Usability Evaluation of Smart Home in a Box (SHiB)

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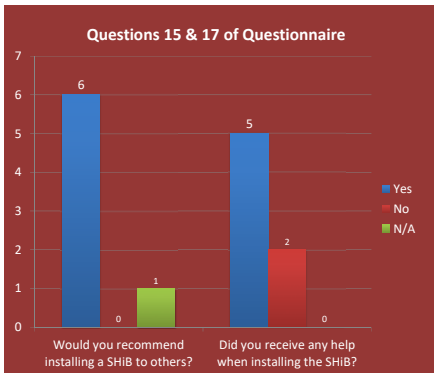
Background

- Smart Home in a Box (SHiB) [1,2] is a project with the purpose of providing researchers with large-scale smart environment data and longitudinal data that monitors older adults' behavioral patterns over months or years.
- Usability is a quality attribute that assesses how easy user interfaces are. A user interface should be designed for all cases [3], a high usability user interface saves time consumed by the user during the product experience.
- Metrics of usability [4] includes easy to learn, efficient to use, easy to remember, few errors and pleasant to use.
- User interface of SHiB includes sensor devices, a server and an instruction manual shipped to participants.
- Our hypothesis is that the Smart Home in a Box is effective enough for self installation.
- The purpose is to validate the effectiveness of the SHiB manual and to generalize suggestions for improving the user interface design of the SHiB.
- Metrics utilized are the installation fail rates of each room and each type of device (sensor).

Methods

- Recruit participants from the older adult population (n=13).
- Demographics: Mean age = 69.2 (54 was the lowest age and 85 was the highest), 5 Males and 8 Females, 8 were married, 2 single and 3 divorced, 4 claimed to have a physical disability.
- SHiB kits are delivered to participants.
- Participants install the SHiB kit.
- Researcher inspects and records the installation accuracy & quality (draw a sketch of house and mark any errors).
- Researcher grades the components of the installation by fail rates (%) of each room and the types of devices.
- Administer a questionnaire to the participant to receive feedback on the installation process.
- After 9 or 10 weeks, the researcher returns to the participant's home to remove the Smart Home in a Box.



Preliminary Data of Sensor Installation

- The data was collected from installation documents of nine sites. Figure 1 shows sensor installation fail rates based upon room types. Table 1 shows the data details of Figure 1. Figure 2 shows device installation fail rates based upon device types. Table 2 shows data details of Figure 2.

Figure 1: Installation fail rate based on rooms

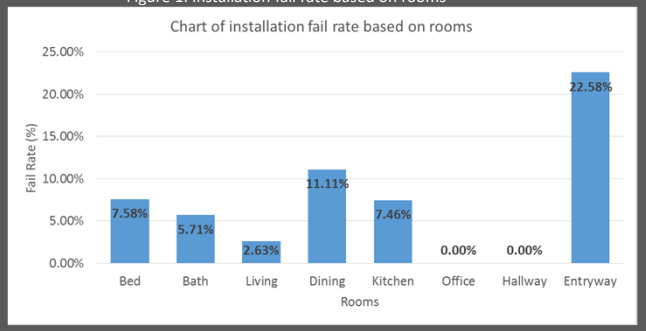


Table 1: Details of installation fail rate based on rooms

	Bed		Bath		Living		Dining		Kitchen		Office		Hallway		Entryway	
Site	Total	Fail	Total	Fail	Total	Fail	Total	Fail	Total	Fail	Total	Fail	Total	Fail	Total	Fail
IHS11	3	1	4	0	2	0	0	0	5	0	0	0	0	0	2	1
IHS12	7	0	5	0	2	0	1	0	5	0	0	0	1	0	2	0
IHS08	3	0	8	0	2	0	0	0	5	0	1	0	1	0	2	1
IHS09	4	0	4	0	2	0	0	0	5	1	2	0	1	0	3	0
IHS06	4	0	8	0	3	0	1	0	5	0	0	0	1	0	1	1
IHS07	6	1	4	1	2	0	2	0	5	0	1	0	1	0	3	1
IHS21	3	0	4	0	2	0	1	0	6	0	1	0	1	0	3	0
IHS28	7	0	5	0	2	1	1	0	5	2	0	0	3	0	3	0
IHS31	6	1	6	2	4	0	1	0	5	0	2	0	3	0	4	1
IHS14	4	0	4	0	7	0	2	0	6	0	2	0	1	0	2	0
IHS37	6	0	4	0	4	0	2	2	5	2	0	0	1	0	3	2
IHS38	7	0	7	0	4	0	4	0	5	0	0	0	2	0	2	0
IHS40	6	2	7	1	2	0	3	0	5	0	0	0	3	0	1	0
Totals	66	5	70	4	38	1	18	2	67	5	9	0	19	0	31	7
Fail Rate	7.58%		5.71%		2.63%		11.11%		7.46%		0.00%		0.00%		22.58%	

Figure 2: Installation fail rate of devices

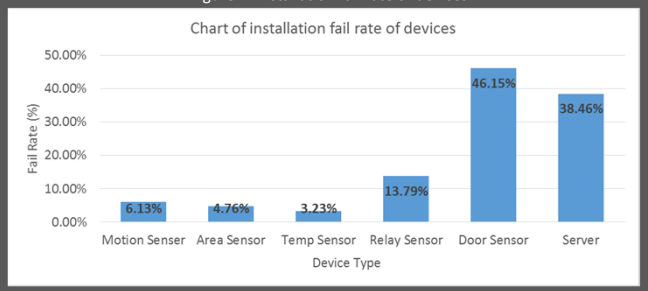


Table 2: Details of installation fail rate of devices

	Motion		Area		Temp		Relay		Door		Server	
Site	Total	Fail	Total	Fail	Total	Fail	Total	Fail	Total	Fail	Total	Fail
IHS11	8	1	4	0	2	0	2	0	1	1	0	
IHS12	11	0	9	0	3	0	2	0	1	0	1	
IHS08	12	0	8	0	3	0	2	0	1	1	1	
IHS09	11	1	7	0	2	0	2	0	1	0	1	
IHS06	11	0	11	0	3	0	2	2	1	1	1	
IHS07	11	0	9	2	2	0	2	0	1	1	0	
IHS21	11	0	7	0	2	0	2	0	1	0	0	
IHS28	15	3	10	0	2	0	3	0	1	0	0	
IHS31	18	1	9	0	3	0	2	0	1	1	0	
IHS14	11	0	10	0	2	0	3	0	1	0	0	
IHS37	13	4	6	1	2	1	2	0	1	1	0	
IHS38	15	0	9	0	3	0	3	0	1	0	0	
IHS40	16	0	6	2	2	0	2	2	1	0	1	
Totals	163	10	105	5	31	1	29	4	13	6	5	
Fail Rate	6.13%		4.76%		3.23%		13.79%		46.15%		38.46%	

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Results & Discussion

- So far, the data indicates, for most devices, the SHiB user interface is effective in installation.
- Figure 1 shows that the highest fail rate occurs in the entryway, which is 22.58%, and most sensors are successfully installed in the hallway and office.
- Figure 2 shows that door sensors (46.15%) and the server (38.46%) are among the highest in failure rates, and the temperature sensors are the most successfully installed.
- The failure rate in the entryway is the highest due to the door sensor. A reason for this failure is that the shapes of residents' entryways vary.
- Some residents refuse/are unable to install the SHiB themselves therefore the fail rates for certain sensors increase.
- Some residents state; "I don't understand it", or "I'm afraid to break it", or "I think it is too hard to do that."

Conclusion & Future Work

- Our conclusion is that our results are too mixed at the moment and there are a few aspects of the SHiB that need to be remedied.
- Based on high installation fail rates for door sensors, finding a better door sensor could make the process easier for participants.
- Current server installation is hard to accomplish, as a result to give more detailed guidelines could be beneficial or to change the server into one that looks "simple" and "easy to install" for residents.
- For the questionnaire, providing a picture of the sensors for the participant to use as a guide could help with the understanding of the questions.
- Pre-recorded installation videos could also be a solution to help with the installation process.
- Popcorn ceilings have been an issue in many homes.
- Implications of this study include usability evaluation in elder care SHiB like systems and to understand the user experience of the SHiB installation process.
- We plan on continuing to expand the sample size so that more data can be gathered.

References

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