Location-Aware Applications

Scenario

Caitlin, a junior in archaeology, is doing fieldwork with her classmates at a site in Arizona slated for development. Part of the students' work involves performing an archaeological survey of the 25-acre tract of land, looking for evidence that the site might have previously been home to a Native American settlement. Working in pairs, students carefully comb the property in search of artifacts and other clues. They photograph all intersecting points of the survey grid—as well as any tools they find and unusual landscape features—and tag all the pictures with longitude and latitude coordinates. The photos and location data are continually transmitted to a database on campus. As the students walk the site with their GPS-enabled mobile phones, a location-aware application at the university provides students with information from the database based on the students' location on an ongoing basis. In this way, each pair of students sees an up-to-date digital map of where they are, where other students are, and which areas have already been surveyed, as well as the photos that have been collected. The geotagged photos preserve information about the provenance of every artifact for anyone standing in that location, and the survey produces a photographic record that alerts the development company that it need to examine further before construction can begin.

Caitlin and her fieldwork partner, Martina, are also assigned the delicate task of excavating a kiva floor with an elaborate pigment-painted design. As the floor pattern emerges during their work, they photograph it with a digital camera that embeds location data like latitude, longitude, and elevation. They use their laptops to add location-linked field notes about the tools and techniques they are using. This information is linked to a map back at their university for further study. After the season for fieldwork is over, the team will fill in the subterranean kiva with dirt to prevent erosion and looting. Researchers who enter the area later with a location-aware device will be offered the option to view the images Caitlin and Martina have uploaded.

What is it?

Location-aware applications deliver online content to users based on their physical location. Various technologies employ GPS, cell phone infrastructure, or wireless access points to identify where electronic devices such as mobile phones or laptops are, and users can choose to share that information with location-aware applications. Those applications can then provide users with resources such as a "you are here" marker on a city map, reviews for restaurants in the area, a nap alarm that's triggered by your specific stop on a commuter train, or notices about nearby bottlenecks in traffic. Applications might also report a user's location to friends in a social network, prompting those nearby to meet for coffee or dinner. While such applications create a highly targeted marketing opportunity for retailers, they also provide increased social connectivity and enhanced environmental awareness, offering users a location-based filter for online information.

Who's doing it?

A number of colleges and universities are using this functionality for applications ranging from on-campus find-a-friend services to locating resources in the library. Duke University has used Google Maps to add a layer of augmented reality to the Digital Durham project, which has turned the city of Durham, North Carolina, into a laboratory for the study of history. Mapping old tobacco warehouses, textile mills, and churches, the project offers location-specific information that illuminates the lives of city residents from the 1870s through Prohibition. Concurrent student projects involve adding audio tracks collected with digital recorders and geotagging photographs of the mapped locations. Montclair State University has implemented a location-aware service that includes find-a-friend, shuttle tracking, and a security service. At MIT, the Scheller Teacher Education department has developed augmented reality games like *Environmental Detective*, in which participants can use location-aware devices to interview virtual characters and gather simulated scientific data to uncover the source of a hypothetical toxic spill.

How does it work?

Location tools can be browser plug-ins or installed onto devices like the iPhone or other web-enabled phones. Physical location can be determined using GPS satellites, cell towers, wireless access points, or a combination of these tools. In the case of cell towers and access points, location is determined based on

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connectivity to individual connection points, which are mapped and logged in databases that are continuously updated. Each method has trade-offs, and the most accurate and reliable services use more than one method.

When a user with a mobile device elects to use a location service, that information is sent to location-aware applications that attempt to provide resources based on where the user is at that moment. Alternatively, a location-aware application might forward a user's position to other location-aware or social networking applications. Users can specify which applications receive the information and how detailed that information is, or they can override all other data by entering location coordinates manually.

Why is it significant?

These devices offer a convenient layer of content filtering with significant promise for education. Field research is boosted by geotagging—embedding location-specific metatdata (coordinates or place names) in photos, videos, blogs, or websites—and location-aware applications can effectively connect geotagged resources to students when and where they need it. Geocaching, or coordinate-specific treasure hunting, can be customized in educational games that leverage location-aware mobile devices. These games might include augmented reality simulations that use clues and riddles to enable student problem solving and collaboration. Location-based information can allow students who opt-in to locate members of study groups on campus or check nearby computer labs to see which have unoccupied bays. Librarians could also point patrons to resources, based on a user's described interests and borrowing habits, by indicating where important books and media on key topics can be found. Security officials can respond to student requests to monitor trips across campus to ensure safe arrival at a destination. Data collected from such security requests might be gathered to identify locations with greater security risks, prompting facilities improvements such as improved lighting.

What are the downsides?

By far the most common questions raised about location-aware applications concern privacy and security. It is important for campus systems that employ these applications to be opt-in services and allow anyone to disable them whenever they choose. To complicate this concern, increasing interconnectivity between social networking sites like Twitter, Facebook, and Flickr means that data posted on one could migrate to another without users being aware of how this happens. Standards are still emerging for these devices, as are etiquette and social protocol. Raising awareness about the implications of allowing online systems to know where users are should be a requisite part of student, teacher, and parent training.

Where is it going?

Location-aware content offers marketing tailored to the convenience of the user. With increasing frequency, we are able to locate physical services within walking distance as simply as we can find any service or product offered on the web. Mobile devices already reach a public focused heavily on information being delivered quickly and simply. As these tools offer greater amounts of data about the environment through which we move, location-aware systems will become increasingly effective at predicting what we would like to know about in the geographical space around us, offering a layer of knowledge superimposed on the physical world that can be accessed for information and convenience. Through applications like Graffitio, users can even add their own comments to that layer, "air posting" notes on the nearest handy geolocation wall. The geotagging of blogs and websites could become part of our expectation of the online experience, and it is possible that we might come to rely on embedded geolocation information in photos, e-mail, or Twitter posts for archival purposes in much the same way we now rely on date stamps.

Technologists are also beginning to consider the possibilities for location-aware devices to inspire a new generation of "citizen environmentalists" who can use cell phones to report location-specific information about the environment around them. Like the rise of citizen journalism before it, citizen environmentalism relies on the unique contributions of informal data gatherers to help scientists paint a broad picture of environmental health and quality. In return, mobile phone users might be able to receive instant data about the air quality in their city or the weather forecast.

What are the implications for teaching and learning?

Applications that employ this technology offer an exceptional opportunity for location-based content and experiential learning. Narratives can emerge naturally from places of historical interest on campus and in nearby towns. Through location-aware browsers on mobile phones, nature walks can not only provide the names of plants but also offer community-generated photos of what a specific specimen looks like in bloom or heavy with fruit. Student researchers might employ the coordinates provided by a location-aware device to tag photos, research data, or other field notes on a map in Google Earth, providing an additional overlay of information. The availability in the public domain of geotagged photos, videos, and audio tracks will allow educators to create effective windows into other cultures for class, group, and individual study. Finally, this technology offers another venue for instructors to link their lessons to geographic locations, whether those lessons are clues in an augmented reality game, data to be collected from the field, or directions to the right section of the library.

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