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Cost Efficient and Higher Accurate Intelligence Automated Highway System using Artificial Intelligence

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Abstract-Automated highway system (AHS) is an intelligent transportation system, which removes human drivers from the operation of vehicles during driving. AHS includes control problems from the vehicle level to the highway network and its challenging opportunities for intelligent mechatronics. This technology requires extreme accuracy in vehicle location within the least times. AHS refers to a set of designed lanes on a limited access roadway where specially equipped vehicles are operated under completely automatic control. It can help reduce fuel consumption and individual vehicle discharge. The AHS designed requires advanced sensors, actuators, and communication technologies. It managed transportation systems for traffic problems in big cities, congestions, accidents, delays. This technique can change the driving & safety scenario of India.

Keywords: Mechatronics, Actuator, Congestions, Scenario

I. INTRODUCTION

The Automated Highway System (AHS) concept defines a new relationship between vehicles and the highway infrastructure. AHS refers to a set of designated lanes on a limited access roadway where specially equipped vehicles are operated under completely automatic control.8 AHS uses vehicle and highway control technologies that shift driving functions from the driver/operator to the vehicle (Figure 1). Throttle, steering, and braking are automatically controlled to provide safer and more convenient travel.

AHS also uses communication, sensor and obstacle-detection technologies to recognize and react to external infrastructure conditions. The vehicles and highway cooperate to coordinate vehicle movement, avoid obstacles and improve traffic flow, improving safety and reducing congestion. In sum, the AHS concept combines on-board vehicle intelligence with a range of intelligent technologies installed onto existing highway infrastructure and communication technologies that connect vehicles to highway infrastructure.

II. SAFER HIGHWAY TRANSPORTATION HIGH ACCURACY

A vehicle that can "predict" the actions of neighboring vehicles is an important step for safer highway transportation. Locating the position of all the vehicles in close proximity to the automated vehicle with high accuracy is essential. This can be accomplished through multi-sensor systems for adjacent vehicles and possibly inter-vehicle communications to give an idea of what to expect beyond adjacent vehicles. Alternatively, the "roadside control" may have knowledge of the positions of the vehicles relative to fixed reference points. This knowledge is obtained by either vehicle based or roadside based detection, and/or by communicating with the vehicle.

1.The System Concept and Technologies

Concepts of Automated Highway System (AHS) can be classified into two groups, partially automated systems and fully automated systems, depending on the extent of the automation. Partially automated systems include notification and warning systems, temporary emergency controls and continuous partial controls, which take limited control of the vehicle in emergency situations. They automate certain routine parts of driving but rely on manual control for most driving functions. Fully automated driving would let drivers be totally disengaged from all driving tasks. The National Automated Highway System Consortium (NAHSC) defined several alternative AHS concepts, from cooperative to fully automated, depending on the degree to which vehicles and infrastructure work together. Table 1 shows these alternative concepts and four functions that they can address – vehicle positioning, lane changing, dealing with obstructions in the road, and managing congestion [1].

III. PROPOSED METHODOLOGY

Cost Efficient and Higher Accurate Proposed System

1.Multimodal Trip Planning

Many public authorities are concerned to provide ever better (public) transport information in order to encourage a mode shift from car to public transport in order to achieve other wider objectives. Multimodal trip planning services – available on the phone, internet, WAP and/or SMS – may do this. The basic idea of a multi-modal journey planner is simple and can be observed, for example, by going to www.transportdirect.info, http://www.travel-andtransport.com or www.ns.nl. The user is able select their origin and desired destination, and the interface then produces a variety of trip options on a variety of modes of transport.

2.Passenger Information Systems

When linked to AVL (see above), ITS has the ability to provide real time information to public transport passengers (RTPI) through a variety of media such as at-stop displays, SMS messaging and the internet. A schematic representation of a typical system is shown below. Theoretically, these systems should lead to some energy saving by promoting modal shift from car to bus, but the evidence to demonstrate such a shift is limited – although a few schemes, including those in Leicester and London (UK) have found, in surveys, a small number of additional passengers using the bus as a result of RTPI.

Fig.1 Schematic representation of RTPI system.

3.Route Guidance and Navigation

Global Positioning Satellite (GPS), as used in fleet management and AVL (see above) can also be used to provide drivers with very detailed route guidance information. This is increasingly commonly fitted to cars as standard. It obviously has a beneficial effect in terms of energy consumption as it can reduce the number of kilo metres driven (when navigational errors are made in manual navigation) and can be used in tandem with congestion information to give drivers advice on how to choose routes to avoid incidents.

4.VMS

Variable Message Signs (VMS) are a form of ITS that provides information to travellers. As its name suggests, the message on a VMS can change in real time. This is usually achieved by means of a display that can be programmed from a control centre remote from the sign. The advantage of VMS is, of course, that the sign can change to reflect prevailing conditions. They are used predominantly to advise drivers on main roads of difficult driving conditions (e.g. “Bridge closed to high vehicles due to high winds”), to give notice of incidents (e.g. “accident at Junction 12”) and also to advise of diversionary routes that can be taken when an incident has occurred.

5.Public Transport Payment

ITS facilitates public transport fares payment in several important ways:

• Electronic ticket machines on buses and trains allow the issue of more specific ticket types, which benefits the passenger. However, they also collect a great deal of management information (e.g. with certain ticket machines it is possible to measure the speed of a bus along a route) which is of use to the operator.

- Ticket issuing machines at stations and stops reduce boarding times and time spent waiting for tickets, thus shortening the overall public transport journey.
- Smartcards retain information about the individual user (e.g. that they have a concessionary permit) as well as facilitating a wider range of fares options than is possible with paper based tickets. They can also be used to reduce ticketing fraud where this is a problem. They can, therefore, have benefits for the passenger as well as for the operator [2].

6.Radio Frequency Identification (Rfid)

RFID is a generic term describing a system that transmits the identity of an object or a person (in the form of a unique serial number) by using radio waves wirelessly. It is grouped under the broad category of automatic identification technologies, with corresponding standards and established protocols. RFID is suitable for applications in different industries and has penetrated into many aspects of our lives. Initially, it was used to identify enemy airplanes during World War II, and has, since then, been widely used in the supply chain, inventory tracking and management, libraries, agriculture, medical affairs, and many other fields.

IDTechEx forecasts a $5.29 billion RFID market in 2008, which is more than 7.3% to the $4.93 billion in 2007. Transportation is a crucial industry that affects the national economy and livelihood of the people. The versatile features and benefits of RFID technology have proven that RFID can be widely applied in the field of transportation to improve driving safety, reduce vehicle collisions, and even help reduce vehicle emissions. However, there are only very limited RFID applications in transportation, including the trucking weight monitor, toll way electronic control system , tire pressure detect system, etc. These applications act as the tip of the iceberg with their narrow scope in the transportation system. To address this issue, the Transportation Research Board organized the "Research Opportunities in Radio Frequency Identification (RFID) Transportation Applications Conference" on October 17-18, 2006, in Washington, D.C. The conference focused on the transportation applications in RFID technology and discussed the research blueprint of RFID application in transportation operations, pavement management, policies, etc.

7.Automatic Online Payment

The success of toll collection programs has spurred interests from payment providers such as American Express, Visa, and MasterCard, who have launched pilot programs to examine RFID-based payments in the india. Sony and Phillips are leading the way to implement radio frequency (RF) wireless payment systems, called Near Field Communication (NFC). These systems will enable RFID communications among PCs, handheld computers, and other electronic devices. The consumers will log on to their personal online portals by swiping their intelligent cards through a specific RFID reader plugged into the USB port on the computer. Consumers may shop and pay online, download any kind of receipt to their PC, and then transmit them, with the help of NFC technology, to an RFID tag in their mobile phones roadside unit (RSU) and Onboard unit (OBU) [3].

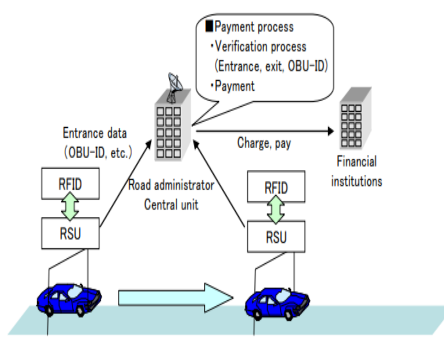

Fig. 2 Image of payment processing at the Center

Accuracy Analysis Method Artificial Intelligence

As we all know, predictive analytics combines techniques like predictive modeling with machine learning to analyze past data to predict future trends. But neural networks differ from regular predictive tools. The most-oft used model – linear regression – is actually a very simple way of going about things as compared to a neural network. Neural networks work better at predictive analytics because of the hidden layers. Linear regression models use only input and output nodes to make predictions.

The neural network also uses the hidden layer to make predictions more accurate. That's because it 'learns' the way a human does.

So why doesn't everyone use neural network prediction? For one, they require massive amounts of computing power, so they are cost-prohibitive.

In addition, neural networks work best when trained with extremely large data sets, which your business might not have. But with IT tech getting cheaper, the first hurdle may soon disappear. Soon, technology like ANNs will mean that there will be no more "unpleasant surprises".

Artificial neural network (ANN) is the component of artificial intelligence techniques built to simulate the human brain while analyzing and processing the information through many interconnected neurons.

Based on this knowledge, ANN presented and extended recently to achieve many successes in various areas of engineering [2]. The self-learning capabilities of ANN enhance its performance to solve difficult and complex problems regardless of the amount of data [1]. An artificial neural network (ANN) has hundreds of thousands of artificial neurons interconnected by nodes used as processing units [4]. The processing units are splitting into input and output units. Based on the internal weight system, input units receive the information. Therefore, the neural network in the hidden layer tries to learn about the presented information to produce an output report. Backward propagation of errors, abbreviated as backpropagation, is used in the artificial neural network as a learning rule to minimize error values [5]. After that, they are producing accurate results for output reports. Artificial neural networks (ANN) are categorized mainly into feed-forward and feedback (recurrent) neural networks [6]. In the feed-forward neural network, signals travel from input to output as straight-forward in one direction. Whereas, in the feedback neural networks, signals can travel in both directions while the network connections can form one or many loops. A feed-forward neural network (FFNN) is the first and most common type of artificial neural network. FFNN may develop through single layer, multi-layer perceptron (MLP), and radial basis function (RBF).

The artificial neural network technique was introduced in the 1980s as a new branch of artificial intelligence (AI) and has been successfully used to simulate complex problems [7]. As an intelligent tool, ANN can efficiently predict output patterns based on a previous learning basis. After completing the proper training, similarities are detected by neural networks while presenting a new way, thus, produce the predicted output pattern. ANN can develop in three steps: network architecture definition, training, and testing. Before further information interpreting, the neural network train by database processing and then tested to obtain more reliable results. Neural network by the feed-forward back-propagation method can model the identification of the problem in input/output pattern [8].

The need of an organization to have a prediction of the project's duration is essential for many reasons [9], such as project portfolio planning, product roadmap planning, resource planning, budget planning, cash flow, customer satisfaction, and more. There are many differences between organizations' projects: the culture is different, the project management process, the tools and techniques, and much more. In some organizations, these differences exist also internally, between different sections of the same organization. This required a project duration prediction tool to be agnostic and flexible enough to fit many types of projects, products, and project management methods; it should support different types of inputs, with different types of units; and it should handle the biases and errors caused by these differences. While the input dataset of each organization can be different, the required output is common to all types of projects; the output is a single value, with units of time, which describe the predicted duration of the targeted project.

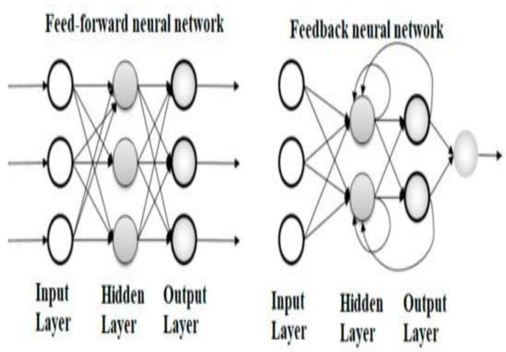

Fig. 3 Artificial neural network technique.

IV. RESULT AND SIMULATION

In terms of growth in economy and population, India is the second largest country. Most of the cities in India are facing road congestion problems. There are practical difficulties in maintaining Intelligent Transport Management Systems (ITMS) in developed countries towards metropolitan cities in India. This is due to slow growth in infrastructure compared to the rapid increase in the number of vehicles, space and cost constraints. The Traffic flow information is needed for travellers to help them to make better travel decisions on congestions and to improve traffic operation efficiency. Predicting short-term traffic flow will be more helpful in managing freeway networks.

1.Dataset Collection

To evaluate the traffic flow, the toll data NH 3 or Agra Mumbai Highway Indore city for two weeks at January in a freeway network. The gathered data can be examined to forecast the traffic structure and in avoiding the traffic congestion during peak hours and particularly on holidays. The properties of the Freeway toll data are given in Table 1.

Table 1 Main Properties of the collected freeway toll data.

Name	Description
V_{ID}	Vehicle Identifier
S_N	Source Name
D_N	Destination Name
T_{In}	T-In Time In Time of the Vehicle entry
TOut	T-out Time Out of the Vehicle
V_h	Number of vehicles crossed per hour

This work used a traffic flow dataset for traffic flow prediction, congestion avoidance and reduces fuel usage. It has 10 attributes, namely,

(1) Vehicle_Id
(2) Source
(3) Destination
(4) Route
(5) Distance
(6) Average_Speed
(7) Time_to_Reach_Destination
(8) Entry_Time
(9) Exit_Time
(10) Vehicle_Type

Table 2 LMV Vs HMV Vs HPMV counts of all Point of Interests

Time (in hours)	Vehicle Count (in hundreds)		
	LMV Light Motor Vehicle	HMV Heavy motor vehicles	HPMV High productivity motor vehicles
12:00 AM	6	6	4
1:00 AM	8	6	4
2:00 AM	2	4	7
3:00 AM	4	7	6
4:00 AM	6	4	6
5:00 AM	5	6	2
6:00 AM	7	4	3
7:00 AM	13	22	12
8:00 AM	38	41	37
9:00 AM	36	41	47
10:00 AM	28	41	21
11:00 AM	3	4	7

Time (in hours)	Vehicle Count (in hundreds)		
	LMV	HMV	HPMV
12:00 PM	7	2	8
1:00 PM	5	7	10
2:00 PM	3	7	6
3:00 PM	6	6	2
4:00 PM	7	4	3
5:00 PM	54	44	46
6:00 PM	41	66	44
7:00 PM	49	46	54
8:00 PM	6	8	5
9:00 PM	4	3	6
10:00 PM	7	9	4
11:00 PM	5	8	10

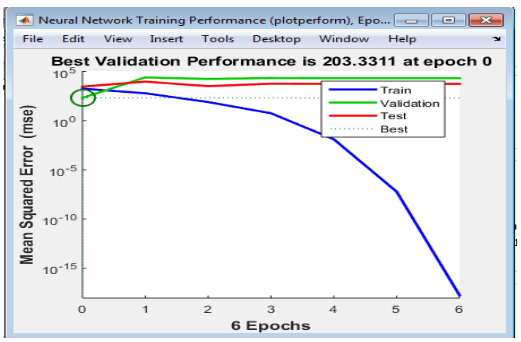

Fig.4 MSE.

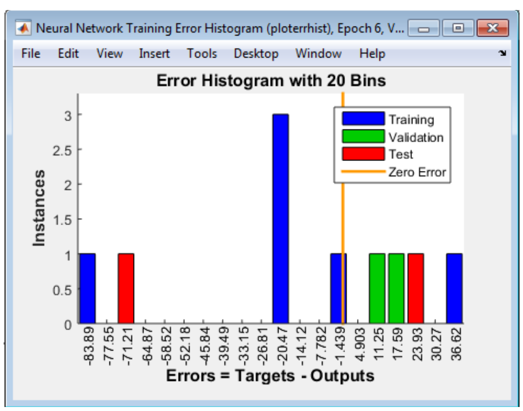

Fig.5 Test Error.

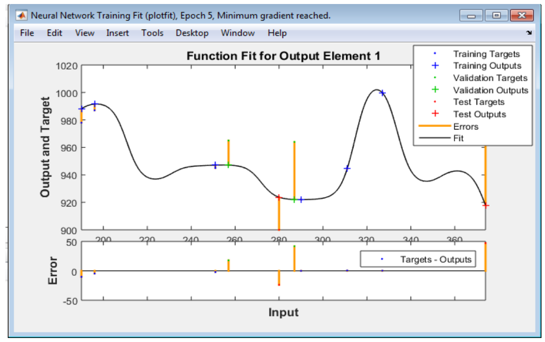

Fig.6 Prediction Error.

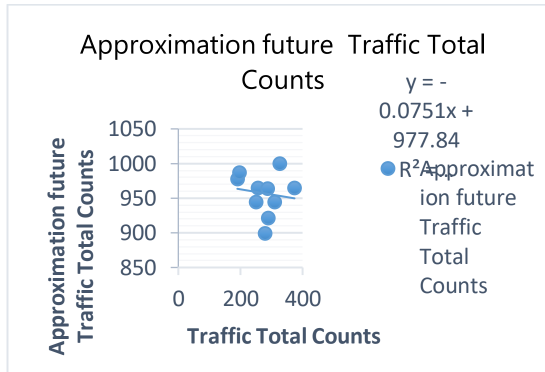

Fig.7 Prediction Curve2)

Hypothesis Testing

Hypothesis Analysis and Findings Interpretation

Hypothesis 1:

- **H01:** There is no significant possibility of some kind of time decrease when Accurate intelligence automated highway system using is being used.
- **H1:** There is significant possibility of some kind of time decrease when Accurate intelligence automated highway system using is being used.

Table 4 Distance and Time Saving minute.

S.N.	Distance	Time Saving minute
1	10	15
2	20	22
3	30	31
4	40	35
5	50	38
6	60	40
7	70	43
8	80	44
9	90	45
10	100	47

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S.N.	Distance	Decrease Transportation costs (%) Savings
1	10	5
2	20	8
3	30	10
4	40	12
5	50	13
6	60	17
7	70	19
8	80	20
9	90	20
10	100	30

Table 5 F-Test Two-Sample for Variances Hypothesis 1.

F-Test Two-Sample for Variances		
	Distance	Time Saving minute
Mean	55	36
Variance	916.6667	110.8889
Observations	10	10
df	9	9
F	8.266533	
P(F<=f) one-tail	0.002138	
F Critical one-tail	3.178893	

Test statistics Result:
In this F- Test F >Fcritical, hence Null hypothesis reject, and the alternate hypothesis is accepted.

Interpretation and Discussion - It is seen that There is significant possibility of some kind of time decrease when Accurate intelligence automated highway system using is being used.

Hypothesis 2:

1. H01: There is no significant possibility of some kind of Cost decrease when Accurate intelligence automated highway system using is being used.

2. H1: There is significant possibility of some kind of Cost decrease when Accurate intelligence automated highway system using is being used.

Table 6 Distance and Decrease Transportation costs (%) Savings.

S.N.	Distance	Decrease Transportation costs (%) Savings
1	10	5
2	20	8
3	30	10
4	40	12
5	50	13
6	60	17
7	70	19
8	80	20
9	90	20
10	100	30

Table 7 F-Test Two-Sample for Variances Hypothesis 2.

F-Test Two-Sample for Variances		
	Distance	Decrease Transportation costs (%) Savings
Mean	55	15.4
Variance	916.6667	53.37778
Observations	10	10
df	9	9
F	17.17319	
P(F<=f) one-tail	0.000121	
F Critical one-tail	3.178893	

Test Statistics Result:
In this F- Test F >Fcritical, hence Null hypothesis reject, and the alternate hypothesis is accepted.

1. Interpretation and Discussion: It is seen that There is significant possibility of some kind of Cost decrease when Accurate intelligence automated highway system using is being used.

Hypothesis 3:

1.H01: There is no significant possibility of some kind of Traffic density (%) decrease when Accurate intelligence automated highway system using is being used.

2. H1: There is significant possibility of some kind of Traffic density (%) decrease when Accurate intelligence automated highway system using is being used.

Table 8 Distance and Decrease Traffic density (%).

S.N.	Distance	Decrease Traffic density %
1	10	10
2	20	12
3	30	13
4	40	13
5	50	15
6	60	16
7	70	18
8	80	19
9	90	20
10	100	25

Test statistics Result:
In this F- Test F >Fcritical, hence Null hypothesis reject, and the alternate hypothesis is accepted.

1. Interpretation and Discussion: It is seen that There is significant possibility of some kind of Traffic density (%) decrease when Accurate intelligence automated highway system using is being used.

Table 8 F-Test Two-Sample for Variances Hypothesis 3.

F-Test Two-Sample for Variances		
	Distance	Traffic density %
Mean	55	16.1
Variance	916.6667	20.1
Observations	10	10
df	9	9
F	45.60531	
P(F<=f) one-tail	1.93E-06	
F Critical one-tail	3.178893	

V. CONCLUSIONS AND FUTURE SCOPE

CONCLUSION

Traffic congestion is a significant problem, especially in growing nations; to encounter this, many models of traffic system were proposed. For a smart transportation system, a new framework is traffic prediction is recommended to avoid congestion. On hourly volume in low and, moderate recurring volume sample data are obtained and establish a probability model and genetic prediction model for predicting traffic congestion and avoidance. This prediction technique with fuel consumption model helps to avoid congestion and also reduces pollution, protects the green environment and safe travel. Based on the traffic flow structure pattern and regression method, a short term traffic flow is predicted. The traffic flow at the next time point can be predicted by using entrance flow information. The traffic flow in a week is predicted using pattern information and LWL.

The significant contributions of the thesis are summarized below:

- Smart Traffic Prediction and Congestion Avoidance System were proposed to enhance transportation services such as safe and secure travel, road safety, informed travel choices, the efficiency of transportation, environmental protection and traffic resilience. This system proposes to predict traffic congestion based on the arrival time of vehicles, thereby helping to reduce traffic congestion before occurrence. By diverting the vehicles through another route, traffic can be reduced. This will be effective at improving the traffic condition in the city, where the prediction can be made with the arrival of the vehicle.
- Short term traffic prediction is one of the required fields of study in the transportation domain. It is beneficial to develop a more advanced transportation system, to control traffic signals and avoid congestions. The proposed short term traffic flow prediction is based on structure pattern and regression methods. It improved the traffic system, also enhance green priority, rerouting, fuel consumption and time-saving the traffic flow structure pattern constructed from freeway toll data.

To minimize the traffic problems typically faced by ambulance, an intelligent transport system is proposed. It is integrated with sensor information and communication technologies to achieve traffic efficiency improve environmental quality, save energy, converse time and enhance safety and comfort, especially for ambulance drivers.

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