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# RFID Based Embedded System for Vehicle Tracking and Prevention of Road Accidents

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***Abstract:*** *In the era of embedded systems time and efficiency are a matter of priority . RFID (Radio Frequency Identification) emerges as one of the converging technologies and transportation plays an important role in urbanization, RFID is one of the key catalyst playing a significant role in it. RFID plays major role in auto ID applications like RFID contact less smart cards used by bus riders, in Super market, Textiles and logistics chain management. This paper aims to understand the benefits of RFID technology possibilities to reduce the accidents on Indian roads. The Global System for Mobile Communications (GSM) has been a great success in providing both voice and low speed data services. The Enhanced Circuit Switched Data on GSM (ECSD) is one of the major evolutionary steps to serve real time high speed data services.*

*Population explosion is the source of so many issues, one among them is transport. In this paper, we propose a novel method to tackle trasport related issues. Applications such as vehicle tracking, accident alert are explained in this paper.*

**Keywords:** ***RFID, GSM, RFID Reader, SMS (Short Message Service), and Microcontroller***

## I. INTRODUCTION

This fast paced World is with number of transport related problems. RFID technology can be effectively used to solve some of them. Some of the problems that require immediate attention are accident risk management, environment alert, traffic rule violation control, vehicle theft identification and traffic signal management. RFID tags are placed on the road giving area information and environment alerts (such as school zone, industry, market, bridge etc.). One RFID is placed in vehicle with owner info, RC book, insurance details, service details etc. to send vehicle identification to traffic information database. RFID reader will be placed with embedded controller in vehicle, Toll Gates, Parking areas and also in traffic signal areas

We used GSM module with embedded unit in the moving vehicle to transmit accident information to different points. Whenever vehicle meets with an accident, the system reads area information from RFID tags placed on the road and transfers this information to embedded module. The details are transmitted to the specific numbers stored in database (Police station, Owner and Hospital). Additionally, vibration sensor activates air bags such that severe accident to the driver driving the vehicle can be avoided and transmits this emergency situation to owner, police control office and hospital through SMS .

Whenever the vehicle crosses the particular road area, the data from Vehicle tag is read and based on the location, an SMS regarding location of the vehicle will be sent to the owner. Vibration/Impact sensors are added to trigger our system, when the vehicle is met with accident. Special zone information can be programmed in active tag and this information is transmitted to RFID reader connected with vehicle embedded kit, it alarms driver about the zone.

### A. RFID

**R**adio frequency identification (RFID) technology has been in use for decades. Only recently, lower cost and increased capabilities made RFID technology to be a commercially viable one. There seems to be developments in support of the movement of inventory tracking and supply chain management toward RFID.

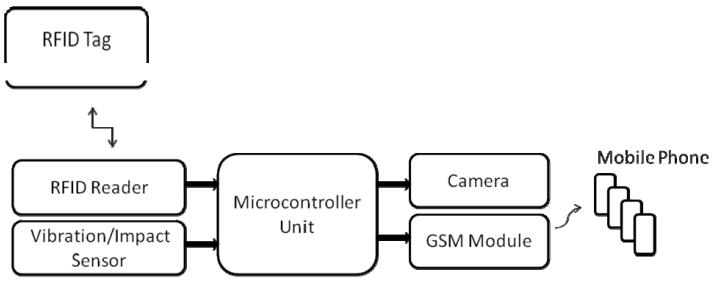



Figure 1. Model System for RFID implementation

Radio frequency identification (RFID) is a system that transmits the identity of an object using radio waves. This identification is transmitted in the form of a serial number that distinguishes each object from the other. The RFID system is composed of a RFID reader and a Tag. The tag is composed of a microchip connected to an antenna; microchip can store a maximum of 2 kilobyte of data, which can include information about the product, the manufacturing date, the destination among other information. In order to retrieve the data stored in the tag we need a reader, which is a device that emits radio waves, these radio waves are received by the tag which

activates the microchip and then the data get transmitted.
The tags can be distinguished by their mode of operation as follows:

**Read Only Tags** - This type of tags has information stored on them during the manufacturing process, and this information cannot be changed.

**Read/Write Tags** - This type of tags has separate writable memory areas. This is a very important feature because the information contained in the microchip can be written and after that changed, especially if the information changes overtime [5].

**WORM Tags** - WORM tags stands for Write Once - Read Many. The information contained in this tag can only be changed once, but can be read as many times The RFID tags contains two parts, one part is the integrated circuit for storing and processing the data, modulating and demodulating radio frequency signal, and the other part is the antenna for receiving and transmitting the signal. These tags can operate on many levels of frequency ranging from 125 KHz until 915 MHz.

There are three main types of RFID tags, which are:

**Passive Tags** - The tags have no internal power supply; therefore the microchip is in sleep mode, until the tag is in the range of the reader, where the reader sends electromagnetic waves, these waves "wake up" the microchip where it converts the waves into digital data using modulators and send it to the reader.

**Active Tags** - The tags have their own internal power supply, which is used to power the integrated circuits and to transmit the data to the reader. Communications from active tags to readers is typically much more reliable than the communications from passive tags to readers. In addition to the power supply the active tag can have on- board electronics such as sensors, I/O ports among others that are powered by the on-board power supply. With this feature the active tags can be used in much more applications than the passive tags. The read range of the tag can reach 100 meters.

**Semi-Passive Tags** - The tags lay between the passive and the active tags, because they have a battery to power the integrated circuit however they use the power from the electromagnetic waves that the reader sends in order to retrieve the data present on the tag.

### B. TECHNICAL OVERVIEW

RFID is an auto ID device like Barcode, Smart cards, Biometric technologies (Retinal scans) and optical character recognition etc. Special feature of this technology is that there is no need of line of sight reception as required in some other technologies.In RFID systems the items are marked with tags. These tags contain transponders that emit messages readable by specialized RFID readers. Most RFID tags store some sort of identity number; for example a customer number or product code. A reader retrieves information about the ID number from a database, and acts upon it accordingly.

RFID tags can also contain writable memory, which can store information for transfer to various RFID readers in different locations. This information can track the movement of the tagged item, making that information available to each reader.RFID tags fall into two general categories, active and passive, depending on their source of electrical power. A ctive RFID tags contain their own power source, usually an on-board battery. Passive tags obtain power from the signal of an external reader. RFID readers also come in active and passive varieties, depending on the type of tag they read. Then based on their frequency range of transmission it is classified as LF, HF, VHF and UHF tags.

### C. GSM

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is a common European mobile telephone standard for a mobile cellular radio system operating at 900 MHz. Throughout the evolution of cellular telecommunications, various systems have been developed without the standardized specifications resulting in many problems directly related to compatibility. The GSM standard is intended to address these problems. In the current work, SIM300 GSM module is used. The SIM300 module is a Triband GSM/GPRS solution in a compact plug in module featuring an industry-standard interface. It delivers voice, data and fax in a small form factor with low power consumption.

## II. DESIGN AND IMPLEMENTATION

In the current work we have designed following operating points. One is on road unit, the second is vehicle unit, the third is traffic signal controller unit, the fourth is parking slot controller unit, the fifth is tollgate unit and sixth is alert receiver unit.

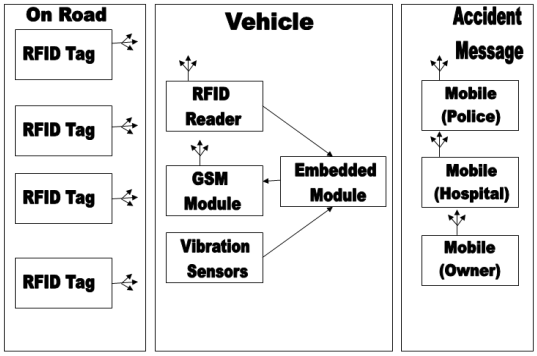



Figure 2. Vehicle tracking and Accident alert system

### A. Section 1 - On road unit

In this unit we can have 'N' number of RFID tags to transmit general area information and alert on special zones like school, hospital, weak bridges and zigzag bends etc., UHF Semi passive tag is used in our application. Its coverage is a maximum of 50 Meters with 64 Kbits of memory operating at 902 MHz range. The location information and driver alert information are stored in this tag. The alert information can be dynamically changed like damage in bridge, condition of road and new changes in road (one way or two ways and other diversion indications) etc.

### B. Sections 2 - Vehicle unit

These units consist of RFID reader, vehicle

information RFID Tag, 8051 embedded module and GSM module. Here we have used SIM 300 GSM module to transmit alert data to the mobile receivers already configured. RFID reader and GSM are connected to receive and transmit of the serial port in embedded module. The total controller program is developed in embedded C language and is downloaded into the memory for operation. Here we use semi passive tag to transmit vehicle database like insurance details (renewal date and expiry date), RC book and license etc., to traffic organizers. This data is collected in the RFID reader enabled traffic signal areas. This controls traffic issues like insurance non payment and also used to manage traffic signal in intelligent way. Digital camera also connected with our embedded module to take photos about accident and it can be sent as MMS. This will be useful for investigation and for security reasons to avoid theft in accident place.

### C. Section 3 – Alert receiver unit

This unit is nothing but alert receiving mobile phones programmed in the embedded module. It may be owner of the vehicle, the hospital emergency care and the police station information number. Short script message or voice message will be sent to the receivers.

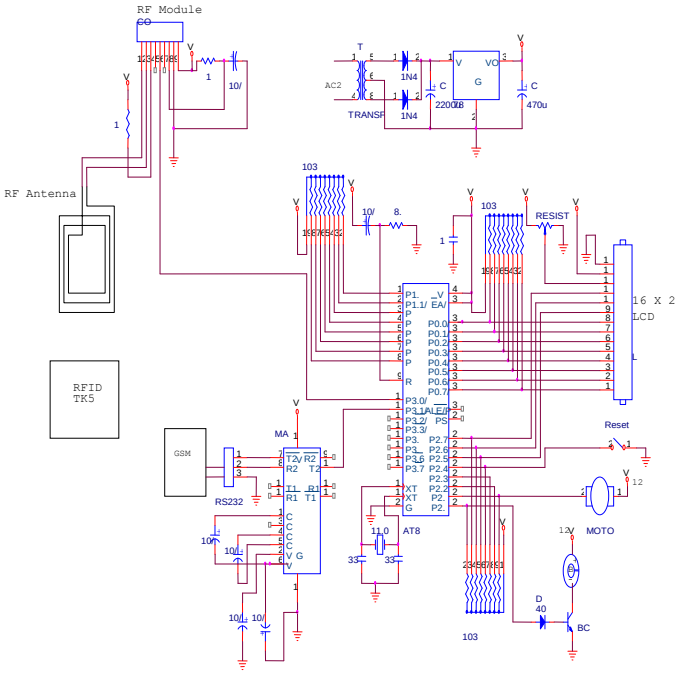
## III. IMPLEMENTATION

We have used Atmel C 52 microcontroller as a base device. GSM module and RFID reader is connected with serial port of the controller also vibration sensors and camera is connected. Whenever vehicle meets with an accident the vibration sensor triggers the embedded module for rescue operation. Embedded module gets area information from RFID reader module and the alert information is sent through the GSM module. RFID reader gets an area information form RFID tags on the road unit.

RFID reader is connected to Receiver (Rx) of the serial port and GSM Module is connected to transmitter (Tx) of the serial port. The digital camera is which is connected with the system will act as black box and it will be triggered on during the accident. Special zones like School, Hospital, Zig Zag bends and weak bridge etc., are programmed in the RFID tag and whenever vehicles crossing that area, embedded module will alert the driver to reduce acceleration. This will control accident ratio.

In addition to embedded module one special RFID Tag is placed inside vehicle to transmit vehicle information. In the traffic signal management system RFID reader and display informer unit are connected with serial port of the microcontroller. If vehicle insurance, pollution test, FC is not proper, the alert system will produce beep sound and vehicle number is displayed. Then the traffic police can easily alert the driver / owner.

## III. SCHEMATIC DIAGRAM




### A. Micro Controller (AT89C52)

The AT89C52 is 80C51 microcontrollers with 128kB Flash and 1024 bytes of data RAM.A key feature of the AT89C52 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI.

The Flash program memory supports both parallel programming and in serial In-System Programming (ISP). Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible. The AT89C52 is also In-Application Programmable (IAP), allowing the Flash program memory to be reconfigured even while the application is running.

### B. Functional description

Power-On reset code execution

Following reset, the AT89C52 will either enter the Soft ICE mode (if previously enabled via ISP command) or attempt to auto baud to the ISP boot loader. If this auto baud is not successful within about 400 ms, the device will begin execution of the user code.

### C. In-System Programming (ISP)

In-System Programming is performed without removing the microcontroller from the system. The In-

System Programming facility consists of a series of internal hardware resources coupled with internal firmware to facilitate remote programming of the AT89C52 through the serial port. This firmware is provided by Atmel and embedded within each AT89C52 device. The Atmel In-System Programming facility has made in-circuit programming in an embedded application possible with a minimum of additional expense in components and circuit board area. The ISP function uses five pins (VDD, VSS, TxD, RxD, and RST). Only a small connector needs to be available to interface your application to an external circuit in order to use this feature.

Input/output (I/O) ports 32 of the pins are arranged as four 8-bit I/O ports P0–P3. Twenty-four of these pins are dual purpose with each capable of operating as a control line or part of the data/address bus in addition to the I/O functions. Details are as follows:

Port 0 : This is a dual-purpose port occupying pins 32 to 39 of the device. The port is an open-drain bidirectional I/O port with Schmitt trigger inputs. Pins that have 1s written to them float and can be used as high-impedance inputs. The port may be used with external memory to provide a multiplexed address and data bus. In this application internal pull-ups are used when emitting 1s. The port also outputs the code bytes during EPROM programming. External pull-ups are necessary during program verification.

Port 1: This is a dedicated I/O port occupying pins 1 to 8 of the device. The pins are connected via internal pull-ups and Schmitt trigger input. Pins that have 1s written to them are pulled high by the internal pull-ups and can be used as inputs; as inputs, pins that are externally pulled low will source current via the internal pull-ups. The port also receives the low-order address byte during program memory verification. Pins P1.0 and P1.1 could also function as external inputs for the third timer/counter i.e.:
(P1.0) T2 Timer/counter 2 external count input/clockout
(P1.1) T2EX Timer/counter 2 reload/capture/direction control
Port 2: This is a dual-purpose port occupying pins 21 to 28 of the device. The specification is similar to that of port 1. The port may be used to provide the high-order byte of the address bus for external program memory or external data memory that uses 16-bit addresses. When accessing external data memory that uses 8-bit addresses, the port emits the contents of the P2 register. Some port 2 pins receive the high-order address bits during EPROM programming and verification.

Port 3: This is a dual-purpose port occupying pins 10 to 17 of the device. The specification is similar to that of port 1. These pins, in addition to the I/O role, serve the special features of the 80C51 family *B.*

## V. Kit Diagram

## IV.CONCLUSION

This project is designed as a system to give complete solution for transport related problems such as accident alert, Vehicle surveillance.

This project can also extended with small changes for Toll gate control, traffic signal control, traffic rules violation control, parking management, vehicle theft and special zone alert using the latest RFID technology. It is proposed as a low cost optimized solution using RFID and GSM mobile technology. This is in line with the developed countries like USA, England, German and Japan, where RFID, GPS and GSM technologies are widely used for traffic management. But in India we have not implemented any automated system for transport management due to prohibitive cost. Keeping this in mind I have proposed this system at low cost.

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