Chapter XVI
Building Applications to Establish Location Awareness:
New Approaches to Design, Implementation, and Evaluation of Mobile and Ubiquitous Interfaces

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ABSTRACT

An emerging challenge in the design of interfaces for mobile devices is the appropriate use of information about the location of the user. This chapter considers tradeoffs in privacy, computing power, memory capacity, and wireless signal availability that accompany the obtaining and use of location information and other contextual information in the design of interfaces. The increasing ability to integrate location knowledge in our mobile, ubiquitous applications and their accompanying tradeoffs requires that we consider their impact on the development of user interfaces, leading to an agile usability approach to design borne from agile software development and usability engineering. The chapter concludes with three development efforts that make use of location knowledge in mobile interfaces.

INTRODUCTION

A key challenge in the emerging field of ubiquitous computing is in understanding the unique user problems that new mobile, wearable, and embedded technology can address. This chapter focuses on problems related to location determination—different ways to determine location at

low cost with off-the-shelf devices and emerging computing environments, and novel methods for integrating location knowledge in the design of applications. For example, many Web sites use location knowledge from IP addresses to automatically provide the user with relevant weather and traffic information for the current location. There is significant opportunity in the use of location awareness for human-computer interaction (HCI) researchers to explore information-interaction paradigms for the uncertainty and unpredictability that is inherent to many location detection systems—particularly indoor systems that use Wifi signals which can be blocked by roofs, walls, shelves, and even people!

The prior knowledge of location to make such decisions in the presentation of information affords it to be categorized as *context awareness*, the use information that can be used to identify the situation of an entity to appropriately tailor the presentation of and interaction with information to the current situation (Dey, 2001). While context awareness can include a wide variety of information—including knowledge of who is in your surrounding area, events that are happening, and other people in your vicinity—this chapter focuses on the identification and use of location information, perhaps the most cheaply and readily available type of context information. This chapter considers the tradeoffs in privacy, computing power, memory capacity, and wireless (Wifi) signal availability in building interfaces that help users in their everyday tasks. We discuss our own SeeVT system, which uses Wifi signals in location determination (Sampat, Kumar, Prakash, & McCrickard, 2005). The SeeVT system provides the backbone for supplying location information to mobile devices on a university campus. Numerous interfaces built on SeeVT provide timely and appropriate location information to visitors in key areas of the campus.

The increasing ability to integrate location knowledge in our mobile, ubiquitous applications requires that we consider its impact on the development of user interfaces. This chapter describes the merging of agile software development methods from software engineering with the scenario-based design (SBD) methodology from usability engineering to create a rapid iteration design approach that is heavy in client feedback and significant in its level of reusability. Also presented are three interfaces developed using our Agile Usability methodology, focusing on the benefits found in using the Agile Usability approach and the tradeoffs made in establishing location awareness.

BACKGROUND

From the early days, navigation has been central to progress. Explorers who set sail to explore the oceans relied on measurements with respect to the positions of celestial bodies. Mathematical and astronomical techniques were used to locate oneself with respect to relatively stationery objects. The use of radio signals proved to be fairly robust and more accurate, leading to the development of one of the first modern methods of navigation during World War II, called long range navigation (LORAN). LORAN laid the foundation of what we know as the Global Positioning System or GPS (Pace et al., 1995). Primarily commissioned by the United States Department of Defense for military purposes, GPS relies on 24 satellites that revolve around the Earth to provide precision location information in three dimensions. By relying on signals simultaneously received by four satellites, GPS provides much higher precision than previous techniques. GPS navigation is used in a wide range of applications from in-car navigation, to geographic information system (GIS)-mapping, to GPS-guided bombs.

GPS has become the standard for outdoor location-awareness as it provides feedback in a familiar measurement metric. Information systems like in-car navigators have adopted GPS as the standard for obtaining location, since it