Vehicle guidance and traffic control system

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An intelligent traffic guidance system is designed to provide real time information about the vehicle traffic situation online. In this concept, every vehicle on road is equipped with a RF-ID tag and a GSM module. RF-ID Receivers would be employed at particular zones and intersections, which will sense traffic conditions based on the RF-ID tags of vehicles. The information would be provided to a server or central governance system which would be analyzed and further forwarded to the user about traffic condition through GSM network. This information will be displayed on LCD screen in form of Maps and real time condition. This data would also be useful in routing the traffic through traffic signals based on traffic density and avoid traffic jams and chaos. Moreover special RF-ID's would be provided to the emergency vehicles (i.e. Police, Ambulance etc). During emergency these vehicles will be detected and the traffic ahead will be notified to make way for the vehicle. Further every vehicle could be equipped with pollution sensor which will gather the data from vehicle's exhaust. Government could track down the vehicle if the pollution level exceeds the limit and necessary action can be taken. This will be very useful for city users where traffic is a major problem. Cops can easily find theft vehicles. At the time of emergency on highway one can get help by pressing just a button. Thus this system provides a multi-dimensional prospect, making the system more effective and robust for traffic management.

Key words: *Traffic guidance, pollution control, GSM technology*

INTRODUCTION

Transportation has a vital role in the development of a country affecting the socio-economic development of the country. The auto-mobile industry is expanding and churning out low-cost vehicles. This has led to a tremendous increase of 40% in number of auto-mobiles in the past 10 years (Qicatabua, N. 2001). Moreover the vehicles are not distributed evenly, but are concentrated in major cities of the country.

A paradigm shift is required in traffic management for managing such traffic. The conventional methods are based on fixed timings and are not capable for handling such traffic during peak hours. This causes chaos, accidents, time-delays and a potential barrier for economic development. Various policies are adopted by various countries to resolve the issue. Congestion pricing being one example has been adopted by cities like London, Singapore, Milan for tackling the congestion, in which the user needs to pay money to use a lane during peak hours (Blythe, P. 1999). There are technologies based on video processing technology, but such technology has limitations in extreme weather conditions and is costly for implementation over the entire city. The increased number of vehicles is contributing towards pollution and it is difficult to keep track on the emission from vehicles.

Various factors are contributing for traffic congestion in Fiji (Rogo and Sania J. 2012) like poor control of vehicles, inadequate capacity to monitor emission levels, increased level of traffic congestion, and slow progress in cost recovery. Public Works Department (PWD) of Fiji government to ensure cost recovery, the introduction of a 'road fund', either through the introduction of fuel tax or using vehicle registration revenue, must be considered (Qicatabua, N. 2001; Rogo and Sania J. 2012). However, infrastructure expansion and re-designing is costly and a time consuming process with limited life span. Thus a new approach is required for traffic management.

CONCEPT

The Traffic Guidance System proposed, provides real time information about the vehicle traffic situation. It has been reported (Persad *et al.* 2006.; Poole, I. 2010) that the system integrates the GSM and RFID technology providing a better solution for traffic management than the conventional system. It forms a network of vehicles on the

road with a view to abstract the model, converting it into a graph model, making management easier.

Every auto-mobile vehicle would be equipped with unique Active RFID-tag as shown in Figure 1 (a). The RFID- tags would be pre-registered with the government database just like the number plate of the vehicle, providing unique identity to it. Active RFID receiver would be deployed along the road at specific intervals and intersections. The vehicles would be detected by the reader and the information would be transmitted to the database.

This information would be further analyzed by the processing center. The number of vehicles detected would account for the density of the traffic in the particular zone. Thus the traffic management would be based upon traffic density and not fixed timing. The system would be adaptable based on the traffic density. Moreover the processed information would be sent over to various other vehicles taking the route and would be used for diverging or routing them through other roadway for avoiding the probable traffic congestion due heavy traffic. Overall system operation using GSM technology is summarized using Figure 1 (b).

The server would be governed by the government body and these servers would be preferred to be decentralized for effective communication. As the information send to the servers would be through predefined GSM service providers, which would be having their network covering the regions locally through their stations at specific regions and also it would be decentralized. Following are some applications and methods discussed using the presented concept.

1 Traffic signal control

This system would be very helpful during the peak hours of traffic. The Active RFID receivers would be placed before intersections at area which suffer heavy traffic and traffic congestion problems. These RFID receivers would be connected to the server through GSM service and to the traffic signal control for manipulating the traffic flow in order to avoid traffic congestion.

As shown in Figure 2, the traffic density is determined by the vehicles detected by the reader near the intersection. This information is utilized for deciding the traffic signal using a algorithm like a queuing algorithms popular in networks.

2 Toll plaza

The RFID tagged vehicles would be having their credit stored with their unique RFID number in the server which would be used at the toll tax plaza for the payment. The required amount would be deducted for using the service; moreover any ticket or fine earned due to traffic rule breakage would be deducted. These would reduce the travel time and traffic congestion and enforce the traffic rules.

3 Vehicle tracking

In case of theft of the vehicle, such tagged vehicles would be easy to track down as the unique tag would be matched to the cars detected at the roadways. Moreover if a vehicle suffered a breakdown at the highway, he /she could get the help at the press of a button. Ambulance, Police Department cars or Fire Department vehicle would be provided with special RFID tags. These tags can also be activated in emergency situation, in which case a user would be alerted on their devices to make space for Ambulance or any vehicles having special RFIDs.

KEY-PLAYERS OF THE PROPOSED CONCEPT

Figure 3 shows the key-players of the proposed concept to make the concept successful. These key-players are worked together for executing the system with their functionalities and responsibilities. The role of each player is identified below:

1. **User:** User plays the key-role in the system. It will decrease the travel time and increase the ease of travel with less congestion. The user will be updated with the real time traffic information relevant to the user using the GSM technology.
2. **Government:** The government would be hiring a private company for implementing the RFID receivers at the heavy traffic zones and would be maintaining the server and database of the vehicles.
3. **Vehicle Manufacturer:** Vehicle Manufacturer can be consulted and asked to implant the RFID-tags to each vehicle produced at the time of manufacturing. The RFID tags are available very cheap. This way the Manufacturer can also keep a track of the manufactured vehicles.
4. **Service Provider:** The GSM service provider would provide the network for communication and information exchange. They would be charging the users for the facility provided. A private company employing this system will be in contract with the service provider.
5. **Traffic Management System:** The private company for this system will be establishing a server for traffic information and manage the data. They can also provide Kits to users.

HARDWARE DESIGN FOR INITIAL SETUP

The prototype design is presented via the diagram, shown in Figure 4. The hardware realization of the presented concept is shown in Figure 5. We would use a hardware programmable processor with add-ons, for example ATMega-16 processor, passive RFID reader (EM-18) and tag, Gobetwino for extracting the data from the processing board and database software in the computer. In addition, we use the GSM technology for getting the information to the user.

To interface the processor, a GSM module SIM300 is required to communicate between the receiver and transmitter. The average time for receiving or transmitting the message would be 3 sec. Thus it would be real time and provide more precise information relevant to the traveler.

ACKNOWLEDGE

The authors kindly appreciate the financial award given by the IEEE Banlgore subsection during 'All India Young Engineers Humanitarian Challenge 2012' competition. Also we are thankful to Prof Nagaraj Shivaramaiah for motivation and support to develop this project.

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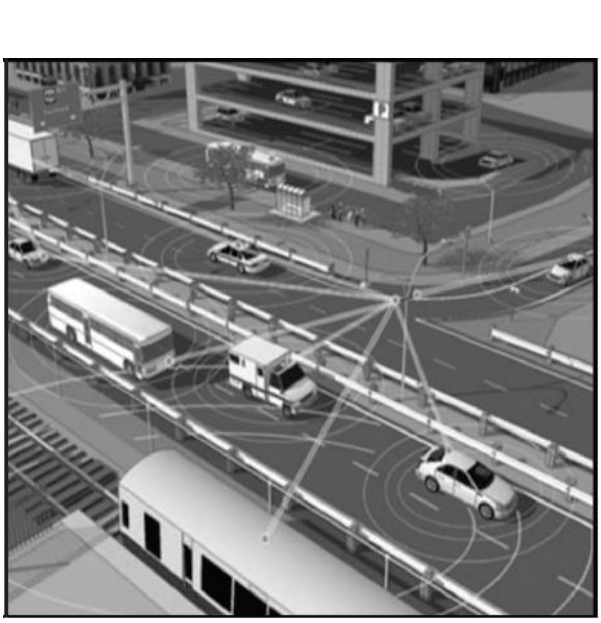
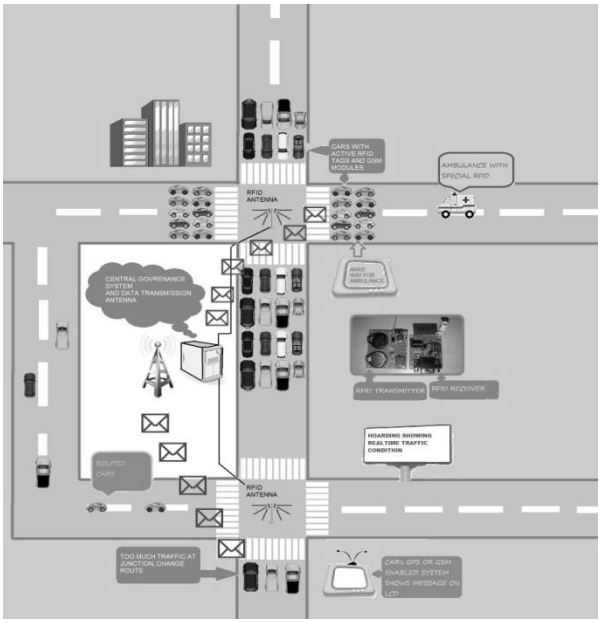
LIST OF FIGURES

Figure 1: (a) Active RFID receiver and transmitter system along with road side, (b) Overall system graph and application of the GSM technology



(a)



(b)

Figure 2: An example of tranffic density situation

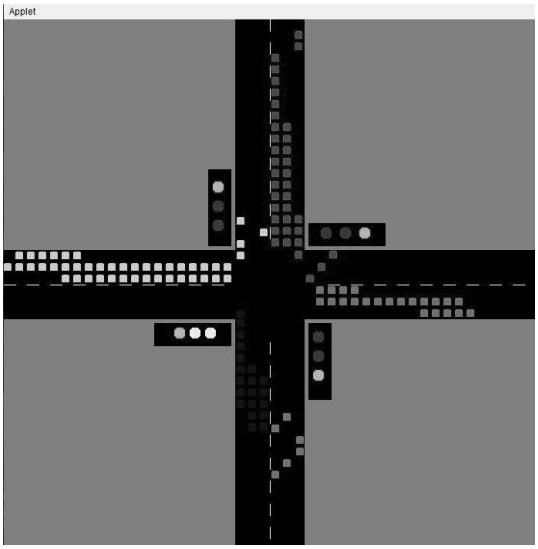


Figure 3: Key-players of the system

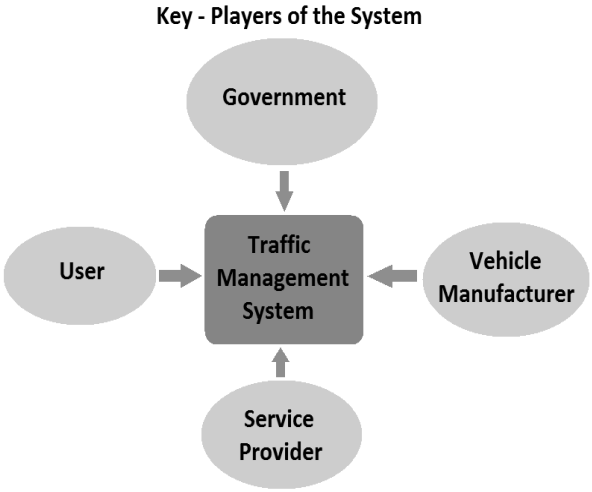


Figure 4: Prototype of the system

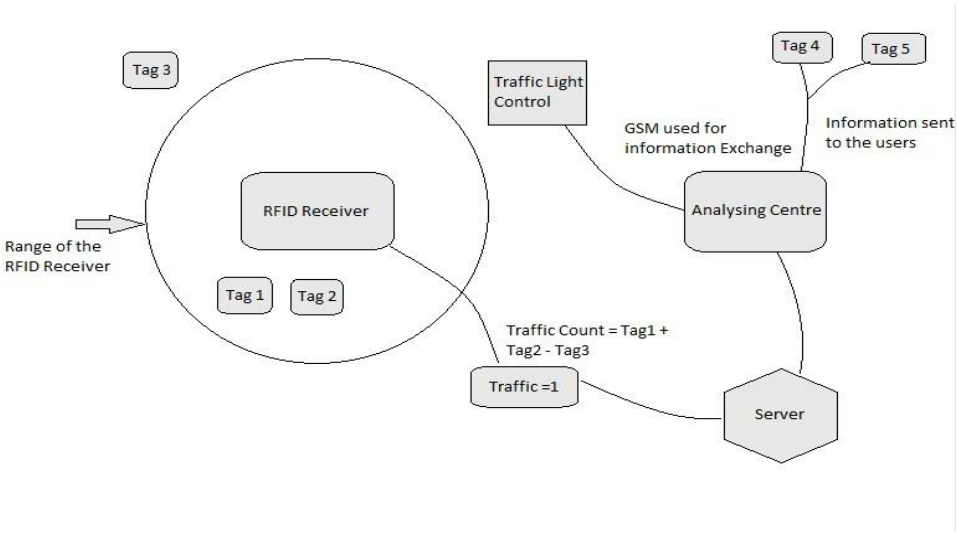


Figure 5: A hardware setup diagram