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Inferring the purposes of passenger trips from GPS records

A technological revolution has emerged in the context of mobility surveys with the wide-scale usability of wearable and onboard global positioning system (GPS) devices. Sri Lanka is also at the edge of utilizing these, in replacing the traditional methods. The earnestness for this transition is supported by the deficiencies such as higher cost, higher nonresponses rates, over and under-reporting, and small sample sizes of traditional surveys. The activity that a passenger performs after a trip, or the purpose of a trip is a vital concern in transportation research as it is the reason behind the generation of travel demands. Hence, trip purpose inference from GPS data has become an important study area in this context [1]. Gong et al. [2] reviewing the existing trip purpose inference studies categorized the methodologies that had been used into three as rule-based, probabilistic, and machine learning-based. In this study, we utilized the GPS records of taxi trips from a popular service provider in the country as shown in Figure 1 in developing a suitable trip purpose inference approach.

Point of Interest (POI) data are often used in this study area as they shed a light on the places that a passenger may visit after completing a trip [3]. In general, a radius is given to select the POIs within proximity to the destination location.

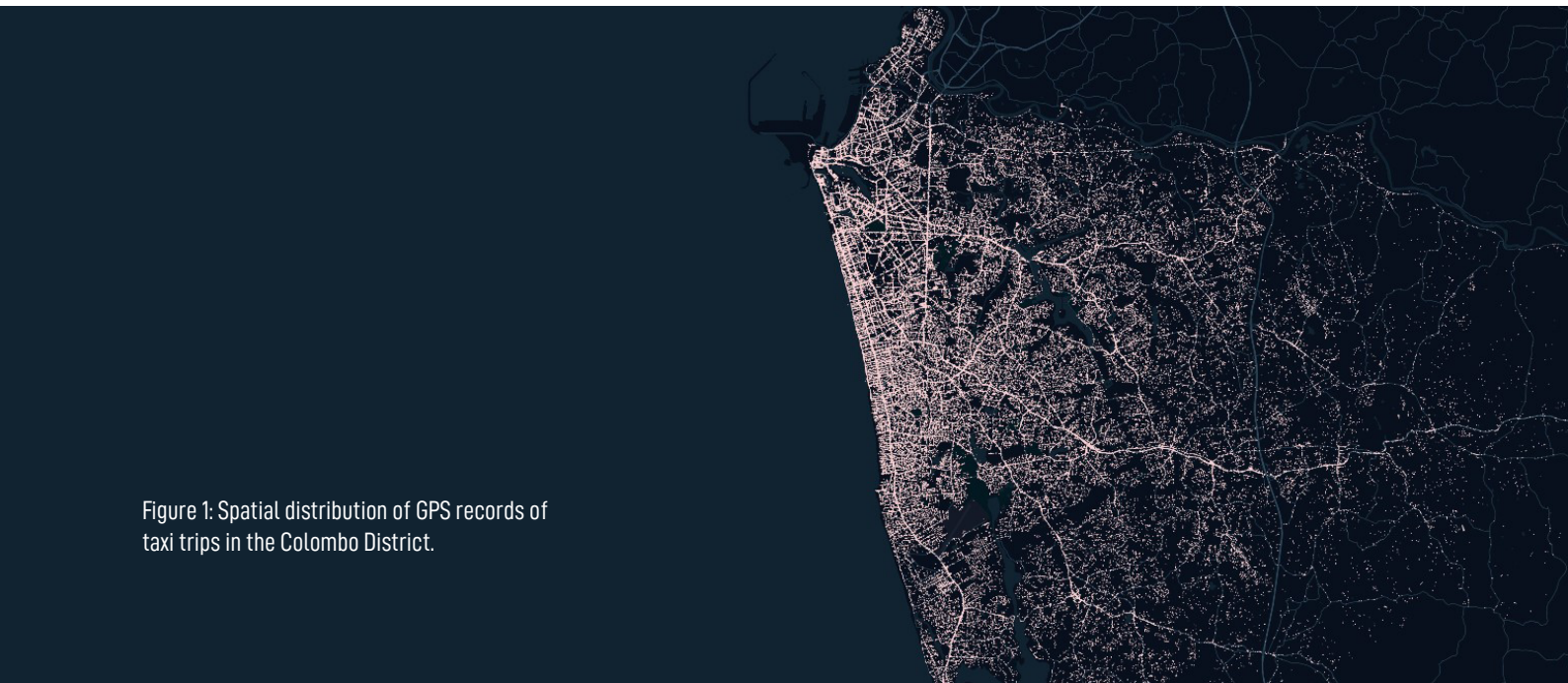

Figure 1: Spatial distribution of GPS records of taxi trips in the Colombo District.

As the quality of POI data highly influences the results to be obtained, we have evaluated the applicability of machine learning techniques to improve some of the embedded issues that often arise from POI data in identifying trip purposes. A natural language processing (NLP) based classification model was built to improve the level of POI categorization which aligns with different purposes. Since residential places are not included with POI data, we assessed the use of outlier analyzes principles to distinguish the trips attracted to residential places from the rest.

The regular trip patterns of passengers also provide an insight into the trip purposes such as work-related and educational. For instance, if a passenger goes to a certain location around 8.00 a.m. most of the days within a week, it has a higher probability to be a work-related trip. This concern was also addressed in our study as indicated by Figure 2 with the help of defined time bins for work and educational trips and density-based clustering models.

With these improvements made, we assessed the applicability of the model proposed by Gong et al, [2] to infer eight trip purposes as work-related, educational, shopping, personal. medical, dining, recreational, transport transfer, and residential. Achieved temporal distribution of taxi trips by purposes are shown in Figure 3 as indicated. However, the fact that the influence of attributes such as time, duration, and distance also impact the trip purposes, we are expecting to develop a weakly supervised deep learning model with the inputs that we can obtain from the completed work. The successful completion of a more accurate model

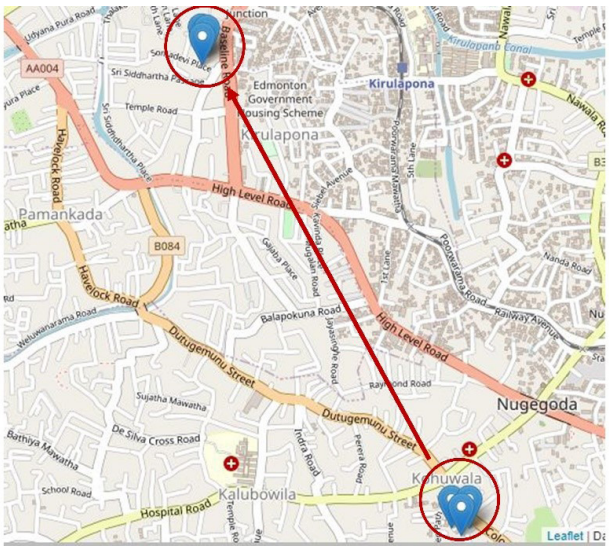

Figure 2: Regular trips made by a passenger.

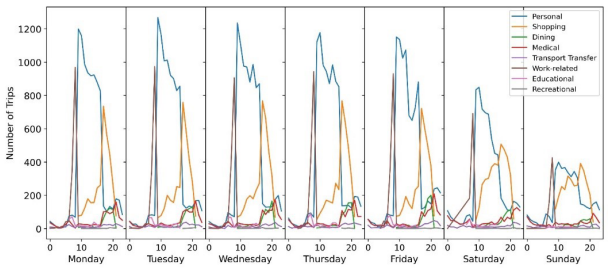

Figure 3: Temporal distribution of the inferred purposes

not only helps the transportation researchers but also for different mobility service providers to improve their service level in increasing the business opportunities.

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