An interactive location service for software agents and intelligent systems

wherehoo.media.mit.edu

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Giving a person “on the street” the benefits of the Internet

- Really “on the street”
- Low search cost
- Coordination
- Discovery of situated resources and people

- Target clients:

  **HARDWARE**
  - Palm devices / PDAs
  - Embedded systems
  - Wearables

  **SOFTWARE**
  - Multiagent systems
  - Explorers

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A place and time for everything

- Temporal and geographic coordinates
  - Where are you
  - When are you?
  - What’s happening - there - now
  - What happened - here - at 0900?

- Scope
  - Long- and short-lived entities (~6 seconds to ∞)
  - Modest storage capacity for data belonging to small agents (1 to 64K bytes)
Queries and Inserts

- Devices with limited communications/processing and more powerful systems will use the server
- Some queries will be answered fully by the Wherehoo server. Others require additional lookups by the client
- Some data will be stored in the Wherehoo server. Other data will be stored elsewhere
Queries and Inserts

- SMTP-like interaction

IDT jim
wherehoo_server 0.56 30 20 1024 65535
ACT QUERY
LLH 42.023 -071.33 0
LEN 250
WID 250
LIM 10

OK
96 N 1443 99999999 33212 WHEREHOO IMAGE/JPG META
DATA
(33212 bytes of data)
138 NW 230 99999999 74 HTTP TEXT/HTML NONE
SKIP

BYE
Queries and Inserts

- SMTP-like interaction

IDT jim
wherehoo_server 0.56 30 20 1024 65535
ACT INSERT
LLH 72.019 288.908 0
MIM TEXT/PLAIN
PRO WHEREHOO
DAT 18
(18 bytes of data)
ACK
MET This is some metadata describing the content of the DATA field
.
OK
c08b9ac6d59dba9be0106096626809b2e4098f0a
.
BYE
Design philosophy

- **Powerful clients** will do their own sorting/filtering and exploration
- **Don't interpret data**, just faithfully store and retrieve it
- **All times are deltas** from local time
- **No content filtering in searches.** Clients will select along many axes we cannot predict
- **Filter literal data** when both client and server benefit (MIME type, protocol, data size, time)
- **Small clients** may require an intermediary to do the hard work

- **Socket interface** yields platform and language independence
- **Minimal embellishment** - add time,distance,heading vector to discovered records - Client cannot do this well; server is authoritative
- **Precise geode model** for accurate distance measures*
- **Read/write facile** - as many clients may be writing records as querying them, for example, subway trains and buses will insert many short-lived records

* Derived from http://www.census.gov/cgi-bin/geo/gisfaq and Perl examples by Darrell Kindred <dkindred@cmu.edu> (1998)
Security

• Protecting your data is up to you!

• Wherehoo is like DNS - its records are all public by design and queries are anonymous
  – (if the data matters) Sign data that must not be changed
  – (and if it's private) Encrypt data that cannot be shared
  – (and if revelation of location is dangerous) Run a private server

• But we try to help:
  – Inserts are authenticated with digital signatures using a shared secret
  – Inserted records return a signed handle that may be used to access the record later
Architecture

- **Server:**
  - Java
  - JDBC
  - MySQL

- **Web interface**
  - PHP
  - Apache
  - MySQL interface
  - Perl

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Applications

• **StreetWise**
• **Transponder** to simulate location awareness in devices that don't have it (phones, Palms) with remote online capability (CDPD) and local only (collect,dump later)

• **Tangible browsers** for exploring the world, "surfing places" instead of "the net"
• **Learning agents** for tracks-based routing. "How did other people get there?"
• **Social applications** - dial by location; friend discovery; "follow me" trails
Problems

- **Data pollution** - no way to detect or delete abandoned records. For example, a building that’s torn down should have its record expired.
  - Quality feedback from clients could possibly help here

- **Imprecision of GPS data** and data loss due to tall buildings
  - Clients designed with knowledge that GPS data does not have sub-meter precision should express appropriate expectations and behaviors, using available information to their advantage.
  - Lost signal is a problem for the clients, not the server, e.g. a navigation client must deal with blackout by switching to dead reckoning and compass direction
Future work

- Views that run forward and backward in time
- Improved algorithms for efficient irregular searches.
- Encoding areas rather than just points.
- Layered or container semantics, and/or XML in the server/client interface, Geography Markup Language (GML), OpenGIS: Probably not
- Automate account creation
- Client feedback about quality or utility of data
- Many self-managed servers
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