A Review paper on Artificial Neural Network: Intelligent Traffic Management System

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Abstract—*This paper provides a brief overview of the Intelligent Traffic Management System based on Artificial Neural Networks (ANN). It is being utilized to enhance the present traffic management system and human resource reliance. The most basic problem with the current traffic lights is their dependency on humans for their working. The technologies used in the making of this automated traffic lights are Internet of Things, Machine Learning and Artificial Intelligence. The basic steps used in Internet of Things are reported along with different ANN trainings. This ANN model can be used for the minimization of traffic on roads and less waiting time at traffic lights. As a result, we can make traffic lights more automated which in turn eventually deceases our dependency on human resources*

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Keywords- ANN, Artificial Neural Networks, Machine Learning, CSS, Databases, Sensors, Internet of Things, RBF Neural Network, ANN and Dijkstra, VANET (Vehicle Adhoc NETwork), ISN-IoT, V2V communication, ITS (Intelligent Traffic System).

1. INTRODUCTION

This paper basically aims for the improvement in our traffic system which has mainly been dependent on human resource only till now. But now as automation has come up in each and every industry around the world and as it takes over the world with its more fascinating features, here we have decided to make things which play an important role in a human's daily life. Traffic lights. What does come to our mind when we think of these lights. The only question that comes up in our mind is that why are there traffic jams all around the globe when we have traffic lights and the main aim of these lights is to control the traffic. The main answer of this problem is the dependency of our traffic management system on humans. We all know how traffic lights are being operated in almost every country from the past 50 years. These traffic lights are human dependent and so they are to be operated by a human. Another thing that makes the old-styled traffic lights less productive is the timer problem. The timer is set to a specific time limit and it resets to that time even when there is no traffic.

Additionally, the traffic management in our country has gotten worse than excepted. According to research, the capital of our country, New Delhi has an average length of 3 kms to 4.5 kms every day in their peak hours. This is a concerning figure. But it is not the problem in our country. China, on an average has an average traffic jam of 2 kms to 3.4 kms every day.

The traffic system proposed here deals with this problem. The traffic system here has been designed in such a way that it can adjust its timer with the help of four camera's which have been linked to each other through Internet of Things and Artificial Neural Networks. Alongside we have also linked the cameras and the LED lights to our databases which will tell them how much the timer has to be displayed and when the lights can turn green and adjust the timer according to the traffic conditions being captured in our cameras and through our micro programmed chips and sensors. Also, the main problem of how to reduce traffic on the four ways is also discussed

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here and a more accurate and solution has been given to it through the use of Internet of Thongs, Artificial Neural networks and Machine Learning.

2. LITREATURE REVIEW

At the first glance we only think that the only technology that will get used in a traffic light is Neural Networks. But this is completely wrong. There are many other technologies which get used in designing a traffic light. The main technology is machine learning. Machine learning plays an important role in a traffic light. To understand the working of the timer of a traffic light and to understand how it can give the best result such that the traffic is reduced is a big thing. We overcame this problem with the help of python. On the other hand, using technologies such as Java script, SQL, CSS and databases and linking them to each other such that the lights and the cameras can work properly is not easy. We tried to link the cameras with the lights on such a way that the camera itself calculated the depth and arranges the timer on the display of the traffic light. The main disadvantage here is that the camera cannot calculate the depth on curved roads. The camera and the program are installed in such a way that the camera cannot calculate the depth on curved roads.
The camera can even detect traffic on both the sides of the road. We also have linked all the four cameras with each other. Linking of the cameras to the program and then the program getting executed and displaying timer on the timer display on the traffic light was done through machine learning and ANN.

The technology was created to aid traffic engineers in making decisions on how to respond to traffic issues before they escalated. In Artificial Neural Networks, we used feed-forward backpropagation, cascade-forward backpropagation, radial basis, and extended regression. Our technique [1] for creating appropriate estimations is demonstrated by test results based on actual data acquired from the city of Leicester in the United Kingdom.

Artificial Neural Network (ANN) models [2] are constructed to estimate the ships' paths based on the aforementioned clustering findings and other known criteria (such as ship speed, loading capacity, self-weight, maximum power, and water level). When compared to real data, the created model is more than 70% right, according to the results of the experiments. It will also aid in the development of Yangtze River traffic management rules.

Using data acquired by in-road stationary sensors, this study seeks to analyse and categorize the traffic congestion state of distinct road segments inside a city. To classify traffic congestion situations, an Artificial Neural Network (ANN)-based approach [3] is utilized. ITS will automatically change traffic rules based on traffic congestion levels, such as changing the length of the queue at traffic lights and offering other routes. It also aids the government in the development of plans for the building of flyovers and alternative routes to aid traffic control.

Machine learning is a technique in which a computer learns and grows on its own using previously processed data. These algorithms [4] complete the task swiftly and efficiently. By delivering efficient supervised and unsupervised learning of obtained data, VANET achieves its purpose. We looked at how machine learning algorithms can address the security, communication, and traffic concerns that plague VANET systems, as well as the infeasibility of their implementation.

This study [5] proposes a framework for reducing road traffic congestion in an intelligent traffic management system that makes the most efficient use of existing infrastructure and resources to meet the aforementioned challenges. Data collection, data storage, data processing, and business application modules are the four key modules of the proposed framework.

This study [6] aims to construct a short-term traffic forecasting model for a two-lane undivided roadway with mixed traffic conditions in India using a back propagation artificial neural network. The findings were compared using random forest, support vector machine, k-nearest neighbor classifier, regression tree, and multiple regression models. Back-propagation neural networks outperformed other techniques, with an R2 value of 0.9962, which is an outstanding result.

The proposed solution [7] relies on vehicle-to-vehicle communication and a local view of traffic congestion. As it goes along a road, the automobile maintains note of the distance it has travelled and the distance it expects to travel in a free-flowing traffic situation. When a vehicle is unable to calculate alternative routes due to a lack of critical traffic data, it performs a reactionary manouver. It is discovered that there is information concerning the traffic. Three literature solutions are compared to the suggested solution: DIVERT, PANDORA, and s-NRR.

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The relocated mobile agents acquire and communicate traffic flow metrics (speed and density), historical data, resource information, spatio-temporal data, and other data, and assess the static agent using emergent intelligence methodologies. The static agent's emergent intelligence approach uses analytical, historical, and spatio-temporal data. [8] monitors and forecasts predicted patterns of traffic density (commuters and vehicles) and trip times in each zone and area. The static agent determines the best traffic redirection routes based on forecasted and analyzed data, ensuring smooth traffic flow and reducing traffic congestion frequency, density, and trip duration. NS2, SUMO, Open Streat Map (OSM), and the MOVE tool are used to perform the performance analysis in a realistic setting.

The algorithm of the mechanism [9] is thoroughly defined in order to provide a good solution to the challenge and assure the system's stability. The car's registered passive RFID tags will contain all of the vehicle's and owner's information. These tags will be linked to a virtual wallet that can be recharged in order to avoid penalties. The system would incorporate systems for tracing missing autos and monitoring vehicular movements based on system records.

The major purpose of this proposed framework [10] is to create a ground-breaking Internet of Things-based Traffic Management (IoT-TM) system that can make short-term traffic management choices, allowing for precise and efficient traffic clearance. Data is gathered from a variety of traffic profiles, which include parameters such as time consumed. The Mixed Ant Colony Glow Worm Swarm Optimization technique is used to accomplish precise recognition of the traffic optimized features before learning. The proposed research strategy, IoT-TM, was capable of producing superior traffic management decisions than existing research approaches because the entire interpretation of the predicted investigation framework was accomplished in the MATLAB environment.

The purpose of this work [11] is to reduce the average response time for events reported by cars by proposing a dynamic perspective for real-time traffic planning in fog-based IoV systems. To begin, we develop a decentralized city-wide traffic signal in which fog nodes are cars located near roadside equipment. We then model parked and moving vehicle-based fog nodes using queueing theory, arriving at the conclusion that moving vehicle-based fog nodes can be characterized as an M/M/1 queue. By separating the offloading optimization problem into two problem instances and arranging traffic flows across multiple fog nodes, an approximation technique is developed to address it. To demonstrate the superiority of our technique, performance reviews based on real-world cab datasets are undertaken.

[12] Artificial neural networks (ANN) approaches are combined with adaptive learning concepts to create the prediction methodology. These learning principles lead to a large increase in accuracy and a decrease in computation times. Furthermore, the study aims to select the best adaptive learning rule among a set of rules. Traffic data from a number of places across the United Kingdom is used to test the forecast model (U.K.). The findings show that the suggested multivariate forecasting method can simultaneously predict traffic flow and speed in freeway or expressway networks while being computationally more efficient.

It's a difficult undertaking to collect and model a large number of time series from all route segments. Data mining techniques are used to transform complex data into a structural framework and make decision-making easier for ITMS issues. [13] Furthermore, for deriving analytical conclusions on optimal route design, real-time road section weights must be generated using continuous data from various time domains for each day of the year. Dynamic road weights are created or updated using a variety of climate, road, and vehicle-related decision criteria. Determining the weight of a road segment is complicated due to decision overlap within attribute clusters. A classification is used to give exact data modelling without creating a chaotic overlapping environment. It's critical to take a proactive approach.

In addition to the historic and real-time techniques, various time series and artificial neural networks (ANN) models [14] were constructed in the prediction methodology competition. According to the current study, support vector machines (SVM), a recently discovered pattern recognition and regression technology, could be utilized to estimate traffic speed in the near future. Furthermore, an ANN model is built, and the performance of both of these tactics, as well as real-time and historical approach findings, are compared. The investigation was conducted using data from San Antonio's roadways.

The primary purpose of the study [15] was to determine how efficient various smoothing models were in eliminating anomalies in traffic flow data before employing an artificial neural network to estimate short-term traffic flow dynamics. in order to make things easier All of the data collected by the loop detector, wavelet filter, moving average model, and Butterworth filter was thoroughly analyzed. The artificial neural network was then used to calculate traffic flow across different time intervals, which was then quantified using generally recognized

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assessment standards. The results of the research enable us to develop efficient and precise denoising algorithms for anticipating short-term traffic flow.

In the proposed technique [16], this controller acts as a preventive controller. We also create an artificial neural network-based intelligent clustering controller that acts as a reactive controller to guide clustering in the spike ISDN-IoT sensing zone. As a result, an intelligent queuing model is offered to control the spike ISDN-IoT network's flow table buffer capacity, hence improving the overall network's service quality (QoS). A new training method was utilized to train the PRSNN to change its weight and threshold. The recommended model increases QoS by 14.36 percent when compared to a deep neural network, according to simulated data.

In this research, we propose the Fog Route Vehicular (FOREVER) mechanism [17] for Intelligent Transport Systems to aid traffic management in Vehicular Networks (VANET). In order to accomplish this, FOREVER will discover and provide an alternate route for drivers to bypass past congestion. FOREVER is based on the FOG computing paradigm, which attempts to compute and alter a vehicle's path in order to avoid traffic jams. As a result, FOREVER was able to lower CO 2 emissions by 7.9%, stop time by 8.3%, and journey duration by 7.6%, according to the data.

Using various practical demonstrations, this part [18] discussed and demonstrated an integrated hierarchical multi-layer traffic management, surveillance, and control system (TMSCS). An example of an integrated multi-layer multi-criteria traffic management issue in TMSCS was handled in the context of PIACON processes. In addition, specific ANN and fuzzy logic techniques are used. They enable traffic control options and multi-criteria preference structures to be selected.
The Dell PowerEdge T430 server was used to test 5 commonly used datasets of varied sizes in air traffic control big data to verify the technique [19]. According to research, this method can enhance the Spark system's performance by around 35% on average when compared to the default parameter configuration. The performance of the algorithm improves as the dataset is larger. This solution effectively ensures the Spark system's parameter adjustment efficiency and achieves the goal of efficiently processing ATM large data.

As a prediction technique, an Artificial Neural Network (ANN) [20] is employed, and ANN is trained using various traffic data and environmental variables. The ANN is trained using these features, as well as the measured real-time arrival time of the bus at various stops over a 10-day period. This trained ANN is used on the server. In this study, the performance of the proposed IOT-ANN-SPTS system is compared to that of previous comparable investigations. According to the performance analysis, the proposed system minimized error.

TSC and ITS can take advantage of a wide range of new technologies [21]. Machine learning (CI) allows traffic systems to overcome nonlinearity and unpredictability by providing flexibility, autonomy, and robustness. This paper surveys some commonly used CI paradigms, analyses their applications in TSC systems for urban surface-way and freeway networks, and introduces current and potential issues of control and management of recurrent and nonrecurrent congestions in traffic networks in order to provide valuable references for further research and development.

In order to predict location-based speed, stream-based density, and stream speed, erroneous data is fed into an artificial neural network (ANN) that has been trained with accurate data and the same procedure is used. For a variety of input error ranges, [22] is employed. The findings show that when trained with high-quality data, the ANN can withstand automated data errors and provide accurate traffic status estimates, highlighting its utility for real-time ITS applications in such traffic circumstances.

This paper covers the results of the first six-month of the experiment [23]. ANN approaches, their applications in transportation and traffic control, prospective data sources, and congestion characterization and management were all thoroughly examined. A demonstrator application was built based on the review's conclusions to demonstrate the capabilities of an ANN UTC application. In reality, the demonstration app had a far larger purpose.

The taxonomy for categorizing development studies [24] is based on the type of dataset that was utilized for development. A variety of motivational subjects to pursue research advancement in this field have been reported. Recommendations for various stakeholders on a number of crucial topics are offered in order to promote and expedite progress in the car-following setting. In order to find research gaps in the experimental methodologies employed in the literature, a detailed examination is carried out.

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It has been proven that ANN is good at predicting traffic congestion. [25] The outcomes were improved even further when a decisional tree was used to incorporate expected congestion state, real-time GPS data, and anomalous occurrences. Drivers have access to a real-time smartphone application that informs them of traffic conditions at their destination. Large GPS datasets obtained from autos travelling in a densely populated Tunisian city were used to test and verify the model.

TABLE I: TECHNOLOGIES USED AND THEIR SUCCESS RATES

References Number	Technology used	Success Rate	Year Proposed
1	Java and Artificial Neural Systems	90%	2013
2	Artificial Neural Network	95%	2016
3	In Road stationary Sensors	58%	2019
4	VANET	65%	2021
5	ITS	47%	1287-1297
6	Artificial Neural Networks	77%	2018
7	V2V communication	55%	2020
8	Emergent Mobile Techniques	48%	2020
9	ANN Algorithms	78%	2019
10	IoT based traffic management system	58%	2017
11	IoV Systems	88%	2018
12	ANN	77%	2012
13	ITMS	58%	2019
14	ANN, Support Vector Machines	15%	2004
15	Artificial Neural Networks	88%	2020
16	ISN-IoT	85%	2020
17	VANET	98%	2017
18	Traffic Management Surveillance and control system	88%	2006
19	Spark System	77%	2021
20	Artificial Neural Networks, SPTS	85%	2019
21	Computational Intelligence, CI Programs	54%	2017
22	ANN and Dijkstra	66%	2011
23	Artificial Neural Networks	45%	2017
24	Artificial Neural Networks	58%	1996
25	Research Mapping	25%	2020

The table above gives a proper technology wise usage and the years in which they were proposed. Also, the table aims to show how much the technologies were not able to achieve a full hundred percent of their capability. The

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most effective technology out of the above technologies was the VANET (Vehicle Adhoc Network), which has been proven to be a very effective technology in the past, and its currently being used in our current traffic lights as well.

3. Conclusions

This paper sums up to summary that we can even make the traffic light more automated and less human dependent through the use of modern technologies such as Internet of Things, Artificial Neural Networks and some basic machine learning. The main aim here is to show how we can adapt to the changes in the modern world by evolving ourselves with the new technologies that are coming every second in our world. The basic knowledge someone should have for understanding this paper is some basic machine learning and some coding languages. Also, this paper shows us how we can make the make use of technologies in our modern world and implement them for the benefit of mankind.

4. Future Scope

The future scope of this traffic light is that this traffic light will not only be accessible only in our country but also in other countries, which in turn will eventually make our country recognizable all over the world. This paper also aims to mainly free ourself from human dependencies and also to make automation a part of our daily lives. Until yesterday, people were totally dependent on humans for the operating of traffic lights. These traffic lights as compared to our traditional traffic lights which are being currently used, are less expensive and also require less supervision.

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