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Some thoughts on geovirtual environments

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1. Background

A virtual globe is a data repository providing masses of digital geographical information in the form of a globe, generally over the Internet, with the best-known example being Google Earth [Google 2010a]. Typically, a virtual globe uses imagery (from satellite- or aircraft-based cameras) for the backdrop, overlaid with various vector data sets (often from official mapping agencies) and then with the capability of users to add their own data (such as volunteered geographical information (VGI)) on top, or create customized views of the data available. Users can contribute their data using a mark-up language (eg: KML for Google Earth), by geocoding data in other services (eg: articles in Wikipedia [Wikimedia 2010] or photographs in Panoramio [Google 2010b]), or submitting data according to a protocol (eg: NaturalWorld [2010]).

Needless to say, because of the masses of data, a virtual globe is a resource hog in terms of storage, processing power and bandwidth. From the user's perspective, the latter is the most important. In many areas in many countries, users could be forgiven for having the perception that the available bandwidth is approaching infinity and the cost thereof is approaching zero! Unfortunately, the developers of virtual globes and other online repositories of data tend to come from such well-resourced environments and to develop their products for such environments, though some have sophisticated data management algorithms to load the processing on the server side and to limit the data that need to be transmitted, such as Google Earth and World Wind [NASA 2010].

However, in many parts of the world, assuming a potential user has access to electricity and a computer, for many their Internet access is very slow, very expensive and

unreliable. For example, because of the poor service offered for land lines in South Africa, many users have wireless access at home as their primary means of access, which typically yields less than 5Mb/s [MyBroadband 2010]. Statistics from the International Telecommunication Union (ITU) [ITU 2010] confirm this. Despite the strong growth in fixed (wired) broadband subscriptions, penetration levels in developing countries remain low at 4.4 subscriptions per 100 people compared to 24.6 in developed countries. Africa lags behind considerably with a penetration rate of less than 1%.

Nevertheless, mobile growth in developing countries provides an opportunity for all kinds of online information and applications, including geovirtual environments. Access to mobile networks is now available to 90% of the world's population and even to 80% of the population living in rural areas. There is also a rapid move from 2G to 3G platforms, in both developed and developing countries. In 2010, 143 countries were offering 3G services commercially (including most of sub-Saharan Africa), compared to 95 in 2007.

The average price for a fixed broadband subscription in developing countries is at least six times as high as that for mobile subscription. Naturally, this is reflected in the respective penetration levels: 4.4% for fixed broadband and 68% for mobile (41% in Africa). Many (but not all) 3G systems provide mobile broadband access, but there is sometimes a premium that one pays for 3G access, which then renders it more expensive than fixed broadband.

2. Research issues

We have identified a number of research issues for geovirtual environments.

2.1: research and innovation is required to develop novel ways of representing geovirtual environments on small mobile phone information displays that require limited bandwidth.

Even though mobile access in developing countries is higher than fixed broadband access, there is often a premium to pay for 3G mobile access. Similar innovations for text-only mobile services have been highly successful. For example, Vodacom's 'Please Call Me' service is free for prepaid customers who are able to receive incoming calls, but have run out of airtime to make a call themselves. The service allows them to send an SMS requesting the recipient to "Please Call Me". An advertisement is displayed on the receiver's phone together with the message, thus generating income for the network provider [Vodacom 2010]. Another example is the highly successful MXiT service that allows users to send and receive very cheaply, text and multimedia messages to and from other users, as well as in general chat rooms. It also supports gateways to other instant messaging platforms. MXit does not charge for one-on-one messages, though mobile operators may charge for data usage [MXiT 2010]. *The challenge is to develop novel ways to deliver geovirtual environments and VGI very cheaply on mobile phones.*

2.2: research is required to improve our understanding of how geovirtual environments can assist

people develop an understanding of their spatial surroundings and how our actions can affect others.

Overall, what is needed is an understanding that the world is bigger than one little village or suburb and that environmental protection is therefore required. A simple zoom-out could convey this message. In other words, how can geovirtual environments be used to educate both literate and illiterate people on issues such as environmental protection? An example would be illustrating how a river still has to support communities downstream, whether one is in an urban or a rural environment, and hence that it is important not to pollute the water passing through one's community.

2.3: research is required on how virtual globes can be used for all types of education, and not just environmental education.

Clearly, with the volume and diversity of data they offer, as well as being a platform for disseminating VGI, virtual globes can make a significant impact on supporting education. Other than the access issues outlined above, other issues to be researched include the ownership of the data, quality assurance (particularly of the VGI), anonymous contributions, the political and other agendas embedded in the data, and facilitating or denying access to the data.

2.4: research is required on the impact geovirtual environments can have on the digital divide – and vice versa.

"In many parts of the developing world, poverty is exacerbated by information poverty. In poor or deprived communities access to information is limited or non-existent" [Pandor 2010]. Can virtual globes and geovirtual environments address information poverty, or are they only for the well resourced? Do virtual globes entrench the digital divide, because the better resourced are able to provide more data about their home turf? Does the bandwidth available in better resourced areas encourage the people there to contribute more VGI? There are more articles in Wikipedia about fictional places such as Middle Earth and Discworld, than there are about many real countries [Graham 2009]. However, it must be borne in mind that access to a geovirtual environment is not limited to the Internet: those with access to one can select and process the data to package products that can be made available to those with access to the geovirtual environment, such as print outs.

Does too much bandwidth actually result in lower-quality VGI, effectively quantity vs quality? In other words, if it is expensive for someone to contribute VGI, do they pay extra care to the quality of their VGI?

2.5: research is required on determining what should be displayed in a geovirtual environment.

How does a virtual globe decide how to prioritise the data that can be displayed? While

the virtual globe might have sophisticated algorithms to enable rapid zooming in and out of the background imagery, the selection of which details to display to reduce visual clutter and their priority when on top of one another is not a neutral process, because of the political and other implications.

The data shown might also be dependent on transient details in the background imagery and might lose its context when the imagery is updated (this is the classic problem of the incremental updating and versioning of base spatial data sets [Peled & Cooper 2004]). An example is the VGI on Google Earth, showing what was claimed to be pirate boats on the beach at Eyl in Somalia ["expedition" 2009] – the boats might then be at sea when the updated image is loaded on Google Earth and the KML would then point to an empty beach [Cooper *et al* 2010].

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