Smart Vehicular System based on the Internet of Things

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ABSTRACT

With the advent of smart city and its implications, different components of the smart city such as traffic, pollution monitoring, infotainment and others need to be considered as well for enabling the complete smartness. One of the major components of the smart city is regulation of traffic and its standards for smooth vehicular movement and it depends on the road conditions and environment. Road conditions provide valuable information for developing assistive systems for the vehicles and to be provided and trained with different road conditions for better accuracy and finally enabling the smartness around the system. With the increasing vehicular population around the globe and in developing countries like India, assistive systems based on Internet of Things (IoT) play a major role in developing smart systems for the vehicles. Once the population of the vehicles increases, assistive systems need a smart mechanism for parking as well. The proposed Internet of things (IoT) based system provides the user with different conditions of the road and a smart parking solution.

KEYWORDS

Accelerometer, Cloud Service, GPS, IoT, Road Safety, Sensor, Vehicular Parking, ZigBee

INTRODUCTION

Road safety is a major issue around the world, especially in urban cities as people daily move around with vehicles. The different elements of the transportation system such as vehicle, driver, environment or infrastructure cause road accidents around the world (Dahlberg, 1979). Regardless of the triggering factor, the occurrence of an accident represents human fatalities or any material damage. It is necessary to set up some actions related to design and construction of safer vehicles, assistive systems for drivers and other related infrastructure improvements. By the statistics Government of India, ministry of road transportation and highways, transport research wing, New Delhi, 3889 road accidents have been caused due to bad weather conditions and in 6320 accidents due to defects in road conditions in 2009 alone. In a more recent analysis, according to the transportation department, in Tamil Nadu alone, bad roads were blamed for 472 cases and bad weather caused 63 accidents in 2012.

The importance of the road infrastructure plays a significant role in ensuring road safety for a smart city. A Road irregularity is one of the common factors that can be considered for analytical applications in the smart ecosystems. Road irregularity is a broad term which includes any potholes, cracks or random deviations that exist. Recent advances in new automobile steering and actuators design have been attempting to develop on the safety measure, the work on the primary challenge of...
assisting the vehicle with road irregularities is lacking. Current vehicle or the methods of safety are not able to analyze the roughness index and provide a feedback to the commuter.

Due to the proliferation of the number of vehicles on the road, parking problems are common in urban places. The limited availability of the parking space may lead to the problems such as traffic congestion, driver frustration, air pollution etc. There have been instances where vehicle users have driven farther than their chosen destination to ensure safe parking. Mobile phones equipped with Global Positioning System (GPS) capabilities are so far been able to guide the vehicle to its destination with reasonable accuracy, but fail to provide information about the destination’s capacity to accommodate the vehicles flowing in. The process of finding an availability of a parking space is tedious and adds to the inefficient vehicle parking in many areas of urban cities. The traffic in high-density traffic roads can be reduced if motor vehicle riders/drivers knew of the availability of an empty space in a nearby parking zone streamlining the parking experience thus, saving time and traffic woes.

In this paper, authors proposed an IoT based system for mapping the road irregularities in a real-time that assists analytical applications and smart vehicle parking systems for making better decisions in the world of smart ecosystems. The proposed system consists of two subsystems one for estimating the road irregularities and another one for smart parking. For determining the road irregularities, an accelerometer is combined to get the coordinates of the location that assists by providing a caution for the user and suggests an alternate path if the irregularity path is not preferred. On the other hand, for smart parking system, a real-time database is used to create the zones and made available to the commuters.

**RELATED WORK**

Several related studies from 1950’s suggest that the deterioration of the road surface is the main factor for vehicle conditions related to operating costs, increased fuel consumption, drive comfort (Dahlberg, 1979; National Quality Initiative Steering Committee[NQISC], 1996). In (Wong, 2001; Ndoye, Vanjari, Huh, Krogmeier, Bullock, Hedges, & Adewunmi, 2006) road profile elevation analysis has been carried out using sine waves, step functions or triangular waves. In these studies, it has been shown that vertical acceleration of a point depends on the horizontal velocity i.e. vertical acceleration depends on the car’s velocity.

A consolidated approach to the analysis of the road profile was studied in (Laurent, Talbot, & Doucet, 1997) using data acquisition systems, accelerometers, laser profilers. This was extended in analyzing the road conditions with sensors in the embedded devices such as mobile phones. In (Eriksson, Girod, Hull, Newton, Madden, & Balakrishnan, 2008) built a system that monitored the road anomalies using the accelerometers and GPS devices on the mobile phones. The study of integrating the inertial sensors (accelerometer) was done in the (Yamada & Mizuno, 2001). Here the study depicted the experimental analysis of how the Global Positioning System and the accelerometer it also highlighted how the results could characterize the vehicle alignment and status with respect to various platforms. In illustrating the use of wireless communication with 802.15.4 protocol for a sensor network design using wireless transducer for wireless data collection.

The different types of smart parking systems can be categorized into 5 types that are summarized as follows. Parking guidance information systems (PGI) consists of vehicle detectors installed at the entrances for providing information on the availability of the parking spaces. The detectors include ultrasonic, loop detectors, machine vision etc (Shaheen, 2005). Transit-based information systems allow the use of public transport systems such as buses by providing necessary information on the availability of the parking through detectors. The information is these systems are provided through variable message signs (Shaheen, 2005).

E-parking systems employ advanced technologies for a parking system where the driver could enquire about the status of availability of the parking space for a given destination and reserve the parking space. It is mostly Personal Digital Assistant (PDA) / cell phone based application system
The Changing Demographics: The Diminishing Role of Age and Gender in Computer Usage


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