

## RFID Sensing & Its DATA Analysis Using Micro-Controller For Vehicle Security & Its Tracking

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### Abstract:

In this paper, the state-of-the-art technology for Vehicle Tracking (VT) and Vehicle Security (VS) using RFID is studied in reference to Indian scenario. The paper shows the basic and cheaper hardware which can be used for the VT & VS of the vehicle in Indian Market. However, the state-of-the-art technology for RFID is better for several reasons because of its numerous advantages which are also mentioned in this study. Apart from that the use of RFID and other technology for Tracking and Security is discussed separately which are discussed by several research groups within last decade. This paper represents the VT & VS using RFID EM-18 and found effective way of communication for the same.

**Index Terms** - RFID, Vehicle Tracking, Vehicle Security, Data Storage, Data Analysis, Modulation Index.

### I. INTRODUCTION

In the last decade, there has been a noteworthy amount of progress in intelligent transportation systems (ITSs). This is largely because of the recent developments in vehicle positioning technologies [1]. The significance of positioning system accuracy and reliability has increasingly been emphasized because of its vehicle guidance and safety related applications such as traveller information, route guidance, automatic emergency calls, freight management, advanced driver assistance, or electronic fee collection [1,2]. Global positioning systems (GPSs) are used in greater extent in vehicle positioning nowadays [1,3,4]. However, a GPS is not accurate and reliable navigation solutions because of signal interruption or blockage due to some obstacles [2,3,5,6]. As an alternative, there has been rapid development of wireless location technologies [7–10] in recent years, such as Wireless Local Area Networks (WLAN), Bluetooth, Ultra -Wide Band (UWB) and Radio Frequency Identification (RFID). Among them, RFID is the most popular and worthy of research efforts due to its merits of being non-contact, cheaper in cost, more accuracy, with long-distance communication and the capability of working in a diverse-environments [11–13]. RFID is an automatic identification technology that depends on remotely stockpiling and retrieving data using tags and readers. Anti-Theft System for Car Security using RFID: Vehicle hijacking or theft is becoming increasingly common nowadays. More number of car theft has pushed the creation of anti-theft systems [14]. Now, various technologies that ascertain sophisticated security in desire places and even in remote location. The security systems can be called to as automatic identification systems that is also by using RFID technology. This advance technology locates the identity of an object and automatically exchange the information of the object without any physical connection [15,16].

### System Overview [17]



*Fig.1 Overview of tracking system*

### II. Vehicle Tracking

Within a decade, traffic congestion has become a crucial problem. Early solutions attempted to lay more lanes to avoid congestion, but increasing number of lanes is becoming less and less feasible. So, to avoid this, an increasing reliance on traffic surveillance, has resulted in a need for better vehicle detection [18]. It can be used in probe vehicles to measure real-time traffic data to identify the area of traffic jam. It is very useful in an emergency case to quickly and

automatically report a vehicle location to a rescue agent when an accident happens to the vehicle [19]. The tracking system is also needed for Intelligent Transportation System (ITS) [20].

### 2.1 Existing Technology for Vehicle Tracking (VT)

There are various methods of Vehicle Tracking using GPS, RFID, GSM etc. In recent years Vehicle Tracking and Safety both have become utmost important for security reasons as well as Human safety emergency. Here, various methods of VT and VS are discussed for researchers to choose them in accordance with need.

#### 2.1.1 GPS

The Global Positioning System (GPS) requires more than 20 satellites, which allows for accurate position triangulation [21]. GPS technology is principally used in vehicles in order to aid route planning and vehicle position estimation. The elementary requirement for effective GPS triangulation is direct line-of-site. Contemporary infrastructure, like skyscrapers in urban areas and underground tunnels, can effectively thwart all GPS signals, which indicates that effective position triangulation will not be achieved. Multi-path effects could also remain, due to the skyscrapers in dense urban locations [22]. In addition to the drawbacks listed above, an updated map database is also a requirement for accurate vehicle location [22].

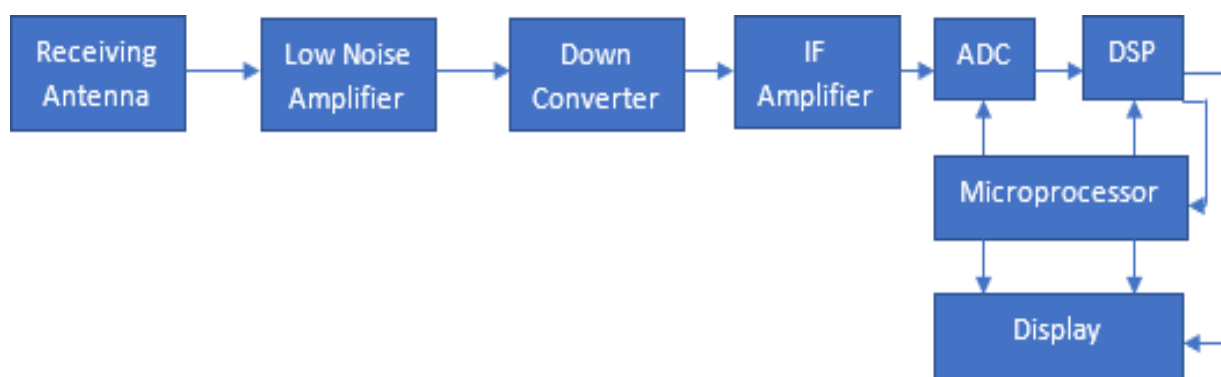


Fig.2 Block Diagram of GPS

#### 2.1.2 RFID

RFID is a technology which uses communication by using radio waves to transfer data between a reader and an electronic tag attached to an object to carry out identification and tracking. RFID makes it possible to give each product in a grocery store its own unique identifying number, to provide assets, people, work in process, medical devices etc. all with individual unique identifiers - like the licenseplate on a car but for every item in the world.

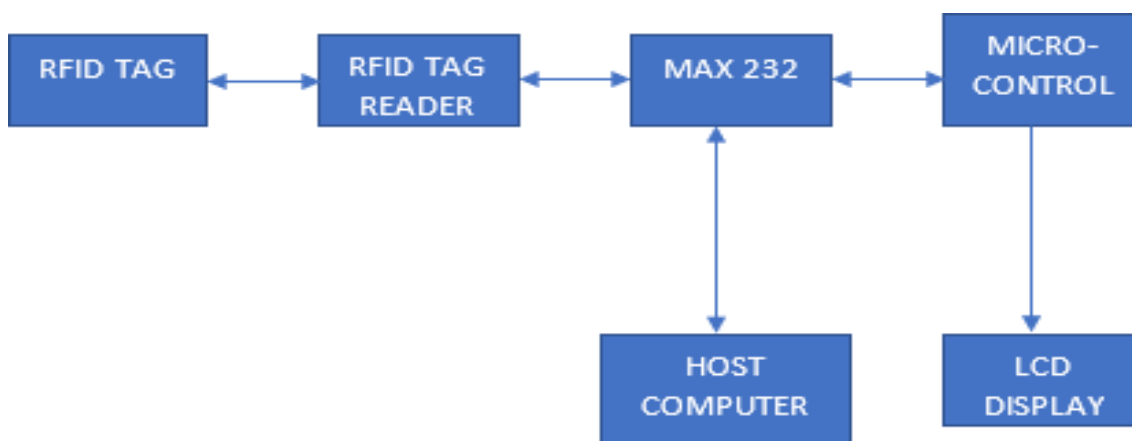


Fig.3 Block Diagram of RFID

RFID tags send its data to the RFID tag reader using amplitude modulation. The reader is connected either through wire or wireless to the host-microcontroller or computer. Every time RFID signal can be read anywhere on the vehicle by the reader using particular frequency. Theoretically, a propagation model can be applied to estimate the distance between the RFID reader and a tag depending upon the signal strength of the RFID tags. In obstruction less space, the Friis transmission equation [13] shows that the signal strength level decreases at a rate inversely proportional to the distance

travelled. The relationship between Received Signal Strength (RSS) and Distance

$$P_0 = P_i \frac{G_i G_0 \lambda^2}{16L\pi^2 r^2} \dots \dots \dots (1)$$

Here, power received by receiver antenna is  $P_0$ , the power input to transmitter antenna is given by  $P_i$ , transmitter antenna gain can be given by  $G_i$ , receiver antenna gain can be given by  $G_0$ , loss factor can be given by  $L$ , wavelength is  $\lambda$  and the distance between transmitter antenna and receiver antenna is given by  $r$ . Based on this relationship and if the value of RSS is known, we can calculate the distance between the RFID tag and the reader. In vehicle applications, the parameters of this model must be determined in a specific environment by statistical analysis of the experimental data [23].

### 2.1.3 GSM Network

Localization and tracking can be achieved with GSM technology [24]. Global System for Mobile communication (GSM) can be integrated with GPS technology to overcome the limitations of a standalone GPS system [25]. GSM technology can be used as the communication platform for the system, in which collected data can be stored in the cloud [25]. A GSM module which allows for the position information along with the vehicle ID, to be transmitted to a central server [25]. The improvement in vehicle tracking is the development of an integrated system using GPS technology for locating and GSM technology to transfer GPS coordinates to a central server and database system [25]. This system is made up of a tracking system which is implemented on buses, a display system which is installed at bus stops, and a base station which facilitates the remote monitoring of data.

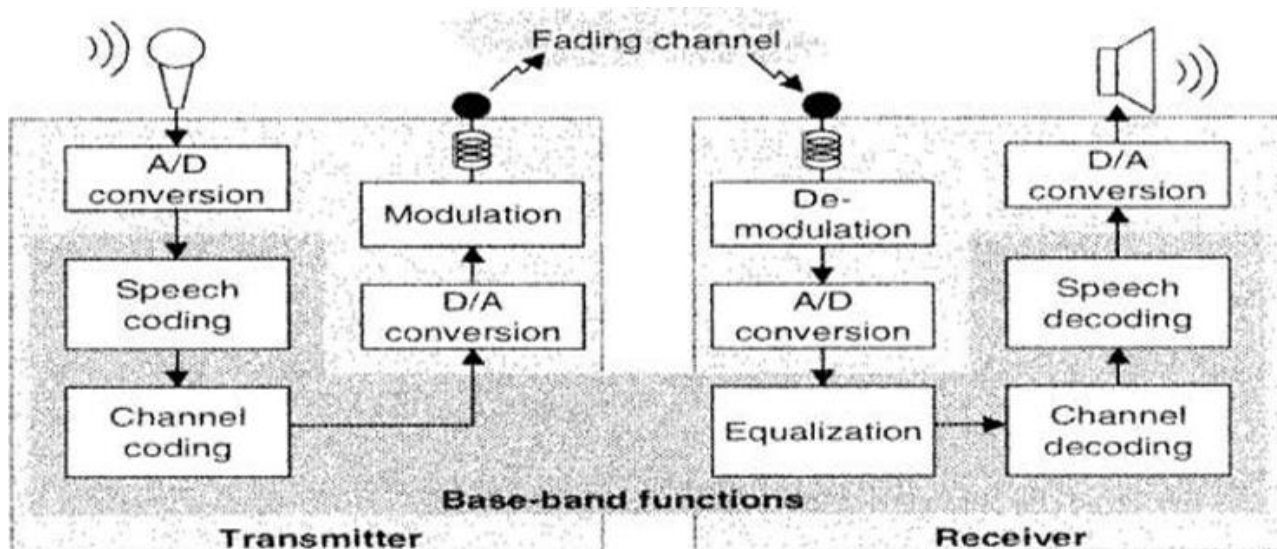


Fig.4 Block Diagram of GSM

### III. Vehicle Security

A report by Tech Crunch [14, 26] stated that United States Citizens lost one smart phone yearly, on average which resulted to 30-billion-dollar loss in 2012. This indicates the necessity to develop a system that will afford car owners to be conscious of possible case of intruder. The term anti-theft system is a technology which is used for protecting and lessening theft action [14, 15]. In past, conventional setting up of security personnel to guard vehicles was the practice [14-16]. In addition, some part of the technology can be attached to a vehicle with an anti-theft system to identify its location when it is stolen [27]. Quicker location of vehicle allows faster security response for both travelers and driver [28].

#### 3.1 Existing Technology for Vehicle Security (VS)

Vehicle Theft has been serious concern for all citizens. So, antitheft systems or vehicle security system are in need and growing exponentially. At present Smart Card, CCTV as well as all existing Technology for VT are used for Vehicle Security. Some of them are discussed here with working methods.

### 3.1.1 RFID for Security

RFID system is something similar to magnetic strip or barcode. Being similar to barcode or magnetic strip, to get identifying information, RFID systems have to be scanned [29]. The Technology of RFID is developed in various sectors for Security and Anti-theft systems. The data of RFID can be utilized by IOT, IOE and Vehicle Security Systems [30]. An approximation to the useful range of a RF transmitting system is given by:

$$d_i = \frac{2\pi h_i h_0}{\lambda} \dots \dots \dots (2)$$

So, here  $d_i$  is the range of transmitting system,  $h_i$  is the height of emitter from ground level,  $h_0$  is the height of receiver from the ground and  $\lambda$  can be given as wavelength of RF signal.

### 3.1.2 Smart Card

As shown in the Fig. 4, smart card is embedded into a plastic enclosure which is used in data storage system that has microprocessor which provides additional computing capacity [14]. The memory which it has is programmable for recording user defined data. Smart cards can be subdivided in terms of their memory and integrated microprocessor. Encryption mechanism is used for the protection of data. Also, when new application is made available to the public, update of data can be obtained, even after purchased by user. They are extensively used in financial sector for making less costly and safe financial transaction. However, to maintain this technology is costly and also, it is sensitive to corrosion, and dirt [15].



*Fig.5 Smart Card*

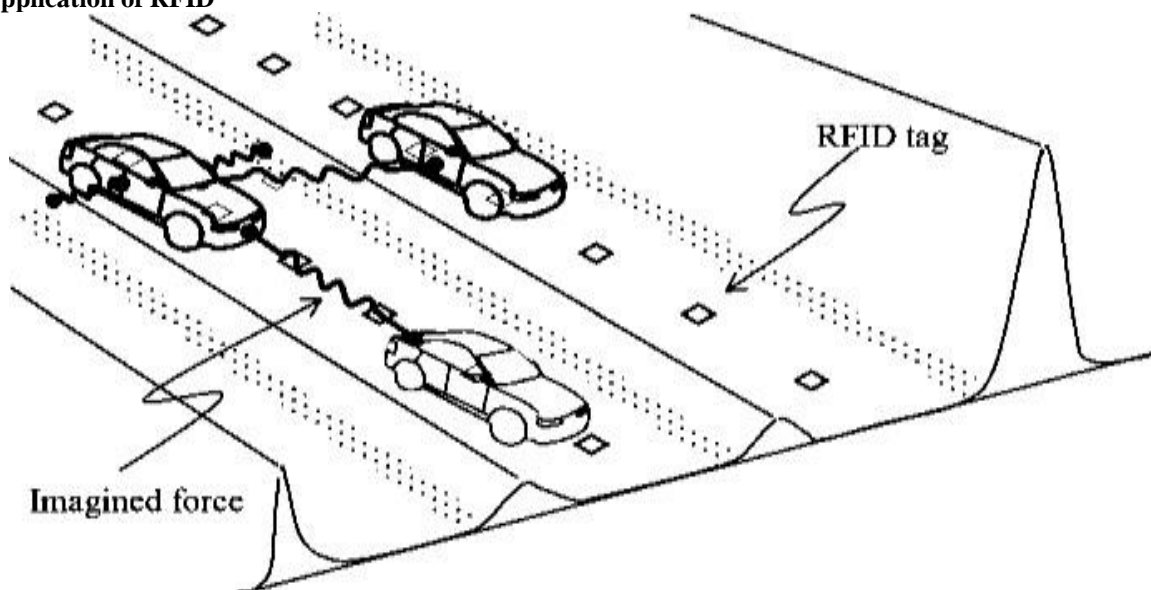
### 3.1.3 Closed Circuit Television (CCTV) System

The CCTV surveillance in Traffic, Parking zone helps to identify Vehicle Tracking as well as in Security as shown in Fig.5. The CCTV camera has been installed extensively in places like department stores, small groceries, shopping malls, school communities, within cities and towns, financial institutions and many more. This technology has contributed greatly for the improvement of security and surveillance work in busy places and even remote locations. Nevertheless, deploying CCTV is quite costly and as such organizations are gradually shifting attention to cost effective technology [28].



*Fig.6 CCTV in Parking Zone*

#### IV. Application of RFID



*Fig.7 Application of Vehicle Positioning and Connected Vehicle*

Under normal situations, if a vehicle checks-in to a parking-lot without RFID notification, then after that vehicle will not be able to check-out. In that way, unauthorized entries will be averted. If a checked-in vehicle does not get checked-out, it won't be able to check-in to any of the parking lots in the city in the centralized system. With this system an automatic income reporting and a centralized vehicle monitoring will be possible. Without stopping the vehicles, check-ins and check-outs will be possible [31]. Because of RFID system a flexible, scalable and competitive solution for pharmaceutical drug delivery has been developed [32]. With the help of optimized RFID, intelligent delivery van of pharmaceutical drugs delivery time and reliability increases as data is collected to centralized system without any human involvement. To add on, a route is developed according to cargo loads with the help of optimized RFID system and dealers or customers can track their orders. So, it represents a successful experience of using Ambient Intelligence environments in a viable way to resolve a real logistic need [33]. Many innovative applications have been tested or under the working, including cooperative collision warning [34-36] intersection safety supporting [37], intersection movement assist and many more. In these applications, real-time vehicle positioning is supposed in their algorithms and protocols for motion guidance, operational control, and interaction with other vehicles. With accurate data regarding positions and speeds of connected vehicles, it is viable to synchronize these vehicles on one or more special, managed lanes at higher speeds without waning safety. Such a model is illustrated in above Fig.7. RFID tags on the ground point out the location of each vehicle which is equipped with a tag reader. When a vehicle passes over a tag, the reader can receive the position information stored in the tag. Thus, this kind of RFID positioning can help by providing real-time, accurate vehicle positions and speeds information [38]. The RFID tags can be used on the numbering plates of the vehicle [39]. So, it becomes easy to find any lost vehicle [40]. The information collected by the reader can be aggregated through LAN or WLAN and processed in the server to find out the thief [41]. RFID technology can be used for monitoring purpose to avoid theft as well [42]. RFID tagging of cars is offered as an alternative method to control the traffic through the data is collected from inductive loops placed beneath the road surface. The information about the traffic collected by the reader tags then the data collected from reader tags is used to control traffic at cross-roads or critical points in the city [43].

RFID tags are extensively used in identification badges by replacing earlier magnetic stripe cards. RFID can also be used in the shopping centres. To add on, Logistic and transportation are the main areas of implementation of RFID. Additionally, it can also be used in the Libraries to manage books. Moreover, RFID can be used to get accurate stopwatch readings for every instant in the race from race start to race end timings.

V. Flow Chart

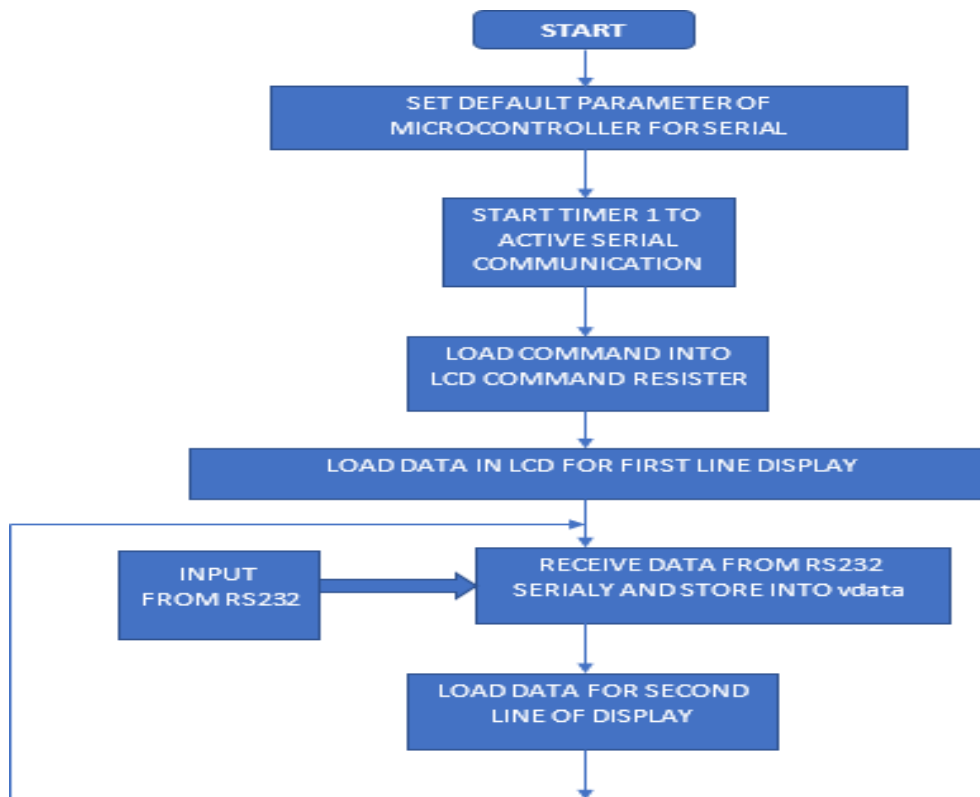


Fig.8 Flow Chart of RFID

The Fig.8 shows Flow Chart for the VT and VS using RFID. Here, RFID module EM 18, RFID tag, 89C51 Microcontroller with MAX232 is used with voltage regulator 7805 and LCD display 16 X 2. The circuit Diagram is shown in Fig.8. C programming is done with microcontroller and implemented successfully with following steps.

VI. Circuit Diagram of RFID

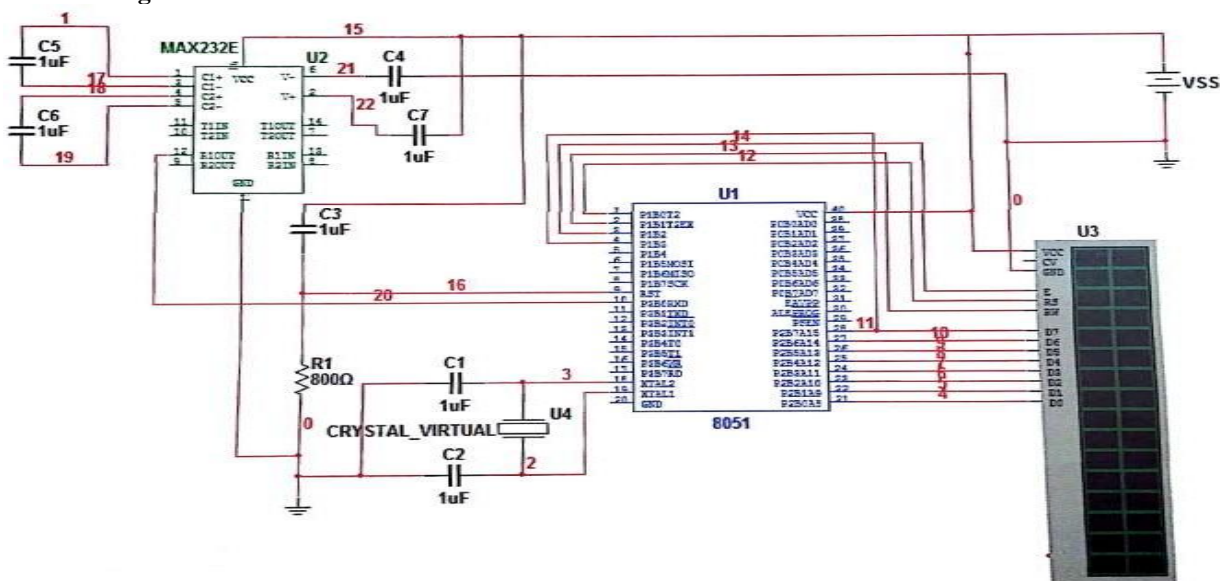


Fig.9 Circuit Diagram of RFID

## VII. Steps to Operate

Host Managers Readers and issue commands, Reader and Tag communication via RF signal, Carrier signal generated by the reader (upon request from the host application), Carrier signal hits Tag(s), Tag receives and modifies carrier signal, “send back” modulated signal (Passive Backscatter-FCC and ITU refer to as “field distribution device”), Antennas receive the modulated signal and send them to the Reader, Reader decodes the data, Results returned to the host application.

## VIII. Advantages of RFID

There are many advantages of RFID based VT and VS, some of them are RFID tags can be read at much greater distance, the range to read a barcode is much less. This system can be extensively used in place of barcode system. Barcode readers require a direct line of sight to the printed barcode whereas RFID readers do not require a direct line of sight. Reading speed of RFID tags are much faster as compared to Barcodes. RFID can be implanted in the product itself. RFID has greater data capacity. RFID has read/write capability whereas Barcodes have no read/write capability.

## IX. Conclusion

Though RFID system is costly and complex, it gives better results with compact and efficient vehicle tracking. It purely depends on samples of RFID modulation. Sometimes, momentarily more than one RFID tags responds which is to be simplified using particular frequency between 900KHz to 1500MHz. This is implemented on two-wheeler or four-wheeler with higher accuracy.

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