Virtual2Reality:
The *Virtual* Shift of the Geographer's Exploration Paradigm

John Ryan

San Diego State University USA

Jrav8@yahoo.com

Virtual2Reality mapping is a remote desktop exploration of the world using world-view and plan-view perspectives similar to that used in the historical geographer paradigm of exploration, the use of maps in support of the physical exploration of specific world locales. This new virtual shift in the paradigm provides real time remote visualization and collaboration using digital panoramic images - mimetic renditions of real-world locales (especially those with limited accessibility). The procedure embeds these panoramic renditions at geographical referenced locales in digital plan-view maps to produce a 'Virtual2Reality' mapping construct. The structure facilitates collaborative spatial decision making by providing a common structure for all stakeholders.

Virtual2Reality; geographic exploration paradigm; visualization; collaborative spatial decision support.

Introduction

The paradigm of geographical mapping for visualization purposes has historically been one in which the individual researcher carried a paper map to a physical locale and observed some theme from this world-view perspective. (S)he georeferenced this spatial knowledge as an anchoring point to the map supporting cognitive map generation. Thus the burden on collaborative visualization rested on the integrity of the physical world-view observer to communicate what they observed. Different themes of the specific locale might need iterative visits to acquire selective knowledge from the visual data. Visualization in the digital realm has until now been limited primarily to plan-view data. Kraak (1999) proposed that virtual referents to true space have three depictions: plan-view (a conventional map), model-view (DEM draped image), and world-view (personal perspective as if standing there). GIS has just become interested in the depiction for visualization of the second of these three perspectives and has always used the first perspective. The analysis through GIS of these two perspectives has allowed geographers to gain insight on tangible as well as non-tangible (though limited) spatial themes through visualization. Where computer visualization capabilities have lagged compared to the historic physical map-supported exploration is in the world-view perspective, both tangible and non-tangible data (Kraak, 1999).

Visualization (exploration, ideation, and discovery) within the realm of geography has, since the formation of the disciple, relied heavily on personal 1:1 scale eyelevel world-viewed observations in combination with the geographer's tool, small scale, large spatial extent physical maps. This paradigm of exploration is costly and potentially biased in assessment and resultant verification is all too often based on the individual researcher's personality/credibility. Beginning in the 1900's photography provided some capture of the essence of the specific locale, but most where single frame images capturing a specific theme and point of view of the area. These photographs where used in support of a specified thesis and were not designed for visualization as would occur in viewing the real world locale.

With the invention of the graphical user interface for computers and various mapping software, digital maps in combination with associated spatial data have lead to a drastic improvement in macro-spatial social and environmental research analyses. Iterative analyses and visualization on this plan-view aggregated spatial data contained in these large spatial extents have greatly improved our understanding of the tangible and non-tangible world. Yet the original geographer's paradigm offered strong geographical visualization potential (though only to those fortunate to visit the specified areas). In combining the knowledge obtained from world-view locales and plan-view overhead perspectives robust cognitive maps of the area/theme were produced that support heightened visualization potential and better decision-making ability.

My research explores shifting this exploration/mapping paradigm to a virtual realm. The interactive multi-perspective approach uses digital panoramic world-view eyelevel linked images (interlinked visual anchor nodes that provide a virtual presence), which are geo-linked to digital plan-view maps, offering distant visualization and collaboration. Virtual movement is accomplished by hyper-jumping, as no motion animation is used. Orientation and wayfinding strategies facilitating exploration, ideation, and discovery are supported by visual and auditory cues added to this virtual realm mimicking and enhancing these data from the real world. These panoramic virtual anchor nodes, VRNodes, can be obtained from digital imagery taken in the real world (photo-realistic real-world captured panoramas), synthetically generated solely within object-based computer graphics, or as hybrid panoramas with enhancements or value added components embedded in the photo-realistic real-world captured panoramas.

The combination of the synthetic and real world panoramas provide a 'Virtual to Reality' construct (Virtual2Reality), which supports initial guidance in the real world by using synthetically developed georeferenced mimetic panoramic images. Collaborative queries can use sight and sound enhancements that are co-hyper-linked to embedded virtual objects within these mimetic renditions, resulting in an object-based referencing system to facilitate collaborative data acquisition.

The developed structure supports the process of collaborative decision making by organizing data collection, visualization, and intra-group communication that can be used by all stakeholders, leading to improved conflict resolution. Even with varying virtual reality software, the structure supports collaboration for decision making by the use of a common platform. This structure, centered on VRNodes, leads to less technologically disenfranchised stakeholders by providing data in a way in which all persons can 'stakehold'.

Co-embedding visual and auditory data for cognitive map development has a historical basis expressed in the Anchor Point Theory developed by Dr. Golledge (please see Golledge, 1999, for a thorough overview). This didactic theory of spatial knowledge acquisition in the real world through centroids of importance correlates well to the VRNode structure.

Within the praxis of my research, I have explored augmentation and incorporation of world-view perspectives into virtual cartography for collaborative decision support in a 'real-time' basis. Connecting real-time world-views to far distant experts poses a constraint on the virtual cartographic structure. The work to date uses Apple's Quicktime ^{TM} viewer for displaying the AV^2Maps.

Active Transmission Pilot Study

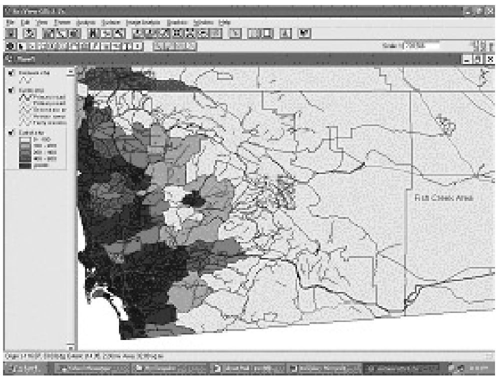

Figure 1. Location map of Fish Creek area.

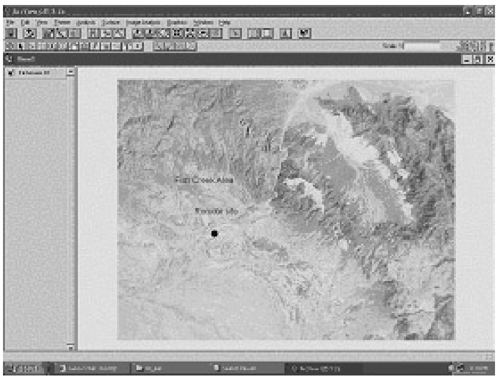

Figure 2. Landsat imagery showing specific location.

On March 21st, 2003 a team of researchers converged on a remote point of San Diego County know as the Fish Creek Area (see reference maps, Figure 1 and 2 below).

The project used the high performance wireless education network, HPWREN system, developed by Hans-Werner Braun. Please reference to this URL for an in-depth understanding of the system: http://hpwren.ucsd.edu/ . For ease of conceptualization, think of this system as an invisible copper line 40 miles long connecting a WiFi card to the Internet. My involvement was to study the nuts and bolts of making a real time collaborative decision support system that was not physically tied to one location, thus a virtual system. The process followed is given below. A field operative took a one shot 360-degree digital panoramic image of the location

The warped image file was downloaded to a laptop computer, which was connected by WiFi to the HPWREN system. The field operator used Yahoo's Instant Messenger TM to inform a facilitator the initial task was done. The field operative then went to perform other non-related tasks. The facilitator physically located away from the specific site (non-location specific), used FTP protocol to access the field operative's computer and wirelessly transfer the warped image file to his computer. The facilitator used PhotoWarp TM software, a product of Kaidan (www.**kaidan**.com), to un-warp the image and build a rectilinear image (see Figure 5 below).

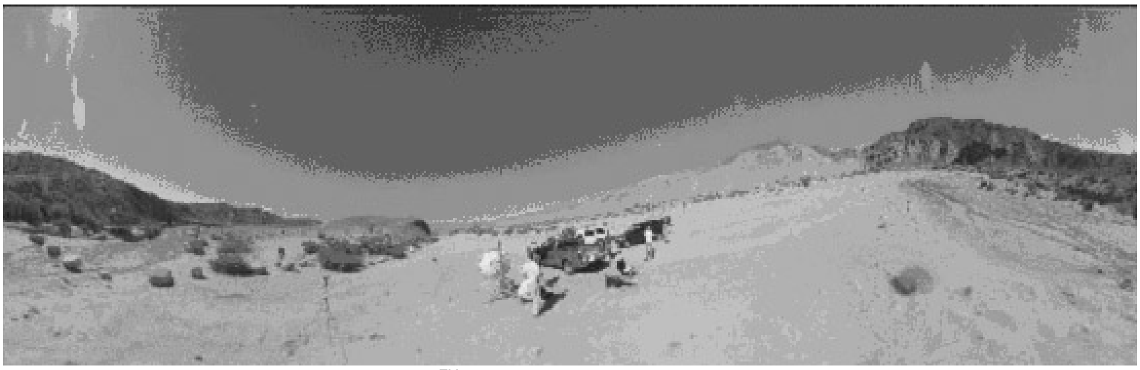

Figure 5. A rectilinear image built in PhotoWarp TM.

An Apple Quicktime TM movie was built from this image and attached to emails to all of the experts (12 in all). The experts visualized the panoramic image and provided input and requests to the facilitator through email. These queries were written into the rectilinear image and wirelessly transferred to the field operative. The operative then viewed the embedded experts' requests in the panoramic image while standing at the exact location, a Virtual2Reality TM query.

Passive Pilot Study

During the international IPV6 conference held at San Diego State University, please see http://www.usipv6.com, a passive test was performed for the conference. Though similar in structure to the test held at Fish Creek the backbone for linking to the internet was an inexpensive yagi antenna, see the figure 5 below.

This system provided connectivity of around 5 miles and showed the universality of the process for field research. Conference goers where able to query and solicit additional imagery, providing a 360 real time virtual presence along the US/Mexico Border. This area though legal for hiking, is at times dangerous for travel. Most conference goers had no idea what the border fence looked like and the images where an 'eye opener'.

Conclusion

In conclusion, the initial test of collaborative visualization using a Virtual2Reality structure has received accolades from numerous groups that have viewed the imagery of related themes. A strong emphasis for the structure's use in decision support rests in the use by stakeholders. In the two tests performed, stakeholders initiated data acquisition and numerous comments were made towards the enjoyment of this activity. It is felt by this author that initiating inter-group data acquisition is directly tied to stakeholder empowerment.

The next step in this evolving praxis is to test cognitive map generation produced from physical presence at a real world locale verse that from only a virtual presence. In multiple stakeholder groups it is likely that some stakeholders will have an opportunity to observe real locales. Knowing the limitations, if any, of those stakeholders whose access to a locale is only 'virtual' will help in the further design of Virtual2Reality.

References

Golledge, R. G., 1999, Human Wayfinding and Cognitive Maps. In R. Golledge (ed.), *Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes*. John Hopkins University Press. Baltimore.

Kraak, M., 1999, Cartography and the use of Animation. In Cartwright, W., Peterson, M.P., & Gartner, G. (ed.), *Multimedia Cartography*. Springer. Germany.