LBWiki: A Location-Based Wiki

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ABSTRACT
Wiki systems provide a simple interface paradigm that allow non-technical users to author collaborative on-line hypertexts. In this paper we propose to use the same simple paradigm to allow users to create content for ubiquitous information systems, and present LBWiki, a prototype location-based Wiki that allows users with a mobile device to create Wiki pages based on GPS co-ordinates. We describe the hierarchical location scheme used within LBWiki and the results of a small evaluation, in which users reacted positively to the concept, but asked for greater control over geographical regions, and highlighted the importance of accurate location technology.

General Terms
Design, Experimentation, Human Factors

Keywords
Physical Hypertext, Location-based Systems

1. INTRODUCTION
Over the last ten years Wikis have brought hypertext authoring into the mainstream, Wiki systems allow ordinary users with little technical experience to create complex hypertexts, to work collaboratively in their creation, and to share the resulting documents and structure with others [2].

Over the same period we have also seen the emergence of Uniquitous, Pervasive Computing and Mobile Computing (Ubicomp) [12]. These are systems that depend on or leverage their users physical context or geographic location, for example to provide information that is relevant to their current location. One of the challenges with Ubicomp systems is that creating applications and content is difficult [11], this is because of a lack of a common platform, and the challenges of creating content that is specific to a particular place.

In this paper we propose that the Wiki metaphor might be brought to bear on this challenge; we present a prototype location-based wiki, that can be accessed on a mobile device through a wireless internet connection, integrates with a GPS device, and allows novice users to create information that is associated with a geographic location. This could be useful in the context of a Wikipedia style encyclopedia of locations, but also in more modest local applications (such as tourist or campus guides).

The Wiki is based on longitude and latitude co-ordinates, but uses a hierarchy of locations to allow users to create content at different geographic levels, this not only makes the wiki flexible, but also gets around the problem of empty content, as it is easy to define content at a high level (for example, a country or state) and allow this to be refined over time.

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2. BACKGROUND
Ward Cunningham developed the first wiki system called the WikiWikiWeb [5]. In general Wikis are online, web-based collaborative hypertext authoring systems [1]. In Hawaiian the word “wikiwiki” means “quick”, and wikis are characterised by easy editing and a relaxed approach to collaborative editing and data creation [2]. The Wiki metaphor has been extended in other work, most notably to improve the expressivity of a Wiki’s knowledge model in order to create a Semantic Wiki [8], a wiki in which all the nodes and links are typed, creating a semantic network that can be queried. The hope has been that the simple Wiki metaphor will translate to more complex knowledge structures [7].

In this paper we are proposing to use the Wiki metaphor with a location-based information system. Location-based information systems use location as part of their primary interaction, for example, a system that took a location, be it using GPS, cellular information or the name of a town, and then compiled a list of bars, restaurants and cafes in the area.

Geonotes is a system written by researchers in Sweden that uses wireless access points as a reference for location and allows users to leave “Geonotes” in specific areas. A “Geonote” is a small textual note that is available for other users to read if they are in the location in which it was left [6]. Other users may then comment on a Geonote which means that not only can users post notes they can also interact with other notes, bringing in a social element.

Another location-based system is NearMe, “a server, algorithms, and application programming interfaces (APIs) for clients equipped with 802.11 wireless networking (Wi-Fi) to compute lists of people and things that are physically nearby.” [3]. NearMe is not designed to find absolute positions but rather uses proximity. Other approaches to location include using a tag to track location, such as the Active Badge system [9], and using radio beacons [4].

Sometimes these techniques can be combined, such as with the Chawton House system which used both GPS and radio beacons [10]. Chawton also describes the problem of *experience building*, the process of creating content for a pervasive or mobile application. Chawton used a card metaphor to enable teachers to create a deck of activities to drive an m-learning experience, but the design had to be done on a desktop away form the physical location [11].

Our hope is that a location-based Wiki could provide a simple metaphor to allow users to create location based content easily, and with the flexibility to do it at the location of interest or through a desktop interface.

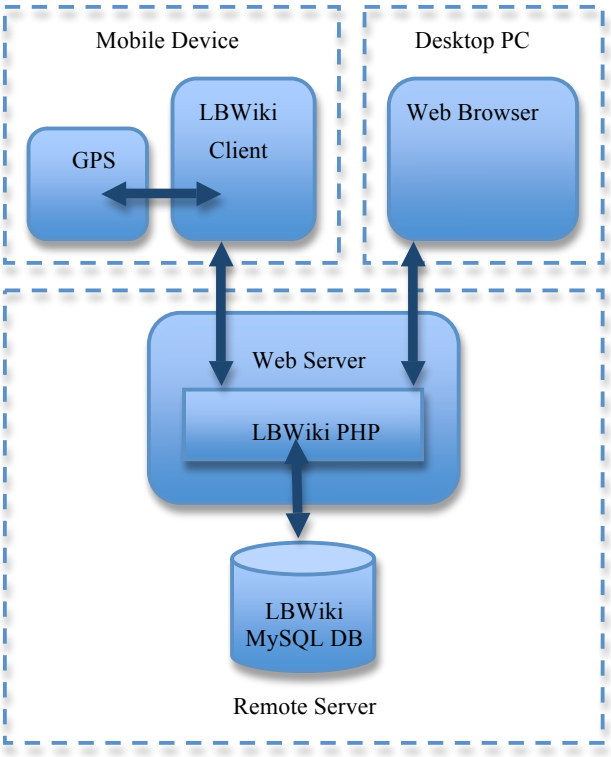

Figure 1: LBWiki Architecture

3. LBWIKI

Our Location-based Wiki is called simply LBWiki, it is a bespoke application written in C# for PocketPC devices, and uses an embedded internet explorer control to access a traditional Web Server running the LBWiki Server code (see

Figure 1). An ordinary browser can also be used to access the wiki pages, but the LBWiki client is capable of automatically reading GPS co-ordinates from the PDA and converting them into a URL to access the server (otherwise the user would have to write in the latitude and longitude co-ordinates themselves, or use the search facility to find pages).

3.1 Wiki Requirements

We had a number of simple requirements for our Wiki:

1. Use GPS data to retrieve a relevant wiki article
2. Have a simple wiki mark-up for formatting purposes
3. Provide an article history and simple versioning
4. Allow users to revert to previous versions of an article
5. Use a simple backend storage and scripting solution

We considered writing an extension for an existing Wiki system (e.g. a MediaWiki extension), however this would actually be more work than creating a basic wiki from scratch, since this was a feasibility prototype we chose to create our own Wiki backend. We also considered writing a plugin for the browser to support the first requirement of using GPS co-ordinates, but browser plugins are not well supported on PocketPC and it was easier to use .NET and wrap the browser control in an LBWiki application.

3.2 Location Model

An important part of our development was to create a location model that could be used within the Wiki, this had a number of separate requirements:

1. Allow for new locations to be added, changed or deleted with minimal disruption to the rest of the model
2. Be scalable - Due to the global nature of the project (locations could be allowed to be added from anywhere on earth with GPS and an Internet connection)
3. Allow users to add multiple locations at the same point.

There are many options for modelling location but the two main options are flat models, where every location is seen to be on one single plane or a hierarchy that sees locations as being at differing 'levels' within the model. We chose the later approach as it gives users the ability to add multiple locations at the same point within a straightforward structure.

Each node is either a geographic location or an area, geographic *locations* are conceptual areas whose dimensions are defined by the geographic *areas* within them, for example we might define a root geographic *location* for Europe, a sub-node for the geographic *location* of the UK, and a further sub-node for the geographic *area* of Southampton (with the last containing actual co-ordinates).

This sort of structure will allow users to add many locations that may be overlapping or may reside within other locations. Each node, with the exception of the root node, should have exactly one parent. It was considered that perhaps allowing multiple parents for each node would be an option but, while it may give users more options, it could create a model that is much harder to control and could be more fragile.

For these reasons each node may only have one parent. This leads to a chain of parent nodes (Figure 3), making it a simple task to show a user the relationship between their current location and the root node. When a node is added it is a simple case of assigning it a parent node (the root node being the default parent). Once this has been achieved the node is then part of the tree and may have children assigned to it later.

An area is denoted by the latitude/longitude of its bottom left hand corner and the latitude/longitude of its top right hand

corner. A geographic location has no co-ordinates, but these can be added to promote it to a proper area at a later time.

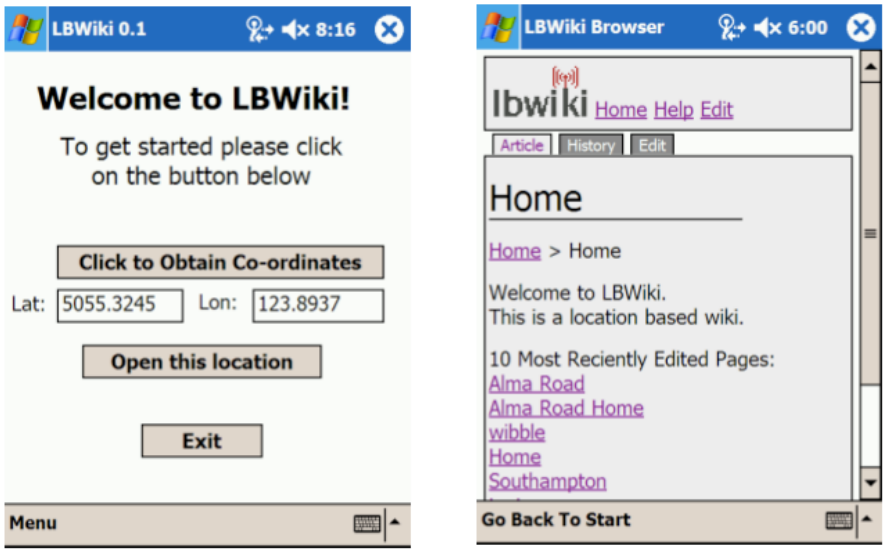

Figure 2: Screenshots of Front Page of Wiki and a Reading page

Allowing users to add locations without having to specify exact dimensions is a useful way of building detail with low user effort, although it does mean that co-ordinates that lie within a location, but not within an area, will not be resolved until an appropriate sub-area is created.

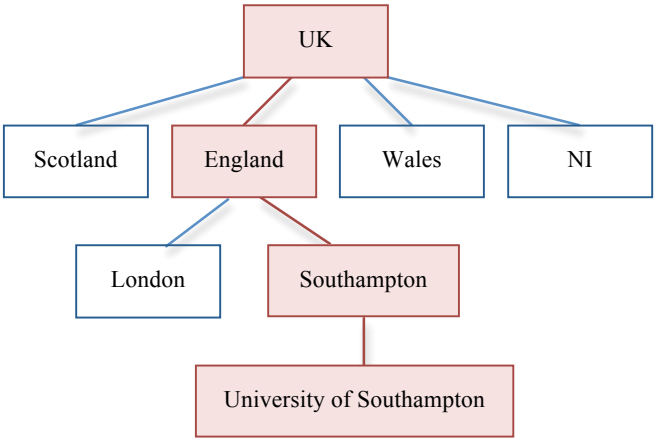

Figure 3: Location Tree (showing parent path in red)

The location/area distinction also allows non-continuous shapes to be modelled as geographic locations with multiple independent areas. For example, the University of Southampton has a number of distinct campuses, so this could be modelled as a location for the University node, and multiple sub-areas for each campus.

3.3 Wiki Application

C# was chosen for implementation as it is supported on Windows PocketPC and made it possible to utilise various helpful features such as the web browser object and serial port control.

The purpose of the PDA application is to get GPS (Global Positioning System) information from a GPS receiver and then to open a built-in web browser at the wiki page for that particular latitude and longitude in a manner that is simple for a user to understand and control.

The Wiki front page (shown in Figure 2) allows the user to get the latitude and longitude co-ordinates from a GPS device and look them up in the Wiki. The latitude and longitude are acquired by reading in a stream of data from the GPS unit via a COM port (a serial port).

Once a latitude and longitude has been obtained from the GPS unit, the user is able to utilise a built-in browser. When the user is happy with the acquired latitude and longitude co-ordinates they may instruct the program to proceed, by pressing the "Open this location" button, and a browser window is shown with the appropriate wiki page for that location (shown in Figure 2).

3.3.1 Editing a Wiki Page

If the user wishes to edit one of the wiki pages several things will happen. When the edit page is loaded the database is queried and the pages details are retrieved from the database. These details, such as the contents and title of the page, are then put into the html form for editing.

The latitudes and longitudes may not be directly edited, instead they must be incremented and decremented in lots of 5, 20, 100 or 1000 meters. This is so that the system may retain some level of control over the user input. This control is needed as giving users a free range to enter any values they wish could break the overall system or they could just give values that bare no real meaning in the real world.

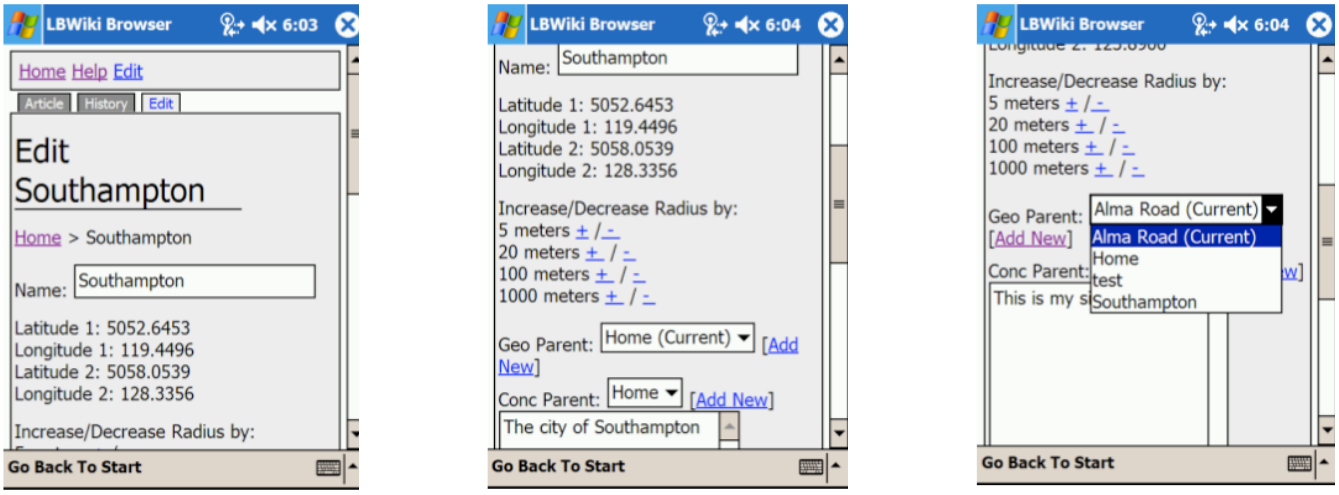

Figure 4: Screenshot of edit page and edit page with drop down list of Parents

Upon loading, the potential geographic parents for the current page are also found and put into a drop down list, starting with the current parent. The generated list is a list of all other areas that fit in with the criteria for being a potential parent of the current location. The user may then choose one of the parents in the list or they may decide that there is nothing suitable and click on the 'Add New' link to create a new area.

When the user chooses to add a new parent they will encounter an edit page much like the edit page described above. The suggested latitudes and longitudes are taken from the previous page and are then altered to be approximately 5 meters bigger in radius than the previous values. This is to try and avoid the user forgetting to make a change and then attempting to create another page with the same geographic data (which would essentially be a new version of the previous page rather that a new parent area). The name of the page is left blank and should be filled in before submitting. The user may then also choose to enter some information about this new area if required.

Figure 4 shows a screenshot of the edit page, and an example of the drop down list of parent locations.

4. EVALUATION

We undertook a small user evaluation to assess users' reactions to LBWiki, to test our interface decisions, and to validate our choice of a location model.

Each participant was given a brief introduction to the device and the functioning of the Wiki client and was asked to undertake a number of tasks using the Wiki (for example, editing an existing page, or creating a new geographic area). They were then asked to fill in a short questionnaire designed to try and get opinions from users as to what they think of the system in terms of the general approach (a location based wiki), the interface, the location model, and the ways in which editing and browsing work.

In general we found that reaction was positive, and users liked the idea of using a hierarchy to order location rather than using a flatter model. However, their understanding of how the model worked varied and some users needed more explanation even after the testing was done.

The users seemed comfortable with the location model, although it was suggested that having more location mechanisms working alongside latitude and longitude would be good:

> *"What's wrong with a post code? People will know their post code but won't generally know their GPS."*

Another issue was the method used to alter the latitude and longitude data. Currently the user is only allowed to expand or contract the radius of the area. This is very restrictive and does not allow the user to create areas that are of different shapes (in fact the only shape the areas will currently be is square). Users had clear expectations about this:

> *"Use Google maps!"*

Google maps can provide GPS data and so would be almost ideal in this respect. However, it was not used in our system as unfortunately Pocket Internet Explorer is not supported by Google maps and therefore cannot render the Google maps application.

During user testing there was at least one comment that there should perhaps be an alternative method for denoting location, just in case GPS is unavailable:

> *"I think it [using GPS locations] is a good idea to a certain extent but if GPS is out of range, another method would be good."*

There was also a comment from a user during the evaluations that it might be a nice idea to try and integrate the application into a browser rather than have a standalone program that integrates a browser into itself:

"Having the browser integrated into the application is good, certainly better than it being in a separate window. It might be useful if the application could be integrated into other browsers."

If this were possible it would make the wiki simpler to use but is difficult with today's limited mobile browsers.

Users also highlighted frustrations with the GPS system:

"GPS is in principle a good idea though it needs to be more accurate..."

The problem was that unlike GPS applications such as mapping and navigation tools, the Wiki takes a spot reading of the current location in order to calculate position. This means that GPS jitter can cause seemingly large inaccuracies, we partially solved this problem by averaging a number of readings, but the rate of polling the GPS device meant that we were restricted to a maximum of ten readings, which meant that in some circumstances more consistent fluctuations (such as signal echoes from nearby buildings) can still badly affect the accuracy.

5. CONCLUSIONS AND FUTURE WORK

In this paper we have described our attempts to build a prototype location-based wiki, LBWiki, to test the theory that the Wiki paradigm could simplify the creation of location-based content in a similar way that it simplified the authoring of collaborative hypertexts.

Our evaluation highlighted basic usability issues rather than any key flaws in the idea of a location-based wiki, for example, more complex mechanisms for defining location, integration with external mapping tools, and problems with GPS jitter. The core idea was well received, and we are now considering how to move LBWiki forward from a prototype to a more robust version that we can deploy in some m-learning scenarios.

Although the evaluation showed that our users were happy with our location model, this needs further exploration, as some more advanced tasks may require more complex models. For example, we could define other types of positional relationship between nodes such as adjacency.

In addition a model that allowed multiple parents for a node could give more flexibility to users as they could directly link locations and areas to each other and create more of a web of locations rather than a tree. This could give the option of linking to "peers" on a page as well as parents.

Other possibilities include linking LBWiki with the latitude and longitude information within Wikipedia, perhaps by querying DBpedia[1] for relevant pages. LBWiki could either become an interface for browsing Wikipedia (similar to Geopedia[2]), or could seed its own pages with relevant content.

Although the LBWiki prototype is relatively limited, we believe that the location-based Wiki idea could be of great use to the Ubiquitous Computing and m-learning worlds, by bringing a well-understood interaction paradigm to bear on the tricky problem of how to create content for location-based information systems, and how to enable non-technical users to build location-based experiences.

[1] DBpedia: http://dbpedia.org/About

[2] Geopedia (iPhone): http://mazinger.cs.yale.edu/iphone-apps/

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