of this academic year.

After the lectures another Electrical Engineer joined us to divide us in two groups and to give us a tour. The first hall we attended was the production hall, where bearings of the 5000 Ton crane are being made. Huisman had to create them itself, because no other company can make bearings that have a diameter of 12 meter.

After that we went to the assembly hall. Some parts of the 5000 Ton crane where waiting to be assembled there. Further down the hall was a door to the electric testing hall. A couple of electric motors, a lot of (very big) testing wires and a test setup of a crane were some of the objects in there. The next hall was the hydraulics hall, with some (again) large hydraulic cylinders. We had to get out of the room quickly, because the workers started testing a hydraulic system.

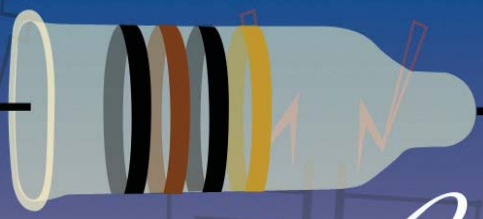
Outside there were some cranes or parts waiting to be put on a ship. But more important to us Electrical Engineers, they just installed a test setup for their new heaving compensation system. It uses a lot of very large super capacitors, in that way can the crane store its energy when it is on the rising flank of a wave. When the ship is on the other side of the wave it can use that same energy again. These capacitors have to be charged and discharged in very few seconds. It has two kinds of control systems, the newer one is still under research, so it did not overrule the old one, that has purple wires.

The delegation of the ETV at the site of Huisman

Het groote ETV

Joost may know it

How are condoms electronically tested?



Condohm

Author: Ben Allen

During a coffee break in the ETV Boardroom, someone asked the following question: "It says on the packaging that condoms are electronically tested. But how?" Frivolous as it may seem, this is an important question, as condoms must be tested non-destructively and should, ideally at least, never fail.

A common destructive method of condom testing is an air-burst test, where a condom is filled with air until the material cannot hold the pressure anymore. To pass the test, a condom should be able to hold approximately 10 litres of air, but modern condoms are capable of much more than that.

Another destructive test is the water leak test, which is used by the the United States' Food and Drug Administration, where a condom is filled with 10 ounces of water and is then observed to see if there are any leaks.

The third common destructive test is the tensile test, also known as the stretch test. This method involves slicing a band from the shaft of a condom, and then testing its stretchability.

The problem with destructive tests is that they destroy the product being tested, and therefore cannot be used on every condom. It's used to single out problems with a batch of condoms, but cannot guarantee reliablity. For this reason, it is preferable that all condoms be tested, and the electrical test was developed for this purpose. There are multiple ways of electronically testing condoms, but two methods appear to be most prevalent.

The first test involves placing the condom to be tested over a mandrel, which is a metal device to hold the condom. It is then passed through an electric field, and if the mandrel registers any electric current then the condom fails.

The second electronic test is a similar test where the condoms are again placed over a mandrel, and then placed in a basin of conductive liquid. At this point a voltage is applied to the mandrel, and once again if the apparatus measures a current the condom fails the test.

These electrical tests allow each condom to be tested individually before they are shipped, increasing the safety of condom users worldwide.

Graduation report

An audio processor using partial FPGA reconfiguration

I'm a musician. Of course, now that I've graduated I am an engineer as well, but I was a musician long before I even aspired to become an engineer. How is this relevant to the article, you ask? Well, it is one of the two main motivation to dedicate my thesis to this particular subject. Please indulge me for now, and everything will come together by the third paragraph. As is to be expected, I've had a special interest in sound for most of my life. More specifically, the generation and manipulation of sound. I play the synthesizer, and spent many an hour tweaking the individual sounds and sound effects.

Author: Siebe Krijgsman M.Sc.

As many of my fellow engineers may affirm, there are many misconceptions about what we electrical engineers do, which can partly be blamed on our general inability to explain to people what it is exactly that we do. This, in turn, can be blamed on the number of technical terms and intangible concepts present in such an explanation. For this very reason, I decided to create something physical, something visual, something that can at least partly show what I've been doing at EWI for the last couple of years.

As promised, both these reasons will now find their way into my project. My project's name was PRAGMA, which stands for Partial Reconfigurable Audio Generation and Manipulation Application. There, I sprung it on you. Now let's take a moment to analyse that name, starting with the easy part. "Audio Generation and Manipulation" is pretty much self-explanatory, but in the context of this project it means that my project is able to generate and alter sounds, much like you would expect from a synthesizer or a guitar effect pedal. The last section, "Application", refers to the fact that this is an actual, in this case even physical, device rather than an idea or a research project. What we are now left with is "Partial Reconfigurable". This is where it ties into the actual engineering. Sure, it is nice to just do a project on the subjects of things you like, but at some point we have to do something that has actual scientific value. Having gotten the easy part out of the way early, most of the remainder of this article will explain what partial reconfigurable means and how it is applied in this project.

The notion of partial reconfiguration is directly linked with Field Programmable Logic Arrays, or FPGAs. In order to be able to explain the concept of partial reconfiguration, a short explanation of the internal structure of an FPGA is in order.

FPGA layout

From a macro design perspective, an FPGA consists of look-up tables (LUTs), connection blocks (C-blocks) and switching blocks (S-blocks). The lookup tables can be programmed to behave like any binary function and are generally based on 4 inputs and 1 output. A 4 input LUT is shown in Figure 1: LUT, where the four inputs are used to select one of the 16 saved values. When combined with a memory element, such as a flip-flop, we end up at a Basic Logic Element (BLE), shown in Figure 2: BLE. In order to facilitate easy routing,

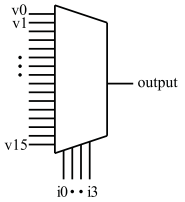


Figure 1: LUT

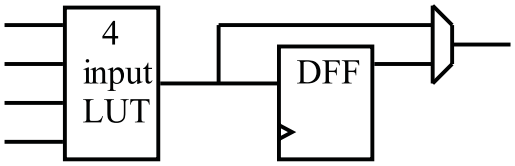


Figure 2: BLE

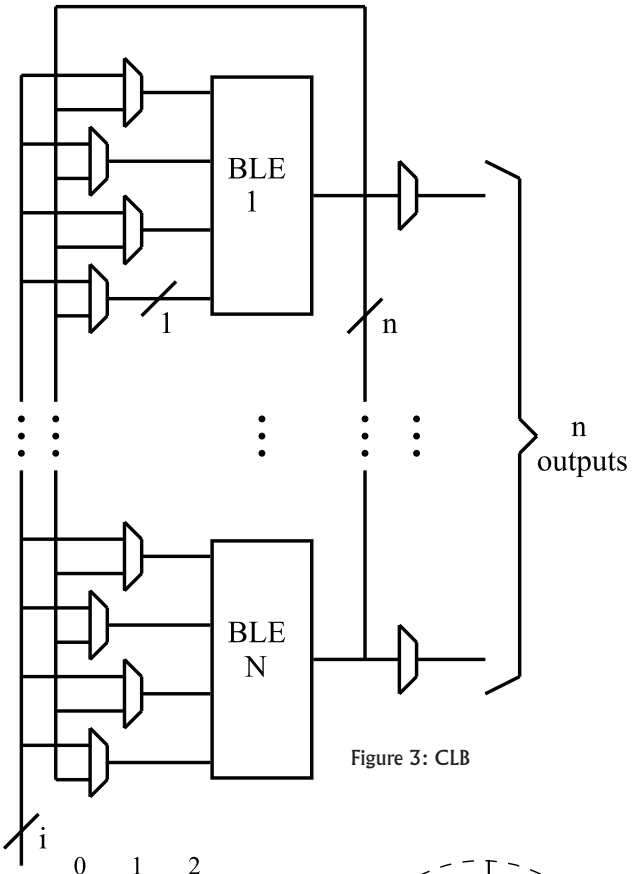


Figure 3: CLB

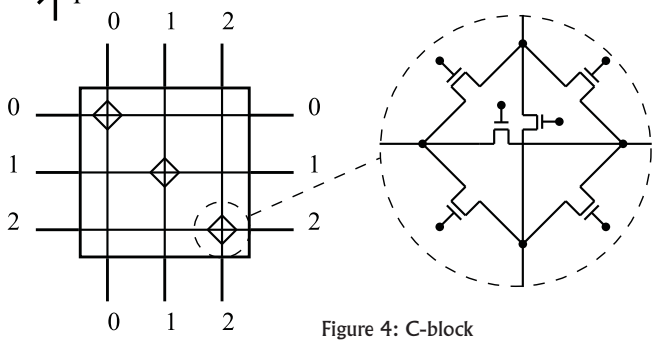


Figure 4: C-block

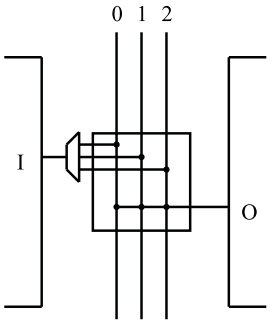


Figure 5: S-block

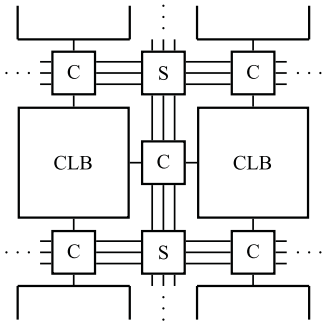


Figure 6: FPGA Layout

we would like to group BLEs together and build an infrastructure of routes around the formed clusters. These clusters of BLE, commonly referred to as Configurable Logic Blocks, or CLBs, with i inputs and n outputs are shown in Figure 3: CLB. When we arrange a number of CLBs in a structure connected by connection- and switching blocks, shown in Figures 4: C-block and 5: S-block, respectively, we arrive at the standard FPGA layout depicted in Figure 6: FPGA Layout. This layout is often referred to as an "island-style" layout.

FPGA configuration

An FPGA is a structured grid of standard logic cells that can be programmed to fulfil any desirable function. FPGAs, or more specifically the Virtex-II Pro used in this project, are addressed in columns of CLBs. This means we cannot program every single CLB separately, but we can program a single column of CLBs. This is the basic premise of partial reconfiguration. When doing a "normal" reconfiguration, all logic present on an FPGA is erased, and the entire range of CLB columns is reprogrammed, one at a time. However, when we conduct a partial reconfiguration we do not erase the entire FPGA, we merely change the logic in several columns, leaving the logic in the remaining columns intact. The main benefits of this technique are the ability to change the functionality of an FPGA, while retaining data previously calculated for further processing, as well as a decrease in reconfiguration time (directly proportionate to the percentage of the chip that is reprogrammed).

Partial reconfiguration

Of course partial reconfiguration also introduces several challenges. Firstly, we have to ensure that the new logic that we program onto several columns of the FPGA connects to the rest of the "old" functions correctly. This may sound trivial, but since in the "normal" reconfiguration scheme we had a program decide the location of all logic, we need an entirely new program that takes the already programmed logic into account. The program that I used in my thesis project was PlanAhead, a part of the Xilinx Design Suite. Although at the time PlanAhead was still under development, it has been since included in Design Suite 11 as a fully functioning tool.

There are several strategies for implementing partial reconfiguration, but as I lack the space to explain

them all, I will constrain myself to the one used in this project. As mentioned earlier, we can only target a single column in the FPGA. Recalling the fact that we have to implement some sort of security that the new hardware will connect to the existing section, we have to build in a connection at the edge of the reconfigurable column, or Partial Reconfiguration Region (PRR). This connection is what Xilinx calls a Bus Macro, depicted in Figure 7: Bus Macro. As you can see, this Bus Macro is nothing more than a connection from one side of the boundary to the other. However, the fact that these macro's have to be pre-placed in the design ensures that connections on the inside of the PRR and on the outside logic align perfectly.

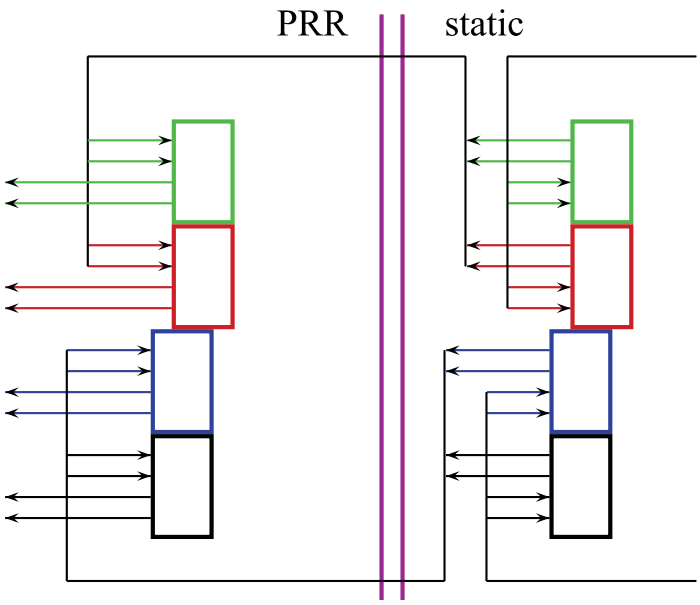


Figure 7: Bus Macro

The demonstration platform

Now that the hardest part is out of the way, I will tell you a little about the final demonstration platform, and the components used in this design. Figure 8: System Design shows the design used for the final demonstration platform. Now, this picture may need some clarification. First, on the left side of the figure there are two components marked "ADC" and "DAC": the analog to digital converter and vice versa. These components make sure that the analog signal coming in from, and going out to, the outside world is converted to a digital counterpart that we can perform operations on. The next two blocks I will briefly discuss are the blocks marked "FFT" and "IFFT": the (Inverse) Fast Fourier Transform. These blocks take range of samples from the time-based signal, for example 1 millisecond, and convert it into the frequency domain. This is similar to what you see on the equaliser of a stereoset, the signal divided up into frequency bins, ranging in this case, from 50 Hz up to 15 kHz. The Inverse transform does the exact opposite, changing the signal back to its original state. The component marked "Video output generator" does, well, exactly what you expect: It generates a video output which can be shown on a screen.

What we are now left with are the main components of this platform. The "PRU Time" and "PRU Freq" are the Partial Reconfigurable Units for the time- and frequency domain, respectively. These blocks represent the regions where several different functions were to be implemented. The block dedicated to time domain functions had a few different implementations, such as an echo, a reverb and a tremolo. The frequency domain block housed the frequency specific effects, such as filtering, phasing and vibrato.

In order to give a little bit of background on effects, I will explain one of the easier to understand effects: the pure delay, the basic building block for the echo effect. The idea of a pure delay is that we feed the input directly to the output, but we also add a delayed version of the input to the output signal. What we get is a single, continuous echo, heard after the amount of time determined by the delay element. If we now apply a feedback loop, i.e. we add a portion of the

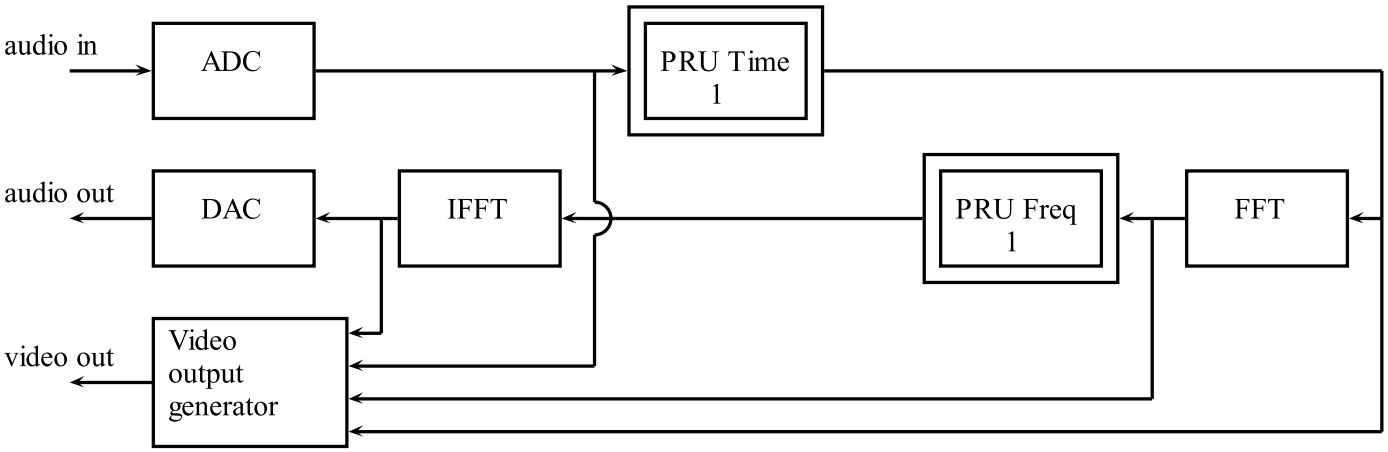


Figure 8: System Design

delayed signal to itself, we get an echo that repeats every time the delay time passes. In this case, of course, we need to use a feedback gain that is smaller than 1. Would we use a value larger than one the signal would just amplify out of control, and if we use a value of 1 (or close to one) the echo would not diminish over time and the sound would just blur together. The effect we have now gained is shown in Figure 9: Echo. The graphical signal obtained when testing this effect can be seen in Figure 10: Echo Signal, which clearly shows that a single impulse on the input results in a periodic and decaying recurrence of this signal.

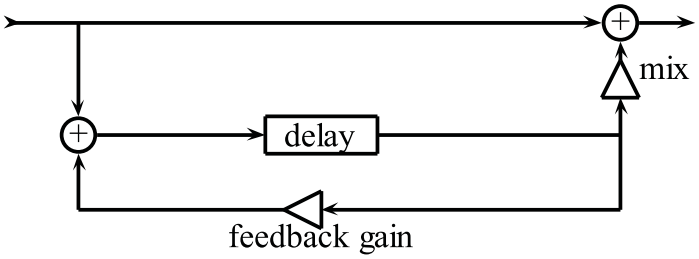


Figure 9: Echo

Goals and conclusions

I realise it's strange to bring up my thesis goal for the first time in the last section, however it was not required to understand the story thus far, but it does relate to the conclusion of my article so here it is: The goal of this project is to design and implement an audio processor making use of the partial reconfiguration technique. This goal was reached, and in fact the platform was able to mask the reconfiguration time required to perform the switch of different elements, leaving no mark of reconfiguration when music was played though this platform. Moreover, and maybe more importantly, this project provides an understandable and easy to use platform for engineers to learn about, and experiment with partial reconfiguration.

If anything in this article has sparked an interest, further reading is available at http://tinyurl.com/pragma-thesis. If, for any reason, you feel the need to check out/use/criticise my code, it is available through http://code.google.com/p/pragma-fpga/.

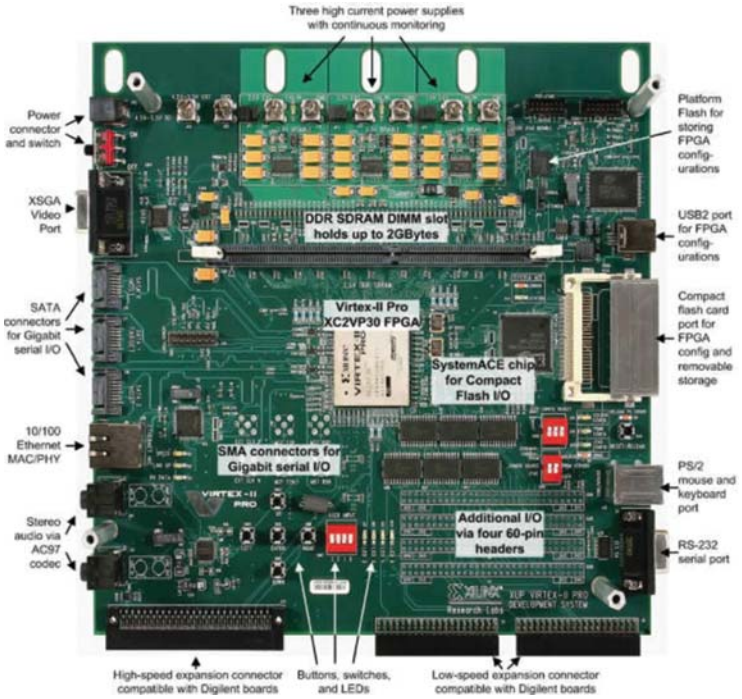


Figure 11: The Xilinx FPGA board that was used

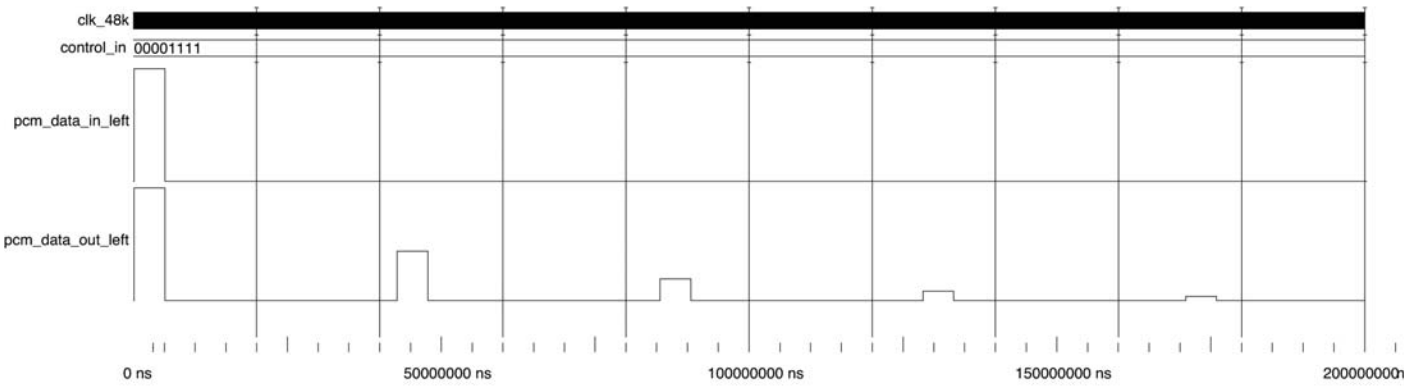


Figure 10: Echo Signal

Smart Grid

... bringing the information age to electric power grids

Author: IEC

It's late September, at night. The power goes down and a whole country is blacked out for hours. Trains and buses stop, lights are out, automobile traffic is chaotic. People mill everywhere not knowing what to do. Power companies struggle to respond.

No, this is not the start of a horror movie but what really happened in Italy in the night of 27 September 2003. This is the night of the annual White Night festival in Rome. The blackout caused the festival to end early. Several hundred people were trapped in underground trains. Coupled with heavy rain at the time, many people spent the night sleeping in train stations and on streets in Rome. Throughout Italy, 110 trains were cancelled, with 30,000 people stranded. All flights in Italy were also cancelled. The blackout did not spread further to neighbouring countries, such as Austria, Slovenia and Croatia, all connected to Italy but part of the Canton of Geneva suffered a power outage for three hours.

The need to do more with less

To satisfy global energy needs and protect our planet, we must become increasingly efficient in how we produce, distribute and use energy. Experts predict that by the year 2050 worldwide energy consumption will have doubled. At the same time we need to reduce CO_2 emissions by at least 50%. This means that we need to increase total energy efficiency by a factor of 4. Smart grids are one of the tools that will allow us to reach these goals.

Since the 2003 blackouts – the East Coast of the United States suffered a similar blackout in August 2003 – the focus has been on improving power grids. Smart grid is the latest buzz word in the media, but really only a nice name for an upgrade of the existing 20th century power grids, which used to distribute energy produced by large utilities to many users.

With the addition of new devices such as smart meters, computers and communication technology, the efficiency and reliability of electricity distribution and use can be greatly optimized.

"Smart grid means different things to different people," says Richard Schomberg Vice President Research at EDF (Electricité de France). Schomberg is also chairman of International Electrotechnical Commission (IEC) Technical Committee 8: System aspects for electrical energy supply, and convenor of the IEC Strategic Group in charge of Smart grids. "It is simply the concept of modernizing the electric grid. The Smart grid is integrating the electrical and information technologies in-between any point of Generation and any point of Consumption."

In Europe, the concern has been on the integration of renewable energy into existing networks. The challenge has been to connect these renewable sources to transmission and distribution networks that were not designed for it.

Smart grids allow better integration of electricity from renewable energy sources such as sun and wind, which may be only intermittently available. And, with more and more buildings producing energy, Smart grids open the possibility for small producers to sell back some of their energy production to the grid.

During peak consumption, intelligent systems and appliances may allow grids to "know" where energy is needed and to reduce consumption in non-critical areas. This can mean turning off a clothes drier for a few minutes or dimming the light in a warehouse. This is very important to utilities because it is costly to power up additional generators or import energy. On another note, through sensors, Smart grids permit utilities to detect problems in real time and often avoid them altogether.

"Smart Grid means different things to different people"

Provide transparent energy saving tools to the consumer

Until now, and despite the information age, most consumers would know about their energy consumption only once they receive their monthly invoice. Home energy-monitoring tools linked to the Smart grid will provide detailed real-time energy consumption information to the consumer. This will allow individuals to save on energy bills through more efficient appliances or by selecting low-peak times to perform certain tasks.

Increasingly, there is a need for standards that provide building blocks on two different fronts. On the one hand, standards need to address requirements. This allows utilities and distribution and transmission operators to document their needs. On the other hand, standards that apply to technical design and specification allow system architects and integrators to implement devices that not only speak the same language but also behave synergistically and could be interchangeable.

Utilities need to determine their requirements

Experience gained from the application of system engineering in industry demonstrates the importance of separating out requirements from any kind of solution. "Very often there's not enough separation between the two and the picture becomes blurred," Schomberg says.

Standards for requirements are a new concept. To be successful, utilities, regulators and distribution and transmission system operators need to discuss what they use today, how they process the information and to whom they send it. Utilities need to work out how, why and where intelligence needs to be added to the network.

Requirements can be considered as building blocks, Schomberg believes. "There are generic requirements – in metering, for example, utilities could reuse 80 % of the same requirements", he thinks. "It helps utilities not to reinvent the wheel. Vendors can recognize standard 'bricks' and manufacturers can see where the market goes. It's cheaper for the user and it also allows for competition."

The precondition for seamless interoperability

Systems engineering may be a mature industrial area, but its level of complexity is staggering. For one, the electrical system must remain in continuous operation at all times. Success depends on protocols and standards that ensure seamless interoperability of existing and new devices and systems. New parts from different suppliers must be integrated with existing legacy systems and the possibility for upgrades in the future must remain open.

The technical challenge is much more than the simple addition of a computer infrastructure to an electrotechnical infrastructure. In fact, each device that is connected to a smart grid is at the same time an electrotechnical device and an intelligent node. Today's interconnection standard needs to address both aspects concurrently. In the IEC, separate TCs are already dealing with each approach.

"There is a huge need for interoperability standards", says Schomberg, explaining that they allow you to buy pieces of equipment from any vendor and know that they will work in the same way. "It's more than interface standards," he says, "because they have to interact at a deep level in the same way."

The need for this 'new' brand of standards was born out of the change that is occurring in and transforming the world of power provision. The 'old' market was one filled with vertically integrated monopoly providers; the 'new' market is one filled with more and different players as re-regulation takes place. Relationships between them are increasing in complexity.

"Developments are happening quickly but separately in many technology areas, including communications, computing and sensing," says Giovanni Valtorta from Enel in Italy, Secretary of TC 8. "Many types of equipment are becoming standardized. Putting them together needs specific system approaches, so that the entire 'chain' provides the expected services." He adds that both electrical and intelligence aspects of power provision need to be dealt with at the same time.

IEC Global Standards for Smart grid

This unique, dedicated web portal, developed in cooperation with leading experts, provides the basis for building safe and efficient Smart grid projects. In addition to information about smart grids, regional differences and the purpose of smart grid standards, it also offers a comprehensive catalogue of interoperability, technical and performance standards.

This resource allows utilities and distribution/transmission operators to document their requirements and permits system engineers to integrate new devices from a wide array of different providers worldwide with the huge legacy systems, hile ensuring that future upgrades remain possible.

To visit the IEC smart grid portal, please go to: http://www.iec.ch/zone/smartgrid/

Cooking with...

Peter Morshuis

Home-made Cantuccini

Biscotti di Prato, better known as Cantuccini, are double baked hard almond cookies from the province of Prato, in Tuscany. Often, they are served with a glass of Vinsanto, an Italian dessert wine made by drying freshly harvested grapes on straw mats. Some dip their cantuccini in the wine to make them softer, but I would prefer them in their genuine brittle-hard state.

Some years ago, in Emilia-Romagna (next to Tuscany) I bought in a pasticceria a variety of cantuccini that was different. The cookies had been baked only once and they had a soft consistency. But the end result was really nice. The baker told me that traditionally in Emilia-Romagna cantuccini are baked only once.

You can use the recipe to make both and see which variety you prefer. If you want to keep them for more than a week than you should stick to the double baked version.

Ingredients (for ~50 cantuccini)

- Saffron (1 package)
- ½ teaspoon fennel seeds
- 100 g non-skinned almonds
- 50 g pine nuts
- 250 g flour (preferably Italian 00)
- 225 g sugar
- ½ teaspoon of baking powder
- 2 large eggs

Tools

- Baking sheets
- Mixer with kneading hooks
- One large and one small bowl
- Oven

Roast the almonds and pine nuts for about 10 minutes in an oven of about 180 °C. Crush the saffron and soak it in a teaspoon of hot water so it will release it's color and aroma. Crush the fennel seeds.

Combine flour, sugar and baking powder in a large bowl and mix well. Break the eggs in the small bowl, add the saffron mix and the fennel seeds and mix, not too long, you just want to have a mixture of uniform consistency. Now add the egg mixture to the large bowl and mix with the mixer using the kneading hooks. Finally, add the almonds and pine nuts again using the kneading hooks. You will end up with a rather sticky dough.

Divide the dough in three portions. Sprinkle your working surface with some flour and for about 10 seconds knead a piece of dough. Then –use more flour if things get too sticky- roll the dough into a kind of sausage shape about 30 cm long. Put it on an oven tray which is covered by a baking sheet. Use the same procedure for the two remaining pieces of dough. Put the oven tray in a pre-heated oven of 180 °C and bake for about 20 minutes until the sausages have a light brown appearance. Take the tray out of the oven and leave it for 5-10 minutes. Then use the largest knife you have, use it as a lever and cut diagonally peaces of about 1 cm wide. If you stop here you have the Emilia Romagna variety.

Put all the pieces back on the oven tray and dry them in the oven using a temperature of about 100 °C or as low as you can. You don't want to bake the cantuccini again, you just want to dry them. After an hour take them out of the oven, let them cool completely. You might be tempted to eat them warm, but they are much better cold!

Buon appetito!

Circuit Bodging

Laser Tripwire Sensor

One very important application of electrical engineering is security systems. Although fear of a Big Brother style continuous surveillance system might be justified in some places, we would once again like to remind you that technology can be used for Good as well as Evil. In this issue of Maxwell we present: a laser tripwire. It's been done in the movies, and now it's been done in Maxwell.

Author: Ben Allen

There are a multitide of reasons why you might want to protect an area from intruders. Perhaps you want to protect your fancy furniture from party guests. Perhaps you want to stop thieves from stealing your things. Perhaps you want to make your roommate jump three feet into the air when he goes to the kitchen to get a drink. Whatever your reasons, electrical engineering is applied in many situations to detect and deter would-be trespassers.

One obvious discussion point is that a laser sensor as simple as this one is easily circumvented. The laser's beam is easily visible, even more so if one introduces a dust or powder in the air. A replacement light source can take the laser's place while an intruder passes through the laser's light beam. The circuit also ignores the colour of the light, so an alternative light source is impossible to detect. Cutting the power to the circuit will also defeat it. However, this is not meant as a fool-proof security system, but more as a proof of concept and a fun little circuit to play around with.

First we will need to choose a sensor to measure the light falling onto it. There are many choices on how to approach this, a photodiode is frequently used for this kind of application. Unfortunately these do need a fair amount of circuitry to get a useful output from the sensor.

An easier method is the light dependent resistor, or LDR.

Figure 1: Symbols for an LDR and photodiode

An LDR's resistance is logarithmically and inversely proportional to the amount of light striking it. This gives it useful properties for our sensor design.

However, building an ohm-meter around the LDR to measure its resistance would be a rather convoluted and unnecessarily complicated excercise. What we're going to do is design a simple circuit around the LDR to turn on a transistor at a certain trip level to provide a logical '1' or '0' to the next stage of the circuit.

First, we must turn the resistance into a voltage. We achieve this by using it in a voltage divider. As the resistance of the LDR changes, so does the voltage at the output of the divider, so when the LDR's resistance drops because light is hitting it, the output voltage of the divider goes up.

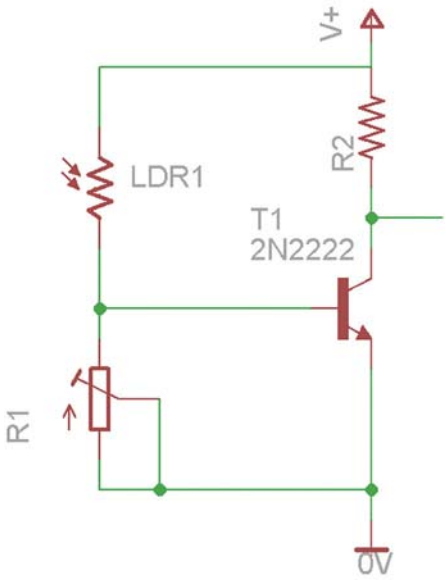


Figure 2: LDR sensor and surrounding circuitry

When the voltage is high enough, T1 will turn on and allow a current to flow through it. Because T1's emitter is connected to 0V, the voltage across it is low and this, in turn, keeps the power low. A 2N2222 in this configuration can sink a fair amount of current before it starts to exceed the power rating threshold.

When the LDR's resistance is low the transistor will conduct, causing Vcc to be low, a logical '0'. When the light source (our laser) is removed the transistor no longer conducts, and as such Vcc rises, delivering a logical '1' at the collector. When you build the detector, adjust the trimmer R1 to set the sensitivity.

The next step is to create a circuit that will 'remember' if the sensor has been tripped. This is achieved by implementing a basic S/R latch with NOR gates.Take note that the symbol in the schematic is non-standard, but does represent a NOR gate, and not a NAND as might be assumed.

The simple S/R latch has one illegal combination, namely both inputs being high. If this occurs both outputs drop low. At this point the latch no longer obeys the rule that the outputs must be each other's inverse, however this is a useful combination for our circuit: while S1, the Reset button, is pressed, the sensor is disarmed.

When the sensor's LDR is illuminated sufficiently and the output was not yet high, the output of IC1A will be high, illuminating the "armed" indicator LED.

When the sensor is tripped the latch will switch outputs and IC1B will output high. IC1A drops to logical '0' and the indicator LED turns off to indicate that the alarm cannot detect further intrusions until the reset switch is pressed. This is a moot point, however, because - depending on the user's configuration - alarms will be going off and lights will be flashing and everybody in a 200 metre radius will be aware of the fact that something is going on.

Now we have a system that will detect the light beam being obstructed and continue to provide a high signal until it is reset. What we must do now is use this digital signal to activate any alarm signals we might want to use.

In the schematic below, the signal from the latch activates relay K1, which will make it possible to connect any alarm or light or siren we want. This is done by once again using a 2N2222 as a current sink. However, the logical high signal could concievably be connected to a microcontroller for inclusion in a larger security system - but that is beyond the scope of this article.

Part list:

LDR1:	**Any LDR**
R1:	**100kΩ trim**
R2, R3, R4:	**680Ω**
D1:	**1N4148**
LED1:	**Any LED**
T1, T2:	**2N2222 NPN**
IC1:	**xx7402 Quad NOR-gate**
K1:	**Any applicable relay**
S1:	**Momentary NO push button**

Another option is to replace the relay with a buzzer, creating a quick-and-dirty alert. Please note that the relay is not necessary if you're just going to use an LED - this can be connected directly to the logical signal in series with an appropriate resistor.

As always, the reader is encouraged to experiment with and improve the circuit, as it can be implemented in various ways, but please remember it cannot replace a commercial alarm system. So there you have it, a laser tripwire for your home security system that will stop your enemies dead in their tracks by scaring them to death!

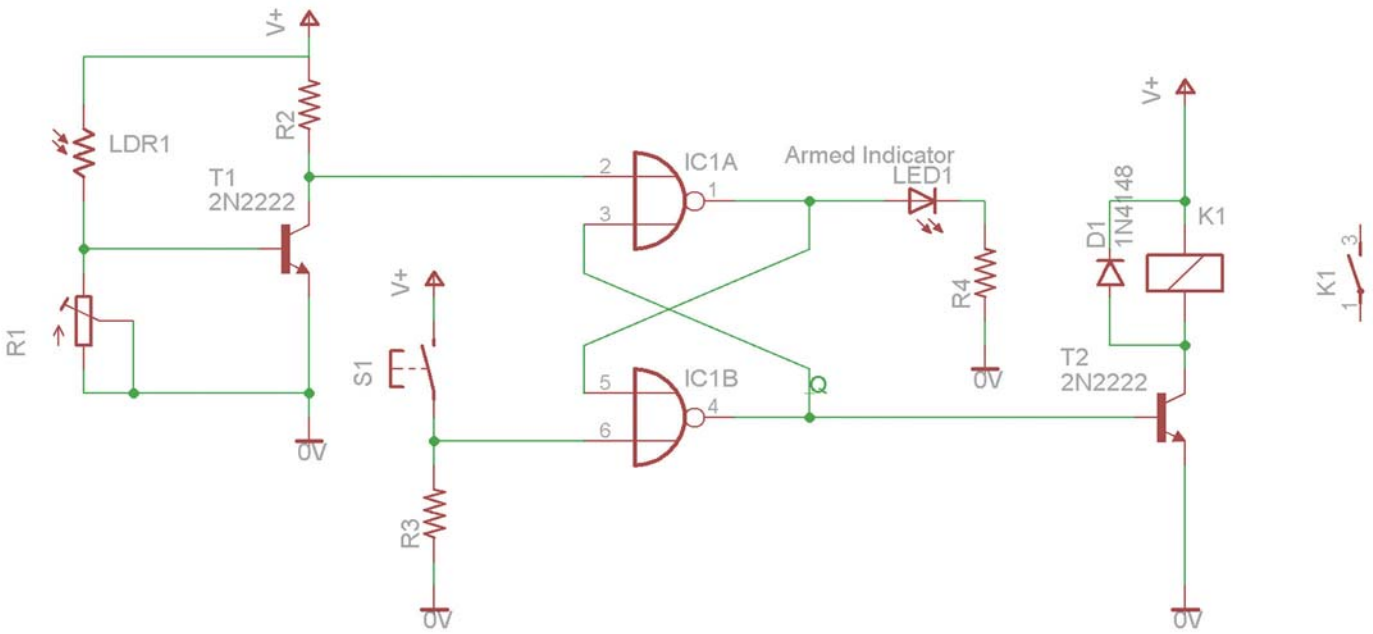


Figure 3: The complete circuit

Gebouw Elektro

DELFT, WOENSDAG, 2

Op 16 juli 1962 sloeg de toenmalige Rector Magnificus van de Technische Hogeschool Delft, prof.dr. R. Kronig, de officiële eerste paal voor de nieuwbouw van Elektrotechniek. Hier weergegeven markeren studenten de plaats waar het gebouw moet komen. Alhoewel niet direct zichtbaar, bezit het complex enkele constructieve aardigheden. Door de betonnen stabilisatieschotten is de hoogbouw één van de stijfste staalbouwen in Nederland. Volgens bouwgemachtigde prof.dr.ir. R.M.M. Oberman en architect G. Drexhage heeft de hoogbouw bij windkracht tien slechts een maximale uitwijking van twee centimeter. Het gebouw is ook het tweede met elektronisch bestuurde lift in Europa.

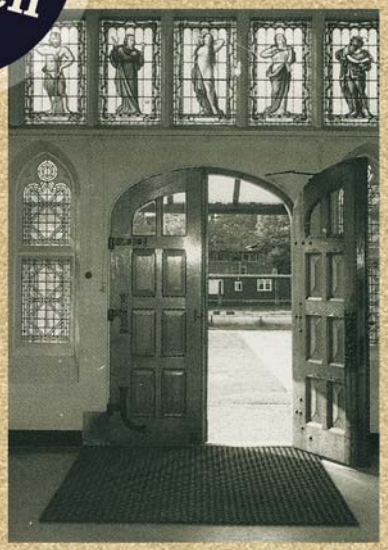
De nieuwbouw van de Afdeling der Elektrotechniek is vandaag officieel geopend door de minister van Onderwijs, Kunsten en Wetenschappen dr. G.H. Veringa. Hij zag "een indrukwekkend en zakelijk, maar toch prettig aandoend complex gebouwen, dat functioneel aan zijn doel zal beantwoorden."

Over smaak wilde Oberman, de geestelijke vader van het gebouwencomplex, ook niet twisten. Het onderkomen van een wetenschappelijke instelling diende immers slechts functioneel te zijn. En dat gold niet alleen voor de indeling van de gebouwen, maar ook voor de keuze van de bouwmaterialen, de vormen en de kleuren.

officieel geopend.

40 jaar geleden

25e NOVEMBER 1969



De vijf natuurkundige symbolen in glas-in-lood naast de hoofdingang zijn overgenomen van het oude gebouw aan de Kanaalweg (rechts).

De fietsenkelder onder het collegezalengebouw biedt niet veel meer plezier dan de wetenschap dat je fiets er redelijk veilig gestald is. Maar woensdag tot en met vrijdag is de deur achter de fietsenkooi vanaf 16 uur geopend. Achter die deur van het E-Kafee doet niets meer herinneren aan een donkere grauwe kelder met een vloer van 1,5 meter dik.

In deze sfeervol ingerichte ontmoetingsruimte kan iedereen die iets met de faculteit te maken heeft een drankje drinken en een praatje maken. Deze horecagelegenheid werd de faculteit door aannemer Hollandse Betonmaatschappij Nederland N.V. (HBM) als geschenk bij de opening van het gebouwencomplex aangeboden. Eveneens een geschenk van HBM is de kegelbaan, die zich in het E-Kafee bevindt. Deze zal naar verwachting helaas in 1990 plaats moeten maken voor enkele biljarttafels.

Bron: *"ELEKTRO" 25 jaar Mekelweg Delft*, Constant Gras

Hier invoegen: pagina24Technolution.pdf