

# Interactive Visualization for Exploring Abnormal Trajectories and Transactions of GAStech Employees



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## Introduction

The IEEE Visual Analytics Science and Technology (VAST) Challenge is an annual contest of which the goal is to advance the field of visual analytics through the competition. The VAST Challenge is designed to help participants to understand how their analytic tools would be used in a novel analytic task and determine if their data transformations, visualizations and interactions would be beneficial for solving the challenges.

2021 Mini Vast Challenge 2 presented the scenario: some Kronos-based employees of GAStech oil and gas company went missing. Car tracking data for the two weeks leading up to the disappearance, as well as credit card transactions and loyalty card usage data related to missing employees are provided. This challenge is concentrated on exploring the anomalies, recognizing the ownership of the cars and cards and identifying suspicious patterns of behaviours by analysing the movement and tracking data, as well as the transaction data.

In this paper, we aim to leverage the richness of the movement and transactions data to provide an interactive visualisation for exploring suspicious behaviours of GAStech Employee and generating insights.

## Motivation

The task of Mini Challenge 2 is to explore anomalies and get meaningful insights based on the given dataset to help the investigation of the incident. As the tracking data provided here are geospatial data with aspatial information, a good way to present the movement information is to show the path on the map.

To identify the anomalies of transactions for credit cards and loyalty cards, we need to compare the detailed transaction information including the location, date and price. Also, in order to identify the owners of cars and cards, looking at the tracking data for each car is inevitable. Instead of generating tracking for each car, an interactive visualisation application which allows user to select carID and timeslots they would look at is more efficient and helpful.

There are four key aspects in this interactive visualization application. With this application, we hope to provide an interactive experience to explore the disappearance of Kronos-based employees of GAStech by linking transactions and tracking data together.

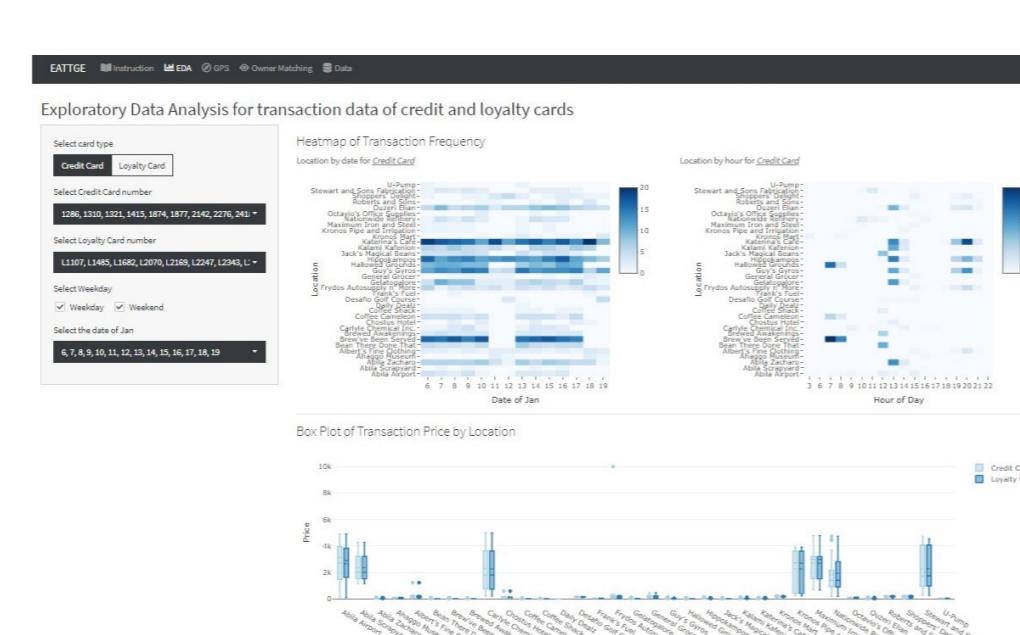
## Approaches

- Analysis of Kronos Incident dataset with background research
- Exploratory Data Analysis (EDA) methods in R
- Exploratory Spatial Data Analysis (ESDA) methods in R
- R Markdown development for functionality checks
- R-Shiny app development for user interactivity

## Results

### EDA for transaction data of credit and loyalty cards

The heatmap on the left side is showing consumption frequency grouped by location and date of Jan, while the right side one is by location and hour of the day. On the left side, users can switch the card type (credit or loyalty card). The boxplot below is designed to show transaction price of different locations. Users can select card numbers, switch between weekday and weekend, or even select the exact days to customize the charts and explore on details.



### Analysis of GPS tracking data

Car GPS movement path shown on the city map of Abila: The left plot represents different dates by colors, while the right one representing different time slot by different colors. Users can explore on each car ID and date by selecting from the dropdown list on the left side. Besides, if hover the cursor over the layer logo on the right side map, users could filter shape layer for the target time slot to see the movement path of a specific time period clearly.

