An Australian Ski Resort System

Kayleigh Rumbelow, Peter Busch and Deborah Richards

Department of Computing, Macquarie University, Sydney, Australia

Abstract: The aim of this system was to use and display existing ski access data in a new way to create business as well as social enhancement opportunities for resorts and their guests. Radio Frequency Identification (RFID) enabled passes, were used as input mechanisms captured by a scanner on snow at various locations. Each scan was stored in a relational database and information extracted from this was shown to a user via a webpage. A comparative analysis of two major resorts, both of which are currently using RFID ticket technology was used to assess what information was currently provided to guests and how it was delivered. This analysis was used to identify areas for future growth and development of an improved system. The use of these services was often more of an after-ski activity rather than during (Jambon and Meillon, 2009). The improvement described herein allowed the user display to operate on a delay rather than instantaneously. The significance of this improved solution enabled a resort to differentiate itself from competitors. An alternative data display is presented detailing the technologies employed and additional functionality that could be explored.

1 INTRODUCTION

RFID (Radio Frequency Identification) technology has been heavily deployed as part of supply chain management strategies, tracking parts or products to help enable greater visibility throughout. Access management using RFID has been implemented in ski resorts, car parks, theme parks, office buildings and public transport environments (Anon, 2003). With many ski resorts adopting RFID as part of their access solution the potential access to huge amounts of data begs the question 'what can be done with all this data?' and 'how can it be displayed to users in different ways to provide an enhanced experience?' Investigating how data is currently collected using variations of RFID technology ticketing solutions can help identify the challenges faced and the limitations created by hardware and software. Working within these constraints, an alternative data display is explored.

2 SKI RESORTS AND RFID

Invented in 1948, RFID is commonly used for resource/asset tracking and management. High frequency (HF) passive RFID tags have become standard for ski pass applications (O'Conner, 2008). HF tags use inductive coupling to transmit data. The reader and the tag form an electromagnetic field which is used to give the chip within the tag, power to run its circuitry to change the magnetic field and register a scan (Violino, 2005). These tags are embedded in a card that can be customized to contain the resort logo, some advertising and the pass-holder's name. RFID lift access cards cannot be punctured and attached to the user, they must be stored in a pocket or protective sleeve. While previous ticketing required line of sight for checking, the RFID system does not, allowing users to store the card within a pocket for the duration of its use (O'Connor, 2008). Although HF passive tags are common in ski ticketing, Vail resorts have opted to use ultrahigh frequency (UHF) (O'Connor, 2008b). The method used to transmit data with UHF systems is called propagation coupling - a reader emits electromagnetic energy in the form of radio waves to power the tag instead of an electromagnetic field. The microchip backscatters this by changing the load on the antenna and reflecting back an altered signal (Violino, 2005). UHF tags have a longer scanning range that Vail is expected to leverage for other applications, such as estimations for how long the wait is for each lift (O'Conner,

2007).

The motivation to employ RFID pass technology include reducing ticket fraud, and increasing customer service by allowing guests to move through lift lines faster (Rafter, 2008). The gated access system checks all tickets are valid, as this is stricter and easier than previous human operated hand held checking devices (O'Conner, 2010). The ability to reload tickets online or over the phone means guests can bypass ticket windows altogether and head straight to the lifts (Anon., 2011). Within Europe the option to purchase passes that allow access to more than one resort was a major factor in the adoption of RFID ski passes. RFID solutions have been fully tested and widely accepted by both resorts and guests for over a decade in Europe (Barto, 2009), and likewise in Australia (table 1).

Table 1: Current RFID ticketing in Australia.

Location	RFID pass used	Online display of data to guests
Perisher	Yes	Yes
Thredbo	Yes	No
Hotham	Yes	No
Falls Creak	Yes	No
Buller	Yes	Unknown
Selywn	No	N/A
Charlottes Pass	Unknown	Unknown
Baw Baw	No	N/A
Ben Lomond	No	N/A

With the introduction of RFID ski passes, resorts have the ability to search a specific pass and find the last scanned location and time an individual was there, which can be of assistance for a missing person or child, and be the starting point for a search. Supervisors also have the ability to hotlist a pass and send a message to it. A children's ski school can also use this feature if a parent cannot be contacted via the mobile number provided and their child needs to be collected early due to illness.

2.1 Capturing Data

While RFID solutions have been adopted in many areas, specialist solutions need to be sought for the ski industry. White Pass resort (Washington USA) found that inclement weather conditions including snow and rain, dramatically reduced the effective read distance of passive tags. While antennas could be configured to allow for the drop-off in read distance, to do so each time the weather became an issue would be impractical (Collins, 2004).

2.2 Going Social

Although ski resorts are using RFID as a ticketing solution allowing access to lifts, some are using it for other services such as tracking the number of vertical feet skied and earning points based on this, along with the ability to share experiences with others via social media (Swedberg, 2012). In 2010 Vail resorts debuted EpicMix, a platform enabling users to track their stats online and connect with each other using social media. The amount of vertical feet skied is calculated using the difference between lifts ridden. Users can earn "pins" based on vertical feet achieved or other criteria specified by the resort, such as riding a lift a certain number of times within one day. Users will also be able to publish their stats to Facebook and Twitter.

RFID combined with social media was used to increase popularity for a series of festivals known as 'Coca-Cola Village' in Israel during summer 2010. A RFID enabled wrist band was issued to each teenager that was linked to their Facebook account. Machines containing readers were placed across the festival site and when a wristband was scanned, it would post information related to a specific attraction to the users Facebook page, photos could also be posted. The system was a hit with Israeli teenagers, claiming 100% reach with every teenager knowing about it (Swedberg, 2010). Furthermore, in a study conducted by Tampere University of Technology it was found that a user's primary use of an online sports service was to keep a personal sporting diary, yet sharing training information and social features were also essential (Ojala and Saarela, 2010).

2.3 Visualisation

Given the above considerations, what was missing was to incorporate visual aspects to data captured at a single resort by the ski lift access gates. Bederson and Shneideman (2003) describe visualization as a way to interpret and translate data from computer understandable formats to human ones by employing graphical models, charts, graphs and other images. Information visualization is concerned with abstract phenomena, whereas scientific visualization is concerned with visualization of three-dimensional physical objects such as blood flow, protein structures and crystal growth. However a physical reality may not even exist for many information visualization projects such as stock market movements, social relationships and supermarket purchases (Bederson and Shneideman, 2003).

Google fusion tables are one such example that can be used to display a variety of data which often has a geographical nature; this can be overlaid on to a google map to allow relationships within the data to

be seen. Papatoniou (2011) utilized google fusion tables to create a framework for visualizing the web of data, this was then used to create a mashup of information and knowledge related to the Mediterranean Sea. Dunlop, Elsey and Masters (2007) used a map of Val Thorens (a French ski resort), to develop a mobile application assessing the suitability of runs based on the physical conditions of the slope; such as its classification, grooming and weather conditions along with user-set preferences. They displayed the suitability of each run on the map in a variety of ways including colour saturation, direct labelling and line width. Line width was deemed the most suitable parameter, allowing for many runs to be displayed on one map clearly. The colours used corresponded with the classification of the run they represented: green, blue, red and black (European classification). Classification of runs in North America and Australia use green, blue, black and double black. Distinguishing between black and double black using this representation could be confusing.

3 APPROACH

The method adopted for this project used a design science approach (Recker, 2013), where the key outcome was an 'instantiation', that is to say an implemented or prototyped system that could be put to use. In line with design science there was a focus on providing "novelty of the demonstrated utility of an artefact; [and] a positive difference of the utility of an artefact in comparison to existing work" (Recker, 2013 p. 108).

A total of 14 tables were obtained from Pulveriser ski resort as XML files ranging from 4KB to 4GB in size. These files contained: access detail, access location, access location group, instructor location, instructor schedule, IP, IP type, lesson level, location, pass media status, person profile, prepaid access profile and status. In short, data collected from readers around the Pulveriser resort was obtained and stored in a MySQL database. The data was then imported into pre-constructed tables. After examination of the data, a number of ideas for how the IT could deliver social enhancement came to mind. Some options are provided below:

3.1 Visualisation of Ski Lifts Taken throughout the Day

One idea is to present the skier with a visualisation of lifts and times of ski-lifts used throughout their day.

3.2 Find Your Instructor/Suggest to Friends

Another option would be to analysing lift access data to identify potential relationships, perhaps looking for friends that have used the same lifts within a given timeframe as a means of sharing social information and experiences

3.3 Infer Ski-level for Days-ridden and Trails to Be Accessed

Another option could be to allow instructors access to the lifts-ridden-history of guests participating in lessons. Logistically this would be difficult as extra hardware would be required at lesson locations or to be carried by instructors. Even if instructors could see last lifts ridden, there is still huge variation in ability within each slope, which could nonetheless be useful. What if the skier had skied overseas or grown substantially in the last year, makes incorporating these options technically difficult.

3.4 Infer Ski-level for Days-ridden and Trails to Be Accessed

Specifically for children, a social addition to the skiing experience could be using a child's lift access data, to provide a quiz for children containing simple questions about where they skied during a specific day, such as "did you ride a chair lift today?" or "did you go on a tbar today?" Admittedly, this would be difficult to make accurate but still be interesting for all age-levels. Within the Pulveriser children's learning area there is a mixed poma and T-bar lift that does not have a RFID reader at the base of it, which could result in a child riding a T-bar, yet the ride not being registered to their pass. Other options could include general skiing questions for children about safety on the hill, as well as challenges such as "find the height of Mount Kosciusko", or whatever peak may be shown on any given trail maps.

4 PROTOTYPE

In line with a design science approach to 'instantiation', the following introduces a prototype system. In this case the system relates to one resort specifically being that of 'Pulveriser' in New South Wales. One approach to working with the prototype

was to incorporate extra features which would be located in a separate tab labelled "MY MAP" within the layout of Pulveriser's current dashboard, as shown at the bottom of figure 1.

In order to visualize data that would be collected from the RFID system of ski lifts taken throughout the day and enhance the online service provided, three different techniques were explored. Firstly Google Fusion Tables, as the lift access data is related to a geographical place within the resort, where a google map could be used to display the geographical data.
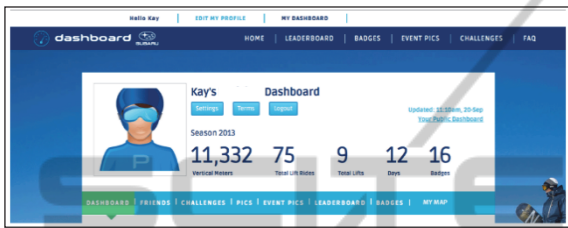

Figure 1: Pulveriser Dashboard with "MY MAP" tab.

In order to accomplish this process, a table was created containing the names of three different lifts and the longitude and latitude of their summits, and the number of times it was ridden by any one user. The resulting map is of this process is shown in figure 2. The red dots illustrated relate to a row in the table and can be selected to display further detail.
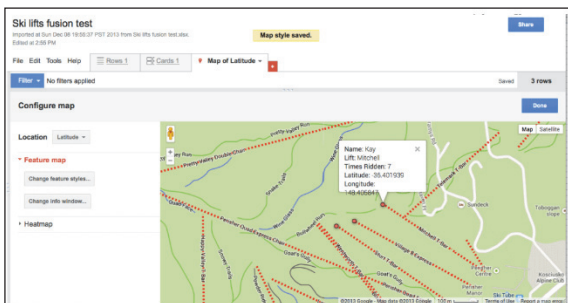

Figure 2: Resultant map using Google fusion tables.

An added aspect to the prototype was to select a ski-run of the Pulveriser ski resort map commonly known as Front Valley, and alter the colour from the original to allow an image to be seen more clearly when the map was used as a background. Front Valley has 3 major lifts servicing it, the Village 8 (V8 - that is an eight seater chair lift and two T-bars), and two more slopes known as Mitchell and Sturt. Mitchell is located on the right side when looking at the map and Sturt on the left, with the V8 in the middle, the whole area is indicated by orange

hatch on the trail map. This section was chosen as it is often the first access point for many skiers and snow-boarders, as it is the first area to open and the last to close each season.

Next a simple outline image of a skier riding a chairlift was placed on top of the selected section of the trail map as an extra layer to indicate a user's location. This indicator was placed along the route of a lift to create a series of 12 separate images. These images if displayed in sequence, visualize the movement of a skier up a lift. Two methods of displaying this visualization were implemented, firstly a moving .gif file was created within Photoshop using the 12 images each as separate frames (figure 3). The second method of showing the movement of a skier up a lift, used each of the 12 sequence pictures together as one picture, like a filmstrip.
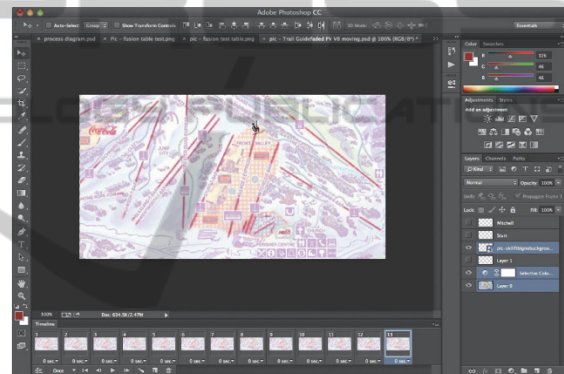

Figure 3: Using Photoshop to create a moving gif.

The image is loaded in to a div (division or a section in an HTML document – figure 4), that has a set height and width equal to that of one frame. The overflow is hidden, giving the effect that the picture is only of the rider at the bottom of the lift.

```
<div id = "mydash" style = "height:340px; position:relative;
width:637px; overflow:hidden;">
<img src="V8All.jpg" id = "v8" style = "position:absolute;
display:block; opacity: 0.0;"/>
</div>
```

Figure 4: Div section in HTML.

A javascript function (figure 5 – following page) is then used to change the position of the frame along the filmstrip, showing each frame for a set time interval, currently set to a tenth of a second, however this can be changed if required.

While this is not a suitable visualization method for resort guests, it could be utilized within the resort for staff members who are already familiar with the lift layout. A table of currently working instructors with details of the last lift they rode, may be useful

for managers to see where lessons are currently taking place around the mountain, or finding out who is in a certain area if assistance was required.

James Niehues, a resort and panoramic artist, has made a living creating maps for over 75% of the large ski resorts (Harris, 2006), including areas in the US, Canada, New Zealand, Australia, Japan and Korea. Each one is hand-painted using watercolour and many aerial photographs for reference, bringing everything into a single view while maintaining accuracy of relationships between elements. A section of one of his ski maps was used for the final two visualizations. Although the final 2 visualizations essentially achieve the same result and look the same to the user, they were created using two very different methods, namely animated .gifs as well as a filmstrip picture. Examining the file size of each of these methods for a single lift visualization of the V8, the animated .gif file is 213KB yet the filmstrip is considerably bigger at 2.4MB.

```
<script>
function moveSkier(id) {
    var img = document.getElementById(id);
    var offset = 0;
    var animate = function() {
        // make selected pic visible
        img.style.opacity = "1";
        //slide the image correct frame of animation given by offset
        img.style.top = -offset + "px";
    //calculate offset to next frame
        offset = Math.floor(offset + 340);
        //if we are not yet on the last frame...
        if(offset < 4080 ) {
            //call me again in a tenth of a second
            window.setTimeout(animate, 100);
        }
        else {
            offset = Math.floor(offset  -340 );
            img.style.top = -offset + "px";
        }
    };
    //start the animation
    animate();
}
moveSkier('v8');
</script>
```

Figure 5: Javascript function to change position.

Each of the individual pictures used to create the filmstrip was 201KB, the quality of each could be reduced to create a smaller filmstrip file if needed. As the filmstrip is considered to be one file, the whole file will be loaded just 1 time when the corresponding web page is visited. The loading of such a file compared to multiple individual files, has implications for speed of page loading, efficiency and accessibility. Although single lift rides can be visualized with the current prototype, linking more than one is a long process requiring editing of files within Photoshop. The time frame between the display of each frame of the filmstrip can be altered within the JavaScript, this may be necessary if multiple lift rides are simulated to keep the length of the animation to a minimum.

4.1 Further Work

Naturally there is further work for the resort to consider, including options of displaying multiple lift rides without editing Photoshop files, allowing reusability for many different combinations of routes taken. Possible solutions could include: an in-depth look at CSS options allowing the background to be separate from the moving lift picture - reducing the file size of each frame or allowing a HTML5 canvas to be used. Alternatively one could use JavaScript to order events and add a time delay where necessary, allowing the move-skier function to be called multiple times but for different lifts, and displayed in an order that reflects pass data.

Once multiple lift rides are displayed in a satisfactory manner, it is possible to link the lift rides undertaken by any given skier in their own part of the resort database, so as to enable an individual visualization to be created dynamically for each user within their own personal dashboard. The idea being largely a social one in this case so that the skier is able to show their friends what they have done and make recommendations for others. Different options could be available, such as last the 10 ski-lift rides undertaken for perhaps a whole day, or the whole week. A limit of how many lift rides may need to be imposed to offer a balance between page loading speed, visualization length and quality of images. An option to customize the version of the resort map displayed could be added, allowing a clearer view of different resort areas if a user did not need to see the entire map, for example just Guthega runs (a separate area of the Pulveriser resort), could be displayed on a Guthega specific map which would be easier to see due to different aspects of the hill. One can imagine the impact of these recommendations particularly amongst the social extroverted and Facebook savvy Generation Y.

5 CONCLUSIONS

Digital representations of ski resort access data offered to users depend heavily upon the data collection method employed at each resort. Two different online displays of ski statistics were compared and additional functionality considered. An alternative visualization was developed within the constraints of the data available, showing lifts ridden using a resort map. The digital offering a resort can produce is limited by the data it obtains from tickets and passes. While many sport tracking networks use global positioning from a mobile

devices, the data collected from RFID passes at the resort investigated here (Pulveriser), only provides information about which lifts were ridden, there are often many routes that can be taken from the top of one lift to the bottom of another. Such data is collected using High Frequency RFID enabled passes and readers positioned at the bottom of each lift. With over 200 million skiers worldwide and many resorts adopting RFID ticketing solutions, online offerings have been labelled the 'evolution of the skiing industry'. For the resort in question, online statistics are currently displayed via a dashboard that uses bar graphs, pie charts and tables to show which lifts have been ridden and how many vertical meters have been skied. Five of the nine well known ski resorts in Australia currently have RFID ticketing systems in place, with only one of those providing access to personal statistics online, which suggests a huge growth area in future years.

A visualization of a single lift ride was developed using a filmstrip of different frames put together in Photoshop to create an animation when displayed in sequence on a web page, whereby JavaScript was used to move through the frames. A Google-Maps image was trialled for this visualization but deemed unsuitable leading to the resort map developed by James Niehues, being used as the background for further tests. Further work would involve expansion of the visualization created as shown here, developing a method that could be linked with resort data to dynamically produce a visualization of multiple lifts ridden in varying combinations, to reflect the actual course of a skier throughout a day or given time period. The social implications of such an action are particularly relevant to the age group most interested in such physical and social activities.

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