

Intelligent Cars using RFID Technology

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Abstract— RFID system (Radio Frequency Identification), an automatic identification system relying on exchange of information through radio frequency, is emerging as one of important technologies that find its use in various applications ranging from healthcare, construction, hospitality to transportation sector and many more. This paper describes about RFID technology, concentrating its use in improving performance of cars. This paper shows how RFID technology facilitates some new different features in the car that are helpful for one and the society.

Index Terms— RFID, Intelligent cars, RFID tags, RFID reader, Transponders, Radio frequency.

1 INTRODUCTION

The RFID technology is capturing many areas now-a-days such as healthcare, construction, hospitality, transportation sectors etc. RFID sensors are being used in evaluating the health and performance of systems such as power facilities in buildings which helps to identify problems which may occur so as to improve them quickly and easily. RFID sensors are finding extensive applications in health care. One example is that the heart beats of cardiac patients can be known with the help of RFID sensors. Also, these sensors provide help in identifying patients those require surgery. In navigation and tracking area, RFID sensors are able to provide information to mobile robots about their surroundings with the help of which they are able to navigate [1].

The cars, which are using RFID technology to perform various functions, are given the name as Intelligent Cars. There have been many reasons that have led to the development of these cars. One of the major reasons is multiple car accidents happened in the recent past. Moreover, these cars being more users friendly help the users in many ways. These cars can also help in managing the traffic in better way which further results in improvement of performance of the cars. The reduction in fuel consumption is one of add on benefits of the result. These cars are also proving eco-friendly by reducing the pollution. Also, these cars help in improving efficiency and could also find applications in defense operations.

There are various factors that are need to be involved in making such cars such as speed control, direction control, maintenance of the car including washing, refueling etc. Some other factors are ability to sense the climatic change such as whether the car is able to automatically perform various operations like activating of wipers etc. One another important factor is handling of emergency conditions like accident, theft etc [2].

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2 RFID SYSTEMS

RFID is an automatic identification technique which relies on data storage and transreceiving of data using devices known as RFID tags or transponders. The power which is required to initiate the tag is transferred with the help of a contactless technology which is known as RFID reader. The mode of communication between the reader and the tag of an RFID system is based on radio frequency (RF) technology. A simplified RFID system is shown in Fig. 1.

The tag includes the antenna within itself, which is responsible for providing communication while the reader is usually having one or two antennas. The reader which contains a transceiver generates a pulse of electromagnetic waves. The transponder receives the transmission which is further, rectified to get the dc power supply for the IC memory.

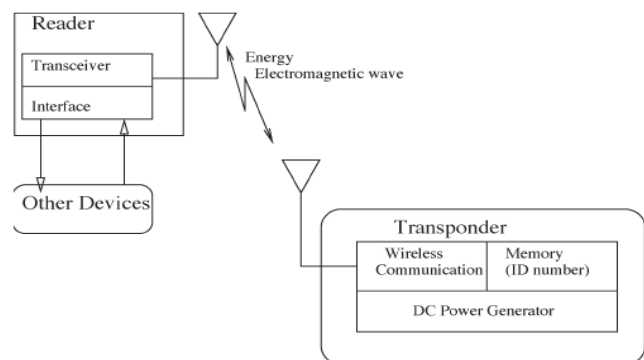


Fig.1 Simplified RFID system architecture.

The processed signal transmitted by the transponder is then received by the reader again to obtain the tag's ID number. As the RFID technology is simple, more flexible and relatively cheaper it is nowadays gaining attention in a large number of applications, such as personal identification, food production control, security guard monitoring, and inventory management etc [3].

2.1 RFID Reader

UHF RFID readers basically are transceivers which perform the function of transmission and reception simultaneously that

too at the same frequency. In order to increase the range of reading, readers are made to transmit in such a way that make use of maximum EIRP (Equivalent isotropically radiated power) using high gain directional antennas. But there has to be a proper isolation between transmit and receive channels in order to have reasonable good detection and decoding of weak tag signals.

Reader antenna is one of the important components of RFID system. The choice of antenna depends on maximum allowable radiated power and antenna beam width in UHF RFID bands. Now-a-days, RFID systems are using a wide variety of antennas such as switched beam antennas, polarization and space diversity antennas, smart antenna arrays etc.

There are basically two types of antenna designs that are:

Bistatic Antenna Configuration:

The main feature of bistatic configuration is that it uses separate antenna for transmission and reception. This is shown in fig 2. These systems also make use of circularly polarized antennas. These systems find application in RFID portals and dock doors.

Monostatic Antenna Configuration:

In this type of configuration, there is only one antenna used for both transmission and reception purpose as shown in fig 3. They are not as good as bistatic configuration because they have poor isolation between transmit and receive channel [4].

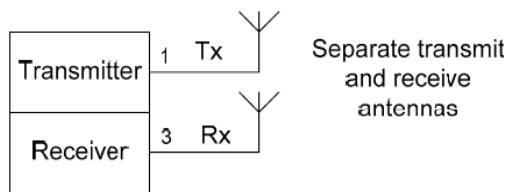


Fig. 2 Bistatic antenna configuration.

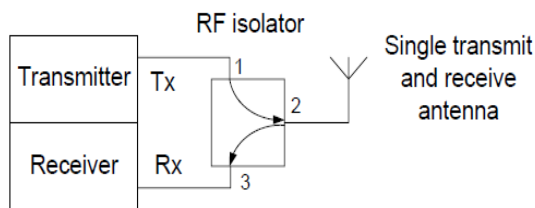


Fig. 3 Monostatic antenna configuration.

2.2 RFID TAGS

Two types of RFID tags are generally used. They are known as active and passive tags. Active RFID tags have a power source which helps them to have communication over a long range, changeable data fields. The main problem of active RFID tags is that they are expensive and their duration of life is also less.

Active RFID tags help in manual sorting associated with

switch lists. Active RFID tags have grown in applications where tagging and tracking is required. The main industries that are making use of active RFID tags are automotive, transportation, logistics, healthcare and military etc.

Passive RFID tags on the other hand, stores the energy provided by the signal in a capacitor. This capacitor when properly charged is used as a power source for passive RFID tags. Passive RFID tags are having a short communication range but they are smaller and cheaper in size as compared to active RFID tags [5].

3 RFID TECHNOLOGY IN CARS

There are many applications of RFID which are being used in cars. Now-a-days, for toll collection, RFID technology is being used. This is done with the help of a RFID tag and a RFID reader as shown in fig 4.

The RFID tags are installed on the cars and there is a server having a RFID reader that gathers information from these tags. As the cars pass the gateway, the readers reads the RFID tags placed on cars. In this way the system is able to identify the car and the charges are made. Many cities, e.g. London and Seoul, are using automatic toll collection (ATC) systems.

Edinburgh Council has adopted a bus track light priority system which is helpful in reducing track congestion and as a resultant, road accidents are also avoided. When a bus or a car having a RFID tag reaches the intersection, a RFID reader which is placed on the road gathers the information about the car or bus and sends it back to the track signaling system in order to control track light.

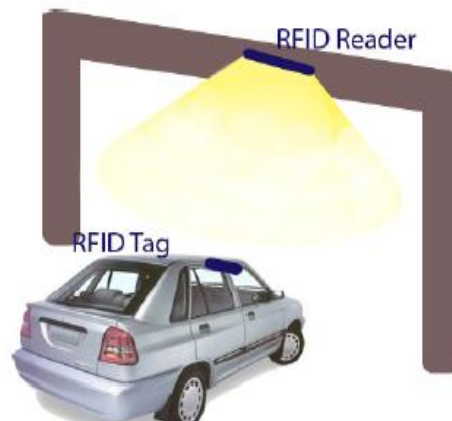


Fig. 4 RFID Toll Road Payment systems

A lane level navigation can be achieved if the car having a RFID reader is passing along a road on which RFID tags are installed. Transport department may also be able to design better signs if they are reviewing the RFID readings of the cars which would indicate them when a car is changing lane suddenly. Thus, an effective system can be realized which is helpful in avoiding collision between vehicles with the help of RFID readers installed in the vehicle and the RFID tag installed

on roads. Such a system would help a vehicle driver entering an intersection to know the position of other vehicle and thus, position can be automatically adjusted relative to other vehicles.

Also an automatic warning system can be made which would give warning if a wrong way is taken. It is very common in dark that many vehicle drivers take a wrong way. With the help of this system, vehicles would be alerted in advance that they are entering the wrong lane and in this way accidents can be avoided.

License plates can also be realized using RFID systems. In this case, a RFID tag is placed on the license plate and a RFID reader on the vehicle such as cars. A car tells about itself to other cars with the help of RFID readers and in return obtains their information also [6]. Example of usage of RFID technology in cars is illustrated in fig 5.

RFID technology is also having its use in car parking lot as shown in fig 6. Cars are identified using RFID tags and readers and the parking fee is collected. RFID system allows cars to check in and out under safe conditions. The RFID tags are placed on the barriers and when the car passes near these barriers, the car is identified with the help of RFID readers placed on the cars [7].



Fig. 5 Some car keys (upper left) contain a passive tag. An EzPass (upper right) helps collect highway tolls, a Smart Trip card (bottom) collects fares in a public transit system.



Fig. 6 Parking Management with RFID

4 RFID-ASSISTED LOCALIZATION SYSTEM

It is generally assumed that different cars are able to have communication among themselves with the help of IEEE 802.11 and RFID. A car broadcasts 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. 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. 7 shown below shows a localization system.

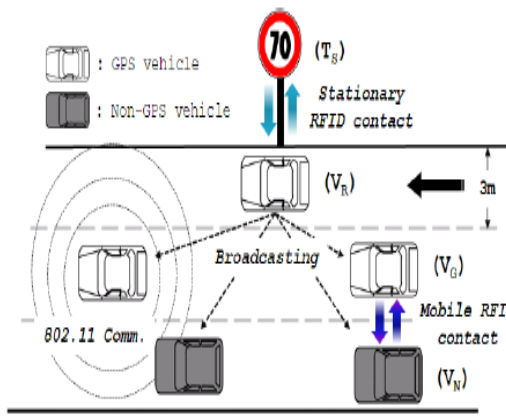


Fig. 7 The Proposed localization system: RF-DGPS and Single Peer Localization [8]

5 CONCLUSION

In this paper possible usage of RFID technology is discussed in cars or other vehicles. It has been shown that RFID technology can be very helpful for cars as this technology helps in traffic management, communication between cars, parking management and other applications. In this paper, it is also described that RFID technology makes use of RFID tags and reader. The tags stores information and are usually installed on the cars and the reader reads the information from the tag. This technology can also be utilized very efficiently for vehicles other than cars.

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