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An IoTbased Smart Architecture for Traffic Management System

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Abstract: *From the last few yesteryears, traffic management is one of the hot issues for the research. There are verities of vehicles are available in the market according to the different status of people. Nowadays, everyone can buy their own vehicle that increases the number of registered vehicles on roads which leads to enormous problems congestion, pollution, noise, increase in traveling time. To improve the efficiency of the transport system, we use Internet of Things which helps to control the congestion. In this paper, we proposed an effective architecture for the management of the traffic congestion and also select the route that helps to avoid congestion or also reduce the traveling time by providing the facilities of security from accident, theft or fire.*
Keyword: *Internet of Things (IoT), Radio Frequency Identification (RFID), Wireless Sensor Network (WSN)*

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I. Introduction

Traffic management is the major problem in the large cities. These cities provide all the major social and recreation sources to people such as mall, shopping complex, movie complex, gardens, historic building etcetera which increase the curiosity of folks to visit one city to another city on different events or holidays. With the advancement in technology, there is the rapid growth of efficient wireless sensors which plays the crucial roles for the development of Internet of Things. It is now easily available in almost all areas of smart grid, smart hospital, smart homes which help to develop the smart city. The idea of Wireless Sensor Network (WSN) and Internet of Things (IoT) was developed parallel. The IoT firstly introduced by[1]Kevin Ashton and refers that each and every object is uniquely identified and communicate with every object with the help of sensors at anytime, anywhere or anyplace. With this, the human can communicate with non-living objects or provide machine-to – human, human-to-machine, machine-to-machine communication. In this paper mainly focus on the development of intelligent and smart transportation system.

Traffic congestion reduces the speed of vehicles and increases the time of the trip. The congestion is caused when the available road capacity does not satisfy the demand. This process is also called saturation [2]. In future, with the smart transportation system, the roads become smarter and will be able to control the traffic much better as compared to now because without any human interaction the vehicles can be able to communicate with other vehicles. Sensors are used to fit in vehicles and these vehicles will be on roads. These will monitor the real-time traffic. Every year millions of money are spent to control the traffic but it has been estimated that, by the implement of smart transportation management, the overall expenditure will be reduced by 20%[3].

II. Related Work

In last few years, there have been many advancements and research efforts in intelligent transportation system (ITS) [4]–[15] are introduced. A smartphone based measurement system for road traffic monitoring and usage-based insurance was introduced by Handel et al.[16].A parking guidance and information system (PGI) is designed to help the user in finding the parking lot more easily with the help of PARC system [17].E. I. Vlahogianni et al. [18] designed logical flow based on data i.e. input or output and the quality of data for selecting the best forecasting approach. There are several traffic situations which are studied to make the efficient transportation system. In this literature, an extensive range of different prediction models has been studied and used for the transportation network to generate the prediction for traffic flow. There are some non-linear model used for the forecasting short-term models like neural network [12],[13]and Auto-Regressive Integrated Moving Average Models (ARIMA) [18],[19]. Kalman et al. [14],[15],[20]for linear models, and simulation-based methods. The kind of application and the nature of the given data help to determine the method which is used for the real-time traffic prediction.

III. Background

There are some existing methodologies which are used for the smart transportation management earlier.

3.1 Inductive Loop

The inductive loop detection is based on the principle of insulated wires. In this, more than one or the multiple turns of insulated wire are placed on the roadways in the shallow cutouts, from the roadside pull-box the wire runs to the controller or the electric unit located in the controller box. When any vehicle stops or passes from the loop, there isthe sudden change in the induction this leads to the change in frequency due to this change in frequency the controller receives a signal from the electronic unit which indicates the presence of vehicles [6]. It is good for checking the presence, occupancy, passage of vehicles but there are some drawbacks in this system that is poor reliability because of improper connection between pull-box and the application over the cutout of the road.

3.2 Infrared Sensors

These sensors are used to detect the objects, vehicles, energy emitted by the vehicles or the surface of roads. The problem with this system is installation or maintenance of the system which is tedious. It is also easily affected by the weather conditions such as rain, fog etc.

3.3 Video Analysis

The video analysis consists of the various smart cameras which are placed with the different sensors and the communication or the processing units. It is used for the continuous monitoring of traffic. The video analysis is used to calculate the statistics frequency of the vehicles, average speed of vehicles[9],[10]. The main problems are the weather conditions like heavy rain or fog. At night time the proper lighting is required on street for the surveillance and the last drawback is the overall cost of the system is quite high. So, this system is expensive.

IV. Proposed System

The group of actions varied to the different devices such as controllers, sensors, GPS, actuators, net access equipment, mobile and the networking technologies like WSN, IoT, cloud computing is used to support the V2V and V2I communication. It also used to gather and exchange the data among the drivers to achieve the goal of the platform that is to reduce the time traveling, pollution, usage of fuel and provide secure and on-demand services to the users.In figure 1, we proposed a system for an effective architecture for controlling and managing the smart traffic system. In this, the user can access the information by using a mobile application or web services. The whole system is consist of sensors, wireless communication or cloud and provides the smart transportation applications to the user. In the beginning, the RFID tags or RFID readers are used to obtain the information regarding vehicles for instance license/plate number or kind/model of vehicles from the real traffic data and set as input for the wireless sensors. These sensors will communicate with the help of li-fi,Wi-Max, internet(3G/4G) whatever interface is present and exchange the data to the cloud.

Table 1 Smart Transportation System

Sr. No.	Acquisition Layer	Network Layer	Application Layer
1	RFID, Radar, sensors	Internet	Smart Transport and congestion management
2	RFID reader	WiFi, Li-Fi,3G/4G	Smart Parking and driver management.
3	WSN,IoT	Wi-Max	A collection of Information.

This data is further stored in the cloud database. With the help of cloud and sensors, the real-time data is updated time-to-time to provide the efficient results. In this,the fuzzy logic is used for the decision-making process. As the fuzzy logic gives the more accurate and instant result for any process based on decision making process. This system provides the smart application to the user such as choice of route, traffic congestion, smart parking system, anti-theft system, fire alert.

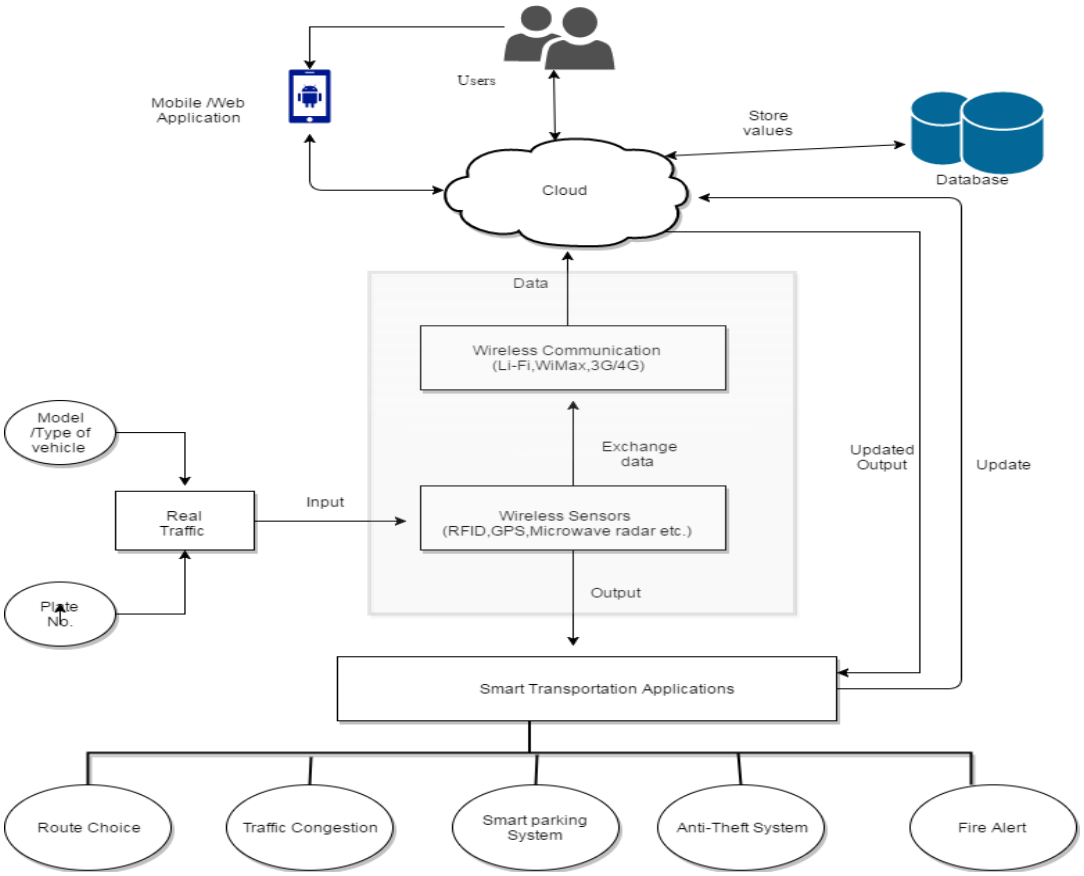

Figure 1 An Effective Architecture for controlling the Transportation System.

4.1 Traffic Congestion

In this application, with the help of microwave radar, RFID tags and RFID readers using fuzzy logic can control the traffic efficiently. RFID used to get the real-time information about the vehicles on road. It is also used in the traffic light system to reduce the waiting time of the user and manage the traffic lights smartly without any human interaction. These also inform the user about the speed volition and alert the user about the accident situation. The radar using fuzzy provides the proper distance between the two vehicles and automatically reduce the speed of vehicle and alert the user to use brake system of the vehicle when the distance between both vehicles become less.

4.2 Route Choice

The route choice is also one of the major problems for the driver or the user. Teodorovic et al.[21] were the first to introduce the complex route choice problem with the help of fuzzy logic. In this, the approximate reasoning and fuzzy logic are used to determine the preference for each network. The approximate reasoning algorithm is used. The resultant route of choice is defined by determining the various inputs like total time for traveling, utility of the roads and the route, risk of accidents, environmental affects or congestion and provides a safe, short, congestion free route as an output to the user.

4.3 Smart Parking System

In this system, we proposed a new system architecture and algorithm which is supported by Cloud and Internet of Things. This system helps the user to find the parking spot online and avoid the unnecessary traveling to find the space. This also leads to decrease in the amount of carbon or reduce the fuel consumption and provides an eco-friendly platform to the application.

4.4 Anti-Theft System

In this system, GPS-GSM and security alarm is used. The decision is made with the help of fuzzy logic. The GSM (Global System for Mobile) is one of the fastest growing mobile communication technologies. This makes the system boundless or provides secured connectivity between the networks. On the other hand, GPS (Global positioning system) was firstly developed by U.S. Department of Defense [17]. This system is used to track the location, to check the distance from current location. It provides the accurate information about the vehicle which is stolen at any position like sea, underground,

land etc.If someone tries to break the lock of any vehicle, the security alarm alert the owner of the vehicles with the help of internet and also play the loud sound to alert the nearby people around the vehicle.

4.5 Fire Alarm

In this system, there is two kinds of alarm are used that is smoke alarm and thermal alarm. The fuzzy logic and approximate reasoning algorithm are used for the efficient and effective result. Firstly, whenever the smoke is sensed by the smoke alarm the stage of smoke is determined by using fuzzy logic and alerts the user accordingly. In the case of fire or explode of a vehicle the temperature of a vehicle is suddenly hiked up and cross the given range of temperature than the thermal alarm is automatically turns on and alert the owner of a vehicle as well as send the location on the emergency numbers and alert the nearby people to control the situation.

V. Conclusion And Future Work

This paper represents an effective architecture for controlling and manages the smart traffic system and provides the smart transportation management system by using IoT, WSN, and Cloud. Now the traffic can easily managed by using enormous technologies like wireless sensors such as radar, RFID, GPS-GSM for the intelligent and smart management of transport and control the traffic of the whole city. IoT and Cloud are used to manage the huge amount of real-time data which can be collected as well as proceed. In this, we use fuzzy logic to instant and accurate result which makes the performance of the system more reliable and efficient. This system also reduces the travel time and provides the safe, secure and eco-friendly platform which also helps to overcome the greenhouse effect. In future, we will work on the implementation of the proposed system using fuzzy on Matlab and determine the results of proposed system. After that, we will compare the previous existing results with our proposed system result to prove the efficiency of our systems.

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