ROSKILDE FESTIVAL

POWERED BY DTU STUDENTS

RF50 / 2022

Roskilde Festival er laboratorium for ingeniørstuderende

For 11. gang indtager DTU-studerende Roskilde Festival med projekter, der skal være med til at gøre festivalen til en endnu bedre oplevelse for alle.

Efter to års coronapause står endnu et hold DTU-studerende klar til at tage på Roskilde Festival. Det gør de med 15 projekter, som giver dem erfaring med at udtænke og implementere løsninger på konkrete udfordringer, og som samtidig aktivt er med til at skubbe på udviklingen af festivalen.

I år drejer det sig bl.a. om projekter, der vil nedbringe energiforbruget i kølecontainere, en app til at finde mistede genstande og en undersøgelse af behovet for et menstruationsrum. *Læs de studerendes egne beskrivelser af projekterne på de følgende sider.*

Gennem mere end ti år har Roskilde Festival og DTU samarbejdet om at styrke uddannelsen af ingeniørstuderende og skabe løsninger på de mange ingeniørudfordringer der opstår i en midlertidig by med omkring 130.000 indbyggere og med en befolkningstæthed, der er større end i Filippinernes hovedstad Manila.

”Samarbejdet med DTU er dannet på baggrund af vores fælles værdier: At give unge mennesker en stemme, et rum til at udvikle sig og modet til at engagere sig i verden. Efter i år vil over 900 DTU-studerende have fået en lille del af deres uddannelse gennem vores samarbejde, hvor de har arbejdet med de mange ingeniørmæssige udfordringer, der opstår i en stor, midlertidig by som Roskilde Festival,” siger vicedirektør og talskvinde for Roskilde Festival, Christina Bilde, og fortsætter:

”På den måde har vi skabt et meget solidt læringsmiljø, som styrker unge mennesker og deres evne til at tage del i samfundet og skubbe på en nødvendig bæredygtig udvikling.”

Gennem årene er flere af de studerendes bidrag blevet faste elementer på festivalen. Det drejer sig om nogle meget synlige, som skraldespanden DropBucket, opladningsservicen Volt og det fleksible urinal PeeFence. Og det drejer sig om en lang række bidrag, der løbende har været med til at udvikle festivalens bæredygtighed og infrastruktur inden for områder som bl.a. affald, energiforbrug, madspild, hygiejne og lyden ved koncerterne.

En del af uddannelsen

I år byder projekterne på nye tiltag inden for hygiejne, energiforbrug, akustik, håndtering af store menneskemængder, belysning mm. Alt sammen projekter, som er udtænkt og udført af studerende på DTU, som en del af deres uddannelse. Der er tilknyttet en vejleder til hvert projekt, og de studerende modtager typisk 5 ECTS-point for deres arbejde.

”På DTU udvikler vi teknologi for mennesker, og på Roskilde Festival betyder det, at vores studerende skaber nye teknologier og løsninger, som kan gøre festivalen til en endnu bedre oplevelse for alle. Samtidig får de studerende mulighed for, at arbejde med helt reelle udfordringer og skabe

eksperimentelle løsninger, der skal kunne fungere under nogle til tider barske vilkår. Det er vores mål, at uddanne ingeniører, der tager lederskab for en bæredygtig forandring, og der er Roskilde Festival med til at give dem nogle virkelig værdifulde erfaringer," siger dekan på DTU Lars D. Christoffersen.

Alle DTU-studerende har mulighed for at byde ind med projektideer eller komme med bud på, hvordan de kan løse konkrete udfordringer, som festivalen har spillet ind med. Således stammer de omkring 70 studerende, der deltager i år, fra mange forskellige uddannelsesretninger. Det afspejler I følge Lars D. Christoffersen DTU's uddannelseskultur og eksperimentelle tilgang til læring, og medvirker til at de studerende ofte kommer med helt nye og overraskende løsninger.

"Jeg er meget stolt af at DTU har medvirket til at gøre festivalen endnu bedre gennem mere end ti år. Roskilde Festival er i forvejen en katalysator for nye ideer, hvor man kan se, hvad der sker når unge mennesker får fri lejlighed til at udtrykke og udvikle sig sammen. Det er en-til-en værdier, vi også arbejder med på DTU, hvor det er vores ambition, at de studerende realiserer deres potentiale og mestrer den teknologiske udvikling til gavn for mennesker og samfund," siger Lars D. Christoffersen.

Fakta om samarbejdet mellem Roskilde Festival og DTU

- I 2010 indgik Roskilde Festival og DTU et formelt samarbejde om at benytte festivalen som et fremtidslaboratorium og skabe innovative ingeniørløsninger på nogle af festivalens udfordringer.
- De studerende optjener typisk fem ECTS-point i løbet af projektperioden.
- Læs mere om erfaringerne fra de første ti års samarbejde i den fælles rapport Roskilde Festival as Living Lab in Engineering Education.
- Samarbejdet har blandt andet medvirket til, at DTU-studerende, der står bag startup-virksomhederne Volt, DropBucket, Kubio og PeeFence, har haft en platform for at afprøve deres teknologi, inden de startede virksomheden.
- DTU's egen dækning kan primært følges på sociale medier: Facebook, Instagram og TikTok.

Journalister, der ønsker at høre mere om de enkelte projekter kan kontakte journalist og presseansvarlig på DTU Tore Vind Jensen på 3026 7710 / tovi@dtu.dk

StandTogether

StandTogether creates a space for inclusivity and togetherness. It redefines the eating experience at Roskilde Festival.

Food is important. And nowadays, especially at festivals, food is much more of a social experience than just about eating. StandTogether's novel table concept brings everyone, from families to old and newfound friends, together at one table.

StandTogether complements the existing offer of seating at tables with specially designed standing tables. Different height levels accommodate kids, humans with reduced mobility and people of below-average height, creating an inclusive space for diverse groups. An eating place for all that makes splitting-up groups a thing of the past.

Moreover, enriching the existing dining infrastructure with StandTogether tables diminishes congestion. It improves the flow of humans in the dining area while reducing dwell time at the tables. This shorter eating cycle allows for a faster table-turn-around, allowing more guests to find a table and enjoy their food.

A/B testing will compare the newly built StandTogether tables in the well-visited outdoor food area to existing tables with seating. This way, the perfect spot between standing and tables with seating may be determined, and the dining layout optimised without compromising guests' happiness.

Acoustics (Concert halls vs. open stages)

This project is a part of the Acoustic Conditions at the Roskilde Festival course.
It is a collaboration between DTU, Roskilde Festival and Rhythmic Music Conservatory (RMC). It will study how a studio mix behaves when translated to the stages at Roskilde Festival.

Mixing and mastering music happens under controlled conditions in a sound studio. When the music is played at open stages and concert halls, the sound engineers usually perceive the music differently. The feel can be lost in translation, and they must alter the original mix to achieve the same feeling they had in the sound studio.

A sound studio is usually equipped with absorbing material to exclude reverb and late reflections. This way, the sound engineers only perceive the speakers' direct sound in front. This ideal setting is difficult to replicate in other locations.

The study will investigate how sound is perceived differently across concert halls and open stages at Roskilde Festival. The approach will be to achieve the frequency responses of the different settings and do listening tests of a specific piece of music in the same locations. This is to look for common differences for both concert halls and open stages compared to the perception in the sound studio.

Energy consumption

Roskilde Festival is an example of a location where energy consumption increases significantly for a period due to 130.000 people attending the festival. To be sustainable, RF organisers face a challenge on how to consume energy in a green way and maintain the needs of the festival attendees.

The largest electricity loads from the festival are due to concerts and stands. The area called Food Court is one of the places where festival attendees can go to eat and drink. Here refrigerated containers (reefers) are used to store food and beverages. These reefers have a compressor with high energy consumption as it can consume power of up to around 10 kW and are operated continuously during the festival days.

This project aims to showcase reefers' potential as a flexible power unit in the electricity grid. The scope is to investigate and define the parameters that limit flexibility in reefer energy consumption. This is done through a techno-economic feasibility study on three rule-based control strategies for a reefer placed at Roskilde Festival Food Court.

Each of these strategies utilises different parameters to evaluate electricity grid loads such as Food Court power consumption, occurrences of concerts and spot prices. Based on these parameters for each strategy, a plan is developed for how the reefer can consume energy.

Strategy no. 1

Consumption

Strategy no. 2

Concerts

Strategy no. 3

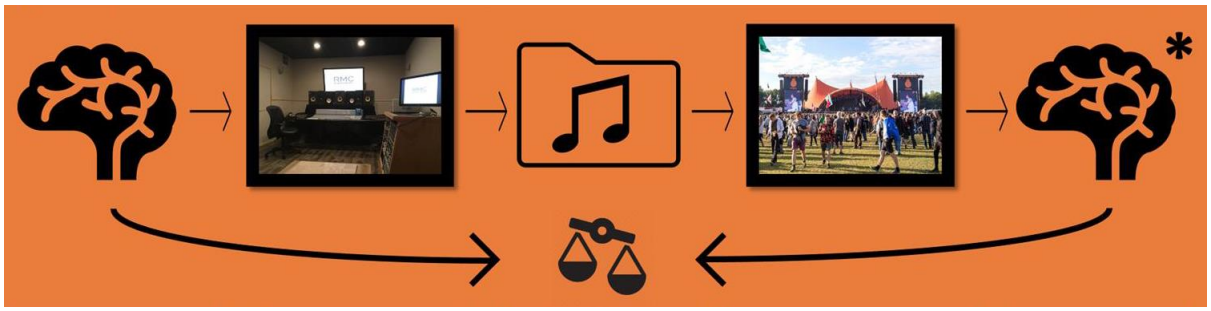
Spot price

Acoustics (Studio vs free-field)

Perceptual audio evaluation of electronic music elements from enclosed studio spaces to free-field acoustic conditions.

Sound quality evaluation has been an important topic that has been under much discussion for years in the audio industry. However, quantifying this perceived sound quality is relatively new in an industrial domain. The goal is to produce objective results as much as possible, as they would be used for crucial decisions in the design of different audio products.

This objective quantification of perceived sound quality involves understanding concepts from many scientific disciplines. Audio recording and production, electronic engineering, signal processing, room acoustics, electro-acoustics, experimental psychology and even statistics are a few examples.



The current research aims to evaluate, through specific criteria, the perceptual difference between electronic music played in enclosed studio spaces and outside. The material used for evaluation will be music created by students from the Rhythmic Music Conservatory.

The said assessment will be done through both subjective and objective metrics. To complete the evaluation, microphone measurements and listening tests will be conducted at Roskilde Festival and in the RMC studio. The outputs of the listening tests, along with the critical parameters obtained from the measurements, will be used to evaluate the perceptual difference from the production stage of this music piece to its playback on an open-air festival stage.

Acoustics (Binaural)

The main idea of this project is to study the difference between experiencing music in a studio and in a live open-air concert. This topic gets complicated because it involves objective and subjective analyses and because the room acoustic parameters commonly used for the objective analyses are very limited to enclosed spaces.

One important aspect that makes these two scenarios very different is the stereo mix and the room influence (or lack of). For this reason, the group focused mainly on measurements and subjective evaluation.

In this project, the binaural response will be compared between a studio and at the Roskilde Festival Orange stage (the stage is to be confirmed). The Head and Torso Simulator (see Figure) is used for the recordings because it has microphones in its ear canals, emulating the human hearing experience, allowing it to be reproduced and analysed afterwards.

By investigating the binaural response, it is possible to analyse the spectrum of what one would hear in a studio compared to at the festival site. Furthermore, in collaboration with Rhythmic Music Conservatory (RMC), two songs of different styles and frequency content will be played and recorded. With the binaural recording of the same songs playing at the festival and in the studio, it will be possible to perform subjective tests afterwards using headphones. This is to define if and why the experience is different.

StepLight - Kinetic Energy Tiles

'Creating power is as easy as taking the first step.'

This project aims to help the festival attendees navigate along designated pathways. Using in-house designed kinetic energy tiles that store energy generated during the day from people's footsteps, we can luminate the tiles at night. Thus, we may highlight a particular pathway.

The main problem we want to solve for the festival attendees is the wayfinding aspect and encouraging people to stick to designated paths with the potential of upscaling the project in the future along all paths in the Roskilde Festival. Naturally, it must be ensured the tiles are bright enough to aid the participants and withstand all types of weather and use scenarios.

Simultaneously we see an opportunity to entertain festival-goers by providing feedback by telling them on a screen the amount of power they have generated and the total amount of energy accumulated on that particular day. Sustainability is central to our solution's development, and operation will require zero external aid.

Piezoelectric Transducers
The word piezoelectric is derived from piezen, which means to squeeze or press. The piezoelectric effect states that mechanical stress or forces applied to quartz crystals produce electrical charges on the quartz crystal surface. A transducer can be anything that converts one form of energy to another. When we squeeze this piezoelectric material or apply any force or pressure, the transducer converts this energy into voltage. This voltage is a function of the force or pressure applied to it. We will take this energy and store it in our battery for later use to power our LEDs.

Roskilde Festival 2022 – Powered by DTU students

Mapping Out Needs of Menstruating People at Roskilde Festival.

We are a group of students from the master's in Quantitative Biology and Disease Modeling at DTU. Our project aims to map the behaviour and needs of menstruating people at Roskilde Festival.

This project's idea originates from our experiences and challenges with bleeding at the festival. Based on these, we are interested in investigating the general conditions at Roskilde Festival and how well these meet the actual needs of menstruating people attending the festival.

To map these needs, we will conduct qualitative interviews with menstruating and non-menstruating festival guests at the campsite and at our stand at the tech lab, where we will have different interactive conversation starters. Additionally, we will interview key staff members in charge of, e.g., toilet facilities, to include their reflections and knowledge in our analysis and solution proposals.

Our project will result in a report for future use and reference for Roskilde Festival. It will contain all the information gathered through our interviews and observations. We will outline the needs and experiences that the festival guests have described and their possible suggestions for improving the conditions.

Our hope and goal are that this report can create a foundation for the festival's further work towards being more inclusive and accessible. Additionally, we hope our project, in collaboration with Roskilde Festival, can be a part of starting the conversations about menstruation at the festival and in general.

Roskilde Festival 2022 – Powered by DTU students

QR codes

After being ignored for years in most Western countries, no one could ever imagine the resurgence of QR codes. Thanks to the global pandemic, we finally witnessed a mighty comeback of the QR codes.

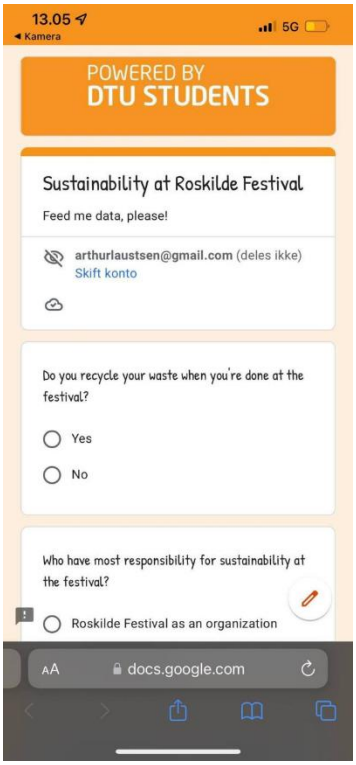
The codes are easy to set up, there is a low cost of producing them, and the product is simple yet complex because it ties the end user's phone with your information. This makes a simple product very advanced and creates a lot of value.

The project entails creating a network of QRs spread around various hotspots at the festival. These hotspots help the user locate the nearest recycling station, location of the user or other helpful information.

A lot of this information is already available, but there are often problems communicating them to an end-user.

Either there is vandalism on the information boards, or a light bulb has gone out. Thus making it difficult to read where you are or where you need to, i.a., drop off a broken, dangerous car battery. The project aims to solve this problem with 20-30 tailored QR codes.

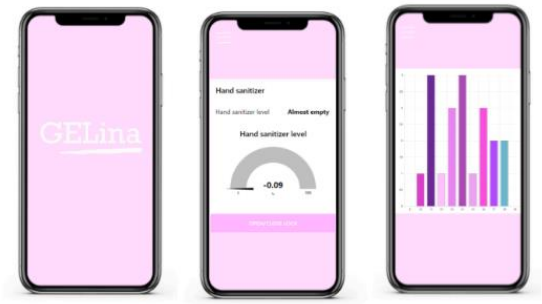
The QR code is organised via map software, and the QR code is made of a luminescent material so that it also works at night. In addition, the sticker is also made of degradable material to fit into Roskilde's sustainable framework, making the clean-up afterwards easy.



GELina

GELina is a digitised hand sanitiser that optimises the daily routines of the cleaning staff at Roskilde Festival. Digitising ensures the fact that the festival participants always meet a full dispenser. Meanwhile, the design of an eye-catching vagina kick-starts the conversation on women in technology and creates awareness of gender equality. Thereby, GELina provokes festival participants to remember sanitising their hands.

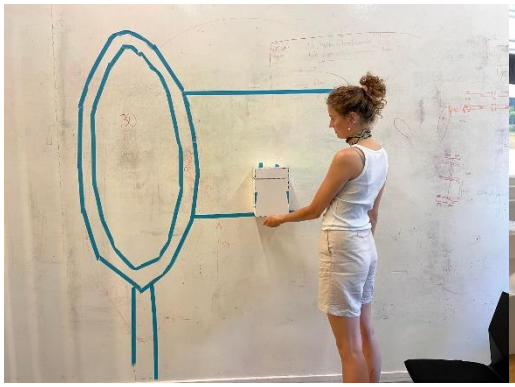
Digitising Roskilde Festival
Through the GELina app, staff will get a complete overview of the remaining gel level and how much the dispenser has been used. A user-friendly app interface will quickly indicate when the dispensers need to be refilled. This will increase work efficiency and save time for the cleaning staff at Roskilde Festival.



Nudging festival participants to sanitise
When in the festival mood, it can be difficult to remember good hygiene. But what is an intelligent hand sanitiser good for if no one uses it?

With the design of an eye-catching vagina, the curiosity of festival participants is awakened, and people are nudged to engage with the hand sanitiser dispenser. Aligning with Roskilde's focus on gender equality and the female sex, GELina wants to normalise and express the diversity of female genitals. As six women representing the gender minority at DTU, GELina promotes women in technology and encourages women to challenge the status quo.

GELina's vision is to maintain the hygienic habits developed during the pandemic while giving people a different educational experience and something to think about!



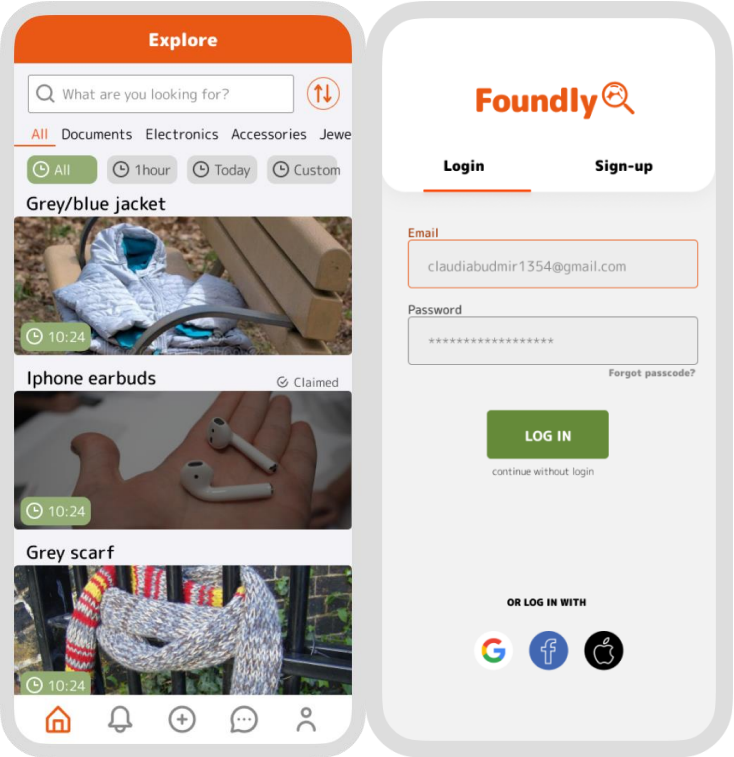
Foundly

Lost & Found app

We all love the festival atmosphere. The food, the beer with friends, dancing your heart out, taking a video of the pinnacle of an artist's show, lost in a sea of people high on the same amazing feeling. And in the end, when you are finally spent, you return to your tent and take out your phone to watch it all again. Only to realise that your phone is nowhere to be found. That's when Foundly comes to your rescue.

Foundly is an app that allows any attendee who finds a lost object in the festival's perimeter to register it inside the app, along with information about its characteristics. The finder who registers the object may leave it in a specific place and provide information about that location. If the object is valuable, they may choose to keep it for safety reasons and provide contact information for the other attendees. In this case, they may create a unique password phrase, an answer to a personalised question, like, for example, what is the background image of a phone's lock screen. In this way, the finder can ensure they are passing the item to the rightful owner.

On the other hand, a festival goer may create a post/alert of their own for an item that they have lost and need to find. In addition, an attendee should also be able to set up an agent and be notified when an item is found within some search parameters, e.g. item type, keyword etc. In short, Foundly helps you lose yourself at the festival. We find your other things.



Big Sun

DTU against skin cancer

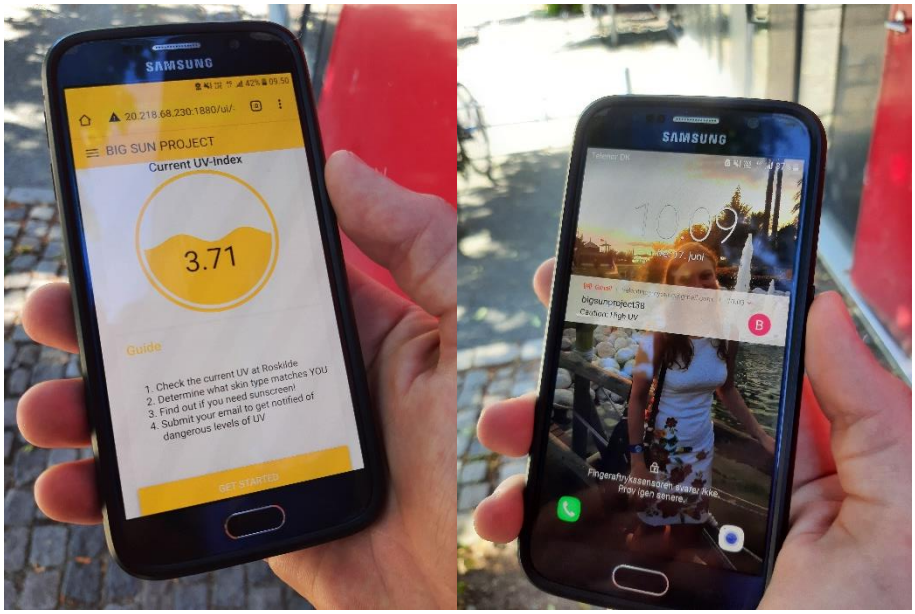
Hundreds of festival-goers emerge from their winter slumber and set off for a whole week of music, fun and plenty of sun exposure during the middle of Danish summer.

One too many end up with sunburns, which causes an unpleasant festival for the individual and supports the title of Denmark, the country with the third-highest skin cancer rates worldwide.

The *Big Sun Project* aims to raise awareness about the dangers of excessive sun exposure and spread information about utilising sun lotion, hopefully reducing the number of sunburned backs walking about the festival.

The design consists of a mechanical tower that registers and displays the ongoing UV index, including its health risks, raised high for everyone to see.

To reach as many festival-goers as possible, the design includes a website. The website will guide the users about whether to apply which type of sun lotion, depending on the relevant UV index and skin type. Furthermore, the website allows the user to sign up for a notification service that will notify and guide the festival-goers when they are not hanging around the TechLab site.



Roskilde Festival 2022 – Powered by DTU students

DTU ScienceShow

DTU ScienceShow is a student-driven organisation under the Institute of Chemistry at the Technical University of Denmark (DTU Kemi). Our mission is to inspire people of all ages to dare and be curious about engineering and the natural sciences. We achieve this by communicating interdisciplinary sciences in innovative and interactive ways, which involve spectacular chemical reactions and fascinating physical phenomena.

We imagine a future where transport and heating on and around Roskilde Festival are powered by renewable energy obtained through PtX technology.

Our project at Roskilde Festival 2022 will be visualising Power-to-X (PtX) technology as an emerging solution for the problem of renewable energy storage. In recent years, Roskilde Festival has focused on decreasing energy use from fossil fuels. It has recently entered into a partnership with Andel to facilitate access to greener energy solutions.

PtX technology converts electricity from renewable sources into storable compounds for use in transport, heating or chemical production. A prototype experimental setup demonstrating the conversion of excess wind energy to chemical energy has already been developed (see attached image). We wish to display this interactively and engagingly for the festival participants. At the festival, we want to use a wind turbine, solar panel or exercise bike to power the generation of green hydrogen.

Counting and tracking RF50

This project aims at establishing technology that enables the use of deep learning (AI) to track the movement of pedestrians.

The solution will consist of a camera connected via a local network to a computer. The computer runs an algorithm which converts the video data into the position of each pedestrian for each frame.

Suppose the camera Is located near an entrance to an area. In that case, one can track how many people have entered or left the area through this gateway.

Additionally, suppose a queue is starting to form at the area's entrance. In that case, we can, with 2 cameras, obtain a service rate and a queue length. This enables us to estimate, or even give an interval, of the expected waiting time.

This information could be communicated through the RF app. This is not only of use to the user but may also alleviate chokepoints. Thus, minimising the average queue time and making RF even more excellent.

We don't know yet whether we will be positioned in an area where this is possible; thus, we have scoped the project to focus on counting people flowing through an area.

The ability to track movement can be used for countless impactful solutions; thus, integrating and testing the underlying technology has value for future projects.

A glowing connection

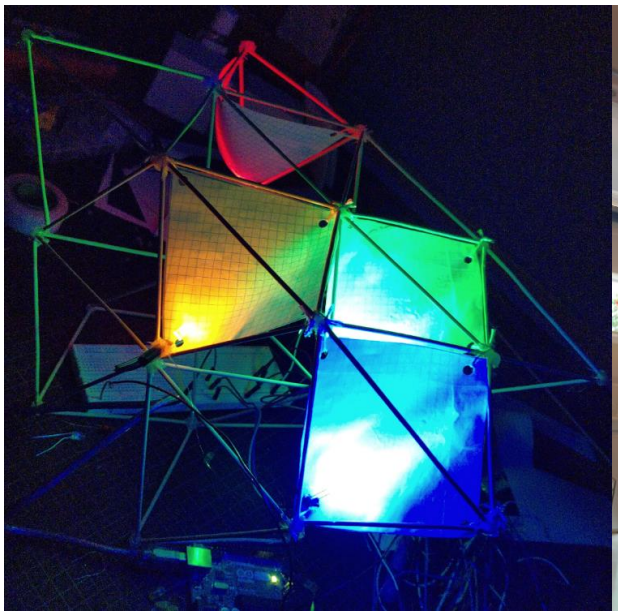
Lighting up the paper pavilion.

A glowing connection is an interactive light display at the Paper Pavillion, the heart of the DTU techlab.

At night you will be able to have the experience of being in control of the lights. Each of the lights is controlled individually through our website. On our website, you can pick one of the lights and switch it to a colour of your choice. Once you have selected a colour, there will be a cooldown before you can change the colour of the light again. If you gather all your friends, you can put in a collective effort and turn the lights into the colour of your football team, national colours or whatever you decide.

The project consists of 12 lights that light up the sails of the pavilion. An interactive map hanging at the pavilion shows the light show in real-time to give our users a better overview of which of the lights they are changing.

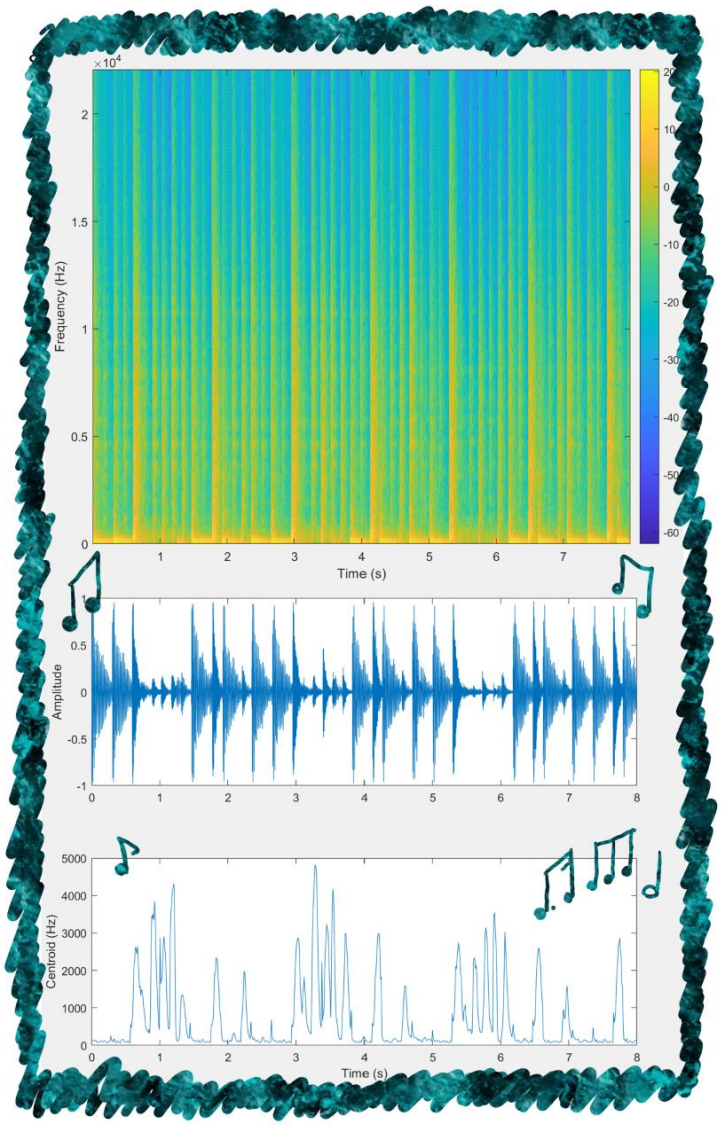
The entire experience is bonded by our virtual platform, where users interact with light through our website. This project was made as a part of a bachelor's course in Mechatronics at DTU.



Acoustics (environment's impact)

A musical experience depends not only on the producers but also on the environment in which it is played. Every environment will impact the acoustic properties of a sound, which will play a role in our perception of the music being played.

While the complexity of a musical piece makes it hard to find a clear connection between perception and sound properties, this project attempts to investigate the matter with the help of audio engineers from RMC.

On one side, objective sound parameters, such as spectral centroid, spectral spread, and spectral flatness, will be calculated frame by frame from a short music mix. On the other side, the change in the subjective parameters, for example, fullness, brightness, and roughness will be attributed to these mixes.

An investigation of how these parameters relate will be conducted, as well as their change in different settings.