

# Design Criteria to Advance Technologies for the Aging Population

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**Abstract**—Design and technology can have a significant impact on the aging with disability population, empowering these individuals to sustain independence, maintain health, engage safely in basic activities at home/community, and fully participate in society. Even though a large number of resources exist, there is a need to increase knowledge, practice, and availability of universal design for the aging with disability population. A competition can be an effective way to tap into a rich, diverse and collective design intelligence to address these issues. The TechSAge Design Competition was launched to inspire talented designers to develop innovative technology-enabled design solutions. As part of the competition, judging criteria were framed through universal design to guide contestants in the design of technologies. This included: independence, integration, implementation, inspiration, and progression. This paper discusses the judging as a mechanism to promote effective universal design practices for the aging with disability population, as well as presents examples of competition entries reflecting the design criteria.

**Keywords**—Design Criteria; Design for Aging; Technologies for Aging; Competition.

## I. INTRODUCTION

User-centered design approaches have been dominating the creative disciplines in order to design products that better serve users [1]. IDEO, a global design company, was one of the pioneers in harnessing the power of methods to develop a more critical, nuanced and responsive design process [2]. Since then, a plethora of methods has emerged in response to better understanding user needs, especially participatory design methods aimed at involving the targeted user in the design process for meeting the needs of the stakeholders [3]–[6]. While the aforementioned methods are effective for better identifying user requirements, usability, and adoption, they still challenge the impact on design practices as it relates to users with varied abilities such as older adults. Aside from methods, designing for older adults requires focused expertise, considerations, and principles for bringing about effective solutions for the population. There are a number of sources aimed at giving easily accessible information as a primer for designing for older adults. Fisk et al. offer a practical introduction to human factors and older adults by illustrating practical translations of scientific data into design applications [7]. Similarly, Universal Design principles provide guidance for designing products and environments involving the consideration of the human factors across populations of varied abilities [8]. Universal Design holds the promise to design products and

environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design [9][10].

While Universal Design principles are an invaluable guide to better design products for older adults, there is still the need to better educate audiences for the successful implementation, especially when designing new technologies [11]. There is a need to collectively position the principles by reformulating how they are presented and communicated. The goal is to set forward a better mechanism to present the universal design principles embedded in practice.

A competition can be an effective way to tap into a rich, diverse and collective design intelligence to address the current needs of our older adults. Moreover, it can be a venue to effectively address the implementation of Universal Design principles in the design process. This paper discusses the guiding criteria for the TechSAge Design Competition built on the Universal Design principles [12]. As a result, the competition aids in not only identifying exemplary practices in design for aging but mainly as a platform to educate and encourage communities of interest to solve the problems the aging population face.

The paper is structured as follows. Section II presents Universal Design competitions while Section III introduces the TechSAge Design Competition mission. Section IV describes the application areas for designing technologies for the older adult population. Section V describes the criteria for guiding the design. Lastly, Section VI presents the exemplars resulting from the competition followed by concluding thoughts about the design competition for framing Universal Design principles for advancing technologies to support a healthy aging for all.

## II. UNIVERSAL DESIGN COMPETITIONS

There are a number of Universal Design Competitions that encourage students to design products for people with varied abilities. University of Southern California has been hosting since 2014 the annual Morton Kesten Universal Design Competition in order to create an opportunity for students across the United States to develop universally-designed spaces and products. The competition is developed in association with the Morton Kesten Summit, which is held every two years featuring the latest developments in aging-in-place efforts by organizations and professionals across the country [13]. The competition is framed following the principles of Universal Design [8]. It challenges students to create an innovative design using the principles of Universal

Design that support aging-in-place in one of two areas: Space: a) re-conceptualizing an existing kitchen/bath space; or b) creating a brand-new kitchen/bath space; or Product: developing a product/prototype that embraces and utilizes the ideas and principles of Universal Design for use at home. While the applicants submit a visual presentation along with a description and explanation for the process, judges use the criteria of: 1-having done market research; 2-integrating aesthetic appeal with function; 3- addressing feasibility and cost-effectiveness; 4-being environmentally friendly; 5- describing how it supports aging in place; and most important, 6- showcasing the exercise of the universal design principles.

There is also the Universal Design Grand Challenge (UDGC) in partnership with the National Disability Authority [14]. The competition has also been running since 2014 with the goal of promoting and awarding excellence in student projects that feature solutions that work for everyone. They offer applicants the option of entering into three categories: 1- Information and Communication Technology; 2- Built Environments; and 3- Products and Services. The main criterion for success in the competition is to see products designed using the Principles of Universal Design, with user feedback at the heart of the design process [8]. The competition emphasizes that the goal is not aimed at submitting solutions for disabled people or assistive technology but designing solutions for all. As a requirement, contestants need to be in their final two years of study, postgraduate students and recent graduates enter their best project. Via the website, the competition provides contestants with information on the principles, success stories, and other online resources related to universal design.

While both competition sites offer resources for understanding the principles and other relevant literature for the topic, contestants are left unguided with a set of principles not linked to measurable outcomes other than the principles alone. Though one of the competitions offer entry categories, the openness of application areas may also be limiting for educating contestants about Universal Design. While universal design aims at designing products for all, there is a need to understand needs and provide guidance on the implementation of the principles as it relates to populations.

The Stanford Center on Longevity Design Challenge offers cash prizes and free entrepreneur mentorship in a competition open to all university students around the world who want to design products and services for optimizing long life for us all [15]. While the challenge topics change every year, they provide focus areas related to promoting habits that improve the quality of life for individuals across the lifespan for guiding design creativity. For example, the latest challenge focused on three areas: 1- Healthy Living; 2- Social Engagement; and 3- Financial Security. The main differentiating factor about this competition is its mentorship approach through the two-phase design. Semifinalists are provided with mentorship to further develop the products and services concepts. The contestants then compete with developed ideas for grand prizes and places. While the aim

of the competition is to *design for all*, their judging criteria is focused on: 1- Alignment with Challenge Topic; 2- Potential for Impact; 3- Originality; 4- Probability of Implementation; and 5- Economic Viability. As the center states, the best designs usually are the ones that are innovative/novel, engaging, practical, scalable, inexpensive and readily understood, in which user testing of designs has been a critical step for past winners. While this competition guides contestants well in the application areas and measurable success outcomes for a specific population—older adults, it lacks the integration of Universal Design principles for guiding the successful design of products and services for the population.

Addressing the aforementioned limitations and combining the properties of these three competitions, it brings about an opportunity to develop a unique competition mechanism to educate, guide and mentor students in the successful implementation of Universal Design principles linked to the aging population. The next section describes in detail the design of the TechSage Design Competition.

### III. TECHSAGE COMPETITION

The TechSage Design Competition is developed to inspire talented designers to bring about innovative technology-enabled design solutions for the aging population [12]. The competition is designed to be a two-phase submission system.

Phase I focuses on the conceptualization of the designs. Phase II focuses on further developing the design through prototyping, testing and co-designing while incorporating feedback from experts in the field. Phase II of the competition allows mentorship through feedback and partnerships. The competition links contestants with varied experts in the topics of universal design, gerontology, human factors, human-computer interaction, to mention a few through different sectors ranging from researchers to practitioners.

The goals of deploying the competition are not only to ignite the design of products, services, and systems for the older adult population but to guide, educate and train international younger generations engaged in effectively designing technologies for aging with disability. More specifically, the competition is framed within the missions:

*To support people with chronic conditions and long-term impairments who are at risk of disability or increased disability due to comorbid age-related losses;*

*By empowering these individuals to sustain independence; maintain health; engage safely in basic activities at home and in the community, and fully participate in society;*

*Through increasing knowledge about, availability of, and access to effective, universally-designed technologies.*

### IV. AREAS OF DESIGN FOR AGING

Through the competition, contestants are given categories for entering their designs. The categories reflect the

contemporary practices of design across sectors, academia, and industry, responding to the needs of healthy aging [11]. As such, contestants can opt to submit in four different areas: 1- Health at Home; 2- Social Connectedness; 3- Active Lifestyle; and 4- Community mobility, as follows:

- Health in the Home:*  
This category is focused on proposing designed technology solutions for the home environment that support health and healthy activities in support to the healthcare system.
- Social Connectedness:*  
This category is focused on proposing designed technology solutions to encourage communication, connectedness with people and social activities.
- Active Lifestyle:*  
This category is focused on proposing designed technology solutions to promote physical and cognitive activities, and how activities can promote healthy lifestyles.
- Community Mobility:*  
This category is focused on proposing designed technology solutions to facilitate access to activities and/or locations.

V. DESIGN CRITERIA

Contestants are given resources in the areas of resources for understanding topics on design, universal design, aging, and disability. While the resources play a significant role in helping contestants in designing their products, services or experiences for the population, the competition judging criteria play a significant role. The criteria were developed through an iterative process of questioning the limitations of the Universal Design principles as they are applied to the aging population with disability. The Universal Design Principles are embedded as enablers in each criterion. The results are five criteria for advancing the Universal Design principles: 1- Independence; 2- Integration; 3- Implementation; 4- Inspiration; and 5- Progression (see Table I). These criteria are used as an evaluation mechanism that guides the designs. The criteria are explained in the next subsections.

TABLE I. DESIGN CRITERIA

Design Criteria To Advance Technologies for the Aging Population	
<b>Independence</b>	Universal Design Principles 1: <i>Equitable Use.</i> 2: <i>Flexibility in Use.</i> 3: <i>Simple and Intuitive Use.</i> 4: <i>Perceptible Information.</i> 5: <i>Tolerance for Error.</i> 6: <i>Low Physical Effort.</i> 7: <i>Size and Space for Approach and Use.</i>
<b>Integration</b>	
<b>Implementation</b>	
<b>Inspiration</b>	
<b>Progression</b>	

A. Independence

The focus of setting this criterion is to guide contestants in proposing products and/or systems to empower older adults to take action in their lives. The goal is to overcome the concept of “taking care of” or “doing things for” and enabling older adults to take initiative, take care of and do things for their lives.

B. Integration

The focus of setting this criterion is to guide contestants in proposing products and/or systems to build intergenerational, supported and connected communities. The goal is to develop bottom-up approaches across generations that can help older adults have access to a community of care.

C. Implementation

The focus of setting this criterion is to guide contestants in proposing products and/or systems to have a successful effect and longevity in the aging population. The goal is to develop solutions that are feasible for implementation in the near future and more importantly, sustainable from the point of view of self-maintaining.

D. Inspiration

The focus of setting this criterion is to guide contestants in proposing products and/or systems that are forward thinking and enablers. The goal is to celebrate the aging population with creative, attractive and pervasive solutions that avoid physical, visual or experiential segregation.

E. Progression

The focus of setting this criterion is to guide contestants in proposing products and/or systems that allow positive growth. The goal is to develop solutions that grow with the aging population and inspire them to do more and be more.

VI. COMPETITION ENTRIES AND RESULTS

Two competitions were deployed since the proposed design. This section reports the results from the first two years of the TechSage Design Competition.

For the entries, contestants were asked to submit detailed documentation of the concept for Phase I which included conceptual thinking, motivation and concept generation, different views of 3D representation, solutions described in use (i.e. storyboard/scenario), material/electronics specifications, and an implementation plan noting its feasibility/cost. For Phase II, contestants were required to resubmit updated documentations a from Phase I but more importantly, adding descriptions of the technology components, and development of a testing prototype that is validated through user studies with older adults. Phase II also required an additional submission of a poster and video documentary.

The entries were judged in both phases with the same on the proposed criteria. Phase I judging was online, while Phase II judging was performed via an exhibition (see Figure 1).



Figure 1. Jury evaluating Phase II of the competition.

### A. First TechSage Design Competition

For the first competition, submissions were distributed across categories as follows: Health at Home category received 39% of the total entries; Active Lifestyle category received 30% of the total entries; Social Connectedness category received 22% of the total entries; and Community Mobility category received 9% of the total entries. The distribution reveals an increased interest among contestants in designing health technologies for the home as opposed to a reduced interest in designing technologies that enable mobility for older adults aging with a disability. In the first year of the competition, up to three semifinalists for each category were selected to move to Phase II of the competition. Contestants received financial support to further develop their concepts into working testable prototypes.

The 1st place was awarded to *Dex*, a smart foot care system designed to promote exercise and health management for people with diabetes (see Figure 2). The *Dex* system features pressure sensitive shoe insoles that interact with a smartphone, enabling the user to monitor their foot pressure and play various exergames.



Figure 2. Dex Smart Sole System.

*CommuniTea*, a connected scheduling board for older adults, was awarded second place (see Figure 3). The peg board tablet offers a simple, connected way for people to

plan meeting arrangements based on their activities, skills and interests [16]. The *CommuniTea* concept exemplifies well the criteria of Progression and Inspiration.

An airport wayfinding app for senior travelers, known as *GatePal*, took third place (see Figure 4). *GatePal* provides step-by-step instructions for users to successfully navigate the airport and complete key tasks, from checking in, locating their gate, and finding their luggage [17]. *GatePal* is universally designed so that older adults with different functional abilities are able to use this app at their own pace and in their preferred way.

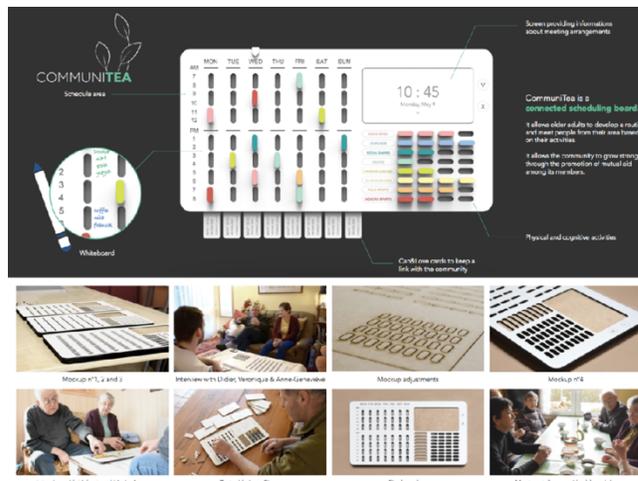


Figure 3. CommuniTea Interactive Scheduling Board.

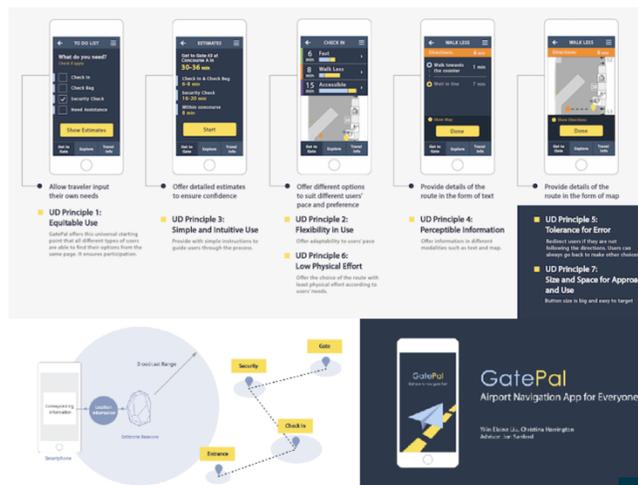


Figure 4. GatePal Navigation System.

While all winning entries demonstrate well all the criteria, the *Dex* concept exemplifies well the criteria of Independence and Integration; the *CommuniTea* concept exemplifies well the criteria of Progression and Inspiration; and the *GatePal* concept exemplifies well the criteria of Implementation, Integration and Independence.

### B. Second TechSage Design Competition

For the second competition, submissions were distributed across categories as follows: Social Connectedness category received 36% of the total entries; Active Lifestyle category received 29% of the total entries; Health at Home category received 21% of the total entries; and Community Mobility category received 14% of the total entries. Compared to the previous year, Active Lifestyle maintained the lead of interest while Health at Home decreased two positions down in interest, switching places with Social Connectedness in the lead. Whereas, Community Mobility remained as the least interest category.

Overall, combining results from the two competitions, students responding to the population needs results in positioning Health at Home in the first place, Social Connectedness in the second place, Active Lifestyle in the third place and Community Mobility last (see Figure 5). With these results, there is an opportunity to increase awareness and resources to better promote the development of design and technologies focusing on mobility.

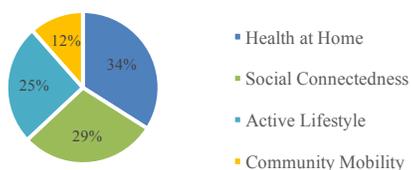


Figure 5. TechSage Competition Submissions Distribution Across Categories.

With entries representing a large number of international institutions, the jury selected *Releaf* not only as the top score in the Active Lifestyle category but also awarded the First Place Prize in the second TechSage Design Competition (see Figure 6) [18]. *Releaf* was created with the goal of increasing the opportunity for active gardening for seniors considering the barriers such as lost grip strength. The design featured a robotic glove that uses cables and servos wired to a sensor controlled by the pinky to engage and disengage the active assistance when gripping tools.

Project *Nettle* won top place in the Social Connectedness category (see Figure 7). The project focuses on designing interfaces which do not require glowing screens or lengthy training to comprehend but instead working naturally with the way information is absorbed by the senses and physically tying into familiar forms. *Nettle* is an intuitive screen less interface for community connection consisting of a teapot and mug and employing the beloved rituals of making tea. Unlike products for teleconferencing distant family members, *Nettle* offers a safe and fun way to incorporate social outreach into everyday routines, fostering resilient community ties over time.

Project “MODU” won top category *Health at Home*. MODU is a universal multipurpose, customizable and modular assistive system designed to assist those who face challenges in mobility.



Figure 6. Releaf Robotic Gardening Glove.



Figure 7. Nettle Communication Device.

## VII. CONCLUSION

Building on the strengths of Universal Design, this paper discussed the TechSage Design Competition, launched to inspire talented designers to develop innovative technology-enabled design solutions. The competition features a mechanism to implement Universal Design training on a broad basis. At the application area, it also generates international awareness and understanding of aging with disability and encourage contestants in generating new technologies for successful aging with disability. For training and awareness, the competition advances criteria for evaluating successful technologies for the older adult population aging with disability. The criteria are: independence, integration, implementation, inspiration, and progression. This paper serves an attempt to provide organized criteria that the design for aging with disability community and related disciplines can adopt for advancing technologies to improve the lives of older adult aging with disability. The significance of this paper is to introduce approaches that better guide the design of products, technologies and/or services when designing for the older

adults. Through this contest, students get to understand that design activities cannot be separated from abilities; design IS ability, and creative technologies can emerge from looking at disabilities as a source of inspiration for great *designs for all*.

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#### REFERENCES

- [1] IDEO, *Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World*, 2 edition. IDEO, 2011.
- [2] IDEO [Online]. Available: <https://www.ideo.com>. [Accessed: 05-Mar-2018].
- [3] B. Hanington and B. Martin, *Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions*, 58480th edition. Beverly, MA: Rockport Publishers, 2012.
- [4] L. Sanders and P. J. Stappers, *Convivial Toolbox: Generative Research for the Front End of Design*. Amsterdam: BIS Publishers, 2013.
- [5] E. B.-N. Sanders, E. Brandt, and T. Binder, "A Framework for Organizing the Tools and Techniques of Participatory Design," in Proceedings of the 11th Biennial Participatory Design Conference, New York, NY, USA, 2010, pp. 195–198.
- [6] V. Kumar, *101 Design Methods: A Structured Approach for Driving Innovation in Your Organization*, 1 edition. Hoboken, N.J: Wiley, 2012.
- [7] A. D. Fisk, W. A. Rogers, N. Charness, S. J. Czaja, and J. Sharit, *Designing for Older Adults: Principles and Creative Human Factors Approaches, Second Edition*, 2 edition. Boca Raton: CRC Press, 2009.
- [8] Center for Universal Design, "The Principles of Universal Design." [Online]. Available: [https://projects.ncsu.edu/ncsu/design/cud/about\\_ud/udprinciples.htm](https://projects.ncsu.edu/ncsu/design/cud/about_ud/udprinciples.htm). [Accessed: 28-Feb-2018].
- [9] W. Lidwell, K. Holden, and J. Butler, *Universal Principles of Design, Revised and Updated: 125 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions*. Rockport Publishers, 2010.
- [10] J. A. Sanford, *Universal Design as a Rehabilitation Strategy: Design for the Ages*, 1 edition. New York: Springer Publishing Company, 2012.
- [11] C. B. Rebola, *Designed Technologies for Healthy Aging*. Morgan & Claypool Publishers, 2015.
- [12] TechSage Design Competition [Online]. Available: <http://techsagecompetition.com>. [Accessed: 05-Mar-2018].
- [13] USC Leonard Davis School of Gerontology, "Morton Kesten Universal Design Competition." [Online]. Available: <http://gero.usc.edu/udcompetition/>. [Accessed: 27-Feb-2018].
- [14] Centre for Excellence in Universal Design, "Universal Design Grand Challenge Student Awards." [Online]. Available: <http://universaldesign.ie/Awards/Student-Awards/>. [Accessed: 27-Feb-2018].
- [15] Stanford Center of Longevity, "Design Challenge." [Online]. Available: <http://longevity.stanford.edu/design-challenge-2017-18/>. [Accessed: 28-Feb-2018].
- [16] P. Giret, "CommuniTea." [Online]. Available: <http://paulingiret.com/communittea>. [Accessed: 28-Feb-2018].
- [17] Y. E. Liu, C. Harrington, S. Melgen, and J. A. Sanford, "GatePal – Universal Design for Airport Navigation to Allow Departing Travellers to Stay Informed," in Universal Access in Human-Computer Interaction. Users and Context Diversity, Cham, 2016, pp. 586–594.
- [18] J. Chang, "Releaf Glove." [Online]. Available: <http://justinchangdesign.com/?p=1345> [Accessed: 5-Mar-2018].