DESIGN AND IMPLEMENTATION OF RFID SPEED DETECTOR USING PLATE NUMBER IDENTIFICATION

[*]OLADOSU, D. A., [**]OPALEYE E. T., [***]ADENIRAN, A. A., [**]ONI. S. O

*Department of Computer Engineering, The Polytechnic, Ibadan, ** Department of Electrical Engineering, The Polytechnic, Ibadan, *** Department of Civil Engineering, The Polytechnic, Ibadan

Abstract

The major threat of Road Transport is the increasing number of accidents on a daily basis. According to the survey report most of the road accidents are caused by negligence of rules and regulations by the people who drive the vehicles. This work presents intelligent Driver's Speed Control Management based on Radio Frequency Identification (RFID). It employed RFID tags integrated with Toy Vehicles and RFID Readers, mounted on road network while ATMEGA 328 synchronised the communication between them. In order to check the Vehicle Speed Limit Violator, the system needs to detect the movement of the vehicle and record the time along the road. To achieve this, we used a Transceiver to send information to a PC with Database and Graphic User Interface (GUI) that were developed by MYSQL and Visual Basic (VB) Software Application respectively. Whenever vehicle over speeds, sensor triggers the embedded module and sends information through Transceiver to the PC. The Bio-Data and Particulars especially Plate Numbers of the Drivers' /Cars' owners are to be pre-loaded and stored in the database during Registration of the Vehicles and Processing of the License. Five (5) Toy Cars with mechanical inbuilt engine were made use of as prototype. The result obtained was quite satisfactory and if prototype can be adopted, drivers can be monitored remotely and caught when disobeys the traffic rule.

Keywords: Database, RFID, Traffic, Transceiver, Visual Basic.

Introduction

Travel is an important part of today's fast paced life as everyone has to move around for their day -to-day work. Road transport is the most commonly used mode of travel due to its ease, low cost and availability to common man. The ease of travel is affected by such factors as the quality of road, congestion, time taken, accidents, speed, etc. The major threat is the increasing number of accidents on a daily basis. According to the survey report most of the road accidents are caused by negligence of rules and regulations by the people who drive the vehicles. The report says that in accidents due to reckless driving is very high when compared to the accidents due to drunken drive (Muthusamy A P, et al, 2015)

Road fatalities are a major concern in the developed world. Recent studies show that a third of the number of fatal or serious accidents is associated with excessive or inappropriate speed, as well as diversion in the roadway (Abdi Raga, et al). Reduction of the number of accidents and mitigation of their consequences are a big concern for traffic authorities, the automotive industry and transport research groups. One important line of action consists in the use of advanced driver assistance systems (ADAS), which are acoustic, hepatic or visual signals produced by the vehicle itself to communicate to the driver the possibility of a collision. These systems are somewhat available in commercial vehicles today, and future trends indicate that higher safety will be achieved by automatic driving controls and a growing number of sensors both on the road infrastructure and the vehicle itself.

A prime example of driver assistance systems is Cruise Control (CC), which has the capability of maintaining a constant user-preset speed, and its evolution, the Adaptive Cruise Control (ACC), which adds to CC the capability of keeping a safe distance from the preceding vehicle. A drawback of these systems is that they are not independently capable of distinguishing between straight and curved parts of the road, where the speed has to be lowered to avoid accident. However, curve warning systems (CWS) have been recently developed that use a combination of global positioning systems (GPS) and digital maps obtained from a Geographical Information System (GIS), to assess threat levels for a driver approaching a curve too quickly;

likewise, intelligent speed assistance (ISA) systems warn the driver when the vehicle's velocity is inappropriate, using GPS in combination with a digital road map containing information about the speed limits.

However useful, these systems are inoperative in case of unexpected road circumstances (like roadwork, road diversions, accidents, *etc*.), which would need the use of dynamically-generated digital maps. The key idea offered by this paper is to use Radio Frequency. Identification (RFID) technology to tag the warning signals placed in the dangerous portions of the road. While artificial vision-based recognition of traffic signals might fail if visibility is poor (insufficient light, difficult weather conditions or blocking of the line of sight by preceding vehicles), RF signals might still be transmitted reliably.

In the last years, RFID technology has been gradually incorporated to commercial transportation systems. A well-known example is the RFID-based highway toll collection systems which are now routinely employed in many countries, like the Telepass system in Italy or the Auto Pass System in Norway. Other uses include monitoring systems to avoid vehicle theft, access control to car parking or private areas, and embedding of RFID tags in license plates with specially coded IDs for automatic vehicle detection and identification (Kumar Chaaturvedula, 2012). Placement of RFID tags on the road lanes has been proposed in order to provide accurate vehicle localization in tunnels or downtown areas where GPS positioning might be unreliable. RFID tags are arranged in the road close to the position of real traffic signals.

Literature Review and Technical Overview

Since last century, scientists and researchers had been studying the effects of reflected backscatter in order to harness the technique for revolutionizing applications especially for military purposes. During the Second World War, the need for passive and covert means of transmitting and receiving information became area of interest for countries with strong military agenda. In 1945 a soviet scientist named Leon

Theremin invented a covert listening device that retransmitted incident radio waves with audio information modulation.

Similarly, in 1939, the British government saw the potential in this technology, and applied it to aid them in aerial combat. Their technology named the "Identify Friend or Foe System" or IFF used an early predecessor for RFID and used to label their aircrafts as a means to determine if an incoming plane belonged to them. A transponder was placed on each of the British aircrafts, and upon being. Interrogated by an incoming electromagnetic wave, would transmit an appropriate signal to identify it as friendly. This system is often attributed to being the first obvious use of RFID technology.

In 1948, a ground breaking publication written by a research scientist named Harry Stockman called "Communication by Means of Reflected Power," was the first article that explored the use of backscatter as a means for information transmission. This article investigated the possibilities presented by this technology and the problems associated with it. Unfortunately, at the time it was written, science had not evolved to a point where the deployment of this technique was feasible. In fact, Stockman himself states in his conclusions that, "considerable research and development work has to be done before the remaining basic problems in reflected-power communication are solved

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. Active 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. This based on their frequency range of transmission. The research and works on RFID can be counted to several thousand sine its inception.

The authors Ashwin K, et al, (2015) with paper titled 'RFID Based Student Attendance and Monitoring System' Student was identified by placing passive tag in the student's ID card. The reader scans the ID card and records the attendance while he/she enters the classroom and if the student moves out of the class and enters some other class room or any other location within the campus, a message which indicates the current location of that student will be sent to the concerned staff. Vishal Pande et al (2016) worked on 'Autonomous Speed Control of over Speeding Vehicles Using Radio Frequency'. The main objective of that was to design a controller and a display, meant for vehicle's speed control and to monitor the zones, with embedded circuit. The IR sensor detects the speed of the vehicle and sends the information to Micro controller. Work of Grewal Kaushal, et al (2015) was focused on 'RFID based security and access control system using arduino with GSM module.

System Requirements and Implementation

In order to have result oriented System, it was implemented as sectionalised modules before final Integration

I. Hardware Section which consists of the followings:

- RFID Reader and Tags; EM-18 RFID Reader reads 125 KHz tags. It features low cost, low power consumption, small form factor and easy to use. It can be directly

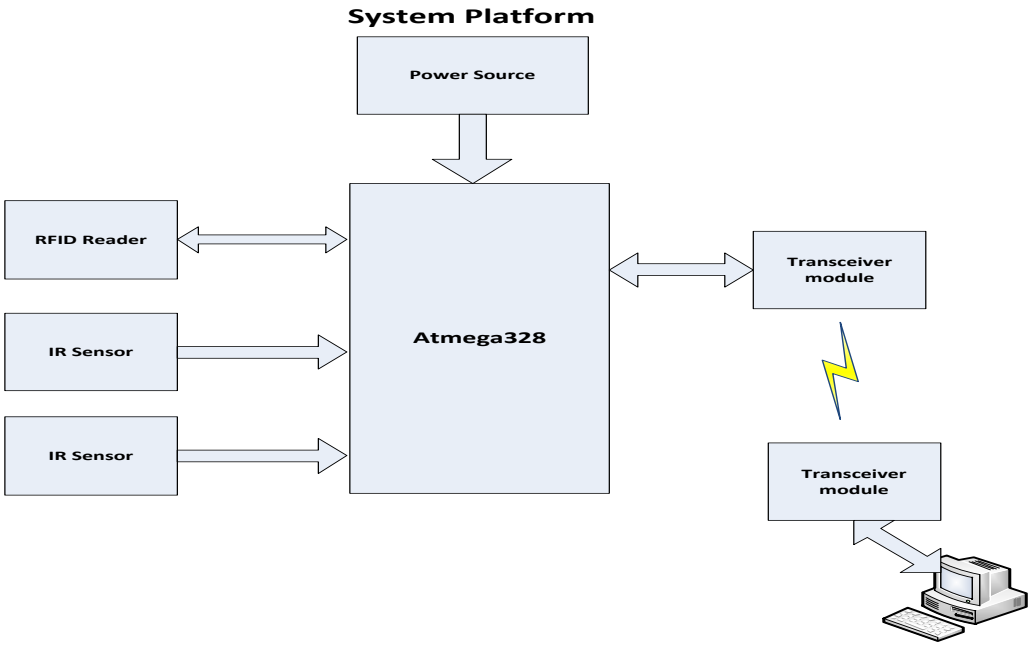

Figure 1: Block diagram of RFID Speed Detector using Plate Number Identification interfaced with microcontroller using UART with PC using an RS22 converter. The RFID reader read the RFID tag on the vehicle

- Two (2) pair of IR-Phototransistors; the pair was used to detect the presence of the vehicle and record the time. An infrared sensor can measure the heat of an object as well as detects the motion of the object.
- Prototype of Road Network: planks of wood was used to build it
- Prototype Vehicles; Five (5) Toy Cars with mechanical inbuilt engine were employed
- Atmega 328;is a low –power, 8-bit CMOS Microcontroller based on the AVR-enhanced Risc Architecture. It achieves thorough puts approaching 1MIPS per MHZ by executing powerful instruction in a single clock cycle. ATmega328 send Tag number to the PC via the transceiver modules integrated to the micro-controller and the PC.
- Transceiver module to communicate with PC; The Sensor Device (Receiver) The sensor it is devices that receive the radio frequency signal (wireless RFID)

from transceiver Whenever vehicle over speeds, sensor triggers the embedded module and send information through Transceiver to the PC

II. Graphic User Interface was developed with Visual Basic (VB) and SQL was used to create Database. The Bio-Data and Particulars especially Plate Numbers of the Drivers' /Cars' owners are to be pre-loaded and stored in the database during Registration of the Vehicles and Processing of the License. To achieve this, we assigned particulars number to the Toy Vehicles.

III Integration of System

The Modules were integrated together (figure 2) to form complete system and in order to have reliable results; the following steps were taken into consideration.

a. Position of the tag in the vehicle

There are multiple positions where the RFID tag can be installed in the vehicle. According to the ISO standard ISO/DIS 24535 for automatic vehicle identification the tag should be affixed to the front windscreen or embedded within the rear license plate of the vehicle. In this system, it was fixed to the windscreen to facilitate easy access and to avoid being damaged by a small car accident. This position at the windscreen enables us to power the tag in the future with solar cells.

b. **Data Integrity and Security**

Additional data (parity, checksum, CRC …etc) was added to safeguard the validity of the original data is determined and to identify the error in the data received so as to correct it or request for retransmission. Data encryption and mutual authentication were also taken care of by using sequential ciphering.

c. Collision Avoidance and Minimum Overhead

In order to save power and increasing the probability of reading the tags successfully which affects the efficiency of the overall system the design and testing of receiver device and Tag device for the Vehicle or PC and achievement of connection between the two device using RFID was established.

Additional data was being added as overhead to the original one for efficient utilization of the communication channel and the reduction of node power consumption with consideration of Coverage areas

d. System Time Performance Evaluation

In this section, the time performance of the system is evaluated. For evaluating the time performance, we need to calculate the time required for a single vehicle to be successfully detected by a road-side reader.

There are three parameters affecting the time delay in this protocol:

- Time for the RF module to send the packet.
- Processing time in each of the vehicle's tag and the road-side reader.
- Propagation delay between the road-side reader and the vehicle's tag.

The RF module operates at 250 kbps and Atmega8 works at 16 MIPS using 16MHz crystal We assumed worst case for Propagation Delay Calculation with under listed Specifications

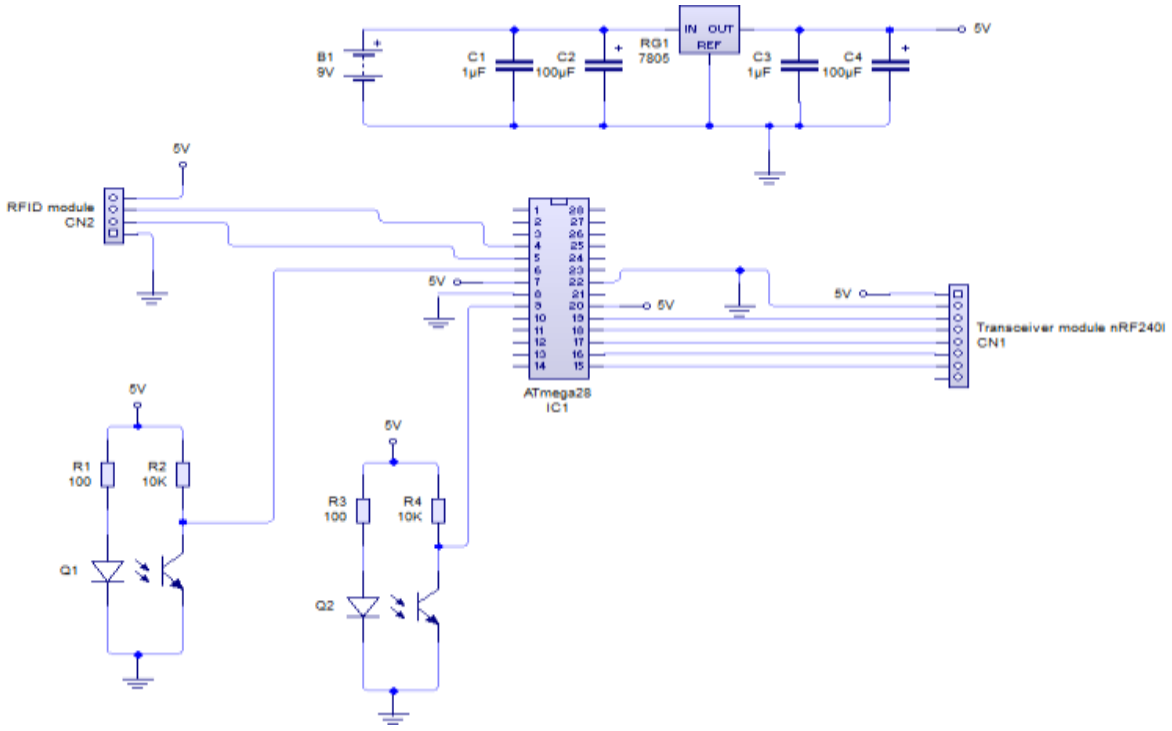

Figure 2: Circuit Diagram of RFID Speed Detector Using Plate Number Identification

- Maximum distance from the Road-side was 50ms.
- Processing time at each step from the communication scheme was 500 instructions (estimated from the Source code synchronized the reader and the tag).

Packet Sending Time Schedule (Ts) by the RF module would be

$$T_s = \frac{500}{16 \times 10^6} = 0.03125ms$$

While Propagation Delay (Td)

$$T_d = \frac{50}{3 \times 10^8} = 0.00166ms$$

Testing, Results Analysis and Discussion

The designed circuit was implemented and tested to ensure its workability; some modification was done so to meet the desired specification. The samples of RFID tags embedded in vehicles were assigned different unique Identification Numbers in the Database developed with MYSQL while the other particulars of Vehicle's owners were also documented. If any of the Toy vehicle swiped over the tag reader integrated to both sides of the Road path and the result obtained was automatically and relatively compared with set threshold Speed Value. The resulting speed value would be displayed on the Computer screen (Graphic User Interface developed with Visual Basic) or Android phone as the vehicle passes (Fig 1). If the measured speed is greater than the threshold value, the details would be sent to the Traffic Authority as Over-speed (Fig 2) otherwise, it would remain as default (Fig 1)

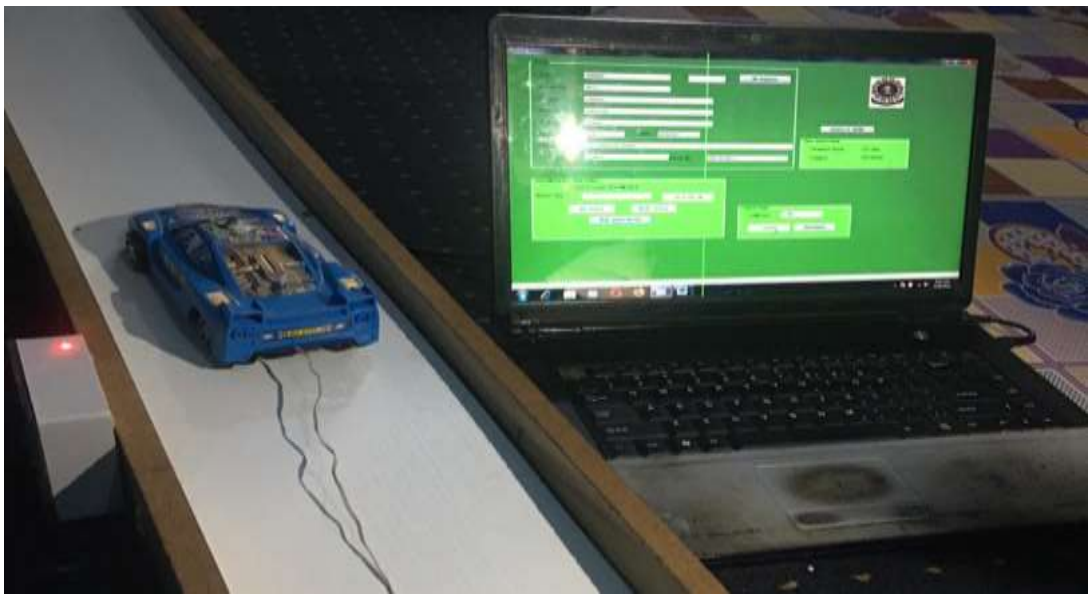

Fig 1: Default Value Displaying of Speed Detector when Vehicle's owner maintains Speed Limit

Fig 2: Default Value Displaying of Speed Detector when Vehicle's owner exceeds Speed Limit

RFID based Traffic Violation Detection systems use radio frequency waves to identify vehicles when car are assigned the unique identification numbers in the form of RFID

tags. The reader has an antenna that emits the radio waves. When the tag comes within the range of the reader signal, it responds by retrieving and showing the unique identification number of that tag embedded in vehicle and give the status of car in relatively to speed limit.

Conclusion and Recommendations

This paper explains the vehicle details retrieval based on the RFID technology. It has explained how to reliably, cost-effectively and securely identify vehicles at various situations. Thus we hope that this can revolutionize the traffic management and avoid accidents caused due to over speeding in the near future. The prototype can be adopted and installed with captured details of vehicles' owners and position the tag readers at different location along metropolis. With this, drivers can monitored remotely and caught when disobeys the traffic rule. Navigation application to the system, by providing the directions to the driver reaching his destination and collision warning applications that allows communication between vehicles and warn the driver about any possible collision. The research can also be developed further to allow Vehicles Communication.

REFERENCES

Arulogun O. T., Olatunbosun, A., Fakolujo O. A., and Olaniyi, O. M. [2013],'RFID-Based Students Attendance Management System', International Journal of Scientific& Engineering ResearchVolume4,Issue2,ISSN2229-5518.

Ashwin K, AswinPerumal A, Krishnakumar S, Maheshwari M [2015], 'RFID Based Student Attendance and Monitoring System', International Journal of Innovative Research in Computer and Communication Engineering,Vol.3, SpecialIssue1,ISSN: 2320-9801.

Cheng-an ZT, Min-lu J [2010], "A RFID Based Traffic Information Acquisition System and Vehicle Positioning Method", Journal of Electronics & Information Technology, pp: 11-15.

Elima Hussain, Priyanka Dugar, VaskarDeka, Abdul Hannan [2014], 'RFID based Student Attendance System', International Journal of Computer Applications (IJCA), ISSN: 0975–8887.

GrewalKaushal, Rishabh Mishra, Neelam Chaurasiya, Paramdeep Singh [2015],'RFID Based Security and Access Control System Using Arduino with GSM Module', IJEEE,Vol.2,Issue2,ISSN:1694-2310.

Khali H, Araar A, Abdulla EZ [2014], "Suitability of passive RFID technology for fast moving vehicle identification", Journal of Emerging Trends in Computing and Information Sciences.

Li C [2010], "Automatic vehicle identification (AVI) system based on RFID", InAnti -Counterfeiting Security and Identification in Communication (ASID), IEEE International Conference,pp. 281-284.

Min Z, Wenfeng L, Zhongyun W, Bin L, Xia R [2007], "A RFID-based materialtrackinginformationsystem",InAutomationandLogistics,2007IEEEInternationalConference,pp. 2922-2926.

Pandit AA, Mundra AK, Talreja J [2009], "RFID tracking system for vehicles(RTSV)", In Computational Intelligence, Communication Systems and Networks(IEEE),2009,CICSYN'09, First International Conference, pp.160-165.

Perez J, Seco F, Milanes V, Jimenez A, Díaz JC, De Pedro T [2010], "An RFID-based intelligent vehicle speed controller using active traffic signals", Sensors,10(6),pp: 5872-87.

P.RaviTeja Kumar, M.S.Pradeep Kumar Patnaik [2016], 'Vehicle Classificationand Speed Measurement using IR Sensors', International Journal & Magazine ofEngineering,Technology,Management and Research,ISSN No:2348-4845.

Sheifali Gupta Professor, Ashmeet Kaur, AvniGarg, Abhishek Verma, Akshay Bansal, Arvinder Singh[2013],'Arduino Based Smart Card', International Journal of Advanced Researchin Computer Engineering & Technology(IJARCET),ISSN: 2278– 1323.

Vishal Pande ,Malhar Mohite,Supriya Mhatre, Siddhesh Desai, Anjali Kumari [2015], 'Autonomous Speed Control of Over Speeding Vehicles UsingRadioFrequency',InternationalJournalofAdvancedResearchinElectrical,Electronics and Instrumentation Engineering, Vol. 4, Issue 4, April, ISSN : 2320 –3765.

Zhang X, Tentzeris M [2011], "Applications of fast-moving RFID tags in high-speed railway systems", International Journal of Engineering Business Management, pp: