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[UBI-A] Better Communication Cues in Video Conferencing Systems

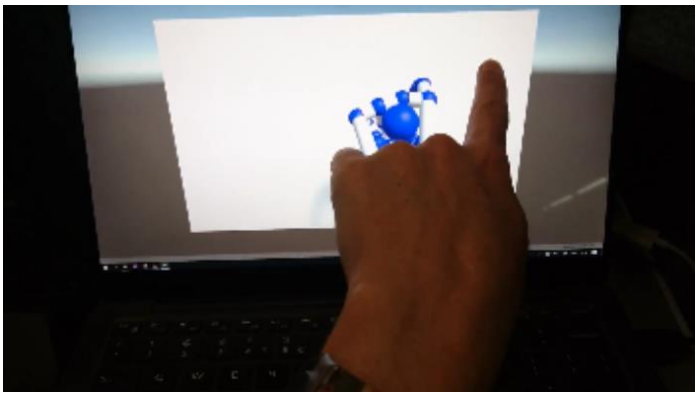
(Hans W. Gellersen – hwg@cs.au.dk, Jens Emil Grønbæk – jensemil@cs.au.dk)

Much of our collaborative work today is mediated by video conferencing tools. The tools today enable meeting participants to share their screen and point at the content with their mouse cursors to support the communication. However, video communication inhibits other non-verbal cues that we normally rely on when sharing the same physical space. For instance, in Zoom or Skype, you cannot see where people are looking, and people cannot naturally point to screen content using their hands. This often results in ineffective collaboration.

You will have the opportunity to extend the work on an existing research prototype designed to support flexible video conferencing. The prototype system is called MirrorBlender. The system already has the infrastructure for video conferencing using WebRTC, which you then do not have to implement from scratch. See video of the MirrorBlender prototype and concept here:
https://www.dropbox.com/s/u1i2aesvmtciwa6/MirrorBlender_CHI2021_FinalDraft.mp4?dl=0 (research on MirrorBlender is currently under peer review. Please, do not distribute this video!) MirrorBlender is a What-You-See-Is-What-I-See interface that supports blending, repositioning, and resizing mirrors. Mirrors are shared video feeds of people and screens. Meeting participants can leverage their mirrored images for gestures, like pointing on the screen content.

You can choose between two subprojects that extend MirrorBlender by addressing different issues of remote communication. You are expected to build a prototype in one of these subprojects and evaluate the system and interaction techniques that you build with users in a controlled setting.

[UBI-A1] Hand tracking for screen pointing in video conferencing systems



Currently, in MirrorBlender (see video link above), users have to point in mid-air in the camera field-of-view for remote participants to see where they are pointing, and they cannot point directly on the screen content, as the hands are outside the camera field-of-view. In this subproject, you develop a prototype with a laptop and a hand tracking sensor (a Leap Motion device) to enable pointing on the screen content during video conferencing. The goal of the project is to enable pointing to screen content with virtual hands. The project involves the following steps:

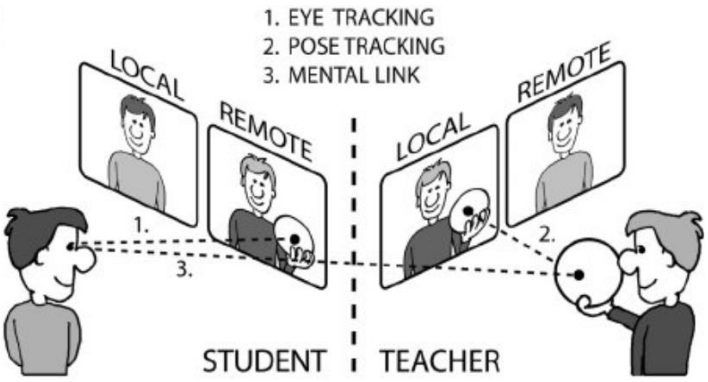
Developing a calibration method based on prior methods (e.g., see reference below). Once the space in front of the screen is tracked, the hands can be visualized outside the web camera's field-of-view, showing not only a person's 'talking head' video, but also the virtual hands extending from a person's real body in the video feed. The challenge here is to create a visualization of the hand that clearly communicates who is pointing where. Different virtual representations of hands and arms should be explored to find a good solution for the visualization. Beyond using the hands for communication cues, they can further be used as a means for interaction input, such as selecting and moving items on the screen via mid-air above-the-surface gestures (for interaction e.g., zoom by spreading fingers, pinching gesture, or communication e.g., highlighting/marking things with drawings). This enables new types of direct manipulation techniques designed to support communication with the hands.

Related Literature:

- Benko et al. 2009 “Enhancing input on and above the interactive surface with muscle sensing”. Proc of ACM ITS. doi: https://doi.org/10.1145/1731903.1731924
- Feuchtner & Müller 2017 “Extending the Body for Interaction with Reality”. Proc. of CHI. doi: https://doi.org/10.1145/3025453.3025689
- Calibration method: https://www.youtube.com/watch?v=7p0-9pBV6BM (“Where you point is what you get: Spatial mapping for touchless experiences with Leap Motion”)

[UBI-A2] Eye tracking for sharing attention in video conferencing systems

MirrorBlender (along with any of the commercial video conferencing systems) lacks support for feedback on shared attention, meaning there are no awareness cues for where remote participants are looking on their respective screens.



In this subproject, you will extend MirrorBlender with communication cues and interaction techniques based on eye tracking (from a Tobii Pro eye tracker). The goal of the implemented techniques is to support more effective communication around screen content in video conferences. Eye tracking can here be used for implementing communication/awareness cues as well as interaction techniques. For instance, your own video feed could follow where your eyes look, allowing others to subtly follow where you are looking as you speak. Or to avoid clutter in the view, when many people are present in the meeting, the video feed that most participants look at, could become more opaque while other feeds fade into the background.

Related Literature:

- Barakonyi et al. 2007 “Cascading Hand and Eye Movement for Augmented Reality Videoconferencing”. Proc. of 3DUI. doi: https://doi.org/10.1109/3DUI.2007.340777
- Gupta et al. 2016 “Do You See What I See? The Effect of Gaze Tracking on Task Space Remote Collaboration”. IEEE TVCG. doi: http://doi.org/10.1109/TVCG.2016.2593778
- Tanriverdi & Jacob 2000 “Interacting with eye movements in virtual environments”. Proc. of CHI. doi: https://doi.org/10.1145/332040.332443

[UBI-B] Multitouch and tangible interaction for web-based visualization

(Marius Hogräfer – mhograefer@cs.au.dk & Hans-Jörg Schulz – hjschulz@cs.au.dk)

Tangible devices allow us to tailor interaction specifically to a certain application, rather than just relying on mouse+keyboard. When using these physical objects on a tabletop display to rotate, move, stack, or connect virtual elements, user experience and performance can also greatly be improved. Therefore, they are a great fit for interactive visualization, where we can explore large datasets using visual representations like scatterplots or geographic maps. State-of-the-art visualization frameworks, however, are deployed through the web-browser, which means that we have no direct access to the hardware events that tangible devices emit.

In this Bachelor project, your goal is to bring together web-based visualization with tangible interaction. For this purpose, you are tasked to develop and implement a communication layer between the tabletop manufacturer's framework (https://ideum.com/products/touch-tables/pro) that receives the events from the tangible interaction and then forwards them to the browser using web sockets (e.g. using https://socket.io). The tabletop's framework uses C++ and Qt5 and the web-based visualization should be d3-based, but other than that you are basically free to choose any programming language that does the job.

Your research challenge in this project lies in exploring the questions on how to handle multiple, parallel interactions on the same device, how to determine the start and endpoints of an interaction, how to deal with noisy sensor data, and how to represent each interaction in the browser so they can be used to manipulate visualization.

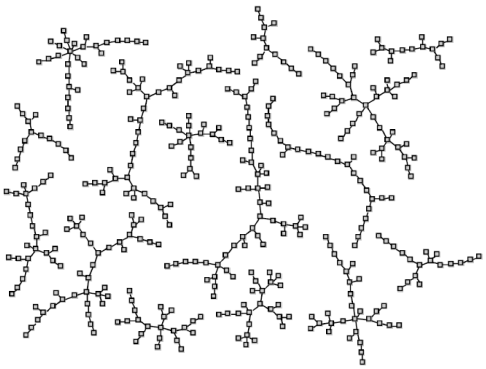
Related Literature:

- Ishii & Ullmer 1997 "Tangible bits: towards seamless interfaces between people, bits and atoms" Proc. of ACM SIGCHI. doi: https://doi.org/10.1145/258549.258715
- Ebert et al. 2013 "TangibleRings: nestable circular tangibles" in CHI Extended Abstracts on Human Factors in Computing Systems (CHI EA). doi: https://doi.org/10.1145/2468356.2468645
- Elmqvist et al. 2011 "Fluid interaction for information visualization". Information Visualization. doi: https://doi.org/10.1177/1473871611413180
- Bostock et al. "D³ Data-Driven Documents", IEEE TVCG. doi: https://doi.org/10.1109/TVCG.2011.185

[UBI-C] Reactive Polynomio Packing for Interactive Data Visualization

(Hans-Jörg Schulz – hjschulz@cs.au.dk)

Disconnected components of graphs are usually laid out individually and then packed together into a compact graph visualization using polyomino packing heuristics. This is for example used for layouts of forests (i.e., sets of trees) or for showing chemical structures, and it works well for generating static visualizations. But what if I want to interactively manipulte the resulting layout? Maybe drag one of the components to a new position. Or rotate or enlarge it? It is your task to adapt the polymino packing heuristic to allow for these interactive adjustments, while at the same time the remainder of the already produced packing is "disturbed" as little as possible to maintain the mental map of the viewers. After all, they only want to readjust one component, not the entire layout. We are looking in particular for a solution that is fast, so that already while dragging the component from one end of the visualization to the



other, all the remaining components continuously adjust themselves along the dragging path, but fall back into their original place once the dragged components cleared the area. To do that, a progressive solution is envisioned that generates increasingly better packings with each iteration, but can already output a first rough approximation of that packing in <100ms to maintain interactive framerates.

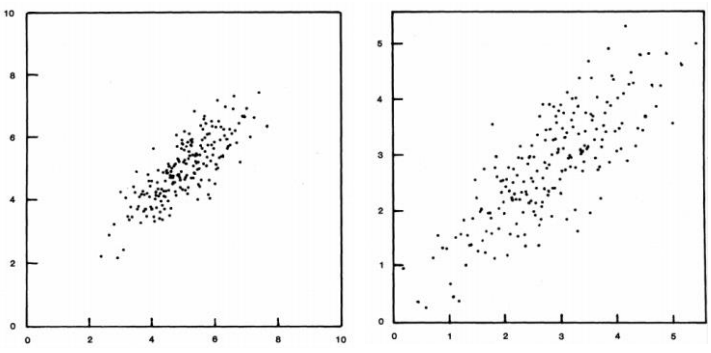
Related Literature:

- Freivalds et al. 2001 "Disconnected Graph Layout and the Polyomino Packing Approach". Proc. of Graph Drawing. doi: https://doi.org/10.1007/3-540-45848-4_30
- Başköy 2003 "Polygon packing approach to disconnected graph layout". MSc thesis Bilkent University. url: http://hdl.handle.net/11693/29260
- Goehlsdorf et al. 2007 "Placing connected components of disconnected graphs". Proc.of IEEE APVis. doi: https://doi.org/10.1109/APVIS.2007.329283

[UBI-D] Reproducible Data Visualization through Embedded Metadata in PNG Images

(Hans-Jörg Schulz – hjschulz@cs.au.dk)

Given any data visualization one can find on the web, all of these "end results of a visualization process" beg the questions whether the underlying data was not tampered with or whether the visualization technique was not deliberately parametrized so that unwanted details are hidden. Take for example the two charts shown on the side: the left one exhibits a rather clear positive correlation between x and y, whereas the right one shows a point cloud that is more dispersed. Yet, the right chart is actually just a zoomed-in version of the left! How can we thus trust a visualization? In a first step, it is your task to explore how metadata about the underlying dataset and the visualization procedure can be generated for a visualization and embedded as "ancillary chunks" in the resulting PNG file. In a second step, you are tasked to extend a standard PNG parser / viewer to read and verify these metadata to ensure that the given PNG image is indeed the result of the specified data + visualization process. In a last step, the possibility of using this metadata for visualization retargeting is to be explored. This would allow, for example, zooming out to see if the authors have not cropped important data points from the figure.



Related Literature:

- Dai et al. 2018 "Chart decoder: Generating textual and numeric information from chart images automatically" Journal of Visual Languages & Computing. doi: https://doi.org/10.1016/j.jvlc.2018.08.005
- Poco & Heer 2017 "Reverse-Engineering Visualizations: Recovering Visual Encodings from Chart Images" Computer Graphics Forum. doi: https://doi.org/10.1111/cgf.13193
- Jung et al. 2017 "ChartSense: Interactive data extraction from chart images" Proc. of CHI. doi: https://doi.org/10.1145/3025453.3025957
- Siegel et al. 2016 "FigureSeer: Parsing result-figures in research papers" Proc. of European Conference on Computer Vision. doi: https://doi.org/10.1007/978-3-319-46478-7_41

[UBI-E] Organic Charts – Nature-inspired Rendering for Data Visualization

(Hans-Jörg Schulz – hjschulz@cs.au.dk)

In data visualization, in particular in visual presentation scenarios, different rendering styles can be used to give otherwise common charts or diagrams a unique look & feel. The field of visualization knows a number rendering styles, such as sketchy rendering, impasto rendering, or watercolor rendering (see below).

Your task in this project is to invent and implement an organic rendering style for selected charts (preferably implicit tree diagrams) that gives a chart an organic – i.e., "amoebic" or "cellular" – look & feel that can be parametrized in its distortion of the underlying chart in a smooth manner from clear-cut & straight to amorphous & blobby. You can find some inspiration for that in the related literature.

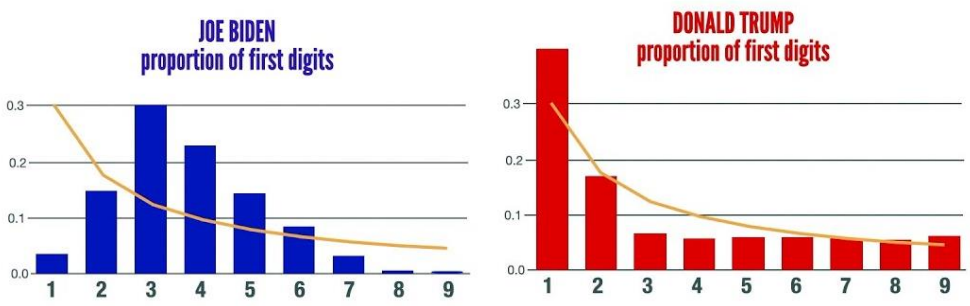
Related Literature:

- Görtler et al. 2018 "Bubble Treemaps for Uncertainty Visualization", IEEE TVCG. doi: https://doi.org/10.1109/TVCG.2017.2743959
- Collins et al. 2009 "Bubble Sets: Revealing Set Relations with Isocontours over Existing Visualizations", IEEE TVCG. doi: https://doi.org/10.1109/TVCG.2009.122
- Hlawatsch et al. 2014 "Bubble hierarchies". Proc. of Workshop on Computational Aesthetics. doi: https://doi.org/10.1145/2630099.2630107

[UBI-F] A Visual Analytics Tool to Identify Data Tampering

(Hans-Jörg Schulz – hjschulz@cs.au.dk)

Numerical data that is collected in an unbiased and even way exhibits certain distributions across its digits. This is known as Benford's Law and it is a simple way to detect potential data tampering, but often tricky to make sense of its results. I.e., if the distribution of digits deviates from Benford's Law, finding out why is not necessarily straightforward. It may for example be that the data simply does not fulfill the preconditions for applying Benford's Law – as is the case with election data. Other tests that can be employed in a similar vein are Zipf's Law and the Pareto Distribution. It is your task to combine these tests in a sensible manner in a "Data Checker Tool" that allows to run them on a numerical dataset, while at the same time warning the user if these tests are not applicable. The outcomes of these tests are then to be visually displayed. In a



next step, you are to extend your concept and tool to accommodate for streaming data – e.g., for sensor data streams to automatically detect not fraud, but malfunction of the sensors. Finally, you are tasked to apply your data checker tool to some openly available datasets, such as the "Skatteoplysninger for selskaber 2014-2018" (https://skat.dk/skat.aspx?oid=2167688) or the daily/weekly numbers of COVID infections across Europe (https://www.ecdc.europa.eu/en/covid-19-pandemic), and a suitable data stream (e.g., bitcoin transaction data).

Related Literature:

- Parker 2020 "Why do Biden's votes not follow Benford's Law?" url: https://www.youtube.com/watch?v=etx0k1nLn78
- Geyer & Williamson 2004 "Detecting Fraud in Data Sets Using Benford's Law" Communications in Statistics - Simulation and Computation. doi: https://doi.org/10.1081/SAC-120028442
- Whyman et al. 2016 "Intuitive considerations clarifying the origin and applicability of the Benford law" Results in Physics. doi: https://doi.org/10.1016/j.rinp.2015.11.010
- Goodman 2016 "The promises and pitfalls of Benford's law" Significance. doi: https://doi.org/10.1111/j.1740-9713.2016.00919.x
- Tao 2009 "Benford's law, Zipf's law, and the Pareto distribution" url: https://terrytao.wordpress.com/2009/07/03/benfords-law-zipfs-law-and-the-pareto-distribution/

[UBI-G] Exposing users to different narratives and opposing opinions

(Kevin Wenkai Han – wenkaihan@cs.au.dk & Hans-Jörg Schulz – hjschulz@cs.au.dk)

Many modern technologies exploit users' reward system and increase time spent in their products by predicting and showing things they like and agree with. As people are constantly reinforced only with views that they agree with, many researchers also argue that this has led people to have more extreme opinions, causing individuals to be more and more narrow-minded and biased.

But what if we show things different from what users look for or disagree with? Will this "de-bias" their preconceptions and open their mind to more different opinions? Does this make sense from a business perspective – e.g. how does it influence users' time spent in the product? Does this make sense from users' perspective – e.g. how does it influence the usability as well as user experience? These are all fascinating and important questions to answer. Your task is to explore possible designs that can expose users to diverse and different opinions, especially when they are doing data analysis, consider how they should be implemented, and how to evaluate them.

Related Work:

- Wall et al. 2018 "Four perspectives on human bias in visual analytics." in "Cognitive biases in visualizations", Springer. doi: https://doi.org/10.1007/978-3-319-95831-6_3
- Kretz 2018 "Experimentally evaluating bias-reducing visual analytics techniques in intelligence analysis." in "Cognitive Biases in Visualizations", Springer. doi: https://doi.org/10.1007/978-3-319-95831-6_9

[UBI-H] Vibrotactile feedback to increase trust and a sense of security in Visual Analytics

(Kevin Wenkai Han – wenkaihan@cs.au.dk & Hans-Jörg Schulz – hjschulz@cs.au.dk)

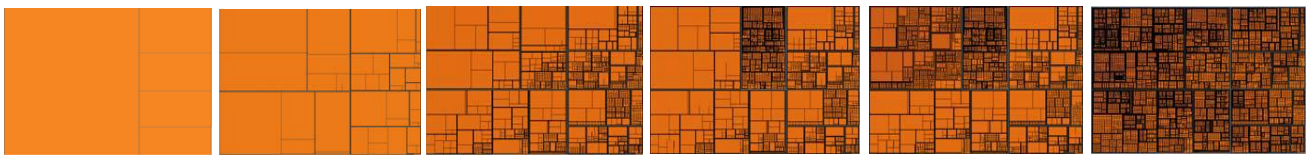
Tactile feedback is a physical response that relates to the human touch senses, and it has been widely used in many technologies – the vibrations on cellphones, tactile switches on mechanical keyboards, or resistances on knobs you are turning. Such tactile feedback usually provides a sense of confirmation, and in turn security of their actions, when users are interacting with different systems. In this project, you will investigate how vibrotactile feedback – essentially vibrations – can help to provide such sense of security and trust in their own actions when users are analyzing data visually.

Related Work:

- Han & Schulz 2020 “Beyond Trust Building — Calibrating Trust in Visual Analytics”, Proc. of TREX Workshop. url: https://trexvis.github.io/Workshop2020/papers/Han.pdf
- Han & Schulz 2020 “Exploring Vibrotactile Cues for Interactive Guidance in Data Visualization”, Proc. of VINCI, to appear. *Preprint available upon request from Kevin (wenkaihan@cs.au.dk).*

[UBI-I] Progressive Visualization Techniques (Hans-Jörg Schulz – hjschulz@cs.au.dk)

Progressive Visualization is a chart drawing paradigm, where not all data is shown at once – possibly after a lengthy layout computation – but instead added bit by bit to a chart so that it “evolves” from a rough sketch to the final polished visualization. A few progressive visualizations techniques are already known, such as Progressive Treemaps, Progressive Parallel Coordinates, or Progressive Scatterplots / Dotmaps. Yet for a variety of other charts, it is still open how to integrate such a progressive visualization paradigm with them and their usual layout algorithms. In this project, it is your task to fill some of these gaps and to propose – e.g., Progressive Line Charts, Progressive Area Charts, Progressive Chord Diagrams, Progressive Icicle Plots / Sunbursts, Progressive Venn Diagrams, Progressive Tag Clouds, or Progressive Cartograms.



Related Work:

- Rosenbaum et al. 2009 “Progressive Presentation of Large Hierarchies Using Treemaps” in “Advances in Visual Computing”, Springer. doi: https://doi.org/10.1007/978-3-642-10520-3_7
- Rosenbaum et al. 2012 “Progressive parallel coordinates”. Proc. of IEEE PacificVis. doi: https://doi.org/10.1109/PacificVis.2012.6183570
- Huron et al. 2013 “Visual sedimentation”, IEEE TVCG. doi: https://doi.org/10.1109/TVCG.2013.227
- Angelini & Santucci 2013 “Modeling Incremental Visualizations”, Proc. of EuroVA. doi: http://doi.org/10.2312/PE.EuroVAST.EuroVA13.013-017

[UBI-J] Evaluating parallelization frameworks for progressive visualization (Marius Hogräfer – mhograefer@cs.au.dk & Hans-Jörg Schulz – hjschulz@cs.au.dk)

In progressive visual analytics (PVA), the goal is to visualize early, incomplete results of long-running analytical computations, instead of having to wait for minutes, hours or even days before seeing a result. This means that we get a look at our data faster and can therefore also detect interesting patterns or errors. In both cases, we can potentially avoid waiting for the result while doing nothing, making the whole analytics process more efficient and the user experience more fluent.

A common way to achieve this progressiveness is splitting up the data into smaller chunks, running computations on these chunks one after the other, and then visualizing these intermediate results. Since PVA is rather recent research field, however, there currently is no tool support for this kind of workflow, where a result is refined over time. There are however many different approaches of parallelizing analytic computations.

The goal of this Bachelor project is to evaluate existing parallelization frameworks for their applicability for progressive computations. Your task will be to implement a progressive computation using a couple of these frameworks and then assess, how they perform in terms of how well they integrate with existing data science frameworks (such as R and scikit-learn for Python), their computational performance, and their ease-of-use (in terms of overall setup, lines of code, etc.). We will provide to you a basic event-based visualization pipeline, in which you can test these frameworks. This pipeline consists of a MySQL database on one end and a web-based visualization on the other. Here is a list of potential frameworks that you may choose to evaluate:

- C++20's coroutines: https://en.cppreference.com/w/cpp/language/coroutines
- Intel's Thread Building Blocks https://software.intel.com/content/www/us/en/develop/tools/threading-building-blocks.html
- Go's goroutines: https://golang.org
- Go for Apache Beam: https://beam.apache.org/documentation/sdks/go/
- Dask for Python: https://dask.org/, https://github.com/dask/dask

[UBI-K] Seamless music streaming room to room (Niels Olof Bouvin – bouvin@cs.au.dk)

This project explores network communication, mobile and server development, personal presence, identity, and preference, as well as collaborative spaces, and integration with and data mining of streaming services. The goal is to develop one of two scenarios, both involving music.

[UBI-K1] A home with speakers in each room

As the user comes home, their music transitions seamlessly from their phone (or other music player) to the loudspeakers in the home. As the user moves from room, their music follows them, so that it is not playing where they are not. If the home is not a single residency, the system keeps track of where the inhabitants are and adjusts the playback accordingly. The music is of course always in sync throughout the home. If there are multiple people, the system can combine their playlists and personal preferences into a shared playlist. Guests can be granted temporary access to affect the playlist.

[UBI-K2] A public place with one speaker and a communal playlist

There is one speaker system and thus only one playlist. The people present can make suggestions to the playlist, and others can in return vote or influence what is going to played next. People who have demonstrated good taste according to the room (upvoted songs) are given higher weight and influence. If no-one is voting, the system automatically plays music that matches the collective taste of those present.

Both projects involve developing a sensor platform that can reliably detect presence through, e.g., Bluetooth LE beacons, ultrasound sensors, or camera input. The sensed data is used to create a context sensitive system combined with what can be gathered from the users' online music profiles. Finally, the playback requires synchronization across different devices. From a concrete scenario, students will gain experience and understanding of Ubiquitous Computing fundamentals as well as advanced topics, distributed programming, and Web integration with existing services.

[UBI-L] Office of the future: Interaction Techniques and Interactive Interiors (Marianne Graves Petersen – mgraves@cs.au.dk)

In this project you should pick a specific challenge related to "Office of the Future", to explore how the design of new interaction techniques, or interactive interiors can provide new opportunities for how we inhabit offices of the future. Challenges might include designing for mixed meetings where some are co-present and others remote, designing for the office@home, designing social architecture that allows for shifting forms of collaboration at work.

Related Work:

- Raskar et al. 1998 "The Office of the Future: A Unified Approach to Image-Based Modeling and Spatially Immersive Displays". Proc. of ACM SIGGRAPH. doi: https://doi.org/10.1145/280814.280861
- Grønbæk et al. 2020 "KirigamiTable: Designing for Proxemic Transitions with a Shape-Changing Tabletop". Proc. of CHI. doi: https://doi.org/10.1145/3313831.3376834

[UBI-M] Interaction Techniques for Cross-*surface* Interaction (Marianne Graves Petersen – mgraves@cs.au.dk)

Cross-device interaction has become a research topic as we no longer engage with primarily one computer at a time, but rather an ecology of different types and sizes devices, both in our individual work and life, but not least in collaborative work. But what happens as the nature of our device ecology changes from devices to surfaces and even to dynamic surfaces? How can we meaningfully interact, collaborate and engage with contents and means of interaction which shifts between e.g. dynamic table-top-surfaces, tablets, and boards. This work extends the work presented in [Grønbæk et al. 2020] in order to explore how the interaction techniques presented in this paper can extend beyond a single shape-changing surface in order to support cross-surface interaction.

Related Work:

- Grønbæk et al. 2020 "KirigamiTable: Designing for Proxemic Transitions with a Shape-Changing Tabletop". Proc. of CHI. doi: https://doi.org/10.1145/3313831.3376834
- Houben et al. 2017 "Opportunities and challenges for cross-device interactions in the wild" interactions doi: https://doi.org/10.1145/3121348

[UBI-N] Computational Thinking and Emerging Technologies in Education: A Tangible Approach to Explainable and Explorable Machine Learning (Marianne Graves Petersen – mgraves@cs.au.dk)

Digital fabrication and maker initiatives have gained immense momentum in education practices, creating new teaching practices and brought a range of new tools into the hands of children and non-specialists. However, during the past decade, increasing attention has been given to children's digital competence in order for them to fit a highly digitalized and automatized future work market and society. Consequently, Computational Thinking (CT) is being implemented in educational programmes providing children and young people with a basic understanding of algorithms, decomposition and pattern recognition. However certain emerging technologies such as Machine

Learning have already shaped and transformed parts of our society (O'Neill, FaCCT conference series, but at the same time, it is particularly hard for the public and young people to understand the fundamental principles, the nature and implications of the widespread use of machine learning. This project will look into designing a tangible interface allowing young people to unboxing and de-mystify emerging technologies such has machine learning in order to empower them to recognize and reflect upon the pervasive integration of ML in their own lives as well as at a societal level.

Related Work:

- O'Neil 2016 "Weapons of math destruction: How big data increases inequality and threatens democracy", Crown
- ACM Conference on Fairness, Accountability, and Transparency - https://facctconference.org
- Kaspersen et al. 2021 "The Machine Learning Machine: A Tangible User Interface for Teaching Machine Learning", in Proc. of TEI (Tangible and Embedded Interaction), to appear
- Bilstrup et al. 2020 "Staging Reflections on Ethical Dilemmas in Machine Learning: A Card-Based Design Workshop for High School Students". in Proc. of DIS. doi: https://doi.org/10.1145/3357236.3395558

[UBI/ST-O] Digital Health (Peter Gall Krogh – pkrogh@eng.au.dk)

The Danish healthcare system and initiatives in public health have an ambition of using digital technologies in care, cure and well-being concerning people's health both mentally and physically. In collaboration with researchers at public health this program invites students to design, develop and cooperatively work with people, patients, and healthcare workers in the range of both chronically ill people and preventive medicine. Conceptualize tools that help family doctors and tools that aid people, patients and relatives to better achieve a sense of well-being. The Bachelor projects may connect to existing research projects in fields such as diabetes, prostate cancer, stress among young people and rhinitis. However, we also welcome work and ideas outside this.

[UBI/ST-P] Technologies for green / sustainable living (Peter Gall Krogh – pkrogh@eng.au.dk)

What might be the role of digital technologies for promoting/ helping green sustainable living? The digital infrastructure of our societies is by character far from CO2 neutral, and not is it in itself "green". However, the infrastructure, configuration and design of such technologies, may significantly help us lead more sustainable life. The ambition of this theme is to unpack, prototype and design and build initial systems, artefact and concepts that help us develop everyday strategies for a more sustainable life on earth. Concepts may range from improved everyday tactics for sustainable consumption, to planning green personal transportation, infrastructuring communities to digital support of concept such as prosperity without growth.

[UBI/ST-Q] Textiles and shape change (Majken Kirkegård Rasmussen – mkirkegaard@eng.au.dk)

This project will investigate how shape-changing interfaces can take advantage of textile construction to control the actuation. The object of the project is to explore how different types of knitting/weaving/treatment of textiles can be used to control the way the shape change occurs, and potentially take advantage of engineering the mechanical properties of the material structure in order to minimize the need for actuators. The project outcome should be a series of material samples showcasing different principles, and at least on example of applying one or more of the principles in a physical prototype. This project requires the effort of a group of students who have experience with constructing tangible user interfaces, as well as an interest in material explorations.

Related Work:

- Albaugh et al. 2019. "Digital Fabrication of Soft Actuated Objects by Machine Knitting". Proc. of CHI. doi: https://doi.org/10.1145/3290605.3300414

[UBI/ST-R] Affordances and shape change (Majken K. Rasmussen – mkirkegaard@eng.au.dk)
This project will investigate how theories on affordances (based on Gibson's ecological perception and activity theory) can inform the design of shape-changing interfaces. The project will explore how form and materials be used to communicate the interfaces'/object ability to transform its shape, as well as test whether what is intended to communicate is perceived in a user test. By doing this project you will get insights into the theoretical foundations of the concept of affordances, which is a widely used concept in interaction design. In addition, you will get experience with designing and implementing shape-changing interfaces. The outcome of the project should be a series of sketches and physical prototypes, that can be tested in user studies. This project requires the effort of a group of students who have experience with constructing tangible user interfaces.

Related Work:

- Petersen et al. 2020 "Affordances of Shape-Changing Interfaces: An Information Perspective on Transformability and Movement". Proc. of DIS. doi: https://doi.org/10.1145/3357236.3395521

Note: Projects [UBI/ST-O] through [UBI/ST-R] will be carried out in cooperation with the Socio-technical Design Group at the Department of Engineering.