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Urban traffic simulation using agent-based modelling: A study in the Sri Lankan context

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Traffic congestion is a crucial issue affecting the quality of life of individuals all over the world. In a country like Sri Lanka where the traffic is mostly unorganised and mixed, traffic congestion occurs due to various reasons such as the volume of traffic exceeding the capacity of the road, road accidents, temporary closures of roads due to constructions, as well as the behaviours of pedestrians and drivers. For example, careless lane changing behaviours of drivers and the bad practices of crossing streets of pedestrians account for a larger portion of urban traffic congestion every day. Due to the significant impact of traffic congestion to economic growth, various approaches have been taken by researchers and administrators to reduce the urban traffic congestion. Some popular approaches to solving this issue includes infrastructure development, introducing new traffic rules such as changing peak hour traffic plans in cities, as well as imposing heavy duties on vehicle imports to reduce the growing volume of vehicles on roads. However, despite all these attempts, the traffic congestion remains a serious issue in Sri Lanka.

Traffic simulation is one of the most effective tools for the testing of traffic solutions and finds the reasons causing traffic congestion. Traffic conditions are different from region to region due to different factors: traffic laws, vehicle types, drivers' and pedestrians' behaviours. Therefore, researches have been done by focusing on modelling traffic simulators considering those factors specific to particular regions. We propose the *Agent-Based Modelling and Simulation (ABMS)* approach, which is a popular computational research method based on swarm intelligence to study complex social and economic systems, to model a traffic simulator simulating mixed traffic conditions in Sri Lanka which is an unaddressed area of research. In this approach, individual vehicles and pedestrians are modelled as software agents who have a set of individual (i.e. micro level) behavioural rules. When these agents are put together, they behave as the vehicles and pedestrians behave in the real world interacting with each other giving rise to emergent macro-level patterns, which we call traffic congestions. This study aims at modelling vehicle following behavior, seepage behaviour of vehicles and pedestrian's behaviours at un-signalized crossings. We use the *ABMS* environment called NetLogo to develop our simulator and Kiribathgoda junction in Western Province, Sri Lanka as the test bed. Data collected from there will be used to calibrate the model with accurate parameter values. Macroscopic statistics such as the rate of traffic flow, average speeds and queue time will be used to validate the model by comparing data from real traffic situations with model outputs. The ultimate objective of this research is to come up with a cost-effective decision support tool for administrators and policy makers to understand various reasons behind congestion in unorganised mixed traffic environments in Sri Lanka, apply and evaluate different traffic control strategies and thereby to make better-informed decisions to control urban traffic congestion in Sri Lanka.

Keywords: Agent-based modelling, Traffic simulation, Multi-agent systems