Sustainability and energy demand project topics HT 2023

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Designing Solar-powered Social Media and Shopping

- **Background:** The vast majority of websites, apps and services are designed for always-on and high bandwidth connectivity. As a result, they use a lot of data, which in turn can use a lot of energy, which is in turn bad for the environment. At the same time high data demand can lead to bloated and slow user experiences. This project will build on examples of the solar internet, to prototype and test interaction techniques and design for the constraints of using solar-powered servers, such as https://solar.lowtechmagazine.com/. The research will develop alongside the Solar Internet research project, funded by the Swedish Energy Agency to ask: How do we communicate the constraints of solar powered internet while maintaining or even extending the user experience?
- **Project/Task:** The project will involve the prototyping of interactions for websites and testing those with a small user group. The prototyping will require some preliminary research, brainstorming design, use of either low- or high fidelity prototyping tools, and design of user tests. User testing will be necessary to ensure successful design strategies are deployed.
- **Research Method:** The project will follow a research-through-design process, where the design of interactions generates knowledge on constraints-based computing for sustainability. The method can follow standard design processes, likely with an emphasis on showcases multiple interactions, rather than one finished product. User testing should follow procedures for usability testing and could make use of the department's usability lab.

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Web design and electricity consumption

Electricity consumption from internet use is increasing. The digital infrastructure supporting cloud services induces environmental effects, . At the same time, web design can affect the energy consumption of surfing the web, there are efforts to redesign websites to be require less data to be transferred.

The purpose of this project is to add to existing research on how design practice affects the environmental impact of the internet. Because web design practice is likely affected by how web design is taught and the kinds of tools employed in the design practice, it is relevant to explore to what extent electricity use is considered in these domains. Hence, the purpose of this project is to explore:

- What is “good design” in the dominant discourse of web design practice?
- To what extent is electricity use considered in the design discourse?

This project is to employ qualitative methods to study how web design is being taught. The exact focus of the project can be adapted to the student’s interest but the focus should be on dominant discourse related to web design practice. Possible sources of material could be university educational material, interviews and/or observation teaching of web design. A focus on textual material could also be appropriate, such as textbooks or authoritative webbased resources on web design such as blogs. Another option could be to study software as a service for website building or other relevant the tools employed in web design. The analysis could be grounded in discourse analysis (or equivalent).

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Energy and environmental impact of games in Sweden

- **Background:** In Sweden, gaming currently accounts for perhaps 0.3% of electricity demand; and a conservative estimate is that this will rise to about 1.2% by 2030. Or, 2.5% if 4K-capable cloud gaming services take off. As gaming continues to grow, we must shape this growth in sustainable ways.
- This is a broad and challenging topic, involving a variety of participants, stakeholders, and data. As such, a project could take any number of approaches, for example:
  - interviewing people that play games about what, when, and how they play;
  - performing network measurements (see the Internet Microscope projects below) and power measurements of games devices to better understand their potential impacts.
- There is a small amount of work on this topic, including one book recently published, and one UU master's project completed in summer 2022. So, any further work needs to be carefully scoped to have a non-overlapping contribution.

References:

Oliver Lönnqvist. Sustainable Game Development: Mapping the climate impact and the negative impact reduction actions in the Swedish gaming industry. UU master's thesis, STS programme. June 2022. http://uu.diva-portal.org/smash/record.jsf?pid=diva2%3A1691000

Abraham, B. (2022). Digital Games After Climate Change. 1st ed. Palgrave Macmillan

Matthew Marsden, Mike Hazas, and Matthew Broadbent. 2020. From One Edge to the Other: Exploring Gaming's Rising Presence on the Network. In Proceedings of the 7th International Conference on ICT for Sustainability (ICT4S2020). Association for Computing Machinery, New York, NY, USA, 247–254. https://doi-org.ezproxy.its.uu.se/10.1145/3401335.3401366

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Is *Twitch* Sustainable?: Streaming for Sustainability

- **Background:** Online live video broadcasting or Streaming stimulates numerous nodes of potential climate and energy impact. The media requires energy to both produce and consume, it relies on high-end computer hardware to facilitate and strong internet connections to distribute. Streamers often broadcast for hours at a time, alongside thousands of others, to millions of concurrent global viewers. What are, and how can we understand the climate and environmental impacts of streaming on, for example, Twitch.tv? Additional facets are certainly also part of streaming, these include; digital platform labor, online content creation & creativity, digital para-sociality, gender, mental health, and so on. These can of course also be considered within the project to supplement the research around sustainability.
- **Project/task:**
  - Enquire into the data and/or energy demands of streaming on Twitch (or other service) through meta-data scraping or other quantified measurements.
  - Interview Streamers and/or Viewers to understand why, how, when, where, etc., they stream/consume streaming content.
  - Simulate streaming and measure the data and energy consumption of devices/services used in the practice.
  - Investigate the footprint of Twitch.tv by deploying LCA (Life Cycle Assessment) methodologies.
- **References:**

Nordgren, Ossian. 2021. “Streaming for Sustenance: A Study of Streamers in Sweden and The Digital Platform Labor Order”. Bachelors’ thesis, Stockholm University.

- Fletcher, Chloe, Jigna Chandaria, Louise Krug, Penny Guarnay, Christian Toennesen, Glynn Roberts, Catherine Van Loo, et al. “Carbon Impact of Video Streaming,” n.d.
- Marsden, Matthew, Mike Hazas, and Matthew Broadbent. 2020. “From One Edge to the Other: Exploring Gaming’s Rising Presence on the Network.”. In Proceedings of the 7th International Conference on ICT for Sustainability, 247–54. Bristol United Kingdom: ACM, 2020. https://doi.org/10.1145/3401335.3401366.
- Taylor, T.L. 2018. Watch Me Play. Available at: https://press.princeton.edu/books/paperback/9780691183558/watch-me-play (Accessed: 29 September 2023).

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Extreme Weather Preparedness with Crisis Informatics

The rates and intensities of heatwaves and heavy rain are expected to increase with climate change. Heatwaves and flooding can have a negative impact on the health, especially for vulnerable populations. The availability of weather data affects the ability to mitigate negative health effects.

- **Option A: Flooding** The purpose of this study is to explore to what extent drones can be used for participatory mapping of flood maps or in flooding response. Drones are already used by emergency services and have the potential to be used to detect flooded areas. It would also be possible to explore how AI can be used to detect flooding based based on mapping with drones.
- **Option B: Heatwaves** The purpose of this study is to explore to what extent existing weather data sensors in households could be incorporated into citizen science infrastructure for heatwave sensing. In the Nordic region, heatwaves are confined to a limited time period. Hence, infrastructure for citizen science based heatwave data could potentially be useful only for a few months. Citizen science has been employed to provide data on the indoor heat stress to account for the micro-climate in urban areas and a way to supplement the weather data produced by weather stations located away from urban heat islands.

The project will follow a research-through-design process to generate knowledge on constraints-based computing for climate change adaptation.

Please reach out for an initial reading list to prepare your project proposal.

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Scaling the Internet Microscope

- **Background:** How can we better investigate home Internet service demand, and how that ties with everyday practices? One way is to look at what Internet services are being relied upon in the home, and how inhabitants report spending their time. We have developed a method of sampling households using an off-the-shelf network monitoring device (described at the link below). Volunteer households install the device and fill out a time use diary, so that we can draw connections between online services used, and how people spend their time (and what they think is meaningful or important).
- **Project:** Apply the method in a small number of volunteer homes in Sweden, and perform an analysis, with possible focus an area of practice (watching, shopping, etc) that you are interested in. Or, you could focus your analysis on traffic that seemingly has no purpose or meaning for householders (e.g. advertisements or smart home devices "phoning home" to a data centre). We also encourage reflection and critique of the methodology.
- **References:**

https://www.it.uu.se/research/human-machine-interaction/digital-ecologies-lab/internet-microscope

Kelly Widdicks, Mike Hazas, Oliver Bates, and Adrian Friday. 2019. Streaming, Multi-Screens and YouTube: The New (Unsustainable) Ways of Watching in the Home. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19). Association for Computing Machinery, New York, NY, USA, Paper 466, 1–13. https://doi.org/10.1145/3290605.3300696

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Machine Learning the Internet Microscope

- **Background:** We are developing a methodology (link below) to quickly gather 24-hour samples of Internet usage from homes using NetFlow. It logs the IP endpoints, time and duration of the connection, and total data sent/received. However, usage of a given service (e.g. Netflix or Facebook) involves many different IP endpoints (advertising, tracking, analytics, and metadata/control channels).
- This project will work with one or more NetFlow datasets, to automatically group and classify the connections logged. Subclassification would also be of interest, for example "1 GB was attributable to a particular social networking service in the 24 hour sample, of which 400 MB was video and 200 MB was advertising."
- **References:**

https://www.it.uu.se/research/human-machine-interaction/digital-ecologies-lab/internet-microscope

For a description of the issues and challenges of attributing (based on reverse DNS lookup) and grouping NetFlow logs, have a look at sections 3.2.1.2 and 3.2.2 of this PhD thesis by Kelly Widdicks:
https://eprints.lancs.ac.uk/id/eprint/143606/1/2019widdicksphd.pdf

For an example of how well-analysed logs can lead to research outcomes:
Kelly Widdicks, Mike Hazas, Oliver Bates, and Adrian Friday. 2019. Streaming, Multi-Screens and YouTube: The New (Unsustainable) Ways of Watching in the Home. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19). Association for Computing Machinery, New York, NY, USA, Paper 466, 1–13. https://doi.org/10.1145/3290605.3300696

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Turning the Smart Home from Brown to Green

- **Background:** Smart home technologies are often perceived as facilitating sustainable energy usage through optimizing and energy efficiency measures. In reality these promising features are often offset by other qualities such as pleasance and comfort that drive energy consumption, thus causing rebound effects. At the same time, recent developments have proven that energy is becoming a precious commodity that needs to be managed frugally.

- **Task:** In this thesis proposal we want you to design and build a smart home technology proof of concept based on the principles of digital sufficiency as well as energy resilience. It could for example be a redesign of an existing system such as Philips Hue or Google Nest.

- **Methodology suggestions:** Research Through Design, Autoethnography, Speculative design, Critical design

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Rural broadband in Sweden

70 % of Swedish households have fibre to the premises (gigabit capable). But there is still a fairly large amount of households that still has no possibility to have broadband in their homes. This project would look into this topic and focus specifically on the possible implications for sustainability and social justice.

This project could either have a desk-based research approach, looking into the government vision and analysing the the policies. It could also have a more ‘empirical’ approach including interviewing and (qual or quant) observation in rural households that have no access to broadband in their homes.

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