The University Consortium for Geographic Information Science

Research Priorities

Pervasive Computing

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The Priority

With the incredibly rapid proliferation of web applications, Internet commerce, wireless communication, and small electronic devices, it will be important to investigate how to further improve the integration of geospatial analytical functionality with these technologies.

Description of Research Challenge

It has been predicted that the web and distributed mobile and wireless networks may eventually become the dominant form for accessing GIS (i.e. GIS will be freed from the desktop). For instance, web GIS currently has the higher potential user base and the lowest cost per user, while society has witnessed the emergence of **g-commerce**, a new multi-million dollar industry focused on a range of "location-based services" (e.g. maps, routing, and service directories for cell phones, pagers, personal desktop assistants or PDAs, etc.). These technologies are also within the realm of "telegeoprocessing", a term coined by Xue et al. (2002) to encompass real-time update of spatial databases, analysis, and decision making via the integration of remote sensing, GIS, GPS, and telecommunications.

While GIS has existed for over three decades, the development of GIS for the web and for mobile distributed devices and networks is a recent phenomenon, beginning around 1995 with the huge rise in the popularity of the Internet. Particularly with the development of web GIS, the Internet is now becoming a portal for GIS functionality as well as data distribution. This development is following a natural progression of increased efficiency in GIS, but is also subject to some of the same challenges.

Versions of web GIS are slowly improving in functionality, but for application of GIS beyond finding one's way to an airport, hotel, or store, research and leadership are needed to improve the performance of current web GIS and in how best to progress from simple web mapping to more complex spatial analysis, real-time scientific collaboration, and the incorporation of environmental models and decision support.

While the infrastructure is desired and needed for ready access to data and the resulting maps via web and mobile GIS (i.e. linking data to data), it is argued that data must also be linked to models for better exploration of new relations between observables, refinement of numerical simulations, and the quantitative evaluation of sci-

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entific hypotheses. For widespread data access, current technologies are therefore only a preliminary step rather than a final solution. Better support for analysis, modeling and decision support within or connected to web and mobile GIS, should move users beyond the "data-to-data" mode towards the "data-to-models" and "data-to-interpretation" modes.

Importance of Research Challenge

The emergence of web and mobile GIS has greatly changed the way in which we produce and view the map, on the continuum from static to interactive, to dynamic. Geospatial technology (and with it, geographic problem solving) will only be able to positively impact society on a large scale if it becomes more pervasive, meaning that more people in more places need to have access to these powerful tools. The potential for powerful change exists, For example, reducing the current gulf between groups with access to GIS, such as government agencies and corporations, and those without, such as non-governmental organizations and individuals, will enable wider and more informed decision-making, community involvement, and positive political action, as well as a boost to the economy.

Eminent Research Questions

How should data models and data structures for web and mobile GIS differ from conventional GIS data structures? What would the data model of a web site or a multi-user domain (MUD) such as a chat room be? New data structures for web GIS need to be developed to accurately represent movements across networks, file permissions, legacy files and data sets, teleportation, etc. Are there standard metrics for GIS functionality that should be developed for specific application domains?

What are the appropriate measures of performance for web and mobile GIS? What are the primary barriers to the usability of most web GIS sites or to mobile mapping devices? Usability engineering techniques should be investigated and deployed. An example would be the development of multi-level Web-to-database interfaces for web GIS, to enable the customized access to meet the needs of very different user groups.

To what extent does a web map or a spatialization accurately reflect the data? What are the ethics of web GIS and access to geographic information on small electronic devices such as cellular phones, PDAs, or pocket PCs? To what end should pervasive computing technologies be developed? Web technologies, for example, are normally best used with broadband access in order to get satisfactory results. And yet, according to McGovern (2001), who cited statistics from NetValue, only 11% of American, 5% of German, 4% of French, and 3% of British households had such access in 2001. And within these privileged households, how do people really use or respond to ever-increasing amounts of geographic information?

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