K-CAS: A Kitchen-CameraS Augmentation Exploration for Blind in the Kitchen

HCII REU 2024

MOTIVATION

What's the problem?

MOTIVATION

Accessible spaces enable blind and low vision (BLV) individuals to perform tasks independently, fostering autonomy by utilizing non-visual cues to interpret and navigate environments effectively.

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There is a lack of information on which form factor -whether smart glasses, cellphones, or stationary cameras-best supports BLV groups in kitchen tasks. **Scenario-based studies will provide insights into improved user design choices.**

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Traditional tactile and auditory aids often fail to provide the visual input necessary for complex tasks.

There are significant risks, including the need to avoid hazards and manage multiple tasks simultaneously.

RESEARCH

Here are some snippets from my research prior to our study.

I wanted to look into current accessibility product pain points. What was missing?

product problems:

technology reliability and accuracy

- misinterpretations by voice assistants or image recognition systems can lead to incorrect instructions or feedback
- failure of sensors or systems (e.g., RFID misreads, camera malfunctions) could lead to safety risks or frustration.

user experience ideas (complexity and cognitive overload):

- high-tech solutions might introduce complexity that can overwhelm some users, particularly older adults or those not tech-savvy (balancing detailed feedback without causing information overload is crucial.)
- adapting new technologies to fit into diverse kitchen layouts and to accommodate existing cooking habits can be challenging — resistance to change from traditional methods to technology-driven methods might affect user adoption (simplification, central idea is creating a personalized assistant, but still giving full autonomy to the user opposed to full reliance on these applications)

RESEARCH

Now how can we focus on giving users full autonomy?

should we explore a specific disability or universal design for a general party? also how can we explore camera form factors?

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focus: giving users autonomy.

1. *comfortable physical spaces and pathways (for general use, are we looking into universal design? or a specific age group?)*
    1. qhat layout designs and navigation aids (e.g., guided pathways with sensors around flooring or directional sound systems) best support safe and efficient movement in the kitchen for someone who is visually impaired?
        1. Fire alarms, hot countertops…
            1. safety features such as automatic shut-off systems or deactivation for cooking appliances such as overheating (and real-time alerts for hazardous situations? Touch dots? Bump dots? tactile pens?)
        2. define specific zones for different activities (prep area, cooking area, cleaning area) with clear tactile or auditory markers to signify transitions between zones.
            1. sensors + voice would be great here - for example, a beeping sound could indicate the location of the refrigerator or oven for less cognitive overload?

- **An example, though the humane pin went under water with tech reviewers, I wish the use case for the product was focused on accessibility - pendant, pin, or even glasses like metas ray bans make assistive technology much more simplified in one product.**
- Do users prefer wear? Do they prefer less tech on them and would rather talk to an assistant?

RESEARCH METHOD PLAN

Here is a rundown of my plan for research.

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1. **Literature Review**

   visual questioning answering (VQA), physical accessibility, HCI methods

2. **Challenges**

   defining challenges with blind-low vision participants, finalizing research Questions

3. **Form Factors**

   exploring camera form factors, looking into a comprehensive analysis for physical spaces

RESEARCH METHOD PLAN

From our literature review, we decided on a behavorial study.

PART A: Pilot Study with volunteers
PART B: Refined final study with BLV individuals

4. **Design Study**

   designing an in person behavorial user study for BLV participants

5. **Pilot**

   pilot study testing for user scenarios, observe interactions

6. **Execute**

   refining user study script, interviewing participants for pilot study

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MAIN RESEARCH QUESTION

Q1: How do different camera form factors influence the behavioral adaptations and user interactions of blind individuals in the kitchen?

What are the preferences of visually impaired users regarding the form factors of camera-based systems functionality during kitchen tasks?

Accurate information access are critical for the safety and efficiency for navigating general spaces.

How do these variations address needs and design preferences?

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PILOT STUDY

5 participants tested 11 kitchen tasks using 6 form factor cameras.

- **Think Aloud Protocols** →Users were given autonomy in task performance and asked to verbalize their process of interaction
- **Participant Observations** → noted behavioral adaptations, questions, and recorded interactions/audio with form factor cameras.

"Have you used any vision assistance for kitchen tasks? Such as finding objects or identifying the food status?"

FIG 1: Kitchen Diagram

Qualitative Data → Pre-Study Interview (7 questions) →Post-Condition Survey per camera (9 questions) → Post-Study Interview (2 questions).

Quantitative Data → Usability Surveys (1-5 Likert Scale to measure comfort, confidence, and safety).

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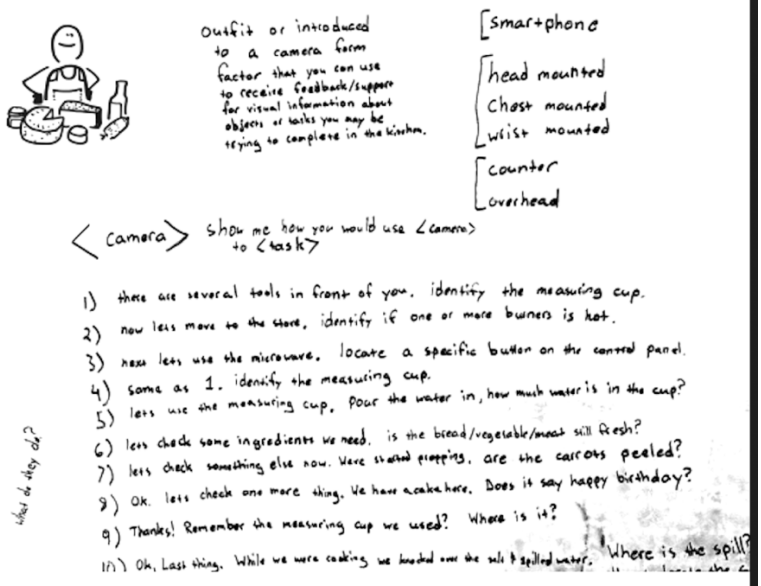
PILOT STUDY

List of Camera Form Factors and Task Script List

Fig 2: User 1, Task 5

Fig 3: User 2, Task 5

Fig 4: Kitchen Layout



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FUTURE

Refine the study design to emphasize user interactions → behaviors in task execution.

- Conduct in-person user studies with blind participants to validate findings for accessible spaces (IRB, testing study length).
- Develop an improved testing platform compatible with more systems to process visual information and questioning using VLMS.

FUTURE

Next Idea?

Does a camera's form factor change a BLV participant's mental model in performing tasks? How can we use this information to assist visual questioning and automated (voice) assistants?