Survey on Real-Time Intelligent Traffic Light Monitoring and Control System Using Data Mining and WSN

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Abstract **- This paper, presents a Real-time Intelligent traffic light monitoring and control system to predict traffic congestion using Iterative Dichotomiser 3 (ID3) data mining and Wireless Sensor Network (WSN). This system not only measures the current vehicle count and different climatic condition such as temperature, gas and light through wireless sensor nodes but also, we predict the possibility of traffic congestion for particular road range by using CSE5230 ID3 Data mining algorithm on system database. Systems approach is to design a delay timer for traffic signal light control, which uses historical collected data and automatically identifies the delay time for traffic signal light. Traffic congestion information and climatic scenario are employed for early warning with the use of server to android-based mobile phones or smart phones connected via a web service. System uses micro controller Bluetooth and an android device for connecting server to different sensors like IR sensor, temperature sensor, light sensor and gas sensor with the help of RS-232 and ADC.**

Database stores the log files containing information about history of climatic condition, the count of vehicle and details of traffic congestion. With the help of which system intelligently study the future control of delay timer for Red, Green and Orange, traffic signal lights.

Index Terms **- Wireless sensor Networks (WSN), Iterative Dichotomiser 3 (ID3), Analog to Digital convertor (ADC).**

INTRODUCTION

In recent decades travel demand in urban area has rapidly increased along with the growth of economic activity and population, however, infrastructure transportation has slowly expanded due to limited space available. Soothing the traffic congestion in urban road network has been a crucial issue for both the research and practical operation. A beneficial and reasonable solution may not obtain always by supplying new infrastructure. Hence, use of existing infrastructure via intelligent or smart traffic management seems to be more feasible and calls for implementation and development of improved traffic signal control techniques and method.

A State of severe congestion that brings traffics in the network to standstill is Gridlock. Such state arises when local queue spills back, there by restricting traffic movement in all directions. In any urban transportation network the activation and evolution of urban gridlock is impacted significantly by traffic signal setting.

Transportation of goods, labor, industrial products and machinery are the keys factors, which influence the industrial and environmental development of any country. Traffic congestion and mismanagement will results in long waiting times, loss of fuel and money. It is therefore necessary to have a fast economic and efficient traffic control system for national development.

The monitoring and control of city traffic is becoming a major problem in many countries. Traffic monitoring authority has to find new methods of overcoming problems that arise due to ever increasing number of vehicles on road. Till now the measures taken are development of new roads and flyovers in the middle of the city; buildings of several rings such as inner ring road; middle ring road and outer ring road; introducing monorails; restricting of large vehicle in city during peak hours and also development of sophisticated traffic monitoring and control system.

One way to improve traffic flow scenario of current transportation system is to apply automation and intelligent control methods to roadside infrastructure and vehicles.

MOTIVATION

One of the sever problem of today's society is on road traffic management. To reduce waiting and travelling times, save money and fuel an intelligent management technique is required. A large number of methods and approaches have been suggested in the literature in order to allocate the problem. In this section the various solution to the traffic control problem suggested in literature are present.

International workshop on "Agents in Traffic and Transportation" held at the 13th international conference on autonomous agents and multi systems (AAMAS), Paris France on 5may and 6 May 2014 in this workshop the topic of world-wide user friendly and effective transportation system was raised; this workshop emphasized on application of multistage technology in traffic transportation and logistics. It also expressed the importance of distributed decision making in traffic and intelligent monitoring of transportation system using agents. The purpose of this workshop was to bring the researchers and the practitioners together in order to set up vision on how agent technology can be and is used for today's isolated IT-tools to model, stimulate, and manage large scale complex transportation systems.

LITERATURE SURVEY

Zahra zamani,Mohammad Hossein Saraee, Mohmmad paurmand[1] presented the "Application of Data Mining in Traffic management : case of city of Isfahan which describes the work in use tagging the application of data mining tools. In this, case study was conducted to illustrate the use of hierarchical cluster analysis. Using evolution, a Time-of-Day signal control system was designed. This system automatically identifies time of day (TOD) intervals using historically collected data.

A system deployed in Isfahan consist of sensors used for determining the volume of traffic. Each entry in junction had a sensor capable of counting the number of entry vehicles. The data collected was then used to deicide the time of the day by creating clusters with the help of Clementine software. It clustered holidays and weekdays separately from other days and further divided days into a cluster 4 cluster for holidays: 5 cluster for Business days and weekends. Tables for Time-of-Day intervals based on the gained cluster were then prepared for signal plan development.

After studying Application of data mining in Traffic management: case of Isfahan [1] one comes to know that this system retrieves historically detector data and clusters the data over 24 hours' time period. Then generate daily Time of Day interval and timing plans based on historical data trends but is not able to control real time traffic flow and cannot provide or measure the different environmental condition.

Chunga yang,Yang cao,Zaiging Nie,Jie Zhou and Ji-Rong wen[2] presented "Design of Intelligent Traffic Light Controller using Embedded system".

They had proposed a system, which makes use of Sensor Network along with Embedded Technology to intelligently deicide the timing of Red, Green light at each crossing of road based on the total traffic on all adjacent roads. Users those who wish to obtain the latest position of traffic congested roads are provided with GSM cell phone interface which helps the car drivers to select an alternative route. After studying Design of "Intelligent Traffic Light Controller using Embedded System". One come to know that this system controls real time traffic by taking into consideration the length of vehicle on each road. Thus, in turn generating outputs signal for Red, Orange and Green Traffic light to monitor their timing but this system makes use of GSM system interface to provide information about traffic congestion which requires pre-registration hence it is not so user friendly. This system does not provide information of climatic condition and about the Time of Day i.e., day or night etc.

Imane L'hadi,marwa Rifai,Yssine Salih Alj[3] investigated energy by representing "An energy efficient WSN based Traffic Safety System". They made efficient use of solar light pads that were deployed in dangerous portion of highways. They had arranged the poles in groups such that each group was equipped with a sensor and an actuator for vehicle detection (sensors) and for switching on and off the light-emitting diodes of group poles(actuators). In this communication between the system component was done through Zigbee

Network which were relayed by the use of repeaters. After studying "An Energy –Efficient WSN based Traffic Safety System" we understand how accidents can be reduced by providing proper lighting in dangerous portion of highways also the idea of

efficiently using Solar Panel can be utilized with Embedded System.

Anand Gupta, Sajal Choudhary, Shachi Paul [4] suggested "DTC:A frame work to detect Traffic congestion by mining versatile GPS data" system which utilizes the available GPS data for mining. The mining of this data is likely to help in detection of the location, which face frequent traffic congestion. All kind of GPS enabled devices like Mobile, Tablet and different vehicle has access to the data thus informing future traffic congestion, which help user to decide whether to opt for route. After studying "DTC: A framework to detect traffic congestion by mining versatile GPS data" system we come to know that such system does not gives accurate result because of its inability to distinguish between jams and random short –term stoppages. The author proposed clustering available as one of the solutions, this system is only capable of detecting traffic congestion. It is not able to control real time traffic nor gives any information about climatic condition and Time of Day.

Kitae Jang, Hgugjoo Kim and In Gwan Jang [5] defined Traffic signal monitoring and control by detecting grid lock situation. They proposed "Traffic Signal Optimization for Oversaturated Urban Networks Queue Growth Equalization" systems that makes use of signals optimization algorithm aiming equalization of queue growth rates across links in oversaturated Urban roadways network. This algorithm was capable of delaying queue by simply distinguishing queue over those links rarely used. This system is capable of avoid in traffic congestion but not able to control real time traffic and also does not provide relevant information about current climatic scenario.

NEED

There is a strong need for the implementation of a traffic light signal monitoring and control system globally. Very few traffic lights controlling systems are capable of managing heavy traffic jam. They are not able to provide significant early warning against these time-wasting congestions. Presently typical conventional traffic light controllers face various problems as mentioned below.

A. HEAVY TRAFFIC JAMS

Heavy traffic congestion has substantially increased in major cities with increasing number of vehicles on road. This usually happens at the main junctions commonly in the peak hours such as morning, before office hours and in the evening, after office hours. Increased time wasting of the people on the road is the main effect of this matter. The solution of this problem is by developing the program that is capable of detecting traffic scenario in real time and provides different setting delays. The junctions that have high volume of traffic should be setting longer delay than the delay for the junction that has low volume of traffic.

B. NO TRAFFIC, BUT STILL NEED TO WAIT.

People have to wait at certain junctions sometimes even if there is no traffic because the traffic light remains red for the present time delay, the road users should wait until the light turn green. They have to pay fine if they run the red light. The solution to this problem is by developing a system, which detects traffic flow on each road and set timing of signal accordingly. Moreover, synchronization of traffic signal in adjacent junction is also necessary.

C. EMERGENCY CAR STUCK IN TRAFFIC JAMS

Usually, an emergency vehicle such as ambulance, fire brigade and police will be stuck especially at the traffic light junction, during traffic jam. This is because the road users are waiting for the traffic light to turn green. It can cause the emergency case to become complicated and may endanger life, so this is a critical issue.

D. LACK OF TRAFFIC INFORMATION TO USERS

Present traffic system fails to provide traffic information including congested road and alternate route available in the case of congestion.

In the proposed intelligent traffic light controller, all these limitations of existing controller are totally eliminated. The proposed project of "Real-time Intelligent Traffic Light Monitoring and controlled system to predict traffic congestion using Datamining and WSN" uses combined efforts of embedded systems and wireless sensors (microcontroller AT Mega) and has advantage of efficient control, monitoring via various sensors and an android user Interference. The fixed timer delay traffic light problem is eliminated in the proposed system. The main objective of this project is to design a program and implement hardware of intelligent traffic light system suitable for real life implementation. This

project also aims to minimize the delay or waiting time at the road by designing a system that provides safe and efficient traffic flow and guides the right way. By increasing the green signal delay time on busy road and decreasing the red signal delay time on non-busy road, one can reduce traffic jams. System can also provide the information about congestion on road or possible alternate routes to drivers on demand of his/her android device. To measure the traffic flow IR (Infrared) sensors are used. In short, this project is real-time, android base intelligent traffic light controller.

PROPOSED WORK

After studying literature survey and understanding the need globally, these papers are modified, and a novel technique is built that gives best result like predicting the traffic flow on each road of the junction and setting the delay for red light more for the road with heavy traffic flow. System will provide notifications of congestion on heavy traffic flow to the drivers via their android device on demand. This may help the drivers to make decisions on whether to opt that route or not. The Architectural diagram helps to understand proposed system in a better way. It consists of three modules all together these three modules communicate via wifi network with each other and form a system. First module consists of PC base station where all the data obtain from the system location is stored in data logs forming database. These data logs are then utilized to control the delay timing of traffic signal light.

Second module consist of the entire hardware made up of microcontroller, sensors capturing on field data in real time, Android devices included in this module to communicate with the hardware via Bluetooth and upload data on the server. This device uses android base application, which not restricted to any compatibility clauses. This module is actual Traffic Controlling and Monitoring Module (TMCM).

Third module is the user end, which includes android application installed on any android devices. This extracts the data from the server and displays it for use. Drivers make the use of this information and can opt for relevant route using their intelligence.

Architecture diagram:

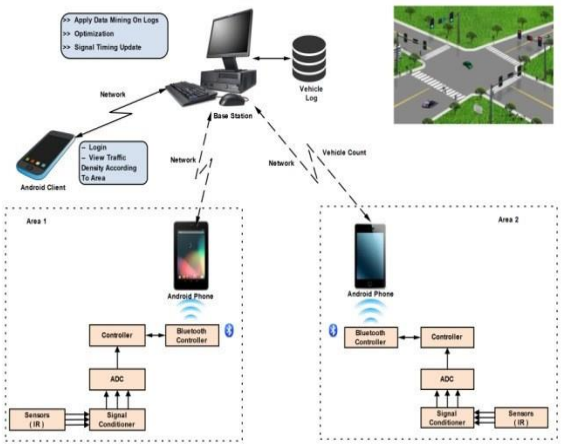

Fig.1 Architectural framework of Proposed System.

The proposed operation of the Real-time Intelligent Traffic Light Controller can be understood better with the help of following: -

First, all sensors sense various parameters and send it to ADC for analog to digital conversion. After signal conditioning these digital signals are forwarded to micro controllers, then micro controller has task to convert this digital data into user define format and send this data to server with the help of Bluetooth, Android Device and Rs-232. Every collected value or data logs are stored in database; applying the data mining on database, system provides the future prediction values.

Data mining works as a decision identifier or decision tree constructor. C0E5230 ID3 decision tree Algorithm constructs a decision tree using the concept of Information Gain. Further this decision tree is use to make a decision about new data. This predicted value is then used to estimate delay timer of red, green and orange light. All this operation is performed by TMCM, which not only stores the data; maintain logs in database but also provides smooth system user interface and communicated with user's android device whenever demanded.

CONCLUSION

A novel technique is to be build will give best results to achieve a better understanding of the climatic condition and to alert users in gridlock situations. System includes not only monitoring and alerting of the traffic signal light but also it provides future predictions based on the data logs for possibilities of gridlock situations.

System monitors the traffic, intelligently control the timer setting in order to avoid gridlock situation and traffic congestion. This allows the user to easily interact with the system via mobile portable devices like android phones.

Hence we come to a conclusion that Real time intelligent traffic light monitoring and control system is a more advances technique that can provide us best features.

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