
Older Adults as Makers of Custom Electronics: Iterating on Craftec

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ABSTRACT

Researchers have designed technologies for and with older adults to help them age in place, but there is an opportunity to support older adults in creating customized smart devices for themselves through electronic toolkits. We developed a plan for iterating on Craftec – one of the first electronic toolkits designed for older adults – informed by the results of a participatory design workshop and user evaluation. We focused on supporting older adults to create exemplar artifacts, such as medication adherence systems. We contribute the exemplars and the current plan for components of the Craftec system as a way to support older adults to design technology for themselves.

INTRODUCTION

HCI researchers have investigated how technology can support people as they age given that the worldwide population has continued to grow older [3], placing increased need on finding ways to support them to live independently. Home sensing systems, such as the Digital Family Portrait [9],

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Figure 1: Craftec Version 1: Hard (left) and Soft toolkits (right).

KEYWORDS

Older adults; maker electronics; electronic toolkits; construction kits; DIY; Internet of Things; IoT; crafting technology; Arduino; participatory design; user evaluation

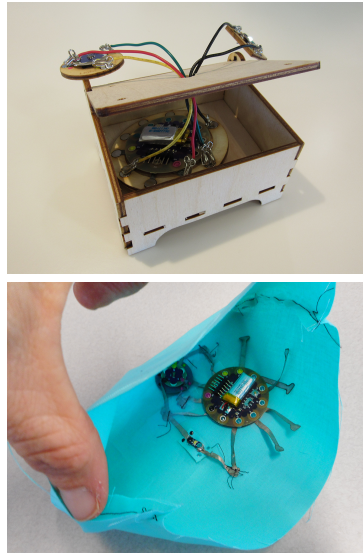


Figure 2: Examples of a crafted box (top) and bag (bottom) from the Craftec user evaluation [6].

have been popular, especially as HCI designers have looked to facilitate aging in place. Many of these systems entail sensors set up by professionals and integrated with a customized software architecture package (e.g., [2]). There has been a growing interest in designing technologies intended for older adults *with* rather than *for* them through co-design or participatory design to involve them more in the design process. Participatory design in particular has been explored as a way to break down the power dynamics between designers and older adults [8].

Despite designing more with older adults, we see an opportunity to engage further by supporting older adults to *build their own* technologies using electronic toolkits. Electronic toolkits have shown that they can support people to engage in creating electronic devices, especially children (e.g., MakerWear [7]). Little research has been done to design toolkits for people who are not children or professionals. Rogers et al. [11] was one of the few who engaged older adults in participatory design workshops with an off-the-shelf toolkit. They considered how to design future technologies.

Therefore, we discuss the next iteration of Craftec [6] (Figure 1) – an electronic toolkit for older adults to use crafting skills to create personalized devices. The first version [6] proved the concept and demonstrated the ability for older adults to create with it. We discuss the participatory design study and user evaluation that informed Craftec’s next iteration that expands the creative capabilities. We focused on supporting exemplar objects – artifact examples that epitomize the system’s capabilities – that we developed based on participants’ ideas. The exemplars we chose to further broaden the possibilities of what older adults can create with Craftec were medication adherence systems and aesthetic-focused crafts. Our key contributions to HCI are the exemplars and the planned updates to the Craftec system – both offer insights into how researchers can support older adults to build their own crafting technologies.

THE CRAFTEC SYSTEM

The Craftec system (Figure 1) is an electronic toolkit designed for older adults to create electronically enhanced devices using their crafting skills [6]. Craftec’s first iteration included an Arduino, light sensor, and LED to investigate how older adults could integrate components into crafts. The system is composed of Hard and Soft toolkits they integrated into a crafted box and bag (Figure 2).

In the next iteration, the Craftec system needs more components (e.g., lights, sensors, screens, etc.) added based on older adults’ interests and usability updates. The additional components will broaden what is possible to build by supporting artifacts relevant to older adults’ everyday lives. To this end, we developed exemplar objects as a research team that are grounded in examples from two informative studies. During the update, improvements to Craftec’s usability are also needed. For example, we need to make labels easier to see component ports (i.e., connection points between components).



Figure 3: Participants used paper circuits from Qi et al. [10] to learn circuit basics.

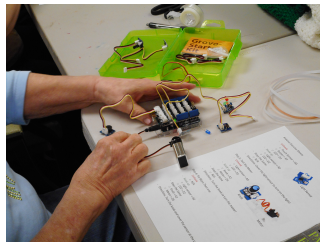


Figure 4: Participants worked in pairs on a pre-programmed Seeed Studio's Grove Arduino Kit © to test electronic components.



Figure 5: A stuffed dog a workshop participant suggested integrating lights, a speaker for barking, and a motion sensor.

INFORMATIVE STUDIES

Participatory Design Workshop

We conducted the participatory design workshop – 3 sessions for 2 hours each – with two groups of older adult crafters (N = 10; 65-90 y.o.; avg. 76.7 y.o.) to inform how we might design Craftec. Occurring before building the first version of Craftec, it gave direction for Craftec, but we focused instead on proving the concept (e.g., abstractions) rather being able to create examples. The sessions included: (1) participants taught us about their crafts in a show-and-tell and focus group style session, (2) we taught them about electronics with paper circuits [10] and Seeed Studio's Grove Arduino Kit (Figures 3 and 4), and (3) we prototyped electronically enhanced artifacts. We focus on session 3's results, where participants developed ideas for how they could use an electronic toolkit, which inform the next Craftec version.

Having learned more about electronics over the first two sessions, in session 3 participants brainstormed and prototyped ideas for artifacts they could build to combine their craft with maker electronics. Two high level themes arose after analyzing the ideas using affinity diagramming [4] – participants brainstormed how to customize artifacts and ways to improve artifacts' aesthetics. **Customized artifacts** had more specific functions – health, games, and safety. *Health* encompassed ideas such as medication reminders. *Games* included modified checkerboards that could help someone with cognitive disabilities identify possible moves. *Safety* artifacts included supporting a participant's personal safety with a smart home system of sensors (e.g., in the carpet, on the bed) that would contact their adult daughter when they are awake and active. **Aesthetic improvements** included incorporating *lights* into various crafts such as adding them to a painting for artistic effect or lighting up a Christmas tree shirt. Other aesthetic improvements were *interactive* artifacts that could incorporate input and output, such as a stuffed dog lighting up and barking when detecting motion (Figure 5).

User Evaluation of the First Craftec Version

We previously conducted a user evaluation of the first version of Craftec where we demonstrated its effectiveness as a tool for older adults to create crafted items [6]. The user evaluations were done with 17 older adults (10 women; 65-75 y.o.; avg. 70.1 y.o.). For the evaluation, older adults used Craftec's Hard toolkit for stiff medium crafts and Soft toolkit for fabric-based projects (Figure 2). Both toolkits used a LilyPad Arduino, light sensor, and LED to complete artifacts.

We found that participants succeeded in facilitating the creation of electronic devices integrated into crafts. The sewn bags and balsa wood boxes (Figure 2) validated continued support for *multiple craft mediums* and *multiple degrees of freedom* when placing components. Craftec's *color scheme* worked well to help older adults make correct, *safe connections*. We also identified how we needed to support older adults to *quickly see intended interactions* and modify circuitry before forming permanent

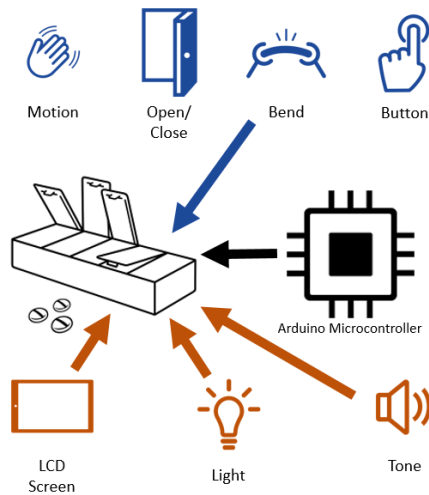


Figure 6: Medication adherence exemplar where an older adult can choose which Craftec input components (top; blue) and output components (bottom; red) to integrate with a pillbox.



Figure 7: Quilt a workshop participant suggested to add lights in a circle to imply the pinwheels were spinning.

connections. We also needed to address a usability challenge – reading the *small port labels*. These insights and more reported in [6] informed our plan for improving Craftec in the next iteration.

ITERATING ON THE CRAFTEC SYSTEM

Building upon the insights from the participatory design workshop and user evaluation, we developed a plan for a new version of the toolkit that integrated the successes of the first Craftec system, while expanding what was possible to build. To this end, we developed exemplars of what could be made with a future version of Craftec grounded in the participatory design workshop ideas. These exemplars guided our design choices in the same way a persona might guide design [1], giving direction for the second version of Craftec.

Demonstrating Craftec through Exemplars

We focused on developing two exemplars for older adults to create with the Craftec system – a customized artifact for medication adherence and aesthetically pleasing crafts. These exemplars, grounded in the participatory design workshop, engage older adults in creating customized electronic devices by providing ideas for how Craftec could be used, which they can modify rather than starting from scratch. They then informed our choices for components in the next iteration of Craftec.

Medication Adherence. We chose medication adherence based on the customized artifacts ideas from the participatory design study because there are several ways an older adult could personalize it (Figure 6). For example, an older adult may first think about how they want to be tracked based on their lives. Many people are familiar with a pillbox and using one to organize taking medications. They could use bend sensors to detect which cells of their pillbox have opened and alert them when they may have forgotten to do so. Alternatively, a different older adult may rely on knowing which bottle to open at which time, so they may only want to be prompted when it is nearly time to take them. Adhering a bend sensor to a pillbox would not be as effective for them, so they could use Craftec to track when their medicine cabinet is open with an open/close switch.

There are also many options for how older adults could be notified by the Craftec system’s outputs. For example, an older adult may initially try relying only on a brief tone combined with a green LED to indicate it is time to take the next set of medications. However, after trying it out for a few days, they may choose to set up an LCD screen, too, to provide more detail on the time since they last opened it and how long until their next medication. Another older adult may prefer using a table runner quilt on their dining room table that lights up as their indicator since most of their medications are taken around meals. An IR beacon and receiver could communicate with the table runner.

Aesthetically Pleasing Crafts. Crafts are a good gateway to engaging older adults in creating with electronics [6]. The older adult crafters in the participatory design workshops developed several

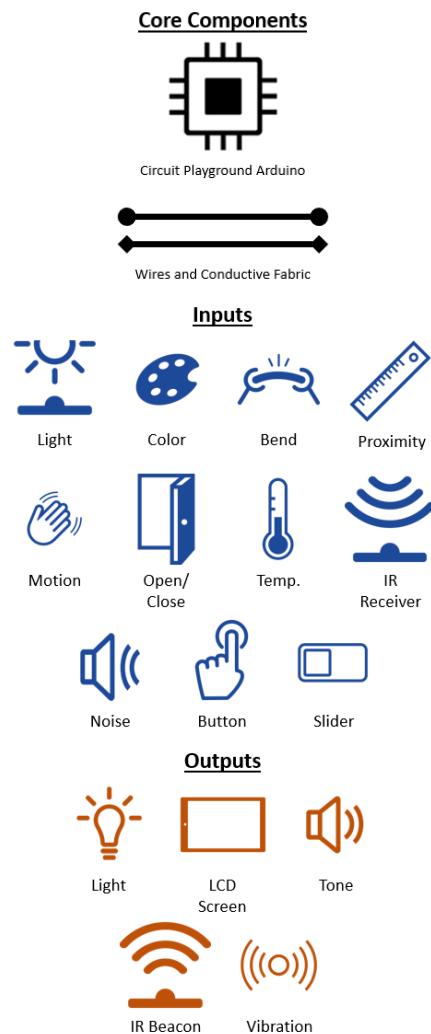


Figure 8: Crafterc system version 2's list of core, input, and output components.

aesthetics focused ideas for how they could integrate electronics into their crafts. Many aesthetic improvements could be made with various input and output components. For example, older adults could add LED lights, a tone board, vibration, and a motion sensor to the stuffed dog example (Figure 5) to have it react as children play with it.

Another possibility would be using a color detector to identify a particular color and replicate it with a series of LEDs integrated into their craft. For example, one participant suggested she wanted to light up her pinwheel quilt block to imply the pinwheel was blowing in the wind (Figure 7). They could use a color detector to set the color of Neopixel LEDs to match the best accent color.

Crafterc Version 2

Based on these exemplars, we plan to add several new sensors and capabilities to the next iteration of Crafterc that will help older adults to create personalized smart devices. In total, we are planning on producing 16 different components as a part of the Crafterc system grounded in their interests (Figure 8). Later, we may add more as we continue to test and evaluate the new version.

In this new version, we plan to build on many of the successes of the first version from the user evaluation. We will continue to support multiple craft mediums, multiple degrees of freedom when placing components, and use color to help indicate where to make safe connections. To improve on quickly seeing intended interactions with the Soft toolkit, we will be including "jumper cable" pieces of conductive fabric to be able to test a setup. We will also make the port labels larger by printing and burning larger font labels as a part of the Arduino bases.

We will also update the LilyPad Arduino microcontroller to an Adafruit Circuit Playground [5]. The Circuit Playground has several built-in components that make it ideal for smart devices (Figure 9) such as communicating wirelessly with an IR beacon, Neopixel LEDs we can use as port color indicators, and motion sensors. We will continue to abstract connections between components by modifying the Circuit Playground with wires and conductive fabric to make it easier for older adults to craft electronic devices.

DISCUSSION AND FUTURE WORK

Crafterc is the first electronic toolkit designed specifically for older adults to craft their own electronic devices. We are continuing to build on the success of electronic toolkits such as MakerWear [7] and Chibitronics [10] which supported novices, especially younger audiences, in creating with electronics. With this plan for the Crafterc system, we have the makings of an electronic toolkit better designed for older adults to create customized smart devices. This iteration of the Crafterc system will have input and output components grounded in exemplars pulled from our participatory design and user evaluations. As a late breaking work, a poster would be a valuable opportunity for the CHI community

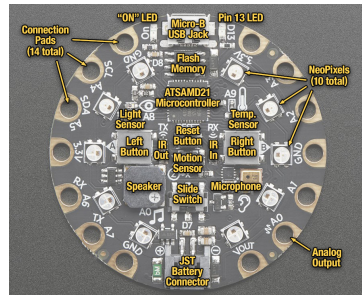


Figure 9: Labeled diagram of the Circuit Playground from Adafruit ©.

to discuss how we could include more older adults in designing technology for themselves, while providing feedback on the toolkit's future directions.

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REFERENCES

- [1] Yen-ning Chang, Youn-kyung Lim, and Erik Stolterman. 2008. Personas: From Theory to Practices. In *Proceedings of the 5th Nordic Conference on Human-computer Interaction: Building Bridges (NordiCHI '08)*. ACM, New York, NY, USA, 439–442. <https://doi.org/10.1145/1463160.1463214>
- [2] M. Jamal Deen. 2015. Information and communications technologies for elderly ubiquitous healthcare in a smart home. *Personal and Ubiquitous Computing* 19, 3 (01 Jul 2015), 573–599. <https://doi.org/10.1007/s00779-015-0856-x>
- [3] United Nations Department of Economic & Social Affairs, Population Division. 2013. World Population Ageing 2013. *Social Science Computer Review* December (2013), ST/ESA/SER.A/348.
- [4] Karen Holtzblatt. 2005. *Rapid Contextual Design: A How-to Guide to Key Techniques for User-Centered Design* (1st ed.). Elsevier, USA, Chapter Do artifacts have politics?, 28–40.
- [5] Adafruit Industries. 2019. Adafruit's Circuit Playground Express. Retrieved January 1, 2019 from <https://www.adafruit.com/product/3333>
- [6] Ben Jelen, Anne Freeman, Mina Narayanan, Kate M. Sanders, James Clawson, and Katie Siek. 2019. Craftec: Engaging Older Adults in Making through a Craft-Based Toolkit System. In *Proceedings of the Thirteenth International Conference on Tangible, Embedded, and Embodied Interaction - TEI '19*. ACM Press, New York, New York, USA. <https://doi.org/10.1145/3294109.3295636>
- [7] Majeed Kazemitabaar, Jason McPeak, Alexander Jiao, Liang He, Thomas Outing, and Jon E. Froehlich. 2017. MakerWear: A Tangible Approach to Interactive Wearable Creation for Children. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 133–145. <https://doi.org/10.1145/3025453.3025887>
- [8] Stephen Lindsay, Daniel Jackson, Guy Schofield, and Patrick Olivier. 2012. Engaging Older People Using Participatory Design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12)*. ACM, New York, NY, USA, 1199–1208. <https://doi.org/10.1145/2207676.2208570>
- [9] Elizabeth D. Mynatt, Jim Rowan, Sarah Craighill, and Annie Jacobs. 2001. Digital Family Portraits: Supporting Peace of Mind for Extended Family Members. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '01)*. ACM, New York, NY, USA, 333–340. <https://doi.org/10.1145/365024.365126>
- [10] Jie Qi, Andrew "bunnie" Huang, and Joseph Paradiso. 2015. Crafting Technology with Circuit Stickers. In *Proc. 14th International Conference on Interaction Design and Children (IDC '15)*. ACM, New York, NY, USA, 438–441. <https://doi.org/10.1145/2771839.2771873>
- [11] Yvonne Rogers, Jeni Paay, Margot Brereton, Kate L. Vaisutis, Gary Marsden, and Frank Vetere. 2014. Never Too Old: Engaging Retired People Inventing the Future with MaKey MaKey. In *Proceedings of the 32Nd Annual ACM Conference on Human Factors in Computing Systems (CHI '14)*. ACM, New York, NY, USA, 3913–3922. <https://doi.org/10.1145/2556288.2557184>