Participatory monitoring of poaching in the Congo basin

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Summary

Supporting communities to share and apply their knowledge of local environmental conditions using scientifically accepted methods can lead to improvements in environmental governance and social-environmental justice. In this paper we discuss our project that seeks to enable the Mbendjele hunter-gatherers in the Congo basin rainforests to monitor and map the activities of commercial poachers in their area. The goal is to allow more effective control over poachers, and, moreover, to curb the harassment the Mbendjele suffer at the hands of corrupt "eco-guards". The fact that the users are non-literate as wells as the harsh rainforest conditions pose significant challenges that we are tackling with our "Anti-Poaching" data collection platform, of which we describe the first prototype.

1. Introduction

Achieving sustainable management of natural resources is arguably the most important challenge humanity faces today. Supporting local communities to share their knowledge by utilising scientifically accepted tools and methodologies can lead to improvement in environmental governance and management practices as well as social-environmental justice.

The Mbendjele, the indigenous Pygmy people of northern Congo-Brazzaville, are semi-nomadic hunters-gatherers that move through huge areas of rainforest over the course of the year. Although they depend on natural resources for their livelihoods, they are rarely consulted in decisions over the attribution, or involved in the management of the areas. However, in 2005 the local logging company started a bid to become Forest Stewardship Council certified and therefore had to show more respect for the rights and resources of local forest people. To allow these people to communicate their wishes about the management of the forest, as well as any violations, Lewis introduced the Mbendjele to the use of rugged PDA devices running software that enabled them to record observations made in the forest using a pictorial decision tree. In 2007 a similar initiative was set up in Cameroon involving other Pygmy groups (Hopkin 2007; Lewis 2012; Lewis & Nkuintchua 2012).

In recent years the Mbendjele have also become very concerned about over-hunting by commercial poachers in their traditional hunting areas, as well as the corruption of local law enforcers, called "eco-guards", that goes with this lucrative business. Building on their positive experience with participatory monitoring in the context of logging (Lewis 2012), some Mbendjele requested Lewis to design a new tool for recording their extensive knowledge about poaching activity. This kind of information can then be applied to put pressure on authorities, as well as help to make local law enforcement more effective.

In this paper, we describe our efforts to develop an innovative solution for this problem by leveraging the latest smartphone technology. The prototype we discuss below is the first component for a larger "Intelligent Maps" platform that allows communities to capture local environmental knowledge, transmit the data, visualise it in ways comprehensible to illiterate people, and efficiently share it with selected outsiders. This effort is exemplary of what we call *extreme citizen science* (Haklay 2010), an approach which has transformative potential to deal with major sustainability challenges.

2. Challenges

Designing and deploying ICT systems for rainforest people presents numerous difficulties. The low or lacking literacy of these users is the most obvious of these because almost any standard user interface (UI) includes various textual and numerical elements. Another challenge is to provide a mobile device that can withstand the adverse rainforest conditions of the rainforest (heat, humidity, dust) and rough handling by people who lack experience with delicate electronics. Moreover it needs a GPS receiver that is sensitive enough to get location fixes under dense forest canopy. There are also various practical challenges that we have to tackle – such as the lack of power facilities and limited cellular network coverage. Finally, perhaps the most challenging problem is that of security and personal safety: the consequences of an Mbendjele being caught in the act by poachers could be dramatic.

3. Platform Prototype

Currently, our "Anti-Poaching" data collection platform is in an advanced prototype state.

3.1 Hardware

We have opted to use the Samsung Galaxy Xcover, a relatively cheap, rugged Android-based smartphone that is IP67-certificatied (meaning it is dust tight and waterproof up to 1m), which seems adequate to withstand the harsh rainforest conditions and rough handling.

To charge the devices in the forest we tried 2 possible solutions, a rollable solar panel (complemented with an auxiliary battery to store energy for later use) and a Japanese-produced customised cooking pan, called the *Hatsuden Nabe*[1], which converts thermal energy from a fire into electricity that can be used to charge electronic devices directly while cooking food or boiling water.

3.2 Software

To overcome the literacy barrier we designed an entirely graphical interface with nothing but a pictorial decision tree – as in Lewis' earlier project (Lewis 2012; Lewis & Nkuintchua 2012). The icons represent different signs of poaching activity, cases of abusive or corrupt behaviour by eco-guards and sightings of live animals and other natural resources, as shown in Figure 1 (a). At the end of each observation the user can optionally complement it with an audio, a photo or a video.

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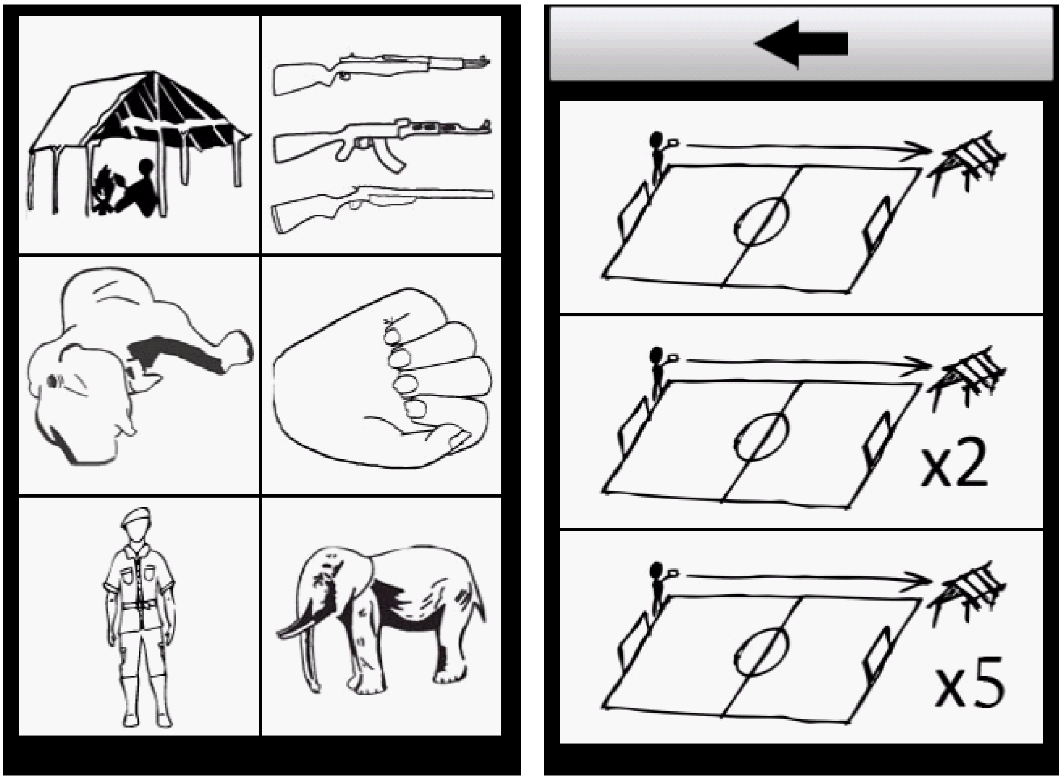
[1] A product of TES NewEnergy Corporation: http://tes-ne.com.



(a) Main Menu (b) Distance estimation

Figure 1. Parts of the decision tree interface

As a security measure we restrict access to the application using a pattern unlocking mechanism, where the user must draw a previously agreed pattern by sliding his finger over the dots on the touchscreen. This type of access control is well known to Android users, but in this case we use it to restrict access to our application, rather than to the device itself.

Making observations of (possibly) active poachers' camps represents an obvious risk of being spotted or caught. Thus, we have implemented an innovative feature that allows users to point the device in the direction of the camp and provide an estimate of the distance that separates them from it. The approximate position of the camp is computed from the user's own position (determined by GPS), the bearing (determined by the phone's digital compass), and the estimated distance. Because our users are unfamiliar with standardised distance units we let them express distance as a number of football pitches, which they have encountered in logging towns, as illustrated in Figure 1 (b). Obviously this method is not very accurate. Multiple factors can influence the accuracy of the estimated position: GPS signal reception conditions, nearby magnetic fields, human errors in the estimation of direction and distance, and finally the rather loosely defined dimensions of football pitches in logging towns. Nevertheless this method allows recording of a reasonable indication of the position of potentially dangerous places.

4. Evaluation

Over the course of April 2012 our prototype platform has been tested in-situ by the Mbendjele, with coaching provided by Lewis.

4.1 Hardware

The results on the mobile phones were promising; the devices and the built-in GPS receiver proved adequate and robust enough to withstand the adverse conditions. For charging, the Hatsuden Nabe, shown in use in Figure 2, proved to be the most suitable solution.

Figure 2. Charging a phone with pan charger

4.2 Software

Due to the need to protect the participants only those members of the community who will be collecting data were trained to use the system. Although the device is different from the ones used in the earlier logging-related project they quickly grasped the concept of the decision tree with icons representing observations. During the training the participants collected a total of 427 observations, 151 photos and 40 audio recordings. Figure 3 shows the software in use. Because this was a first evaluation no risks were taken and hence the data does not reflect actual poaching activity.

The users seemed to have no difficulty understanding the concept of pointing the phone in the direction of a dangerous place in order to record the position from a distance. The participants were able to understand the concept of 1, 2 and 5 football pitches.

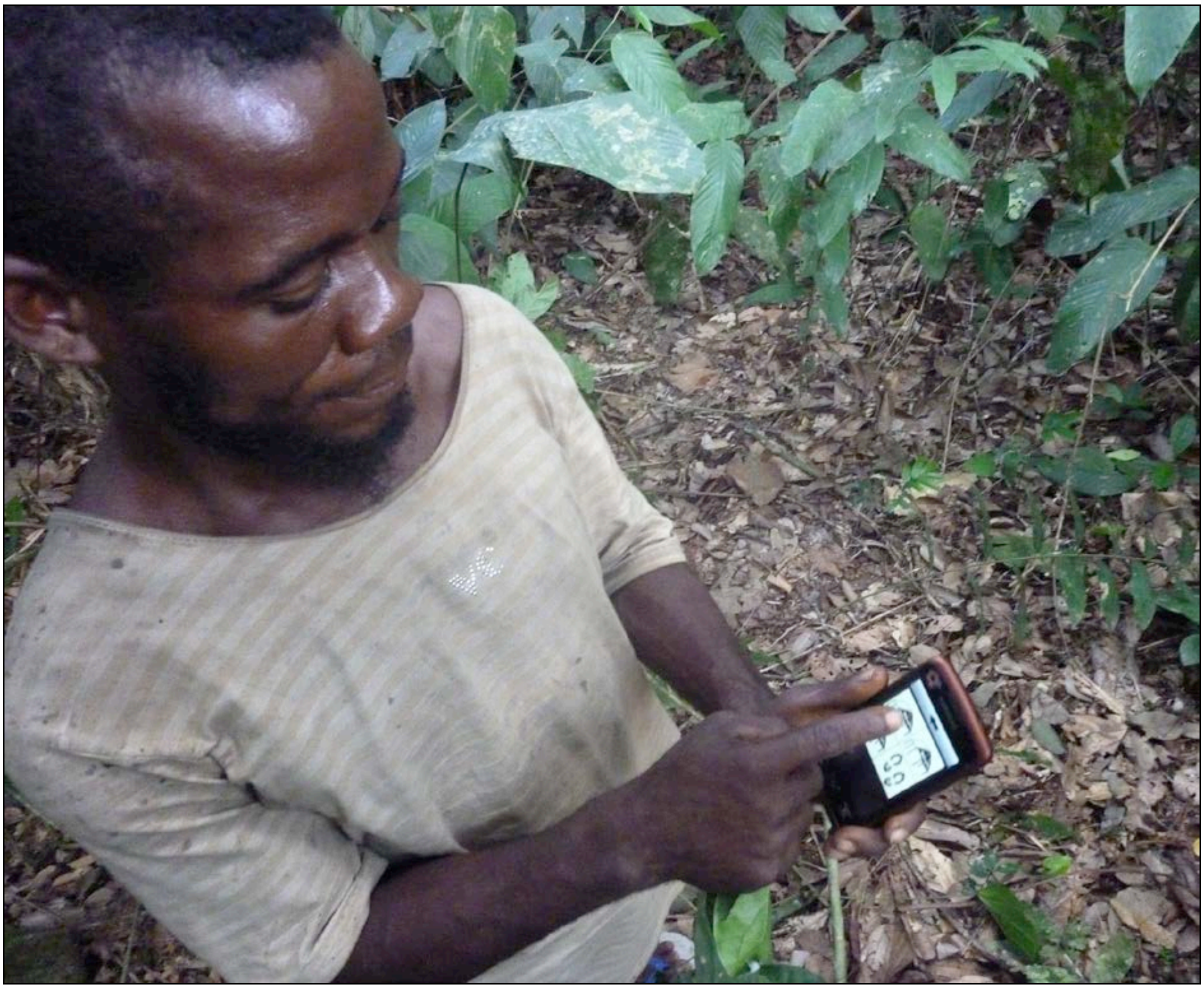


Figure 3. One of the Pygmies records an observation

4.3 Visualisation

For now we rely on Google Earth and Google Maps to visualise the observations, as illustrated by Figure 4.

To visualise observations made from a distance (using the "point & estimate distance" feature discussed above) we created a prototype tool using the Google Maps API. As illustrated by Figure 5 this tool indicates the approximate position, in yellow, of the intended place, as well as the observer's own position, in red. The diameter of the red circle is determined by the GPS accuracy. A black arrow represents the compass bearing and the approximate distance the user indicated. To account for errors affecting the bearing and distance estimation (see above) error percentages can be manually adjusted on the right, after which the yellow area will be redrawn accordingly. Of course this prototype is aimed at literate users only and it needs further refinements. In the future we plan to conduct additional field trials to determine optimal visualisation parameters. Eventually this sort of interface could be used by trusted partners of the Mbendjele, or local authorities, to give directions to eco-guards to help them find poacher's camps that were spotted from a distance.

Figure 4. Visualisation of observations using Google Earth

Figure 5. Visualisation tool for places observed from an estimated distance

5. Conclusions & Future work

Our data collection platform takes proven concepts (Lewis 2012; Lewis & Nkuintchua 2012) but adds innovative features based on the affordances of today's smartphones. Moreover, the use of alternative power sources vastly increases the flexibility of the platform. The initial evaluation demonstrates that the prototype works as expected but it also resulted in helpful suggestions for further improvements.

We are currently extending our platform with a flexible mechanism to transmit data to a central server using a background service running on the phones which regularly checks for network coverage. Transmission should happen automatically via SMS, Wi-Fi or GPRS, depending on the availability, without any user interaction. This work is part of a wider effort to generalise the data collection and transmission platform such that it can be used by different communities to address other (environmental) issues in the spirit of extreme citizen science. The next round of field trials in Congo-Brazzaville is planned for April 2013, during which we will test the generalised platform in the context of the anti-poaching project as well as a new initiative related to the monitoring of logging activity.

The biggest task that lies ahead is to move from the initial visualisation tools discussed in this paper to the realisation of a concept we call "Intelligent Maps": a novel, dynamic approach to presenting spatial data and informing about emerging trends, both in ways comprehensible to illiterate people.

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References

Haklay, M., 2010. Extreme Citizen Science. In *London Citizen Cyberscience Summit (2-3 September, 2010)*.

Hopkin, M., 2007. Conservation: Mark of respect. *Nature*, 448(7152), pp.402–403.

Lewis, J., 2012. Technological Leap-frogging in the Congo Basin, Pygmies and Global Positioning Systems in Central Africa: What has happened and where is it going? *African study monographs. Supplementary issue*, 43, pp.15–44. Available at: http://jambo.africa.kyoto-u.ac.jp/asm/suppl/asm_s43.html.

Lewis, J. & Nkuintchua, T., 2012. Accessible technologies and FPIC: independent monitoring with forest communities in Cameroon. In K. Swiderska et al., eds. *Biodiversity and culture: exploring community protocols, rights and consent*. Participatory Learning and Action 65. IIED, pp. 151–165. Available at: http://pubs.iied.org/14618IIED.html.

Biography

Matthias Stevens is a computer scientist and works as a post-doctoral researcher at the UCL ExCiteS group. His research interests include citizen science, participatory sensing, and public participation in environmental resource monitoring and management. Before joining UCL he obtained a PhD from Vrije Universiteit Brussel in Brussels, Belgium, with a thesis on concept of *community memories* and its application in a system for participatory monitoring and mapping of noise pollution, called *NoiseTube*.

Michalis Vitos is currently a PhD student at UCL ExCiteS group. The objective of his research project is to develop innovative GIS tools that can be used by semi-nomadic and non-literate indigenous communities to capture environmental knowledge in methods that can be efficiently shared and assist them to the control of their land and resources.

Jerome Lewis began working with Pygmy hunter-gatherers and former hunter-gatherers in Rwanda in 1993. This led to work on the impact of the genocide on Rwanda's Twa Pygmies. Since 1994 he has worked with Mbendjele Pygmies in Congo-Brazzaville researching child socialisation, play and religion; egalitarian politics and gender relations; and language, music and dance. Studying the impact of global forces on many Pygmy groups across the Congo Basin has led to research into discrimination, economic and legal marginalisation, human rights abuses, and to applied research supporting conservation efforts by forest people and supporting them to better represent themselves to outsiders.

Muki Haklay is a Professor of Geographic Information Science at the Department of Civil, Environmental and Geomatic Engineering, University College London. He is the Director of the UCL Extreme Citizen Science group, which is dedicate to allow any community, regardless of their literacy, to use scientific methods and tools to collect, analyse, interpret and use information about their area and activities.