Design and Implementation of Smart Car with Self-Navigation and Self-Parking Systems using Sensors and RFID Technology

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Abstract - In this paper it is proposed to do the research on making a smart car prototype which includes some functions like self-navigation, space detection for parking, self-parking, obstacle detection, alcohol detection. AVR microcontroller is used for achieving these tasks. Radio Frequency Identification technology helps for making self-navigation, with the help of Radio Frequency Identification cards. On-board Radio Frequency Identification module is to locate Radio Frequency Identification tags embedded in the path in the form of a grid. IR sensors are placed into the car in different directions for sensing the obstacles. Alcohol detection module detects that the driver has consumed alcohol or not, if it detects that, then the car will not get turn on for driving. This smart car is having two modes of operation, one is manual mode and other is automatic mode. Automatic mode consists of features like self-navigation, self-parking and obstacle detection and manual mode consists of alcohol detection. The goal of this research is that to make smart car like Google's self-driving car project. Some of the features of Google car are achieved here by making self-navigation and obstacle detection with the help of Radio Frequency Identification module and Infra-Red sensor module in very low cost and for small purpose.

Keywords - AVR microcontroller, RFID, GPS, IR, ADC.

INTRODUCTION

We used here RFID module for navigation from one place to other place automatically. Instead of using RFID technology, we can use GPS module also for navigation from source point to destination point [1]. But the costing for that is very high and one more disadvantage is that the latitude, longitude information from satellites can have errors up to 3 meters. But the small prototype cannot withstand with this much tolerance as compare to real cars. RFID cards are inserted into the path of the car. So that it can be sensed by the RFID receiver module. Each card is having its unique code and that code contains information of moving in particular direction. While moving in any direction it detects the obstacles coming in front of it. At that time car executes the routine for obstacle detection, which performs the braking task. Once the destination is reached then if user wants to park the car, then he can put the car into auto-parking mode. In this mode smart car moves in forward direction with space detection for parking. If the required space is detected then it will start moving for parking the car. In alcohol detection module, if it senses alcohol from the driver then it will not get turn ON the car. The supply for turning on is getting isolated in this case.

LITERATURE SURVEY

RFID TECHNOLOGY IN CARS
A. There are many applications of RFID technology which can be used in cars. Now-a-days, for toll collection, RFID technology is implemented somewhere. [2] This is done with the help of a RFID tag and a RFID receiver module i.e. RFID reader as shown in fig. 1. The RFID tags are installed on the cars and a server having a RFID reader that collects information from these tags. As the cars passes from the gateway, these readers read the RFID tags placed on cars. In this way the system is can identify the car and the charges for that.

Fig. 1 RFID Toll Road Payment System

B. A lane level navigation is another application area where this RFID technology is used. In this the car having a RFID reader is passing along a road on which RFID tags are installed[2].When car is changing lane suddenly the transport department may also be able to design such a system by reviewing RFID readings. This is an effective system in avoiding collision between vehicles with the help of RFID readers. And also helpful to the driver to know the position of other vehicle and adjust the position of his vehicle relative to other vehicle. Map free lane following solution is also invented which is based on low-cost 2D laser scanners for Autonomous Vehicle to fill the gap between driverless car and the lane keeping assistant [3].

METHODOLOGY

The overall system block diagram is shown in fig. 2, which also shows the algorithm type procedure for navigation of smart car.
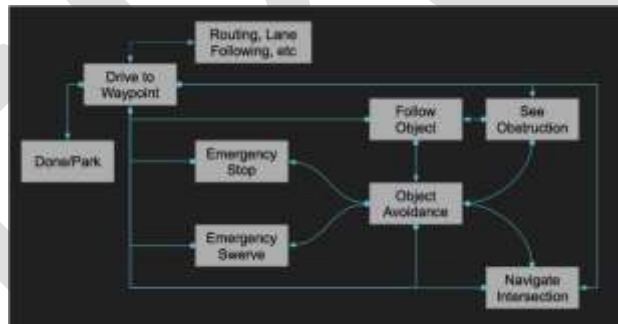

Fig. 2 Block Diagram

The different cars are able to have communication between themselves with the help of IEEE 802.11 and RFID [2]. A car transmits packets to the nearby car using IEEE 802.11 radio. At the same time, the data can also be exchanged between the two cars using RFID tag and reader as shown in fig. 3.
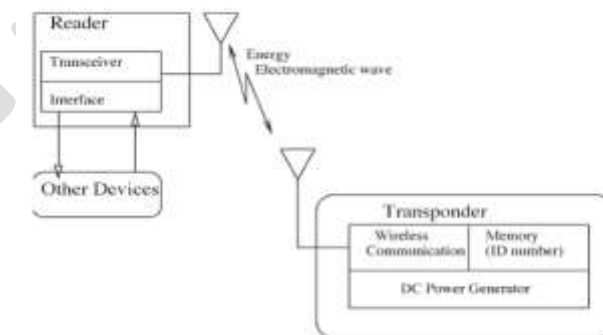

Fig. 3 Simplified RFID System Architecture

Almost every car is having RFID reader and tag but only some cars are having GPS receivers. The RFID tags are put at selected roadside units e.g., speed advisory signs. The fig. 4 shown below shows a localization system. This RFID cards is having the unique code. Whenever this code is read by the RFID reader, it identifies the action written in the program for that unique code and performed accordingly.
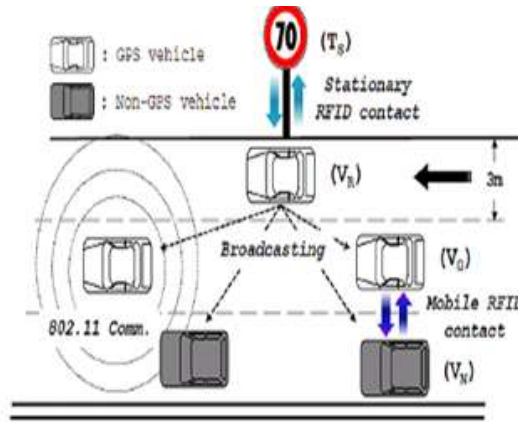

Fig. 4 RFID Localization System

For e.g. if the card have the action as movement to the right hand side, then the smart car do that action by giving excitation to the motors connected to the wheels by the controller. So the objective of self-navigation is achieved by this RFID technology. Fig. 5 shows the action wise block diagram of RFID self-navigation system.
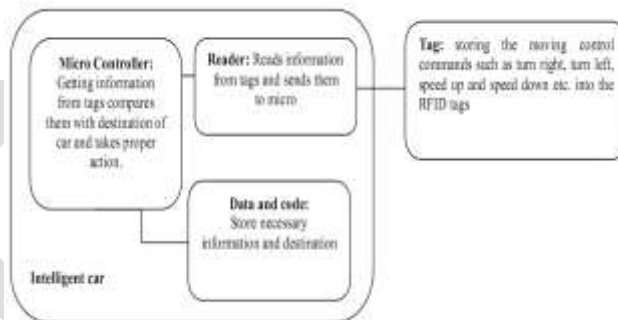

Fig. 5 Block Diagram of RFID System

The feature of obstacle detection is achieved with the help of IR sensors which detects the obstacle coming in the way and it is informed to the controller [8], so controller takes the action of braking with the help of code written behind that. The IR transmitter emits continuously infrared radiation in a direction of IR LED placement which reflects back on IR receiver from the surface of an obstacle which is shown in fig. 6.
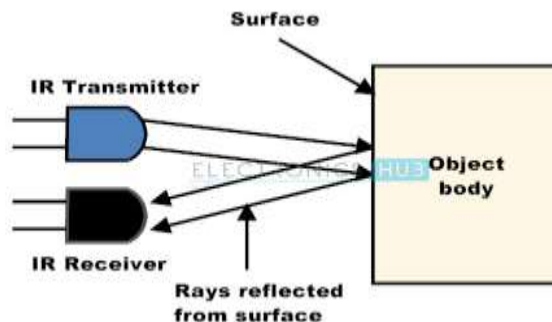

Fig. 6 IR Transmitter and IR Receiver

This IR receiver is connected to the port of controller having internal ADC. This ADC compares the received voltage with the threshold voltage which is set by the programmer and generates the output accordingly.

Self-Parking feature is also achieved by the Infrared sensors which are mounted at the three different directions around the car. The fig. 7 shows self-parking car concept.
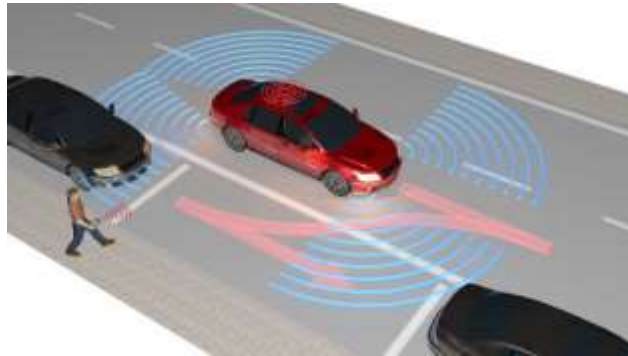

Fig.7 Self-Parking Car

These sensors emit the IR light and reflect back from the surface of the object in front of it. The intensity of the reflected light rays is totally depends on the distance between object and the car. If we want to park the car, then user has to turn ON auto-park mode of the car. Whenever it starts functioning, first algorithm is to start the count for sufficient space detection for parking. When this algorithm is executed successfully, then only car starts the algorithm for movement to park in that space safely. This is done with the help of wheel's motors by moving in left, right, front and back directions. While moving in any direction all sensors data are observed and compare by the controller to park the car safely without dashing anywhere.

CONCLUSION

In this paper the research is done on smart car having various features. Here the self-navigation feature is achieved with the help of RFID technology because when we perform this feature into small prototypes or for small models which will be used in industrial campus, college campus, society premises or on the highway also, it is desired to move our smart car very precisely. So if we use GPS module for self-navigation it will receive latitude, longitude points from various satellites which may have error up to 3 meters and it is not that much accurate for small models. So to overcome this type of error RFID technology is very much useful in this case. This paper includes various features of smart car like self-parking, obstacle detection and braking, alcohol detection. These are achieved by using different types of sensors attached to the AVR microcontroller.

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