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AN OPTIMIZED TECHNIQUE FOR AUTOMOBILE DATA COMMUNICATION TO SHARE AIR QULAITY INDEX

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ABSTRACT

This paper studies the vehicle to vehicle communication to share Air Quality Index messages. The United States Department of Transportation announced that it is proposing a rule to require vehicle-to-vehicle communication technology in new cars. AQI Indicates whether pollutant levels in air may cause health concerns. AQI Ranges from 0 (least concern) to 500 (greatest concern). This air quality message is passed by communications like one-to-many, local, and geo-significant. The vehicular communication network is ad-hoc, highly mobile, and with large numbers of contending nodes. We design several random access protocols for medium access control. The protocols fit in the facility of RFID, GPS and WA P.

Keywords: AQI, Air Quality index, RFID, GPS, Protocol, Automobile Communication.

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1. INTRODUCTION

Air Quality Index indicates whether pollutant levels in air may cause health concerns .it ranges from 0 (least concern) to 500 (greatest concern). Air pollution causes by natural and by unnatural .Natural air pollutions are forest fires, pollen, dust storm etc .Unnatural air pollution are man-made: coal, wood and other fuels used in cars, homes, and factories for energy.

A Vehicular Ad-Hoc Network or VANET is a technology that uses moving vehicles as nodes in a network to create a mobile network. The main objective of this is to turn every participating vehicle into a wireless router or node, allowing vehicles approximately 100 to 300 meters of each other to connect and, in turn, create a network with a wide range. To provide AQI measures where information about Major Pollutants on that area, current AQI, location coordinates are passed with or without the deployment of Infrastructure. To incorporate intelligence into a VANET to improve more information's and to facilitate easy and effective communication between vehicles with dynamic mobility. To provide value added services like email, audio/video sharing etc., Various communications types are Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I), Vehicle to Roadside (V2R), Hybrid Models such as Vehicle to Vehicle (V2V) & Vehicle to Infrastructure (V2I) and Vehicle to Vehicle (V2V) & Vehicle to Roadside (V2R) . Vehicle to Vehicle communication approach is most suited for short range vehicular networks. It is Fast and Reliable and provides real time safety it does not need any roadside Infrastructure. V2V does not have the problem of Vehicle Shadowing in which a smaller vehicle is shadowed by a larger vehicle preventing it to communicate with the Roadside infrastructure. Vehicle to Infrastructure provides solution to longer-range vehicular networks. It makes use of pre-existing network infrastructure such as wireless access points (Road-Side Units, RSUs). Communications between vehicles and RSUs are supported by Vehicle to-Infrastructure (V2I) protocol and Vehicle-to-Roadside (V2R) protocol. The Roadside infrastructure involves additional installation costs. The V2I infrastructure needs to leverage on its large area coverage and needs more feature enhancements for Vehicle Applications. Thus when RFID is combined along with GPS and WAP we no need to have a separate infrastructure which is achieved with DSRC.

The rest of the paper is structured as follows. Section II provides related work. Section III deals the Air Pollution Index background Section IV discuss the technological background of VANET. Section V is the problem formulation and Section VI is the conclusion of the System.

2. RELATED WORK

Saranya.B, Sasikala.N, et al proposed a system with a barcode scanner is used to read the barcode present on the object. The microcontroller will check the input from the barcode scanner with the predefined code present in it. If the barcode is not matched with the code then the microcontroller will send the signal to the driver circuits for controlling the motor operations.

Asaad M. J. et al, proposed a novel method in 2012.In this method Vehicle tracking device is installed in specific vehicle which helps the owner to track location of the specific vehicle.

This is done using Global positioning system and Global system for mobile communication. This method will monitor a vehicle continuously and report its status to the owner on requisition command .

Ramya V et al., proposed a system in 2012 which detects obstacles when an obstacle comes near the vehicle. It alerts the vehicle user of the approaching danger. The vehicle user

takes immediate action to avoid any change of accident to himself and the pedestrian. It also monitors the system for any toxic gases and intimates the owner if it becomes aware of its presence.

Peijiang Chen et al., proposed a system in 2008 in which the vehicle parameters are monitored from remote location. The various parameters received from vehicle is sent to the remote centre via GSM where a computer is used to show the results in VB.

Kiruthikamani.G et al proposed a system in which the speed of the vehicle is controlled by means of communication through RFID Technology for short distance range. Which won't be applicable for long distances.

Albert Alexe, R.Ezhilarasie et al proposed a system basedon cloud computing. Here sensor datas's are collected and based on that required actions are taken. Also the vehicle's location is found using GPS

3. PROPOSED TECHNIQUES

3.1. Air Pollution Index Background

Any visible or invisible particle or gas found in the air that is not part of the original, normal composition. Natural: forest fires, pollen, dust storm. Unnatural: man-made; coal, wood and other fuels used in cars, homes, and factories for energy. How the air pollution is measured is by means of Air Quality Index (AQI). Indicates whether pollutant levels in air may cause health concerns. Ranges from 0 (least concern) to 500 (greatest concern).

Table 2.1 Air quality Index

ir Q Air Quality uality	**Air Quality Index Air Quality Index**	**P Protect Your Health Health**
GGood	0-50	No health impacts are expected when air quality is in this range.
Moderate	51-100	Unusually sensitive people should consider limiting prolonged outdoor exertion.
Unhealthy for Sensitive Groups	101-150	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
Unh Unhealthy	151-200	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion, everyone else, especially children should limit prolonged outdoor excertion.
Very Unhealthy (Alert)	201-300	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion everyone else, especially children, should limit outdoor exertion.

The five Major Pollutants are Carbon Monoxide, Sulfur Dioxide , Nitrogen Dioxide Particulate Matter and Ground Level Ozone.It causes more problems like Limits visibility ,Decreases UV radiation, Yellow/black color over cities ,Causes respiratory problems, bronchial related deaths, allergies, strengthens lugs, and a risk for cancer. Also other problems like greenhouse effect, global warming, thinning of upper ozone layer, acid rain, indoor air pollution etc. The waste in landfills releases methane. Sulfur oxides, carbon monoxide and carbon dioxide, and methane all have a very negative effect on air quality.

These pollutants can also contribute to the greenhouse effect. However, most air pollution is linked directly or indirectly to human activity. This means that air pollution can be best controlled by modifying human activity to burn a smaller quantity of fossil fuels.A major form of air pollution is emissions given off by vehicles. Acid rain contaminate drinking water and vegetation, damage aquatic life, erode buildings and alters the chemical equilibrium of some soils.

3.2. Technological Background

Each vehicle in VANET equipped with WiFi/WiMax device acts as a node Unique ID and IPaddress for each vehicle. Each node can communicate with any other node. Any vehicle can register its identity to a roadway WAP Information provided by the vehicles directly to the WAPs.

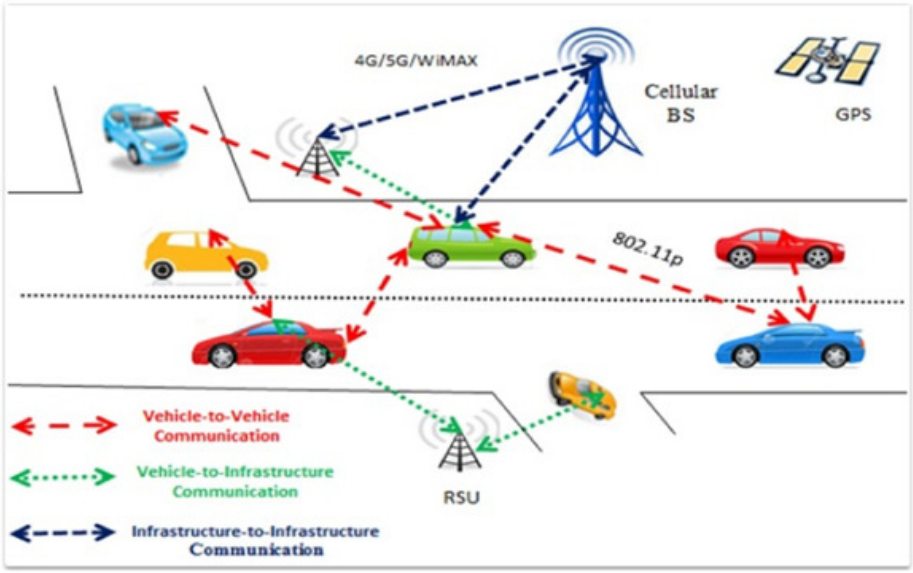

Figure 1 Vechile to Vechile Communication Using RFID, VANET *GPS and WA P*

Collective information stored by the WAPs at a dynamic server database If there is a gridlock /high traffic density detected by a roadside infrastructure then the roadside system can broadcast the information to all its nodes/vehicles In turn using the DTN(Delay tolerant Network)capabilities of VANETs, the information can be transmitted to other vehicles heading towards this junction. Likewise, it can convey to the incoming vehicles other paths, depending on a centralized system co-ordination of finding non-traffic routes at that point of time. Sensor technologies(Infra-red sensing/Video and Camera Image Perception / RADAR /gyro sensor / inertial sensor),process data through mathematical algorithms to come up with a virtual understanding of the vehicle environment. In-vehicle digital maps and positioning technologies (GPS / WiFi / WiMax)as sensing systems to accurately identify the vehicle position and interpret the environment. RFID complements to the current GPS navigation system when GPS signals are not available (such as in tunnels) or if the GPS position is ambiguous to a vehicle (such as at cloverleaf intersections).But in practice, GPS does not provide sufficient information for navigation due to its low positioning accuracy (5 to 7 meters). Moreover, even combined with map-matching technologies,

GPS still cannot achieve lane level positioning and can not provide information regarding the traffic direction in the current lane. Nevertheless, this information is necessary to prevent vehicles from entering a wrong way when roads are under construction or lanes are temporarily borrowed by the traffic along a different direction. Radio frequency identification

(RFID) is a radio based communication technique The RFID system consists of reader and tags. Both reader and tags are equipped with antenna. Data is transferred between a tag and a reader via low-power radio waves. In communication between reader and tags the most applied frequencies are the following: LF(low frequency): 125-134 kHz, HF (high frequency): 13.56 MHz, UHF (ultra high frequency):868-956 MHz, Microwaves: 2.45 GHz. The system is capable of detecting bad weather conditions, poor visibility.The goal of a this system is to warn the road users as early as possible if there is a high air pollution . Such rapid detection system can be supported by the RFID technology by deploying RFID readers on the roadside.

4. PROBLEM FORMULATION

Computing the AQI

The air quality index is a piecewise linear function of the pollutant concentration. At the boundary between AQI categories, there is a discontinuous jump of one AQI unit.

To convert from concentration to AQI this equation is used:

$$I = \frac{I_{high} - I_{low}}{C_{high} - C_{low}}(C - C_{low}) + I_{low} \quad (1)$$

where:

I = the (Air Quality) index,

C = the pollutant concentration,

C_{low}= the concentration breakpoint that is $\leq C$,

C_{high}= the concentration breakpoint that is $\geq C$,

I_{low}= the index breakpoint corresponding to C_{low},

I_{high}= the index breakpoint corresponding to C_{high}.

EPA's table of breakpoints is:

O_3 (ppb)	O_3 (ppb)	$PM_{2.5}$ (µg/m^3)	PM_{10}(µg/m^3)	CO (ppm)	SO_2 (ppb)	NO_2 (ppb)	AQI	AQI
C_{low} - $C_{high}(avg)$	C_{low} - $C_{high}(avg)$	C_{low}- $C_{high}(avg)$	C_{low} - $C_{high}(avg)$	C_{low} - $C_{high}(avg)$	C_{low} - $C_{high}(avg)$	C_{low} - $C_{high}(avg)$	I_{low} - I_{high}	Category
0-59 (8-hr)	-	0.0-12.0 (24-hr)	0-54 (24-hr)	0.0-4.4 (8-hr)	0-35 (1-hr)	0-53 (1-hr)	0-50	Good
60-75 (8-hr)	-	12.1-35.4 (24-hr)	55-154 (24-hr)	4.5-9.4 (8-hr)	36-75 (1-hr)	54-100 (1-hr)	51-100	Moderate
76-95 (8-hr)	125-164 (1-hr)	35.5-55.4 (24-hr)	155-254 (24-hr)	9.5-12.4 (8-hr)	76-185 (1-hr)	101-360 (1-hr)	101-150	Unhealthy for Sensitive Groups
96-115 (8-hr)	165-204 (1-hr)	55.5-150.4 (24-hr)	255-354 (24-hr)	12.5-15.4 (8-hr)	186-304 (1-hr)	361-649 (1-hr)	151-200	Unhealthy
116-374 (8-hr)	205-404 (1-hr)	150.5-250.4 (24-hr)	355-424 (24-hr)	15.5-30.4 (8-hr)	305-604 (24-hr)	650-1249 (1-hr)	201-300	Very Unhealthy
-	405-504 (1-hr)	250.5-350.4 (24-hr)	425-504 (24-hr)	30.5-40.4 (8-hr)	605-804 (24-hr)	1250-1649 (1-hr)	301-400	Hazardous
-	505-604 (1-hr)	350.5-500.4 (24-hr)	505-604 (24-hr)	40.5-50.4 (8-hr)	805-1004 (24-hr)	1650-2049 (1-hr)	401-500	Hazardous

Suppose a monitor records a 24-hour average fine particle ($PM_{2.5}$) concentration of 12.0 micrograms per cubic meter. The equation above results in an AQI of:

$$\frac{50-0}{12.0-0}(12.0-0)+0=50$$

Corresponding to air quality in the "Good" range. To convert an air pollutant concentration to an AQI, EPA has developed a calculator.

If multiple pollutants are measured at a monitoring site, then the largest or "dominant" AQI value is reported for the location. The ozone AQI between 100 and 300 is computed by selecting the larger of the AQI calculated with a 1-hour ozone value and the AQI computed with the 8-hour ozone value.

8-hour ozone averages do not define AQI values greater than 300; AQI values of 301 or greater are calculated with 1-hour ozone concentrations. 1-hour SO_2 values do not define higher AQI values greater than 200. AQI values of 201 or greater are calculated with 24-hour SO_2 concentrations.

Real time monitoring data from continuous monitors are typically available as 1-hour averages. However, computation of the AQI for some pollutants requires averaging over multiple hours of data. (For example, calculation of the ozone AQI requires computation of an 8-hour average and computation of the $PM_{2.5}$ requires a 24-hour average.) To accurately reflect the current air quality, the multi-hour average used for the AQI computation should be centered on the current time, but as concentrations of future hours are unknown and are difficult to estimate accurately, EPA uses surrogate concentrations to estimate these multi-hour averages.

Each vehicle in VANET equipped with WiFi/WiMax device acts as a node Unique ID and IP address for each vehicle. Each node can communicate with any other node. Any vehicle can register its identity to a roadway WAP Information provided by the vehicles directly to the WAPs. Collective information stored by the WAPs at a dynamic server database If , high pollution is detected by a roadside infrastructure then the roadside system can broadcast the information to all its nodes/vehicles .In turn using the DTN(Delay tolerant Network)capabilities of VANETs, the information can be transmitted to other vehicles heading towards this junction. Likewise, it can convey to the incoming vehicles other paths, depending on a centralized system co-ordination of finding non-polluted routes at that point of time. In-vehicle digital maps and positioning technologies (GPS / WiFi / WiMax) as sensing systems to accurately identify the vehicle position and interpret the environment. RFID complements to the current GPS navigation system when GPS signals are not available (such as in tunnels) or if the GPS position is ambiguous to a vehicle (such as at cloverleaf intersections).But in practice, GPS does not provide sufficient information for navigation due to its low positioning accuracy (5 to 7 meters). Radio frequency identification (RFID) is a radio based communication technique The RFID system consists of reader and tags. Both reader and tags are equipped with antenna. Data is transferred between a tag and a reader via low-power radio waves. In communication between reader and tags the most applied frequencies are the following: LF(low frequency): 125-134 kHz, HF (high frequency): 13.56 MHz, UHF (ultra high frequency):868-956 MHz, Microwaves: 2.45 GHz. The system is capable of detecting bad weather conditions, poor visibility.The goal of a this system is to warn the road users as early as possible if there is a high air pollution . Such rapid detection system can be supported by the RFID technology by deploying RFID readers on the roadside

5. CONCLUSION

However, the proposed system work well in sharing of AQI in Automobiles such as , it can convey to the incoming vehicles to other routes that depending on a centralized system co-ordination of finding non-polluted routes at that point of time. The Methods like Air Quality Management Plan ,Development of new technology- electric cars, cleaner fuels, low nitrogen oxide boilers and water healers, zero polluting paints, less polluting BBQ lighter fluids, Use of natural gas, Carpooling.

To incorporate intelligence into a VANET to improve safety. To make intelligent inferences about traffic incidents, like identifying the speed and distance covered one can predict the chances of accident. To facilitate easy and effective communication between vehicles with dynamic mobility. To provide value added services like email, audio/video sharing etc.,

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