Making Drones Civic

Values and Design Principles for Civic Technology

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Presented during the "Unmanned Rights: Drone Use By Civil Society" panel at the International Studies Association's 56th Annual Convention, New Orleans, Louisiana, 20 February 2015.

Abstract

Can drones be fully accepted as civic technologies? Are there values embodied by drones that undermine their ability to perform in a civic capacity? What design principles might make drones more civic? Where does responsibility lie between civil society actors, drone designers, and policymakers in pursuing this goal while balancing privacy, security, and innovation? Although drones have several proposed civic use cases, particularly involving practices described as monitorial citizenship, drones are different from other civic technologies. Civic technologies are about shifting power away from corrupt actors and toward virtuous actors. And a motivating concept and ethic for civic technologies, whether used for interacting with governments or against them, is participatory practice. If we aspire to a definition of civic action that is fundamentally participatory and we hope for our civic technologies to embody that value of participatory practice, we must investigate whether drones can be fully accepted as civic technologies. This paper will address these questions and issues, problematizing the use of drones for civic purposes by defining a set of values and design principles for civic technologies and by showing where drones may play a role, situating contemporary cases among relevant political and ethical questions.

Introduction

Can drones be fully accepted as civic technologies? Are there values embodied by drones that undermine or enhance their ability to perform in a civic capacity? What design principles might make drones more civic?

As a technological platform unmanned aerial vehicles or "drones" represent a potent tool for monitoring and reporting on terrain inaccessible to users due to political, economic, and geological barriers. They can also deliver payloads to similarly inaccessible areas. These affordances have been most notably deployed by militaries for surveillance and bombing missions. However, these capabilities need not be restricted to military use. Rather, drones may be civic technologies; as Choi-Fitzpatrick (2014) catalogs, drones can benefit civil society actors through a diverse set of issues and uses including:

- art
- mapping
- public safety
- environment
- humanitarian and development aid
- journalism
- corporate accountability
- state accountability and conflict
- human rights monitoring
- social movements and protests
- material and technical disruption

A motivating concept and ethic for civic technologies, whether used for interacting with governments or against them, is participatory practice—processes centered on community development and underpinned by an "ideology of equality" (Ledwith and Springett 2010, 14). If we aspire to a definition of civic action that is fundamentally participatory and we hope for our civic technologies to embody that value of participatory practice, we must investigate whether drones can be fully accepted as civic technologies.

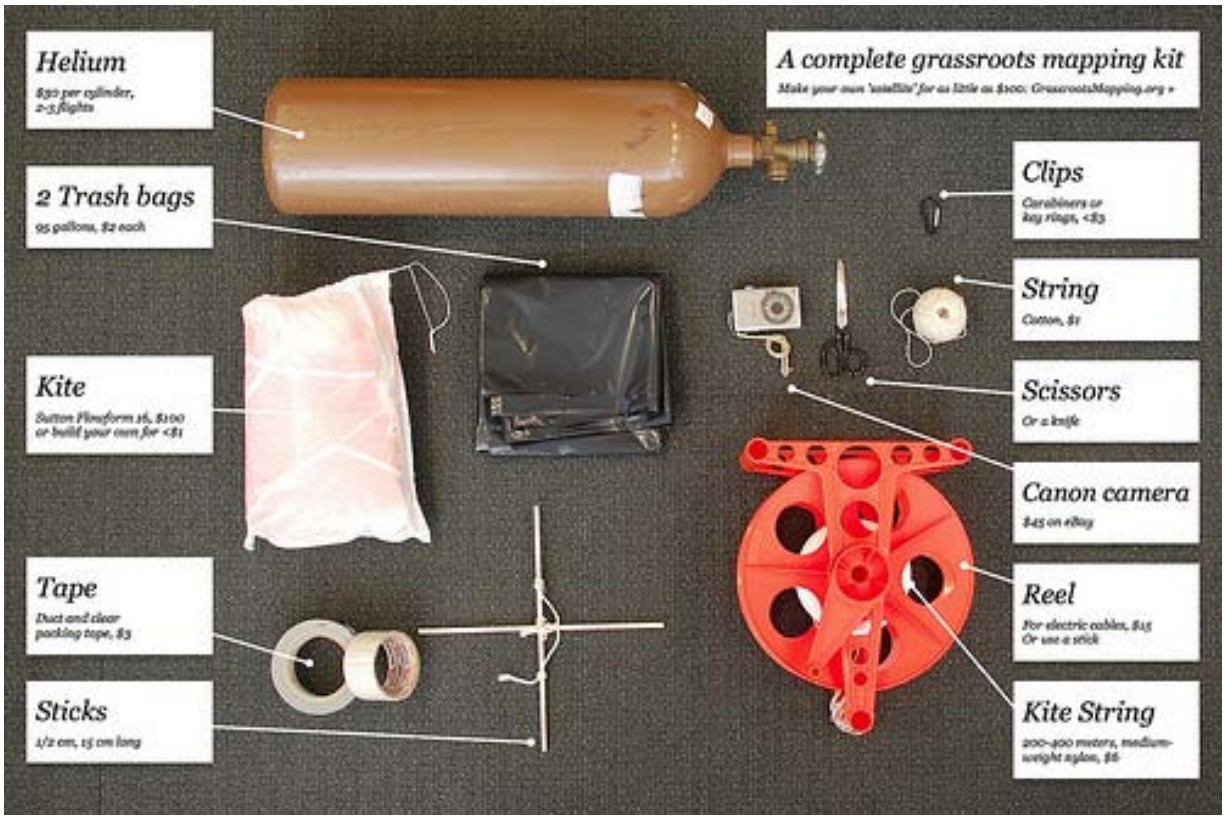
Monitorial citizenship (Schudson 1998; Graeff & Zuckerman 2014) efforts represent a class of participatory civic activities perhaps best poised to exploit the affordances of drones. Examples of participatory mapping projects like OpenStreetMap[1], most notably Map Kibera[2], could benefit from cheap aerial photography that can be released into the public domain. Similar efforts in "grassroots mapping" by the Public Laboratory for Open Technology and Science, using balloons and kites, have been successful in capturing aerial photography cheaply and aiding efforts to document illegal mountaintop coal mining in West Virginia, to

[1] http://www.openstreetmap.org/
[2] http://mapkibera.org/

claim benefits from polluted fishing waters in the Gulf of Mexico, and to support legal cases for historical Peruvian land rights (Warren 2010).

Civic technologies framed as participatory practice, which "treads a fine line between transformative change and maintenance of the status quo" (Ledwith and Springett 2010, 15), ideally shift power away from corrupt actors and toward virtuous ones. Often the empowerment is in favor of individuals standing against institutions, where institutions represent an abstraction of people—bureaucracies plagued by Allisonian problems (1969).

The Standpoint of Drones in the Struggle to Govern the Commons



Grassroots Mapping kit used to document the BP Deepwater Horizon oil spill[3]

In *The Struggle to Govern the Commons*, Dietz, Ostrom, and Stern outline the role of information gathering in the "coevolutionary race" among governments, private interests, and publics to govern the use of common goods like oceans, forests, and rivers (2003). They argue that this race plays out as "humans devise ways of evading governance rules." This is especially challenging in cases where the exercise of power is "spatially displaced from their causes and hard-to-monitor... in ways that swamp the ability of locally evolved institutions to

[3] http://grassrootsmapping.org/

regulate." Information collection and provision is the first step in supporting effective governance in this context, supporting effective conflict management processes and rule compliance. Infrastructure for data collection and communication is critical to this process; they use the example of local fishers who use mobile phones and radios to document illegal resource use. Civic drones expand the monitorial reach of citizen groups for these spatially-disparate issues and issues where other forms of monitoring activity are constrained. Drones can cover large areas of ground with aerial photography, access areas that citizens cannot safely or legally enter, and can be allocated dynamically to citizen groups' points of interest.

Especially in cases where data held by government or private interests might be deployed to overwhelm the influence of citizen groups, drone information can offer a powerful counter-argument in the struggle to govern the commons. Feminist STS theorists situate this kind of work as "explanatory pluralism" (Keller 2003), "situated knowledge" (Haraway 1988), a "standpoint epistemology" (Harding 1986), "displacing the dominance of linear constructs of causality" (Fortun n.d.). In the words of Haraway, offering scientific data and explanations from a situated standpoint contributes knowledge that "offers a more adequate, richer, better account of a world, in order to live in it well and in critical, reflexive relation to our own as well as others' practices of domination."

Efforts by Grassroots Mapping to monitor the scope of the BP Deepwater Horizon oil spill in the Gulf of Mexico offer a practical case of participatory aerial photography used to contest the narratives of private interests in spatially disparate situations (Warren 2010). In the first weeks after the Deepwater Horizon spill, fly-over data collected by BP was not being shared with the public, and NASA satellite data (250m resolution) was too low resolution to identify specific coastline damage. In the following weeks BP collaborated with the US Coast Guard, the Department of Homeland Security, Federal Aviation Administration, and the National Oceanic and Atmospheric Administration to restrict flyovers over the affected area, limiting them to altitudes that were too high to observe the specific effects of the spill (Peters 2010). Collaborating with local fishermen, the Grassroots Mapping team were able to offer aerial data on the spill at a 3cm resolution on an ongoing basis during this blackout. The resulting pre-spill and post-still data was then used by as an independent data source by journalists and citizen groups in efforts to hold BP accountable for the effects of the spill, rather than relying solely on BP's overflight data or NASA's low-resolution data.

The Deepwater Horizon spill illustrates the contestational nature of aerial data collection by citizen groups, since BP and the U.S. government explicitly denied monitorial access to journalists, citizen groups, and scientists. Aerial balloon mapping, as a novel, unregulated technique, became an alternative strategy to circumvent these restrictions. In the ongoing struggle to govern the commons, it may be that drones and other civil society aerial systems may only offer a temporary advantage in this "coevolutionary race."

Civic Data Creation as Media Making in Organizing for Change

Drone footage of a factory pig farm by Mark Devries[4]

Including communities in collection and interpretation of drone data can also be seen as a media-making tactic towards community organizing. Firstly, images taken by drones are often seen as beautiful novelties, the kind of spreadable media that characterizes participatory online publics as they like, share, and retweet beautiful images (Cohen and Kahne 2012). Secondly, involving communities in collecting data and telling their stories through that data offers opportunities for *frame changes* that expand communities' capacity to organize collectively around an issue of common concern.

When we label something as "civic" in Western contexts, we generally mean that it contributes to the public good in some way. This is interpreted as one of many civic acts committed by the public whereby all citizens working together constitute a democracy. In the U.S., we know that in fact we have changed our ideas of the role of the "good citizen" over time—starting with James Madison's Federalist No. 10 disempowering the masses to prevent factionalism in public elections up to the early twentieth century and Walter Lippmann's view that the public lacks the expertise necessary to contribute effectively to governance (Schudson 1998).

Democracy is now construed more literally, thanks in part to new technologies that have changed communication patterns from one-way broadcasts to two-way dialogues empowering more people to express their voice and make change. Cohen and Kahne define the current state of citizenship as "participatory politics" characterized by acts which can

[4] screenshot from https://www.youtube.com/watch?v=ayGJ1YSfDXs

> "reach large audiences and mobilize networks, often online, on behalf of a cause; help shape agendas through dialogue with, and provide feedback to, political leaders (on- and offline); and enable participants to exert greater agency through the circulation or forwarding of political information (e.g., links) as well as through the production of original content, such as a blog or letter to the editor." (2012)

Beautiful images and footage filmed by drones, are currently considered highly novel, shareable media, whether the output is an online video or an aggregated mapping resource. In contestational settings like the Deepwater Horizon oil spill, where international media outlets are banned from observing the effects, aggregate balloon maps collected by fishers gave journalists an opportunity to carry out their accountability role (Bilton 2010). Images and footage from drones can also be amplified by online audiences in acts of participatory politics. This was the case in a drone project by Mark Devries (n.d.) to document the U.S. practice of storing factory farm waste in open cesspools and disposing of it by spraying waste into the air. Three months after the drone video was posted in December 2014, it had received nearly three million views on YouTube, with over half a million people watching in one day (Devries 2014).

Participatory practices that involve communities in sharing drone material with each other have the potential to support *frame changes* in social movement organizing. Collaborative media-making initiatives by the *Hollaback!* social movement offer an illustration of this strategy (Dimond et al. 2013). *Hollaback!* crowd-sources women to pseudonymously tell stories online about their experiences of street harassment. By doing so, *Hollaback!* hoped to support *frame transformation*, where "people shift from one way of seeing an issue and oneself to a different way." By telling their stories together with *Hollaback!*, participants who previously felt like their experience was an isolated incident "felt that their own experience was validated and that they were part of a larger epidemic that warrants change" (Dimond et al. 2013, 483). The *Hollaback!* designers also hoped to support *frame extension*, to move from recognition of the problem to recognizing themselves a group and moving towards action (Dimond et al. 2013, 480). By visiting the site, telling their stories, and meeting each other, participants were able to connect their individual experiences, developing responses as individuals and as a networked public (Dimond et al. 2013, 485). As drone-using communities share data and techniques with each other on issues of common concern such as logging, participatory drone use may come to support similar frame changes and movement building.

Participatory Practices in Civic Technology and Political Communication

At the Citizens UK Assembly Shoreditch in 2009, local candidates were asked to account for policies and make campaign promises with direct impact to the Shoreditch area of London[5]

Our views on civic drone practices are an extension of theorizing civics in an age of participatory politics, as carried out through technology-powered monitorial citizenship. Monitorial citizenship as first proposed by Schudson focuses on citizens role in "environmental surveillance more than information-gathering" (1998, 310–311), residents working together in an informal capacity to keep their communities functioning well and safe. "Technology-powered monitorial citizenship" takes this idea and marries it with technologies like mobile phones, shared data repositories, and visualization tools to create a grassroots form of governance (Zuckerman 2014; Graeff & Zuckerman 2014; Graeff 2014).

Designing civic technology for a participatory vision of citizenship like monitorial citizenship requires participatory design methodologies that acknowledge the acknowledge the critical role of the public. Approaches like human-centered design, appropriate technology, and participatory technology design collaborate with the ultimate users (citizens) and respect the contexts of the communities wherein technology will be deployed (Rhea 2010).

[5] Photo by Chris Jepson. http://www.citizensuk.org/?attachment_id=1943

Participatory design is at its heart a philosophy about research and learning: taking its roots in (participatory) action research practices and constructivism (Spinuzzi 2005), honoring and complementing local knowledge and skills rather than a top-down systematizing of the world. The practice comes, in part, from a reading of (dis)empowerment from the subtle effects of dominant institutions and culture, similar in view to Paulo Freire's *Pedagogy of the Oppressed* and Antonio Gramsci's *Selections from the prison notebooks* (Ledwith and Springett 2010). This why the legitimacy of the output of participatory practice is based on the legitimacy of its process, which focuses on a value of equality maintained through every aspect of work (ibid.).

Spinuzzi (2005) suggests three stages comprise participatory design: initial exploration of work, discovery processes, and prototyping. The first stage involves establishing relationships within the community and understanding existing technologies and ways of working. The second stage involves designers and local users collaborating on setting and prioritizing goals and finding a shared set of values to drive the work. The third stage is the iterative process of developing and testing prototypes. In fact, all stages are meant to be iterative and can be revisited in an effort of collaborative meaning making, where local knowledge is leveraged to understand objectives, contexts, and utility of designs.

As part of a first stage-style exploration of work with Boston-based community groups who adopt civic technology adoption, Eric Gordon and Rogelio Lopez (2014), found two recurring themes "keeping up" and "keeping it real." There was an interest in keeping up with contemporary technology trends, especially such that their community work was able to keep up with local youth. Keeping it real was about staying true to the grassroots nature of the organization and its work. Gordon and Lopez found a lack of the usual technological frame of "disruption" amongst the participants they interviewed at the community organization. They were more interested in maintaining legitimacy and how taking risks through innovation might threaten that legitimacy.

Evaluating the success of participatory design like this means checking for evidence of full participation throughout the process. From her work focused explicitly on civic technology, Laurenellen McCann (2014) proposes five criteria for "community-driven civic technology:" start with real people in real communities, cater to existing social infrastructure and sociopolitical contexts, let needs and ideas expressed by communities drive problem identification and solving, build solutions most useful to community and support their goals and needs, and prove that you have incorporated community contributions by documenting throughout the project's lifecycle. Specific metrics could also include "directness of interaction with the designers", "length of involvement in the design process", "scope of participation in the overall system being designed", and "degree of control over the design decisions" (Kuhn and Winograd 1996).

Civic Drones in Practice

Participatory Objective Design

Foraging Drone[6]

The effort to make drones civic must start at the beginning of the participatory design process: connecting technology designers, civil society organizations, and community members affected by a particular issue. In the monitorial citizenship project Promise Tracker, design researchers were quickly disabused of their assumed vision of a tool for tracking explicit election promises of politicians once they started collaborating with their Brazilian partners in Minas Gerais and Sao Paulo (Zuckerman 2014; Barabas 2014). Alexis Hope describes the workshop in Minas Gerais:

> "On our first day together, we discussed the goals and priorities our twenty participants had, and how those might translate into something that could be monitored. The Belo Horizonte group had many goals and priorities related to housing appropriation, trash pickup, the accessibility of the stairways in their community, education, and sanitation. We talked with the group about how some of the more complex issues — education, for example — may be difficult to monitor, but we were urged by the community that just because such issues were difficult to monitor did not mean that we should not try." (2014)

[6] image via dronesforforaging.com

In the example of Grassroots Mapping, the technology project is seen from the start as a community in contrast to professional cartography and geographic information systems which empower members of the community to produce their own quality maps (Warren 2010). Jeff Warren, the founder of Grassroots Mapping, states this very clearly in his thesis:

> "My work is intended to teach and assist communities and individuals to map themselves, for themselves. This includes building literacy and proficiency in geographic tools an information, and making good choices about how to publish their maps—if at all. the maps which I have published here are only those for which I have requested specific permission to reproduce for purposes of education and research." (2010, 22)

In the case of "Drones for Foraging," Carl DiSalvo commented that Georgia Tech's Public Design Workshop was initially planning to offer the foragers a mobile app to help with their foraging of fruit trees in Atlanta. The foragers themselves came back and asked if they could use a drone (DiSalvo 2014). This shifted the priorities of their collaboration from the start and introduced a new context and set of design constraints.

Participatory Drone Design

3D map of Sholinab village in Guyana created by a Wapichana monitoring team[7]

[7] screenshot of video on http://www.digital-democracy.org/blog/we-built-a-drone/

The focus on collaboration between designers and users and empowerment in participatory design leads to a focus on designing potential civic technologies like drones in ways that are accessible to the users and ideally using kits that those local users can build themselves. The open science movement, which includes examples like Grassroots Mapping and Safecast, focus on kits that can be assembled by non-professionals. Returning to the founder of Grassroots Mapping's earlier statement, there is an explicit goal of assisting communities to "map themselves, for themselves."

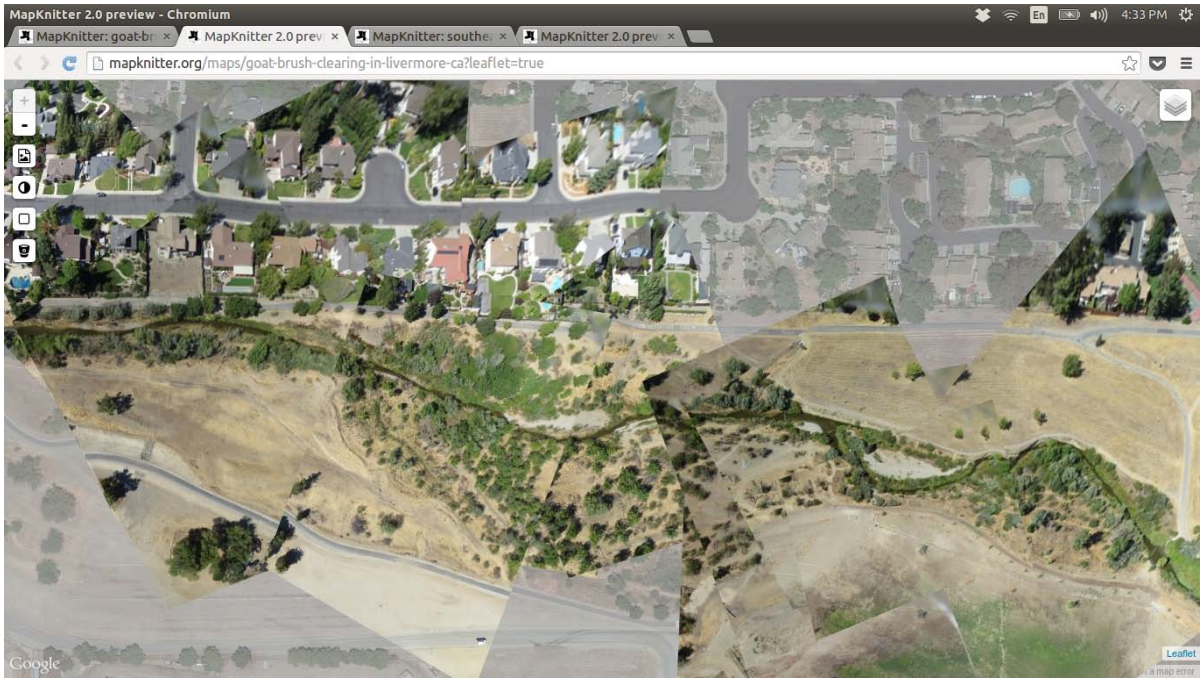
In Guyana, members Digital Democracy worked with the local Wapichana people to build drones and monitor and map deforestation (MacLennan 2014). Gregor MacLennan talks about the ownership the locals took in the project as they soldered their own video transmission system and tested and repaired their drone:

> "When the motor mount broke, the team scoured the village for different types of plastic, and fashioned a new mount from an old beer crate. The drone was no longer a foreign, mysterious piece of technology, but something they owned, built, and therefore understood." (2014)

This was similar to Grassroots Mapping's model in two ways. First, Digital Democracy developed a kit that users with limited pre-existing experience can build and even repair their own technology locally. And second, they developed mapping workshops and software similar to Grassroots Mapping's MapKnitter[8], which automatically stitches aerial photos together. Digital Democracy's efforts to map with drones was based on an ongoing collaboration that started by performing remote sensing via satellites, which they made accessible through in-person trainings followed by the ability to interact with the data via email and simple website (Digital Democracy n.d.).

[8] http://mapknitter.org/

Participatory Data Interpretation Practices



Using the MapKnitter software, web users create maps from DIY aerial photographs[9]

The collection of data for accountability and transparency is not where participatory practice should end. Communities can and should be involved in interpreting data collected about them and for them. In his "data therapy" work, Rahul Bhargava describes an approach of "creative data literacy for non-data people" as "Popular Data" (2013). He cites Paulo Freire's vision of popular education in an effort to locate empowerment through "engaging, participatory approaches to data-driven presentation and decision-making." There is a focus on facilitation rather than teaching, such that community members are not disempowered through the use of jargon or complicated technologies. Rather, Bhargava encourages data analysis in the form of "story-finding." This focus on storytelling offers communities opportunities to engage in the frame transformations associated with social movement organizing.

Micro-tasks and human computation through crowdsourcing offer powerful means for processing large amounts of data quickly. Optimizing for speed, efficiency, and quality can also detract from broader civic goals, as participation is replaced with centrally-directed labor and participants are evaluated as volunteers rather than stakeholders, in terms of the quality and quantity of their contributions. As Matias and Geiger observe (2014), many systems across crowdsourcing and human computation appear to make this trade-off between a focus on civic values and a focus on outcome values. For now, this apparent but perhaps false dilemma is often made visible in evaluation processes, with story-oriented qualitative methods

[9] http://publiclab.org/wiki/mapknitter-leaflet

characterizing civic systems and quantitative experimental methods characterizing more output-oriented systems (ibid.).

In the case of drones, civic technology can accelerate the process of collaborative meaning-making so that arcane tasks like GIS in the case of Grassroots Mapping can be handled automatically using free and open source tools like MapKnitter. At this point, users can bring their local knowledge to bear on the problem of finding a story in the data, analyzing it and employing it in an argument that represents their voice, such as the fishers mapping the BP Deepwater Horizon spill.

Participatory Infrastructures for Sharing Drone Data

As demand for drones and use of drones by civil society grows, there will be an increased value in standardized infrastructures for drone information processing and data sharing across groups. As this occurs, the capacity of drones to support local community goals will be mediated by the participatory or non-participatory nature of those infrastructures themselves.

Cross-community sharing of drone data is already occurring in the field of conservation. The Conservation Drones project is an international network of practitioners, developers, and trainers from several continents, who have pooled drone-generated maps from Sumatra, Borneo, South Australia, and elsewhere, in order to train machine classifiers to detect logging (ConservationDrones 2015). By sharing data with each other, they are able to improve the quality of automated classification of aerial footage.

Projects like Conservation Drones follow the pattern of the Volunteer Geographic Information movement and projects like Open Street Maps. OSM has created high quality maps of many parts of the world through voluntary effort, supporting local communities to document their local areas. Yet as Jude Mwenda Ntabathia has documented, the Open Street Maps system accepts only one, canonical map that is shared by everyone, with a canonical taxonomy that fails to account for geographic items that are common outside of the United States and Europe (2014). When Kenyan volunteers attempted to add M-Pesa mobile payment shops and local religious shrines to Open Street Maps, they were resisted by organizers based in the U.S. and Europe on the grounds that Western taxonomies would suffice (ibid.). As a result, local communities were not allowed to search, index, and classify geographic data on their own terms. The same could happen to drones as common infrastructures increasingly mediate the deployment of drones and the sharing of drone-collected data. Unless the platforms and schema are designed to support local epistemologies, they might shut out participation from local civil society actors.

Barriers to Civic Drone Use

The Fear of Drones as Military Objects

In the course of his work with the Humanitarian UAV Network, Patrick Meier cataloged common concerns shared by humanitarians of using drones in humanitarian contexts (2014b). This is the list in order of the frequency of mentions in "documents, reports, articles, etc., on humanitarian UAVs:"

- Military Association / Stigma
- Privacy / Data Collection / Surveillance
- Transparency and Consent
- Fear / Confusion / Psychological Terror
- Laws and Regulations
- Response Expectations
- Technological Weakness
- Inappropriate Use
- Ineffective Deterrence

One conclusion, well-described by Helena Puig Larrauri (2014) and reiterated by Meier (2014a), is that non-lethal drone use in conflict settings pose complicated ethical problems due to their military association and the fear and confusion they inspire. Despite this stigma, Meier fully expects communities to use drones in conflict settings where they see a value for monitoring or civil resistance (Meier 2014a, Meier 2014b, Meier 2012).

The Humanitarian UAV Network has a code of conduct, which proposes guidelines to help mitigate problems following from military association and psychological terror (UAViators 2014). These include conforming to the humanitarian Do No Harm principle and rights-based and safety management-based approaches. Additionally, they recommend flying only small drones, less 2kg in weight, to reduce perceived threats. And in accordance with good participatory practices, UAViators recommends:

> "Engage local communities when possible to ensure they are aware of UAV flights and to provide an avenue for learning. Seek local partnerships to ensure UAV projects are relevant and appropriate. Train local partners and communities on how to use/fly UAVs." (2014)

Privacy and No Fly Zones

As seen in Meier's informal analysis of UAV reports, issues of privacy, data collection, and surveillance were the second most frequent raised. We have already addressed the question of data collection practices and the ownership of both the resultant data and participation in its analysis and presentation. However, privacy remains an important concern. In cases of monitorial citizenship, we are explicitly and literally talking about surveillance. And this

happens on an unprecedented scale thanks to drones' aerial coverage and range of activity unencumbered by traditional privacy-enhancing barriers like fences.

Some of this is being addressed through legal and technical policy barring drones from flying in so-called No Fly Zones. Recreational and Commercial drones are limited to flying outside of five miles radii of airports and not above 400 feet or 500 feet, respectively. Drone manufacturers are also coming together to create a national No Fly Zone[10] list, where residents can register their property addresses to be added to the geofence databases incorporated in participating drones' firmware updates. This has become a high profile issue following the crash-landing of a recreational drone "too small for radar to detect" within the White House's perimeter (Schmidt and Shear 2015).

In terms of privacy protection, software-based systems that automatically keep drones clear of places may be better solutions than relying on the judgment of human pilots. However, this also undermines the ability of civil society to use those same technologies for civil resistance or monitoring in places where corporate and public interests may be colluding such as in the case of the BP oil spill or factory farms.

In humanitarian contexts, as Larrauri (2014) argues in her meditation on the ethics of drone use, consent is key to the use of drones in order to ensure that they protect the privacy of the often marginalized populations in the area. Even in periods of crisis, it's unclear whether the use of drones for aid should supercede the respect of privacy or more ideally the participation of the local population.

Drone Licensing laws

While No Fly Zones regulate the *locations* of drone usage, drone licensing laws are likely to influence who is allowed to operate drones and for what purposes. In the United States, journalists have typically been prevented from using drones under policies that prohibit what the FAA considers to be commercial uses (Chapa 2013; Barr 2014). In 2013, the FAA sent cease-and-desist notices to universities attempting to test journalistic uses of drones (O'Neil 2013). In February 2015, the U.S. Federal Aviation Administration released regulation proposals that would require drone operators at least 17 years old to pass a test at an FAA knowledge center, be vetted by the TSA, and and report injury or damage-related incidents to the FAA (FAA 2015).

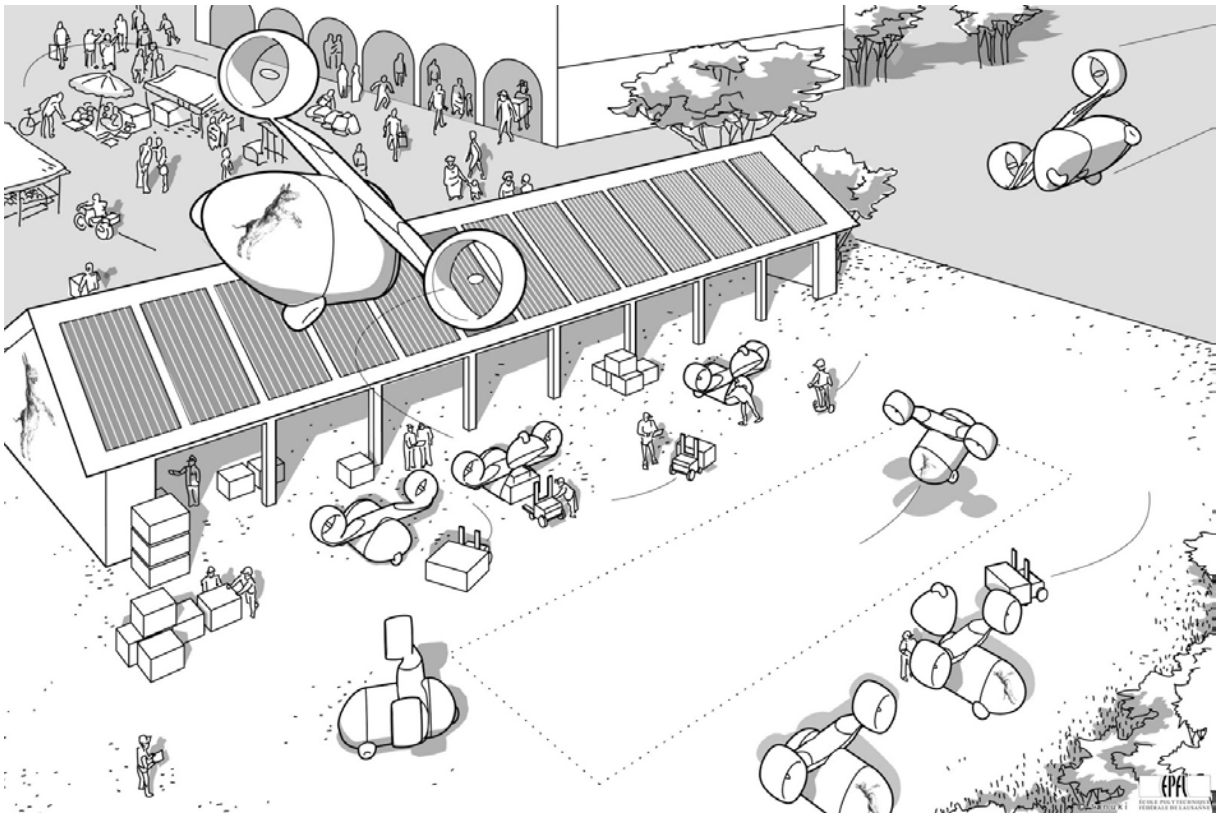
In Kenya, the Kenya Civil Aviation Authority has announced that all unlicensed drone use is illegal, even though no Kenyan policies yet exist for licensing drone use. Upcoming regulations are expected to be governed by the military and the Kenyan department of defense (Kariuki 2015). These regulations have already prevented the use of drones for anti-poaching monitoring by the Ol Pejeta Conservancy (Kariuki 2014), although some

[10] http://www.noflyzone.org/

universities and civil society groups are proceeding despite the lack of regulations (Okune 2014).

Drone regulations will have a profound effect on the risks associated with civil society uses of drones. Training requirements can improve safety, but they can also limit access. Definitions of commercial and hobbyist uses can be applied to limit legal use of drones by civil society actors. As was the case in the Deepwater Horizon oil spill, safety and privacy concerns can motivate regulations that prevent aerial photography and sensors from becoming a critical resource for citizen power and participation.

Preserving Participatory Values in Scaled Drone Infrastructures



Ledgard's work on cargo drones imagines widespread drone infrastructures across Africa[11]

In this paper, we present participatory values and design principles for civic drone design and usage. Throughout, we have made the assumption that drones are operated by individuals or small community groups who have near-complete agency over the piloting, objectives, and overall use of individual drones, even if the data might be shared and aggregated by a wide network of actors. In the short term, this is likely to be how drones will be used. In the longer term, small-scale, un-coordinated done operation may be replaced by larger infrastructures of drones similar to current air transport systems, communications infrastructures, or dynamic allocation infrastructures such as virtual machines or micro-labor.

[11] https://medium.com/message/build-cargo-drones-get-rich-9b858dffaba

In this *drone-iverse* of "donkeys in the sky" (Ledgard 2014) many of the assumptions of this paper are transformed. Imagine, for example, a network of semi-autonomous drones that are managed like a common carrier resource, through a central switchboard of drone allocation. Perhaps local drone owners can contribute a drone to the network, or perhaps it is run by a small number of major players in all regions except the fringes of the drone system. To carry out a routine drone use, an operator simply allocates a task, which is then carried out through the drone network on whichever drone is best situated to carry out that task. In this scenario, the operator does not know what drone is used, plays no role in flying it, and merely waits for the successful retrieval of information or completion of the task. In some cases, like the acquisition of aerial footage, we could imagine that the allocation of a task is further abstracted to a request for information. If the drone system possesses recent enough imagery, no drone need actually be sent in order to fulfil the surveillance task. We could also imagine infrastructures of standardized payloads that are compatible with a wide range of aerial platforms; to enhance the functionality of the drone network, one need only to design new forms of payloads (sensing, delivery, agriculture, decoration, rescue, drone-interception, games) that are then allocated to drones in the network on-demand.

In the drone-iverse, barriers to participation are lowered while issues of community ownership, privacy, and civil disobedience are transformed. Communities would no longer be required to develop the resources and capacities to build, maintain, and operate their own drones. More communities could use them, and the learning outcomes might be lost. The drone-iverse would also offer opportunities for unprecedented scale and coordination among civil society actors. In this network, the cost of coordinating well-calibrated sensor systems across regions for large-scale data collection and transparency might become very low indeed. On the other hand, such a highly coordinated system might be disproportionately controlled by private or government interests, shifting the balance in the "coevolutionary race" away from local groups, with No Fly Zones rigorously controlled, unauthorized footage censored, and civil society uses of drones electronically surveilled. In this commercial context, drone use by activists against corporate terms of service could also carry overly-reaching, cybercrime-like penalties similar to uses of the U.S. Computer Fraud and Abuse Act against "hacktivists" (Sauter 2014). In this vision of scaled drone use, the privacy and visibility concerns of drones might also be magnified, offering no visible indication at all of the purpose or operating entity. The same drone used to monitor a factory farm could be used the next day to drop threatening messages over the homes of the activists monitoring the farm.

Conclusion

Grassroots/participatory mapping and monitorial citizenship are sometimes termed "sousveillance" to distinguish their practices from surveillance. In sousveillance, the power to surveil is redistributed by citizens owning their own wearable recording devices that can "watch the watchers" (Rheingold 2004). Smartphones are the most common of these technologies, but can easily be extended to digital cameras suspended from balloons or kites.

There is an implicit assumption that if these technologies are accessible to all then there is a right to counter-surveil, especially against institutional actors like the police and the military. The hope is that differential socio-political power could someday be offset by a "right" to inverse surveillance by the disempowered if they have access to monitorial tools.

But drones are different. They might distort the values of civic practices and even sousveillance because of their scale, association with military activity, and requirement of advanced technological skills to design, build, and use. These lead to difficult questions about privacy, consent, and representation of marginalized communities.

Participatory design offers a potential path through some of these concerns: guiding advocates of civil society drone use to incorporate community members (users) through every stage of design and deployment, including data interpretation and encouraging contributions back to a shared commons. This vision for civic drones may allow them to play an ethical and effective role in governing our public commons.

It's important to caveat this claim by acknowledging the practical limitations of participatory design processes, which stem from the "enormous amount of time, resources, and institutional commitment" necessary to pull it off (Spinuzzi 2005, 169). When participants don't show up it slows the process and can undermine its legitimacy over time. And because it relies on a portfolio of techniques and broad outline of stages of participation, there are no simple, specific methods to check off and ensure rigor.

Whatever the future holds for drone use in civil society, we hope designers strive to make drones civic by adopting the values and exemplars of participatory practice.

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