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Practical Implementation of an IoT based Vehicle Maintenance System

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Abstract: In the proffered paper we present a solution to Vehicle Maintenance and Support using Internet of Things technology and a real-time data acquisition system. We use the concept of IoT to not only increase transport efficiency of a car (vehicle) but also use the generated data to analyze and rank the driver and integrate this available data with other sectors. The system is a set of many sensors that collect the operational data of different parts of the vehicle and update them to a common server wherein the vehicle performance parameters can be observed and processed. This data can also be accessed by service stations and nearby mechanic in case on any anomaly in the vehicle or to understand the best plan for the car's servicing. Also, this data can be shared with insurance providers so as to rate the driver and the vehicle which can also help them to negotiate a cheaper package of insurance depending on the history of the car's usage. Also, in cases of accidents the guilty party can be easily spotted using the driving data and the history of drivers and the performance parameters of the car (vehicle).

Keywords: Internet of Things, Smart Car, Automation, Data Analytics, Transportation, Performance Parameters, Intelligent System,Efficiency.

I. INTRODUCTION

Cars are a very basic form of roadways transportation system used for individual/personal transportation. With the upcoming Internet of Things, we see an opportunity in extending some features of a car and converting it into a smart car. We undertook the project to make minor changes in the vehicle system without changing a large part of it to collect data and process it for a better experience and increasing the efficiency and to further rank the drivers for their car handling. Thus, creating an intelligent transportation system that can monitor the environment and report its status and even take action based on the information they receive.

Furthermore, this data is used for further analysis of the vehicle servicing plan by the service station engineers and thus compared to the traditional method of servicing all parts only parts that need maintenance are serviced, not only making the process cheaper but also more efficient on the workshop's end. Also, the driving data, car maintenance details et al. can be used by various insurance providers to study the pattern of driving and the condition a car is kept in to offer rates with respect to the ranking generated. This, not only helps in cost reduction of cars that are well maintained but also helps in improving the way a driver treats the car and thus can help in increasing road safety also. This, system can also be used by the government and judiciary in cases relating to the vehicle or vehicular damage by processing the driving and performance parameters to recreate the situations and thus resulting in a better decision using the data.

Finally, this data can always be accessed by the driver and (or) the car owner to analyze his/her driving patterns and to schedule the best date for their periodic maintenance. Furthermore, the parameters and sensors can notify the driver in case of any anomaly in parts that can't be directly seen or observed by the user.

Also, this data can be used by companies to understand the basic problems that might be faced at the user-end and thus can be rectified when the next model is to be launched.

The paper ahead is organized as follows. Section II is gives the overview of the related work in this field. The different modules and their tasks of operation are discussed in Section III with some hardware details that were implemented in hardware. Section IV highlights the backend of the system that was used for research. The future scope is discussed in Section V and Conclusion is discussed in Section VI.

II. LITERATURE REVIEW

The concept of a smart car has been discussed before [1][2] and it is seen that Internet of Things is a rapidly growing user-innovated industry that proposes solutions to many real-time problems faced in traditional and conventional systems [3].

As discussed in [4] we understand that the basic system of IoT can be divided into 3 basic modules that are:

• Sensors, that accept inputs and track and measure various parameters.
• Connectivity, to enable the use of a communication channel. For IoT, we use internet for communication.
• Processors, that process the variables to be analyzed further.

Further, in [5] the possibility of a self-parking algorithm is discussed such that the sensors analyze the data and self-drive the vehicle into parking spot. This is a localized system but we propose to use the data generated to connect the car to a global stage where it can be compared with the data of other cars and thus a median of parameters can be formed for regions to analyze the driving patterns of these smart cars.
Also, the advantages and profits of a smart device or system as compared to its conventional and traditional system is presented in [6] thus enabling us to understand that many of these factors can be the motivation for this project.

III. MODULE DESCRIPTION AND HARDWARE USED

A. Brake Module

This module is used to sense the parameters when the brakes are applied and the pressure with which they were applied. These help us in estimating the mileage that is lost due to unnecessary application of the brakes. Further, the driver can be analyzed for sudden braking or strong application of brakes. This behavior can be used for various purposes to understand the effects it has on the car's parts and mileage. Also, this data can be used to understand the driver's habits and used by different sectors to rank the car for services provided on the vehicle.

For this application we simply attach a mCube accelerometer with the brake pedal. This helps us detect each time the brakes are applied as well as estimate its magnitude. The new MC3600 family of accelerometers is used for this project which consumes only 0.6uA of current and has impressive low power consumption with IoT compatibility.

B. Fluid Module

This module is used to track the various fluids in the vehicle. This can help the driver realize any abnormal level of the fluids as well as whenever the fluid levels drop at a rate more than the natural rate of depletion the service center can be notified to arrange for refills and repair of the issue. This data can also be used to schedule a more effective servicing plan as per the car's parameters.

For basic and non-flammable liquids a simple water-level detector circuit is enough. For the more sensitive fluids, an ultrasonic sensor is used for fluid level detection. This is done using a simple 89S52 Microcontroller and an Ultrasonic sensor integrated with an IoT modem and programmed using IoT Gecko.

C. Tire Module

The tire module is set to sense pressure and temperature of the tires. This is used to detect any leakages or any wear and tear that the tire has that can cause any permanent anomalies. Also, in case of overheating of the tire rubber the notification can be sent to the user and the nearest service station.

The Motorola TPMS pressure sensor is used for the purpose of pressure sensing and a LM35 is used for temperature sensing, with the core comprising of a custom HC08 Series microcontroller that has very low power consumption. It is integrated to the common IoT Modem.

D. Collision Detection Module

This module is used to detect any collision that the car is in. This is not a user notifier but notifies the nearest garage to check for the car's status. Also, it auto dials a helpline center that can send in the necessary medical attention and the ambulance in case needed. And finally, it backs up the data on the server and notifies the insurance provider and law enforcement that a collision of certain magnitude has occurred with your details.

This module is generally available in the car nowadays although it is not integrated with IoT. This collision detecting mechanism is connected to a microcontroller that controls the seat belts and the airbags. This is further integrated in the IoT modem that is programmed using IoT Gecko. This acts like a beacon signal, that is it sends a single signal in case of a collision which can be reset in a car workshop.

E. Internet of Things Module

This is set-up to connect all the modules together and further integrate them to the internet to communicate with the backend website and database setup.

This is setup using an MDM9206 LTE modem [7]. The MDM9206 LTE modem is designed as a global multi-mode connectivity solution to provide reliable, optimized cellular connectivity requiring low bandwidth and years of battery-life. It supports ultra-low power consumption and cost-optimized solutions that cover full range of low data rate IoT applications.

IV. BACKEND

Use The backend website and database run on a PHP script which runs on 000webhost domain. It is basically a web scraper, which first uses the Google API, Google Maps Geocoding API which provides a place for the latitude and longitude sent by the GET request of the MDM9206 LTE modem module. This gives a response in a JavaScript string about the details that are to be communicated with the user and with the other sectors servicing the vehicle in different manners.

The other scripts use MySQL and PHP forms to create a fast updating system for keeping a track of all the data sent by the car.

V. FUTURE SCOPE

This project has large potential of future scope with the increase in more complex circuitry to track parameters of a vehicle other than the ones mentioned in this paper. Also, with the increase in technology and data security and privacy we can implement systems wherein the sensors are interfaced with the internal systems of the vehicle. This isn’t implemented in this project as the privacy and data security is still questionable as a large part of the system is developed using open-source software as well as the backend. Also, with further development of a coherent global internet of things we can predict much more availability of user-invented tools.

VI. CONCLUSION

We believe that this smart car modifications that we have implemented might still be a bit traditional in nature but of extreme useful nature for the implementation of IoT technology with the vehicle industry. Also, it can help in developing a sapling relation between the conventional drivers to build a mutual trust to the IoT technology for the further larger developments that are to come in the industry. It will also ease the jobs of the user in maintaining the car and help him/her in records needed during any necessary formalities. It can also help insurance providers track their customers and also group them based on their mannerisms in the vehicle.

In conclusion we believe that this is the beginning of the Internet-enabled era and we are developing a new way on how we interact with the world around us.

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