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# Exploring Future IoT for Families through End User Development

Applying Do-It-Together practises to reveal Family Dynamics in Technology Adoption

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## ABSTRACT

Industry and research increasingly explore opportunities to make our homes smart, e.g. through the Internet of Things (IoT). Technological developments nurture this rise of smart products, seemingly corresponding to households' needs. Yet, these domestic environments remain a complex domain to study or design for. This work explores the understudied complexity of families' needs and values in relation to connected and smart technology, in particular as a multi-user group. By leveraging participatory and do-it-yourself practices, I aim to engage families in discussion - and empower them to externalize and reflect upon their views. As such, I can study their reflective practices to reveal (tacit) understandings and (latent) needs which informs future developments in smart home technologies.

## CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; *Interactive systems and tools*.

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**KEYWORDS**

Smart Homes, Internet of Things, Do-it-Yourself, Research through Design, End-User Development

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This research is set up to answer the following two main research questions:

- What are family needs and values as a group, beyond functional and instrumental benefits, that engaging connected artefacts can support?
- How can we conduct and sustain End-User Development research into connected artefacts that is inclusive for all family members?

Subsequently, I am interested in:

- How do we involve all varying family members, who have different needs, values, skills and attitudes towards technology, whilst living in a (strict) social construct?
- What family dynamics underlie and influence technology adoption?

**Sidebar 1: Research Objectives****RESEARCH CONTEXT**

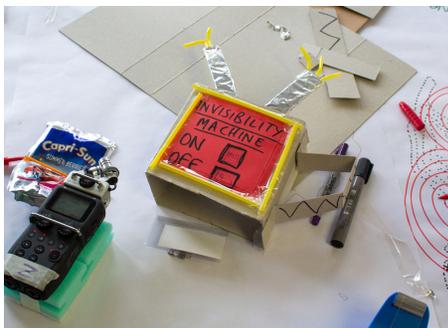
Domestic environments are increasingly being 'enhanced' with (inter)connected technologies, such as smart thermostats or smart speakers. The majority of these consumer market products have a strong focus on functional or instrumental benefits, such as saving money, time or energy - and equally focus on a universal user, rarely mentioning multi-user scenarios [4]. This exemplifies the challenge of conducting research in, or design for, multi-user domestic environments [1, 4] due to their complexity in values, needs and social constructs. Whilst the insights from deployment of specially designed research products and artefacts (Research through Design - RtD [11]) cannot always be generalized, this methodology allows us to get into these environments, and observe their complexity in response to (researcher intentional) changes and provocations. These designs could even not be grounded in needs and desires the participants or target groups are already aware of (e.g. in Cultural Probes [3]). Rather than developing artefacts to provoke and observe specific (future) scenarios, this research opts to leverage the multi-functionality trend of consumer products and contribute to a growing body of End-User Development (EUD) [8] work. As with Participatory or Co-Design practises [10], EUD considers end-users the experts of their own experiences, by allowing them to (re-)configure and alter the products functionality and purpose. This allows them - in my case the families - to experience a reflective development process that can elicit (tacit) values and (latent) needs, similar to the act of making in (RtD) design processes [12]. This research hereby explores family values for future smart home products, see Sidebar 1.

**APPROACH, METHODOLOGY AND CONTRIBUTION**

End-User Development (research) products can widely range from Graphical User Interfaces (GUI) to control factory processes, to playful toys to build mechanical constructions. As my interest lays within family processes towards smart technology adoption, I focus on empowering families to appropriate connectivity at home. The rise of the smart homes is envisioned to emerge through incremental additions of individual smart technologies [2], and thus my research intends to similarly concentrate on incremental additions of connected technology or functionality. To involve all family members with



**Figure 1: Our to-be deployed toolkit allows families to build data enabled artefacts without the need for coding or soldering - and thus focuses on making.**



**Figure 2: To gain a better understanding of household creativity and making, a workshop with 35 participants informed the development of our toolkit.**

<sup>1</sup>[www.arduino.cc](http://www.arduino.cc), last accessed 12/10/18

<sup>2</sup>[www.raspberrypi.org](http://www.raspberrypi.org), last accessed 12/10/18

<sup>3</sup>[www.samllabs.com](http://www.samllabs.com), last accessed 12/10/18

<sup>4</sup>[www.microbit.org](http://www.microbit.org), last accessed 12/10/18

their variation in age, interests, needs and attitudes, these additions will aim to invoke engagement, such that these engagements provoke the family members to learn and reflect [9]. This approach contrasts research into home automation (e.g. Artificial Intelligence, context-aware computing) and might contribute to the realization of seamfulness and heterogeneity in interaction ecologies [1].

To support this approach, my work leverages engagement from Do-it-Yourself (DIY) practices, and translates them to Do-It-Together (DIT) practices. It includes the development of a research approach into empowering families to craft/make engaging connected artefacts together (DIT), such that they might repeatedly appropriate these as they deem fit (EUD). By following an RtD methodology, I will use participatory practices to develop deployable DIT EUD designs (e.g. toolkits). Through their in-situ deployment and subsequent observation, I will report on their appropriation and influence on the family dynamics. The results will inform successive deployable designs within the research project, and will contribute to research into and developments towards connected technology for domestic environments. The developed designs and their deployment will further present themselves as feasible methods for participatory engagements for domestic research.

### Related Work

Do-it-Yourself (DIY) activities are not new. However, DIY in electronics and software - due to its increased in accessibility - has received increased attention in recent years [7]. Prototyping platforms have increased in popularity, and range from coding languages and platforms (e.g. Arduino<sup>1</sup> or Raspberry Pi<sup>2</sup>), to school and child-friendly modular hardware kits (e.g. SamLabs<sup>3</sup> or MicroBit<sup>4</sup>). Whilst these solutions are widely used and applied in educational settings, their cost or requirement for technical understanding remain a barrier for family DIY technology adoption. In EUD research, where costs are less of a threshold, support in creativity and creation remains a challenge, particularly in social-technical contexts and for non-information workers [13]. To overcome these challenges, my work contrasts educational toolkits by focusing more on making/crafting with materials - which I deem a known and accessible activity for many households. This work thereby contributes to EUD and DIY research and development through its shift in focus, to involve all family members in their experiences towards smarter homes.

Within our first toolkit we narrowed the technology and connectivity down to allow the creation of a simple data physicalization [6]. Related work often focuses on static data-sets, yet has also been applied in exploration of data representations in the home (e.g. [5]). This work builds upon those explorations by emphasizing the reflective development process during the act of making.

### RESEARCH STATUS

I recently commenced the second year of my faculty funded PhD (department of Computer and Information Science) under supervision of Prof. David Kirk and Dr. Kay Rogage and with support



**Figure 3: Through public engagements (here the UK Maker Faire 2018) initial feedback from our end-users can be gathered. This offers engagement with families before a more complex and invasive in-situ deployment.**

from the Northumbria School of Design (e.g. Dr. Abigail Durrant). I am nearing completion for my first deployable DIT EUD toolkit, see Figure 1. My first year has concentrated on the theoretical and experimental development of that toolkit, including participatory workshops to study household creativity and making (see Figure 2) and public engagements (see Figure 3).

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