Traffic Injury Severity Prediction and Classification Via Interpretable Machine Learning and Spatial Analysis Techniques

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Traffic Safety: Global Scenario

- Traffic accidents are among the major global public health concern, causing 1.35 deaths and 50 millions injuries every year.
- The resulting economic consequences on average accounts for 3-5% nations' GDP irrespective of economic growth and rate of motorization.
- Majority of accidents victims belong to low-income developing countries; however, traffic safety issues are also growing in developed countries.

Traffic Safety: Canadian Scenario

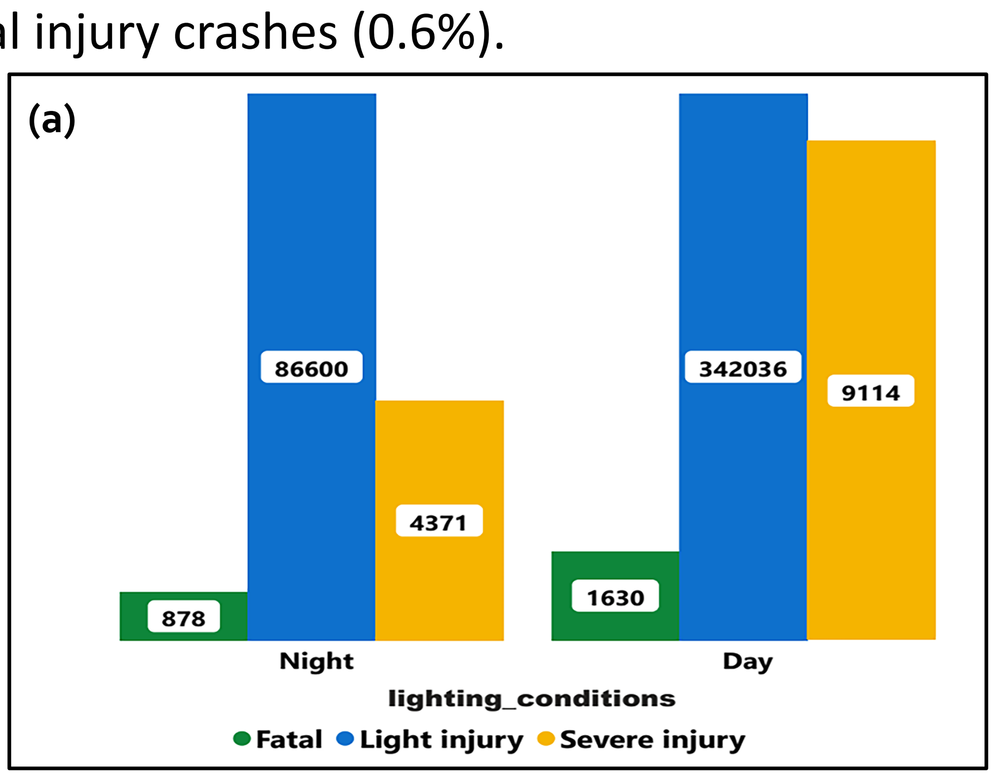
- In 2018, the number of motor vehicle fatalities in Canada was 1,922, up 3.6% from 2017 (1,856). *Source* : Canada Road Safety Week 2020 – National Facts & Stats.
- According to Canadian Automobile Association economic losses caused by traffic collision-related health care costs and lost productivity are at least $10 billion annually. That's about 1% of Canada's GDP! (Government of Canada)
- The challenge is to move toward zero fatalities and serious injury collisions, where the price of mobility is not death or disability.

Research Objectives

- To perform the detailed descriptive statistical analysis for crash patterns.
- To study the effect of built environment, demographic factors on injury severity outcome of motor vehicles crashes
- To explore the applicability of newly developed Machine Learning (ML) interpretation techniques for identification of severity risk predictors
- Developing QGIS based maps to identify the crash hotspots on different road sections

Descriptive Statistics Crash Data

- Crash data (for year 2011-2019 – in Montreal) is collected from the Société de l'Assurance Automobile du Québec (SAAQ)
- A total of 444,629 crashes happened from 2011 to 2019: 428,636 (96.4%) light injury crashes, 13,485 severe injury crashes (3.03 %) and the rest (2,508) for fatal injury crashes (0.6%).



Descriptive Statistics Crash Data

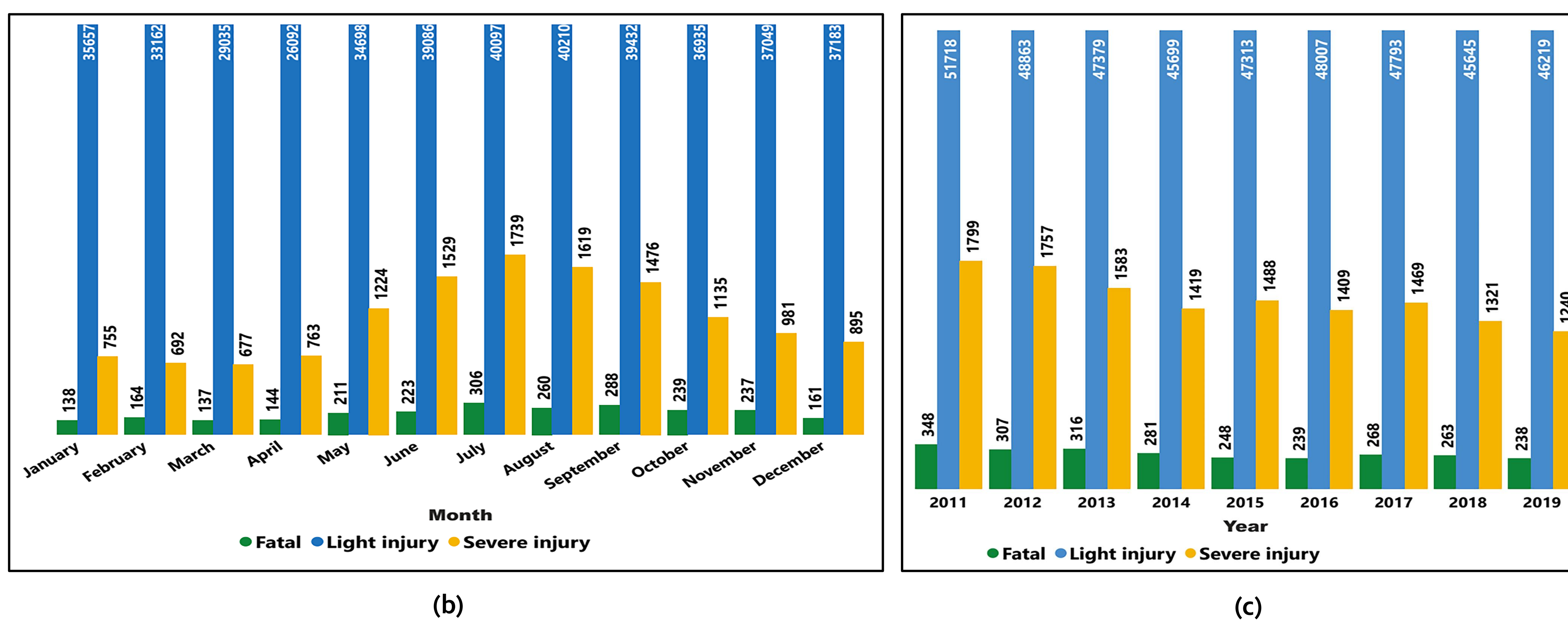


Figure 1. Temporal distribution of crashes in the study area (2011–2019): (a) crash severity versus lighting condition, (b) monthly crash severity count, (c) Yearly crash severity count

Methodology (stage 1)

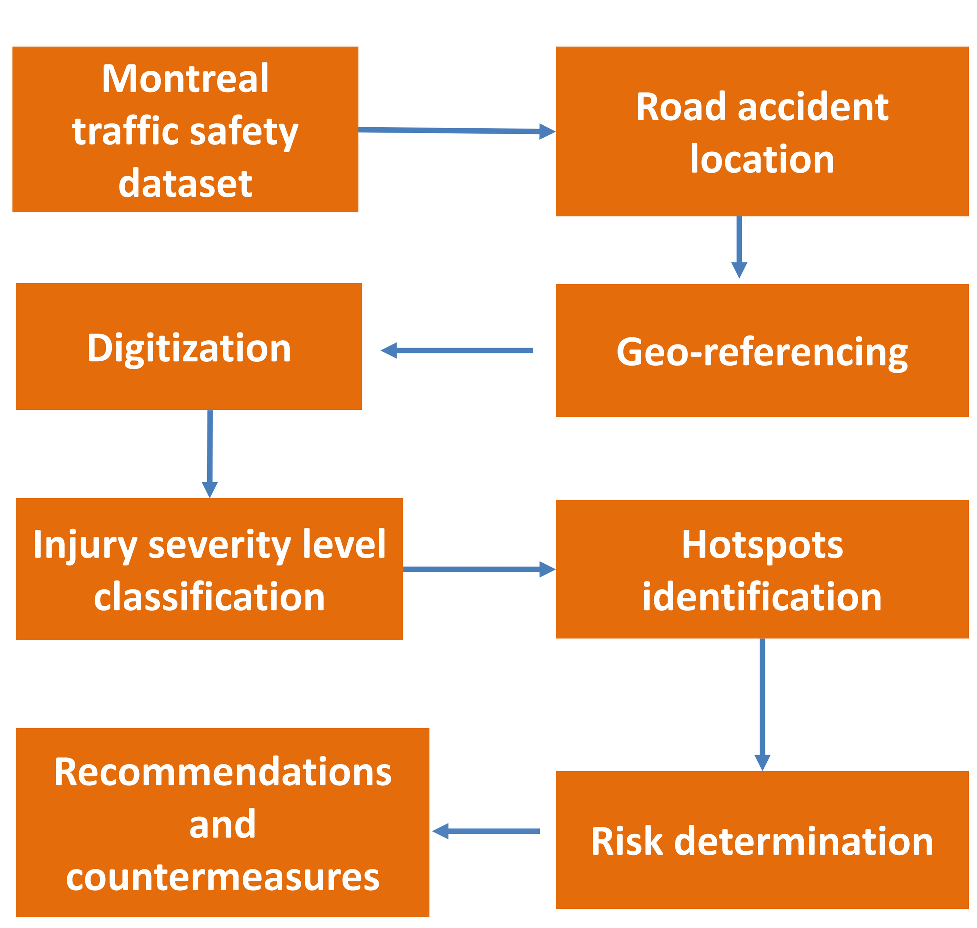


Figure 2. Framework of QGIS hotspots identification

Methodology (stage 2)

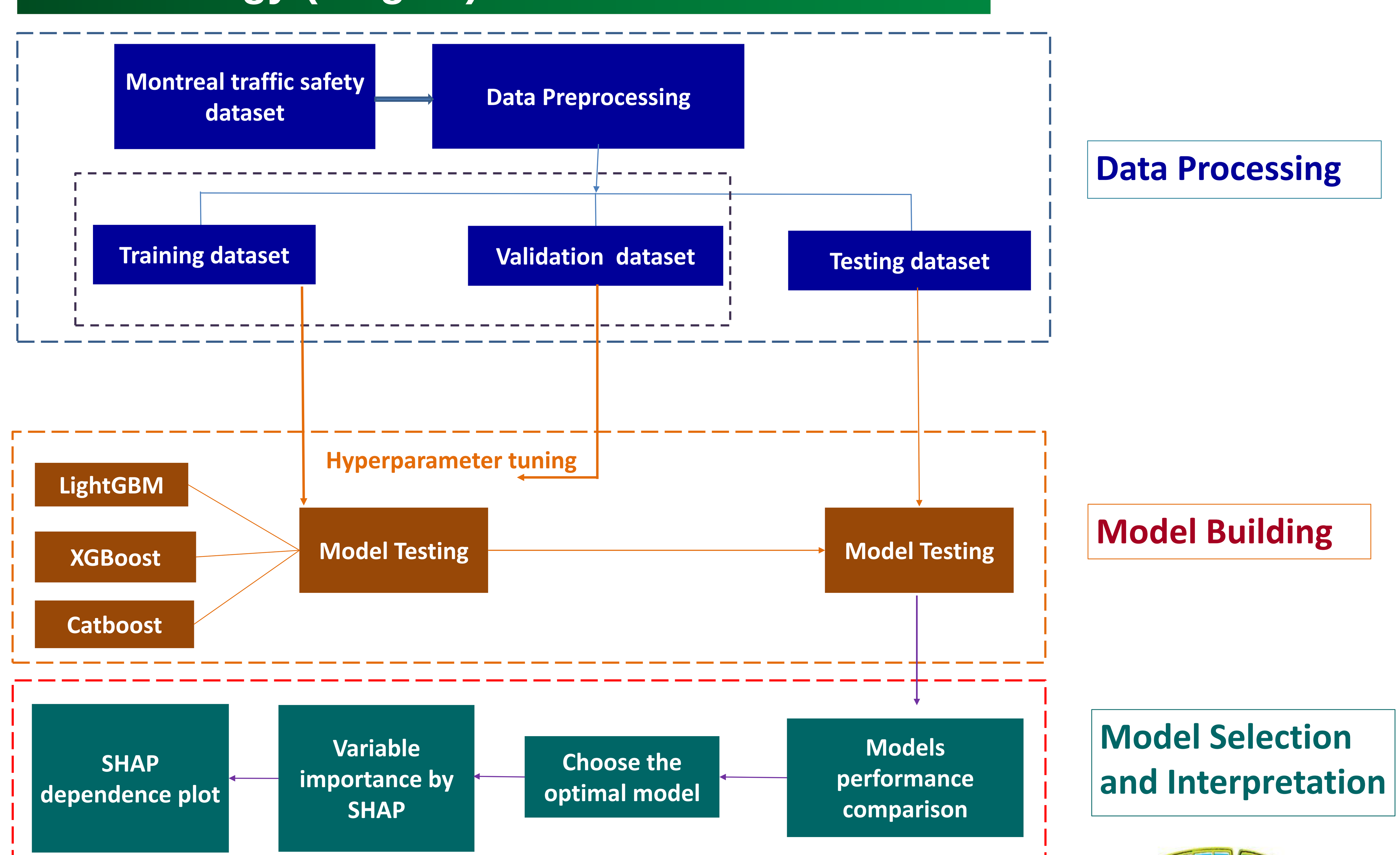


Figure 3. Framework of ensemble learning models and SHAP (SHapley Additive exPlanations) analysis for model interpretation

Expected Outcomes

- Descriptive statistics analysis and crash pattern analysis.
- Accurate identification of hotspots will help to prioritize and implement proactive countermeasures on hazardous road sections.
- Relative impact of demographic, geometric and built environment characteristics on the resulting crash injury severity will be established.
- Study result will help road safety agencies, practitioners stake holders and policy makers for initiating concrete steps to mitigate road safety issues.

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