Vehicle Speed Violation Detection Using RF Communication

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***Abstract*—Radio frequency identification and detection (RFID) is an emerging technology that uses wireless radio to identify objects from a distance without requiring line of sight or physical contact. This study aims at assessing the feasibility of applying RFID for vehicle speed tracking purpose on the highway. Vehicle is given a unique identification by using binary coding. This identification number of the vehicle will be transmitted along with its information of speed by transmitter, which is fitted in the vehicle. This signal has been received by the receivers which are placed at regular distances and hence the vehicle speed tracking and its violation have been carried out.**

***Keywords*—Direct current (DC) Motor, Decoder, Encoder, H-Bridge, Peripheral integrated circuit (PIC) Microcontroller.**

I. Introduction

WITH the advancement of the technology, high speed vehicles arrived in the market which resulted in the accident and traffic rule violation. It is necessary to track the speed of vehicles. Tracking of these high speed vehicles became a concern for a traffic control authority.

In infrared vehicle tracking system, problem occurs when two vehicles run simultaneously; this problem can be eliminated by using RFID tracking system. Global positioning system is a costlier system to implement and its maintenance is also high and it does not work well while vehicle is running under the tunnel [1]. This problem is also eliminated by RFID tracking.

Other advantages of the RFID system are:-

- Since every vehicle is uniquely connected to the receiving database system, so presence of any obstacle (any other vehicle) does not produce any error.
- Radio frequencies are insensitive to the temperature.
- Since every vehicle emits its unique signal so running of two or more vehicles simultaneously does not affect the system.
- Since distance between the RFID tag (transmitter) and the RFID reader (receiver) is very less so the vehicle can be traced anywhere (under the tunnel as well).
- It does not require line of sight interference and line alignment as required by the other known technology.

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RFID is a unique identification device like barcode, smart card, optical character recognition, retina scan etc. In RFID system the vehicles are given unique identity tags. These tags contain transmitters that emit messages to the receivers which are placed at a regular interval of distances [2]. A reader receives information about the vehicles from the database and acts upon it accordingly. RFID tags can also contain writable memory which can store information to transfer them to various RFID readers placed at different locations. Vehicles can be tracked by using this information. Based on their frequency range of transmission RFID tags are classified as low frequency, high frequency, very high frequency and ultra-high frequency [3]. RFID reader falls into three general categories active, passive and semi-passive depending on their electrical power source. RFID transmitter composed of microchip, which detect speed of the vehicle and transmit it to the receiver. Transmitter microchip can store a maximum 2kB of data which can include information about the vehicle, its speed and location. Various types of transmitter tags are available for this kind of communication and can be operated on a frequency range from 125kHz to 915MHz. Basically there are three types of RFID tags: (a) Passive tags-They have no internal power and hence external electromagnetic signal is required to wake them up[4]. (b) Active tags-They have own internal power supply. Communication from active tags to reader is easy, accurate and much more reliable than communication from passive tag to the reader. Their applications are much more than passive tags because of having their own power supply. Read range of active tag can reach up to 1000m. c) Semi passive tags- The tag lay between passive and active tags. It has battery to power the integrated circuit and it can also be activated from the external radio waves.

In this paper, it has been proposed that a speed violating vehicle has been tracked by using RFID [5-7] communication. This can be made possible by installing electronic devices in the vehicles. It is the signal send out by the devices that enable user to trace and follow a vehicle. An RFID tag (having its unique address) is an object that can be applied to or incorporated in to a vehicle for the purpose of identification and tracking using radio waves. These radio waves are received by receiver and provisions are done regarding speed

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tracking of the vehicles [8]. If any violation of traffic rule is found then it informs to the traffic authority. This paper proposes the feasibility of this system using RF communication, information for vehicle detection and speed estimation, as a first step toward long term vision. To check feasibility of experimental setup, only one vehicle is used and its speed is tracked by RFID based speed tracking system.

II. HARDWARE DESCRIPTION AND OPERATION

Working of hardware operation has been explained as under.

A. Transmitter

Transmitter is fitted in a robotic car which can run at variable speeds. Fig. 1 describes the block diagram of transmitter. Speed sensor senses the speed of the vehicle and gives its output to the PIC microcontroller in the voltage form. Microcontroller interprets the speed of vehicle according to the voltage signal sent to it.

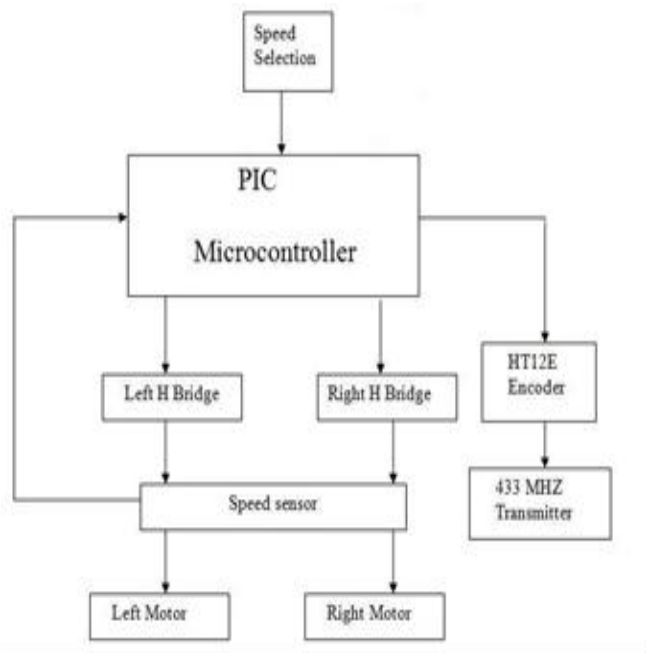

Fig. 1 Block Diagram of Transmitter

DC Power supply is given from a 12V battery to run the robotic car. Speed of the motor (car) is directly proportional to the current supplied to it.

A resistance of known value is connected in series with the motor of the car. Voltage drop across this resistance is connected to A/D pin of PIC microcontroller.

This voltage drop is directly proportional to the speed of the car. PIC microcontroller receives the voltage signal from the resistor, estimates the speed and sends the signal to the encoder in the binary form. Then the encoder encodes the binary signal and the signal is transmit it at the frequency of 433 MHz. The circuit diagram of transmitter is shown in Fig. 2.

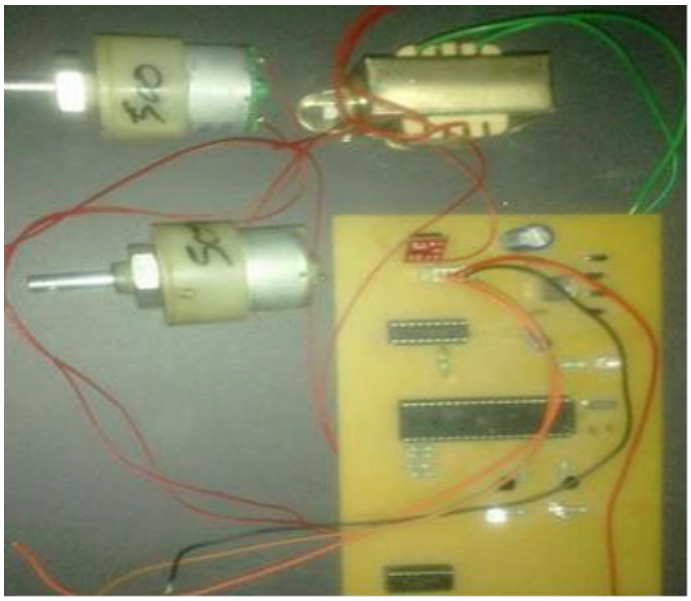

Fig. 2 Circuit Diagram of Transmitter

B. Receiver

Receiver receives the signal of 433 MHz frequency. Signal is decoded by the decoder and is converted into binary form [8]. This signal is sent to the PIC microcontroller in which speed of the vehicle is compared with the pre-defined speed limit of the vehicle. If decoded speed of the vehicle is found more than the defined maximum speed for the particular switching mode then the identity number of the vehicle will be displayed as a defaulted number to the reader (LCD screen).

The function of microcontroller flowchart is shown in the Fig. 3. It reads the input signal and decodes the speed, if the speed is greater than top speed then microcontroller will activate an alarm and display the over speed otherwise display the speed.

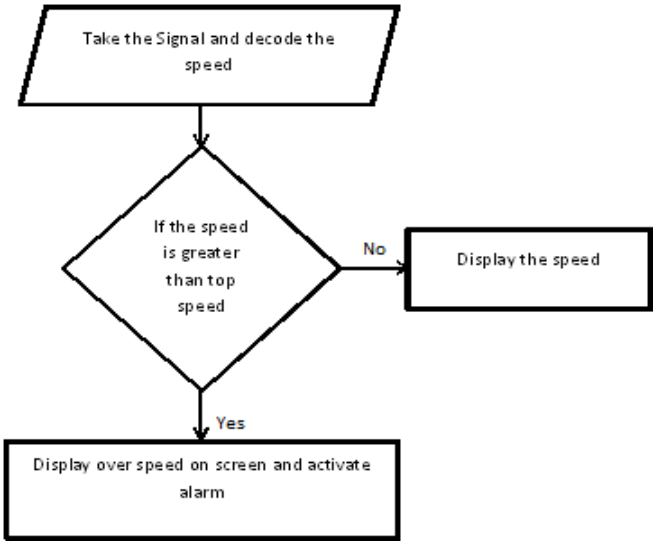

Fig. 3 Flowchart of Microcontroller Function

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The circuit diagram of receiver is shown in Fig. 4.

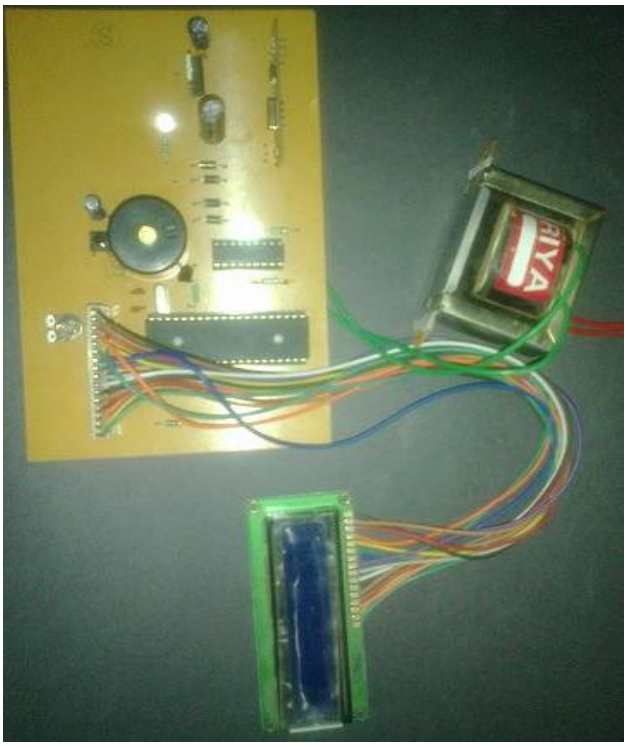

Fig. 4 Circuit Diagram of Receiver

Fig. 5 shows the block diagram of receiver in which 8051 microcontroller compares the speed of vehicle with the maximum allowable speed of the vehicle [10].

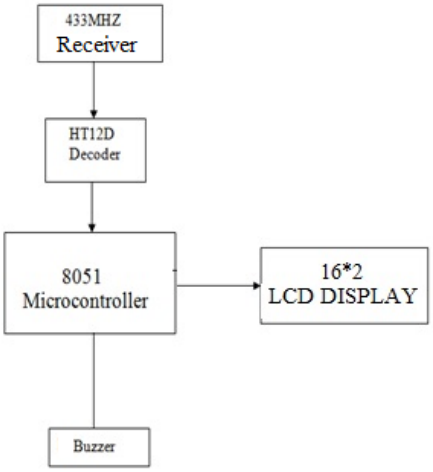

Fig. 5 Block Diagram of Receiver

LCD is interfaced with the microcontroller in order to display the speed violation.

C. DC Motor

DC Motors are used to run the robotic car. Speed of motor depends upon electric command given according to the selected mode. Each mode is defined for a particular range of speed; maximum speed limit for each mode is different.

D. LCD

A 16×2 LCD display is used to display the selected mode and over speed. A buzzer is also attached to alarm when the vehicle over speeds.

E. PIC Microcontroller

PIC microcontroller is used because of its compact circuitry over other microcontrollers and it has inbuilt A/D pin.

F. Encoder

HT12E encoder having an operating range of 2.4V~12V is used to encode binary data of microcontroller output. Encoded signal is received at the receiver and signal is decoded by the decoder into the binary form and send to the PIC microcontroller for its further processing.

G. H-Bridge

H-bridge is an electrical circuit which is used to apply a voltage on load in both directions such as forward and backward. .An H-Bridge is combination of four switches S1, S2, S3 & S4. When H-Bridge switch S1 & S4 are closed positive voltage is applied and vice-versa.

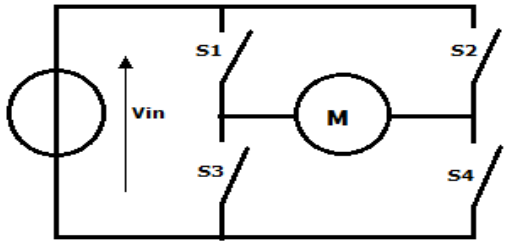

Fig. 6 Switch Diagram of H-Bridge

In fig. 6 if switches S1&S4 are close (S2&S3 are open) then a positive voltage is applied and motor moves right .If switches S2&S3 are close (S1&S4 are open) then negative voltage is applied and motor moves left. If all switches are close, motor run free. If switches S2&S3 (S1&S4are open) are close, motor brakes.

Table 1: Switch Combination

S1	S2	S3	S4	Result
1	0	0	1	Motor moves right
0	1	1	0	Motor moves left
0	0	0	0	Motor free runs
0	1	0	1	Motor brakes

III. TRACKING AND SPEED ESTIMATION

RFID is a flexible technology that is convenient, easy to use and well suited for automatic operation. It combines advantages not available with other identification technologies. RFID can be supplied as read only or read/write and it does not require contact or line-of-sight to operate, can

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function under a variety of environmental conditions and provides a high level of data integrity because the technology is difficult to counterfeit. RFID provides a high level of security. The model comprises of transmitter and receiver which contain PIC microcontroller in it.

IV. CONCLUSION

The proposed work presents the design and analysis speed estimation using RFID. This project can be implemented to detect speed limit violation on highways and can be extended further with little changes to traffic signal control, traffic rule violation control, parking management, vehicle theft and special zone alert using the RFID technology. It is cheaper, requires low maintenance and cost compared to GPS system. It can well work even under the tunnel where GPS system cannot work properly.

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