Empowering Older Adult Crafters to Electronically Enhance Artifacts for Health

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ABSTRACT
Abstract text. Abstract text. Abstract text. Abstract text. Abstract text. Abstract text. Abstract text.

Categories and Subject Descriptors
H.4 [**Information Systems Applications**]: Miscellaneous; D.2.8 [**Software Engineering**]: Metrics—*complexity measures, performance measures*

General Terms
Theory

Keywords
older adults, crafting, electronics, prototypes

1. INTRODUCTION

1. POTS

   - Older adults are capable of designing wearable devices independently that have the potential to improve their health, but a toolkit designed specifically for older adults has not been developed
   - Maker technology is trending and many kits have been developed for children, such as MakerWear [11], littleBits, EduWear, and MakerShoe , [2], [10], [12].
   - While these toolkits are accessible and abstracted to make electronic tinkering easy, they are designed for school-aged children and are physically constrained in relation to inputs, outputs, and aesthetics.
   - Many of these toolkits also consist of modular building blocks that fit together in a certain way, hindering open-ended creation. An exception to these kits, however, is David Mellis's "untoolkit," which appeals to the userâĂŹs creativity and avoids imposing certain construction techniques [17].
   - Additionally, some electronic kits have been developed for a variety of ages, such as LilyPad Arduino [4], circuit stickers [9], and MaKey MaKey [21] - the latter kit was used by older adults, however they had reservations about its suitability for their demographic.
   - These kits reach a wider audience but require a higher level of programming knowledge and guidance to get started.
   - We propose a maker kit designed specifically for older adults, using data gathered from participatory design sessions.

2. Approach and/or overview of innovation

   - Researchers typically determine the needs of older adults and then create something suited to their needs, which has resulted in varying levels of success [24], [18].
   - Participatory design is a common method for involving all of the stakeholders and eliciting ideas [16] [18].
   - We used a modified Participatory Design method. In addition to the standard sessions, in which we introduced participants to introductory concepts in electronics and conducted a joint brainstorming session, we had an initial session in which participants taught us their craft and held a show-and-tell session.
   - Using information gathered from the participatory design workshops, we designed a toolkit
   - Rather than contribute to the ongoing conversation of how technological solutions can overcome obstacles of aging, we empower older adults to create and personalize their own technological devices.

3. Contribution

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- A thorough description of our modified Participatory Design method
- Detailed description of process for creating toolkit
- Description of the toolkit itself
- Qualitative analysis of participant activities and interactions utilizing the maker toolkit that sheds light on how it was used.

2. RELATED WORK

We organize related work into two main sections: creativity and maker technology. We discuss maker technology in two separate subsections: generalized maker technology and maker technology for children.

2.1 Creativity

The use of art as a therapeutic measure has largely been studied in the context of mental impairments such as dementia. Art therapy typically seeks to minimize the social isolation and loss of personal identity that people with dementia experience [18, 24]. However, art therapy does not only compensate for deficiencies in health. Art therapy can encourage sharing of personal thoughts and emotions among people with mental impairments, even in situations where they would normally feel isolated or detached from the rest of society [8, 15]. For example, the Third Hand is a practice in art therapy that empowers and enables the desires of the client, encouraging creative thinking without focusing on health deficiencies [14]. We drew upon the concepts of the Third Hand and the importance of inclusion in a larger community when designing our toolkit, ensuring that it promoted creativity and affirmed older adults' abilities as innovators. However, our toolkit is designed for the general older adult population rather than just those with mental impairments.

Engaging in creative activities has proven health benefits. Several studies reported that participating in the creative arts as an adult was associated with higher cognitive function as compared to the control group [7, 19]. Additionally, cognitively stimulating activities can reduce the risk of Alzheimer's disease [23, 25]. Participating in creative activities provides health benefits to older adults; however, toolkits targeting this audience have not been developed.

2.2 Maker Technology

One of the most predominant precursors to our work is the development of "Maker Technology," a technology-based extension of do-it-yourself projects. Maker technology is centered around learning by doing, or creating tangible, technological artifacts. If older crafters are given the opportunity to use their physical senses and build tangible artifacts in a familiar context, we propose that they will be more prepared and motivated to build personalized art that betters their health.

Previous studies with designing maker technology and artifacts in general found benefits to working with tangible visualizations. Lazar et al. found that older adults were satisfied by leisure activities that resulted in tangible products, such as knitting [13]. Participants cited the tangible benefits as the reason they enjoyed working with e-textiles [20]. Brereton et al. [3] conducted a study with engineering students engaging in design project work and found that engineers learn by comparing their knowledge of the physical world to unfamiliar theoretical models. Although the study was conducted with engineering students, the results, which point to the importance of physical objects in design, can likely be extended to older adults as well. In addition to the benefits of creating with tangible objects, previous studies have explored the creation of tangible visualizations of health. Running data is transformed with Activity Sculptures into three-dimensional representations, resulting in increased motivation and self-reflection [22].

While designing toolkits to introduce children to electronics and encourage the creative development of tangible objects is a burgeoning research field, there is a dearth of toolkits designed specifically for older adults. littleBits is one example of kits catered towards school-aged children [2]. They consist of pre-programmed electronic modules that snap together with magnetic connections, allowing participants to "play with electronics without knowing electronics" [2]. MakerShoe and MakerWear explore this vein further, allowing children to plug hexagonal modules into shoes and other items of clothing to create different effects [12, 11]. Quilt Snaps is a textile-based toolkit developed to expose children to electronics [6]. These kits allow children to be creative without fully comprehending the concepts of electronics, a crucial aspect of Maker toolkits. The field of maker technology for children is expanding, but these kits are unsuitable for older adults as the applications are centered on children's interests and the method of connections limits the possibility of fully integrating the modules into pre-existing household objects.

The maker toolkits for children were often more effective when the children were invested in creating their wearable. Eduwear, a toolkit designed for the construction of wearable technology, capitalizes on this principal by enabling children to create personally meaningful artifacts [10]. Building on this finding, Anathanarayan et al. found that children who spent over 90 minutes creating their wearable device used it more often [1]. While these toolkits were designed for children, we utilize the principle that creating a personally meaningful device results in greater use of the device in our toolkit for older adults.

Maker technology has also been developed for a broader audience. Circuit stickers are pre-programmed modules connected through a common substrate and designed for prototyping purposes [9]. Circuit stickers provide a novel interface but are somewhat untested for integration in three-dimensional spaces. Some maker technology, such as MaKey MaKey has been studied with older adults, but while they enjoyed playing with the technology, they "felt the kit was target more for others and not themselves" [21]. When older adults were working with MaKey MaKey, they weren't brainstorming potential applications, but rather noting that they would like to share the experience with their grandchildren. Mellis et al. [17] describe an "untoolkit" as a toolkit that appeals to the user's creativity and encourages the artistic design process to a greater extent than traditional kits. The "untoolkit" required some programming knowledge, limiting the audience, and was designed for two-dimensional spaces, limiting the applications. Our toolkit builds on these previous craft approaches to technology but is designed to fit the needs of older adults, rather than the general population.

In addition to maker technology, wearable technology has been developed for adults. The LilyPad Arduino allows for easy creation of e-textiles as the electronic modules can easily be sewn into fabric and connected with conductive thread [4]. Our toolkit builds upon this advance by providing older adults with the necessary materials to build wearable devices. Buechley and Eisenberg discuss new techniques for attaching electronics to textiles to create wearable devices, such as PCBs, electronic sequins, and socket buttons [5]. Electronic sequins and socket buttons make it much easier to sew electronics into textiles and are utilized within our toolkit.

3. METHODS

Our methods are university ethics board approved. We recruited X older adult participant ([ages]) from Y senior living communities and Z crafting groups in A participatory design workshops. The participants were over 65 years of age and actively making something with their hands.

3.1 Participatory Design Workshops

We conducted a series of participatory design workshops to better understand the baseline level of skill of older adults, their ability and willingness to learn electronics, and ideas for future technology and interest in adopting electronics into current work. For each of the three two-hour workshops, we placed a strong emphasis on mutual learning. We recorded participants' interactions through photos and video.

In the first session, participants taught their craft to the researchers and then brainstormed technology skills, demographics, and crafting habits. Researchers and participants worked together throughout the session, exchanging ideas for electronic prototypes and helping one another learn crafting skills.

In the second session, researchers taught participants electronics skills and assessed their confidence in electronics before and after the session. The researchers first demonstrated how to build paper circuits. Then, they introduced Arduino and the Grove kit and described the technology's capabilities and limitations to the participants.

The third session was a brainstorming session where participants helped develop low-fidelity prototypes and described their interests in creating technology. The session began with participants sharing pictures they had taken to help brainstorm electronic prototypes. Afterwards, they created demo objects and explained their creations to the group.

The workshop was analyzed using an affinity diagram and the pre-post test conducted in the second session was analyzed using a paired t-test.

3.2 Toolkit Design

Using information gathered from the participatory design workshops, we manufactured a toolkit to allow older adults to create personal electronic devices independently. Our toolkit is designed to be accessible and customizable, allowing adults with little electronic or programming knowledge to benefit while more experienced individuals are not limited. We tested a series of electronics from the LilyPad set and Flora set to decide if they should be included in our toolkit.

Component	Included or Excluded	Reason
Light Sensor	....	....
Motion Sensor	....	....

4. FINDINGS

The findings will go here.

5. DISCUSSION

The discussion will go here.

6. CONCLUSION

The conclusion will go here.

7. ACKNOWLEDGEMENTS

Acknowledgements will go here.

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