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Educational Assistant Wireframe for the Elderly to Mitigate Urban Climate Health Risks

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Abstract: The climate in urban centers can differ significantly from the immediate surrounding areas; this can pose health risks to the elderly who have spent much of their lives in urban centers and then move to more rural areas for retirement. Therefore, there is a need to develop educational software applications for the elderly that needs to account for their life experiences aside from physiological restrictions. This research created a connected wireframe for an educational assistant to make the elderly aware of the climate differences between their urban and rural residences. To address the difficulty of recruiting vulnerable subjects, especially during the COVID-19 pandemic, we evaluated our wireframe using a combination of heuristic evaluation and a variation of the Delphi process, an expert consensus-building tool typically used for market forecasting.

Keywords: urban climate, healthcare technology, educational technology, human-computer interaction, Delphi process, personal assistant

1. Introduction

Climate change is one of humanity's defining problems since our society's rapid development in the 20th century. Some of the salient observations include global warming or tremendous shifts in weather patterns across continental, regional, and neighborhood scales (Varquez & Kanda, 2018). At the district level, its spatial variability poses location-dependent health risks. For example, projections on urban development in Jakarta conducted using a high-resolution 1-kilometer regional climate modeling have shown that urbanization may have more significant consequences than global climate change scenarios if left unmitigated (Damanto, et al., 2019). Areas that are geographically near can have drastically different climates if they have different degrees of urbanization, such as in the case of city centers and their surrounding suburbs. By the 2050s, greater Jakarta's urban climate change increases the risk of elderly heat-related mortality by as much as 15 times compared to the 2010s (Varquez, et al., 2020).

For similar large metropolitan areas such as Tokyo and its surrounding areas, the above conditions exist and awareness of these should be known to the public. In 2014, 172,000 people moved out from Tokyo city center to these nearby areas such as the relatively rural West Tokyo suburbs and the neighboring prefectures such as Saitama and Kanagawa (Tokyo Metropolitan Government, n.d.). For the elderly who chose to have their careers in Tokyo and retire near the city center where they spent decades living and working, it can be hard to realize that there can be drastically different climates between places that are somewhat close. These unrealized differences can pose serious health risks. A way to make the elderly aware of these health risks is using smartphone applications. In this paper, we explored the process of creating an educational assistant that can help mitigate such climate-related risks.

2. Related Work

Enabling humans to interact with their environment, ensure well-being and health, and foster learning and creativity are just some of the grand challenges in human-computer interaction (Stephanidis, e al., 2019). As such, there is existing work in the same space as we are trying to break through. Examples of this include usability of health applications (Zapata, et al., 2015), and accessibility of the ubiquitous smartphone user interface for the elderly (Salman, et al., 2018). Our work is not just at the intersection of health application and elderly UI but also on adult education.

Eudaimonia, or "true happiness" as found in the expression of human excellence and virtue, is also one of the HCI grand challenges. Basic psychological needs such as autonomy and competence must be respected to achieve this so-called life worth living (Ryan & Deci, 2017). This is especially visible in adult learners: they are self-directed and use their life experiences to learn (Knowles, et al., 2014). As such, for them to be receptive to new learning, they must see the value of it first.

This puts several concerns to light. While existing applications cover our general areas of interest - weather, health, and learning - we are yet to find an application that addresses the vital need to educate the elderly about weather-induced health risks. How can we present this information so that the elderly will decide on their own worth their while? How can we package this information to appeal to the elderly with highly varied competency levels in the subject matter? And finally, how can we impart life-saving knowledge to them that will seem contradictory to what their lifelong experience tells them? To address these concerns, we conceptualized an application that will contain weather forecasting, health tracking, and educational technology to highlight health risks while providing utility to the user.

3. Method

Members of the research team conducted brainstorming on the target application first through exchanges in email and a messaging platform to narrow down the problem intended to be solved and propose potential solutions. A member was assigned to collate the information from the exchanges. The same member then created an outline composed of a list of screens and their intended functionalities based on this information. This outline was subjected to a face-to-face intense brainstorming session where starting points for the wireframe had been decided. The wireframe was designed for smartphones since smartphones are ubiquitous and have the least space availability. Scaling up to larger devices will be easier than scaling down since accessibility by the elderly greatly suffers when user interface (UI) components are too small. A low fidelity connected wireframe, or a set of monochrome linked screen illustrations, was created to enable the evaluators to focus on the application content and interaction instead of the overall look and feel.

Ideally, a UI should empirically be tested by actual users. For our particular use case, the elderly may be a vulnerable population; hence, ethical and health considerations should be given more attention, making too frequent user testing of wireframes relatively impractical. Heuristic evaluation where experts assess a user interface based on established rules may complement user testing. Since we are still in the very early stages, we decided to use heuristic evaluation first. For the heuristics, we started with the 12-item heuristic SMArtphone's uSability Heuristics (SMASH) (Inostroza, et al., 2016) to match our target environment.

Aside from usability on smartphones, we also need to consider whether our proposed system aligns with proper relaying of weather information, has educational value, approachable for our target population, and will not endanger their health. We used the Delphi process to identify important factors to consider during evaluation. Delphi process, or estimate-talk-estimate, is a tool used in marketing decision-making where experts arrive at a consensus through a series of sharing forecasts and refining said forecasts based on the currently available information from other experts.

The Delphi process result is combined with SMASH, including the items that may not apply to the wireframe. Deciding the applicability of each SMASH item is left to the evaluators. For the heuristic evaluation itself, the experts are provided with short explanations and inspect the wireframe. They listed the issues encountered for each heuristic, which is then summarized by the moderator. The heuristic evaluation was done by the same experts who executed the Delphi process. The experts from the areas of elderly healthcare, urban climatology, science communication, and educational technology.

4. Results

It is evident from the heuristic evaluation that a higher fidelity is needed to assess the application definitively at a minimum viable product stage. The difference in expertise areas of our experts was evident, especially during the heuristic evaluation. Each expert was able to raise issues not raised by the other experts. However, since the experts are well-versed in their areas only, evaluating areas they are less familiar with during the heuristic evaluation or giving suggestions for evaluation criteria during the Delphi process has introduced unease in each phase. Briefing and debriefing protocols (e.g., kick-off meeting to introduce team members, discussion sessions to internalize results, etc.) must be established for assurance and expectation clarification.

The wireframe is yet to undergo user testing. Additionally, demographic considerations, such as culture or generation, remain to be investigated. For example, some cultures view daily news consumption, including weather reports, as the norm. Thus, the effect of such a knowledge gap on weather differences between nearby areas may not be as drastic. We also anticipate that this application will require real-time updates to various data providers (e.g., local weather providers, at the very least). Interactions with external sources can introduce other usability issues, such as latency of information updates. As such, evaluation using prototypes with a minimally functional back end is necessary before full development.

Using the Delphi process for HCI research, and the modifications we introduced, is yet to be scrutinized. This new process can enable interdisciplinary teams with different area concentrations to arrive at a consensus on proposed computer-based solutions to human problems. But at the very least, a separate experiment where the entire Delphi process is executed must be considered.

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