Human-Centered Location and Navigation

Summary

This project will explore absolute addressing schemes for locations in the world (such as buildings, corners, and park benches) that are easy for humans to understand, remember, locate, compare, and communicate to others.

Motivation

Commonly, people identify locations in a city by giving a street or block address, such as "77 Massachusetts Avenue, Cambridge, MA 02139 USA," or "7-8-4 Roppongi, Minato-ku, Tokyo, Japan."

Today, however, the increasing availability of Global Positioning System (GPS) receivers raises the possibility of using absolute coordinates for everyday location and navigation. Absolute coordinates have some powerful advantages. A location can be found, and distances and directions can be computed, without reference to a map. Fine-grained locations can be described by coordinates even if they lack a distinct street address --- for example, buildings in a complex (such as a shopping mall, campus, or office park), locations in a public space or park, and particular features of a building (such as entrances, loading docks, or parking lots). Finally, unlike street addresses, absolute coordinates are unambiguous. There are many streets in the Boston area named "Main Street" or "Broadway", which can easily lead a visitor astray. No such confusion is possible with absolute coordinates.

Current GPS receivers use latitude and longitude to express absolute positions. Describing a position to an accuracy of a few meters requires 5 decimal places, such as "N42.35933 W71.09400". Unfortunately, this code is not ideal for a human user to remember and communicate to others. Part of the problem is its length (14-16 digits) and self-similarity (digits can be easily confused or transposed). Worse, latitude/longitude coordinates bear no relationship to the human world --- unlike street addresses, in which the hierarchy of country, province/state, city, neighborhood, and street correspond to social and geographical features that are easier to remember and understand. Latitude and longitude must be expressed absolutely, even if the destination is only a few blocks away --- unlike street addresses, which allow users to take advantage of spatial locality. For these reasons, it seems unlikely that people will rush to use latitude and longitude for everyday addressing.

Approach

We propose to devise new addressing schemes for GPS that overcome these flaws, and compare them against both latitude/longitude coordinates and traditional street addresses.

One addressing scheme might start with the name of a region (such as a neighborhood or postal area), along with enough digits to specify the latitude and longitude of a point

within the region. An address in this scheme might look like "933400, Cambridge, Massachusetts, USA". The challenge lies in devising an algorithm that can produce an address with as few digits as possible while remaining robust to inaccuracies or variations in region boundaries, since neighborhoods may grow and shift over time.

Another scheme might specify the address as a vector relative to a known landmark, such as a monument or public building. Other schemes might compress the digits of latitude and longitude into letters or words, to relieve the monotony of digits.

A user study will compare the new schemes with current approaches, including street addresses and latitude/longitude coordinates. The addressing schemes will be evaluated on several dimensions, including memorability, ambiguity, ease of navigation with and without GPS assistance, ease of entry into handheld devices, ease of communication to other users, and ease of comparison (e.g., determining whether two locations are near each other). The new schemes will be implemented in a web service that translates between street addresses, latitude/longitude coordinates, and the new addresses. A handheld application will also be developed that uses GPS and the web service to navigate using the new addresses.

Later work will extend the addressing scheme to building interiors, so that rooms within a building and locations within a room can be identified within the same scheme.

OTHER SUPPORT
FOR THE PROPOSED
ALLIANCE PROJECT

Project Title: **Human-Centered Location and Navigation**

Principal Investigator: **Rob Miller**

Co-investigator(s): **none**

The terms of our Alliance Agreement require that MIT identify in advance any third parties, which are anticipated to provide support to the proposed project, and negotiate any necessary special terms and conditions to be applied to the project to accommodate this support. These steps must be completed before a final funding decision can be made and the project can begin.

To assist you in your evaluation of third party support for the project, please respond to the following questions.

1. Do you, or your co-investigators, have or anticipate any other source of external funding for the development of intellectual property anticipate under this project?

   What are those current or proposed funding sources?

   None at the present time.

2. Do you, or your co-investigators, have or anticipate any other obligations (for example, obligations associated with use of incoming software, data, materials, or equipment or obligations associated with fellowship support) which might limit the intellectual property rights arising from this project?

   What are those obligations?

   No obligations, current or anticipated.