Information Technology to Support Indigenous Peoples

D.D. Cowan,[1] F.M. McGarry,[2] H. Moran,[2] D.D. McCarthy,[3] C. King[4]

Technical Report CS-2011-28

Abstract

Indigenous peoples face challenges retaining their traditional knowledge and culture and in negotiating with governments and proponents of resource exploitation, settlement and infrastructure development on their traditional lands. This paper outlines the issues faced by indigenous peoples and describes the Dreamcatcher software system. Dreamcatcher is a powerful web-based information system containing interactive mapping tools, mediated social networks, geo-spatial consultation services and a security model that can support indigenous peoples in the endeavours just described. Interactive mapping is a key tool since landscapes valued by indigenous peoples can be integral elements of indigenous cultural identity.

Introduction

Indigenous peoples were usually the first group to populate a geographic region and they share a cultural identity shaped by that region. This identity is typically based on language, spirituality, ancestry, cultural practices, resources for sustenance and communal history. Traditional practices such as oral history and traditional ecological knowledge (TEK) often relate to the landscapes and landscape features; consequently landscapes can be integral elements of indigenous cultural identity [1].

The traits that characterize indigenous peoples are under attack in many parts of the world as other dominating cultures intrude in various ways on their landscape through colonization. Such intrusions can be through immigration; resource, infrastructure or economic development; or cultural assimilation. Regardless, Indigenous peoples value and want to preserve their cultural identity and connection to their traditional territories.

Can the Web and Internet be used effectively to preserve, manage and impart this cultural identity and relationship to the landscape and empower Indigenous communities to take control over their unique and rich knowledge and strive for self-governance and autonomy? In this paper the authors describe a web-based information system that was originally designed, implemented and deployed with the First

[1] David R. Cheriton School of Computer Science, University of Waterloo, Waterloo, Ontario, Canada {dcowan@uwaterloo.ca}
[2] Centre for Community Mapping (COMAP.ca), Waterloo, Ontario, Canada {mcgarry@comap.ca, heathermoran@sympatico.ca}
[3] Department of Environment and Resource Studies, University of Waterloo, Waterloo, Ontario, Canada { dmccarth@uwaterloo.ca}
[4] Mississaugas of New Credit First Nation, Hagersville, Ontario, Canada {clynt@live.ca}

Nations of Ontario, Canada. However the authors believe that the lessons learned from this system and the actual system itself could be applied to indigenous peoples across the globe.

Issues

Before describing the system, we focus on the issues that often arise in indigenous societies and their interactions with other cultures as they govern the system requirements.

Passing on of Knowledge

Many Indigenous peoples have a written language. However this written language, whether imposed by external groups or created by the indigenous people themselves, has not existed long enough to capture all the nuances of the relationships with the landscape. Thus, information is usually passed on orally by the elders to the rest of the society, and this oral tradition of knowledge transfer is likely to persist for quite some time.

Interaction with Dominating Cultures

Secondary cultures have come to dominate indigenous societies through force of arms followed by immigration and disease, economic development or cultural assimilation through the process of colonization. Both for reasons of dominance, resource exploitation and governance, tensions and mistrust have arisen between the indigenous peoples and the dominating culture(s). These strains produce a cautious approach to relations between the dominant and indigenous groups. For these reasons the indigenous people want to own and control access to the TEK and other information they supply about their territory.

Need to Consult

Some political jurisdictions recognize that indigenous peoples have “rights” over the land they have occupied for many decades if not centuries. In Canada these rights have been ensconced through Supreme Court decisions in the form of the Crown’s “duty to consult,” which means that any substantive change to an indigenous group’s traditional lands is governed by negotiation [2]. The results of these negotiations often result in settlements such as an impact and benefit agreement that can provide monetary and other forms of benefits to First Nations communities. For example, the agreement might include provisions for quotas for jobs for local, indigenous people, contracts for local, native businesses or other local economic development opportunities.

The Dreamcatcher[5] Web-based Information Systems for Indigenous People

[5] A dreamcatcher or "dream snare" is a handmade object based on a willow hoop, on which is woven a loose net or web. The dreamcatcher is then decorated with personal and sacred items such as feathers and beads. While dreamcatchers originated in the Ojibwa Nation, they were adopted during the 1960s and 70s by Native Americans of a number of different nations. Some consider the dreamcatcher a symbol of unity among the various Indian Nations, and a general symbol of identification with Native American or First Nations cultures.

Indigenous groups have a strong tie to the landscape of their traditional lands and so mapping is a good way to illustrate these connections. The design of the Dreamcatcher Web-based Information System focuses on community-based interactive mapping services and has been designed in collaboration with several First Nations communities in the Province of Ontario, Canada. Interactive mapping with attached databases empowers an Indigenous community in capturing and saving traditional cultural and ecological knowledge and other community information.

Narratives well supported by multimedia are used to connect the values of the indigenous peoples with related geographic features. Each map feature and related narrative may be associated with a specific sub-group. Thus, the Dreamcatcher system is supportive of the oral tradition related to the landscape. The narratives that the elders tell can be recorded and played back, thus avoiding the limitations of the written record. These stories are geo-located and can contain videos that provide a visual interpretation of landscape surrounding these descriptions. They provide a way to teach community traditions more efficiently, thus appealing to the younger members of the community who are being attracted to the lifestyle of the dominant cultures.

The information generated through Dreamcatcher could be incorporated into municipal planning processes, infrastructure planning processes, and resource development processes. Having this information available supports the need for consultation between community, government agencies and proponents of development on traditional lands. In fact having advance knowledge of the landscapes that indigenous groups have identified as valued should enable the government and development proponents to design proposals to limit impacts and engage with indigenous communities where impacts are anticipated. The results of this use of the landscape and related knowledge could result in beneficial agreements being negotiated with the involved indigenous group(s). Various documents such as the First Nations Environmental Assessment Toolkit [3] could be adapted for use in conjunction with the Dreamcatcher system.

However, there are concerns over sharing the group information related to a number of factors. In the past, survival of a group may depend on knowledge of the location of food sources or traditional medicine. More recently the group may not want to share information about locations such as sacred places as the local dominant culture may change the character of the space by declaring property rights through fencing or desecration.

Thus, an indigenous group may want to reveal a map area but not the related content. This “hiding” of details of map features that overlap or are adjacent could be by a polygon enclosing the features. All such polygons can be shown as a single map layer on the map defining an indigenous community’s layer of concerns. Hence, the sharing of information requires a well thought-out implementation of a security model.

Since negotiations of this type can be adversarial, the indigenous group must protect its interests, assets and intellectual property. Therefore the Dreamcatcher system data including map features and geo-

spatial narratives must be managed, owned and securely controlled by each indigenous community. Because of cost and complexity of operating servers and the need for indigenous communities to share information, the Dreamcatcher system could function from a computing cloud operated by a neutral and trusted third party.

The Dreamcatcher System – Some Functional Details

The Dreamcatcher System is built using the Web Informatics Development Environment (WIDE) toolkit. In the WIDE context, "programming" has been replaced with a declarative methodology thus providing a wizard or forms-based approach to building most Web-based systems for the desktop or mobile environment. WIDE is primarily based on open source software including PHP, JavaScript and relational database technology. WIDE consists of a number of software assets including those for building input forms or reports containing extensive multimedia materials such as interactive maps or any 2-dimensional diagram, databases, indexing and searching methods, agents, push technologies, mediated social media, collaboration and security.

The Dreamcatcher system has six components built around a powerful interactive mapping engine and related databases. We describe the mapping technology followed by the six components and then provide a brief description of the security model.

The Interactive Mapping Engine

The map features are built on an interactive map engine technology that has been in continuous development since 1992, rather than on a geographic information system (GIS) platform. The mapping engine predates the current map engines used by Google, Yahoo and bing by several years and has several extra features.

Interactive maps are delivered from a map-server, which supports zoom-in or zoom-out functionality and positioning over areas of interest. When connected to a geo-referenced database the maps can be used to:

- display and interact with the location of an object such as a building or park;
- find geo-referenced data in databases or Web sites based on an area on the map defined by the user. The map area searches can be defined by the frame around the map or a shape including a circle, rectangle or general polygon. The search function uses Ajax technology to display the results as the search frame is defined; and
- attach an "electronic pushpin" and accompanying data to a map location or area and then store that data in a database. Transactional map features and attribute data contributed in this way can be exported to a GIS.

The maps can represent any spatial or map-based concept including thematic maps such as ones showing environmental or demographic data, roadmaps or even floor plans. Maps can contain layers such as a road map with a superimposed thematic map. Vector-based maps can also be displayed.

The simple API (application program interface) to the maps provided by the server supports rapid development of map-based applications. The mapping functionality is based on the Scalable Vector Graphics (SVG) [4] open W3C standard or Vector Markup Language (VML) [5] to support all browsers. Data can be geo-referenced using Lat-long, UTM, address range, postal code or wireless GPS and many different projections. The mapping engine can be presented as an API in conjunction with other mapping systems such as those produced by Google, bing or Yahoo.

The interactive mapping engine supports appropriate sections of the "Canadian Geospatial Data Infrastructure" (CGDI) [6], which is based on the Open Geospatial Consortium (OGC) standards. Supporting these standards allows direct communication between applications based on the interactive mapping engine and any GIS platform incorporating the OGC standard Web Mapping Service (WMS)[7] or Web Feature Service (WFS) [8] protocols as well as shapefiles [9].

Home Page Component

The Home Page has searchable mapping and displays map features called “mapups™” and an example is shown in Figure 1. Each mapup gives a comprehensive highlight, using text and multimedia, to illustrate and link to web pages with more content. A search can combine content type(s) with keyword text and selected map area. All results listed and mapped are based on the visible map unless a map area has been selected for a search. Search results are presented on the Home Page allowing refined searches without “getting lost.”

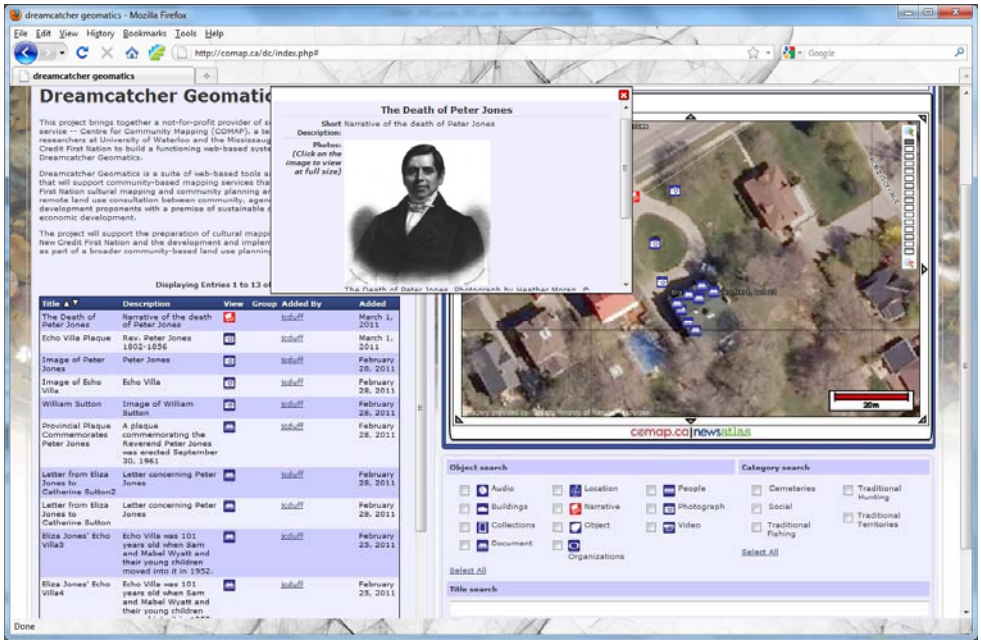

Figure 1 - Home Page showing map and mapup

Community Mapnotes Component

Community MapNotes enable the mapping of cultural knowledge using content management services for (i) the development of heritage landscape stories (Narratives) and (ii) the development of constraint

mapping based on mapped cultural knowledge (Narratives and cited content). Content management services are provided to develop wiki- style documents with tools for multimedia including embedding photographs and linking to (citing) digital artifacts that have been previously described, mapped and uploaded to a database.

The Community Mapnotes page, an example is shown in Figure **2**, presents an opportunity to add content to the map with a selection of content types. All but two of the content types are targeted to referenced content such as scanned documents, photos, videos, audio recordings or locations. There are provisions for attaching Mapnotes to a point or polygon geographic feature and there are provisions for adding meta-data based on archivist's standards. Referenced content can be cited in the "Narrative" using wiki-links.

There is also a content type and a content management page for "Constraint Maps" which is used to create a constraint mapping layer, based on the spatial relationship of Mapnotes. These constraint maps can be shared with development proponents or the government within their view of Dreamcatcher without attributed content (or exported as a shapefile).

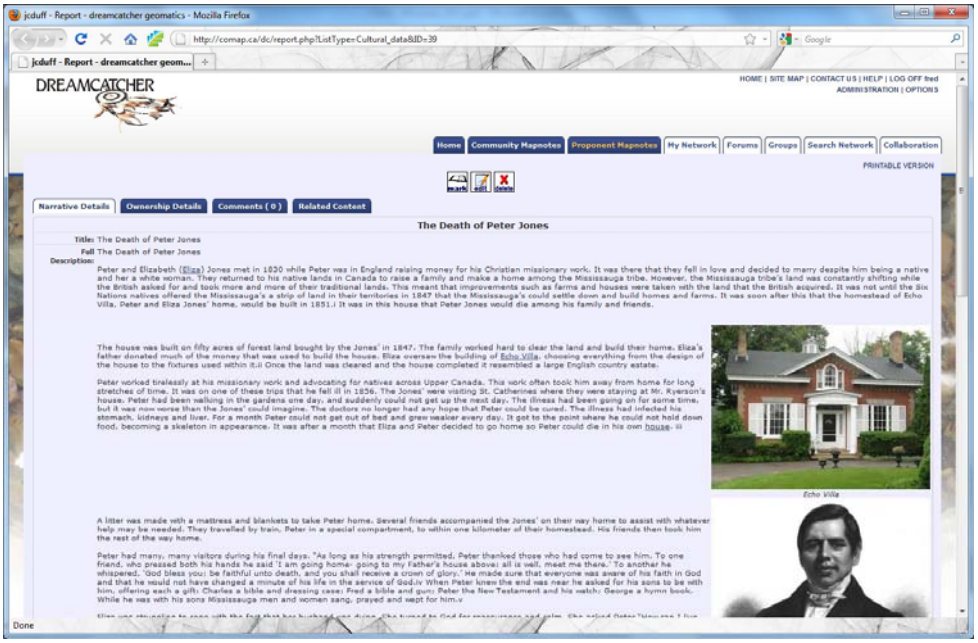

Figure 2 - Example of a wiki narrative

Proponent Mapnotes Component

The Proponent Mapnotes page enables all development proponents to enter basic information about their proposal so that indigenous groups can develop work flow processes around triaging, managing and tracking correspondence with those proposing development. The triage will reference the Proponent Mapnotes to the indigenous Community Mapnotes content and constraint mapping. This approach helps to put proposals into different categories depending upon how much extra investigation and negotiation is required.

Social Media - Network, Groups and Forums Component

The Dreamcatcher system has a mediated social network for securely and collaboratively accessing, contributing and sharing content. The organization of any social network can be highly granular.

The social network is a tree structure with a master group at the root and sub-groups under it ad infinitum. For example, an indigenous community could form a master group with each family in the community forming a sub-group. Forums provide the structure around which any sub-group discusses topics of interest. For example, sub-groups could create forums around topics related to locations for food, medicine, or sacred places.

Currently forums can be restricted to the group (private) or be open (public). Anyone from outside a group can be invited to join a private group or can ask to join if he/she knows the group exists. Similarly resources such as documents created by a group can be shared with other groups.

The custodian of a mediated social network is in control of establishing the groups and assigns a group moderator for each group. The moderator can then admit members to that group. Both the custodian and the moderator have tools for their respective duties. Members also have access to application tools and tools for creating forums. There is also a “contract” among the participants with respect to their individual responsibilities.

People can apply or be invited to join based on expertise or interest and be provided with identification in the form of userids and passwords. Thus, access control mechanisms must be in place to allow construction, distribution and access management.

Collaboration Component

The **Collaboration** page is intended to offer real-time synchronous web-based consultation services focused on land use negotiation. These services enable either party to initiate a conference or share a view of her/his Proponent Mapnotes web-page with community constraint mapping.

The responding party can view the entry of mapping and attribute data by the initiator of the conference and with permission of the initiator alter contributed mapping or data. Every step of the online negotiation is saved to a database and can be replayed with accompanying time stamped minutes that are recorded using a chat tool. Once the session is complete and saved to the database, it can be replayed where the time-stamped minutes have links to advance a replay.

Administration Component

Administration services link leads to a web page with tools to manage access by users, to create mediated social media groups and manage Mapnote categories.

Security Model

Control of sharing also requires a security model such as role-based-access-control (RBAC) [10, 11]. The system currently incorporates an RBAC-based security system. Although the discussion in the paper has

focused on managing information for purposes of negotiation, the content could be made available for other purposes such as historical studies or experiential tourism. Such applications also have to be considered when creating the security model.

Comparison to Other Systems

First Nations Stewardship Tools (FNST) [12], a service that is somewhat comparable with Dreamcatcher, is in development by the Departments of Geography and Computer Science at the University of Victoria. FNST is a map-centric stewardship decision-support system with spatial planning tools and shared decision-making protocols between British Columbia, Canada First Nations (FN) and the British Columbia government. The tools allow contact management, proposal tracking, reporting and work flow processes. Proponent data referred through government and traditional use studies (TUS) [13] where data is input and managed by the FN Stewardship Manager. Reporting services include mapping that allows the user to determine the extent of possible area conflicts between proposal footprint and constraint polygons for TUS and agency data.

While FNST and Dreamcatcher services for contact management, proposal tracking and reporting are comparable the context of use is not. In British Columbia the government is proactive in its interpretation of "Duty to Consult" regulations and the BC government gathers and refers proponent information to First Nations Stewardship Managers for review, decision and response. In Ontario the Crown is far less proactive and standards for traditional use information have not been adopted. Consequently, the Ontario experience is closer to that of indigenous peoples in most parts of the world.

FNs in Ontario negotiate directly with development proponents, without a Crown-based referral system. Moreover, the (i) community managed role-based access system that supports FN governance of cultural and traditional ecological knowledge; (ii) valued landscape narrative service; and (iii) synchronous consultation and collaboration service in Dreamcatcher do not appear to be contemplated in the FNST. Dreamcatcher will enfranchise indigenous peoples by supporting interactive community mapping that is less dependent on an external agency.

Lessons Learned

The Dreamcatcher system is being deployed incrementally across Ontario in order to get feedback from the user community. In general the system has been well received, but issues around security and sharing have been significant. For example the security system has 5 levels of sharing: no sharing, my group, my First Nation, other First Nations and everyone. Initially the default security level was set to everyone. Considering indigenous groups' concerns about sharing information this was not appropriate as most users did not realize they should change the default setting. Thus, some information that was not meant to be shared became part of public knowledge including through search engine hash pages, whose disappearance is beyond system control.

Concerns with security led to a rather cumbersome procedure to join groups in the social media structure. Initially an individual had to request membership in a group from the moderator and then

appear before the moderator before being approved. This approach has been modified to allow individuals to send the moderator an electronic request.

Community mapnotes are tied to groups. At the moment the sharing level can be changed easily but changing the group connected to a mapnote is not possible. This has not been a problem because of the way information is shared. However, sharing will be watched to see if this approach needs modification.

The indigenous communities that have been involved with Dreamcatcher use social networks such as Facebook to communicate among family and community members. Although social networks do not have the security structure necessary to implement a system like Dreamcatcher, we are examining ways that we can leverage this connection.

Examples of Narratives

Mississaugas of the New Credit First Nation (MNCFN)

In developing approaches to creating narratives backed by primary sources, one of the authors (Moran) produced several accounts about the Mississaugas of the New Credit First Nation (MNCFN). These stories were supported by thoroughly researched source content. This work was presented at a conference on MNCFN culture, history and traditional territory. This information was mapped as heritage and cultural layers into the current Dreamcatcher mapping system to demonstrate areas of geographic importance to the MNCFN.

To keep the demonstration manageable a small collection of documents at the Grey Roots Museum and Archives in Owen Sound, Ontario, Canada was chosen. These documents outlined the life and political struggles of Catherine Sutton. A variety of historical sources from original letters and journals kept by the Sutton family to newspaper accounts of their lives supported two narratives; one outlined the final days of Peter Jones, chief of the Mississauga people and the other outlined Catherine Sutton's story. Each narrative is wiki-linked to the original source material within the Dreamcatcher system.

Primary source materials are often scattered over many libraries, archives and museums and this was true of the numerous documents relating to the MCNFN. For example four major archives in Ontario, Library Archives Canada, Ontario Archives, University of Victoria in Toronto and the United Church Archives contain thousands of pages of MNCFN materials stored on paper and several other formats.

Through this experience a protocol was devised to determine narrative topics and "themes" as a method to organize the archives, assign documents to the themes, develop a wiki-linking plan and create the resulting narratives. The results would make primary source material available to historians and the general public in order to promote and preserve the history and heritage of the MNCFN.

Archeological and Burial Layers

The Museum of Ontario Archeology is developing digital records for many thousands of boxes containing archeological artifacts that will be stored in new facilities at the Museum. A database and mapping layer will be created to allow the association of the artifacts and burial sites with the location in

which they were found. This data could be shared through the Dreamcatcher system and strengthen the evidence base in the Narratives layer.

Conclusions

This paper has provided a description of the characteristics of indigenous communities based on our observations of the First Nations in Ontario, Canada and other communities around the world. Using those observations we have worked closely with the MNCFN community and other Ontario First Nation communities to create an information system that will support their lifestyle and traditions.

Through several deployments the authors believe that the system that described in the paper meets the basic needs of indigenous peoples. However the design is being refined as more experience is accumulated.

Acknowledgements

The current implementation is funded by the MNCFN, Ontario Ministry of Culture and Tourism, Ontario Ministry of Aboriginal Affairs, Ontario Research Fund, Centre for Community Mapping (COMAP), Natural Sciences and Engineering Research Council of Canada (NSERC) and Social Sciences and Humanities Research Council of Canada (SSHRC).

References

1. Dene Cultural Institute, cited in Stevenson, 1996: 281
2. Duty to Consult – Aboriginal Affairs and Northern Development Canada {http://www.aadnc-aandc.gc.ca/eng/1100100014664}.
3. First Nations Environmental Assessment Toolkit { http://64.26.129.156/article.asp?id=5020}.
4. Scalable Vector Graphics { http://en.wikipedia.org/wiki/Scalable_Vector_Graphics}
5. Vector Markup Language {http://en.wikipedia.org/wiki/Vector_Markup_Language}
6. Canadian Geospatial Data Infrastructure {http://www.geoconnections.ca/en/aboutcgdi.html}
7. Web Map Service { http://en.wikipedia.org/wiki/Web_Map_Service}
8. Web Feature Service { http://en.wikipedia.org/wiki/Web_Feature_Service}
9. Shape File { http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf}
10. Elsa Bertino and Lorenzo Martino and Federica Paci and Anna Squicciarini, “Security for Web Services and Service-Oriented Architectures.” Springer, 2010, ISBN 978-3-540-87741-7.
11. Jim Longstaff and Mike Lockyer and John Nicholas, “The Tees confidentiality model: an authorisation model for identities and roles.” Proceedings of the eighth ACM symposium on Access control models and technologies, 2003.
12. First Nations Stewardship Tools (http://web.uvic.ca/fnst/)
13. Traditional Use Studies (http://www.ubcic.bc.ca/Resources/tus.htm#axzz1evKfEY1U)