"hubbel": A Hybrid Letterbox That Stimulates Civic Participation Through Local Information Sharing in Neighbourhoods

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ABSTRACT

Local civic participation is essential to democracy. Yet, citizens need to be informed about local matters to get involved. Becoming and staying informed about developments in one's neighbourhood is difficult as local knowledge is scattered among online and offline sources, hard to find and understand. Using participatory Contextual Design we curated a novel form of participation with the interactive artifact "hubbel", which combines the *digital* and the *analogue* through a hybrid letterbox to crowd-source local knowledge. During our two-month in-the-wild evaluation, the hubbel was heavily used (260 postcards, 2067 visits). It stimulated democratic discourse and (offline) political participation by rendering tacit local issues visible. We propose ways to improve the hubbel's design so that citizens can more easily share their expertise with others and to avoid harmful consequences like pseudo-participation. Finally, the hubbel demonstrates why analogue components are indispensable for civic participation tools. Supplements and open-source code: OSF-Link.

CCS CONCEPTS

• **Human-centered computing → Interactive systems and tools**.

KEYWORDS

civic participation, political participation, civic engagement, blended participation, digital participation, participatory design, neighbourhood, crowd-sourcing, local information, local news

1 INTRODUCTION

What do you know about your own neighbourhood? Where and when you can shop your groceries? Which modes of transportation exist and what is the nicest route to walk your dog? Where can your friends park their car when visiting? What about the construction site that has been blocking the pavement for six months? Has the city council followed up on our referendum for a district school?

If you have lived in your neighbourhood for some time, you might know the answers to some of the questions. For others, you may need to ask your neighbours, search online or regularly read the local newspaper. Information about local matters is diverse, scattered, and often hard to understand [20].

But, why is it important to know about local matters in our neighbourhoods? Democracy is said to be "in crisis" [22]. Citizens lack insight into the administrative processes affecting them, are unaware of their opportunities to participate in local matters [20], and often experience pseudo-participation [30]. Being able to influence political processes is at the heart of democracy. Yet, people's participation in democratic processes highly depends on the degree to which they are (politically) informed [4, 14, 31] and personally affected by a topic [20], especially in local matters [28]. Access to information about local issues enables people to form their own opinions and debate or challenge the status quo of their living environment. Hence, focusing technology design on the *local* [29] presents promising options to strengthen people's active participation in democracy.

Human-Computer Interaction (HCI) has a long history in designing technology to support the organisation of information as well as civic participation [26]. Yet, most participation systems focus on organisation-led, top-down agenda-setting with organisers deciding on what, how, and when citizens may participate [26]. So, even if these tools enable people to decide on the outcomes (e.g. voting), options to have a say in selecting the mode and topics of participation remain rare.

Using a combination of Participatory and Contextual Design [12, 33], we illustrate a case of design activism [7] or design experiment in civics [5], which by "deploying settings, devices and/or things experimentally makes it possible to curate novel forms of participation, eliciting expressions or accounts of public issues that would otherwise remain underarticulated or exist only *in potentia*" [17, p. 195]. We argue that, because local knowledge is underarticulated, scattered across online and offline sources, hard to find and understand, democratic discourse and civic participation in neighbourhoods hinges on tools which support collaborative, analogue-digital, publicly accessible information gathering. We present a tool that fills this gap by combining previously disconnected modes of participation (digital vs analogue) and communication (citizens,

city employees, organisations): the *hubbel*, a hybrid letterbox (see Fig. 1). Here, we report on the Participatory Contextual Design, deployment and in-the-wild evaluation of the hubbel. In separate publications, we report in more detail our design method (Participatory Contextual Design) [19], and we plan a publication on an analysis of the hubbel's long-term use beyond the project's end, its uptake by city employees, and the editorial board's experience of moderating the hubbel's contents.

Figure 1: hubbel letterbox on the district town square and exemplary postcards (translated to English).

In the following, we detail what local knowledge entails and how it is currently shared. Then, we give a short insight into the project's background, design method, and our positionality before describing how the hubbel was designed and iterated. After outlining the final hubbel prototype, we report the methods used to evaluate it with co-designers in the wild. Finally, we present and discuss our results and point to future work like setting the hubbel up for long-term use.

2 RELATED WORK

Before we discuss current forms of information sharing, we explain what we mean by *local knowledge* and *local information*.

2.1 Local Information and Knowledge

Our understanding of local knowledge, as presented below, was formed through a one-year participatory Contextual Inquiry of

citizens' needs for civic participation in a local neighbourhood [20]. During this process, we learned about available local information and the ways in which people acquire local knowledge by conducting interviews and Photovoice, by co-organising, and participating in a regular neighbourhood meeting.

In this paper, we use the terms *local knowledge* or *local information* to refer to a broad conception of all the things people (need to) know about their neighbourhood reaching from knowledge about the district's history, development, and architectural aspects (e.g. street names or important buildings), to characteristics of the neighbourhood's population (e.g. approximate number of people), public infrastructure (e.g. schools or libraries), and means of transportation (e.g. buses, parking or bike lanes), to leisure facilities (e.g. clubs, playgrounds, parks, or religious communities), and events. Local knowledge might also include information about businesses and options for shopping, sharing, and repairing in the neighbourhood. We also use these terms to describe citizens' knowledge about political or administrational processes related to the neighbourhood (e.g. "who is responsible for what?", relevant city departments, previous civic participation or city council resolutions), about future plans (e.g. the district's urban development concept), and about public nuisances or vandalism.

Local information is scattered across many outlets (online and offline), not all of them public. For example, city employees may know why the kindergarten cannot be opened yet, while neighbours keep wondering when child care facilities will be finally available. But, neighbours are domain experts, too. They hold experience about spending everyday life in the neighbourhood (e.g. where pedestrians are frequently endangered by traffic or which playgrounds are less crowded on weekends). Yet, this tacit knowledge is not systematically shared among neighbours or with city administrators. As local information is scattered and only partially public, finding relevant information, and staying up-to-date on local matters is difficult for many neighbours.

2.2 Forms of Local Information Sharing

Based on our Contextual Inquiry [20] and HCI literature, we demonstrate how local information is distributed currently. Citizens seek or stumble upon local information in different analogue forms. There are print media like local newspapers, posters, leaflets, and bulletin boards. Citizens listen to the radio or watch local news on TV. Some local information is digitally available through city, district or city council websites [36], online newspapers, and blogs. These information sources represent *top-down*, one-way, passive ways for people to acquire local knowledge. Citizens typically have no part in their creation [38], which prevents them from setting an agenda and sharing their domain expertise, as noted above. While local information shared with citizens would often be relevant for them, citizens do not necessarily know where and what to search for [20]. An example for a tool to support neighbours in monitoring local information from different online resources is Virtual Townsquare [13], an online information aggregator for local communities that allows to gather local information scattered across the internet into one place. Yet, it is only able to aggregate information that is already written out or publicly available. As noted above, this is not (yet) true for a lot of local knowledge and curating or publishing

requires a lot of resources (often more than is available, for example, to city staff despite their willingness to involve citizens [20]).

Of course, there are also ways for neighbours to share their knowledge *bottom-up* or amongst each other. In analogue settings, information is shared by word of mouth among neighbours. Here, knowledge can be shared informally, thus allowing opinions and tacit knowledge to surface. Yet, this kind of local information is not structured, potentially relies on misconceptions or becomes distorted over time when passed along. Digital tools can help to gather and structure local information, and making it publicly accessible. There are several examples of digital tools for crowd-sourcing local information in the HCI literature, such as ChangeExplorer [39], FixMyStreet [16] or StreetBump [1]. However, they are limited to covering current issues and neglect more static or not necessarily problematic local topics (e.g. events, local businesses, parks, or public transportation), and thus can not be used to gain a comprehensive overview. In many neighbourhoods, citizens appropriate social media (e.g. Facebook or WhatsApp groups [6, 25]) or use digital platforms tailored to local contexts (e.g. nebenan.de [8]) to cooperate and share local knowledge. Besides sharing information, these tools also provide citizens with a means for direct or private conversations and features like online marketplaces. But these platforms come with a catch: they are not (always) publicly available or require registration and only allow for *digital* participation, thus excluding people without own devices or little digital literacy from participating. Moreover, information that is only available online has to actively be sought out and found by citizens. This way, they turn staying up-to-date into *another* task people have to do rather than stumbling upon information [20]. Additionally, most existing social media platforms (and hence all data processed through them) are not owned by the public, but instead belong to (big) corporations, which do not allow citizens no influence the design. Furthermore, social media tools or groups (apart from forums) are not designed to structure (local) content in a way that helps people to search, find or trace accumulating information on specific neighbourhood topics. Finally, social media is not used as a tool for collaboration between city and citizens, but rather as an internal way for citizens to communicate amongst each other.

Overall, we have seen that despite many existing local information sources, citizens are rarely actively involved in gathering and contributing to local knowledge or setting an agenda and are presented with the complex task of juggling (unstructured) digital and analogue information sources. Yet, previous work has demonstrated that online and offline civic activism influence each other [23], that hybrid participation tools hold the potential to combine the best of both worlds [10, 11, 15], and that (hybrid) tools designed with an agenda [7] to promote civic participation are able to increase people's engagement [e.g., 11, 18, 35] and people's say [e.g., 26, 34, 37] in local matters.

We argue that a common basis of local knowledge is essential for civic participation and therefore make a case to foster bottom-up civic participation by using technology to crowd-source local information from neighbours in a structured way that allows people to choose between digital or analogue input formats with the hybrid letterbox hubbel. In the following section, we will describe how we designed and iterated the hubbel over a period of two years together with residents of a local neighbourhood.

3 ITERATIVE DEVELOPMENT OF THE HUBBEL

3.1 Project Background

The hubbel was designed for and with people at *Hubland*, a newly (and still) emerging neighbourhood in a mid-sized, south-German town (Würzburg). Starting in 2017, the district was converted from former US army ground. At the project's beginning in 2019, about 2000 (of the planned 4500 neighbours in 2025) had already moved in. The neighbourhood is rather young (M = 34.9 years; 14.5% over 65 years) and accommodates a higher proportion of families than other districts. As it is still under development, many infrastructures (e.g. streets) and facilities (e.g. child care or clubs) are either provisional or not yet established. The Hubland neighbourhood meeting (HublandTreff) is an exception from this. It was established in 2019 and is since run in cooperation between the local library, city employees (family department) and the first author of this paper. A typical meeting involves five to 20 participants including organisers, neighbours, and people from local organisations (e.g. adult education centre) sitting together for 90 minutes in the library to discuss districts matters. It is an (analogue) hub for local information and political education where citizens learn about the administrative processes necessary to shape the district.

3.2 Method Used to Design the hubbel

We used a combination of Contextual and Participatory Design [12, 19, 20, 33] to develop and evaluate the hubbel together with citizen co-designers from the neighbourhood, city staff, and other relevant stakeholders (e.g. head of adult education centre). That means the hubbel was designed with a strong focus on contextual fit. In the beginning, we conducted participatory Contextual Inquiries and design sessions during the neighbourhood meetings involving more than 100 people [20]. When COVID hit, we changed to one-on-one sessions and participatory online-workshops with citizen co-designers from the neighbourhood that later developed into a regular bi-weekly design-meeting (supplementing the neighbourhood meeting). They would remain co-designers over two years from creating the visions for a first prototype, the cardboard letterbox, to evaluating the functional hubbel in the wild, and writing this paper. In retrospect, they attributed their continued participation to the fact that "it was fun [and] allowing [them] to get a glimpse into scientific practice" (co-designer01), while "creating tangible outcomes [...] with nice people" (co-designer02). We used a shared kanban to plan next steps, distribute tasks among (co-)designers, students, and the researcher, and took all design decisions together. During the design-meetings, we created the hubbel's vision, the cardboard letterbox, and wireframes, decided how design features should be implemented, and planned the evaluation. Building the hard- and software components was then mostly done between meetings by student researcher assistants or HCI students (e.g. implementing the front-end), co-designers (e.g. designing, assembling, and programming the hubbel's scanner) or external service providers (e.g. carpenter building the hubbel's wooden case), and brought back into the meeting when finished. Additionally, we regularly brought the iterations of hubbel back into the neighbourhood meeting, asking for feedback to keep them in the loop. In her role as

neighbourhood meeting co-organiser, the first author of this paper made connections with several city departments, local businesses, and organisations, involving them along the design process. This participation was important for the deployment of the hubbel as several city departments and organisations were happy to join and use the hubbel.

3.3 Positionality

As this paper is co-authored by quite a number of people, we want to clarify what we mean, when talking about "us" or "we" in this paper. As mentioned above, the hubbel was designed in a joint effort led by the first author, a female, white, German doctoral candidate (HCI) in her late 20s. She held a dual role, as she co-organised the neighbourhood meeting and also prepared and moderated the bi-weekly design-meetings. She was supported throughout the project by two white, German student research assistants in their mid 20s (one female, one male), a female HCI master's student (during the evaluation) as well as two groups of six HCI bachelor students in their fifth semester. Since the University Campus is part of the neighbourhood the hubbel was designed for, the first author and HCI students represented possible future hubbel users. The design team was extended by four white, German citizen co-designers (age: 27 to 72; two female, two male) from the neighbourhood, who were eager to improve their district.

In this paper, we take a political stance: we believe that more (and more diverse) civic participation in matters that affect people's daily life (local matters) is a desirable democratic goal. We also believe that it is important to support citizens in voicing their concerns and organising bottom-up political action, yet we recognise that many people employed by the city work hard to improve civic life.

3.4 Civic Requirements for Local Participation Tools

Before designing the hubbel, we had inquired citizens' needs regarding digital tools for civic participation more broadly by involving 105 citizens in a participatory Contextual Design process [12, 20]. Summarising this research that is reported in detail elsewhere [20], we had learned that, generally, citizens want to be heard and be able to voice their opinions in local matters. Neighbours are not one homogeneous group, so digital tools should allow for varying degrees of civic involvement, be useful to those eager to shape a district as well as those lacking the time or resources to participate. Citizens emphasised that digital tools for civic participation need to be inclusive, allowing as many people to engage as possible, also the ones having difficulties using or without access to own digital devices. When looking more closely at information sharing, we had learned that even though citizens want to be up-to-date on local matters, relevant information is scattered among different outlets, hard to find and understand (e.g. written in bureaucratic language), and do not necessarily reflect what citizens are interested in. Thus, many people are unaware of participation opportunities and lack insight into the administrative processes affecting them. Yet, if citizens know the reasoning behind municipal decisions, they will show sympathy. Importantly, we have to acknowledge that people do not look for ways to get informed all day, many rather prefer to stumble upon information in their daily lives. Especially during

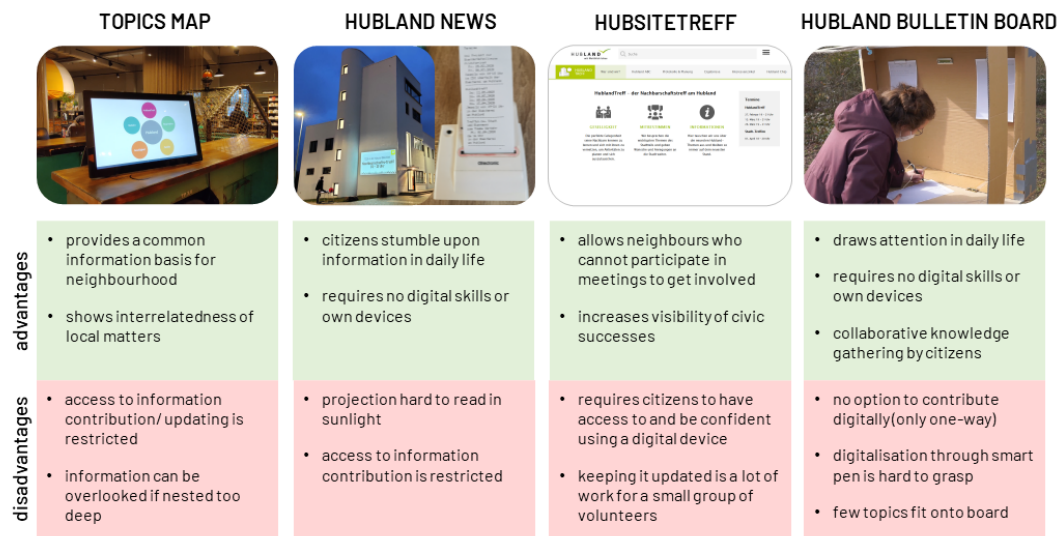|	TOPICS MAP	HUBLAND NEWS	HUBSITETREFF	HUBLAND BULLETIN BOARD
advantages	• provides a common information basis for neighbourhood • shows interrelatedness of local matters	• citizens stumble upon information in daily life • requires no digital skills or own devices	• allows neighbours who cannot participate in meetings to get involved • increases visibility of civic successes	• draws attention in daily life • requires no digital skills or own devices • collaborative knowledge gathering by citizens
disadvantages	• access to information contribution/updating is restricted • information can be overlooked if nested too deep	• projection hard to read in sunlight • access to information contribution is restricted	• requires citizens to have access to and be confident using a digital device • keeping it updated is a lot of work for a small group of volunteers	• no option to contribute digitally (only one-way) • digitalisation through smart pen is hard to grasp • few topics fit onto board

Figure 2: Four preceding prototypes for sharing local information in the neighbourhood.

COVID, when sharing local information by meeting other citizens was hindered, neighbours at Hubland had a hard time keeping track of new developments in their district that were relevant to them. City employees holding some of this information are eager to involve citizens, but struggle to reach them. Moreover, as local information is often tangential to more than one city department, making it public is very complicated and time-consuming.

3.5 Predecessors of the hubbel: Four Information Sharing Prototypes

Responding to the neighbours' needs, we developed and tested four low-fidelity prototypes together with neighbours as part of the neighbourhood meeting and additional participatory workshops. They cover different aspects of "being informed" and thus could supplement each other. The first prototype *Topics Map* addresses the civic request for information to be structured and accessible in one spot (Fig. 2, left). It is an interactive collection of the district's most important topics and their relation. Its content is gathered and maintained by members of the neighbourhood meeting and city employees. The map can be accessed through a touch display at the local library. *Hubland News* addresses the need to integrate local information into citizens' daily lives by projecting recent news (e.g. the upcoming neighbourhood meeting) onto the library's wall and offering an option to take-away an instantly thermo-printed copy (Fig. 2, second left). Civic initiatives, local organisations, companies, and city employees may contribute information to be shared and local shops can append the information to sales receipts for people to stumble upon. Participants of the neighbourhood meeting wished to have a self-managed space to share information about their own activities (e.g. meeting protocols, successes or upcoming events and meetings; Fig. 2, second right). Thus, the web page *HubsiteTreff* acts as a digital extension to the group's offline work. The last prototype *Hubland Bulletin Board* is concerned with structuring and gathering knowledge about ongoing local processes without

relying on city employees (who cannot provide this work on the side) (Fig. 2, right). Information is organised at a public bulletin board on paper sheets for each topic. Citizens can add or amend information using a digitising pen. This way, the growing body of knowledge can also be viewed online.

The four prototypes all allowed to disseminate local information at Hubland, yet, they were either only analogue OR digital, allowed only to share OR receive information, were just not up to the complexity of gathering local information from different sources, required too much effort on the city's end or did not allow citizens to set the agenda. Building on these insights and being particularly inspired by antique letterboxes in Würzburg and Schubert's [32] hybrid letterbox, we co-created more complex visions in one-on-one sessions and two participatory online-workshops with citizen co-designers, resulting in the novel concept, the *hubbel*, that incorporates digital *and* analogue ways of participation, allows producing *and* receiving information, and most importantly, supports neighbours to gather information on the topics relevant to *them*.

3.6 The hubbel Concept

The hubbel concept envisions a digital-analogue tool that enables neighbours to collaboratively collect (tacit) local knowledge and disseminate it in a structured way. Thus, a common level of information is created that is accessible to all neighbours (including people spending time in the neighbourhood such as visitors or undocumented people, and those in the process of obtaining citizenship) and city employees. The hubbel should not substitute existing participation formats, but additionally support successful political participation in the neighbourhood. Hence, it can be described as a democratic innovation: It is envisioned to become an urban, digital infrastructure for civic participation maintained in collaboration between the city and its citizens. The city provides the technological infrastructure and citizens populate and moderate its contents.
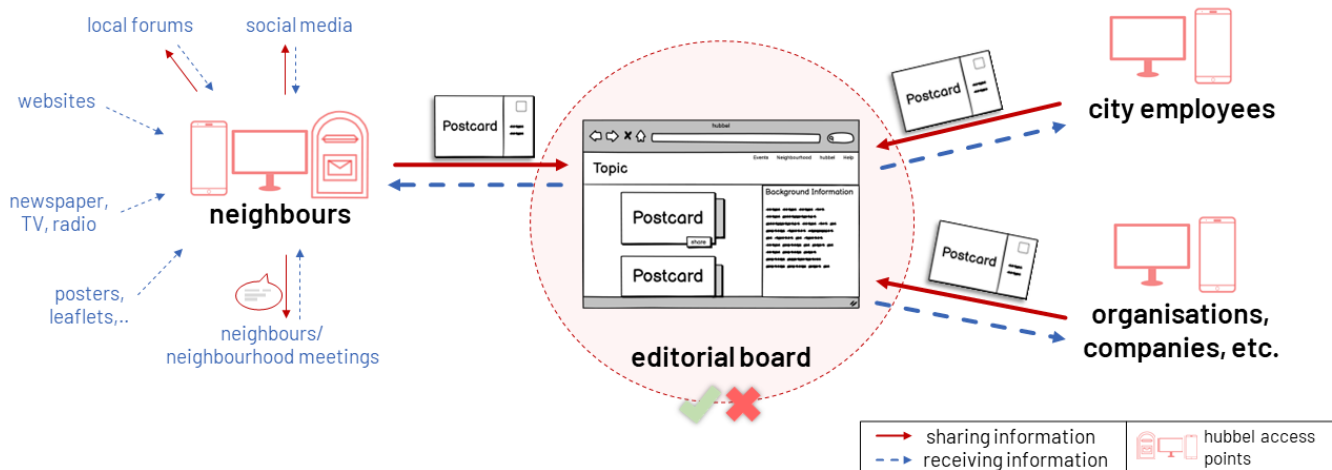
Figure 3: Local information is shared between stakeholders through the hubbel, which is moderated by the editorial board.

The name *hubbel* is derived from the German word [ˈhʊbl̩] "Hubbel" meaning "bump" (a thing that one might stumble upon) as well as "Hub" referring to the name of the district and the English meaning of "hub" for tying together information.

In order to easily integrate participation into the daily lives of a wide range of people, the hubbel has two access points: a hybrid letterbox and a website. The digital system is accessible via both access points, allowing (digital) postcards to be read and written. The hybrid letterbox is reminiscent of a letterbox that has been expanded to include a touch display and postcard scanner. With the help of the hybrid letterbox, people can spontaneously publish information or questions without the need for an own device by submitting handwritten postcards, which are automatically digitised and fed into the hubbel's digital system. In this way, the contributions can be read and answered by other people at the hybrid letterbox or via the website. In addition, the letterboxes physical presence in the district is intended to raise awareness for the participation opportunity and provide a physical place for neighbours to meet and talk about their district. The letterbox is designed to be modular, so that it can be adapted to the needs of residents (e.g. adding a roof or book sharing shelf).

Postcards can also be written and read digitally via a website, to allow people to participate without having to visit the letterbox, and to add supplementary material (e.g. photos) to their postcards.

The hubbel chronologically organises postcards in neighbourhood specific topics. Each topic is accompanied by a short background information section introducing the relation to the district, highlighting previous (civic) efforts (e.g. petitions), possible sources for digging deeper into the topic or people to contact (e.g. an employee of the city's family department).

We consciously adapted the concept of *postcards* because it reflects the idea of "letting each other know", but in a playful, fun, non-rushed kind of way. They allow for an analogue and culturally learned way to share information and require short texts, so people (especially city administrators) have to formulate "in the citizens' language" rather than throwing incomprehensible documents at people. This is also why the hubbel addresses people with a personal

you instead of the more formal German *Sie*. We further imagined postcards to encourage informal, benevolent dialogue that does not feel like work (e.g. by providing a topic for "Greetings, thanks and fun") and that the effort of writing something by hand would reduce the risk of hate speech.

Furthermore, the hubbel acts as a link to external resources that regularly publish information on the district (e.g. the local newspaper or city council protocols). This way, neighbours can learn where to start further research and may gather information that is not present in the hubbel yet.

We recognise that digital media allowing people to (anonymously) post opinions and information online bears the risk of spreading misinformation and hate speech [24]. Also, many citizens at Hubland are motivated and engaged in local matters and search for ways to contribute to their community [20]. Thus, the hubbel's content is maintained by a small, dedicated group of locals (the *editorial board*) who regularly check incoming postcards for hate speech and - as far as possible - correctness before publishing it. Moreover, they care for the hubbel's content by creating the background information and explicitly looking out for news relating to the district (e.g. in the local newspaper).

Overall, the hubbel is distinct from other social media platforms and civic participation tools in its combination of the digital and analogue, participatory design and bottom-up agenda-setting by citizens, open source software and vision to become a public digital infrastructure, hyper-local focus, strict focus on content and topics, emphasis on inclusion and playful interaction, integration with existing local (analogue) participation and complementary civic editorial board, gathering and structuring of local knowledge and its ability to stimulate civic participation.

3.7 First hubbel Prototype: A Cardboard Letterbox

We co-designed the hubbel's first prototype, covering wireframes and a cardboard letterbox, with four citizen co-designers based on the four prototype's insights described in Section 3.5.
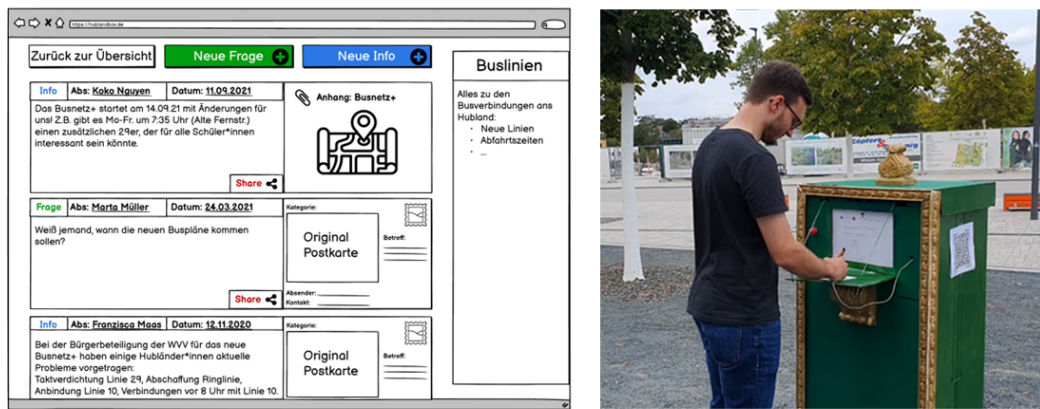
Figure 4: Left: Wireframe showing an exemplary topic feed; Right: Cardboard letterbox during the usability testing.

The wireframes sketched the hubbel's digital interface consisting of a landing page presenting local topics, topic feeds with chronologically sorted postcards and background information (see Fig. 4, left side), and the process for creating a new postcard. The letterbox resembled an antique letterbox with golden ornaments and contained a transparent window at the upper front to simulate a display showing the digital user interface (see Fig. 4, right side). The display was covered with a fold-down desk pad for writing postcards that would then be inserted into a letter slot. The letterbox prototype was build from a 135 cm high cardboard box.

3.7.1 Evaluation of the Cardboard Letterbox. We evaluated the hubbel's first prototype by conducting a heuristic usability evaluation [27] with six HCI students and a one-day usability test at the Hubland town square in September 2021 with eleven passersby ($n = 7$ female, $n = 4$ male; M_{age} = 42.5 (range: 25 to 63); $n = 9$ neighbours, one city employee, one visitor).

From these, we learned that the hubbel's concept struck a chord with participants and received overall enthusiastic feedback, especially for the option to choose between website and letterbox as well as the option to hand-write postcards. People suggested that the hubbel could help to share *more than just information* (e.g. books) and provide a place to rest. Yet, the letterboxes opulent design received mixed feedback: while some found it appealing, others wished it would be a bit more modern and similar to the district's Bauhaus-kind of design. Furthermore, we learned that the letterbox display was too low for some and thus should be accessible to a wider range of body heights (seated and standing). The fold-down desk hindered some people to recognise that there was a display. Some people were confused about who runs the hubbel and the editorial board moderating the postcards. In respect to the user interface (UI), the biggest take-away was that it would have to be less packed (e.g. hide postcard supplements).

In response to participants' feedback, we changed the letterboxes appearance to a more functional box. This allowed us to build a cost-efficient, easy to construct prototype in a timely-fashion that would still endure different weather conditions over several months, even without supervision. We added the suggested options to sit and share things, but replaced the fold-down desk with a stable

writing pad so that the display was always visible. In parallel, one of our citizen co-designers designed and built the postcard scanner and accompanying software. Also, we decluttered the UI during the design-meetings and the HCI students implemented the wireframes in-between meetings. Furthermore, the initial evaluation demonstrated that only deploying a functional prototype over a longer period of time would allow us to gain reliable, valid insights into hubbel's integration, and use in daily life.

4 FINAL FUNCTIONAL HUBBEL PROTOTYPE

All self-developed open source hubbel components can be accessed at the project's OSF page.

4.1 Hardware Components

The hubbel letterbox is a wooden case (see Fig. 5). On the front, it holds a multitouch outdoor display, a writing pad, DIN A6 postcards in a transparent dispenser, a secured pen, and a slot for inserting written postcards. We use the postcards' motives, depicting people's favourite places in the district, with the kind permission of neighbours who participated in a joint photo contest with the local library.

Behind the postcard slot, a scanner captures the postcards. It consists of light barriers to detect the insertion, a motorised conveyor, a camera with LED light, and control electronics based on a Raspberry Pi. The mechanics are made of standard parts combined with 3D printed PETG parts. The scanner pulls inserted postcards in (see Fig. 6), where they are captured with a camera, digitised using Optical Character Recognition (OCR), and saved into a database (for more technical details, refer to the appendix). Then, the postcard is ejected into the transparent postcard container on the letterboxes' side to highlight the amount of postcards already submitted.

On the sides, the hubbel also provides a sharing shelf for small items such as books. On the back, it has a seating option that also acts as a counterweight for the writing pad, and a service flap to access the hubbel's interior. All letterbox components (e.g. height of writing pad) are designed to accommodate different bodies (e.g. sitting and standing, tall and small). For a video depicting how the letterbox is used, refer to the supplements in OSF.

Figure 5: hubbel's hardware components.

4.2 User Interface

The hubbel website (see Fig. 7) can be accessed through personal devices or the letterbox (adapted version) for flexible use. The user interface is designed to support people in becoming and staying informed about the neighbourhood and sharing local knowledge. The website is structured into a landing page (see Fig. 7, left side) with *topic tiles* and six *tabs* linking to information about the current scientific evaluation of the hubbel, a help page with FAQ, events, background information about the neighbourhood (incl. an interactive Map and links to other information resources e.g. official district website), and the hubbel, its editors, and development team.

The landing page presents all local topics in chronologically ordered tiles, so people can get an overview of and discover the breadth of local topics, and easily recognise news. To dive deeper into a specific topic, users click the tile to get to the topic-page (see Fig. 7, right side). Here, postcards are displayed in chronological order, so that discussions can be retraced and returning users only have to read the newest entries. To enable information to spread beyond the hubbel, buttons on the bottom right side of each postcard allow to *share or save* the postcard.

At the letterbox, users can instead "take a postcard" with them by scanning a QR code which opens the postcard in a smartphone's browser. For users who are new to the topic (e.g. new neighbours), the hubbel provides a condensed overview of *background information* about established knowledge, previous civic efforts, and contact information on the right. If people want to share information or questions through the hubbel, they can write a digital postcard via the website or a physical postcard using the letterbox.

To initiate the submission process, users press a floating *send postcard button* in the bottom corner (or simply insert the physical
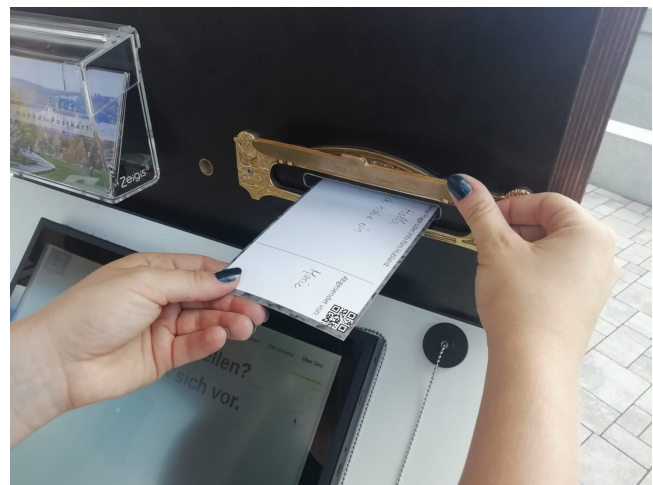

Figure 6: A user writing a postcard at the letterbox.

postcard at the letterbox, see Fig. 6). During the submission process, users assign a topic to the postcard, decide whether it is an *Information* or *Question*, and finally check their (digitised) text before submitting the postcard to the editorial board.

The adapted version at the letterbox resembles the website in all aspects except the option to log in or create an account (and thus to save postcards) and to write digital postcards (instead postcards are written by hand), so people using the letterbox have equal access to information as those using the website. For a screen-recording of all website elements, see supplements in OSF.
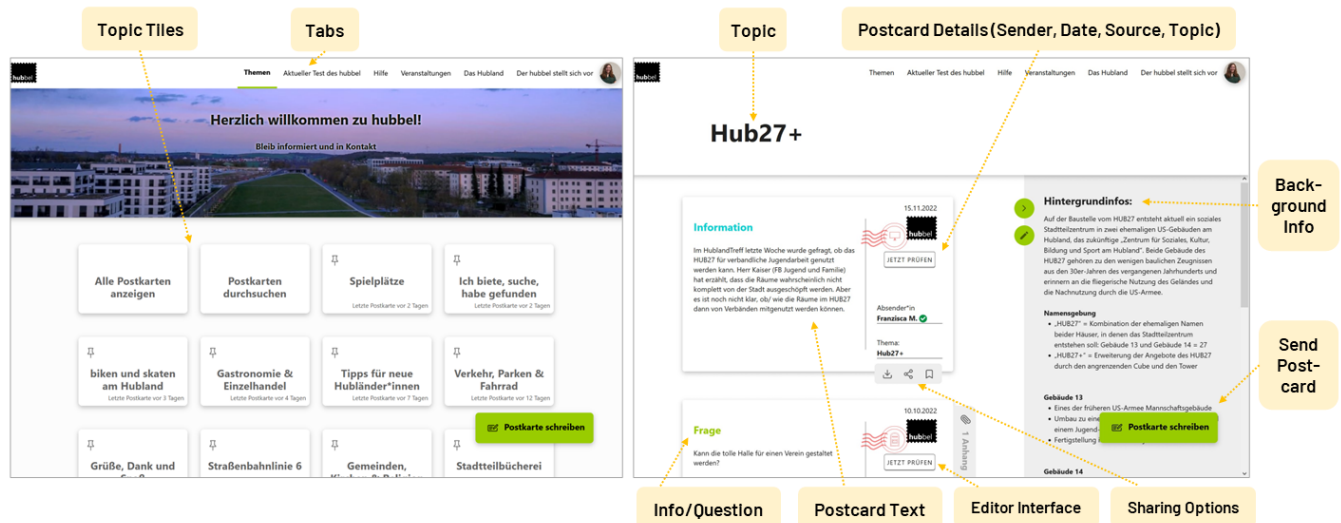
Figure 7: Left: hubbel website landing page with topics; Right: hubbel website example topic.

4.3 Initial Content

The hubbel is designed to make citizens' matters visible (bottom-up), thus its topics needed to reflect existing civic discourse. Also, during the previous testing, we had observed how important realistic content is to communicate the concept and to encourage neighbours to use the prototype. Hence, we populated it with topics and initial postcards before deployment. The topics were sourced during the neighbourhood meeting, the bi-weekly design-meeting, and with a group of researchers working in the district to establish a wide range of topics. We revised this collection during the bi-weekly design-meeting, with an elderly neighbour, a city employee, and the head of the local library, resulting in a list of 40 topics. We created and collected "initial postcards" whenever we found relevant information (e.g. in the local newspaper) or had questions ourselves. We also asked users of the neighbourhood platform nebenan.de whether we could reuse their posts (e.g. people informing others of changed bus routes) for the hubbel.

4.4 Editorial Work

The editorial board evolved in parallel to the deployment and evaluation of the hubbel. We started with a team of eight editors (one researcher, two HCI student research assistants, two HCI students, and the three citizen co-designers), who had all been involved in designing the hubbel. Over the course of deployment, we were joined by two more citizens who wanted to get involved after using the hubbel.

Editors took weekly turns being editor-in-chief. This entailed checking for new postcards at least once a day to approve or reject them using an authoring interface, filling up physical postcards at the letterbox, and checking whether the hubbel was still running. If the editor-in-chief was unsure about approving a postcard, they would post it to the editorial's group chat asking for advice. This way, we iteratively established common values and decision rules

that we collected into a shared document as reference and guidance for new members.

5 PARTICIPATORY IN-THE-WILD EVALUATION

We pursued two goals by deploying the hubbel: Participatory testing the functional prototype in a realistic scenario to learn how it impacts the community and whether it is able to stimulate civic participation, and setting the hubbel up for long-term use in the neighbourhood.

The letterbox was deployed in mid-August 2022 at the district town square. It was important to pick a public area with high visitor rates so that passers-by could embed the hubbel into their daily lives and that it was somewhat supervised (e.g. to prevent vandalism). We kindly received power access from a local solar tree company. We advertised the hubbel's deployment through flyers, posters, social media, online platforms, and a newspaper article (for more details see supplements in OSF).

We triangulated methods using four exploratory studies (accepted by the university's ethics committee) to investigate how the hubbel would be used realistically, for example, when left unsupervised, approached for the first time or revisited over a longer period of time. The four studies were conducted in parallel and included logging behaviour, covert observations, usability tests, and interviews (see Sections 5.1, 5.2, 5.3, 5.4).

We participatively planned, conducted, and analysed the four studies with three citizen co-designers who participated in all steps of the evaluation except conducting the interviews (due to their limited time resources and interest). In all evaluation phases, we aimed at three central PD goals: having a say, mutual learning, and co-realisation [33]. For example, to plan the evaluation, a researcher introduced common HCI evaluation methods and the whole team, including citizen co-designers, discussed and decided which methods were most suitable for our research questions and context

Table 1: Participant Demographics from the Evaluation

		Logging	Observations	Usability Test (UT)	Interview Series (I)
No. Participants/ Observations		2067	1341	12	8
Gender	Male	n.r.	n.r.	6	3
	Female			6	5
Age (in years)	M			46.08	49.00
	SD	n.r.	n.r.	15.56	21.22
	Range			26 - 83	31 - 84

Notes. "n.r." = not recorded. These demographics were not recorded to adhere to the university's ethics guideline.

(mutual learning, having a say). Together, we developed the materials needed to conduct the studies (such as use cases, follow-up questions for the usability testing and templates for the observation) during our design-meetings (co-realisation, mutual learning). During the evaluation, co-designers and researchers formed usability testing teams (mutual learning, co-realisation). Here, co-designers could lead the study or simply keep protocol (having a say). In our participatory evaluation, everybody's opinion was actively sought out and heard and then decisions were taken by finding consensus among the group. Also, co-designers freely decided how (much) they wanted to be involved in every step (e.g. number of observations they wanted to perform) (having a say). We further elaborate on our Participatory Contextual Design process (e.g. how we dealt with conflict, disagreement and power differences) in a separate publication [19].

After data collection, a master's student researcher gathered and prepared the data depending on the study (see below). Then, the data from all four studies were gathered into one digital whiteboard. In a half-day participatory analysis session with three co-designers, the master's student then presented the preliminary results from each study. Next, we merged Affinity Notes resulting from the usability tests and interviews and Affinity Notes containing important data from the logging and observation studies to analyse the data from all four studies by creating an Affinity Diagram [12].

The four studies, method of data collection and preparation for analysis will be detailed in the next sections. The material used (e.g. observation protocols and follow-up questions) can be accessed in the supplements on OSF.

5.1 Study 1: Logging

We logged digital behaviour to observe *where*, *when* and *how (long)* people used the hubbel when being unsupervised. We used the open source web analysis tool *Matomo* [21] to log page views, session durations, click behaviour, and the time users spend exploring content on the website and letterbox. 2067 visits (see Table 1) were recorded over two months from August 15th to October 1st 2022. The master's student then exported and prepared the logging data for the participatory analysis session at the end of the evaluation.

5.2 Study 2: Observation

We conducted covert observations to evaluate users' reaction and behaviour specific to the physical hubbel letterbox. To standardise observations by different team members (researchers and co-designers), we created a template covering the characteristics about

the observer (e.g. name, location, day, and time), and a table to document types of passers-by (groups vs. individuals, walkers, bikers, etc.), and their behaviours (e.g. interacting with letterbox or features). We evenly distributed observation across times during the day and week. We conducted 29 observations on 16 days from August 18th to September 28th (see Table 1). After completion, the master's student researcher collected and summarised all observation sheets in a table that was later used during the participatory data analysis session.

5.3 Study 3: Usability Tests

We performed usability tests to observe how people actually use the letterbox when interacting with it for the first time and their understanding of the hubbel concept and hybrid components. Test protocols and use cases were created during our design-meetings and tests were performed in researcher-co-designer teams. All nine test sessions (see Table 1) took place in mid-August and September 2022 at the letterbox. Participants were recruited on site. Each session lasted around 20 minutes and was voice recorded for analysis if the participant had given consent. Participants were asked about their expectations, freely explored the hubbel, completed use cases while thinking aloud, and finally answered follow-up questions about their experience with the hubbel. The researcher or co-designer took notes and recorded the session if participants agreed. Participants received a small compensation (5€). Because analysing each session soon afterwards was not timely feasible for our co-designers, the researchers from each usability test conducted Interpretation Sessions [12] after several tests had been completed. They re-listened to recordings, generating Affinity Notes that were later brought into the participatory analysis meeting.

5.4 Study 4: Interviews

We conducted a series of semi-structured interviews to gain insights into longer term and daily usage of the hubbel. Eight interviewees (see Table 1) were interviewed three times: Right after hubbel deployment, after about four weeks, and after four to six more weeks. The questions had been prepared with co-designers during the design-meeting. Participants chose the interviews' time and location (video chat, phone or at the letterbox). The first interview concerned participants' expectations, general interaction, and perception of the hubbel. The second and third interview focused on how it had been used in daily life and how interviewees' experience and perception had changed over time. An interview lasted 15 to 30

minutes and was voice recorded. Participant received 30€ as compensation. After completing all interviews, the two researchers who had conducted the interviews analysed the data using a mixture of Thematic Analysis (researchers revisited the notes and recordings of the interviews and generated codes on Affinity Notes) [2] and Contextual Design (researchers and co-designers merged codes into an Affinity Diagram and generated themes in the participatory analysis session) [12].

6 RESULTS

Below, we report the most important results of the four studies based on our participatory evaluation meeting (see 5).

6.1 The hubbel Was Used Intensively

"When I saw how many postcards had already been written, I was positively surprised" (I08) one of our interviewees recalled two-months into the hubbel's deployment. Participants made the hubbel's success largely dependent on the degree, frequency, and continuity to which neighbours would use it.

And indeed, the hubbel attracted a notable amount of interaction during its first two months. Across both, the website and the letterbox, 260 postcards (n=45 website, n=215 letterbox) were written, of which 179 were approved and published by the editors (see Fig. 8). Out of the 81 unapproved postcards, half were rejected based on our editor guidelines (e.g. hate speech), while the rest had technical reasons (e.g. postcards being inserted upside down).
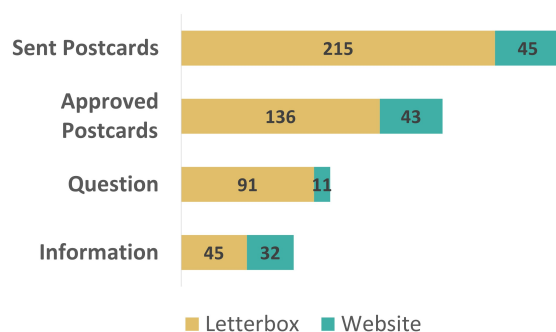

Figure 8: Number of postcards (sent, approved, questions, information) from hubbel letterbox and website.

We recorded a total of 2067 digital hubbel visits ($n_{\text{letterbox}}$ = 680; n_{website} = 1387) and both, letterbox and website, were predominantly used around noon and in the evening (around 19:00).

At the letterbox, we recorded 1341 passers-by within the two-month observation period, of which 611 had been busy or preoccupied (e.g. riding bicycles). Out of the other 730 passers-by 101 interacted at least shortly (more than 70% lasted one to five minutes) with the hubbel letterbox. The most commonly performed actions were touch display usage (71 observations), sharing shelf exploration (30 observations), and postcard take-away (12 observations).

The top three topics across both platforms and all postcards were "biking and skating at Hubland" (34 postcards), "meadows, parks, and places" (16 postcards), and "gastronomy and retail" (12

postcards), but postcards were submitted to 32 of the 40 topics. By the end of the evaluation period, 37 accounts (including moderators and a functional account for the letterbox) had been created. Among a total of 18 postcard authors, most postcards were submitted by the letterbox account. The second most active account was an editor replying to questions. Most of the postcards written at the letterbox were "Questions" whereas most postcards submitted from the website were "Information" postcards (see Fig. 8).

6.2 hubbel's Hybridity Allows Use According to Interests, Needs and Contexts of Use, But Has to be Learned First

The evaluation highlighted how the hubbel's combination of digital and analogue components (letterbox vs website and analogue-digital letterbox) supported citizens with different needs, interests, and preferred use contexts.

6.2.1 The hubbel Letterbox Is Used in Groups, for Having Fun, and Sharing Questions. Most people interacted in groups of two or more people (74 observations) with the hubbel letterbox during our observation, either discussing with each other (27 observations) or interacting focused or calm (38 observations) with the letterbox. The letterboxes physical presence made people stop on their paths (e.g. to grocery shopping (I03)) and the "fun" (UT08), "playful" (UT04), and "nostalgic" (UT011) "experience" (UT01) of handwriting postcards resulted in more postcards submitted using the letterbox than the website (see Fig. 8). People used the letterbox to write short postcards with an average of 80 characters that were almost exclusively questions. The playful usage of the hubbel can also be observed in the number of postcards with little fun drawings (n = 7 of 18 postcards in "greetings, thanks and fun"). Combined with the analogue sharing shelf, the letterbox "[became] a place for people to go to" (I08).

6.2.2 The hubbel Website Is for Sharing Detailed Answers and Material. Even though the website had not yet been optimised for mobile phones at the beginning of the evaluation period, we recorded most hubbel visits there (n = 1387). The website was utilised for reading postcards ($M_{\text{visit duration}}$ = 5:54 minutes) and accomplishing more complex tasks like writing longer postcards ($M_{\text{text length}}$ = 285 characters) with information or appending material (n = 7), mostly by organisations and editors. This is also reflected by the fact that the most popular topics people wrote postcards about using the website differed from those at the letterbox (postcards written from website: "youth" (5), "adult education centre" (5), and "HublandTreff" (4) vs at the letterbox: "biking and skating at Hubland" (34 postcards), "meadows, parks and places" (16 postcards), and "gastronomy and retail" (12 postcards)).

6.2.3 People Have to Learn the New Hybrid Concept First. One major challenge for the hubbel concept is that its combination of analogue and digital parts presents people with a new interaction that was not obvious to all participants from the start. Sometimes, this was exacerbated when the letterbox was not recognised as such. If people identified the letterbox, many were (positively) surprised that it actually digitised their postcards. Yet, participants acknowledged that "when [they] had learned the hubbel's concept, it was fun to use" (UT08) and several participants appreciated that they

had learned about modern technological possibilities in the process (UT01, UT04). While the hubbel's hybridity has to be explored in the beginning, most usability test and interview participants reported using the digital interface "was easy, even with no prior technological experience" (I08).

Overall, the usability tests and interviews showed that it is exactly the hubbel's mix of analogue and digital, bridging use contexts by allowing people to choose the website OR letterbox, depending on their preference, that made it successful (UT04, UT12, I07).

6.3 The hubbel Renders (the Amount of) Tacit Local Knowledge and Issues Visible

We designed the hubbel so that neighbours would share their local knowledge with each other, making tacit information visible. On the one hand, we succeeded: the hubbel helped people to learn something new about their district. Participants appreciated that the hubbel "made [them] aware of local topics" (I08) and made them realise that "there are quite a few topics" (UT02) and thus, the district "had more to it than [they] had thought" (I03). Especially, the high-level overview of topics on the front page (and background information) invited people to learn more about their district and introduced people to local topics they otherwise would not have engaged with (I02, I08) (e.g. an older woman noticing need for daycare or youth activities). In fact, several topics and issues (that had, for example, not surfaced during prior neighbourhood meetings) became visible through the hubbel. For example, in the topic "meadows, parks and places" several people used their domain expertise to point to local issues by writing postcards requesting more shaded spots during summer, asked why trampling paths crossing the central park still had not been paved or why the park is not equipped with lights at night. Yet, people also shared publicly what they *liked* about the district (e.g. "I really like it here at Hubland. The playgrounds are very great. I wish I would move here. Greetings from [name anonymised]"). One piece of missing public information surfaced in the topic "playgrounds", where kids and parents asked why (and for how long) a very popular plane-shaped climbing frame remained broken and expressed how much they wanted to see it be repaired. In contrast to our intention, a look into the written postcards revealed that the kind of tacit knowledge shared by neighbours in the hubbel were mainly questions rather than information (or answers). Yet, it shows that neighbours used the new platform to make their voices heard and to tell the politically responsible which local issues they wanted to see addressed (e.g. repair of the playground). In other words, people sharing what they *do not* know or *want to learn* in the form of questions was an act of civic participation, as citizens made persisting knowledge gaps visible so that they could be addressed (possibly in democratic processes outside hubbel, see 6.4).

6.4 The hubbel Affects the "Real World" and Stimulates Further Offline Political Participation

Participants emphasised that they also made the hubbel's success dependent on whether it will be able to bring about tangible changes in the neighbourhood. Over our two-month evaluation period, the hubbel already stimulated several changes. For example, the adult

education centre created courses based on neighbours' suggestions in the hubbel. Most notably, we want to elaborate one example of teenage mountain bikers to show how the hubbel stimulated bottom-up political participation by rendering previously under-articulated local issues visible and created an interplay of online (using the hubbel) and offline civic participation (presenting their request in the neighbourhood meeting).

Teenage mountain bikers extensively used the hubbel by submitting postcards to the letterbox asking to be heard in their desire for a bike trail in the neighbourhood [online]. Quickly, they developed a critical mass and *biking* became the most popular postcard topic, with up to 12 cards a day restating the issue. Recognising the teenagers' willingness to get engaged, the editorial board used the hubbel to suggest political ways to implement their request [online]. As a consequence, the teenagers presented their issue in the neighbourhood meeting and representatives of the city's garden and family department were invited to the next meeting [offline], and the results were fed back into the hubbel by an editor [online]. In the meantime, the teenagers gathered further support through the hubbel [online] and other forms of offline civic participation (e.g. creating a signature list). The city's gardening department employee used the hubbel to get an overview of written postcards to prepare for the meeting [online]. During the following neighbourhood meeting, the teenagers were then able to convince the city employees to take further action and review possible places for a bike trail, but learned about necessary administrational processes [offline]. These results and explanations were then fed back into the hubbel [online]. Overall, the hubbel acted as a catalyst for the subsequent (offline) democratic processes and political education in the neighbourhood meeting, and supported neighbours in tracking the development of issues over time and in monitoring whether civic efforts have been truly effective.

6.5 Citizens (Mis-)interpret the hubbel as an Agony Column to Voice Requests

The idea behind the hubbel was to enable bottom-up participation by supporting neighbours to inform each other of new local developments, instead of relying on city administrators to prepare and bring the information to them. During the hubbel's first two months, most postcards were questions, many of them not stating a direct addressee, yet requesting changes only the city can implement (e.g. planting more trees, installing lights in the park, or fixing a playground). During our interviews and usability tests, participants stated that the "hubbel is for asking questions and making requests and helping each other out" (UT05). Yet people regarded it as "a modern suggestion box" (UT10) saying "it would be great if not only citizens would get in contact with each other, but when somebody from the city would monitor [the hubbel], so that one can reach those responsible" (UT02). This was also reflected when people repeated questions (e.g. "when will the playground be fixed?") without checking that it had already received an answer.

6.6 The hubbel Reached Unexpected User Groups

The hubbel was designed to meet the needs of as diverse a user group as possible. Introducing the physical component (letterbox)

to the hubbel was partly motivated by the idea of providing people with little technological knowledge and/or no digital device with a possibility to participate through well established means of communication (writing postcards). We expected this to be especially attractive to elderly people who are often overlooked or not reached in digital participation. While we cannot make quantitative claims about the hubbel's uptake by older people, as we refrained from collecting demographic data during observations due to ethical reasons, elderly interviewees and participants of usability tests confirmed that the letterboxes interface and handwriting postcards are "suitable for seniors" (UT06) and "supports people with little technological experience" (I08). Most surprisingly, the hubbel was able to attract another group, that has traditionally been hard to reach for digital participation tools: teenagers. As reported above, they actively used the hubbel letterbox to gather political support for their needs. Moreover, the hubbel became attractive for neighbours who wanted to get more involved: Since we deployed the hubbel, two neighbours volunteered to join the editorial board and have since been active in posting information and moderating content. The hubbel letterbox helped people to stumble upon information in their daily lives without having to seek out more time-consuming analogue participation formats (e.g. the neighbourhood meeting) or search through online resources as it provides short summaries of current issues and meetings. Participants also emphasised the hubbel's ability to bring people "up-to-date" on previous conversations and providing background information, thus being especially attractive for tourists or new neighbours (UT04). The hubbel was also used by organisations to disseminate information in the district (e.g. about the church).

6.7   Practical Observations

We also made some practical observations that we think are interesting. First, we struggled with some technical instabilities, especially in the beginning of the evaluation phase. This included the hubbel losing internet connection and the display, scanner or Raspberry Pi shutting down unexpectedly. We reacted to this by using a smartphone with a personal hotspot instead of a public Wi-Fi and by implementing a daily restart of the system in the middle of the night. Moreover, we experienced some vandalism at the letterbox when it was out of service due to the solar tree's power shut down. After several days of appearing "dead" the letterboxes white writing pad was smeared using the attached pen, so we had to take the pen away until the power had returned.

We had a surprisingly hard time finding a company that would print postcards in acceptable quality. Several batches were not cut to norm or postcards started to bend in higher humidity, thus getting stuck in the hubbel's scanner. Nevertheless, the postcards were extremely popular: from the about 600 printed postcards, "only" 215 found their way into the letterbox (and some were used for testing). This means more than 300 postcards were taken by people who visited the letterbox. While we cannot know the reasons behind this, we feel encouraged in our decision to crowd-source civic motifs for the postcards and knowing that postcards are an attractive takeaway means presents an opportunity to further promote the hubbel (and its website).

Finally, the OCR was not yet perfect and highly depended on the quality of the handwriting (as we expected). Hence, the editors had to correct almost every digitised postcard using the original text.

7   GENERAL DISCUSSION

For a vital democratic discourse, citizens have to become and stay informed about local matters. Yet, local knowledge is scattered, hard to find and understand, and available technologies do not support neighbours to gather and structure the matters important to them in a way that is accessible and bridges analogue and digital. Thus, we set out to co-design a tool to facilitate collective knowledge gathering in neighbourhoods to support civic participation. Over a two-year participatory Contextual Design project, the hubbel, a hybrid letterbox, was developed, deployed, and tested for two months in the wild. The hubbel was used extensively, both through the letterbox and the website, made civic concerns publicly visible, and elicited further political participation.

We want to discuss our findings and provide insights related to the design of local civic participation tools for sharing local information.

7.1   Elicit Citizens' Knowledge Through Bottom-Up Participation Tools

Our findings highlight how designing for bottom-up local civic participation stimulates citizens to share their local knowledge. Because the hubbel's topics being sourced in cooperation with local experts: neighbours, they reflect real, relevant, relatable, and thus interesting district topics that people want to talk about [20]. Organising the local knowledge around these topics creates a space to share tacit local knowledge and issues that find no place in top-down, city-lead local civic participation tools (e.g. consul [3]), which only allow citizens to give feedback to predetermined topics the city is interested in. In our case, hubbel stimulated citizens to make their local knowledge (mostly questions to the city administration) publicly visible and thus addressable. Overall, the participatory design of the hubbel is a good example for the importance of involving people in the design of technology that is affecting them like civic participation tools [33].

7.2   Build Hybrid Tools to Stimulate Diverse and Fun Civic Participation

While existing (digital) tools for local information like digital websites, social media or forums [8, 13, 36] have to be sought out and remembered, tools with a physical, tangible component (like the hubbel letterbox) meet people *where they are*: on their way to work, shop, strolling, learning bike tricks, etc. This way, hybrid tools help to integrate civic participation as an everyday practice in a playful, fun, but also inclusive way. Future research could investigate how to interweave hybrid civic participation tools even further with people's lives, e.g. introducing them to citizens' homes. The hubbel's hybridity (website and letterbox) and integration into the neighbourhood meeting created an interplay of online and offline conversation around local issues. Hence, it is a useful example for how to bridge otherwise disconnected arenas of civic participation and provides further prove that on- and offline participation can

support and influence each other [23], if designed correctly. Drawing from our experience, we suggest that future tools for local civic participation should consider incorporating digital AND analogue components, allowing for playful and fun interaction and integrate the tools with existing (offline) participation processes.

7.3 Discussing Reasons for the Surplus of Questions

There are several possible reasons for people's misconception of the hubbel and the following surplus of question-postcards. People may write "blind requests" because they have only read the *show all postcards* feed (it was the most clicked topic), which presents all postcards chronologically, making it harder to realise that the questions have been asked or even answered before. Other people may not have read any other postcards, but just wanted to drop off of their request. Moreover, we had not implemented an option to reply to postcards to keep the interaction as simple as possible. Yet, referencing postcards by hand was cumbersome (e.g. "To person XY:" or "'When is the library open?' It is open from...") and answers were not grouped with questions, making it hard to follow conversations within topics (UT01, UT03, UT05, UT07). Finally, people struggled to realise that they hold valuable information others might be interested in. For example, after the interview, an interviewee would casually talk with the researcher about the neighbourhood, sharing their domain expertise by explaining that "planting more trees [as requested in the hubbel] is not possible, as it hinders airflow to the city" (I08). When asked if they thought about writing a postcard about it, they realised the information was not known to everybody, but that it felt good to be an expert for one's own neighbourhood.

We propose three ways to increase the rate of information-postcards (by neighbours) in the hubbel, while emphasising that we do not regard questions as a problem per se (see 6.3). (1) Re-design the hubbel to make people realise (and remember) they hold valuable expertise that they could share through the hubbel. One way would be to make unanswered questions more visible within the hubbel (e.g. presenting them in a screen-saver-mode at the letterbox and by making it possible to directly reply to postcards) or in the neighbourhood (e.g. using posters with interesting hubbel-questions or using location-based technology like ChangeExplorer [39] to present questions in related places). Another way to increase the rate of information-postcards by neighbours would be (2) to attract more and different people to use the hubbel as they might provide fresh knowledge. This could be achieved by making the letterbox and the hubbel's website more visible (e.g. using more striking colours) or implementing features that are attractive for passer-by (e.g. one co-designer suggested a lap counter for joggers passing the letterbox on their daily route). (3) As an intermediary, the editorial board could also contribute to input more civic answers in the hubbel, modelling the way answers might be formulated or guide neighbours how to find answers themselves (e.g. searching the city council protocols).

7.4 Reflecting on Potentially Harmful Consequences of the hubbel's Design

Our evaluation showed the hubbel's ability to provide neighbours with a way to share local knowledge. Yet, we also want to discuss three potentially negative consequences of the hubbel's design and ways to avoid them.

First, one might imagine scenarios in which civic requests, surfaced through hubbel, would elicit negative reactions from city's administration or other neighbours. For example, one interviewee said it made her angry to read how neighbours complained about the same things over and over again, when there would be steps they could take themselves (I08). Also, city employees might feel pressured to constantly monitor the hubbel as an additional task.

Second, based on our observation that people were unaware of their domain expertise, used the hubbel as an agony column or suggestion box, and mostly posted questions, the hubbel risks to invoke a feeling of *pseudo-participation* [30] over time. If citizens expect the politically responsible to be active users of the hubbel, a high number of unanswered questions will frustrate people and leave them with a feeling of (yet again) not having been heard.

The editorial board is essential for the hubbel's operation. Yet, we want to discuss a third potential negative consequence of the hubbel design. Having a small group of non-elected, non-representative volunteers with the power to delete postcards, searching for further information, also holds the risk of steering local conversations in political ways or silencing unwelcome opinions. Thus, we will place special care on the further development of the editorial board.

7.5 Limitations

We evaluated the hubbel during summer and early autumn. We consider this to be the ideal use period for the hubbel letterbox, with a lot of people outside who walk by. The colder and darker months are likely to reduce the activity around the physical letterbox, thus probably cutting the amount of written postcards. We are curious to see whether the winter months will lead to a user migration towards the hubbel website.

Moreover, we only evaluated the first two months after deployment. Thus, our results cannot reflect the hubbel's long-term use. Also, we did not observe extremely polarising postcards during this time. Thus, we cannot tell whether its current design (e.g. editorial board) and planned features (e.g. a reply-feature) would be sufficient to support people in discussing and learning from each other in a civilised manner [20].

Another limitation is that the hubbel website was not yet fully responsive during the evaluation (e.g. postcards would be displayed too wide for typical smartphone screens). We improved mobile usability over time, but this might be one reason why less postcards were written via the website compared to the letterbox.

Finally, we want to acknowledge that all members of the hubbel's editorial board had also been involved in its design. We discussed this potential conflict of interest in our bi-weekly design-meeting and decided not to be overly-active posting information to the hubbel in our roles as editors while the evaluation lasted. Yet, we did not hold back important information when we felt it would benefit the neighbourhood.

7.6 Future Work

To ensure the hubbel's continued maintenance beyond the project's end in December 2022, we already started a cooperation with the city's Smart City project for which we have produced another two

hubbel prototypes. We plan to move the hubbel from the university's to the city's servers to incorporate it as democratic infrastructure in the district allowing us to investigate the hubbel's long-time effects. Moreover, we plan to further establish the hubbel at Hubland by expanding the editorial board and gradually handing it over to the neighbours and district management.

We plan several adjustments to the hubbel software for future iterations. As concluded in Section 7, we plan to implement an option for replying to postcards so that neighbours are prompted to recognise and share their expertise. Additionally, we will continue to improve the website's responsiveness to make it more usable, especially when the letterbox becomes less attractive during winter months.

Furthermore, we would like future versions of the letterbox to more closely resemble antique letterboxes again to help people understand the concept of submitting information in the form of postcards and making it more eye-catching. Also, we consider a fully analogue variant of the hubbel's contents in the form of a quarterly neighbourhood magazine for people to read up on the most important discussion and information.

Finally, we would like to encourage others to implement and adapt the open-source hubbel for their neighbourhoods.

8 CONCLUSION

Democracy is about giving people a say in matters that affect them. This paper argued for a digital-analogue tool that allows neighbours to crowd-source local knowledge, because being informed about local matters is necessary to ensure that people can participate in democratic discourse. We therefore proposed the hubbel, a hybrid letterbox for sharing local information using postcards. The paper described how we designed, iterated, deployed, and evaluated the hubbel together with neighbours over the course of two years as a design experiment in civics [5].

Our results show that the hubbel was used extensively, both through its website as well as at the letterbox. It became a hub for people to stumble upon local knowledge that had previously been tacit, scattered and hard to find. The hubbel succeeded to get people more engaged in local matters as neighbours used it to make their local concerns heard and started further (offline) civic participation. The letterbox and website were used for different purposes (e.g. writing questions vs information). The positive feedback for and heavy use of the option to hand-write postcards at the letterbox shows the importance of incorporating physical components when designing tools for civic participation. Yet, the hubbel's novel combination of digital analogue components has to be made more clear. Also, we observed that people (mis-)interpreted the hubbel as an agony column, with a tendency to ask questions rather than share information. To avoid pseudo-participation, we propose several ways to increase the amount of information and answers submitted by civic experts (e.g. implementing a reply feature). Finally, we hope the hubbel inspires other researchers, civic tech initiatives, neighbourhoods or cities to use, adapt and further develop the hubbel in their contexts to support local civic participation for a more resilient democracy.

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A TECHNICAL DETAILS ABOUT THE SOFTWARE COMPONENTS

The hubbel is a full-stack web app using the JavaScript server environment Node.js and its framework Express.js for the backend, MySQL for the database, and the JavaScript framework Vue.js for the frontends. All of these components are open-source and well-documented. We use two slightly different frontends: one for the website and one for the letterbox. The code and database are hosted on a single server and the frontends can be accessed on different subdomains using a web browser. While the frontends differ in some aspects of layout and functionality (e.g. logging into a user account is only possible on the website), they use the same backend API and therefore also work on the same data. The letterbox frontend is opened in a web browser on the Raspberry Pi inside the letterbox 24/7. Additionally, the Raspberry Pi permanently runs a scanner software (written by one co-designer) in Python as a local service. This scanner service controls the scanner (logic and hardware) to create pictures of inserted postcards and provides an API that is polled by the frontend to detect and receive new postcard scans.

A.1 Postcard Scanner

When a new postcard is inserted into the hubbel letterbox, the scanner pulls the postcard in, takes a picture of it, and pushes it ahead into the letterbox. This is done autonomously by the scanner service. The picture is encoded as base64 and sent to the frontend where it triggers the postcard creation process. The image is sent to the backend, where Optical Character Recognition (OCR) is applied to automatically transform a handwritten postcard into digital text, which is then returned to the frontend and displayed to the user who inserted the postcard.

We use OCR, so the postcards appear seamlessly and easily readable alongside digitally written postcards. More specifically, we use Google's pre-trained Cloud Vision API [9], because it showed decent results during initial tests and can be used for free up to a certain number of scans per month. To make sure postcards are inserted correctly and can be processed, a small QR code placed in each postcard's front top-right corner is scanned. If successful, the orientation of the text is corrected automatically. However, if the postcard was inserted upside-down, users are informed and asked to re-insert their postcard. Each postcard is divided into text (left-hand side) and sender's information (right-hand side) and we make some technical corrections for line breaks because Google's API does not reliably detect lines and line breaks correctly depending on the spacing between words. During the OCR process, we also remove pre-printed text for user guidance on the postcards. If the scan was successful, the digital text is displayed. The image of the postcard is only stored as a file on the server when the user completes the postcard creation process and finally submits their postcard to be checked by the editorial board.