De Vonk

Periodical of E.T.S.V. Scintilla

Main Article: MRI compatible biopsy robot

Master: Coping with Parkinson's disease

Moteq re-engineering challenge

Year 34 | Edition 3 | September 2016

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Presidential note

Author: Shing Long Lin

It is the time for making plans again. Plans on how you are going to pass you exams because you did not do enough planning yet, plans on what you are going to do once these dreadful days are over and you can start celebrating your summer holiday, and maybe even plans on what you are going to do next year if you decide to shake life up a little: a big project, a trip through exotic lands or maybe a board year? Myself, I am planning for this to be one of the last presidential notes I am going to write for the Vonk and that I will be able to go throughout my days again without several calls for 'Bestuuuuhuuur 'aimed for me each day anymore.

With lots of to-be-graduates busy with their bachelor's and master's projects, I am already curious about all the new discoveries we are going to see at the end of this period (and also of course in the Vonk!). I can still remember a bachelor project last year which studied the charisma of robots depending on the amount of mistakes and apologies the robot made. The surprising conclusion was that a robot which made a mistake and then afterwards apologised, was found more charismatic than a robot which did not make any mistakes at all. Maybe this is why the board was so likeable this year...

With these projects almost coming to a close, we can also already start looking forward to the projects that we are going to see next year. A new symposium committee is being founded right now and there are talks about setting up a national workshop on the future of Electrical Engineering. Furthermore Skitilla has been very busy and is in the process of convincing people to sign up for the winter sports trip in February. And of course the candidate board is very busy with preparing themselves for the coming year and accustoming themselves with all the other boards.

This afternoon I was talking to the to-be-freshmen and they were looking enthusiastic towards the coming year. Busy with looking for a room and celebrating that they are finished with high school. I am already looking forward to seeing all the fresh faces in the Kick-In this year.

It is a time for a some things to be finished and for making new plans. A time for beginnings and endings so to say. A time where I am hoping that our BBQ was not badly planned and that the guy in charge of the weather understands that June is supposed be summer and that he will be nice to us.

Ladies and gentlemen,

Op de koningin, op Scintilla!

Shing Long Lin,

President of the 86st board of E.T.S.V. Scintilla

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Masthead

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RAM

Devices used inside an MRI machine can't contain metal. So how do you build an MRI-compatible biopsy robot? Vincent Groenhuis explains about the solutions found by RaM.

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MOTEQ RE-ENGINEERING CHALLENGE

The Scrapheap Challenge is back as the Moteq Re-engineering Challenge. This years challenge: Robot Soccer! Read about the event, found loopholes, and the strategy of the winning team.

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Editorial

A bright new world

It is the little things in life that make life beautiful. This morning the magnificent new displays were installed. Though I have no real source for this information, I am sure that Scintilla's Operator Team did that especially for the editorial team as a nice surprise. A big thanks from the Vonk to the SOT for that.

To our own dismay there were some issues on getting some essential articles for this edition of The Vonk. This led to some major delays on the publication of this edition. To all the authors that did deliver their articles in time, our apologies. We are however proud with the publication as is, but it may happen that some articles may be a little outdated because of beforementioned issues.

Despite that I would like to conclude this editorial note with a fun fact. We sincerely hope that you are still in possesion of the previous two editions of this year's vonk. When all editions are published, you can put them together and it the prints on the back cover will form a nice text! We hope this will look great in your book shelfs later and thinks back on all the happy memories from Scintilla!

And ofcourse, have a great time reading this edition of The Vonk!

JippeRr

P.S. I personally think this edition's puuzle is awesome, I advice you all to check it out and to try to claim that pie!

News for the electrical engineer

Set-up of a wireless connection inside the MS1600 coater

Authors: Steven Gies, Martijn Schouten, Tobias Feijten, Maurice Baveco [XUV-optics, ‚study tour]

As you may know a group of 23 Scintilla members (SPOCK4) visited Canada and the USA in May, 2016 for a study tour. In order to fund this trip all participants are working on so-called case studies for various companies and research chairs. The XUV Optics group at the UT has played a big role in this by offering SPOCK4 three assignments to work on.

One of the case studies deals with the set-up and testing of a wireless connection inside the MS1600 coater, one of the machines XUV uses to produce high precision optics. As shown in Figure 1 this large, hexagonal vacuum chamber contains a rotating arm with at its end a rotating substrate holder. The coater is able to deposit thin optical layers onto the substrate by means of a technique called magnetron sputter deposition.

As a single production process may take half a day, it would be useful if the product in development can be checked during production such that perhaps modifications to the coating process can be made in time. These measurements can be done by placing a measurement system inside the substrate holder. However, the measurements have to be transferred outside of the coater which is problematic due to the moving arm.

> "A single production process may take half a day"

That is where the case starts. First, it has been tested whether it is possible to establish a wireless network inside the coater at all. Despite the various sources of interference a stable Wi-Fi connection has been set up between two antennae positioned on the floor of the chamber. The next step is to send the measurements from the substrate holder. A tiny computer, battery packs and other components have been selected, small enough to fit inside a specially designed, vacuum sealed substrate holder. Currently this substrate holder is in production, after which the next round of testing can start!

> "Despite the various sources of interference a stable Wi-Fi connection has been set up between two antennae positioned on the floor of the chamber."

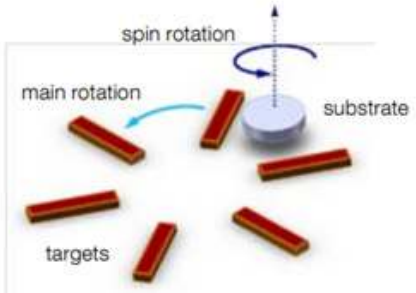

Figure 1: Layout principle of the MS1600, including magnetrons (targets).

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LEO Robotics conference huge success.

Author: Alex van Geldrop [RAM]

On April 21, LEO hosted its first annual congress. As a partnership between the University of Twente, Saxion and local industry, LEO aims to improve collaboration and business activities surrounding robotics. With speakers varying from Vanessa Evers to Stefano Stramigioli and from the mayor from Enschede to Martin van den Heuvel from Shell, it was an interesting program with lots of inspiring examples. Over 15 organization were also present in the DesignLab with 35 robots or robotic applications, like the ones in the picture shown below. The congress was also the place for the first KIVI / LEO bachelor award. The prize was €1.000 for the student with the best bachelorthesis on robotics. For more information:

http://www.leorobotics.eu/congress

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MRI-compatible biopsy robots

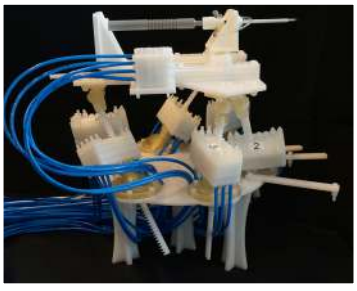
Vincent Groenhuis

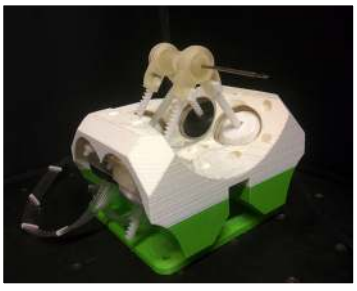
"We need something new. Accurate, smart, efficient. A better device for MRI-guided breast biopsy." "Hey, what about a biopsy robot? We will make it!". What started three years ago as small talk in South Korea between a Dutch entrepreneur and a professor with Italian accent, has now emerged as one of the largest projects at the group of Robotics and Mechatronics (RaM). The labs on the third floor in Carré are full of activity on medical robots moving needles around, worked on by enthusiastic teams of students and researchers.

Clinical problem

Besides regular mammography, women with e.g. genetic susceptibility for breast cancer increasingly undergo additional MRI screening. MRI has the major advantage that it is more sensitive than palpation, ultrasound and X-rays. When a suspicious lesion is found with a size of maybe 5mm, a biopsy may be needed for histological pathology assessment. This is done by targeting the lesion with a biopsy needle, which has a small notch near the tip over which a cannula slides, cutting away a piece of tissue. The question is now: how do you get the tip of the needle exactly at the target location? Existing manual procedures for MRI-guided biopsy are inaccurate and inefficient: the needle is inserted blindly using a mechanical grid for guidance; a lot of tissue is removed to get a fair chance of sampling the lesion which is uncomfortable. Also, aspiration and needle-tissue interaction may displace the lesion, missing the target altogether, causing delays and possibly a false negative biopsy. So the question is: how can we make a better device to get the tip of the needle at the (X,Y,Z) position of the lesion with millimeter accuracy?

> "how do you get the tip of the needle exactly at the target location?"





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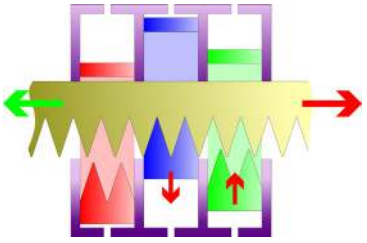
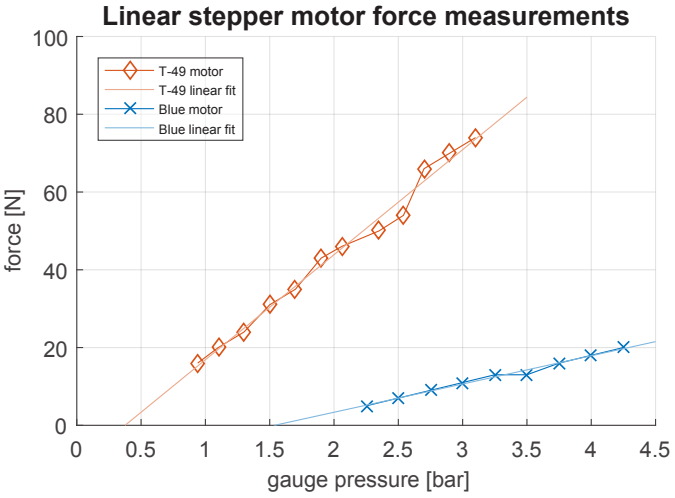




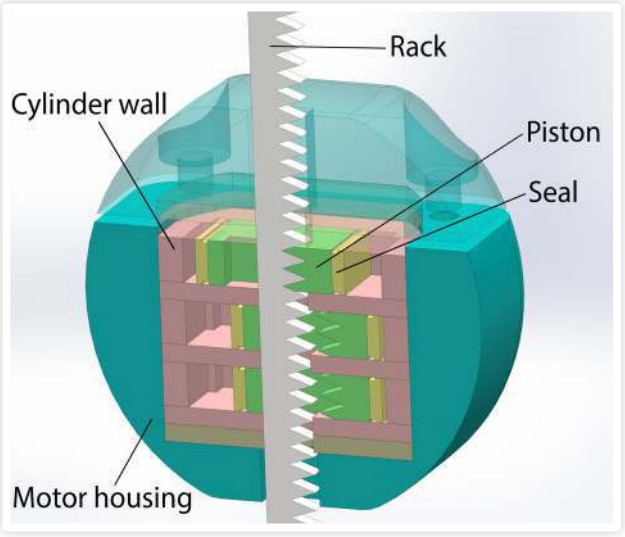
Biopsy robots as a solution

At RaM, we take two different approaches on the problem. The first approach, MRI-compatible robotics, deals about robots that are placed inside the MRI scanner, manipulating a needle towards the target. The second approach, MURAB, is based on a robotic arm placed outside the MRI room, on which an intelligent ultrasound probe with tactile sensor, camera and needle holder are mounted.

MRI-compatible robotics

It looks so easy: place a robot arm driven by common servo motors inside the MRI scanner, with a needle as end-effector. Make a scan of the patient, locate the suspicious lesion and extract its coordinates, and let the robot move towards the given (X,Y,Z) position from the desired angle. Well? Big chance that the robot strikes right through the patient as a loose cannon!

> "Big chance that the robot strikes right through the patient as a loose cannon!"



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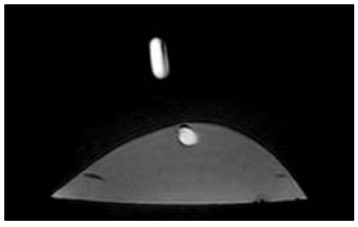
through the patient as a loose cannon! A MRI scanner has a very strong magnetic field: 1.5 or 3 Tesla is common in hospitals, and here at the UT we have a small-but-cosy one of 0.25 Tesla which already exerts considerable forces and torques on ferromagnetic objects nearby. And even when an electric device is non-ferromagnetic (e.g. a digital camera with plastic housing), it easily goes on tilt when making small movements, due to the currents induced by the changing magnetic field. The worst part is that

> "The worst part is that the MRI scans also suffer a lot from small electric signals"

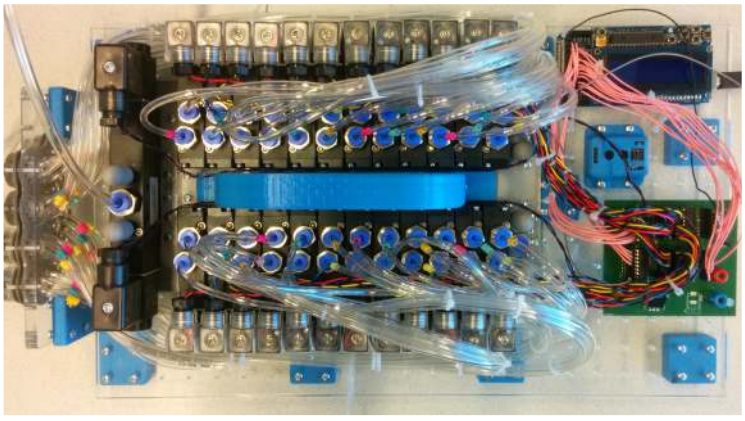
the MRI scans also suffer a lot from small electric signals, so that's why the scanner itself is always fenced off by a room-sized Faraday's cage. (I wonder if it is a good idea to write in an electrical engineering magazine that you cannot use electricity for your robot?) So, how do we proceed? The Twente answer: a fully plastic robot, driven by pneumatics, controlled by electric valves outside the cage! Plastic and air have zero influence on the magnetic field. OK, we are not the first to come up with this idea, but we are trying to become really good at it. Ambitious, or realistic? Let's see!

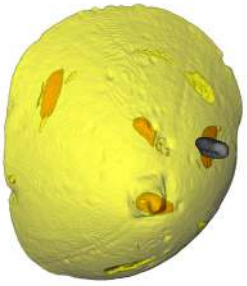
Stormram and McRobot

My graduation project in 2014 resulted in the Stormram 1 robot. It is driven by pneumatic linear stepper motors, which are constructed from laser-cut Delrin parts. Held together by nylon screws, the housing contains cavities in which

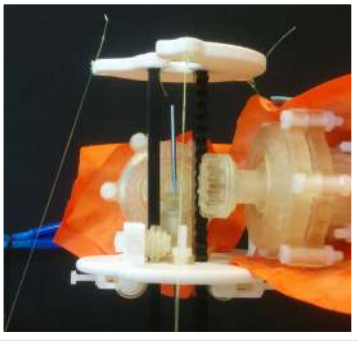


rectangular beam-shaped pistons can slide back and forth, pressing against a rack: the rapid-prototyped plastic stepper motor is born. Six of them, combined with 3D printed ball joints, form a Stewart platform on which a seventh actuator is placed for driving the needle forward. The 7 DOF assembly is controlled by a manually-operated,





DC motor driven pneumatic valve manifold. The resulting robot performed quite well, it is only a bit bulky in size (30 centimeters). So, in the next version (Stormram 2) the stepper motors were miniaturized and embedded inside the ball joints, which resulted in a much more compact robot of 15 centimeters in size with five degrees of freedom. The third generation, Stormram 3, has



additional improvements such as smaller steps to increase accuracy, and almost complete elimination of backlash by switching from ball to pin joints. Also, the needle piercing actuator was made much more powerful thanks to the development of a fully 3D printed four-phase miniature stepper motor, called T-49. Measurements show that the T-49 motor is capable of delivering 70N of force at 3.0 bar pressure, thanks to its 200mm2 cylinder cross-sectional area, while the 'Blue' motor only delivers 20N at 4.3 bar pressure with its 60mm^2 cylinder cross-sectional area.
Besides linear stepper motors, our group also develops rotational motors with

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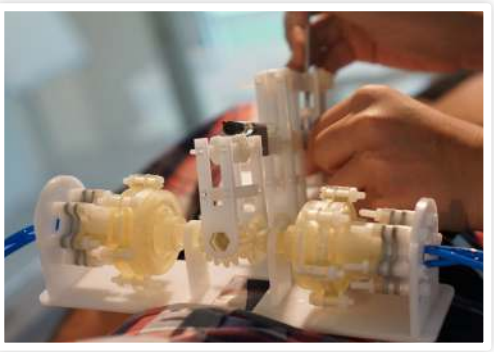
which we drive parallel manipulators with various kinematic configurations. Of course, almost all parts of these robots are also produced with our own five 3D printers and/or laser-cutter. Also, we are busy programming computer-controlled valve manifolds, in order to steer the different robots autonomously to a given (X,Y,Z) location or teleoperate using a 6D joystick. Which could be done with feedforward control (counting steps in each stepper motor), or by feedback (near-realtime analyzing MRI scans).

MURAB

When you place a robot arm outside the MRI scanner, the lesion we have to target is invisible. Ultrasound visualizes surrounding structures, but not the lesion itself (otherwise you could just do a relatively simple ultrasound-guided biopsy procedure). But if we overlay realtime ultrasound with existing MRI scans, could we project and track the lesion realtime on the ultrasound scans? This is the underlying idea of the "MRI and Ultrasound Robotic Assisted Biopsy" (MURAB) project, in which different European universities, clinical and business partners participate. In order to overlay MRI and ultrasound images correctly, you have to register scans an take care of possible deformations of soft tissue in multiple dimensions. An elastographic model is needed for this, which will be measured by the robot arm and its arsenal of sensors. The merging of MRI, ultrasound, camera images and elastography together is a die-hard challenge for which we have the following name: "Tissue Active SLAM".

Safety and conclusion

Oops, a programming error in the software: patient killed by robot?! Safety is also very important: how to prevent that the robot arm moves right through the patient? Variable compliance is frequently called in our group: joints driven by variable stiffness actuators have a level of compliance which makes it behave more like human joints, making them inherently more safe. This way, instead of being fenced off, robots can undergo close interaction with people. Whether this is actually a desirable development or not is an everlasting discussion: wouldn't the radiologist prefer to keep performing biopsies by hand, and keep robots in factories? Here at RaM we are do not worry about such questions: the students and researchers are unleashing their limitless creativity on awesome designs, and meanwhile our professor enthusiastically tells about all the developments, from here to South Korea.



Video:

MURAB:
https://youtu.be/txslCWxX8Bo
Stormram 3:
https://youtu.be/u6DHG9x-fFU

References:

V. Groenhuis and S. Stramigioli, "Laser-Cutting Pneumatics," in IEEE/ASME Transactions on Mechatronics, vol. 21, no. 3, pp. 1604-1611, June 2016.
(just google for Laser Pneumatics)

V. Groenhuis, J. Veltman, S. Stramigioli, "Stormram 2: A MRI-Compatible Robotic System for Breast Biopsy," in Proceedings of the 9th Hamlyn Symposium on Medical Robotics, 25-28 June 2016, London, United Kingdom, pp. 52-53.

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I believe that with genuine interest you can master the theory. When I started work at Thales I was surprised by the open corporate culture. You can talk to anyone and they make time for you to give you support. If you take the initiative, there are many opportunities. After having Business Administration at the University of Amsterdam in September. I Business Administration at the University of Amsterdam in September. I think that the combination of a Bachelor's degree in engineering and a Master's degree in Business helps you find solutions looking through two different spectacles. I stay in touch with my superviser and I hope that i will be able to work at Thales once I have my masters degree"

Judie Ibrahim,

Aviation Studies Student,
Amsterdam University of Professional Education, aged 23

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Annelot Schuring

Graduated in Physics, Radboud University Nijmegen
Aged 24

"When I was still studying, I was already seeking employment. I was ooking for a technical company with an interesting product where could make use of my physics background. At the Beta Business Fair [Bèta Bedrijven Beurs] in Nijmegen I had a conversation with a recruiter from Thales. She invited me to their head office to discuss the opportunities at Thales. One of the vacancies stood out right away, namely the position of Trial Conductor. I applied for this position and after a few interviews they hired me. Meanwhile, I have been working at Thales for a few months and am enjoying it very much. As the Trial Conductor I constantly build on the knowledge gained during my studies. I will regularly go abroad as part of a team to test our naval radar systems. At sea we show the client that our system is indeed as good as promised in the contract. We do this through various scenarios. For example, we have an F-16 fly in to see when the redar detects it first. While Iwas applying for jobs I also received an offer from another technical company, but the good atmosphere at thales was decisive for me. People here are very helpful and take the time to explain something. Thales certainly lives op to the image I had of it: a high-tech company with a pleasant working enviroment."

"As the Trial Conductor I constantly build on the knowledge gained during my studies. I will regularly go abroud as part of a team to test our naval radar systems."

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Moteq Re-engineering Challenge

Authors: Nahuel Manterola, Tom Vocke

This year the Scrapheap Challenge was renamed to the Moteq Re-engineering Challenge. As you might have guessed, Moteq sponsored the challenge this year, and supplied a nice donation, hats, and customized apple juice. This year's challenge was a tough one: robot soccer. In a field of around 5 by 3 meters the teams had to compete against each other for eternal fame.

For those who somehow haven't heard of this magnificent event: the Scrapheap Challenge is organized each year by Scintilla. Teams of 3 to 6 participants get an assignment to build something out of scrap which is found on a heap, much like the TV show with the same name. After about 2 days of building the contraptions of the teams are tested against each other to find which team performed best.

The challenge started on Friday, where the twelve teams were given the assignment, brainstormed on the different options, and found loopholes around every single rule made by the organization. The list of rules had to be nearly doubled to keep the teams from evading them. As you might know, the most creative ideas are found under the influence of alcohol. Therefore some teams needed explaining you couldn't shoot darts or water at the opponent, or destroy the ball intentionally. Another team luckily did not go through with their plan to bring a 3D printer.

> "Build a robot that can play soccer out of scrap parts, in two days"

On Saturday we started early. The Westzaal opened at 8:30, and the heap was stormed at 9 o'clock. All teams got out alive, heavily bruised, but carrying various kinds of scrap: printers, tv screens, fans, and many other pieces of broken junk. Every piece of scrap was torn apart, in hopes of finding working transistors, capacitors, or even a microcontroller. After a day of hard work, the teams were forced out of the Westzaal at 21:30 to enjoy a beer in the Abscint.
Sunday was another early day, since the teams needed all the time they could get to finish their contraptions. After some pizza the matches started. The matches lasted 2.5 minutes each, unless one of

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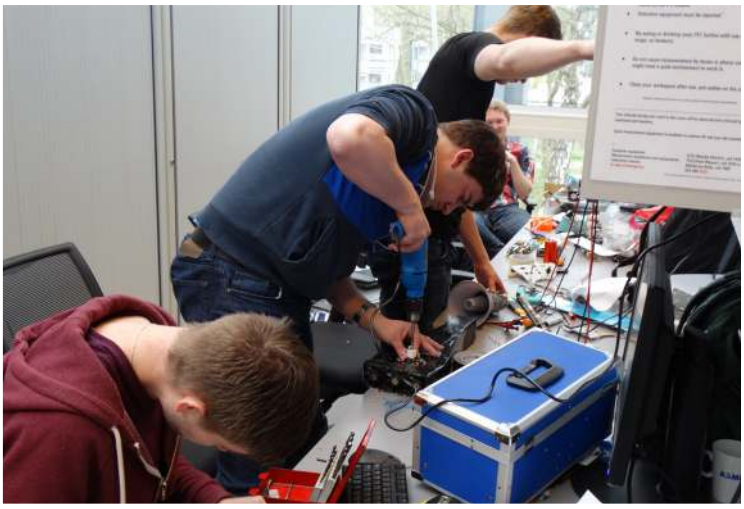
the teams scored 3 goals before reaching the time limit. The randomly chosen pools turned out to be quite unfair, having one pool with two motionless cars, and one with three great contraptions.
As most years, the teams had very creative solutions. Cars with grabbing arms, kicking feet, one with a sucking fan to pull the ball in, and the winner of the originality prize: The Fanboy. In contrast to the other contraptions this device had no wheels, and worked purely by blowing the ball in the right direction with a sophisticated air cannon. Sadly the cannon was no match for Solar Team Drenthe in the semi final, and had to leave the race. The grand final was played between the Solar Team Drenthe and Huize Swaffelaer. After an exciting match Solar Team Drenthe scored the deciding goal in overtime, ensuring a 3-2 victory.



"The most creative ideas are found under the influence of alcohol"

In case you're wondering why the Solar Team won, here's an explanation by Tom Vocke:

"Build a robot that can play soccer". At first sight, that sounds like a tough challenge, especially when you add "out of scrap parts, in two days". However with four former solarteam electrical engineers and two former solarteam mechanics, anything is possible. We gave it our best, and built the 21 R.O.B.O.T. (Explanation pending...).
With unique features like matched (hand-picked and meticulously constructed) geared-reduction for the wheels, two-player remote controls to reduce multitasking, a lightweight actuator that launches the ball into warp speed, and an even more light-weight ball guide to be able to maneuver the ball around opponents we knew we had a good chance of winning.
Although the ball never quite achieved the intended warp-speed, it turned out the reduction (more torque, less speed) helped greatly during the matches, as we were able to push other teams past the goal-line robot and-all.
Also, from past experiences, we knew preparation is everything. We gave our drivers the training the needed and showed that ultimately the greatest weapon in a robot soccer match is a good TEAM!
It was a great event this year, and of course well be back to defend our title in the 2017 challenge!

"The ball never quite achieved the intended warp-speed.."

Afterwards the final there was beer, either to drown your sorrows, or to celebrate victory. Both the winner of the originality prize and the winner of the grand final received an award and some specialty beer.
I'd like to thank all the participants for their great sportsmanship, and I hope to see you all back next year! In fact, if you would like to organize the challenge next year, the committee still has to be formed, so this is your chance to apply by sending an email to:
scrapheap@scintilla.utwente.nl

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Racing and testing the H2.Zero

Author: Friso v. d. Boom

Green Team Twente is a student team which develops and builds a fuel-efficient hydrogen car. They have been competing in international competitions for fuel-efficiency since 2011. This year, they competed in France at the EducEco, to test the performance of the H2.Zero in preparation of the Shell Eco-marathon.

The challenge

The EducEco challenge is an efficiency-oriented race organized since 2009 by a French association. This year, the race was held in Valenciennes. This race does not receive a lot of coverage by the press, since it is greatly overshadowed by Europe's biggest fuel-efficiency race, the Shell Eco-marathon. Nevertheless, the race is still a full-scale event. Over 70 teams participated, including 4 foreign teams from Germany, Poland and of course, the Netherlands.

The track

The organization of the EducEco have stepped up their game this year in terms of track safety. This was probably due to an incident which happened last year, where a prototype vehicle hit a curb and flipped over. This year the entire track was guarded by red and white road barriers. Even though there were multiple incidents where teams overshot a corner, nobody sustained an injury.

The total distance driven to complete the race is slightly less than the teams will have to complete in London. The inclines are also not as long as they will be in London, and the average speed teams have to reach was set at 22 km/h instead of 25. All in all, this track presented the teams with a nice challenge, which can be used as an intermediate step to prepare the teams and their cars for the challenges of the Eco-marathon.

Green team team Photo.

Our goal

This corresponds rather nicely with the goal we set out to complete. To clarify, we did not enter this race to win, and the publicity was also not our main priority. This event was a chance for us to test the H2.Zero in a full scale racing simulation. This was valuable to us since it greatly increases our chances of completing an attempt in London. Actually setting a result may seem trivial, but this is more difficult than it may seem. This

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Green team car

is painfully apparent when looking at the results from Green Team Twente at the Eco-marathon in 2014 and 2015, when we were unable to get a place on the scoreboard. This is the reason we are so determined to set a result this year, even if that means some efficiency will be lost to achieve a more robust system.
The single most important aspect of building a robust system is having tested the system in practice, which is why this race was such a great opportunity for us.

> "The H2.Zero set a result with a result of 621 km on the energy equivalent of a liter petrol."

We raced with off-the-shelf motor controllers and boost converter. This meant we had bigger electrical losses in these components, but also that there was no regenerative braking. Furthermore, the boost converter offered much less controllability over the current draw from the fuel cell, which meant we were not able to make optimal use of our buffer. This resulted in a pretty dramatic decrease in the average efficiency of the fuel cell. These off-the-shelf solutions are obviously less than ideal, but they enable the racing and testing of the H2.Zero before the custom boost converter and motor controllers are operational.

Racing the H2.Zero

Aside from testing the car itself, the EducEco also presented the team with a very useful practice exercise. After all, most of the team members have never experienced these races, which can lead to stressful situations that could be foreseen or even avoided. This is especially true for the drivers. Since the results of this race was not essential to the team, it presented our back-up driver with a nice opportunity to learn the behavior of the car and to get used to driving around a track with other vehicles.
At the start of the race, the team was distributed over different points along the track. Two people were stationed near the start, they were responsible for keeping track of the average speed and hypermiling (a fancy word for energy-efficient driving). Whilst one kept constant track of the location of the position of the car, the other one was responsible for the communications with the driver. Communication was done via walkie-talkie. Team members spread around the track helped determine the location of the car, were on the lookout for other vehicles and sometimes helped determine the optimal line through a corner.
After two successful attempts, the H2.Zero set a result with a result of 621 km on the energy equivalent of a liter petrol. This result was good enough for second place in the urban concept hydrogen category at the EducEco. Although this result is quite impressive in and of itself, the competition set a result of 1205 km per liter. This was of little surprise to us, and we were nothing short of thrilled with the result that we set.

Looking ahead

After having learned a lot from the EducEco, the team set out to improve the H2.Zero to compete for first place at the Eco-marathon. In the five weeks in between the two races, work will continue on the custom motor controllers and boost converter, whilst the mechanical engineers keep working on improving the efficiency of the gearbox and the brake pedal. Having a working car helps a great deal in testing these systems. This will enable us to work toward the Eco-marathon in the upcoming weeks.
And after the Eco-marathon the transition into the new team starts. If this team sounds like a project you might want to participate in, or if you're just interested in the developments of the

> "This event was a chance for us to test the H2.Zero in a full scale racing simulation."

team, you can keep up to date with our Facebook (facebook.com/greenteamtwente) or website (greenteamtwente.nl) for more information. You can also contact us directly by mailing info@greenteamtwente.nl. Alternatively, you can talk to one of our team members which are easily recognizable by their fashionable red jackets.

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Sjaarsie bierbingo
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Little sensors, huge impact

Author: Anja van Gestel

6.3 million, that is the estimated number of people who have Parkinson's disease worldwide. As Parkinson's can have many different symptoms, many patients have to deal with what is called _'Freezing of Gait'_ (FoG). It is sometimes described by people with Parkinson's as feeling like their feet are glued to the ground. In literature it's defined as a brief, episodic absence or marked reduction of forward progression of the feet despite the intention to walk. If you now still cannot imagine what it is like you should really check out the links of the videos I added. Due to these gait disturbances patients have a higher risk of falling, they will lose their capability to be independent and all of this will result in a significant impairment of the patients' quality of life. It really sounds terrible but what can we, technical people, do to help them? Of course! We add some electronics: a couple of sensors (or is just one enough?), a pair of smartglasses and a smart algorithm to make it all work. My job in this master assignment, at the group of Biomedical Signals and Systems (BSS), is to make it all work, or, to design the smart algorithm.

Parkinson and FoG

Parkinson's disease (PD) is a chronic, neurodegenerative disease in which the degeneration of dopaminergic neurons of the substantia nigra (part of the basal ganglia) leads to a characteristic motor dysfunction. The main task of the basal ganglia is to suppress unwanted movements and prepare upper motor neuron circuits for the initiation of movements. The reason for degeneration of the neurons in PD is not known yet. It leads to a diminished ability of the basal ganglia to control the thalamic output to the cortex. Therefore PD patients can experience e.g. tremor, bradykinesia, akinesia, rigidity of the extremities and neck or different kinds of gait disturbances. Freezing of gait is one of these gait disturbances and occurs when initiating gait, turning or walking through narrow passages. It is not only dependent on dopamine level but also on variations in sensory and cognitive input and on changes in motor task requirements.

Due to the different aspects contributing to FoG appearances it can be hard to elicit FoG in a clinical environment. FoG usually affects PD patients with a high disease severity and long disease duration. Patients commonly get medication (e.g. Levodopa) to reduce PD symptoms but FoG often appears to be resistant to such treatments. So, medication does not really help these patients overcome FoG. Therefore, we have to search for other methods or tricks which maybe can improve these people's lifes.

"FoG usually affects PD patients with a high disease severity and long disease duration."

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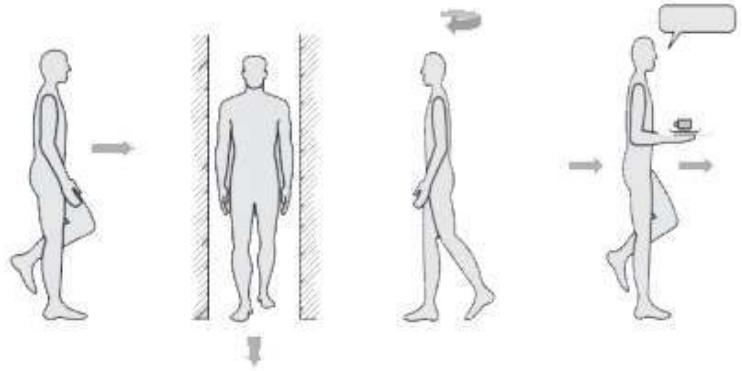


Visual and auditory cues

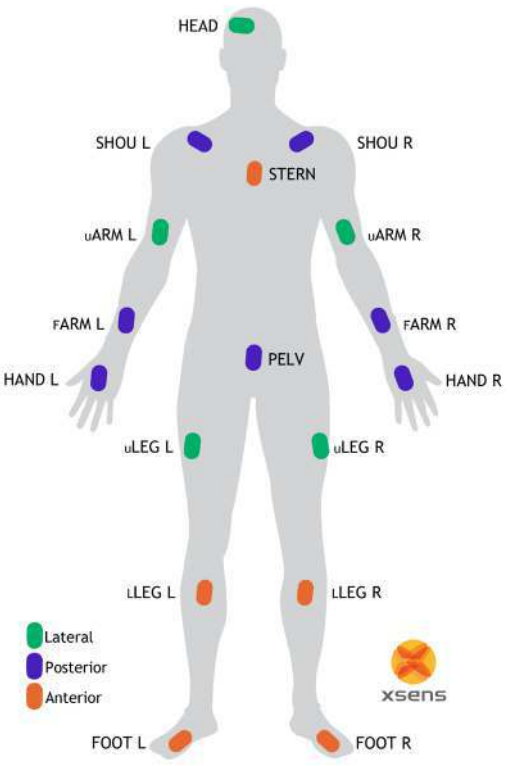
One trick is to place your foot on the ground in front of the patient (visual cue!) and tell him/her to step over it. Another trick is to walk in the rhythm of a beat or song (rhythmic cue!). Earlier studies showed that rhythmic sounds or visual cues can indeed shorten the duration of FoG episodes and help patients resume walking. However, continuous cueing (placing your foot for every step of the patient or, listening to the same beat all day) would be very intrusive. It is thought that the habituation effect would reduce the effect of the cueing. A research group in Austria indeed showed that on-demand cueing, i.e. provisioning the patient with cues when freezing actually occurs, is more effective to reduce the duration of the freezing episodes than continuous cueing. These two findings, gait improvement due to cues and the benefits of on-demand cueing, lead to the idea to unite Parkinson patients with smartglasses!

"Earlier studies showed that rhythmic sounds or visual cues can indeed shorten the duration of FoG episodes and help patients resume walking."

Smartglasses for Parkinson patients – the idea & my goal

The idea is to give the patients visual and/or auditory cues via the smartglasses the moment they need them. Sounds doable, but how do the smartglasses assess when the cues are necessary? The moment of necessity to receive cues is preferably *before* the patients experience a FoG episode, so the episode could be

"how do the smartglasses assess when the cues are necessary?"



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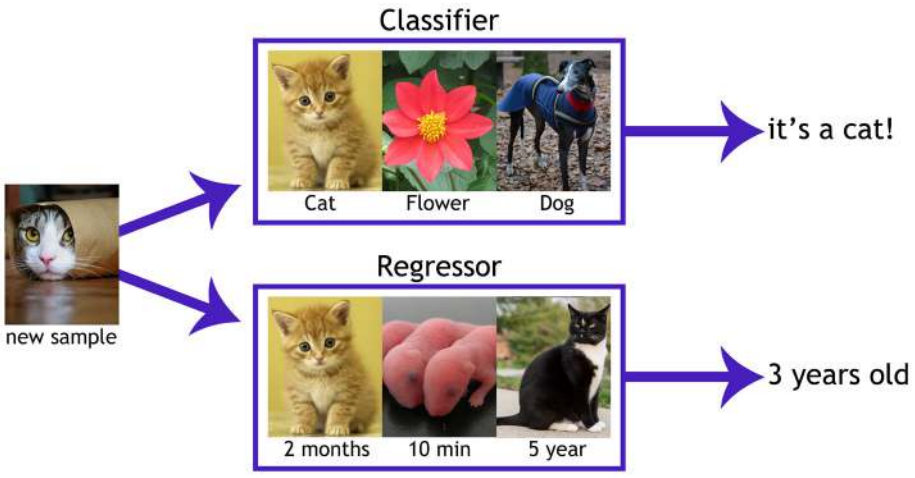

prevented. Therefore the system we are going to make has to predict upcoming episodes rather than detect them (previous work in this field mainly focused on detection of FoG), ideally would be 1 or 2 seconds before the episode. The system will use machine learning techniques and data obtained by sensors (accelerometers/gyroscopes in one) placed on the patient's body to decide when to give cues. To accomplish this the algorithm has to assign the sensor data to one of the three classes; FoG, no FoG or pre-FoG. Where FoG represents the patient having a FoG episode, no FoG represents not having one and pre-FoG is defined as a certain period before having a FoG episode. The challenge is to design an algorithm which needs a minimal amount of sensors and still be sensitive and specific enough.

> "The challenge is to design an algorithm which needs a minimal amount of sensors and still be sensitive and specific enough."

Real experiments!

You could maybe have "completed" this assignment by just quickly placing yourself behind your computer and start programming like crazy using online FoG databases. But, if you don't even know what a FoG episode looks like, how it's so different between patients and what these people actually need, you will never make the perfect algorithm. So, learn where your data is for and where it's from. Ofcourse I also started programming in Matlab using an online database (Daphnet), but only to make the first steps. I got the extraordinary opportunity to assist a PhD student in experiments with Parkinson patients to collect data where I know everything about.

Every patient gets 17 sensors (wireless motion trackers made by Xsens) attached to their body. Then they have to complete different kinds of walking tasks (trials); either walking through a hallway, with in the middle a narrow passage, for 15m with three stops in between, or with three times turning on the spot, or without a task in between. These tasks are supposed to elicit FoG episodes, because they are needed to learn the algorithm what FoG episodes are like. I think working with patients is really exciting, motivating and satisfying (if everything goes according to plan)! So collecting data is one side of the job, while the other side looks like Matlab, a lot of Matlab...

A little more in-depth

Machine learning is building algorithms that allow computers to learn to perform tasks from data instead of being explicitly programmed, it's a subfield within Artificial Intelligence. It's already extensively used for applications in the categories image processing, text analysis, video games & robotics, and for data mining. Data mining is the process of discovering patterns or making prediction from data, which is what we'll have to do.

There are two sorts of machine learning algorithms, supervised and unsupervised learning. Unsupervised learning is meant for finding hidden structures in unlabeled data, but because we already know what we are looking for (FoG, no FoG or pre-FoG) we are not going to use unsupervised learning. With supervised learning the algorithm uses a

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known set of input data and known (labeled) responses to the data to build a predictor model that generates reasonable predictions for the response to new data. Within supervised learning again there are different types of algorithms, there's classification and regression. Classification is used when the output value belongs to a discrete and finite set or i.e. to a certain class, e.g. is this picture a cat or not? On the other hand, regression belongs to the problems where the output value is continuous, e.g. how old is this cat?

> "So collecting data is one side of the job, while the other side looks like Matlab, a lot of Matlab..."

For the question 'is this a FoG, no FoG or pre-FoG' a classification method is going to be perfect. The data of a trial is split in windows to be able to look at the behavior of the signal over small time periods. The sensors record data with a sample rate of 1000 Hz, let´s assume the window-size used is 1 second and the time of the experiment is 45 minutes. The raw accelerometer data of one trial will be split in 45x60 = 2700 windows and the input data will look like:

$$x \in \mathbb{R}^{1000\times2700}$$

To be able to learn the algorithm something we have to know which windows contain a FoG episode. This means, for data to be useful for classification it has to be labelled. The golden standard for this is to let a neurologist (or someone trained in working with Parkinson patients) label the data, that's why the whole experiment is recorded with video camera's. The annotation for this example contains 0's, 1's and 2's representing the three classes, giving the vector:

$$y \in \mathbb{R}^{2700\times1}$$

The algorithm could now be trained with the raw accelerometer data x and annotations y, but it´s very likely that other features of the signal can provide much more (additional) information. An example of an input feature could for instance be the variance (per window) of the acceleration of a certain sensor and axis, which results in:

$$x \in \mathbb{R}^{1\times2700}$$

Choosing which features best represent the training examples is an important part of machine learning.

> "Choosing which features best represent the training examples is an important part of machine learning. "

We could use a linear function to predict an output when given new data, but this can result in values higher than 1 and lower than 0. For classification you want the classifier to output values between 0 and 1 and that's why the logistic function is often used to represent a hypothesis.

$$h_\theta(x) = \frac{1}{1 + e^{-\theta Tx}}$$

To use this hypothesis for multiclass (more than 2) classification problems the so called one versus all method can be used. Which means training a logistic classifier $h_\theta^{(i)}(x)$ for each class i to predict the probability that y=i. And then on a new input x, to make a prediction, the class i that maximizes the probability that $h_\theta^{(i)}(x)=1$ should be picked.
The performance of the algorithm can be tested by providing it with a set which is not present in the training data, x_test, and comparing the by the algorithm calculated prediction, y_{pred}, with the real annotations, y_{test}. All in all, it is a lot of Matlab, but it is amazing!

That's the rush!

In the end it would be awesome if the patient could clip on just one sensor, then a pre-trained algorithm predicts in real-time the chances of getting a FoG episode. And just before getting one the patient is provided with cues via his/her smartglasses and he/she can without troubles happily continue with his/her daily routine. The idea of making this work and the motivation from working with enthusiastic patients is what makes it so rewarding.

References & Videos:

This video shows how visual cues can affect a Parkinson patient:
https://www.youtube.com/watch?v=jOuw35-7uPw

Really suprising to see this patient cycling:
https://www.youtube.com/watch?v=aaY3gz5tJSk

The sensors used are made by Xsens:
https://www.xsens.com/

The smartglasses prototype, showing visual cues to the patient, used are made by Cinoptics:
http://cinoptics.com/

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Study tour

Beyond Frontiers

Author: Vera Nauta

In May of this year, a group of 23 student left for a three-week long study tour to Canada and the United States. Many companies and universities were visited, but luckily there was also plenty of time for other fun activities. However, this trip would not have been possible without some hard work.

It all started in January of 2015, when the list of participants was announced. After everyone was divided over the four sub-committees (acquisition, admin, graphics and travel) the work could start.

> "In May of this year, the long awaited moment was finally there"

"Beyond Frontiers" was chosen as the name for the study tour. The graphics committee designed a company brochure. Armed with this brochure the acquisition committee could start to approach companies to offer our electrical engineering expertise in the form of case studies. All participants worked hard during the case study weekends and in their spare time in order to finish the case studies. When it became clear that there would be enough funds available, the travel committee could start booking hotels.

It was more than a year of hard work, but in May of this year, the long awaited moment was finally there. Everybody packed their suitcases (or only one small backpack, in one case) and flew to Toronto. Because almost everyone arrived at least a day before the official start of the study tour, it was chosen to all sleep in the same hostel for these nights. It was only a small hostel, so suddenly it was populated with almost exclusively Dutch people.

The quickest way to dry a towel

Niagara Falls

On Sunday the first of May, the study tour officially started. After drying some wet towels between two flatirons, and checking-in at the hostel for the coming week, it was time to explore Toronto.

Toronto is an impressive city with many skyscrapers. However, with its location at Lake Ontario, there were also some

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At the Blue Jays game

beautiful views. One of the more notable companies that was visited in Toronto was Upverter. A small startup company, located in a regular house, with only a few employees and one very large dog. The visit consisted of grabbing a beer and some snacks, while the founder talked about his company. The visit was continued at the "conference room"; the patio of a nearby bar. Other companies that were visited in the area of Toronto were Cisco/Waterfront, Xerox, SNC Lavalin and Teledyne Dalsa. The University of Waterloo and the University of Toronto were also visited.

One of the evenings in Toronto was filled with a baseball game of the Toronto Blue Jays. It was surprising how long one baseball game could take. But luckily, after 3 hours and 25 minutes, the Toronto Blue Jays won from the Texas Rangers with 3-1.

On the last evening in Toronto, one of the biggest tourist attractions of the area was visited: the Niagara Falls. The largest one of the three falls, the Horseshoe Falls, are about 790 meter wide and drop 57 meter. There was a great view on the three falls, as well as the firework show, from the boat tour.

After this outing, the end of the first week was already in sight, and it was time to leave Canada and fly to Los Angeles. The hostel in Toronto was swapped for a hotel with pool in sunny Laguna Hills. The Sunday was used for sightseeing in Venice Beach.

On Monday, Thales was visited. Most people will know Thales as the defense company with a location in Hengelo. However, the section of Thales that was located in California has a completely different focus; it creates in-flight entertainment systems. It was interesting to see what the future of in-flight entertainment has to offer.
Other companies that were visited in the area of Los Angeles were MaxLinear, Broadcom, EPC and Cymer. Cymer is the company that makes EUV light sources for the newest ASML machines.

> "Going to a shooting range, driving quads through the sand dunes, watching elephant seals and visiting Santa Cruz"

One day was spent sightseeing in Los Angeles. The two most important tourist attractions were the Walk of Fame, and the well-known Hollywood sign.

While traveling northwards, the University of California Santa Barbara and Sonos were visited in Santa Barbara. Santa Barbara was also the location for the study tour cantus. This cantus was held at beer pong tables, surrounded by very confused Americans.

The conference room of Upverter

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Company visit at Xerox

The next few days were spend driving towards San Francisco, while also going to a shooting range, driving quads through the sand dunes, watching elephant seals and visiting Santa Cruz.

In the area of Silicon Valley, Gainspeed was visisted. One of their employees used to be a board member of Scintilla. Other companies that were visited are Cisco, Dialog and Xsens. Xsens is a successful start-up company from the University of Twente.

The Thursday of the third, and already final, week of the study tour was spent in an amusement park called "Great America". This park does justice to its name, as right before the park opened, the national anthem of the United States was played for all the people waiting in line.

All good things must come to an end, and this was no different for the study tour. Luckily not before the last day was spent visiting Alcatraz, and going on a fancy dinner cruise on the bay of San Francisco. It was the perfect evening to end the amazing three weeks spent in Canada and the United States.

Overall, this study tour was a great experience. A lot of interesting companies and universities were visited. It was nice to see the latest developments in technology, while also learning a lot about the cultural differences between the Netherlands and Northern America.

If you are interested in visiting a faraway location while also learning a lot of new interesting things about technology, it can be greatly recommended to join the next study tour. We would like to thank the UFonds for helping to make this trip possible.

Maak uw bijdrage over op banknummer 59.27.19.189 ten name van Stichting Universiteitsfonds Twente.

Op onze website www.utwente.nl/ufonds kunt u makkelijk en veilig via IDEAL een bedrag overmaken.
Daar vindt u ook meer informatie over notariële schenkingen.

Hartelijk dank namens de studenten van de Universiteit Twente.

Met het Universiteitsfonds Twente komen ze verder.

Word nu donateur!

UF

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De Stichting Universiteitsfonds Twente is een door de Belastingdienst officieel erkend goed doel.
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Module 11: Electronic Systems Design

Author: Ronan van der Zee

The people at the Vonk asked me if I could tell something about module 11. Sure, and my first thought was to copy the module manual here, because that would explain everything at once, right? On the other hand, people will read the module manual anyway at some point (right?), so I decided to use this space here to give you my personal story about module 11. So don't believe everything or anything I'm about to tell here.

A little over a year ago, module 11 was still largely undefined. We had some wild ideas in the beginning, but soon enough reality started to kick in. You had to have these 'motivations' to do something. Damn, that's what we always ask from the students, too, so we'd better do the right thing. Let's see, there's this university wide guideline that we should incorporate 10EC of reflection on technology in our curriculum. So let's have 5EC of Science 2 Design 4 Society (S2D4S) in this module. Also, when we look at the OER (Onderwijs & ExamenRegeling. Education & Examination Regulations in english), there should be more attention to design processes and since the start of TOM the projects are largely specific for the module, so let's throw in some Systems Engineering and define a broad project. OK, but we also want some hardcore EE in it, we're still electrical engineers. We could define some new material, but module 8 had been terribly full, and most people didn't make it, so it had to lose a bit of weight. We saw the opportunity to move a significant chunk of Embedded Signal Processing (ESP) to module 11. Thematically that's a good fit, because the whole analog/digital partitioning, choose SNR, bits, oversampling ratios, etc, is very much a system design process. At the end, the name of the new module was 'Electronic Systems Design' and the idea was like shown in Figure 1. We have a project that runs all the way from transistors to societal impact, and each part of the module handles a number of levels.

> "I even heard someone say they learned a lot."

The idea is to start with a problem. In academia we call this a 'challenge'. Then, instead of immediately starting to build an electronic device, we first try to analyze the problem. I have tried to explain it in a number of ways, and it takes a lot of text, but Figure 2 shows it rather compact. I'm sorry about Figure 2, but it shows (brace for impact) a design

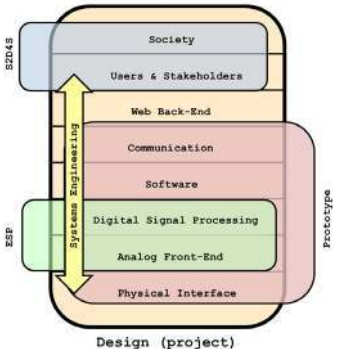

Figure 1: The design stack and the module

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process of (gasp!) Creative Technology. Where electrical engineers usually start with a technical product specification, there's a whole world to consider before that. What is the idea of the product? How will it help? How will it be used? Who are the other stakeholders, etc. Although it seems like this is not typical for the work of an electrical engineer, don't underestimate the percentage of EE students that end up in management, consulting, (marketing) communication and product/business development. In these areas, these first steps are vital.

Figure 3: During the final presentation.

> "You had to have these 'motivations' to do something."

The ideation takes place in the first half of the module, and the technical realization in the second half, followed by a presentation of the whole design process and the prototype. See figure 3 for the cool specs of a health bracelet. I shouldn't forget to mention that we defined big project groups (>10 students) to free the way for some project management and cooperation 'challenges'.
This year the module ran for the first time, which is potentially stressful for both students and instructors, not to mention the module coordinator. Personally, I'm not unhappy because no major disasters happened (yet, not everything is graded yet). The project groups built some nice gadgets and I think most students got the idea in the end. I even heard someone say they learned a lot. That's good to hear, although I hope he's not the only one.

There's also plenty to improve for next year. Better project start timing w.r.t. the S2D4S and Systems Engineering part, better use of systems engineering in the project and tighter technical integration of ESP in the project are some of the improvements that we're already thinking about.

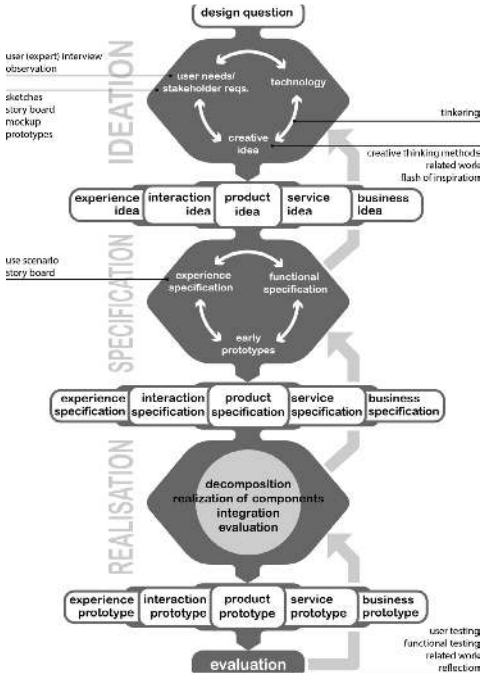

Figure 2: Design process of Creative Technology [1].

References

[1] Angelika Mader, Wouter Eggink "A Design Process for Creative Technology," DS 78: Proceedings of the E&PDE 2014 16th International conference on Engineering and Product Design, University of Twente, The Netherlands, 2014

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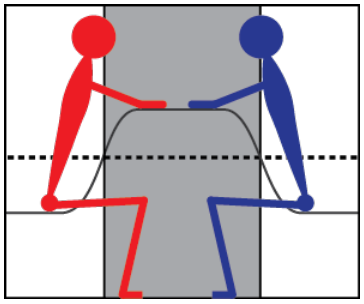
Junction

Authors: Maarten Thoonen
Mark van Holland

Raymond Veldhuis is a teacher from SCS here on the UT, and most recent winner of the teacher of the year award. Raymond tells about his experiences studying, and teaching on the UT.



Where did you study?

I studied here on the university, back when it was still called the "technische hogeschool"(technical college)

Did you study EE?

Yes, I studied electrical engineering.

Why did you choose to study EE?

When i began here, I thought it was fun to make amplifiers. *Not anymore?* Well, that is when I discovered that there were more fun things to EE, then just building amplifier, so then I started going more to the math side of the study.

Did you do an internship when you studied here?

Yes, I did my internship at the Koningin Wilhelmina foundation in Nijmegen. That was in a lab at the university of Nijmegen, at the nature science department. That is where I worked on the analysis of photos of smear tests, to detect cervix cancer. My internship took three months.

Did you do your master here in Enschede?

That is not how it was back than, it was still called a engineers degree. I graduated in 1981, and that is when you became an engineer, and it was also called the technical college. Back then when you studied at the university you got your decorate, and when studying at the technical college, one became an engineer. It was only later on that this became an university, but the study stayed the same.

> "Teaching is not a competition for me"

Did you study any more later on?

I never did a master, the engineers degree I got is equal to the masters degree, so I could also call myself a master I think. It is just the same title, only difference is the name.
Every country called it differently. Here in the Netherlands, if you didn't study at an not technical university you got an doctorate, and here in Enschede you got an engineers degree (ir.), and if you studied at the HTS you got an engineers degree (ing.). "easy isn't it?" To make matter more fun, back then there was an bachelor like study, where you got your degree after three years and a half years, just like the bachelor degree now, later the study was discontinued, and now it is back again.

What subjects do you teach within EE?

In the second year I teach linear systems in module six, and some digital signal processing in module eight. In the third year, in module eleven, together with Bram Nauta, I teach embedded signal processing, also the digital part of it.
In the masters, I teach a course, which is more about research, called: introduction to biomedics.

> "You have to like what you are doing"

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Raymond Nicolaas Johan Veldhuis

What kind of student were you?

I performed well, I did my engineers degree with good grades, the average was higher than an eight. I never really had much trouble with my study. There were subjects which I disliked more than other, and some that were better than others, but all in all it was a great time. So as much as my study is concerned I was a good student. Especially the first two years, later on I started doing more activities besides my study.

I lived a short time on the campus, just

> "When i began here, I thought it was fun to make amplifiers"

Age	61
Birth place	Den haag
Favorite Color	terracotta
Favorite Drink	good old gin

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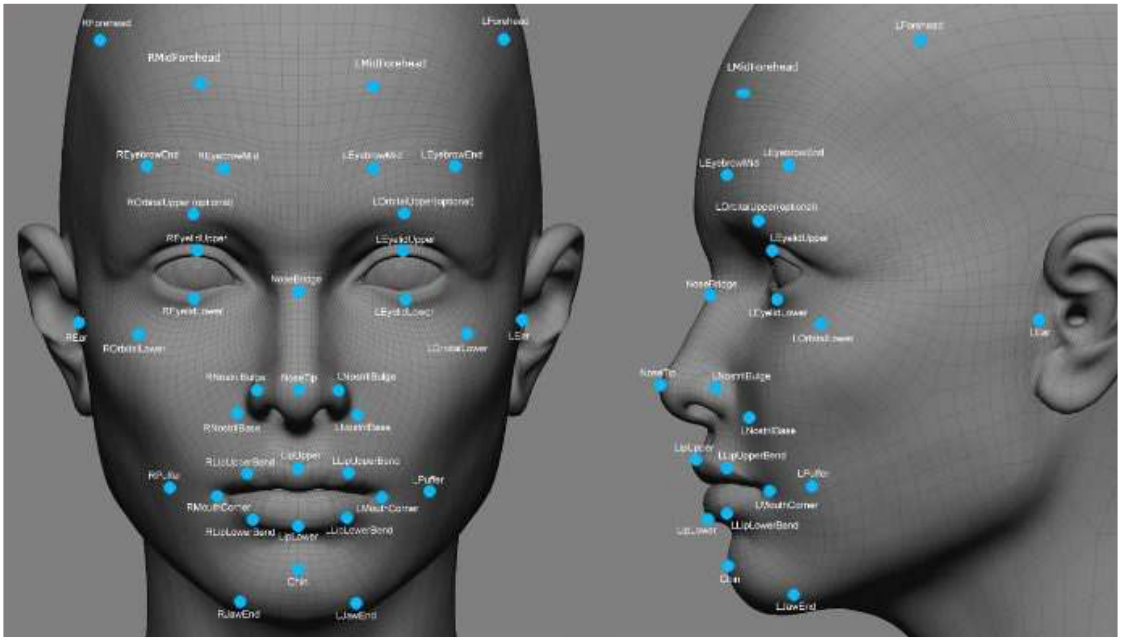

like everyone else at the time, because the campus seemed to be half empty at the time. After about a year I moved to the city.

As a student I was a bit different, for example we didn't graduate in suit. Just a bit different as normal. *Was that how it normally went?* There was a small group that did graduate in a suit, like what is normal nowadays when study's or study association go out, back then that was not the case. It was shortly after the sixty's, where everything had to be different and not like our parents, so we did not go to our graduation in a suit.

Did you do something besides studying at the time?

I was a board member at what was at the time called the ssht. now it is called the "Stichting Jongeren Huisvesting Twente", SJHT. I, together with some fellow students, with some help of the university, and the city, we bought some buildings in the city, so we then rented rooms to students. I also was landlord in one of these buildings.

After that I helped setting up the science shop here on the campus. I don't know where it is located now, but it still exists, but when we started we had a room in the building which is now called the Spiegel.

What do you think of TOM?

I have mixed feelings about it. It is a good idea to prepare some subjects together with the other teachers, if done right, it can be beneficial. It seems to help the flow, and increase the success rate of the first year. In the second year however we don't see this effect.

> "It was shortly after the sixty's, where everything had to be different and not like our parents"

I think that on the one hand the goal to invest less time in the teaching is not achieved, because it doesn't scale. I mean if we get more students, and there are the practicals, and parts that needs to be individually guided, then the efficiency is gone. But for me, the subjects I thought before TOM I still teach in the same manner. I do think TOM helped to increase the flow, but does it make it more students come here because of TOM? That I don't know.

One of the downsides is that we need more time to deliberate. More things need to be adjusted to fit one another, and this takes time. One other thing is, but this will improve as time goes on, is that because we are still in the starting phases, the system is not stable yet, which makes it so that it takes up more time.

What would you want to see changed about TOM?

Now when you do not pass one subject within a module, you fail the entire module. What I would do is make the system more flexible, where if you fail

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at one subject, you get a change to redo that subject instead of the whole module. Because this is causing much delays in the study.
One thing we struggle with now is that there are a lot of different types of students, who all have other criteria to pass. So are the pre-tommers, students from other studies, and people who do something for the second time. So when grading all these people need to be taken into account, even though the pre-

> "I still like doing what I do enough to keep going for a while."

tommers will disappear over time, the other groups still remain.
We also need to make more uniform type of tests, that is basically always the same, so the administration can be done, not by the module coordinator or the teachers, but by educational matters. This way the administration will go much more smoothly.

Did you know you wanted to start teaching when studying, or did you do something else first?

Initially I did something different. When I was studying, I gave some guided practices which I liked doing, but I did not think I would end up teaching after graduating. When I graduated I first started working at Philips, where I also gave some courses. Later I got promoted within Philips, and at some point I went off to work at the university of Eindhoven, after which I started here at university of Twente. So basically I ended up back here after doing something else, and when working at the university, you also need to teach some subjects.

What kind of research do you do?

The subject here is biology, and in particular the recognition of fingerprints, facial recognition, or recognition of the iris. This is a nice thing to do, and I believe it is also important to do. We look in particular to the recognition of fingerprints, and facial features. When looking at facial recognition, we focus on the forensic side of it, like recognizing a criminal by it facial features caught on camera, and improving the existing techniques.

How do you like teaching here?

I like teaching here, however I find teaching three subjects is enough, but I like doing it. If someone teaches against their liking, the students are bound to know, and it looses its value, so it is good to have fun teaching.

Did you notice differences after winning the teacher of the year award?

Well sometimes someone congratulates me with it. And this is not the first time I have won it, back in 2011 I also won, I get nominated basically every year. That for me is the best part of it, not the winning, because teaching is not a competition for me, but getting appreciation from the students who nominate me. Getting nominated is not linked to having a high success rate, my success rate isn't even that high though, because it is quite a difficult subject. Which means it is my manner of teaching the students like.
In linear systems, and in digital signal processing I often use the blackboard, but in the third year I work more with slides. These can also be used like a the blackboard, as long as you don't go through them too fast. The main problem with slides is that often they go through them too fast.

Do you have a family?

I have a wife and three children, all daughters. They are 14, 17, and 19 years old. The oldest of which is starting studying this year, but not at this university.

Do you have any hobbies?

Yes, I currently row. I used to jog, and then the long distances, like marathons, and half marathons. Now with rowing I also go for the long distances, like the Rijnijssel marathon, where we row in shifts from Arnhem to Zwolle. I live in Deventer so I usually row in the Ijssel.

Are there things you want to do in the future?

Not going to retire any time soon, I still like doing what I do enough to keep going for a while. I already travel a lot for my job, to go to conferences and sorts. When we go on vacation we often go camping in terrains without luxury.

Do you have any advice for the students?

You have to like what you are doing, that's basically it. So you have to have fun doing what you do, and if you don't then you have to find a way get fun doing your job. When doing something you don't like day in day out, is not going to work out. Studying have to be fun, but you also need to have time to do something besides studying, like sports. I also like to say don't go after the money, but go do something you like doing.

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Afterlife

Author: Tijmen Hageman

Just like the many 'afterlifers' which held this very pen before me (well, digitally speaking), I was confronted with the end of my master's and the choices after. And that was not easy for me, as for a long time I saw the end of my masters as the finish line with no plan ahead. Luckily EE masters have a wider selection of options than many less fortunate, leaving us the luxury of choosing from a range of options. But let's not get ahead of myself yet...

Although many of you do not know me, I'm sure there will be enough people around with which I have shared some beers, stories or time in the lecture seats. My name is Tijmen Hageman, currently 26 year old. I started my bachelor's in 2007. Although the first year was rough which gave me doubts about continuing, I decided to finish it.

> "Oddly both research groups I worked at are not in existence anymore..."

Highlight of this period was study tour Ngoi Sang to Asia in 2009 (Malaysia, Singapore, Vietnam and South Korea) which had a big impact on me. Not only was this my first 'big' travel experience, it also opened my mind to other cultures and placed my life in a wider perspective. I highly recommend other people to participate in one given the chance.
I did my bachelor assignment at TST on a particular MEMs sensor. I then proceeded with the EE masters program with a custom program instead of a standard track because neither of them appealed to me. I wrote my master thesis at SAS on stereo vision and 3D tracking. Oddly both SAS and TST are not in existence anymore...

Exploring new horizons

Ngoi Sang awakened my thirst for traveling, and I decided to go backpacking when the time would be right. During my masters assignment I got in touch with Bram Ton who got excited by this idea and we decided to team up for a trip to Asia for a total duration of 4 months. In april 2013 we started off by flying to Moscow and taking the Trans-Mongolian railway to Beijing, a trip of 7600km taking 6 days non-stop. We spread this out over a month, allowing us to explore the highlights of Moscow, visiting the Eurasian border, hiking over the frozen Baikal lake, and riding horseback over the Mongolian steppe. This trip is not for the impatient ones, as at one moment we stayed in the train for two-and-a-half days straight.
Then followed a full month of traveling through China to Hong-Kong. Climbing the overgrown ruins of a non-restored section of the Great Wall, visiting the Terra-Cotta army and watching pandas doing nothing at all is just a small selection of the vast amount of things to do there. And of course we took some

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time to visit the electronics market in Shenzhen as well. China is perfect for backpacking: the infrastructure is well developed with convenient night trains between cities, it is not expensive and the food is great. Furthermore there are so incredible many hidden gems to be found; have you ever heared of the hanging monastery of Datong, the giant Buddha of Leshan or the beautiful stone pillars of Zhangjiajie?

It was quite a change when moving to the next stage of the trip: we would subsequently travel through Thailand, Laos, Cambodia and Vietnam starting in Bangkok. These countries have a far more laid-back attitude, and are less structured. This slowed our travel pace down greatly and it took us about two months for the remaining 5000km. We sampled countless temples, raced around on motorbikes and rode elephants before arriving in Hanoi.

It is a great thing to be traveling for such a long time. However, I found that after about 2 months the traveling itself loses a bit of its appeal; seeing new things becomes routine such that each next temple is 'just another temple'. I was definitely ready to get back to daily life in the Netherlands.

The perfect job?

Jumping back about 7 months: I started searching for a job during writing my thesis. I am one of those guys who didn't know what to do after their study, so I wanted to start my search early. I decided I studied enough and didn't want to pursue an academic career. Though I did want something else than the typical EE jobs such as hardware engineer. It was hard to find something what both really appealed to me and was available for starters. Most employers seem to be searching for staff with several years of experience. Recruitment agencies also could not find me a satisfactory position. I finally found a local small company via connections on the university, which offered a contract for after my trip to Asia. This eventually did not work out that well, and I had to resume searching. This time I looked into positions as researcher as well, as I started missing studying a bit. Oddly enough my applications for research positions worked much better, and I got PhD offers from the University of Eindhoven as well as from professor Leon Abelmann at KIST Europe. The latter offered some exciting extras, including moving to Germany, so I jumped into the deep.

Starting as PhD

And thus, I moved to Saarbrücken, Germany, near the French border. The Korean Institute for Science and Technology over there is a European daughter institute of KIST in Seoul, with a blend of Korean, German and other nationalities (among which a few Dutch). Rather than the traditional individual PhD trajectory where each person is working on his own 'separate island', we have a team-based approach. This results in me participating in several projects where I take on the roles of building setups, performing measurements and processing the data. Those who attended lectures of Leon Abelmann will not be surprised that magnetism is central in each of them. One of the project deals with characterization of magnetotactic bacteria, which are self-propelled magnetically-steerable bacteria. Another project is macroscopic self-assembly, in which we observe and model how centimeter-sized magnetic particles connect and disconnect in a turbulent pool. We also take this to microscopic scale, where we study how magnetic disks interact with each other, as well as with biological samples.

My current position feels a bit like doing my master thesis over again, but longer and with more freedom but also responsibility. Not only for my own projects, but also for occasional supervising students. The position also allows for developments I did not have during my study. Something very valuable to me was a course on professional effectiveness focusing on soft-skills such as personal branding, how to approach people in certain situations and which role you can take on in a team. Another thing that is of great value to me is that I can easily explore more of the world due to visiting international conferences.

At the moment of writing, I have just started my third year of the four-year program. So far I'm still motivated and have no trouble continuing this life for two more years. And what comes after is still to be determined. Traveling again? Moving abroad? Or returning to the Netherlands? Who knows...

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Puuzle

Author: Truustje

The winner of last week's puuzle was Thomas Hoen, congratulations! This edition we got a nice nonogram for you! Below you see a grid of squares. These have to be made black in such a way that for every row and column there is a subsequent amount of black boxes in a row as indicated, with any number of white boxes in between. Please mail the top row of the resulting sudoku to vonk@scintilla.utwente.nl to be eligible for a delicious pie!

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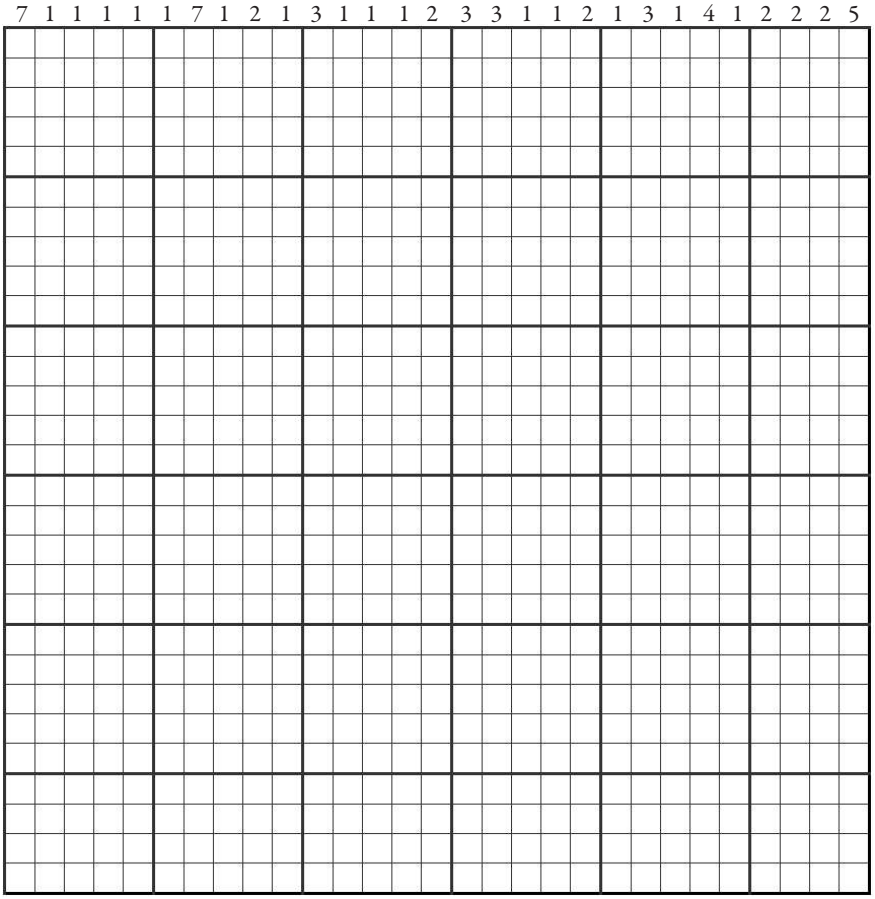

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From WB to EE

Author: Christian Top

At the moment I wrote this article, the third module is almost at its end. However, for me it was just the second module of Electrical Engineering. This year I started at the University of Twente with the study Mechanical Engineering, but a couple of weeks after the second module had started, I realized that Electrical Engineering was a lot more fun. Luckily it was still possible to switch to electrical engineering.

Of course I didn't make this decision in a couple of days. I have always been interested in electricity and when I was a child, I disassembled all kinds of electric devices.I could imagine that you may wonder now why I still chose to study mechanical engineering. At high school I already doubted between mechanical engineering and electrical engineering. Nevertheless, I chose to study mechanical engineering, also because this study was Dutch. But when starting with the study Electrical Engineering it appeared that the lectures in English weren't difficult at all.

> "I have always been interested in electricity."

Now I'm very happy that I made the switch just in time, because I think this study is very interesting. Of course I had to do a lot of extra work to catch up all the stuff I missed in the beginning of the year, and also during the Christmas holiday I studied a lot, but it was worth it and I passed the subject electric circuits of module 2 with quite a good grade.
After the second module the third module started, and still tired of the work I had done to pass the second module, it quickly became clear that this has been just basic knowledge needed for the third module. But the third module was also very interesting. In the project we had to make an audio amplifier and transmitter, and it was very nice to see that you are able to make such nice things after a little period of studying electrical engineering.

Something that was less nice in this module was a program called 'Perusall' which was introduced for the subject electronics. This is a program on the internet in which students could read the reader of electronics, and when something is unclear or you just want to make notes, you can put it as an annotation in Perusall. Other students are able to read these annotations and can respond to it. Based on these responses and annotations made in Perusall, students can earn points which are a part of the final mark of the subject electronics. The idea of Perusall is very nice, but when students can earn points with it, they are just going to make annotations to get these points, and not to learn something. Also, students who understand everything are disadvantaged, because they have nothing to ask and therefore don't get points. As a result, many students start to complain about this program, and luckily the rules have become more flexible. But maybe Perusall also brought something good, because quite a lot of students passed the subject electronics without retake. I was one of that persons, although my grade wasn't as good as I hoped it was.
Assuming that I have said enough now about the third module, there are also a lot of nice things you can do besides your study, and despite the fact that I still have to catch up some things of the first module, I also try to find time for other things. Every Saturday I have a little job, and I also participate in activities of Scintilla. One of these activities was the excursion to the Grolsch factory. Although I've lived in Twente for my whole life, I have never been in the factory before.

> "I realized that Electrical Engineering was a lot more fun."

Next year I plan to go to live in Enschede, and joining a Christian student association.

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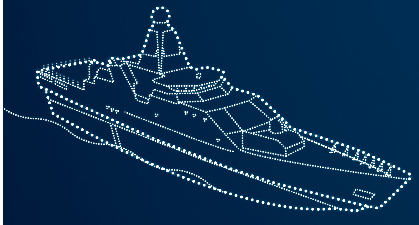

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