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Smart Car Design using RFID #Aravind E, #Ramya Sundaram B, #Karthick G, #Harithaa S and *Shriram K Vasudevan #Electrical and Electronics Engineering Department, Amrita University. India. *Department of CSE, Amrita University, India. E mail: shriramkv@gmail.com Abstract— The Indian automobile market has seen a drastic change in its trends over the past decade with several road commuters opting for mid-range sedans and SUVs, owing to the safety features of cars that two-wheelers can never provide. At times, the driver is not fully aware of his surroundings, leading to inconveniences and compromises on safety. This problem has several facets to it. Blocked vision due to a large vehicle in front is a major hassle that persists especially during heavy traffic, in turnings and in narrow lanes. Bright headlights at night cause discomfort and troubled vision to drivers. It is the worst nightmare of a “fuel-conscious” driver to get caught in a traffic jam when he could have chosen a different lane and or to be forced to return back due to blocked roads. The most frustrating experience for any driver would be to get stuck under the sweltering sun in a road either due to a flat tyre or an empty fuel tank. These issues could be solved if the driver is given constant inputs about vehicles near him and the fuel level, battery conditions and tyre pressure status. Providing information from other vehicles could be facilitated through vehicle-to-vehicle communication. Keywords— Radio Frequency Identification (RFID) system, Vehicle-to-Vehicle communication, sensors, electromagnetic field, tag, reader. 1. INTRODUCTION: With the traffic density showing a sharp rise with time, road accidents rates have also risen comparably. According to WHO (World Health Organization) statistical reports, India records more than 100,000 fatalities due to road accidents each year and the number of injuries reported amount to more than 500,000 (7). Accidents mainly occur due to negligence and obsolete technologies that are not competent to meet the traffic demands. Vehicle-to-vehicle communication can remove these hitches by making the driver more conscious about his environment and providing with automation when required. The innovation discussed here makes use of RFID (Radio Frequency Identification) tags as its core. RFID tags can effectively track the location and speed of systems and can be used for wireless communication. These tags are capable of automatic identification and data capture. Quick identification of moving objects, ability to count objects and identifying objects at longer distances are special attributes of the RFID system. 1.1 Principle of Operation: The technology recommends cars to be affixed with RFID readers and tags. Consider car A, which is equipped with an RFID system. When the tag component of the RFID system of car B comes within the range of car A, the RFID reader of car A receives information from it through electromagnetic waves. This information could include the location and speed of car B. Similarly car B receives data from car A. The RFID reader has access to a computing device (3), which helps it to provide data from the reader as visual information to the driver. An active RFID system which depends on an external power source would suit this application. The RFID reader of car A could also intimate the driver about low fuel

level, flat tyre or low tyre pressure and poor battery conditions using necessary sensors and indicators, through an SMS. To overcome hindered vision, RFID systems could be installed in roads at strategic locations. These tags could then keep the driver well informed on what lies beyond his field of view. RFID tags could also help in reducing headlight glares at night, by controlling the headlight intensity when there is a vehicle nearby. The principle of operation of RFID is depicted in figure 1. Figure 1 RFID working 1.2 Objective of Study: The technology presented here aims to enhance the safety features of cars through an exclusively automated system to provide a better experience for road commuters. It offers an efficient solution to reduce road accidents by providing constant alerts to a driver on the driving behavior of other drivers nearby. It helps in putting an end to negligence and recklessness while driving. This system informs drivers about blocked and jammed routes, enabling them to choose an alternative path. Through this feature the driver could avoid unprecedented fuel loss and conserve fuel. Further, this system could provide a better traffic organization. It also encompasses a solution to make vehicle maintenance more convenient. Such systematic maintenance would have long term benefits for the vehicle like a prolonged lifetime and reduced wear and tear of components. 2. MATERIALS AND METHODS: The engineered system uses an RFID tag cum reader unit as its essential component. The key aspects of the technology proposed are as described below. 2.1 Tracking Location and Speed: Each RFID tag emits radio waves of specific frequencies which gives it a unique identity. This enables each vehicle to be distinctly identified. Locating moving objects is a special feature of RFID tags (1). This operation of tracking makes use of two parameters – time and angle. Distance is tracked by measuring the time taken to receive the electromagnetic signal from the RFID tag. The exact location is determined by measuring the angle at which the signal is transmitted. Figure 2 Vehicular communication Tracking the speed of the moving car can be done using the speedometer in the car. The voltage that helps the speedometer pointer to move is obtained from the appropriate terminals. This voltage is then applied to an electromagnet or an induction coil to produce an electromagnetic field. This electromagnetic field gets interpreted as speed by the RFID reader. 2.2 Vehicle-to-Vehicle Communication: RFID tags have the potential to communicate with each other and also to access the Internet. This property aids in transferring data like location and speed between two vehicles, thus making the driver more aware of his surroundings. This also helps a driver to know if sudden brakes are being applied on a vehicle in front. Further RFID systems installed on roadsides, at suitable elevations, can detect a jammed road as there would too many vehicles in near rest conditions. Hence, the RFID tags on the roads can communicate with the RFID readers of cars and instruct the driver suitably. The vehicular communication is shown in figure 2. 3. DISCUSSION OF THE SOLUTION ENGINEERED: The techniques discussed in the preceding section are utilized for the applications that follow. 3.1 Hindrance–Free Vision for Drivers: Often drivers are unable to look in front due to a larger vehicle like a truck that obstructs their vision [2]. This happens especially at traffic signals and at turnings. In a traffic junction, a car driver is unable to look at the traffic signal by himself. Instead, he chooses to take cues from the truck driver. This would lead to lots of chaos and confusion, if the truck driver does not obey the signal and moves when the signal is still red. To avoid this, RFID equipment could be installed in traffic signals, on roadsides and medians at suitable heights. The RFID readers on roadsides and medians read the information provided by the RFID tag of the traffic signal. Accordingly the RFID reader of the car obtains information from the RFID system on roadsides and medians and the driver is able to act as per signal. Hindrance due to large vehicle is shown in figure 3. Figure 3 Hindrance due to larger vehicle Figure 4 Clear vision at turning Consider the turning in the figure 4. The car is about turn from street A into street B. Let the RFID system installed at the intersection considered being a main RFID system and those at roadsides is the supplementary systems. The main system provides information about any vehicle or other object the driver would meet upon turning. With this information the driver can accordingly modify his speed. 3.2 Reducing Headlight Glares: High intensity headlights prove to be a major discomfort when driving in the dark as they cause troubled vision for the drivers. By installing

RFID systems in cars the headlight intensity of vehicles could be automatically reduced. The RFID reader of car A locates car B. When car B is at a specified distance from car A, the headlights of car A automatically lower their intensity. The distance at which headlight intensity should reduce is prescribed in the software in the computing device of the car. At this distance, the headlight is made to automatically switch to a different intensity mode using a computing device. The headlight glare depiction is shown in figure 5. Figure 5 Headlight glare reduction 3.3 Monitoring Fuel Level, Tyre Pressure and Battery Status: To obtain a measure of the fuel level, the fuel indicator in the car can be utilized. The voltage from the meter is used to generate an electromagnetic field using inductance coils. The voltage level is to be amplified to the adequate level so as produce sufficient electromagnetic energy. This electromagnetic energy can be interpreted by the RFID reader in the car. The same technique can be made use of in a tyre pressure monitoring system. Tyre pressure from the meter can be fed to the RFID reader. A voltage sensor (5) could be installed along with the battery to provide the status of the battery conditions. This voltage sensor could then be used to produce electromagnetic fields for the RFID reader. With Internet access and using the computing device in the car, the RFID tag could send alert notifications containing these data through SMS. 4. FUTURE DEVELOPMENTS: Employing RFID tags to facilitate accident control and installing these automatic identification and data capture devices has a wide range of advantages as discussed below. 4.1 Emergency Vehicle Prioritization: Installing RFID systems in traffic signals and in emergency vehicles like ambulances, fire engines and police vans could serve extremely useful. With RFID tags on emergency vehicles, these vehicles could be clearly identified and sorted out. The processing units of the traffic signal is to be programmed to temporarily tweak the regular traffic signal function upon detection of an emergency vehicle in the incoming traffic. Traffic in all other directions is immediately halted through red signal. Green signal is emitted to allow the emergency vehicle to pass without having to wait. This system helps in speedy implementation of rescue operations and in saving lives. 4.2 Vehicle-Actuated Traffic Signal: The present traffic management system in use employs conventional pre-timed traffic signals [6]. These signals are obsolete and are inefficient in saving the time and fuel of road commuters. Hence, it is necessary to implement a traffic control system where the timers are not pre-timed and instead work depending upon the traffic density. In this system, the direction with higher traffic density is allotted more time for green signal and less time for red signal. This system uses the fact that RFID tags could be effectively used for counting objects. It requires RFID systems to be fixed along road sides at appropriate altitudes. 4.3 Speed Control in Roads: This application works on the fact that RFID tags are capable of unique tracking of each vehicle and speed detection. When a vehicle is found to drive beyond a definite speed, the RFID tag can detect rash driving. It can be programmed to either track down the driver or to deduct a fine amount from the bank account linked with the RFID tag of the vehicle. 4.4 Payment at Toll Gates and Petrol Bunks: The RFID tag mounted on a vehicle could be linked with a certain bank account. So when the RFID tag comes within the field of another registered RFID reader, cash could be deducted from an account exclusively used for this purpose, through net banking. This could be used for easy payment at toll gates and petrol bunks. To prevent inadvertent use of this account, only registered RFID readers should be allowed to scan the tag. 5. TECHNICAL HINDRANCES: RFID has various cons that hinder our system. Since, RFID technology makes use of electromagnetic spectrum; it can be disturbed in some cases. There is also a possibility of reader collision when signals from two or more vehicles overlap. Hence, the tags won’t be able to answer multiple queries at the same time. So, the system must be developed using anti- collision protocol which enables easy transmission to the readers. There is also a possibility of tag collision when numerous tags are present under a small region. The RFID tags can read fast, so this can be prevented by programming system to respond queries one at a time. Further, the privacy and anonymity of the users are also affected (4). It can be read without the knowledge of the users. Since the tags used here should be able to respond over a large range, high gain antennas are preferred, which in turn hinders the privacy of the users. Hence it

poses security and ethical problems. There is also a lack of standard in the RFID technology. Since, there are no global standards for the implementation of the tags. Most of the above stated disadvantages of RFID is minor problems. These cons can easily be outweighed by the advantages of the tag. 6. CONCLUSION: Implementing RFID tags in automobiles offers a radical approach to controlling road accidents. It helps in eliminating negligence from the scene. It is enough if a single computing device is used to perform all logical operations. This computing device could be either a powerful microcontroller unit or a microprocessor or an embedded system like the Raspberry Pi. With modifications this technology could be used for building driverless cars. 7. REFERENCES (1) J. Bohn, “Prototypical implementation of location-aware services based on a middleware architecture for super-distributed RFID tag infrastructures”, Pers Ubiquit omputing, (2008) Journal 12:155-166. (2) J. Schwieren1, G. Vossen, “A Design and Development Methodology for Mobile RFID Applications based on the ID-Services Middleware Architecture”, IEEE Computer Society, (2009), Tenth International Conference on Mobile Data Management: Systems, Service and Middleware (3) B. Glover, & H. Bhatt, RFID Essentials, O’Reilly Media, Inc, Sebastopol, (2006), ISBN 0-596-00944-5. (4) S. Garfinkel, B. Rosenberg, “RFID Application, Security, and Privacy”, USA, (2005), ISBN: 0-321-29096-8. (5) J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori, Sensors for Automotive applications (volume 4), 2003 WILEY- VCH Verlag GmbH& Co. KGaA, Weinheim. (6) W.Wen,2008. A dynamic and automatic traffic light control expert system for solving the road congestion problem. Expert Systems with Applications, 34:2370-2381. DOI:10.1016/j.eswa.2007.03.007 (7) Ministry of road transport and highways, Government of India. http://morth.nic.in/writereaddata/mainlinkFile/File761.pdf