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Locative Media : a literature review

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Abstract : This document presents a state of the art review of locative media projects. It also explains the concept of location awareness and its different categories. It finally explains to what extent this spatial feature named “location” is used in terms of social activity by allowing to infer multiple levels of knowledge.

Keywords : HCI, CSCW, collaboration, spatial features, awareness.

Introduction

To fit the needs of distributed organizations **work becomes ubiquitous**, and the notion of distributed virtual teams emerged. People still need to work together from different places at the same time and collaboration must be fluid. The use of Information Technology enable to bridge the distance between teammates thanks to different features. As a matter of fact, mobility is a focus of interest in the field of CSCW (e.g. Luff and Heath 1998, Belotti and Bly 1996, Bergqvist et al. 1999).

Dispersed teams often suffers from relationships problems like the **failure to communicate context information**, the difficulty to communicate the salience of information or the meaning of silence (Cramton, 2001). The challenge of today's computer-supported collaboration is to overcome the technology limits so as to make participants and their activities visible to one another. This concept is termed "**awareness**" : the understanding of other person's interaction with a shared workspace (Gutwin & Greenberg, 1999). The **lack of information about the geographically-dispersed partners** is addressed by providing users with tools that try to "recreate the information landscape of a real-world landscape" (Gutwin & Greenberg, 1999): the awareness tools (from now on called AT in the remainder of this document). We are concerned here with one specific type of AT : Location-based awareness tools which are often referred to as '*locative media*' or '*location-based services*'.

The term "locative media"[1] refers to **every information about the physical location as well as other contextual cues**. The most commonly used context of mobile systems is the location of the user since it is easy to determine and it could be meaningful to use it in order to adapt the behavior of a mobile application. Academics (Schmidt et al., 1998) proposes a wider definition of location awareness. They structure the concept of context by defining **a hierarchically organized model** in which they distinguish two categories according to the level of abstraction : physical environment and human factors. At the **lowest level**, the **physical environment** refers to all the physical variables like **location** (absolute or relative) as well as **conditions** (e.g. light, temperature) or **infrastructure** (surrounding resources for communication, computation, task performance). At the **higher level**, **human factor** related context is structured into : **information about the user** (emotional state, knowledge of habits, ...), **the user's social**

[1] This term has been coined by the community of people working on the field of location-based services at http://www.locative.net/

environment (co-location of others, social interaction, group dynamics,...) and **the user's tasks** (spontaneous activity, engaged tasks, general goals, ...). In this paper, we will refer to the lowest level of this model (the physical environment) by the concept of location awareness.

Additionally, there is **two way to acquire context** using information technology : **requiring the user to specify it or by monitoring users** and computer-based activity. For instance, people can write their location in instant messengers (active user) or it can be detected by sensors (passive user). Thus, the cost of using such an awareness tool is more important in the second way. Research on collaboration suggests that this cost has an important impact on how partners build a shared understanding of a situation when they have to work together.

Sensor technology enables mobile devices to provide cues about context. There is a wide range of sensors that can extract information from motion, audio data, optical elements (light intensity, density, type of light, ...), biosensors (pulse, skin resistance, blood pressure). This technology can be used to obtain context meaningful in different applications (biosensors could be useful in sports and medical apps for instance).

As presented in figure 1, location awareness could refer to information about the present (synchronous awareness) or about the past (asynchronous awareness). We can decompose a locative media into three awareness components : presence (who was present and when), location and direction. Gaining location awareness require **two positioning techniques** (Bergvist et al., 1999) :

- absolute : awareness of the co-ordinates, the actual location or the place (city/country, building, room). This technique is supported by the Global Positioning System (GPS) or the Global System for Mobile Communication (GSM). It could be used in outdoor context. Such models are required for accurate positioning e.g. in augmented environments where a visual impression may be enhanced with location information.

- relative : awareness of what other objects or which places are in the proximity. IR, WiFi (IEEE 802.11b) or Bluetooth supports this kind of positioning. This is the case of indoor positioning system. In this case, the idea is to localize the devices with regard to a known beacon or antenna. Triangulation techniques allow to compute the position of the device.

Another relevant dimension of location awareness is place. Sometimes, absolute or relative positioning is not the proper way to show location information. Knowing in which place or which kind of place is your

teammate/friend is more meaningful. A place is defined as an area of space bound with a specific activity. Erickson (1993) sums up this by stating that “Place is Space with Meaning”. By building up a history of experiences, space becomes a “place” and then its significance and utility is put forward. Harrison and Dourish (1996) go on and states that place is a medium for significant actions : **place affords a kind of activity**.

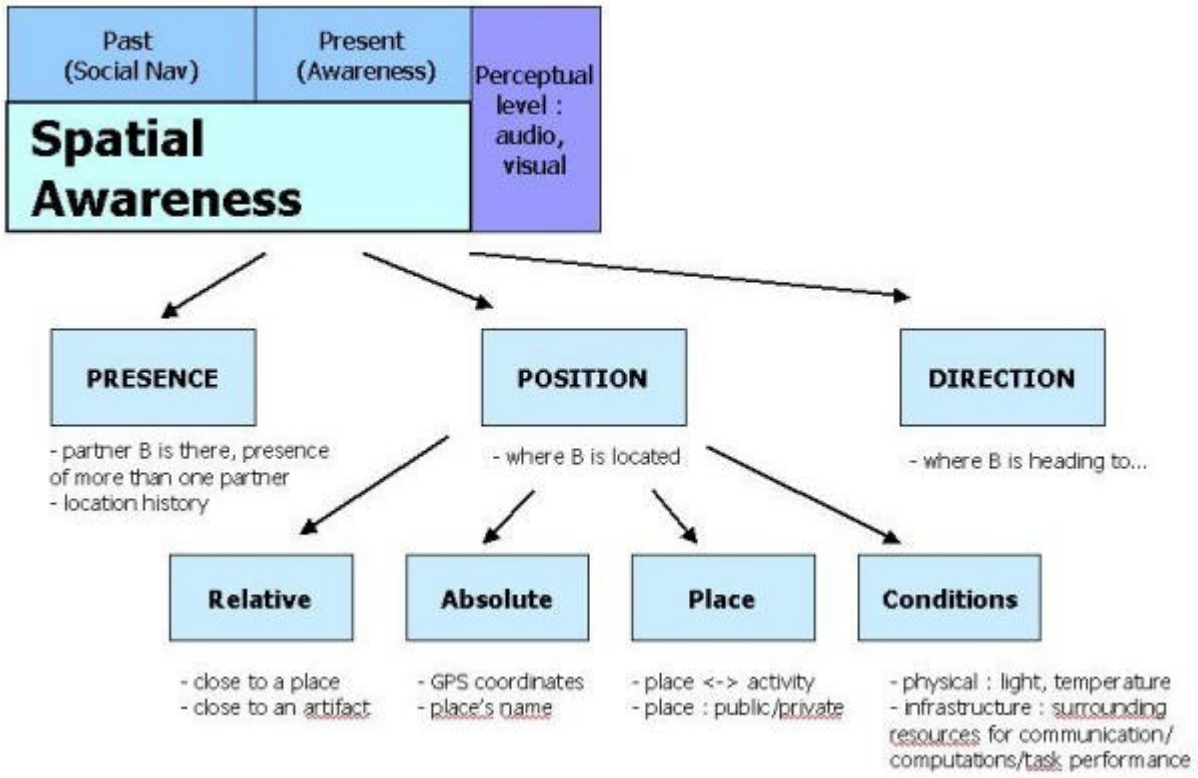

Figure 1 : features of locative media

Existing Locative Media

Location-aware systems take advantage of the users change of location to aid the user in certain tasks. The actual utility of context-awareness in mobile systems has been demonstrated in a wide range of application examples, in obvious domains such as fieldwork and tourism, as well as in emerging areas like mobile gaming. However, it appears that most of the applications are devoted to individual activities or just cooperative activities. Just few systems indeed supports joint and collaborative tasks.

Location-based services for individuals

One of the most obvious domain in which locative media are used is navigation. As a matter of fact, navigation Technology provides these functionalities : address search, optimal route generation (fastest, shortest), preview of entire route, history (saves previously visited cities and streets), nearest point of interest (POI) search based on current location, self-location, voice and written driving instructions - maps display during instructions, off-route and return to route notification, real, time traffic update supports, accurate display of junctions and display of estimated time of arrival and distance to destination.

Social Location-based services

With this title, I refer to location-based services that could be use by a community of users in order to perform either individual activities (like finding a good restaurant thanks to your friends advices) and collective actions.

The ***Cyberguide*** system (Long et al., 1996) is an example of location-aware systems used as tourist guide. It has been developed to provide city visitors with a hand-held location-aware tourist guide. It uses infrared beacons to send wireless transmissions to detect a tourist's position and orientation. The beacons transmissions can be translated into a map location and orientation.

ActiveBadge (Harter and Hopper, 1994) indicates the physical location of people and artefacts using an infrared transmitter that emits a short signal. It is employed to aid telephone receptionists in order to locate people and redirect calls to another location.

The ***Lovegetty*** beeps and flashes when it is close to another Lovegetty with a matching configuration. Each user can set his/her own configuration between “talk”, “karaoke” and “get2”. It was compared as a “matchmaker” between two persons, use to create one-to-one relations. It is an example of relative location awareness.

The idea of **Trepia** is different: it Trepia tracks the movement of people through Wi-Fi access points, and then notifies you of other users who are in your area. Trepia is not limited by Wi-Fi's range because it even works when two people are not on the same access point, but the access points themselves are close to each other. Trepia is built on the idea that If two people are within range of the same Wi-Fi access point, they must be close to each other. **Outetoi**[2] is also based on this idea

[2] http://www.outestoi.com/

that you can be told if and when buddies are in the vicinity or if there is a service you want to access in the area (for instance, if there is a close starbuck coffee).

Among the large quantity of location annotation software available on mobile devices, we should first quote **GeoNotes** (Espinoza et al., 2001) because it is one of the first. It is some sort of mobile notice board. People can write messages in the form of "virtual post-its" at the a specific location with a PDA. Other users that pass in the vicinity of this location can then read the messages. **LLI** (Mankins, 2003) offers the same idea of location-linked information, that is to say connect geography (the "physical world") with the Internet (the "virtual world") thanks to XML. Other systems like **[murmur]**[3] or **Tejp** (Gaye and Holmquist, 2003) propose to leave audio notes linked to a specific place. Likewise, mobile blogging applications allow people to enter blog post on a PDA and add location information to each posts.

Holmquist et al. (1999) calls IPAD (Inter-Personal Awareness Device) the devices that can support this kind of awareness. They have constructed a prototype, named ***Hummingbird***. This device gives participants of a team continuous aural and visual indication when other team-mates are close.

FieldNote (Morse et al., 1998) is and asynchronous awareness tool ran on hand-held computers connected to a GPS receiver to support fieldwork in the environmental sciences and archaeology. The system is used for data collection, the authoring and delivery of field exercises and student field experiments. Experiments shown that it is possible to collect more data, more quickly using hand-held computers than it is by using the traditional field notebook.

Context-aware telephony is also possible. A WAP-based application can offer a phone interface that allow the receiver to submit his or her context when setting up a call (Schmidt et al., 2000). The caller can then decide based on that information to place the call, to leave a message or to cancel the call.

The field of mobile gaming also benefits from the location aware techniques. ***BotFighters***[4] for instance, is one of the world's first location based mobile game that takes advantage of mobile positioning and let's the users play against others in their vicinity by using a standard GSM phone. Players locate and shoot at each other with their cell phones (by sending a SMS) out on the streets, where mobile positioning is used to determine whether the users are close enough to

[3] http://www.murmurtoronto.ca/

[4] http://www.itsalive.com/

each other to be able to hit. **Uncle Roy**[5] and **Can you see me now?** proposes the same game concept: self-reported positioning in which street players would report their won position, either explicitly by declaring their position to Uncle Roy or implicitly by their PDA sending information about which area of the map they were looking at to remote online players. **Human Pacman**[6] is also a mobile entertainment system that is built upon position and perspective sensing via Global Positioning System and inertia sensors.

Discussion

From a CSCW/CSCL perspective those LBS are of interest considering the new way people can deal with social spaces. The very concept of "social software" or "social middleware" is not just a overhyped buzzword. Rheingold (2002) coined the term "smart mobs" to refer to group of people who use this kind of tools:

> *"smart mobs consist of people who are able to act in concert even if they don't know each other. The people who make up smart mobs cooperate in ways never before possible because they carry devices that possess both communication and computing capabilities"*

Apart from navigation system mostly based on GPS, locative media falls in two categories that work on both synchronous and asynchronous timescale:

- **collaborative mapping / spatial annotation**, location-linked information (text or audio), allowing various application like collaborative mapping of an area, mobile blogging, social navigation, new forms of guiding for tourism or conferencing, spatial annotations, events triggering, location-based storytelling and so on.
- **finding and tracking** a person, a group or an artifact. Those systems offer both synchronous or asynchronous location awareness. Matchmaking devices belongs to this category.

Each of this category is meant for a different kind of use but they rely on the same technology as presented in the first section.

One of the most striking feature of those locative media used in a social context is that people can infer many things based on those information. "**Spatial assumptions**" **foster multiple levels of knowledge mutuality**. For instance, if A knows that B is at the library or heading to the restaurant, A can infer B's activity. If A knows that B is connected, A and B feels copresence and there is a virtual sense of

[5] http://machen.mrl.nott.ac.uk/Projects/CitywidePerformance/Unlceroy.htm

[6] http://mixedreality.nus.edu.sg/research-HP-infor.htm

community. The point is hence to find and interpret traces from others in space. An audio note left in Tejp is such a trace that tells you few things:

- your partner passed by (it is your partner because your part of the same community/group, you registered !)
- he or she found this area (or something is in this area) interesting because a note was left
- he or she wanted to communicate something to you that can be useful in the context of your activity/community

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Appendix 1: Geocode your gear ! linking information to an object

Attaching information to real world's stuff and gear is a trend. Projects like Aula or HP Cooltown ("everything has a web page!") are a step toward this direction. Geocoding is about embedding the location of an object in… the artifact itself. At the moment, geocoding an object in the physical world is possible but difficult. Indeed, one could use RFID tag and a tag reader but there is no universal protocol to sort out the artifacts or to search them. On the contrary, web pages (kind of artifacts) could be easily geocoded thanks to tag or RDF structure format (META tags, meta stands for metadata).

For instance, tags are used on geourl. This website maps documents in cyberspace to real-world locations. You add this code in the <head> part of your html document :

```
<meta name="geo.position" content="41.8833; 12.500" / >
<meta name="DC.title" content="Jackson's blog" /  >
```

The first line contains the Latitude and Longitude, and the second line contains the site's name. Once the site is added to GeoURL's database, you can immediately see who else has registered Web pages in (or about) your neighborhood. These coordinates are called an "ICBM Address." (Like, Inter-Continental Ballistic Missile). geourl is a search engine that can help you to search website and locations with map and vizualisations. The problem is that using latitudes and longitudes is not that trivial. GPS coordinates or those indication are not human readable as well as location names.

Another more complete format (source : igargoyle) for holding geospatial data is proposed by Dublin Core (beware xml syntax):

<dcterms:spatial> Elements:
<dcterms:description> (#PCDATA) : The description of your location.
<dcterms:projection> (#PCDATA) : The geospatial projection used.
<dcterms:north> (#PCDATA) : Distance north or south of the equator, measured on a meridian. Same as Latitude. This number is expressed in degrees.
<dcterms:east> (#PCDATA) : Longitude in degrees east of the Greenwich Meridian, with any number of decimal places. This number is expressed in degrees.
<dcterms:elevation> (#PCDATA) : The distance from sea level. This number is expressed in meters.
<dcterms:accuracy> (#PCDATA) : The geospatial accuracy of your coordinates. If you are purposely being fuzzy about your location, pick a point near your location and under accuracy, put an approximate

distance to your real location. This number is expressed in meters. <dcterms:speed> (#PCDATA) : The temporal speed, usually obtained from a GPS unit. This number is expressed in meters.

On the one hand, we have those metadata presented above. On the other hand we need software in order to search, sort, parse and transform into graphical maps those data. At the moment, those applications are yet to be developed... Use a searchbot to find your keys, your wallet or a book your geocached !

Appendix 2: Locative packets

Locative Packets is just an example of interface with a simple RDF/XML format for geoannotation. It has been created by Jo Walsh[7]. Omitting the header which declares XML namespaces, this is a complete locative packet, in outline.

```
1: <locative:Packet>
2:
3: <geo:long>-0.0104</geo:long>
4: <geo:lat>51.2377</geo:lat>
5:
6: <dc:title>Greenwich Observatory</dc:title>
7: <dc:description>It gets windy up there
sometimes.</dc:description>
8:
9: <foaf:maker>
10: <foaf:Person foaf:mbox="mailto:jo@frot.org"/>
11: </foaf:maker>
12:
13: </locative:Packet>
```

lines 3/4: WGS84 latitude and longitude, in decimal format

lines 6/7: title of, and text description of, your annotation, using terms from the Dublin Core metadata initiative.

lines 9/11: the annotation is attributed to a person, using terms from the FOAF vocabulary for people.

If you want to annotate a space with more than text, packets can be annotated with media objects of any kind - Image, Sound, MovingImage, InteractiveResource etc. We offer the DCMI Type vocabulary provided by Dublin Core as a way of typing media for this purpose.

Here is an example in full of a locative packet with media object attached; it doesn't get more complex than this.

```
<rdf:RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:rdfs="http://www.w3.org/2001/02/rdf-schema#"
xmlns:geo="http://www.w3.org/2003/01/geo/wgs84_pos#"
xmlns:foaf="http://xmlns.com/foaf/0.1/"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:locative="http://locative.net/etcon2004/loc#"
xmlns:media="http://purl.org/dc/dcmitype/"
>
```

[7] http://space.frot.org

```
<locative:Packet>

<geo:long>-0.0104</geo:long>
<geo:lat>51.5722</geo:lat>

<dc:title>Greenwich Observatory</dc:title>
<dc:description>A cool but quite clear October afternoon in
Greenwich Park.</dc:description>
<dc:date>2003-10-15T13:45:31+01:00</dc:date>

<foaf:maker>
<foaf:Person
foaf:mbox_sha1sum="c43ff6d043d3f72a7e94640aa036f654eaed804b"/
>
</foaf:maker>

<locative:media>
<media:Image
rdf:about="http://iconocla.st/photo/2003/10/12/img_0299-
m.jpg"
dc:format="image/jpeg"/>
</locative:media>
<rdfs:seeAlso
rdf:resource="http://iconocla.st/photo/2003/10/12/img_0299.ht
ml"/>

</locative:Packet>
</rdf:RDF>
```