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# Documenting how we Design with Data from Internet of Things devices.

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**Abstract**

The development of an Internet of Things Lab at the University of Edinburgh, offers an opportunity to better understand how the flow of data from connected devices influences the design process. The proposed study will document how data that is observed and captured from domestic internet of things appliances affects the decision making of the design team including users. The use of a bespoke router software will be used to capture data from devices, whilst established ethnographic methods will be used to understand social practices.

**Author Keywords**

Design, Data, Internet of Things, Security,

**ACM Classification Keywords**

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

**Introduction**

Design has captured and documented its processes throughout it's history using varying forms of qualitative and quantitative methods. From sketchbooks to accounting tools, cameras to emails, designers understand the need to capture activities in various means in order to engage with others and for self reflection. Traditionally, whilst the methods of

gathering material has been split between the qualitative dimensions of sketchbooks and participatory activities that demonstrate creative process, and the quantitative aspects of contract work in order to evidence financial, legal and temporal activities, the emerging role of databases, code and algorithms within design practice requires us to find new ways to capture how we design with data.

### **Background**

This proposal is inspired by the design activities within a series of research projects that forced the investigators to reconsider how they capture material that informed the design process both in material spaces (studio, ethnographic settings), as well as through the data that was captured by artefacts and was pushed to databases (Cila et al 2015). Within these design contexts data captured as document of process (analogue and digital), also becomes material for design.

The research also evokes the Ablative Framework for Designing from/with/by Data proposed by Speed and Oberlander (2016) that provides definitions and categories for occasions in which designers use data in different ways to inform or lead their practice. The setting proposed for documentation for the Documenting Design Research Processes workshop, falls in to the 'designing with data' category 'when systems are designed by people, where they take into account the flows of data through systems, and the need to sustain and enhance human values.' (Ibid).

### **Proposed project for capture**

#### *The project or institutional/organizational frame*

The Centre for Design Informatics has been awarded monies by GCHQ to create an Internet of Things (IoT) lab composed of common domestic internet connected devices that surreptitiously gather data and a packet capture system that can be used to monitor home user behavior. The lab will be used for multiple projects around home network privacy and security across the Schools of Informatics and Design.

#### *Describing the design process to be documented*

The project involves interactions between an interaction designer, a software engineer, students for whom the final outcomes are designed, research investigators and the behaviours of a suite of commercially available domestic Internet of Things appliances. The design processes that we would like to capture involve the relationships between humans (designer, software engineer and users) and the data that the domestic appliances produces.

#### *The focus of the documentation*

The project involves 4 stages, and we are particularly interested in the more designerly elements of this; parts 2-4, which involve designer 1. understanding the nature of the data that the artefacts send and receive across the local network and the internet, 2. Design of an API to allow students to interface with the system, 3. Design of devices that allow users of the appliances to quickly understand the network activity of 'things'. These projects will follow University ethical guidelines.

#### *The tools and and strategy for documenting the project*

A two person team has been identified to lead four significant parts of the development of the platform:

1. Establish a router which will perform packet capture and store the resulting packets in a SQL database.
2. Turn 'on' a suite of new IoT devices within a domestic context to capture and understand the purpose and destination of any data that these commercial devices are sending through the router .
3. Design and implement an API similar to the ThingSpeak API that allows students to attach personal devices to the same router, but to also interface with the commercial products to understand how they function.
4. Design people-centred feedback devices that are connected to individual devices in order to make them aware of any adverse activity associated with each device, but also as a collection of devices.

To date (mid-April 2016) part one of the work packages has been completed and we are about to begin part 2 which would represent the first part of the three empirical studies to document the design process:

1. During part 2 of the above process the designer's experiences will be documented through three primary methods:
  - a. Tasked with unpacking each appliance and following manufacturers instructions to turn each one on, the router (1) will capture all and any data that the device is sending across the local network and on to anything across the internet. The log files that are written down to the database represent the first document of 'thing' activity that will inform the designer decisions in parts 3 and 4.

- b. We will request that the designer documents their activity through electronic and physical note books, sketch books and photographs as they work through the task. The designer and artifacts will be fitted with an Autographer (SenseCam) whilst carrying out the work.
  - c. An unstructured interview will be recorded following the designer's completion of the task.
2. Part 3 involves close collaboration with the programmer in order to develop an API that will support MA/MSc Design Informatics students in their engagement with the router, database and physical artefacts. This process will be captured in the following way:
  - a. We anticipate a series of meetings with the project investigators, the software engineer and the designer to better understand the next steps toward the API, following findings from part 2. Meetings will be captured on video / audio and any notes, sketches or diagrams will be photographed.
  - b. The software development will be lead by the software engineer but with close communication with the designer. Email communications during development will be stored, and physical meetings that involve reflections upon stages of development will be captured through audio and with the Autographer.
3. Part 4 is a design centered small project that involves the development of small electronic systems (Arduino / Electric Imp) that are associated with each domestic appliance and allow the owner / user to understand if the network activity of each

device exceeds the levels that were established earlier in part 2 testing the devices. Although some directions have been mooted about how this device will be manifest in form, function and user design, a series of steps will be documented toward the design of a first version.

- a. It is anticipated that the designer will be based in the Design Informatics hack lab whilst developing the electronics and software, the space will be equipped with a GoPro to observe the use of materials and tools, whilst the designer will wear an Autographer to capture their perspective.
- b. The designer will work closely with masters students who are residents of the T-Room studio and will be able to participate in the form of the device for whom they will become the ultimate users. Meetings, small workshops that include any iterations between the designer and the students will be captured using stills cameras and where possible video / audio to better understand the conversations that we expect to involve explanation of the system, memories of part 2, and how the API has been designed in part 3. We also anticipate the designer to reveal data held on the database in order to explain the network activity of the devices, and documentation of how this data was captured.
- c. Any installation and preliminary testing will be documented through video and still camera, as well as network activity on the database.

At each stage documentation will be compiled and stored on a secure server for use in the workshop.

Where we have funds, files will be transcribed for analysis at the workshop.

## **Conclusion**

The intentions of this study are to better understand how to document design processes that involve the flow of data. With the design of Internet of Things devices beginning to become central to interaction design studios, there are very few projects that try and make privacy data available to designers and understand how this data informs the design process.

The objectives of the IoT Lab achieved through the work packages detailed in this proposal, offer a series of opportunities to better understand how this documentation in both qualitative and quantitative forms influences decision making and communication between those involved.

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