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Transportation Systems: Modelling in Real-Time

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Introduction

Transportation Systems offer a vast potential for applying computing solutions. Considering the different types of transportation mechanisms in existence, we would like a journey prediction between a start and end location that is efficient, environmentally-friendly, safe, comfortable and realisable in the shortest possible time. While methods currently exist to cater to these optimal requirements individually, we would like a system that combines these metrics together to return an optimal journey prediction that is updated in real-time.

Specifically, we wish to address the following issues:

Efficiency

It is important to balance the goal of arriving in the shortest possible time with travelling in the most environmentally-friendly manner. For a segment of the journey travelled by car, this would mean conserving fuel and reducing carbon emissions. This is achievable by maintaining a relatively slow but stable speed throughout the journey. Thus, a route where a fairly constant speed can be maintained will be preferred over one interspersed with a number of road works, traffic signals or congested areas.

Real-Time Congestion Avoidance

Congestion is likely to occur at various stages of the transport infrastructure. This can range from peak times, where certain road junctions and sections of highways can become congested, to planned events, such as road works, rail track replacements and popular sports and theatrical events, and further, to anomalous situations, such as accidents and floods. It is important to avoid congested areas or to choose a route with minimal congestion. Further, as the congestion profile can change significantly over time, e.g. an accident earlier in the day causes a highway section to be closed to traffic resulting in queues building up in road segments far away from the original incident or all rail traffic at a station can be suspended on account of floods, it should be possible to continue to monitor the transport infrastructure and report back on a developing situation in real-time. This will enable a dynamic update of the most feasible route.

Routing

Static routing in near-optimal manners has been the basis of current applications. A dynamic aspect needs to be incorporated to the route-calculation phase to take into account foreseen and unforeseen circumstances, as they develop. This will be suitably biased with past historical tendencies of the appropriate route, e.g. susceptibility to congestion or saturation at certain times.

Traffic Lights incorporation

Previous methods have not incorporated delays caused by traffic signals or have assigned a static time penalty for each traffic light on the route. However, precise real-time monitoring of the states of traffic lights means we can do better. A dynamic route allocation strategy that updates periodically to take advantage of upcoming or current green traffic signals will result in a net time saving and consequently, a faster route to be adopted. Further, historical records of traffic signals can be used to aid the route prediction process.

Current Work

We have looked at the last of the previous 4 issues in detail. A model has been created from the historical states of traffic lights. Machine Learning has then been applied to learn the rules governing the signaled traffic intersections. The results of this framework show that fairly precise modeling accuracy can be achieved in real-time.

We propose to incrementally consider the other 3 issues as well and then combine the results to obtain an optimal dynamic, up-to-date and real-time route prediction scheme.