# *RFID Based Vehicle Identification During Collisions*

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***Abstract* - The RFID (Radio Frequency Identification) based collision detection basically uses collision sensors to detect a collision between two vehicles. Once a collision is detected, RFID readers on both vehicles are activated and they extract vehicle details from RFID tags. This system makes it easier for vehicle owners to track down rash drivers in hit and run cases. The details extracted can also be used for insurance claims, as court evidence, etc.**

***Keywords- collision detectors, vehicle identification, RFID applications, vibration sensors***

## I. INTRODUCTION

In recent years, with the number of vehicles on the roads increasing exponentially, vehicle safety has become of utmost importance. The demand for auto-safety features and crash rating systems has gone up and this has led to the development of sophisticated technologies.

The idea behind the development of RFID (Radio Frequency Identification) based vehicle identification is that vehicle details can be exchanged during a collision and this makes it easier to track down the transgressor. This is a microcontroller based system and uses an RFID reader, tag and collision detector.

## II. EXISTING TECHNOLOGIES

Leading manufacturers of RFID systems have developed vehicular technologies that allow vehicle identification at toll booths, checkpoints, parking lots, etc., using the RFID tags embedded in the vehicle.

3M, a leading provider of RFID technology for motor vehicle services and systems worldwide, has developed the Automatic Vehicle Identification system (AVI). The AVI is an integrated, total solution that utilizes RFID to electronically identify vehicles and validate the identity, status and authenticity of vehicle data for a specific application.

The use of RFID for vehicle identification has already been implemented worldwide. The use of RFID for toll collection [10], traffic management [13] and parking lot management [12] has already been experimented with extensively.

This project goes one step ahead by using this identification technology to track vehicles in cases of motor vehicle accidents. By using a collision sensor, an ID system has been designed that is activated only during a collision.

## III. BASIC PRINCIPLE

When two cars collide, they must exchange registration numbers and other required details. These are to be stored on microcontrollers on both cars. This is the basic idea behind the project.

To enable the exchange of information between the two cars, RFID techniques have been used. Each car has its details on an RFID tag placed somewhere on its surface. Each car also has its own RFID reader which is activated in case of an accident.

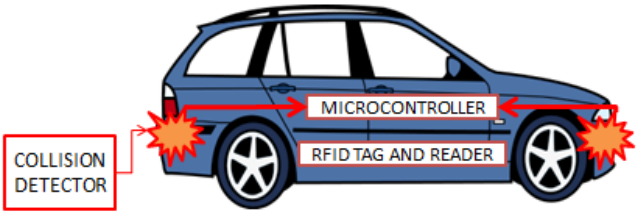


Figure 1: Overall System

Collisions are detected by the collision sensors that are located on the front and rear of both cars. During an accident, the output of the collision sensor activates the readers on the both cars to note the details of the other car.

Hence, essential details are exchanged during collisions. The level of collision that is considered to be an accident can be adjusted using the microcontroller.

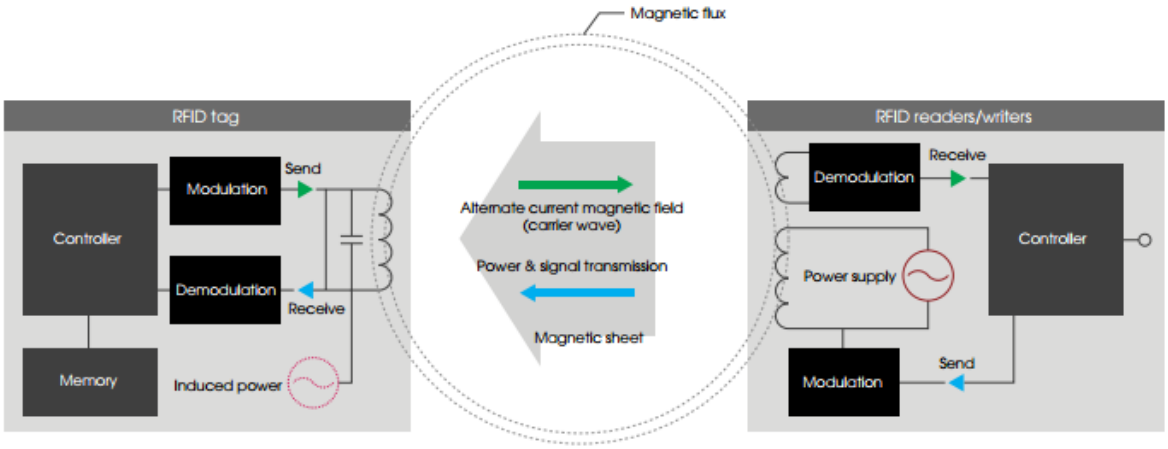


Figure 2: Typical model of communication of the 13.56MHz RFID System with a tag and reader

## IV. COMPONENTS

### A. RFID Tag and Reader

Radio frequency identification (RFID) is a generic term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object or person wirelessly, using radio waves. A typical RFID tag consists of a microchip attached to a radio antenna mounted on a substrate. The chip can store about 2kB of data. Data stored on the RFID tag is retrieved using a reader. A reader is a device that has one or more antennae that emit radio waves and receive signals back from the tag. The reader then passes the information in digital form to a computer system.

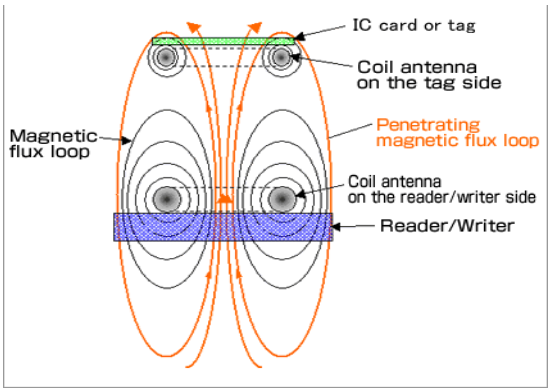


Figure 3: Working of RFID in the absence of metal

Generally, tags are not placed on metal surfaces since metal reflects the RF. Since the system requires the placement of tags on the metal body of a car, special metal-mount tags need to be used. These tags reduce the eddy currents produced by the metal surface using a magnetic shield between the tag and the metal. This magnetic shield attracts the flux causing it to pass through the tag before being reflected by the metal surface. The NOX-TM4 is the tag that is best suited to the proposed system. It is small, durable and has a range of up to 15 feet. The NOX-TM4 is encased in a durable material which is designed to withstand impact and intense heat. Hence, it is ideal for use in cars.

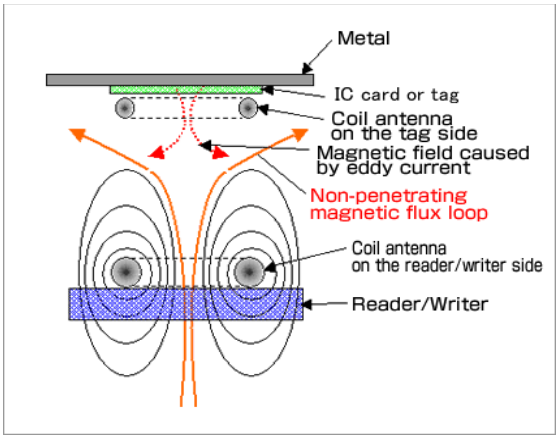


Figure 4: Communication failure caused due to presence of metal sheet

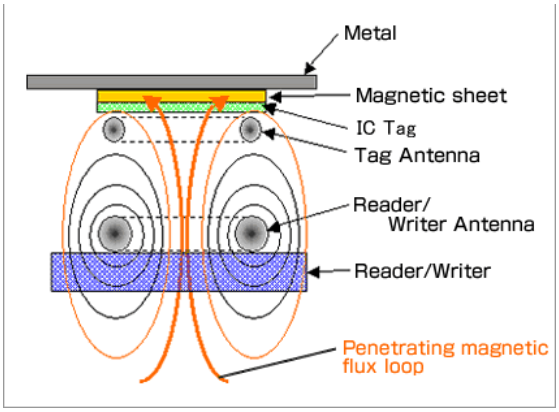


Figure 5: Use of magnetic sheet to nullify effects of metal sheet

### B. Collision Detector

A collision sensor is an electronic device that measures and quantifies a stimulus and converts it into a measurable electronic signal.

When a car hits something, the car's bumper is pressurised. Depending on the amount of pressure on the bumper, the impact will be detected by a collision sensor. The collision sensor then triggers an electrical current, which is directed to an analog input pin of the microcontroller.


Figure 6: Piezo vibration sensor chip

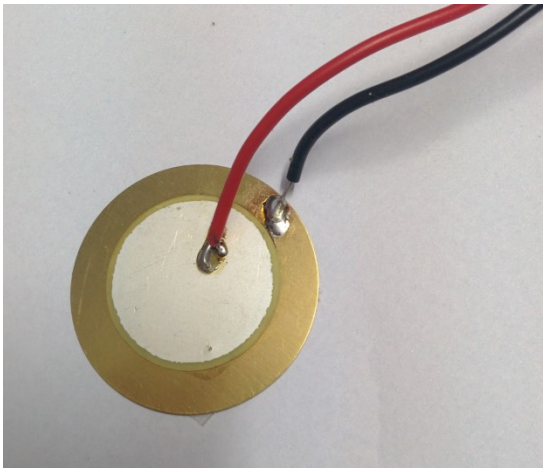

Figure 7: Simple piezo sensor

This project uses the piezo sensor chip, depicted in Figure 7, which converts applied pressure to voltage based on the intensity of pressure. The sensor is a thin strip of piezoelectric material on a circular metal plate. When stressed, it produces a voltage spike of up to 3V.

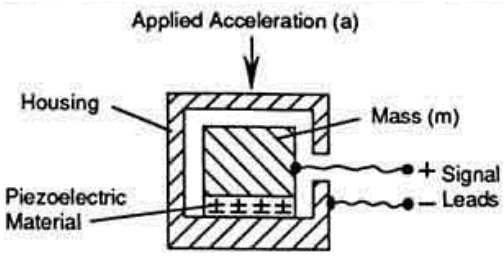


Figure 8: Working of a piezo sensor

### C. Microcontroller

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory and programmable input/output peripherals. The main function of the microcontroller is to decide when a collision has occurred and appropriately activate or deactivate the RFID system.

Above a certain threshold current, the microcontroller triggers the RFID reader to extract information from the RFID tag of the colliding vehicle.

## V. BLOCK DIAGRAM

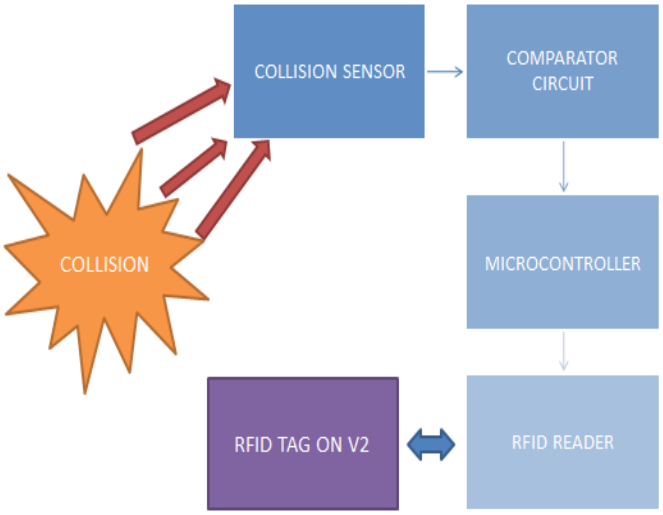


Figure 9: Block diagram of the system

## VI. TESTING THE PROTOTYPE

The prototype was set up with unidirectional data transfer. When Vehicle 1 collides with Vehicle 2, the reader on Vehicle 1 reads the data stored on the tag of Vehicle 2.

When Vehicle 2 hits Vehicle 1, the piezo sensor on Vehicle 1 is stressed and it produces a voltage spike of about 2-3V. On the occurrence of the spike, the reader is activated and it reads the data on the tag of Vehicle 2. This data is stored on the microcontroller of Vehicle 1.

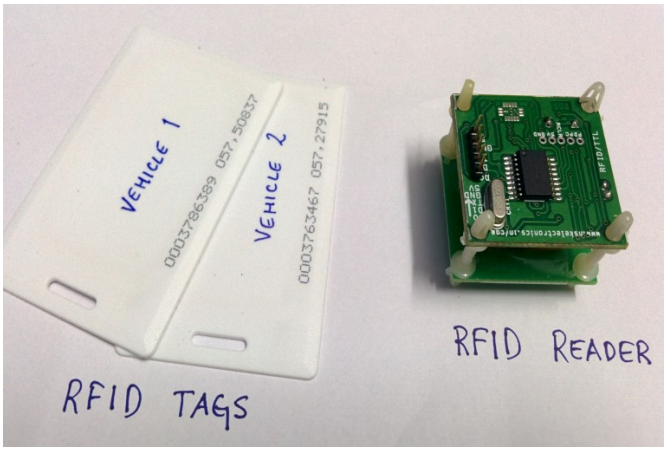


Figure 10: The tags and reader used for the prototype

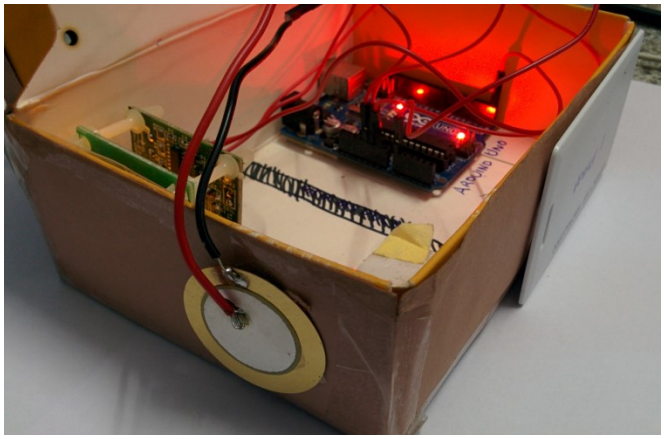

Figure 11: Interior view showing the components of Vehicle 1

Threshold output voltage of the piezo sensor was set to 0.8V. For any impact that causes a spike above 0.8V, the reader is activated and the tag on the nearest vehicle is read. The threshold can be decided accordingly when used practically.

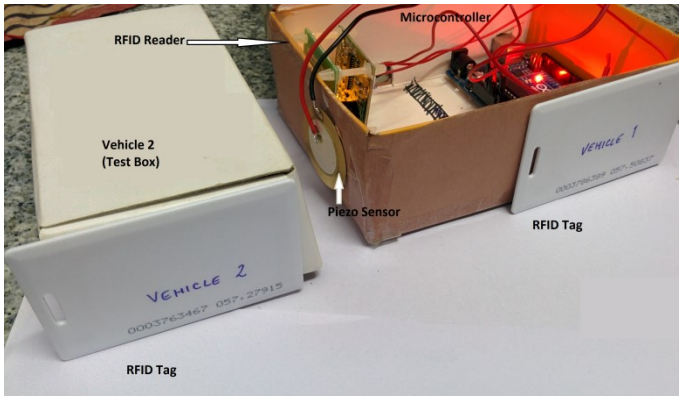


Figure 12: Final prototype with Vehicles 1 and 2

## VII. APPLICATIONS

The RFID based vehicle identification system can be used to track down rash drivers in hit and run cases. It can be used for insurance claims when a vehicle has been damaged. The microcontroller of the system can also tap into the ECU (Electronic Control Unit) of the car to record the vehicle speed at the time of collision. This can serve as evidence in accident cases. This data can also provide driving patterns to a traffic police officer in case of any violation. Ultimately, this motivates people to drive safe.

## VIII. FUTURE SCOPE

The use of RFID can be expanded in this sphere to develop smart vehicles. The RFID technology can be integrated with NFC devices (Near Field Communication) to make payments at petrol pumps, payment of fines etc., and also record these payments for future use. For example, a traffic police officer with an RFID reader can access previous fine and payment details of a vehicle from the RFID tag located near the rear of the vehicle. Using NFC, the officer can also book the vehicle in case of any violation. This becomes a digital record that can be accessed by any authorized officer. Also, fines can also be paid by the driver, directly from his bank account, the details of which are also stored in the tag. The driver is only required to enter a pin to approve the transaction. This technology can also be used to make payments at petrol pumps, service centres, etc. This makes the whole process convenient as well as secure.

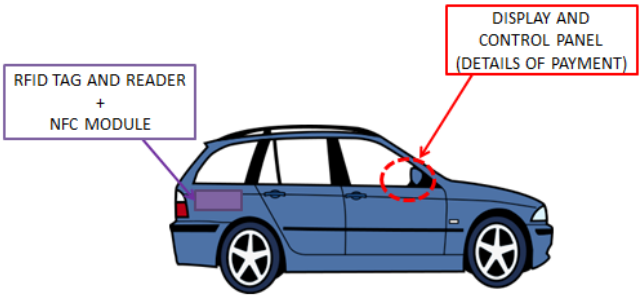


Figure 13: Use of NFC to make payments using RFID tags

With further developments, the system can also be used to determine the guilty party in an accident. This can be done by tapping into the data of the ECU of the car to note the speed at instance of the collision. Linking the system to the ECU will also give it access to information to driving patterns. These can be analysed by the police in case of accidents or during routine checks.

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