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RootIO - Platform Design for Civic Media

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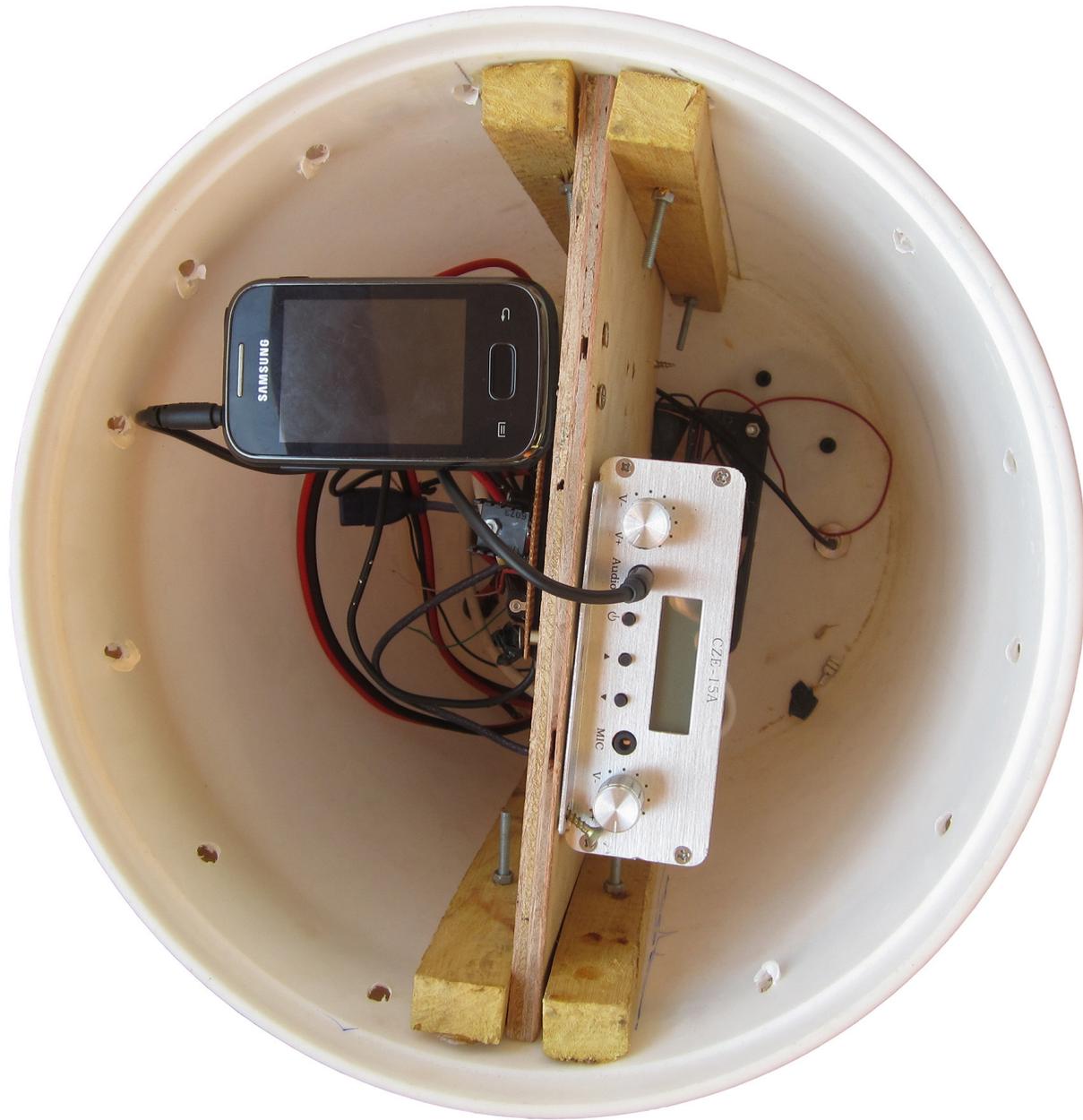
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Abstract: TRootIO is a civic media platform and research project in the context of rural farming communities in Uganda. The RootIO project draws from prior work in Civic Media, the design of public goods and information services for communities rather than individuals. This project presents the additional challenge of designing a participatory community information platform in a relatively low literacy, low income area with little

access to ICTs. Unlike many “development” projects, it focuses on local peer production rather than top-down “behavior change” messaging. RootIO is in active development and prototype FM stations will go on air in 2015: what follows is a prospective exploration and report of current and future work. RootIO is being developed with an open-ended and iterative method, where use and failure can be tracked and analyzed in real-time.

We begin the paper by defining the context and background of the RootIO project, then present our research goals in building the system. We then discuss some of the methodological techniques that inform our design, including civic media and platform design. Finally, we will introduce the RootIO project. Our submission to the exhibition is a functioning FM “microstation” design of the sort deployed in rural Uganda.

Keywords: Civic Media; Platform Design; Community Media; Radio; Participation.



Background and Research Goals

From Broadcast to Network

FM radio was invented in an era of expensive communications, when broadcast was the only game in town. Newspapers, radio, and television all worked by consolidating resources -- reporter and editor labor, printing presses and hundreds of tons of paper, huge transmission towers -- so that a “high quality” product could be distributed to the most people possible. Large media organs (for example, USA Today, BBC, or CNN) trade economies of scale for specificity: the better the production value the more averaged the content. The relatively “smaller” the viewer/reader/listener becomes in relation, the less likely their local issues will be deliberated in the media.

FM radio is still very popular globally because of a host of affordances: it is aural, handsfree, “edited,” “visual,” “warm,” and highly mobile. Because there are a limited number of radio frequencies “on the dial,” commercial radio and television stations grow as large as possible within a region, offering only a handful of types and little variety of programming (Benkler 2006). Community needs are not served by these large stations.

Community Information Access

Information availability varies tremendously around the world, and often correlates directly with wealth. A community with access to medicine, food, and human rights is also likely to have access to information that will help its members to deliberate and make informed decisions. In Uganda, where RootIO is being developed and tested, newspapers have never been common. Only about 100,000 newspapers -- all newspapers combined -- are printed per week in the entire country of 33 million people. UNDP estimates that 73% of adult Ugandans are literate, a high number that belies the paucity of available reading material in rural areas. Radio does not require literacy.

GSM and 3/4G networks allow text and audio to flow nearly anywhere in the world. However, in most of the world the price of 3G networks is prohibitive to daily use; few people in the “global south” have a data plan, let alone power to routinely charge their phone (Wyche and Murphy 2012).

Radio Dashboard

Stations



Name	Battery	GSM Signal	WiFi Network	Memory	Storage	CPU	Audio Plug
Mugongo Farm Fresh SACCO	✓	📶	📶	📶	📶	📶	📶
Radio Aber	✓	📶	📶	📶	📶	📶	📶
Testi Testalot	✓	📶	📶	📶	📶	📶	📶
Tom Pi Diki FM	✓	📶	📶	📶	📶	📶	📶
Radio Granja	✓	📶	📶	📶	📶	📶	📶
Alero Community Radio	✓	📶	📶	📶	📶	📶	📶
Pabo FM	✓	📶	📶	📶	📶	📶	📶
Metuli RootIO	✓	📶	📶	📶	📶	📶	📶

Figure 1. RootIO Cloud Platform, Station Dashboard, RootIO Project.

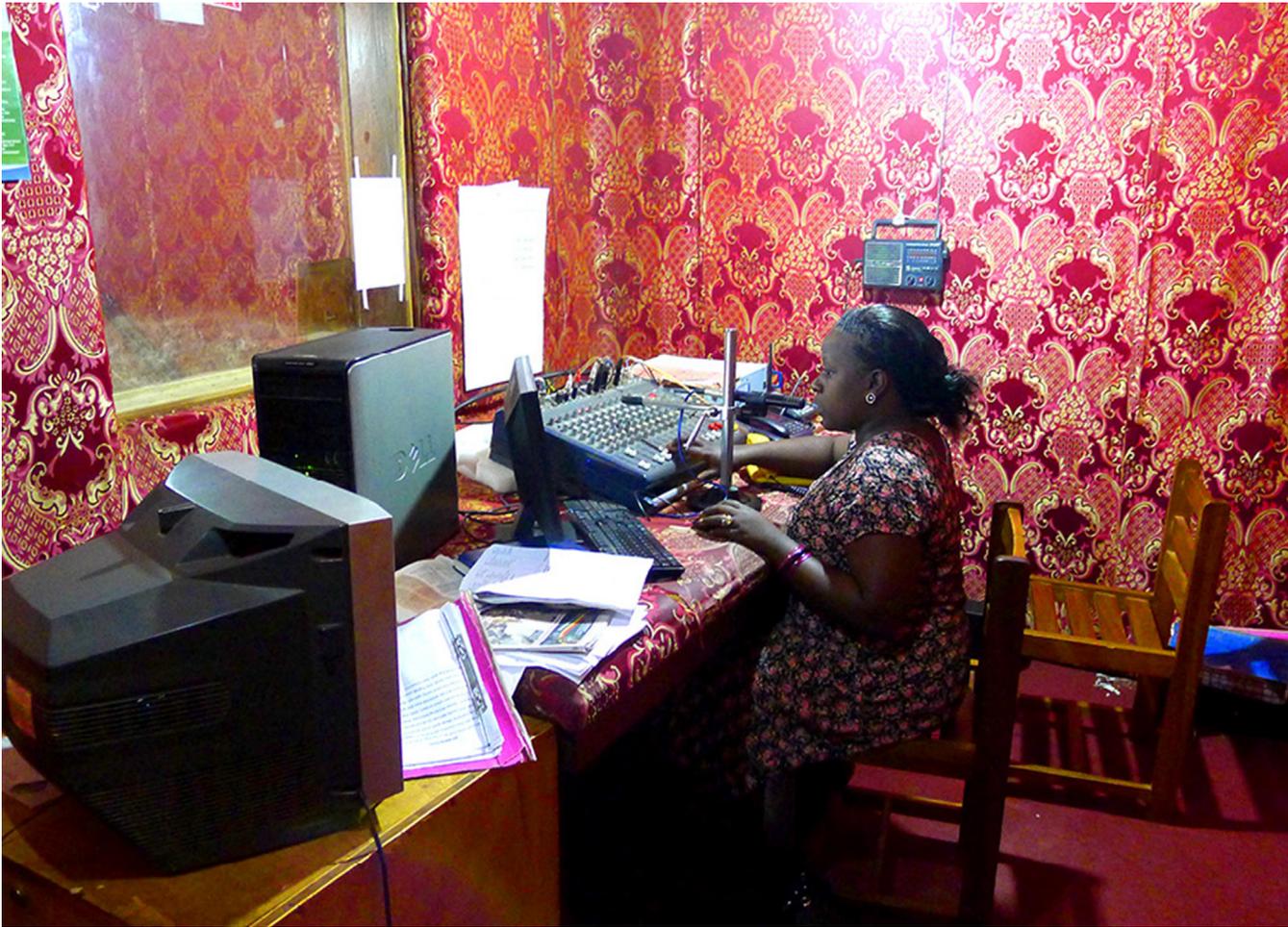


Figure 2. Ugandan News Broadcaster, RootIO Project.

Radio is king of media in Uganda, with over 100 stations throughout the country, up from only one in the 1990s. Most stations are classic broadcast media: Capital FM, with repeaters that cover most of the country, broadcasts traffic reports from downtown Kampala to listeners in rural villages 200 miles away. The lowest common denominator of broadcast means that stations will often broadcast primarily in one language (English, Luganda), with a few minutes a day in one or two other

languages. Uganda has 41 languages (“Ethnologue” 2014), many of which are not supported by any media, and only a handful by a range of media. Broadcast notoriously erodes minority languages; community radio is often seen as a potential bulwark (Camp and Portalewska 2013).

The majority of programs on the radio in Uganda are “call in” shows, with a host and guest discussing a topic and responding to listeners’ calls.

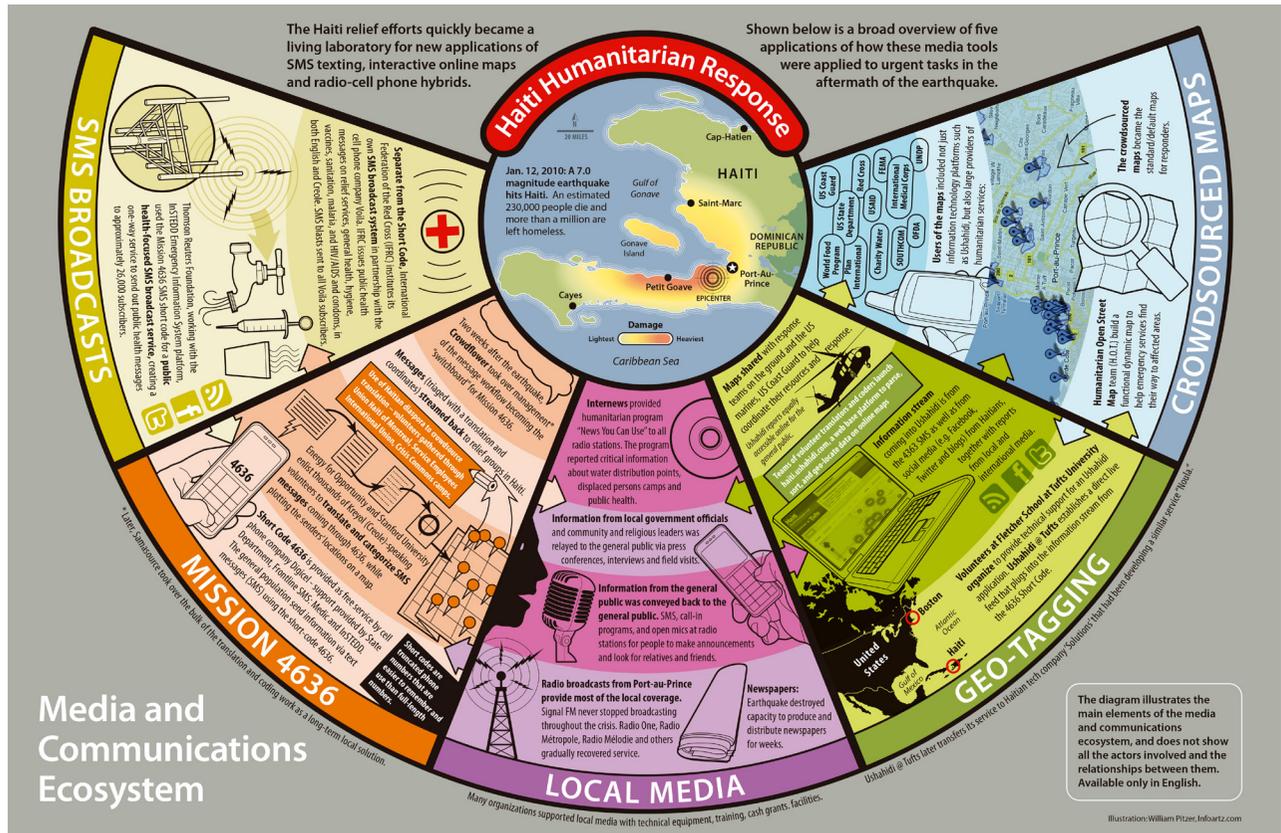


Figure 3. Media and Communications Ecosystem, Haiti Earthquake Relief. Graphic designed by Bill Pitzer for Knight Foundation cc-by-sa2.0.

These shows allow members of the community to join in as proxies for the community. Callers make stations with millions of listeners far more personable and seemingly grounded in the community. Analysis by Farm Radio International (Sullivan 2011) and our own research confirms that these shows, while providing the illusion of inclusivity, are only available to those callers who 1) have charged phones, 2) have enough credits to initiate a voice call from their phone, 3) are motivated to call a radio station

to chat, despite the fact that this is a very significant expense to most rural smallholders. During our travels in rural Uganda, we met few rural farmers who met these criteria. They exist, but they are certainly only a few percent.

Radio has a proven to be a tool for “community resilience”: for example, radio stations in Haiti responded to the 2010 earthquakes by changing

their programming completely, instead listing locations of clean water, medical clinics, and power. As Nelson and Sigal (2011) describe: 'Although much of the attention has been paid to new media technologies, radio was the most effective tool for serving the needs of the public.' But with only two stations available in the weeks after the earthquakes, airtime was extremely limited and only the most general information was shared.

Research Questions

With the broad parameters outlined above, we can now ask, how do we:

- reimagine a community information platform in an era of networked communications, but in a way that is economically sustainable even in the poorest community?
- emulate the role of the older community newspaper or grassroots, low power fm radio station, because this is the smallest unit whereby media remains a shared resource and a public good?
- simultaneously make the stations as "permeable" as possible to information, giving them access to the wealth of sonic knowledge available?
- enhance the technologies of radio without demanding many new user hardware or practices?
- encourage community members to take the time to create radio content, and ensure that they have the knowledge and technique to do so?

- serve as many in the community as possible -- the old, the poor, the illiterate, the speakers of minority languages -- who have been minimally served by media technologies in the past?
- defray the costs of inclusion and participation to the poorest in the community?

Research Goals

RootIO is a media design initiative hybridizing high and low technologies to create a new network of micropower grassroots community stations. Listeners still use the FM receivers in their portable radios, boom boxes, feature phones, or in their cars, but technologies like cloud-based servers and computational telephony make the stations highly networked and permeable to local, regional, national, and global news and information in ways community stations have not been. Stations have no studio and require little capital investment or maintenance costs, consisting of little more than an inexpensive smartphone, a cheap transmitter, and a solar panel. These small stations, however, offer interaction and networking capabilities that meet or exceed those of traditional radio stations.

By exchanging the costly economic model of broadcast (measured by transmitter power) for the cheaper model of network (connected via a smartphone), many more stations can fit into a given area, allowing stations to serve more languages and much smaller, more focused geographic



locations. Social and community costs of running a station (surplus time and creative “capital”) are minimized by the fact that the stations can share programs between communities, or pull programs from podcasts, Soundcloud, or other Internet-based sources.

Because RootIO exactly mimics the usability of traditional radio and its content echos community radio, both of which are extremely successful globally, we have little doubt about its uptake with listeners. The ongoing research questions have more to do with how to engender a community of contributors, how to make the project economically sustainable, and how to proselytize the system to government regulators who are used to a very different kind of radio.

With these goals, we can now introduce a set of methods that we have developed or borrowed, and which inform our design choices.

Design Methods

Disrupting and Fixing

While most technologists hope to create new systems, we are trying to “fix” a system that has been around for 100 years. We are motivated to do so because radio in Uganda has many times the availability of newer systems like phones. Over 90% of Ugandan households have access to a radio, and over 90% of Ugandans receive their news by radio. But it

needs “fixing” because the quality of radio information -- its utility to most listeners -- is quite low, even if it is the best media available.

One method, then, is to borrow from Christensen’s (2003) notion of “disruptive innovation”: lower the cost of a product -- in this case the radio station -- while maintaining its key functions, familiar affordances, and modes of interaction with users. To succeed in this, we must retain the “warmth” of radio programming without a large and costly staff. We must run a full-featured station without a costly studio. We must design many small stations to be as economically viable as one large one, linearly scaling both their costs and incomes.

Platform Design

Developing countries may have low Internet penetration rates, but that hasn’t slowed the epidemic of Facebook. India, Brazil, Indonesia, and Mexico join the US in the top five countries by number of users. Facebook’s ability to spread derives from its relative openness to participation and user-contributed content, as well as the fact that many developing countries have large diasporas: Facebook allows families to stay connected after emigration. The feed of a Ugandan user in Kampala is dramatically different than that of an American user in Silicon Valley, filled with locally relevant, timely information, often in one of Uganda’s many languages. Designing for this kind of open contribution is in many ways

quite different from traditional product or service design. It involves, to some degree, creating both medium and genre, while leaving it to users to provide the plot.

RootIO looks at the challenge of creating a new kind of radio as similar, in some ways, to Internet platform design. We can model and study rural farmers in a particular village, or across a series of villages, and participate and codesign with them (we are in fact doing so), but the concerns of farmers 30 or 3000 miles away will be different. We cannot anticipate the rise of new cultural memes in our design, or future shifts in politics or climate. Media platforms bring valuable information to users regardless of these changes and indeed are strengthened by them.

Civic Media as Community Platform

Civic media is an ongoing research program to create novel designs for public goods. A civic media design models individual users not as consumers but as citizens; moreover it emulates public works projects in that the unit of design tends toward community (geographic or “of interest”) rather than any one citizen (Csíkszentmihályi 2012). Community focused products have not been common in a world dominated by for-profit enterprises and markets. Recently, however, global electronic communications networks have lowered the cost of communication and collaboration, allowing distributed groups of individuals with shared purpose to design and maintain advanced and complicated designs

without the need for an overarching economic entity (von Hippel 2006; Benkler 2007; Kelty 2008; Baldwin and von Hippel, 2009). Designs that would have been too complicated to accomplish by anyone other than a corporation or a state can now be realized by loosely coupled but committed parties across the world, in a process that more closely resembles a social movement than a company (Hess 2005). We are taking advantage of these processes in the development of RootIO and will engender this process in the development of content as well.

A civic media approach to design thus combines both 1) a set of values about design and use, for example designing a product to serve many members of a community rather than individuals in that community, or a service that would enhance social justice or redistribute resources toward the bottom of the economic ladder, and 2) a specific means of production and sustainment, leveraging distributed, electronically mediated social production by committed interested or activist participants rather than paid employees. Other design methods may be leveraged as well, but these techniques are orthogonal to civic media per se. Exemplar civic media projects include Sourcemap.org, the ExtrACT project, BetweenTheBars.org, and the PublicLab.org.

We now move to a discussion of the actual design choices in the RootIO framework.

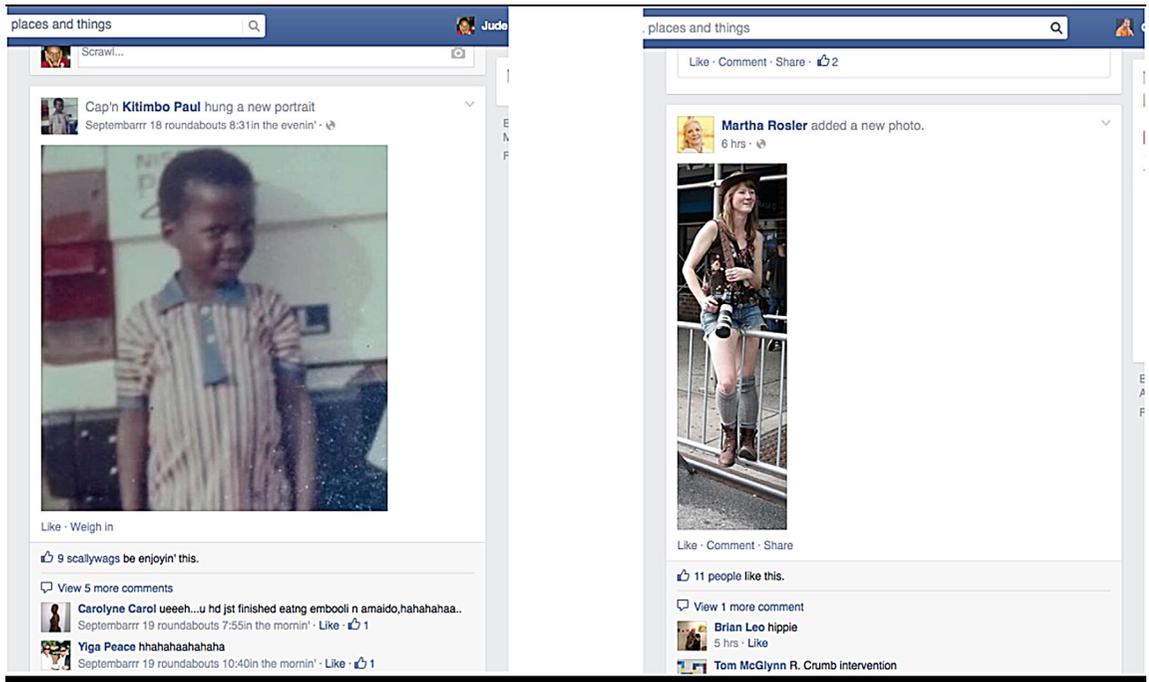
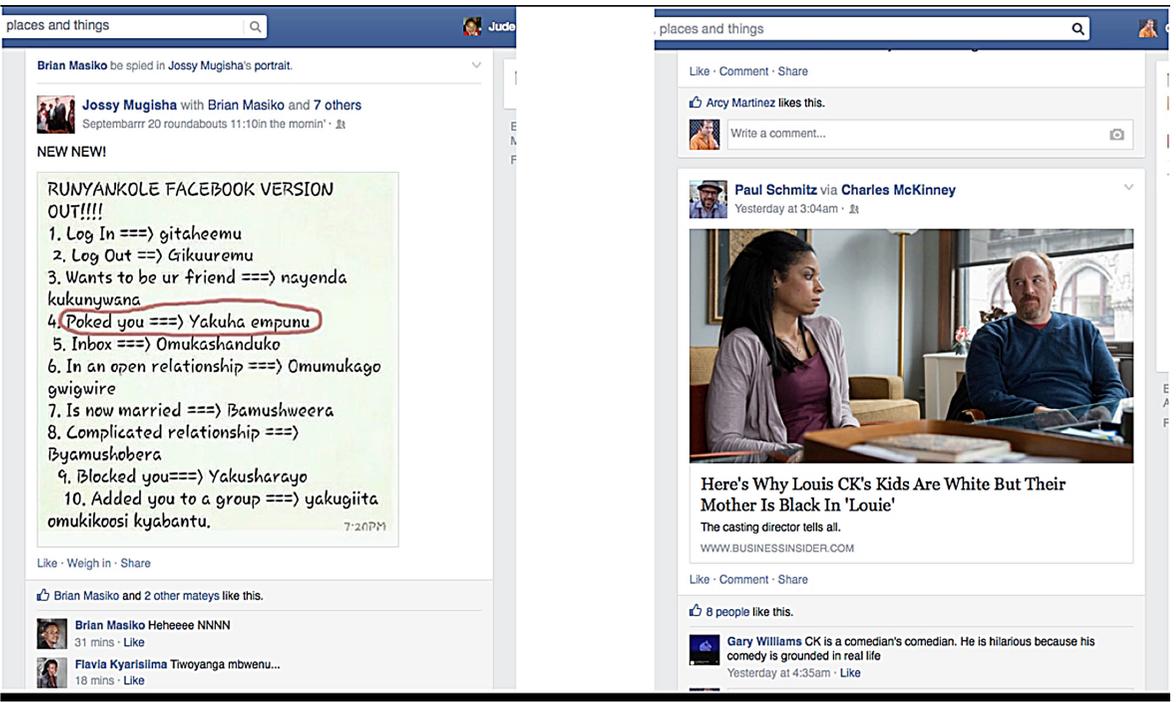


Figure 5. Ugandan Author's Facebook Stream (bottom left) and American Author's (bottom right).

Figure 4. Ugandan Author's Facebook Stream (above left) and American Author's (above right), RootIO Project.



RootIO Framework

Depending on how it is viewed, RootIO is a bucket filled with wires and electronics, some 60,000 lines of code spread across servers and phones, or a set of sociotechnical practices and organizational patterns. For the sake of this paper we will describe its components as station, cloud, and site.

The technical components of RootIO act together to pipe sound and interactivity to radio listeners, facilitate the production and dissemination of radio content, and pull and store information as well. Financial information is also processed, allowing us to model where and how costs are generated and defrayed. Individual programs can be recorded or “simulcast” in other communities around the world. The technical components also help to add modes of participation, including through more inclusive call-based programs to SMS votes and opinions. In some ways RootIO resembles a contemporary web service, but outputting to radios rather than browsers.

The sociotechnical side of RootIO is under active development. It manifests as complex mix of stakeholder interviews and dialog, training and codesign, licenses and MOUs, strategic alliances and staffing. Our goal is to engender an ecosystem of “radioheads” who will eventually take over many of these processes, but for now we are “eating our own dogfood” and

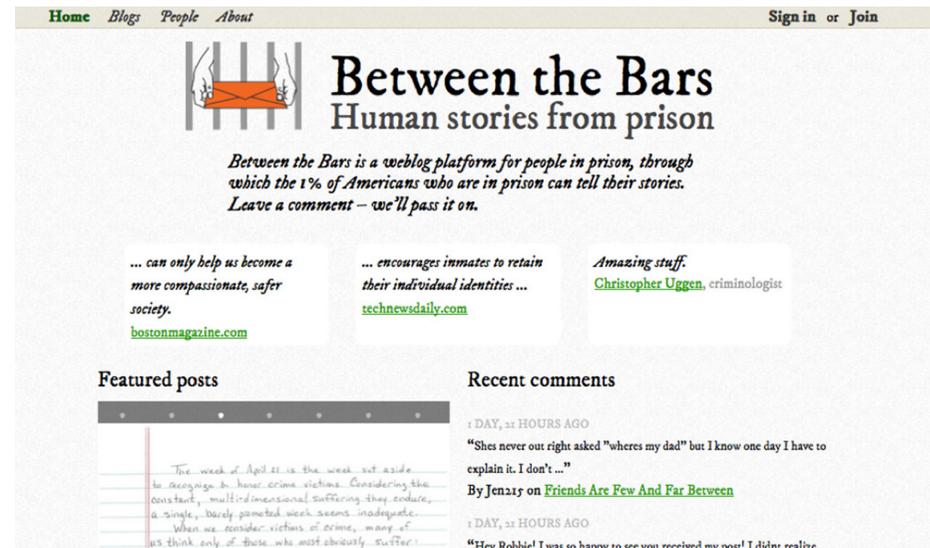


Figure 6. *Between the Bars*, Blogging Engine for the Incarcerated Charles DeTar.



Figure 7. *Cronicas de Heroes*, for Reporting Quotidian Moments of Civic Good, Yesica Guerra and Alyssa Wright.

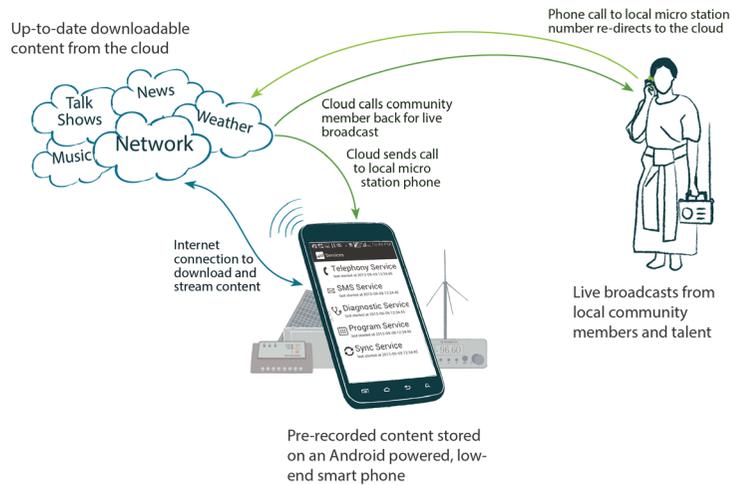


Figure 8. RootIO System Diagram, RootIO Project.



Figure 9. RootIO Microstation Testing in Northern Uganda, RootIO Project.

leading the process ourselves. For the processes to scale, our design and fabrication team must be able to pivot to concentrating on the technical infrastructure and its operations, but to learn important information that will inform that infrastructure, we must also work with the communities and learn from their interactions with the stations. As the project grows, we will have to increasingly adopt techniques of deploying user studies through the platform itself.

Station

Each station is built from locally sourced materials to the degree possible. We have purchased our solar panels, smart phones, and sundry electronics in downtown Kampala and other regional capitals. The heart and voice of the station are a smart phone and transmitter, respectively. The phone is the cheapest Android smartphone available in a given market; in East Africa this is currently the Samsung Pocket Galaxy, available for 70\$US.

The simplicity of the hardware system cannot be understated: the output of the smartphone's headphone jack is plugged into the input of the transmitter. Instead of being carried to headphones, the audio is broadcast to listeners' radios up to 30km away. Anything the smartphone would play -- music, podcasts, the voices on live calls -- now goes out the the community the same way as a commercial station, but ours costs several orders of magnitude less; about \$800US. Of course on a standard phone nothing would play through the headphones unless a user manipulated the

screen to answer calls, choose a podcast, launch Pandora, or some similar action. The free RootIO App takes the place of such a user, coordinating the many features of the smartphone to produce radio content for listeners; the app is currently in the Google Play store, though it works on only a few models of phone.

We have concentrated on simple, locally available materials so that stations can potentially be built by anyone who needs one. For our current deployments we have chosen to house stations in the ubiquitous white plastic 5 gallon buckets that -- like lead and PCBs -- are now everywhere in the world. They are cheap, sturdy, and waterproof. Buckets are also instantly recognizable as quotidian objects with a DIYish read, useable for almost anything. Our hope is that this housing, rather than a custom one (cf <http://www.brck.com/>) will increase the chance that people will open the system, explore it, and replicate it. They need only to register the phone on the RootIO web site, put together a schedule, and then hook up the simple electronics much as one hooks up a home stereo.

Of course, the solar panel and bucket need to sit somewhere. There are physical constraints: the installation should be secure, out of the sun and rain, and in a place with reasonable GSM reception. But the more important questions are sociopolitical: Who should “own” the station? How can a community share responsibility for it without letting maintenance fall through the cracks? Who will generate the initial

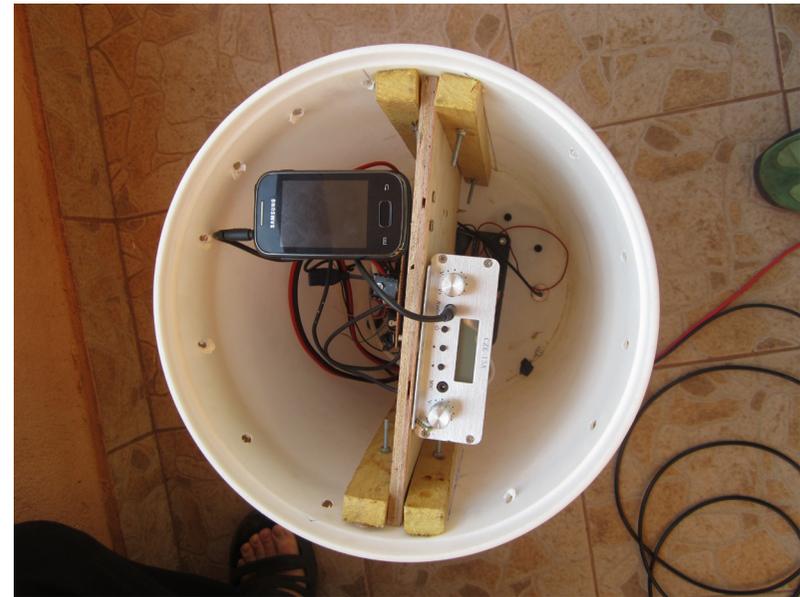


Figure 10. RootIO Microstation Internals, RootIO Project.

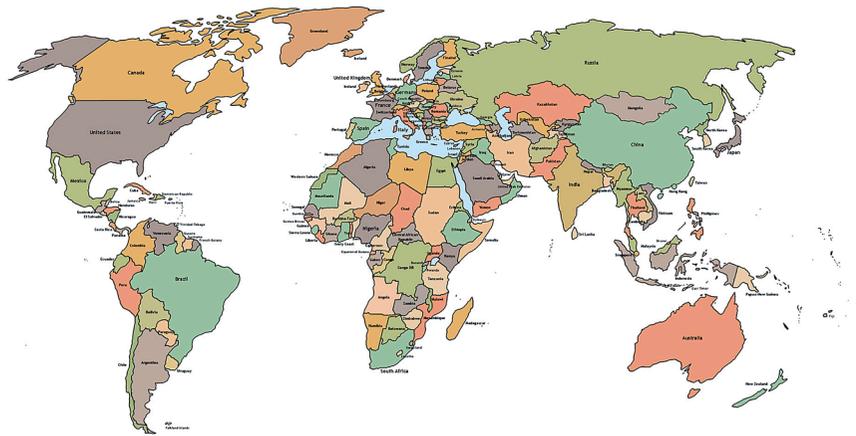


Figure 11. The Five Gallon Bucket Around the World.



investment? These are areas of active research, and we expect there to be many answers to these questions depending on the location and community.

In the simplest configuration, a program on the phone might consist of simply mixing between a folder full of 90s R&B songs that has already been stored on the phone's memory card, or playing an hour long political debate or educational program. Many radio programs around the world are nothing more than this, though it is simple and robotic. Where the system starts to be a platform for community dialog is when cloud and telephony are added to the mix.

Cloud

In the mid 1990s a group of computer scientists invented SIP, a protocol for moving media through the Internet much the way phone calls moved through the telephone system. SIP is what gives us Skype, those frustrating Interactive Voice menus when you call your credit card company, and "robot" ad calls. It is also what gives RootIO the ability to get programming out to most remote (with regard to the Internet) areas of the world, because it allows our cloud server to call a station smartphone and pipe audio back and forth through a ubiquitous GSM connection.

The RootIO cloud also takes care of station scheduling, recording programs that are produced locally, managing audio assets, diagnosing the

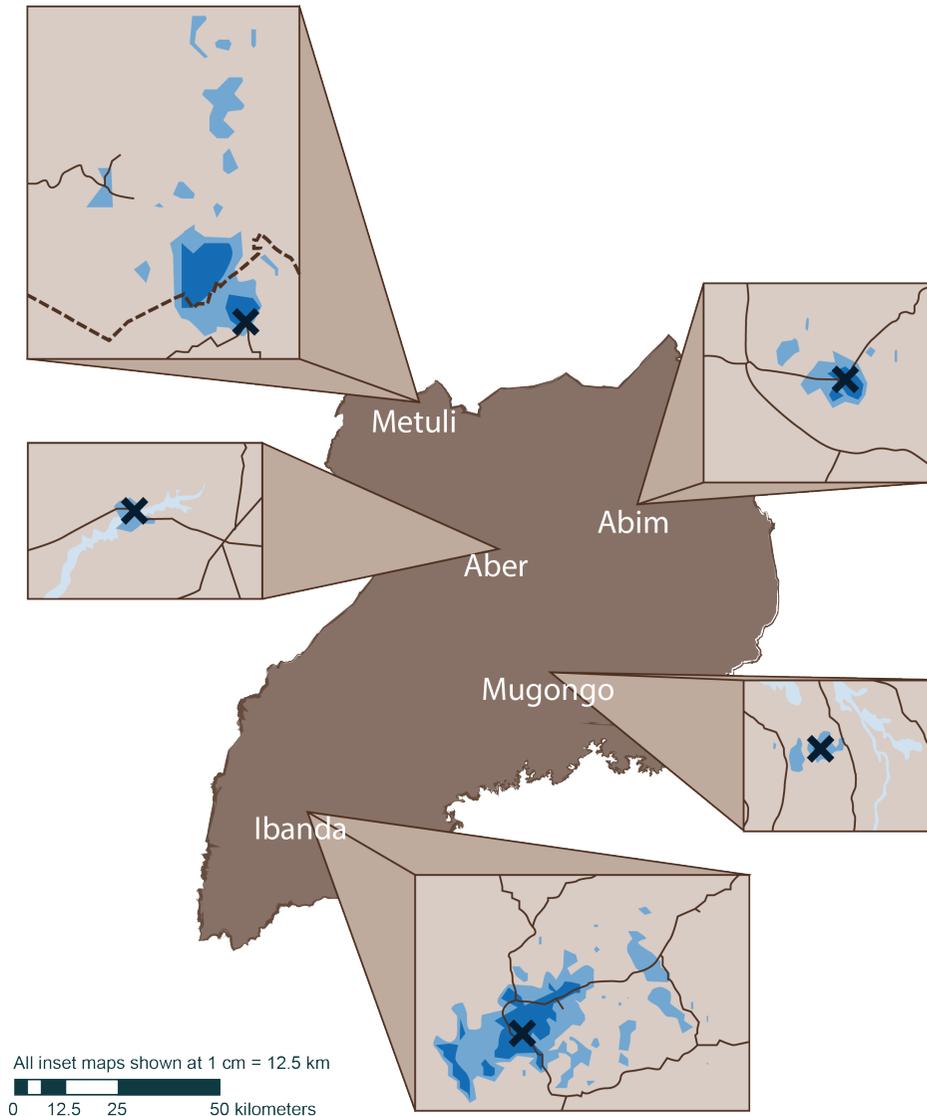


Figure 12. Examples of RootIO Microstation Geographic Coverage, RootIO Project.

status of stations, and many other functions. We won't go into cloud features exhaustively; this is the part of the project that most resembles a web platform.

Phone & Cloud

The simplest configuration for a cloud/station program is an hourly news broadcast.

Uganda Radio Network, an independent news organization and partner of ours, creates national news summaries in English every hour. These are uploaded to Soundcloud. A few seconds before the hour, our cloud server (in London) calls every station smartphone in the RootIO Uganda network, joining them into a sort of one-way conference call. The RootIO app on each phone checks the number of incoming calls against a "yes list"; since the server is on that list it automatically answers the phone. The server plays some introductory music and then the news report, and each station phone pipes the conference call it to its transmitter. At five minutes past the hour the phone switches to its next program and hangs up.

This example illustrates several key features: first, any audio content can be played from the cloud server. Emergency messages, news, weather reports, live streaming of a parliamentary hearing or verdict. Of course,

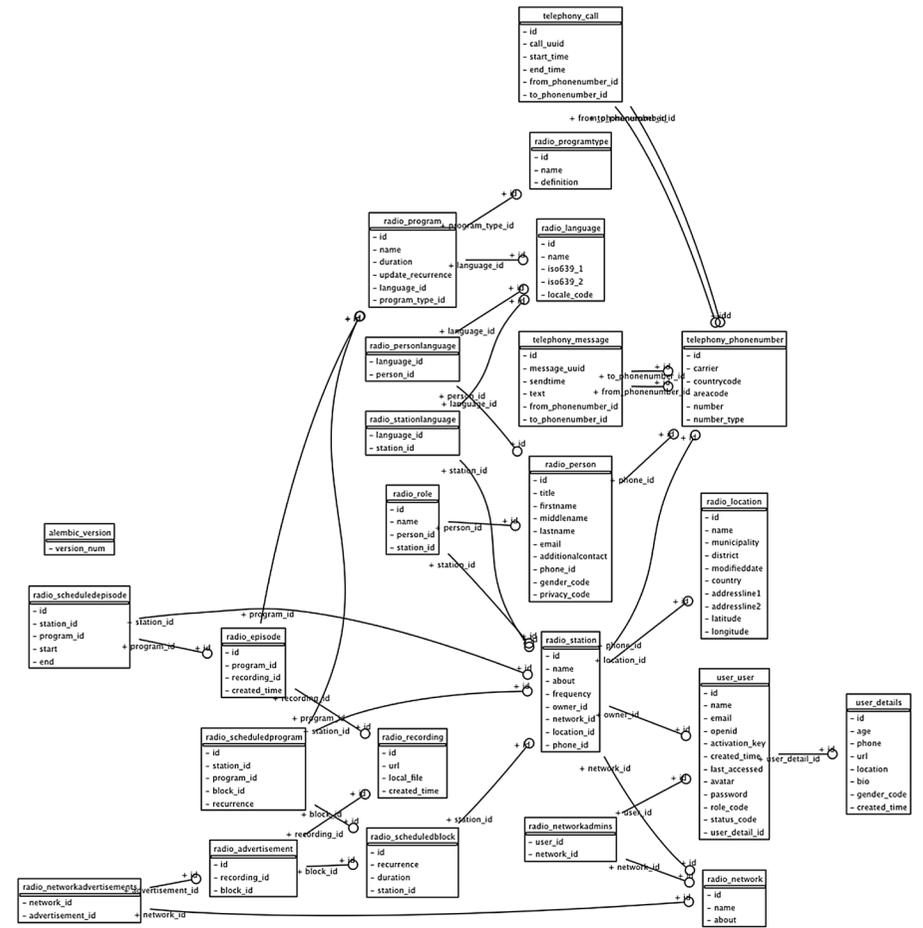


Figure 13. Early Version of RootIO Database, RootIO Project.

audio will be the same quality as a cell phone call, but this is barely a problem for anything but music, as most FM receivers in the developing world are not capable of high fidelity playback. Second, because calls received are not charged, the stations incur no cost in receiving this audio content. Had they “downloaded” digital audio files over the 3G network (assuming it exists, which it doesn’t in much of the developing world), they would have incurred significant costs. While this user story is also relatively simple, it nonetheless represents a “real time” capability that almost no stations in Uganda currently support. But let us give one more example that demonstrates the more complex types of station interactivity possible through RootIO.

Goat Talk is a program format for which RootIO provides a program “kit.” For a local linguistic region or community to use the kit, it needs to recruit a veterinarian. The vet offers two hours on Thursday evenings to discuss health problems of goats, and take calls from the community. The vet has given their phone number to the RootIO team, and in return is presented with a laminated “menu” tree of instructions for how to run the program (see below).

In the Northern Uganda Acholi speaking region, Dr. Patience Komakech sits in her Gulu office at 5:55PM. She receives a call from the cloud server, which uses IVR to ask her if she is at a landline (yes), if she is ready to run the program (yes). It then reminds her of the touch tone commands

available for her program; most importantly that she can press 0 to hear the instructions at any time. Komakech presses 1 to indicate that she’s ready to begin. At 6:00 the cloud calls all 7 RootIO stations in the Acholi region and patches them into a conference call, playing music and the pre-recorded introduction to the show. The phones pipe the audio to their transmitters, which together reach about 20 communities. At 6:01 Komakech’s phone is patched into the conference call. She speaks for about 10 minutes on goat diabetes.

At 7:10 Komakech opens the show to callers, announcing a local phone number that in fact leads to the cloud. She reminds callers that their calls will not be answered, so they should just let the call ring once or twice then hang up. In this way, callers are not charged. Komakech presses 7 on her landline to join the first caller, who is called by the cloud. They discuss the caller’s goat issues, then Komakech presses 9 to end the call. Komakech reflects on the discussion, adds a bit, then presses 7 again to join another caller, on until 7:45. At this point there are no callers left, and Komakech has run out of things to say, so she presses 6 to advance to the last segment of the program, which plays goat-related music and ads until the end of the hour.

Note key aspects of this story: programs can include one or more hosts and many callers; cost is defrayed from farmers “upstream” toward the server; hosts can lead programs from anywhere in the world.



Site

The most complex part of any station is, of course, the dense social, cultural, political, organizational, and financial mix that allows it to run. Because this strays from the object orientation of RTD, we will not delve far into this process, but suffice it to say that this is where the bulk of our remaining research lies. We have many content partners, are working with journalists and musicians, politicians and community leaders, and a network of existing youth centers which will securely host our prototype stations. Much ink has been spilled on methods of community organization and media. On the other hand, successful technical systems often “find a way.” Indian motorcycles exist everywhere in East Africa, even though there are no billboards or radio advertisements for them, no certified dealer mechanics; Facebook has no salespeople. If RootIO is a successful system that responds to community needs, creative individuals within the community will find ways to fund, operate, and maintain stations.

Our sociocultural research, then, will involve seeking to defray the cost of stations away from communities and upward in the network; creating affordances for community ownership of stations; insulating communities from possible legal or political ramifications of their free speech; and working with regional and national content providers to make sure that communities have access to high quality information.

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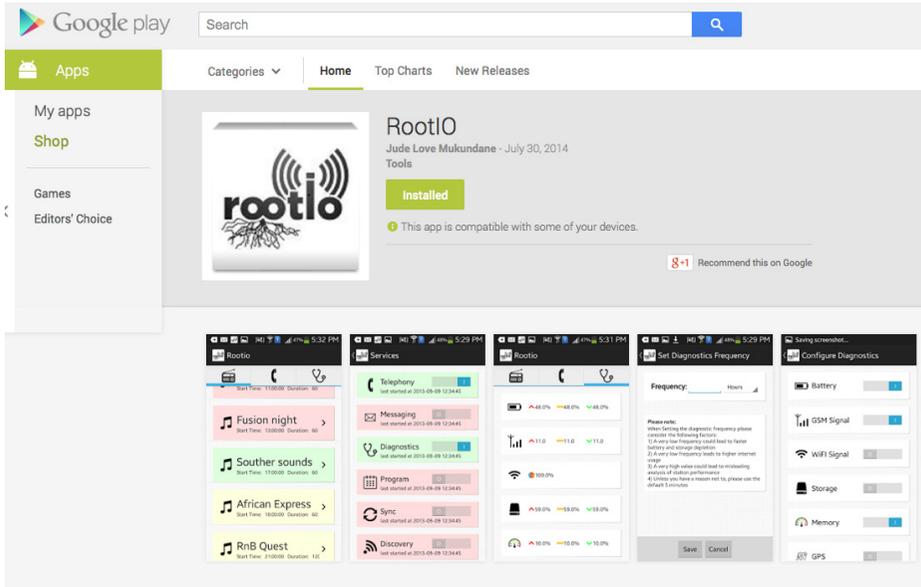


Figure 14. RootIO App in the Google Play Store, RootIO Project.



Figure 15. Reporter for a Rural Ugandan Radio Station Narrating a Football Match Live Via His Phone, Patience Atuhaire.



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