# RFID Technology for Smart Vehicle Control using Traffic Signal & Speed Limit Tag Communication

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## ABSTRACT
Traffic violations are a major problem. Monitoring these traffic violations by human intervention over a wider area is too complicated due to the increasing population. The main motive behind this paper is to reduce these reckless accidents for which we propose a system that governs and controls the speed of the vehicle without any direct inconvenience to the driver. There are instances where the speed of the automobile is beyond the expected speed limit or the driver does not obey the traffic signals. An RFID reader present in the vehicle senses the RFID tag linked with a red traffic light or senses the vehicle speed limit on the tag attached to the speed limit signboard. The Electronic Control Unit (ECU) present in the vehicle will then decide upon the required control measure by comparing the tag information with real time speed of the automobile. Finally the proposed speed control simulation techniques and electro-hydraulic braking system is explained in detail.

## General Terms
Traffic regulation, Safety.

## Keywords
RFID (Radio Frequency Identification) Technology, ECU (Electronic control unit), electro-hydraulic braking, electrical fuel pump and injector.

## 1. INTRODUCTION
The seriousness of running a red light traffic signal and speed violation on roads can be seen from the statistics as given below [1].

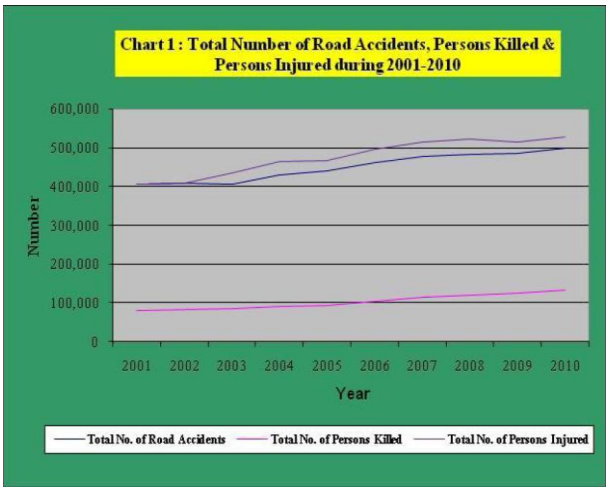



**Fig 1: Statistics report on total number of road accidents**

80% of road accidents are caused by human error say senior police officials, according to a news report in the TOI. Incidentally, India holds the dubious distinction of registering the highest number of road accidents in the world. According to the experts at the National Transportation Planning and Research Centre (NTPRC) the number of road accidents in India is three times higher than that prevailing in developed countries. The number of accidents for 1000 vehicles in India is as high as 35 while the figure ranges from 4 to 10 in developed countries. The report, based on 2006 and 2007 statistics collected from 178 participating countries, said globally over 1.2 million people die in road accidents every year and 20-25 million people suffer non-fatal injuries.

Speed is the main reason behind accidents. An increase in average speed is directly related to both the likelihood of a crash occurring and to the severity of crash consequences. A 5% increase in average speed leads to an approximately 10% increase in crashes that cause injuries and a 20% increase in fatal crashes.

The statistics report shown in Fig 2 shows that the cause of road accidents is 78% due to the fault of drivers.

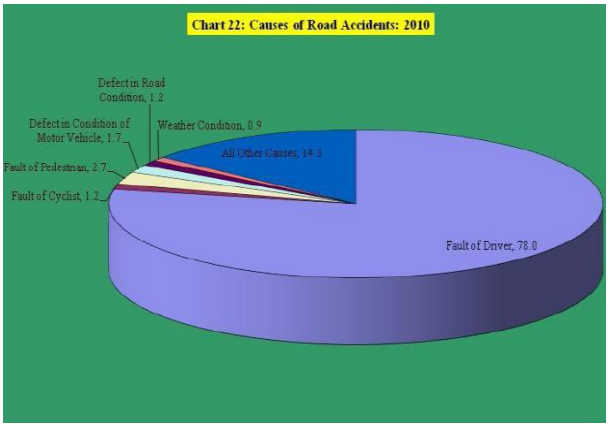



**Fig 2: Statistics report on cause of road accidents**

## 2. TECHNOLOGY & COMPONENTS USED

### 2.1 RFID Technology
Radio Frequency Identification (RFID) technology shows a continuous growth in various application fields, like logistics, medical science, security, access control etc. The RFID system is a three component system consisting of: tag, reader and database. The access control, specifically, is detection of IDs entry to or exit from the range area of the RFID reader.

Transponders (Tags) must have the circuitry needed to harvest power from the electromagnetic fields generated by the interrogator, the necessary memory elements, as well as the different control circuits [2].

Figure 3 shown below is how communication takes place between a tag and a reader. In our discussion we consider active tags only.

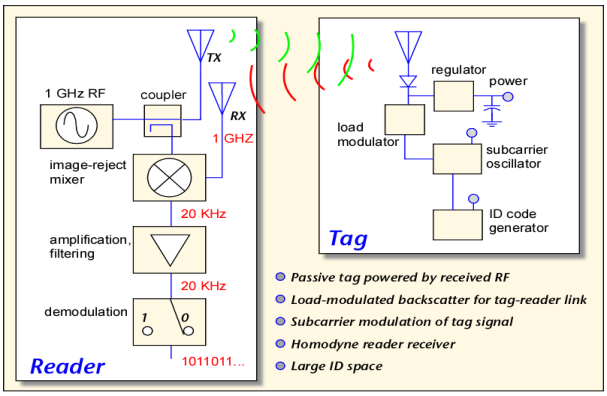



**Fig 3: Working of a tag-reader[3]**

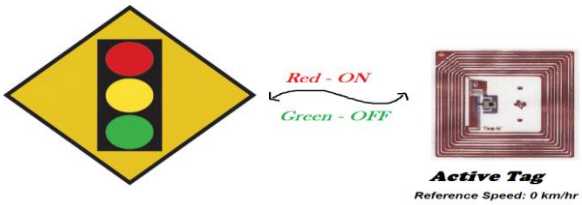
The advantage of RFID is its low cost for tags and can be attached to the traffic signals easily. Apart from this the tags have an ID code generator which is modulated and sent to the reader. This improves security, transmission & detection of data.

RFID reader is placed in the car which detects the tag within a particular range [4].

The tags placed here contain specific information. The tags which we use here are active tags (turns on only with the power supply).

In this case we consider two possibilities:

A. Tag connected to a red signal.




Whenever there is a red light traffic signal situation, that is, if the traffic signal turns red, because it is an active tag it powers ON when the red light is active. The tag remains inactive as long as there is a green traffic signal. The reference speed in this case is taken to be 0 Km/hr. This information of red light is modulated and sent to the reader.

B. Tag connected to speed limit boards on the side of the road.


These are tags which contain a particular unique code corresponding to the speed on the speed-limit sign boards. This particular reference speed to which the vehicle's speed has to be reduced to is transmitted by this tag to the RFID reader.

## 2.2 Electronic Control Unit (ECU)

In automotive electronics, electronic control unit (ECU) is a generic term for any embedded system that controls one or more of the electrical systems or subsystems in a motor vehicle.

Some of the reasons for use of microprocessors in a vehicle are:

- The need for sophisticated engine controls to meet emissions and fuel-economy standards
- Advanced diagnostics
- Simplification of the manufacture and design of cars
- Reduction of the amount of wiring in cars
- New safety features
- New comfort and convenience features

The heart of electronic control unit is its micro controller. The micro controller receives the input and process is based on the program fed onto it.

ECU supports USB, CAN and/or RS-232 Interface.

## 3. PROPOSED CONCEPT – BLOCK DIAGRAM

The block diagram of the proposed concept is as shown in figure 3 below.

It consists of an RFID Tag connected to a traffic light or a speed limit sign board which modulates and transmits the reference speed to RFID reader (present in the vehicle) and then to the ECU (Electronic control unit). The actual speed of the vehicle is measured using a vehicle speed sensor. The modulated tag code is demodulated in the reader. The electronic control unit then takes the necessary control action which is described in the next section- speed control.

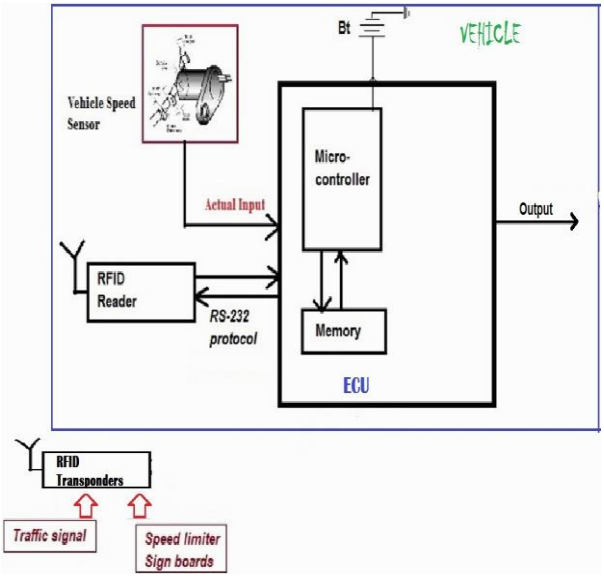



**Fig 4: Block diagram of the proposed system[5]**

## 4. PROPOSED SPEED CONTROL MECHANISM

We suggest two methods as shown below to control the speed of the vehicle. In case a red light signal situation occurs the speed is reduced to zero, else it is reduced to the speed limit specified on the roads. The circuit diagram as shown in Fig 5(a) and 5(b) explains the proposed speed control system in vehicles.

The start switch used here acts as an ignition switch which starts the engine. There are 3 main conditions that govern the speed control of the vehicle.

- *First condition*- is when the ECU is in switched OFF. This means that the RFID reader is out of the range of the tag which in turn suggests that no red light traffic situation or speed limit condition is imposed. During this time full supply goes to the Pump and Injector circuit. Refer Fig 5(a).
- *Second condition*- the ECU is ON but the vehicle is in a speed limit range. In this case, the reader encounters a speed limit transponder and the ECU sends a control signal to the RL2 and POT control as shown in Fig 5(b). Thus there is a limited supply to pump and injector circuit.
- *Third Condition*- is when the vehicle encounters a Red Traffic Signal transponder. Now, the ECU sends a control Signal to RL3 because of which all supply is sent to the ground thereby not allowing any supply to the Pump and Injector circuit. Refer Fig 5(c).

The simulation diagrams shown below explain the 3 conditions specified above. The units present are Battery Unit, Start Switch (Ignition Switch), RL1, RL2, RL3, Pump and Injector Unit and ECU Unit.

## 5. ELECTRO HYDRAULIC BRAKING

The ECU output turns on the dc motor, which pumps the braking fluid from the container upwards. The limiter present will set a constant pressure flow and send it to the electro proportional valve [6]. On the basis of the output provided by the ECU, the valve sends only the necessary pressure to be applied on wheels. Now since the high pressure will be from the motor side, the ball will close the manual braking system by a switching valve. This pressure is applied on the wheels so that the vehicle stops under the necessary condition without violating.

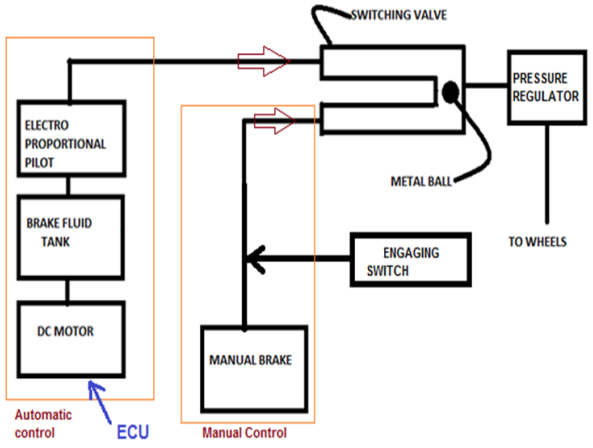



**Fig 6: Diagram of Electro-Hydraulic Braking System**

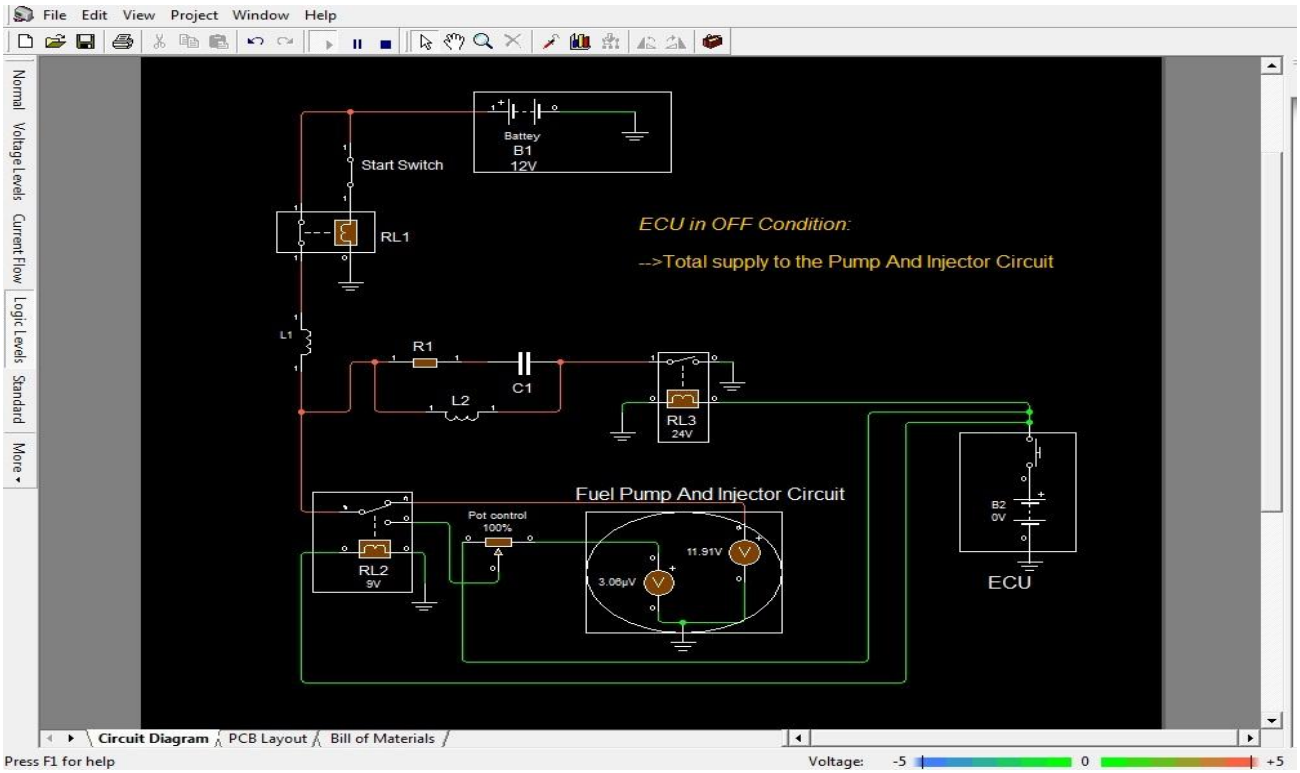



**Fig 5(a). When the ECU does not take any control action (when the reader is out of the range of tag which means no traffic signal or speed limit situation)**

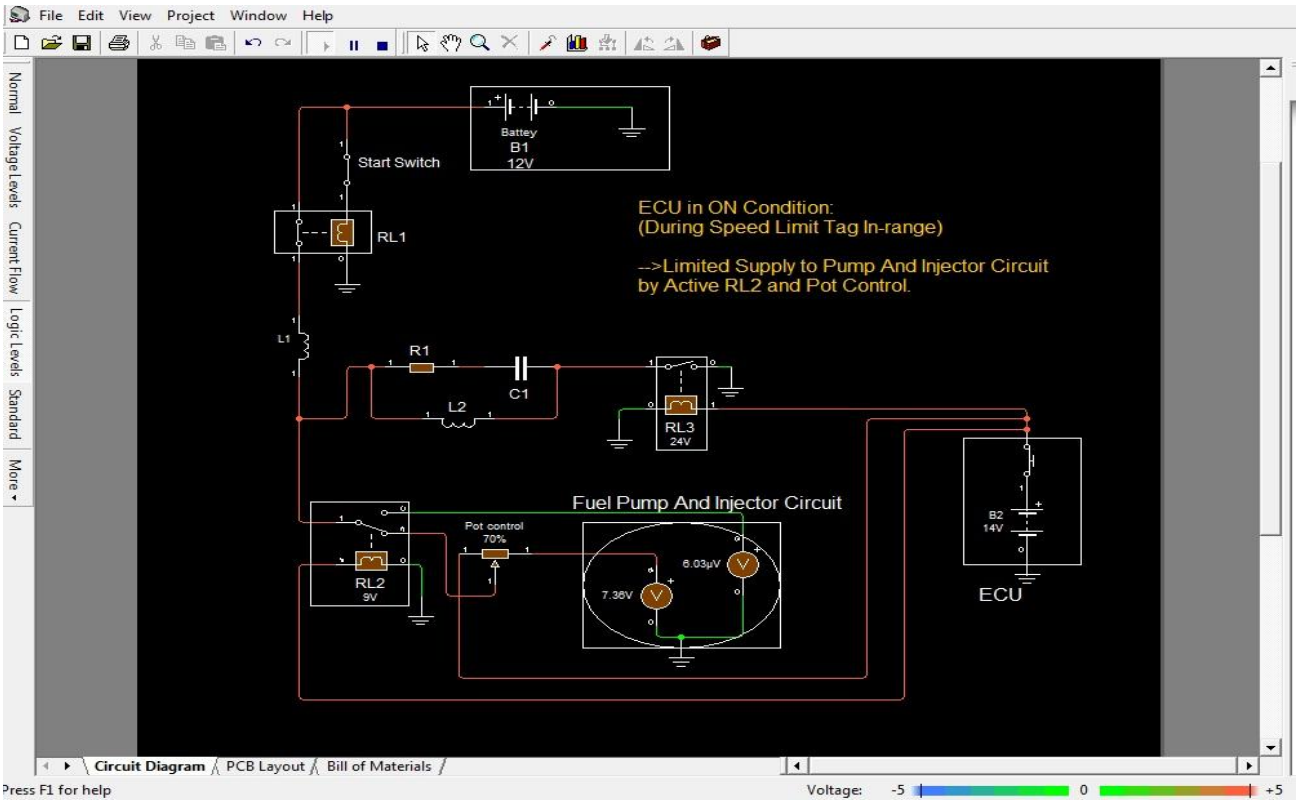



**Fig 5(b). When the ECU is in ON condition (when the reader is in range of tag of a speed limit sign means that limited supply is given to the Pump And Injector Circuit)**

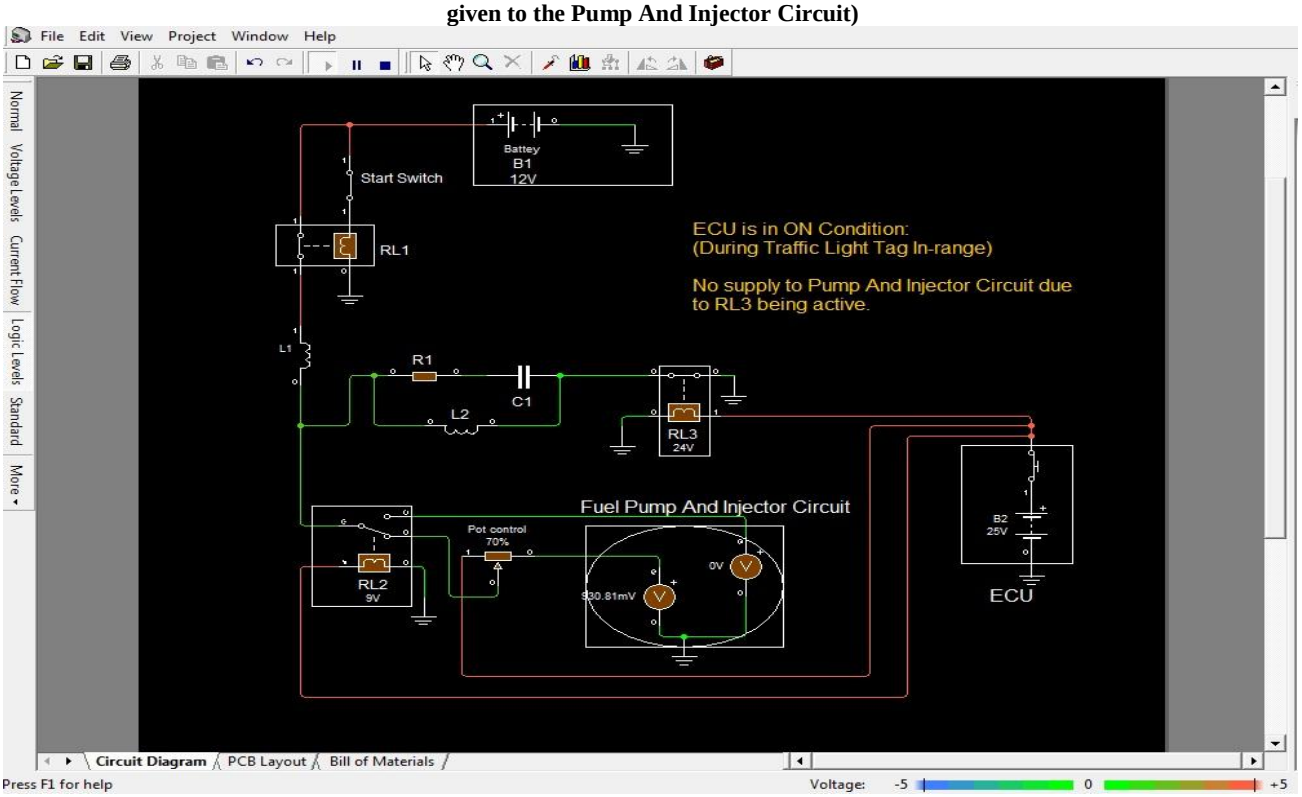



**Fig 5(c). When the ECU is in ON condition (when the reader traffic signal tag which means that RL3 is active so that all supply is sent to ground)**

## 6. ELECTRO HYDRAULIC BRAKING

The implementation of the smart control using RFID for a vehicle was done. In this case we have used only passive RFID tags because of cost and availability.

The microcontroller used here is AT89S52 [7] which acts as a substitute for the ECU in our case. It communicates with the reader using RS232 serial communication. The reader along with the antenna is marked in the figure. MAX 232 IC is used as driver for communication using RS 232 standard. The microcontroller is interfaced with LCD display to caution the driver giving various signals.

The microcontroller drives the relay switches using ULN 2003 IC which acts as a power driver circuit.

The range of detecting the tags by the RFID reader can be increased by using an UHF reader.

The figure 7 shown below describes the model of the proposed system.

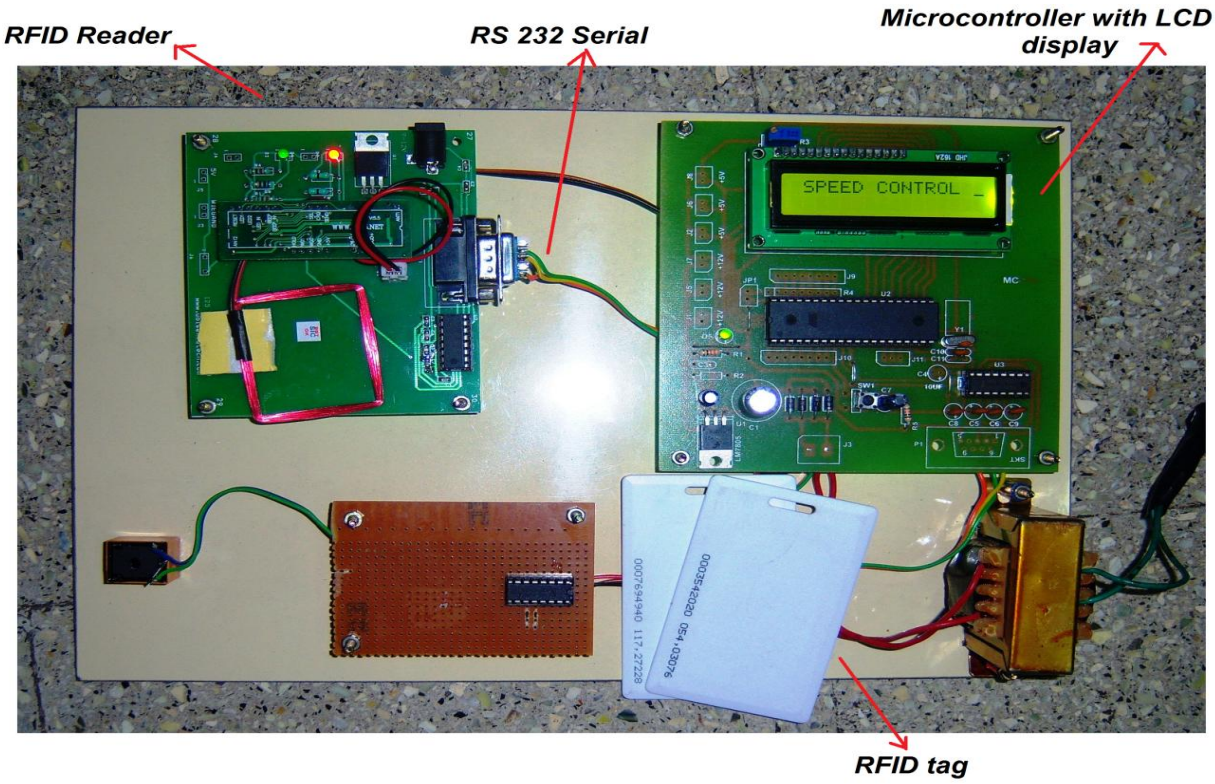



**Fig 7: Implementation of the Proposed System Model**

## 7. CONCLUSION

This paper explains the smart vehicle control based on the RFID technology. It has explained how transponders and readers can be used to communicate with the vehicle thereby providing autonomous vehicle control with the ECU. The simulation technique for speed control has been given and the electro hydraulic braking system dealt with. Thus we hope this can revolutionize the traffic management system in an effective manner.

## 8. REFERENCES

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