Presidential Note

Author: Ewout Baars

Dear reader,

Upfront, a year seems like a really long period. It all starts with a very powerful hammer strike. After the first GMA and, for how it feels, a thousand constitution drinks, you can finally start with the real work. Energized and full of passion, everyone wants to make the best of the upcoming year. The whole year feels like a roller-coaster with all advantages and disadvantages included.

Just like a rollercoaster, there are very high ups which can change in very deep lows really fast. The same holds during a board year, one day everything works out. You and your fellow board members have an amazing idea, everyone you speak about it likes it and the whole plan is fixed in no time. While sometimes you think you have an amazing idea and when you try to work on it you get a lot of backfire, negative opinions or nothing works out. This can change from month to month, but sometimes even from day to day, which makes it always interesting. Just for fun some high peaks: Thoringcar, fruit in the Scintilla room, a new TV, new chairs in the board room and of course the new fridge.

In a rollercoaster, you are tied to your chair, this for safety reason obviously. As board member you are not literally tied to your chair, except for that one time a member ties you to it. The Scintilla room might not be the ideal place for everyone to work, but for board members it definitely is. Bounded to your place in the Scintilla room you can work every day for long hours, most of the times, because you get distracted every 5 minutes you try to work. Sometimes it is even more alike with a rollercoaster than you would expect. You are not only bounded to your chair, but sometimes you also throw your hands in the air and shout something really loud, just like in a rollercoaster. The only difference is that instead of screaming "yeeaaah" people in the Scintilla room often shout "ooh F*****CK off" after which they go downstairs for a beer.

In a rollercoaster you have the idea that the time flies. You can say much about a board year, but everyone will agree it goes way too fast. One moment you are just starting up, everything goes really slow and you are climbing towards your first peak, one moment later you are shooting through your year. One other moment you are going downwards, clinging fast to everything you see. There are moments where you take a rest to look around and enjoy the moment, while sometimes you are in the middle of a rush and don't have time to see everything that is going on. In the meanwhile, the last moment is coming closer and closer. The moment which you thought was too far away to be scared of, the last moment of the rollercoaster.

It shall again be with a hammer strike, one powerful, meaningful, thumping hammer strike.

I want to thank you for this awesome year, which passed by way too fast.

Op de koningin, op Scintilla!

Ewout Baars
President of the 89th Board of E.T.S.V. Scintilla

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Masthead

De Vonk

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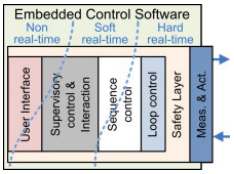

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Icons of EE 14

A few scientists have managed to extensively shape the field of Electrical Engineering. In this edition: Richard Feynman.

Datasheet 32

Herjan has bravely accepted the challenge to rate all pubs on the 11-bierentocht! Read about his findings on the atmosphere and beer quality on page 32.

Editorial

Dear reader,

Sadly, this will be the last editorial I write to you as chairman to the Vonk committee. As I am finishing my final few courses, I am mentally preparing for the summer holidays.

I hope you are too, as the summer is one of those periods that allows us to fully recharge for the next academic year and for all endeauvours that that year may comprise.

Luckily, this edition of the Vonk will make sure you will not be bored during those moments in the summer holidays where you have nothing specific to do. We have compiled a great set of interesting stories covering education and entertainment, filling this Vonk with 40 pages of content.

We have started with a new category of articles in which we plan to feature Electrical Engineers that have amazed the world with groundbreaking discoveries or research. This rubric will be kicked-off with an article on Richard Feynman, the bongo-playing scientist most of us will remember from the module on Fields and Waves.

This edition also widely features elements from all sections of the Electrical Engineering curriculum, ranging from the Bachelor project in module 11 to PhD research on robust motion control. We have even asked a recently graduated Scintilla member to give us a sneak peek into what live is like after graduation.

Anyway, I wish you all the best and hope you will enjoy reading this edition just as much as we have enjoyed making it!

Stef

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Modelling and characterisation of a pressure sensor implemented in surface channel technology

Author: Bas van Laerhoven

One of the easiest pressure sensors to design is a resistive pressure sensor. A structure under pressure changes in geometry which causes the resistance of the structure to change. This change in resistance can be measured with an electronic readout circuit. But, how does this sensor precisely work? In my bachelor assignment I made a theoretical model of the working principal of a resistive pressure sensor.

It all starts with taking a trip into the domain of a mechanical engineer. The starting point is the geometry of the structure and the way this structure behaves under pressure. For my bachelor assignment, I used the assumption that the structure was a rectangular beam, fixed by a substrate at both ends. This assumption resulted in a formula which describes the deflection for this kind of structure.

$$w = \frac{F}{2Eh^3}x^2(L-x)^2$$

The formula is based on the dimensions of the structure and the Young's Modulus of the material of the sensor. In the case of my bachelor assignment, the material of the sensor is gold and the material of the structure underneath is SiRN (Silicon Rich Silicon Nitride). Gold has a Young's Modulus of approximately 80 GPa, SiRN has a Young's Modulus of approximately 210 GPa. When the structure is subjected to pressure, the SiRN will determine the movement, because it is the stiffer material. Because of this, for determining the deflection, the Young's Modulus of SiRN is used and it can be assumed that the gold sensor does not influence the movement of the SiRN structure. To give you a feeling about the difference in dimensions: the SiRN structure has a thickness of 3.5 μm and the gold has a thickness of 0.21 μm.

The formula for the deflection can be derived to find the strain at every point in the rectangular beam.

$$\varepsilon = \frac{h}{2}\frac{\partial^2 w}{\partial x^2} = \frac{F}{2Eh^2}(L^2 - 6x(L-x))$$

The strain is also known as the relative elongation of the structure. In simple words; a measure for how much longer the material became because of the pressure. In my bachelor assignment, rectangular beams were placed at 3 different positions along the width of a channel. Figure 1 shows the positions of the rectangular beams on top of a channel. The rectangular beams at the sides (R1 & R4) are compressed and the beams in the middle (R2 & R3) are elongated. The compressed beams have a negative strain and the elongated beams have a positive strain. The strain from the rectangular beams has a linear relation with the change in resistance, this is because the resistance of material is largely dependent on the length and area.

$$R = \rho\frac{l}{A}$$

This linear relation is important for getting a formula for the electronic readout of the sensor. Before we get to this electronic readout, we first need to know how this rectangular beam becomes a pressure sensor.

In theory, a single rectangular beam, also known as a strain gauge, can be used as a pressure sensor. Most likely this will not give very accurate or reliable results. Therefore, multiple rectangular beams are combined in a meandering pattern to form a bigger strain gauge. Four of

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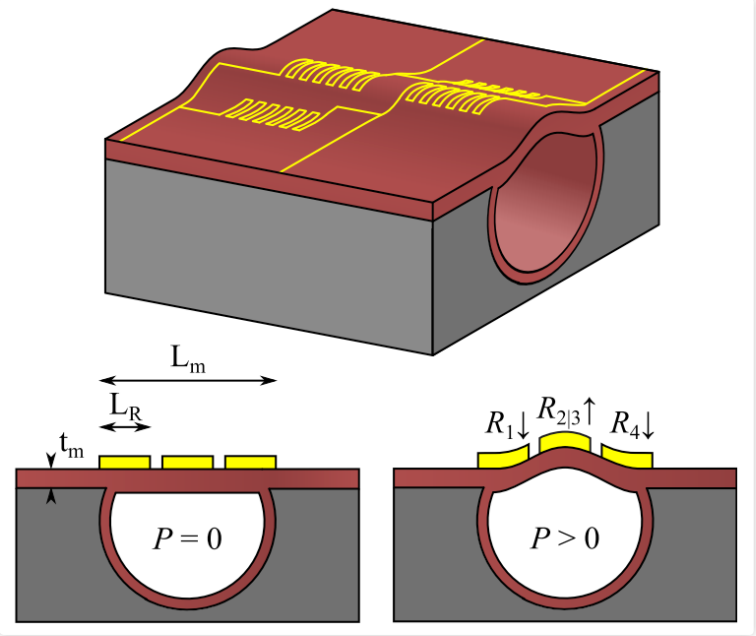

Figure 1: Design of a resistive pressure sensor. Gold strain gauges are placed on top of a channel roof. When under pressure the strain gauges are elongated and compressed changing their resistance.

those bigger strain gauges are placed in a configuration that every Electrical engineering student knows; the Wheatstone bridge. Figure 2 shows all the resistors involved in the Wheatstone bridge. The strain gauges in a Wheatstone configuration make the results more reliable because four strain gauges are used to obtain a result. To give a short recap up until this point; a pressure sensor is made up from four strain gauges that are placed in a Wheatstone configuration. Each strain gauge is subjected to a positive or negative strain which results in a change in resistance.

Because of the linear relation between the strain and the resistance, the change in resistance of each of the Wheatstone resistors can be expressed as a strain.

$$\frac{\Delta R}{R} = (1 + 2\nu)\varepsilon$$

Using this in the formula for a Wheatstone configuration leads to a formula for the output voltage of the total sensor.

$$V_{out} = V_{in}\left(\frac{\varepsilon_{2,3} + \varepsilon_{1,4}}{2R}\right) R(1 + 2\nu)$$

The problem with this formula is that parts connecting the pressure sensor to the power supply and measurement setup are neglected. Those parts do have a relevant length and lower the supplied voltage. To solve this, Vin needs to be compensated with the connecting parts.

$$V_{in} = V_{cc}\left(\frac{R_w}{R_s + R_g + R_w}\right)$$

In this formula, Rs and Rg correspond to Figure 3. Rw is the resistance of the pressure sensor in rest position. The value of Rs and Rg is dependent on the design of the pressure sensor. The ideal situation would be to have the voltage supply and the readout circuit directly connected to the Wheatstone configuration. The contribution of Rs and Rg would be minimal. This would decrease the total resistance of the pressure sensor making it more sensitive. Realising this brings a lot of design issues, the connections of the power supply and readout circuit would have to be placed at difficult positions on the chip making it difficult to connect the chip with wires.

> "The results showed that a lot of progress can be made in the accuracy of the fabrication process of the microchips."

Combining all the separate formulas, a model is created that gives the sensor output as a function of the applied pressure. This sensor output can be used to look at the sensitivity of a pressure sensor. As already mentioned before, the sensitivity can be improved by making sure that all the connecting parts are as small as possible. In current applications, there is a trade-off between a higher sensitivity and a complex design which is necessary to reach this sensitivity. In my bachelor assignment, I used a theoretical model to validate results from several existing pressure sensors. The results from this showed that a lot of progress can be made in the accuracy of the fabrication process of the microchips.

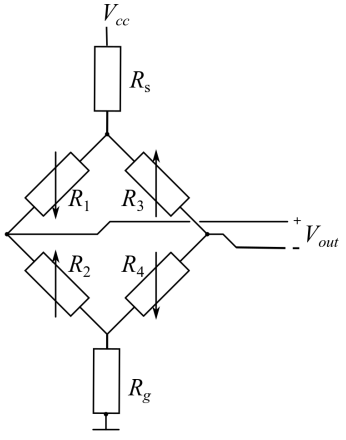

Figure 2: Circuit diagram representing the Wheatstone bridge.

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Robust motion control

Author: Tim Broenink

My PhD research has started almost three years ago. These years have been rich in lessons and experiences. In this article, I give an overview on these three years. I will show some of my research lines and some of the results of this research, but first, it is time for some introductions. I started as a PhD student at the Robotics and Mechatronics group (RAM) in September 2017. Fresh from my master in Electrical Engineering, which I finished at the same group.

At that time there was a big project starting in collaboration with a lot of groups. This project was funded by the then called STW organization, which is now known as NWO-TTW, a perspective program. The title of this project is "Robust Design of Cyber-Physical Systems" and the project is a collaboration between Twente, Eindhoven, Groningen, Nijmegen, Delft, Leiden and Amsterdam. Within this project, there are a lot of different tracks, or maybe research lines, nine to be exact. I am part of the ninth line, which is "Robust motion control". This line is a collaboration between us and the Radboud University Nijmegen. This research line has been the basis for my research of the last three years.

> "We focus on the design of cyber-physical systems in such a way that we can design motion systems in a robust and reliable way."

Next to being part of this perspective program, I have also spent quite some time of my PhD on educational affairs, more specifically module 6 of the Electrical Engineering Bachelor. This article will however focus on my research.

Based on the title of the project and research line, you might already have some inclination on the subject of my work. My work focusses on "Robust motion control". More specifically we focus on the design of cyber-physical systems in such a way that we can design motion systems in a robust and reliable way.

If we take a step back and look at the concept of a cyber-physical systems (CPS), we can see that it is a very broad subject. Any system that can be said to interact with both the cyber world, by including some sort of computation, and to interact with the physical world, can be called a cyber-physical system.

This dual nature of these systems creates a set of design challenges. These challenges are already described by (Lee 2008). A particular set of challenges arises from the fact that the physical part of the system introduces safety and reliability considerations that are very different from the ones in general computing.

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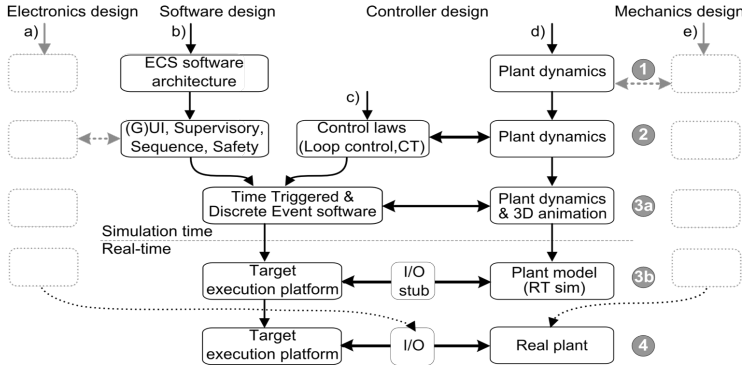

Figure 1: An overview of the design flow of cyber physical systems as presented by Broenink and Ni 2012.

Even if we only take into account the cyber physical interface of the system, and thus ignore the purely mechanical and software design, there are a lot of aspects that need to be taken into account. An overview of these steps was presented by (J. F. Broenink and Ni 2012) and can be seen in Figure 1. There exist some strategies to help overcoming these challenges. This can be done using smart development approaches, simulation tools and physical prototypes.

Approaching the development of CPS using a model driven approach can work. But as you can already see coming, the fact that the system covers different domains and different models of computation, results in a lot of different aspects of the system that have to be modelled and simulated. This modelling and simulation of CPS is not a trivial problem and is also part of this research. The rest of this article will focus on our solutions for modelling, simulation, designing, and maybe a bit of testing of these cyber-physical systems.

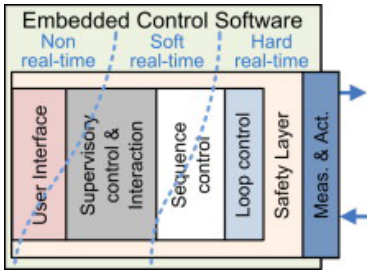

Figure 2: Layered control structured of embedded control software (Broenink and Ni 2014).

So step 1, the simulation of these cyber physical systems. It is not as trivial as you might expect. There are a few ways to simulate a system that exists in different domains, or to be more specific with different models of computation.

The first one is to approximate one domain in the model of computation of the other domain. This way you effectively make a single model. The advantage of this method is that it is very easy to implement. The disadvantage is that it becomes more complex when more models of computation are used, and when the system (thus the part of the model that needs to be transformed) becomes larger. Now you might think, how many different models of computation can you have? But let's take a look at a computer program for embedded control software. The layered control structures as posed by (Ni and Broenink 2014) shows multiple different layers. These layers, as shown in Figure 2, have already multiple models of computation. Where the loop control and safety layers are discrete time based, the supervisory control and user interface will probably be based on discrete events. This shows that even in the cyber part you might need more that one model.

The second option is to simulate all the models within their own model of computation, and then use a communication layer to synchronize these models. This principle is known as co-simulation. The advantage of this method is that all parts of your system can remain within their own model. You will however require some sort of extra software/information to control the complete simulation.

You would need to specify what models to simulate together, how to simulate them and also what in- and output to provide. This is still a difficult problem. Luckily for me, I worked together with a computer scientist in Nijmegen who worked on this problem. He designed a domain specific language to generate these co-simulations, called CoHLA. The design and development of this system is shown in (Nägele et al. 2018). How a simulation would be structured is shown in Figure 3. As you can see, there is an interface to communicate with all the different simulators, the RTI. And there is a implementation of simulators for different models. This way you can simulate the multiple models you need for a cyber-physical system together.

But simulating all these models together is not the only thing required. When you start the design of your system, you will hardly have any models at all. During the

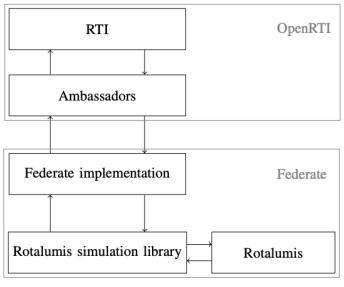

Figure 3: The structure of a simulation made in CoHLA (Nägele and Hooman 2017).

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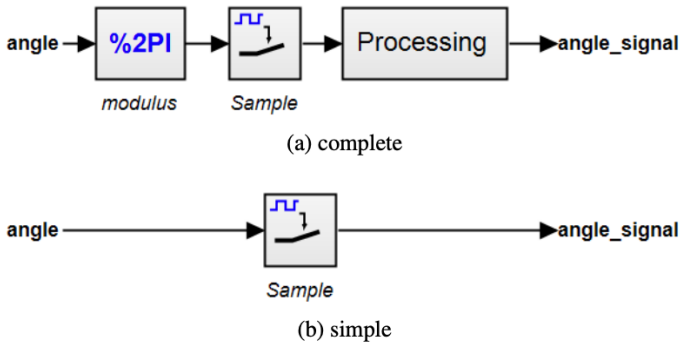

Figure 4: A simple and complete implementation of a sensor system, with the same interface.

design process, you will make decisions which will influence the final product. This results in a different design, and thus in different models. When you want to know which decision is better, you might even want to simulate the different choices both. So you will get a lot of different simulation during your design. For every new simulation that you want to do, you will need to construct a new co-simulation. Okey, maybe not for every simulation. If your overall model structure of the system remains the same and only the internals of these models change, you might be able to use the same co-simulation.

> "If you want to keep your model structure as constant as possible, you will need to choose your model interfaces in a smart manner."

This is why it is important to think about in what structure you model your system. You want to make sure that the top level of your system keeps the same structure, independent of where you are in the design process. Of course this might not always be possible, but you must try to achieve it.

If you want to keep your model structure as constant as possible, you will need to choose your model interfaces

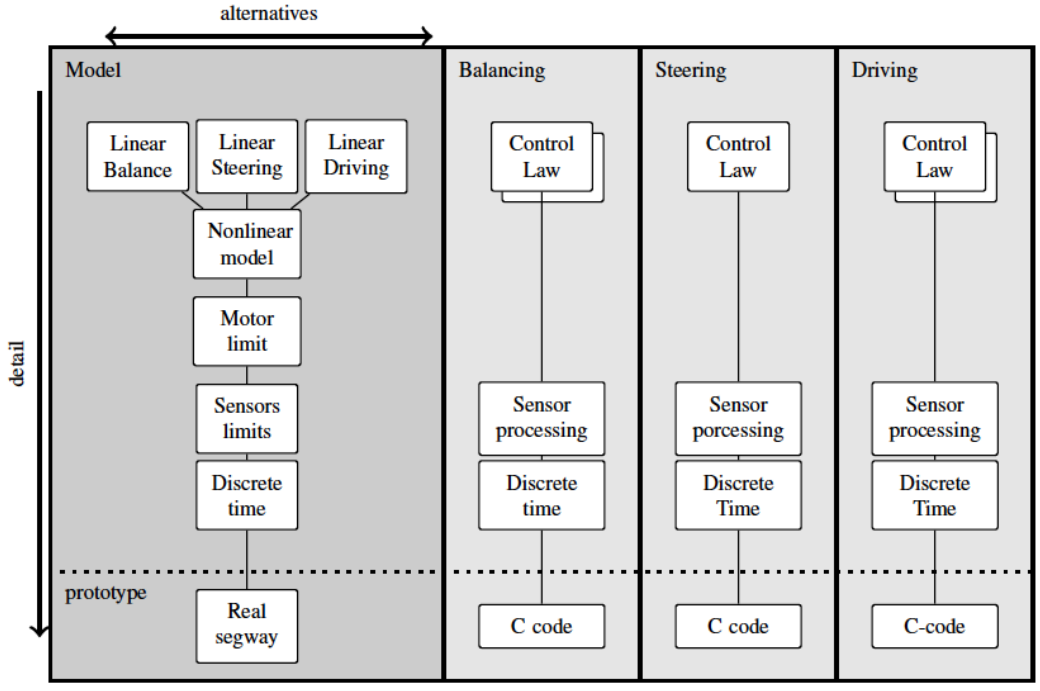

Figure 5: An overview of the models generated for a segway as shown in (T. Broenink and Broenink 2019).

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in a smart manner. You need to base them on physical signals, or at least representations of physical signals. These physical signals are mostly invariant of the amount of detail present in your models. Thus while the implementation of a part of your system will change, its outside will remain the same. An example of this I show in (Broenink and Broenink 2018). An example from this publication is shown in Figure 4. This shows two models of a sensor system. The first model (a) shows the complete model of this sensor. With all extra behavior included. The second one (b) shows a simpler version of the same sensor, with different behavior. However, the interfaces of both of these models are the same, and both of them could be used in the same co-simulation.

With these tools we can effectively design simulations of a cyber-physical system. This does however, tell us nothing on how to design these systems effectively. The rest of my research focusses not on how to simulate these systems, but on how to design them. During this design we of course want to leverage the capabilities provided to us by the previous work on co-simulation.

This is why we have developed a method of designing cyber-physical systems in a structured way based on an iterative approach. This approach is detailed in (Broenink and Broenink 2019). This approach shows a way to develop a CPS by dividing the design problem into manageable features and detail levels. Both of these will result in a large set of models, that can be simulated during the design process. One example set of models is shown in Figure 5.

The specifics of this method can be found in my publication, but is is safe to say that this structured approach should allow for more simulations and thus also tests during the design process. This process should be as automated as possible. Thus after changing a part of your design you can receive feedback immediately on the performance of the system.

This brings me to my final subject for this article, that is the future work. While I have shown you some of the results of this research project, the work is not yet done. Currently we are working, together with students, on different ways to improve this. These subjects include but are not limited to: Automated tests with simulations. Generating standalone code based on the design process. Effectively switching hardware platforms.

> "We have developed a method of designing cyber-physical systems in a structured way based on an iterative approach."

Hopefully this work will improve the methods and approaches mentioned in this article into something that can really help with the design of robust cyber physical systems. Who knows, you might read all about it in my final thesis.

On a final note

If you do think these subjects are interesting, or are looking for an bachelor's or master's assignment within these subjects, feel free to contact me or our group.

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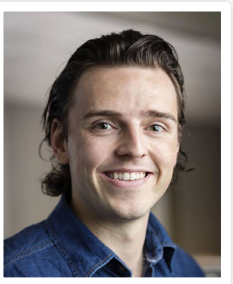
Advertorial: Arcadis

Author: Erik Rietbergen, Arcadis



Solar panels are part of the design of building-related installations. When calculating and/or implementing a Photo-Voltaic (PV) system, several factors have to be countered and/or implemented to make the system safe and the design optimal. Not implementing these can result in a less effective or even dangerous (Health & Safety) PV system. In this advertorial, these factors/subjects are brought to (sun)light and provided with a solution.

Intro

A PV panel consists of multiple solar cells which are electrical devices. These cells convert light into direct current (DC) electrical power which is transported via cables to an inverter which turns the DC energy into alternating current (AC) power, see Figure 1.

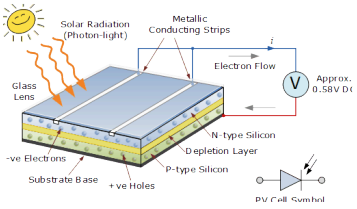


Figure 1: Solar Cell (source: Alernative Energy Tutorials)

Shadow influence

Shading is one of the biggest influences on the performance of a PV system. An inch of shade on a panel will result in a decreasing output of the panel and if not designed effectively, the whole series of panels will decrease their output. An exhaust on the roof, a speck of dirt (lack of maintenance) or even another panel can create enough shade to the panel for it to 'restrict' the flow of the current through the cell string. For these reasons extra design calculations and research needs to done, which is often forgotten. Implementing the equation in Figure 2 below we can counter the shadow cast by the panels on each other.

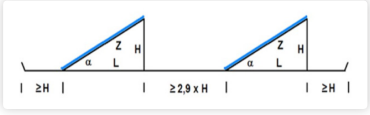


Figure 2: How to counter shadow influence.

A string of solar panels is usually connected in series. In which the current produced by the first panel is the maximum of the second panel, etc. This combined by a restriction of the current created by the shadow will have a chain reaction that can reduce the output of the whole string of panels.

By utilizing Direct Current optimizers, the influence of shade is countered by adjusting the output voltage and current and maintaining the maximum power of the system. These optimizers will boost the decreased current so it matches the current of the unshaded panels.

Gradual Degradation

The next factor is the degradation (in percentage) of the panels, as soon as a panel is exposed to sunlight its cells start to degrade. This degradation reduces the output of the cells and thus the output of the whole system. The amount of the degradation varies from less than 1% to even 3% in the first year and 0.3 to even 1% in the years following. Causes of degradation are:

- Quality of the panel's materials;
- Weather conditions;
- Physical damage;
- Maintenance (panel cleaning).

When the degradation is sub 80% it's seen as the system has reached its end of its lifespan and will need to replaced. This percentage is achieved faster with implementing low quality panels as seen in Figure 3.

Next to the lifespan, the degradation is important when the reason to implement a PV system is to counter the energy usage of an installation. If not implemented in the design there's a possibility that after a couple of years (or even after year 1) the output of the system is lower than the to be countered usage.

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Example of Gradual Degradation			
LQ panel		HQ panel	
Year	Efficiency	Year	Efficiency
0	100%	0	100%
1	97%	1	98,5%
2	96,1%	2	98,2%
3	95,2%	3	97,9%
4	94,3%	4	97,6%
5	93,4%	5	97,3%
6	92,5%	6	97,0%
7	91,6%	7	96,7%
8	90,7%	8	96,4%
9	89,8%	9	96,1%
10	88,9%	10	95,8%
11	88,0%	11	95,5%
12	87,1%	12	95,2%
13	86,2%	13	94,9%
14	85,3%	14	94,6%
15	84,4%	15	94,3%
16	83,5%	16	94,0%
17	82,6%	17	93,7%
18	81,7%	18	93,4%
19	80,8%	19	93,1%
20	79,9%	20	92,8%
21	79,0%	21	92,5%
22	78,1%	22	92,2%
23	77,2%	23	91,9%
24	76,3%	24	91,6%
25	75,4%	25	91,3%

Figure 3: Gradual degradation (quality panel).

Power outage (black-out)

What happens to a PV system when there is a power outage? Is it smart enough to power down or will it continue to produce power and thus create a dangerous situation?

Unfortunately most PV systems will continue to operate as if the grid or the connected distribution board is still active. This not only creates a fire hazard when the produced power is "piling up" in the distribution board, but it also creates an electrocution hazard, which is specified in Figure 4 according to the standard NEN-EN-IEC 60038/NEN 1010.

IEC voltage range	ACV (rms)	DCV	Risk
High voltage	> 1000	> 1500	Electrical arcing
Low voltage	50 to 1000	120 to 1500	Electrical shock
Extra-low voltage	< 50	< 120	Low risk

Figure 4: Electrocution risk.

When an inverter is switched off, it will only interrupt the current of the system but the voltage will remain at a dangerous level (>120 DCV). The height of the voltage is dependant on the number of PV panels that are connected to the system, for example four panels will generate more than 120 DCV which will create a risk of electrical shock. Larger systems for residential or commercial projects have dozens or even hundreds of panels in which the voltage can go up to 1kV.

An effective solution to counter these risks is using the optimizers (explained in "Shadow influence") to lower the voltage per panel. These optimizers can be provided with a modus which switches off the panel and the string cables. This modus is activated when the connected inverter signals that the power supply from the grid or distribution board is gone.

The output from the panels while switched off is 1 DCV each. The capacity of the string cables has to be designed so that the output is lower than 120 DCV which equals to less than 120 panels per string.

Outro

Erik Rietbergen is an electrical designer and PV specialist for Arcadis in the division Buildings department Building Services, where he designs and engineers a wide array of projects from offices to laboratories.

At Arcadis, Erik has many opportunities to develop himself personally with Arcadis Imagineers and a personal action and development plan. Next to his work and personal development he has multiple opportunities to develop his technical skills via the varied projects and his bachelor Engineering and Applied Science at which he is going to graduate in 2019.

ARCADIS Design & Consultancy for natural and built assets

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Icons of EE: Richard Feynman

Author: Nahuel Manterola

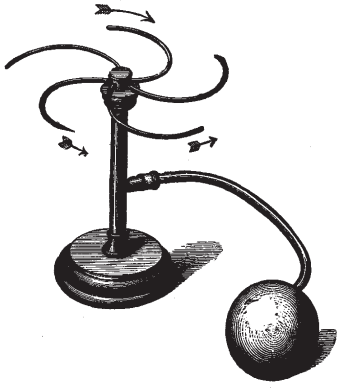
After following module 4, you might have wondered, "why is there an image of Feynman playing the drum on page one?" Well, you're in good company, he didn't get it either. Richard Feynman was, however, an avid drummer. He was also a safe cracker, a nude model painter and a world-renowned lecturer. Oh, and he also won a Nobel Prize in physics, but, considering his personal life, one could argue that's not his biggest achievement.

Feynman is one of those figures in science everybody vaguely knows. Considering his accomplishments in science and his eventful life, he deserves more than that. I'll try to give an overview of his life, and add a few interesting anecdotes.

Youth and studies

Richard Feynman was born in New York in 1918 and lived there until he started studying. In his childhood he already showed a great affinity for science and engineering, teaching himself advanced math and repairing radios in his basement. He also developed a strong tendency to try and fool people and make practical jokes, like the classic upside down cup filled with water.

When he finished high school, he initially applied for Columbia University in New York, which at the time still had a Jewish quota. Despite being an avowed atheist, Feynman was rejected. He then decided to attend MIT, where he studied mathematics, electrical engineering and finally physics, in which he got his bachelor's degree. Afterward, he moved to Princeton, where he worked with some renowned scientists like Einstein and Pauli. Of course, he did important research there, but something I would like to focus on is a device named after him: the Feynman sprinkler. See Figure 1. The ball to the side contains air, and when you press it the air goes up through the pipe and comes out of the sprinkler ends at the top. The sprinkler top is able to rotate and will do so in the opposite direction of the air. The big question is, what happens when you release the ball and air is sucked back into it through the sprinkler? Feynman did this experiment with water instead of air, and broke a large water tank trying to find out. You could just look up the result, but it's way more fun to try and think for yourself what the solution might be.



The Manhattan Project

Feynman had just landed a job at the Bell Laboratories to work under William Shockley, who would later discover the transistor, when an army general requested physicists to work for the army. Feynman agreed and left his prestigious job at the Bell Labs. He first worked on mechanical computers, a few years before they would be replaced by their electrical counterparts. Later, after a short return to Princeton to finish his thesis, he was asked by Robert Oppenheimer to join the efforts in Los Alamos to make an atomic bomb. He was

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initially hesitant, but considering the importance it could have in the war he decided to move to the facilities there. His wife, who was infected with Tuberculosis, moved to a hospital not too far away. Feynman quickly impressed his boss, Hans Bethe, and got assigned as the head of a small group of theoretical physicists who made calculations for the fission bomb. Later, he would also be in charge of controlling the safety of the uranium enrichment plant, to prevent a nuclear chain reaction. During this time, communication with his wife happened through mail, and for Feynman, this meant playing cryptographic games. His wife would encode her letters and he would try to decipher them. The censoring agents, employed at Los Alamos to prevent espionage, didn't like this one bit, because they couldn't read what information was being transmitted. After some discussion, they agreed that the letters could remain encoded, but the key had to be delivered along with the message. The censoring agents would then check the message and remove the key. This became a game to Feynman, who started making bets with colleagues on what he could or couldn't send out through the censoring office. Feynman also quickly got a name as a safecracker. He often borrowed documents he needed from coworkers by stealing them from their filing cabinets. This was his way of protesting the low security for classified documents. His actions caused a few cycles of the organization buying better locks, and Feynman picking them again.

Rio de Janeiro

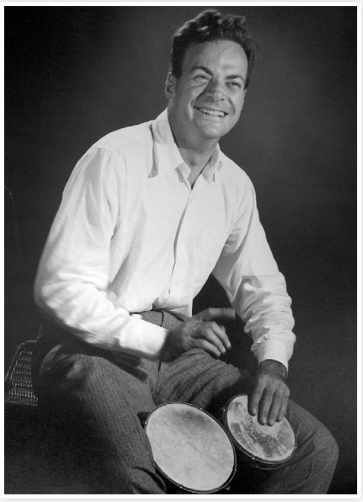
After the war, Feynman was hired at Cornell University, New York. Here, he laid the groundwork for his research on quantum electrodynamics, for which he would eventually receive his Nobel Prize. A few years later, in 1949, the Soviets detonated their first atomic bomb. This started a communist witch hunt in the USA. The loyalty of Feynman was questioned, and he emigrated to Brazil for a year, until the situation calmed down. In Rio, he taught some classes at the CBPF university. He quickly started to love the country and its culture. He also got in touch with samba music. His love for percussion found a new form with the frigideira, a small metal frying pan. He even used it to perform in the Carnaval parade of Rio. During his lifetime, Feynman would often return to Brazil.

Caltech

His trip to Brazil was part of his contract with Caltech, who was willing to do a lot of concessions to get Feynman to work for them. When he returned after one year, he had a very clear opinion about teaching. He grew discontent with the way science was taught in some places, and emphasized the importance of teaching understanding instead of just giving information. He got a name among students for being an outstanding lecturer, and put a lot of work into it, earning the title "The Great Explainer". Some of his lectures were recorded and written down in a book we all know: the Feynman Lectures on Physics. For the cover, Feynman requested a picture of a drum sprinkled with powder to show wave modes. Considering his somewhat alternative lifestyle, the publisher feared this would suggest a connection with drugs, and replaced the image by one of Feynman playing the drums himself. So that's why!

In his free time, Feynman got interested in painting and drawing. With the help of a friend, he got to a level worthy of holding an art exposition. To the right, you can see one of his best paintings. Feynman himself was very critical of his paintings, and was never very open about them.

Besides teaching and a bit of painting, he did research on numerous subjects. One of these was quantum electrodynamics, which describes how light and matter interact on a quantum scale. For



this research he earned a Nobel prize in physics, jointly with Julian Schwinger and Shin'ichirō Tomonaga. Feynman hesitated before accepting it because he didn't want to get the same level of fame as, for example, Niels Bohr. Years before, he had seen how nobody dared to debate with Bohr because he was such an important scientist, and didn't want anybody to treat him this way. After some deliberation, he concluded that refusing the prize would make even bigger headlines, and decided to accept it.

I realize this summary is nowhere large enough to tell all the interesting stories of this curious character. If you're interested in reading more, the semi-autobiography 'Surely You're Joking, Mr. Feynman' is a good choice.

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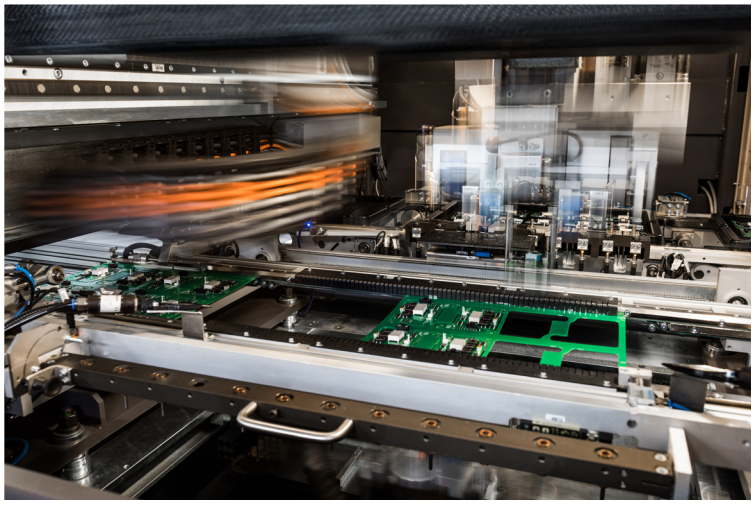
From theory to AME

Author: AME

Applied Micro Electronics B.V. (AME) is a developer and producer of electronics, mechanics and software. As an original design manufacturer (ODM), situated in Eindhoven, we strive to deliver cost-effective, high-quality products in close cooperation with our customers for both the consumer and industrial markets. We take full responsibility for the development of our customers' products. This responsibility starts at the project definition phase and does not end at the production phase, as we offer extensive product service and life-cycle support.

"Graduating at an interesting tech company and receiving an offer for a position of electronics system engineer was a very nice start of my professional career." Already two and a half year ago Luc Peters (27) received his Master of Science degree in Electrical Engineering from the Eindhoven University of Technology. "During my Electrical Engineering BSc curriculum at the TU/e I found out how broad Electrical Engineering really is. However, I got more and more interested in power electronics and electro mechanics, and after the automotive minor I was sure about pursuing a Master's degree from the TU/e, specialized in the field of power electronics."

After following the regular and elective MSc courses, and internships within the Electrical Energy Systems (EES) and Electromechanics and Power Electronics (EPE) groups, Luc got the opportunity to graduate at AME. "I gained a lot of theoretical knowledge at the university, after which I was really looking forward to a challenge within a commercial company and the development of an actual product; but also personal growth and getting familiar with working in a professional environment were important to me." AME offered a graduation assignment for the development of an off-line AC-DC converter.



Still, over time the graduation project turned rather more into research on an interesting energy conversion topology, instead of the development of a market-ready product, as Luc explains: "The topology was more interesting and complicated than we all initially thought, so investigating all the pros and cons, and thinking of a control method became the new goal of my graduation project. AME gave me room to do so, even though this would not lead to a final product. Even before the end of the graduation trajectory AME offered me a position as full-time electronics system engineer. By then I had a positive impression of AME and accepted the offer. What really convinced me is the high diversity in interesting projects, the young team, and the possibility to be part of a fast-growing company."

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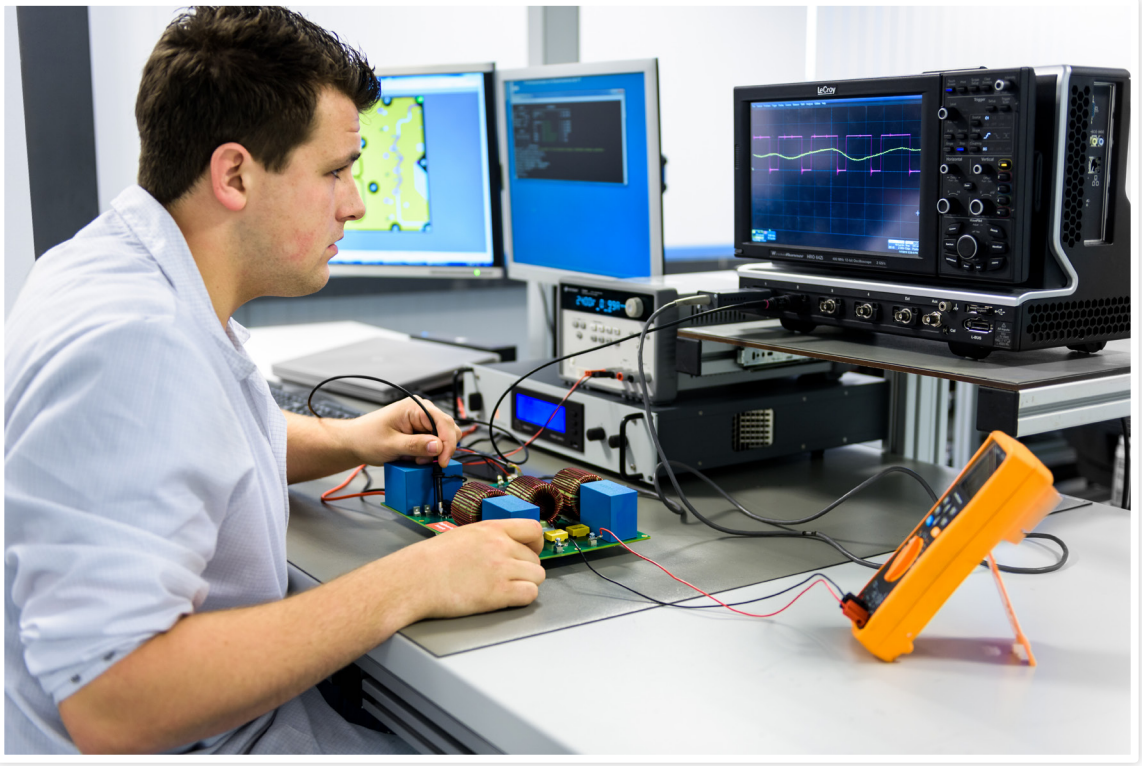
As an electronics system engineer at AME, you are part of multidisciplinary project teams, in which you work closely together with mechanical and software engineers to develop a product. "In my role as electrical engineer I have worked on different projects: my career started with a three-phase brushless dc (BLDC) motor driver project for ventilation applications, which for example challenged me to put my theoretical knowledge of electromagnetic compatibility (EMC) into practice with the aid of the EMC test-equipment that AME has in its own laboratory." This immediately shows that the job is not done after the design phase: "What I particularly like about my function is that I am not only involved in the design phase, but I also qualify my own electronics design for functionality and EMC, take part in the certification trajectory to put it on the international market, and see it being produced at our own production facilities. It really makes me proud to see that my own product design is actually used in daily life."

How about the future? "With two current projects developing electronics for consumer products I feel that my design skills have improved significantly. That is also the reason why, with support from my work coach and colleagues, I will start making small steps towards the role of electronics architect. The culture at AME is that if you want something, it is up to you to actually make it happen." If your curiosity about AME has risen, feel free to contact us: "We offer internships, graduation projects and part-time jobs to students and are always looking for enthusiastic, new colleagues who want to help us develop and manufacture tomorrow's products".



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Electrical Extravaganza

Author: Tara van Abkoude

Have you ever wondered why you study electrical engineering? You might have thought about it for your whole life, just before you started, or not at all, and just picked a study with a high salary. Is it because you wanted to explain lightning, build the newest sound system and/or follow in the footsteps of Rowan Atkinson, a.k.a. Mr. Bean?

Anyway, I just wanted more of the adrenaline rush I got from working with electrical systems. Occasional sparks that hit you when you accidentally touch the leads of charged ELCO's. Connecting wires that should not be connected causing components to explode in front of your eyes. Seeing the wondering eyes of little kids when you just showed them an exploding capacitor with lots of smoke. Isn't that dangerous? Nah, not when you know your shit. Which is where your teachers come into play. A good education is key if we do not want to blow up the world.

So, how do we make sure that the education stays on the level its supposed to be? As you might know there are a lot of organizations dealing with the quality of education. If not, I refer you to edition 35-4 and 36-2 of the Vonk where Stef van Zanten explains it all. In edition 35-4 he states that Scintilla is one of these organizations. Which is logical. Why would it otherwise be called a study association. Within Scintilla there exists a committee called the VAUXHALL*. This yearly award is a way for us to show appreciation for the effort the lecturers put into the education and most of all a method for giving teachers constructive feedback on their way of teaching in order to improve the overall education.

> "This yearly award is a way for us to show appreciation for the effort the lecturers put into the education"

You can imagine that this award is highly wanted by your teachers. It is the first round leading up to the central educational award of the university. When teachers win this you can compare the emotions they are experiencing to the feeling of when your electronic circuit finally works or when it is 16:00 o'clock on Friday. With every award there is an award ceremony in the same way as that Kierewiet de borrelkip never comes without his boot of beer. The award ceremony of this academic year took place on the 3rd of April. If you weren't there that's a pity since the event is paid entirely by the faculty which means the drinks as well. If you were there, you know what I'm talking about.

Each year the VAUXHALL award is connected to a different theme selected by the committee members. This year our theme was 'Educational Extravaganza' which relates to the workload teachers experience and the chaos that ensues from it. After collecting your votes four teachers stood out and became the nominees for the VAUXHALL award; Bram Nauta, Luuk Spreeuwers, Ronan van der Zee and Tracy Craig. Aside from the statistics the nominations were

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also based on some of your awesome comments like he explained sonic fast, she is lit, #1 table climber and keeps the students awake**.

After conducting interviews with the nominees on the theme Tracy Craig came out as the winner. Her eagerness to perform research in the field of education is fuelled by her passion for education which can be identified by the students during her lectures. This helps her with dealing with the attractive force of both research and education. What really amazed me though is that as a mathematician she is also interested in the practical part of electrical engineering to be able to explain the way electrical engineers use math better. As a prize she got her very own Arduino toolbox with a nice wooden enclosure. I wish her the best of luck with the central educational prize and hope to see you next year at the VAUXHALL drink!

> "As a prize she got her very own Arduino toolbox with a nice"wooden enclosure."

*Yes, this is an abbreviation. Every committee has an abbreviation. Don't ask me why. This one means: Valuable Award for University's most eXperienced, Helpful, Appealing and Lustrous Lecturers.
**It is left to the reader to link the comments to the right nominee

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Jam session
SKIC theme presentation
How do we get there?
Langlaufen
Planning
How are we going to pay for this?
Drain SIF
The faculty
Sombrero Escafero


Scrapheap
Challenge

Afterlife

Author: Tobias Feijten

Let's start of a little philosophical: where does time go when it passes? Of course it goes in the past, but it seems that it doesn't always get in our memories in a linear fashion. It seems like a couple of weeks ago when I was working on my graduation assignment, attending almost all of Scintilla's activities and doing many helpful things at Scintilla. However, I've been working already over one and a half year (and scarcely present at Scintilla gatherings), and as such, many things happened.

Study period (2011 – 2017)

Like many of you, I have walked the corridors and stairs in the Carré and Zilverling buildings during my studies. For me, the start was about 8 years ago, when there still was no TEM but we were just bothered with finishing courses and projects. I started off still living with my parents in a small town near Hengelo, so I could first check out the study load and see how that would play out. About half a year later, I realized I wanted to be more independent so I moved to a dormitory at the campus. At the same time, I joined a committee at Scintilla (the parents day committee) since I wanted to experience more than just the study and grow my network at the same time.

During my studies I have done a couple of committees at Scintilla and outside, such as the STORES, the iDB (in which I'm still active and which develops the web site, including registration, scenarios, logistics and much more, for the Kick-In of the University of Twente), the Borrel and the safety response officers (BHV). I even founded my own company together with a fellow active Scintilla member (BobV), in which we do soft- and hardware development: Drenso. Each time I joined another committee I wanted to see whether my grades and study progress would deteriorate. After two and a half years, that still was not the case so I decided to set up and become part of the 85th board of Scintilla.

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Together with 4 (5 if you count our administrator) great guys we led the study association from September 2014 to September 2015. During this time, we set up a symposium, prepared the 10th lustrum, kicked off a study tour to the United States and Canada (in which I participated as well), updated the articles of association (statuten in Dutch) and wrote the long term policy for 2015-2019. In my function of treasurer I came along some policy shortcomings, for which I drafted some addendums to the by-laws of Scintilla, of which most are still being used. Besides the serious work, we also had a lot of fun organising activities, going to constitution drinks and enjoying bonding activities when another association 'braste' something from Scintilla.

I already started my master's degree on biochemical sensors during my board year, which means I had a head start of 10 ECTS when my board year was finished. As such, I was able to enjoy the study tour 'Beyond Frontiers' with a holiday afterwards, and still finish the necessary courses in the first year of the master's programme. For my internship I was intent on doing it in a foreign environment within a company. With the help of Jan Eijkel of BIOS I was able to find a nice company in China which was willing to accommodate my internship. If you want to know more about this internship you can read it in Vonk 35-2. After that I did my master's assignment at the BIOS group and even went to Switzerland with them for a week to find out what research they were doing there. My graduation was at the 31st of August in 2017, and that finalized my studies. Now what?

YER/Benchmark Electronics (2017 – now)

So you're graduated and thrown in the 'big bad world'. Recruiters will fly towards you like vultures (already during your final phase of the study programme). This happened to me as well, so I could take my pick of many interesting career options. However, I had no idea what I wanted to spend the rest of my life on (all right, this is a little dramatic, but it can have a large impact...). When somebody from YER (a recruiting and secondment company) approached me to tell me they had a nice career opportunity for me, I went to them to discuss the details. Of course, I wanted to keep doing work for my own company, so it was important for me that the job and my company can be combined. They offered me a programme in which I could develop my soft skills and my business skills by 6-weekly training sessions and intensive coaching, while working at one of their clients. If I decided that the client I was working wasn't the right match, it would be possible to change to another client without losing my employment. That sounded very interesting to me, so after some deliberation I took them up on their offer.

> "So you're graduated and thrown in the 'big bad world'."

After signing the contract they busied themselves with finding clients which would match my interests. They managed to find a job at Benchmark Electronics in Almelo which sounded very good in my opinion. Of course you should all at least have heard the name Benchmark Electronics, since they have collaborated with Scintilla for some time now, being present at the symposium 'City of the Future' and giving lunch lectures once in a while. For those not acquainted with Benchmark, here is a short recap. Benchmark Electronics Almelo has about 500 employees, 150 of which are working in product development. Besides development it also is a manufacturing site. Most of the projects they work on are for clients in the industrial, medical and avionics business, such as Airbus, ASML, Fluke and many more. Projects vary from consulting to complete design and industrialization of products based on back of the envelope ('bierviltje') ideas. (a little propaganda can go a long way...)

I was to be employed as a hardware design engineer, which means that I do the design and verification of the electrical part of development projects within Benchmark. In order to do so I have to know what a product should do exactly,

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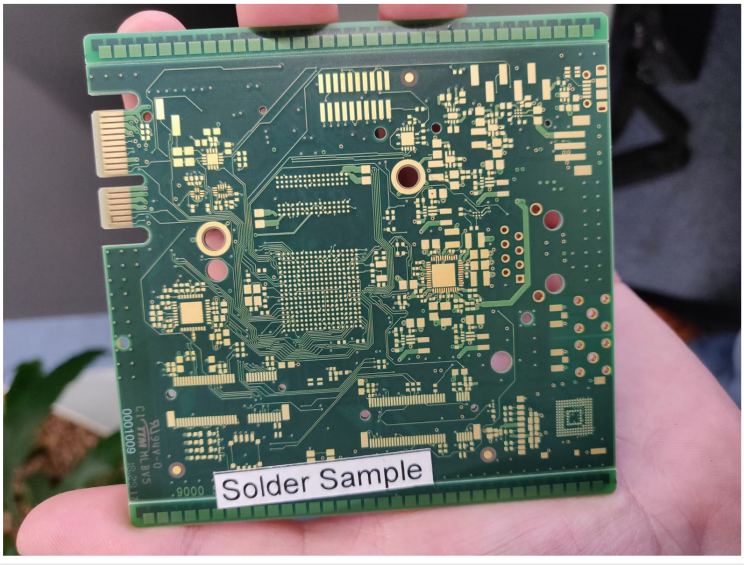
what technologies can solve certain problems, whether they are available on the market in a way we can implement them and then make a schematic in order to implement this functionality. I have to take all factors of the design process and the wishes of the customer into account when doing my job, such as quality, price, manufacturability, testability, safety and so on. In order to do that a lot of communication is part of my job. I have to talk to the project team, fellow hardware design engineers, supply chain management, customers, manufacturing engineers and sometimes even the management team of product development.

In the beginning, I was not sure whether the job at Benchmark would be my dream job. I was set on trying it for a year, then evaluating whether it satisfied my wishes for a job and if not, transfer to a different company (thereby leveraging the offer YER made me). However, after a year I realized the job is perfect for me right now. There are many aspects about my job I like, and I will treat them here. The biggest pro of the job at Benchmark is the atmosphere at the company. The atmosphere is quite informal, it is very easy to get to know colleagues and have a little fun with them. Next to that, if I want to know something (hey, we don't know everything after graduation) I can just walk to a colleague and they will help me right away, whether it is a question which can be answered in a couple of seconds or a mini-lecture of half an hour. It doesn't matter whether the person is smothered in work or has some time on their hands, which is something unique in my opinion.

> "It can therefore be seen as a 'professional' Raspberry Pi, complete with a Linux software environment."

Variation is another thing I really like about this job. It could be that one day I'm going to a customer to talk about a great new project they want us to do, the next day I'm going to a training or seminar about interesting technological subjects, the next day I review a design of a fellow design engineer and the next day I'm performing electronic measurements on my own design. Of course there are some less attractive tasks in the job as well, like documenting every choice and detail of a design, but that's part of the job. I can tell you that it is very rewarding when you receive gratification for the good documentation you made from people in management, which is important to me as well. What really struck me as extraordinary is that you will get a lot of responsibility and freedom, even though you have just graduated and have no experience at all.



For the past one and a half year I have worked on my own solo project, which is a Benchmark internally driven development. The product is an embedded platform outfitted with a CPU, some working memory and Ethernet, and many slots for extension modules. These extension modules can provide functionality such as Wi-Fi, LTE (4G), LoRaWAN, NB-IoT, USB, CAN and much more. It can therefore be seen as a 'professional' Raspberry Pi, complete with a Linux software environment. I based the design on a project done by an intern some time before I started, which was somewhat similar but some of the requirements changed in the meanwhile. I first had to establish and finalize the requirements for the project, which I did by talking to the people involved in the project in the first place and researching what would be feasible to implement on the platform, given the constraints of the used CPU.

With a reviewed set of requirements I started on the design. As such, I started by drafting the schematics needed. In order to do so I could not just say 'ah, here is a resistor of exactly this value, and a capacitor of exactly this value, and let's use this ideal op amp'. I had to use real components with a certain tolerance, footprint, (vendor) availability and price. Within Benchmark, many components were already present in the internal component database including

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schematic symbol and PCB footprint. Using these components and some new components which haven't been used before, I finalized the schematics and let more experienced people review them.
Of course, a schematic representation doesn't give you a usable product. Therefore, I had to make a PCB layout using the more than 900 components I used. Since I had no experience with a complex board like this, I started in a very naïve way by making a small board outline and putting all the components on the board. Of course I asked my experienced colleagues about certain design techniques to make a successful layout in order to learn from previous mistakes. However, I did not take into account the space it would take to connect all the ICs and connectors on the board. After a couple of weeks I realized that I wasn't going to manage to implement all of the functionality on the board dimensions I chose, which meant I had to restart the layout process. This was quite frustrating.

Some iterations and reviews later, the layout was ready to be ordered and manufactured and this part of the project was done. It was a fascinating feeling to hold my own design in my hands and finally see the real-life representation of the multi-coloured drawing I had been working on for some months. Of course, a thorough verification of the design was now imminent to find out whether all the requirements as set up are fulfilled by the product now produced. Some of the functionality was not implemented as should, which was valuable information to improve the product and make it into a good design. Currently I'm finalizing the verification of the second design iteration, which should finish my work for this project and allow me to transfer to the next exciting project.

During my time at Benchmark, although it being short, the management of the department noticed my accomplishments. During an 'all employee meeting', in which the financial results of the previous time and other important announcements are made for all of the 500 employees of Benchmark Electronics, I was appointed 'employee of the year' in 2018 for the design department! It was amazing (and a little awkward and embarrassing) to stand in front of 500 people, many of which I came to know, and have the vice president of development talk about my accomplishments and the way they saw me as a great example towards the rest of the department. Of course I see it as a great encouragement and think the team at Benchmark can achieve great things in the future.

> "It was amazing (and a little awkward and embarrassing) to stand in front of 500 people, many if which I came to know."

Not all my time is spent working at Benchmark, luckily. As mentioned I'm still doing work for my own company (which will create the next version of the sales program for the STORES!), enjoy playing the clarinet in an orchestra and doing fun stuff with friends and colleagues and I like travelling a lot. Next to that I'm still involved in helping Scintilla by checking the accounting each year as part of the Financial Audit Committee and advising the board as part of the Advisory council. It's not that often I'm present at Scintilla activities anymore, but I try to at least stay connected by going to the General Meetings and activities for former board members. Twente is, after all, a great region!

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A Word with the Eating Contest Winner

Author: Matthijs van Minnen

What started as a fun idea a few years back has grown out to become an annual contest with participants from all outreaches. In fact, this year's winner does not even study Electrical Engineering! Being an editorial member of the Vonk provides many advantages and can create great opportunities. As such, I got the opportunity to meet up with, and ask questions to, the winner of the 3rd annual eating contest: Cas Sitvast!

Shortly after his performance, Cas and I met up at the bar and had a drink together. Cas managed to devour 5 buns loaded with frikandel within the time of 2 minutes and 37 seconds. This means an average of below 45 seconds for one bun, go figure! It is no wonder that Cas had difficulties talking after his performance, as his stomach still had to recover after his achievement. Nonetheless, Cas is willing to explain everything for the readers of de Vonk!

It might seem strange that someone from Abacus joins in on a Scintilla eating contest, but Cas explains that he did not just stumble into the Abscint by accident. In fact he was invited for a special reason. He mentions a waistcoat went missing from '(A)bac(ch)us', Abacus' drafting committee. Cas phrases it as 'swiped'. Nevertheless, Cas was told he could redeem the waistcoat by attempting the eating contest and not placing last. But, to Cas 'not placing last place' is no challenge. He mentions that he upped the stakes for himself by going for first place directly. He says he 'only wants to participate to win'. Perhaps that is how he turned a go-big-or-go-home strategy into a go-big-and-bring-the-prize-home strategy.

> "No chewing, just swallowing!" - Cas

His secret? Well, that is rather simple Cas says. "No chewing, just swallowing!" is his strategy. With just 7 bites he is able to devour an entire bun. Although this was Cas' reason for success, the editorial staff cannot recommend this technique, and neither can Cas' stomach! According to Cas, it started showing signs of unhappiness after the large inflow of frikandel chunks. To calm it a bit, as well as to lubricate the process, Cas made good use of the water that was available during the contest. He was able to wash down his bites with a big splash of water. It is likely that this strategy would not be viable at all if it wasn't for the water.

After this quick round of questions I gave Cas time to recover and enjoy his victory. If you are longing for more eating contest content, you're in for a treat, as according to rumors, EE-Sports is already plotting a new eating contest for next year. Hopefully Cas doesn't show up then, as we won't stand a chance if he does...

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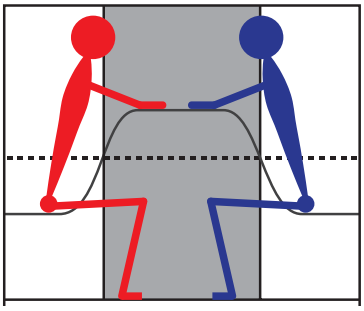
Junction

Meet a Curious Man: Nesar Moshtaq

Author: Matthijs van Minnen, Melissa Tijink

The students of Electrical Engineering can prize themselves lucky, since they have not one, but two study advisors! Kirsten Voncken is responsible for bachelor students in EE as well as master students in EE and Embedded systems, but we can assume you know her from the Vonk junction in Edition 3 from 2017. If not, then another interesting junction is waiting for you. The other study adviser, Nesar Moshtaq, has not been properly introduced in the Vonk yet. This is perhaps the reason that Nesar is less known among the students, and that whilst he has an interesting story and a strong drive to help students! He is responsible for bachelor students in EE and the master students for EE and Systems & Control, but is also interested in showing students other aspects of student life. We asked him all about this.



How did you end up here at UT in the role as study advisor?

"I used to study at the department of BMS where I studied the masters business administration. When I started my study, my idea was to become a successful manager of a great (national) company. Through personal development I learned about myself that I am more of a social person and I would like to contribute to the development of other people and especially students.
So I saw this job offer at UT and then questioned if for a technical department the basics to be able to listen very well and ask questions and analyse is sufficient. That is when someone comes to you with a question and you can see where the problem comes from. It gives me a lot of self-fulfillment to let students see why they are here and to help them in the process of personal development.

Why at the University of Twente?

I really love this university, the environment, all the great things we are doing here. Even when I was a student, I was also working at the university giving workshops and masterclasses at Pre-U to high-school students.

Word has it you helped organize a christmas dinner for international students?

How the idea popped up was, I started with this job in August 2018 and Christmas was coming. I was talking to a lot of international students, especially from far countries. They cannot go back easily to their family to celebrate Christmas, but Dutch students do go back home to their families. For me it was quite logical to create some kind of event around Christmas, surprisingly it was not there. So I went to connecting hands, a foundation in the Bastille, they work with refugees. They were really collaborative, and they organized something very last minute. Something is better than nothing.

You came from the BMS faculty which is not focused on Electrical Engineering or technology necessarily, but here you are a study advisor for Electrical Engineering students. They are obviously more involved with technology. Do you feel like you're skilled enough to help them?

"I believe that these days we are all connected to technology. I learned that Electrical Engineering is in everything. That made me even more curious to go more in depth, the more in depth in the field I go and read about it, the more in-

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terested I become and the more I value how important this field is. So I think as mentioned, the basic skills that Study Advisor needs are the social skills (communicating, understand and being empathic) and then he/she should know about the content of the program. Find out how the modules work by reading, and talking to professors. What is the module about and why are they [the students] following these courses. If there are really some content wise question, like field and waves, then I direct them to the professor. My duty is to listen to the student and to analyze what is challenging for the student and if the student is really enjoying his or her study.

Is it difficult to get the jargon of the technical side? I assume students use a lot of uncommon words in your conversations.

No, but I can ask them to clarify it. I am curious what it is exactly. What are fields and waves? What are mechatronics? Yesterday I was talking with the program coordinator and I asked: 'why do you have three masters, what is the difference?' He explained, Systems and Control is more about regulations and control. An Electrical Engineer is more experienced in the field of electrical parts, for example he knows how a motor works. Embedded Systems is more related to the software. I found out that later they could work together in a team in a company and make interesting projects.

By going to the Open Days and seeing what different chairs are doing I was like sh*t, why didn't I study this program, but then I found out my mathematics is not that good. So far it is challenging and it is really nice. I learned a lot about it. I discovered how detailed and how broad it is. Right now I'm encouraging my friends and telling them: 'guys you need to know more about Electrical Engineering!'

You have now had almost a year to gain knowledge. Do you think you have an idea of what is going on here and what the problems are?

When I started working here I discovered that the UT is a huge organization, even our in our department there is are a lot of things going on. Every day I learn more and more, by reading and seeing how the structure works and how study associations are involved, so it is a next master study for me.

You said you would like to replace yourself with technology. Why, social contact is important right?

We are in a scientific environment. I am as a person quite innovative and this AI-algorithms and robotics are in our department. We continuously talk as Study Advisors, and we have these appointments with students and we have to make notes on Osiris. This takes a lot of time. During my study [Business Administration] I learned that you need to think out of the box. I like to do this and share this with others to see if its a good idea. We are in the Electrical Engineering department where there is a lot of skill and knowledge, so it should be possible.

We are now having this conversation and it would be great to connect a device with Osiris and have it automatically make notes. We also have a lot of meetings. If you look on a daily basis at the University of Twente and see how many meetings we have, it could be 200 or something. 200 meetings of an hour each, are quite some hours. The costs for this are quite high.

Nesar Moshtaq

Age	29
Favourite artist	A h m a d Zahir
Favourite food	Anything with fish
Favourite Drink	(Green) tea

You are now proposing to replace yourself by a robot. Are you not afraid to lose your job?

"No. But that is a fundamental question on how to organize society. There are some guys that say that if we work really efficient, you could work 4 hours a day. The rest you can spend on other things. I think this is a long term thing. If you have the basic incomes, everything you do extra is good for the society. There is a young philosopher that says that there are a lot of jobs in the Netherlands that are bullshit jobs. We have a lot of burnouts and a lot of people stressful. I ask myself what are you doing exactly. Why are you doing it. What is the benefit of it? That is why I am doing this job and not a manager of a profit making company. Today I had an email from a student:

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'Nesar thank you very much, also on behalf of my parents. You really helped me with the pre-master. Thank you for your continuous support and guidance.' This helped me a lot. It gives me a lot of self fulfillment. So I think it is not a bullshit job and is actually good to have. I still believe that 40% of the appointments would not be needed. It is just about providing information, but talking to a Study Advisor is always needed. Students need support and guidance." And we are there for our students.

So you basically want to optimize the process of a Study Advisor to focus on what is really important. You want to place students in the right place, right?

"I believe that studying is not a goal. Studying is a tool. When you study you need some hard skills, knowledge, and also some soft skills as interpersonal skills. How to collaborate in a multidisciplinary team, how to communicate, intercultural communication, you need to be able to communicate with people from different nationalities effectively. What I try to do is to help students to open their eyes: 'why am I studying what I'm studying?'"

Do you consider it is one of your strengths that you are able to help students out this way?

"I think it is some experience from my own background. It is also a skill like being empathic and social intelligence and being curious. I don't see it as a 9-5 job.. Then it would not be challenging. What I try to do is to listen to students and see how I can help them and how they can help themselves. Learn someone to catch fish instead of giving them a fish.

Are there still things you want to improve during the upcoming years? What are your goals?

"My goal is that personal development is something that is throughout your entire life. I want to have a social impact. My goal would be to contribute."

[Interviewer]: "Are you looking for something bigger than students knocking on the door?"

"Yes it is already bigger. I am now involved in strategic policy development department, I will be talking with them about the public engagement strategy of the University. They are asking me because of my background as a refugee. They wonder if we can help more refugees in Twente from a social impact point of view.

Something else is internationalisation, because we already do great things. When we talk about impact and HTHT, we can do a lot in the field of knowledge transfer to other countriescountries. A question I have on my mind is 'why is it not possible to have groups of students from different Universities around the world working on the same project and getting credits for it?' Yes, I see the world as a global village. We have a small village here at the University, with 82 nationalities. All these students that go back to their country are ambassadors of our University. The department of ITC for example is doing great things in that field.

I have ideas, but they go step by step. For now my duty is to do my work as Study Advisor and to help every student on their way and contribute to the improvement of things here. For example: efficiency, the way of communication and helping each other as a team. And to give input from my background on how to help international students study. So, small steps big impact."

You are now here for almost one year, have you changed a lot? Have things improved?

"When I came here, most of the people said that the technical guys are introverted and they talk not that much. I said: 'the technical guys, I like them! You cannot generalize all technicians'. It is easier for people to think in boxes. At BMS they talk about technicians and the technicians talk about the social guys. In the end it is about personal connection. Being honestly interested in something. I call it professional love. There is a book about coaching of students that I read, they emphasize about professional love. This means that you dare to create the connection with the other person. Then you don't have barriers and you can openly listen to the other person. This is what you need to help students. I try to talk to others around me, sometimes I think I'm too passionate. I say: 'guys, open your eyes! Don't you see what I see?' What I like about this University is that we are constantly working on the improvement. We don't have the mindset like: oh no everything is perfect. We are an open and learning organization. What we preach we also practice."

Do you have any final advice for the readers?

"I think any advice for the students... [Silence] 'Be curious and to get out of your comfort zone' would be my advise. It sounds cliche perhaps. Explore and enjoy the process of studying, because you have the privilege to fail. If you didn't fail, please fail, because from failure you can learn. You [the Electrical Engineering student] are very occupied with study, but enjoy the process of personal development, meet cultures and enjoy it. That would be my advise."

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Controlling on nanometer level

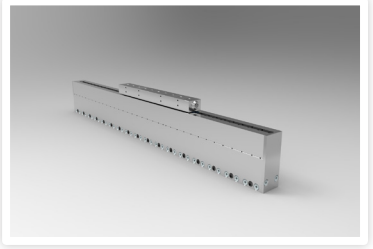
Author: Prodrive

Controlling a linear motor with nanometer level precision. And as efficient as possible. That's just one of the challenges the people of Prodrive Technologies face every day! And with success, because Prodrive is the worlds leader in these and other technologies.

Linear motors have a very wide range of applications: ranging from innovative elevator systems to the production of chips. Especially in the latter applications is precision positioning of the linear motor of essential importance. This takes out of the ordinary performance of the hardware, firmware and software. And also of the people who take on these challenges within Prodrive.

Lets meet...

For the one who doesn't know Prodrive Technologies: the company has five establishments worldwide, from which they develop and produce unique technical solutions in different branches. Ranging from automotive to medical, from semicon to industrial, motion and so on. The HQ of Prodrive is at Science Park Eindhoven, Son.



One of the many great projects at Prodrive consists of the development of linear motors. These motors work based on magnetic fields, set up by permanent and electronic magnets. The control of the spools, the motor-drive, are designed by, among others, Cas Bakker (drive design architect), Sander van den Hoek (firmware developer), Tom Thevissen (motion software developer) and Remon Damen (drive design developer). They bite into the challenging technology behind the motor-drive every day!

High end application

When a motor must be controlled at nanometer level, very strict requirements apply to the drive. Technical demands who take the fullest of existing techniques, and even more! The people at Prodrive get the task to search the boundaries of technology. For the drive in this case, a very precise current and low noise is required. At the same time, the motor has to move from A to B as fast as possible, in order to realize an efficient as possible manufacturing line. "That asks for a technical tour de force", says Remon Damen. "We have to be very precise in gain errors, offset errors and linearity, in order to generate a precise current." Besides that, it is of utmost importance that the position of the drive is monitored constantly through all kinds of sensors. "This really is a high-end application. One of the best drives available on the market."

Producing products fully tailored to the customers need is good, but extending the tailored product to a wider level, making it a off the shelf product, is even better and something Prodrive takes on daily. That's why it's, according to Remon, important to let the drive communicate through different protocols, like Ethernet and EtherCAT. That's realized by using a SoC (multi-processor system-on-a-chip), which contains embedded processors and a FPGA (field programmable gate array). The use of a SoC gives a lot of flexibility, which makes the drive applicable for stand-alone and real-time connected applications.

Prodrive Motion Platform

On the drive runs the PMP-software (Prodrive Motion Platform). This doe-

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sn't only take care of the precise current but to control the movements but also of extensive diagnostics. And that's, according to software developer Tom Thevissen, the power of the platform. "Four years ago, we started from scratch with the development of the platform and the diagnostics are doing great. We can now trace very easily what is happening on the controller. And the customer can easily ask for the exact current at this exact point, what the position error of the motor is, what the encoder is broadcasting and what temperature sensor is measuring. And all of that in one image! Whether it's at 1 kHz, at 10 kHz or even at 250 kHz, so with a really high frequency you can exactly see what's happening. If we didn't use the software platform it would have been much harder."

To enable the communication between the PMP (running on the drives) and the system of the customer, Prodriv delivers API's. The customer can then call in different languages like C#, C++, Python and MATLAB. That's how every customer can get its own customer specific data and diagnostics.

From chips to elevator shaft

Just like the hardware and firmware, the software needs to be deployed for a lot of different customer needs and with a wide range of specifications. That's why the system is built modular. The customer can simply indicate which building blocks are necessary in this specific case. According to Tom Thevissen, that's what makes it all so cool: "Ranging from the production of very small chips to medical Röntgen arcs and an elevator who can reach theoretical heights of a kilometer... everything can be controlled by our software platform. The diversity is one of the best things about my job."

Everything in house

Starting with the PCB all the way to super-low-level programming, the software platform and the API's which take care of the link to the systems of the customer: everything can be developed by Prodrive in house. And sometimes this can mean a big challenge has to be taken on. Sander van den Hoek: "In the early days we used a separate processor and a separate FPGA for the linear motor which were then combined by a PCB. The MPSoc (combined chip) is delivered to us, but the code running on the processor, is designed in house. We make the hardware description running on the FGPA, we make all interfaces and hardware surrounding it, we do the PCB-design ourselves. It has been a real challenge to combine and set up everything. The only thing that's delivered to us, are the components. But we made it, and that exact challenge makes it so interesting."
When you develop everything in house, it may be a challenge on one side, but on the other hand it gives you a better result. To get to that optimal result, it is necessary according to drive design architect Cas Bakker to have a close collaboration between all the different disciplines within Prodrive. "Myself being a hardware designer I have to ensure an optimal cooperation with for instance mechanics. You must facilitate and help each other to the next level. Every piece of circuit that is in the drive is for instance documented and reviewed by colleagues, to see if we have chosen the best concept. The production department is involved with that as well. Because eventually we have to develop a drive that can be manufactured. I really like that cooperation between disciplines within Prodrive. It is very easy anyways since we have an organization where everybody is treated equally. There is virtually no hierarchy and that promotes collaboration."

Technical challenging environment

Besides the close collaboration with a lot of specialist colleagues, the technical challenging environment is praised by the employees. Cas Bakker: "Within Prodrive you face real challenges: you can really dive in deep in a technical way. You won't be bored and will be challenged! But besides your own part you can also take part in the bigger picture. Sometimes I'm in a meeting with a customer, I'm in the design process from start to end. First something in theory, that gets converted to drawings on paper and eventually a prototype is in the lab ready for testing. That's something that makes us really enthusiastic!"

Interested?

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Datasheet

The Elfbierentocht

Author: Herjan Barkman

The yearly tour for the real student. Beer everywhere, tropical temperatures, huge amount of fun and ofcourse a medal. Hundreds of students go from pub to pub at the campus in the so called Elfbierentocht. Together with travel companions Sjoerd, Lisanne and Lonneke we go on this adventure, rate all the pubs and give advice to the reader.

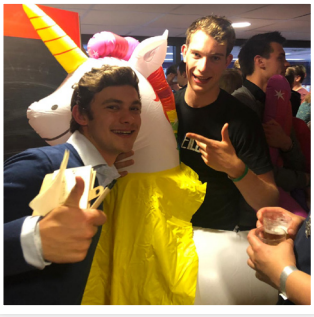
First of all, I will explain how the Elfbierentocht works. On your personal ticket there are 11 boxes, which will be ripped for beer. At every student pub, of which there are five, you can get two beer. The final beer can be drunk at the Vestingbar where you can also pick your medal if all your boxes on the ticket are ripped.

Now you know the concept, our journey begins slightly after four and we first go to the Kelder under the Horst. Here are two pubs located, namely Diepzat and Beneden peil. Most of the student begin here, as then you can pass by the other pubs in a sort of straight line to the Vestingbar. Once arrived in the Kelder we already feel the warmth of the two pubs. The atmosphere is good and everywhere people are talking and having fun. You can feel the tension and hype for what this evening will bring these people. However, it is really crowdy and moving is quite hard actually. We get a protip from someone called Mart: "If you walk to the back, you will see that it is way less crowded." Also, people can drink outside the drinkroom as well. We did this and although it was still a bit cramped it was indeed way better. As we only drank two beers, we are not going to try one of our opening sentences to test the fixability.

A really big advantage of Diepzat is that you only have to walk through one door to get to Beneden peil. So that is where our journey continues. The first thing to notice in Beneden peil is the temperature. Diepzat was really warm, but to our pleasant surprise Beneden peil is actually very nice due to an air conditioner. It is a bit more crowded, but because of the nice temperature we can drink comfortable inside. The atmosphere is again very good. So dear reader, if you are getting a bit hot inside Diepzat, don't hesitate to walk to Beneden peil. We meet a guy called FAMAS and he gives the amposphere an eight. We get our golden wheat smoothies directly. So serve speed is quite fast as well. The beer is really cold, which makes the normal beer nice, but the adtbeer less pleasant. After these beers we drank four out of eleven, so it is time to start testing the fixability. We see a handsome lady and ask I her the question: "If I make dinner for you tonight, can I get you as a dessert afterwards?" Sadly, the lady laughs at me and Charlotte joins the conversation. Charlotte says that the fixability is not that good, because there are too many pancakes walking around. When we walk around a guy called Stefan says people didn't drink enough yet.

After this we continue our journey to Carré where De Tap is. On the go we find the board members of the 88th board with their unicorn. People really take the strangest things with them.

Once arrived in Carré we are helped by a guy called Sebastiaan as we could not find it. Well dear reader, it is at the fifth floor of Carré so be prepared for a



long queue in front of the elevator or a lot of stairways. However, on the stairways the fun is still there and we meet a guy called Tim who is sliding downwards on his beer plank. Strange things happen quite often during this event. We go inside De Tap and the warmth is overwhelming, a reason for Lisanne and

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Lonneke to drink their beer outside. The atmosphere is really great though. We ask a guy called Cas to give us feedback on his adtbeer. He says that it is nice, not too warm and not too cold. An eight. The serve speed is again very fast and the beer tastes amazing. If this is because we already had a few beers or that it was just that good we don't know. After we drank our beers, we went on with the fixability again. I saw a handsome lady and asked: "If I was a watermelon, would you spit my seed out or would you swallow it?" A risky question, but after some thinking she says "I go for swallow". Bingo, after some nice talking I go to search for the rest so that we can go on to the next two pubs. I find Sjoerd who just got out of a conversation with a lady as well. He smiles at me and tells that his opening sentence worked and that the lady wants to be his dessert. So dear reader if you want to score, go to De Tap as till now it doesn't let us down.

Our next stop is the reliable Abscint and Mbasement, which the reader will probably know for sure. If not well those are the two drinking rooms behind the Starbucks. The wall between the rooms was removed so it became one big pub. The atmosphere is as you would expect great again. The only disadvantage was that it was super warm and really crowdy. So after some minutes I already lost the others. At Mbasement however, something was broken behind the bar so waiting for our beer took half an hour. Which was a bit of a mood killer. When we eventually got the beer, the quality was good, but a bit warm. This however made the adtbeer quite pleasant. The fixability was not that good, Sjoerd was also not that successful. After the MBasement I went to the Abscint and, as I lost my travel companions, I was delighted to see some nice familiar faces behind the bar. It is not that crowdy in front of the bar and I can get my beer really fast. The quality is nice and the adtbeer tastes good. However, the temperature was going sky high. So dear reader, if you don't want to stand at the bar, take my advice and go to the Educafe. There the temperature is a bit colder.

Our journey ends at the Vestingbar. You have to walk a bit, but the rewards are worth it. Hundreds of people who prelude the afterparty. There is also food outside and we can obtain our medal. A final advice I would like to give to you. If you want to get food, first grab a beer, as the queue is quite long. Then you can at least enjoy your beer when waiting. In the Vestingbar I also found my loyal companions back and it became a long evening.

Diepzat

Reporter	Lisanne & Lonneke	Herjan	Sjoerd	Average
Atmosphere	7	8	8	7.7
Bartender beauty	6.5	2	4	4.2
Adt beer	n.v.t	8	8	8
Normal beer	5	6	4	5
Crowded	5	6	7	6
Draft quality/skills	10	7	6	7.7
Serve speed	7	6	5	6
Fixability	n.v.t	n.v.t	n.v.t	n.v.t
Temperature	3	3	x	3

Beneden peil

Atmosphere	8.5	8.5	7	8
Bartender beauty	5.5	6	6	5.8
Adt beer	n.v.t	5	4	4.5
Normal beer	7	6	7	6.7
Crowded	7	8	7	7.7
Draft quality/skills	9.5	8	8	8.5
Serve speed	9	8	7	8
Fixability	n.v.t	7.5	n.v.t	7.5
Temperature	8	7	x	7.5

De tap

Atmosphere	6	9.5	8	7.8
Bartender beauty	6	8	8	7.3
Adt beer	n.v.t	9	9	9
Normal beer	6.5	8	6	6.8
Crowded	2	6	7	5
Draft quality/skills	6.5	8	7	7.2
Serve speed	9.5	10	10	9.8
Fixability	n.v.t	10	10	10
Temperature	1	2	x	1.5

Mbasement

Atmosphere	7.5	7	x	7.3
Bartender beauty	6.5	4	x	5.3
Adt beer	n.v.t	7	x	7
Normal beer	7.5	5	x	6.3
Crowded	1	3	x	2
Draft quality/skills	8.5	9	x	8.8
Serve speed	1	1	x	1
Fixability	n.v.t	5	x	5
Temperature	2	2	x	2

Abscint

Atmosphere	8	7	9	8
Bartender beauty	8	10	10	9.3
Adt beer	n.v.t	7	7	7
Normal beer	7.5	6	8	7.2
Crowded	7	7	7	7
Draft quality/skills	2	5.5	4	3.8
Serve speed	7	10	3	6.7
Fixability	n.v.t	2	1	1.5
Temperature	4	6	x	5

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PRODRIVE TECHNOLOGIES

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Master assignment

Action selection in Parkinson's disease and the effect of (closed-loop) DBS

Author: Joan Benet i Bertran / EWI-BSS

Parkinson's disease is a well-known neurodegenerative disease in the aging society, that is mainly recognized by the problems of shaking (tremor) and rigidity. Besides these common symptoms, patients may also suffer from cognitive malfunction and slowness of movement, which may become visible in some clinical experiments like the Go/No-Go tasks. These tasks consist of two types of stimuli that are presented to the subject, one indicating that the subject has to respond to the stimulus and the other one saying that the subject has to withhold the response. Parkinson's patients show difficulty to perform these tasks correctly, but the exact physiological mechanism(s) of these defects are still unknown.

In this thesis, the cortico-basal ganglia-thalamo-cortical loop in the brain is modelled according to the Hodgkin-Huxley representation of neurons which is a mathematical model describing the generation and propagation of action potentials. This loop is known to be the origin of Parkinson's disease as the loss of dopamine caused by the disease directly influences the striatum, causing a cascade of improper spiking of the different compartments of the basal ganglia which is finally reflected in the thalamus and cortex.

The Hodgkin-Huxley model is also known as the conductance-based model. In this model, the membrane of neurons is represented by a sequence of nonlinear differential equations which describe their electrical properties (describing each of the components of the membrane as an electrical component) and allows to emulate the connections between the different populations of neurons. It allows to study the characteristics of neural networks like their synchronization or spiking rate.

The model that will be implemented in the thesis is the one shown in the figure below. The input corresponding to the task modelled is introduced via the cortex to the model, which depending on whether it is a go or stop signal activates or inhibits the different compartments of the brain structures. These cascades of activation and inhibition finally act on the thalamus obtaining a more activated or inhibited region when the go or the stop task is performed under healthy conditions, respectively.

The goal of the thesis is to try to reproduce the problems that appear in Parkinson's subjects in order to try to understand the underlying mechanisms causing the symptoms. To do so, variation in the parameters like conductivity or rest potential of certain populations

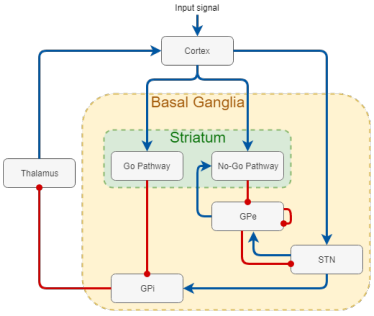

Figure 1. Structure of the model of the cortico-basal ganglia-thalamo-cortical loop that is implemented in the thesis. Red lines indicate inhibitory connections while blue lines indicate excitatory connections.

of neurons will be addressed as well as different architectures of connections between the different populations of neurons. This should lead to certain patterns of spiking which will be analyzed to test if synchronization between neurons occurs and to observe if activity within the β-band (12-30 Hz) increases. Finally, deep brain stimulation (DBS) will be added to the model. Deep brain stimulation is a technique which consists in applying high-frequency pulses to the subthalamic nucleus which diminishes the symptomology of Parkinson's disease. When applying this stimulation as an input to the model, it is expected that the network will return to typical values of β-band activity similar to those seen in the healthy network. It will be tested if it is possible to use this frequency band as biomarker for DBS for closed-loop stimulation application.

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D-I-Y Module 11

Author: Guus Frijters and Maarten Bonnema

Almost at the end of the bachelor module 11 commences. During this module everything is based around one big project designing a Bluetooth/wireless speaker. What, how, and why is completely up to you. Two groups had the chance to write something about their experience with module 11.

Guus Frijters

My group and I (group 4D) had brainstorm sessions in order to figure out what the best speaker was to get the highest grade but which also would be fun to design. We had to think about it in order to achieve the ultimate philosopher bonus and the different subject needed to be integrated. This meant that there had to be analog processing as well as digital.
After multiple brainstorm sessions a few ideas came to light. The idea that won our contest was the UPASD. It is actually just a speaker which can recognize a beat and overlay a beat-sound, but we needed a cool name. Therefore the Ultra Portable Assistant Speaker for Dancing was born in the hope that the teacher would say the speakers name and we would be done with the module since we passed.

> "All these different parts needed a glue to keep everything together which would be the Systems Engineers domain."

With the awesome idea present, division within the different domains could commence. The processing part is quite clear since we needed beat recognition. Therefore the digital domain could focus on beat recognition (and of course communication). This left the 'speaker'-part open for some analog processing. Since we are all familiar with Module 3, the blown-up amplifiers, this was THE chance to use all knowledge gained over the years to design a better amplifier (which would not blow up).
With the different parts integrated, a housing was needed to make our speaker look good as well. Using all the functions of the design lab as well as our inner creative minds, an acceptable looking speaker was born.
All these different parts needed a glue to keep everything together which would be the Systems Engineers domain (as well as the project-leader). My task was to play the glue, which meant that I assisted where needed and wrote a lot of report and made a lot of diagrams.
Due to unforeseen sudden issues, the looks of the speaker changed (twice) to make sure everything would fit. Of course, most parts did not fit in the spea-

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ker anyways. Integrating the different parts also created big problems which made the project less successful as it was during our own testing. The demo did not go as well as we had hoped but luckily we could explain it away as issues with the components and not our own fault.

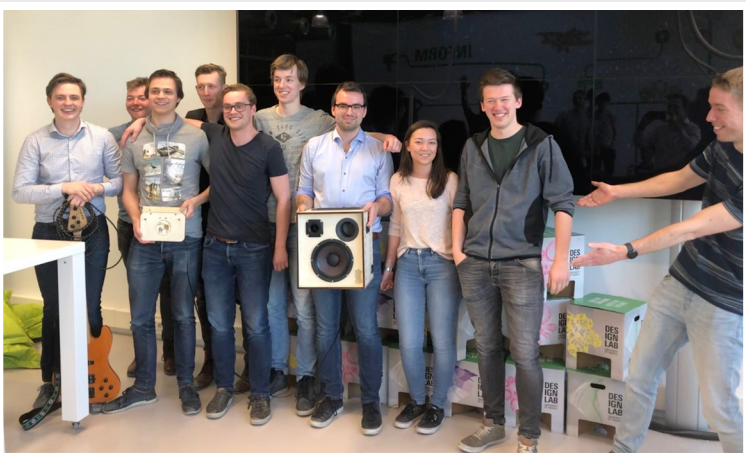
Maarten Bonnema

Module 11 is, apart from the Bachelor assignment, probably the module with the most freedom. The task of the project is to design and prototype a portable speaker with a human touch. The kick-off of the project was right on the first day, so our group immediately started brainstorming. We came up with the wildest and craziest ideas. At the end we designed a portable speaker for semi-professional musicians, the Easy-Jam. The speaker would be an all-in-one portable unit that would combine all the functionalities of professional equipment into a single speaker.

> "we came up with the group name 'Winner Schnitzel', a 'winning name'"

In such a large project where multiple disciplines come into play; structure, organisation, and planning are key. Fortunately, the Systems Engineers and project leader in our group kept their heads cool and (tried) to manage the overview. Everyone in our team was divided into one or more subgroups to ensure all tasks would be fulfilled.

Using the knowledge of the courses Electronics and Embedded Signal Processing the analogue-group designed the front-end of the speaker chain, containing for example a line-select, pre-amplifier, and 3-band equalizer. Fortunately, this part of the chain was designed and constructed without major hassles.



Our main challenge was located in the digital domain. We opted to use an FPGA as some were quite prompt with VHDL in module 5. As a key functionality for the musicians, we implemented a looper station with pedal, where the user can loop his or her guitar and vocal clatter. We wanted to mix all the inputs digitally, for example, a microphone, a guitar, a backtrack from the Bluetooth receiver, and a signal from the looper. This brought about various challenges and problems, but we managed. Furthermore, the class D-amplifier proved to be one of the most demanding blocks. We asked our project supervisor for the code to convert from Pulse Code Modulation to Pulse Width Modulation, which ran at 750 kHz. The circuit that drove the loudspeakers turned out to be rather troublesome. We asked PhD-candidates various times for help and improved our design.

> Like many other technical students we also procrastinated the writing of the report to the end, something that always backfires.

On the day of the final presentations, the same day as the deadline for the report, we were all stressed out to finalise the report and prepare a proper presentation. Like many other technical students we also procrastinated the writing of the report to the end, something that always backfires. Unfortunately, our speaker did not fully function during the demo, but we were still proud of what we achieved. Postponing the integration of multiple blocks to the last week, turned out to be the bottleneck. We learnt that planning and communication is crucial for the success of a large-scale and multidisciplinary project.

As a group of friends, we still had a lot of fun during the project. When module coordinator Oude Alink said that we could change our default group name, we came up with the group name 'Winner Schnitzel', a "winning name" according to Oude Alink. We had numerous 'brainstorm' sessions together and enjoyed fooling around from time to time. The most intriguing and appealing part of the project is that it does not only integrate the knowledge of the courses within the module, but it invites you to use all the know-how of the Bachelor and beyond.

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