FRAMING NATURE: VISUALISING ECOSYSTEM SERVICES USING AUGMENTED REALITY

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1 Introduction

The rural landscape around us is changing rapidly due to a range of economic and climate driven factors, putting some ecosystem services at risk (Hawkins & Selman, 2002). With agriculture and forestry traditionally being central to the strategies used to manage rural landscapes it is time to consider the wealth of other functions (ecosystem services) which landscapes offer human kind. Some of these functions are obvious such as food and fresh water, and some so subtle they do not feature in the public consciousness (National Ecosystem Assessment, 2011). With a shift away from top-down management approaches, stakeholders are playing an increasing role in decision making (Lange and Lange, 2010). Increased awareness is needed amongst the general public about ecosystem services, including why it is important to manage the rural landscape at a landscape scale, and the link between individual actions and local level issues (Nicholson-Cole, 2005).

Visualisations are recognised as an important engagement tool with potential for influencing behavioural change (Appleton & Lovett, 2003; Sheppard, 2005; MacFarlane *et al*, 2005). Historically visualisations have been viewed in a laboratory or theatre setting, or on the viewer's own computer. Lange (2011) suggests that there is a great deal of potential in the use of mobile visualisations to increase public engagement in the environment around us, that communicating information while in the field both enables the non-visual senses to be engaged, and stimulates a sense of interaction impossible within a building. With the improvement in data coverage and a rise in mobile smartphone use the time is ripe to understand how this mobile technology can be used as a communication tool.

This paper reports on the design and development of a smartphone-based augmented reality tool to communicate ecosystem services in a landscape, and its subsequent evaluation with members of the public in small groups attending short organised rambles in Norfolk, UK.

2 Development of the augmented reality application

The augmented reality application VESAR (**V**isualising **E**cosystem **S**ervices using **A**ugmented **R**eality) was developed using a suite of internet-based applications including the Hoppala web service (Hoppala, 2011) and the layar™ augmented reality provider (layar, 2011a). The layar™ shell which the VESAR applet runs within was originally created by layar™ to be used as a marketing tool or as a game platform, and as yet the application to landscape visualisation has been limited. The applet is to some degree a gimmick, a fun application, but with its free download and its ease of use and accessibility VESAR has the potential to appeal to a section of the population who would not otherwise engage with the outdoor landscape and realise the benefits nature gives us.

VESAR utilises a combination of camera, GPS, compass, accelerometer and a high quality mobile internet (or data) connection: GPS determines the exact location of the device (within a few meters) and the compass and accelerometer determine the field of view. The person using the device sees the world via the camera image which is displayed on the screen (Figure 1); additional digital information such as text, images and animations are augmented on top of the camera view via mobile Internet (layar, 2011b) and accessed by the user touching the Point of Interest (POI) as it appears in the field of view (see Figure 1). The POIs were digitised in ESRI ArcGIS 10 to obtain coordinates. These positional details with the text attributes were then entered into the Hoppala web service which is consumed by the layar server and then transmitted to the Smartphone app.

Figure 1 - VESAR on an HTC Android phone

Descriptive text displayed on the screen is limited to three lines of 30 characters each. The National Ecosystem Assessment (2011) and the Millennium Ecosystem Assessment (2006) were used to describe the types of ecosystem services in the selected river catchments. Further information about the ecosystem service which the POI represents can be accessed by tapping the "More about..." area which takes the users to a webpage with more details about the ecosystem service. The decision not to include imagery on this webpage was taken to reduce the wait time in areas with lower data speeds. The user of the device can also tap "Take me there" which opens a plan map of the area with all the POIs shown, and select a list view to show details of all the ecosystem services currently within radius.

3 Methods: Evaluating the communication potential of the application

After the initial development phase a series of public events took place at both urban and rural sites around King's Lynn and Norwich in Norfolk, UK. The overall aim of the evaluation exercise was to examine the potential of augmented reality for communicating information about features within the landscape and engaging people with the importance of the ecosystem services they offer. Study sites were chosen based on the number and mix of ecosystem services present, as identified on site visits. Participants at the events undertook a short ramble during which they were shown the area's ecosystem services using two tools: a paper handout (see Figure 2) and the VESAR application (see Figure 1). The ramble lasted about 30minutes in each direction; participants used one tool on the way out from the start, and a different tool on the way back walking the same route. Due to the number of devices the maximum group size was six although one session of eight has been run.

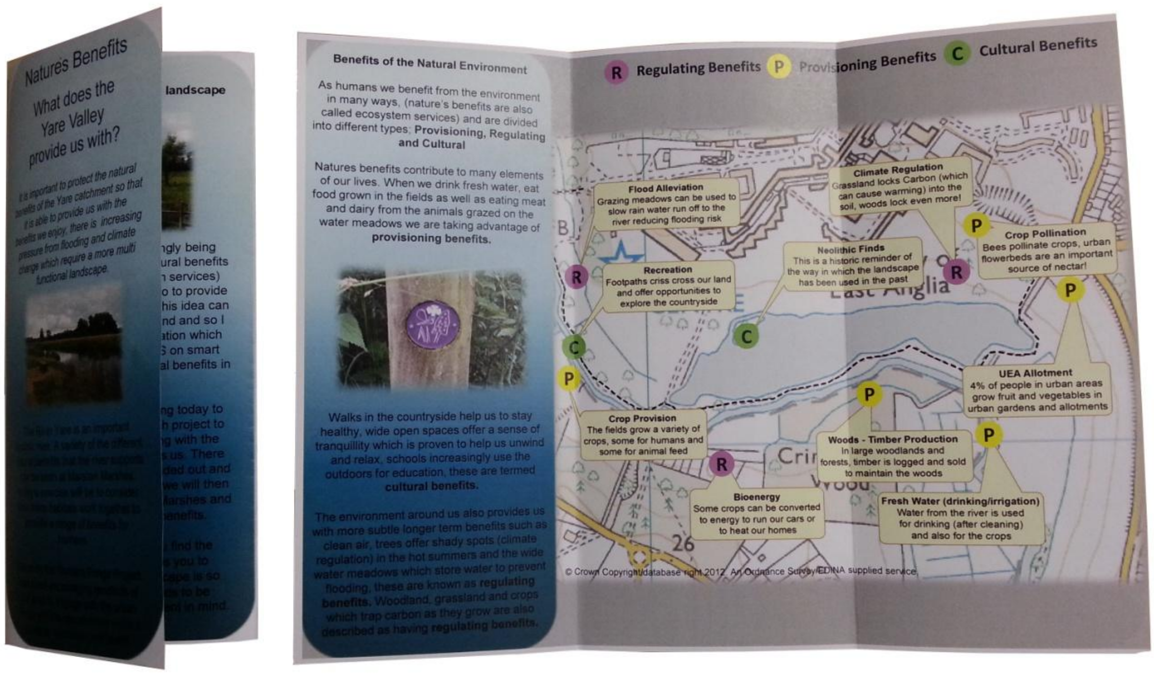

Figure 2 – The guided ramble tri-fold paper handout

Questionnaires, of which parts were completed at various stages within the event, aimed to to establish which tool was most effective and which was preferred; demographic information was also collected to examine any differences in responses due to age, technological familiarity, and other factors. After the event participants were encouraged to discuss the session, these post session debriefings provided valuable insight into the use of the tools.

4 Results and Discussion

The research is currently at the stage of evaluating early results and increasing the size of the sampled population, the preliminary findings are detailed below. The evaluation of the tool can be divided into two sections: the performance of this specific tool in communicating information, and the more general limitations of mobile technology. The questionnaire design worked well, all were completed (except for two sessions which were rained off partway) and post session feedback was interesting.

4.1 Performance of the tool in communicating information

- The language used within VESAR and on the leaflet to communicate ecosystem services was considered engaging but still too formal. Feedback suggested the ecosystem service categories were irrelevant but that the information communicated was interesting and previously unknown.
- Initial review of the data indicates that far from engaging all people in the landscape the mobile phones in fact for some people detracted from the enjoyment of the open space due to needing to constantly review the phone screen.

- Age and experience with smartphone technology did play a part in the user preferences although there is not a simple association - additional data is required and will be gathered by the end of 2012.
- Communicating the location of the ecosystem services in the landscape was one aim of the application; the feedback collected indicated that the technology gave a better idea of where the features offering ecosystem services were located in the landscape whereas the paper leaflet gave more of an overview of the area.
- The technology worked better as a communication tool where there were wide open vistas such as over open farmland and on a wetland nature reserve; walks within enclosed spaces on the urban tours became confusing when POIs appeared and the associated feature was not within the line of sight. Adjusting the radius for POIs to be picked up did mitigate this to a degree.
- Post event feedback suggested that actively prompting the use of the technology contributed to a greater understanding of the interlinked nature of the landscape and the location of ecosystem services without detracting from the enjoyment of the scenery. This prompting was done by a facilitator during the sessions; modifying the app design in future development could handle this interaction by a sound or vibration.

4.2 Limitations of the mobile technology

- Screen glare - despite using an “anti-glare” screen protector on the tablet (Samsung Galaxy 10.1) there was difficulty viewing the screen clearly on days where the sun was very bright or directly overhead. Feedback suggested that this did lead to some participants choosing the leaflet as a favoured method.
- Battery life - during the pilot it was rapidly established that the phones needed to be turned off between evaluation sessions. The GPS accuracy was directly affected by the battery life; similar observations have been made by others on relevant internet forums.
- Accuracy - the POIs had a tendency to ‘dance’ and disappear from the field of view when the device is stationary. Further testing is required but early results suggest that this is a GPS accuracy issue and does vary across handsets. The dancing could usually be managed by restarting the application.
- Data Signal - the application is reliant on a good mobile data signal, but currently rural landscapes (with diverse ecosystem services to communicate) have poor coverage. The intended rollout of 4G networks in the next year should bring improvements. In the meantime research into other GPS mobile apps has shown poor data signal can be handled by developing a version of the application which is downloadable onto the phone’s hard drive prior to visiting sites. It is important to note that in a built up area mobile internet strength would most likely not be an issue, but interference from buildings may affect the GPS accuracy.

Some aspects of the technology reduced engagement with the tool. The issues with hardware (battery life, signal strength and screen dimming) rely on general technological progress, but there are elements which further research could address.

- Design of the display – there were concerns that the text size was too small and hard to read. Improved design coupled with stronger data signal could increase the the amount of imagery contained in the applet and the web links, so improving the content.
- Develop a proximity alert so that there is no need to continually review the information on the screen. This would beep or buzz as the user came within range of an augmented reality POI and alert the user to the fact that there was information to be discovered in this vicinity.

5. Conclusions

This research has evaluated the use of an augmented reality smartphone app as a means of communicating with the general public about ecosystem services in the landscape. Overall the results indicate that this technique shows considerable potential, particularly due to its novelty and consequent positive effects on enjoyment and interest. However, a number of limitations were also observed, some of which can be addressed relatively easily while others are more complex external factors. Evaluation of the research completed to date suggests;

- Contrary to the conclusion by Lange (2011) that augmented reality used outdoor is an 'immersive' technology, not all people appreciate their attention being distracted from their surroundings.
- Engagement with the tool is influenced by age and previous exposure to technology, however there is not a simple correlation between these factors.
- The technology worked better where there were wide open vistas; walks within enclosed spaces became confusing when POIs appeared and the associated feature was not within the line of sight.
- Early indications are that the technology gave a better idea of where the features offering ecosystem services were located in the landscape, whereas the paper leaflet gave more of an overview of the area.
- Few participants had heard of the phrase ecosystem services, suggesting that the concept is not well known. Feedback during events amongst those who had heard of ecosystem services suggested that the term 'nature's benefits' was more accessible and understandable.

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8 Biography

The author has a background in GIS in industry, an MSc with Distinction from the University of Southampton in 2008 and an RGS award for her Masters project on modelling tranquillity in EIA using GIS. She is currently funded by ESRC on a PhD researching innovative uses of visualisation and spatial technologies for visioning river catchment futures.