GRACE: Broadening Narratives of Computing through History, Craft and Technology

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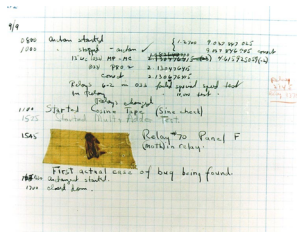kasper.lorentzen@gmail.com

Figure 1. Image of Grace M. Hopper's diary displaying the first computer bug (source: Wikimedia – photo courtesy of Naval Surface Warfare Center, Dahlgren, VA., 1988. - U.S. Naval Historical Center Online Library Photograph NH 96566-KN)

Abstract

Inclusion in computer science education and profession is a debated topic in recent feminist HCI literature. To enable inclusion in computer science, we must find new ways to create opportunities for broadening the narrative of computing embracing diversity. In this paper, we present GRACE, an interactive installation, which combines history, crafts, and digital technology. The installation creates an opportunity for multiple people to engage into discussions around inclusion in computer science, thus facilitates open discussion of perspectives beyond predominant narratives of computing.

Author Keywords

Inclusion; Interaction design; Narratives; Feminism; Grace Hopper.

ACM Classification Keywords

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

Introduction

On September 9th 1947, exactly 70 years ago, the computer scientist Grace M. Hopper reported in her diary the "first case of a bug being found", when she
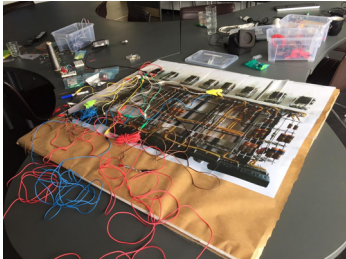
Figure 2. Early prototype of the installation

Figure 3. Large display of a vintage electromechanical computer with origami, microcontrollers, servos and LEDs
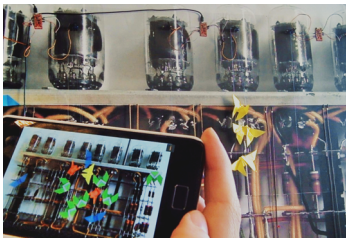

Figure 4. Interacting with the physical with the mobile app

was operating the Mark II computer (see Figure 1). Ever since, computer scientists have been "debugging" software, sometimes without being aware of the origin of the term and of the paramount role that women played in the early days of computing. Building on this story, we have developed GRACE: a playful interactive installation that enables a space to discuss challenges and opportunities for inclusion in computer science. The GRACE installation is part of FemTech.dk[1] research project, which aims at broadening existing narratives in computer science by creating, building, and introducing interactive artefacts based upon IoT principles of mixing physical and digital interaction. The FemTech artefacts are central to the arrangement and execution of both specific workshops or public events, which facilitate participants with different skills, perspectives and backgrounds come together experience computer science in new ways.

Conceptually, FemTech.dk builds on critical and reflective design in the creations of the interactive artefacts, and utilize these strategies to broadening narratives of computing. In concrete terms, we explore objects of design as a way to provoke reflection on issues of public interest (e.g. [3,4,8]). More concretely, GRACE is an installation grounded on the concept of critical design artifacts. Critical design artifacts are design objects that open questions regarding predominant narratives, while proposing an alternative agenda [7]. In addition to broadening narratives of computing, FemTech.dk envisions that the all artefacts created within the project contribute to a long-term engagement aimed at creating opportunities for inclusion in computing.

Methodologically, long-term engagement is attempted by combining events, artefacts, and digital platforms as a method to bring people together into issues of public interest [6]. Our aim is to create an international social network that can drive this agenda and, for this purpose, we have opened several social channels in Twitter and Facebook where groups of people can engage across events, time, and contexts. The GRACE installation is designed to broadening participation into computing though public events, thus, through GRACE we are able to join others in exploring the potential of public interventions (such as hackathons [5] and make-faires [9]) as a research methodology within HCI.

The following sections describe the installation and how it came to life at the Copenhagen Maker Faire in September 2017. We conclude discussing how we envision to demo Grace at GROUP 2018.

Installation: GRACE

The GRACE installation is a combination of physical and digital representations. The installation consists of a large public display (340cm by 180cm) of a vintage electromechanical computer, which serves as an IoT-platform for interactive analog/digital representations of origami paper bugs, which are added by participants (Figure 3). The origami bugs can be controlled (movement-servos and light-LEDs) by squishing digital representations of the origami bugs in the Grace App, which participants download to their own mobile devices (Figure 4). The app is freely available on Google Play[2] and in iTunes[3] .

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[1] Website at FemTech.dk

[2]https://play.google.com/store/apps/details?id=com.ettinenterta inment.grace&hl=en

The design choices attempt to open up questions on what is computing, telling the story of the historic event of Grace M. Hopper. By conceptualizing the installation around this historical event, we aim to create awareness on the role of women in the early days of computing. Furthermore, the choice of developing an installation, which combines basic materials (paper) and craft (origami) with software, microcontrollers, and actuators serves as a playful provocation of what creating a computing system might be [4]. With this provocation, we want to open discussions on various perspectives on computing with respect to, e.g., multidisciplinary approaches (arts, making, crafts, technology) and predominant narratives (nerdy, male-dominated, screen-based, solitary activity). In this way, the GRACE installation take a quite different approach to inclusion compare to prior approaches [2] based upon a deficit mode focusing on how to bring underrepresented populations into computing. Instead, GRACE creates a space, where diverse groups of people can discuss how computing can be transformed in a way that it can more clearly relate to people with different skills, backgrounds, and perspectives [1].

Event: Copenhagen Maker Faire 2017

The GRACE installation went public for the first time at the second edition of the Copenhagen Maker Faire, which took place in September 8th-10th 2017 in Carlsberg Byen in Copenhagen (Denmark). The organizing team was composed of seven people: four researchers (three from the computer science department and one from the science education

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[3] https://itunes.apple.com/us/app/grace-femtech-dk/id1269731761?mt=8

department), one origami expert (who helped selected four bug origami models), one software developer (who created the mobile application), and a computer science student (who replied to an open call to all the students at the computer science department, where we requested volunteers to offer their time to the project).

During these three days, we celebrated the 70th anniversary of the first bug being found by telling Grace Hopper's story to visitors, helping people to create origami bugs and engaging into discussions regarding inclusion in computing (Figure 5-7). More than 300 people (children, parents, makers, researchers, entrepreneurs) participated in the installation. Participants engaged in many different ways with the installation: some created the origami bugs, others interacted with the wall by playing with the mobile app and many engaged into discussions on the project and on the importance of broadening the narratives of computing. Indeed, we – researchers, origami expert, developer and student- played a paramount role in mediating discussions on narratives in computing.

Once participants left the installation, they were invited to do a micro-interview. The analysis of these data is currently in progress and it is out of the scope of this paper. However, building on preliminary results based on our observations, we think that having GRACE as a demo at GROUP 2018 can prompt informal discussions about inclusion in computer science: What does it mean to facilitate inclusion in computing? What can be alternative narratives? How can they be pursued? What can GROUP, as a research community, do about it? We propose to do micro-interviews with those conference attendees who participate in the demo. In concrete, we would ask them to reflect on the statements: "To

Figure 5. Participants interacting with the installation with their mobile phones

Figure 6. Organisers and visitors engaged into discussions around the installation

Figure 7. Participants creating their origami bugs to add to the installation.

facilitate inclusion in computer science I would…" and "I have experienced exclusion in computer science when…". The video-recorded replies would be archived and shared with the community as a collaborative effort to broadening narratives of computing.

GRACE at GROUP 2018

The installation can be set-up at GROUP 2018, given that we have access to the following materials:

- The original installation requires a large vertical wooden board (340cm by 180cm), but for the conference we would do a smaller version (84cm x 119 cm). We would need a wooden board or a wall on which two microcontrollers and four servos can be firmly attached. We would bring a printed image of the vintage electromechanical computer to be placed on it.
- Tools to attach the devices to the wooden board/wall such as a hammer and nails.
- Stable WiFi connection to which the microcontrollers can be connected. It is important that the connection does not have any network security system (e.g. firewall) preventing the microcontrollers to access the Internet network.
- Tables and chairs were people can do the origami and talk.

Acknowledgements

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