CAR AUTOMATION USING IOT

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ABSTRACT:- *In today's developing world, traveling from a place to another has become an unparalleled part of our day to day life. A substantial amount of resources as well as time on traveling which might not always be pleasurable as there are various problems such as accidents and the roadblocks caused due to these accidents, vehicles parked in an undisciplined manner, and various human errors. Also, the problem that haunts all the people is the possibility of theft of the parked vehicles. To overcome these challenges, there is a pressing need to develop automated car system or smart cars. This can be reached using the Internet of Things (IoT) based platforms and services. There are many technology giants as well as automobile giants such as Google, Mercedes-Benz, Edmunds, etc. are racing for developing smart cars or intelligent vehicle system. The existing smart vehicles incur a huge amount of money and resources for development and require well-organized paths with all the road markings and signs visible very clearly. There is a need to improve the efficiency of these smart vehicles. One of the main advantages of these systems is that the user can monitor and control their automobiles from anywhere in the world provided that the user has an active internet connection. Developing automated car systems will ensure security and comfort of the user. It will also reduce the accidents and the inconvenience caused due to various human errors. Many applications have been developed using IoT technologies. The platform for developing such technologies are Raspberry Pi, Arduino or other microcontrollers which are responsible for controlling various operations. These systems can be controlled and monitored from a registered device which is present with the user.*

Keywords: Car automation, Smart car, Vehicle automation, IoT, LIDAR (Light Detection and Ranging), IR sensor, GSM shield, RF module

INTRODUCTION

This is the age of automation where human efforts are reducing to a great extent. Making lives simpler and smarter is the aim of Automation. With smartness of Automation comes information and awareness of the technology around us. With the continuous progress and evolution in information technology and the rising demands of safe travel, it has become necessary to find better and innovative systems to aid human life and make it easier. The most common cause of traffic accidents is the Driver error. With cell phones and other electronic media, in-car entertainment systems, the growing traffic, and complicated road systems, this problem has become bigger than ever. So for public transportation, we can use Driverless vehicles[1]. Car automation is a technology with the use of which we can control different things or we can keep a track of the vehicle for the security comfort and efficiency. Multiple applications have been developed so as to support the safety and security of the vehicle[2]. There is a wide range of potential social, economic and environmental impacts on the concept of Autonomous driving. Each of these impacts revolves around the inherent efficiency gained by doing a task normally as performed by humans by implementing an optimized computer algorithm to do the task[3]. Technologies are evolving day-by-day involving self-driving cars including LIDAR (Light Detection and Ranging) to Image Processing techniques, due to which the idea of a self-driving car has come to a reality in 2016[4]. The concept of the self-driving car helps enforce many of the constraints related to the efficiency and reliability of road transport such as:

Fuel conservation can be done at its maximum level by using driving techniques and speed limits of the vehicle efficiently.

Strict obedience of traffic rules, especially in India, which is being neglected and ignored by many of the human drivers such as not following of traffic signal lights, not following of speed limits especially in city areas, improper lane keeping, blowing horns in horn restricted areas, etc.

Efficient use of parking space which can be achieved with the help of automated parking algorithms and sensors which will help the autonomous cars to avoid collision with other parked vehicles and in turn also increase the space for parking[4].

RELATED WORK

In journal paper, titled [5] "How Google's self-driving car Works", Ericco Guizzo presented the key objectives for the self-driving vehicles and its functions. The key objectives included the implementation of LIDAR systems for 360% image production and mapping, parking assistance systems. It also explained the obstacle detection systems to avoid collisions with other vehicles and the most important function is the lane keeping management, which is carried out by the self-driving car itself which does not require any human interference. Guizzo's research findings also highlighted a couple of backdrops which were responsible for increasing the cost of vehicles with LIDAR systems by implementing LIDAR sensors and also responsible for self-driving car's inefficiency in adapting to dynamically changing environments. Most of the time it's difficult to adapt itself to changing environments and infrastructure like traffic signal lights, roads, potholes, speed breakers, addition of new lanes as all these requires prior knowledge of the roads and its infrastructure for autonomous driving.

Ryan Krauss [6] proposed a platform of combining raspberry pi and Arduino for autonomous vehicle. To reduce the error in real time they created a feedback system. The value of the constancy of the controller was displayed on the web page which they had created and it got its value from the raspberry pi which was interfaced to the internet.

Gummarekula Sattibabu et.al[7] introduced a method for detection of a speed breaker. The speed breakers were detected with the help of RF module and ARM microcontroller by placing the RF module on the signboard and at the vehicle's dashboard. A message is displayed on LCD screen with a buzzer when the vehicle is in the zone.

Christoph Stiller and Keith Redmill[8] presented ideas and possibilities of detecting and avoiding obstacles and analyzing and estimating the nearby obstacles or objects by autonomous vehicles. The major drawback of the results was due to the sole dependence on only RADAR sensors which resulted in the unreliability of the complete system. It makes the system inefficient which may cause a collision with other vehicles due to the failure of detecting the objects and sole reliance on a single system.

Thus, from all these research ideas and results it can be concluded that for a long time the motivation behind smart automobiles has been going and it is a promising vision and not just a myth. Autonomous vehicles will soon be a future and they will help to tackle many worries related to road traffic environment and infrastructure such as not following traffic rules, avoiding the accidents, etc.

METHODOLOGY USED:

A smart car was designed using components such as an Arduino module, ultrasonic sensor, GPS receiver, sound sensor, IR sensor, GSM shield, LCD, LED and buzzer. There were three sections- input section, processing unit, and output section. The ultrasonic sensors were installed to detect any obstacles such as speed breakers that come in the way. The range of operation was to be increased when detecting speed breakers which was achieved by the RF module. For determining the exact location of the car, a GPS receiver was used in order to record the latitude and the longitude. To sense the horns honking in the surrounding, a sound sensor was used. The Arduino module which is the main platform has four loops, namely, loop 1, loop 2, loop 3 and loop 4. Loop 1 activated when the engine was powered ON and the also true key was present. It also contained Loop 2 which ran when the parking mode was enabled. Loop 3 initiated when the conditions of Loop 1 were negated. Loop 4 started when the engine was turned on even though the true key was absent.[9]

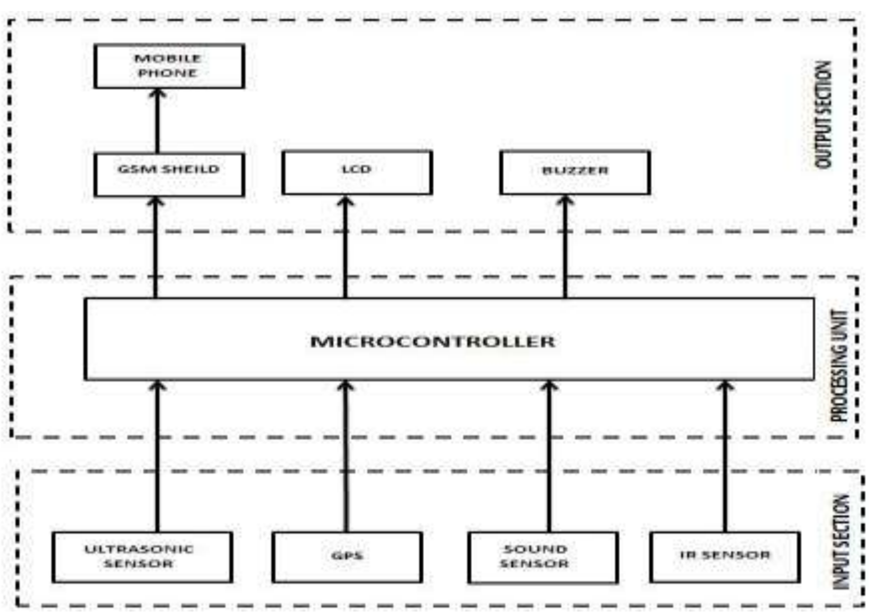

Fig.: Block diagram for a Smart Car[9].

To reduce the chances of a collision, a collision warning system was designed which after gathering knowledge about the state of a vehicle with respect to other vehicles, either assisted the driver for controlling the vehicle or doing it autonomously. In this system, the desired motion of the vehicle was determined by the higher level controller. The lower level controllers decided the actions that the engine should take after gaining the knowledge about the environment. Various parameters such as inputs from the driver, the infrastructure, other vehicles, and the onboard sensors were processed by the higher level controllers so as to control the brakes and the throttle. These controllers are based on mathematical models. To ensure that this system emulates human beings, neural networks were built.[10] Car automation was also achieved using a Raspberry Pi module. Different sensors such as fuel level sensor, humidity sensor, temperature sensor, ultrasonic sensor, and Wi-Fi module were connected to the Raspberry Pi. These sensors sensed the environment data continuously and transmitted it over the web. The ultrasonic sensor connected to raspberry pi was used to calculate distances. It used the same methodology as SONAR in which the distances are calculated on the basis of the time required for the ultrasonic wave to return to the sensor after getting reflected by any obstacle. The moisture sensor connected to it was responsible for the action of car wipes as it determined whether it is raining in the surrounding by checking the moisture levels of the environment. A Photoresistor(LDR) was used to turn the car lights ON and OFF as it could check the presence of light around the car. All the observations made by these sensors were sent to the cloud storage and to the controller to take appropriate actions.[2]

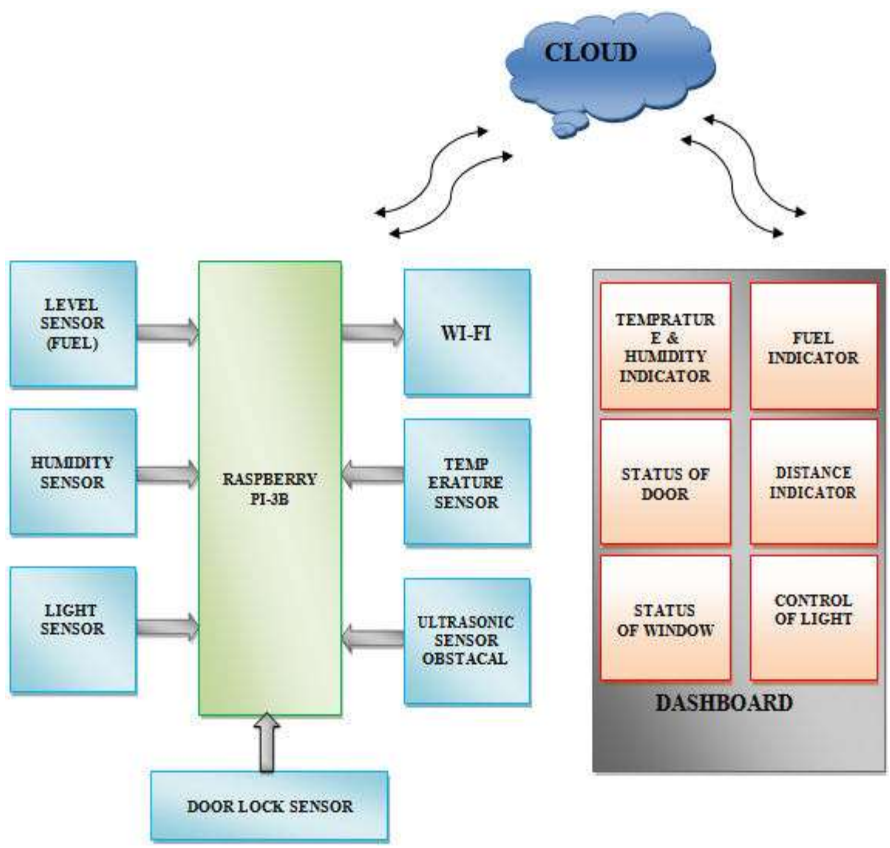

Fig.: Car Automation Using Raspberry Pi[2].

In the self-driving car developed by Technology giant, Google, the user first had to set the Destination. The route was calculated by the software in the car. The Light Detection And Ranging(LIDAR) sensor installed on the roof checks for the radius of 60 meters and created a 3-dimensional map of the immediate surrounding. The rear wheel had the ultrasonic sensor which was used to detect the positions of other vehicles with respect to the created map. The distance sensors placed on the rear and front bumpers determined the distance between the car and the obstacles detected. All the data collected by all the sensors along with the street view recorded by the Video camera was given to the Artificial Intelligence system. The Artificial Intelligence processed the real-time data to make decisions and simulated human perceptions to control various actions required for driving a car. The override function enabled the user to take control over the artificial intelligence.[12]

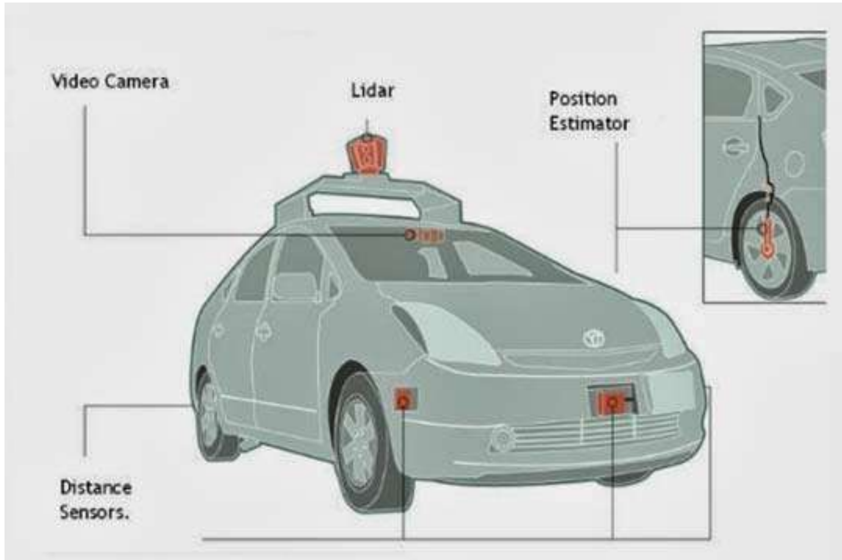

Fig.: Self-driving car by Google[12].

RESULTS

The results were recorded by testing in a simulated environment that had potholes and speed breakers along with all the challenges that the system may have to overcome to ensure a smooth, and safe ride. For checking Speed breaker detection, there were two situations. In the first situation, the speed breaker was within a distance of 80cm. As soon as the speed breaker was detected, the buzzer beeped. In the second situation when the speed breaker was not within 80cm, RF transmitter and receiver had to be used. For the pothole detection, the threshold distance was set in the range of 15 to 30 cm. If pothole was detected within the threshold, the buzzer made a sound. In case of traffic chaos, if a high pitch noise was detected over a certain period of time, the keychain of the owner received a signal captured by it from the RF transmitter. While parking, the parking key was turned on. It helped the driver by blinking either on the left side or the right side. When the distance between the car corner and any detected obstacle was less than the set threshold of 2 cm, the buzzer made a beeping sound[9].

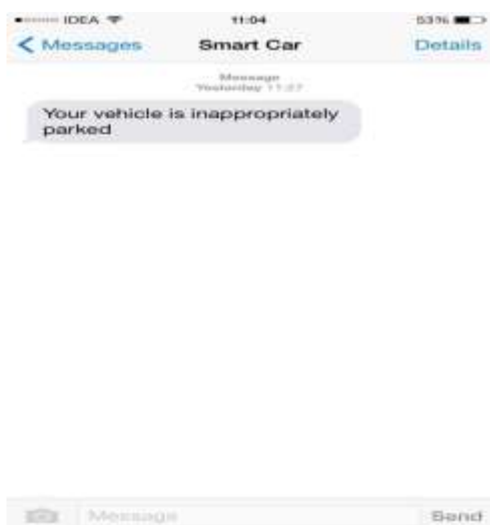

Fig.: Notification sent to the user for inappropriate parking [9]

To verify the Accuracy of the system, GPS locations were chosen as deciding parameters. To locate the exact car location, GPS data (string of character) needs to be translated into the value of longitude and latitude. The MCU helped in the process of navigation as it could identify the GPS data. To check the Reliability of the system, many single target / one-way trips were made from different start points. In order to ensure the reliability, the car had to come to the desired target and terminate the trips. The car was able to do this most of the times [1].

In case of Car Automation system Using Raspberry Pi, the control actions were taken by the Raspberry Pi. The data collected by all the sensors was collected by the controller. The controller after assessing the data, performed various actions [2].

Fig.: Dashboard of a Raspberry Pi controlled Smart vehicle [2]

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