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Alice Birdwatching: a community built knowledge base for birdwatchers

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Abstract

Drawing on the reasons for the origins of the Internet, the web 2.0 phenomenon in the latter decade has enabled Internet users to become not only consumers but also producers of information, something that most of them didn't let pass.

The success of User Generated Content (UGC) sites like Wikipedia has inspired the expansion of the principle to other, more specific contexts. Similarly, there has been an explosion in the abilities of mobile devices, which have also started contributing to this content frenzy with different types of data, such as geographically referenced content.

This document describes the conception and development a project, Alice Birdwatching, that aims at creating an online community for content generation in the context of birdwatching. This application will allow birdwatcher to generate content about their favorite hobby (sometimes taken very seriously) in an easy and comfortable way, such as it was not available on the web as of the writing of this paper. The application will also take advantage of mobile technologies, both to help generate content and to help bird watchers on the field, where a computer would be a liability.

We will begin by explaining the motivations behind the project, and the potential it has for success, then giving an overview of what is being made in the web, as well as explaining the UGC phenomenon through the research done, both in technological and psychological terms.

The technologies used will also be explained, as well as the architectural and implementation details.

The final chapters will report on the results obtained so far and conclude upon those, giving better vision of the potential success of the application and closing with suggestions for future additions or uses of the application, its content and its structure.

Resumo

Baseando-se nas razões que levaram à criação da Internet, o fenómeno web 2.0 da última década permitiu aos seus utilizadores tornarem-se, não só consumidores mas também produtores de informação, uma oportunidade que muitos não deixaram passar.

O sucesso de aplicações que permitiam a geração de conteúdo da parte dos utilizadores (*User Generated Content*, UGC) como a Wikipedia, inspiraram o desenvolvimento de novas aplicações, expandindo-se a outros contextos mais específicos. Paralelamente, tem havido, nos últimos anos, uma explosão no mercado das comunicações móveis e nas capacidades dos seus aparelhos, permitindo que estes se tornem também fontes de informação, contribuindo com conteúdo com formatos diferentes, nomeadamente dados referenciados geograficamente.

Este documento descreve a conceptualização e desenvolvimento dum projecto, Alice Birdwatching, que almeja a criação de uma comunidade de criação de conteúdo no contexto do *birdwatching*. A aplicação permitirá aos seus utilizadores gerar conteúdo acerca do seu hobby (por vezes levado bastante a sério) de uma maneira fácil e confortável, não ainda disponível na Internet no momento da escrita deste documento. A aplicação tirará também proveito das tecnologias móveis, tanto para gerar conteúdo como para ajudar os utilizadores em situações em que um computador não é um instrumento utilizável.

Começaremos por explicar as motivações por detrás do projecto e o seu potencial para o sucesso, fazendo de seguida uma observação do que se faz actualmente na Internet em termos de conteúdo gerado por utilizadores, referindo pesquisa tanto na área tecnológica como na área de psicologia.

As tecnologias utilizadas serão explicadas, tal como a arquitectura do sistema, bem como os detalhes da sua implementação.

Nos capítulos finais serão colhidas conclusões baseadas nos resultados obtidos até então da utilização do sistema, bem como serão oferecidas sugestões para futuras adições ao sistema e utilizações do seu conteúdo e estrutura noutros contextos e aplicações.

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This paper and its work are dedicated to the one that has helped, inspired and also distracted throughout its development, proving to be at the same time my best and worst companion, the Internet.

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Abbreviations

ADT	Abstract Data Type
API	Application Programming Interface
DBMS	Database Management System
GIS	Geographic Information System
GPS	Global Positioning System
HTTP	Hypertext Transfer Protocol
OECD	Organisation for Economic Co-operation and Development
OGC	Open Geospatial Consortium
ORM	Object-relational Mappings
PDF	Portable Document Format
RDBMS	Relational Database Management System
REST	Representational State Transfer
SDK	Software Development Kit
SOAP	Simple Object Access Protocol
WWW	World Wide Web
XML	Extensible Markup Language

ABBREVIATIONS

Chapter 1

Introduction

1.1 Context

Ever since they started valuing knowledge, humans have thought of ways to register it, to save it somehow, in order to share it with others as well as not to forget it. It started with cave paintings, evolved into engraved writing, ink (or blood) on papyrus, then paper, and eventually, thousands of years after the first hand print in Chauvet, France, 32000 years ago [Zuc], on the Internet. The more portable the means of storing knowledge, the easier it became to share it and at the same time, the easier it became to improve on it and to spread it. Thus we can infer that portability of information has been, in some ways, related to human technological evolution.

In its early years, the Internet was used as a means of quick written communication between two or more points of the globe. The difference to other instantaneous communication devices of the time was that it was easier to save the conversation. This was the beginning of e-mail and early discussion boards. These devices allowed people to rapidly create content and respond to other people's content with their own, be it with the objective of improving that same content for scientific reasons or simply as a form of amusement.

A parallel can be established with the Internet and the evolution of communication in general. As more people were able to access the medium, the more knowledge was created, the more improvements were made upon the medium, the easier it became to share knowledge, and so on. Speed, bandwidth and storage space have increased through the years that the sizes and speeds used 15 years ago are laughable matter.

In more recent years, many were the tools that made possible that knowledge generation could be done by virtually anyone with access to a computer connected to the Internet, making everybody online a potential content creator (and most of the times an

effective content creator). Although some of the "ancient" ways of sharing information are still in use today, new and improved forms have appeared that have made some of the most impressive knowledge bases possible and made the Internet the main, and most of the times the only source of information.

Coupled with this information evolution was the evolution of another form of communication, that eventually converged with the Internet, the mobile phone. Nowadays, most mobile phones are connected to the web and are information generation sources as well. Being easier to carry around, mobile phones can also share a different kind of information, namely georeferenced information, as well as they allow the filtering of existing information depending on their position on the planet.

1.2 Project

This document describes a project that proposes a web application that, based on the present tendencies of user-generated content and geographically referenced data, creates a community able to share information about Birdwatching. This project was proposed by Ubiwhere (www.ubiwhere.com) and its concept and context area was developed in conjunction with another company called Ecoinside (www.ecoinside.pt), of which some members are active birdwatchers.

The project aims at enabling an existing and active community of birdwatchers to produce content related to their hobby, namely information about species of birds, as well as allowing them to share their experiences in the matter.

Drawing from other existing concepts and the fact that the context of birdwatching has not been served with such a service, the project was classified as potentially successful, if well implemented.

In combination with another project at Ubiwhere, the online application will support the creation of textual and multimedia information, and will display information produced by its mobile counterpart. In addition, it will be possible for users to operate a system that alerts them on their mobile phones, according to rules established online.

More specifically, users will be able to:

Read, Create and Update information on bird species, points of interest and events related to birdwatching, by means of text, photographs and geographically referenced data (such as bird sightings and habitats or geographical locations of points of interest)

Create Trip Reports on voyages they have done in order to observe exotic bird species and wildlife in general. This is a subject birders take seriously but that does not have a standardized format nor any other way of easily read that by downloading

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PDF documents. It will allow the sharing of textual and pictorial information about the trips as well as displaying the route followed during said trip.

Interact with other users and bring the existing community of birdwatchers to the online world.

Create notifications to be received by their mobile devices according to the rules specified by them online, such as proximity warnings on bird sightings, habitats, points of interest or events.

The fact that it is an innovative system, specially in the birdwatching sector, is a major motivation for the author and the company, both in terms of the development of such a product but also in its commercial potential.

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Chapter 2

State of the Art

This section will provide an overview of collaborative content generation tools, virtual communities and geolocate tools existing today, as well as quoting some research done in the field. Possible applications of such systems will be presented as well as their commercial opportunities.

2.1 Introduction

Since the beginning of the Internet, one of its intended uses was the share of knowledge. Users would communicate on themed bulletin boards (BBSs) that evolved into forums and into social networks, wikis, blogs and other modern applications of user connectivity and information sharing [Rut95].

While the 1990s saw a growth in personal and isolated webpages, the early 2000s brought about what was called Web 2.0, bringing new solutions in networking and cooperation to its users.

In recent years, this ability was made available to the mobile market, with mobile phones and smart phones gaining the ability to access the World Wide Web, adding data of their own, such as photographs, videos and geolocate data.

The possibilities that these systems bring, by themselves and joined together, are huge, their complexity and wide range of application deems it necessary to understand them fully. This section will describe these systems as a whole, as well as some successful examples existing on today's market.

2.2 User Generated Content

Although there is no widely accepted definition of user generated content, the most agreed upon conception, defined by the Organization for the Economic Co-Operation and Development (OECD, www.oecd.org), is that User-Generated content:

- **i)**: is content that is made publicly available over the Internet;
- **ii)**: reflects a certain amount of creative effort;
- **iii)**: created outside of "professional routines and practices".

That means that such content is uploaded by "normal" people by their own free will, on their free time and not by someone who is being paid or ordered to do so. Also, this content is the fruit of that person's creativity and the fact that it is available online for distribution, evaluation and alteration allows other users to give feedback to the original work and collaborate with their own knowledge to improve it. The requirement that it must be done outside one's professional routine exists to ensure that the content does not serve a company's agenda or market purposes.

This was made easy when Internet connections became faster and information storage became cheaper, users could easily access a website with more information than before and enter their own data almost instantly and service providers could sustain all the data that was being posted by their users.

User generated content's importance was acknowledged by Time magazine in its 2006 choice for "Person of the Year", mostly due to user participation in site such as Youtube and Wikipedia [[Mag](#)].

Reasons behind the motivation to contribute content may seem unclear at first. The benefits of user generated content for its host and "read-only" users are obvious, as readers get a lot more data with many different viewpoints and companies get huge knowledge bases from where to extract vital data, from user opinions to market opportunities. Motivation for a user to generate content comes from two kinds of incentives: implicit and explicit [[Sma10](#)] [[WVV07](#)].

Implicit Incentives are driven by an intrinsic motivation not based on anything tangible. They can be separated in social and user experience incentives.

- *Social Incentives* - Mechanisms that provoke a pleasant feeling on the user, for being a participating member of the community. They are generally a way to highlight the impact of a specific user on other users of the same community. These incentives can be verified in the way an user relates with others (receiving more visits to his page, being well rated, agreed upon, replied to or replicated), being given privileges (like a feature on the main page, being made part of the "most influent" users, user

content being elected as significant by administrators) or gaining awards such as badges or levels, for achievements on participating in the site's activity.

Examples of this kind of incentives can be found in many applications on the web such as Yahoo! Answers [[urli](#)](that rates users based on amount of answers as well as acceptance of answers by others).

Social incentives appeal to motivational aspects that financial incentives do not. Although money can be a great source of motivation, social rewards seem to trigger deed psychological reactions that can sometimes bring very high motivation.

- *User Experience* - Mechanisms that provoke a pleasant feeling on the user for being on and using the site. The experience depends on the quality and quantity of the site's content as well as the site's design. The way a person feels while using a web site will influence the duration of the visit and the will to return to the site. If we think about sites that require user participation, the ease with which people use the site is a key factor on its success.

Implicit incentives, while they required little monetary investment, require a sizable community in order to draw new users and keep the ones that already belong. There is no sense of connection or belonging to a group if there is no group.

Explicit Incentives refer to tangible benefits from usage of a service. That is to say that a user is paid or is given a way to monetize his participation on the site. This can be done by direct or indirect financial reward (such as cash, vouchers, coupons, etc) or prize draws such as lotteries that offer cash or other material gifts.

These incentives can help attract users to a service, but are obviously more expensive for the host and may bring consequences, if withdrawn.

Depending on its nature, purpose, relation between users and method of participation, different types of User-generated content sites can be defined.

2.2.1 Discussion Boards

Some of the earliest and most popular forms of communication between multiple users on the Internet, the bulletin board systems, newsgroups and mailing lists proliferated from the 1970s to the 1990s. These allowed users to sign in to the service and access and post data like news, bulletins or exchange messages with other users. Although still in operation today, bulletin boards evolved into Forums in the mid-90s, switching from the operating system terminal to the web browser. These work as sequences of messages devoted to a specified topic. Usually one user begins a topic by asking a question, and others answer the question by replying directly to the message posted before or by posting another question in the same topic. This creates a list of sequential messages called thread

that can run as long as it takes, usually being deleted if left unanswered for long. In these Forums, a sense of community often develops, especially if there is a sizable number of regular users. Depending on the forum's theme (music, film, sports, politics, etc) and type, (image board, discussion board), the kind of content and the way the community works differ.

Often, registration is required to access or at least to post messages on these boards, but sometimes anonymity is encouraged. This sometimes has a great impact on the way message threads develop, for people posting anonymously will feel a greater freedom to express themselves, express incendiary opinions or even insulting content, even if it differs from their actual beliefs.

To keep order in such environments, most forums have moderators or administrators that delete messages deemed inappropriate or expel users that were reported as abusers. Internet forums are usually the birthplace of most of what is known as Internet Slang, Internet Memes and Image Macros, that eventually spread to other parts on the Internet, sometimes by means of users who do not understand the origin of the content they are spreading [Bla00].

Discussion in these forums has led, in special occasions, to actions taken by the community outside the forum, such as the demonstrations against the Church of Scientology all over the world by members of the Anonymous community, belonging to a widely known image board called 4chan (www.4chan.org).

Despite their usually dated visual aspect and unchanging method of communication, forums are still widely used and, sometimes, the only source of information in some topic on the World Wide Web.

2.2.2 Blogs

During the 1990s, many website owners would have a section on their site dedicated to what was called a diary or a journal, where one would post daily or frequent updates on one's life or activity (depending on the web site or person keeping said diary). Early on, these diaries were manually updated to the site by the author, and, because of their nature were called *weblogs* (web logs) by Jorn Barger on December 1997. In April 1999, Peter Merholz coined the term "Blog" when he deconstructed the word weblog into the phrase "we blog" on his own blog [Mer99].

From then on, a blog was defined as a list of articles, with relative periodicity, listed in reverse chronological order and edited by a person or group of people online. Eventually, tools for the creation and maintenance of blogs became widely available and used, with sites such as Open Diary [[urle](#)] or Blogger [[urla](#)] gaining huge popularity. Eventually, comments were also incorporated into blogs, making it possible for readers to comment on each post and, sometimes, creating communities of readers of a specific blog. In

present days, blogs are a significant part of the Internet, being used either by companies to publicize their products or by costumers to complain about said products, by news reporters, music critics, artists, teenagers or moms talking about their personal lives.

Originally, blogs were mostly text articles, but, as web technologies evolved, video blogs ("vlogs"), blogs focused on photography and other types of media have appeared as well. The ease with which users were able to update their blogs and the access to broadband connections gave way to a phenomenon called "liveblogging", in which posts are made describing or transcribing events that are happening at the moment, so that others without access to the event can take notice of what is happening.

Since everybody can own a blog and post, most politicians, company owners, political and economical analysts, other specialist and opinion makers frequently update their own, news papers have lists of relevant blogs on their online versions. The role of blogs as an accepted and credible news source was important during events such as the natural catastrophes of New Orleans or Sri Lanka and political scandals in the United States of America.

In recent years, coupled with the arrival of mobile phones with access to the Internet, a new kind of blogging has appeared. Microblogging is described as basically the same as blogging, in which a user posts a text, image, sound clip or video in his "blog" (usually known as timeline in microblogging), but in a smaller size. Texts are usually around 140 characters long.

One of the most famous microblogging services, Twitter (www.twitter.com) has begun with the premise of asking it's users what they were doing at the moment. Massive use of the service through the years brought it to major attention when it became a primary source of news updates in crisis situations, most notably the Mumbai terror attacks and Iran protests, in which journalists, with no other way to report the happenings, wrote quick messages to twitter, bringing the news to the world almost instantly [CES09]. As with blogs and social networks, microblogging services are extensively used by companies to announce and market their products, arguably bringing more attention to a small post, compared to a publicity banner or an e-mail.

2.2.3 Collaborative Projects

Although discussion boards allow input from various users, this input can only be appended to the end of the thread, which means that any alterations to content have to be submitted in a new post. Blogs allow editing of previously written text, but only by the owner, or owners of the blog. Both blogs and discussion boards bury old posts or messages under new ones, making navigation and search difficult. Due to these difficulties, different tools for content generation by large groups have been created. The most well know and widely used is the *wiki*.

The first wiki, WikiWikiWeb was developed by Ward Cunningham in 1994, who chose the hawaiian word for "quick" to name his product in order to avoid calling it "quick-web" [[urlh](#)]. Since then, wikis garnered a large user base, whenever communication and collaborative content creation (sometimes in large networks) is needed.

Usually, a wiki is a website that, at first, displays content of some type. Users (often-times, all Internet users) are invited to add their input to the already existing content and to alter content they find in need of changing, despite being authored by other users. This way, the content's authorship is shared by every user that has made an input. Most wikis, nowadays, facilitate the creation of pages, links and other text enhancements to users that might not know HTML code. The simplified markup used in wikis is sometimes called "wikitext".

As with forums, moderation is often needed, especially in terms of biased content, for the openness and ease with which a wiki can be edited may attract vandalism or posting of untrue content. Despite such risks, it is the same openness and user friendliness that allows such content to be corrected and brought back to normal.

Most wikis also implement some kind of version control system in order to revert malicious or erroneous changes. Some of these systems allow for the comparison of two versions of the same text, highlighting the differences between them, so that editors can choose which version to keep and which to discard.

Wikis are now most prevalent on websites that require user input to keep and enlarge a knowledge base, the most well known being Wikipedia (www.wikipedia.org), a universal encyclopedia where virtually anyone can add and change content and has around 15 million articles in 262 languages.

2.2.4 Social Networks

A Social Network is a web application based on the social relations and interactions of its users [[BE07](#)]. It usually relates a user with people he knows, provides a base for sharing and communicating easily through the web and allows one to find other people through the relations of others and the people and interests one might have in common with them. Oftentimes, social networks are based on a specific context, for instance social networks about the users' musical tastes or reading habits. This allows for the notion of web community, in which the users share specific information about their tastes and interests with people they know in real life, but also with people they have met online through not only other people but also their common interests. Some of the more widely used social networks are Hi5 (www.hi5.com), Myspace (www.myspace.com) and Facebook (www.facebook.com).

Since membership is usually free of charge, most social networking services are not financially profitable, but they allow for different business approaches from other companies, such as game companies or targeted advertising. Companies are also beginning to value social networking services as a means to connect with the costumers in a deeper and cheaper way, originating a new form of marketing.

Recently, social networking services have begun using geolocateive capabilities to give their users one more way to interact, allowing users to know the location of people they know in real time and some even allow users to add data to the virtual representation of the world in different ways such as comments, images or place descriptions.

2.2.5 Virtual Worlds

Virtual worlds are platforms that create a three dimensional environment in which users can interact with each other by means of their personalized avatar, much like user profiles in social networks. In these worlds, users can do virtually anything they would be able to in real life, and sometimes more. There are two types of virtual worlds in use today. The first is virtual game worlds, in which users have to obey certain rules and follow a more or less strict path in order to complete quests, gain points and rise in the game ranking. User input takes the form of items to be sold on virtual game markets, worn or used by them in their quests or given to others. Famous virtual game worlds, like Blizzard's "World of Warcraft" (www.worldofwarcraft.com) or Sony's "EverQuest" (everquest.station.sony.com) have millions of subscribers and earn those companies million of dollars each year, both in monthly user fees and in-game advertising.

The other type of such applications is virtual social worlds. These, like game worlds, allow users to create their avatars and interact in a virtual three dimensional world, but users are subject to a less strict list of rules and can roam about and do whatever they please. Instead of quests or missions, users can have jobs, construct buildings and do other things that are possible in actual real life and some other more. The most prominent of such applications is Second Life (www.secondlife.com). In the Second Life virtual world, users can earn virtual money for their efforts during play, such as having a job or selling items created using the game's many building tools and eventually exchange virtual money for actual U.S. dollars. This virtual market works as an incentive to users to create their own content, besides the implicit incentives already explained. As in game worlds and social networks, virtual social worlds have become a haven for different approaches to company advertisement.

2.2.6 Intellectual Property and UGC

Taking into consideration that user-generated content is, mostly, an original creative expression of a person, this person's rights must be observed.

Generally, copyrights confer to authors and/or right holders a set of exclusive rights, namely related to control over reproductions, derivative works, distribution to the public, public performances and public display. In some countries, copyrights are also intended to protect rights of integrity and attribution, sometimes identified as the moral rights of authors.

In OECD countries, copyrights aim at balancing a creator's exclusive rights and the public interest of the creation. This is done by means of exceptions and limitations made to the original set of rights.

Copyright issues related to UGC arise from a number of different factors. It is necessary to distinguish between "original work" and work created from pre-existing content. The derivation of original work is a difficult issue because it becomes hard to identify when a work is a copy or a derivation, and with which permission was the original work used.

A large section of UGC consists in the upload by individual or groups of original content, being automatically granted copyrights due to their originality, not implying a standard of quality or effort on the creation. Rights granted to these users are the same as those granted to creative efforts in other circumstances. As with those other circumstances, the copyright factor may be a catalyst to the production of the work, especially when users aim at a gainful activity through the commercialization of their works. Creators of UGC platforms may opt for other licensing schemes, such as the Creative Commons licence, under which other users are automatically allowed to copy and distribute the content, provided that they give credit to the original creator. While these licences permit copying and non-commercial use, original authors can specify restrictions that need to be observed by those interested in creating derivative works.

Copyright laws typically limit the copyright holder's ability to control derivative works. Some examples of UGC actually depend on these derivative works to constantly improve their content [[WVV07](#)].

2.3 Geolocate System

A Geolocate system is one that identifies the real-world position of a Internet-connected device such as a laptop, mobile-phone or Smart Phone. Usually, these systems attach the identified location to a virtual map. From this simple ability, many different applications can be created, based on specific needs. From simple tracking systems that store the geographic positions of a truck delivering goods, to GPS systems that advise drivers on the best route to their chosen destination, or to social networks where people can know where their friends are at each moment.

All these different applications use some or all of the following concepts: user, map, route, points of interest, area of interest, direction and distance. The descriptions of said concepts are as follows:

- **USER:** A user, in a geolocate system, is, normally, the person that owns or carries a device that possesses a GPS cell or any other means of providing geographic coordinates.
- **MAP:** A geometrically accurate representation of an area, in this case, the whole world. Most Internet-based maps offer the choice between a satellite view or a graphic view of the ground. Other viewing options include basic navigation options such as panning and zooming.
- **ROUTE:** A sequence of points in a Map, depicting a path or succession of points in the map that were followed or are to be followed by a user.
- **POINT OF INTEREST (POI):** A static point on the map that is of particular interest to one or all users of said Map. It may or may not possess additional information other than the position itself such as a name, textual information or multimedia contents.
- **AREA OF INTEREST (AOI):** The same concept as a POI, only applied to an area instead of a point.
- **DIRECTION:** The way a user is facing at a given moment. Usually calculated based on two or more sequential points on a user's recent path.
- **DISTANCE:** The space between a user and a POI or AOI, that can be used to support the user with relevant information or trigger events.

2.3.1 Geolocate Community

By the end of the last decade, many websites started providing ways to associate content on the web with real places on the surface of the earth, taking advantage of the availability of maps of the world on-line and their users' will to contribute content.

These applications can have all sorts of shapes and purposes, ranging from simple geographic tagging of photographs, to social networks that tell users where their friends are in real time, to tourism oriented applications that advise users in terms of points of interest and routes to follow.

All these applications have one or more of the concepts that are described in the next sections in common, so they must be understood to a broad extent.

2.4 Human Factors on Geolocative Communities

Some research has been made in the area of Geolocative Communities. Most of it deals with the Human and Social points of view and the way users react to the services provided, specially concerning levels of participation, immersion with the application and privacy concerns.

2.4.1 Information credibility and will to contribute

Members of these communities accept content displayed for them as credible, even knowing it is provenient from other users [PKHD09]. In fact, users take their social network members' opinion as a reference point for their own decisions (for example in a touristic context). This also prompts users to submit their own data, be it descriptions of a place, comments on such place or their experience in said location.

In cases where place popularity was revealed, users' opinions were divided, some stating that place popularity was a good sign of quality, but, for others, this would mean a place would be too crowded and thus unpleasant. Users also revealed to be careful with this issue, preferring not to give popularity to a place when aware that it would decrease the place's appeal to others [LPRT07]. However users also revealed that this opinion would depend on the user's mood. In any case, users would accept a place as recommendable if the recommendation came from a friend [PKHD09].

Users using mobile devices prefer to read all information left by other users about a place than approaching another member of the community personally to get information [BFDL08]. This is most important especially because users want to gather the most information in the least time possible, thus preferring this asynchronous way of accessing data.

Users were also pleased when presented with information regarding places or events on their vicinity that were related to the one they were analyzing at the moment [PKHD09].

2.4.2 Privacy issues

One of the most important issues with location-aware applications concerning communities of users is the user's privacy. Despite users' will to submit information about locations they know, they are reluctant to submit personal data, mainly references to one's house and workplace [LPRT07]. Most users are also reticent about the availability of their actual position to others and even more about their dwelling history [LPRT07] [PKHD09]. Since these systems show to be aware of a user's actual position, users were wary that this information was not entirely confidential. Given the rise in popularity of social networks, the notion of privacy has become less strict, with users preferring to create rules about when or where to disclose their geographic position [TKD⁺09]. When contributing data

to the system, some users also revealed that they would rather choose to whom it would be available, regarding the data's privacy and possible readers' level of personal proximity to them [LPRT07].

2.5 Existing Applications

In this section we list some of the most used user-generated content applications, with some attention given to those that implement geolocative data and would be most similar to the project in discussion.

2.5.1 Web Only

On this section we refer only to those applications based solely on the web or that their primary use is through a web browser.

- **Wikipedia** (www.wikipedia.org), as mentioned before, is an user-generated encyclopedia. Its name is a *portmanteau* from wiki and encyclopedia, meaning that information is uploaded to the site by means of wiki technology. Since its beginning, in 2001, this ever-growing website, based on the principle of "neutral and non-biased" point-of-view, hosts articles on virtually everything with links between articles, references to sources and contents of different media formats. Since anyone can edit information, it has been a target of criticism, especially in articles about more sensible matters such as some religious institutions. To avoid bias and marketing, companies are banned from editing the site, allowing users to post information that companies would possibly not allow on their articles.
- **Last.fm** (www.last.fm) is a service based on the United Kingdom and dedicated to music. It provides information about music, artists and albums, based, mostly, in a custom recommender system that suggests users artist they might like, based on the songs they most listen to, previously registered by a small program installed in the user's computer. Meanwhile, users are invited to update information about the artists, be it descriptions, videos, images or concert dates. This service is particularly interesting, considering that part of the content is uploaded passively (i.e. by simply listening to music).
- **nextstop** (www.nextstop.com) is a web based application where users can add *recommendations* about specific locations in a world map. The content added consists of a small textual description and visual content such as pictures. The system creates collections of recommendations on a common subject, called *guides*, so that users can discover what is available in a certain location and plan a route through locations within the same theme, be it architectural types or historical spots.

- **Qype** (www.qype.co.uk) allows users to review locations with focus in user experience of said locations. It's main focus is on quick search of local or nearby business, mainly restaurants, bars and entertainment venues. It's base of information is completely user created.
- **Panoramio** (www.panoramio.com) is an application that allows users to identify photographs with real-world locations. It's objective is to complement *Google Maps* and *Google Earth* with user-uploaded photos, so that map users can learn more about the places they are looking at on the map. It's content has context, giving users the possibility to filter the information and search for specific locations or contexts. The application also offers an API so that developers can use its capabilities in applications of their own.
- **Hotlist** (www.thehotlist.com) is a web location based social application that focus on showing users information on their surroundings, based on their friend list on *Facebook*. Users are informed about what their friends are doing and where, the events that are happening or going to happen on their vicinity or to which their friends are attending, with information relating to gender ratio, age groups and other affiliations between attendees. Users are also allowed to review venues and places they visited.

2.5.2 Mobile Only

This section lists Geolocate community applications primarily or exclusively based on mobile devices.

- **Gowalla** (www.gowalla.com) is a location based *iPhone* application in which users are encouraged to generate content with geographical references like monuments, bars, restaurants or gyms and leave, at those places, virtual objects or messages for others to find out. The application recognizes the actual position of the user, allowing him to "check" into it, in case it is a *known* position. Once checked in a location, the user can see if other users have left messages, virtual objects or messages or he can leave his own objects or messages on that location.

This game-like interaction between users and places, creates a sense of community, in which users share objects and plan on the next place to meet or exchange information on where to find a certain object.

- **FourSquare** (www.foursquare.com/). Similarly to *Gowalla*, this application works based on it's users' capability to "check-in" to a place and add information about that place. Information added can be of many forms, such as tips on nearby places or suggestions on menu items (in case the location is a restaurant or a bar). As

before, the application's idea is competition and cooperation between users, decorating users with "badges" for the achievements they make, which can be being the first to "check-in" to some place or venturing outside the user's usual dwelling area.

- **Aloqa** (www.aloqa.com) is a **context-aware** application that alerts users to their nearby places, events and friends (via *Facebook*). By subscribing to different contexts, the user will be notified about items of that context that exist on his vicinity and that might be of interest to him. The position of the user's friends is also disclosed, so meetings can be arranged. Although the actual position of the user is known to others, it's history is never kept on a database, protecting, thusly, the privacy of the users.

2.5.3 Mobile and Web

This section is dedicated to list applications that combine their use and approach to users on both platforms, web and mobile.

- **Loopt** (www.loopt.com) is a web and mobile based application that allows users to know where their friends are and what they are doing. The application integrates data from other applications, mainly on content related to places like bars and restaurants, but also on the social networking aspects (like *Twitter* and *Facebook*). It also enables users to share geo-located photographic content, lookup and share place and event information and filter information.
- **Dopplr** (www.dopplr.com) presents itself as a service for smart international travelers. Initially developed for users to compare travel plans so they could meet if the plans crossed, it is now an application where users share personal and business travel plans exclusively with their social network. Users are encouraged to create content relating to locations they have visited or plan on visiting. The collection of content is presented as a Social Atlas, as the application's developers call it. In addition, this application is also able to calculate the *carbon footprint* of a user's trip.

2.6 Birdwatching

Birdwatching, also known as birding, is the activity of recreational observation of birds in the wild, both with the naked eye or by means of a visual enhancement device, not often without the aid of sound recording equipment. It differs from ornithology, where one studies birds using formal scientific methods and not for recreational or social reasons [Dun03].

Although discrete, birdwatching is a hobby practiced by millions of people worldwide, most notably in the United States and the United Kingdom and, more importantly, people with income levels usually well above average. In 2006, birders (or birdwatchers) have spent 36 billion USD in North America alone [url], and there are many tourist resorts overseas dedicated mainly to birdwatching tours.

For the most part, the birding market revolves around books, binoculars, telescopes, voyages, hotels and guides. Most of the scientific information available to birders is located in relatively expensive illustrated books. The next sections will describe other kinds of applications, their relations with what was mentioned before and the market possibilities this hobby offers.

2.6.1 On the Web

There are several types of websites dedicated to birdwatching. Some are built by birdwatchers on their free time, with little to no knowledge of proper web development while others are developed to market birding trips. Following is a list of some of the most popular websites and respective descriptions:

- **We Love Birds** (www.welovebirds.org) is a social network dedicated to birdwatcher, created by the Natural Resources Defense Council in a partnership with the Cornell Lab of Ornithology with the Ning platform (www.ning.com). It allows users to create a user profile (similar to most social networks) and share photographs, videos, blog posts (by means of a community blog) and ask and answer questions related to birding. The site also has a section that lists books about birds and birdwatching and a section that shows activities to protect birds and nature in general. Despite creating a community of birders, the site has a very restricted structure, both in terms of design and in terms of usage. There is not much interaction to be had between users, apart from posting or commenting on blog posts and photos. Nevertheless, it is probably the best birdwatching site around.
- **Birdpedia**. There are a few sites with this name on the web, but, for the purpose of this document, we shall mention only two. www.birdpedia.org is an open access wiki about birds, especially birds in general, not isolated species. The main page offers some links to texts and pictures, but the bulk of the site is in some pages with long texts about general information on birds, like migration, nesting or morphology. Despite the Wikipedia-like aspect, navigation is not facilitated, due to lack of links between pages. (www.bird.pedia.com) is a site built with the intention of offering information about the past and present of birds and to be the main source of such information. In fact, the site, as of June 2010 is basically one page with some information about birds and a list of links to news about birds and nature.

- **The Internet Bird Collection** (ibc.lynxeds.com) is a website with the aim of providing a knowledge base on birds species. It urges its users, the birdwatchers, to share their material about birds with the world, stating that such material is of no use to the world if kept at home. Being a little more dedicated to multimedia (image, sound and video) content, there is also textual information about each species. Bird species are grouped by orders, families, genera, species or subspecies. The site also provides visitor with simple statistics on its data and a ranking of the material, achieved by user votes. Besides this, the site has a more appealing design than its counterparts, which is probably one of the reasons for its apparent success.
- **Traveling Birder** (www.travellingbirder.com) is a service created by two danish brothers, that hosts trip reports, that is to say, reports written by birders on the trips they make to various countries in order to watch the local avifauna. It presents a list of such reports in their original form, i. e. pdf files and html pages, as well as statistics on the locations the trips were made and other data. Although most of these reports follow more or less the same structure, there is, apparently, no standard for their creation. Besides, this method leaves no other choice for the user than downloading a pdf document, if he wants to read a report. Other than that, the site also offers news about birding in its main page.

As we can see, there are many websites dedicated to birdwatchers, some with the intent of taking advantage of the community factor and new opportunities offerer by the Internet, but, so far, there is none that groups all those functionalities that appeal to birders and most are simply not appealing.

2.6.2 On the mobile phone

Keeping up with the recent rise of the mobile and smart phone market, and especially with the application stores of smart phone companies, some applications focused on the birdwatcher market niche have appeared. In this section we will list some of the most popular applications, their ups and downs and compare them with each other and the scope of our project.

- **iBird** (www.ibirdexplorer.com) is a iPhone and iPod application that aims at replacing books on every birdwatcher's backpack or pocket. It provides the user with text, illustrations and sound clips, to help him better identify the species he finds. The application packs a powerful search engine, with various parameters raging from name, color, habitat, wingspan and more. Despite having the alleged equivalent of 4000 book pages, it only carries data on north american and hawaiian bird species. There are various versions of the same application that differ on the amount of species they carry and with the cheapest carrying 15 species and the most expensive

carrying 924. Despite its many interesting search and comparison features, it does not make use of the phone's geolocation device, to show the user possible species on the vicinity.

- **Audubon Birds** (www.greenmountaindigital.com) was created with the help of the National Audubon Society of the United States for the iPhone. It comes with data on 752 North American bird species (U.S. and Canada), 3000 photographs and, allegedly, the largest library of bird calls. This application allows users to contribute to the web community with sightings and photographs via their mobile phones as well as showing a map with migration ranges and habitats. It also provides the user with a quick guide, that helps one find a bird based on its shape and size, and allows the user to create lists of birds based on a subject of his choice.
- **National Geographic's handheld birds** (<http://www.handheldbirds.com>) is a multi-platform mobile application, created by the National Geographic Society, that boasts 867 bird species of north american birds, with illustrations, textual data, non dynamic maps with ranges and migration patterns of each species and its songs and calls.

As shown, there is some offer in the market for birdwatching oriented applications, and most of them offer the same range of capabilities, like text, image and sound data, most also have search engines optimized to quick identification on the field, and one even has the ability to register bird sightings. Unfortunately, all of them are solely dedicated to species existing in the United States and Canada and they all depend on data created by professionals.

2.7 Conclusions

In this section we presented the current panorama and tendencies of the collaborative web, found some applications that follow such tendencies and narrowed the selection to the project in discussion in this document.

Nowadays, a large part of the data flowing on the Internet is uploaded to it by its normal users. Sometimes, this content creation is done by collaboration between users, either synchronously (photo and video editing, blogs, discussion boards) or asynchronously (wikis, other types of data). Either way, users are constantly creating new content or improving on the one already existing, most of the times with no monetary incentive at all, only for amusement or a sense of usefulness in the community.

Narrowing the field to birdwatching, a popular activity in the middle to upper classes in some countries, this kind of approach to content is not yet well tackled by currently available applications and websites, leaving open ground to new ventures. Such is the aim of this project.

Chapter 3

Solution Specification

Drawing on the conclusions of the previous chapter, we will now specify our approach to a possible solution.

3.1 Overview

The proposed solution is a content community website where users will be able to create content specifically dedicated to birdwatching, with particular attention to bird species and trip reports, but also with information on points of interest to the community (such as hotels, stores, parks, etc) and a notification system to users with the mobile application that complements the online version.

It also allows users some level of interaction, in order to improve the cooperation process and especially the sense of community around the website. In an initial phase, some suggestions are also made to the user, mostly in terms of possible birds he might like to know about or points of interest he might want to visit, based on his previous history of content creation (both text, image and sightings) and reading.

The next sections will present the system in full detail and will explain some of the reasons behind the choices made during its development.

3.2 Content creation

One of the main features of this application is content creation by users.

After doing research on UGC websites and applications and the human factors behind it (seen in chapter 2) and taking into account the capabilities of the technologies used for development, it was decided that all content, with the exception of trip reports, may be created and edited by all users. Trip reports, due to their more personal context, are created

and edited only by their creators. All content is, nevertheless, subject to supervision by website administrators in order to avoid untrue, offensive or copyright infringing content. Content administrators will have the power to edit content and, in extreme cases, ban any user that repeatedly abuses the system.

As with most such applications, there is no reward to content creation at this point (possibilities will be discussed in the chapter 6) leaving the activity itself, and its implicit incentives, as sole motivation.

Creation and alteration of content is made in separate pages from the one where it is displayed. Textual content is edited by section, that is, each of the sections seen in a bird species's or trip report's page is edited in its own textbox or area. When applicable, title and content of sections are edited on its own editing areas, which are coupled together. File upload pages are also used, especially because of their nature and the need to search for the file. Separate pages are also used to manipulate geographic content and to interact with the Google Maps interface. The use of separate pages for different types of content, was used in order to avoid cluttering of pages with text editing areas, maps and other options, thus simplifying and harmonizing the user experience. In most cases, all data upload or deletion is done seamlessly, by means of Ajax requests, so that the user does not have to wait for page loads to add another section or save the work done so far.

Text edition is mostly done in simple text areas, leaving little margin to text formatting and not allowing the creation of links in mid text, as seen, for instance, in wiki-type services. This choice was made in order to avoid the creation of empty links and to simplify both the editing and the reading of the texts,

Following are detailed descriptions of each type of data a user is allowed to have an input.

3.2.1 Bird Species

Bird species and their data are critical in this application. The required *basic information* for a species is their name, their scientific name and conservation status. Other information such as a brief description or introduction is also included in the identification section of a bird species.

Additional information, such as breeding, feeding and appearance, among others, is inserted as separate sections and their titles are given as a suggestion for users to include and in a separate page.

Users can upload an *illustration* that will appear on the species's page or upload *photographs*, to which they can append a description and credits (if it was not take by them). There is also a photograph editing page, where users can change descriptions and credits, as well as deleting photographs deemed inconsistent with the species.

Habitats are edited on the habitat edition page, which gives access to a map and shows which habitats have been created (as areas on the map), allows to move or add new vertices to the area to be edited, change the title and description of each habitat and delete a habitat, if found inappropriate.

Although *Sightings* are created via the mobile application, there is a sighting editing page, where a user can change text or delete sightings he has uploaded related to that species.

Users are also able to create a list of *similar species*, by means of a simple list of existing species.

3.2.2 Points of Interest and Events

Points of Interest (POIs) are locations in the world which may be of relevant interest to the user, in this case for birdwatchers. They can be any kind of point, such as a landmark, hotel, vacation resort, store, national park, etc. Creation of POIs can be done in two ways, either by creating a draft POI while editing a trip report's route, or by using the POI creation page.

On the first case the user can choose the geographic location of the POI, by means of an interactive map and can add a name and a brief description to that point.

By using the POI creation or editing pages, the user can insert a name and a descriptive text, as well as upload photographs (similarly to bird species) and change the geographic position.

Events follow the same structure, but they do not need a specific geographic reference (although they can have one) but they have a date and time reference, that works as an expiration date.

Further use of POIs and their marketing potential are discussed in chapter 8.

3.2.3 Trip Reports

As seen in chapter 2, trip reports are extensive descriptions of trips made by birdwatchers in order to observe bird species and other wildlife. The current method for the creation of a trip report is by writing a text document in a text editor and save it as a PDF file or by creating a simple html page. It was noticed that trip reports, although not following a specific or standardized structure, had many sections in common but could sometimes be used as a diary of the trip. They usually incorporate photographs and references to hotels and other places that were visited and used during the trip.

We decided to provide users with an easy way to both read and create a trip report, without having to change website nor to write or download a text document.

To create a trip report, a user begins by providing a *title*. Afterwards, on the trip editing page, the user can specify the locations visited during the trip and write a brief summary.

As with bird species, edition of different content of a trip report is done in separated pages. *Sections* can be added to the trip report, suggestions being displayed for their titles (accommodations, weather or money information, for example) but allowing users to provide their own title to each section, in case he wants to have the trip report to work as a diary. As with bird species, saving or deleting a section works seamlessly, so that a user can easily edit several sections without waiting for each section to be saved.

The *Route* followed during the trip can be changed in the route page, where, with the aid of an interactive map, a user can add POIs to the trip and order them, being able to easily change the order or remove a POI from the route. A choice can be made between listing existing points or creating a new one (as stated above).

Photographs can be added and edited in the same way as is done with bird species, and the user is also allowed to upload a PDF file, if he as already created one for the trip, or wants users to be able to have a printed version of it.

There is also the ability to create a list of bird species sighted during the trip, in order to help navigation.

3.2.4 Notifications

Notifications are part of the interaction between the web and mobile versions of the applications. Users edit their preferences on when and how they should be notified, in their mobile application. Notifications are associated with POIs, events and bird species, as in, a user can choose to be notified when in physical proximity with a POI or a bird species (sighting or habitat area), or temporal proximity with an event.

Users can choose to follow specific species, in order to receive notifications for sightings, but they can also choose to be notified of all sightings within a specified radius.

3.3 Content presentation

A very important part of the user experience in such an application is the way the users will see the data presented to them. As we saw in the previous chapter, most sites supporting user generated content, such as wikis, blogs or forums, follow a very specific and formulaic format. Taking into account the fact that birdwatchers are used to read information on books, where images and text struggle for space, we decided to give priority to illustrations in a first impact and text as extra information.

This way, every piece of content, bird species, trip report, point of interest or notification, appears with a big illustration or map centered on its geographic location. To the right, some important but short pieces of information, such as names and titles, scientific names, summaries or small descriptions and creation credits are shown. Under this section, the user is presented with three icons, depending on the content he is reading,

that give access to more data. Common to all data types, is the "Read More" button, that shows the text sections referenced above. In order to spare the user the need to scroll down through long extensions of text, sections are separated by title and are instantly displayed when the respective title is clicked. The title changes its color when selected, in order to show the user which section is being read. The "Gallery" button is also common to all data types, showing a paginated photo gallery, displaying not only the images but also their description and upload and creation credits.

Bird species have a "Map" button, that shows a map with further options of showing sightings or habitats.

Trip reports have a "Birds" button, that lists the species observed during the trip.

List menus are presented as three columns that list content according to different contexts. Bird species are listed as recently created, recently sighted and recently uploaded images. Trip reports are listed as recently created, most read and recently uploaded images. Points of interest follow the same scheme. User pages list their recent activity, users following and users followed.

3.4 User interaction

User interaction in this application is aimed at providing a sense of community and help providing the implicit incentives mentioned in the previous chapter. Thusly, users are credited for the content they create and can see each other's user profiles. A connection between two users can be established, both unidirectionally or bidirectionally by means of a system similar to that of services such as Twitter, that is, users can choose to follow one another, giving priority to information created by people they follow on their main screens and profile pages. This system also works as an incentive mechanism, for users might see as a reward and token of appreciation the fact that others choose to follow them.

Displaying users identities in content also allows for the reporting of abusive users to the administrators.

3.5 Chapter Summary

The chapter started by overviewing Alice Birdwatcher, an online content community website.

It described different types of content displayed on the website, such as *Bird Species*, *Points of Interest*, *Events* and *Trip Reports* and the way users will be able to access, create and edit it.

Solution Specification

The manipulation of content is made in separate pages depending on the type of media to be updated in order to simplify the content generation experience. Text formatting is limited so that the reading experience may benefit.

Users may follow each other's activity in order to prioritize content to be displayed and to measure community acceptance of content created by them.

Chapter 4

Technology

< Alice Birdwatcher is an on-line community developed using the ASP.NET MVC 2 framework, extended with the Nhibernate and Sharpmap frameworks. It uses a Postgresql database with PostGIS extensions. It also uses the GoogleMaps V3 API to provide the maps interface. It is hosted in an IIS7 server. This chapter will describe these technologies and explain the reasons behind their choice.

4.1 ASP.NET MVC 2

ASP.NET MVC 2 is an open source web application framework released in early 2010 by Microsoft. It is built upon the ASP.NET MVC framework, that implements the model-view-controller pattern. The reasons behind the choice of this technology are based on the previous familiarity with .NET technologies as well as some flexibility in defining the project's architecture, that is, in case the model component would not be necessary. ASP.NET MVC 2 uses the MVC pattern but also allows for more flexible programming and for the use of Object-relational Mappings (ORMs) other than the one used by default. This last fact was proven important, when it was decided that the Relational Database Management System (RDBMS) would not be SQL Server, ASP.NET's RDBMS by default.

4.1.1 ASP.NET

The ASP.NET framework was created by Microsoft in the late 1990s and early 2000s to try to improve on the problem of separation between presentation and content and to try to allow developers to write "cleaner" code.

Separation of presentation and content management is done by having different files host the code of each section.

Presentation is done by means of files with the .aspx extension that host regular *XHTML* code with the possibility to have markup that defines or calls code that runs in the server, used either to call server-side methods or to display server-side variables. As with other technologies this code is defined within the a block as thus: <

Content managing code, running on the server can be developed in any language running over the Common Language Runtime (CLR), which encompasses C#, Visual Basic.NET, or other .NET languages. This code is usually known as *codebehind*, especially in .NET Web Forms applications and websites, and is written in the same way for web sites and other applications. Codebehind files bear the same name as presentation files, with the addition of their own extension, for example, WebPage.aspx would be the presentation page, and WebPage.aspx.cs would be its corresponding codebehind file written in C#.

This separation, as with the model-view-controller is aimed at helping development to be more agile, leaving the content presentation to those in charge of design and the content management to programmers.

4.1.2 MVC

As its name clearly states, ASP.NET MVC 2 uses the Model-View-Controller architectural pattern. This pattern imposes a division on the code in three separate parts, according to their function in the application. This helps organizing the code, allowing for different roles in the development process. Following is a description of each section.

- **Model** - maintains the state of the application, that is, is responsible for storing the data used in the application, usually on a database, and managing any constraints applied upon that data. This insures that these constraints do not have to be made elsewhere on the code and that the data always remains consistent and valid.
- **View** - generates what is displayed to the user, that is, it generates the user interface. Usually, a view is the visual representation of a model, but the same model can have multiple views, both for output and input of information. Despite this, a view never handles the input data.
- **Controller** - controls the application, receiving data and events from users, interacts with the model and renders the views. ASP.NET supports request handling by the controller, in which a routing component selects which method in which controller the request is supposed to call, based on the request URL.

As with webforms, server-side code can be run from a view if, for instance, the intention is to show a user's list of friends, it can be iterated as follows. (code example)

Model, in this case, is the object sent to the view by the controller (in this case, a User type object), whose properties and methods can be accessed by the view.

Technology

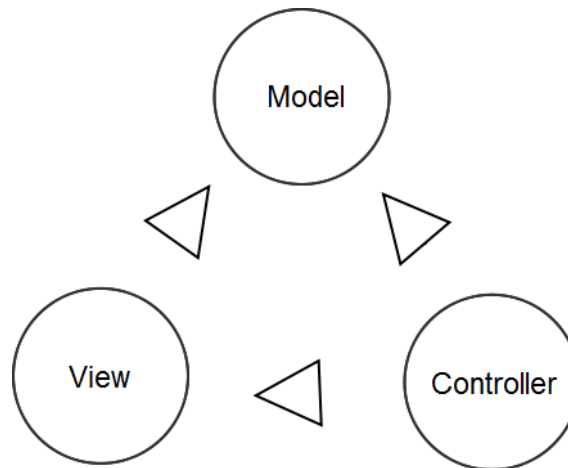


Figure 4.1: MVC pattern

Input forms, such as textboxes, can be associated directly with that object, in an *Edit* page for instance, and their content is sent via POST request to the controller, where they can be accessed by their names.

ASP.NET MVC 2 is built so that it facilitates the easy development of unit tests and test driven development in general.

4.1.3 Nhibernate

Nhibernate is an open source Object-relational Mapping solution for the .NET platform and a port from the Java ORM Hibernate. It provides mapping of an object oriented domain model, that is, objects in an object oriented programming language, to a traditional relational database. Its purpose is to relieve the developer from writing relation data persistence code (such as SQL).

A typical Nhibernate implementation comprises a set of classes, written on a .NET language (in this case C#), a set of xml files that maps each class to and from the relational database and an interface that brings them together. This interface is used by the application (in our case, the *controllers*) to read, save, update or delete data. In this project, the Nhibernate interface and the set of classes it maps to the database work as our *model*.

Mapping in Nhibernate manages all types of relations in a database, from simple tables to join tables and many to many relations. Since mapping is done in xml, it is human readable and thus easier to write and correct, contrary to writing full SQL mappings.

Following is an example of how the mapping works.

Technology

```
class Employee
{
public int id;
public string name;
public Employee manager;

}
```

The model class, written in C#.

```
TABLE Employee (
id int identity primary key,
name varchar(50),
manager int )
```

The "Employee" table definition in SQL.

```
<hibernate-mapping xmlns="urn:nhibernate-mapping-2.2"
auto-import="true">
<class name="HelloNHibernate.Employee, HelloNHibernate"
lazy="false">
<id name="id" access="field">
<generator class="native" />
</id>
<property name="name" access="field" column="name"/>
<many-to-one access="field" name="manager"
column="manager" cascade="all"/>
</class>
</hibernate-mapping>
```

The mapping file, in XML.

```
static void LoadEmployeesFromDatabase()
{
using (ISession session = OpenSession())
{
IQuery query = session.CreateQuery(
"from Employee as emp order by emp.name asc");
IList<Employee> foundEmployees = query.List<Employee>();
Console.WriteLine("\n{0} employees found:",
foundEmployees.Count);
foreach( Employee employee in foundEmployees )
Console.WriteLine(employee.SayHello());
}
}
```

A function from the Nhibernate interface, that lists the employees on the database [[KHBK09](#)].

After being built, the Nhibernate interface is completely transparent to the controller, both in terms of code and performance.

Although ASP.NET MVC provides an ORM to SQL Server, it does not support PostgreSQL, the RDBMS chosen for this project.

4.1.4 Sharpmap

Sharpmap is a simple open source mapping library for use in web and desktop applications using the .NET framework it provides access to many types of GIS data and enables spacial querying of that data. The engine was written in C# and is based on the 2.0 .NET framework.

Sharpmap includes a Geometry Object Model based on the Open Geospatial Consortium's Simple Features and includes all the objects define therein, such as Points, Lines, Rings, Polygons and combinations of multiple of these objects at the same time. It can also calculate distance between objects, whether a object is inside one other, and many other functionalities.[\[urlf\]](#)

4.1.5 Ajax

Asynchronous JavaScript and XML, usually known as *Ajax* is a group of interrelated web development techniques used on the client-side of a website to create interactive web applications and improve the user experience on web sites, by avoiding reloading the pages when an action is performed by the user. Data is still retrieved from the server, by means of XMLHttpRequests, but the use of XML is not necessarily required.

The technologies used by Alice Birdwatching to implement Ajax are listed as follows:

- **Javascript** - an object-oriented scripting language that runs on most actual web browsers, that is, on the client-side of a web application, although it can also be used in other contexts.
- **JQuery** - a Javascript library created in order to simplify client-side scripting. It is the most used JavaScript library today and is used, in this context, to facilitate HttpRequests and animate some displaying activity, to improve the user experience[[urlec](#)].
- **JSON** - an acronym for JavaScript Object Notation, JSON is an open standard designed to provide human readable data interchange. Despite its relation with JavaScript, it is language-independent, with parsers available for virtually every programming language [[urld](#)].

In this project Ajax is used in most pages, be it listing, displaying or editing pages, by means of *Javascript* code enhanced by the *JQuery* library. JQuery is used to send request to the controllers, which send their responses by means of *JSON* objects. This facilitates the receiving of data to be swiftly displayed on the website.

4.1.6 REST

REST is an architectural style which considers the web as a collection of resources addressable with Uniform Resource Identifiers (URIs). A resource is the conceptual target of its URI. Each resource may have multiple representations, and provides a common interface to act upon it [[FT00](#)]. To make this clearer, an webpage is not a resource, it is a representation of a resource in HTML, normally accessed through a GET request on its URI [[Tom09](#)]. However, there are other methods such as POST and UPDATE, which are used in REST as well. The following table shows the methods allowed by REST.

Table 4.1: HTTP methods used in REST

METHOD	ACTION
GET	<i>gets</i> information from the resource
POST	<i>adds</i> information to the resource
PUT	uploads a representation of the specified resource.
DELETE	<i>deletes</i> the resource

ASP.NET MVC 2 takes advantage of its routing engine to execute these methods, allowing for not only shorter and cleaner URLs and giving developers the freedom so choose their shape. Usually, URLs take the following shape:

```
http://{server}/{controller}/{action}/{parameter(s)}
```

Parameters are usually an object's identification number but can be a list of parameters. If, for example, we wish to show an user's profile page, the url for the get method can be as follows:

```
http://{server}/{Account}/{ShowUser}/1
```

Whereas *Account* refers to the *AccountController* controller, that manages all accounts and users, *ShowUser* is the view that displays an user's content and *1* is the parameter that tells the controller which user shall be displayed in this view.

These URLs can be used both by the MVC mechanism and by Javascript (via the JQuery library), to implement the Ajax calls that allow for quick and swift edition pages we talked about in the previous chapter.

4.1.7 Summary

ASP.NET MVC 2 helps developers separate work in three separate sections, allowing for different teams or developers to concentrate on their work instead of having to meddle with other parts of the code. The learning curve might be steep, either for ASP.NET developers or developers used to other languages, but the fact that code is mostly on HTML and C family languages, it is less steep than other languages. Being partly compiled increases its performance and scalability, which is essential for a project like ours, that requires a satisfying user experience and must allow for massive amounts of data to be processed.

Some downsides, as the need to use proprietary technologies was overcome by using PostgreSQL instead SQL Server. Despite this, applications developed in this technology must be stored in a IIS server, which is not free, but many web hosting services provide ASP.NET hosting without a big increase in price.

4.2 PostgreSQL and PostGIS

4.2.1 PostgreSQL

PostgreSQL is an open source object-relational database system running on all major operating systems. It is fully ACID compliant, has full support for foreign keys, joins, views, triggers and stored procedures and includes most SQL:2008 data types. It also supports storage of binary large objects including pictures, sounds or video.

Some of its advantages are its speed, extensibility, reliability, stability, scalability and availability of a vast documentation and support community.

4.2.2 PostGIS

PostGIS is an extension to PostgreSQL that enables it to be used as a back-end spatial database for geographic information systems (GIS). PostGIS follows the Simple Features for SQL specification from the Open Geospatial Consortium, thus including all basic geometry types mentioned above, as well as spatial predicates and operators.

Geometry types from the Sharpmap framework are mapped to Well-known Binary types in PostGIS. Well-known Text and Binary types are also regulate by the OGC.

PostGIS has little competition, especially in the open source database world, which makes it an easy choice.

4.3 Google Maps V3

Google Maps is an Application programming interface (API) that allows for the display and interaction with a world wide map in web pages, desktop applications and mobile devices. Besides displaying the map, the API also allows markers to be set on it, as well as areas and information windows, among other features.

V3 is the most recent version of the Google Maps API, now implementing a modified MVC framework, reportedly brings improvements in performance to both the web and mobile applications. The API is accessible through Javascript code, using the map and its components has objects. This allows for easier collaboration between the map and the rest of the website, in this case, the controller and models, and for faster and more responsive Ajax pages.

This project uses some of Google Maps characteristics such as the map itself, *markers*, *polygons* and *infolwindows* [[urlb](#)].

4.4 IIS7

IIS7 is a full-featured and robust web server application and set of extension modules created by Microsoft. It is the second most popular web server in terms of overall websites. It provides important features such as basic authentication, digest authentication, content negotiation, HTTPS, FTP, CGI and IPv6 and is extendable. Since its initial versions, security and performance issues were fixed and IIS is now a safer and faster web server. IIS facilitates deployment directly from the development environment (Visual Studio 2010), by means of its WebDeploy agent, but FTP deployment is also possible from Visual Studio.

4.5 Chapter Summary

This chapter presented the technologies used in the development of this project, beginning by presenting ASP.NET MVC 2 and the frameworks used to complement it, Nhibernate and Sharpmap. Together, these technologies make it possible to develop fast, scalable and complex applications without that complexity having a great reflection on the development work.

The application uses PostgreSQL to store data, with the PostGIS geospatial extension. Both are a fast and reliable database service, as well as an open source solution to build application needing to store geographical data.

Part of the interface of the application is based on maps, provided in this case by the Google Maps API Version 3. This new version brings better performance as well as a new and improved architecture, that integrates perfectly with this project's application via Javascript.

Technology

Chapter 5

Implementation

This chapter sheds light on the implementation details of this project, such as its logical and physical architecture, as well as other significant implementation details and decisions.

5.1 Architecture

This section explains the architecture chosen for this project, both physical and logical.

5.1.1 Physical Architecture

Considering the needs of the application, it should be hosted, as should the Database Management System, in a single server. If successful, though, the system is liable to need more space and better bandwidth, deeming the move to a better service a crucial necessity, at that point, in order not to compromise the whole service.

5.1.2 Logical Architecture

This system's logical architecture is organized in terms of components and entities.

Alice Birdwatching is has five components, server, website, mobile device webmethods and the relational database managing system, which are described graphically in [5.1](#).

Server - Hosts the web application, manages all the data flowing to and from the database and the interaction with the mobile devices.

Mobile Device - The mobile application, installed in a mobile device (such as a smartphone). Interacts with the whole system via Web Methods running on the Server.

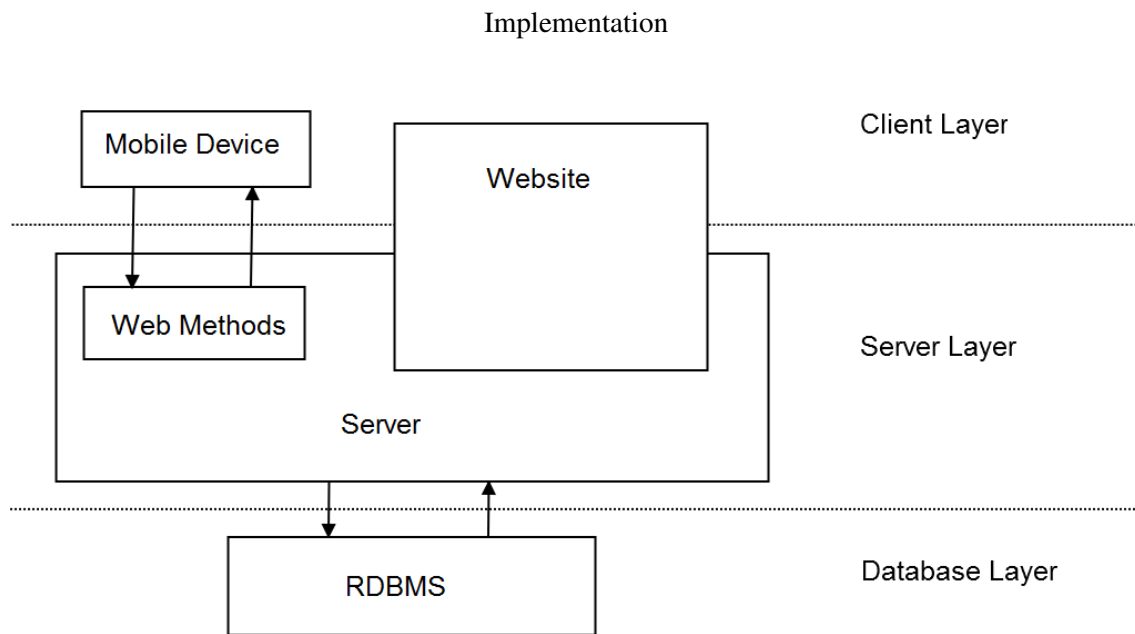


Figure 5.1: Logical Architecture

Web Methods - Endpoints for interaction with the mobile application, get and set information to and from the mobile devices.

Web Site - The main concern of this paper, provides interaction between online users and the whole system, allowing the input of data to the server.

RDBMS - Holds all the data used by the other components of the system, mapping the relations between all the system's entities.

The server, website and mobile device components use the entities defined on the system. Following is the list of entities and their relationships, shown in [5.2](#).

User - a human individual who is registered in the system. Besides being able to access all readable data available in the system, the user can also create new and edit existent data, such as Birds, POIs and Trip Reports.

Bird Species - an entity representing a bird species, containing textual information (as fields as well as sections), as well as images and geographic data (habitats and sightings).

Trip Report - a report about a specific trip taken by a user or group of users. Includes textual data in the form of fields (for basic information) and sections, as well as a list of birds sighted during the trip, a route and photographs.

POI - a point of interest to birdwatchers, such as a store, hotel or park. Contains textual data in a similar way as the previous entities, a geographical position and photographs.

Implementation

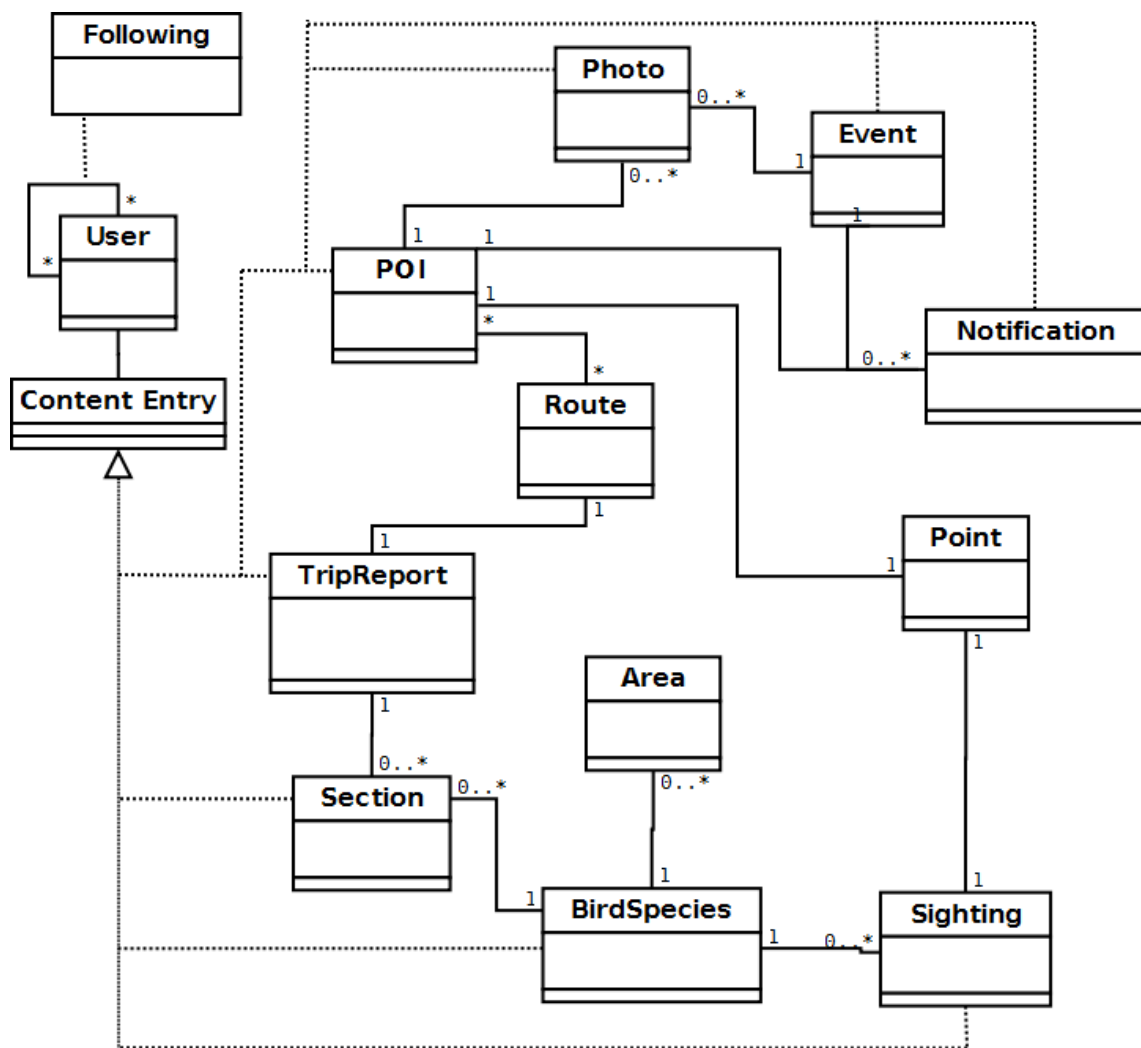


Figure 5.2: Alice Birdwatching's Class Diagram

Event - works much like a POI, only with a temporal reference (date and time). Carries the same data as a POI.

Photo - a photographic image, posted by an user. Contains, besides the path to the file, a description, a reference to the uploading user and a time reference.

Section - a piece of text related to a trip report, bird species, POI or event. Contains a title, content and a reference to the creator or last updater.

Area - an area referring to a place where a species of bird can be found more frequently. Contains a name and a description.

Sighting - a point on the globe where a specific bird species was sighted. Contains a reference to a bird species, a user, a time reference, a name and a brief description.

Notification - related mostly to the mobile application, a notification is an alert received by a user in a variety of different events such as proximity to a point of interest, habitat, bird sighting or other define by the user himself.

5.2 Requirements

This section lists the functional and non-functional requirements for Alice Birdwatching. Some of the initial functional requirements were not fully implemented by the time this paper was written due mostly to the synchronization between the development of this application and its mobile counterpart.

5.2.1 Functional Requirements

Following is a list of the functional requirements for this project.

Sign up - users must be able to make a registration on the application, so he can be able to create or update data on the site. A user identification is also needed for the mobile application to work.

Log in - after registration, users must be able to log in to the service, to access the content generation and editing pages.

View user profile - users must be able to see their user profile, in order to better manage content they have created and the list of other users they follow.

Follow user - it is possible for a user to select other users in order to give priority to their content on list pages. This works similarly to other services, but instead of small text messages, the user is notified about the content that was uploaded or created.

Unfollow user - users must be able to unfollow users, that is, stop prioritizing other user's content on list pages.

View details pages - either logged in or not, visitors to the website must be able to access the pages that show the details of birds, trip reports, events and points of interest.

Edit details - registered and logged in users are able to edit details on most available content (except for trip reports, where only content created by them can be edited).

Create content - users that are authenticated on the service may create content such as bird species, trip reports, points of interest and events.

Notifications - users must be able to set which, if at all, notifications they want to receive on their mobile devices, be it sighting alerts, proximity alerts or temporal alerts.

Administrate users - administrator users must be able to manage users that repeatedly posted abusive content, being able to ban them from the system in extreme cases.

5.2.2 Non-Functional Requirements

Non-functional requirements are related to the work of the system as a whole, rather than specific behaviors. This section discusses the non-functional requirements for this project, with special attention to those relative to privacy and user experience.

Security - the system must ensure that no private data provided by the user is ever stored or leaked. Since this system, in part, works with geolocative systems used through personal devices, their location must never be stored nor disclosed. Personal profile information is not required, in part to avoid breach of privacy.

User Experience - the usability of the system is of utmost importance for its success, as it is a service directed completely to regular users. It must be enjoyable to the point that potentially elderly users or users not used to internet interaction may be able to easily flow through it and contribute with their knowledge.

Reliability - the system must be reliable in the sense that, since a lot of that will potentially be uploaded to it and downloaded from it, this must not interfere in any way with the user experience or the consistency of the system's data.

5.3 Data Structure

This section presents the data structure of the Alice Birdwatcher system, shown in figure 5.3. Some fields were omitted, due to lack of importance and in order to simplify the presentation of the diagram.

5.4 Details

5.4.1 MVC

This section shows a diagram, figure 5.4, that shows how the models, views and controllers interact. Some of the models and controllers were omitted, in order to show those of utmost importance and to help readability of the diagram. Similarly, only the more important views of each controller are shown, as an example of all those existing in Alice Birdwatching.

As their names clearly state, each controller takes action upon one model. Almost all controllers allow for the creation, editing and reading of their respective models, as well as more specific functions, like **EditTripRoute** (for editing a trip's sequence of points of

interest) or **EditBirdHabitat** (for editing a bird's habitat areas). Some of these controllers have methods that do not return views, but instead respond to Http request made from the views, both to return and receive data. Not depicted, among others, is the controller in charge of most of the interaction with the mobile device, as it is being developed in a parallel project.

5.4.2 Data Upload

As stated in the previous section, the insertion of data by the users is done in two ways. When creating a new item, be it a trip report, a bird or a point of interest, data is posted by the view, when it is submitted. The same happens when uploading photographs and PDF files.

However, when editing an item, data upload is made by JavaScript through Http requests (with the help of the JQuery JavaScript library). As mentioned before, this is done in order to avoid the reloading of pages, in case the user wants to make several alterations to the item at the same time. As mentioned in 4.1.6, all Http requests that are aimed at entering information in the system, are POST requests, whereas the ones retrieving information are GET requests.

5.4.3 Notifications

By the time of the conception of this paper, the notifications system was not yet implemented. This is due mostly to the synchronization needed with the development of the mobile application that pairs with this project. Despite this, other simpler aspects of this synchronization are already implemented, such as the ability to show sightings made by users.

5.4.4 Interface Design

A good user experience was one of the main goals of the Alice Birdwatching project, especially considering that part of the user base is past mid-life and might not be used to a web interface. Thus we tried to build an interface that would be simple enough and, at the same time contain all the data and functions needed.

Considering that most of the information would be text and images, it was decided to present bird species by giving more relevance to its illustration than its name (see figure 5.5). The same happens to other types of data, but with map information instead of an image (figure 5.6). Text sections are not displayed by default, but easily accessible through an obvious button. Avoiding the necessity of scrolling, sections can be easily navigated through by selecting their respective title. Something similar happens with the

photo galleries, where thumbnails are shown, to facilitate navigation among photographs and buttons are shown in case pagination of the thumbnails is needed.

Content generation pages were also designed in order to minimize user confusion and strain, separating the information by type and taking advantage of the Ajax capabilities (figure 5.7).

Note that the application still lacks a proper logotype.

5.5 Tests

This section will describe and discuss the results obtained so far during tests done to the application.

5.5.1 Results

By the time this paper was written, the web application is in a prototype stage only. As mentioned before, since this project is coupled with one other, developing the mobile application that parallels the one described herein, there has been some delays in the cooperation of the two, mostly in the process of developing the notification system.

Nevertheless, the current stage of development already allows for all the content generation done via web.

The application was shown to our partner company, Ecoinside, and was used by expert birdwatchers, to good reviews. These users were satisfied with the overall design of the application and had no difficulties accessing whatever functionalities they wanted without further explanations.

The way the items' information was displayed was appreciated and the contents on display appealed to the expert birdwatcher, both in their scientific accuracy and relevance.

Users valued the fact that editing pages had separated contexts, as well as the fact that most text was edited by section, with possible titles being suggested, but also valued the liberty to add their own titles to sections. In addition, the lack of liberty to text formatting was not criticized, due, possibly, to the fact that users had no experience with wiki technologies, and thus felt like it was easier to just write their content.

Criticism was made mostly to list pages, that the users felt could be confusing at first. Partners at Ecoinside also criticized the lack of place for Internet publicity (ads), although that option was made based on the fact that profit made on the project will come mostly from mobile application sales.

Despite these premature tests, further tests will be done by other expert birdwatchers with no connection to the project. These are expected to test, not only the interface but the system as a whole, especially in terms of performance.

5.5.2 Discussion

Although tests were made in a prototyped version of Alice Birdwatching, the response obtained from users was most motivating and a signal that we are on the right path. After all, the success of the application depends on the number of users that contribute to it, and that number depends on how well they relate to the application and how willing they are to contribute to it.

5.6 Chapter Summary

In this chapter we were able to better understand the implementation of the application proposed in this paper.

We began by describing the architectures, logical and physical, of the project. Physically, the application and its database will be installed in a single server, until it becomes necessary to move it to a larger size and larger bandwidth server. The logical architecture showed how the web application interacts with its users, the database and the mobile application.

The requirements, both functional and non-functional were also enumerated. It is required of the application that it is possible to create, edit and see the items therein (such as bird species, trip reports or points of interest); users must have a profile and be able to follow and unfollow each other and administrators must be able to do their duty by punishing abusive users. It is also required of the application that the users' privacy must be respected; users must feel comfortable while using the application, and even compelled to contribute their content, which calls for a good user experience; and the system must also be available to users, that is, it must not fail due to excess data or excess use, as well as it must always be responsive to the users' requests, not compromising the user experience nor the content obtained in any event.

Structure of the database and the MVC pattern used were also demonstrated and explained in this chapter, as were some other implementation details relevant of mention in this paper.

Finally we were able to conclude, upon having a prototype tested by potential end users, that the application has potential for success, once design details are fixed.

Implementation

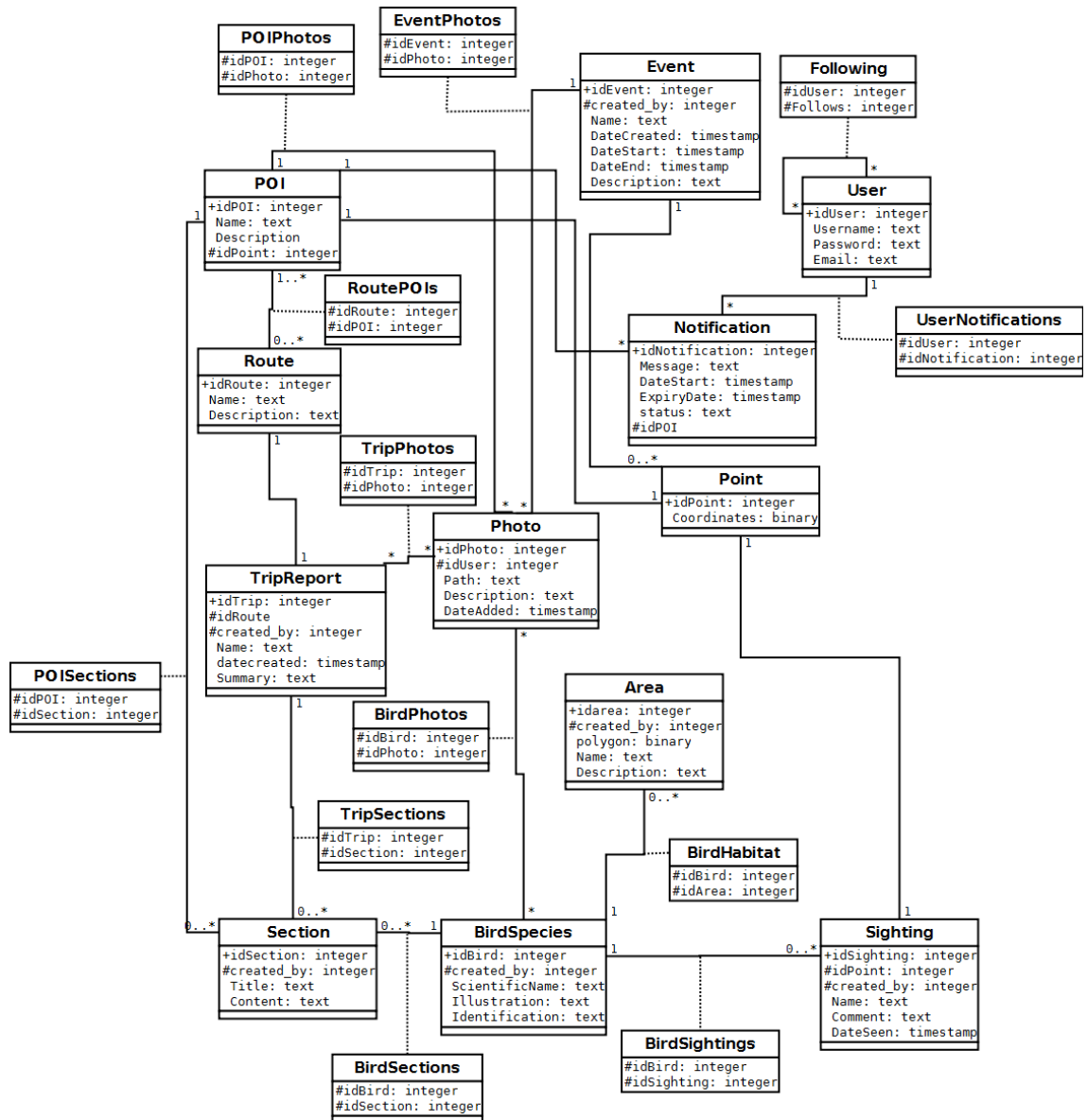


Figure 5.3: Alice Birdwatching's Database Diagram

Implementation

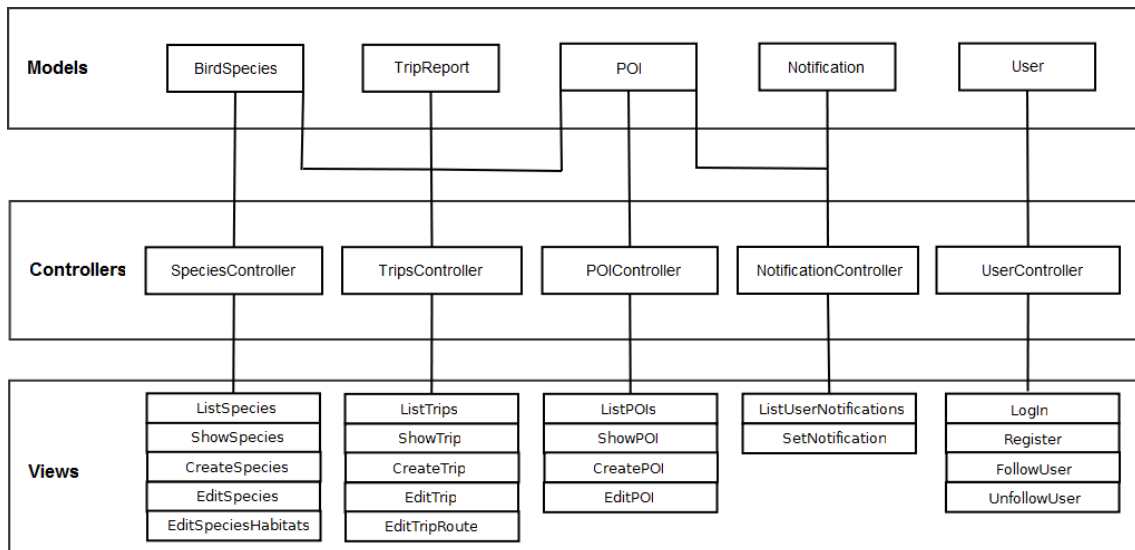


Figure 5.4: Models, Views and Controllers of Alice Birdwatching

Alice Birdwatcher
JLago

Trips
 Birds
 POIs/Events
 Notifications
 Profile



Common Blackbird

Turdus Merula

Conservation Status: Least concern – LC.

Identification:
A species of true thrush. The all-black male with his bright yellow bill is unmistakable and the female is distinctively dark brown all over with only obscure streaking on the breast similar to the juvenile. Breeds and winters in woods, farmland, gardens, wasteground and hedges. It breeds in Europe, Asia, and North Africa, and has been introduced to Australia and New Zealand. Depending on latitude, the Common Blackbird may be resident, partially migratory or fully migratory.

Map
 Read More
 Gallery

Extended Identification

Description

Distribution and Habitat

Status

Behaviour

Breeding

Songs and Calls

Feeding

Natural Threats

Similar Species

The Common Blackbird was described by Linnaeus in his *Systema Naturae* in 1758 as *Turdus merula* (characterised as *T. ater, rostro palpebrisque fulvis*). The binomial name derives from two Latin words, *turdus*, "thrush", and *merula*, "blackbird", the latter giving rise to the French name for this species, *merle* and also the Romanian name, *mierlă*. There are about 65 species of medium to large thrushes in the genus *Turdus*, characterised by rounded heads, longish pointed wings, and usually melodious songs. The Common Blackbird seems to be closest in evolutionary terms to the Island Thrush (*T. poliocephalus*) of Southeast Asia and islands in the southwest Pacific, which probably diverged from *merula* stock fairly recently.

It may not immediately be clear why the name "Blackbird", first recorded in 1486, was applied to this species, but not to one of the various other common black British birds, such as the Carrion Crow, Raven, Rook or Jackdaw. However, in Old English, and in modern English up to about the 18th century, "bird" was used only for smaller or young birds, and larger ones such as crows were called "fowl". At that time, the Blackbird was therefore the only widespread and conspicuous "black bird" in the British Isles. Until about the 17th century, another usual name for the species was *ouzel*, *ousel* or *wosel* (from Old English *osle*). Another variant occurs in Act 3 of Shakespeare's *A Midsummer Night's Dream*, where Bottom refers to "The Woosell cocke, so blacke of hew, With Orange-tawny bill". The *ouzel* usage survived later in poetry, and still occurs as the name of the closely related Ring Ouzel (*Turdus torquatus*), and in *Water Ouzel*, an alternative name for the unrelated but superficially similar White-throated Dipper (*Cinclus cinclus*).

Two related Asian *Turdus* thrushes, the White-collared Blackbird (*T. albocinctus*) and the Grey-winged Blackbird (*T. boulboul*), are also named blackbirds, and the Somali Thrush (*T. (olivaceus) ludoviciae*) is alternatively known as the Somali Blackbird.

The icterid family of the New World is sometimes called the blackbird family because of some species' superficial resemblance to the Old World thrushes, especially this species, but they are not evolutionarily close, being closer to the New World warblers and tanagers. The term is often limited to smaller species with mostly or entirely black plumage, at least in the breeding male, notably the cowbirds, the grackles, and especially around 20 species with "blackbird" in the name, such as the Red-winged Blackbird and the Melodious Blackbird.

It is also called Eurasian Blackbird (especially in North America, to distinguish it from the unrelated New World blackbirds), or simply Blackbird. It has a number of subspecies across its large range; a few of the Asian subspecies are sometimes considered to be full species.

The male of the nominate subspecies, which is found throughout most of Europe, is all black except for a yellow eye-ring and bill and has a rich melodious song; the adult female and juvenile have mainly dark brown plumage. This species breeds in woods and gardens, building a

Figure 5.5: Typical page with information about a bird species.

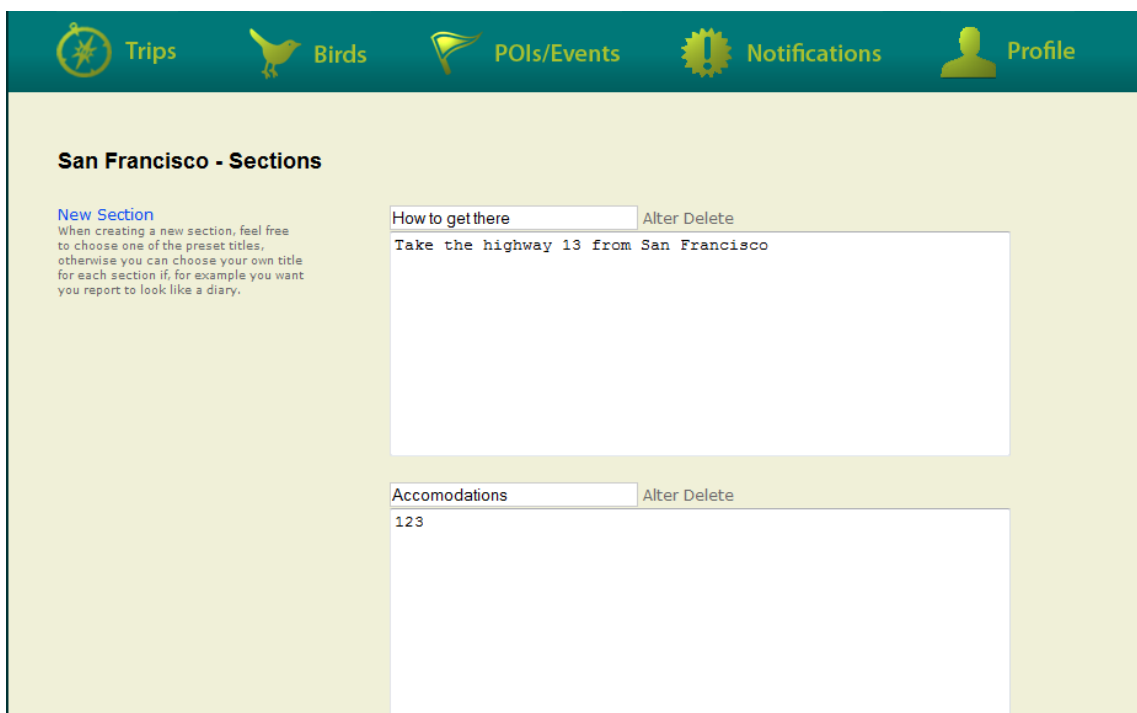


Figure 5.7: Detail of the sections edit page in a trip report.

Implementation

Chapter 6

Conclusions and Future Work

In this section shall be presented the conclusions gathered from the development of the project and testing of a prototype, as well as some thoughts on how to improve it in the future and explore other uses of its data and structure.

6.1 Conclusions

From the response received from our partners at Ecoinside and their test of our prototype, we can conclude that the choices made in both technologies, concept and design were right.

The application allows users to access content directed to birdwatchers in a more appealing way than the ones available on the Internet. Not only that, it allows users to edit and create content, thus taking advantage of the new user-generated content paradigms.

Some risks present in UGC applications and websites (such as biased content and marketing) are nullified in this case due to the size of the community as well as its purpose. Other risks, such as abusive or untrue content, are easily avoided by either the fact that users can edit virtually all content, thus leading to a constant evolution in content quality, and the fact that there are administrators monitoring the content, especially the one that can not be edited by the whole community.

ASP.NET MVC 2 proved to be a good choice in implementing the solution, by making it easy to develop the business logic as well as the interface design, while allowing the freedom to use a different model building technique than the one by default. The adoption of the MVC architecture was indispensable to the easy development of the application, facilitating not only the development of the website but also the methods that interact with the mobile version of the project. It must be said that this choice was essential to developing the whole application as we wanted. It should also be noted that, despite

having no experience in MVC prior to this project, the author felt that, in conjunction with his previous knowledge of .NET technologies and web development, this technology made it easy to fall into the pattern, quickly learn its features and easily develop both the user interface and the logical structure behind it.

A positive opinion can also be had about PostgreSQL and its PostGIS extensions, that proved to be as fast as they were accurate in keeping and retrieving geographical data.

Google Maps API V3, although a big departure from previous versions, does have improved performance, which is a key factor in our user-experience demands. The fact that it is now more object-oriented and also implements the MVC pattern to some extent has helped in its interaction with the rest of the application.

After being tested by people outside of the development process of the application, the author feels sure that, when complete, the website and its mobile version can be very successful and fruitful, both in disseminating knowledge about bird species but also in where to see them, eventually bringing awareness to endangered species and natural resources. Attracting people's attention to nature, especially its most fragile sectors, is paramount in preventing the extinction of species and thus keeping the biodiversity essential to our own existence in this planet.

6.2 Future Work

Although Alice Birdwatcher will be a fully functional content community as it is conceived, some improvements can be regarded. While some of these features regard this project only, others are related to existing applications created by Ubiwhere and possible future projects within the company. Following are some of these future possibilities.

6.2.1 Print format Trip Report

. Birders are used to record their birding trips in printable formats for the simple fact that, in some events, there are no Internet connections or phone coverage, thus deeming it necessary to resort to the printed format. This is the main reason most trip reports seen online are in PDF format. Thus, it should be possible for users to create and organize their trip reports online, via Alice Birdwatching trip report creator, and then ask the application to print out their trip report in a printable format, together with possible pictures and references to bird species and points of interest, in addition to all the trip's text.

6.2.2 Birdwatching game

. Although it was found that, usually, UGC services do not need an extraordinary form of incentive to attract users, it is also true that this is easier if the community is already built and fully working. Taking this into account, it was suggested that a simple user ranking

should be developed, awarding users for creating content of any kind, based on the type of content, location and rarity of species (as in sightings, for example).

6.2.3 Content history

. Although the idea of the project is to allow users to continuously update its content, some measures must be taken in order to avoid accidents. One of those is reversion of content, that is, keeping an history of the content that was uploaded to the system in order to be able to restore content state in case some part of it was completely deleted.

6.2.4 Apply concept to other contexts

. Some parts of Alice Birdwatcher's structure were developed in order to be easily adaptable to other contexts, namely points of interest, users, all geographical types of data, photos and sections. This was aimed at helping future developers at Ubiwhere to simply grab the structure and adapt it to a different context, such as tourism, biology, geology or any other.

6.2.5 Integration with existing projects

. Some project developed at Ubiwhere may use data created by users of Alice Birdwatching on their own systems, namely Data Mining related projects.

6.2.6 Integration with other social networking and content-generation services

. Although Alice Birdwatcher was built completely separated from any other existing content generation community or service, or any existing social network, a possible feature should be, as other systems have already implemented, to share the content with those networks, such as status updates on Twitter or Facebook every time a user creates a new trip report or sighting. This could work both as a marketing mechanism for the service as well as helping with the environmental matters discussed in [6.1](#).

Conclusions and Future Work

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