INTELLIGENT SPEED CONTROL USING EMBEDDED RFID TRAFFIC SIGNS

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Reshma Krishnan, Jisha S Najeem, Gilda D'Costa, Varsha Pammi
Affiliation
Email:be1002@waljat.net

Abstract. Oman has the highest death rate from road accidents in the GCC and third highest in the eastern Mediterranean region, according to figures released by World Health Organization (WHO) in its Global Road Safety Report 2013.Our project aims at effectively and economically preventing road accidents due to negligence of traffic signs and speed limits. To accomplish this we are using RFID technology (Radio Frequency Identification). The basic concept is to automatically reduce the speed of vehicles to that specified on the speed limit sign. This will include speed control at traffic signals, speed limit sign boards at highways, residential areas, unprecedented diversions (road excavations, accidents etc.).The RFID system consists of RFID reader placed in the vehicle and RFID passive tags attached to speed limit signboards and active tags to traffic signals. The challenge is to make a controlled algorithm to maintain the speed of a vehicle within the desired speed limit.

Keyword. RFID; Traffic Signs; Speed control.

INTRODUCTION

As per the WHO report of 2010, Oman registered 30.4 deaths per 100,000 people. At present radar surveillance of roads is used to keep a watch on traffic violations in most parts of the world, but this does not prove to be a total solution as traffic violations continue in areas which are not monitored by radars. Therefore there is need for automation to revolutionize traffic management and thereby prevent loss of human lives and damage to assets. We have made use of RFID technology, Radio Frequency Identification (RFID) systems consists of an electronic data carrier device and reader that communicate information using radio technology. The contactless transfer of data has numerous applications in commerce and industry. RFID is more flexible than optical and magnetic technology. A prime example of driver assistance systems is cruise control (CC), which has the capability of maintaining a constant user-preset speed [3], and its evolution, the adaptive cruise control (ACC), which adds to CC the capability of keeping a safe distance from the preceding vehicle [4].

METHODOLOGY

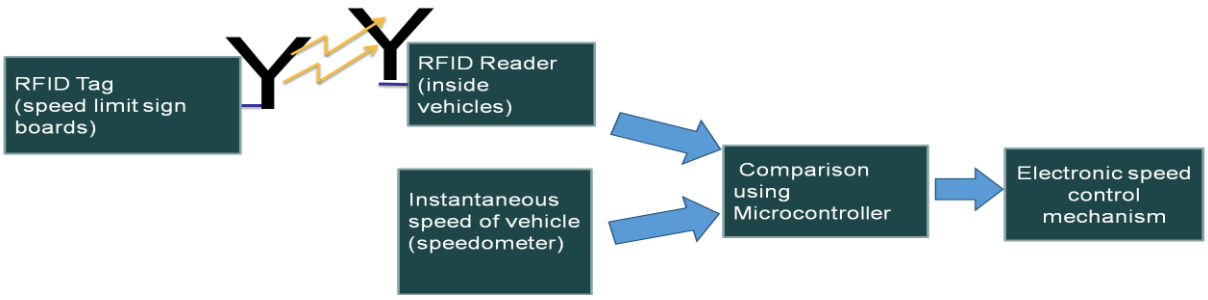

Figure 1. Block diagram of the system

The advantage of RFID (Radio Frequency Identification) 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.

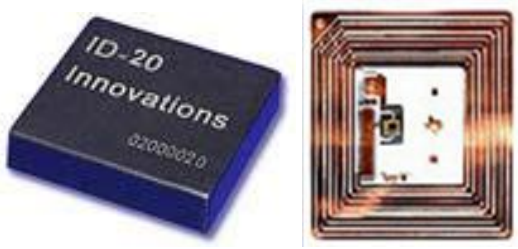

Figure 2. ID-20 RFID Reader and Passive Tag

RFID reader is placed in the car which detects the tag within a particular range. The tags placed here contain specific information. The tags which we use here are passive tags. Tag connected to speed limit boards on the side of the road.

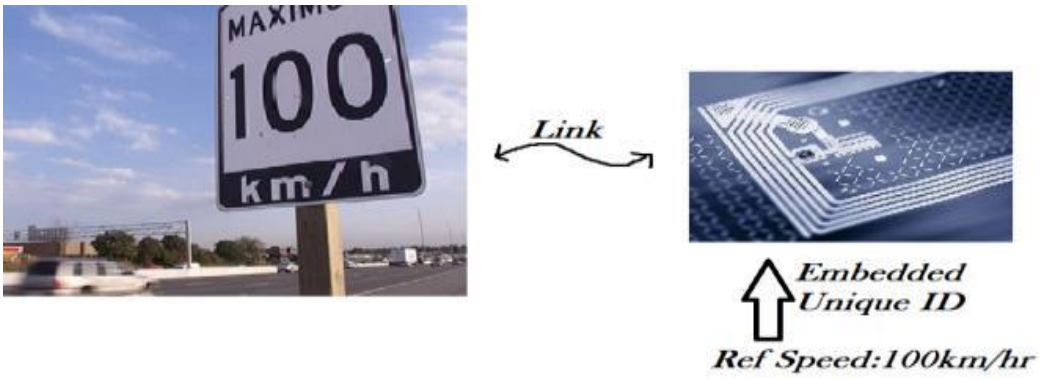

Figure 3. Tag connected to speed limit boards on the side of the road

When a vehicle passes speed limit sign board, the tag is read by the RFID reader placed in the vehicle. The actual speed of vehicle and the speed specified by the RFID tag are compared. If the actual speed of vehicle is greater than the speed limit on that road then the speed of vehicle is reduced gradually to that specified by the speed limit sign board. This will include speed control at speed limit sign boards at highways, residential areas, unprecedented diversions (road excavations, accidents etc.).

The working of the system can be summarized in the flow chart below:

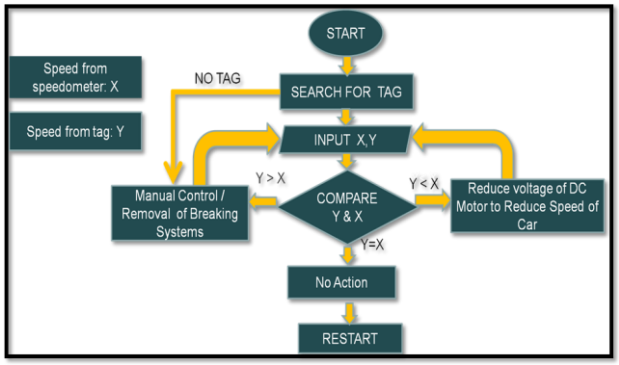

Figure 4. Flow chart showing the logic of the system.

When the car passes a speed limit sign board, the tag is read by the reader and the speed of the car is gradually reduced to the limit specified on the sign board. This is done by using two speed control techniques which can be used for this project implementation:

1. Electronic Fuel Pump Driving System Control.
2. Electronic Hydraulic Breaking System.

Main hardware used:

1. RC controlled toy car
2. RFID reader (ID20) and tags (passive tags).
3. Arduino UNO microcontroller.
4. Atmel 89S52 microcontroller, NOT gates, etc.

Software used:

1. Arduino v1.0.5
2. NI Multisim 12.0
3. 8051 IDE
4. ISP

RESULTS AND DISCUSSION

Our project is divided into three parts:

1. RFID tag (speed limit) detection
2. Car instantaneous speed detection
3. Comparison and speed reduction

1. RFID tag (speed limit) detection

The RFID reader supports ASCII and Magnetic ABA Track 2 data formats. The range of an RFID reader depends on its frequency. We have chosen ID-20 (Low frequency) reader because our project is a prototype, but for actual implementation we can use a reader of ultra high frequency range.

RFID is based on storing and remotely retrieving information or data as it consists of RFID tag, RFID reader. RFID tags store unique identification information of objects and communicate the tags so as to allow remote retrieval of their ID. RFID technology depends on the communication between the RFID tags and RFID readers. We first displayed the RFID information on LCD screen in ASCII format.

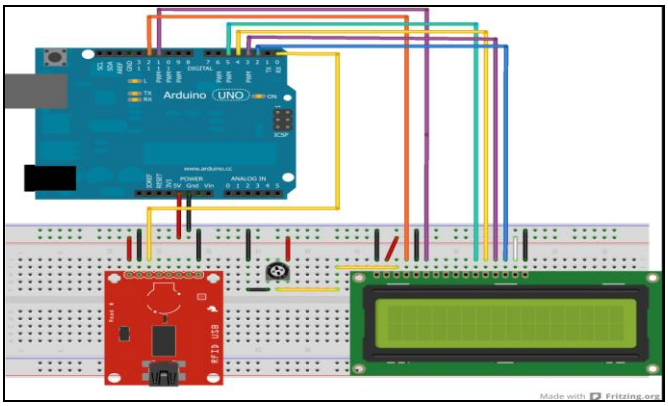

Figure 5. RFID reader, LCD and Arduino microcontroller to display the tag detected.

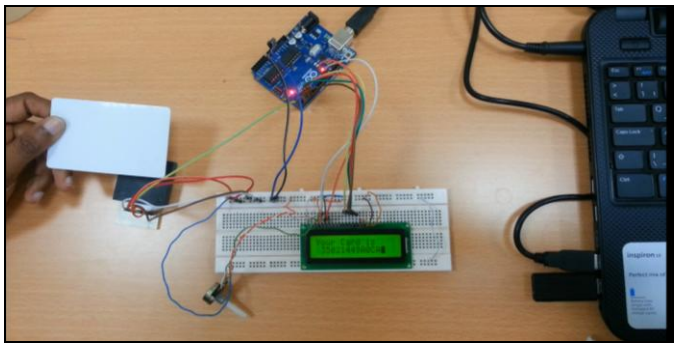

Figure 6. RFID tag information is displayed on the LCD screen.

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The reader output is converted into binary also for ease of comparison in the third stage.

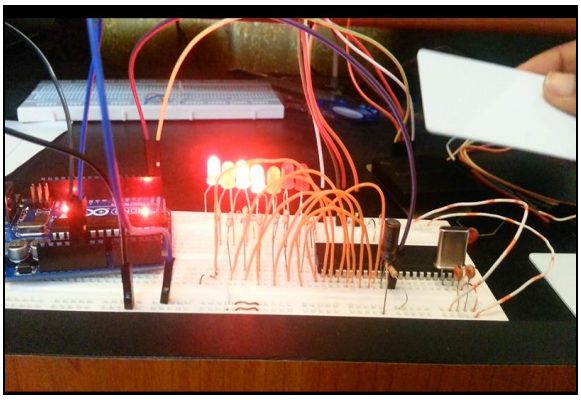


Figure 7. RFID tag as binary output

2. **Car instantaneous speed display (speedometer):**
   We have used Hall Effect sensor that generates pulses each time the Hall Effect cuts the field of the magnet are pulses are generated. The speed of the toy car is displayed on the LCD screen in RPM (as counts).

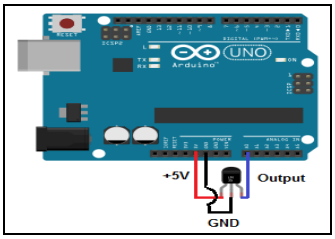


Figure 8. Hall Effect Sensor connected to Arduino

The sensor was coupled to a wheel attached to one of the rear wheels of our toy car. The output of the sensor is connected to the arduino permitting us to obtain the vehicle's speed easily. Specifically, the advantages of this sensor are: more precision (directly related to the number of teeth in the wheel), faster sensor reading times, compatibility with standard devices (USB-analogue card) and, finally, the possibility of increasing the sample time of the longitudinal control.

3. **Comparison and speed control :**

The speed of the DC motor of the toy is controlled by programming AT89S52. The driver circuit using transistors and relays connected to the power supply.

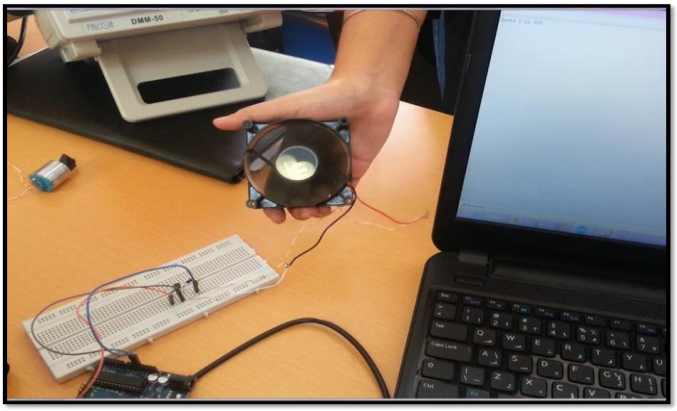
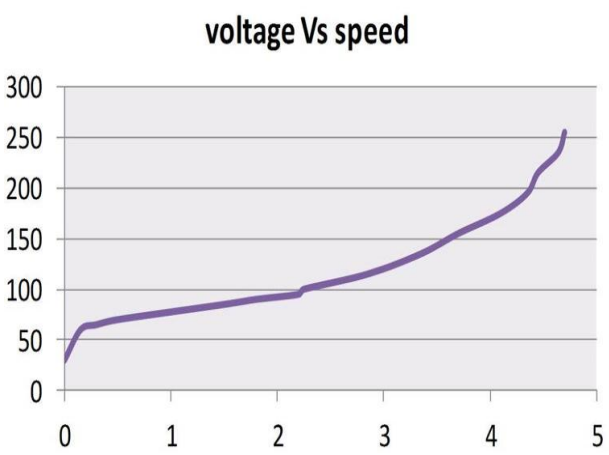


Figure 9. Controlling the speed of a fan(DC motor) using Arduino

Table 1. Voltage Vs Speed Control of a DC Motor



Voltage	Speed
0	30
0.15	60
0.3	65
0.5	70
1.5	85
1.8	90
2.2	95
2.25	100
2.85	115
3.35	135
3.7	155
4.1	175
4.35	195
4.45	215
4.64	235
4.7	255

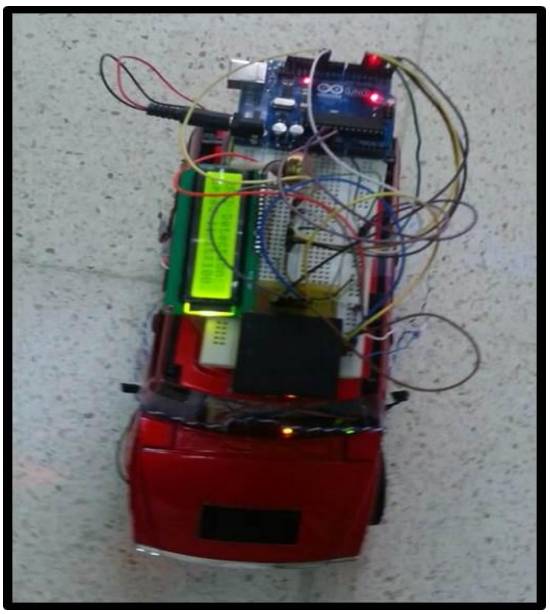


Figure 10. Overall arrangement of the approach

CONCLUSION

This paper presents architecture for automatic adaptation of the speed control of a vehicle to the circumstances of the road which can help to decrease one of the major causes of fatalities: the excessive or inadequate vehicle speed. Our approach is based on using RFID tags in order to reduce the speed of the vehicle in accident prone areas. The proposed on-board architecture is portable and easily adaptable to any commercial car with minimal modifications. The system would show promising results, since active RFID technology permits to detect the presence and identity of the traffic signals reliably and sufficiently in advance, so corrective actions on the vehicle's behavior can be taken. The technology developed can assist human drivers in difficult road circumstances. In our experiment, only the test vehicle would be present on the road. In normal driving situations, we can expect other vehicles circulating nearby and possibly blocking or attenuating some of the RFID transmitting signals, especially with large vehicles like trucks. In this aspect, more experimentation is needed to know how this circumstance will affect the vehicle's control performance. A possible solution is the use of redundant RFID tags (since their cost relatively low), placed at different locations near the traffic signal, to guarantee RF signal reception in unfavorable conditions. The results suggest that an automatic intelligent speed control system can be used to prevent any unexpected traffic circumstance and improve the safety of the occupants of the vehicle.

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