

PRODUCTS FOR HEALTHCARE

Medesign graduation projects 2010-2012

TU Delft | Faculty of Industrial Design Engineering





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Products for Healthcare

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FOREWORD

The faculty of Industrial Design Engineering at Delft University of Technology has extensive experience in developing products and services in the field of healthcare. In our 'Medisign' healthcare programme, we continue to address the topics of care, cure and prevention in both research and education. Central are the needs of the patients, healthcare professionals, informal caregivers or a combination of these. Our students approach these miscellaneous needs using their knowledge and understanding of different technological disciplines, human factors and psychology, often leading to unconventional and surprising results.

We are once again proud to present this booklet showcasing 97 healthcare graduation projects, completed in the period 2010–2012. This is the fifth edition of a series of booklets showcasing our

healthcare graduation projects; the first appeared in 1997. Projects in this edition include an anatomical model for training in laparoscopy, a game for online burnout therapy, and a vision on future robotic caretakers. Compared to previous editions we note an increase in emphasis on design for mental health and elderly care, in addition to a steady number of projects on the design of medical devices for healthcare professionals. This shift in topics reflects the on-going developments in society and research at our faculty.

We hope this booklet inspires you and will serve to initiate future collaborations.

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Delft, September 2013.



DESIGN FOR DIAGNOSIS

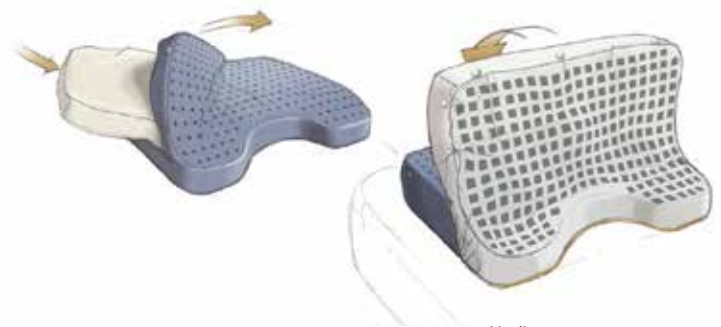
UNOBTRUSIVE EEG CAPTURING DEVICE

Graduate: S.N.A. Wolswinkel. **Supervisors:** J.M.P. Geraedts, I.A. Ruiter.
Partner: Philips, 2012.

Classical, clinically used polysomnography (PSG) provides insight into a patient's sleep quality. A significant part of the PSG setup is the measurement of the brain activity, better known as electroencephalography (EEG). EEG normally consists of at least eight electrodes attached to the head, but the Brain Body and Behavior group at Philips Research found that using only three electrodes, limited to the facial area, is sufficient for reliable sleep classification. As there is no longer a need for multiple cables attached to the head, this opens possibilities in terms of the obtrusiveness of capturing EEG during sleep.

The 'Pillow EEG' was designed in response to this development and integrates the technology into the pillow that the user lies on. The design is optimised for signal-to-noise ratio and features a pillow with dry electrodes mounted on the casing. The electronics for amplification and processing are integrated into the product, and can send the recorded signal to an external platform via wireless Bluetooth.

Though the functional application of unobtrusive EEG capturing is attractive for health care, the unobtrusiveness comes with issues regarding accuracy of the signal and signal coverage overnight. These issues unfortunately limit the possible applications. To optimise the product's functioning, the Pillow EEG promotes positions in which the user lies facing sideways, which is the only way for a signal to be detected.



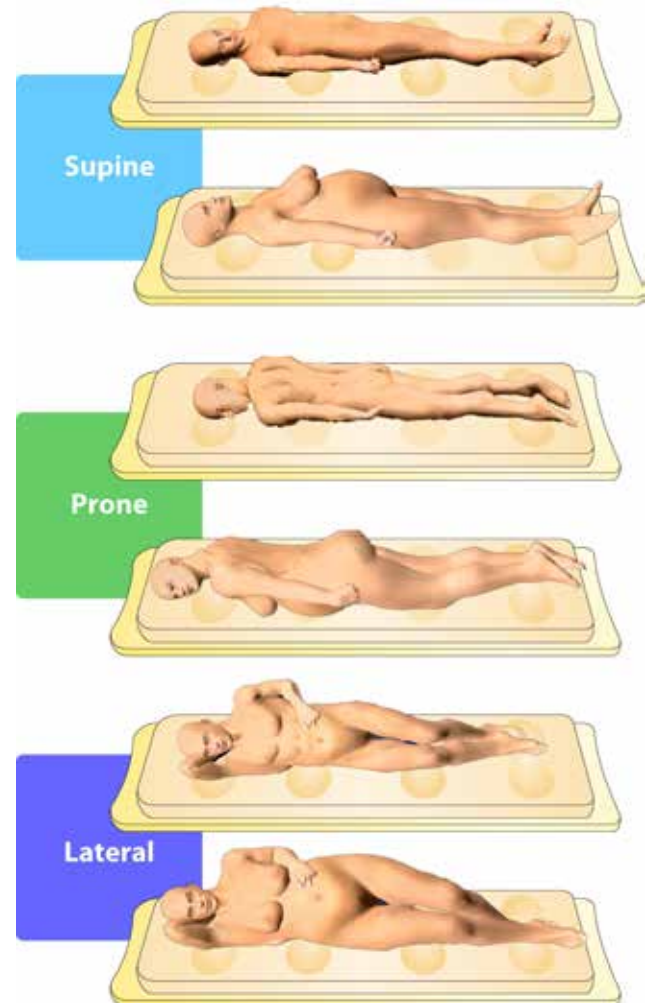
HUMAN INTERACTION IN INTERVENTIONAL PROCEDURES WITH PHILIPS MULTIDIAGNOST ELEVA: A PATIENT CENTERED STUDY

Graduate: N.R. Da Mota Ferreira. **Supervisors:** S.U. Boess, I.A. Ruiter.
Partner: Philips, 2011.

This project focused on the interventional procedures performed with the Philips MultiDiagnost Eleva X-ray system. Two rounds of field observation and interviews with patients, doctors, nurses and other staff at several hospitals revealed opportunities for improving patient experience, comfort and safety. Following the research, the project focused on patient comfort.

A new mattress is proposed for the MultiDiagnost Eleva to improve the patient's physical and mental comfort. This in turn improves workflow and safety by allowing for better adjustment. It also improves outcomes by avoiding post-procedure injuries. The main body positions used in interventional procedures are prone, supine and lateral. To avoid fatigue in those positions, the body needs support at the neck, back, knees and feet. The proposed design elevates those four main areas using integrated foam pillows inside the mattress. The pillows can be inflated individually depending on the required body position and are adaptable to different body dimensions.

The project concluded that doctors and other hospital staff want and need health care equipment that supports patient comfort and that integrates well with the workflow of interventional procedures.





INTEGRATED VIDEO EXPERIENCE FOR MRI PATIENTS

Graduate: N. Buratti. **Supervisors:** S.U. Boess, M. Melles.
Partner: Basel University Hospital, 2012.

Undergoing an MRI is a stressful experience. It is claustrophobic, noisy and time consuming. Also, when a patient moves during the procedure, the image quality decreases and the procedure often has to be repeated. In order to reduce stress, Basel University Hospital has developed a video technique to guide the patient's breathing pattern. This project looked at the design of the video projection system. The new projection system surrounds the patient's face inside the MRI. A pico laser projection is pointed towards a parabolic mirror that reflects a constant-sized video on a screen that is placed close to the patient's face. The video experience does not change when the patient slides in or out of the scanner, allowing the patient to watch the video at all stages of the examination. To prevent disorientation and dizziness, the screen has been designed in such a way that it does not completely isolate the patient from the outside environment. One of the major challenges was to design a system that works in a high magnetic MRI environment. A working prototype of the video system was developed to demonstrate the proof of concept.



DEVICE FOR DIAGNOSIS AND TREATMENT OF PELVIC FLOOR DYSFUNCTIONS

Graduate: F.L. op de Macks. **Supervisors:** R.J.H.G van Heur, A. Freudenthal.
Partner: MAXAM Medical, 2011.

Pelvic floor dysfunction can be very disabling and have an enormous impact on a patient's quality of life. Over 180 million people in Western countries suffer from a pelvic floor dysfunction, such as urinary incontinence, bowel problems, pain, pelvic prolapse and sexual dysfunction. Diagnosis is difficult and based on limited information derived from probes and poor graphic representation on displays. Technology allows for the development of refined probes, but regular representation of this detailed information on displays becomes too complex. In addition to improving the representation of information and thus improving the diagnosis, there is a need to improve treatment. Direct feedback given to a patient about whether and how treatment will improve pelvic floor functioning would be enormously helpful to both the pelvic floor physiotherapist and the patient.

This assignment was initiated by MAXAM Medical, a TU Delft start-up company. The design consists of an advanced probe which can be used in both the diagnosis and later to provide electric stimuli for direct treatment. Information from the probe is displayed on mobile displays and is so intuitive that it can benefit both pelvic floor physiotherapists and patients. The proposal includes a detailed working template which supports physiotherapists in their daily work routines. The project has been developed to an operational level as the basis of a successful business model for MAXAM Medical.



OPTICAL SKIN SCANNER TO MONITOR THE EVOLUTION OF SKIN NAEVI FOR EARLY DIAGNOSIS OF CUTANEOUS MELANOMA

Graduate: F.P.C. Goethals. **Supervisors:** M. Melles, M. Verwaal.

Partners: Reinier de Graaf Hospital, Leiden University Medical Centre, 2011.

Although cutaneous melanoma accounts for only 10% of all skin cancer cases, it results in 75% of the deaths related to skin cancer due to its aggressive nature. When diagnosed in time, the prognosis after tumour removal is very good, but when the tumour is left to grow invasively, the chance of metastasis increases rapidly. When melanoma occurs, the appearance of a neavus changes. For example, the shape can change or new colours can appear. Patients should regularly inspect their skin for these symptoms at home. A device was developed during this project to improve the quality of self screening and provide patients with advice on when to visit their dermatologist.

The patient uses the device to record monthly images of a selected group of naevi. The device is then connected to a PC on which a program analyses the images. The program keeps a record for each naevus in which the changes over time can be measured. When change is detected, the patient is alerted that it is time to visit the dermatologist. The dermatologist can also read the device to see how the naevus has changed



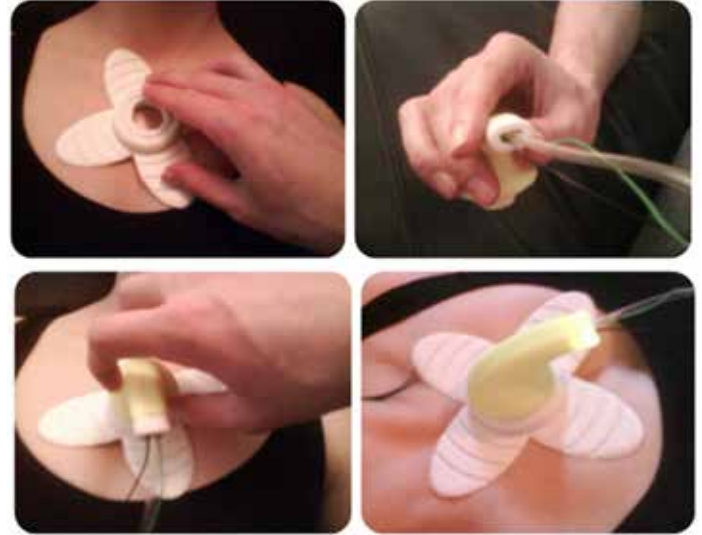
CELLULAR OXYGEN CONSUMPTION MEASUREMENT SYSTEM FOR DIAGNOSING SEPSIS

Graduate: J. Qiu. **Supervisors:** C.C.M. Moes, S. Pont.
Partner: Erasmus Medical Centre, 2012.

Sepsis is a serious condition in which 30 to 40 percent of patients die because of an organ dysfunction caused by low energy production in a later stage of the disease. Physicians currently diagnose sepsis and its different stages based on symptoms such as fever and low blood pressure. The current treatment of sepsis only focuses on improving the oxygen supply, however, the problem might also be caused by the oxygen consumption in the cells.

The anaesthesiology department of the Erasmus Medical Centre is developing a technique to measure oxygen consumption in cells from the skin surface. This technique mainly uses the 'oxygen-dependent delayed fluorescence' property of an element called protoporphyrin IX (PpIX). When illuminated by a laser light pulse, the PpIX accumulated inside the skin cell responds by sending a light pulse back. Since PpIX reacts to oxygen in the cells, the duration of this delayed fluorescence effect depends on the available oxygen pressure. A higher oxygen pressure results in a shorter fluorescence period.

Based on these measurement techniques, a device has been developed that consists of two parts. A lower part that has direct contact with the skin surface and a main part connected to the lower part that contains optical fibres and elements for heating and pressure. A user test was performed to evaluate the usability and ergonomics. Recommendations were made regarding the product's size and material properties.



DIAGNOSTIC DEVICE TO TRIAGE INJURY OF THE HAND AND WRIST

Graduate: B.P. Nederstigt. **Supervisors:** R.H.M. Goossens, M. Verwaal
Partner: Leiden University Medical Centre, 2011.

Hand and wrist injuries are commonly seen in emergency departments. Adequate treatment is required for proper healing, but diagnosing the injury can be difficult. Only a small percentage of patients visiting a doctor actually have a fracture, but initial standard radiographs do not show all fractures and can provide misleading information. The likeliness of a scaphoid (carpal) fracture can be predicted by measuring and comparing the maximum torque and range of motion (ROM) of pronation and supination, the ulnar and radial deviation, and the dorsal and volar flexion in both hands.

A functional prototype has been developed and can be used by researchers at the LUMC to validate the predictive power of ROM and torque measurements in triaging hand and wrist injuries. The device uses Velcro straps to fix the arm in the preferred position to prevent patients from influencing the test with their body weight. Wrist torque in volar and dorsal flexion is measured by force sensors built into a cylindrical handgrip. ROM is measured by a three-axis MEMS gyroscope built into a lean stick. Every measurement starts with a neutral orientation of the wrist. The amount of feedback patients receive during the test must be controlled, as this can strongly influence the test results.



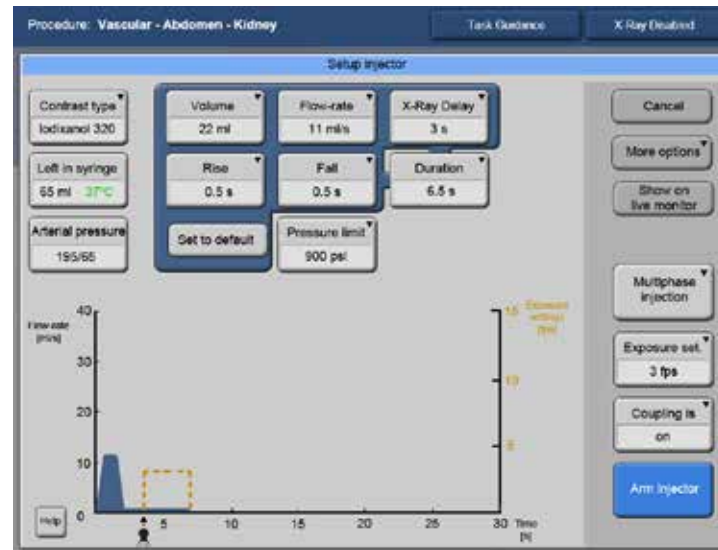
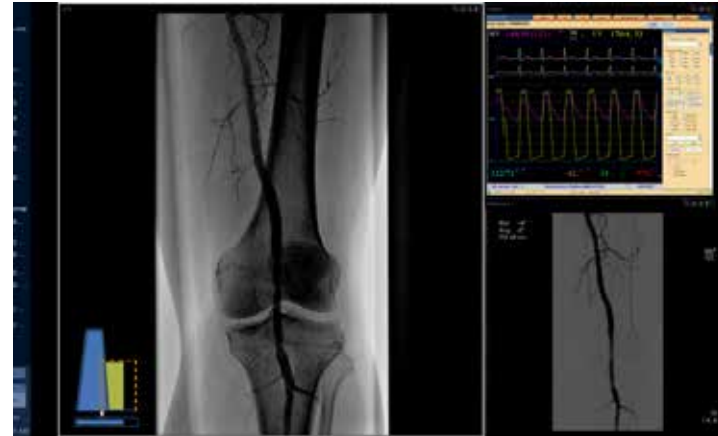
USER INTERFACE FOR CONTROLLING CONTRAST FLUID IN THE NEXT GENERATION OF INTERVENTIONAL X-RAY SYSTEMS

Graduate: M. Zweers. **Supervisors:** H. de Ridder, F. van Mourik.
Partner: Philips, 2011.

Interventional radiology uses X-ray imaging to help guide physicians when inserting catheters, wires and other small instruments into a body. Physicians use this technology to diagnose and/or treat conditions in many different parts of the body. To visualise vessels and improve the quality of the X-ray images, contrast fluids are used. These fluids, which can cause allergic reactions and kidney failure in patients, are often manually injected. Research shows that benefits can be gained from using a contrast fluid injector, which reduces the amount of fluid needed for a patient, improves image quality and can significantly reduce fluoroscopy time (time needed to create real time moving images of the internal structures of a patient). This latter is important because X-ray radiation is damaging for both patient and medical staff.

This thesis describes the development of a user interface for controlling contrast fluid. A concept was developed after a thorough analysis of the workflow of laboratory assistants and usability problems. A new and more user friendly interface was designed and integrated into the X-ray system. The benefits of this integration include display feedback on demand, protocols for injector settings coupled to a selected X-ray procedure, automatic reporting, improved workflow.

The concept was evaluated by laboratory assistants. The results of this evaluation were translated into adjustments of the concept.





DESIGN FOR TREATMENT

INTRAUTERINE INSEMINATION DEVICE

Graduate: V.K.L. Tran. **Supervisors:** C. Spitas, L.H. Langeveld.
Partner: VU University Medical Centre, 2010.

Intrauterine insemination (IUI) refers to the insemination of semen into a womb or uterus. It is a simple process entailing the following steps:

- Collection and preparation of semen monster
- Suction of the semen into a syringe
- Injection into a female uterus via a catheter

The insemination itself is a non-automated process and is performed by an IVF doctor. It is conducted by depressing the syringe plunger. Each IVF doctor has their own velocity of injection, however, this step should never be performed too quickly in case the uterus contracts. It is not known what effect the velocity of injection has on pregnancy rates. The injection is not the only step involving human action, but it does seem to be the most important one that can be improved.

The main challenge lies in developing a device that controls the injection stage with its variable velocities and therefore variable flow rates. The device should make it possible to standardise and control the IUI procedure in terms of the ability of the doctor to stabilise the device to create a constant force output and therefore a constant velocity output of the syringe.

An insemination device was designed based on these requirements. The result was a device that is easy to handle, involves minimal handling and meets specialists' expectations.



MODULAR GYNAECOLOGICAL APPLICATOR FOR BRACHYTHERAPY

Graduate: T.R.O. Martens. **Supervisors:** J.F.M. Molenbroek, A.L.M. Minnoye.
Partner: Nucletron, 2012.

Gynaecological cancer is often treated by brachytherapy. Brachytherapy is a method where a radioactive source (Iridium-192) is administered inside or close to the treated area using a tube. Cancer of the cervix, in particular, is often treated with this technique. Currently, many different applicators with different shapes and sizes are used because of patients' anatomy or the preference of the specialist. This makes the development and maintenance of these applicators very expensive. The development of a new modular applicator can help improve the treatment of gynaecological cancers. The product solution designed during this project has a cylindrical applicator which allows for easy insertion of the device and multiple sleeves with different shapes and sizes for different anatomies. These sleeves are disposable and can be pre-assembled with flexible catheters. This makes it easy to guide the tube to the area requiring treatment. A prototype was built and was tested by specialists, who indicated that the applicator's working principle was clear but that technical feasibility could be improved. Based on these insights a second prototype was made and evaluated again by the same specialists.



IMPROVING THE USER EXPERIENCE OF NASOENTERAL TUBE FEEDING

Graduate: N.S. Tijdeman. **Supervisors:** M.C. Dekker, M.H. Sonneveld.

Partner: Internal research project, 2010.

The idea for this graduation project originated from observing the discomfort of patients unable to consume regular food in a natural way due to an obstruction in the digestive tract. These patients require tube feeding, during which a nasoenteral feeding tube is inserted into the digestive tract. Despite the necessity of this procedure, the user experience throughout the treatment is extremely unpleasant.

Extensive research showed that the insertion of the tube is unpleasant and, when the tube is in place, it causes pain, irritation and fear and restricts the patient's movement. Its maintenance is also very time consuming. The tube is secured with adhesive plasters that often need to be replaced as they can loosen or cause irritation.

As a solution, a tube holding device was developed to improve user experience. The device secures the feeding tube to the patient's face without having to use adhesive plasters. This new device increases the patient's mobility, prevents kinks in the tube, naturally guides the tube to the administration system and holds the weight of the feeding tube. Because the tube is secured tightly inside the device, it also makes the tube look more subtle and prevents the tube from moving. Finally, less maintenance is required since adhesive plasters are no longer necessary.



REMOLDING HELMET FOR NON-SYNOSTOTIC DEFORMATIONAL PLAGIOCEPHALY AND BRACHYCEPHALY

Graduate: C.E. Peters. **Supervisors:** A.J. Heidweiller, I.A. Ruiter.
Partner: LIVIT Orthopaedics, 2010.

Since the early 1990's, parents have been advised to let babies sleep on their backs, as part of the Back to Sleep programme to prevent sudden infant death syndrome (cot death). The programme has been successful in decreasing the number of cot deaths, but has led to an increase of deformational plagiocephaly and brachycephaly (DP).

DP is a flattened skull that can develop on one side of the back of the head when babies spend too much time in the same position. It can be treated with helmet therapy. The Dutch orthopaedic company LIVIT has produced three slightly different types of helmets. The aim of this graduation study was to design a new remolding helmet that combines the best features of each helmet type.

The following improvements were made in the new helmet design:

- Smaller, lighter and cooler
- Improved appearance
- Improved comfort and safety of the chin strap
- Improved effectiveness of the side-cuts.

Recommendations were given to keep track of therapy results in a database to acquire a precise understanding of the working principle of the helmet. An important issue that was still unclear was the tightness of the helmet fit.





INCUBATOR COVERS FOR THE NICU

Graduate: M. El Massoudi. **Supervisors:** J.F.M. Molenbroek, A.H. Jellema.
Partner: Senso-Care, 2012.

In the Netherlands, about 8% of all infants are born prematurely. Because they are born at an early stage of pregnancy, their brain and nervous system are not yet fully developed. Premature infants with impaired vital functions are therefore admitted to a neonatal intensive care unit (NICU). Here, they are continuously observed, nursed and treated. Further development of the vital functions takes place during their stay in the incubator.

Certain factors in the NICU, like inappropriate stimuli of light and sound, can negatively affect this development process. Incubator covers are used in NICUs to protect infants from unwanted external stimuli. However, these covers are washed so often to make sure they meet hygienic requirements that they wear out quickly. Furthermore, the irregular shape of the incubator requires a custom-made cover.

The final proposal of this project was a new incubator cover made with durable and hygienic fabric that fits over the Giraffe® Omnibed incubator. The cover has magnets inside the corners of the flaps allowing the flaps to be stuck to the ferromagnetic material when it is opened. This offers a lot of freedom and flexibility in use.

The user research showed that the cover was easy to place over the incubator. Some recommendations were made regarding the thickness of the material and the location of the flaps and openings.



QUALITY AND COMFORT IN HEAD AND NECK HYPERTHERMIA: A REDESIGN ACCORDING TO CLINICAL EXPERIENCE

Graduate: R.A. Roskam. **Supervisors:** R.H.M. Goossens, S.G. van der Geer, A. Albayrak.

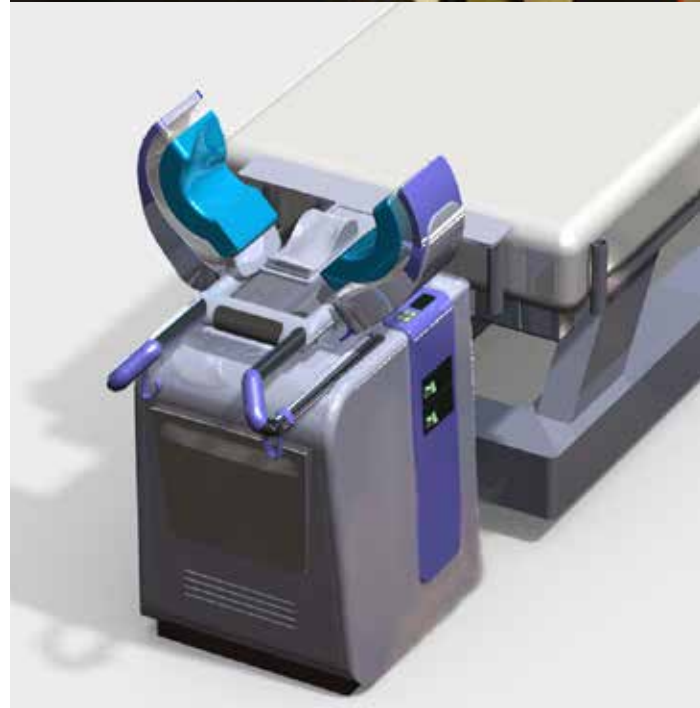
Partners: Erasmus Medical Centre, Daniel den Hoed Cancer Centre, 2010.

Head and neck cancer treatment with hyperthermia is performed with the 'HYPERcollar', a circular antenna applicator. During treatment, electromagnetic energy is focused inside a tumour, while a water bolus is used to cool the skin and transport energy. Folds and shape instabilities in the water bolus can affect the quality of the treatment, causing hotspots and pain. Moreover, the closed shape makes it difficult to position the patient and restricts breathing and communication.

The new water bolus design uses compressible foam inserts for shape stability as well as elastic foil to prevent folds. Internal circulation preserves cooling, thereby minimising the chance of hotspots. The water bolus is divided into two halves, which allows for the patient to be installed and positioned comfortably before administering the applicator with water boluses from the sides. Pre-shaped gaps on top allow for easy breathing without the need to rearrange the water bolus.

Experiments and volunteer tests showed promising results for both quality and comfort. Technical parameters in the new prototype, such as material properties and shape stability, performed well during testing. The new positioning strategy is more precise and causes less inconvenience. The breathing option and elastic foil make treatment more comfortable and make it more likely that the treatment will be completed.

The water bolus and positioning strategies were combined into one integrated redesign of the head and neck hyperthermia applicator.



PROEFMONSTERS: NEW EATING EXPERIENCES FOR CHILDREN WITH CANCER

Graduate: N. Hollenberg. **Supervisors:** W.A. Aprile, P.E. Esser.
Partner: Princess Máxima Centre for Child Oncology, 2012.

Cancer treatment has a big impact on the food-intake of children. Due to medication they suffer from various side effects that discourage them to eat. While some of the nauseous children's complaints result from physical pathology, others are consequences of their experience of hospitalization. The challenge of this project was to improve a child's eating experience while being hospitalised.

A hospital food application was developed that incorporates a personally adapted menu, a personal eating profile and a game. The menu shown in the application is personal, based on the child's personal eating profile. There is nothing on there the child cannot order due to their treatment or allergies. To play the game, the patient can order a free 'Proefmonster' (taste sample) every day. This Proefmonster is a possible new inhabitant of a personal city that is protected by the patient or their digital hero. The monster gets served together with their dinner. They taste the sample, open the game and indicate whether or not they liked the flavour. If they liked it they receive a new monster villager, if they do not like it they receive a "monster in sheep clothes" that is placed in the meadow. The monster villagers can be played with. In their houses the child will find all sorts of information, recipes, movies and experiments corresponding with the food it represents.

A monster in sheep clothes can be traded in for cool gadgets to improve your hero or they can be saved to be tasted again later. The sheep can also be played with in AR. Putting two cards together will give surprising interactions between characters.





ERGONOMIC MULTIFUNCTIONAL SYRINGE

Graduate: W.J. Krouwel. **Supervisors:** J.F.M. Molenbroek, B. Ninaber van Eyben.

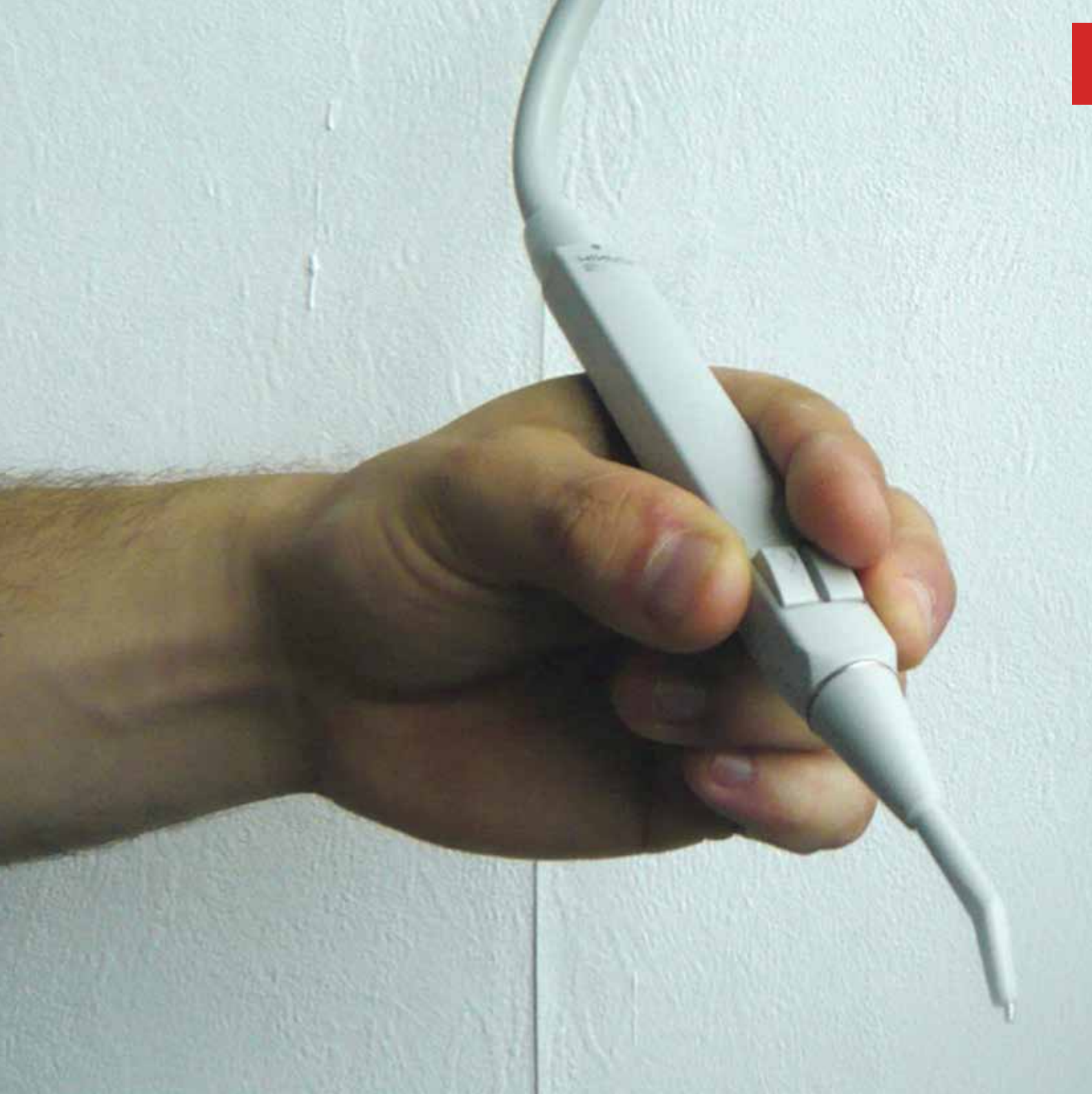
Partners: Utrecht Dental, University Medical Centre Groningen, 2011.

In the dental profession (e.g. dentists, dental hygienists and assistants), there is high rate of complaints of the back, neck, shoulders, arms and hands, better known as work-related musculoskeletal disorders (WMSDs). Ergonomic guidelines for dental equipment have been created to improve work conditions and physical comfort. However, the 'multifunctional syringe' (MFS), which can be used for blowing air and spraying water, still does not meet the ergonomic requirements for dental equipment and could be improved from an ergonomic point of view.

The new MFS design proposal, called the 'CEwave', features a unique combination of hygiene, comfort and ergonomic support. It provides more comfort and ergonomic support for both left and right-handed professionals and is also suitable for different hand sizes thanks to different removable grips. The pen grip allows a comfortable and ergonomic use of the product. In addition, the CEwave has no seams, which keeps dirt from entering the main body shell and coming into contact with the internal mechanism.

User research was conducted to evaluate the comfort of the grip and test whether the model fits all hand sizes. The participants were satisfied with the concept and the model proved suitable for both small and large hands. The comfort of the grip could be further improved by creating more friction in the thumb area.





MOVEMATES: ENCOURAGING PHYSICAL AND SOCIAL ACTIVITY IN COPD PATIENTS

Graduate: S. van Oorde-Grainger. **Supervisors:** C.C.M. Moes, P.E. Esser.
Partners: Evalan, University Medical Centre Groningen, 2011.

Chronic obstructive pulmonary disease (COPD) is the fourth largest cause of mortality in the world. Although exercising is difficult for COPD patients, maintaining good levels of physical activity is one of the most effective methods in reducing the severity of the disease and maintaining a good health-related quality of life. The current project, performed for Evalan, focuses on the development of a product-service system to aid in the pulmonary rehabilitation of patients with COPD. This system incorporates persuasive elements into a programme developed by the University Medical Center Groningen.

The final design is a combination of a smartphone app and a monitoring device which consists of a high sensitivity three-axis accelerometer, flash memory and Bluetooth module. It measures normal and higher activity levels. The smartphone app is the user's main source of interaction with the hospital's physical activity programme. It provides feedback (e.g. progress in achieving daily targets) and can be programmed to send notifications and encouragements. Persuasiveness is further explored by integrating a social competition component between users.

A prototype was tested by patients and health care professionals. The main findings indicate that both groups expected the design to be suitable for daily use and to have a positive impact on motivation and physical activity.



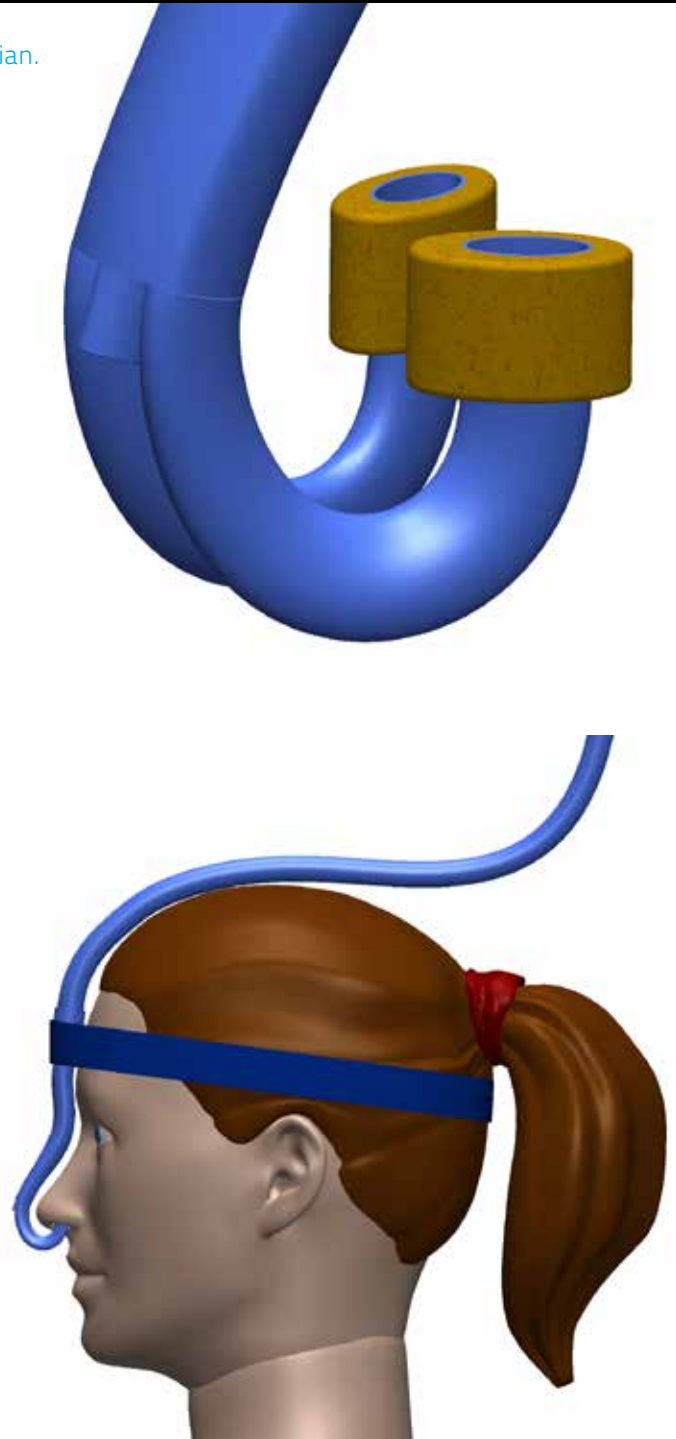
INCREASING USER COMFORT IN THE TREATMENT OF OBSTRUCTIVE SLEEP APNOEA

Graduate: M.B.J.M. Maassen. Supervisors: R.H.M. Goossens, M. Hajian.
Partner: Philips, 2011.

Obstructive Sleep Apnoea (OSA) is a sleep disorder which affects 3 to 4% of the male and 2% of the female population. A blockage in the throat, caused by relaxation of the tongue, causes patients to repeatedly stop breathing for periods of ten seconds or more. This can happen over 30 times an hour. Untreated OSA causes insomnia, increased blood pressure and oxygen shortage and triples the chance of fatal heart failure.

The most common treatment for OSA is Continuous Positive Airway Pressure (CPAP). The treatment is highly effective but still not very comfortable. The discomfort is mainly caused by the mask connected to the CPAP device, which causes skin irritation. As a result, one out of three patients quits the treatment, drastically reducing their life expectancy.

The new design, 'SmartPAP', increases user comfort. The large mask is replaced by memory foam nose plugs that are very efficient in sealing the airway pressure, are easy to mount and can be held in place by a single head strap. The hose between the machine and the mask has been made more flexible and is now also half the size. A whole new way of airflow regulation was developed for the machine itself. This has led to a 55% energy reduction, allowing the device to run the entire night on rechargeable batteries. Three invention disclosures were filed to the Philips patent office.



WEARABLE, COMFORTABLE LIGHT THERAPY: ILLUMINAID

Graduate: M.C. Pothen. **Supervisors:** A. Albayrak, A.J.C. van der Helm.
Partner: Philips, 2011.

This master's thesis explored the possible applications of light therapy in a wearable product, particularly for the treatment of wrist-related disorders. The target group consisted of professionals prone to repetitive strain injury (RSI) in their wrists due to excessive computer usage for long continuous periods.

An iterative design process was used within a user-centric evaluation method. Multiple prototypes were created and evaluated during qualitative user research. This research looked for the main comfort parameters, which were then adjusted progressively in each stage of the prototype development to find an optimum solution.

This resulted in the design of the 'Illuminaid', a product that offers comfortable wrist support as well as blue light therapy to treat wrist-related disorders. The ergonomic shape of the Illuminaid constrains unwanted deviation of the wrist and keeps the wrist in a more neutral position. The overall design of the product creates a highly portable, compact and easy-to-use solution for frequent photo therapeutic treatment that can be applied as and when the need arises without obstructing normal activities.

A prototype close to the final design was created and evaluated by users, all of whom highly appreciated the product and its comfort parameters.





LIGHT THERAPY PATCH AND RELATED INTERACTION FOR JOINT PAIN RELIEF

Graduate: X. Yu. **Supervisors:** M.C. Dekker, A.J.C. van der Helm.
Partner: Philips, 2011.

Many professionals suffer from pain as a result of their work. Light therapy can help by enhancing blood circulation deep in the skin. To improve user mobility during the occasional 15-minute treatment at work or at home, traditional light bulbs can be replaced with small and lightweight Light-Emitting Diodes.

This graduation project was the result of Philips wanting to explore possibilities for pain relief in an existing blue light platform. Research showed that users were looking for a simple and mobile product they could use during breaks at work or at home.

'Enjoint' is a simple, flexible and intelligent device that is easy to operate and provides high mobility for users. It has a unisex design that conveys professionalism. Several optical rubber covers were also designed to provide micro-massage effects for additional pain relief. The product can be operated by a button on the patch or with a smartphone app. User testing showed that people were enthusiastic about the design. The only concern was the marks that the micro-massage element left on the skin.

The next step for Philips in the feasibility study of this concept includes quantitative consumer validation, functional proof of the pain relief principle and product detailing.

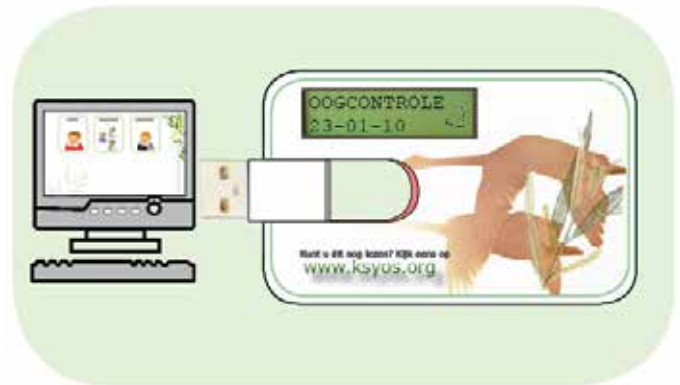


DIABETES MELLITUS CARE CARD

Graduate: F.T. van Breda. **Supervisors:** R.H.M. Goossens, P.E. Esser.
Partner: KSYOS TeleMedic Centre, 2010.

All patients with diabetes mellitus type II need to have their eyes checked annually. In practice, patients often do not. TeleOphthalmology is thought to be a useful innovation, as it allows patients to visit their local optometrist instead of the ophthalmologist at the hospital. However, the technology is not used regularly because patients are often unaware of the new service or have forgotten the information given by their nurse practitioner or general practitioner. A second problem is that some health-care professionals prefer conventional referral protocols. The current project, performed for KSYOS, focuses on the patient-side of the problem. A USB flash card with display and sound was developed to supply patients with timely information. The 'Diabetes Card' supports the patient in taking more initiative in their own health-care process. The card has a number of different functions: diary-based alerts, access to general information, information managed by professionals and information managed by patients.

A prototype of the card was tested by patients and health-care professionals. Its functions, use and added value were recognised by all parties and it was experienced as a useful innovation. As such, the Diabetes Card could feasibly become part of the health-care process and have a positive influence on fundus screening.



DASHBOARD FOR E-HEALTH COUNSELLING

Graduate: S.N.J. Lotgering. **Supervisors:** H. de Ridder, A.P.O.S. Vermeeren.
Partner: Parnassia Bavo Group, 2010.

E-health is on the threshold of a substantial patient increase. The existing monitoring interface for counsellors at the Parnassia Bavo Group was not yet ready for these developments: counsellors' needs for monitoring control had not yet been addressed and the multiple communication portals for counsellors inhibited efficient and controllable job management. During the conceptualisation phase of this project, parameters were determined for progress monitoring and task management, based on trend analyses, user tests and generative sessions with 20 counsellors. A dashboard interface was designed to provide counsellors with a portal for digital patient contact. The dashboard contains three pillars: the communication inbox, the patient database and the patient environment portal. The redesign provides substantial improvements to facilitate structured and efficient patient monitoring. The redesign provides flexibility to match a counsellor's individual form of patient management by providing multiple opportunities for taking mental notes and enabling much freedom in performing tasks. Other improvements include an additional system for task management and the option to expand the number of patients and treatment types. Once the system has been implemented, counsellors will need time to fully grasp the system dynamics and feel they can rely on the system. Involving 61% of all Parnassia Bavo counsellors as well as the departments that were planning to implement e-health helped to increase trust in the system.



database

home page

task list online

zoek

Patiëntencostand

filter: Alle patiënten

naam patiënt / aanspreeknaam	geboortedatum	notitie	Interventie
♂ Adriaan	07-05-1973	noeustisch	AcC
♂ Alcantar, R.	11-09-1979	motiliteitsproblemen	Onisp
♀ Audou, Bousuy	07-03-1982	voetbal (AZ)	TVP
♂ Bram	28-04-1990		TVP
♀ Boussef Dragovic	18-12-1979		

- Patiëntcontact
- P2F contact (15)
 - Online modules (17)
 - Groepsbericht sturen
 - Mijn teksten
 - Nieuws headlines



Online Behandelen stijgend succes

Volkskrant

De afgelopen jaren is het aantal aanmeldingen voor online behandelingen in Nederland gestegen naar 500.000 per jaar. Het succes is vooral te danken aan de

14 19 jan



P2F module binnen P2F module

De huidige online module is een voor jongeren ontwikkeld bij Parnassia. Inhoudelijke verschillen

Online modules (12)

Inbox behandelen/onderzoekende modules

Patiënt	Interventie	Actie	Orderwrap
Therm ter Dam	AcC		
Thendria	AcC		
Trudy de Bakker	AcC		
Boussef Dragovic	AcC		
Cyrt	AcC		
Ricardo van Dunen	AcC		

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FIXATING DEVICE FOR PERIPHERAL INTRAVENOUS LINES FOR CHILDREN

Graduate: P.C.M. van Schie. **Supervisors:** J.F.M. Molenbroek, L.S.G.L. Wauben.
Partner: Panton, 2010.

Patients and medical staff are confronted daily with splints used to restrict the movement of limbs with catheters during intravenous therapy. These devices are currently inefficient, uncomfortable for the patient and do not protect the catheter well enough. Also, because of its primitive appearance the device does not contribute to a positive healing environment.

The 'Embrees' was developed as an alternative solution. It helps secure a catheter placed on the hand or forearm of patients aged 2 to 18 in a way that is comfortable, safe and friendly.

The Embrees improves the safety of intravenous therapy by providing better protection of the catheter and allowing for earlier detection of malfunctioning. It saves an enormous amount of time thanks to faster emergency access. Most importantly, the Embrees is more patient friendly by enhancing the physical as well as the emotional comfort.







DESIGN FOR THE OPERATING ROOM



A NEW DRAPE FOR TOTAL HIP REPLACEMENT SURGERY USING THE ASI APPROACH

Graduate: A.W. Sungkono. **Supervisors:** R.H.M. Goossens, S.U. Boess.
Partner: Reinier de Graaf Hospital, 2011.

Before a surgical procedure, the patient needs to be covered with sterile drapes. During total hip replacement surgery using the anterior supine intermuscular (ASI) approach, the patient lies on their back and a surgical incision is made from the front (anterior) of the hip. The patient's legs are positioned in such a way that both legs have to be draped separately. This involves multiple drapes and many separate steps. Also, holding both legs up simultaneously is experienced as uncomfortable. Above all, the pubis, perineum and groins area is draped in such a way that sterility cannot always be guaranteed.

A new drape is needed that is easy to use, increases sterility and reduces the number of steps. The final concept developed in this project consists of a double layered drape that is placed over the patient before the orthopaedic team is scrubbed and gowned. This approach means that the pubis, perineum and groin area is covered before the sterile draping begins and the outer layer of the drape is removed to expose the sterile inner layer.

A prototype was built to test whether the usability of the drape had improved. The test showed that the envisioned interaction had been realised but the product's usability could be further improved.



LIGHTING FOR PELVIC SURGERIES

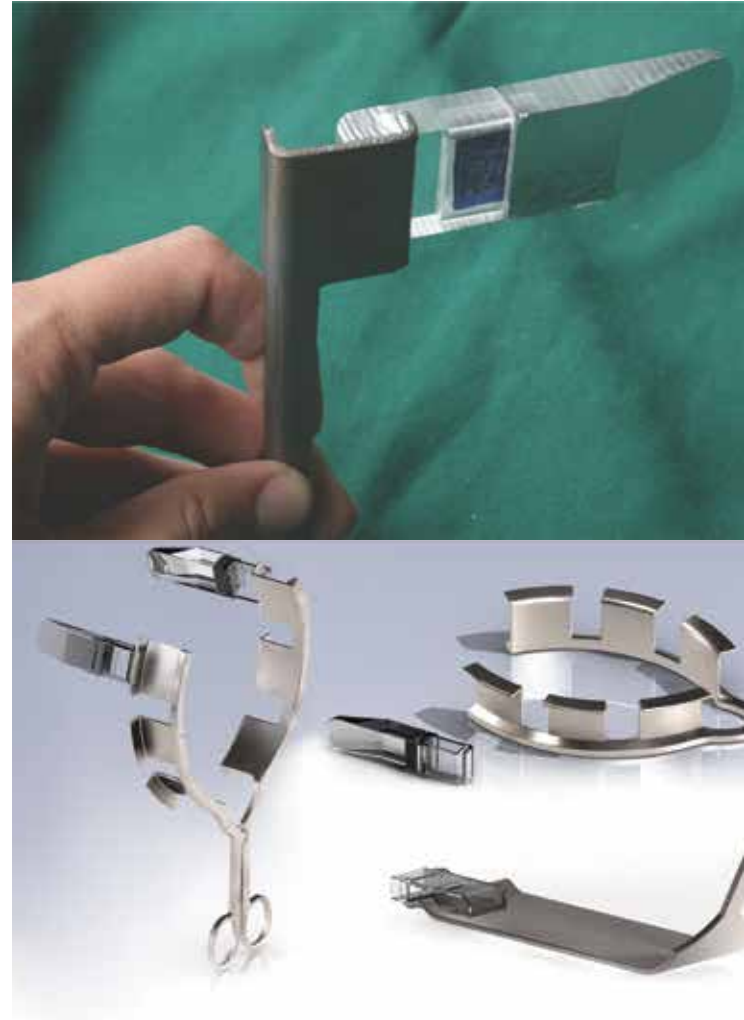
Graduate: A.L. Rodrigues Santos. **Supervisors:** R.H.M. Goossens, J.J. Jakimowicz.

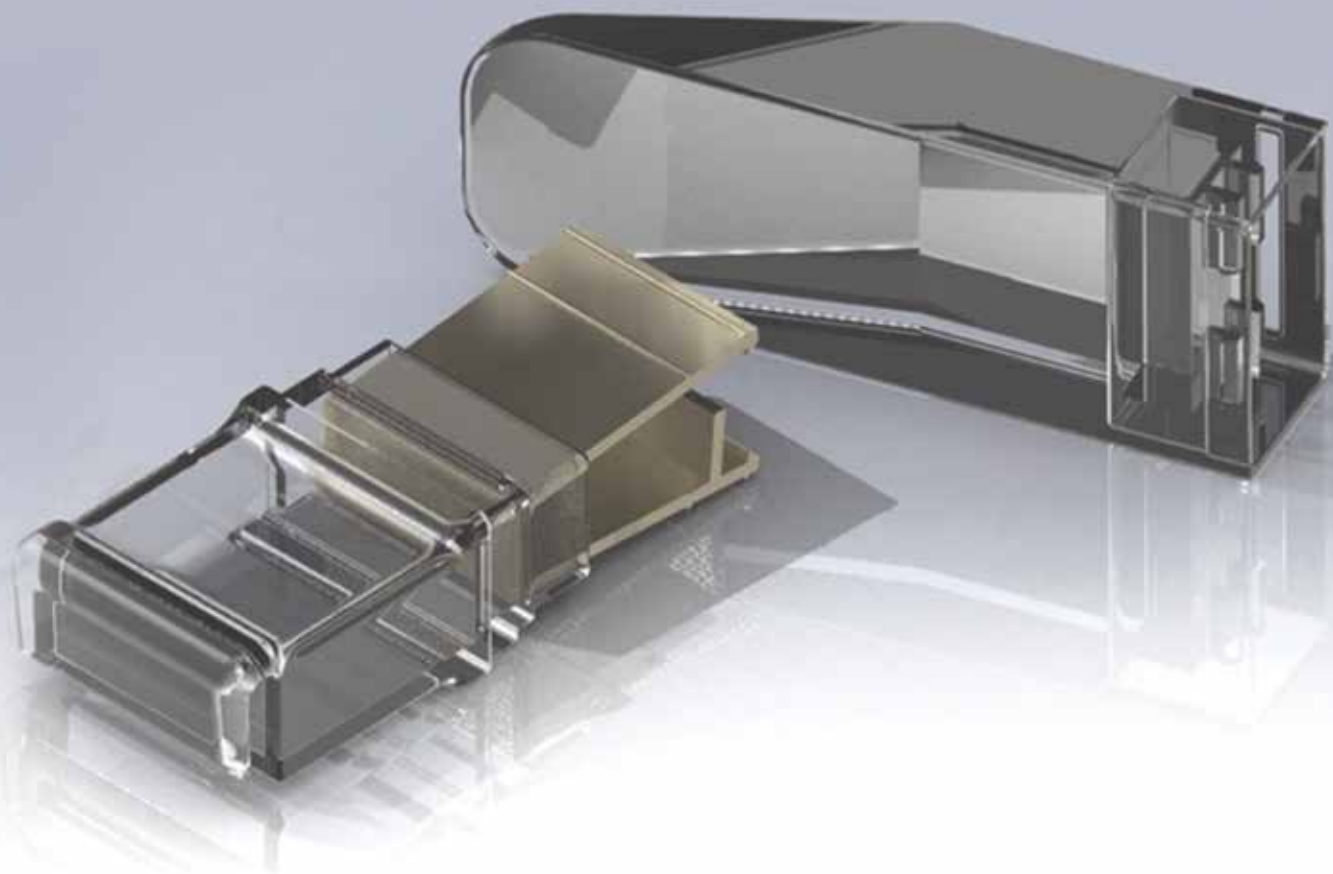
Partner: Catharina Hospital Eindhoven, 2009.

Surgeries in the pelvic cavity require extra attention to lighting conditions. The anatomic curves and dimensions of the pelvis, as well as the patient's position, limit the access and visibility of surgeons and operating teams. Furthermore, glare and intensity contrast, harsh shadows and blood obstruction pose permanent challenges for surgeons when operating in this region. The available lighting alternatives do not solve the problem since they provide no adequate light focus, are not designed to manoeuvre within space limitations, are considered too expensive and are uncomfortable to use.

The 'Indirect' is a battery-powered add-on developed for a rectal retractor. The device is modular and composed of a rechargeable electric circuit and two disposable parts which snap together in a watertight and sterile connection. The shape of the add-on provides a strong, even distribution of light into a wound using the Total Internal Transmission principle. It simultaneously extends retraction and reduces harsh shadows. Moreover, the add-on can retract a permanent force of 15N and has a maximum temperature rise of 10°C in the first hour of use.

Functional models were built and tested at the Catharina Hospital in Eindhoven. Surgeons and nurses played a fundamental role in the evaluation of the final proposal. The principle solution can, with further development, be adapted to different surgical retractors.





PREVENTING SPILLAGE DURING TREATMENT OF HYDATID LIVER DISEASE: MEDICAL INSTRUMENT SET

Graduate: D. Epema. **Supervisors:** J.J. Jakimowicz, D. Vonck, L.H. Langeveld.
Partners: Karl Storz, Catharina Hospital Eindhoven, 2011.

This project was inspired by the idea of a Tunisian surgeon to close off liver cysts by means of a dome. A new instrument was needed to prevent spillage of cyst fluid because the existing instruments leaked. The project goal was to develop a proof of principle and a working model.

A hydatid cyst is often filled with fluid containing protoscolices (infectious miniature adult tapeworms) produced within the cyst. The risk of spillage of cyst fluid during treatment is ambiguous. First, secondary echinococcosis can occur as a result of spilled fluid, and scolices can develop into new cysts in the abdominal cavity or other organs. Second, spillage of hydatid cyst fluid can lead to an anaphylactic reaction, which is fatal if not treated promptly. Several techniques and instruments have been developed to prevent spillage of hydatid cyst fluid during treatment, but none of these are completely spillage free.

This project resulted in two working models, a dome and instrument. The dome can be attached to the liver with the special vacuum ring and creates a safe and closed workspace within the abdominal cavity. The instrument can puncture the cyst through the dome and safely aspirate the content of the cyst. A screw inside the tube prevents the tip of the instrument from becoming blocked by cyst flakes. Both tools were successfully tested.



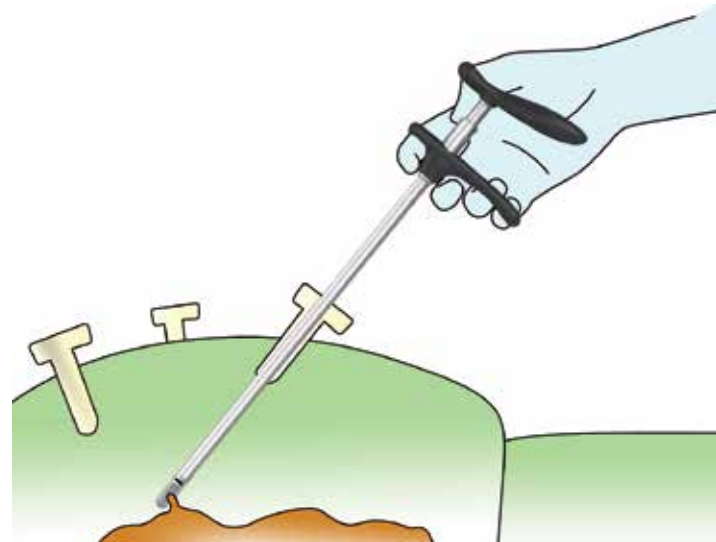
NEW HANDLE FOR A VACUUM GRASPER

Graduate: N. Nuri. Supervisors: R.H.M. Goossens, D. Vonck.
Partner: Karl Storz, 2010.

Laparoscopic graspers are used to grasp tissue in the abdominal area during laparoscopic surgery. These tools have sharp ends with notches that make it easier to grasp the tissue. These sharp ends are also the reason for many complications. The graspers can damage soft organs, which can result in perforation or infections. Vacuum technology offers a promising alternative for grasping bowel tissue.

This project is about the development of a new handle for a laparoscopic tool with vacuum function. The three main requirements for the new handle concerned ergonomics, intuitive use and ease of sterilisation. The final design works with a piston system to create the vacuum. When the surgeon triggers and releases the back handle piston, vacuum is created and the tissue is sucked into the nozzle. The surgeon is then able to manipulate the tissue until the next push. No force is required until the next grasp, providing temporary muscle relaxation for the surgeon. This is an improvement on the conventional graspers, which require surgeons to tense their muscles continuously.

A prototype was built to prove the working mechanism and run tests for evaluation. EMG tests and tests in the skills lab using animal tissue showed that the new product is an improvement over conventional graspers.



"SEEING IS BELIEVING": CAPTURING IMAGES OF AN OPEN OPERATION FOR OPERATIVE NOTES

Graduate: J.A.M. Maas. Supervisors: A. Freudenthal, L.S.G.L. Wauben.
Partner: Erasmus Medical Centre, 2010.

Colorectal anastomotic leakage is a post-operative complication that is extremely dangerous for the patient. One cause is poor quality of the surgical work. In this thesis, an electronic reporting system was developed to track visual indicators of quality and predict insufficiencies. The goal was to design a system that visually records critical moments during open surgery and supports surgeons when dealing with complications.

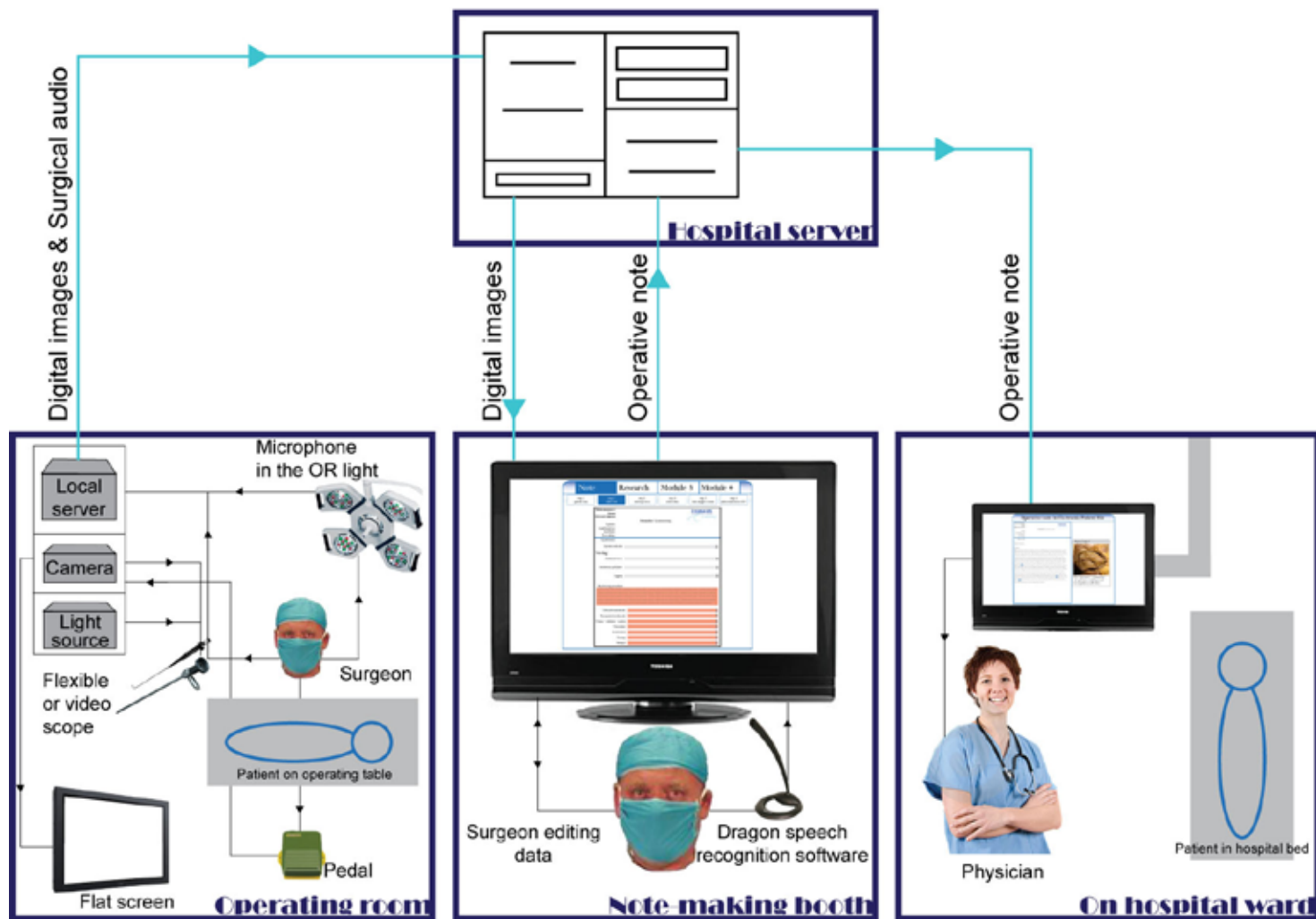
The design research included tests and observations in the dissecting room and OR, interviews with medical experts and literature study. The design focuses on workflow in the OR, colorectal resection, the electronic reporting system, the surgical camera market and legal issues. The design of the electronic reporting system uses per-operative images (i.e. photo or film) of critical events and audio comments. After an operation, a surgeon can add written text by using speech recognition software. The design includes a new camera scope for different operation situations, peripheral equipment, a local and main hospital server and 'DigiNote' (user interface software for ORs and post-operative wards). The new workflow was defined in a new method called 'WARM' together with the systems requirements.

The results suggest that it is possible to provide more per-operative information of the anastomosis in the electronic reporting system. Hospitals can further develop the system and new workflow using WARM.



flexible scope

video scope



SUTUREAID EQUIPMENT FOR CARDIOVASCULAR SURGERY

Graduate: C.M.N. van Nassau. **Supervisors:** A.J. Heidweiller, L.S.G.L. Wauben.
Partner: SutureAid, 2010.

The goal of this project was to design a SutureAid® product that is suitable for cardiac surgery, in particular coronary artery bypass graft surgery. The design had to fit within the current SutureAid® idea (patent), which is based on the invention of forceps with a soft tip. The soft tip, called a needle receptor, is placed on one arm of the forceps and can support tissue while it is being sutured. It also provides a location where the suture needle can be secured during suturing, which reduces the probability of needle damage.

The redesign has a spherical-shaped micro needle receptor that consists of an elastomer with a hardness of shore 30. The design was based on tests using elastomers with different degrees of hardness. The higher the hardness, the lower the force needed to insert the suture needle. The fixation of the suture needle in the receptor also needed to be taken into account. The angles for inserting the needle in the micro needle receptor were increased making it easier to pick up the suture needle. A final user test showed that the time needed to perform an anastomosis was reduced as a result of the improved repositioning of the suture needle from the forceps into the needle holder.



PRODUCT TO POSITION MONITORS ERGONOMICALLY FOR MINIMALLY INVASIVE SURGERY

Graduate: M.C. Hensbroek. **Supervisors:** R.H.M. Goossens, S.N. Buzink, J.J. Jakimowicz.

Partner: Catharina Hospital Eindhoven, 2010.

In integrated operating rooms (ORs) for laparoscopic surgery, monitors mounted on boom-arms provide the opportunity to create an ergonomic working environment. Unfortunately, there are no ergonomic guidelines yet for this new working environment and users are often unaware of the optimal monitor position and experience physical discomfort as a result.

This project formulated a set of ergonomic guidelines for integrated OR systems and designed a product to help users find the best monitor position for respective MIS procedures. A handheld tool was also developed that can be connected to the monitor. The tool displays the current and recommended location of the surgeon's eyes and the operating field and indicates whether these match.

A usability evaluation showed that the product is easy and straightforward to use. The monitor position was assessed by 10 different surgeons. They considered the vertical monitor position to be most ergonomic, but generally preferred a lesser degree of downward gaze than the ergonomic guidelines recommended. The product helps users to place monitors in an ergonomic position in the integrated OR and helps improve working conditions.



TROUBLESHOOTING IN THE OPERATING ROOM

Graduate: E.P.A. van Rossum. **Supervisor:** A. Albayrak, S.N. Buzink, J.J. Jakimowicz.
Partner: Catharina Hospital Eindhoven, 2011.

According to a report by the Dutch Healthcare Inspection (DHI), there are no universal norms or standards to assess the minimal performance of a surgical team, the equipment and the instrumentation. The DHI states that this lack of standards might be putting patient safety at risk. To improve patient safety in the operating room, risk factors need to be defined and solved according to a 'troubleshooting' protocol. Laparoscopic surgery was researched as the context for this assignment. The risk factors were analysed and a potential design was defined for a troubleshooting tool.

The assignment was carried out in close cooperation with the Catharina Hospital Eindhoven (CHE). The CHE operating rooms are equipped with the Karl Storz OR1™ system, enabling the user to control all equipment from one workstation. However, this system is not used to its full potential, mainly because surgical teams lack basic system knowledge.

To ensure a minimal level of basic system knowledge, a support tool was developed in the form of a wheel chart that provides the user with information on four basic procedures. The 'Technical Equipment Troubleshooting' tool is integrated in the OR1™ and provides support for technical and surgical problems. User tests showed that both tools are felt to provide added value. Recommendations were provided for further development.



REALISTIC ANATOMICAL MODEL FOR TRAINING IN LAPAROSCOPIC BILE DUCT EXPLORATION

Graduate: P. Driessen. **Supervisors:** R.H.M. Goossens, J.J. Jakimowicz.
Partner: Catharina Hospital Eindhoven, 2011.

Laparoscopic bile duct exploration is a minimally invasive procedure for the removal of bile duct stones in the biliary tract. These stones can cause obstruction, resulting in pain and disruption in food digestion. The procedure requires advanced skills in laparoscopy. Procedural training is currently performed on animal tissue models. This project developed an anatomically correct physical model for training with surgical simulators. A key aspect is the mimicking of human tissue in terms of look and feel.

The proposed training model was built with elastic materials and consists of an anatomical landscape of the human abdominal area that can be used repeatedly and a disposable biliary tract. Tests were conducted in cooperation with a number of surgeons to determine the best composition and thickness for the structures. These were then specified by way of an iterative design process.

A first prototype was evaluated by 27 experienced surgeons. Overall, they were enthusiastic and assessed the prototype as a good training modality for laparoscopic bile duct exploration. This model enables realistic and repeated training, at low costs and with real surgical instruments. A second series of a more advanced model was built based on the evaluation results and is now in development.

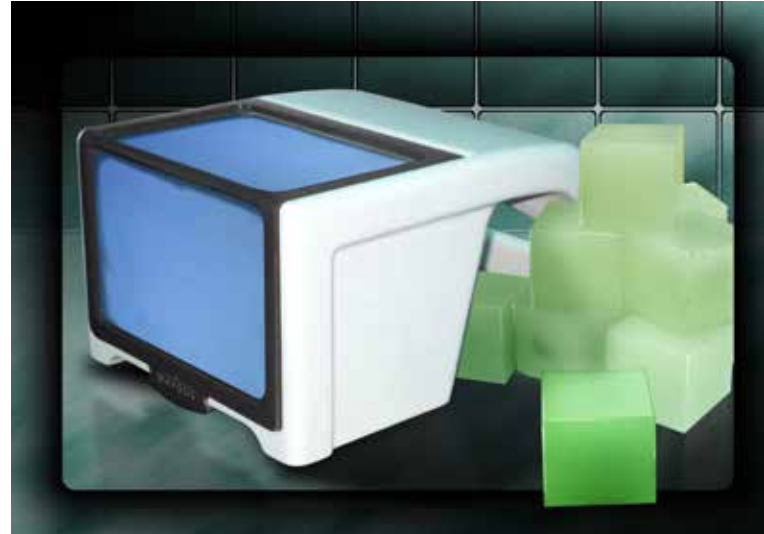


TRAINING TOOL FOR ULTRASOUND-GUIDED REGIONAL ANAESTHESIA

Graduate: K. Terra. **Supervisors:** R.H.M. Goossens, Z. Rusak.
Partner: Mavous, 2009.

In the last few years, there have been a number of new developments in the field of regional anaesthesia. The urge for higher accuracy for injections and more precision in the doses of anaesthetics started the search for new and improved techniques. One promising new method is ultrasound-guided needle piercing. Existing ultrasound technology enables the anaesthesiologist to visualise the needle inside the human body. Along with the visualisation of the nerve, the relation between the needle tip and the nerve's position can also be monitored in real time. Even the dispersion of the anaesthetic can be checked. The use of ultrasound in the described application causes a number of difficulties such as bimanual manipulation of different tools and representation of a 3D volume on a 2D gray scale image.

The goal of this project was to design an accessible training product for pre-clinical hands-on experience in ultrasound-guided regional anaesthesia (UGRA). The 'WhiteLine' makes it possible to assemble the phantom on the spot by using different independent cubical components. The WhiteLine is an abstraction of reality with the cubes forming a body that represents the muscle tissue. Small details are left out to allow a better focus on the first aspects in training UGRA. The targets represent the nerves or veins. The ultrasound makes it possible to visualise both the targets and the needle and to train for operations.









DESIGN FOR REHABILITATION

SMART-TIP: INTERACTIVE ADD-ON DEVICE THAT MONITORS REHABILITATION WITH CRUTCHES

Graduate: M. Geels. **Supervisors:** R.H.M. Goossens, M.H. Sonneveld.
Partner: Erasmus Medical Centre, 2010.

Although the recovery of temporary injuries is a dynamic process, the present walking aids are limited in functionality. It is up to the patients' gut feelings and verbal feedback from therapists to determine what amount of partial weight patients should put on an injured leg. This project aimed to design a new tool for the therapist. A potential design solution was a walking aid that informs users and adapts to different phases of the recovery process. The 'Smart Tip' can monitor weight-bearing activity on the leg and is adjustable in compliancy. The device gives immediate feedback to the patient and provides data for therapists about everyday physical activities. This gives the therapist the opportunity to adapt the settings to changes in the treatment. A functional prototype was tested by participants. The prototype was connected to a laptop to store data and activate feedback. A number of improvements were made based on the user research. Further research is needed about the effect on the patient's body and rehabilitation.



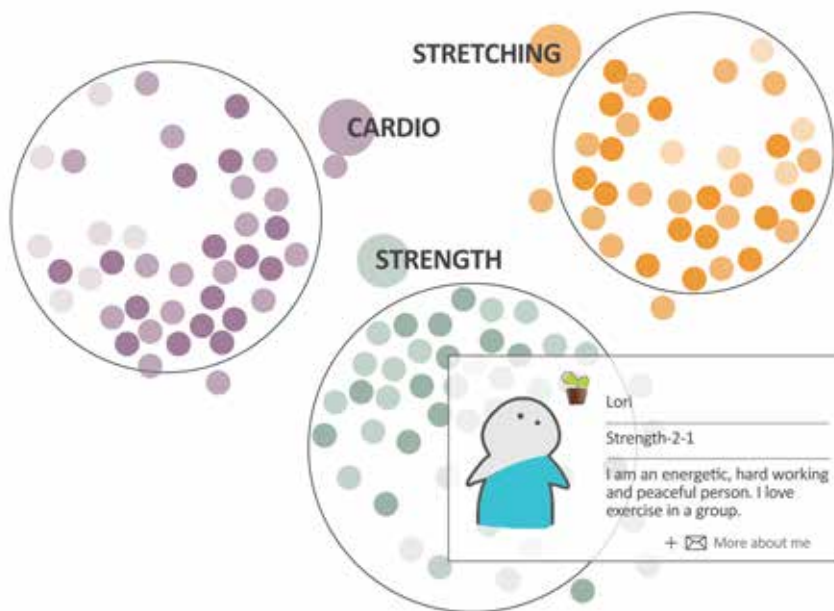
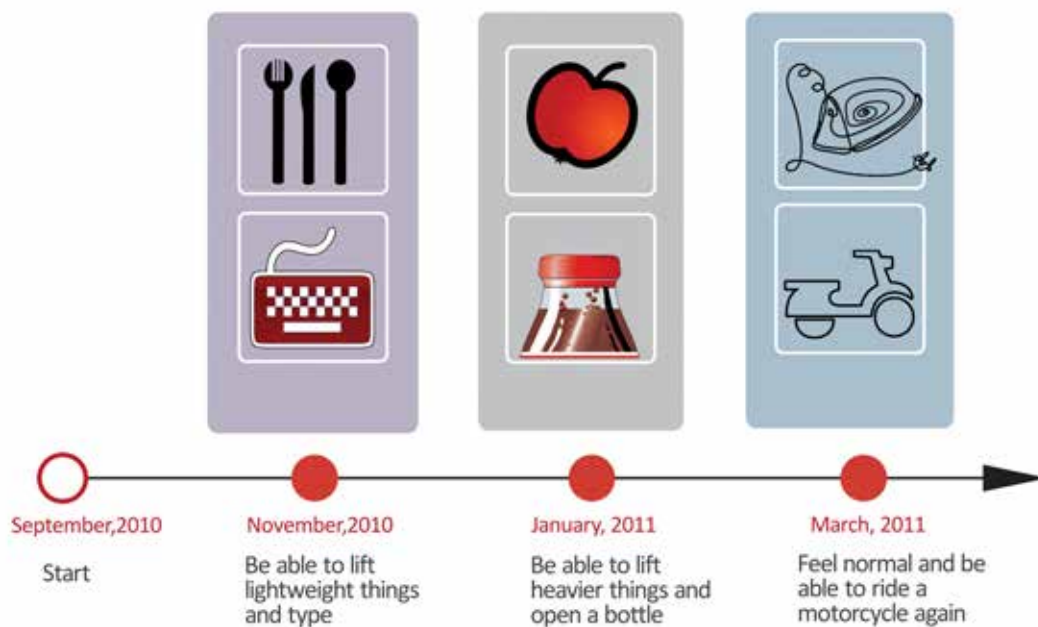
Graduate: R. Cheng. **Supervisors:** K. Lauche, P.S. Bayerl.
Partner: Brevidius Crossmedia Projecten, 2010.

A lack of compliance to exercise is a widespread and recurring problem in the treatment of diseases. One of the main reasons patients lose the motivation to exercise is a lack of peer support and low self-efficacy. Online interventions have been discussed as a possible solution for these problems. This research project developed guidelines for the development of a virtual exercise community as a platform for internet-based interventions in combination with traditional health care.

A diary study (also called 'culture probes') and interviews with 12 patients and two physiotherapists captured experiences with and attitudes towards daily exercise and online exercise. This qualitative phase provided insights into possible reasons for non-compliance and expectations for online exercise communities. A usability study of the existing online exercise system investigated the feasibility of virtual communities for improved exercise compliance.

This thesis provides design guidelines for developing multifunctional online physiotherapy communities to increase exercise compliance, including online peer support and live coaching of physiotherapists. This thesis further outlines supporting factors and barriers for users and potential users of the online exercise platforms as well as strategies to address the barriers. The anticipated benefits of the online physiotherapy community included enhanced consistency and reinforcement of exercise as well as time savings and reduced work load for health professionals.





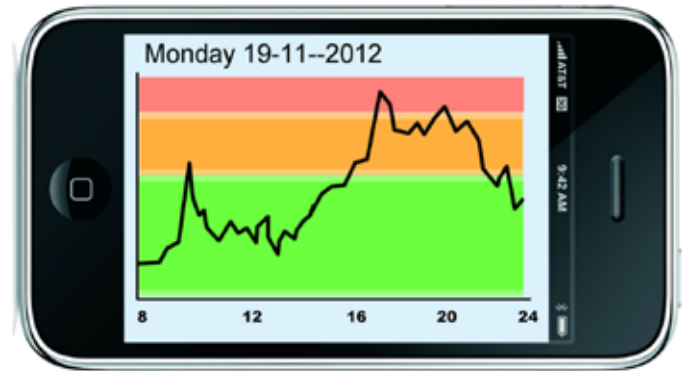
DEVICE TO SUPPORT TRAUMA PATIENTS DURING THE REHABILITATION FROM AN UNSTABLE SPINAL FRACTURE

Graduate: L.A. Bohlander. **Supervisors:** C.C.M. Moes, A. Albayrak, H. Anderiesen.
Partners: University Medical Centre Utrecht, Evalan, 2011.

Nowadays, when someone is diagnosed with a traumatic unstable spinal fracture, the spine is surgically stabilised and the patient is required to wear a corset brace for 8 to 12 weeks. These corset braces are highly uncomfortable and restrict almost all movement. The corset brace, however, is only intended to limit certain movements of the back. One of the main conclusions from preliminary user research on the brace was insecurity. Patients and their relatives indicated that they were not sure how much they are allowed to do with and without the corset brace.

This project aimed to design a comfortable and wearable device that monitors spinal movements and provides immediate feedback by warning the patient if they make a possible harmful movement. It also transfers the data to the medical staff so they can adjust the rehabilitation programme.

The new product consists of four parts: a shirt, two sensor modules, a wristband and a docking station. The project focused on the development of the wristband and shirt with the sensor modules. The two main functions of the product are to provide feedback and telemonitor the patient's progress. Direct feedback is provided in real time on the display of the wristband and by means of a vibration signal in the lower part of the sensor module. This feedback can also be consulted online at any time by both patient and doctor.



KJOEPIE!: TRIGGER AND REWARD CHILDREN WITH CEREBRAL PALSY

Graduate: R.T. Paulissen. **Supervisors:** M.H. Sonneveld, J.F.M. Molenbroek.

Partner: Sint Maartenskliniek, 2011.

Cerebral palsy (CP) is a physical disorder that affects the development of movement and posture, causing activity limitations. It is the most common physical disability in childhood with an incidence of 2-2.5 per 1000 live born children in Western countries. The Sint Maartenskliniek offers an intervention therapy for children inflicted with limited arm function (hemiparesis) as a result of CP at a young age. The children do not naturally use the affected arm in their daily activities, which counteracts the development of the arm and can even increase their disability.

'Kjoepie!' is a product for the home context that stimulates children to use their affected hand in daily activities and play. Over time, the product should help make it more natural for the children to use both of their hands in their activities. Kjoepie! is a package of products. It consists of a tactile cue (vibration bracelet and portable sensors), a visual cue (activity pictograms) and a reflective reward system (reward boards, reward cards and treasure chest). The sensory cues are placed in the child's surroundings to trigger the use of the hand for daily activities like opening doors and eating dinner. The reflective reward follows after the child performs the activity.

The product elements can be used and combined in a variety of ways. Therapists can, in consultation with parents, set up a customised programme to match a child's abilities and personality.



REHABILITATION PRODUCT FOR POST-STROKE PATIENTS

Graduate: O.G.W. Klaas. **Supervisors:** A. Albayrak, M. Melles.
Partner: Philips, 2012.

Many post-stroke patients suffer from one-sided disability and lose the ability to perform everyday tasks with one of their hands and arms. The assignment in this project for Philips Research Asia was to develop an affordable rehabilitation device for the Chinese market that stimulates post-stroke patients to use the motor skills they learn during in-patient rehabilitation in the context of their own home.

Most existing stroke rehabilitation devices are developed around conventional rehabilitation principles that only target the muscles. However, recent major breakthroughs in neurological research have led to new rehabilitation methods that focus on how the brain relearns tasks. These new insights were used to develop a two-part system consisting of a software package called 'Quester' and a ring. Quester allows the user to choose the tasks they want to practice (e.g. lifting a cup or combing hair), shows progress and guides patients towards their goals to learn more advanced tasks. The ring is a wearable device that reminds the user what tasks were selected and allows the user to log them.

A functional prototype of the new design was evaluated in a small-scale user test by Chinese post-stroke patients and yielded promising first results.





ASSESSING THE DRIVING CAPABILITIES OF POST-OPERATIVE ORTHOPAEDIC PATIENTS

Graduate: S.Y. Stolp. Supervisors: C.C.M. Moes, S.G. van de Geer.
Partner: Vlietland Hospital, 2012.

Patients recovering from joint replacement surgery of the lower extremity (hip or knee arthroplasty) often feel uncertain about the functionality of their hip or knee and require expensive and time-consuming instructions from professionals. Driving is one of the most frequently mentioned issues. Medical professionals want to help but lack the means of assessing their patients' fitness for driving.

A set of four orthopaedic training devices was designed to offer a solution. The 'Orto-Car' was designed for use at the hospital to set benchmarks for getting in and out of a car soon after surgery and to validate driving skills at a later rehabilitation stage. The 'Ranger-Hip' monitors the angle of the hip and warns patients when they risk dislocating the joint. The 'Pedal-Box' trains force exertion and reaction time and the 'Ranger-Knee' helps patients with a knee prosthesis to improve the range of motion in the knee joint and prevent tissue scarring.

The validation of their restored capabilities will help patients regain confidence in conducting daily activities. Once the devices have been implemented at the hospital, guidelines could be developed to help orthopaedic surgeons assess patients' driving capabilities and provide patients with well-founded advice.

Prototypes were developed of the various designs and evaluated.



REHABILITATION DEVICE FOR POWER PLATE

Graduate: M. Marass. Supervisors: R.H.M. Goossens, A.L.M. Minnoye.
Partner: Power Plate, 2011.

Vibrating plates are commonly used for training purposes. People with a disability, however, who might benefit a lot from such type of training, are often not able to use such devices. A new device helping in positioning spinal cord injured patients was designed for Power Plate, a leading company in vibrating devices. The product needed to be an accessory for current vibrating devices and facilitate the positioning of disabled users by means of body weight compensation.

The project started with a research on vibration training benefits and observing users in attempts to use the Power Plate. Several concepts were generated in order to solve what was identified as the key problem: how to provide support to the user in reaching a standing position.

Both mechanical and electrical solutions were proposed. The preference was a purely mechanical principle based on the spring lever mechanism, partly because it improved patent possibilities. The chosen solution is based on two spring balancing systems, which compensate a predetermined mass (body weight portion) at every height. This way the user can easily stand up because he feels less weight on his legs.

During the embodiment phase a mathematical model, a virtual model and a physical model were developed. The physical model was tested by users with and without a disability to validate the working principle and identify future steps for the design process.



PUSH ACL II: OPTIMISED FOR THE POST-OPERATIVE MARKET

Graduate: I.E. Boonekamp. **Supervisors:** I.A. Ruiter, E.W. Thomassen.
Partner: Nea International, 2010.

Knee braces are used to stabilise the knee joint in patients with damaged anterior cruciate ligaments. NEA has developed a knee brace, the 'Push ACL', for long-term use. This brace needed to be optimised for the post-operative market. The aims were to increase comfort, make it easier to put the brace on and adapt the brace dimensions to those of the patient's knee and reduce the price of the brace.

The knee joint both rolls and slides during motion. A brace hinge with a slide mechanism has been developed that enables the knee to move naturally. A leaf spring provides the required lateral support while the tibia is supported to relieve the anterior cruciate ligament. The slide mechanism compensates for itself when the brace is worn too high or too low and eliminates friction between the brace and the skin. The brace's functional frame has been integrated with the required compression stocking. The process of putting on and removing the brace has been improved by adding openings at the front of the leg. Tests conducted with the prototype showed that the brace can easily be adjusted, is easy to put on and comfortable to wear. The costs of the brace are also reduced.



REMOTE MONITORING TO SUPPORT HEALTH CARE: APPLICATION TO MEASURE HUMAN BACK MOVEMENT

Graduate: R.J.G. Boon. **Supervisors:** C.C.M. Moess, E.J.J. van Breemen.
Partner: Evalan, 2010.

The 'Remote Monitoring Navale Application' (RMNA) was designed as part of Evalan's 'Remote Monitoring System'. It is capable of monitoring a patient's back movements and providing feedback which can be used to support patient care. The initial target group of the RMNA consisted of patients receiving treatment from a physiotherapist after spinal disc hernia surgery.

The design of the RMNA comprises of a tight fitting garment with six flexible stretch sensors that can be worn under clothes and that assesses back movements by measuring the elongation of the skin caused by the movements. The garment is developed to transfer the elongation of the skin to the attached sensors while maintaining a high level of comfort. The optimal location for these sensors was researched by conducting multiple tests with a prototype and by reviewing results of a finite element analysis conducted by Mattmann (2008) of strain patterns on the back during movements.

The RMNA design was evaluated by testing the performance of the prototype. The performance was defined as the ability to classify movements correctly and to measure the deflection of the movement accurately. The results of this test show that the RMNA scores almost perfectly without clothes (classification 100% and deflection 95%) and a little less accurately with clothes on top (classification and deflection 73%).





DESIGN FOR MEDICATION



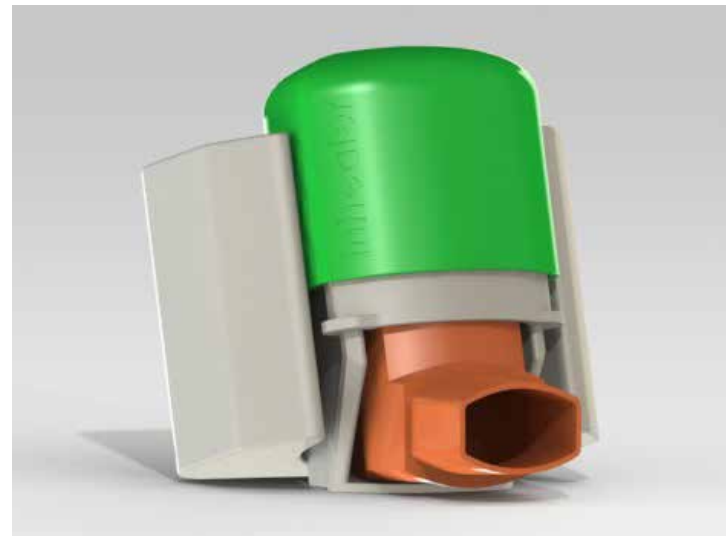
INHEALER: SUPPORTING SELF-MANAGEMENT IN PATIENTS WITH SEVERE LUNG CONDITIONS USING E-HEALTH

Graduate: A. Greijdanus. Supervisors: C.C.M. Moes, R.H.M. Goossens.
Partner: Evalan, 2011.

Most deaths related to chronic obstructive pulmonary disease (COPD) occur due to severe and acute exacerbations. The incidence of these exacerbations can be controlled with medications. However, many patients are not compliant with their treatment regimen. The goal of this project was to examine e-health possibilities to improve compliance to COPD therapy.

The 'Inhealer' is a product-service system that strives to change the patient's behaviour by providing them with insight into their lung condition and a personal action plan. It consists of an add-on that can be attached to dose aerosol inhalers (puffers) and a smartphone application. The add-on registers the medication use, for example, the release of a dose or use of a spacer. The smartphone application presents the medication use in an overview together with the patient's symptoms, which the patient monitors by completing four diary questions each day (based on the Anthonisen symptom diary-card algorithm). A customised action plan is also presented to stimulate patients to be more proactive.

Collected insights are shared with health care professionals who are able to telemonitor patients and intervene in treatment procedures when needed.



INCREASING MEDICATION ADHERENCE BY SUPPORTING SELF-MANAGEMENT

Graduate: F.P. Chan. Supervisors: A.P.O.S. Vermeeren, V.T. Visch.
Partner: Logica Nederland BV, 2012.

Improper use of medication causes about 6% of all hospitalisations in the Netherlands. 46% of these hospitalisations (19,000) can be avoided.

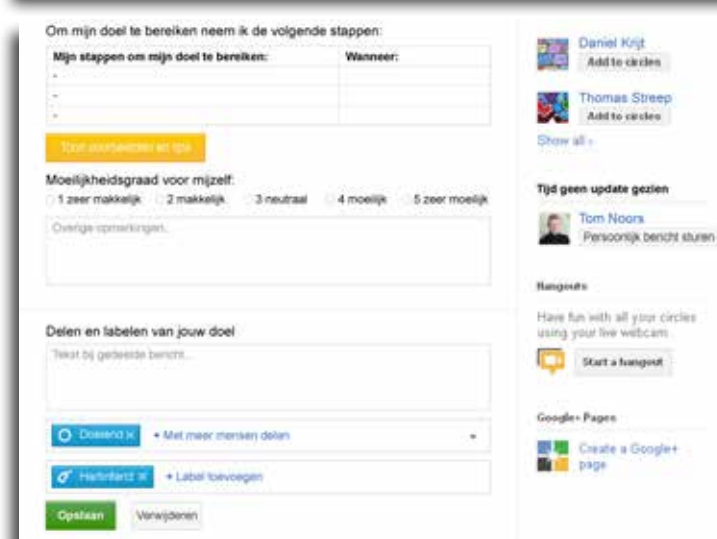
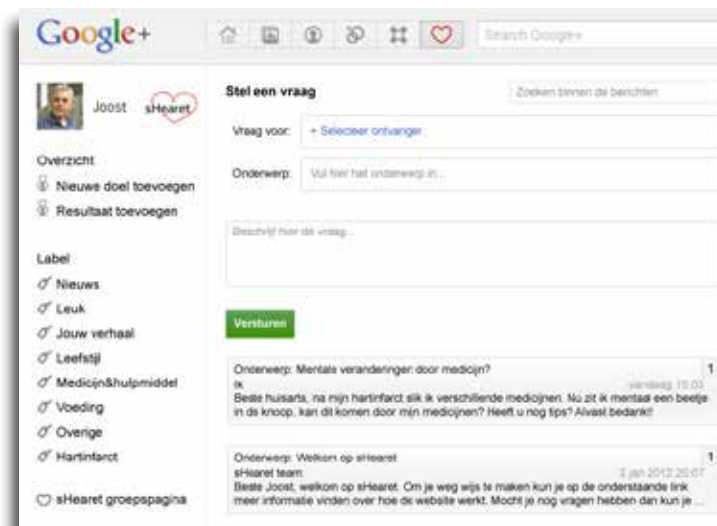
This project consisted of three phases: 1) identifying the problems regarding medication adherence, 2) designing the 'sHearet' tool and 3) evaluating the tool.

In the first phase, the current patient and health care contexts were studied by means of questionnaires and interviews. The results showed that patients appreciate personal contact, information and the feeling of being understood, and that social support could be effective for changing behaviour.

A design vision was developed based on these findings to create health awareness and stimulate better medication adherence through social networking with fellow patients.

In the second phase, the sHearet tool, a Google Plus feature, was developed. The sHearet allows users to define personal goals and report progress in goal achievement, find and read shared messages, contact experts or professionals from the sHearet help desk, chat with fellow patients and add fellow patients to a patient circle.

The expected effectiveness, usability and feasibility of the sHearet was evaluated by five patients, three health care professionals and three Google Plus users. It was concluded that the sHearet would be useful especially during rehabilitation periods. The sHearet fits into Google Plus in terms of look and feel. Implementation seems feasible.



INCREASING TREATMENT COMPLIANCE FOR A NEW ALCOHOL DEPENDENCE DRUG: A PERSONAL ONLINE TOOL

Graduate: H. van den Bos. **Supervisors:** R.H.M. Goossens, J. Blijlevens.
Partner: Schering-Plough, 2009.

Schering-Plough, a multinational pharmaceutical manufacturer, develops medication for treatment of psychiatric disorders. Medication compliance is important and necessary for successful treatment and requires extra attention when developing new medication. A new medication is currently being produced for alcohol addiction and Schering-Plough wants to increase patient compliance to this new drug by offering a personal online tool.

For this purpose, interviews and focus group sessions were held with professionals, patients, patient groups and relatives. The insights from this research have resulted in a personal online tool, the 'HelpmeHelpyou'. This tool will be provided together with the medication and can be accessed via the website using a unique login account. This tool offers information about the treatment, illness and related complaints and gives digital instructions on the medication. It reminds patients to take their medication and monitors the medication intake and progress of the treatment. A digital personal coach is included to guide the patient through the website and the treatment process.

An interactive concept was built and this was tested by users. The results of this user research show that patients experience the tool as a welcome tool to help them take their medication. The tool in its current design can be extended with other options like a community so that patients can get in touch with others and share experiences.



Graduate: A. Voeselek. **Supervisors:** A.M. de Jong, R. Wever.
Partner: Groupe Danone, 2010.

Sarcopenia is the loss of muscle mass and strength, resulting in immobility and frailty. Danone has recently developed a new powder-based shake to help prevent sarcopenia. The product is targeted to pre-frail to frail elderly people who still live independently. The assignment was to design a new packaging for this product fitting the abilities of the target group.

First, a usability test was conducted with elderly people to learn which usability problems occur with the current powder packaging solutions. The test looked at can and sachet packaging formats, both used for medical nutrition, and the eazypack, currently used for baby nutrition. It also assessed the preparation methods stirring and shaking, the latter of which was also used in the clinical trial. The test focused on three aspects: opening, dosage and preparation.

According to the elderly participants, dosing is easier with a sachet than with a scoop (in cans or eazypacks). In contrast to expectations, these participants reported that shaking was a more comfortable preparation method. The usability test and the analysis resulted in a list of requirements for the development of a 'starter kit': a box with a shaker and four sachets.

A series of diverging and converging paths were used to develop two concepts for a shaker and three for a single serve sachet. These concepts were tested in a second usability test, which resulted in the final design of primary and secondary packaging and a shaker.





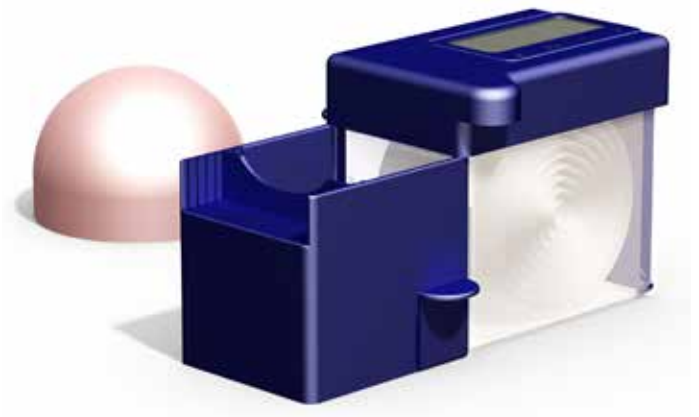
MEDI-MANAGER AND MEDI-MARKER: SAFE AND CONVENIENT MEDICATION USE

Graduate: L.J.L.M. van der Kaaij. **Supervisors:** G. Gemser, A. Albayrak.
Partner: Logimedical BV, 2011.

Medication safety at home is gaining more attention as more elderly patients are developing chronic diseases and taking multiple medicines. A 2010 study by the Dutch Health Care Inspectorate (IGZ) showed that at least 16,000 hospital admissions each year are caused by avoidable medication errors. NIVEL found that 40% to 70% of these patients are more or less not compliant with their pharmacotherapy. Patients are already supported in their therapy compliance by medication rolls in which different pills are packaged in a pouch. However, literature and user research has shown that users had trouble opening the pouches and remembering administration times and medication that was not stored in the pouches.

The 'Medi-Manager' and 'Medi-Marker' were developed based on these findings. The Medi-Manager consists of a manual pouch cutting system and a pill catcher. The dispenser can be extended with a display presenting the administration schedule, which is connected to the Medi-Marker through a wireless connector. The Medi-Marker is a reminder alarm for the administration time. It is based on coloured light and sound and can be placed in different locations in the house.

This project developed a working prototype of Medi-Manager and a 3D simulation of Medi-Marker, which were evaluated positively with different stakeholders.









DESIGN FOR MENTAL HEALTH



PROJECT SENSORY ROOM: FROM ISOLATION TO INTERACTION

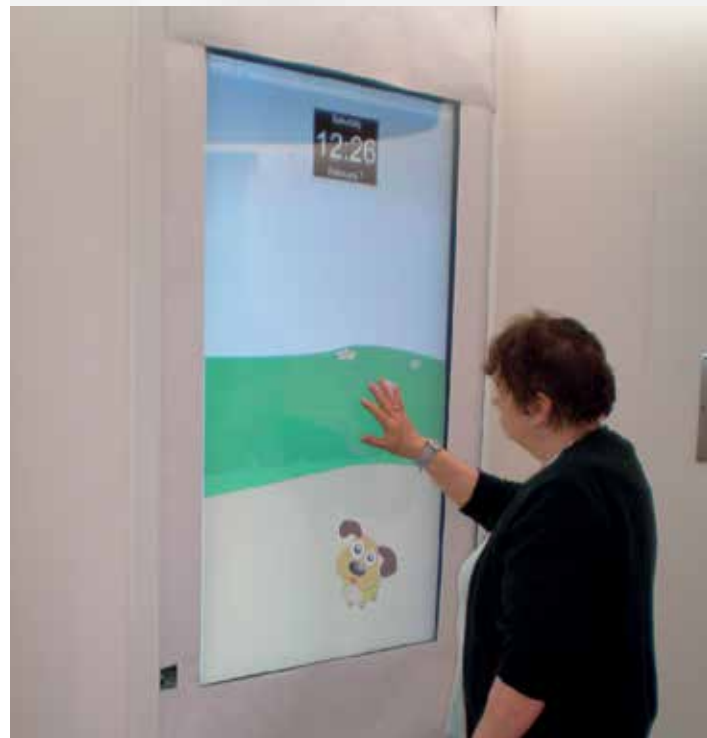
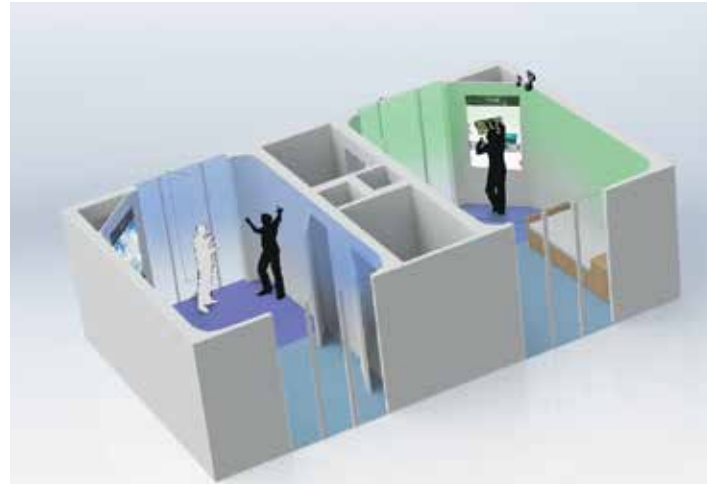
Graduate: W.L. Li. **Supervisors:** M. Melles, P.M.A. Desmet.

Partners: Philips, GGZ Eindhoven, 2012.

Isolation cells are used in psychiatry to isolate patients when they become emotionally unstable and a danger to themselves or their environment. The purpose of these low stimulus cells is to give the psychotic mind peace. In practice, however, patients often suffer from trauma after seclusion. Many patients describe the experience as inhumane and say it causes feelings of humiliation, loneliness and anxiety. As part of 'Project Sensory Rooms', a collaboration between Philips and the Dutch mental health-care organisation Geestelijke Gezondheidszorg Eindhoven, alternatives for the current isolation cell were developed that reduce the negative impact caused by seclusion.

An interactive wall was developed for the new sensory room to support the patient during seclusion and provide an improved sense of control. The wall offers the patient a number of features with different levels of interactivity: nature videos, a drawing program, a personal picture wall, a digital pet dog, video call options, a radio and ambient lighting. Which features are enabled depends on the patient's condition. Intuitive gestures are used to control the user interface.

A working prototype was developed and assessed positively by patients with a psychotic disorder.



PRODUCT FOR PATIENTS WITH PANIC DISORDERS TO FACILITATE POSITIVE MEMORY RETRIEVAL

Graduate: L. Smits. Supervisors: V.T. Visch, M. Melles.

Partner: PsyQ, 2012.

Patients with panic disorders often suffer from low self-esteem. Competitive memory training (COMET) is a therapy aimed at increasing the patient's self-esteem by restoring the balance between the retrieval of negative and positive memories. The patient is asked to recall a positive autobiographical memory and is then trained to retrieve this memory, which is referred to as a 'control theme', whenever they feel the onset of a panic attack. This project focused on how to support the retrieval of this control theme by means of a product design.

Categorising various control themes made it clear that most patients select a memory that relates to relaxation and nature. For this reason, grass was chosen as a cue to facilitate positive memory retrieval. Experiments were then conducted to study the influence of sensory stimuli on memory retrieval. Twenty panic disorder patients experienced the olfactory, tactile or visual trigger of grass and were then asked to recount a personal experience. The tactile stimulus delivered the best results with regard to the valence and vividness of the retrieved memory.

Based on these experiments, the 'Rookie' was designed, a piece of bedroom furniture covered with grass. When placed next to the bed, the user can touch the grass while lying in bed. Panic disorder patients often have problems falling asleep or they wake up in the middle of the night with increased bodily arousal. The Rookie can help them during those moments to retrieve their control theme.





SMART INFLATABLE VEST FOR CHILDREN WITH SENSORY PROCESSING DISORDER

Graduate: J.E. Maes. **Supervisors:** I. Horváth, B. de Smit.

Partner: Internal research project, 2012.

Children with sensory processing disorder (SPD) experience neurological difficulties when processing incoming sensory signals. This disorder makes them oversensitive to sensory input, leading to social, communication and educational problems in stressful situations.

The idea of this project was to reduce the intensity of the experienced stress by means of a wearable appliance. The target group was children aged between 8 and 14 years. The solution combined the principle of Deep Pressure Therapy with sensor and actuator technology into a smart system that recognises stressful situations, applies pressure to remove stress symptoms and evaluates and adapts the treatment to the user. The solution uses heart rate and respiration rate sensors to determine when the child experiences stress.

A prototype was constructed using an inflatable vest and a sweatshirt containing a pump, a microcontroller and electronics that connect the different elements of the system. The vest inflates when heart rate and respiration rate increase during a stressful situation. This inflation provides deep pressure to the upper body and influences the signal processing in the brain.

Usability tests showed that the automatic application of deep pressure during stressful moments has a positive effect on the behaviour and attention regulation of children with SPD. A functionality test of the prototype showed the need for more accurate heart and respiration rate sensors and long-term testing.



IMPLICATION DESIGN: CHANGING BEHAVIOR AND EMOTIONAL WELL-BEING FOR PEOPLE DIAGNOSED WITH DISRUPTIVE BEHAVIOR DISORDERS

Graduate: A.W.C. Bruil. Supervisors: V.T. Visch, N. Tromp.
Partner: Fjord, 2011.

Reactive visible aggression is a problem for society. It is costly and generates feelings of unsafety. People with disruptive behaviour disorder are often a burden to themselves and the people around them. This project aimed to contribute to changing aggressive behaviour and emotional well-being of young people being treated at Fjord. 'Beat-it' uses embodied emotion interaction, game play and music to emotionally and physically calm users down. Beat-it applies emotion regulation strategies such as acceptance, distraction and reappraisal in order to help users control negative emotions and prevent aggressive outbursts. Beat-it is a smartphone application that asks users to express their emotion by shaking their phone. Based on the intensity of the movement, Beat-it plays a song that matches the user's emotion. If the song fits the emotion, the user starts a game by placing the phone on their heart, indicating that they accept the song and thus implicitly also the emotion. The challenge of the game is to swing the phone according to the beat. The game distracts and calms users down. Afterwards, the young person can save their score and listen to their favourite song. Beat-it proved to be a beneficial and pleasant tool for Fjord employees. The concept calmed users down and positively influenced their emotions.



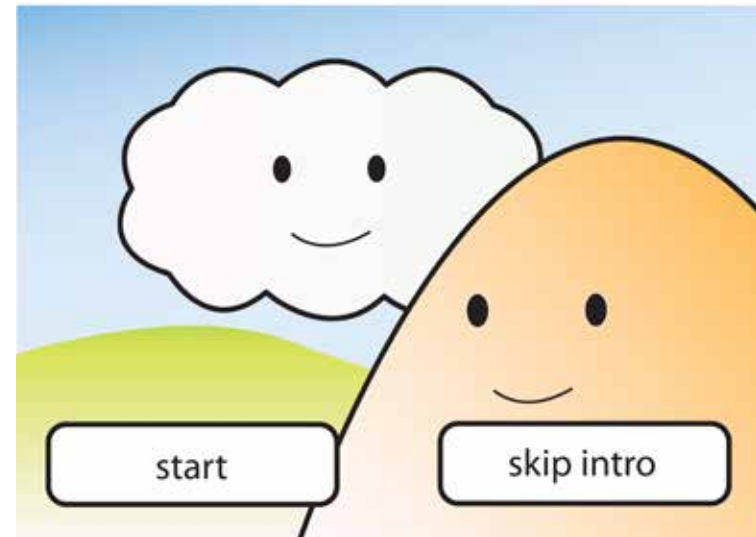
GAME FOR ONLINE BURNOUT THERAPY

Graduate: D.L. van den Brule. **Supervisors:** V.T. Visch, M. Melles.
Partner: Interapy, 2011.

Interapy, a psycho-therapeutic institution that offers online burnout therapy, wanted to extend their current text-based treatment with a game-based intervention to increase patients' engagement with their therapy. After an analysis of Interapy's protocol and user research, it was decided to focus on improving patients' confidence in dealing with others.

The game-based intervention consists of four levels, progressing from an abstract level to a more concrete and realistic level. During the first level, patients match negative thoughts with positive alternatives. During the second level, patients earn points by shooting negative thoughts away with the best counter arguments. The patients are sensitised with these thoughts and when they reach the third level they place the thoughts in a work-related animated scenario. During the dialogue, thoughts pop up and patients decide whether these thoughts are positive or negative. The last level is a virtual behavioural experiment, where patients practise a conversation with an actor representing their manager. Their response is recorded, which gives the patients the opportunity to review their response and evaluate it. After the game, patients can decide if they want to share the recording with their therapist in order to receive feedback.

The concept was evaluated by therapists and patients. Their overall impression was highly positive. Both groups expected the game to stimulate patients to participate in a behavioural experiment and to increase patients' confidence.



A LITTLE LESS STRESS...: STRESS MONITOR FOR EMPLOYEES WITH AUTISM

Graduate: J. van Hoevelaak. **Supervisors:** H.H.C.M. Christiaans, H. van Rijn.
Partner: Waag Society, 2010.

It is often difficult for people with autism spectrum disorder (ASD) to find a job and stay employed. Often a person with ASD is capable of performing professional activities, but also encounters problems within social contexts, for example, disturbed social interaction, misunderstandings and reduced empathy. All these aspects cause stress.

This graduation project designed a stress monitor for employees with autism with the aim of stimulating job participation. The stress monitor aims to raise awareness and help the user to deal with stress. After exploring the technical possibilities to measure stress, heart rhythm variability (HRV) was found to be the most reliable indicator of stress. Integrating an electret microphone into a wrist watch was proposed as a solution to measure HRV in a non-stigmatising way. HRV is used to measure the user's level of stress and the user is informed by the 'Pebble' if high levels of stress are found.

The pebble is a stone-shaped object that attracts the user's attention by vibrating and informs the user about the level of stress by means of different coloured lights. It also provides the user with a breathing pattern to help them relax in times of stress.

The stress data is recorded and can be accessed via a website. Most people with autism have a job coach and have regular sessions with this coach. The stress data can be used during these sessions to identify and reflect on problems.



BEADED: EMOTION-BASED PRODUCT TO IMPROVE QUALITY OF LIFE FOR CANCER PATIENTS

Graduate: M.J.M. de Wit. **Supervisors:** M. Melles, V.T. Visch.
Partner: Internal research project, 2010.

Fatigue is one of the most common side effects of cancer treatment and can persist for months or even years after treatment. An important difference between fatigue after cancer and regular fatigue is that the level of fatigue experienced by breast cancer survivors is not in proportion to the performed activity and cannot be objectively measured. Fatigue can only be assessed subjectively and communicated by the cancer survivor.

The proposed emotion-based product developed during this project connects to this subjective approach of energy management. The product contains a number of beads that represent different activities. By wiring the beads on a string, the user assesses the expected energy flow during their activities throughout the day. Evaluating their activities by means of an application, helps the patient to learn to manage their energy and gain insight into when fatigue occurs.

Breast cancer patients and survivors were involved in different studies to collect insights into their experiences and contexts. These insights helped to design an appropriate emotion-based product.





THERAPY INTERVENTION FOR DRUG ADDICTED YOUTH: THE TOTEM POLE

Graduate: N.T.L. Dinh. **Supervisors:** M.H. Sonneveld, V.T. Visch.
Partners: Brijder Verslavingszorg, Parnassia Bavo Groep, 2011.

The 'Totem Pole' is a therapy intervention that aims to increase therapy adherence among young people with a drug addiction. One of the product requirements was that it be based on tangible interaction driven by a game element.

The Totem Pole embodies five user activities. Some of these activities are for individual therapy and others are for group sessions. First the client is given a wooden box and is instructed to create a personal avatar that has supernatural powers and represents who they are or wish to be. The wooden box is then placed inside the pole. At the start of a new therapy phase, the client is instructed to define and then add 'power objects' that empower the avatar and represent their personal motivation to follow the therapy.

When a client wants to talk about a topic during a group session, they are instructed to first express this topic and the emotions it evokes in a piece of clay, which is then placed inside the client's personal avatar box. The box is taken out of the Totem Pole during the therapy session and the piece of clay is used to support communication. The client closes the subject by adding a small piece of the clay to the group totem. Over time, the members of the therapy group build a group totem together.









DESIGN FOR THE PHYSICALLY CHALLENGED



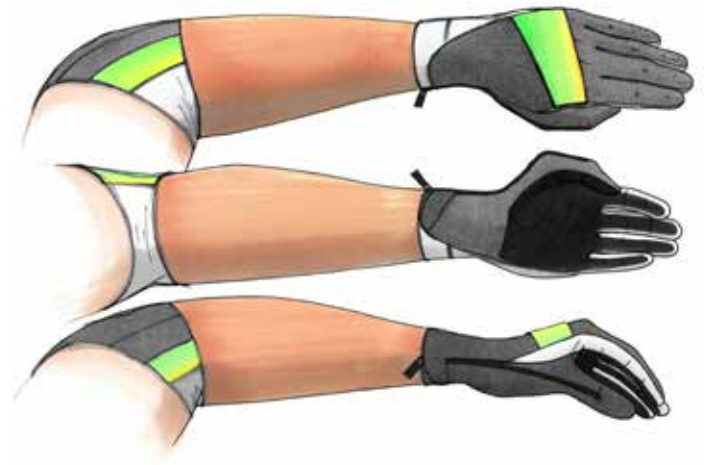
ARMWEAR: COOL PROSTHETICS

Graduate: M.A. Geurts. **Supervisors:** J.F.M. Molenbroek, P.M.A. Desmet.
Partner: Delft Institute of Prosthetics and Orthotics (DIPO), 2010.

About 3,750 people in the Netherlands have an arm prosthesis. Unfortunately the rejection rate is very high, in particular among young people going through puberty, a time when appearance and fashion become more important.

Several studies were conducted with young prosthesis wearers, their teenage peers and their prosthetics professionals to measure emotions and concerns regarding existing and future prosthesis designs. Natural appearance is an important issue. The cosmetic glove receives the most positive emotional response of all prostheses. However, current gloves are vulnerable, maintenance sensitive, expensive and unsuitable for the physical activities that teenagers perform during their active daily lives. A prosthesis appears most natural when it looks like it is covering a healthy limb. This responds to prosthesis wearers who see their prosthesis not only as a replacement of their arm, but also as an accessory.

The 'ArmWear' products elaborate on this idea, with a glove and elbow cover that can be worn over any existing hand-shaped prosthesis. ArmWear is a tailor made product that can be produced individually. In addition to its natural appearance, the ArmWear's functions allow the teenage prosthesis wearer to quickly add protection and grip to their cosmetic glove and easily customise the appearance to match their personal style and clothing. Develop-your-own patches can be custom designed to create a prosthesis that makes them feel confident and that they are proud to wear.



FLEX FINGERS: PARTIAL HAND PROSTHESIS

Graduate: E. Stoop. **Supervisors:** A.J. Jansen, A. Albayrak.

Partner: Delft Institute of Prosthetics and Orthotics (DIPO), 2010.

'Flex Fingers' is a prosthesis for people with a partial hand defect. A partial hand defect is defined by the absence of fingers and sometimes part of the hand, combined with the presence of a functioning wrist. People with a partial hand defect experience problems in grasping objects and performing certain tasks like opening a bottle. There are many types of hand prostheses, but none of these are suitable for partial defects.

The prosthesis designed in this project is wrist actuated. It opens on wrist extension and closes on wrist flexion. The number of fingers can be adjusted to the user. An opposable thumb is optional. The phalanges are designed to mimic natural finger movement. Haptic feedback is present in the wrist. Rapid Manufacturing proved to be a promising technique for the low batch size prosthetic finger production because it offers low production costs and the option of personalised finger sizes.

A user test showed that this prosthesis has a pinch force of around 40% of the pinch force of a human hand. The final design functioned properly during the test and proved to offer added value to the lives of people with a partial hand defect.





ACCESSIBLE MOBILE WEB INTERFACES FOR USERS WITH A VISUAL DISABILITY

Graduate: R. van Rijn. **Supervisors:** H. de Ridder, M. Melles.
Partner: Green Valley, 2011.

Mobile web applications are of significant importance to visually disabled users. Applications related to travel and navigation in particular support freedom and independence. Many smart phones offer built-in accessibility features exclusively meant for visually disabled users. Examples include the pinch gesture to magnify the screen content and screen readers to translate content and interactive behaviour of the interface. It is crucial that such features are optimally embedded in mobile application for visually disabled users.

The purpose of this project was to formulate a set of design principles for accessible mobile web applications for visually disabled users. Visually disabled participants were interviewed and observed while using a number of mobile web applications. The insights gained were used to formulate six design principles. In order to determine the effect of the design principles at an accessibility level, the principles were put into practice by creating a redesign of the '92920V Pro' app. The original design and an interactive prototype of the redesign were then evaluated by sight impaired and blind users. The test confirmed that applying the design principles strongly improves the accessibility of mobile web applications for visually disabled users. Design principles for accessible mobile web applications for visually disabled users: use your imagination, strive for profound simplicity, ensure optimal first impressions, apply substitute solutions for typing, provide magnification accessibility, and provide screen reader accessibility.



EDUCATIONAL AID FOR THE VISUALLY IMPAIRED

Graduate: S.E. Klencke. **Supervisors:** C.C.M. Moes, J.F.M. Molenbroek.
Partner: Optelec, 2012.

In the Netherlands, there are approximately 10,000 visually impaired people under the age of 24. Visual impairment makes it challenging for these young people to follow classes. They frequently have trouble reading the classroom board, books and handouts and often miss non-verbal communication between their teacher and the class.

There are quite a few products on the market specifically designed to help students with a visual impairment to follow classes. These products help students to read by magnifying the texts. However, these products are stigmatising and poorly adapted to the current education system.

The 'StudyKompanion' concept was developed in cooperation with Optelec, a company specialised in the development of simple and effective solutions for people with a visual impairment. This design aims to improve the role of the assistive product from a magnifier to an all-round educational tool. Users control a powerful camera with simple mouse movement allowing them to stay focused on the teacher without needing to look at the product. The StudyKompanion not only magnifies; it also creates a complete virtual study environment in which the user can make notes, write summaries, read textbooks, take photos of the classroom board and scan papers.

A user test showed that the students were enthusiastic about the design. They indicated that the quality of the camera could be improved and more functionalities could be added.



AUDITORY NAVIGATION IN PUBLIC BUILDINGS FOR PEOPLE WITH A VISUAL IMPAIRMENT

Graduate: X. Wang. **Supervisors:** R. van Egmond, R. Jansen.
Partner: Stichting Geluid in Zicht, 2012.

Compared to people with normal vision, blind and visually impaired people have limited accessibility to and poor user experience of public buildings. Other senses like sound and touch can be stimulated to increase accessibility and create a richer experience. The aim of this project was to help blind and visually impaired people navigate and explore a building independently.

A field exploration and literature study showed that familiar auditory landmarks are very important in indoor navigation and orientation. A scale model was built for indoor navigation with auditory landmarks of familiar sounds.

The final product covers eight common landmarks, including toilets, receptions, canteens, offices, elevators, staircases, doors and smoking rooms. User studies showed that the most effective auditory information tends to be clear signal sounds rather than environment sounds recorded in real settings. The final concept, 'Audigator', was designed using iterative building-and-testing cycles.

Audigator is an interactive sound system that could be applied to interior scale models for navigation inside public buildings. The system tracks the user's hand movement in the scale model by using a blue finger sleeve, colour detection and a webcam. Sound is processed and played according to the relative position of the finger and the pre-set positions of sound sources in the scale model. The sound can help users to recognise the main functional objects or areas in the scale model and provide them with navigational information.



TACTILE NAVIGATION IN PUBLIC BUILDINGS FOR PEOPLE WITH A VISUAL IMPAIRMENT

Graduate: M. Xiao. **Supervisors:** R. van Egmond, M.W.A. Wijntjes.
Partner: Stichting Geluid in Zicht, 2012.

Limited accessibility to and poor user experience of public buildings form serious problems for blind and visually impaired people. Insufficient consideration is given to their need for guidance in unfamiliar surroundings. The current navigation tools and level of accessibility do not often meet functional and experiential demands for indoor orientation.

The navigation tool 'Haptic Guide' was developed in response to this need. It consists of eight haptic icons for receptions, cloakrooms, toilets, doors, lifts, stairs, cafés and smoking rooms in public buildings. The haptic icons were made by redesigning the geometric shape of a representative object and incorporating material features.

The Haptic Guide is used with a 3D scale model that has a drawer structure, which allows users to better explore the ground floor. By placing the haptic icons in certain locations, the 3D scale model facilitates blind and visually impaired people to recognise the eight places or objects and their locations in the building. Based on the spatial layout information provided by the model base, users are able to plan routes to these places or objects and to use them as landmarks with their own navigation strategy.

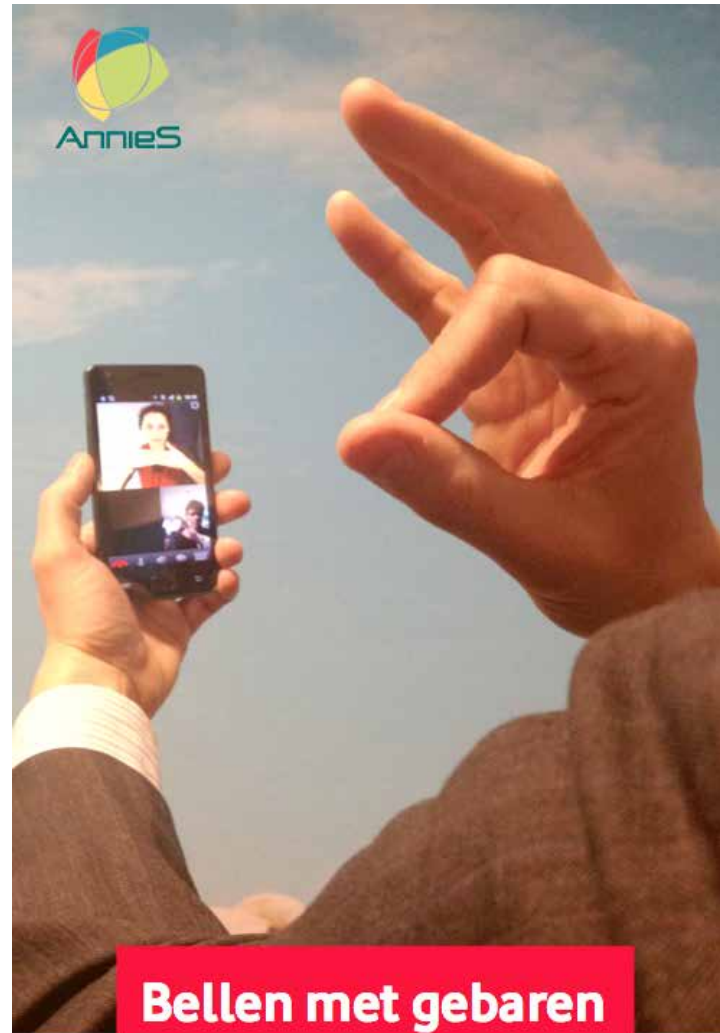
The Haptic Guide could be universally applied in public buildings. The modular design would make it possible to combine auditory and other information sources.



Graduate: S. Vis. **Supervisors:** J.F.M. Molenbroek, L.W.L. Simonse.
Partner: Vodafone Foundation NL, 2012.

There are currently many developments in mobile communication technology for people with a hearing impairment. Many of these products have the potential to improve users' quality of life and boost their confidence by increasing independence and decreasing uncertainties. Earlier Vodafone projects have produced interesting service concepts for hearing impaired people, but many of these lack a clear business model. This fuelled this project to design a new service proposition with a profitable business model for hearing impaired people.

The project developed a feasible business model including many internal and external stakeholders and implemented a new product and service combination. The final product is a spoken manual that helps hearing impaired people to unpack, install and use their iPhone 4S and the standard VoiceOver functionality. The service is a complete sign language communication package for hearing impaired people, including a unique mobile phone contract and a smartphone and dedicated software that allows users to have a mobile sign language conversation or have someone interpret for them.



Bellen met gebaren

XSvodafone.nl

COMMUNICATION TOOL FOR DEAF TO HEARING IN SOUTH AFRICA

Graduate: P. Chininthorn. **Supervisors:** A. Freudenthal, J. Verlinden.

Partners: University of Cape Town, University of the Western Cape, Sign Language & Development, 2011.

Most people in South Africa with a hearing impairment are functionally illiterate, which makes it very difficult for them to communicate with others. Especially in the health care context, patients with hearing impairments need to understand their medication requirements from the moment their doctor prescribes the medicine until the time the medicine is dispensed by the pharmacist.

As people with a hearing impairment commonly use mobile phones, the communication aid 'SignSupport v3' was designed. This tool can be stored on a phone and serves as a portable interpreter when the patient communicates with health care practitioners. The designer made recommendations about the properties required to make a mobile phone an ideal tool for people with a hearing impairment to communicate. Recommendations were also provided for features to enhance the performance of the SignSupport v3 as well as a message and queue notifying system to prevent patients from missing their turns in public hospitals, which was one of the main complaints.

Participants in a user test (including people with a hearing impairment and one pharmacist) rated the efficiency of the SignSupport v3 for assisting pharmaceutical communication as satisfactory. They clearly understood the SignSupport v3 message outputs. However, certain aspects of the product could still be improved and further research is needed before the communication tool can be launched.



JACKET FOR PEOPLE WITH BALANCING PROBLEMS

Graduate: H.K. Assink. **Supervisors:** R.H.M. Goossens, E.P. Westebring-Van der Putten.

Partner: Instrument Development Engineering and Evaluation (IDEE) Maastricht, 2010.

Patients with impaired balancing organs (bilateral vestibular loss) can have serious problems maintaining their balance and walking in a straight line. The balancing organ registers the orientation of the body in relation to gravity and the environment. It also helps to register the orientation of the head in relation to the body.

In 2002, the Maastricht University Medical Centre developed the Vestibular Labyrinth Substitution (VLS) system. In a nutshell, the VLS system consists of a sensor and a belt of vibration motors. The sensor (a set of accelerometers) reads the orientation of the body and sends feedback to the belt. Patients using the VLS system receive vibration signals from one actuator at a time and can correct their body orientation accordingly.

Until now, the VLS system has been designed for research purposes only. A new design could optimise the vibration feedback sent to the torso and integrate the feedback into a textile garment. This would allow users to wear the design for a longer period.

This project developed a balancing jacket and built a prototype that sends vibrational feedback to the torso using actuators that are placed perpendicular to the skin. Patients can now clearly localise the vibrational feedback without significantly adapting the skin to the vibration. A number of recommendations were made regarding the comfort of the jacket.





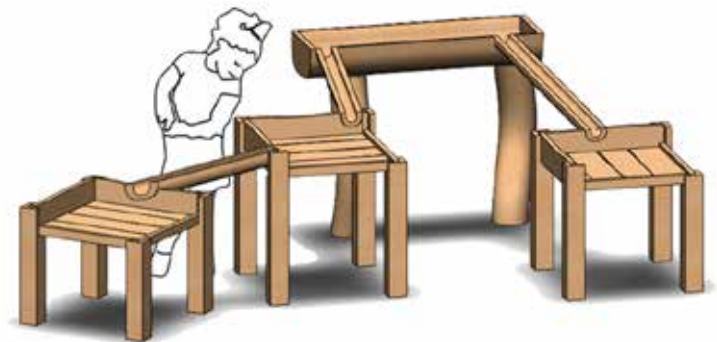
NATURE EXPERIENCE FOR CHILDREN WITH PHYSICAL DISABILITIES

Graduate: E.M. Ooms. **Supervisors:** M.A. Gielen, H. van Rijn.
Partner: Stichting Bio Kinderrevalidatie, 2010.

It is not always easy for children with disabilities to experience nature. How do you climb a tree when you are in a wheelchair? Stichting Bio Kinderrevalidatie has developed a holiday location in Arnhem for children with physical disabilities. The surroundings of the premises are currently being adapted to facilitate outdoor activities. Bio would like to offer activities in the surrounding forest that give children staying at the resort the opportunity to experience more of nature.

To the children who participated in this project, 'nature' means virtually everything found outside. Most of the children enjoy being active and playing together outside. A caregiver is always present during outdoor activities.

The insights gained during the research stage of this project led to the design of the 'Bio Belevingen Bos' (Bio Forest Experience). The forest consists of different elements for experiences and activities. There are trays for the children to collect and play with natural materials they find in the forest. There is also bigger play equipment for the children to build their own natural landscape in a 'build' area. Three cabins across the terrain offer sensorial experiences, for example, visual and sound experiences, and experiences that bring them in closer contact with animals.



A NEW MADIBA: REDESIGN OF A POSTURE SUPPORT

Graduate: A. Beeftink. **Supervisors:** A.G.C. van Boeijen, J.F.M. Molenbroek.
Partner: Shonaquip, 2011.

Shonaquip, a company in Cape Town, South Africa aims to improve the quality of life for people with severe disabilities by producing and selling wheelchairs that they have developed in close cooperation with a team of physiotherapists. The 'Madiba Buggy' is the most popular of Shonaquip's five posture supporting wheelchairs available for adults and children in South Africa. The buggy needed to be redesigned to lower costs and increase sales.

Research was conducted to gain insights about the intended users, user and usage context, availability of materials, production facilities and the company's know-how and skills. Also, thorough understanding was gained of existing wheelchairs, including properties such as stability, propulsion efficiency, manoeuvrability, transportability and adjustability to users' individual needs.

The result of this research is the 'new Madiba': a three-wheeler that is easier to adjust to different users thanks to its modular structure. It integrates the different user functions and has a sporty form.



DEMOUNTABLE SANITARY UNIT FOR SENIOR CITIZENS WITH A DISABILITY

Graduate: F.P. Verstraelen. **Supervisors:** H. Kuipers, R. Wormgoor.
Partner: Kip Caravans, 2011.

Over the coming years, we will see a big increase in demand for suitable housing for senior citizens. There is a great demand for senior housing (nultredenwoningen) in the Netherlands, where people can choose to either move to a nursing home or stay at home and receive homecare assistance. In the latter case, adapted houses are needed with a range of conveniences (e.g. stair lifts, sanitary adaptations).

This graduation assignment involved designing a demountable sanitary unit for people with a disability. The assignment covered the entire design process from 'idea to product' and included an extensive analysis of the market and target group. A 1:1 working prototype was built for user testing and constructional insights.

The sanitary unit makes it possible to use a bathroom anywhere in the house with the help of a carer. The unit can be placed anywhere that has an available drain connection, electricity and water.





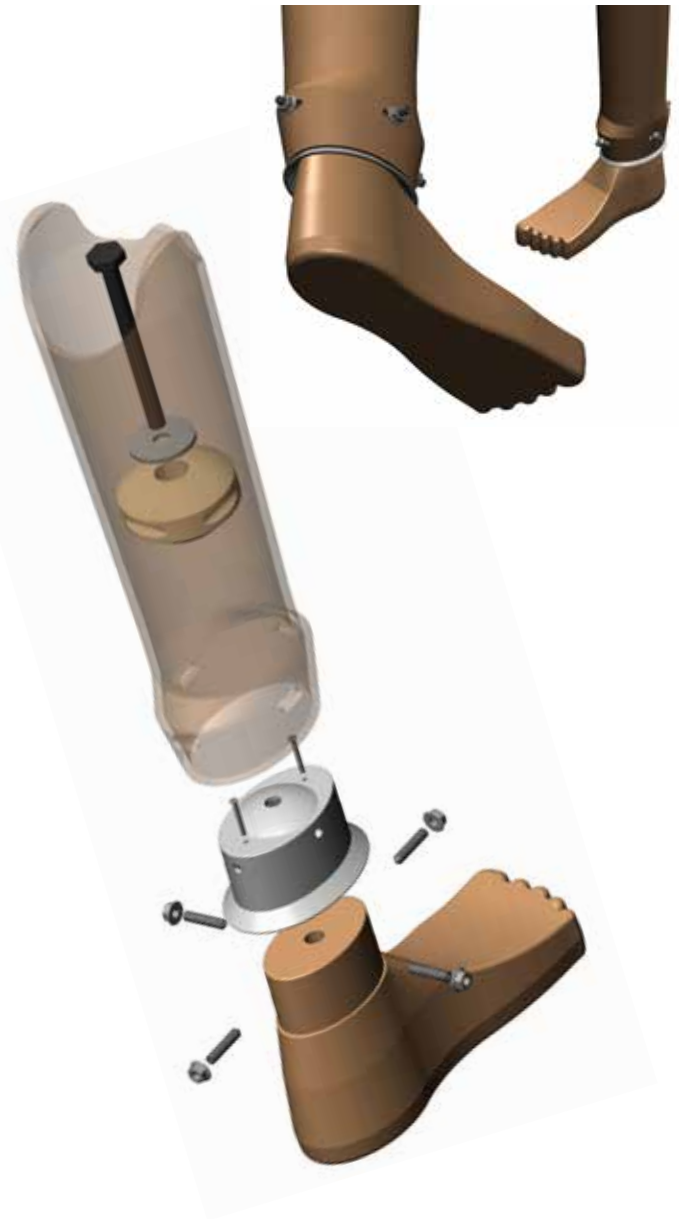
TOOLS FOR FABRICATING PROSTHETIC DEVICES AT JAIPUR FOOT

Graduate: A. Recamier Elvira. **Supervisors:** P.V. Kandachar, E. Tempelman, V.S. Parmar.
Partner: Jaipur Foot Organization, 2011.

People who have suffered from limb loss are regularly fitted with a prosthesis or artificial limb. Prosthetic devices enable amputees to regain mobility and independence and are therefore a vital part of the amputee's rehabilitation process. In India, the vast majority of people who require prosthetic products live below the poverty line and have limited access to rehabilitation services due to the high costs of products and services.

The Jaipur Foot Organization addresses this issue by providing orthopaedic products and services at no cost to patients. Their fast processes, use of local materials and technology and patient-centric management system are a proven model for clinics elsewhere. However, some aspects of their products and processes could benefit from improvements. In particular, an improved assembly method for the lower artificial limbs could speed up the production process. The assembly of the artificial foot to the prosthesis could also be optimised to prevent premature failures, as could the alignment adjustments between the artificial foot and device, which are not always accurate and can cause abnormal walking patterns.

This project developed a proposal for a design that integrates the alignment system with the current prosthesis using alignment bolts to temporarily attach and adjust the foot during the delivery stage. Further testing is needed to indicate whether the positive effects of accuracy during alignment compensate for additional fabrication steps.









DESIGN FOR ELDERLY CARE



ROBOTIC CARETAKER: VISIONS ON THE DESIRED FUTURE OF ROBOTS IN LONG-TERM CARE

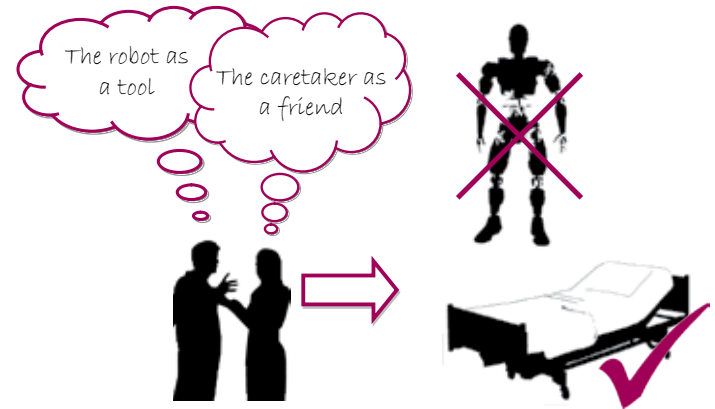
Graduate: A.P. van der Plas. **Supervisors:** J.A. Buijs, C. Wehrmann, M. van der Sanden.

Partner: Rathenau Institute, 2010.

This double degree graduation project was carried out at the Rathenau Institute, an autonomous technology assessment agency for the Dutch parliament.

The development of robots for long-term care is often driven by a fascination for the technological possibilities rather than an eye for the needs and desires in the designated context. Although robots are seen as the ultimate solution to the continuously ageing population and the decreasing availability of caretakers, robot experts are not familiar with the daily needs of caretakers and patients. Early involvement of relevant stakeholders through participative vision assessment can steer robot technology towards a desirable future. One of the intriguing insights gained during this project was that nurses in hospitals emphasised the importance in their work of personal contact with the patients, something that robots could never offer. The patients, however, appreciated the idea that robots could perform work like washing patients without making patients feel embarrassed.

Many robot applications were designed during the dialogue workshop as examples of a desirable future of robots. Rather than aiming for super intelligent autonomous humanoids, robot experts should focus on developing modest robotic tools to solve the urgent needs in long-term care.



Exchanging visions & assumptions leads to new visions on what robots should be: from super intelligent humanoids to practical applications like a robo-bed



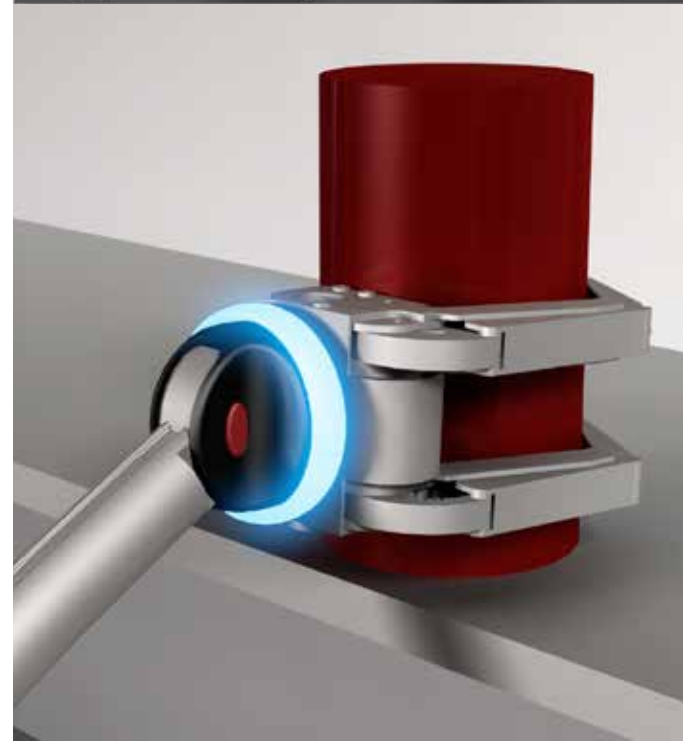
Combining technological and contextual knowledge & visions leads to new visions on the future of robots in long-term care.

ROBOTIC PERSONAL ASSISTANCE TOOL FOR ELDERLY PEOPLE

Graduate: E.L. Doubrovski. **Supervisors:** J.M.P. Geraedts, S.G. van de Geer.
Partner: Delft Biorobotics Laboratory, 2010.

The initial assignment from the Delft Biorobotics Laboratory (DBL) was to design a personal assistant robot for elderly people. Design directions were explored by looking into the worlds of domestic robots and elderly care. It was concluded these two worlds do not match; the kind of assistance needed for elderly people is too complex to be performed by present-day robots. However, this study also showed that many elderly people have preventable accidents at home caused by falling from a ladder. DBL reformulated the assignment based on these findings, and this project used an existing DBL technology to design a gripper to solve the ladder problem.

This new gripper is based on the technology of the DBL gripper, which uses one motor without sensors, and makes it unnecessary for people to stand on ladders. The main issues addressed by the new design included a need to reduce force on users and the need for a simple, intuitive and safe product. People from the target group were involved regularly to test possible solutions for these issues. The result is a new archetype reacher. A working prototype was built to evaluate the principle. The costing calculations showed that the selling price of the product for large series fits within the price range of domestic appliances.





FUN TO DRIVE PERSONAL MOBILITY VEHICLE FOR ELDERLY AND EVERYONE ELSE

Graduate: E. de Boer. **Supervisors:** J.F.M. Molenbroek, A.A. Visser.
Partner: Vitaal Groep, 2010.

The goal of this project was to design a personal mobility vehicle for elderly people that would deal with the negative image and stigmatising character of the current mobility scooters.

There is a large group of people above the age of 50 who are no longer able to ride a bike or walk longer distances. The assignment was to design a fun-to-drive personal mobility solution for this group of people. The vehicle had to fit in a medium sized car because a large part of the target group intends to take the product along on holidays or family trips.

The four 'pleasures' distinguished by Patrick W. Jordan (2000) - psycho, physio, socio and ideo - were used to determine the design criteria and develop a pleasurable product.

The final concept is the three wheel scooter. It has a stable platform at standstill and at low speeds and a tilting mechanism that is unlocked at higher speeds. This allows the driver to lean into a corner, which makes it smoother to turn corners and makes riding the product look more elegant.



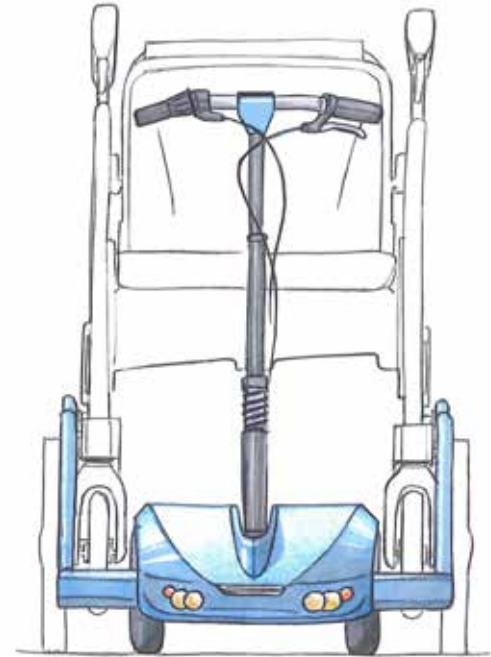
ROLLZ DRIVE: COMBINING THE POWER OF WALKING AND DRIVING

Graduate: R.T. Mense. **Supervisors:** J.F.M. Molenbroek, S.F.J. Flipsen.
Partner: Inmarket-Rollz, 2011.

The number of elderly people in the Netherlands is rapidly increasing and is expected to have risen from 2.5 to 4 million by 2025. Considering that almost 20% of elderly people suffer from decreased mobility, the number requiring a mobility aid will rise over the following years. Mobility impairment develops gradually and when a rollator is no longer sufficient people switch to a mobility scooter. It is an extremely big step to go from being relatively active and walking with the support of a rollator to passively riding a mobility scooter. A solution in between these two products would be very helpful for those who can still walk short distances.

One such solution is the 'Rollz Drive', an electric drive that can be attached to the existing Rollz rollator. The electric drive is unobtrusively tucked away under the seat allowing elderly people to be out and about without having to worry about getting tired. Having an electric drive to fall back on will stimulate elderly people to walk more often and remain more physically active.

A prototype was built and evaluated by means of predefined product requirements. The functional prototype and recommendations will lead to an improved product proposal.



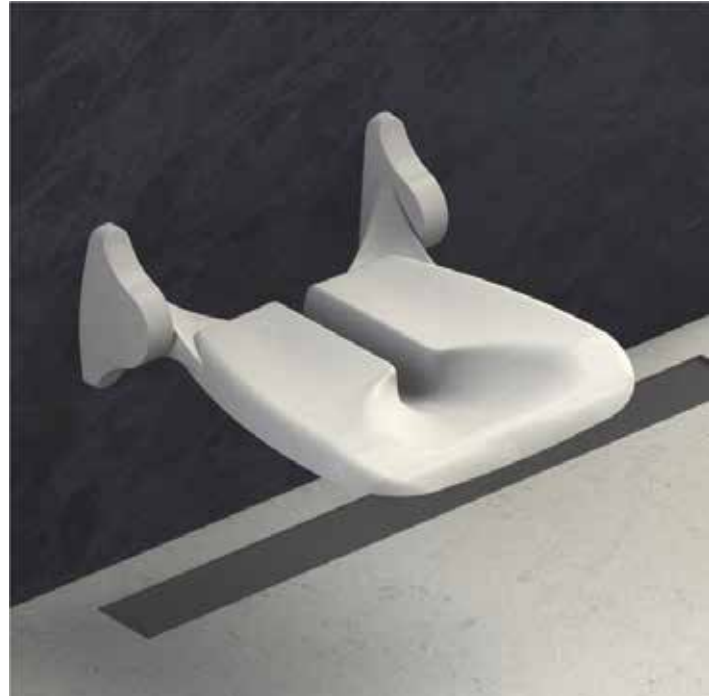
REDESIGN OF THE HANDICARE SHOWER SEAT

Graduate: L. Welzen. **Supervisors:** J.F.M. Molenbroek, A.H. Jellema.
Partner: Handicare Bathroom Safety BV, 2011.

This graduation project was the result of a request from Bathroom Safety BV to redesign their shower seat. The shower seat had to be suitable for the Dutch, UK and Spanish markets. The original shower seat provides support for users in a seated posture while showering. The seat is also foldable and is available with or without back and armrests.

User research conducted during the project showed that some users have difficulty standing up, cleaning their lower legs and feet and transferring from a wheelchair to the seat. Cleaning intimate body parts can also be challenging in a seated posture. Users generally have to stand up to properly clean this body area, but often have difficulty doing so. Some existing products provide hygiene openings but are still not optimal and are highly uncomfortable to sit on.

'BILLY' was developed based on the user research in this project and is now available as Handicare's next generation shower seat. The BILLY combines the regular shower seat with the ease of a hygiene opening. The user is now supported on the ischial bones allowing for a more pleasant showering experience.



RELUX: SUPPORTING SIT-TO-STAND MOVEMENTS

Graduate: R.W. Tinke. **Supervisors:** A. Albayrak, S.G. van de Geer.
Partner: Welzorg, 2011.

The first sign that a person's mobility is deteriorating is when they start having difficulty standing up. The sit-to-stand (STS) movement from a chair is essential for elderly people to maintain muscle function and thereby independence and mobility. As people age, the ability to perform STS movements gradually deteriorates. The 'Relux' was designed to prevent this deterioration and help elderly people maintain their independence. This product supports STS movements and stimulates the muscles.

An analysis carried out as part of this project resulted in an interesting possibility to disguise the product's 'assist function' by integrating it into an every-day product. The floor lamp was chosen because many interiors have a lamp next to the couch. The Relux functions as a floor lamp and a device to help users stand up without assistance from a second person. It also simulates the muscles by supporting natural STS movements.

The Relux is a stable device that does not need to be secured in its environment. Its trendy design means it does not stigmatise users. The results of the user test showed that the Relux was perceived as a high quality multifunctional product that intuitively assists users in standing up.



MOTIVATING ELDERLY PEOPLE IN RETIREMENT HOMES TO CHANGE THEIR ACTIVITY BEHAVIOUR

Graduate: P. Siemerink. **Supervisors:** M. Sonneveld, H. Anderiesen.
Partner: Humanitas, 2011.

As people age, they tend to become more passive. This passive behaviour is both the cause and consequence of physical decline. The goal of this project was to design a product or service that motivates elderly people to be more physically active so that they feel good, stay healthy and remain more independent.

Target group research found that elderly people do not perceive physical activity as important. Doing things for and with other people is considered more meaningful. However, elderly people have often lost their partner and need new contacts with whom to share recreational activities. The vision that inspired this project was 'Go out and meet the world'. The aim was to encourage people to discover the world around them together with neighbours or friends.

'Pearls of the North' is a service that stimulates residents at the Humanitas nursing home in Rotterdam to discover their neighbourhood. Small businesses such as restaurants, shops and cultural places are given the opportunity to invite the Humanitas residents to their establishment and offer discounts for two. Each month there is one Pearl of the Month activity. This way residents are introduced to different 'Pearls' lowering the threshold to visit again. Residents can write reviews about and take photos of the Pearl of the Month. These are displayed at the home and inspire others to visit the Pearl of the Month.



Parels van het Noorden



Parel van de Maand

Nika Koffie & Thee



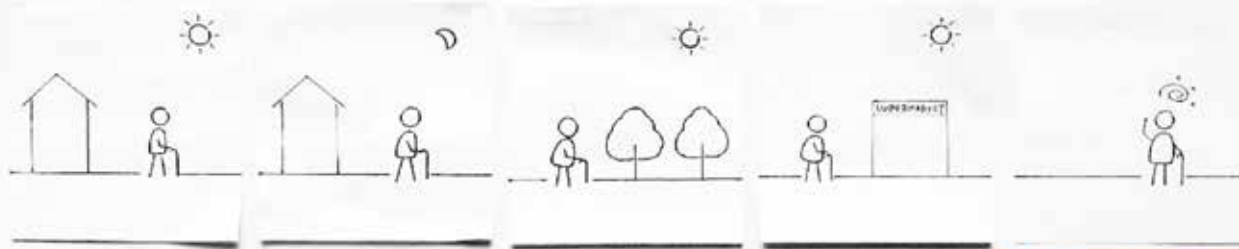
COMMUNICATION AND COLLABORATION TOOL FOR CAREGIVERS OF SENIOR CITIZENS WITH COGNITIVE IMPAIRMENTS

Graduate: X. Zhang. **Supervisors:** M.H. Vastenburg, N. Romero Herrera.
Partner: Independent@Home 2012.

As a result of the demographic shift and ageing population, the number of senior citizens with cognitive impairments is increasing. Caregivers experience both financial and emotional burdens in taking care of these senior citizens. This project studied three care parties who take care of the senior citizens with a mild cognitive impairment (MCI) in home settings at an early stage of disease. The study included case managers, home nurses and family caregivers. The project's main goal was to design an engaging tool to improve communication and collaboration between these different people. Many insights of how caregivers experience the MCI were gained through extensive qualitative research, which led to three essential product qualities for the new design: provides control, is friendly and connects people.

The final design entails a friendly user interface which elaborated into an interactive prototype. This prototype was tested by seven users, both professional and family caregivers. The participants positively evaluated the concept and the design, and listed several recommendations concerning the design and the information displayed. Their feedback was processed and used to refine the concept.





1 Anna's mother goes outside at day (if at night go to 4)

2 She goes to park.

3 She goes to the supermarket.

4 She suddenly falls ill then gets lost

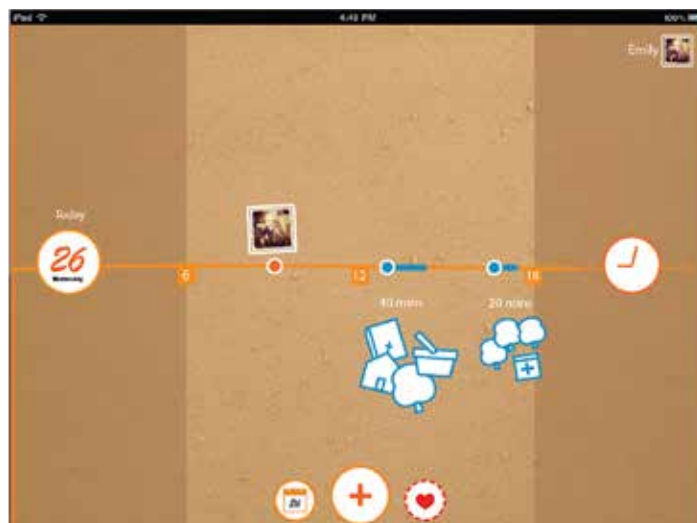


5 Anna and other caregivers receive an alert

6 Anna contacts other caregivers

7 Anna decides who go to the place.

8 Anna finds her mother and take her back home.

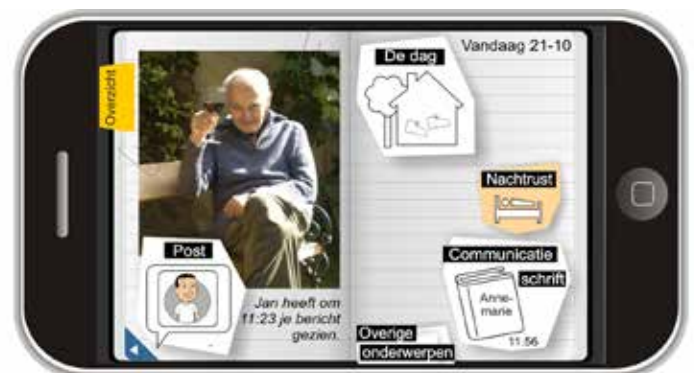


FAMILY CARE BOOK: PROMOTING PEACE OF MIND FOR FAMILY CAREGIVERS

Graduate: M. Cruijsberg. **Supervisors:** P.J. Stappers, M.H. Vastenburger.
Partner: Independent@Home, 2010.

Family caregivers are often key to ageing-in-place. They not only help with everyday activities and needs, but also tend to be a valuable part of a senior person's social network. Family caregivers, however, find it difficult to combine care activities with their busy job and family life. At the same time, they indicate that they feel insufficiently aware of the actual situation and needs of their senior relative, which results in worries and inefficiencies in care. This project studied the needs of family caregivers using context-mapping techniques and semi-structured interviews. A communication device was developed to improve awareness and communication, and thereby provide peace of mind. The final concept, the 'Family Care Book', provides an up-to-date overview of the senior person's situation. Sensors are placed in the house to automatically collect contextual data. Also, messages are used to share experiences, activities and feelings. The Family Care Book highlights when things are going right rather than problems and alarms.

An iPhone prototype was developed and evaluated in the field with two participant couples. The participants indicated that they valued the system and reported that it lowered stress levels. The findings from the study suggest that both functional awareness and peace of mind need to be considered when creating new communication services for a sustainable family care setting.



DATA/POWER TRANSMISSION INTERFACE FOR TELEHEALTH PRODUCTS FOR ELDERLY CARE

Graduate: Y. Jo. **Supervisors:** J.F.M. Molenbroek, S.U. Boess.
Partner: Robert Bosch Healthcare, 2011.

This design study was conducted to develop a data/power transmission interface for Robert Bosch Healthcare's telehealth products for elderly care. The project included the redesign of the data/power transmission interface of an existing activity monitoring system ('MoMo') and a complete new design of a wireless telehealth platform ('NXG'), consisting of a handheld tablet and a docking station. An initial empirical study showed that the product should provide adequate visual cues to elicit a proper mental model upon initial encounter and provide further visual, tactile or auditory feedback to reinforce, create or correct the initial mental model. The results of the concept evaluation were used to generate the following new major design features: contours of major surfaces for each product that provide primary visual and tactile guidance and secondary geometrical constraint to ensure consistent docking performance. The next step was a small-series production of prototypes with a highly accurate representation of aesthetic, tactile and functional qualities.



Motion Monitor

SOLO-LINK-BASE: SYSTEM FOR NURSE CALL PURPOSES

Graduate: P.A. Schreuders. **Supervisors:** A. Freudenthal, A.J. Neger.
Partner: Ascom Tateco BV, 2010.

Patients in health care facilities can call a nurse by using the handset next to their bed. However, these handsets are often difficult to reach and patients sometimes need to ask others to call a nurse for them. It would be highly beneficial for patients to have a permanent communication line with nursing staff.

This project addressed this issue by designing a new product set. One part of this product, called the 'Solo', is a personal device that the user can wear around the wrist, with an ID-strap or wristband, or as a necklace or clip-on. When patients press the button, a nurse receives a phone call and can see who is calling. Another part of this product, the 'Link', is mounted on the wall as a speech connection. This allows the nurse to determine the urgency of the call and let the patient know that their call will be answered. The third part, the 'Base', is used to store and recharge a Solo when it is not being used. A management system can also be used to keep track of the location of the Solo. This can be used to track people with dementia, to avoid them from wandering and getting lost. Nurses can assign a Solo to an individual patient and modify the settings if needed. Several supplementary functions include notification if the battery is low; visual, auditory, and/or tactile feedback; and the option to remove detection alerts. The concept was positively tested by patients and nurses.



FOLDABLE BED IN NURSING HOMES

Graduate: R.V.M. Luttikhoud. **Supervisors:** H.H.C.M. Christiaans, H. Anderiesen.
Partner: Van Aken Architecten, 2012.

Nursing homes for people with psychiatric problems in the Netherlands can often only provide residents with small rooms. Furniture must be placed as efficiently as possible to make optimal use of space. Van Aken Architecten was interested in developing a pleasant and efficient room for residents in psychiatric nursing homes. One of the items they focused on was the care bed, which is mostly positioned in the centre of the room, leaving very little space for other furniture. The room can be used more efficiently if the bed is removed temporarily.

A set of requirements were drawn up and several concepts were developed based on user research and market analysis. An innovative concept was chosen and detailed further into a product proposal. The new care bed can be transformed into a chair and the bed can be folded up into a closet, which creates space in the small room. The bed also supports the client in standing up.

A prototype was developed with the main functions of the new care bed. It can transform from horizontal positions to chair position and finally to vertical position inside the closet. The prototype needs to be tested by caregivers and patients.



LONG-STAY SUPPORT FOR IMMOBILE PEOPLE IN NURSING HOMES

Graduate: Y.F. Chow. **Supervisors:** J.F.M. Molenbroek, C.C.M. Moes.

Partner: Medsorg GmbH, 2011.

People with a terminal illness are often confined to a wheelchair for long periods of time. When nearing end-of-life, it becomes hard to move one's body and regular wheelchairs will feel uncomfortable and even painful.

This project designed a net suspension chair with a sliding sheet for terminally-ill people in nursing homes. The focus was to support users' daily activities and create comfort and efficiency for transfers. A net suspension based on the hammock principle was used to increase comfort and decrease the chance of pressure ulcers.

The net suspension chair needed to be flattened out to support transfers with the sliding sheet. A flattening mechanism was designed for this purpose. This combination of a comfortable net suspension with the ability to support transfers with a sliding sheet is unique for wheelchairs.



MOBILE CARE SEAT FOR ELDERLY IN THE LAST STAGE OF THEIR LIVES

Graduate: D. Unsal. Supervisors: J.F.M. Molenbroek, L.H. Langeveld.

Partner: Medsorg GmbH, 2012.

Many elderly people living in hospices and care and nursing homes can no longer move. To make daily life a little more attractive for these people, they are often driven around in mobile care seats. They are moved from the bed to the seat using a patient lifter. This procedure is time consuming, requires a lot of effort and puts a great deal of strain on the elderly person and caregivers. This project proposed a new design solution to improve the transfer procedure by making it quicker and easier. This was achieved by developing a seat that can stretched out and be used as a bed and then be converted back into a seat again. This product can be used for sitting and sleeping and also provides optimal positions for receiving care. It is easy to use and the large wheels make the seat suitable for both outdoor and indoor use.

User evaluations of the 'care seat' showed that the seat meant no longer having to use the patient lifter to move elderly people in and out of the seat. Since the seat is smaller than a bathing stretcher, it also makes it easier to reach the elderly person, meaning that caregivers do not have to overextend themselves when washing the elderly person.





DESIGN FOR PREVENTION



PREVENTING AGEING DISORDERS BY STIMULATING PHYSICAL ACTIVITY

Graduate: M. van der Hout. **Supervisors:** R.H.M. Goossens, A.G.C. van Boeijen.
Partner: BOB, 2009.

In the Netherlands, a growing number of young elderly people have a high risk of developing ageing disorders. Physical activity has proven to prevent or postpone a number of these disorders and improve people's well-being. The company BOB (Bewegingstechnologisch Ontwerp Bureau) develops products that stimulate people to exercise by focusing on abilities rather than disabilities. The aim of this graduation project was to design a product that stimulates young elderly people to be more active on a regular basis. A vision was developed for future interactions together with intended users by means of context-mapping techniques. This resulted in many ideas. The final result is the 'Flex-Up', an alarm clock with audio-guided exercises that can be used during a user's wake-up routine. The product content can be extended online with the help of the Flex-Up web tool that offers the possibility to create individualised sets of exercises.



THE ENERGY BALANCER: A MINDFUL EATING SUPPORT TOOL FOR WEIGHT MANAGEMENT

Graduate: A. Weekamp. **Supervisors:** H. de Ridder, M.C. Dekker.
Partner: Philips, 2011.

Overweight is a well-known problem. People often underestimate their food intake by 20 percent. A well-used method for creating more awareness of what people eat is the self-reporting daily food diary. However, this method requires a lot of effort and people often underreport their daily intake.

The 'Energy Balancer' was developed to increase users' awareness. The working principle is based on sensor technology that detects food intake. The product consists of a weight scale and on-body sensor. The on-body sensor is worn on the stomach in an elastic band. It measures the timing of consumed food and liquids as well as the portion sizes (based on bowel sounds, heart rate and skin temperature). At the end of the day, the sensor is plugged into the weight scale where the user assigns one of three categories to the detected food. These three food categories were determined by the Voedingscentrum (the Dutch Nutrition Centre) as GO (healthy), SLOW (in between) and WHOA! (unhealthy). The user can look the category up in a table. Being confronted by these categories makes the user more aware of their food choices (mindful eating). Energy intake and expenditure can also be measured and displayed to the user. This information is considered useful because it determines whether a person loses or gains weight.



PRODUCT LINE OF DIABETES SPECIFIC SELF-CARE PRODUCTS WITH A FOCUS ON FOOT CARE

Graduate: J.D. Degenaar. **Supervisors:** J.P.L. Schoormans, J. Blijlevens.
Partner: BioClin, 2011.

Diabetes is one of the most prevalent diseases worldwide and the number of patients is only increasing. Diabetes comes with many complications that cannot be treated by medication or prevented by healthy behaviour. BioClin has developed a new line of products for this new, but growing market of self-care products for diabetes patients. This research investigated the use of foot foam for preventing harmful bacteria from growing on the feet.

This foam is placed in contact with the skin for 10 to 15 minutes, during which time it changes into a fluid. The product needed an applicator to prevent this fluid from spilling when it is applied to the skin. The result of this design process was an applicator to apply the BioClin foam, and perhaps foot products from other manufacturers as well.

The retail channels and promotion of the products were explored. Recommendations were given to BioClin to introduce the product in the spring or autumn because people focus more on their health in these periods of the year.

BioClin wanted to introduce the products as soon as possible and therefore initially only introduced part of the product line. Introducing the other products later has a number of advantages: the product line receives renewed attention through the new products and BioClin has extra time to develop new products.



EXO LIGAMENT: A NEW MEANS OF ANKLE SPRAIN PREVENTION

Graduate: M.J.D. Fleuren. **Supervisors:** J.F.M. Molenbroek, A.L.M. Minnoye.

Partner: Internal research project, 2011.

This thesis presents research conducted to develop an injury prevention brace that provides effective external support to the ankle joint without reducing comfort and flexibility. The currently available braces all rely on securing the brace tightly around the ankle region. Although it has been proven that the use of ankle braces can reduce accident rates, these are often rejected by athletes because they are inconvenient.

The analysis and concept development process were guided by the similarity between the evolved principle of the foot's ligaments and the preferred basic function of an ankle support. A solution was found that restricts the relative motion between two rigid parts (the foot and the lower leg) using an external ligament. The 'Exo Ligament' is positioned around the user's ankle and is subsequently connected to an attachment feature on the shoe.

An ankle sprain injury occurs when high impact forces make the foot rotate beyond its normal range of motion. The Exo Ligament restricts this range of motion. The challenge to effectively transfer force from the foot to the lower leg was solved by developing a half open clip that allows pressure to be exerted onto the malleoli without the need for a tight strap around the ankle.

The result of the development process was a technical proof of principal accompanied by a patent application describing the innovative principle of motion restriction. A range of prototypes were successfully tested by athletes.



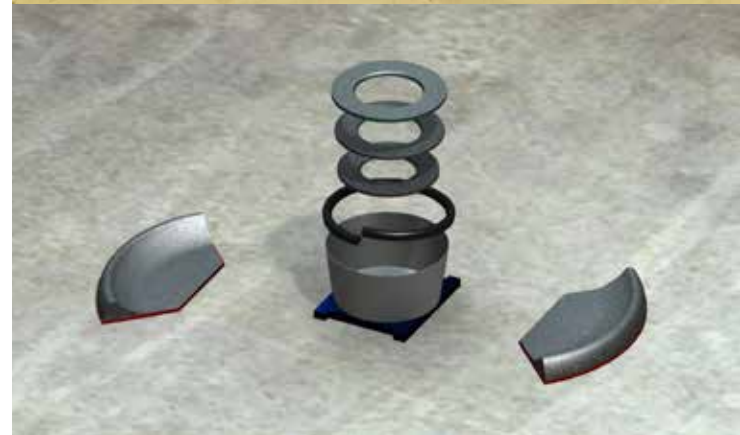


PREVENTING LOW BACK PROBLEMS

Graduate: C.F. Cuijpers. Supervisors: R.H.M. Goossens, T. Wiegers.
Partner: KLM, 2010.

Physical work can cause injury to employees' health, which in turn can result in absenteeism. Low back pain is the most frequent physical cause of absenteeism. It is also experienced in the KLM Engine Shop by mechanics of the Low Pressure Turbine (LPT), a component of the aircraft jet engine. The problems result from unhealthy postures which have to be maintained for extended periods of time. In order to reduce back problems, extreme joint postures should be avoided, the upper body, head or arms should be supported, and operating times should be decreased. Variation in postures can also contribute to better health.

Two concepts were developed during this project: the 'Fat Support', to give users more comfort and support during the assembly process, and the 'Feet Support', to enable mechanics to straighten their back and support their feet. A prototype of these devices was tested by the KLM mechanics during an LPT assembly. The mechanics were enthusiastic about the devices and enjoyed using them. The Fat Support increases comfort for mechanics of different heights, ensuring that the arms are provided with more support and the pressure on the stomach is reduced. The Feet Support mainly improves the situation for smaller mechanics. It positions them closer to their task, makes it easier to stand up with less extreme joint postures and enables them to straighten their back more often.



PAMOJA: ORAL HEALTH EDUCATION IN VULNERABLE KENYAN COMMUNITIES

Graduate: F. Brutto. **Supervisors:** P.V. Kandachar, A.G.C. van Boeijen.
Partner: Jukumu Letu, 2011.

Maintaining good oral hygiene is one of the most important everyday practices for keeping healthy teeth and gums. Healthy teeth not only make people look and feel good but they also make it possible to eat and speak properly. In a developing country like Kenya, factors such as a lack of hygienic tools and clean water and poverty make it difficult to maintain personal hygiene. In terms of products, most families have toothbrushes but usually keep them in poor conditions for long periods of time. The main problem is the affordability of toothpaste for regular family use. This problem also plays a role in the kindergartens, where teachers and staff are in charge of purchasing and distributing dentifrice for more than one hundred children every day.

A design solution was developed that takes into account the local and available resources. A natural toothpaste was embedded in a design solution: a school dispenser that allows children to make their own dentifrice every day and keep their toothbrushes hygienic and clean. Almost all the ingredients can be planted in the school garden by the staff, saving money and at the same time offering the children a 'green' education.



MOLLY: HAND HYGIENE FOR CHILDREN AT DAY CARE CENTRES

Graduate: J. Ho. **Supervisors:** M. Melles, M. Sonneveld, V. Erasmus.
Partners: Erasmus Medical Centre, GGD Rotterdam-Rijnmond, 2011.

In 2009 the department of Public Health of the Erasmus Medical Centre and the Regional Public Health Service (GGD) Rotterdam-Rijnmond started the project 'Heel gewoon, handen schoon'. This project addresses hand hygiene behaviour of caregivers and children at child day care centres. The main goal is to reduce the amount of intestinal and respiratory diseases among children that visit day care centres.

The assignment of this graduation project was to develop a product or service that stimulates toddlers to wash their hands more often and for a longer period of time. Drying the hands, an important step in proper hand hygiene behaviour, should be addressed also. The final design is 'Molly', a little fish-shaped sponge. Molly is the main figure of a story in which the fishes, the Molly's, need to be saved and cleaned by the children. This way using Molly, and consequently washing their hands, will become part of a ritual for the children. The storyline holds all the different steps that need to be done for proper hand washing, including drying the hands. Molly is developed based theories about play, development and tactile experiences of little children.

Molly should be used in combination with the soap dispenser designed by Chan (see next page).



DISPENSER FOR CHILDREN TO IMPROVE HAND HYGIENE AT CHILD DAY CARE CENTRES

Graduate: M.K. Chan. **Supervisors:** M. Melles, E.J.J. van Breemen, V. Erasmus.

Partners: Erasmus Medical Centre, GGD Rotterdam-Rijnmond, 2011.

This project was part of the intervention project 'Heel gewoon, handen schoon' aiming to reduce infections among children at child day care centres. The aim of this graduation project was to improve children's hand hygiene by designing a wall-mounted soap dispenser to attract the children's attention and keep them occupied to prolong the time their hands stay in contact with soap.

The 'Funny Fish' concept was developed based on a scenario where children in day care centres watch a story while washing their hands when visiting the bathroom. The story instructs them to pick up a fish-shaped sponge ('Molly', developed by Ho, see previous page) and clean it while washing their hands. The soap dispenser design displays the picture story when children pull the soap lever. This story motivates children to keep washing their hands for a longer period of time.

The user tests showed that this hygiene product helped children comply with hygiene guidelines, prevented spillage and enabled 73% of 2 and 3 year olds to use the product on their own.



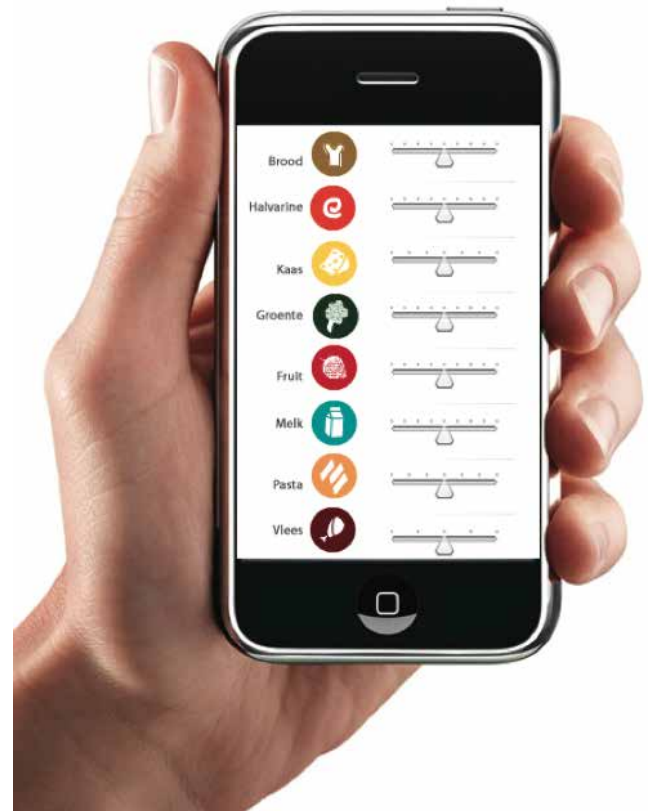
SLIMMER ZWANGER: INTERACTIVE TOOL FOR STIMULATING A HEALTHY DIET PATTERN

Graduate: K.T. Nguyen. **Supervisors:** R.H.M. Goossens, G.J. Pasman.
Partner: Erasmus Medical Centre, 2011.

The objective of this project was to design an interactive e-health tool to motivate pregnant couples to improve their nutrition habits and lifestyle and create optimal circumstances before, during and after conception. Since many complications during and after pregnancy originate in the first 12 weeks of the pregnancy, it is important to assess and improve medical conditions before the actual pregnancy.

Preconception care consists of health measures for the child and mother before conception has taken place. The preconception period offers an opportunity for couples to start controlling factors that could be favourable to a healthy pregnancy and life after pregnancy. Although there are many websites and applications for health care, nutrition and lifestyle advice and pregnancy, there are currently none that combine all three categories.

Based on insights from user research and research on behavioural change, a design proposal was created that uses a food checklist to make users aware of their nutrition behaviour and gives motivating feedback in the form of advice, tips and information. A prototype of the tool was built, tested and redesigned. The final tool is a web application that expands on the current measures for preconception care developed by the Department of Obstetrics and Gynaecology at the Erasmus Medical Centre Rotterdam.



PREGNANCY SUPPORT FOR PREGNANT COUPLES

Graduate: M. Arrieta Odria, **Supervisors:** R.H.M. Goossens, N. Tromp.
Partner: Erasmus Medical Centre, 2011.

Each year more than 130 million children are born worldwide, of which 175 thousand in the Netherlands. Having a baby means a new life for the mother and father and their unborn child. However, the new life should begin before the conception of the future baby. The prenatal care of children is aimed to get the optimal outcome of the pregnancy.

'Kwiek' is a product service design for couples to be used during preconception, pregnancy and breast feeding. The product service begins with a website where the current status of the couple (preconception, pregnancy or breast feeding) will be explained weekly. This information will be related to food, giving nutritional advices according to the couple's status. There will also be information about the fruits and vegetables of the season at every moment.

The physical product consists of a board and 15 food indicators that will be placed on the door of the fridge. Whenever the user eats something, the corresponding food indicator should be moved to the board. Consequently, the board will show a light when the indicator's (RFID) tag is read and send the information to the website. The user will be able to follow his or her nutrition.







DESIGN FOR CARE MANAGEMENT

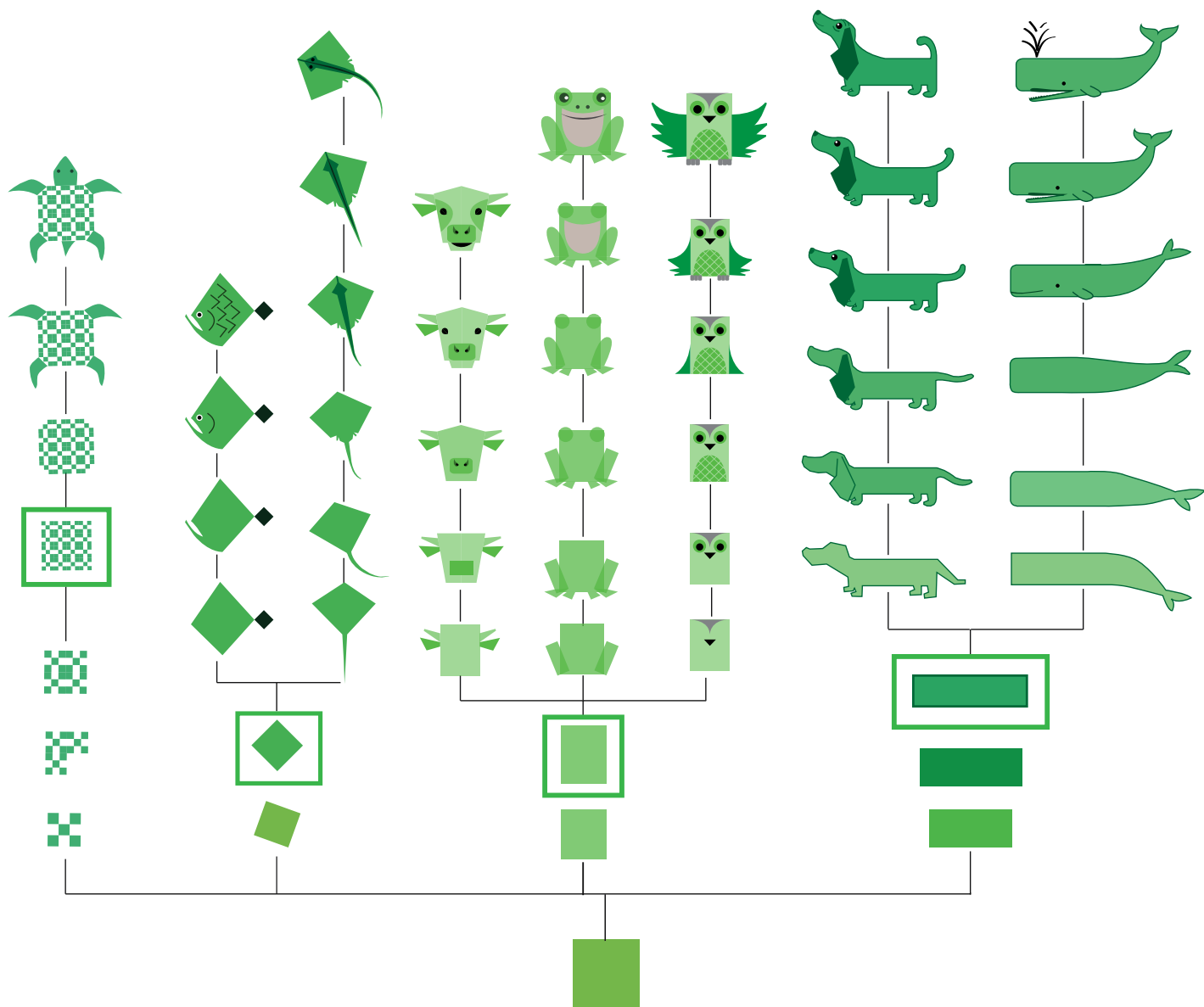


WAYFINDING SYMBOLS FOR THE HOSPITAL OF THE FUTURE

Graduate: S. Emami. **Supervisors:** P.P.M. Hekkert, T.R.A. de Rijk.
Partner: Mijksenaar, 2010.

This thesis is about the design of symbols for the hospital of the future. In future hospitals, patients will no longer need to search for the specialist; they will be directed to a certain area where the specialist will visit them. Although this approach is much more patient friendly, patients will still worry about the outcome of their consultation. The design developed during this project aimed to help people forget about their worries in a hospital by encouraging them to focus on the moment while intuitively finding their way to their destination. The set of symbols that was designed is a tree of forms that starts with basic, abstract forms that slowly evolve into natural organisms, such as animals or flowers. People can follow these sequences intuitively.





INVOLVEMENT AND MUTUAL UNDERSTANDING IN THE DESIGN PROCESS OF PATIENT ROOMS

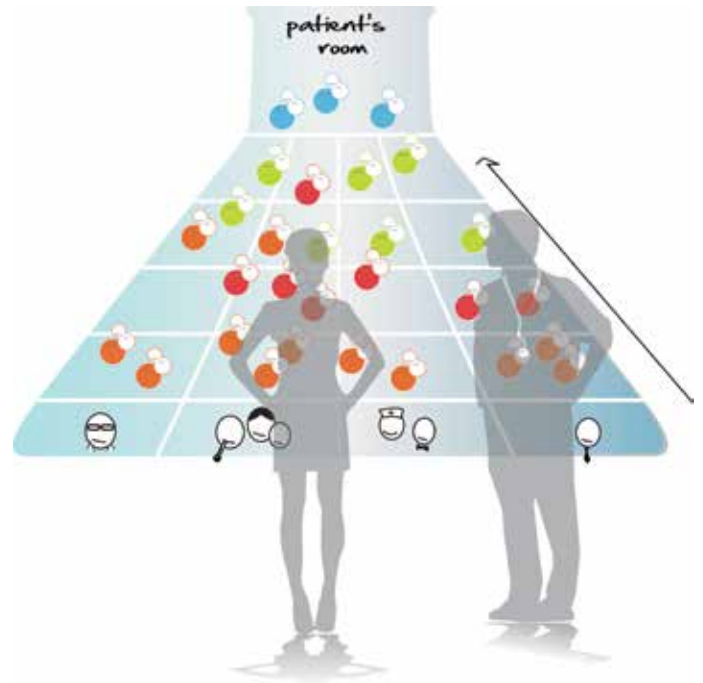
Graduate: J.M. Geluk. **Supervisors:** S.U. Boess, I.J. Mulder.
Partner: Office Concepts & Solutions BV, 2010.

This project sought to support an interior design firm in communicating with stakeholders about hospital patient room design. Building a hospital takes years and is a complex process involving multiple influential stakeholders. Patient room design is only one of many priorities.

This project involved literature research, observations and interviews on patient room design trends, stakeholder processes during hospital planning and existing and promising design process methods. Research shows that evidence based design and healing environment principles point to the importance of patient surroundings for health outcomes. Interviews with Dutch hospitals that were in the process of designing new buildings showed that they advocated patient-centeredness, but used quantitative needs elicitation. User-centred design methods, however, recommend direct research with patients.

A design support tool was developed for the external interior designer. The support tool guides the designer through a user-centred design process that is based on three aspects: inclusion of different stakeholders including patients; anticipation of outcomes so that stakeholders are aware of the different perspectives; step-by-step representation of the entire process for stakeholders.

The concept was evaluated by means of open interviews with different stakeholders. Although usability adjustments are still needed, implementing the design support could help hospitals become more patient-centred and offer a more pleasant experience for both staff and patient.



'GO-TO' MARKET STRATEGY FOR AMBIENT EXPERIENCE IN THE FIELD OF NEONATAL INTENSIVE CARE

Graduate: D. van de Kamp. **Supervisors:** C.J.P.M. de Bont, E. Roscam Abbing.
Partner: Philips, 2011.

Philips Healthcare is interested in entering the neonatal intensive care unit (NICU) market with ambient experience. Entering this market requires a well-thought-out business plan that demonstrates why this step is interesting for Philips. This project specifically focused on understanding what is important to NICU administrators.

Two solution directions were defined based on context-mapping research. Solution direction one addresses support services for NICU families. Developing such services enables Philips to target all NICUs, regardless of their design and configuration. Furthermore, support services for NICU families are an important differentiator for hospitals. Solution direction two focuses on a communication system for NICU staff. This solution direction addresses the need for a means of reducing noise levels in the NICU. Introducing a communication system that results in more quiet NICU rooms helps hospitals create a better experience for NICU families and stimulates the steady growth of infants.

A concrete concept was developed for each solution direction with the aim of opening a dialogue with NICU and Philips stakeholders. Based on this evaluation, Philips was advised to move forward in developing support services for NICU families. The context study also demonstrated that administrators generally do not involve vendors such as Philips in analysing possible solutions, although these parties have a great deal of knowledge and expertise that could help hospitals design and create useful innovations.



SUSTAINABLE BUSINESS MODEL FOR HEART FAILURE HOME TELEMONITORING: OPPORTUNITIES IN WESTERN

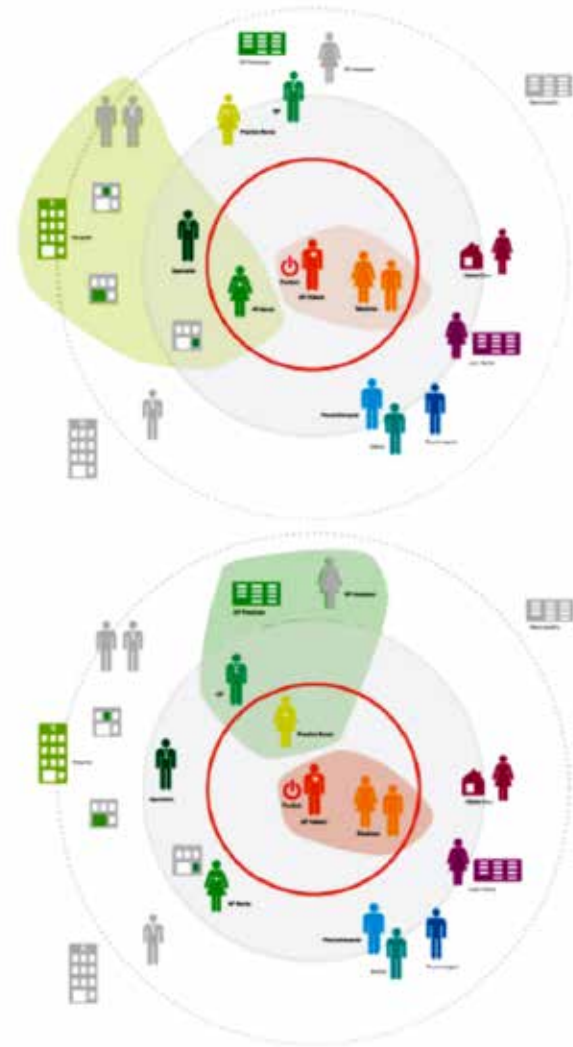
Graduate: E. Griffioen. **Supervisors:** R.H.M. Goossens, L.W.L. Simonse.
Partner: Philips, 2012.

Heartfailure (HF) is one of the major diseases in Western Europe, with prevalence rates between 1% and 2%. Between 47% and 70% of all health-care costs related to HF are due to hospitalisation. Telemonitoring can offer a solution by preventing hospitalisation and reducing the costs of HF disease management.

HF disease management is a complex problem involving multiple stakeholders such as the HF patient, general practitioner, specialists (cardiologists) and HF nurses. It was important to gather insights into the daily practice of HF disease management to define a proper business model.

The value transaction-mapping tool that was designed during this project was inspired by the 'IDEO Human Centered Design Toolkit'. The activity mapping tools for creating a context map and personal journey were adjusted to fit the transaction element of a business model. The purpose of the tool is to communicate roles and transaction relations.

A number of different models were designed. One of these, the 'Product Lease Model', was presented as the most sustainable long-term business model for introducing home telemonitoring to the market. The 'Software Support Model' was proposed as a short-term model. These two models suggest customer value propositions for different beneficiaries: the patient with a mild to medium condition and the severely ill patient. These suggestions lead to two scenarios on service design, profit formula and key processes and resources.







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