Impulse: Location-based Agent Assistance

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ABSTRACT

In the physical world, a user experiences products and places, explores physical surroundings, and participates in location-specific activities. Software agents, trapped in their electronic world, offer users valuable assistance online, for example by personalizing searches and queries. The Impulse research project at the MIT Media Lab [1] examines what happens when the rich experience of the physical world is augmented with the low search costs and information resources available through the Internet. This paper presents a subset and implementation of one aspect of the Impulse vision: a scenario demonstrating a mobile device which uses location-aware queries to digitally augment and explore the physical world.

PROJECT OVERVIEW

Related research on learning agents within wireless devices [6] and the combined work of wearable computing and ubiquitous computing [5] explore placing agents into our physical environment. Our work takes these previous explorations and introduces the idea of an agent that provides a user with personalized information dependent on his/her geographic location.

We approach location-based computing by structuring our agent communication into four components: the User Agent, the Wherehoo Server, Provider Agents, and Providers, as shown in Figure 1. The "User Agent" represents a user's interests and interacts with Provider Agents on the user's behalf; the "Wherehoo" server is a search server using location as its primary criterion and keywords as its secondary criterion; "Providers" are physical resources such as businesses, services, attractions, events, or points of interest in the user's physical search domain, which have an Internet presence and have registered with the Wherehoo server; "Provider Agents" are controlled by Providers and interact with User Agents. The Wherehoo server allows a User Agent to ask such questions as "Is there 'coffee' near my present location?" (By "location" we mean physical coordinates, versus "context" which includes actions, motivations, interactions, etc. [5])

In one type of usage scenario, the User Agent receives its tasks from the user in the form of a list of goals or "Wants." Each Want consists of basic keywords entered by the user, a physical radius in which to search, and a target time during which the requested good or service should be available to the user. The User Agent uses the Want data to build an internal user profile and to build queries for both the Wherehoo server and Provider Agents.
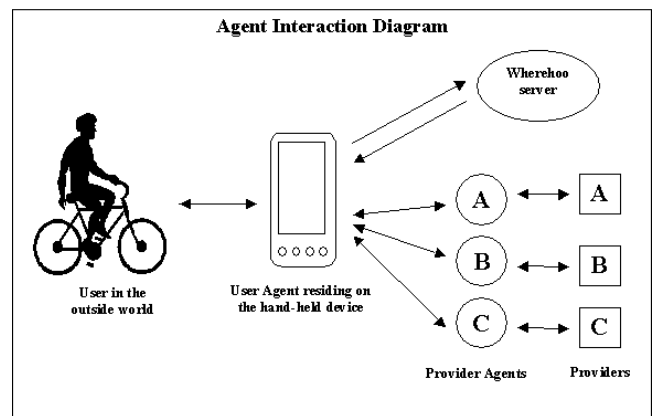

Figure 1

The User Agent first issues a query consisting of a location, search radius, and keywords to the Wherehoo server (e.g. "<GPS location>, 0.5km, coffee and English" for a query seeking coffee houses with English-speaking staff). The server returns URLs for physically-nearby Providers whose descriptions match the keywords. In the current implementation, the User Agent then retrieves the documents at those URLs and seeks matches to standard XML elements. Future implementations will employ Provider Agents to allow transactional queries. Finally, the Provider may offer the URL of a human-readable page, if the user wishes to browse.

Our hypothesis is that a geographic constraint applied a priori to a traditional keyword search domain implicitly acts as a useful relevance-filter, especially when a user is in the physical world rather than at a desktop terminal exploring the digital world. This filtering limits the range of responses to those which are most relevant to an individual who expects a situation-specific response, eliminates classes of irrelevant responses to otherwise-naïve searches, and allows imprecise queries to return highly-relevant answers.

For example, a query for "coffee" returned 234,000 results when submitted to Google [2] and 1.09 million results when submitted to Yahoo [3]. The same query fed to the Wherehoo server, restricted by a physical radius, always returns far fewer responses. Coffee equipment manufacturers, coffee wholesalers, and web sites not connected to a physical place, such as the "Coffee World" web site [4] returned as the top choice in traditional keyword searches, are not returned by the Wherehoo query.

EXAMPLE SCENARIO
The following scenario illustrates the capabilities of our proposed combination of a hand-held device with a software agent querying the Wherehoo server to assist in the location of relevant items in the user's vicinity.

Brad is visiting Barcelona for the first time. He has a keen interest in architecture, so while in town for a conference, he would like make sure he sees all the sights. Brad tells the personal agent on his hand-held device that he has an interest in Antoni Gaudi's work and the International style of architecture popular before WWII. This information is added to Brad's profile and Brad's agent also knows that his preferred language is English.

As Brad explores the city after the conference, his agent alerts him of relevant goods, services and points of interest in his physical vicinity.

- As Brad wanders through a shopping district, his agent alerts him of a bookstore specializing in English-language books on architecture.

- Brad tells his agent that he wants to see Gaudi buildings. His agent returns with the location of Casa Batlló, Casa Milà and Sagrada Familia, three of Gaudi's most famous structures.

- When Brad approaches the Metrónom, his agent informs him there is a special temporary exhibit on architecture today.

- At lunchtime, while Brad looks for a place to eat, his agent points him towards a nearby restaurant where Mies van der Rohe ate during the 1929 World Exposition.

In this last scenario, Brad's agent proactively finds places that relate to his long-term interests ("architecture") and short-term interests ("lunch").

TECHNICAL IMPLEMENTATION
The display device for our prototype is a Palm™ computing appliance equipped with a GPS receiver and a wireless Internet connection. In the background, an agent residing on the device constructs queries and communicates with the Wherehoo server and with Provider Agents, retrieving and filtering results which match the user's "Wants."

The user's "Wants" are gathered explicitly from the user through form-based applications on the Palm device. The agent interacts with the user through a series of alerts and listings of relevant places in the user's vicinity.

The Wherehoo server is a modified search engine, which is fed a query consisting of several parameters including GPS coordinates, search radius, and keywords, and returns an XML document including the geographic location of each Provider's service and a description of how to query each Provider Agent.

After determining the list of reachable Providers, the User Agent selects those which provide what the user wants, and issues direct queries to them. At present this is accomplished by reading documents at supplied URLs. In future implementations, User Agents will directly interact with Provider Agents. Once the available Providers have been analyzed, the User Agent announces potential matches to the user.

FUTURE WORK
An immediate extension to this project will be for a user's accumulated "Wants" to be retained and form a long-term user profile applicable to future explorations by the agent.

Given access to local transportation data, the User Agent could expand its search radius by downloading information about transportation within the search zone, then use the route descriptions of a bus or train to search local regions which can be reached through transportation rather than just those accessible on foot.

Finally, we are beginning to explore negotiation scenarios to enable negotiation of goods and services between User Agents and Provider Agents.

CONCLUSION
This project presents an application in which geographically constrained queries enable a user's agent to give relevant, real-time alerts and suggestions. These suggestions are based on the user's interests, location and surroundings.

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