"BRAILLEBUDDY: A TANGIBLE USER INTERFACE TO SUPPORT CHILDREN WITH VISUAL IMPAIRMENT IN LEARNING BRAILLE"

01 BACKGROUND

AUTHORS & AFFILIATIONS:

FLORIAN LANG: LMU, GERMANY
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SIGNIFICANCE IN HCI:

- FLORIAN LANG: ADVANCES HCI WITH BRAILLEBUDDY AND MIXED REALITY.
- VERENA PUES: ENHANCES ACCESSIBILITY WITH BRAILLEBUDDY AND PLAYMAKE.
- ALBRECHT SCHMIDT: CONTRIBUTES TO MIXED REALITY AND MACHINE LEARNING.
- TONJA-KATRIN MACHULLA: FOCUSES ON ACCESSIBILITY AND USER EXPERIENCE.

PUBLICATION YEARS:

- FLORIAN LANG: 2020-2023, RECENT RESEARCH.
- ALBRECHT SCHMIDT: 1998-2024, LONG HCI CAREER.
- VERENA PUES: 2023, NEW RESEARCHER.
- TONJA-KATRIN MACHULLA: 2016-2023, MID-CAREER RESEARCHER.

COLLOABORATION:

THE AUTHORS HAVE PREVIOUSLY COLLABORATED ON VARIOUS RESEARCH PAPERS, INCLUDING WORK ON SMART HOME INTERFACES AND MOBILE GAME ACCESSIBILITY.

02 METHODOLOGY

THE STUDY HAD THREE PHASES:

1) INTRODUCTION: PARTICIPANTS WERE BRIEFED ON THE STUDY AND ENCOURAGED TO GIVE FEEDBACK.
2) EXPLORATION: THEY INTERACTED WITH BRAILLEBUDDY, RECEIVING MINIMAL GUIDANCE.
3) EVALUATION: PARTICIPANTS PLAYED GAME MODES LIKE WORD COPY, WORD SCRAMBLE, AND WORD RIDDLE TO TEST USABILITY.

EACH 30-MINUTE SESSION WAS TAILORED TO CHILDREN'S ATTENTION SPANS.

PARTICIPANT FEEDBACK:

CHILDREN'S FEEDBACK ON LIKES, DISLIKES, AND SUGGESTIONS WAS COLLECTED TO IMPROVE THE SYSTEM.

DATA COLLECTION TECHNIQUES:

- OBSERVATIONS: EXPERIMENTERS TOOK NOTES ON PARTICIPANTS' BEHAVIOR AND COLLECTED TEACHER FEEDBACK AFTER SESSIONS.
- VIDEO/AUDIO RECORDINGS: CAPTURED PARTICIPANTS' INTERACTIONS WITH BRAILLEBUDDY FOR ANALYSIS.
- DIGITAL INTERACTION LOGGING: RECORDED ALL INTERACTIONS WITH BRAILLEBUDDY, INCLUDING TIMESTAMPS.
- TEACHER INTERVIEWS: GATHERED ADDITIONAL INSIGHTS ON PARTICIPANT BEHAVIOR AFTER EACH SESSION.

SUPPORT WAS CLASSIFIED INTO:

- FINDING LETTERS: HELP WITH LOCATING THE CORRECT LETTER CARDS.
- SOLVING GAMES: ASSISTANCE WITH GAME CHALLENGES, INCLUDING CLUES OR TIPS.
- INTERACTING WITH BRAILLEBUDDY: SUPPORT WITH USING THE DEVICE, SUCH AS OPERATING IT OR UNDERSTANDING ITS FEATURES.

03 RESULTS

1) GAME PERFORMANCE:

- SIGNIFICANT IMPROVEMENT: MEAN TIME PER CARD PLACEMENT DECREASED FROM 113S TO 72S ($P < 0.01$).
- NON-SIGNIFICANT IMPROVEMENTS: ERROR RATES, LETTER SUPPORT, GAME SUPPORT, AND INTERACTION SUPPORT SHOWED POSITIVE TRENDS BUT DID NOT REACH STATISTICAL SIGNIFICANCE.

2) PARTICIPANT ENGAGEMENT:

- INTEREST: 10 OUT OF 11 PARTICIPANTS WANTED TO USE BRAILLEBUDDY AGAIN, WITH SOME REQUESTING TO TAKE IT HOME.
- ENJOYMENT: MOST PARTICIPANTS ENJOYED THE DEVICE, WITH CURIOSITY ABOUT ITS FEATURES.
40 MINI

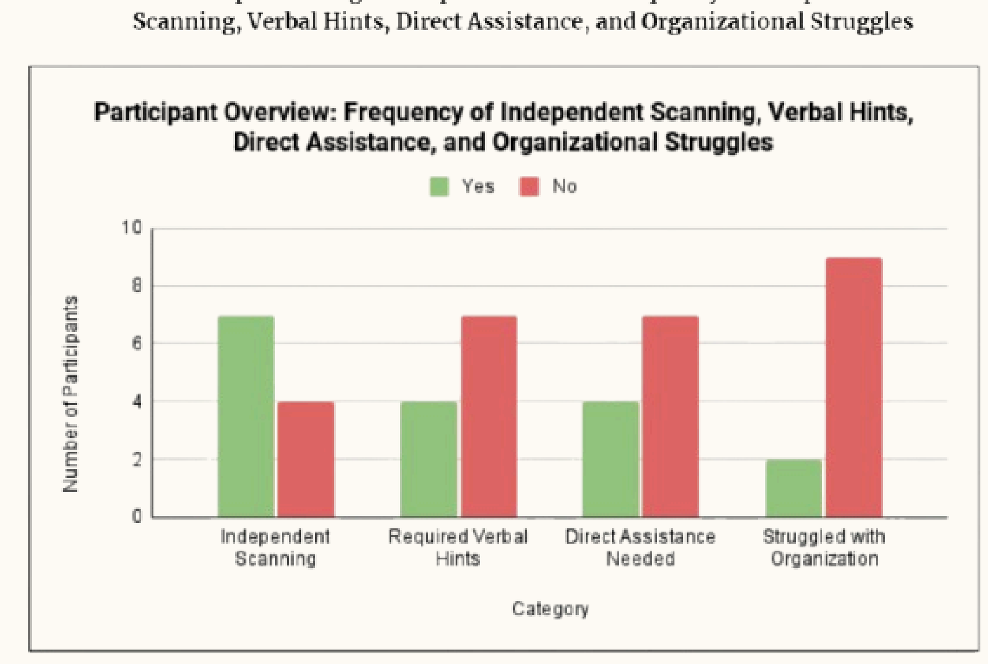
3) PREFERENCE FOR 3D VS 2D OBJECTS:

- 3D FIGURINES: PARTICIPANTS PREFERRED 3D FIGURINES (12 OUT OF 14 ROUNDS) OVER 2D RELIEF IMAGES.
- TACTILE FEATURES: DETAILED 3D OBJECTS ENHANCED RECOGNITION AND INTERACTION.
- CONFUSION MITIGATION: AUDIO FEEDBACK HELPED CORRECT ERRORS FROM SIMILAR SHAPES.

4) LETTER CARDS:

- INDEPENDENT SCANNING: 7 PARTICIPANTS SCANNED LETTER CARDS INDEPENDENTLY.
- VERBAL HINTS: 4 PARTICIPANTS NEEDED UP TO 3 VERBAL HINTS.
- DIRECT ASSISTANCE: SOME PARTICIPANTS NEEDED MORE DIRECT HELP WITH LETTER CARDS.
- ORGANIZATION ISSUES: SOME STRUGGLED WITH MAINTAINING CARD ORGANIZATION.

Bar Graph showing Participant Overview: Frequency of Independent Scanning, Verbal Hints, Direct Assistance, and Organizational Struggles



04 DISCUSSION

IMPLICATIONS FOR HCI:

- USER-CENTERED DESIGN: HIGHLIGHTS THE IMPORTANCE OF ITERATIVE DESIGN AND CUSTOMIZED SUPPORT IN IMPROVING EDUCATIONAL TOOLS LIKE BRAILLEBUDDY.
- 3D VS. 2D OBJECTS: PREFERENCE FOR 3D FIGURINES EMPHASIZES THE ROLE OF MULTI-SENSORY INTERACTION AND INTUITIVE DESIGN IN ACCESSIBLE TECHNOLOGY.
- ENTERTAINMENT VALUE: FUN AND ENGAGING FEATURES IN ASSISTIVE TECHNOLOGY BOOST USER MOTIVATION AND LEARNING, ALIGNING WITH HCI RESEARCH ON ENJOYABLE INTERACTIONS.
- AUTONOMY: INCREASED SELF-DIRECTED INTERACTION SHOWS HOW ASSISTIVE TECHNOLOGIES CAN FOSTER USER INDEPENDENCE AND CONFIDENCE.
- INCLUSIVE DESIGN: THE STUDY UNDERSCORES THE VALUE OF INCLUSIVE AND ADAPTIVE DESIGN PRINCIPLES IN ASSISTIVE TECHNOLOGIES, GUIDING FUTURE RESEARCH AND DEVELOPMENT IN EDUCATIONAL AND ACCESSIBILITY TECHNOLOGY.

LIMITATIONS/SHORTCOMINGS:

- CARD INTERACTION: IMPROVE WITH DIFFERENTLY SHAPED CARDS OR LARGER SLOTS.
- ATTENTION AND FOCUS: ADD DYNAMIC FEEDBACK FOR BETTER ENGAGEMENT.
- AUDIO FEEDBACK: SUPPORT MULTIPLE LANGUAGES AND SOUND OPTIONS.
- CARD ORGANIZATION: ORGANIZE STORAGE AND REDUCE CARD QUANTITY FOR EFFICIENCY.

05 CONCLUSION

MAIN TAKEAWAYS:

- EFFECTIVE LEARNING TOOL: BRAILLEBUDDY SIGNIFICANTLY IMPROVES LEARNING AND SKILL ACQUISITION FOR VISUALLY IMPAIRED CHILDREN, REDUCING CARD PLACEMENT TIME.
- FEEDBACK AND INTERACTION: MULTISENSORY FEEDBACK AND CLEAR TACTILE FEATURES (3D VS. 2D) ENHANCE ENGAGEMENT AND ENJOYMENT.
- OPPORTUNITIES FOR IMPROVEMENT: AREAS LIKE CARD PLACEMENT, ATTENTION SPAN, MULTILINGUAL SUPPORT, AND STORAGE ORGANIZATION CAN BE IMPROVED.
- PARTICIPANT ENGAGEMENT: HIGH INTEREST IN USING BRAILLEBUDDY BEYOND EDUCATIONAL SETTINGS SUGGESTS BROADER APPLICATION POTENTIAL.

RELEVANCE AND IMPACT:

- CONTRIBUTION TO HCI: PROVIDES INSIGHTS INTO DESIGNING EFFECTIVE ASSISTIVE TECHNOLOGIES WITH ADAPTIVE FEEDBACK AND MULTISENSORY INTERACTIONS.
- GUIDANCE FOR DEVELOPMENT: SUGGESTS ENHANCEMENTS FOR CONTEXT-AWARE FEEDBACK, MULTILINGUAL SUPPORT, AND BETTER STORAGE SOLUTIONS.
- BROADER IMPLICATIONS: EMPHASIZES INCLUSIVE DESIGN AND ADAPTIVE SUPPORT IN TECHNOLOGY TO EMPOWER USERS AND ENHANCE LEARNING EXPERIENCES.

Supporting the Contact Tracing Process with WiFi Location Data: Opportunities and Challenges

BACKGROUND

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Contact tracers aid in preventing the spread of infectious diseases by liaising with positively infected community members to identify close contacts. In order to aid them, a visualization tool was created so that with WiFi, it can provide location data and better inform these tracers of areas of potential inconsistencies.

ABSTRACT

The main objective of this paper was to determine how HCI components can support the manual contact tracing process, along with analyzing the data collected in order to reduce the recall problem that currently exists.

By using WiFi technology, HCI designs were implicated and tested with the intention of monitoring users under a standard network wherein the efficiency of this visualization tool could be assessed.

The data gathered from this research showed that the visualization tool did indeed help these tracers aid the users in recalling information. However, data inconsistencies, false reports and information sharing hesitancy were noted to be negative aspects of this tool.

METHODOLOGY

MODELS: Both decentralized device-based and centralized device-based models are used in contact tracing but for the duration of this research centralized device-based models were used. (The entire university WiFi network was used in order to facilitate the testing of the HCI component)

DATA SOURCES: The university WiFi was chosen as a data source as it could pinpoint locations of ther user's devices and give valuable information such as the duration of their time at a given place and proximity to other users.

DATA COLLECTION: Interviews with contact tracers were set up to understand the workflow of these tracers along with what would be necessary tools to aid them. The questions asked focused on how contact tracing systems work and how it could be implemented within the university. Furthermore, more interviews were done with trained, active tracers in order to get a better grasp of the active workflow.

DESIGNS: The initial design of the visualization tool was created, to which concerns were raised and quickly addressed. (Privacy concerns as user IDs were visible.) An updated version was then created but with more feedback from participants, other aspects were added and the final version of the tool was created. (Date edits, location filtering etc...)

EXPERIMENTATION: Mock calls were done by the contact tracers to the university students alongside investigations and interviews after to discuss the performance of the tools. Each participant was also compensated for their time.

PARTICIPANTS: In order to get participants in the first place, email surveys were sent out in order to get a fresh batch of users (as no participants present in the design aspect were used again). Data was then analyzed and participant recruiting was finished once recurring themes were found.

PREPARATION: Case ID numbers were created for the university participants and this information was then given to the contact tracers (no personal information however). The contact tracers were trained with the visualization tool beforehand in order to ensure they used the tool to its best ability.

PARTICIPATION: All contact tracers operated more than one call, and the real locations of the university students were used with the WiFi technology. Follow up interviews were done to assess the usefulness of the HCI component in aiding these contact tracers

DATA PROCESSING: Thematic analysis which gave way to three themes (benefit- tracers' confidence, challenges- privacy and inconsistencies), inferences from participants along with reviewing the interview transcriptions and analyzing the mock calls for qualitative data.

RESULTS

DATA: 14 mock phone calls, 158 identifications

CHALLENGES: WiFi ambiguity (i.e. in a large space using the same network which produced false positives), user memory problems, information sharing hesitancy by the university participants.

POSITIVES: Most inconsistencies were resolved due to the tracer and user making use of the HCI component and the contact tracers agreed that it made recall much easier.

PRIVACY: Participants agreed that they were willing to participate due to transparency of researchers when it came to their data and also wanted access to their data if possible

CONCLUSION

The visualization tool successfully helped contact tracers jog the memory of the participants and raised their confidence in HCI tools. However, the challenges that arose meant that the HCI component was not 100% functional. By using this research paper and getting feedback from participants, the HCI tool can be improved and can help give developers insight into ways they can do this.

DISCUSSION

Socio-technical gaps i.e. false positive reports occurred due to the same network being used in large spaces or false negatives occurring when the participant was logged off the university network. This type of data analysis is limited to the scope of the network, and if students were to leave the range it would not be recorded.

Imperfect data can be contextualized due to the visualization tool which helped participants jog their memory and recall more information for the tracers.

The overall system design should have the best user experience for the tracers as well as the participants, and relevant data should always be able to be prioritized (along with the visualization tool helping in reconciling inconsistencies).

The system should also allow users to refine or adjust data as necessary in the event that future information is provided.

LIMITATIONS: Only a small number of participants were used, community bias was also a limitation as those willing to participate in this study already trusted the researchers to handle their data to some degree, unlike the real world where users may not be comfortable sharing their data. The utilization of the pre-existing network was also a limitation as in the real world there are many different networks and forms of infrastructure a person may visit in their day to day life.

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EXPLORING RENEWABLE ENERGY FUTURES THROUGH HOUSEHOLD ENERGY RESILIENCE

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ABSTRACT

Due to the depletion of our climate state, there have been many studies carried out by experts to discover the ways in which the Earth's population may contribute to the improvement of our climate. One of these identified strategies is a transition to renewable energy as an alternative to fossil fuel based production of non-renewable energy.

The paper investigates how households can adapt to intermittent energy supplies as the world transitions to renewable energy sources to meet climate goals. It emphasizes the concept of household energy resilience and identifies strategies that households can employ to manage energy consumption effectively as well as the roles HCI can play to support resilience

METHODOLOGY

The study employed qualitative research methods, including semi-structured interviews and experience sampling with 21 Swedish households. (So first the 21 participants received a workbook describing a possible renewable energy scenario, then. Secondly they were interviewed about their experiences and expectations in relation to the scenario. Finally, they received follow-up questions via text message). Data collection focused on understanding household practices, challenges, and strategies related to energy resilience in order to identify possibilities for supporting household energy resilience. Participants were asked to reflect on their experiences with energy use, particularly during power outages or shortages, and to speculate on future scenarios and expectations involving intermittent energy supply. The participants were sought from varying types of households to diversify the results of the study and account for different possibilities and scenarios. (eg. households with experience in limited electricity supply, people living off-grid, and households with scarce experience in dealing with limitations to electricity. They were also selected with variation in their location and type of home.)

RESULTS/FINDINGS

The results from the study were categorized and presented in two parts, those being (1) the participants' reflections on experience and expectations of limited electricity supply, and (2) identified strategies for household energy resilience.

(1) Key Observations from Table:

- Households in rural areas (farms, houses) tend to be better prepared, especially if they have solar energy systems.
- Urban and apartment households, particularly in living lab buildings with PVs, show varying levels of preparedness, with many being "somewhat prepared" or "unsure."
- Electric vehicles (EVs) and future plans for PV installations are common in households that are somewhat or very prepared.

(2) The key findings identified three strategies for enhancing household energy resilience:

- Response Diversity: Households adopt varied approaches to manage energy use.
- Creating Opportunities for Resilience: Households leverage technology and community resources.
- Building Community Energy Resilience: Collaboration among households enhances overall resilience.

TABLE : OVERVIEW OF THE PARTICIPATING HOUSEHOLDS BASED ON THE APPLICATION FORMS. PERCEIVED PREPAREDNESS WAS IN RELATION TO A POTENTIAL 24-HOUR POWER OUTAGE.

Code	*Type of home (location)*	*No of adults in the household (age of any children)*	*Gender **	*Age span **	*PVs, solar water heating or electric car (EV)*	*Comment*	*Perceived preparedness*
P01	Farm (rural)	2 (0, 5, 7, 11, 12)	Man	35-44			Very prepared
P02	House (rural)	2	Woman	65-74			Can adapt
P03	House (urban)	2	Woman	55-64	Solar water heating, EV	Planning for PVs	Somewhat prepared
P04	Apt (urban)	1	Non-binary	45-54			Somewhat prepared
P05	Farm (rural)	3	Man	55-64	Solar water heating		Very prepared
P06	House (rural)	2	Woman	35-44	PVs in future home	Previously lived in and about to move to off-grid house	Very prepared
P07	Attached house (urban)	3 (17)	Woman	45-54	PVs in holiday home		Very prepared
P08	Attached house (urban)	2 (5, 10)	Man	25-34			Somewhat prepared
P09	House (rural)	1	Man	35-44	PVs	Off-grid house	Very prepared
P10	House (semi-urban)	1	Man	65-74	EV		Somewhat prepared
P11	House (urban)	2	Man	65-74	PVs in holiday home	Off-grid holiday home	Can adapt
P12	Apt (urban)	1	Woman	18-24	EV		Somewhat prepared
P13	Apt (urban)	2 (10, 12, 14)	Woman	45-54			Somewhat prepared
P14	Apt (urban)	1 (15, 17)	Woman	45-54			Not at all prepared
P15	Apt (urban)	1 (9, 12)	Woman	35-44			Somewhat prepared
P16	Apt (urban)	2 (2, 7)	Man	35-44	PVs on apt building	Living lab building	Not at all prepared
P17	Apt (urban)	1	Woman	18-24	PVs on apt building & holiday home	Living lab building	Somewhat prepared
P18	Apt (urban)	1	Man	18-24	PVs on apt building	Living lab building	Unsure
P19	Apt (urban)	1	Man	18-24	PVs on apt building	Living lab building	Somewhat prepared
P20	Apt (urban)	1	Woman	18-24	PVs on apt building	Living lab building	Unsure
P21	Apt (urban)	1	Man	25-34	PVs on apt building	Living lab building	Can adapt

DISCUSSION

The findings underscore the critical role of HCI in facilitating household energy resilience. By designing technologies that align with household practices and routines, HCI can help mitigate the challenges posed by intermittent energy supply. The study suggests that future research should focus on developing user-centered designs that consider the social and cultural contexts of energy use.
Implications: The research has significant implications for policymakers and energy providers. It suggests that fostering community-based energy initiatives can enhance resilience and encourage sustainable practices. Additionally, the findings highlight the need for educational programs that inform households about energy management strategies.
Limitations: The study's focus on affluent households may limit the generalizability of the findings. Future research should explore the experiences of diverse socioeconomic groups to gain a more comprehensive understanding of household energy resilience.
Future Directions: The authors call for interdisciplinary collaboration between HCI researchers, energy experts, and community organizers to develop holistic solutions that address the complexities of energy resilience in various contexts.

CONCLUSION

The research done used the perspective of household energy resilience to underscore the potential of HCI to contribute to sustainable energy practices. Given the enhanced digitalization and electrification that has been made common throughout society that inhibits dependency on stable electricity supply, HCI can be made to take into consideration energy constraints and strengthen resilience.

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