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EFFECTUAL SIGNALISED INTERSECTION BY USING COUNTING OF VEHICLE AND QUEUE LENGTH

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ABSTRACT:In urban area arising the problems due to traffic congestion is one of the major issues faced by India today. In that traffic control system for an urban traffic management plays an important role in reducing traffic congestion and negative effect of social and economical aspects. In this paper advanced actuated signal method were introduced. This method is based on numbers of vehicles arriving towards the intersection and give the specific amount of time to convoy. The process of counting the vehicles is carried out by camera sensor which is mounted on the certain distance before the intersection. The location of camera sensor is the major factor to count the precise number of vehicles to assign the time period for the next phase. So, the distance from camera sensor to the intersection is maximum queue length for particular phase. This maximum queue length is obtained by the survey of vehicle arriving rate and peak hour of a particular intersection. The data get from the camera sensor gives appropriate idea about deciding the actuated signal time, which control the smooth and continuous flow of traffic.

INTRODUCTION

India is a developing country. In India rapid increase in number of vehicles on the roads as well as growing size of cities have led to a plethora of challenges for road traffic management authorities such as traffic congestion, accidents and air pollution. This congestion commonly occurs at intersection. One of the major-problem which we can face in Indian cities is that we cannot extend the infrastructure more, so we have only one option available that is better management of traffic. The utilization of a proper control plan for traffic management can prevent congestion unless the maximum capacity of the intersection situation takes place. The traffic signal is categorized based on its operational principle to four types: traditional or fixed time, semi-actuated, fully actuated and adaptive control method. The parameters that can be optimized in traffic signal control include cycle length, time variant and queue length phase sequence.

The present traffic control system uses fixed average waiting time concept for controlling the traffic. Since webster published his famous minimum delay optimal cycle formula in 1958, formula became dominant in the field of fixed time traffic control for an isolated intersection. However, until now, this formula has been limited to calculate optimal cycle from historical data for a pre-timed traffic signal control. But in large cities it is still difficult to handle the traffic, using fixed time traffic control system. Sometimes we observe that there is no

vehicle in lane and heavy traffic in another lane, still the traffic light is green for latter lane and red for other lane. This leads to traffic congestion adaptive traffic management system will be better choice than manual traffic-based system.

Actuated signals are used to reduce vehicle delay where the traffic distribution keeps on changing. It is flexible and can accommodate the small fluctuations (minor changes) in traffic flow. This system controls the signal through automatically moving vehicles. The actuated signal timing is completely influenced by traffic volumes, and it is detected through sensors at all the approaches. There is lot of sensors used to detect the traffic like: magnetic sensor, infrared sensor, photoelectric sensor, doppler and radar sensor, video camera system. It is mainly used at the intersections of the two main arterial streets. It provides frequent operation under the low-density conditions. These systems are very effective only at multiple phase intersections. This system will lead to increased capacity.

The purpose of project is to handle the signal effectively and to maintain smooth traffic flow at road intersection. Overcome the delays due to unnecessary and inefficient signals. Improving the traffic flow capacity at the road junctions by determining the proper location of camera sensor.

LITERATURE REVIEW

SR. NO	TITLE	CONTENT	AUTHOR NAME
1.	The Research on Optimal Green Time for Intersection Groups. (2006)	This paper puts forward an adaptive traffic signal control algorithm for a single intersection first, which is believed to determine the most superior green light time of each phase under any fixed cycle time, the principle of the algorithm is to minimize vehicles delays according to a mode that has been initiated in the Paper.	Wei Cheng, Xiaolan Liu, Yueming Chen
2.	A video-based real-time vehicle counting system using adaptive background method. (2008)	This paper presents a video-based solution for real time vehicle detection and counting system, using a surveillance camera mounted on a relatively high place to acquire the traffic video stream. The two main methods applied in this system are: the adaptive background estimation and the Gaussian shadow elimination.	Manchun LEIa, Damien LEFLOCHa, Pierre GOUTONa and Kadder MADANI
3.	Intelligent Traffic Signal Control Approach Based on Fuzzy-Genetic Algorithm. (2008)	Fuzzy theory and machine learning are applied in this paper. Through fuzzy clustering the number of arriving cars, the schemes of signal control are put into knowledge-database in the form of rule-set under different conditions of cars' arriving. The set of traffic control rules is divided into the set of fixed-rule and the set of variable-rule. A self-learning traffic signal control model based on fuzzy clustering and genetic algorithm is established.	Xiangjun Cheng Zhaoxia Yang
4.	Vehicle detection and counting from a video frame. (2008)	The research intends to develop the vehicle detection and counting system using image processing. Overall works are software development of a system that requires a video stream and capture to a video frame. They consist	Chomtip Pornpanomchai, Thitinut liamsanguan,

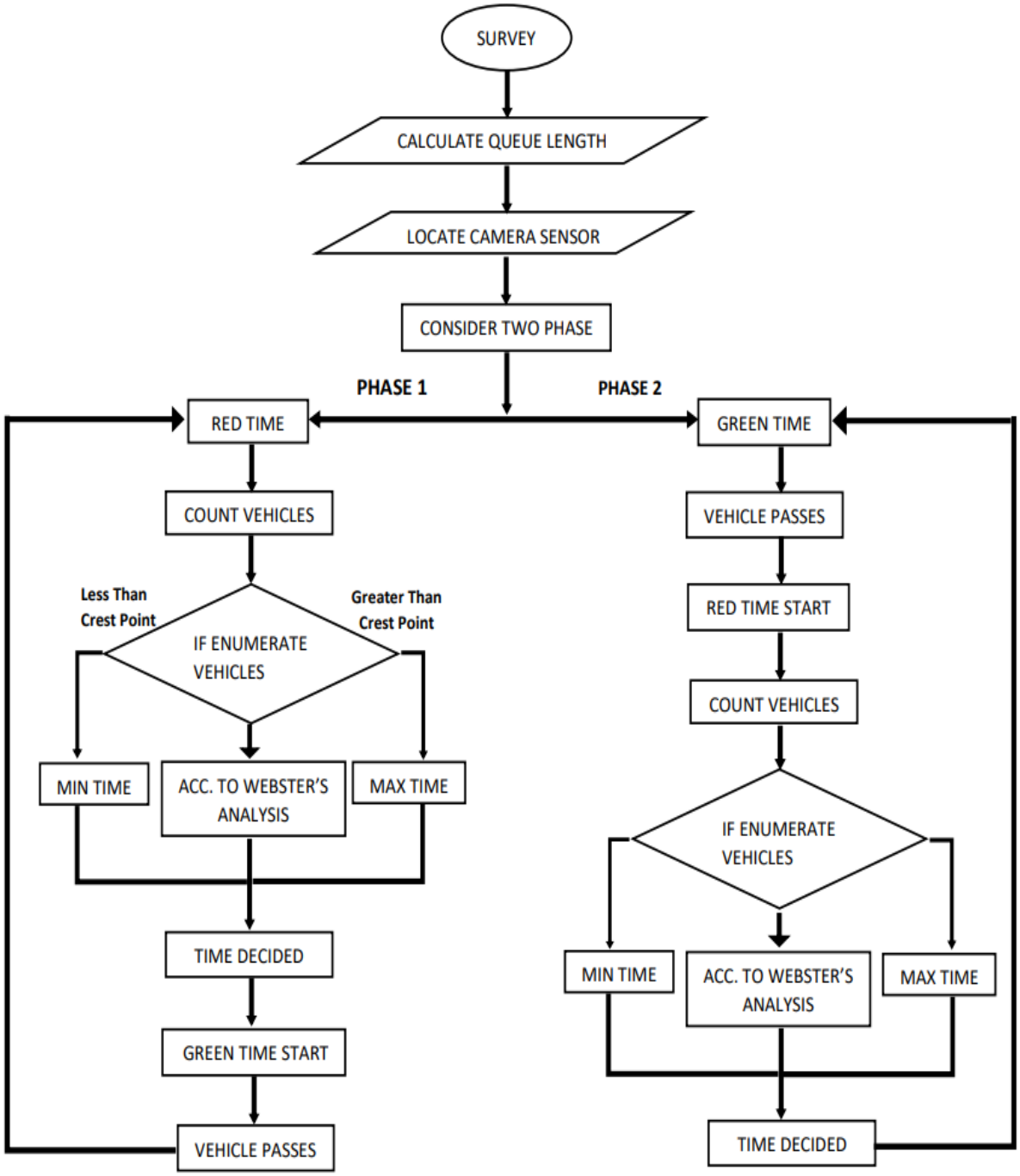
		of the following components: background road without any moving vehicle and the frame with moving vehicles. The system is designed to find the differentiation which is the moving vehicles and find the number of moving vehicles from the video frame. The vehicle detection and counting system consists of four major components: 1) Image Acquisition, 2) Image Analysis, 3) Object detection and counting, and 4) Display Result The experiment has been conducted in order to access the following qualities: 1) Usability, to prove that the system can determine vehicle detection and counting under the specific condition lay out. 2) Efficiency, to show that the system can work with high accuracy.	Vissakorn Vannakosit
5.	Traffic Signal Coordination Control of City Arterial Road that Based on Graphic Method. (2011)	In order to reduce the number of vehicle parking stops , and traffic delays, and improve operating speed and travel safety, a measure can be settle these by coordinating traffic signal control of the Huaian south road, the method of Webster is used to set signal control plan, then use the method of arterial road coordination control to map out each signal coordination control program, then graphic method for each phase of the signal, and finally get the conclusion that the coordination control signals program is more superior than current signal control scheme by using intersection Vissim simulation.	Jun Zhou
6.	Adaptive Traffic Management for Secure and Efficient Emergency Services in Smart Cities. (2013)	The work presented in this paper focuses on the particular problem of traffic management for emergency services, for which a delay of few minutes may cause human lives risks as well as financial losses. The goal is to reduce the latency of emergency services for vehicles such as ambulances and police cars, with minimum unnecessary disruption to the regular traffic, and preventing potential misuses.	Soufiene Djahel, Mazeiar Salehie, Irina Tal and Pooyan Jamshidi
7.	Vehicle Counting and Speed Measurement Using Headlight Detection. (2013)	CCTV is one of the tools that can be used to extract the needed traffic Information. Extracted information from image sequences of CCTV can give us real information about the number of passing vehicles and vehicles speed. In this paper we propose a new method in detecting the number of vehicles and vehicle speed measurement in low light conditions. Headlight detection is used in order to identify the existing vehicle. There are few steps in order to extract the information from CCTV. First for vehicle headlight detection, the vehicles are detected with normalized cross-correlation method and centroid-area-difference. We can use both Euclidean distance and pin-hole model for vehicle speed estimation, but pin-hole model has given us a better accuracy in estimating	Sina, Wibisono, A. Nurhadiyatna, B. Hardjono, W. Jatmiko, and P. Mursanto

		the vehicle speed in low light condition or at night time.	
8.	Vehicle Counting Method Based on Digital Image Processing Algorithms. (2015)	Vehicle counting process provides appropriate information about traffic flow, vehicle crash occurrences and traffic peak times in roadways. An acceptable technique to achieve these goals is using digital image processing methods on roadway camera video outputs. This paper presents a vehicle counter-classifier based on a combination of different video-image processing methods including object detection, edge detection, frame differentiation and the Kalman filter.	Ali Tourani, Asadollah Shahbahrami
9.	A Prediction Algorithm for Network Traffic Based on the Queue Length of Steady State. (2017)	In order to make quantitative research on network traffic, this paper puts forward a kind of prediction algorithm based on the queue length of steady state for FARIMA model, PQSF. The algorithm firstly uses the theory of product solution based on the queue length of steady state to derive node packet queuing situation, then calculates the mathematical formula of the traffic's average queue length when there are failure nodes, and establishes the prediction method combined with FARIMA.	Siyu Dong Hong Zhang
10.	Smart Traffic Light for Congestion Monitoring using LoRaWAN. (2017)	Traffic light congestion normally occurs in urban areas where the number of vehicles is too many on the road. This problem drives the need for innovation and provide efficient solutions regardless this problem. Smart system that will monitor the congestion level at the traffic light will be a new option to replace the old system which is not practical anymore. Implementing internet of thinking (IOT) technology will provide the full advantage for monitoring and creating a congestion model based on sensor readings. Multiple sensor placements for each lane will give a huge advantage in detecting vehicle and increasing the accuracy in collecting data. To gather data from each sensor, the Lora WAN technology is utilized where it features low power wide area network, low cost of implementation and the communication is secure bi-directional for the internet of thinking.	Ruhaizan Fazrren Ashraff Mohd Nor, Fadhlan H. K. Zaman
11.	Adaptive Traffic Signal Control Using Fuzzy Logic. (2018)	We present a distributed approach to traffic signal control, where the signal timing parameters at a given intersection are adjusted as functions of the local traffic condition and of the signal timing parameters at adjacent intersections. Thus, the signal timing parameters evolve dynamically using only local information to improve traffic flow. This distributed approach provides for a fault-tolerant, highly responsive traffic management system. The signal timing at an	Stephen Chiu and Sujeet Chand Rockwell International Science Center 1049 Camino Dos Rios Thousand Oaks,

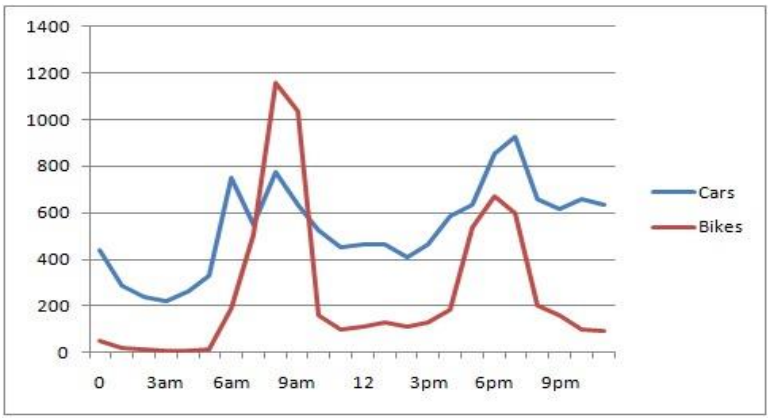
		intersection is defined by three parameters: cycle time, phase split, and offset. We use fuzzy decision rules to adjust these three parameters based only on local information.	California 91360
12.	Analysis of Intersection Queue Lengths and Level of Service using GPS data. (2018)	In this paper, we present a method to estimate queue length, control delay and LoS of intersection approaches. Queue lengths and control delays are estimated by processing aggregated historical GPS data. We analyze LoS, queue length and control delays for most relevant intersections in the City of Zagreb. The results show the application of the proposed methods for evaluating intersection approach performance in urban areas in order to detect low performance intersections. We computed daily queue length profile which shows a variation of queue length for single intersection approach. From computed control (a) Adriatic bridge intersection (b) Kruge intersection (c) Holjevac intersection Figure 3. Queue lengths of analyzed intersections approaches delay values, LoS category can be estimated and together with queue length used to measure intersection performance in traffic management systems.	Leo Tisljaric, Tomislav Erdeli, Ton ci Caric
13.	Partially Detected Intelligent Traffic Signal Control. (2019)	Partially Detected Intelligent Traffic Signal Control (PD-ITSC) systems that can optimize traffic signals based on limited detected information could be a cost-efficient solution for mitigating traffic congestion in the future. In this paper, we focus on a particular problem in PD-ITSC - adaptation to changing environments. To this end, we investigate different reinforcement learning algorithms, including Q-Learning, Proximal Policy Optimization (PPO), Advantage Actor-Critic (A2C), and Actor-Critic with Kronecker-Factored Trust-Region (ACKTR). Our findings suggest that RL algorithms can find optimal strategies under partial vehicle detection; however, policy-based algorithms can adapt to changing environments more efficiently than value-based algorithms. We use these findings to draw conclusions about the value of different models for PD-ITSC systems.	Rusheng Zhang, Romain Leteurtre, Benjamin Striner, Ammar S. Alanazi, Abdullah Alghafis, Ozan K. Tonguz
14.	An Adaptive Method for Traffic Signal Control Based on Fuzzy Logic with Webster and Modified Webster Formula Using SUMO Traffic Simulator. (2021)	This paper focuses on the design of an adaptive traffic signal control based on fuzzy logic with Webster and modified Webster's formula. These formulas are used to calculate the optimal cycle time depending on the current traffic situation which applying in the next cycle. The alternation of the traffic condition between two successive cycles is monitored and handled through the fuzzy logic system to compensate the fluctuation. The obtained optimal cycle time is used to determine adaptively the effective phase green	Muzamil Eltejani Mohammed Ali Akif Durdu seyit alperen celtek Alper yilmaz

		times i.e. is used to determine adaptively the maximum allowable extension limit of the green phase in the next cycle.	
15.	Research on Traffic Optimization Based on Computer Modeling of Maximum Queue Length. (2021)	This paper takes fluid mechanics simulation theory as the theoretical basis, considers the shortcomings of the traditional vehicle flow wave model, and revises it with the Greenberg model to establish a more realistic parking wave model. At the same time, the traditional calculation model is only aimed at the shortcomings of a single intersection, considering the impact of adjacent intersections, and trying to establish a maximum queue length calculation model. This paper takes some intersections of Lean Street in Boxing District as an example to verify the adaptability and effectiveness of the model. The queuing length at intersections is an important parameter to evaluate the operation level of urban road traffic systems, and it has a wide range of applications in traffic design, control and management.	Zhichao Li

METHODOLOGY



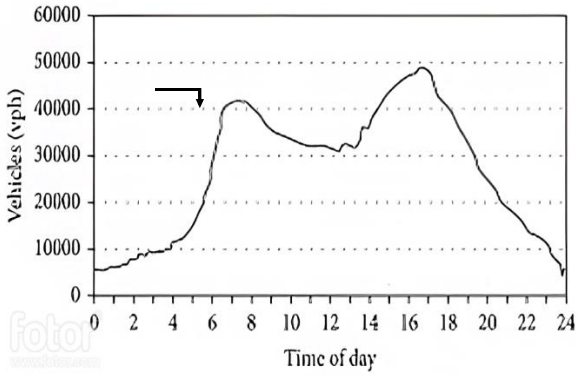
1. Traffic Survey: The traffic survey is conducting to measure the various data related to traffic like traffic flow, vehicle speed, vehicle arriving rate, traffic capacity, saturation flow, normal flow, average delay, signal time, peak hour.



2. Queue Length: Based on the surveying data, concluding the major factors which defines the queue length, that is vehicle arriving rate, crest point of time, and minimum space headway.

Vehicle arrival rate plays a vital role to enumerate the vehicles. This is the time vs traffic flow survey where this survey gives an idea about the highest arriving rate of vehicles during peak hour and also lowest arriving rate of vehicles. This survey helps to determine the peak and minimum time of signal.

Peak number of vehicle per hour



Number of vehicles = vehicle arriving rate (veh/sec) x peak time (sec)

$$\text{Queue length (m)} = \frac{\text{Number of vehicles x min. space headway (m)}}{\text{Vehicle factor per lane}}$$

Vehicle factor per lane : for four-wheeler - 1

: for two-wheeler - 2

Minimum space headway : for four-wheeler - 5

: for two-wheeler - 3

3. Location Of Camera Sensor: Location of camera sensor is the important factor to count the number of vehicles because if location of camera sensor is near the intersection, then the number of counting the vehicles is less and vice versa. And also it determines the convoy releases in next phase. So, co-ordinates of sensor are decided according to the maximum queue length.

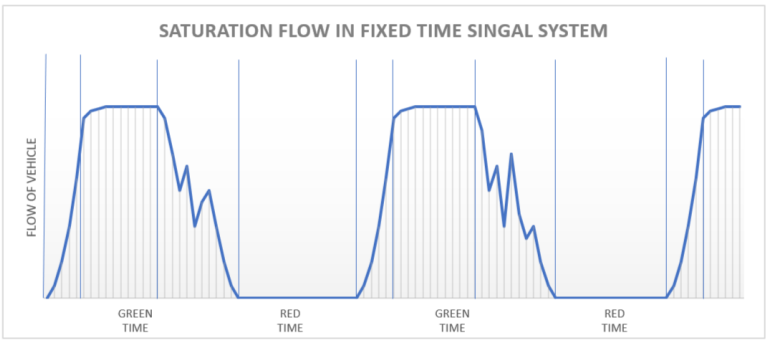
4. Camera Execution: By calculating the major parameter i.e., queue length, from that defining the co-ordinate of camera sensor. This camera sensor is counting the number of vehicles by using video-based real-time vehicle counting system using adaptive background method. Then signal execution is handled according to the data which get from the camera sensor. But the starting and closing operation of camera sensor is affects the count of vehicles. That means execution of camera sensor is starts some seconds before the termination of green time, to count the vehicles which not able to passes from the intersection but crosses camera sensor. That seconds is derived as below:

$$\text{Time required to start camera sensor just before starting of red light} = \frac{\text{Distance between camera sensor to intersection (m)}}{\text{Vehicle speed (m/s)}}$$

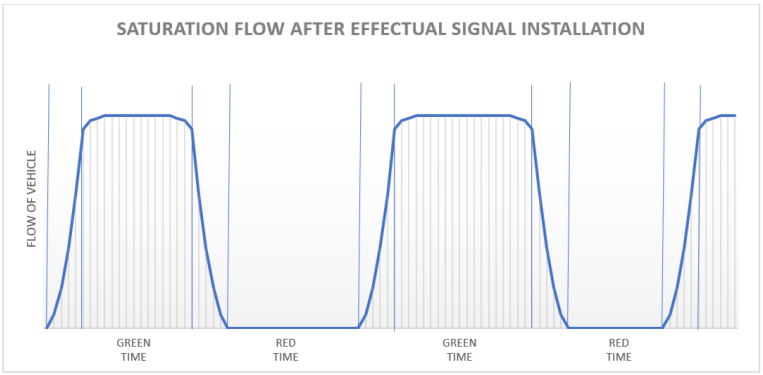
5. Signal Implementation: The data get derived from the camera sensor time analysis will be carried out and according to that, time will be deciding for the particular phase. This analysis of time occurred number of vehicles and some additional factors which affects the signal time. For this analysis maximum and minimum time is required to maintain smooth traffic flow. This time is calculated from the peak flow of daily traffic and arriving rate of vehicles towards the intersection. If number of vehicles is maximum than its peak point then the time is set to its maximum time limit and if number of vehicles is less than its lowest point then time is set to its minimum time limit otherwise time is deciding according to number of vehicles.

RESULT

In Fixed time signal system red time and green time is fixed and hence if any fluctuations happen with number of vehicles, time remains constant and due to that effective green time is not fully utilized.



After installation of actuated signal system time will be fluctuated according to the number of vehicles. So, saturation flow remains throughout the effective green time.



CONCLUSION & DISCUSSION

In actuated signal system counting the number of vehicles by using camera sensor is the major part, who decides the number of vehicles coming towards the intersection. Hence location of camera sensor is the most important parameter. if the location of camera sensor near the intersection it can't able to measure the total convoy who is waiting for the green signal. And if the camera sensor is so far from intersection, then it measures the smaller number of vehicles. Which means the number of vehicles passes from the sensor and waiting for green signal are not counted by the camera sensor. So, commence the camera sensor few seconds before termination of green signal, these few seconds are time required to reach the last vehicle from camera sensor to the intersection. These proper counting of vehicles for next phase, fulfil the requirement of actuated signal system.

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