VEHICLE SPEED MONITORING AND AUTOMATIC TOLL COLLECTION SYSTEM IN HIGHWAY

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***Abstract*-- The aim is implementation of a automatic toll gate management and Vehicle speed monitoring and Control System Based on ZigBee, RF and ARM Microcontroller. RFID is non-contact automatic identification technology which could be applied to various industries extensively. Accessing the vehicle speed range in freeway, we could use RFID technology to monitor speed of vehicles. Then we could determine whether the vehicles are over speed. Therefore, the use of RFID technology can effectively reduce speeding violations and enhance traffic safety. Its toll is paid by credit card automatically through computer network. Therefore, realize the non-stop automatic toll collection. Contrarily, punish the illegal vehicle by monitor network.**

***Keywords*- RFID, Electronic toll collection, highway, speed detection, Zigbee.**

I INTRODUCTION

Radio-frequency identification (RFID) is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by and read at short ranges (a few meters) via magnetic fields (electromagnetic induction). Others use a local power source such as a battery, or else have no battery but collect energy from the interrogating EM field, and then act as a passive transponder to emit microwaves or UHF radio waves (i.e, electromagnetic radiation at high frequencies). Battery powered tags may operate at hundreds of meters. Unlike a bar code, the tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object. From 90 years of the last century, China had entered a period of rapid development of highway construction. To 2010, the total highways has exceeded 65000 km in China, which is kept on second in the world. According to the Planning of Ministry of Transport of the People's Republic of China, it will reach 70000 km to 2010,which is form the national skeleton road network together with the current National Highway. However, lacking intelligent traffic management, China's highway traffic management level is still kept in a people-based management model. Thereby, it is a pressing task to increase the level of highway traffic management, improve the highway traffic environment and enhance the level of driving Safety. As an automatic identification technology, Radio Frequency Identification (RFID) technology is applied to highway management,

which can achieve efficient and intelligent, and can significantly reduce the incidence of highway accidents, to improve road safety.

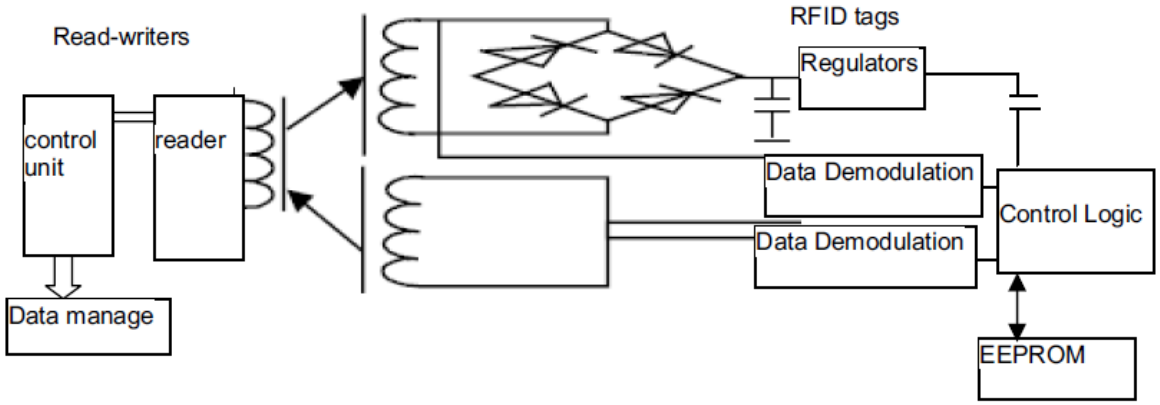

Fig 1.0 Radio frequency card work process

1.1 How is RFID used in the real world?

Many consumers are already familiar with one form of RFID – the toll-pass that drivers can keep inside their cars to go through toll booths without having to stop to pay. The chip in the toll-pass sends information to a reader located in the toll booth. This information, the reader's location, and the time and date of the reading are then transmitted to a computer system, which may be linked to databases containing other information such as the toll fee and the bank account that will be billed for the toll. Another use of RFID that some consumers are familiar with are payment systems that allow them to wave a tag in front of a reader on a gas pump to fill up a gas tank. RFID technology is also being used to control entry into certain buildings. Some pet owners are having their dogs or cats implanted to help track them in case they get lost, and the U.S. Food and Drug Administration has approved a tag to be implanted in humans containing their patient records for use in hospitals.

1.2 Mobile RFID Technology

RFID is expected to be the base technology for the ubiquitous network or computing, and is likely to be associated with other technologies such as MEMS (Micro Electro Mechanical Systems), Telemetric, and Sensors. Meanwhile, it is widely accepted that Korea is one of the countries that has established a robust mobile telecommunication networks in the world. In particular, about 78% of the population uses mobile phones and more than 95% of those phones have Internet-enabled functions .Currently, Korea has recognized the potential of RFID technology and has tried to converge it with mobile phone. Mobile phones integrated with RFID can be expected to create new markets and provide new services to end-users, and as such will be considered as an exemplary System Framework and Its Application in Mobile RFID Service Network 3 technology fusion. Furthermore, it may evolve its particular functions as an enduser terminal device, or a u-device (Ubiquitous device), in the world of ubiquitous information technology Actually, the mobile RFID phone may represent two types of mobile phone device; one is the RFID-reader-equipped mobile phone, and the other is the RFID-tag-attached mobile phone. Each type of

mobile phone has different application domains: On the one hand, for example, the RFID-tag-attached type can be used as a device for payment, entry control, and identity authentication, and the main feature of this application stems from the fact that RFID readers exist in the fixed position and recognize each phone, giving the user specific services like door opening; on the other hand, the RFID reader equipped mobile phone, to which Korea is currently paying considerable attention, can be utilized to provide end-users with detailed information about the tagged object through accessing the mobile wireless network.

II TECHNOLOGY AND ITS APPLICATION

In This project we are implementing automatic toll gate management and vehicle access control system using ARM based LPC2148, PIC18F452 and wireless technologies such as RF , ZigBee and GSM. In this system three sub-systems are present those are vehicle unit, tollgate unit and central database system. They are discussed one by one.

2.1 Vehicle Unit

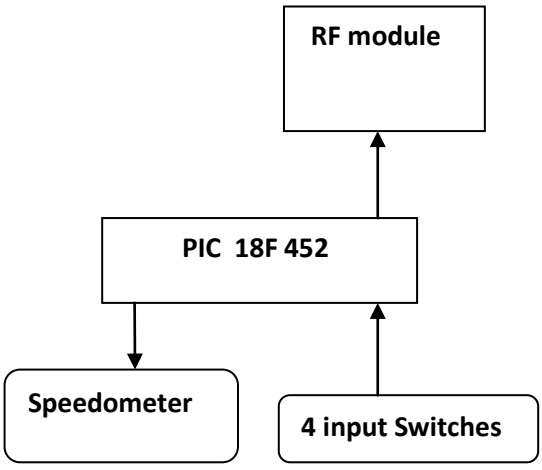

Fig 2.0 Vehicle Unit

Vehicle unit was implemented by using PIC18F452 Microcontroller It is interfaced with speedometer, input switches and RF module. Speedometer calculating the speed of the vehicle and send this speed trough RF module by using PIC controller. Here 4 input switches was connected to the PIC controller one for sending ID of the vehicle to the tollgate station second switch for sending vehicle speed third and fourth switches for incrementing or decrementing speed of the vehicle. RF module is used for transmitting data from vehicle unit to tollgate station unit like vehicle ID, speed of the vehicle. There are millions of drivers passing through Toll Gate Stations every day. The conventional or the traditional way of collecting the toll from the vehicle owners or the drivers is to stop the car by the Toll Gate Stations and then pay the amount to the toll collector standing (or perhaps sitting!) by the side of the toll booth, after which the gate is opened either mechanically or electronically for the driver to get through the toll station. An efficient utilization of communication link between RF Modems over a wireless channel to facilitate vehicle monitoring, vehicle authentication and automated toll collection on the highways is proposed. The system is implemented to automatically a more convenient way of collecting the toll and traffic management. It's called Electronic Toll Gate Stations using RFID and ZigBee Technologies. In This project we are implementing automatic *toll gate* management and vehicle access control system *using* ARM based LPC2148, PIC18F452 and *wireless technologies such as RFID , zigbee and GSM. In this system three sub-systems are present those are central database system , tollgate unit and vehicle unit.* The vehicle unit consists of a active rfid tag ,GSM modem, keypad and ignition control unit. The Active RFID tag send the necessary vehicle identification information to tollgate unit based on user request. GSM send the vehicle starting intimation to user and also receive the necessary command from user for stop the vehicle. Keypad is used for authentication password to access to start the vehicle. The tollgate unit contains the Active RFID reader to the necessary vehicle identification information When a vehicle comes in the vicinity of the toll gate the tag attached to the vehicle is communicates with the reader attached to Toll gate station.

2.2 Tollgate station unit

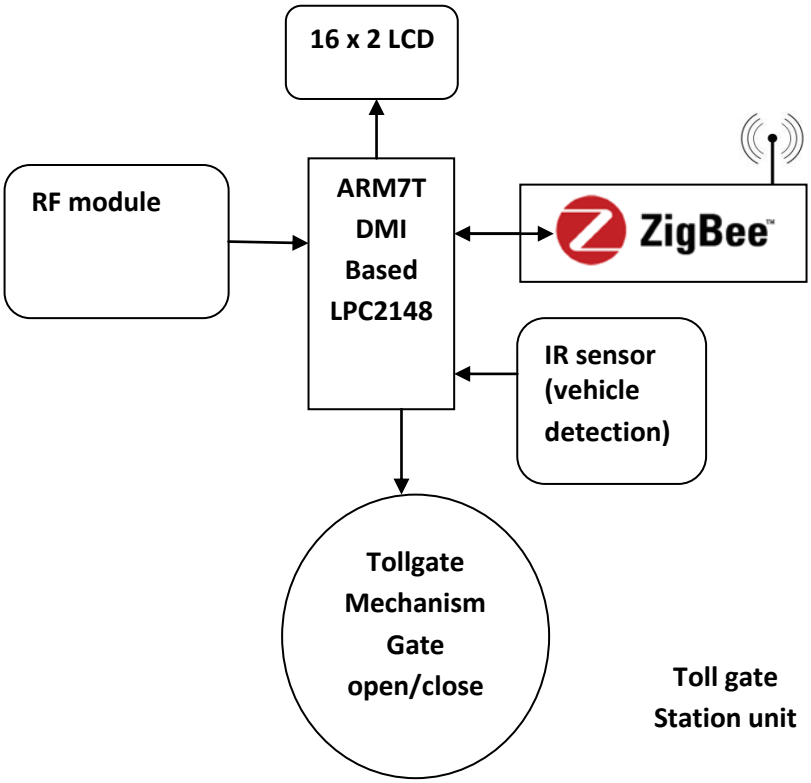

Fig 2.1 Toll gate Station unit

Tollgate station unit implemented by using ARM7TDMI based LPC2148 controller it is interfaced with RF module, LCD display, Tollgate mechanism like stepper motor and Zigbee. This toll gate system automatically reads the vehicle identification via RF receiver when the vehicle entered into tollgate zone. It will receive the vehicle Id and speed then tollgate station send the this information to central data base station by using Zigbee technology. The central database check balance against the customer deduction the necessary balance sends the acknowledgement to Tollgate unit and gate automatically open and close by using stepper motor. This system also proving additional feature like vehicle access control to prevent the unauthorized persons access the vehicle. Automatic Toll Collection System perfom information exchange by the device RFID fixed in the vehicle and road head device IR SENSOR which is fixed in the toll station's roadway. It consists of Central Database, Vehicle Unit, and Tollgate Station unit. The RFID tag send s the signals from 100- 200mts to the tollgate station, then IR SENSOR detects the signal and the information to Central database, if information is matched an acknowledgment send to Tollgate station ,amount will be detected. Then automatically gate will be opened.

2.3 Central Data Base Station

The Central station is equipped with one ARM7TDMI based LPC2148 microcontroller, and

is interfaced with Zigbee wireless module, EEPROM and PC interface. In this system complete information of vehicles was stored in EEPROM . External memory (EEPROM) interfaced to the station using I2C protocol. When it receives vehicle information and speed by using zigbee. the controller checks date base whether that vehicle ID present in database or not. If the vehicle id present in the database then it checks whether required amount present in the account. If the required amount present in the account then it deducts toll fair and also deduct the fine if the vehicle speed is above limited speed and then send the acknowledgement to the tollgate station by using Zigbee. . If there are any errors like tag detection, not enough balance then the central station will send the appropriate command data to corresponding toll station. In this central station we are providing choice to admin, they can modify the data and update the balance of users whenever they needed. At the other side the central data base system receives this information compares the database for the sufficient details and amount. If the details are matched and sufficient amount is found then the successful information is sent to the corresponding toll gate station via Zigbee. At the toll gate if the received information is about success then the toll gate will be opened after vehicle passed away it will be closed automatically based on IR sensor interfaced at toll gate.

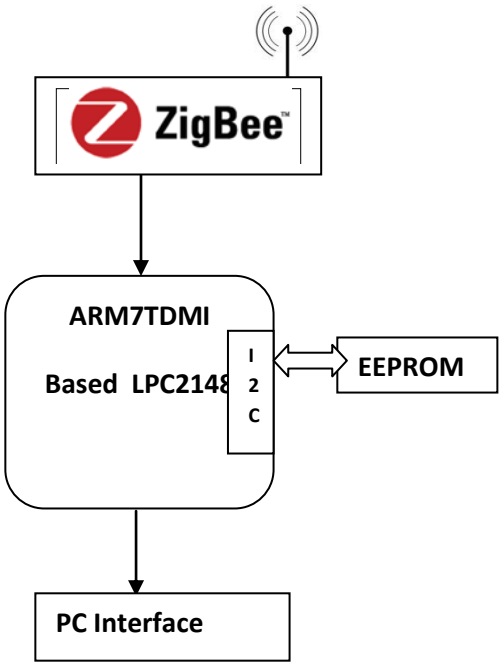

Fig 2.2 Central Database station

III ARM

3.1 Register file & modes of operation:

The ARM architecture has register file with 37 registers. In addition to these registers there will be several other registers inside the processor which will not be visible to the programmer but used by the processor internally to execute instructions. The current program status register (CPSR) has condition flags and several other control bits.ARM has 16 general purpose registers, through r0 to r15. The ARM processor has three registers assigned to a particular task or special function: r13, r14 and r15.

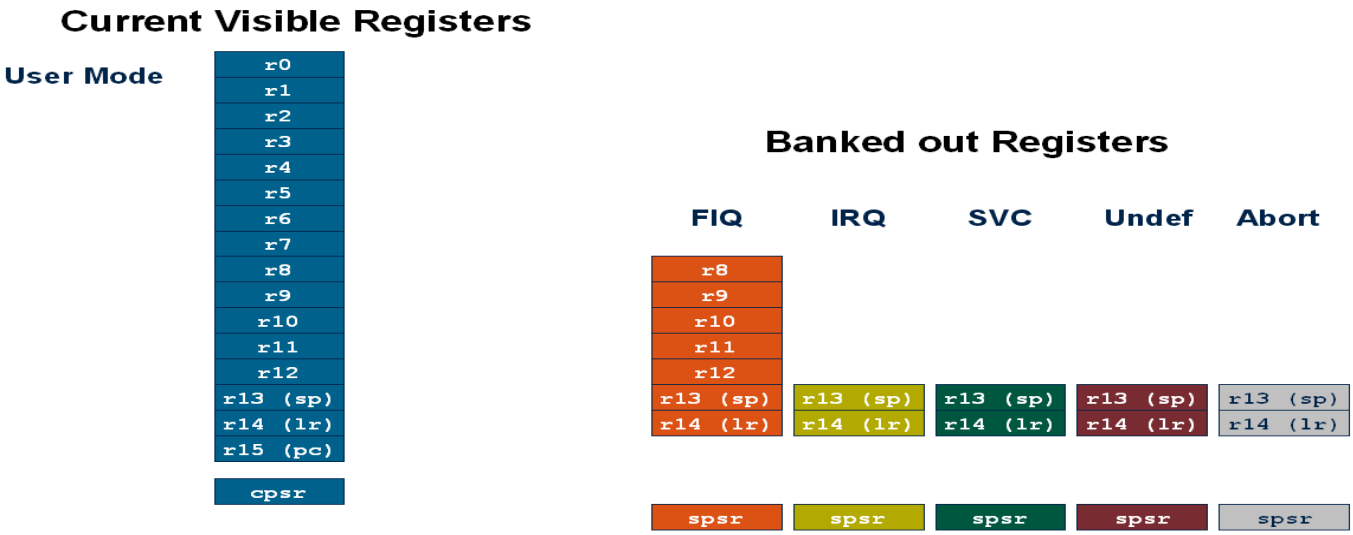

Fig 3.0 Register set of LPC2148

3.2 Current program status registers:

The CPSR is a 32 bit register in addition to the 16 general purpose registers. The CPSR has flag and control bits in it. The following figure illustrates the bit positions of various control or flag bits of CPSR. The CPSR is divided into 4 fields, each of 8 bits size. They are Flag, status, extension and control fields. In the present versions of ARM the status and extensions field's bits are reserved for future use. If flag up date option is enabled[1] then the flag bits will be changed as described below. Remember that flag bits are only affected when such option is chosen in the instruction; otherwise flag bits will preserve their old values. Different ARM architectures revisions support different instructions. However new revisions usually add instructions and remain backwardly compatible. The following shows the type of instructions that ARM support. The ARM7TDMI core is a 32-bit embedded RISC processor delivered as a hard macro cell optimized to provide the best combination of performance, power and area characteristics.

IV ZIGBEE COMMUNICATION

ZigBee is an open technology developed by the ZigBee Alliance to overcome the limitations of BLUETOOTH and Wi-Fi. ZigBee is an IEEE 802.15.4 standard for data communications with business and consumer devices. It is designed around low-power consumption allowing batteries to essentially last forever. BLUETOOTH as we know was developed to replace wires and Wi-Fi to achieve higher data transfer rate, as such till now nothing has been developed for sensor networking and control machines which require longer battery life and continuous working without human intervention. ZigBee devices allow batteries to last up to years using primary cells (low cost) without any chargers (low cost and easy installation).

Fig 4.1 Zigbee Module

The ZigBee standard provides network, security, and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer (PHY) wireless standard. It employs a suite of technologies to enable scalable, self-organizing, self-healing networks that can manage various data traffic patterns. The network layer supports various topologies such star, clustered tree topology and self healing mesh topology which is essential in Smart dust Apart from easy installation and easy implementation. ZigBee has a wide application area such as home networking, industrial networking, Smart dust, many more, having different profiles specified for each field. The upcoming of ZigBee will revolutionize the home networking and rest of the wireless world. The ZigBee Alliance is not pushing a technology; rather it is providing a standardized base set of solutions for sensor and control systems.

V CONCLUSION

One of its main features is the ability to communicate operation commands from head-quarters or any other subsidiary command station to any location in the system via existing infrastructure such as GSM or Internet. Especially for the more serious problem of the current highway over speed. RFID technology can full monitor while vehicle driving from entrance to export, effectively make driver control vehicle speed. Thereby, it will greatly reduce the occurrence of speeding behavior and further enhance the driving safety of high-speed highway.

ACKNOWLEDGMENT

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REFERENCES

[1] Yunus A.Kathawala."The use of RFID for traffic management",Int.J.Technology, Policy and management, 2008,8(2):111-125

[2] Shi Jing.”Applied study of price discrimination implemented on a two-path route expressway”.Tsinghua science and technology , 2006,11(6):632-639

[3] Xu Guang-xian."The research and development of the highway’s electronic toll collection system".Proceedings of world academy of science,engineering and technology,2007,25:231-235

