Discovering Users for Technical Innovations through Systematic Matchmaking

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ABSTRACT

Every year Human-Computer Interaction (HCI) researchers create new technical innovations. Unfortunately, the User-Centered Design (UCD) processes used by most designers in HCI does not help much when the challenge is to find the best users for these innovations. We augmented the matchmaking design method, making it more systematic in considering potential users by using a list of 399 occupation groups and by incorporating the customer discovery interviews from the Lean Startup. We then assessed our new design method by searching for users who might benefit from two different technical innovations: ViBand and PaperID. We found that matchmaking with the list of occupation groups helped surface users we would likely have not considered. In addition, the customer discovery interviews helped to generate better applications and additional target users for the innovations. This paper documents our process, the design method, and insights we gained from using it.

KEYWORDS

Design Method; Customer Discovery; Human-Computer Interaction

CHI'19 Extended Abstracts, May 4-9, 2019, Glasgow, Scotland, UK.

ACM ISBN 978-1-4503-5971-9/19/05.
DOI: https://doi.org/10.1145/3290607.3312843

Figure 1. Different forms of PaperID [5]

PaperIDs are inexpensive RFIDs made with a paper substrate. They function as battery-free buttons that can be placed on almost any surface, making it easy to make anything interactive. They can also be used to detect when tagged objects move in or out of a space.

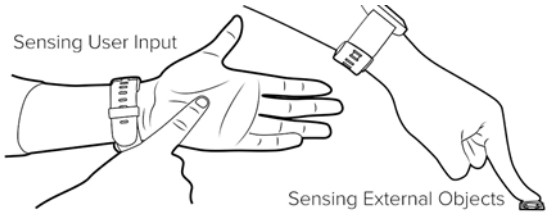

Figure 2. Schematic sketch of ViBand uses [4]

ViBand uses a high sampling rate of accelerometers (4000 Hz) found in most smart watches to recognize objects the user touches based on the object's vibration (e.g., guitars, electric toothbrushes, and drills). It can also detect distinct hand gestures and receive new information via changes in the pattern of vibrations.

INTRODUCTION

Every year HCI researchers develop exciting technical innovations. They often present these as demonstrations showing the novelty of the technology, but they typically do not detail the broad set of users who might benefit from the advance. Designers working in HCI typically follow a UCD [1] process. However, this process, which begins with the selection of a user group to study, does not work well when the challenge is to discover a broad set of users who might benefit from an innovation. Consequently, only a limited set of methods is available to tackle this challenge.

In 1999, Bly and Churchill described a four step process they called matchmaking where designers work from a technology towards the discovery of new users [2]. Interestingly, few in the HCI community appear to have picked this up and used it to find users for HCI innovations. We suspect that this approach has not yet launched for two reasons. First, the strong UCD culture within HCI can make it seem design teams must always start with user research, not user discovery. Second, the high-level description of matchmaking does not detail how a design team might systematically consider a broad set of possible users for the innovation.

Recently, this idea of moving from innovation to users has re-emerged. The Lean Startup asks innovators to engage in a process of customer discovery; to go out and ask potential customers if they would pay for access to an early, incomplete version of a system [8]. Each contact with a potential customer leads to one of three outcomes. A team can persevere and continue to make the same thing for the same customer, they can pivot and make the same thing for a new (more underserved) customer, or they can pivot and make a new thing that provides a different value for the same customer. This approach works well for startups that often have a weak commitment to any specific technology. However, when committed to a specific innovation, it would take a long time to consider hundreds of possible customers doing one interview at a time.

Our work attempts to advance matchmaking, enabling possible customers to be considered more systematically. We hope this approach will make it easier for design researchers to find a broad set of new users for HCI innovations, thus increasing the value of the research investment to create new technology. We first selected two distinctly different HCI technical innovations (figure 1 and 2) to use in the process. Then, we enacted a matchmaking process augmented with a list of 399 occupations. After ranking each in terms of value to user and service provider, we conducted customer discovery interviews from the Lean Startup. Finally, we spoke with inventors working on the technical innovations to see if our efforts produced users and insights they had never considered. In this paper we describe our process and reflect on what we learned.

METHOD DESIGN

Process structure

We wanted to make matchmaking more systematic. Specifically, we wanted to augment it so design teams consider a broader range of possible users than they can recall when brainstorming. In addition, we wanted to add the customer discovery interviews from the Lean Startup to validate a design team's inferences around how an innovation might benefit specific users.

Augmented Matchmaking Method

1. Technologic Capabilities
Using literature on the technology to detail its capabilities.

2. Activities
Using the '5Ws and H' theory to envision capability enabled activities through its usage context.

3. Domains
Ranking unit (occupation) groups on activity value and occurrence to discover domains of interest. Ideas are envisioned for top ranked unit groups.

4. Verification
Using the Lean Startup customer discovery interview process to verify the match found between the technology and found users while iteratively developing the found application.

Finally, we wanted to understand if HCI technical innovators found the discovery and ranking of new users valuable, and whether they found the work to discover new users to be outside of the scope of their own research efforts. In order to augment the matchmaking design process, we used matchmaking on two different technologies and continually reflected on our process. We chose to work with two distinctly different kinds of technology in order to prevent the peculiarities of any specific design case from interfering with what we learned about matchmaking. We chose to work with PaperIDs [5] (a cheap way to instrument an environment) and ViBand [4] (a way of sensing things and activities using a smart watch) because we had access to the HCI technical innovators working on these technologies.

Augmented Matchmaking

Matchmaking employs a four-step process: (i) detail the capabilities of a new technology, (ii) detail the work activities these capabilities support, (iii) identify the domains that require these work activities, and (iv) select and verify the specific target users that can benefit from this technology. After completing this process, a design team typically selects a single user group and engages in UCD. In our review of matchmaking as a way to find users for new HCI innovations, we observed a challenge in transitioning from step 1 to step 2; making the leap from technical capabilities to human activities that might benefit from one or more of the capabilities (Who needs this and what might they do with it?). As the activities abstractly define a usage context, they were hard to be envisioned based on capabilities as they felt too abstract to connect with all possible contexts people might find themselves in. When faced with a similar challenge, designers can use the Five Ws and H method [7] to ground their ideation to specific people while defining contexts. We used this method as inspiration to describe the usage context and define the activities.

Next, we needed to systematically consider all possible users. After some searching, we decided to try the International Standard Classification of Occupations [3]. This list categorizes almost every occupation in a four-level hierarchical structure: 10 Major groups (e.g. "Professionals"), 43 Sub-Major groups (e.g. "Science and Engineering Professionals"), 130 Minor groups (e.g. "Physical and Earth Science Professionals"), and 436 Unit groups (e.g. "Physicists and Astronomers"). We chose to work with unit groups, as the abstraction of higher level groups made it hard to envision a person in a context. Some duplicate unit groups (e.g. 'Other Cleaning Workers' after specific 'Cleaners and Helpers' groups) were left out to increase the quality of the result. This concluded in a total list of 399 unit (occupation) groups usable for further evaluation. For every found activity, we considered its occurrence for each unit group. We worked to envision each as people working in place, and we drew on our personal understanding of these occupations to imagine how the specific capabilities might be useful. In many cases, the capabilities enabled by the technology were not thought to provide value to the group. When we did imagine a use, we generated a score for this group for every found individual activity on a 1 to 3 scale; subjectively assessing the value of the technology on each activity for the unit group.

By considering both the sum of the activity scores and the reachability (the effort required to get in contact in future phases), we produced a ranked list of users for the innovation.

Table 1: 1. Technologic Capabilities

PaperID	*ViBand*
Disposable	Feedback
Location-aware	Connected
Connected	Data communication
Interactive	Gesture interactions
Wireless	Sensors
	Vibrating object detection

Table 2: 2. Activities (predefined)

PaperID	*ViBand*
Logging	Logging
Defined interaction subjects	Personal interactions
Defined interaction environment	Tool – User communication
Moving interaction subjects	In-action communication
High cost environments	Vibrating object usage

Table 3: 2. Activities (iterative)

PaperID	*ViBand*
Present output device	Present output device
Disposing objects	Micro-movements
Company communication	No touchscreen interactions
Small environments	Inaudible communication
Entering/leaving environment	Analog object communication
Objects stationary	
Logging key moments	

In order to address needs unmet by existing technologies, a focus on rarely supported activities and/or combinations can be used while selecting unit groups of interest. For the top ranked target users, we envisioned several different products or services that might help them. Later, following the customer discovery process from the Lean Startup, we verified our insights about the usefulness of the innovation using interviews. We created storyboards detailing several possible systems and used these in the interviews to validate that we had understood the unit group's needs and envisioned systems they might want to use. In order to improve the found match and system presented, conceptual changes were made iteratively in between interviews based on the insights obtained. Following the customer discovery interviews, we arranged interviews with HCI researchers working on the technical innovations. During these interviews, we shared the work we had done including a list of highly ranked users that might benefit from the technology and different uses we had envisioned based on the capabilities. During these interviews, we paid attention to if we had characterized capabilities the technology could not easily achieve, if they felt we had discovered new and valuable users and uses for the technology, and to what extent they felt doing matchmaking should be a part of, or be consecutive to, their technical innovation work.

FINDINGS AND DISCUSSION

Technologic Capabilities

We generally found it quite easy to generate capabilities for the technology based on the papers describing the innovation. We generated 5 capabilities for PaperID and 6 for ViBand (table 1). Interestingly, we were surprised that we came up with capabilities never mentioned in the papers. Specifically, PaperIDs make it easy to see if tagged items are in or not in a specific space based on the tag readers that can or cannot find a specific item. We suspect this has to do with the fact that all technical innovation advances the state of the art, so researchers don't always mention a capability of an earlier version of the technology that is likely still available in their new version. We recommend that designers using matchmaking search backwards from the innovation to better understand the overall development and use of a technology.

Activities

While defining activities, we found the Five Ws and H method quite helpful in refining our understanding of a technology's capabilities and then relating this to various contextual features. For example, PaperID's capability of being 'Wireless' led us to ask the question: "*Why* are the tags wireless?" In considering the fact that the tags don't need any wires or batteries to enable interactions (only a reader that is powered and networked), we could see that PaperID could be useful in environments where wires/batteries can't easily be installed or serviced. In the process of exploring initial application domains using the predefined activities, more activities were found and added to the list iteratively as the context of use gradually became apparent. In total, we matched 12 activities to the PaperID capabilities and 10 activities to ViBand capabilities (table 2 and 3). It will take more uses of this new type of matchmaking to see if that number is consistent.

3. Domains

- 399 Unit groups rated on Activities
- Total individual Activities rated:
  - PaperID: 12
  - ViBand: 10
- Unit groups effective for ideation
  - PaperID: 16
  - ViBand: 11
- 4 Domains and concepts (A, B, C, and D) selected for validation

Concepts used for further evaluation

A. Ambulance Workers (PaperID)
By using the paper tags as stickers on consumables (e.g., medications, IV fluids, bandages) in Emergency Medical Service (EMS) Vehicles, an EMS Responder is able to accurately log their actions. By pressing the tag when a drug is used a timestamp can be created, creating a log of the medicine usage. The log can be communicated to the destination hospital, providing accurate insights in the emergency situation.

B. Shelf fillers (PaperID)
By equipping groceries in a grocery store, a cashier-less grocery shopping experience can be achieved similar to Amazon Go [6]. Using shopping carts as scanning devices the picked groceries can be recognized and billed automatically.

C. Home-based personal care workers (ViBand)
Elderly suffering from Alzheimer or dementia are preferably kept at their own home for as long as possible. In order to ensure their safety, they can wear a ViBand. By equipping often used objects and appliances (e.g., stoves, oven, door handles) tips and help can be provided in reach instantly. On top of this, caregivers can be notified when a patient has left their residence to prevent people from unwanted wandering.

Domains

Rating the value of each capability for every unit group and focusing on rarely supported activities proved useful. This focus prevented concepts from being generated where the users already had a "good enough" solution. For example, ViBand initially appeared to connect to several work activities as a communication device. One of the unit groups we considered was firefighters as they have a need to communicate their actions and intentions to others in a noisy and chaotic environment. After rating the value ViBand might bring to firefighters, we compared it to the communication tools firefighters already have, and we determined that their current portable radio system provides a better solution to their need than ViBand. By focusing on activities unsupported by other technologies, innovative concepts were able to be explored in new domains.

The top domains were selected based on their scores, and initial concepts were ideated for unit groups of interested until sufficient for further evaluation. A broad range of application domains were found, concluding in PaperID concepts being generated for 16 unit groups and Viband concepts for 11 unit groups. Four concepts (A, B, C, and D) were thought worthy of further evaluation with the target users.

Verification

To validate that we had appropriately inferred potential user needs, semi-structured interviews (each approximately 30-60 minutes) with people involved in our domains were proposed for every concept. For PaperID, we interviewed eight participants in five interviews. Gaining access to supermarket, hotel, and homecare workers proved much more difficult. For ViBand, we were only able to speak with three participants in two interviews (table 4). The customer discovery interviews functioned similarly to how they work with the Lean Startup. Participants shared new ways how the technology might be useful to them and others. For example, the paramedic crew chief noted how the discussed concept (A) could moderate the challenge of tracking controlled substance as everything currently has to be documented manually. Mentioned features were added to the concept and evaluated in future interviews, iteratively developing the concept.

Participants also shared occupations they regularly interacted with that might as well benefit from the capabilities of the technology. While talking to a local hotel manager, concept D was found to be more interesting for a hotel franchise as their hotel provided room-service on demand rather than door-to-door. Opportunities within companies were noted by a director of nursing, as it was found that tracking caregivers over patients (concept C) would be more valuable as they commit fraud by deliberately documenting their worked hours incorrectly. In addition, when probing participants on whether they would pay for this technology, we gained interesting insights on the decision and implementation process of new technologies in their work environments. In most cases, they were not the person to make the decision about the technology they used. In speaking about these decision makers, participants shared details on what features might be most motivating to them. As an example, this occurred talking to a medical director where we learned that instead of convincing EMS Responders of our system, we should focus on the Quality Insurance Committee as they control the procurement of the equipment used in ambulances.

D. Cleaners and helpers in offices, hotels and other establishments (ViBand)
By equipping every door in a hotel with an information tag, updated room information can be provided to room-service providers. For example, customers can indicate specific room-service (extra towels or groceries), or prevent employee from entering by using the ViBand as an authentication device. Also, a log can be created on who entered a specific room.

Table 4: Participants

PaperID	*ViBand*
Emergency physician	Home-care worker
Medical director	Director of nursing
Home-care worker	Local hotel manager
Director of nursing	
Paramedic crew chief	
Paramedic instructor	
Controlled substance supervisor	
EMS Equipment development employee	

Method Evaluation

Overall, we found the modifications we made to matchmaking to be quite helpful. Even though most of the occupations we considered had no reason to use the technical innovation, the use of the list did seem to surface ideas we were unlikely to have thought of in a brainstorming session performed without such a list. The list created a feeling that we had more broadly considered the many target users that might benefit from the technology. We also found the use of the customer discovery interviews to be helpful in gaining a preliminary understanding of what the target users might want. We think the combination of matchmaking with occupations and customer discovery interviews can provide an effective path to discovering a target group that can benefit from technology and that designers could successfully use this method ahead of a UCD process.

Our work was motivated by the observation that lots of technical HCI research creates new innovation, but it does not identify the best customers/users for the innovation. To understand if our version of matchmaking identified users and uses technical researchers had not imagined, we interviewed two researchers who had worked on the different innovations. Interestingly, we learned that the users and activities we identified most often had not been considered during their brainstorms. For example, the PaperID researchers had not considered paramedics nor had the ViBand researchers considered hotels or home-based personal care. Our discussions with them revealed that their selection of uses had most to do with demonstrating novelty of the innovation. We conducted matchmaking after the technical innovation work was complete. But, in reflect on our process, we suggest design researchers consider using and advancing our matchmaking approach while collaborating with technical HCI researchers as it enables the exploration and evaluation of the innovation's usefulness.

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