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Application for Traffic Event Analysis in the City of Most

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Abstract

This paper focuses on the replacement of existing programs used by the city of Most for acquiring, processing, visualizing, and analyzing traffic data. Users of these applications do not have access to all available information and thus cannot fully utilize it. A Python script and a React web application were developed to resolve these issues. The script enables the automatic retrieval of traffic accident data from the website of the Czech Police, its processing and filtering based on a provided polygon, which represents a given geographical region. The web application visualizes the processed data on a selected map along with additional charts, which show trends and statistics related to roads and traffic cameras. Data can be analyzed through several views with a variety of adjustable parameters. These new tools can provide citizens and employees of Most with valuable insight into traffic conditions over a long time period. The script can be used with or without an ArcGIS license and is highly configurable, so it can be used by any administrative district.

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1. Introduction

Traffic data plays a crucial role in infrastructure planning and preventive measures introduced by cities to reduce the number of accidents and, in turn, the number of injuries and deaths. To accomplish this, cities need a way to process large amounts of data and extract as much useful information as possible [1, 2].

The city of Most is currently unable to extract all of the available information with its existing tools, which consist of a data processing script and a web application for data analysis. This means that the extracted information cannot be used reliably as it does not paint the whole picture with parts of the data missing. The primary objective is to develop replacements for these tools that are easily configurable and maintainable should any changes occur in the future. Additionally, the solution aims to provide the script with free-to-use alternatives to the ArcGIS libraries, which require a license to operate, enabling use by other municipalities without the need for a license.

The new data processing script consists of modules whose functionality adjusts based on the current configuration. This design enables the processing of various data and file formats, allowing for easy updates or extensions to accommodate new formats in the future. Similarly, the web application also allows changes to its functionality and the data it presents through configuration settings.

The resulting solution enables automatic acquisition and processing of available traffic accident and traffic camera data. It is highly maintainable and can be adapted either through configuration adjustments or by extending the existing processing modules to support new data types. The web application allows its users to analyze processed data via multiple visualization options and customizable filters. Map visualizations are supplemented by graphs depicting accident and injury trends, traffic density averages, speeding averages and the influence of traffic cameras on the number of accidents.

2. Results

The city of Most uses ArcGIS solutions to create, publish and host its map applications and feature services. The main sources of traffic data are accident records gathered and published monthly by the Czech Police, and data from traffic cameras placed throughout the city.

2.1 Data processing

The designed Python script is divided into modules, each responsible for a specific part of the processing workflow. Each module consists of a base abstract class and additional classes that extend it and implement its methods. These classes provide functionality for different data structures and allow the use of different libraries to achieve their goals. The classes that will be used to process specific data are set in the configuration file. An example of this behavior is shown in Figure 4.

The city of Most uses ArcGIS geodatabases to store traffic data, requiring a licensed ArcPy library. However, with this design, the script can alternatively utilize classes that use the GeoPandas library, making the tool accessible to users without an ArcGIS license.

The entire process consists of scraping accident data, fetching data from specified APIs, filtering the data for a provided polygon area and storing the results in a geodatabase or as a file in the case of GeoPandas-based modules. Additional Arcade scripts were developed for the ArcGIS geodatabase to calculate values not present in the original datasets, such as the number of accidents on specific roads over the past five years or the average traffic density for a given day of the week. The schema of the created database and the Arcade scripts can be seen in Figure 2 and Figure 3, respectively.

2.2 Data visualization and analysis

The designed React web application was created to fit the requirements of the city of Most. It is not as universal as the data processing script, however, a large part of the application can be changed simply by updating the configuration. This includes data and map sources, available filters and visualizations and component properties. Components from ArcGIS Maps SDK for JavaScript and the Calcite Design System were used to efficiently implement visualizations and filter elements.

Data fetched from published ArcGIS feature services can be visualized as points, heatmaps or lines, depending on the data type. Accident data can be filtered by all relevant categorical and numerical attributes, as well as by time and date using the TimeSlider component.

3. Application of the Results

The designed data processing script and web application are currently being internally tested by the employees of the city of Most. The schema of the developed script is shown in Figure 1. Screenshots from the deployed application can be seen in Figure 5 and Figure 6. The script allows users to automatically acquire, process and store traffic data, which can then be visualized and analyzed within the web application. Both solutions are highly configurable and offer significant improvements over the current tools.

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