Smart Transportation System

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ABSTRACT
This paper throws light on Smart Transportation System. It explains what Smart Transportation system means to each and every one of us by its ability to take our own worlds of vehicles and Traffic information with us wherever we go. So we can always be in touch with road, other vehicles, weather predictor and even our family members. The various experiments and implementations are listed. Finally a new protocol architecture has been evolved for Smart transportation.

Categories and Subject Descriptors
C.3 [SPECIAL-PURPOSE AND APPLICATION-BASED SYSTEMS] ***Microprocessor/microcomputer applications*** , ***Process control systems*** , ***Real-time and embedded systems*** , ***Signal processing systems*** ,***Smartcards***

C.4[PERFORMANCE OF SYSTEMS] ***Design studies*** , ***Fault tolerance, Measurement techniques*** , ***Modeling techniques*** , ***Performance attributes*** , ***Reliability, availability, and serviceability***

J.7 [COMPUTERS IN OTHER SYSTEMS] ***Command and control*** , ***Consumer products*** , ***Industrial control*** , ***Military*** , ***Process control***, ***Publishing*** , ***Real time***

General Terms
Algorithms Management, Design, Experimentation, Standardization, Legal Aspects.

Keywords
Traffic , GPS , Telematics , Dissemination.

1 INTRODUCTION
"Smart transportation systems", also known as intelligent vehicle highway systems, utilize advanced and emerging technology in such fields as computer technology, information technology, electronic communication and control, artificial intelligence, and electronics. Innovations in traveler information, traffic management, and vehicle control can make possible changes in the way that highway systems and vehicles interact.

Soon all transportation devices will be working together hand in hand thanks to technologies. Smart transportation system encompasses universal and integrated instant vehicle to vehicle or road to vehicle communications. And as we know well, a world connected and synchronized is a world perfected. Together with worldwide build-up of a global infrastructure for the wireless Internet, the advanced and complex technological components, smart transport system can deliver an elegant and functional end-to-end solution to transportation.

2 LITERATURE SURVEY
No doubt, smart transportation system has made our daily lives easier! It has also contributed its most to the growth of auto mobile industries. Herewith we categorize the various applications of smart transportation systems researched and implemented all around the world.

Many intelligent transportation systems (ITS) are being designed to better manage traffic on well-traveled roads to reduce congestion and achieve these goals. Inside cars, navigational systems with display panels are intended to guide drivers around heavy traffic and help them avoid accidents. Traffic management technologies are designed to communicate with drivers on busy interstate highways through navigational systems and variable message signs.

2.1 RF Controller Development
In [1] Yang Guohao, Tian Jun, Chen Guochong express that in the application of the Intelligent Transport System, the RF sensor receives the signal, expressing the vehicle's information in the RFID tag. The process, including information display, transmission of the signal, action of the peripheral equipments, will be run under the control of RF controller.

2.2 Pedestrian Protection System
In [2] Tarak Gandhi and Mohan Manubhai Trivedi present a comprehensive review of research efforts underway dealing with pedestrian safety and collision avoidance.The pedestrian detection approaches are classified according to various criteria such as the type and configuration of sensors, as well as the video cues and classifiers used in detection algorithms.

2.3 Super Resolution of License Plates
K. V. Suresh, G. Mahesh Kumar, and A. N. Rajagopalan, in their paper [3], a novel method to enhance license plate numbers of moving vehicles in real traffic videos is proposed. A high-resolution image of the number plate is obtained by fusing the information derived from multiple, sub pixel shifted, and noisy low-resolution observations.

2.4 Frontal Collision Warning system

In [4], X.Y. Lu, S.E. Shladover and W.B. Zhang express that the effectiveness of a frontal collision warning system (FCWS) depends on the ability of its sensors and software to distinguish threatening driving scenarios and to provide the driver with a warning that leads to a safe (collision avoidance) response.

2.5 Lane guidance Technologies

The paper [5] describes the development process and the initial field test results of an automated snow blower, focusing on one of the more difficult snow removal operations: blowing snow off the freeway alongside a guardrail without the snow blower touching the guardrail.

2.6 Push – to – Talk Service

In [10] Chai-Hien Gan, and Yi-Bing Lin, talk about Push to talk (PTT), a walkie-talkie like service. In this service, several redefined group members participate in one PTT session. At any time, only one group member is allowed to speak.

3 STS – AN ARCHITECTURE

This paper presents a distributed framework for a multi-layered STS architecture that has been designed for integrating information generated and used by future as well as existing intelligent transportation systems and applications.

The STransT framework provides a data model that allows complex STS domains to be successfully decomposed into a number of data layers. This multi-layered data model may be distributed across multiple systems and exploits the overlapping temporal and spatial aspects of traffic information to allow the federation of data from diverse STS systems.

Moreover, the abstractions used to compose the data model combined with the range of interaction paradigms supported by the STransT architecture allow interoperation between systems based on different communication technologies.

3.1 Introduction

The continued increase in traffic volumes coupled with increasingly limited space for new infrastructure development mandates that existing transport networks are employed to maximum efficiency and capacity.

This paper presents the STransT framework for STS architecture and its data model. The STransT framework has been motivated by the requirement to enable a structured approach to the design and implementation of planned ITS systems so as to ensure the interoperability of ITS systems and traffic data sets. Furthermore, the framework has particularly been motivated by *the necessity to support integration of existing or legacy STS systems*.

3.2 The future of Traffic Management

It's envisioned that future Automatic Traffic Management Systems (ATMSs) will know every vehicle's location (but not necessarily the identification of the vehicle or its driver, unless the driver has provided this information for extra services). Also, traffic management controls and advisories will ensure that vehicles in the network have the smoothest, safest, and most efficient ride from their origin to their destination.

The controls and advisories will include:

- Traffic signals and the phase timings
- Roadside or above-road changeable message signs
- Incident and road work information by Highway advisory radio
- Pretrip information through radio, television, and in vehicle navigation systems
- Enroute route guidance through in-vehicle systems

ATMSs will obtain traffic information from these sources:

- Inductive-loop detectors below the road surface
- Video detectors over the roads that count vehicles in defined fields of view
- Other types of detectors such as microwave detectors, infrared detectors, acoustic detectors, and sonar detectors
- In-vehicle *automatic vehicle locators*
- Roadside vehicle identification

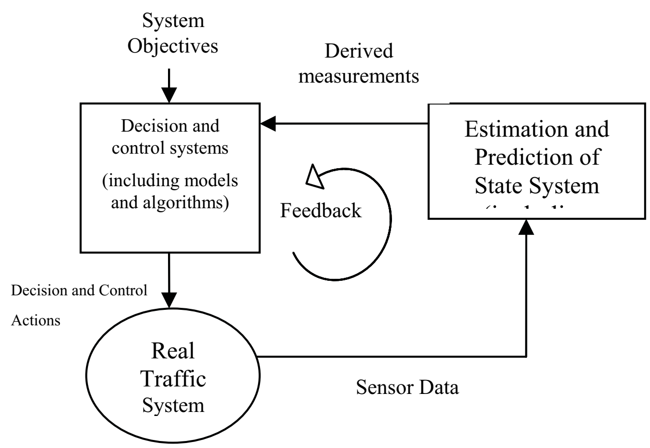

Fig 1. A feedback control diagram for traffic-adaptive systems.

The feedback control diagram (Fig.1) illustrates an effective traffic-adaptive signal control system. The sensors monitor the traffic on the network. Using a traffic model, the system estimates the current traffic flow and predicts future traffic flow. Using an optimization algorithm or an optimum-seeking heuristic, it then determines the best plan or phase timing to apply for the next control period.

As in Fig.2, Basically, the system carries out two main processes. The first is *estimation and prediction*, which takes the sensor data and estimates the actual flow profiles in the network and the flows' subsequent propagation. The second process involves the *decision system*, which selects the phase timing to optimize a given objective function, the optimization being based on DP and decision trees. Possible objectives include minimizing the average delay per vehicle, minimizing the average queues at intersections, and minimizing the number of stops.

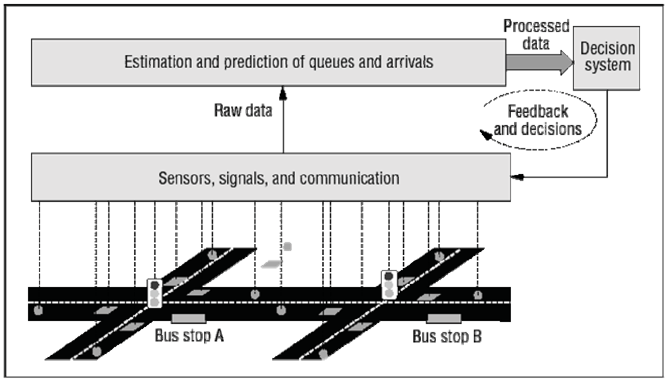

Fig 2. A Simplified Diagram of STS Operation

At the middle level, called *network flow control*, the system updates the green-time decisions. At this level, the system measures traffic flow characteristics in terms of platoons of vehicles and their speeds. Given the approximate green times, the *intersection control* at the lowest level selects the appropriate times for phase changes.

3.2.1 The STransT Architecture

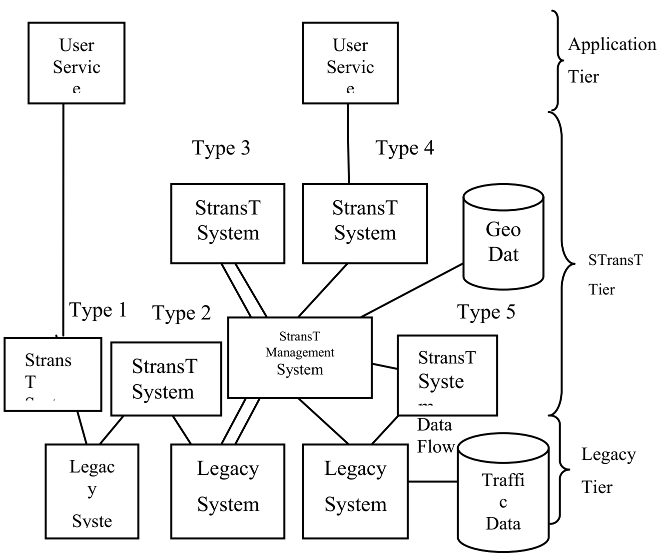

Fig.3. STransT ITS architecture framework overview

The framework for the STransT STS architecture and its three tiers is illustrated in Fig. 3. The legacy tier provides for the integration of legacy systems and describes existing as well as future transportation systems that have not been developed to conform to the STransT system architecture and layered data model.

4 DATA DISSEMINATION PROTOCOL

Recent vehicular sensors give much information. Frozen road surfaces can be detected by slide conditions of tires, and rainy conditions can be detected by movement of wipers. By propagating such information, other vehicles' drivers can prepare themselves for dangerous situations by slowing down in advance. Suppose that a preceding vehicle-A holds a set of its own speed, location, direction, and surrounding facility information for past several minutes and disseminates such information to its surrounding vehicles at time *t* [Fig. 4(a)].

Vehicle-B, which is driving on the opposite lane, receives the information, moves to another place, and redisseminates vehicle-A's information together with vehicle-B's information at time $t + d$. If another vehicle, say vehicle-C, receives the vehicle-A's information, it can know its preceding traffic conditions and road-surface situations by intervehicle *ad hoc* communication. If a vehicle stopping at an intersection with a traffic jam disseminates such information to the following vehicles, as shown in Fig. 4(b), then a vehicle reaching the tail of the traffic jam can know the length of the traffic jam and how long the preceding vehicles have been required to pass the traffic jam.

In this section, we show a way to disseminate and propagate local-traffic information among vehicles by intervehicle communication.

4.1 Outline of Proposed Dissemination Protocol

Here, we assume that each vehicle senses the following vehicular information: present time, its location, speed, ID of the moving road in the standardized map, moving direction (angle), road-surface condition, vehicular status, and so on. We also assume that each vehicular location and moving road ID can be obtained by car navigation systems. As shown in Fig. 5, such vehicular information is recorded into its own data buffer.

When disseminating vehicular information, each vehicle selects 300 units of vehicular information from its reception buffer randomly [*Select_object* (*reception_buffer*)] and moves them into its transmission buffer (*transmission_buffer*). Each vehicle disseminates 30 vehicular information as one packet, and totally, ten packets are sequentially disseminated at one time. Each packet size is less than 1 kB, and the total size is at most 10 kB, which can be sent within 0.1 s.

Our dissemination protocol is based on the chain of data broadcasting. Each vehicle is listening to a specified communication channel (*receiving_channel*) and counts the numbers of reception messages (*reception_counter*) and reception errors (*error_counter*). If a correct packet is received from its surrounding vehicle, the packet is held in its reception buffer (*reception_buffer*). It selects data from the reception buffer and its own data buffer and holds them in its transmission buffer (*transmission_buffer*), as shown in Fig. 5. Then, if the specified transmission interval has passed, it randomly waits and disseminates the data in its transmission buffer. In order to avoid synchronous data transmission from multiple vehicles, we introduce a short random waiting time before disseminating data. Depending on the situation of the surrounding vehicles, each vehicle autonomously adjusts its dissemination interval.

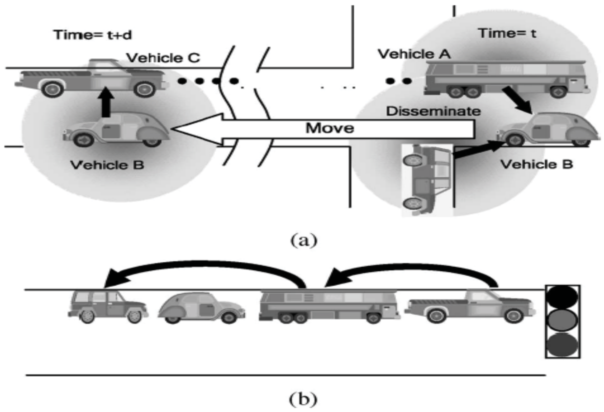

Fig.4. Intervehicle communication.

(a) Hopped by opposite-lane vehicles.(b) Hopped by the same-lane vehicles (particularly when jamming).

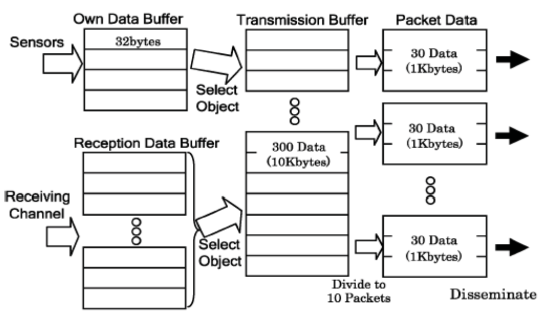

Fig. 5. Data structure of disseminated information.

Although the way for each vehicle to adjust its own dissemination interval is described in the next section, roughly speaking, each vehicle executes the following protocol:

Receiver ::

While(*true*)

{

If (*Received_data*(*receiving_channel*) = *true*)

{

Store(*data*(*receiving_channel*)*, reception_buffer*);

reception_counter ++;

}

else if (*Reception_error*(*receiving_channel*)=*true)*

{

error_counter ++:

}

}

Sender ::

While(*true*)

{

Wait_timer_interrupt; *// wait until r becomes zero*

transmission_buffer := *Select_object*(*reception_buffer*);

Disseminate(*transmission_buffer*);

v := *Get_current_speed*();

r := *Transmission_interval*(*v, reception_counter,error_counter*);

r := *r* + *rnd*(); *// add a short random time to r*

reception_counter := 0;

error_counter := 0;

timer_set(*r*);

}

5 CONCLUSION

Our proposed protocol adjusts the dissemination interval autonomously, depending on the number of reception messages and reception errors. RMDP works well on both the light-traffic and heavily jammed traffic conditions.

As a future work, we are doing research on rapid emergency information exchange using priority stable propagation of static and moving pictures of intersections and mountain passes. We are also working on the dissemination-data-selection algorithm, not only for acquisition of the preceding traffic information but also for identification of fleet dangerous driving, and so on.

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