Traffic Collisions : Montgomery Dataset Analysis

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*Abstract*—Traffic safety is becoming a major concern for all the communities throughout the world, including Montgomery County in Maryland state of the USA. To give a thorough picture of the traffic collisions, the study examines the effectiveness of considering and analyzing three main datasets of an Automated Crash reporting System – ACRS used by Montgomery County to track the details about day-to-day traffic incidents within the county. The study presents an in-depth analysis of traffic collision data of Montgomery County. This analysis uses an Extract, Transform and Load (ETL) pipeline, following which the study does Exploratory Data Analysis and visualizations to inform and conclude urban planners on to develop targeted strategies for minimizing the impact of traffic collisions, and thus enhancing public safety and transportation facilities.

The Integrated analysis of the ACRS datasets utilizes MySQL as the source database, Python Pandas as the Staging area, and MongoDB as the destination. After the ETL pipeline, the study does the visualizations with Python’s pandas’ library and other visualization tools like matplotlib and seaborn. The study aims to find some insights into traffic collisions into aspects such as weather conditions, drivers characteristics and road conditions.

Keywords—Traffic Collisions, Montgomery County, Python, ETL, Visualizations, API, Automation, ACRS, MongoDB, MySQL

# Introduction

Traffic incidents are the major public health and safety concern around the world, resulting in injuries, deaths and financial damages. With developments in vehicle safety and traffic control systems, incidents continue to happen at an disturbing rate. Solving this problem needs an innovative strategy based on thorough data analysis and rational decision-making.

The Montgomery County’s datasets which are obtained from the Automated Crash Reporting System (ACRS) provided by the county’s government offers to be a valuable resource for studying the incidents in-depth. The datasets provides plenty of information on incidents, those involved as well as the contributing factors. With this datasets, studies can obtain the understanding of the occurrence of the collisions and foster specific measures to improve road safety.

To help the study, an ETL meaning Extract, Transform and Load pipeline that uses a relational database- MySQL as the source database followed by Pandas as the staging area for the transformations and MongoDB as the destination database. The overall flow of the pipeline provides a seamless integration of direct data obtained from APIs and direct files, including manipulation of the data ensuring data integrity and consistency throughout the process of analysis.

# Related work

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# methodolgy

## Datasets Selection

This study’s datasets comes from the official government site of Montgomery County [1] which maintains the data into various format like JSON, CSV, APIs that are collected by the Automated Crash Reporting System (ACRS) within the county. These datasets have been selected as it tracks all the information on the collisions in the County and provides the complete information required for the thorough analysis.

## Datasets Descriptions

* Incidents Dataset: Provides general information about each incident as well as traffic information that occurred in Montgomery County, collected via Automated Crash Reporting System (ACRS). The dataset has been extracted from the API provided on the official government site of the county which is powered by Socrata [4]. The dataset identifier for this dataset is Dataset Identifier: bhju-22kf. The total number of rows are 97458 which can be exported as a CSV file without API. As for API extraction via Socrata that rows limit is 1000. Each row is collision record.
* Drivers Dataset: Contains information about the drivers engaged in the traffic incidents on the county and local roadways in the Montgomery County as collected by the Automated Crash Reporting System (ACRS). The dataset has been extracted from the API provided on the official government site of the county which is powered by Socrata [4]. The dataset identifier for this dataset is Dataset Identifier: mmzv-x632. When exported the total number of rows are 172105 and 43 columns into a CSV file. As for API extraction via Socrata that rows limit is 1000. Each row is represented as a driver record.
* Non-Motorist Dataset: Includes information about the non-motorists like pedestrians and bicyclists engaged in the collisions on the county and local roads in the Montgomery County , tracked via Automated Crash Reporting System (ACRS). The dataset is directly exported from the official government site of the Montgomery County. The total number of rows are 5650 with 32 columns, where each row is represented as non-motorist.
* Common Features in all three datasets:

## Tech Stack

* Python: is used as a primary language and a medium for handling an analysing data due to its simplicity and flexibility. The study uses many visualizations and processing libraries of python like NumPy, Pandas, Matplotlib, Seaborn. As for linking with source an target database, the study uses pymongo to establish a connection with MongoDB and mysql-connector-python for getting the language linked to MySQL database.
* MySQL: A relational database link MySQL is the source of data flowing from API and exported data from the official government site of the county as it’s well suited for the applications with complex queries.
* MongoDB: A NoSQL database like MongoDB is the target that is the destination database where the transformed and cleaned data is stored as it is free from any predefined schema requirement.
* Socrata API: an API provided by Socrata, enables developers to interact programmatically with datasets hosted on the platform by the detailed documentation, code samples, and developmental resources to assist users in getting started with the API.
* Luigi: a strong python utility used for creating an organization of data pipeline by defining workflows as tasks.

## Data Architecture

Figure 1. represents the actual lifecycle of the process including the ETL pipeline and visualizations.

* The data for Incidents and Drivers is extracted via Socrata API in the form of JSON which is converted using pandas into a CSV file. As for Non-Motorists, the data is exported into a direct CSV file.
* These 3 CSVs – the original datasets are integrated into MySQL which is the source database in the ETL pipeline.
* Using Python, the connection is established with MySQL to extract data from tables to data frames which acts as a staging area where all the transformation takes place.
* Once the transformations are completed, 3 intermediate JSON files for each of the data frame is created which are loaded as 3 collections into MongoDB which is the target in the established pipeline.
* Finally for getting insights and performing final analysis the cleaned and processed data from MongoDB is fetched into data frames whereby using visualization libraries insights are generated.

## Preprocessing Methods

#### Incidents: The government of montgomery county has uploaded the data collected via Automated Crash Reporting Sysytem (ACRS) onto the Socrata Platform enabling users to use an API endpoint to fetch data

#### Drivers: jbn ,.m

#### Non-Motorists: bhbhvbhjsb

# Results and Evaluation

## Incidents

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1. R. Hasarinda, T. Tharuminda, K. Palitharathna and S. Edirisinghe, "Traffic Collision Avoidance with Vehicular Edge Computing," 2023 3rd International Conference on Advanced Research in Computing (ICARC), Belihuloya, Sri Lanka, 2023, pp. 316-321, doi: 10.1109/ICARC57651.2023.10145607.
2. Z. Luo, J. Li and M. Zhong, "Prediction of Seasonal Variation in Traffic Collisions on Urban Highway: A Case Study in the Province of British Columbia," 2021 6th International Conference on Transportation Information and Safety (ICTIS), Wuhan, China, 2021, pp. 104-109, doi: 10.1109/ICTIS54573.2021.9798674.
3. D. Denti and M. Modica, "Born to Hit and Run? Rugged Individualism, justice quality and non-stopping after traffic collisions in the U.S.," Case Studies on Transport Policy, vol. 15, p. 101137, 2024. [Online]. Available: <https://doi.org/10.1016/j.cstp.2023.101137>.
4. <https://dev.socrata.com/foundry/data.montgomerycountymd.gov/mmzv-x632> for Drivers API
5. <https://dev.socrata.com/foundry/data.montgomerycountymd.gov/bhju-22kf> for Incidents API

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