Unpacking Tensions in Designing Annotation System for Public Toilets to Support Menstrual Mobilities

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ABSTRACT

Safe menstrual hygiene practices are central to maintaining good menstrual health. In addition to menstrual literacy, practicing safe menstrual hygiene requires access to menstrual products and a private, safe, and hygienic space for changing and cleaning. Access to such infrastructure, specifically *functional* public toilets, becomes even more crucial for menstruators when navigating public spaces while having periods. This work presents the learnings from the prototyping of MenstruSPACE, a toilet locator application offering an annotation system for public toilets towards supporting menstrual mobilities. Our design journey revealed a set of design tensions and open challenges to be considered when designing public infrastructure annotation systems to facilitate safe menstrual mobilities.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; **Empirical studies in interaction design**.

KEYWORDS

Menstrual mobilities, Public toilets, Annotation system, Menstruation, Menstrual hygiene

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1 INTRODUCTION

Menstruation is a biological phenomenon experienced by nearly 26% of the global population [14], where on average a menstruator experiences 456 periods over 38 years of their life [25]. However, the taboo and stigma associated with menstruation adversely affect the everyday experiences of menstruators [12, 22, 28] making it a social justice issue [32]. For instance, literature shows how cultural practices and beliefs (ibid) and lack of public infrastructure (e.g., toilets, sanitary product dispensing machines, and more) restrict a menstruator's mobility during menstruation [27]. Prerequisites to enabling environment for menstruators include menstrual literacy supplemented with access to menstrual hygiene products while safely changing and disposing of them [29]. Thus enabling easy access to public infrastructure supporting menstrual mobilities is crucial for empowering menstruators.

Governments across the globe have revisited their policies and efforts to promote healthy menstrual hygiene practices towards sustainable development goals of health and wellbeing, gender equality, and clean water and sanitization. For instance, in 2015, the Government of India adopted the National Menstrual Hygiene Management (MHM) guidelines to foster positive-period experiences for menstruators [17]. The guidelines focus on multiple areas, including building infrastructural support to enable easy access to clean water, toilets, and sanitation (ibid). The government supplemented its efforts to build civic infrastructures with digital infrastructures like toilet locators apps to realize these guidelines further (e.g., [7, 9, 24, 30]). Tuli and colleagues have established the potential of these public toilet locator apps as a third space to support safe menstrual mobilities [27]. We extend this work by presenting learnings from our design journey of operationalizing Tuli et al.'s recommendations to develop a mobile app prototype offering such a digital third-space.

Following social justice oriented *design for enablement* [8] approach, we conducted 24 co-design sessions with women menstruators in Delhi to iteratively design our application prototype promoting the annotation of public toilets to support menstrual mobilities. Our findings unpack tensions and challenges when designing an annotation system supporting subjective parameters (e.g., cleanliness, safety, and more) and using these parameters as a metric to define shared spaces (like public toilets) to assist users in making an informed choice to use or altogether avoid a space.

2 BACKGROUND

Historically an individual's mobilities have long been restricted and compromised on the pretext of taboo and stigma associated with

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natural bodily phenomenons like breastfeeding [4] and menstruation [15, 18]. Recently, taking an activist stance, HCI researchers have started exploring the potential of technology at the intersection of design and public infrastructure to support such mobilities. For example, Balaam et al. designed a mobile application supporting breastfeeding individuals to locate public places which are safe to breastfeed [1]. Fox and colleagues have designed sensor-based solutions for public restrooms for distribution of menstrual products in public spaces of Boston [10, 11]. Tuli et al. extended this perspective by taking a qualitative approach to study the experiences of having periods in transit in Delhi, India [27]. Their data revealed that menstruators always carry spare sanitary products to be period-prepared and primarily aspire for functional public washrooms supporting basic amenities like water, soap, toilet paper, and more. Although multiple toilet locator apps are available, they fall short in supporting safe menstrual mobilities to the menstruators (ibid). Tuli et al. unpacked the potential of toilet locator apps to offer a third space [3] where users can recognize, express, and address their menstrual hygiene needs safely. Our work is the next step in designing technology to support safe menstrual mobilities. Building on Tuli et al.'s work, we present our design process of developing a high-fidelity prototype of MenstruSPACE, a toilet locator smartphone application promoting menstrual mobilities. We unpack tensions in designing an annotation system for public infrastructure supporting menstrual mobilities.

3 MENSTRUSPACE: APPLICATION PROTOTYPE SUPPORTING MENSTRUAL MOBILITIES

Our prototype, MenstruSPACE, is a smartphone application designed to support menstrual mobilities by primarily offering a digital space to annotate and locate nearby public toilets (including toilets in malls and restaurants) central for practicing menstrual hygiene in transit (see [27]). The prototype offers users a digital space to share their experiences and views of public toilets via images, reviews, and annotating the list of available amenities like water, soap, toilet paper, and more. The prototype supports crowdsourced annotation of amenities using choice chips supplemented with emoji-based icons (see fig. 2.iv). The most recent crowdsourced data is presented in the *navigation screen*, supporting a map view and a carousel displaying summaries of nearby toilets (fig. 2.v). Each toilet has a dedicated *annotation screen* reflecting the availability of amenities in circular progress bars displaying percentages of positive responses and directions via different transportation modes (e.g., metro, car, walk, etc.) The prototype also offers support to locate pharmacies and departmental stores that help procure essential items such as menstrual products and comfort food. Additionally, the prototype offers *emergency contact* support, offering easy access to personal contacts/helplines during an emergency, a space to express, share, enquire, and interact on the subject of menstrual health and hygiene with peers in the form of a *public forum*, and an *information support* in the form of blogs and videos by experts. The users can personalize all these features to create a custom version of the app by removing features per their preference.

4 DESIGN PROCESS

The study's objective was to (re)design public toilet locator apps to support menstrual mobilities. Our study, situated in the urban settings of Delhi, was conducted between July 2020–March 2021, where we conducted 24 co-design [21] sessions with 13 menstruators who identified as women to design our application prototype. We thoroughly accessed the findings from our design sessions, collating different user perspectives to develop the initial prototype. Subsequently, we raise the fidelity of the ideas and iteratively design and test the prototypes with the potential users leading to the final version of the prototype.

We recruited our participants in the age group of 20–25 years through email, WhatsApp, and social media posts using purposive sampling [26]. All the participants signed due consent after thoroughly understanding the study objectives, procedure and risks. They belonged to urban households with family income within the range of USD 6k–20k and were avid smartphone users. Our co-design sessions were spread across three phases: designing a low fidelity prototype, transitioning to a high fidelity prototype, and evaluating the high fidelity prototype. These sessions were planned out in a virtual environment owing to the global pandemic situation of Covid-19. We used Miro to facilitate co-designing activities, Google Meet for video calling, and Google Forms to collect demographic details. We collected data in the form of audio and screen recordings, screenshots, and field notes across the phases. The audio data was later transcribed and translated before subjecting it to inductive thematic analysis [5].

4.1 Phase-1: Developing Low Fidelity Prototype

We began by curating a list of 16 detailed features for the prototype from the learnings and recommendations proposed in Tuli et al.'s work [27]. The sample features included: *'map navigation,' 'encyclopedia page,' 'adding personal contacts,'* and *'locating address of personal contacts.'* Next, we used this list to conduct card sorting exercise [23] with seven participants (see fig. 1). The card sorting exercise was followed by a quick sketching session where the participants sketched out their visualization for different prototype screens, using the *sketch* functionality in Miro. To better capture the user's expectations of the interface design, we followed the crazy eight design sprint method [16].

Learnings and design decisions: The thematic analysis of audio recordings of the sessions resulted in a set of 61 codes. The examples of codes included: *'prepared based on travel plans,' 'personalised feature set,' 'incentives to rate/review the toilets,' 'tips and advice by doctors/gynae,'* and *'desire for a public forum.'* We performed affinity mapping on the code set to synthesize functional features and implementation objectives to develop the low-fidelity prototype (see table1).

4.2 Phase-2: Low Fidelity —> High Fidelity Prototype

The second phase, conducted with seven participants from phase-1, was divided into two parts. In the first part, we used Apala Lahiri Chavan's 'Bollywood style' [6] method to evaluate the low-fidelity prototype (see fig.1). We asked the participants to interact with the application prototype to navigate the following three scenarios:

(i) (ii)

Figure 1: Screenshots from the virtual design sessions conducted using Miro. (i) Phase-1: Participants were directed to categorize predefined list of features into *liked, disliked* or *doubtful*. We also encouraged the participants to propose new features. (ii) Phase-2: We used Miro's *hide frame* feature to simulate a real-time user interaction experience, i.e., the moderator revealed the subsequent screens based on the participant's interaction with the current screen.

Table 1: We synthesized the functional features of our prototype by analyzing card sorting activity in phase 1, where participants were asked to supplement and sort feature lists derived from the learnings of Tuli et al.'s study [27] as per their preference.

Theme	Definition	Implementation
Locate spaces	Locate nearby toilets for changing space and pharmacies to procure menstrual products.	*Navigation screen* supporting map view with geotagged locations, directions, and available transportation facility.
Practicing solidarity	Seeking and sharing views on public space (toilet/pharmacy), problems, challenges, queries, and information regarding menstrual health and hygiene practices.	*Annotation screen* enabling annotation the state of toilet facility via a rating system, reviews, and images. *Public forum* offering space to share experiences, stories, problems, challenges, and queries regarding menstrual health and hygiene practices with peers. *Information screen* offering expert tips, blogs, and videos on menstrual health and hygiene practices.
Emergency support	Easy access to support (e.g., helplines/ organizations) to offer a sense of security during an emergency.	*Emergency contact screen* offering emergency SOS feature for emergency contacts along with a list of helpline numbers. *Annotation screen* provides an option to report a toilet to cater to user safety.
Personalization	Need for customization to support personalised menstrual mobility experience in both digital and physical space.	*Customization* forms the core of the prototype, offering freedom to choose from different themes, different filters to locate spaces and enable the user decide the features the app prototype should offer.

"experiencing a surprise period while traveling in a public transport," "seeking feedback on an unfamiliar toilet," and *"using the app on behalf of a friend when they face an unexpected period"*. Their interaction in all three scenarios was timed and screen recorded. Using this approach helped us better understand the user interaction pattern to identify opportunities for further improvement. In the second part, we asked our participants to redesign the application prototype screens (if needed) to suggest improvements using the *sketch* feature, followed by a user satisfaction survey in the end.

Learnings and design decisions: We primarily received critical feedback on navigation and annotation screens (see fig. 2). A majority (6/7) of our participants liked and appreciated the toilet annotation feature. As expressed by one of the participants, *"I did not know that something like this is possible where an application can give you information about the facilities of the washroom" (sic).* Taking inspiration from prevalent rating systems for public spaces [13, 31], the low-fidelity prototype was designed to collect rating of the public toilets based on the parameters of 'hygiene,' 'cleanliness,' 'safety,' 'privacy,' and 'facilities'. Participants questioned the subjectiveness and abstract nature of these parameters while highlighting the need for granular information (e.g., availability of water, soap, etc.) representing the state of the toilet facility. In line with previous observations (see [27]), participants here too weighed greater on the perceived usability of annotating the availability of facilities in the toilet. For example, one of our participants said, *"when you see detailed information, you get an idea about the facilities. Everyone wants maximum facilities, so you will tend to use that toilet. Otherwise, you are skeptical as to how the toilet is, and you will end up not going there."*

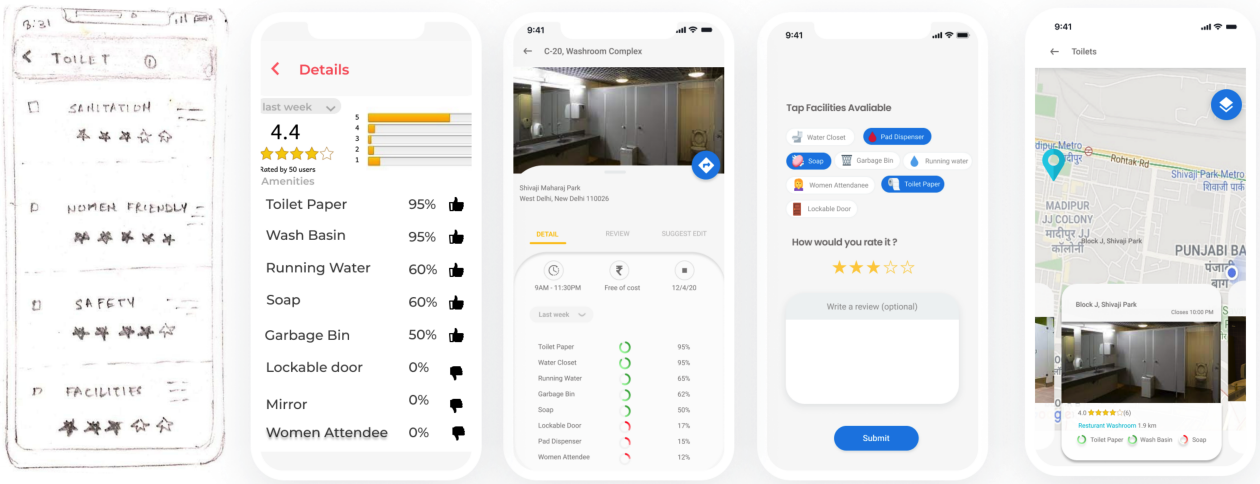

Figure 2: (i), (ii), (iii) : Evolution of design of annotation screen across three phases of design sessions depicting low fidelity, high fidelity prototypes and final version. (iv), (v): Final version of rating screen and navigation screen.

We made changes to the annotation system in our high-fidelity prototype, incorporating detailed information about the facilities available in the washrooms (see fig. 2). We expanded the subjective rating parameters to collect the availability of different facilities using checkboxes, which now displayed the percentage of affirmative responses on the availability of a facility. We also added a time filter to display the annotations for the same day, within the month or six months. Accordingly, we also updated the navigation screen to reflect the cumulative star rating of a toilet and the top three available facilities, including other basic information like timing, cost, and more. The prototype now supported a feature to sort the toilets based on distance, time (most recently reviewed), or availability of a specific facility.

4.3 Phase-3: Evaluating High Fidelity Prototype

We developed our high-fidelity interactive prototype using Figma software. We revisited the protocol followed in phase-2 and reused the Bollywood style method to evaluate our high-fidelity prototype for the same three scenarios. We recruited ten female menstruators who identified as women using purposive sampling [26], where 4/10 participants were the same across the earlier phases. We explicitly focused on and discussed the updated functionalities in navigation and annotation screens in detail.

Learnings and design decisions: Participants who were critical of the annotation system in phase-2 felt confident and satisfied with the updated implementation, specifically with the detailed annotation feature for toilet facilities. One of the participants explained it as a unique and helpful concept, *"I liked the listing and annotation options a lot, and I do not think detailed annotations like this exist anywhere till now."* Use of percentages of affirmative responses indicating the availability of amenities within the toilet facility was highly appreciated as it would help in the decision to use (or not) a given facility by offering *"real-time statistics about the [status of the] washroom."*

Our participants also pointed out further opportunities for improvement by highlighting the need for custom callouts on the map interface, scope to reduce the number of clicks to access the annotation screen, and an overwhelmingly long facility list on the annotation screen. One of them explained *"the screen where you ask for ratings should be easy to fill as a user. People who use the app might not rate it, which will affect the entire structure of the app."* Building on the feedback received, our final prototype offers an updated navigation screen (map screen) presenting a summary of the toilet via listing the top three available facilities based on the percentage of positive crowdsourced responses. Further to simplify the annotation process, we now provide choice chips with emoji-based icons in our final prototype (see fig. 2).

5 LEARNINGS FROM DESIGN JOURNEY

Our prototyping journey of MenstruSPACE revealed the following design tensions, trade-offs, and open challenges that need consideration when designing annotation systems for public toilets to support safe menstrual hygiene practices:

- *Designing annotation system for subjective parameters:* Requirements from space to practice safe menstrual hygiene include cleanliness, safety, sanitation, and privacy [27], which are subjective concepts. While interpreting these subjective themes, there can be individual differences, and different users have different comfort and tolerance levels associated with these parameters. Thus, expanding these themes to include a list of available amenities describing a toilet facility became imperative. This design decision highlights a tension between facilitating quick annotation for a long list of items (unlike popular star rating systems for a few parameters)

and deciding on 'what' amenities to choose as parameters to communicate the toilet's current state effectively.

- *Reflecting dynamic status of toilet facility:* The state of public infrastructure is highly dependent on its timely maintenance. A public toilet facility's state is dynamic where an annotation made an hour earlier might become obsolete, i.e., might not represent the actual state of the facility. For an annotation system to best reflect the most current state of a public toilet, the timestamp of annotation becomes central to support menstrual mobilities, which is not the case for most rating systems in other scenarios (e.g., product rating, hotel rating, etc.)
- *Challenges with crowdsourced data:* Preventing and accounting for obsolete and missing data is crucial as our annotation system is crowdsourced. Our interaction with participants reflects a tension in interacting and contributing to a detailed annotation system. Although our participants acknowledged the value of a detailed annotated summary for a toilet facility, they were skeptical about investing much time in providing data each time they visited a toilet. The requirement of detailed annotation further adds to the well-defined challenges of user engagement for crowdsourcing the data. This tension offers a site for innovation for designing incentive strategies for user engagement and interaction design on 'how' to facilitate quick data collection and effectively display the crowdsourced data.

With the advancement of computing technology, a sensor-based approach might seem a fitting solution for the last two challenges mentioned above, as exemplified by Fox et al. in the context of Boston [10, 11]. However, this approach entails the development of civil infrastructure, requiring Government involvement and a longer implementation time. For instance, for the last 2.5 years, we have been closely working with Sachhi Saheli [20], a non-profit organization working towards menstrual health and wellbeing, sexual and reproductive health rights, and women's empowerment. As a starting point, the Sachhi Saheli team has led multiple proposals for installing intelligent sanitary product vending machines at Delhi's metro stations and has yet to achieve a concrete outcome. Taking an emancipatory action approach to research [2, 19], we are in the process of planning the deployment of our prototype to refine it further iteratively. We aim to empower menstruators to support their menstrual mobilities within the constraints of existing civic infrastructure, meanwhile continuing our efforts to take our proposal forward. Although our observations are grounded in learnings from designing an annotation system situated in and for a specific context, we believe these are crucial to consider when designing annotation systems for public infrastructure to support the safe navigation of public spaces.

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