Report on IoT and Lifestyle Products

Acknowledgements:
This project is an activity under Lifestyle & Design Cluster and funded by the Danish Agency for Higher Education and Science. We would like to acknowledge all the companies involved in this exhibit: GANNI, Pufin ID, Wehlers, MiCollect, FORCE Technology, United Textile Group, Digimarc. And the educational institutions: KEA School of Design and Technology, VIA University College and Aarhus University. We thank Petra Ahde-Deal, Hanne Falkenberg Jørgensen (KEA School of Design and Technology) and Sofiaa Rajasegaram (Humber College) for developing this report.

Abstract/Background:
This report aims to dissect the application of Internet of Things (IoT) technologies within current Denmark lifestyle products. IoT is a technological structure embedded in physical objects. Its primary purpose is to interact with objects by collecting, processing, analyzing, and reporting data (Salam et al., 2019). The development of IoT leads to lifestyle objects such as chairs and clothing having the potential to sense, connect and produce network information to enhance users' experiences. The IoT technology within the lifestyle industry bridges the interaction of everyday products with the average consumer to be more mindful and practice sustainability. The textile industry is one of the major contributors to climate change through their carbon emission outputs. The garment and footwear sectors account for 8-10% of the global carbon emissions due to the extensive supply chain and production techniques (European Commission, 2021). This report will highlight three lifestyle brands and their ventures into sustainability through IoT technologies.

Introduction:
On Tuesday, November 15, 2022, a group of individuals who share a passion for all things IoT participated in the *IoT in Lifestyle Products Exhibition Opening & Panel Discussion* led by KEA's Petra Ahde-Deal. The event is hosted at the Lifestyle Lab in Copenhagen, Denmark, which is an incubator for startups that are directly working with the circular economy. The keynote speaker, Majken Overgaard, a program director for CATCH, the Center for Art Design and Technology, kicked off the presentation by asking "What is the future of the internet and technology? Why should we do IoT now?" The application of IoT technologies in lifestyle products is nothing new, in fact, in the 1980s, students from Carnegie Mellon University who wanted a cold bottle of Coke did not want to trek to the vending machine and found a way to connect it to the Internet. The machine was then able to communicate a new restock and the temperature of the drinks (Ornes, 2016). IoT technologies exist in the hybrid reality space; integrative technology increases user-interactive experience every day; Overgaard expresses "the pandemic is a health crisis that led to a digital revolution". Organizations accelerated into digital transforming structures to better connect and communicate with the public through innovative and adaptable technology.

Case Study #1: GANNI X PUFIN ID X KEA
GANNI, a B-Corp-certified Danish contemporary brand has partnered with Pufin. ID, a solution-based tech company that guards brands, products, and the environment to strengthen consumer loyalty. The purpose of this project is to see whether IoT technology can influence consumer behaviors and reduce the overall carbon footprint when it comes to clothing. Physical Unclonable Function, or PUF, is a serial number that cannot be copied and cannot be duplicated. This project was in collaboration with KEA School of Design and Technology where students were able to produce visual content that can be further translated into app space.

The Pufin.ID has been implemented into buttons on GANNI jeans and is readable by smartphones. The aim of this project is to determine whether consumers can be influenced to adopt more sustainable practices when presented with easy-to-digest, accessible information. How does this relate in terms of carbon footprint? In this case, we see that 12% of GANNI's annual carbon emissions are directly sourced from the use phase of the garments after the product ends up in the consumer's hands. After that, the company loses all visibility of its ecological footprint. Upon scanning the jeans, consumers will be able to open an app where they are given access to a digital wardrobe, gain insight into the journey of their jeans, connect with a larger, like-minded community, and a care guide for their jeans. Some findings from this project were that consumers want to take a sustainable approach but do not have the resources, so this supplied a platform and bridged access for everyday consumers.

To understand the consumer's reception to sustainability measures, the students at KEA performed a user study to assess what information is essential to GANNI's consumers and produced video proposals of the findings to be visualized in an app. The main concepts found from this study were:

Journey: Users will be able to see the journey of the jeans, from the origin of the raw materials, through to the manufacturing process, and finally to when the jeans end up in the user's closet. By transparently giving consumers access to the ecological impact of producing a pair of jeans, consumers will have increased awareness and, in turn, may be more willing adopt more sustainable practices. Jean owners can use the GANNI x Pufin.ID app to sell and share their denim to continue the jean journey and post photos of wearing their jeans.

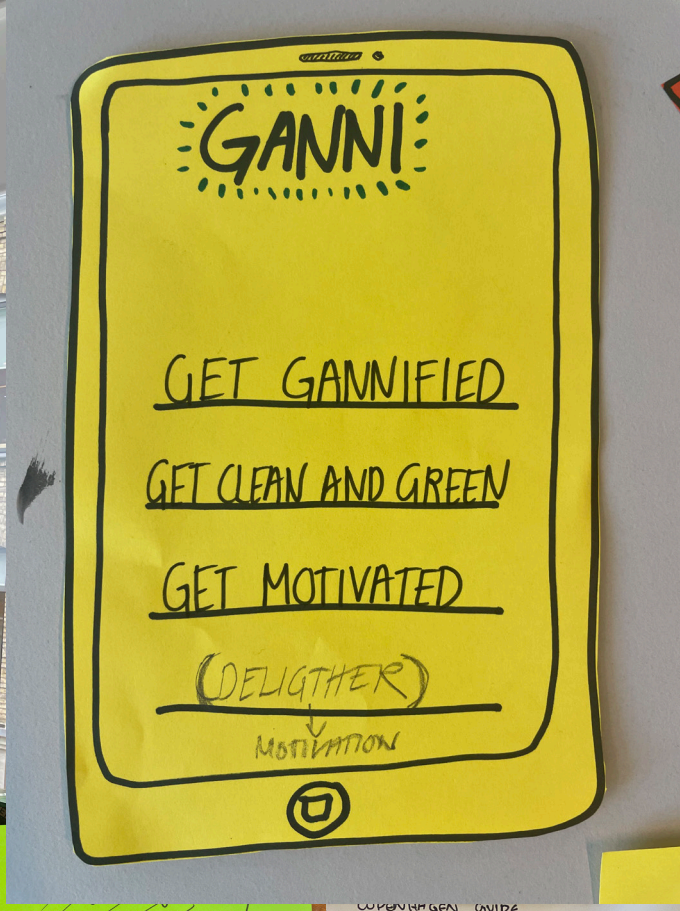
Care Guide: When scanning the jeans, users will be able to find sustainable repair and care methods to prolong the life of their jeans. This can allow users to make a profit from their jeans when reselling them by ensuring their denim retains value.

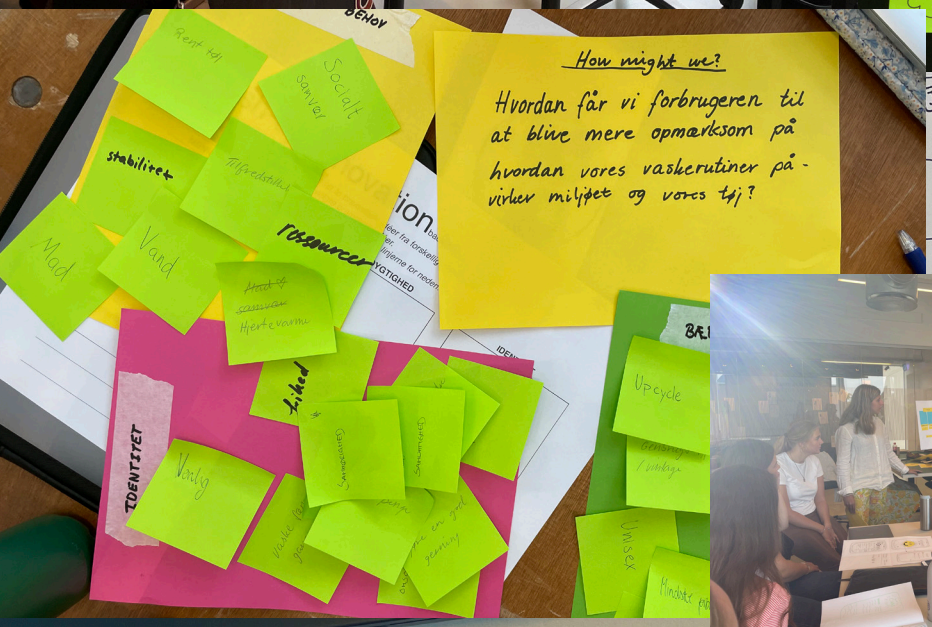
The Digital Wardrobe: By giving users access to their own personal digital wardrobe, it can lead to a decrease in clothing consumption by being able to create outfit ideas from their uploaded GANNI clothing. This will serve as inspiration to encourage users to wear all their clothing and experiment with new outfits from their pre-existing GANNI pieces.

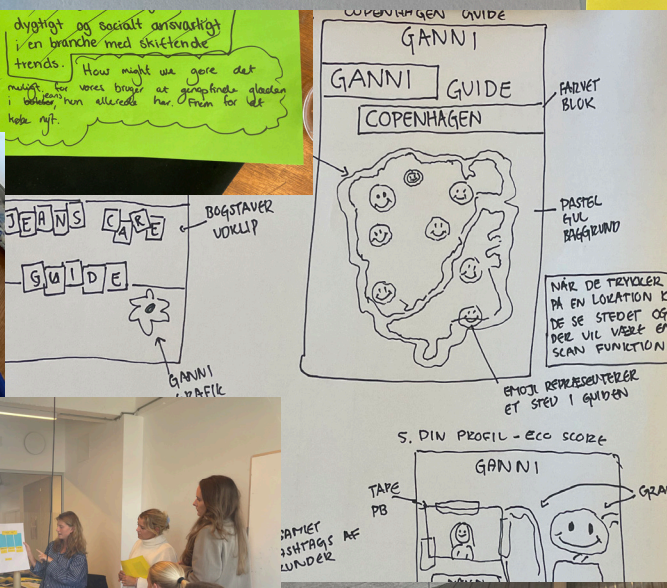
The Community: GANNI OUT LOUD serves as a movement to connect environmentally minded individuals who relate to the GANNI brand and acknowledge sustainability measures. Members can be given pink tags for their jeans upon purchase to proudly express their sustainable pact with the environment and their community. GANNI can hold in-person creative labs to offer advice on how to be more responsible when taking care of their jeans, while also cultivating a repair community to extend the life of one's jeans.

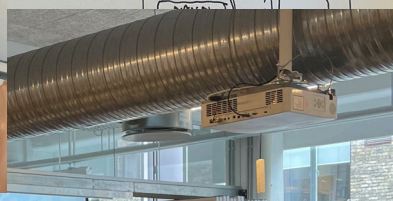
Case Study #1: GANNI X PUFIN ID X KEA

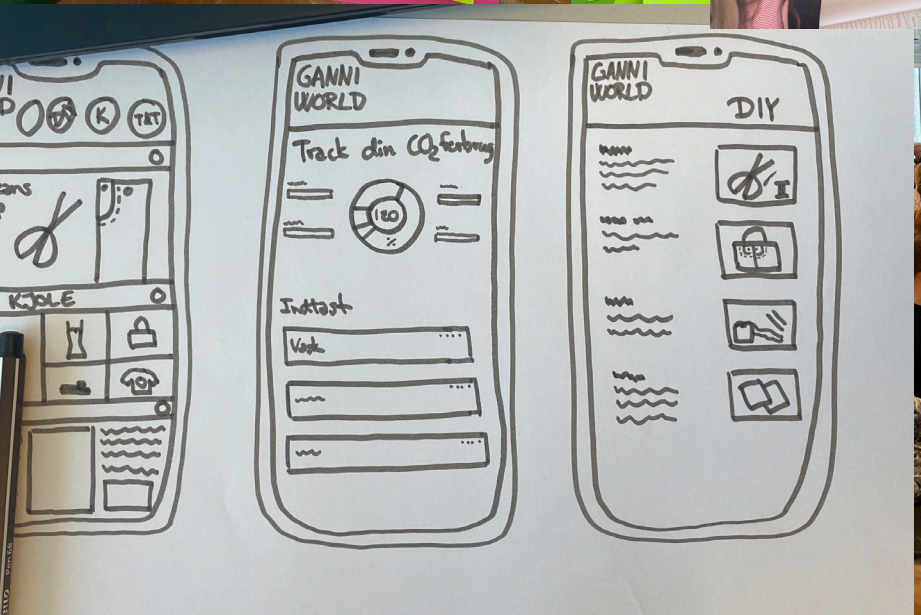
Workshop at KEA process pictures.











Case Study #2: WEHLERS X MICOLLECT X FORCE Technology

Wehlers is a Danish based sustainable furniture brand and are partnered with Mi-Collect, a data and information-based technology startup and FORCE Technology, a digital solution company. Wehlers has released furniture that is made up of recycled and sustainable materials and ensuring that they are making the necessary actions to join a circular economy through repairs, reusing and recycling their furniture. This project aims to collect data from the furniture through the measurement of energy consumption through IoT technologies to better understand the usage of the furniture for furniture producers and end users.

To track the data through the furniture, there were different sensors placed on the chairs to measure motion, temperature, and humidity. This data was collected from sensors to capture the activity rate of the chairs, in other words, to see how often the chairs were being used and to then, send recommendations to consumers on how to properly maintain and increase the longevity of the chairs. However, the sensors from the prototype were met with some challenges; the sensor was running on battery and if the sensors were needed to collect the data through longer periods of time, the battery can drain. This can affect the data's validity and take away from the activity's interpretation.

The company's experience with the IoT technology of sensors with the energy consumption levels and the battery life requires going further with the study. The investigation of energy harvesting techniques would be a requirement to counteract the issue of the battery's lifetime. In terms of accessing and sharing data, it would help choose a specific consumer base that understands what type of data on furniture usage would best benefit them to increase sustainability measures in their everyday lives.

Case Study #3: UNITED TEXTILE GROUP X DIGIMARC X VIA

The United Textile Group, a textile production company based in Denmark that produces garments through 3D technology collaborated with DIGIMARC and partnered with HL-repro, in the addition of a digital watermark that captures and uploads data to the cloud such as the origin, recyclability, location etc., of the products. This project aimed to find out how digital watermarking technology can be integrated into garments in small designs using little ink and investigate new sustainability approaches in business.

The exhibit had vibrant patterned dresses on display that do not have any sort of technology in them, instead, it was a way of transforming pixels into readable data. Recycling transparency is an output of this project as users may be able to cut up the textile products into multiple pieces and it would still detect the data. DIGIMARC's one-of-a-kind traceable code that is found in textiles uses a small amount of ink through the digital watermarking technique. Traceability is critical for brands and products as it creates a line of information sharing from the brand to consumers.

It is necessary to look at technological structures in patterns versus solid printed clothing to obtain the DIGIMARC code. The textiles will pull out an extensive amount of information on how it is made and track the origin of the clothing. In terms of the textile print, upon scanning, it will investigate the reusability of the products and the recyclability factors. In the future, both these companies hope to investigate having products that be able to share data from the fibers themselves such as if the item is made by a certain generation of recycled material.

Insights (Panel Discussion)

The European Commission (EU) is leading a sustainability directive called the Corporate Sustainability Reporting Directive (CSRD) to ensure that companies are publicly disclosing information on environmental matters (European Commission 2022). This use of information shows a united commitment for not just companies but the nation's leading the way for sustainability. However, with new regulations, it is critical to incorporate this into the technology at hand because it is evolving and there are always concerns for modern technologies. Getting access to sharing data can be newly adaptable for business models such as the concept of reselling, which is a new way to collaborate amongst each other and share new methodologies to approach sustainability. These companies are not users, but they become a part of the users' chain and continue with them on their circular product journey. Thomas Hartvigsen from HL-repro discussed the importance of industries tackling circularity and sustainability issues together as a united front to influence new directives with the EU. The bridging of information from corporations to consumers informs the circular economy but it is integral for these companies to grasp what information should be shared and be overwhelming for the average consumer.

Conclusion

What is the future of IoT technology in the lifestyle space? In all three brands, IoT technologies paved the way for the traceability of critical data that leads to the sustainability of the products and the reduction of carbon emissions. Blockchain and IoT technologies tackle the management of carbon emissions through the integration of supply chain partners and strengthen supply chain carbon emissions (Wang et al., 2020). Traceability gives consumers brand transparency and enables them to be more sustainably conscious with the consumers as well. This exhibit promotes innovation in reducing energy consumption within everyday products and offers consumers a chance to lead a sustainable life with the integration of IoT technologies. The incorporation of such technology in clothing is transforming the fashion industry. When brands like GANNI and Wehlers include IoT in their denim and chairs to share valuable education, it influences circularity amongst consumers where they are more willing to understand their sustainability impacts and take care of their products. Consumers will be more self-aware of the products that they purchase and are more inclined to maintain them if given the right information. Lifestyle companies should collaborate with technological companies to promote inventive products that are committed to being environmentally conscious. We hope that the research behind the projects will inspire students from KEA and both the lifestyle and textile industry to see the possibilities to do better in terms of providing sustainable options to consumers.

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Case Study #3: UNITED TEXTILE GROUP X DIGIMARC X VIA

Case Study #2: WEHLERS X MICOLLECT X FORCE Technology

Case Study #1: GANNI X PUFIN ID X KEA

Final panel debate