

VISUALIZING FUTURE BIOLINKS USING A TOUCH TABLE – NEW DIMENSIONS IN PLANNING

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ABSTRACT:

Visualization is an emerging collaboration tool to support landscape planning. Integration of collaborative visualization systems and GIS, using a touch screen table has the potential to become an essential part of land-use and environmental planning and so to facilitate better decision making.

The paper focuses on a method to interactively plan for future forest regeneration areas (*biolinks*) with multiple stakeholders and conflicting objectives. This project automated three-dimensional representations of landscapes comprising key Ecological Vegetation Classes (EVC) that can be used to generate and visualize future biolink scenarios interactively. The approach involved: creation of a rule based database to generate landscape objects and EVCs; new GIS based software to facilitate freehand drawing over regional based maps and the use of touch table technology to enable participants to collaboratively design biolink scenarios.

1. INTRODUCTION

Land clearing for agriculture, or other purposes, leaves remnants of vegetation which may not be sufficient for the survival of native flora or fauna. Provision of ecological connectivity in the landscape to allow for species re-colonizations and migration has been widely called for (Brereton et al., 1995; Hilty et al., 2006; Pham and Wachter, 2004; Soule et al., 2004). Provision of areas for renewed linkage, commonly called biolinks in Australia (e.g. Mansergh et al., 2008), should be carefully planned to provide maximum ecological benefit with constraints of cost, land ownership, land suitability and other factors.

Multi-factorial and multi-criteria landscape planning with spatial information systems has a long history beginning with McHarg (1969) using manual overlays. This work provided the impetus for the computer mapping systems (such as SYMAP) and analysis tools (MAP) which evolved into geographic information systems (GIS). As ecological connectivity also has a large impact on the visual landscape, visualization tools offer an important additional component to inform the debate about future landscapes. Visualization tools, particularly when dynamically linked to GIS and realistic image libraries offer a powerful medium to assist the community, scientists, planners and policy-makers to more actively participate in the planning and redesign of new landscapes. When combined with appropriate ecological data such systems provide the facility for identification of areas for effective use of planting and regeneration to create cost effective biolinks. These digitally created landscapes that display physical properties of the real world provide a medium of visualizing the outcomes of different management approaches aimed at building in biodiversity conservation (Mansergh et al., 2008).

In this project, integration of a touch table, a visualization tool-Spatial Information Exploration Visualization Environment

(SIEVE) (Stock et al., 2007) and GIS –based tools, allowed the effective use of spatial information in participatory decision-making of land use plans for future biolinks. The touch table uses a touch enabled screen, which allows multiple participants to view the screen and interact with the data using hand movements (gestures). The information can then be visualized as a pseudo-realistic three dimensional landscape using SIEVE. The essential GIS data includes EVCs (Ecological Vegetation Classes), DEM (Digital Elevation Model) and aerial photography. In our case study, these integrated technology systems have been used to communicate and exchange knowledge amongst scientists and stakeholders while viewing the existing physiographic conditions of the study area in the greater Grampian region, Southern Victoria, Australia.

2. BACKGROUND

Touch table systems assist in managing and viewing large amounts of data, primarily focussed on GIS, in a manner conducive to discussion and decision making (Arciniegas and Jensen, 2009). A common problem when dealing with large volumes of data is seeing the overall picture. When using high resolution GIS data like satellite images/ aerial photographs, DEM (Digital Elevation Model) etc, conventional displays are too small and limit the number of individuals that can access the data and engage in the discussion. Also, the problems stemming from conventional presentations are magnified since they limit the role of most participants to passive listener. (http://www.army-technology.com/contractors/data_management/touchtable/) (accessed 05 Nov 2009).

Touch table systems not only increases group comprehension and help decision making through better visualization but also helps with data management and improved participation. Interacting with touch tables is similar to working with a paper

map (2D). A computer interprets the location of the hand movements on the touch surface. A single touch can be used to query source data, turn data/group layers on or off, zoom in and zoom out, set data classification levels and lock screen display. Anyone in the group can access or manipulate data simply with a touch on the touch surface of the screen as no one person controls the mouse.

A number of different types of touch table are available in the market, each one of them having specific characteristics. The choice in this case was made considering a number of factors and parameters such as product's features, specifications, applications, price and availability in Australia. Each touch table under a different manufacturer brand had a distinguishing

property, such as; Object Recognition, Touchshare GIS software, Gesture-Control and Multi-Touch Surface Computing, Multitouch, Multiuser (WHO IS WHO). The brands and their key features are summarised in Table 1. Our choice was the 52" multi sensor touch screen table from Touch Screen Solutions, affordable, efficient and user friendly. The Touch Screen table integrates well with our GIS interface (ESRI's ArcMap) and the BioZone Constructor extension made for assisting Biolink planning and design. The touch tables's screen can be integrated with multi touch sensor technology using its "Infrared Multi-point Touch Screen Application Programming Interface (API)".

Product	Diamond Touch	Microsoft Surface	TT45 & TT84	Touch Screen Solutions	Gesturetek
Multitouch	YES	YES	YES	YES	YES
Multiuser	YES	YES	YES	YES (using API)	YES
Projection Type	Front Projection	Rear Projection (Cameras and infrared spectrum)	LCD	LCD	LCD
Customisable/API	YES	YES (SDK)	YES (Touchshare GIS software)	YES	YES
SPECIFICATIONS	32" & 42" & larger screens made to order	30" Display	45" & 84" respectively	32", 42", 50", 52" larger screens made to order	50" Display, different sizes screens made to order
APPLICATIONS as Advertised	DiamondTouch plug-in tool for ESRI's ArcGIS.	Stores, Restaurants, Hotels and GIS, object recognition using barcode	GIS Specific-sits on top of ESRI's ArcGIS or Google Earth	Commercial like a PC or Laptop	Everywhere
PRICE	\$9500 (USD) for single unit & \$12500 (USD) with SDK	\$12500 (USD) for single unit & \$15000 (USD) with SDK	TT45 \$59000 (USD) TT84 \$1,79000(USD)	\$8000-\$13000 (AUD)	\$69542 (AUD)
AVAILABILITY (in Australia)	YES	NO	YES	YES	YES

Table 1. A comparison of the key features, prices and availability of touch tables in the market (Information collected in May 2009)

3. CASE STUDY

The BioZone Constructor (figure 1) software assists users to plan future biolinks. BioZone Constructor is a standalone application built within ESRI's ArcGIS on VB.NET which enables users to build biolinks through the ArcMap interface (2 dimensional) and view the resultant landscape in SIEVE Viewer (3 dimensional).



Figure 1. Screenshot of BioZone Constructor

BioZone Constructor contains tools to support participatory decision-making processes. The users choose these GIS based tools one by one to help them to construct the BioZones, divide them into Ecological Vegetation Classes (EVC) and label them with their respective names in the ArcMap interface. After

finishing this task they will activate the live link with SIEVE Viewer where they will see all constructed BioZones within the existing 3D landscape filled with the correct vegetation types, heights and densities for the chosen EVCs. At the completion of the participatory planning and design process end users can save the BioZones into the Geodatabase.

The first tool in the BioZone Constructor is called the 'Draw Biolink' which enables the user to draw a biolink polygon using fingers, pen or stylus on the surface of the touch enabled screen. Every polygon made by the user is given a name of choice by the user and this shapefile automatically generates its own attribute table including area, perimeter and space for the EVC name of the polygon. Each user can make multiple polygons with different names.

Once the biolink has been drawn the user can subdivide their polygon into numerous sub-polygons using the second tool called the 'Draw EVCs'. These sub-polygons can now be assigned to one of the ten dominant EVCs in the Grampian area. In addition, the options of 'Plantation', 'Windbreak' and 'No EVC' were added as other landscape elements. Each EVC's flora type was limited to trees and shrubs only. Once the users complete drawing and assigning names to their polygons they can finish it by using the 'I finish' tool.

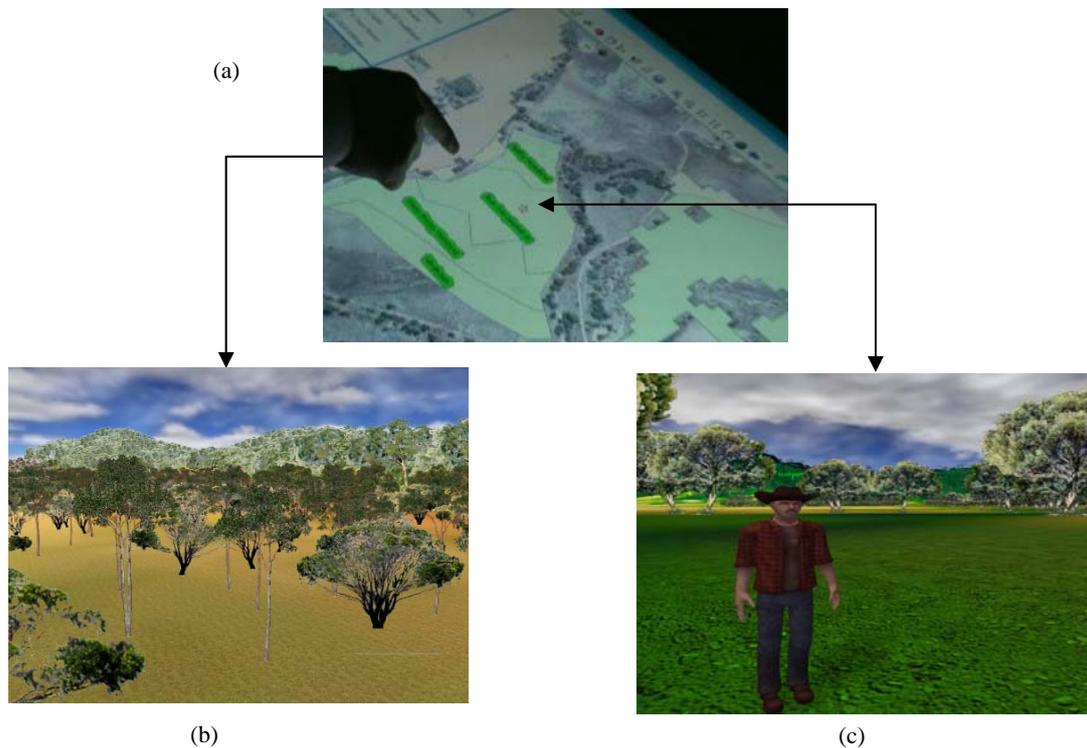


Figure 2. Screenshots from Biolink planning process (a) ArcMap interface on Touch screen, (b) showing Birds eye view of the a proposed Biolink, and (c) Avatar position in SIEVE within Biolink

The next step in this process is to activate the 3D visualization interface - SIEVE, which allows users to explore existing spatial data and hypothetical future scenarios (newly constructed biolinks) in a real-time 3D environment. SIEVE

incorporates a multi-user environment that allows users from different locations to gather in the virtual landscapes for exploring and decision-making purposes (figure 2). This functionality is frequently implemented in game engine

software, on which SIEVE is built, and users are represented in the virtual world as so-called avatars. Using avatars in a collaborative environment has several advantages. It makes it easy to recognize other people and gives a feeling of physical presence. During collaborative discussions it may be important to know what features other people are looking at, or even where they are located. This can be especially useful if the meeting is run with participants involved from different locations either via a network setup or possibly with some participants involved through the use of augmented reality sets situated in the actual study area and their avatars reflect their true physical position (Chen et al., 2008; Stock et al., 2007). Remote users can communicate via a chat box and our avatars have been programmed to make gestures appropriate to the message being typed (e.g. nodding for 'yes').

The sixth tool of BioZone Constructor, 'Place avatar', helps to the user to place an avatar which means that with just a click in ArcMap interface(2D), one will start viewing an area of choice in SIEVE. "Stop 3D visualization of biolinks" allows users to disconnect from the SIEVE environment while the "Labels" tool allows users to view the names of the EVCs. Users can always switch the names on or off for their convenience. "Save session" writes output of the work session in a new Geodatabase automatically with the respective date of the work session. Users can start the SIEVE viewer on the 'local machine' or on the 'network machine' by entering the IP address of the machine into the "SIEVE Settings" window's form. Hence users can view the 3D visualization from a different location while the main Touch table interface remains in the original location.

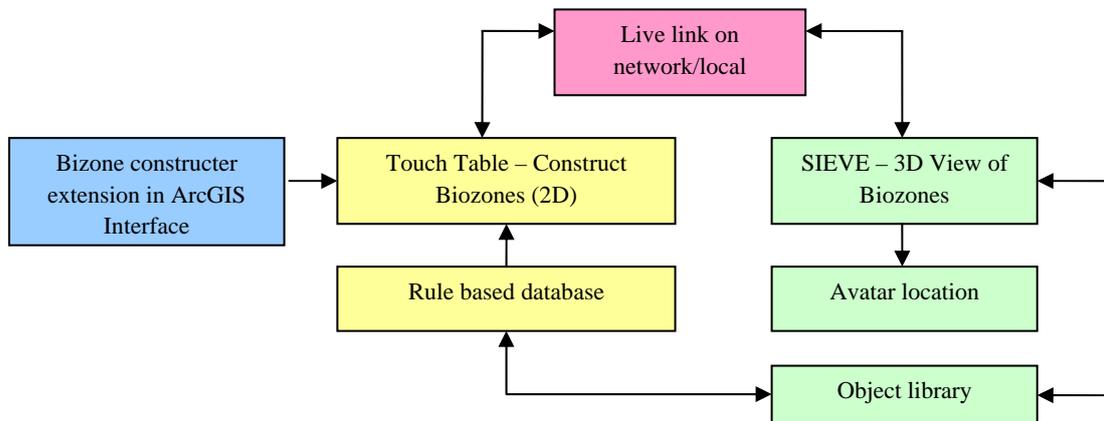


Figure 3. The workflow for the BioZone Constructor system

The workflow in Figure 3 illustrates how the BioZone Constructor functions for the scientists, planners and stake holder in a collaborative environment. The main component is the touch enabled screen which gives a chance to the participants to conduct a participatory and collaborative discussion whilst designing a Biolink on the touch screen. Any relevant background data (soils, land ownership, slope etc...) can be made available through the GIS view on the touch table. This gives users the opportunity to consider these factors in their biolink delineation. Using the GIS functions they can also measure distances or even run suitability analysis. The areas of drawn biolinks are available through the attribute tables.

The BioZone Constructor tools described above give users freedom to prepare multiple scenarios and to reconfirm or reassign the EVC classes during the discussion. Once they have agreed on one element they might move further. The other important aspect of the system is the back end database i.e rule based database created in Microsoft Access. This database contains all attribution information of each type of object and defines some rules to project them into the 3D SIEVE environment.

The Live Link functionality between the GIS and SIEVE platform plays a significant role to connect the touch screen with a local machine or a network machine. All participants can view the designed biolink in the virtual environment containing all respective EVC species. This gives the resemblance of the future biolink in the real world. At this stage in the project, the vegetation objects are stored in SIEVE directories locally but in

the future the objects will be retrieved from a server based Object Library.

Once the transformation of the biolinks is complete the users have the option to move around in the virtual environment and view the location of their Avatar on the Touch screen. This particular approach gives freedom to the participants to view different locations holding various perceptions instantaneously while also knowing where they are relative to key GIS themes. Exploration of the virtual environment can be undertaken from an above ground perspective and also from an on the ground perspective.

4. CONCLUSION

With the help of BioZone Constructor improved biodiversity and habitat plans can be created between conservation areas that were once fragmented leading to the likely loss of habitat. The current prototype system can provide:

1. A more informed way of understanding environmental processes.
2. An interactive participatory decision making approach to involve multi-stakeholders in landscape planning and design process.
3. A fast and engaging way to plan and design future biolink scenarios both in two dimensions and three-dimensions.

We note that the current prototype system does not support multi-touch functionality. However, this would be possible to implement through the multi-user touch technology using the application programming interface or migrating the current system onto a touch table platform which already supports multi-touch functionality such as the Microsoft Surface.

5. FUTURE RESEARCH

What we have reported in this paper is the development of a prototype touch table participatory planning tool. The next steps of this research will include advances in both technology and application development.

Specifically the next steps in the research and development include:

1. A more robust and comprehensive object library database platform: Both the Victorian Department of Primary Industries (DPI) and Victorian Department of Sustainability Environment (DSE) are working on vegetation and/or infrastructure libraries with appropriate management tools (Pettit et al. 2009). We anticipate building these into the product as it develops. The object library would include a wide range of vegetation types and vernacular infrastructure elements representing local landscapes.
2. More knowledge driven case studies in the landscape: a market driven project that allows scientists, stakeholders and landholders to calculate the steps and costs to improve an ecosystem. This could revolve around a number of critical natural resource management issues such as climate change, weeds, bushfires, endangered flora and fauna and their habitat and soil salinity to name a few.

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