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Smart Traffic Control System: A Review

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Abstract— As traffic congestion becomes a huge problem for most developing and developed countries across the world, intelligent transportation systems (ITS) are becoming a hot topic that is attracting the attention of researchers and the general public alike. In this paper, we demonstrate a specific implementation of it's a system whereby traffic lights are actuated by DSRC radios installed in vehicles. That this system can reduce travel time and commute time significantly, especially during rush hours. therefore, propose a vehicle-to-infrastructure (V2I) communication solution extending by introducing a collision-free MAC phase with an enhanced prioritization mechanism based on vehicle positions and the overall road traffic density. A roadside unit using a polling mechanism is then able to provide real-time support such that it can guarantee collision-free channel access within its transmission range. Part of the bandwidth remains unchanged such that best-effort services like ongoing vehicle-to-vehicle (V2V) applications may continue. Our solution guarantees that all communication deadlines of the V2I applications are met while minimizing the required length of the collision-free phase. This, in turn, maximizes the amount of bandwidth available for best-effort services and ongoing V2V applications. The position-based prioritization mechanism further improves the throughput of both real-time and best-effort data traffic by focusing the communication resources to the most hazardous areas.

Keywords— smart traffic control, congestion, vehicle to vehicle, vehicle to infrastructure

I. INTRODUCTION

Now a day, cities are developing and increasing around the world and inside the cities, the transportation sector plays a vital role in the urbanization of cities. Therefore better traffic control system needed to control vehicles from traffic congestions [1].

Ever increasing population growth in urbanization because of migration from rural to urban and economic expansion has made an impact on the rapid increase in vehicle population. It puts a massive amount of pressure on transportation infrastructure and particularly on traffic management practices in cities and town of the urban area. Based on worldwide best practices observed in countries like the USA, Dubai, Canada, United Kingdom etc., the ITS application appears to be providing promising solutions for traffic control and management. In this paper, we have tried to explore the world of ITS and an efficient model can be designed by an integrated approach with a number of sensors and technologies. On another hand, each technology has its own limitations [2]. Vehicle travels increase all over the world, especially in cities. The better accommodate these increasing demands need to be controlled and optimized [3]. Therefore, better traffic control system needed to control vehicles from traffic congestions problem in the many countries' cities. The poor traffic management system has led to traffic congestion. The major problem of congestion in many countries cities is that the existing infrastructures are difficult to expand and technologies. traffic congestion has an impact on the economy, the environment a living standard of citizens. There are different methods are available for traffic congestion management systems, video data analysis, infrared sensors, inductive loop detection, wireless sensor network, etc. all methods are effective of smart traffic control system traffic congestion on road network is lower speed increased trip time and increase queuing of the vehicles when the number of vehicles excess the capacity of the road, traffic congestion occurs traffic congestion causes economic loss, environmental pollutions, time and wastage of energy [4]. traffic light timing according to the traffic conditions for low or high-density traffic congestions [2].

The conventional traffic system needs to be upgraded to solve the severe traffic congestion, alleviate transportation troubles, reduce traffic volume and waiting time, minimize overall travel time, optimize cars safety and efficiency, and expand the benefits in health, economic, and environmental sectors. This paper proposes a simple, low-cost, and real-time smart traffic control system that aims to overcome many defects and improve traffic management. The system is based on vehicle-to-vehicle and vehicle-to-infrastructure that controls the various operations, monitors the traffic volume and density flow and changes the lighting transition slots accordingly.

1. Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I)

Vehicle-to-vehicle (V2V) communications comprises a wireless network where automobiles send messages to each other with information about what they're doing. Whereas Vehicle-to-Infrastructure (V2I) communication is the wireless exchange of data between vehicles and road infrastructure. These data would include speed, location, direction of travel, braking, and loss of stability. Both vehicle-to- infrastructure and Vehicle-to-vehicle technology uses dedicated short-range communications (DSRC), a standard set forth by bodies like FCC and ISO. for more accurate to the range is up to 300 meters or 1000 feet or about 10 seconds at highway speeds.

Connect vehicle technology has far-reaching opportunities for the modern fleet, and the transportation industry in general, that need to be explored. V2V has the following futures: Improving Traffic Management, Providing Driver Assistance and Providing Direction and Route Optimization and V2I is beneficial for vehicles of all types regardless of whether they are manned or autonomous. In manned vehicles, the driver gets alerts about the road conditions, roadside construction, the state of upcoming traffic lights, weather alerts and a lot more. V2I and V2Vcommunication, much research has already been conducted utilizing the current data gathering methods of inductor loops and estimating the speeds based on the occupancy, a number of vehicles, and the average length of a vehicle [9]. Further, using this data to attempt routing of vehicles along the fastest paths have been done in. Many applications based on speed and location data from vehicles have also been proposed, such as incident identification, characterization of traffic flows, fastest path retrieval, and trip planning [9]. Many papers have been written on traffic prediction [11, 12], and many simulators exist that attempt to implement these and other ITS applications. a communication protocol for safety-critical V2I communication, guarantees for the timely delivery of safety-critical data are given. Additionally, the position-based priorities ensure a decrease of the period and deadline of data packets to and from vehicles close to a zone of hazard. Communication resources are thereby focused on areas where they are most needed and the response time of proactive safety applications to critical situations is improved. Real-time schedulability analysis is used to minimize the bandwidth reserved for safety-critical data traffic while still guaranteeing timely delivery. Bandwidth can be used for various best effort services (infrastructure-based services or ongoing V2V applications), thereby reducing the interference on the safety-critical V2I applications to a minimum. The number of priority zones, their respective period and the threshold for reserved bandwidth for best-effort services can be fine-tuned to fit the conditions of the individual road. Thereby, our solution provides the flexibility to e.g. adjust the number of supported vehicles, the reactiveness of certain ITS safety applications or the amount of possible best-effort data traffic in the network [16]. Connected Vehicle Technology (CVT) requires wireless data transmission between vehicles (V2V), and vehicle-to-infrastructure (V2I). Evaluating the performance of different network options for V2V and V2I communication that ensure optimal utilization of resources is a prerequisite when designing and developing robust wireless networks for CVT applications. Though dedicated short-range communication (DSRC) has been considered as the primary communication option for CVT safety applications, the use of other wireless technologies like Wi-Fi, LTE, WiMAX allows longer range communications and throughput requirements that could not be supported by DSRC alone [17].

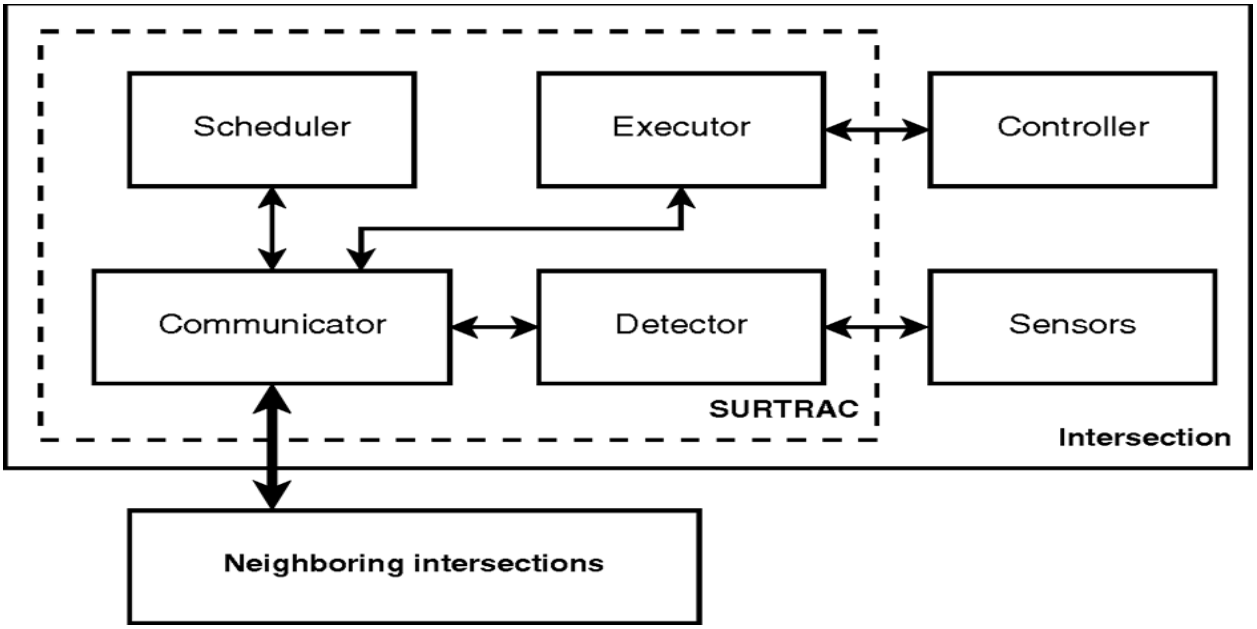

Fig. 1. Representative diagram of smart traffic control system

2. *Challenges*

Several attempts were made for traffic optimization by researchers. One of the challenges is to integrate the predictions for upcoming traffic conditions. Another challenge is to design a flexible model to deal with objectives like time, financial cost, convenience and environmental pollution etc. From the technical point of view, correct detection of vehicle density on road by keeping high accuracy including improved algorithmic solutions for multiple cues, for statistical and learning methods, sensors and telematics such as V2X communication and GPS. One of the key aspects in ITS is the proper collection of data set can carry out by employing more powerful sensors or developing sensor fusion to handle software and hardware issues coming at the algorithmic level. In the Asian nation like India, the National Development Policy Committee (NTDPC) was legitimate by the government of India in 2010 to formulate long run ITS policy. It identifies methodologies to unravel current ITS issues and targeted towards a too long run vision in 2032 by introducing multi-model structures [7]. Because of people's demand and expectation of service quality has changed due to the availability of maps, GPS, etc. People plan their routes based on distance, time and cost. Therefore „Information and Communication Technology' (ICT) enabled transport is stressed nowadays. This functionality will help to collect more efficient data and analytics will lead towards better decision making in systematic execution of ITS applications [8]. For the ITS implementation the key aspects that India is facing are given by world bank study report : improper developed road networks, economical restriction observed in the government, uncontrolled population growth, lack of resources for function and maintenance of roads, less requirement for automation, less interest in decision making and lack of user awareness. At the same time, the number of small scaled ITS pilot projects are being implemented that are given in the previous section. So far there is hardly any fully implemented ITS application present in India. In India, ITS applications must focus on emergency management, congestion management, advanced traffic management system, advanced traveler information system, commercial vehicle operations, advanced vehicle control system etc. This probably can be achieved by implementing proper road network. Following are some specific challenges in the implementation. Evolving an ITS standard for its different essentials and applications

- To monitor, regulate and document the current and future ITS projects.
- Fully functional Traffic Management Center coordinating urban and regional ITS activities.
- Surfacing and applying the good methodologies for data collection techniques in Indian traffic conditions.
- Setting up national data records.

To achieve all the above in ITS applications in wide area current infrastructure has been made proficient as much as necessary for its successful functioning.

II. CONCLUSIONS

A smart traffic control system eliminates the drawbacks of the existing system such as the high implementation of cost, dependency on the environmental conditions. traffic congestion effectively managed and cost-effective. The V2V architecture provides fault tolerance in a highly distributed environment, whereas the V2I architecture provides fast queries and accuracy given an abundance of speed and location data. The bandwidth requirement for the V2I architecture may make it unappealing, especially when bandwidth-intensive ITS applications, such as a fastest path or traffic prediction algorithms, become more prevalent. Further, the use of other wireless technology potentially reduces the need for costly DSRC infrastructure.

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