This proposal presents a research plan to develop an open source Geographic Information System (GIS) software framework that supports and evaluates the effectiveness of traffic-related decision making by monitoring, modeling, and forecasting road traffic crashes.

Across the world, road traffic crashes take the lives of 3700 people every day – resulting in 1.35 million lives lost each year [1]. Over 50 million survivors of road injury suffer from disabilities, psychological trauma, financial losses, and legal burdens [2]. In 1997, Sweden introduced a road safety policy called *Vision Zero* that centers road design around valuing human life, envisioning zero road traffic-related deaths, and sharing the responsibility between road users and designers [3]. Since the implementation of Vision Zero, the number of road traffic deaths were reduced from 6 deaths per 100,000 people in 1997 to 4.7 deaths per 100,000 people in 2006 [4]. Road traffic crashes are often non-random events that can be prevented with changes to policy, infrastructure, health care, transportation, and societal culture – reducing the severity of injuries and ultimately preventing the loss of human lives over time [5]–[7].

In order to support and evaluate the effectiveness of decisions such as Vision Zero, road traffic crashes are recorded as data, analyzed, and then presented as evidence to lead the design of roads, traffic signs, rules, and regulations. These data have primarily been processed from police reports, which may not be immediately available, under-reported, or missing potentially useful information [8], [9]. To account for the limitations in police reports, multiple sources of data for models and analyses can be used to cover a larger number of road traffic crash cases and associated characteristics – which increases the information available on road traffic crashes and decreases the misrepresentation or bias of the data. These data sources include hospital records [10], news reports [11], real-time traffic data [12], and, more recently, social media posts [13]. Although there has recently been a growth in data availability with the increase of social media use [14] and initiatives that open data to the public, these data suffer from three major issues [15]:

1. Inconsistent formats causing incomparable outputs across models and analyses
2. Difficult to discover and use without technical knowledge
3. Lack of software tools that make use of the data for specific purposes

My research seeks to resolve these issues by developing a GIS software framework that improves the compatibility of these data, and reduces the technical knowledge required to use these data for monitoring, modeling, and forecasting road traffic crashes – enabling more informed evidence for supporting and evaluating the effectiveness of traffic-related decisions.

The design of the software framework will be based on the review of road traffic crash forecast models and common road traffic crash data sources available in recent research literature. The idea is to design the software framework around tested and potentially useful models in recent literature that have already used road traffic crash data. In general, models can be seen as simplified representations of reality that can be created by computer programs for the purpose of forecasting road traffic crashes [16]. These models are created with a set of instructions called code that accepts different formats of data, processes the data, and discovers a pattern or a representation of the data that can be used to forecast future road traffic crashes. Although this code is able to create models, it is often implemented differently among researchers, where the code may only accept very particular data inputs, process the data inconsistently, or produce forecasts that are not comparable with other models. Software frameworks can solve these issues by providing standardized and comparable components containing the same code that can interact with each other and be extended with additional functionality [17]. These components ensure that programs are consistent, but flexible enough to generate a variety of comparable road traffic crash forecast models, data inputs, and forecast outputs. The software framework for monitoring, modeling, and forecasting road traffic crashes will be open sourced to promote transparent, comparable, and reproducible research, which will eventually reduce the technical knowledge required to model road traffic crash forecasts with user-friendly documentation and repeatable experiments. The following software framework components will be developed:

a) Source: data sources for road traffic crashes

b) Database: storage that can scale across several computers

c) Model: road traffic crash forecast model with performance measures

d) Forecast: forecasted road traffic crashes

e) Visualization: plots/maps showing visual information for the end user

Currently, a prototype application has been created, a lab environment has been setup, and a collaborative review paper has been published. The prototype web application visualizes real-time geo-located social media data from Twitter in Toronto, Ontario, with a dashboard interface. The interface monitors the collected social media data in real-time and presents useful count statistics that monitor the size and behavior of the data. A lab environment containing scalable databases has been setup with graphical web interfaces to manage current and future road traffic crash related data. Future code will use these databases to conduct case studies, tests, and experiments for the proposed software framework. The published review paper surveys current methods of traffic event detection with geo-social media data to obtain an overview of the recent models, data sources, and visualization techniques used. This paper provides future directions and background knowledge for researchers to improve and develop geo-social event research in traffic applications. Another review paper will be written that further surveys road traffic crash forecast models that use geo-spatial data.

With the proposed GIS software framework and planned research for road traffic crashes, I hope to improve the evidence and research for supporting and justifying data-driven decisions that lead to the reduction in the number of road traffic related deaths and injuries.

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