INTELLIGENT DRIVER ASSIST & FUEL CONSUMPTION SYSTEM FOR ROAD TRANSPORT USING UBQUITOUS RFID

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Abstract:
It is aimed at developing a combination of cooperative systems and tools that is capable of providing continuous monitoring of desirable vehicle close to the querying user. This identification of the vehicle is done with the help of RFID tag fixed at the vehicle. Then using the vehicle-infrastructure communication, we help the drivers to sustainably eliminate unnecessary fuel consumption and thus the road operators manage traffic in the most energy-efficient way. Controlling the traffic near junctions has always been a matter of concern in many modern cities. Currently many traffic control systems in use around the world are time based switching control units and thus these systems doesn’t respond to unexpected real time changes in traffic flow. It results in long average waiting time for the vehicles at road crossings. So we take the existing system and update the system to make it useful for our application in order to reduce the traffic by deploying the detectors at signal points. And integrating a fuel consumption system thus leads to cutting greenhouse gases and CO\textsubscript{2} emissions which results in a cooperative eco-driving providing the driver with support, feedback and guidance on a more fuel-efficient driving behavior.

Keywords: Ubiquitous RFID, Vehicle monitoring, Wireless Communication, Intelligent Transport System (ITS), Traffic Congestion, Emissions and Energies, Fuel Consumption, Acceleration Control, Vehicle-Infrastructure Communication, CO\textsubscript{2} Emission, Eco-Driving.

I.INTRODUCTION

Radio Frequency Identification (RFID) is a technology that has risen to prominence over the past decade. RFID systems and wireless sensor networks (WSNs) represent two key technologies for ubiquitous computing that have attracted considerable attention in recent years because their use revolutionizes diverse application areas. RFID presents global and ubiquitous challenges to legal systems. Intelligent Transportation Systems (ITSSs) have rapidly been evolving in the past two decades, leveraging advanced computing and communication technologies. Automobiles are a part of everyday life in urban and suburban countries. ITS is the technology needed to develop a fully integrated, multimodal transportation system, with the ability to enhance and integrate transit services, smooth traffic flow, and provide traveler information, the region can achieve this goal with a likely benefit of reduced vehicle emissions.80% of transportation CO\textsubscript{2} comes from cars and trucks.

Much fuel is wasted and CO\textsubscript{2} is emitted by vehicles, when the vehicle waits at signalized intersections. Vehicle speed trajectory can be planned based on knowledge of signal timing

This project will construct the basic infrastructure for broadcasting the timing signal information to vehicle for planning vehicle trajectories, which is composed of numbers of traffic information collectors like IR detectors and RFID’s, where detectors are installed across the signal points and information-processing nodes and road side units connected through the internet to build diverse applications to facilitate public transportation. According to the blue paper of the project, wireless transmitters and RFID readers will be deployed throughout the area considered. Due to the deployment of these devices, the location and status information of vehicles can actively be captured and logged in the LabVIEW at the Server side using V2I communication.

A wide spectrum of applications can be implemented on top of this service. Drivers must pay attention to traffic signals, on failure results in increased traffic congestion and accidents. While traffic signal control points are a necessary part of any roads and highway systems, measures are taken to keep the traffic flow on major arteries of the roads moving as much as possible, without over flooding.

Congestion occurs when transport demand exceeds transport supply at a specific point in time and in a specific section of the transport system. Under such circumstances, each vehicle impairs the mobility of others. Traffic congestion is a major recurring problem faced in many countries of the world due to the
increased level of urbanization and the availability of cheaper vehicles.

Worldwide death due to traffic accidents in 2002 reached to 1.8 million, which results that more than 3000 peoples dies everyday worldwide. This number is the equivalent of 6 or more jumbo jets crashing each day. Thus as a result as the number of vehicles grows and the need for mobility increases on a worldwide scale, the frequency and duration of traffic jams in major cities increase.

In this paper, we propose a novel decentralized scheme for assisting vehicles, so that the server identifies the shortest path and intimate the drivers to solve this problem. Interestingly, we find that such a search for the nearest vehicle using the RFID and routes the distance path and making the vehicle to move towards the querying user. We provide a method to reduce fuel consumption of the vehicle thus reducing the CO₂ emissions caused by fuel usage, as when the vehicle waits in the traffic signal. Thus the reduction of CO₂ in road transport therefore raises issues of energy supply, fuels (energy transport) and associated powertrains. Eco-Driving thus results in shorthand for a number of techniques to reduce fuel consumption through influencing human driving behavior.

The contributions that we have made in this paper are highlighted as follows.
1) We propose an Intelligent Driver Assist System which assists the driver to move to the querying destination point thro’ the city, without being caught in traffic, this is done by updating the existing traffic system using IR sensors to calculate the density near the traffic points.
2) We then address the querying user as when a query is raised, which is located by the server and intimating the corresponding vehicle to move to the query point.
3) We then propose an acceleration control and vehicle idling scheme for vehicles which results in a fuel consumption system, avoiding wastage of fuel. So that when the vehicle stands in the signal the engine automatically switches off and on single acceleration the vehicle gets turns its engine on.
4) We then propose a small-scale prototype system to track the experimental vehicles in specific area.
5) We evaluate the performance through trace-driven simulations using LabVIEW in the Server side. We base our simulations on the real-road network and trace the data of vehicle movements in the area considered.

The rest of this paper is structured as follows. In Section II, deals with the literature survey and Section III, with the proposed system model. In Section IV, about the automated traffic signaling unit and Section V deals with the Fuel consumption system and in Section VI, we outline the directions for future work. And finally, we draw conclusions in Section VII.

II.RELATED WORK

In the literature, there exist many solutions to locating moving objects based on different scenarios. The Globe system [11] constructs a static worldwide search tree for mapping object identifiers to the locations of moving objects. It is not flexible to expand or adjust the structure and may have the bottleneck problem near the root of the directory tree structure. Urban traffic is responsible for 40% of CO₂ emissions and 70% of emissions of other pollutants.

In the database community, indexing techniques have been proposed for tracking moving objects, but they are based on the assumption of the existence of a centralized database. Despite the large number of existing methods, there is no applicable method for update-intensive applications, where it is infeasible to continuously update the index and process queries at the same time.

In peer-to-peer (P2P) networks [12], various distributed hash table (DHT) schemes were proposed to map objects to peers in a decentralized way and enabled the system to very efficiently satisfy queries. However, DHTs and ANTS uniformly cast objects using consistent hash functions into the whole network, which cannot handle query locality.

Manual Options like car sharing, park-and-ride facilities, parking cash out, and road pricing policies doesn’t turned out to be best fit for reducing CO₂ emissions because it depends on the driver’s behavior.
So we propose a system using RFID implemented in ITS using the V2I communication, which uses Shortest Path, which needs no such dedicated directory servers or centralized database and achieves good scalability and flexibility by updating information to the drivers to sustainably eliminate unnecessary fuel consumption and thus the road operators manage traffic in the most energy-efficient way.

III. SYSTEM MODEL

RFID technology is a significant development in the auto industry, departmental security, inventory management and the like. More specifically it is currently used in toll bridges for a quick way to identify automobiles and tax them accordingly. The various aspects of this technology can be combined and put to use in developing a monitoring system that can be placed on traffic junctions. Such a system would be able to provide important data in terms of traffic density reduce traffic policing costs, make current automated systems more efficient, save on energy spent on road illumination, etc. It can be further developed into a quick way to access driver information and store registration records eliminating the need for paperwork. Transport remains heavily dominated by petroleum fuels in all world regions with 95% being either gasoline or distillate fuel such as diesel or kerosene.

It exploits the promising RFID and local-area wireless communication technologies. RFID readers and wireless APs or transmitters, which are typically installed at crossroads, will be deployed throughout the area considered. A local node is responsible for collecting data from several close RFID readers and sensor nodes within its own domain and thus it accepts queries from nearby users.

The infrastructure-based approach employs vehicle-to-Infrastructure (V2I) communication to collect real-time traffic information. With this approach, a large number of roadside sensors and communication equipment’s need to be installed to monitor the traffic condition on each road. The roadside sensors and communication equipment’s make use of v2I links to collect the required traffic information.

The vehicles information is gathered both actively and passively. In the initial prototype, a vehicle is passively captured by using an active RFID. A moving vehicle attached with an active RFID tag can be captured if the emitted signal reaches some reader. Reader can actively communicate with wireless AP’s or the radio transmitter as the vehicle passes by them. Several reasons prohibit this initial effort from being extended for vehicle tracking.

First, with crowded high buildings it is very difficult for the GPS system to accurately work without any other assistant accessories. Second, the time intervals to update the location information reports can notably be long. Third, is the expense of the GPS usage, which limits the wide deployment of this technology.

So we evaluate Shortest Path and intimate the driver using real trace data obtained from the reader and hence guides the vehicle to move to the querying user at the querying point. The system model is splitted up into 4 active units. First is the Traffic Control Unit, Second is the Vehicle Unit, Third is the Standalone unit & Fourth the Server.

First is the traffic control unit, which periodically updates the server regarding the traffic condition as shown in fig 3 below.

Fig. 3: Trace Driven Simulation Indicating High Density Traffic

In the Second Unit the vehicle contains the RFID tag which is an Active Tag. This sends its information to the reader which is to be transmitted to the server for monitoring purpose.
Third is the Standalone unit which is determined to receive information from the vehicle and transmits its information to the server.

Fourth is the Server, it receives the information from the reader, based on the location and the time and movement of the vehicle; it identifies the location of the moving vehicle.

IV. AUTOMATED TRAFFIC SIGNALLING UNIT

Next is the traffic signaling, the traffic unit used here is an existing automated system, which works in a principle that the signal lights switches its state automatically from one state to other after a certain amount of predetermined time. Because now in countries like India, we have these types of systems are in use currently. Thus we take the same system and update it for our own convenient usage based on the application required. Then we implement IR sensors at the signal points to calculate the density of vehicles at traffic signals.

By calculating this density of vehicle, it would be easier for the vehicles to move across the city between the traffic points to do their service as when required, without any interruption. Once when the Density is high we use microcontroller to send message to server indicating that the corresponding road has high traffic as shown in Figure 3. And we can even maintain a database in server as when it reaches high traffic. This database can be used for further references. It is even possible to maintain a secured system using LabVIEW, so only the concerned authorities can be able to login to the LabVIEW for monitoring the status of vehicles.

V. FUEL CONSUMPTION SYSTEM

A. Congestion and Emissions:
- Smoother traffic flow: stop-and-go traffic generates more emissions
- Faster traffic flow: at which point is that no longer beneficial
- Higher speeds of vehicles may increase or reduce emissions, depending upon the pollutant.

B. ITS based on Emission and Energy:

C. CO₂ Emissions:

The use of energy accounts for a major fraction of all anthropogenic emissions of greenhouse gases (GHGs), and in most industrialized countries transportation fuel use produces a major fraction of all energy-related emissions. Furthermore, transportation sector emissions are expected to increase rapidly over the next few decades. Carbon dioxide emissions from the transportation sector are projected to rise due to ongoing reliance on fossil fuels and increases in vehicle miles traveled. Congested travel conditions may result in slower and more variable travel speeds and more stop

Fig. 4: Trace Driven Simulation Indicating when a Vehicle passes through Street 1

Fig. 5: Trace Driven Simulation Indicating when the same vehicle passes through another street.

Fig. 6: Driver Support Application Of ITS
and go traffic which could result in increased emissions relative to free flowing traffic. The production and use of fuels for transportation also results in emissions of other important GHGs besides CO₂, including methane (CH₄) and nitrous oxide (N₂O).

CO₂ emissions due to road transport are a factor of four key elements: Vehicle technology, how the fuel is produced and used, what customers drive and how they drive it, how efficient the roadway environment is and what alternatives such as bikes and public transport are available.

These emissions can be significant, especially for some types of vehicles and fuels. Solutions are needed to reduce emissions and energy consumption from the transportation sector, now widely believed to be contributing to climate change.

D. CO₂ Savings:

CO₂ savings include:

- Increasing fuel efficiency by making traffic flow more smoothly.
- Help drivers finding their most eco-friendly route & mode choice
- Giving travellers information about different journey alternatives
- Collecting real-time information about traffic and environment conditions, incidents
- Reduce congestion by improved traffic flow management and by responding quickly to any discontinuation
- Support drivers to acquire and adopt eco-driving techniques

E. Solutions To Emissions Using ITS:

Intelligent Transport Systems are sets of technological and business solutions aimed at achieving efficient, reliable, safe and clean transportation of passengers and goods. ITS are based on modern information and communication technologies, successfully integrated with existing technology systems in transport. We assist and help the driver intimating the traffic which took place a few km or certain meters ahead of him, if the driver accepts the signal and moves to the path as we direct him. Then there won’t be a problem of slowing down the speed of the vehicle. What if the driver doesn’t recognize or doesn’t follow the way the system routes to. Then that particular car surely, will get held up in the traffic which is ahead of the vehicle. If the vehicle engine is on as when he waits in the signal, the fuel will be consumed unnecessarily. Thus we designed a system such that engine of the car is directly controlled by a switch and it controls the opening of the throttle valve thus controlling of vehicles acceleration with the help of a microcontroller, so that as when the vehicle gets caught in the traffic, the engine of the vehicle automatically gets stopped. Once as when the traffic starts to clear, by pressing the pedal, the engine automatically gets on and runs as usual. Thus the vehicle engine is off during traffic as when the driver releases the pedal and hence it consumes fuel during that time as long it waits. This leads to reduction in the amount of emissions of greenhouse gases due to fuel wastage in air and thus results in a Cooperative eco-driving – providing the driver with support, feedback and guidance on a more fuel-efficient driving behavior.

VI. FUTURE ENHANCEMENTS

Some additional features can be incorporated into the same system so that it can serve the society in a sophisticated manner. The whole design should be scaled up for a multilane, multiload junction by adding extra tags between two lanes (on a divider or by hanging them from a post). If any vehicle violates the signal a caution notice can be issued electronically, based on the information obtained from the RFID tag fixed to the vehicle. Such a statute is rationally related to the state’s interest in promoting highway safety. Emergency applications like automatic accident identification of vehicles can also be designed or even a vehicle involved in an accident can sends its precise location, obtained by satellite positioning, via a communication network to an emergency centre, to help the people those who are really in need.

VII. CONCLUSION

The main feature of this operation is the ability to locate a vehicle and communicate with any headquarters local or central at any location securely via the internet or wireless communication. This system can help in reducing the loss of valuable time as well as the number of accidents and may solve many common problems that exist within any traffic system, and even it reduces the congestion of the traffic as well as the vehicle thefts. It also reduces the consumption of fuel
thus results in the reduction of Emission of \( \text{CO}_2 \) in atmosphere leads to Eco-Driving. CO\textsubscript{2} emissions can be lowered by improving traffic operations, specifically through the reduction of traffic congestion.

Even if there are any accidents, it helps us to identify the people who are in need by maintaining a query management system. By which the server locates the emergency vehicles and give the guidance to that vehicle and makes the vehicle to move to the query point as soon as possible using the Shortest Path. The dynamic time management scheme operates in real time and emulates the judgment made by a traffic policeman on duty. This system aims at saving a large amount of man-hours caused by traffic problems and accidents, where prevention can save lives and property. It is able to manage priority emergency tag vehicles. It offers a valuable detailed database records and preference to planner and investigators. In order to ensure the smoothness of this implementation, a lot of effort is required integrating the management of the databases among the local authorities. Sharing a secured database and protocol must be designed to integrate with the existing system. Extremely low-power dissipation could actually be achieved, which holds promises for low-cost, high-performance passive devices, suitable for ubiquitous computing applications.

The issues of the integration require collaboration with the authorities that are concerned with managing the databases and need to be discussed further at higher levels. The legal issues and privacy laws relating to the monitoring of drivers all the time will be the future challenge as this matter is predicted to be a debatable public concern.

VIII. REFERENCES


