**A TOPIC BASED ANALYSIS OF THE SOLUTIONS OF VAST 2015: MINI CHALLENGES**

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1] INTRODUCTION:

This paper presents an analysis of the solutions for VAST 2015 mini challenges titled ‘Mayhem at DinoFun World’. But instead of a generic analysis of strengths and weaknesses of solutions, a topic-based analysis in the order that was followed in class was done. So, the analysis would begin with Sense-making, followed by Interaction, Information Visualization, Time & Space analysis, and GIS. In doing this, the goal was to have a sort of a recap of the topics covered so far and then apply the concepts in these topics to analyze the solutions for the mini challenges.

In Sense making analysis, the processes that the teams followed were observed. If they have directly or indirectly used the notional model of sense making in any of the activities. If any top-down or bottom-up processes were involved in their sense making phase. Interaction analysis was a bit tricky in this case, as there were no actual tools that could be tested for interactions amongst the solutions. However, in the solutions, they had provided a video demo in which they showed some interactions. In those cases, the video was investigated for interesting interactions. Information Visualization was analyzed by looking for any Visual Thinking algorithms used for better cognition. If any data glyphs were used and if used, then their effectiveness in a visualization. In time-space analysis, the team’s solutions were observed for any temporal or spatial aspect used in their visualization and if these were a contributing factor towards their solution or not. In GIS, the thing that was observed was, how well the teams have used the ‘DinoFun World’ map provided in the challenge description.

2] MINI CHALLENGES:

The VAST 2015 challenge was titled ‘Mayhem at DinoFun World’. It had two mini-challenges and one grand challenge [1]. This paper contains the analysis of the two mini challenges only. The first mini challenge was focused on the analysis of movement of groups of people. In doing so, the participants had to accomplish a set of tasks such as identifying twelve different categories of people or groups of people that visited the park, identifying notable patterns of activities done by these groups over a period of three days, and recognizing any unusual activity patterns that might be relevant to any crimes within the park [2]. The second mini challenge was focused on the analysis of communications [3]. The participants were provided with communications data between the paying park visitors, communications between the visitors and park services as well as messages between user and an external party. The three main task for this mini challenge were identifying those IDs that had large volumes of communication (and identify any patterns), identifying ten different communication patterns, and formulating a hypothesis as to when the vandalism was discovered.

3] ANALYSIS OF SOLUTIONS:

A] Sensemaking aspect:

Although none of the teams have directly made use of the notional sensemaking model, most of them, if not all of them have indirectly used it in some form or other, whether it be the bottom-up and top-down processes, or the foraging loop or the sensemaking loop. The team from KU-Leuven has explained the process that they followed while addressing the mini-challenge 1 (MC1) [4]. The descriptions that they had provided for each group were precise and distinct leaving no room for misunderstandings. The team from Middlebury College developed their own tool to visually analyze the VAST 2015 mini challenges. In [11] they have explained the process that they had followed. This team seems to have made extensive use of ‘search and filter’ process from the notional model of sensemaking which were a part of bottom-up processes from the foraging loop of the model. The team from UKON also developed their own analytical tool for this challenge. Although the findings of this group were commendable, the representation and nomenclature of the group categories was mixed up a bit. There were certain overlaps between the groups, for example, the group ‘Medium sized groups’, could be determined as a vague category, considering it could easily be a part of ‘morning visitors’, ‘Families’ or even ‘weekend tourist’ groups [6].

Besides the above, almost all the top solutions made use of sensemaking loop activities such as hypotheses building and bottom-up process of ‘building a case’ which are most notable in [7,8,9]. This might be because the challenge itself demanded to build a case against individuals who had suspicious communication activities which might have led to the vandalism incident.

B] Interaction aspect:

As mentioned in section 1 of this paper, the interaction aspect was a little tricky to analyze, there was no access to the tools that the participants used to come up with the solutions. However, every team made a video demonstration of the tool(s) they used along with some or all the possible interactions. Therefore, an investigation of these video demos was done to find interesting interactions.

A common theme found in all the video solutions and the tools was a sequential use of low-level interactions [16] such as selection, dynamic querying and filtering. The team of KU-Leuven has programmatically obtained the resulting graphs and plots by using R studio. Thus, there was no interaction in their solution. On the other hand, the teams of Middlebury college and Purdue University displayed a very high level of interaction in their tools such as showing comparisons, identification of patterns, showing outliers which would help the user understand the visualizations.

One more interesting interaction is visible in the tool from team UKON where in the user can see what query is being executed when making a selection [12]. This is interesting as, usually, querying takes place in the backend and the user directly sees the results from the query. But this team decided to keep it on screen so the user will understand what is being queried through the interaction.

C] Information Visualization aspect:

In [17], the author introduces various ‘Visual Thinking Algorithms’ that help us in a better information visualization and cognition. These algorithms have been used as a guideline in this section. One of the most common algorithms used in either of the mini challenges is the ‘Pathfinding on a Map or Diagram’ algorithm. This is also due to the nature of the challenges which demanded tracing movements of the visitors as well as finding communication patterns. An example can be seen in Figure 1 below [5].

A picture containing different

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Figure 1: Example of Pathfinding on a map showing movement tracing of a visitor across the park. (Snapshot from [11])

Another algorithm that is used in the tools developed by teams CSU and UKON is the ‘Brushing’ algorithm in which the same data is represented in different forms and selecting a data point on one forms highlights respective data points on other forms. We can see the use of this algorithm in the ‘DNViz Tool’ of CSU video demo [13] of team, wherein when we select one of the network nodes in one visualization, we see the respective incoming and outgoing communication related to that node in another visualization. A similar brushing is also observed in UKON video demo wherein as we drag the cursor along the timeline, we see a corresponding change in the position of the individual on the map [12].

D] Time, Space and GIS aspect:

Time, Space and GIS were the most critical aspects in the VAST 2015 mini challenges. Mini challenge 1 was completely based on these aspects. The tools or visualizations developed by the teams consisted of temporal, spatial and geographical elements in some form or the other. Most teams used the timeline-based plotting approach to show the movement of groups within the park. These plots were made on the park map itself to give it a spatial and geographical element. Following are some examples of temporal, spatial and geographical aspects being used in mini challenge 1:

A close up of a map

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Figure 2: Movement pattern of eight security guards shown on the map by Team KU-Leuven. [10]

A screenshot of a computer

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Figure 3: Movement of individual shown on the map by Team UKON [12]. The position of individual on the map is highlighted by a black dot inside the blue circle.

Interestingly enough, these critical aspects were used in the mini challenge 2 as well. The team from Purdue University developed a heatmap of communications data to show hotspots of communication (shown in figure 4). The team from CSU used the DinoFun World map in their movement and communication analysis for plotting region with the greatest number of check-ins as well as plotting the region with most number of sent texts (shown in figure 5).

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Figure 4: Communications heatmap developed by Purdue University [7]

A close up of a map

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Figure 5: Check-ins and communication data plotted on the map by Team CSU [9].

4] CONCLUSION:

This paper was an effort in analyzing the solutions of VAST 2015 mini challenges in a rather unique way. The analysis was based on various facets of the Visual Analytics domain such as Sense-making, Interaction, Information Visualization, Temporal-Spatial Analysis and GIS. The main objective was to have a complete recap of the topics covered under the ISTE-782 Visual Analytics course, going through the suggested reading materials and then applying them to analyze the solutions of VAST 2015 mini challenges. In this sense, it different from generic analyses although future work may involve complete statistical analysis, or it can be generalized even further to analyze all VAST challenge solutions.

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