IoT Intelligence-Connected Cars WSN-IoT Integration On Transportation System

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Abstract: In this paper, We introduce a system of wireless sensor networks which connects our automobiles with internet cloud interface which analyses and monitors real time data. As the name suggests connected cars is the exchange of transportation data in between cars, outside infrastructure and inside the car peripherals. Using sensors in cars will communicate between other cars to avoid collisions, better route planning, accidental emergency alert and reducing human fatigue. Vehicle sensor networks interact with the external infrastructure like pedestrian detection using laser sensors will trigger a faster collision avoidance than a human response. Avoiding long traffic blocks and choosing the best route by the real-time data obtained from the server as well as time-distance ration by the help of an algorithm. Autonomous driving technology will be improved to a better level by the inside vehicle communication by the altogether synchronized communication between the sensors like ultra-sonic sensors to know the outside objects. All these are connected to a cloud server which communicate between other cars to perform a synchronized transportation system altogether.

Keywords: IoT, WSN, Car automation, intelligent transportation

I. INTRODUCTION

In the world we live today communication stands the most important role. Communication does the 80% work on a process altogether running in a perfect order. According to Open Government Data (OGD) of India road accidents have an enormous increase from the rate 48% to 76% from 2005 to 2014 and 43% of the accidents are due to the improper driving and delayed response of the drivers on instances which requires a faster response.

Car manufactures around the world are now concentrating on the safety features they could implement on their cars which they could offer their client safer than other company to choose from. But these safety features never came down the medium genre of people India. Even the basic safety system airbags aren't a part of a normal configuration on a 5 lakh car. In India people tends to pay to get a better audio system if they are given a choice to have an airbag for the same price tag. These needs to be changed where the safety of the pedestrians as well as the driver should be in the top priority. Installing a small box of microcontroller in a car which have data transfer in a WSN (Wireless Sensor Networks) connected to a cloud server which analyses and monitors real-time data of the vehicles, traffic data and infrastructural data.

A. IMPLIMENTATION OF WSN

Wireless Sensor Networks (WSN) is the connected networks of sensors like ultra-sonic, Proximity sensors, physical atmospheric sensors, distance-geolocation sensors etc. These sensors are connected together to get a much higher accurate data rather than from individual sensors. WSN plays a vital role in accident avoidance. Displacement sensors like laser and ultrasonic sensors are fitted around the car to perform collision avoidance from pedestrians as well as external objects. Geo-location sensors tends to provide the location of the car providing the servers to reroute to a hassle free driving route saving both time and fuel.

B. PHASES OF TRANSFORMATION

Connected cars defines a new era of transportation where safety will no longer be an issue. Early 80s arrival of IC changed the world of electronics where the huge vacuum tubes where replaced into a pin sized chips which altogether work for a billion processes. Here we applies latest technologies to implement the WSN networks in and out of the car. Open Source programmable Microcontrollers like Arduino. Raspberry Pi, Intel Edison etc. are used to communicate and send the data in and out of these sensors. Data read from the sensors are converted into the desired data format further send into online cloud sensors. All these process are partitioned into three phases.

II. PHASE-I

Vehicle to vehicle Communication

V2V BASICS

Vehicle to Vehicle communication is the primary communication line established to know the real time statistics of the vehicle geo location, velocity and in-depth details of nearby surroundings.

SYSTEM IMPLIMENTATION AND COMPONENTS

WSN is to established in every automobile to achieve perfect communication. Basic sensors used are displacement sensors used to obtain the distance of obstruction and GPS sensors to get the velocity and geo location of the vehicle. FPV (First Person View) Cameras are used to get a clearer picture of the road and displayed in a GUI for the user. Advanced laser sensors detects the lanes and road limit and provides warning system to respond efficiently.



Image reference: Electronic-lovers daily Figure 1 Microcontrollers plays a major role in creating a communication line in and out of these sensors.



Figure 2

ARDUINO MEGA

Arduino Mega is a microcontroller with open source programming and a lot cheaper than its rivals raspberry Pi and Intel Edison.

Displacement or Object detection Sensors

ULTRASONIC SENSORS

Ultrasonic sensors used to measure/detect any incoming object in front of the sensor. Here, we uses HC-SR04 ultrasonic sensor module which compatible to work with Arduino microcontroller. In short, the ultrasonic sensor generates a pulse from one end and its reflected back and received by another receiver diaphragm and then the time in between the reflection is calculated and thus the distance is obtained to the obstacle.



Image Reference: Arduino forums Figure 3

FPV CAMERA SENSORS

The first person view (fpv) camera mounted in the front of the car have two purposes. It records every journey and what is happening through out the journey which can be accessed online and further used to analyze if any accidents occur. On the other side, while using latest Digital Image Processing (DIP) techniques, road sign boards are read by the camera are processed and later given to the GUI and server. Speed limits, schools nearby and other warning signs which the driver missed can be read by the system and further warnings are given.



Figure 4

DIP SOFTWARE WINDOW

The FPV camera can be mounted in front of the car where perfect visibility can be obtained.



Image reference: PT-grey systems Figure 5

CRASH MITIGATION SYSTEM

Pre crash system or crash mitigation system triggers automatic braking of the car when the sensors in the car detects an oncoming collision. Sensors like displacement sensors, geo location and velocity sensors analyses real time locational data of the car and an additionally fitted mechanical arrangement in the brake system which is connected to the control servers triggers the output.



Image Reference: Toyota Crash Mitigation Dept. Figure 6

III. PHASE-II

Vehicle to Infrastructure communication

V2I BASICS

According to the United States Transportation Department, 12% of the accidents are caused by the infrastructure collision. Inadequate visibility of the driver sometime cause big accidents. The driver may or may not recognize the external infrastructure which leads to collision. Vehicle to infrastructure communication is established by communicating with the general database of public places integrated to the cloud servers of connected cars.



Image Reference: Toyota public relation Figure 7

Further adding emergency services location and calling the nearby emergency response teams upon a situation and necessary facilities like petrol pumps, repair centers, 24x7 stores etc. are mapped for the user when needed.

Increased fuel efficiency is achieved by the optimized route planning. Since the whole transportation system is connected to the cloud network, real time traffic data is obtained and thereby a vehicle gets alert to reroute to an alternate route since the oncoming road have a traffic block ahead. In this way, traffic blocks can be reduced as well as time and fuel can also be saved.

IV. PHASE-III

VEHICLE TO PERIPHERAL COMMUNICATION

Autonomous and synchronized working of all the above systems need a perfect linking inside the vehicle sensors. The schematics of the connected cars system includes multiple microcontrollers linked together, Wireless transceiver sensors to achieve communication all around the sensors, network modules to connect to the online cloud servers. When the pre crash system is activated, all other active process are changed in accordance with the system. Real time adaptability of the system is necessary. Automatically engine is disengaged and alert systems will be online when the pre crash system is activated. Also there will be a GUI console for the user to manually configure all the settings.





In order to maintain the privacy of the user, geo locations are disabled for public access. But the emergency systems like police will have access to every car database to maintain a hassle free driving.

EXPECTED OUTCOME

Combination of the connected working of the three phases will result in a hassle free transportation system. Increased fuel efficiency is also one of the best advantage. It may take some time to implement the system in a vast transportation area around the world. Recent articles and news states that most of all the vehicle manufacturing companies are now funding research teams to improve the connectivity and to improve the safety of the car by implementing new technologies. In order to get the maximum benefits from this system, this intelligent transportation system should be affordable to the general public.

Rather than depending on the stock systems provided by the manufactures, 3rd party systems introducing latest safety systems in an affordable cost will enable the transportation system to widen its connectivity.

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