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Internet Technology and Urban Sustainability

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Abstract

Environmental conservation and anthropogenic climate change are issues which can no longer be ignored by any government, industry or academic community. However, compared to the rapid rate at which internet technology has been developed and integrated into everyday life for the past few decades, efforts to improve the ecological situation via such technologies have by and large remained inchoate. This paper seeks to identify nascent opportunities for sustainability that can be amplified, augmented or realised via internet technology. Three main aspects of significance coalesce in this paper's discussion: participatory culture, internet technology, real-time information. We draw on these three research themes in order to inform an exploration of what can be done to better meet the needs of urban users as they try to embrace a more environmentally friendly lifestyle. The insights can then guide the design and development of usable and useful information interfaces and feedback mechanisms as well as persuasive and motivational approaches to help the urban user achieve their goal.

Introduction

The Nobel Peace Prize 2007 was awarded to Al Gore and the Intergovernmental Panel on Climate Change (IPCC) "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change." The citation highlights the urgency that information and awareness about causes and implications are necessary but not sufficient to combat climate change. Action is required, and related research that can deliver actionable knowledge about the ways urban informatics and human-computer interaction (HCI) can make a significant contribution to improve the sustainability of society.

Urban informatics¹ (Ellison et al., 2007; Foth, 2008, in press) is an emerging research area that investigates the intersection between people, place and technology with a focus on cities, locative media and mobile technology. Cities host a rapid flow of exchange facilitated by a meshwork of infrastructure connections: road systems, building complexes, information and communication technology and people networks. In this environment, the internet and mobile phones have advanced to become the prime communication media that connect many threads across the fabric of urban life. Predicting the significant role that urban informatics research will play in helping to alleviate some of the sustainability challenges we face, Townsend proclaims in the foreword to Foth's (2008, in press) book, "the timing is certainly right. Urban planning is

¹ The authors have set up an Urban Informatics group with currently over 500 members at <http://www.facebook.com/group.php?gid=2493830797>

well into an undeclared crisis of thought leadership – despite it being one of the best avenues for dealing with global challenges like climate change and migration. Information science is poking its head out of the burrow and seeing the enormous intellectual challenge of expanding what worked on the desktop of the elites, to a diverse and mobile urban population.”

The term *convergence* (Jenkins, 2006a), situated in between technological and socio-cultural domains, and the increasing ubiquity of internet and mobile applications in everyday life has led many scholars to question the utility of dichotomies such as online/offline, cyberspace/real space, local/global, and producer/user (Foth & Hearn, 2007; Mesch & Levanon, 2003; Wellman & Haythornthwaite, 2002). Our own evidence of how web services are being used challenges these dichotomies and shows that face-to-face and mediated communication augment and reinforce each other through multi-modal integration (Urry, 2003). The increasingly seamless transition between mediated and unmediated interaction afforded by these convergences enables innovative research and design opportunities to exploit three significant developments that we now discuss in turn: participatory culture, internet technology, real-time information.

Participatory Culture

As evident in many grassroots organisations such as the *Campus Climate Challenge* and *Stop Global Warming*, significant transformations arise from massive consensual participation of individuals identifying with the value of a sustainable lifestyle both conceptually and pragmatically (Leadbeater, 2008; Shirky, 2008). The means to engage in such participatory culture are not limited to the technically versed or the civically inclined anymore. Scholars such as Jenkins (2006b) and Burgess et al. (2006) have identified socio-technical trends towards a wider (“vernacular”) ability of people to participate in digital culture through personal expressions of creativity. The implications for citizenship, and especially cultural citizenship, only start to be realised now. Many examples of how participatory culture is enabled by recent technological innovation rely on so-called ‘Web 2.0’ applications and services such as blogs, Wikipedia, YouTube, Flickr, and social networking sites such as Facebook which are arguably more open, collaborative, personalisable, and therefore participatory than the previous internet experience. According to Kolbitsch & Maurer (2006), the participatory qualities of Web 2.0 encourage ordinary users to make their knowledge explicit and help a collective intelligence to develop. Bypassing the terminology debate whether the term ‘Web 2.0’ is adequate, we argue that examining the features and the utility of Web 2.0 services can become an aid in support of urban sustainability.

According to Kolbitsch & Maurer (2006), the participatory qualities of Web 2.0 encourage ordinary users to make their knowledge explicit and help a collective intelligence to develop. In an urban context, Foth et al. (2007) argue that such capabilities present diverse possibilities for a profound urban epistemology to evolve. New tools and practices, inspired by user-led innovation, are springing up faster than our ability to analyse them individually. Therefore, we draw attention to Beer & Burrows (2007) who argue not to focus on individual applications and sites but instead harness the underlying principles of participatory culture by building on three broad areas of investigation:

1. The changing relations between the production and consumption of internet content;
2. The mainstreaming of private information posted to the public domain; and,
3. The emergence of a new rhetoric of ‘democratisation’.

Simply providing people with environmental data and educational information – via mass media such as print and TV, or micro communications such as sensor networks – does not necessarily trigger sufficient motivation for participation and behavioural change towards a more environmentally friendly lifestyle. How can we go beyond just informing and into motivating and encouraging action, participation and change through persuasive technology and motivational design (Aleahmad et al., 2008; De Young, 2000; Fogg, 2003; Kaplan, 2000)?

A study commissioned by the Australian telecommunication network carrier Telstra outlines telecommunications-based opportunities to reduce greenhouse gas emissions (Climate Risk, 2007). The study's report proposes seven scenarios in the Australian context to achieve nationally significant carbon-opportunities using participatory social networking systems as well as individual and collective urban informatics. The study defines carbon-opportunities as 'carbon dioxide emission abatement opportunities' which include real and measurable reductions in, or avoidance of, greenhouse gas emissions and not the use of offset mechanism to reduce emissions. Urban informatics technology (Foth, 2008, in press) is well positioned to enable collective, networked decision-making and take advantage of the scale effects of urban living (e.g., transportation options). Example scenarios may include:

- Persuasive and motivational designs and feedback loops such as Slashdot's karma system;
- Novel 'frequent flyer' type of programs that offer points, rewards and incentives based on loyalty and status ('deep green');
- Personal carbon trading and green currency schemes with transaction points similar to the London Transport's Oyster system;
- Fan culture and game theory that leverage off the labour of consumption; and,
- Collaboration and trust based on personal social networks.

Internet Technology

Internet technology becomes more and more ubiquitous: small, embedded and accessible anywhere, anytime (Greenfield, 2006). Bell & Dourish (2007) argue that the design and development of ubiquitous computing (ubicomp) as well as the ability to access information in places other than the conventional 'desktop' is less driven by an attempt to fix past problems but more by a mission to imagine the possibilities of the future. In their vision of a 'ubicomp of the present', they call for a better appreciation of the 'messiness of everyday life' which ultimately requires social and cultural research skills in addition to technical expertise. Dave (2007) started to compile examples of such cross-disciplinary studies in the field of urban ubicomp. The findings of both our own (Bilandzic et al., 2008; Satchell, 2004, 2006; Satchell & Singh, 2005) as well as others' research (Consolvo et al., 2007; Goggin, 2006; Kopomaa, 2004; Nyiri, 2005) corroborate this paper's presumption that the mobile phone will play a crucial role in realising our aim to expand the means of participatory culture in an effort to embrace and foster values of sustainability.

Paulos et al. (2008) propose 'Citizen Science' as a way to enable a participatory urbanism: "We need to expand our perceptions of our mobile phone as simply a communication tool and celebrate them in their new role as personal measurement instruments capable of sensing our natural environment and empowering collective action through everyday grassroots citizen science across blocks, neighborhoods, cities, and nations."

Paulos and his team (Consolvo et al., 2007) – as well as other colleagues such as Carlo Ratti at MIT’s SENSEable City Lab (Calabrese et al., 2007) and Christian Nold’s bio-mapping project – have been researching and developing sensor networks using mobile phones as network nodes to respond to Lindenberg and Steg’s (2007) and Darby’s (2006) call for more individually meaningful data that shows users what environmental conditions they are exposed to as well as what impact they have on the environment. In tandem with social networking environments, which help collate and collectively visualise individually sampled data, these initiatives may give the natural world an opportunity to ‘speak’ whilst at the same time being mindful to address imbalances. For example, sensors embedded in the environment could allow creeks and rivers to blog their own pollution levels, local parks could upload images of native bird life. But how can the process of blogging sensor data (‘slogs’) assist us in becoming more aware of the needs of nature? And how can we examine them comparatively with the downsides to minimise and avoid the ecological impact of embedding ubicomp in the environment?

The convergence of mobile systems, intelligent environments, ubicomp and sensor networks sees 21st century societies evolving into a hybrid of organic and synthetic worlds. The increasing digitisation and networking of everyday experiences provides new challenges for HCI researchers and practitioners. The HCI discipline provides valuable insights into how and why people adopt new technologies; however, as noted by Sengers et al. (2006), too often the focus is on ‘efficiency’ and ‘ease of use’. They argue that HCI must expand its focus to critically consider the values embedded in the design, deployment and evaluation of technologies. In order to bring about a ‘greener’ HCI practice, further cross-disciplinary collaborations with arts and humanities in HCI are needed, especially cultural theory and internet studies, so the nuances of use are understood within the culture of everyday life. An integral part of any research in this area will require the development of innovative methodological approaches to engage with and better understand user needs (Hochheiser & Lazar, 2007). Methods developed to engage users in design enquiries and conversations start with generating data from contexts close to the user’s terms, e.g., *Cultural Probes* (Gaver et al., 1999) and *Video Card Game* (Buur & Soendergaard, 2000). These approaches give users more control over data production and flexibility to express themselves when the time is right than traditional methods. Data is treated as design inspiration, as a source for conversation, analogy production and idea generation. In serving a design purpose, its intent is different than data gathered for analysis, which is treated as objective material to be analysed and interpreted by experts.

Real-time Information

As a consequence of widespread ubicomp deployment in urban environments such as sensor networks, locative media and mobile devices (Scharl & Tochtermann, 2007), the accessibility of real-time information enables a major transformation of the way we perceive, understand and subsequently conceive and plan city spaces (Calabrese et al., 2007). Heralding the ‘real-time city’, Anthony Townsend writes in the foreword to Foth’s (2008, in press) urban informatics book:

“Where we will see lots of change is in the software that shapes cities. Embedded sensing will replace a lot of human watchers, and ‘watch’ things on a frequency and scale we can barely imagine. But what will be important is how these abundant data streams provide a new ability to model and simulate very complex urban systems in real-time. Whereas today, urban managers and planners react on the time cycle of a census, by mid-century real-time dashboards and predictive models will rule the trade. ... If aerial photography

showed us the muscular and skeletal structure of the city, the revolution in urban informatics is likely to reveal its circulatory and nervous systems.”

The design of real-time mobile information systems that make the invisible visible holds great potential to have wide-ranging impacts on sustainable urban development. By being mindful of these developments at the very outset of research into this area, as well as avoiding to pre-empt any conclusions (that urban informatics are good for environmental sustainability – are they really?), we call for a balanced affinity considering social, economic and environmental downsides. Ubicomp applications and devices require electricity, one of the main causes of greenhouse gas emissions; in Australia, for example, the combined domestic and workplace usage accounts for one fifth of total national emissions (Climate Risk, 2007, p. ix). However, as noted in the Stern (2007) report, removing ‘barriers to behavioural change’ (McKenzie-Mohr, 2000) is one of the essential and important elements in advancing opportunities for energy efficiency. Bringing real-time environmental data into the homes and hands of the city dwellers via ubicomp is likely to find vast potential for positive feedback and learning so that the impacts of personal and collective habits and trends can be understood.

Conclusion

One of the key goals of the United Nations Decade of Education for Sustainable Development (2005-2014, DESD) administered by UNESCO is the integration of the principles, values and practices of sustainable development into all aspects of education and learning. Research that will effectively explore the utility of information about ecological and sustainable development for the purpose of in-situ decision making and environmental education assists the DESD’s efforts to encourage changes in behaviour that will create a more sustainable future in terms of environmental integrity, economic viability, and a just society for present and future generations.

Sustainability is not an absolute categorical concept with the same core set of associations and expectations for everyone, but a term for an amalgam of diverse ideas, institutions, initiatives, and images. Sustainability is inherently “time and place specific” (McGrath et al., 2004, p. 562) – it is a context that is particular to specific levels of society (regional, national, and global). A sustainable society firmly bases itself on citizens who share the common vision for sustainability not as an issue, but a value context (Haanpää, 2007). Rosenblatt (2004) confirms that value-based initiatives have a longer life-span than those that are issue-based, signifying that ‘sustainable living’ should not be about sustainability as a concept, but rather about changing political, socio-cultural, and economic values.

Previous approaches to the problem of environmental degradation have been predominantly linear, pre-determined and top-down with an over-concentration on providing information to the public. However, scientific evidence shows that the environmental condition continues to deteriorate globally, urging for a different conceptual move towards what sustainability means to various communities and how change is created to ensure balanced development among ecological, social, and economic domains. The OECD argues that significant change for a sustainable society will only occur by “creating the right environment and stimulus in the quest for sustainability” (2002, p. 8). Here, economy encompasses not only financial but also emotional and social domains – in other words, an economy of desire. Petrescu (2005, p. 46) asserts, “the economies of cities should be understood as contiguous with the economies of desire of those that live and work in these cities” and further highlights participative molecular revolutions within the desire economy that together create large

transformations. This paper highlights three related trends that point towards a quest to re-conceptualise and grow a 'sustainable society' by examining the persuasive capacity of urban informatics in forming, communicating, and appropriating values of sustainability on both micro and macro-levels specific to the ecological, social, and economic well-being of society.

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