Three Lessons from Aurorasaurus about Public Facing Information System Design

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ABSTRACT

Response-focused information systems have the same data processing needs as citizen science initiatives. We present three lessons learned over a three-year period with a public facing information system devoted to early warning and event detection that will benefit designers of similar systems. First, we urge those creating information systems inside of crisis response to look for proxy events that will serve as an inexpensive means through which to pursue proof-of-concept or to explore pre-existing fully tested products. Second, we urge information system designers to engage the communities and gatekeepers of enthusiast communities surrounding the event that information system is meant to serve. It will not only help development, but also increase the chances of that system's success. Finally, aiming for self-interest rather than event-interest will allow users to feel involved; ultimately aiding participation and retention.

Keywords

Early Warning System, Information System Design, Citizen Science, Social Media, Agency

INTRODUCTION

The information system and citizen science initiative called Aurorasaurus has assembled the efforts of space weather science, human computer interaction, early warning system design, computer science, social science, and space weather enthusiast communities. It did this through an easy to use, easy to understand, public facing information system devoted to aurora forecasting and prediction model verification (see: (Newell et al., 1999)). Citizen science is often referred to as the natural science discipline's interpretation of crowdsourcing (Wiggins and Crowston, 2011; Rotman et al., 2012). Through this interpretation, scientists task everyday citizens with the processing or creation of data that is meant to address a research question. Aurorasaurus' research question involves nowcasting the current location of the two geomagnetic, donut-shaped storms that wobble unpredictably around the earth's poles (LaLone et al., 2015; Tapia et al., 2014). It attempts to answer this question by harnessing the beauty of these two tourist-oriented natural events to gather and process tweets about the auroras. More than that, Aurorasaurus is a bounded object through which disparate disciplines and communities work together. In this work, we evaluate three distinct lessons we have learned after Aurorasaurus' public launch. These lessons range from design of information systems meant to detect irregularities and pre-existing communities encountering grant-funded entities using their authority to achieve goals but possibly disrupting those pre-existing communities in the process.

Aurorasaurus is represented by a website and mobile application (see figure 1) that allows citizens to participate in locating the aurora. They do this in two ways. The first task citizens are asked to perform is evaluation of tweets that are scraped from the Twitter search API. Our users evaluate if the tweets that are scraped are current sightings or simply retweets (see: Figure 2). Aurorasaurus relies on twitter as a means to circumvent or prevent many participation and retention issues citizen science is currently encountering (Patel et al., 2015; Rotman et al., 2012). Second, we ask our users to do a more traditional citizen science task. We ask those users who are standing under the Aurora to report their sightings directly. This provides an additional data point for enthusiasts who are interested in the aurora but also benefits each stakeholder involved with Aurorasaurus in its own way.

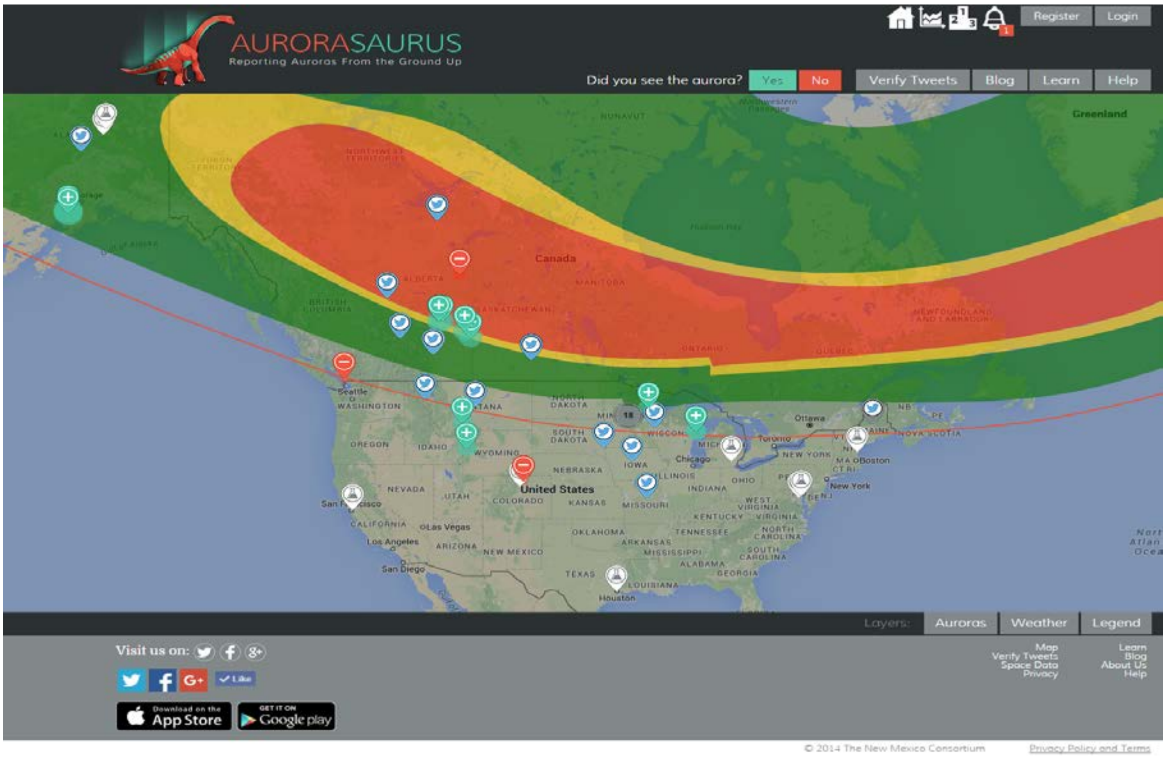

Figure 1 - Aurorasaurus' Front Page. Note the inconsistencies among the Green + (which represents a verified sighting) and where the ovation model (heat map) predicts where the Aurora is viewable.

Through twitter and google maps, Aurorasaurus provides a real-time display of people all over the world currently looking at and talking about the Aurora. Because all satellites looking for the Aurora on Earth have been decommissioned, Aurorasaurus also present an inexpensive (comparatively) stopgap that provides real time, instrument-based observation and detection (Case and MacDonald, 2015). Aurorasaurus also provides additional benefits as a means through which to test the accuracy of the ovation prime prediction model provided by the National Oceanic and Atmospheric Administration's (NOAA) Space Weather Prediction Center (SWPC) (Machol et al., 2012). This system has also presented an inexpensive and effective early warning system for those users who wish to be alerted when an aurora is sighted nearby. Combined with educational efforts, a blog, and social media pages, we offer a means through which to test any number of community-oriented information system concepts.

For crisis-focused information system designers, citizen science practitioners, and sociologists, Aurorasaurus provides a means through which they can witness a multi-stakeholder project in the wild. That is, they can witness each stakeholder interact with not only the product, but also the various viewpoints that product represents. After three years, these interactions have provided numerous lessons, three of which we would like to present to the communities of practitioners that attend ISCRAM. First, we urge those creating information systems inside of crisis response to look for proxy events that will serve as an inexpensive means through which to pursue a proof-of-concept. Second, we urge information system for crisis response designers to engage the communities and gatekeepers of enthusiast communities surrounding the event that information system is meant to augment. It will not only help development but also aid in that product's success. Finally, aiming for self-interest rather than event-interest will allow users to feel involved; ultimately aiding participation and retention.

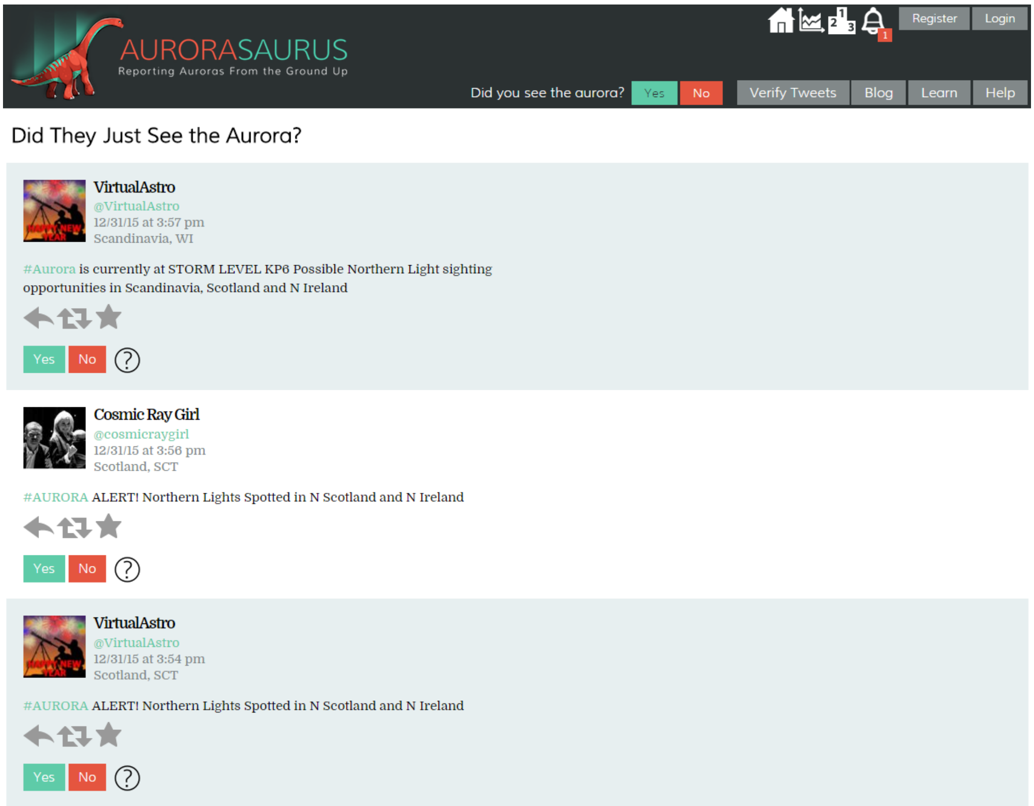

Figure 2 - Voting screen for tweets. Here, users filter through tweets scraped from Twitter in real time in search of verifiable, geo-coded tweets. Each tweet must be voted on 3 or more times before it is moved to the corresponding noise or positive sightings database.

THREE LESSONS FROM THE FIELD – THE CASE OF AURORASAURUS

A Note on Method

Many of the aspects of this paper are presented through the combination of three specific research projects. These projects were aimed at understanding Aurorasaurus users. First, before Aurorasaurus officially launched we conducted a variety of "think aloud" as users engaged our product (Boren and Ramey, 2000). Users would speak their thoughts aloud as they used Aurorasaurus. Here, we wanted to know what Aurorasaurus was missing. From these think aloud, we adjusted a number of features of Aurorasaurus. A few months after launch, we conducted several qualitative interviews. These interviews were aimed at existing users who belonged to specific types of user communities: professional, enthusiast, and the idly curious. Finally, from the interviews and the think aloud, we surveyed our existing community of users about their attitudes about citizen science, the science surrounding the auroras, and Aurorasaurus itself. In total, 385 users provided answers to a 45-item instrument containing questions that hit on a variety of concepts including social media use, citizen science participation, and general design opinions. We begin the central portion of this paper with what we feel is the most important lesson we feel we have learned – proxy events are difficult to navigate for practitioners of the event being substituted but after that hurdle, become immediately useful.

Lesson One – The Proxy Event

Aurorasaurus is the result of a number of different fields and disciplines meeting and attempting to work together. This meeting can be boiled down to a series of confrontations between two sides. On the one side are those practitioners of crisis management and early warning who saw an opportunity to take a rare event like a sighting of the aurora (rare for most parts of the world) and use it to test concepts surrounding information systems for early warning. On the other side are those earth-based space weather scientists who lost their ability observe the auroras in real-time. These space-weather scientists were forced to work with data from the sun instead. This lead to prediction equations rather than direct observation. Therefore, the space weather scientists found a proxy for scientific instrument data by using Twitter and citizen scientists to make those same measurements.

On both sides of this tool, the use of a proxy has been seen as problematic at best. In fact, most often our proxy events, and the data those events produce have often been deemed as unacceptable, even damaging. However, this is slowly changing. We have found that as our research expanded and changed voices and venues that we began to gain traction. This has allowed us to go back to our original fields to pursue new opportunities. As such, our most important lesson then is that changing minds, especially in the natural sciences, is often difficult. However, the lack of immediately publishable work was not reflected in the press or participation we were receiving. Despite our use of proxy events and proxy data in a professional setting, our audience was thrilled to see a real-time map of people looking at the Aurora. This lead to an increase in participation, an increase in attention, and ultimately created enough data for us to start to change a few minds.

Crisis response is often mired in a lack of funding with additional lacking in real-time tests through actual conditions. This lack of funding has created an unbalanced pursuit of purely computational products that often are cheap, but rarely produce results in the field (MacEachren et al., 2011). Proxy events that involve multiple disciplines are indeed difficult to pursue (Fish, 1991) but are often much easier to fund. As Aurorasaurus enters the next stage of its development, the proof-of-concept it has achieved has already begun to attract other types of interested parties in crisis response. To augment this proxy event, the next lesson we have learned concerns pre-existing communities within the various events that might serve as proxy or central focus of new, government-funded projects.

Lesson Two – Basic Ethnography

The Aurora has been an essential component to tourism in the northern hemisphere for quite some time. Over the years, tight-knit communities have developed around the phenomenon. From what we have discovered, these groups seem to have begun as a group of HAM operators that were interested in solar radiation and its interference with their hobby. In time, this grew to become enthusiasts using publically available data to predict solar storms and ultimately, the appearance of Auroras. We have learned a lot about this community as Aurorasaurus has attempted to infiltrate it; however, had we known about them before the tool was released, the mobile application as well as the web page might have been a little different. These groups have rarely had any communication with space weather scientists, despite numerous ties to local universities. Instead, their enthusiasm for this phenomenon resulted in a community of well-educated and well-connected aurora enthusiasts. They have become incredibly recalcitrant to official scientific presences and have come to possess an incredible amount of social capital (Burt, 2000). In essence, this group became something of a gatekeeper of the Aurora itself.

Aurorasaurus had an initial target audience in mind but it was lost quickly. At first, the target audience was a teacher, a young person, and a news correspondent. Through these three design personae (see: (Martin et al., 2007)), Aurorasaurus would insert itself into space weather forecasting. However, as the tool developed, these personae were replaced with what could only be called a generic layperson. This person knew a little about how the Aurora worked but generally just wanted to know where it was and look at pictures. This particular type has provided quite a bit of friction as Aurorasaurus has entered the public. As we began to advertise and take part in existing communities of aurora enthusiasts, the social capital this tool had as being associated with NASA and the NSF began to cause issues with participation and acceptance among our targeted audiences. Many in those communities indicated that they felt slighted. They felt that their existing community had been ignored and that the NASA folks had come in to destroy their community.

After this initial backlash, we began to contact these individuals and smooth this friction. We were forced to do what we should have done to begin with – get to know the culture surrounding an object. This is our second lesson – do your basic ethnography. Around any phenomenon, around any community, there are always those gatekeepers who can sway an entire group of users toward using your product. While Aurorasaurus has found success in a generic conceptualization of “user,” there is a community associated with the Aurora that has been hesitant to help us because we did not acknowledge them. Had we contacted them, we may have had a much easier time producing a tool that is immediately useful to more than our generic audience. The next lesson touches on agency through design and the power of self-interest.

Lesson Three – Self-Interest and Curiosity

The most important trait of a crowdsourced information system like Aurorasaurus or any information system like it is sustained participation and retention of users. Although there is a wide scholarly literature on motivations for volunteering, with a variety of perspectives and methods (e.g. (Clary and Snyder, 1999; Shye, 2010), there has been little empirical research exploring motivations for volunteering for citizen science activities specifically (Nov et al., 2011). On attempt to evaluate motivational factors was performed by Raddick et al. (2010) which examines the motivations to participate in the Galaxy Zoo project. In this initial paper, the researchers found that there were a number of common categories for motivation among their users. The Galaxy Zoo motivation categories include contribution to research; learning about the topic; and the discovery of rare objects. Further, categories that are more social include a community of like-minded individuals and tools for teaching scientific concepts to others. Next, participants were motivated by beauty both of the data and of the object, fun with data, and a general amazement at the scale of the cosmos. Finally, Galaxy Zoo participants were eager to help in general as well as the project itself. This sense of help extended to the science in charge of the study as well as that of science interest in general.

The shortcomings of information design are that they increasingly rely on computation instead of community due to ease and cost of design (MacEachren et al., 2011). In community-based systems like Aurorasaurus, members of a community work through their own self-interest by performing anomaly detection. It is difficult to predict where and when a viewable Aurora will be for citizen or scientist, even during the elongated nighttime of the extreme northern hemisphere. By allowing users to work for themselves, the friction created by Aurorasaurus' insertion into the aurora communities was assuaged. However, if we had done our basic ethnography, if we had looked at the field of enthusiasts, we would have constructed our tool to suit a much different user.

CONCLUSION

Aurorasaurus is an early-warning system for a non-life threatening event. However, its design can easily be adjusted for nearly any kind of event that people post about on social media. All that is needed is a few keywords and some re-branding. Nearly twenty years ago, Scott (1998) noted of local expertise and local epistemologies that, "a mechanical application of generic rules that ignores these [local] particularities is an invitation to practical failure, social disillusionment, or most likely both." This was before the creation of social media but in the midst of the formation of the fields surround big data. Through information systems, we can achieve a sense of being local by understanding the parameters of what makes locales, local. Instead of attempting to create a product that focuses on a specific event, we urge crisis-oriented information system designers to think more generally about how an information system can reassemble the concept of the local. This is opposed to a computational tool existing outside of the local, evaluating data as it is created and attempting to detect when disruptions occur. Each of the lessons we have presented forms a building block for that argument: event does not matter so proxy the event whenever funding is easier to achieve, know the pre-existing communities before designing, and design for self-interest rather than pro-social behaviors.

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