VAST Mini-Challenge 1

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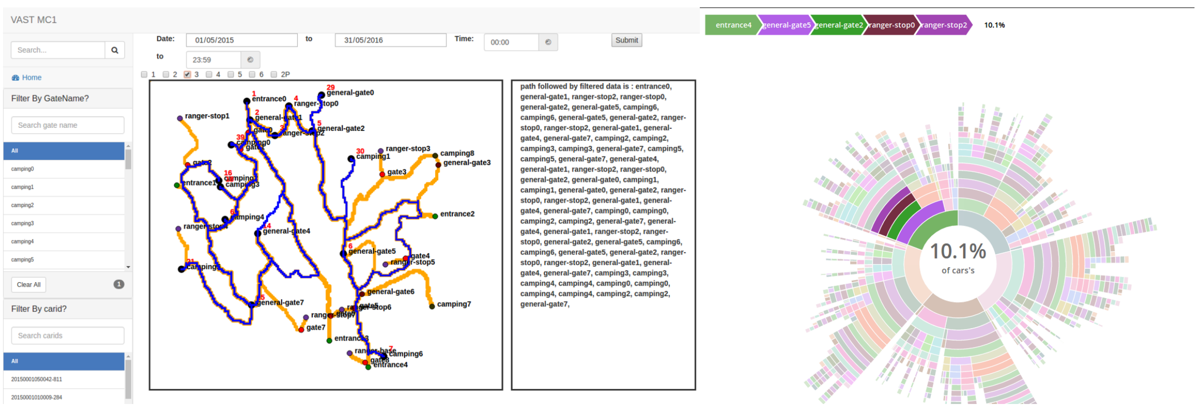

Figure 1: (a) sequence sunburst depicting percentage of users following a given route (b) MapView Toolkit: Visualizing trajectory path of car id : 20155705025759-63 (Orange color indicates road map of Leakgul and blue color indicates path opted and order of visit of gates indicated by red color.

Abstract

We propose an interactive visual analytics system for exploring spatio-temporal data in VAST 2017 Mini-Challenge-1. As part of this challenge, we are expected to determine repeating, seasonal and unusual cars' movements in Lekagul park dataset. We use varied visualizations such as heatmap, sequential sunburst and line plots. Further, we have developed a web deployable ad-hoc system for displaying spatio-temporal information on geographical map.

Index Terms:

1 Introduction

VAST 2017 Mini-Challenge-1 requires the visual analysis on spatio-temporal data. The traffic senerio of this challenge was in Boonsong Lekagul Nature Preserve which was used by local residents and visitors, and their movements were monitored by sensors deployed at various check-points/gates. In this work, we have developed an interactive visual analytics ad-hoc tool that helped us analyze movement traffic through the preserve using a visual analytics approach.

Our tool (visual analytics toolkit) uses flask framework to build up the web service. For visualization, we primarily used D3.js, plot.ly (for graphs) and backend coding was done in python.

2 Data pre-processing

We are provided with spatio-temporal dataset where each vehicle is provided unique ID and their movement within the park is tracked at each gate. The movement data as provided gave little insight into the Lekagul park operations. Our approach is to precompute and store given spatio temporal dataset into spatio-temporal graph where each edge indicates trajectory followed by a given car-id in the road network along with time [1]. This preprocessing step helped us in identifying frequent routes/paths opted by various vehicles. Also, we labeled each edge with additional information such as holiday, weekday and day of the month using time stamp of movement.

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3 Visual Analytics for Lekagul Sensor Data

To analyze the vehicles movement data in-depth, we designed the MapView tool which consists of Filter selection option, map view and description panel in the right of the map view. The analytic interface provided in the left frame containing filter options can help to analyze the characteristics of the paths on the Middle Frame i.e., Map View. Fig. 1 shows the movement path of a car-id based on filtered options. In the map drawn, orange color indicates the road network of map with varying width as per the traffic through the network and blue color indicates the path followed along with ordering (indicated by numbers in red).

3.1 Analytic Interface

The analytics interface allows the user to filter the dataset depending on the objective of their exploration. The interface is made up of 5 subcontrols. a) **Date selection :** On providing range of date, user can visualize the movements of all vehicles in the range selected. b) **Day Selection :** User can filter the dataset based on day of the week. Map displays sequence of paths on that day of the week along with count of vehicles for each path. c) **Car-id Selection :** This option allows only the movements of particular car ID's and view their trajectories on map view. The sequence of check-in's for the selected car is displayed with serial number. d) **Cartype Selection :** On selecting a particular car-type, we will get the count of car's of the given car type following a path. d) **Gate Selection :** User may filter the dataset based on gate also. This helps to find the flow of traffic through a particular gate.

3.2 Statistical Analysis

Our Visualizations are used for analysing and answering the questions given. Sequential sunburst [see Fig. 1(a)] shows percentage of vehicles following a route/path starting from either of the five entrances.

3.2.1 Repeating patterns

To identify sequential pattern we took into consideration vehicles entering the preserve more than once. There are a total of 5 vehicles (ID 20154519024544-322 ,20153712013720-181, 20162904122951-717 and 20154112014114-381) which visited the preserve significantly more number of times than the rest (6 vehicles entered twice). By further analysis we discovered: i) They followed the same path in every visit ii) Stayed at particular camping site around midnight (very few vehicles opt for night camping) iii) They belong to car-types 1,2 or 3.

Fig. 2 shows traffic flow through each gate per hour. In this visual representation, red color blocks indicates a very high flow of traffic. This depicts that general-gate7 is the most heavily used gate from 7:00AM to 14:00PM along with general-gate2, general-gate1, ranger-stop0 and general-gate0 and very less traffic (indicated by yellow color or no color) is observed in night.

For sequential patterns, we found distribution of duration of stay at each gate and how frequently a gate is being used with respect to time.

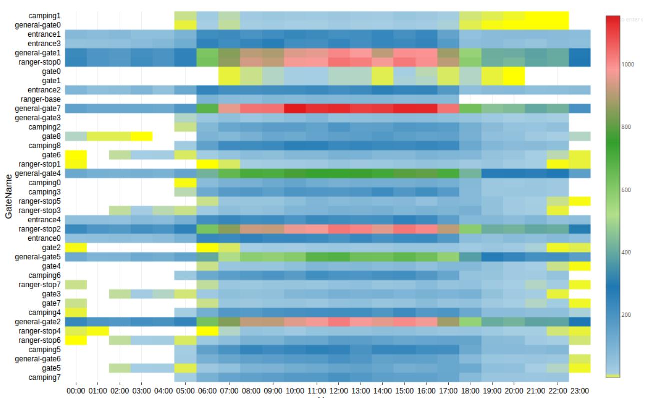

Figure 2: Count of vehicles passing through each gate per hour.

3.2.2 Seasonal patterns

For seasonal patterns we computed count of vistors passing through each gate per month [see Fig. 4]. a) The peak season for the preserve is identified by plotting number of vehicles inside park on a given day [see Fig. 3]. b) An interesting seasonal pattern we observed is heavy vehicles (cartype 5,6) passed through a set of restrictive gates.

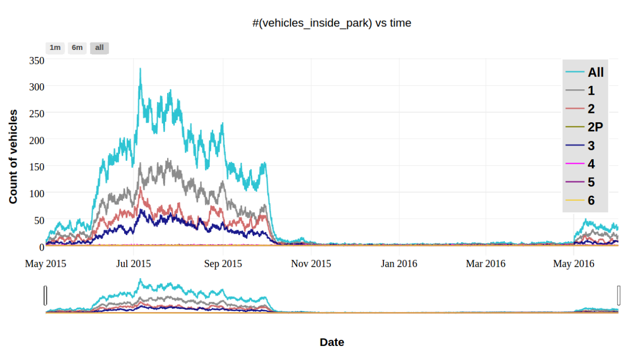

Figure 3: A visualization of count of vehicles inside the preserve on a given day

3.2.3 Unusual / peculiar patterns

The heat map [see Fig. 5] of the number of vehicles of a given type passing through a gate was computed to identify unusal patterns. The plot showed that cartype4 visit a set of gate (gate3, gate5, gate6,ranger-stop3 and ranger-stop6) which were being visited by ranger vehicles only. The plot also showed car-type1 visiting ranger-stop1 which was only meant for ranger vehicles. On further analysis we found that there were 6 vehicles (20161008061012-639, 20160623090611-424, 20150322080300-861, 20153427103455-30, 20150204100226-134 and 20154501084537-684) which visited ranger-stop1 by-passing gate2.

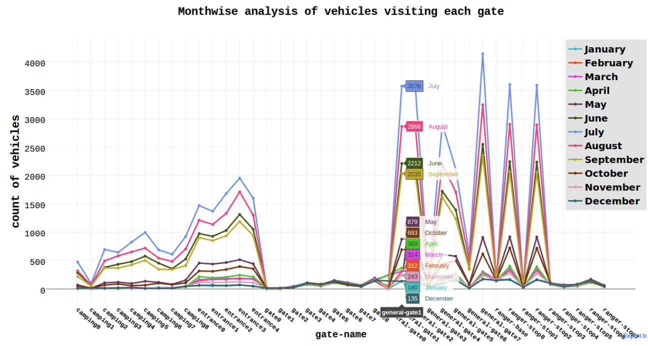

Figure 4: Count of Vehicles passing through a gate per month

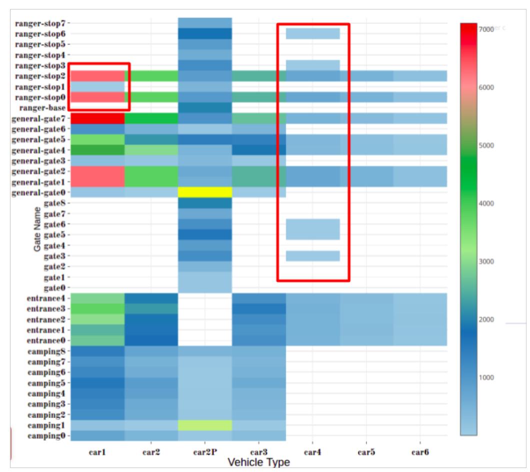

Figure 5: Number of vehicles (per type) passing thorugh gate

In Figure 1(b) the route highlighted are the trajectories of a peculiar vehicle (ID : 20155705025759-63), which keeps on traversing the premises and didn't exit the preserve not even once. This vehicle have been wandering inside the premises since 1 year and still present in preserve.

4 Conclusion

Our tool and visual graphs helped us analyse patterns both seasonal and unusual. MapView tool played a significant role in understanding spatio-temporal patterns of trajectories followed by vehicles and finding unusual patterns.

References

[1] G. M. Nielson and B. Hamann. The asymptotic decider: Removing the ambiguity in marching cubes. In *Proc. Visualization*, pp. 83–91. IEEE Computer Society, Los Alamitos, 1991. doi: 10.1109/VISUAL.1991.175782