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Adaptive green time allocation method for traffic congestion based on cell transmission model and genetic algorithm

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Traffic congestion is defined as a physical phenomenon relating to the manner in which vehicles impede each other's progression as demand for limited road space approaches full capacity. This makes trip time longer and increasing queuing. Also it causes serious problems for the day to day lives of people, massive financial and man-hour loss, environment pollution, some diseases etc. In Sri Lanka, traffic congestion in a given area occurs for many reasons. The main reason is that the demand of road does not match to road capacity. In Sri Lanka, although an increase of 10% per year road demand is expected, it can increase road capacity by around 2% to 3% per year. Other important reasons are the existing traffic control system and traffic intersections. Traffic control systems play a central role of traffic management in Sri Lankan cities. Existing traffic light system mainly controls the traffic light change in constant cycle time. But road conditions in a given area vary day by day. If the traffic control system does not deal with these variations, then traffic control system will create bottlenecks and delays. Therefore, the control of traffic requires adequate adjustments to these variations. This research focused on studying and applying cell transmission model to dynamic traffic signal controlling procedure. Basic cell transmission model is used to model the dynamic changes of vehicular traffic flow and to estimate the total delay of vehicles in a given region within a given time interval under different green time allocations. To find an optimal signal timing plan, the Genetic Algorithm is used. The proposed model is applied with certain assumptions to find an optimal time plan to a signalized intersection in main Kandy - Colombo road which has heavy traffic congestion in the morning hours in weekdays. A section of this region is selected to minimize the total delay and to find an optimal dynamic time plan for the signal lights analyzing the actual data collected in this region using four video cameras. The results are compared with the existing pre-timed signal time plan and the corresponding total delay. It is observed that the proposed dynamic signal timing plan will reduce average delay by 6.2675% and it can be proposed as an alternative for the existing system.

Keywords: Cell transmission model, dynamic signal light plan, genetic algorithm