THE UNIVERSITY OF HONG KONG

DEPARTMENT OF COMPUTER SCIENCE

COMP7507 Visualization and Visual Analytics

Visualization on Traffic Accidents Data of HK

Project Report

Group 7

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Visualization Website： http://8.218.186.230:8080

GitHub Repository:
Web Client: https://github.com/tian-yu-moker/visualization-web-pages
API Server: https://github.com/shituweian/visualization_back_end

Content

1. Introduction

The project mainly focuses on the visualization of the road traffic accidents (RTA) in the UK from 2005 to 2015. The following section will give a brief introduction of the background as well as the purpose of the project.

1.1 Background

The road traffic accidents (RTA) have become a serious problem as the rapid growth usage of vehicles. Every year millions of people get injured or even die in RTAs. Therefore, it is vital to pay more attention to traffic accidents so as to reduce life and property loss. In this case, the project utilizes the typical dataset of UK traffic accidents and tries to show the explosive patterns of RTAs.

1.2 Project Objective

The main objective of the project is to provide a comprehensive traffic accidents visualization system to show some important patterns as well as knowledge, so as to help reduce the damage of RTAs. In this case, the project mainly focuses on the human-computer interaction. By visualizing and analyzing the dataset, some implicit relationships and patterns can also be explored. Moreover, some novel diagrams are utilized to make the visualization more effective.

Some explorative visualization and sights are involved in this project. For instance, using the map to indicate the geo-information of RTAs, using calendar coordinate system to explain the accidents related to seasons, festival, weekdays, weekends and some UK traditional festivals, using the dynamic charts to show the implicit relationship between population, GDP and accidents as well as applying Cartesian heatmap and matrix to explain why different time periods have an impact on the number of traffic accidents.

2. Datasets Introduction

In this project, multiple datasets are utilized, including the traffic accidents information of the UK, accident vehicles information, UK GDP growth in different regions as well as population statistics of UK main areas.

2.1 Road Safety Data of UK: Traffic Accident information

The dataset is collected by the UK government to show the nation RTAs from 2005 to 2015, which has a large size and high dimension. Basically, the number of entries is 200 million and the dimension is 34. Hence, it is comprehensive but complex as well.

The project handles all the 200 million data, with some major dimensions such as Date, Casualty, Time, Severity and Location. In total, there are about 20 dimensions utilized in the project.

2.2 UK Accidents: Vehicle Information

The vehicle information records the accidents vehicles in the UK, where there are approximately 300 million tuples. The dataset can be combined with the last dataset based on the accidents index.

According to the dataset, multiple useful attributes such as vehicle brand, type, age and gender of drivers are picked to construct visualization diagrams.

2.3 Region Gross Domestic Product: City Regions

The dataset is captured from the Office for National Statistics and shows the concrete economic change of UK cities from 1998 to 2019. The data includes gross value-added, value-added tax, subsidies on products and other economic-related data, here we mainly use data on gross domestic product from 2005 to 2015.

2.4 City Regions: Total Resident Population

The dataset is from the Office for National Statistics and shows the specific population changes of cities from 1998 to 2019 across the United Kingdom. Here we mainly apply population change from 2005 to 2015.

3. Visualization Tools

Due to the complexity of datasets and requirements of the project, the powerful tools are required. Therefore, after rigorous consideration, in this project, several tools are applied, including ECharts, Tableau, Vue, Spring Boot and MySQL.

3.1 ECharts.js and Tableau

The EChart is a JavaScript library, which provides intuitive, vivid, interactive and personalized data visualization charts. As the library is in light of JavaScript, it is convenient to customize the charts based on programming. Through the library and Vue.js framework, direct interaction with static web resources can be rapid. Moreover, customized data, interaction methods and charts provided by the library make the graphs implemented in this project more distinctive.

The project also inserts the Tableau dashboard into the web page to add some additional chart types that are not provided by ECharts. The usage of Tableau, the charts implemented in the project can be prompt and intuitive. Also, the tool fills the gaps and disadvantages of ECharts.

3.2 Vue.js and Spring Boot

The project selects the Vue.js as the web client framework to develop the chart logic and web representation. in light of the framework, it is simple to design the layout of

the project dashboard and the related charts, together with the description. Moreover, it is more flexible to implement the web page and provides additional information through the Vue.js framework.

Moreover, due to the large scale of data, it is slow to read all data from Excel files by JavaScript. Therefore, the project applies the application programming interface (API) to transfer the data from the database based on Spring Boot. The framework can handle a large number of queries, and thus it is quite suitable for the project. Additionally, the data pre-processing is also finished in the related backend interface. On this occasion, the load of rendering charts and web components can be released.

3.4 MySQL

In order to extract useful information from the huge amount of data, MySQL is employed as the database management system in this project, which is deployed in the remote server to avoid inconsistency.

According to the database, it is convenient to process data by creating new tables using SQL statements. The main data pre-processing stage is operated in the database.

4. Visualization Implementation

This part introduces the visualization results under the traffic accident datasets of UK, with exploration and analysis of the visualization results.

4.1 Overview Line Charts Visualization

The line chart shows the overview of traffic accidents over the 11-year period. In order to clearly see the trend of traffic accidents in the UK during the past eleven years, the line chart is used to intuitively show the fluctuation of data.

- **Visualization Methodology**

Blue line indicates the total number of traffic accidents, green line indicates the total number of casualties. Especially, the tooltips show more information, the number of three accident injury levels. Users can also click the button to see the situation of bad weather and road conditions.

- **Exploration**

From figure 1, it can be observed that the overall number of traffic accidents shows a downward trend from 2005 to 2015, indicating that the government's control of traffic is gradually improving in the UK, and people pay more attention to traffic safety.

However, there was a slight increase from 2013 to 2014 because there were heavier weather in that year. According to the bad weather and road conditions line chart, in 2014, there was an obvious increment for bad weather and road conditions, which lead to small increase of total accidents.

At the same time, it can be seen that the overall number of casualties is greater than the overall traffic accidents, which shows that there is more than one casualty at each accident site on average.

Figure 1 Overview of accidents and bad weather trend

There is also a line chart about the top five regions traffic accidents over 11 years, users can observe the top five cities with the most traffic accidents in the UK. From figure 2, the overall trend is downward, but Kent is always the city with the most traffic accidents.

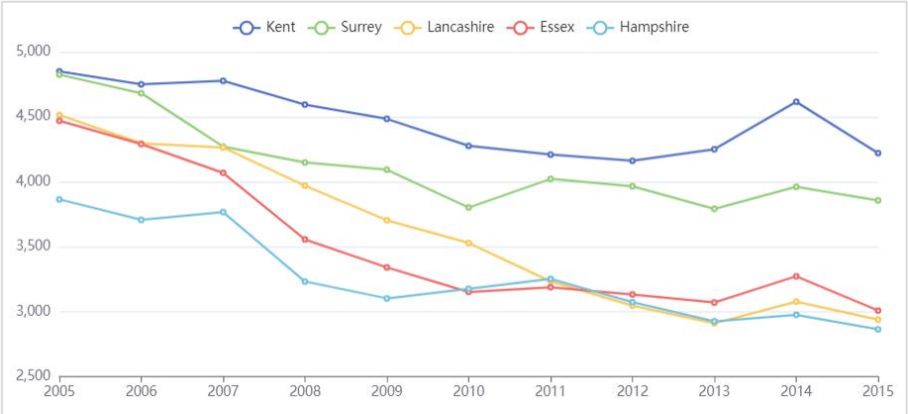


Figure 2 Top five regions traffic accidents

4.2 Map Visualization

A map can be used to represent the accidents distribution throughout different regions in the UK. In this case, the geographic information can be combined with accidents data.

Based on map visualization, a series of problems can be solved. For example, the map of the project can effectively show the spatio-temporal relationship of accidents. In this case, the data expression is clearer and more intuitive, which makes it clear at a glance and is convenient for users to mine deep information.

- **Visualization Methodology**

Using the diverging scale, two sequential scales cross-fade through a neutral color to quantify the number of traffic accidents. The gradient color from deep blue to dark red indicates the date from small to large. Additionally, a slider is provided to view the accidents in different time periods.

Also, the heatmap of the left can be dragged to see areas in a specific accident number range. Furthermore, the mouse hovers event id processed using a tooltip inserted with a line chart of the current region in the ten years, which can be seen in figure 3. Besides, the module also provides a button to switch to the accident rank in

the UK during the select period.

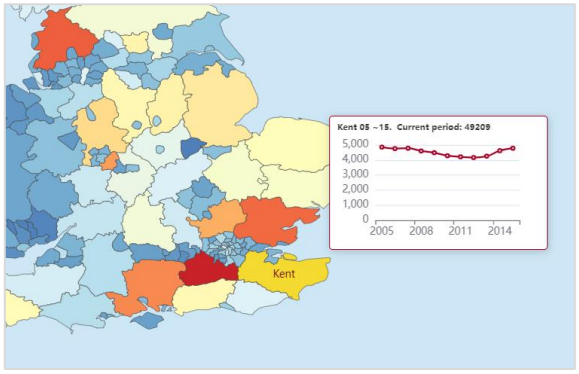


Figure 3 Hover events tooltip with line chart

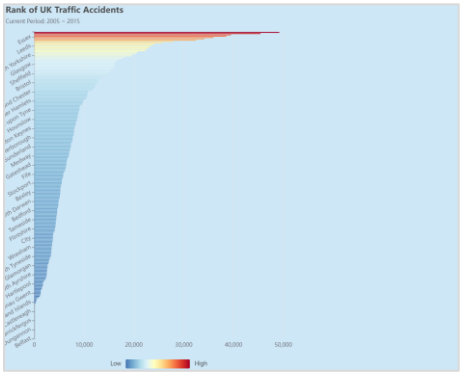


Figure 4 Bar chart rank of cities

- **Exploration**

According to the map, the southeast part of England has the deeper red color, which refers to higher accidents in other regions of the UK, while the RTAs for areas in the north of the UK are generally less than those of southern cities. Additionally, in general, east coast of British also has a higher accident frequency compared with cities on the west coast. Therefore, it is important for the UK to govern Furthermore, as mentioned before, in 2014 there is a small increase, which can also be observed on the map as the color becomes deeper (shown in the figure 6 and 7).

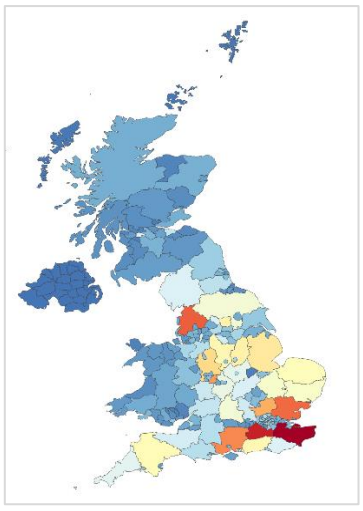


Figure 5 Map (Overall)

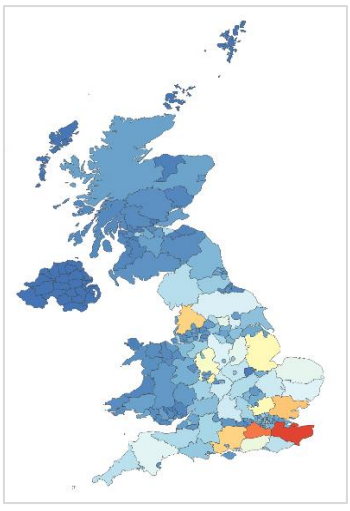


Figure 6 Map (2013)

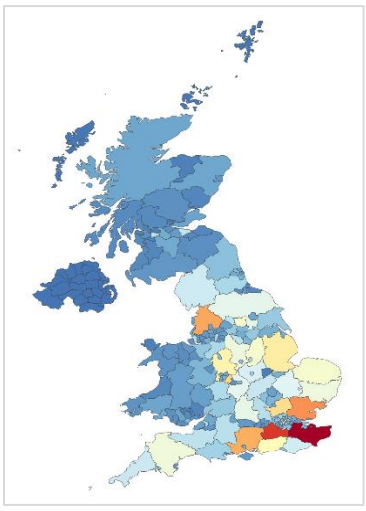


Figure 7 Map (2014, deeper)

4.3 Calendar Coordinate System Visualization

The project implemented the calendar coordinate system to visualize three possible factors that may have impacts on the traffic accidents, including light condition, road surface condition and weather condition, together with the daily accidents visualization.

Due to the large amount of traffic data and complexity of impact elements, using a line or bar chart is hard to observe how these factors may affect the traffic accidents in detail. Additionally, compared with two-dimensional diagrams, the calendar coordinate can add an extra dimension, time in to the graph. Therefore, it is helpful for

users to check the useful accidents pattern and find out effective information based on specific dates. Moreover, it is also useful in traffic accidents report to form a comparison between months and years.

- **Visualization Methodology**

The calendar charts have a high level of interaction. For example, users can select a month in ten years in four different modes as they want to find out any information. Additionally, some effective visualization properties such as gradient color and size of points in the heatmap, color in pie charts, legends click interface and hover events enhance the useability and interactivity of the calendar system. The following figure shows an example mode of the calendar system.

Figure 8 Example layout of the calendar visualization

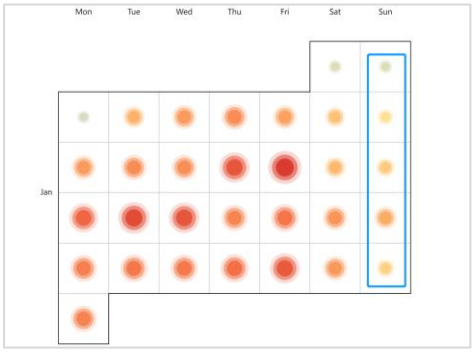
4.3.1 Daily Accidents

To find detailed patterns, the daily accidents can be used, which applies the heatmap to show the accidents number on each day. The red color and size of the circle in each cell refer to the accident number in that day. Through this diagram, users can simply select any date within the period and find out the accident situation in one particular month.

According to the diagram, there are two typical patterns that can be concluded. First of all, it is clear that in most of the month, the number of accidents on weekdays is generally larger than that of weekends because the color and size of points in weekend cells are smaller. Normally, this is because in weekday, most of the citizens need to go to work, which leads to more traffic streams. In this case, it is easier to suffer from traffic accidents. The figure 9 shows an example of the exploration.

Another interesting thing is, in the December of each year, the traffic accidents number has a significant decline around December 25th, which is the Christmas Day. And after the Christmas Day, the accidents number increases rapidly. There are the similar pattern around other festivals such as Easter and New Year's Day. It can be concluded that, in public holidays, there are fewer accidents. Nevertheless, more

accidents happened on the day after holidays. Therefore, it is vital for people to be careful on those days. It can also be heuristic for the traffic police to enhance monitor after the public holiday.



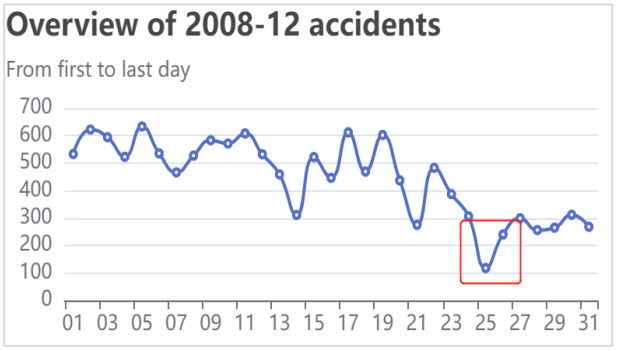


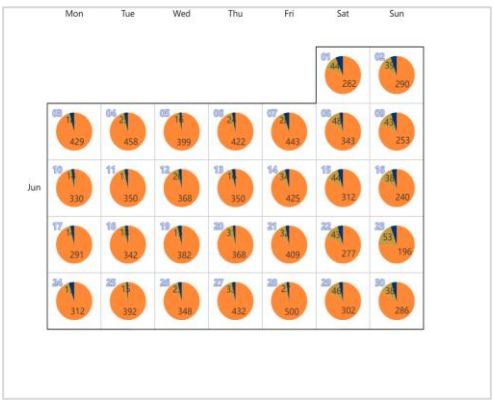
Figure 9 Weekends less accidents

Figure 10 Example 2008 Christmas Day: decline

4.3.2 Light Conditions

The second mode is the visualization of light conditions, which can be switched through the second box. The chart utilizes the pie chart to illustrate the percentage of light conditions in each of the cells, with the color related to the light intensity. Using the bottom tag can select which of three conditions are visible on the chart.

In light of the chart, it can be observed that in winter months, the percentage of weak light and no light accidents accounts of a larger rate of total, while in summer months, the daylight accidents are more, as shown in figure 11 and figure 12. More generally, throughout one year, the percentage of daylight accidents first increases and reaches the peak around June and then declines in the following months. The reason is that the daytime is shorter in winter. Hence, it is vital for the UK government to lit light earlier in the winter months, which can reduce the accidents caused by weak lights.



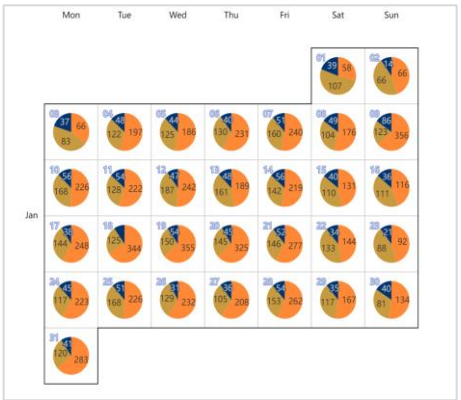


Figure 11 Summer light conditions

Figure 12 Winter light conditions

4.3.3 Road Surface Conditions

The condition of the road surface has a vital impact on traffic accidents. When road conditions are bad, accidents tend to get worse. Therefore, this calendar focuses on five different levels of road surface, applying celled pie charts to show how frequently these

road surface occurred. The color of pie elements is also related to condition level. Moreover, on the right panel, the bar chart is used to show the number of each condition in selected month, as shown below.

In light of selection function, it can be simply found that in winter months of each year, the road surface conditions are worst. In these three months, the percentage of the dry road surface is the lowest. Bad conditions such as damp and frost are more frequent, as shown below. Therefore, after checking the daily accidents mode, the accidents are more frequent in three months. The phenomenon is mostly related to the climate of the UK, where the humidity of air is high and temperature is low, and thus roads can be easily damp. Therefore, the government should spend more time and human resources to keep the road dry in the winter months.

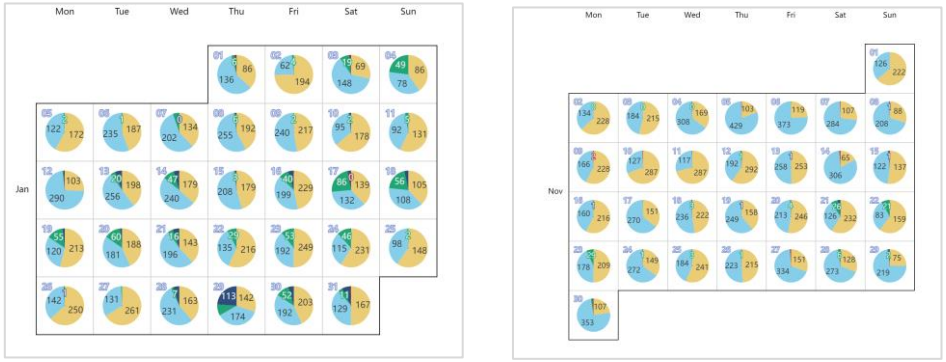


Figure 13 Road surface visualization of January and November

4.3.4 Weather Conditions

Another important issue is the weather condition, which can affect visibility and road surface. Therefore, in this figure, different colors are utilized to represent the seven kinds of weather that can affect traffic accidents, in order of severity.

According to the chart, it can be explored that in most cases, the fine weather takes up the major percentage of all weathers. In the low-temperature months, the category of weather becomes more complex. Therefore, drivers in the UK had better be more careful when driving on the road in these months.

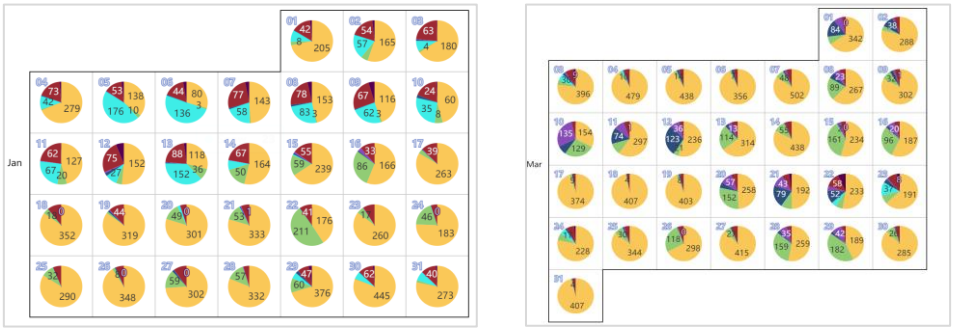


Figure 14 Low temperature months example

4.4 Score Rings Visualization

As mentioned above, the light, road surface and weather probably have some impact

on traffic accidents. Therefore, the score rings chart is used to explore how these factors may affect the occurrence of traffic accidents.

- **Visualization methodology**

This chart takes the casualties number for every 1000 accidents as measurement to evaluate the severity of accidents in different factors. In order to make the result more meaningful, the original value is set to 1000 for every ring, while the maximum value is set to 1600. In this case, the length of each ring indicates the score each element gets. The higher score refers to the factor has a more significant impact on traffic accidents.

- **Exploration**

It can be observed from charts that bad conditions such as no light, flood road and raining weather have a more serious impact on traffic accidents. That is, when traffic accidents occur under such situation, there will be more people get injured and the accident severity can be high.

Nevertheless, good conditions, such as daylight, dry road and fine weather do not lead to many fatal accidents. Although these good situations always account for the major part of whole accidents occurrence, they have a slight influence on the severity of traffic accidents.

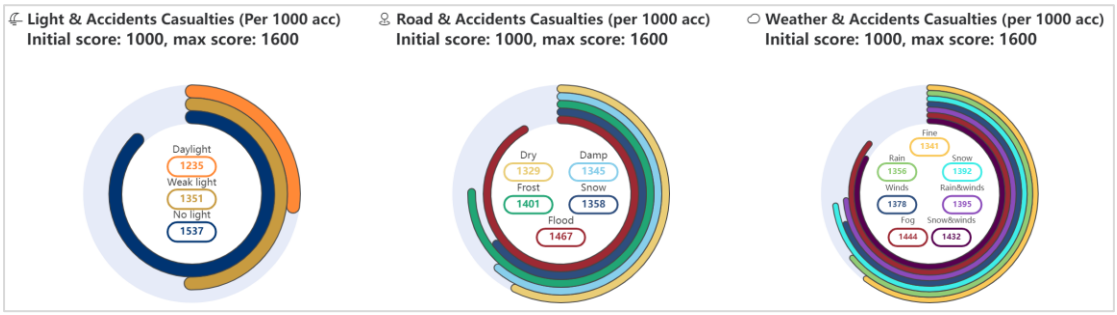


Figure 15 Score rings for light, road, weather conditions

4.5 GDP and Accidents Relationship Visualization

We believe there is a strong connection between the GDP, population and traffic accidents, from this chart, people can see the social changes at the UK. And from the implicit relationship, people can check if whether the traffic condition of a city is healthy or not; if an abnormal city appears, the public can make relevant corrections.

Furthermore, because of the limited performance of the website, and in order to show a clear picture to users, we only selected 20 typical cities as an example.

- **Data Processing**

We grouped accident data by year and urban areas, and connected the data to GDP and population.

We chose Manchester, Glasgow, and Bradford as representative cities with developed economy, large populations and the high number of car accidents, and chose Angus, Oldham and Somerset as representative cities with less developed economy, small population and fewer car accidents, and also some cities between them.

- **Visualization methodology**

A scatter diagram is used here to illustrate the relationship between GDP, population and traffic accidents. This map has four dimensions, Y-axis display accidents number, X-axis display GDP (pounds millions), size of points shows the population, points position and size changes with the year, different color means different council area, if some council areas belong to a lieutenancy area, they will have similar color, for example, all areas belong to greater London are purple.

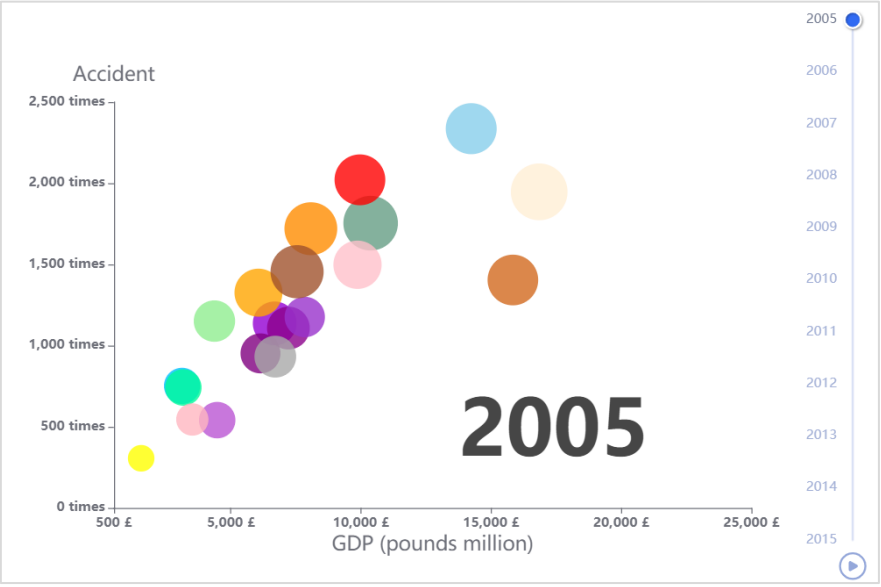


Figure 16 Scatter diagram Visualization

In addition, there is a broken line chart to show the GDP changes of 20 cities in 11 years, and a bar chart on polar to show the population growth.

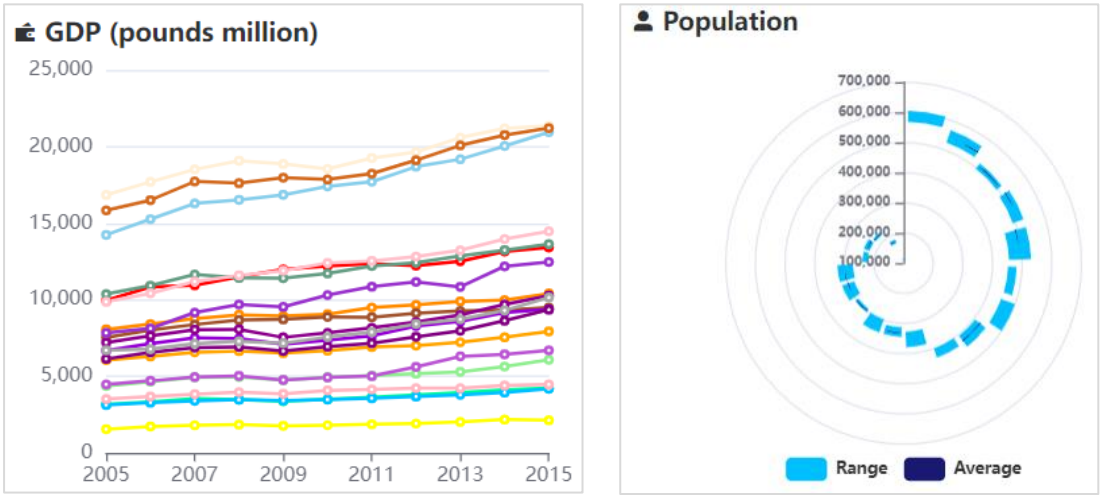


Figure 17 GDP and Population Visualization

The lines on the diagram and the points on the scatter diagram have matching colors which enable the user to check cities' GDP quickly. The rectangle size in the bar diagram shows the amount of population growth, as can be seen from the diagram, Manchester experienced huge population growth.

- **Exploration**

During this period, accident numbers show a decreased intendancy whether in a big city or in a small city. From 2013 to 2014, all cities show a slight increase because of the unusual weather that year.

From the economic point of view, in 2005, megacities experienced the most accident, after a decade, the relationship between economy and traffic accidents became weaker, cities with different GDP had similar traffic conditions.

From the population point of view, cities with small population had few accidents, from the map, big circles always higher than small circles. Lambeth is a special, there were three hundred thousand citizens at Lambeth but its accident number ranked second in 2015, which means traffic of this city is unhealth and the government should take action to reduce the accident rate.

4.6 Line Chart Matrix Visualization

This module mainly identifies the number of traffic accidents in various months in any two years under the twenty-four hours. Figure 18 shows the number of traffic accidents every two hours in each month and compares them between different years and months.

Line chart matrix can intuitively see the growth and decline trend in different time periods and different months, and help users observe the accident-prone time, so as to avoid traveling in the peak period of accidents. furthermore, the line chart matrix can also clearly show the difference in traffic patterns between two years in a month, traffic police can allocate their force flexibly based on changes in morning and evening peak hours, or differences in traffic patterns between different months.

- **Data Processing**

Query the data of the number of traffic accidents in each month of each year from the database, and then partition the data every two hours in a day of each month.

- **Visualization Methodology**

In the whole matrix, different colors of the line are used to identify seasons; for a specific line chart, the shade of colors are used to identify the selected year. The color of the first year is light, and the second year is dark, Y-axis represents the number of accidents, X-axis represents the different time period during a day.

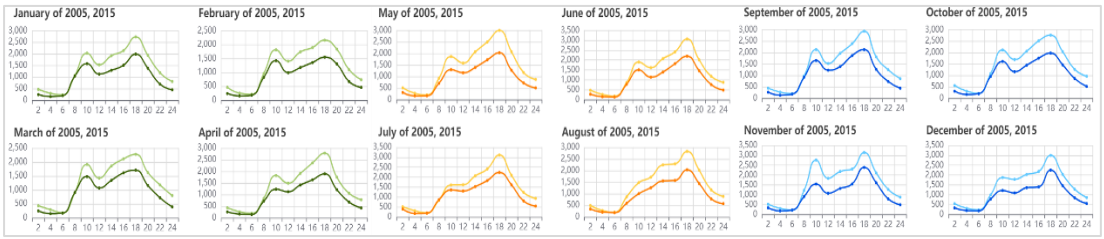


Figure 18 Line charts matrix visualization

- **Exploration**

It can be seen from Figure that there is an obvious prominence from 8:00 am to 10:00 am and from 16:00 pm to 18:00 pm every month, indicating during this period, accidents were common. According to the understanding of the general commuting

time in the UK, it can be found that traffic accidents are very easy to occur in the morning and evening peaks of commuting.

At the same time, it can be seen that the data changes seasonally. The number of traffic accidents during the morning peak was lower during student holidays in July, August or December than in other months, indicating that student commuting has a significant impact on morning traffic, and the government can ease traffic pressure by adjusting school start time.

4.7 Heap Map on Cartesian Visualization

The heatmap on cartesian shows the accident frequency time during the week; during the week, the number of accidents varies depending on the time of the day and the day of the week; people can choose a different time to travel according to the table, to avoid the time when accidents are most common. Traffic police can increase the number of police in the corresponding time period to ensure the normal operation of the city order.

- **Visualization Methodology**

Heat Map on Cartesian is a special chart, which is a statistical chart that displays data by coloring color blocks. Because it is necessary to observe the number of traffic accidents in each period of each week, Heat Map on Cartesian is suitable for viewing the overall situation, observing special values, displaying the differences between multiple variables, detecting whether there is a correlation between them. Using this chart is more conducive to observe the prominent changes in the overall data trend.

In this map, Y-axis is a specific time of day, X-axis is a specific day of the week, dark red represents the time when accidents are most common, and light yellow represents the time when accidents are less common. Users can manually select data they are interested in and remove irrelevant data.

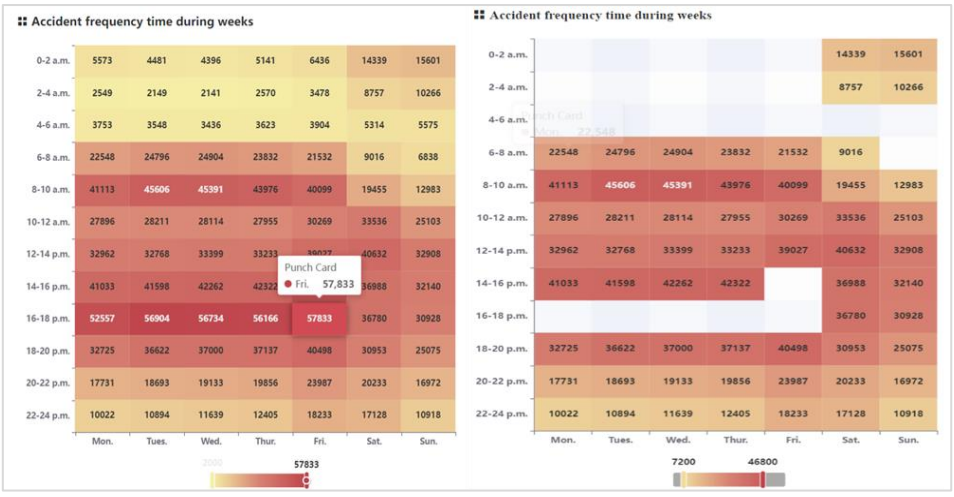


Figure 19 Heat map on Cartesian visualization

- **Exploration**

During the weekdays, most of the accidents happened from 6 am to 20 pm, and from 16 to 18 pm happened the most accident, traffic police should invest more police in these hours to ensure the safety of the road when citizens are off work, in the middle

night, there were few accidents.

During the weekend, accidents were evenly distributed, evening peak has eased, but accidents in the early hours of the morning have risen significantly, with 15000 incidents between 0 a.m. and 2 a.m. on Saturday and Sunday over the 11-year period. Police should pay special attention to road conditions at night.

4.8 Double Directional Bar Chart Visualization

This bar chart shows the distribution of drivers by gender and age, insurance companies can charge different prices for different insured people based on age and gender.

- **Visualization Methodology**

The bidirectional bar graph is used here to show accident between different sex, blue represents male drivers and pink represent female drivers. Y-axis shows the distribution of different age groups, X-axis shows the number of accidents. tableau is good at making a bidirectional bar chart, so this chart was made by Tableau.

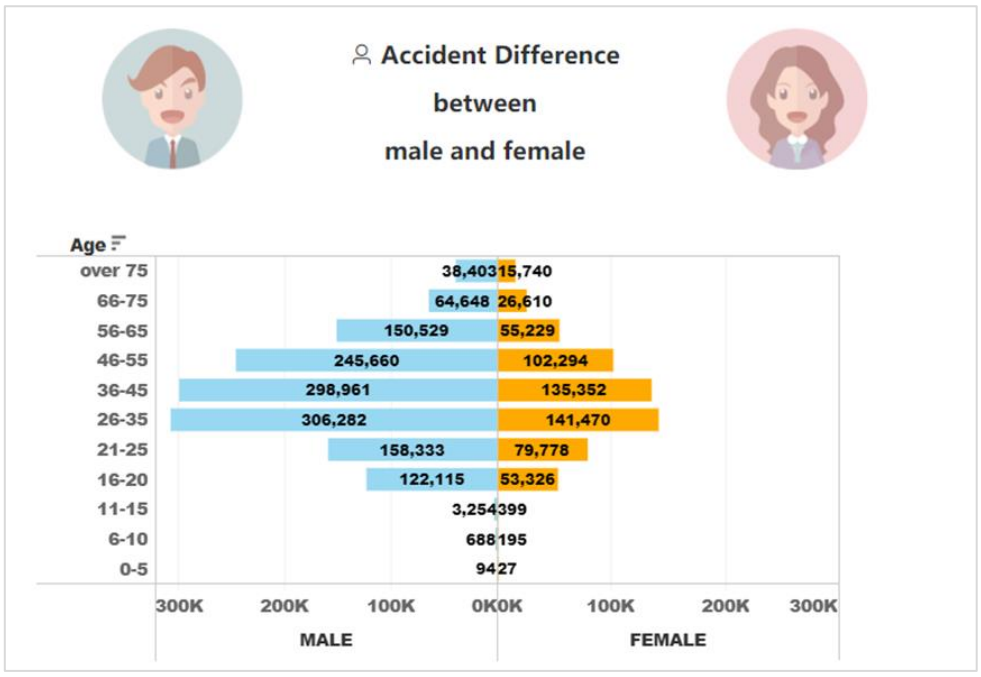


Figure 20 two-direction bar chart visualization

- **Exploration**

From the diagram, it can be seen that male drivers caused more accidents than female drivers, 26 to 45 years old male drivers were really good at making accidents.

Also, 0 to 5 years old babies still have the ability to make accidents, during 11-year period, there were 94 accidents caused by male babies and 27 caused by female babies.

4.9 Tree Map Visualization

The occurrence of traffic accidents may also relate to the safety level of different car brands. Therefore, the tree map is applied to visualize the number of accidents caused

by diverse car brands.

The chart shows which brands had high accident rate, which can be used by car companies to improve the safety of cars. Insurance companies can also use this chart to customize the price of insurance for different brands.

- **Visualization Methodology**

Different colored boxes label different vehicle brands. The size of boxes is used to distinguish the number of traffic accidents big area represents high accidents number. When mouse touches a box, the car brand and total accident count are shown in the website, as shown in figure 21.

Moreover, this module also has a high-level interaction. For example, when clicking the pie button, it will switch to a pie chart to show propagate of each brand, as shown in figure 22. Click the element, the module will show the trend of the selected brand from 2005 to 2015, as shown in figure 23. Additionally, use the selection box to observe the rank of accident brands in specific year, as shown in figure 24.

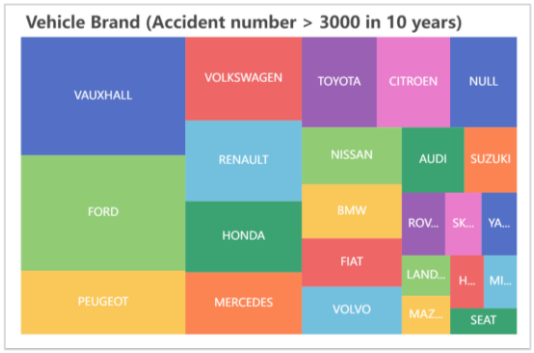


Figure 21 Total accident of brands

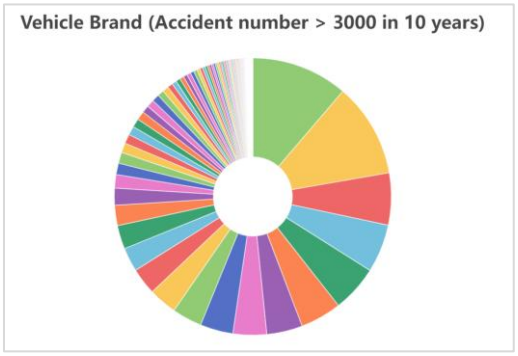


Figure 22 Pie chart of vehicle brands

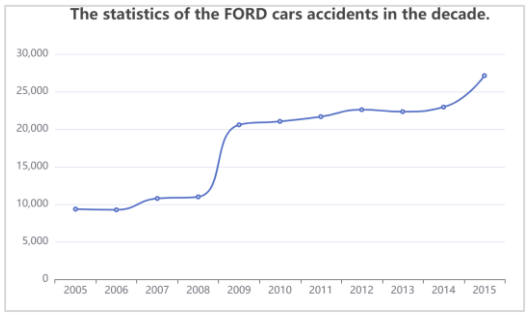


Figure 23 Trend of one brand

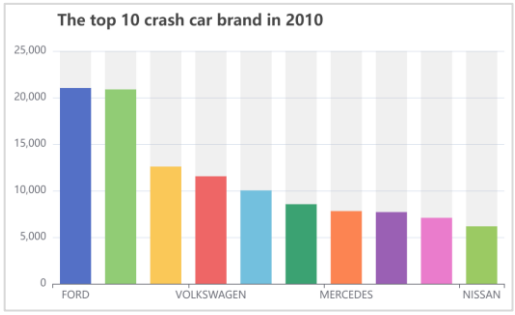


Figure 24 Rank of accident brands

- **Exploration**

From the figure, the number of accidents caused by Honda ranked only sixth, but its market share is 10% in the UK, indicating the safety of Honda is higher than the average level, insurance companies can appropriately reduce the insurance of Honda to attract more customers.

4.10 Sun Brust Charts for Vehicle Types

Another useful traffic information is the vehicle types. This project utilizes the sun burst chart to show the inheritance relationship among different types. Also, the pie chart is employed to show the rate of different vehicle types.

- **Visualization Methodology**

In the sun burst chart, except the “car” type, the reminding vehicles are divided into four categories with their children. Using the gradient color and the size of each element to indicate the number of accidents in the four different types.

In terms of the pie chart, it shows the proportion of all types of vehicles with different colors. The visualization result can be shown in the following figure.

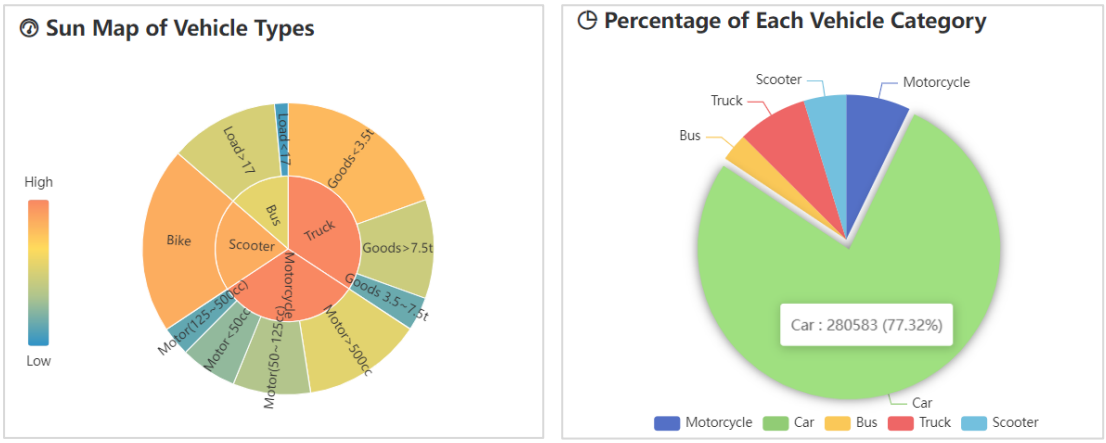


Figure 25 Sun map of vehicle type and percentage of each category

- **Exploration**

According to the sun burst chart, it is clear that the motorcycle and truck are two secondary vehicle types that meet accidents. For truck, the vehicles with goods under 3.5 tonnes is account for the main part of truck. In this case, it is enlightening for the government to enhance the light-vans in cities because the size and goods make them have a high weight, which lead to high kinetic energy when traffic accidents occur and cause more damage.

On the other hand, for motorcycles, a reason that leads to relatively high traffic accidents is the 500cc displacement motorcycles takes up more rate among the type. In this occasion, the speed of motorcycles can be higher, which is hard to control compare with normal cars.

Moreover, in light of the pie chart, the “car” is the major type that suffer from traffic accidents because cars are most frequent vehicle usage type in daily life.

5. Limitations and Future Work

This part will introduce the limitation in this project, and the future plan of design more data visualization.

5.1Difficulties and Limitations

This part will mainly focus on difficulties we have met, and also lists the limitation from the tools and datasets.

- **Difficulty of Drawing UK Map**

In the process of making UK map, we found that Tableau does not contain the detailed information of UK provinces, so we have no ability to import the detailed traffic accident data of prefecture-level cities into Tableau directly.

After searching online, we found that many British people were also unhappy that Tableau does not contain detailed information of England. Some people made detailed information of UK provinces by themselves; after trying, their data does not match the data we have; so, we have to abandon this approach.

Later, we found that EChart supports GeoJSON data to draw maps, so we downloaded the UK map data in the form of GeoJSON from CSDN. After importing EChart, it worked perfectly.

- **Difficulty of Data Synchronization**

When dealing with such a large number of data sets, importing data into the MySQL database and querying is the fastest way, but the difficulty is to keep the database in the group consistent, which will be more convenient and clearer.

Therefore, we share the database in the cloud, put all the data sets into the cloud database, and can jointly access the same database. After updating the database on one node, other nodes will also update synchronously, which helps us process the database more conveniently together and saves the time of integrating the database.

- **Limitation from EChart**

Restricted by the framework design of EChart, it is difficult for EChart to change the linkage of two graphs in the meantime. For example, it is hard for EChart to change two unrelated graphs at the same time with a time line selection button. When we want to do multi-graph interaction, we often need to set a global variable in JS to act as a relay.

- **Limitation from Website**

Performance of the web page is limited, if the data in a dynamic diagram is too much, running of the web page will be slow. therefore, some dynamic diagrams can only select several typical cities.

- **Limitation from the back-end**

The web page cannot directly connect to the database to obtain data, so we need to spend time writing a Java interface for data transfer, which consumes more computer performance than APP.

- **Limitation from lacked datasets**

We cannot access the accurate city market share for car brands in the UK, so it is hard for us to make a more reliable analysis of car brand safety, and we don’t have accurate weather data for UK cities, so we can’t get a precise link between weather and accidents.

5.2 Future Work

The project has realized some data visualization and helped users solve some problems, but some data have not been applied. In the future, more data can be used to analyze

some factor types leading to traffic accidents, and help users better explore and deeply understand the current traffic situation in Britain. Even through the analysis of different factors, it can help to adjust and improve the transportation policy.

In the future, we will seek more in-depth data visualization and analysis, for example, find the speed information at the time of each accident, and analyze how many accidents are caused by speeding by comparing the road speed limit at that time, find the causes of traffic accidents and observe which factors lead to the most and most serious traffic accidents, so as to standardize the traffic overspeed more strictly.

6. Contributions

During the implementation of the project, each of the three group members tried their best to complete the project in a high level. The following section clarify the work contribution on the three members.

- **Yu, Tian**
  - ✓ **Dataset collection:** UK traffic accidents and vehicle information
  - ✓ **Configuration of framework:** EChart.js, Vue.js and Spring Boot
  - ✓ **Implementation of project web page:** HTML and JavaScript
  - ✓ **Built the diagram:** the whole map visualization module
  - ✓ **GitHub repository:** web client
  - ✓ **Built the diagram:** calendar part, the “Daily Accident” mode
  - ✓ **Built the diagram:** calendar part, the “Light Condition” mode
  - ✓ **Built the diagram:** calendar part, the “Road Surface” mode
  - ✓ **Built the diagram:** calendar part, the “Weather Condition” mode
  - ✓ **Built the diagram:** calendar part, the right panel of all four modes
  - ✓ **Built the diagram:** score rings of three factors (light, road and weather)
  - ✓ **Built the diagram:** vehicle brands treemap
  - ✓ **Built the diagram:** pie chart of vehicle
  - ✓ **Built the diagram:** line chart of specific vehicle brands
  - ✓ **Built the diagram:** bar chart of select years top ten crash brands
  - ✓ **Built the diagram:** sun burst chart of vehicle types
  - ✓ **Built the diagram:** pie chart of vehicle types
  - ✓ **Post processing**: demonstration video
  - ✓ **Post processing**: report writing
- **Shiwei, Gao**
  - ✓ **Data collection**: GDP change in UK from 1998 to 2020
  - ✓ **Data collection** – Population changes in UK from 1998 to 2020
  - ✓ **Cloud sharing database establishment**
  - ✓ **GitHub repository:** API sever
  - ✓ **Built the diagram:** Heatmap on Cartesian with back-end API
  - ✓ **Built the diagram:** gender bidirectional bar graph by Tableau and insert into website

- ✓ **Built the diagram:** Dynamic scatter graph which shows relationship of GDP, Population and RTA, with back-end API
- ✓ **Built the diagram**: GDP change line chart with back-end API
- ✓ **Built the diagram**: population change bar chart on Polar
- ✓ **Post processing**: video clips, caption add
- ✓ **Post processing**: report writing

- **Ke, Xing**
  - ✓ **Data Preprocess:** the data of map
  - ✓ **Build the overview line charts:** line module visualization
  - ✓ **Build the top five line chart:** top five line module visualization
  - ✓ **Build the line chart matrix:** line chart matrix visualization, including choose any two years to compare
  - ✓ **Analysis of these visualization:** find the exploration of some visualizations
  - ✓ **Post processing:** help to finish the demo recording
  - ✓ **Post processing:** finish some part of this report

7. References

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