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Artificial Intelligence Based Smart Transportation System: A Survey

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ABSTRACT

Traffic congestion is getting more and more common throughout the nation and the world as a result of the growing number of motor vehicles. These frequent traffic jams are the outcome of overpopulation and lack of traffic management as well as monitoring system and it hard to control the traffic manually so it is necessary to build a proper traffic management and monitoring system which will be based on Artificial intelligence. In this article a survey is conducted among all the proposed system and methodology which is deployed to build a proper traffic management and controlling system.

Key words: Artificial intelligence, Smart traffic control, machine learning, YOLO.

1. INTRODUCTION

Monitoring and management of transportation system is getting difficult day by day as population is increasing day by day. Due to poor management and monitoring system traffic jams occurs daily. Till date most of the Traffic control systems are operated by humans. these operators are working hard to track the incidents happing in the roads as well as the flow of traffic. the process involved to monitor and control the traffic manually is very hectic as well as time consuming. Due to human error and weariness, certain errors are commonly present in the results. Therefore, to minimize the workload of human operators and make these traffic monitoring systems automated and have less errors Artificial intelligence can be incorporated.

Hence automated surveillance monitoring systems are one of the most significant researched topics and many researches have already been conducted to transform the normal transportation system into intelligent transportation system.

Automated traffic monitoring systems powered by artificial intelligence (AI) not only make it possible to effectively manage traffic but also to monitor and analyze common occurrences which can reduce the frequency of traffic accidents. An Artificial Intelligence powered system can detect every automobile and keep track of its movement patterns to spot any risky driving habits, like irregular lane changes. The accurate detection of any parked vehicles on the road is another important factor of an AI-powered traffic surveillance system. Parked vehicles are often left behind, which prevents vehicles from moving forward and leads them to line up. These lined up vehicles causes Congestion, which makes it difficult for automobiles to move freely. Thus, intelligent traffic surveillance systems are an essential aspect of the systems required to promptly identify and reduce the effects of traffic and personnel congestion.

In the recent years there are a lot m ore research has been done into using machine learning and deep learning approaches to make more intelligent traffic monitoring system. Now artificial intelligence is doing certain activities like counting the vehicles, checking the vehicle number plate without any human operator's intervention. For example, human operators are required to monitor the CCTV footage to analyze the traffic flow and sometimes they need to be present in the field as well to get estimate traffic count. It can be a fast-paced and tedious task. Similarly, it is very hard to analyze the real-time traffic situation just by looking traffic footage from several surveillance cameras. Therefore, there is a need of deploying automated system that can monitor, analyze the traffic and make a proper traffic management system. By deploying this automated system, it will reduce the workload on human and reduce the human errors as well. At the same time if will help to build a cost efficient traffic management system. In this survey we present all the research work and proposed methods that was present in this field, further we have discussed the machine learning approaches and technologies that are being used in these propose system.

2 LITERATURE SURVEY

In recent years many computer vision-based research has been done to build automatic traffic control and management system. We briefly review a few related articles that concentrate on anomaly detection, traffic flow, and traffic congestion prediction.

2.1. Object detection and classification using Deep Learning

Using deep neural networks and traffic pictures, Willis et al. [1] examined the classification of traffic queues. To detect traffic network congestion, the researchers used a two-phase network that had been trained using GoogLeNet and a custom deep subnet. Chakraborty P. et al. [2] utilized traffic images and deployed D-CNN and YOLO algorithms for a variety of environmental configurations. A deep learning model that uses an RCNN structure to constantly identify vehicle speed was proposed by Wang et al. [3].by using this model and incorporating spatiotemporal traffic data, they were able to identify what was causing the traffic jam on city ring roads. Carli et al. [4] presented an analysis of urban street's automatic traffic congestion. For this purpose, GPS- data was used to generalize the traffic patterns.

Similarly, in this study, the authors have shown how to use a video-based congestion monitoring system, which, while less precise than a GPS-based method, is robust and results in cheaper operational costs. Additionally, given how frequently metropolitan streets are congested, it would be advantageous to find several indications for efficiently planning transportation systems [5]. Mask R-CNN [6], YOLO [7], and Faster R-CNN [7], are the frameworks most used for object detection frameworks that have been applied in a significant way in the area of intelligent transportation systems. CenterNet[8] is an another object detector but unfortunately it has not been used enough in the field of Intelligent transportation system but in the field of robotic[9-10] CenterNet has been successfully used for object detection. CenterNet is popular for detecting objects in real time due to its faster inference and it has a short formation time. [11].

2.2. Computer Vision based system for Traffic analysis

An automated traffic surveillance system with an object segmentation algorithm that can recognize, track, and detect vehicles from traffic images was presented by Chiu et al., [12]. Their method differentiates between moving and immobile vehicles by using a moving object segmentation algorithm that categorizes different types of automobiles based on geometric aspects of the vehicles.

In addition to detecting traffic jam and motor vehicle counting, few more were examined to investigate anomaly detection systems. To detect traffic accidents at crossings, a motor vehicle tracking technique based on spatio temporal Markov random field was developed by Kamijo et al. [13]. The model used in their research successfully track individual vehicles reliably without being significantly hampered by occlusion and clutter effects. Therefore, computer vision-based techniques have been widely used, mostly as a result of their higher capacity for event recognition. Computer Vision-based systems could be used to quickly extract information about accidents, traffic offences, traffic congestion, and other events. Rojas et al. [14] and Zeng et al. [15] both suggested techniques using a static CCTV camera to identify motor vehicles on a highway, while an approach for identifying traffic offences at crossings was proposed by Ai et al. in [16]. In diverse traffic scenarios, forecast and categories traffic abnormalities. an anomalous finding technique that might be applied in a distributed manner was proposed by Thajchayapong, S. et al. [17]. Image-processing methods were utilized by Ikeda et al. in [18] to automatically identify unusual traffic events. Their technique could identify four different forms of traffic abnormalities, including halted vehicles, slow-moving vehicles, and vehicles that are attempting to change lanes repeatedly.

Table 1 Literature Review

Sr. No	Year	Author(s)	Key Finding	Methodology	Research Gaps
1.	2018	Chakraborty P. et. al.	YOLO and D-CNN	you only look once (YOLO) and deep convolution neural network	Future research could make use of other models to detect varying

				(DCNN), to detect traffic congestion from camera images	levels of traffic congestion with greater accuracy.
2.	201 5	Carli R. et at.	Traffic congestion detection, using GPS generated data	The proposed methodology uses GPS-generated data from a local transit bus monitoring system and is based on the idea of using a bus as a probe. In order to generate a detailed picture of the congestion on urban roads, offline analysis of archived GPS pulses is conducted to derive useful indices related to general urban traffic characteristic s.	Future research can be done to investigate the dependency of the presented algorithm’s performance of different aspects like unavailability due to satellite communicatio n loss.
3.	201 7	Kaiming He et.al.	Mask R-CNN, Object detection, Faster R-CNN	Mask R-CNN is an extension of Faster R-CNN	It only works on still images.
4.	201	Bochkovskiy, A.	You Only	For GPU	Scope of

	4	et. al.	Look Once (YOLO),CNN, Object detection algorithm	author used a small number of groups (1 - 8) in convolutional layers: CSPResNeXt50 / CSPDarknet53 For VPU authors have used combined-convolution, but they abstain from using Squeeze-and-excitement (SE) blocks – in particular, this includes the following models: EfficientNet-lite /MixNet/ GhostNet/ MobileNetV3	improvement of accuracy in classifier and detector as well
5.	2019	Duan, K.et.al	CenterNet, CornerNet	CornerNet is the baseline of this method.CenterNet uses triplet including one key point and two corner point for object detection	Some more advance strategies can be used to train the method for better performance
6.	2019	Rakhimkul, S et al	Assistive Robotic	Hidden markov model	The primary issue with this

			manipulation system, deep learning		project is the manipulator's blockage of the target object.
7.	2020	Cui, X. et.al	3D semantic map, deep learning, edge computing, robotics	Based on the edge computing environment, a better ORB-SALM2-based 3D semantic map creation for mobile robots is recommended.	The thermal infrared picture and the depth image can only be used to estimate poses in a narrow area with clear features at this time. Additionally, there is a requirement to enhance the positioning effect for a range of scene types.
8.	1999	Kamijo S et.al	Hidden markov model,traffic monitoring, road accident detection	Hidden markov model was used to detect road accident and tracking the motor vehicles	Scope of more accuracy after deploying other model
9.	1997	Zeng N. et. al	Color matching,traffic monitoring system	Compute Vehicle Models Module, Match Vehicles Module,Evaluate module	The model works only on still images and it is hard to identify the moving vehicle
10.	199	Andrew H. S. et.	Red light	Red light	The

	8	al	runner detection,video base identification system	video methodology	assignment of the virtual loop detectors and stop line detection are negatively impacted by inadequate contrast.
11	2012	Thajchayapong, S. et.al	Distributed traffic monitoring system, , traffic anomalies detection	Microscopic traffic variables, feature extraction is based on wavelet based filter	Designing a model that can include data on traffic irregularities from various road links to deduce potential effects on the entire road network is one component.

3. CONCLUSION

The rapid improvement in artificial intelligence contributes to the construction of an excellent transport system. Using AI in the traffic control system will enhance the transportation model as it has multiple benefits. Smart video monitoring system can reduce the human workload and will provide fast and more accurate results. Building a more precise intelligent transportation system that is capable of object detection, traffic violation detection, vehicle identification, and anomaly detection required the application of deep learning algorithms including Faster R-CNN, YOLO, and Mask R-CNN.

However, further more research work and development in this intelligent management system could bring that extra advantages. Applying human monitoring to these intelligent systems can make these automatic traffic control systems highly effective

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