Improving logistic ICTs for community-based dengue prevention.

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Abstract
Organizing a community to participate in weekly entomological surveillance activities that reduce the risk of Dengue and other arbovirosis was the focus of the TopaDengue project, a cuasi-experimental impact evaluation of a community-based prevention program, supported by ICTs. This paper discusses our learnings while addressing a key challenge of this project, which is likely a common problem in participatory mapping initiatives supported by civic technologies.

Author Keywords
ICT4D, Dengue, Aedes Aegypti, Community Informatics

Introduction
Once a week, and equipped with paper and digital tools, volunteers of TopaDengue in Asunción, Paraguay, visited houses in their communities in order monitor the presence and evolution of mosquito breeding sites. This type of prevention program, which relies on the active participation of residents in the entomological monitoring of their communities (i.e., systematic collection and socialization of evidence about the presence of *Aedes Aegypti*), is a promising approach for sustainable dengue prevention, proven effective in previous studies [8]. Based on the *Green Way* [9] and supported by DengueChat[1] to map, process,

[1] www.denguechat.org

GraviTreks *[2]:* Quick scanning and instant report of adult mosquitoes surroundings.
Spectra: georeferenced information of breeding sites [1].
Mosquito Habitat Mapper: *[4]* part of *Nasa Globe Observer*, it facilitates sampling and counting of mosquito larvae (as DengueChat, but without the social component).

Table 1: Dengue prevention or control ICTs.

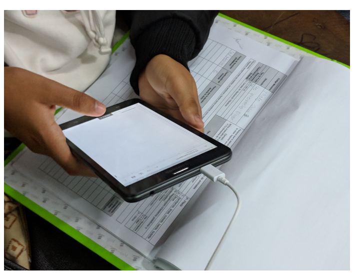

Figure 1: Evolution of paper forms

and socialize data, TopaDengue was a research project that designed, evaluated and found evidence of positive impact of a community mobilisation program for dengue control [11]. The program was tailored to the characteristics of a flood-prone neighborhood in Asunción, and used a cuasi-experimental design to evaluate its impact by comparing infestation levels in an intervention area versus a similar control territory. Drawing on design research within TopaDengue, we identified that one of the key challenges driving the efficient implementation of the program was the lack of good support for coordinating the activities (i.e., selecting city blocks to visit, assigning volunteers, enabling offline data collection and synchronization, etc.), a need that is likely common to other civic technology participatory mapping initiatives. In this paper, we discuss how we came to focus on this challenge and the lessons we learned while designing and testing solutions to address it.

Related Work

DengueChat is similar to *civic technologies* in the engagement and civic data spaces[2] like Ushahidi, FixMyStreet, Urban Decor, and others used in participatory mapping of issues or resources for collective action. In the Dengue domain, previous studies have designed and evaluated similar ICTs to support entomological [7][3] or epidemiological [5] [6] surveillance through citizen engagement (see Table 1 for other examples). However, none of them addressed the challenge of improving logistics of the participatory program in which they were integrated.

Identifying the Challenge

By accompanying volunteers and facilitators in their fieldwork, we observed the experience in detail. The first important observation was the need for a closer look on the usability of the mobile app for DengueChat, used to collect breeding sites data at house level. Through heuristic evaluation[10], we identified major usability problems (see table 2). Development work required to address these issues led us to consider other tools for data collection. Once we identified alternatives, we conducted user testing through four training sessions and one field test day where we shadowed volunteers to document their experience using the tools in the context of real house-by-house visits. We followed up with semi-structured interviews to further deepen our understanding of the experience. Insights from these activities led to the selection of the Open Data Kit (ODK)[3] toolset for data collection, coupled with an automated synchronization system that moved data from ODK to DengueChat. Concurrent to this exploration, we also observed different issues on the use of the paper version of the data collection forms, used for backup and places less safe to walk around with tablets (see Figure 1). Combining ODK with better paper forms gave us a robust and lightweight data collection workflow that worked offline, was easy to use for post-activity uploads and digitization, and required no development on our end, shifting coding efforts entirely to the DengueChat server components, particularly, to a single synchronization module.

Mobile app development and maintenance plus paper form issues of use and integration into a digital workflow were the first hints that fieldwork coordination and seamless orchestration and integration of digital and analog tools were key to the success of the program. This would become salient when we realized that up to one third of every fieldwork day was used to select city blocks to visit and decide assignments for volunteers, which was done manually, at the beginning of the day, by looking at physical binders with paper forms documenting previous visits and printed maps. Our focus became then how to improve

[2] See purposes of civic tech: https://civictech.guide/

[3] https://opendatakit.org/

Compatibility: compatibility issues on many low-end smartphones prevented the app from installing, or resulted in partial functioning (e.g., camera not working).
Storage: storage needs for installing were not met in many low-end smartphones. This caused some of the volunteers to uninstall the app in order to accommodate other data, like personal photos.
Usability: some problems were found with respect to all of the design principles of Nielsen, requiring a development team to re-design the app, if it were to address these problems.

Table 2: Problems in the original mobile app

logistics and increase the time spent visiting houses rather than planning to visit them (see table 3).

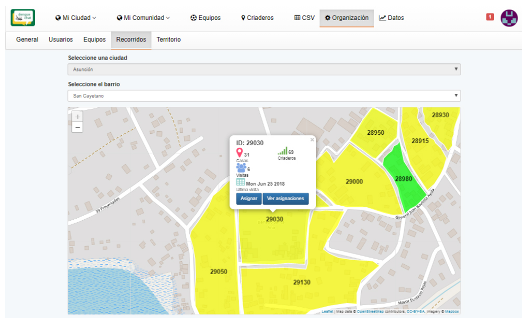

Figure 2: Route Assignment Module.

Addressing the challenge of logistics

To improve logistics, we designed a map to schedule fieldwork days, explore city blocks status and previous visits statistics, and assign them groups of volunteers. Each city block polygon displayed its number of houses, its current infestation level, its number of *'green houses'* (i.e., houses free of breeding sites for over a month), the date of the last visit, and the number of previous visits (See Figure 2. We also developed UX improvements on several pages of DengueChat and a new points distribution algorithm to reward the collective effort of volunteers, a feature only feasible now based on the logistics data the new module allowed to store and manage. The new gamification process rewards all the volunteers assigned to a city block when new green houses appear on that block. In the old mobile app, only the user who uploaded the data received the rewards.

Evaluation and key results

We organized 12 think-aloud sessions (4 facilitators, 8 volunteers) in which they evaluated these improvements. Half the participants tested the initial version of DengueChat, and the other half tested the new version. Half of each group completed the tasks on a laptop, and half on a tablet. We asked them to try several tasks, but mainly, the route assignment process was observed. Three key results emerged from these tests: first, the new logistic module was praised by both facilitators and volunteers as good way to organize the work, second, the module made it possible to follow explicit city block assignment strategies (i.e., assign the least visited city block, assign the most infected ones, etc.), and third, implicit knowledge of the territory and previous visits was no longer paramount to organize the activity. Facilitators and volunteers who used the old version depended on their implicit knowledge of the territory and previous weeks of work: facilitators knew where did all volunteers go in previous weeks and use that to organized the routes, while volunteers knew only their assignments and struggled to come up with assignments. In the new version, volunteers who did not have prior experience with organizing this work, showed their own strategies to organize the routes based on the existing information on the screen and had now difficulties doing so, which means that volunteers themselves could potentially self-organize with these improvements.

Conclusions and Future Work

Our work within the TopaDengue project has resulted in an interesting design research loop between community, researchers and volunteers of a community-based dengue prevention programs, built upon civic technology in the engagement and civic data design spaces. Actively involving facilitators and volunteers early on the research and design activities ICTs, we uncovered key challenges driving the efficiency of the program's implementation, making it possible to respond and adapt quickly, introducing new and better data collection tools and synchronization

Problem: Fieldwork by volunteers to implement the program entomological surveillance activities were characterized by a large amount of time devoted to logistics (i.e., organizing how carrying on the fieldwork, selecting city blocs to visit, assigning tasks, etc.). **Design Challenge:** How might we minimize the amount of time that was devoted to the logistics of the fieldwork to implement the program's entomological surveillance activities?.

Table 3: The logistics challenge

algorithms, and finally introducing new features to the main platform that led to interesting new practices of self-organization and gamification strategies that reward collective effort of volunteers working together. Because our new designs were introduced at the end of the program's implementation, it remains for the future to replicate these results beyond the laboratory think-aloud sessions. However, we see values in these insights for the development of civic technology and initiatives for participatory mapping and collective action. They also point to the importance of a continuous feedback loop between research, design, development and community action when deploying civic technologies and community participation processes in a local context.

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