# An Interactive Method for Visualising Physical Activity in Parks

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*Abstract*—SOPARC is a widely used method for collecting data about park-based physical activity, however there have been no interactive tools designed for visualising this data. Due to this many researchers using the SOPARC method use tables, bar graphs, or other static methods to visualise the collected data. Many of these methods result in highly obfuscated visualisations [1]–[7].

The aim of this research is to design an interactive tool for visualising SOPARC data that can produce user customised output according to their needs, is easy to use, allows for rapid differentiation of distinct areas, and allows for numerical results to be shown.

An interactive visualisation tool has been designed and developed that uses a map-based approach, with colour and numerical overlays. This interactive visualisation tool will provide a new, more transparent way to make sense of SOPARC data that will enhance the decision making process for parks and related policies.

*Index Terms*—Visualisation, Human-Computer Interaction, SOPARC, Physical Activity

## I. INTRODUCTION

"The System for Observing Play and Recreation in Communities (SOPARC) is a reliable, valid and easy-to-use tool for quantifying park-based physical activity" [8], [9] and can be used to assess the characteristics of activity spaces within parks.

Currently there are very few methods that have been adapted for visualising data collected using the SOPARC method, with many researchers opting to simply use tables and bar graphs to visualise their data. This method is very opaque and makes it difficult to quickly, visually draw conclusions about data. An interactive visualisation technique specifically designed with this type of data in mind has the potential to reduce the time spent inferring patterns and relationships from data.

This project focused designing of a tool for the visualisation of SOPARC data. An interactive method was chosen, in which the user selects the parameters of interest, and a map-based visualisation which uses colour for quick recognition, and numbers for precision is displayed according to their selection. To the best of our knowledge there have been no prior interactive visualisation for viewing SOPARC data.

## II. RELATED WORK

"SOPARC is a reliable, valid and easy-to-use tool for quantifying parks and park-based physical activity" [8]. The method first separates the park into zones, and then by systematically making observations multiple times a day and across different days, information about the activities, level of activity of park users and park user demographics, can be recorded, and used to assess the characteristics of activity spaces within parks. By repeating this process an evaluation of policies, programs and park improvements can also be made.

There have been many projects that have relied on the SOPARC method for the collection of data. Many of these projects utilised tables or simple graphs to display and make sense of this data, resulting in data that is very opaque.

This trend of utilising only tables and simple graphs for visualisation, appears to be heavily connected with the use of SOPARC data. This trend is shown in Table I.

There have been some more complex visualisation techniques used for the visualisation of SOPARC data. A key example of this can be found in "Digital Age for Observations: The Use of GIS for Analysing Observations and Behaviour Mapping" by Bozkurt [10]. In this paper a method for visualising various forms of data, including SOPARC data, using GIS is developed. This system uses a map of the site and overlays a coloured dot for each observation made. This system has some advantages, as it allows for the exact location within a zone of each type of person is performing each action to be displayed. This however requires additional information about the exact location of each observation to be recorded , making it inappropriate for visualising data that has already been collected. This would introduce some ambiguity to the recording process, for example, should a runner be recorded when they first enter view or when they leave view. In "A Multi-Scale Spatial Data Integration System for Park Management", Blanchard shows a method for querying data based on zone to display a table of observations using GIS [2]. This method allows the user to interact with a map of the site to get a table of results, however, no further attempt of then visualising this information is made.

TABLE I
HOW DATA IS VISUALISED IN THE 7 RELEVANT PAPERS

| Paper | Table | Graph/Plot | GIS-based Visualisation |
|-------|-------|------------|-------------------------|
| [1] | Yes | Scatter Plot | |
| [2] | Yes | | Click map to show table |
| [3] | Yes | Bar Graph, Pie Graph | |
| [4] | Yes | Bar Graph | |
| [5] | Yes | | |
| [6] | Yes | Scatter Plot | |
| [7] | Yes | | |

## III. MATERIALS AND METHOD

This method was designed to be used as part of a larger project undertaken Landscape Architects, local government and Public Health researchers who are interested in how people interact with each other at community parks. These researchers will henceforth be referred to as "Clients". As these clients are from varying disciplines and will have varying levels of IT proficiency, it is important that the tool be designed such that it does not require any special technical knowledge and is flexible enough to explore the data in a way that satisfies all clients.

As the clients will be the primary users of this tool, its effectiveness will be evaluated using their feedback.

### A. Dataset

The data was collected from 12 recreational sites in the Morten Bay Region, located north of Brisbane in Queensland, Australia. The data was provided in the form of 12 Microsoft Excel Files, with each file representing 1 recreational site. Each of the spreadsheets has been then further separated into books, with one book representing a zone. Some zones were then further separated into sections. Inside each book information about the observation, activity and intergenerational co-participation was recorded. The recorded information is described in Table II.

### B. Visualisation

A colour overlay is added over the satellite map of the park (sourced from Google maps), and in response to a query entered by the user, the colour of the overlay is altered to show the percentage of the total that meet the criteria specified by the user. This colour is found by linearly interpolating between the colours represented by RGB values (255, 255, 0) and (51, 0, 51), which are a bright yellow and a dark purple respectively. Synaesthesia can be exploited to create an intuitive link between colour and the data being represented [11]. As such, the colours (bright yellow and dark purple) were chosen because they are easy colours for most end users to differentiate [12]. Yellow was mapped to higher frequency data and purple to lower frequency in an attempt to make use of synaesthesia.

In addition to showing the frequency in each zone using colour, the statistics for each zone can be viewed by clicking

TABLE II
THE FORMAT OF THE PROVIDED DATA

| Information Type | Name |
|------------------|------|
| Observation | Park ID |
| | Added Time |
| | Observer ID |
| | Observation Time |
| | Status e.g. Accessible, Usable, Supervised |
| Activity | Gender |
| | Activity Type e.g. Primary or Secondary |
| | Activity Name e.g. Basketball |
| | Age Group Count (Child, Teen, Adult, Elderly) |
| | Ethnicity Count |
| | Activity Level Count |
| Intergenerational Co-Participation | Talking |
| | Physical Contact |
| | Co-Participation |

on the "View More" button for that zone. This can be seen in Figure 1.



Fig. 1. The Final Visualisation Version

### C. Interaction

The User can interact with the visualisation using input controls located to the right of the tool. This can be seen in Figure 2. The primary way the user interacts with the tool is using selection boxes.

For each park the input controls are separated into 2 main groups; a group for specify the time of day of interest, and a group for specifying the demographic or activity level the user is interested in. As data collected using the SOPARC method does not specify the number of people of each demographic at each activity level, only aggregated data for age or activity level can be returned for a given day and/or time period.
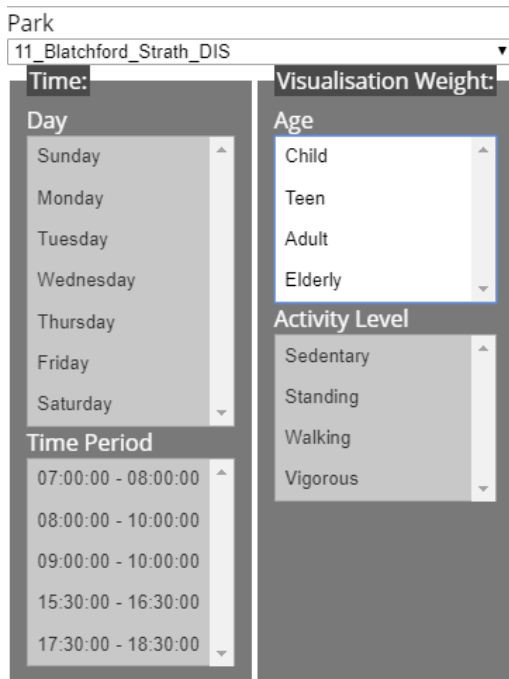
Fig. 2. The Final User Interface Version

## IV. RESULTS

To test the tool it was shown to clients, who were then able to give feedback which was taken into account in revisions of the tool. This process was first conducted with one of the clients, and their suggestions were taken into account when creating the revised version of the tool. This revised version of the tool was then shown to several of the clients simultaneously and their collective feedback was taken into account for the final revision of the tool.

### A. Initial Version

Initially, user interaction was separated into 4 main groups of input controls. These were "Co-participation Details", "Activity Details", "Observation Details", and "Age Details". This layout was created such that related input controls are grouped, and the input controls that are most important to the target audience are in the top row. The most important of which is in the top left corner of the tool. Most input controls in this version were check boxes. This can be seen in Figure 3.

This version was found to be confusing to the user when tested. This was because it was not immediately clear to the user what the check boxes changed when they were interacted with. This version did not allow the user to delimit results by day and time period, which was reported to be of great importance to the client.

The version of the visualisation included with this version of the tool showed the breakdown of results about each zone on top. This proved to be difficult to read.

### B. First Revision

The first revision removed the check boxes in favour of a system using three radio buttons with the labels "Yes", "Any",
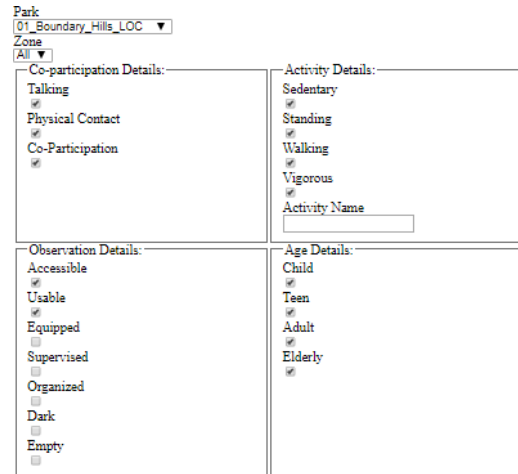


Fig. 3. The first UI version

and "No", in an attempt to make it clearer to the user how they were interacting with the data (Figure 4). This UI (User Interface) iteration was poorly received as it was not clear to the user how the "Any" option changed the Visualisation. In addition, it was still possible for the user to make selections that caused duplicate results (selecting "yes" for children and walking for example would result in the counts for all children and walkers of all ages to be added). Additionally it was made clear that the input controls for "Activity Type", "Observation Details", and "Co-Participation" where not of primary interest to the clients, and contributed significantly to confusion when interacting with the tool.
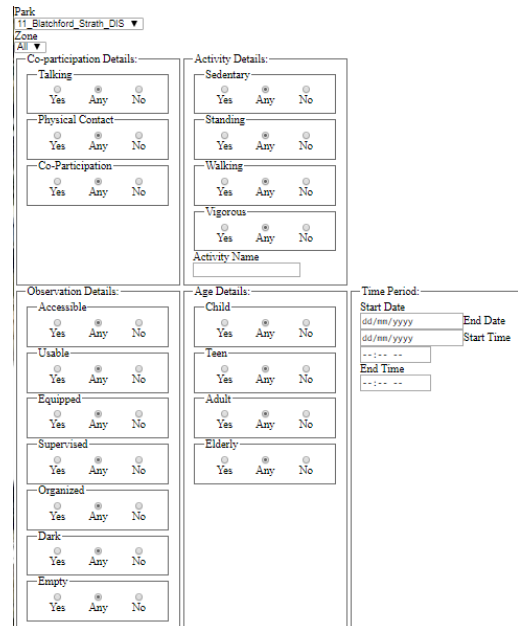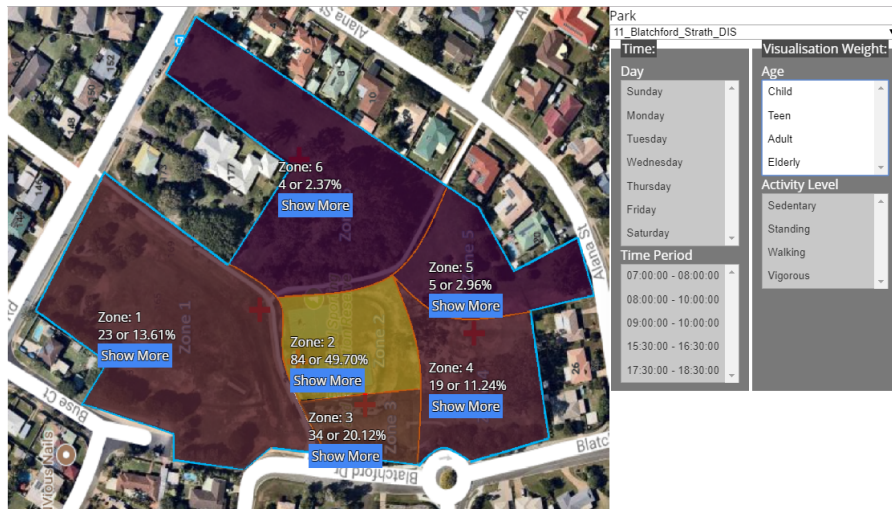


Fig. 4. The First UI Revision

Fig. 5. The Final Tool Version

## V. DISCUSSION

### A. Visualisation

This version also introduced input controls for time period. This feature was well received, however the implementation was difficult for users to understand and did not allow selection of some time combinations (e.g. Tuesday and Thursday).

In this version statistics are automatically hidden from the user and can be shown by clicking a button titled "View More" next to each zone. This allowed for significantly more information to be shown without being too difficult to read. In addition, the row under the user's cursor is highlighted to assist with showing which items in the data are related.

### B. Final Revision

The final revision of the tool uses multiple select boxes for all main input controls and a selection box for the recreational area. This can be seen in Figure 5. As only one of "Age" or "Activity Level" can be selected, when the user attempts to use one of these selection boxes, all options in the other are automatically deselected. In this final version the visualisation size, and text size has been increased due to feedback that it was hard to see from a distance. The use of multiple selection boxes was received well by the clients and allows combination of times to be selected. The map-based visualisation described uses a colour overlay and numerical overlay together to allow the user to make sense of data. This system allows the user to quickly identify zones with large differences between them using the colour overlay. Due to imperfections in the human visual system, as the difference between the overlayed colours and sizes of overlayed regions becomes smaller, colours become more difficult to differentiate [13]. This makes it more difficult for a user to identify differences between small, unpopular zones. The effects of this could potentially be mitigated by using a logarithmic scale (a difference of 1 appears more significant with smaller numbers than larger). As our system uses a linear scale a numerical overlay is used to identify small differences between zones.

The system was designed with people with typical vision assumed, however it is not a requirement that users in the target demographic to have typical vision. The colours that were chosen were of high contrast were of hues that are quite different, making the system also accessible to most people with atypical vision. The colours yellow and purple can be differentiated by people with common forms of colour blindness, however those with tritanopia (insensitivity to blue) and complete colour blindness may have some difficulty, however this is quite rare, effecting only 0.002% and 0.003% of Caucasian males, with colour blindness itself effecting only 0.4% of females [12]. In order to ensure further compatibility user customisation of colours could be added.

### C. Interaction

The client can use the interface to filter information according to location, time period, and age group or activity level by using multiple-selection boxes. There are some limitations to this system.

- Currently it is not possible to filter by Ethnicity despite this information being collected when using the SOPARC method. This limitation was deliberately introduced as ethnicity was based on observation and deemed unreliable
- There are currently no input controls that allow the user to pan through the data (e.g. viewing days of the week sequentially). This makes it harder to explore the data quickly. This could be solved by adding sliding handles that allow the user to move through options sequentially.

### D. Limitations

This visual method for interacting with SOPARC data has been tested on the clients, however large-scale testing has not yet been conducted. This means there may be problems with the method that have not yet become apparent.

## VI. Conclusion

To the best of our knowledge this is the first interactive tool for visualising data collected using the SOPARC method. A map using a colour overlay supplemented with statistics that can be viewed by clicking on the zone and can be controlled using a selection box based user interface allows the user to quickly and transparently explore the data.

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