

An Innovation in Using RFID Technology in Automation of Traffic Fine Issue and Management

Vali Derhami, Mohammad Ghasemzadeh, Mina AmirSadeghi

Electrical and Computer Engineering Department, Yazd University,
Pajooresh, Yazd, 89195-741, Iran.
{vderhami; m.ghasemzadeh}@yazduni.ac.ir

Abstract: This research paper is concerned with using information technology in automation of traffic fine issue and management, which is one of the topics in e-Government. RFID (Radio-Frequency Identification) tag is an electronic label, known as an advanced form of bar codes. This research work suggests a method in using this technology in issuance and management of traffic fine. Each vehicle would carry an RFID tag on it, when a violation of the law happens, specification of the vehicle would be read from its RFID tag. This data would be transferred into a local station and from there it would be transmitted to a central data centre. The amount of fine can be calculated depends on by considering the violation history of the vehicle and some other parameters, available in the database of the central station. In this research we survey storage and transmission of related data, processing, as well as performing some kind of data mining in the accumulated data. The advantages of our suggested system are: improved performance, higher level of accuracy, possibility of taking variable parameters into account when calculating the amount of fine (like history of violence). It also allows performing some data mining, in order to discover special reasons for violations, which can be considered in future modifications.

Keywords: Electronic fine, Information Technology, Automation, RFID.

1. Introduction

High speed computers with massive memory and processing capabilities, as well as developments in tele-communications and spreading of internet has led to fast development of information technology [1,2]. Utilizing the developments in information technology makes it possible to give efficient solutions for different techno-logical, educational and other social challenges [3]. With the development of information technology, the number of services which migrate from the traditional form to the online form grows as well. Today citizens expect new informatics applicants in electronic government [4].

Traffic and transportation management is one of important challenges in governments [5]. The traffic fines are used to drivers respect traffic laws.

The traditional traffic fine system has some problems such as:

1. The necessity of seeing the license plate totally: This task is not so easy and in the most of the cases is full of mistakes specially when the vehicle has a high speed or the weather condition is unfavorable.
2. Errors occur at the time of inserting the information to the system: Everyday, there are many complaints from the drivers who claim that they have not done the traffic violation which were recorded in the system. The traffic officials accepted many of these complaints are true most of the time because inserting the information are taking place by hand so many errors will happen excessively [6].
3. The high rate of inserting the information of the fines to the concentrated center: inserting the information of fines by hand is full of humanitarian errors, time consuming and expensive.
4. Legal problems: One of the recent challenges in fine issue is that drivers protest to the amount of the fines and to the fine itself which lead to many legal problems and investigation to them [7].
5. Disputes and discussions about the amount of fines: The police officials proclaim that increasing the amount of fines is the solution to prevent

committing crimes in one side and on the other side the present amount of fines is intolerable for some people of the society. The fine system which is use today is so fixed and static and it is impossible to increase the amount of fine dynamically and suitably to the crime. In some occasions it led the officials to legislate some harsh laws which cause fear and horridness.

In this article, an innovative solution using information technology will be presented to eliminate the above problems. The mentioned idea has named electronic traffic fine. In this plan at first the vehicles will be equipped with an intelligent tag which can be sensed by the fine device. {The fine device has been explained in the third section.}. At the time of committing crime, the police officer transfers the vehicles code to the fine device with the radiation of the beam toward the vehicle. Then the official exerts the fine with pressing the key which is suitable to the fine. The proposed devices are in connection with the local stations through SMS and information related to fines will be transferred to the local stations. Depending on the repetition amount and other related parameters, the amount of fine will be fixed for the driver.

The proposed system will eliminate the above described problems in the conventional traffic fine system and it also cause the high speed, accuracy, sufficiency, decreasing the expenses and exertion a dynamic fine.

The structure of this paper is as follows. In the second section we introduce RFID; the intelligent tag. The electronic traffic fine system is proposed in Section 3. In the forth section the presented electronic traffic fine plan is evaluated. Finally, conclusion and future works are given in Section 5.

2. RFID

RFID (Radio Frequency Identification) which is known as an intelligent tag system which uses radio waves to transfer information related to identity of an object. Figure 1 shows one of these tags. In the intelligent tag

system we have some tags with different sizes and characteristics which have placed on the objects. These tags are included SIM card and a very small antenna that enables to send the information which had saved in them (usually a special code) with the use of SIM card and the antenna inside themselves [8]. Receiving information from the tags is accomplished by a reader device.

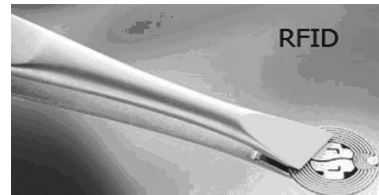


Figure 1. A sample of RFID tag



Figure 2. A sample of READER

This element is accounted as a part of RFID system. Figure 2 shows a type of reader. The technical characteristic tag of the readers can perform in different intervals, accuracies, environments, and shapes. The information which is related to tags and acquire through the reader need to gather in a suitable form that this job will be done by means of a reader named software. The tags are nominated with regard to the source which is supply the power. They divide into three main groups [9,10]:

1. Passive tags which acquire their energy and electricity from the reader.
2. Active tags which acquire their energy from an interior battery and for establishing the connection it has a processor, a memory and a sensor.
3. Semi-passive tags that in addition to use their interior battery they can use the transferred energy by the readers [10]. According to the usage type of RFID, they are produced in different sizes. The smallest one is in the size of a molecule

that can be injected to the body. The advantages and capacities of RFID have caused a revolution in different systems especially in cases which are related to information technology. Installation of the RFID tags to the goods at the markets to tracing the goods, on the hand of adults in a grown up house to tracing them and also attaching them to passports for automatic recognition is some of this applications [11].

3. Electronic Traffic Fine System

In this section, the proposed plan which has named the electronic fine system will be expressed. In general in any information technology plan, we should notice to the points which are mentioned below:

1. Which data and how they should save. In the proposed plan, the code related to vehicles characteristics, the time and area of committing the crime should be stored. A passive RFID tag has installed on every vehicle for this purpose. This tag should be confirmed by legal centers and then it taken into account as a unique plaque for every vehicle and no one can alter or passive it. The fine device is an electronic tool which has a responsibility of reading tags, receiving the kind of a fine from the official, sending it to the local stations and exertion of the fine. In fact this electronic tool is a reader that an electronic vehicle and a SIM card have added to it. The reader section receives the related code from the vehicle and gets it to the card. Then, police officer assigns the kind of fine by the keyboard which has twenty keys, each key for one violation. Afterwards the designed electronic card sends a message that includes the vehicle's code and type of the fine to the local station.

2. How is the manner of transferring data, information and information progress. It has recommended four layers of information progress as it can be seen in the Figure 3. In the first layer the communications is done through the cell phone network. Since the officers are moving in roads and streets, we suggest a network based on SMS (Short Message Service that is the text

communication service component of mobile phone). In order to use SMS service, an electronic card has to be designed. The electronic card is placed in the fine device. The tasks of this card are as follows:

- i) Receiving the data provided by the reader system, scanning the keyboard of fine device, and gathering the information that the officer enters by the keyboard.
- ii) Combining the received data and generating the SMS code that includes these data.
- iii) Sending the generated SMS to the local police station. For sending SMS, we need a suitable SMS interface for example GSM modem (details of GSM modem is given in Section 4)
- iv) Receiving the sent SMS from police station. It is noticed that the computer system in the local police station received the SMS that has been sent from the card and based on included data in the received SMS computes the amount of traffic fine. Afterwards the system generates an SMS including the traffic fine and other information and sends this SMS to the fine device of police officer. The card has to receive this SMS. After receiving this SMS, the card decodes the information of the SMS and shows the amount of traffic fine on the display. Receiving the code of the intelligent tag related to the vehicle should be less than 5 ml/s [12]. In fact in this layer, we have a structure of point to the multi point computers of local station.

Since the computer systems in the second layer are placed in local stations, we can use the internet network to connect those to each other's and to the upper layer. Therefore, computers in second layer are connected to Internet network. Sending and receiving data to other computer are done by internet protocols. However, for receiving and sending data to fine devices by SMS, the computer systems in the second layer use suitable SMS module.

In the third layer, computer systems are placed in the provincial stations. These computers are connected to upper and to lower layers by internet network. Finally, the

main computer system in the highest layer is connected to internet and sends and receives data by internet network.

3. Which processes takes place on the data. As the Figure 3 shows data will be gather in a central data base. These data will mix whit other data like the information of the vehicles owner, the specifications of the vehicle and legal cases of the vehicle that can be traced. The first processing job is to fix the amount of the fine progressively and according to the history of vehicles crimes and the approved rates. For example, a vehicle in spite of the warning of the official commits a unique crime. The rate of the fine for repeating a crime will grow progressively. In this system we can establish different amount of fine for especial days such as New Year holidays. Also, we can put the information of vehicles which are following up in this base for the officials to be informed.

the central station and the amount of the fine transferred to the fine device according to the defined functions at data base. The amount of the fine can be seen on the fine device. If the fine is attached, the official writes the amount of fine in a paper and hand it to the violator driver. Pay attention that in this system it is not necessary to insert the information of the papers to the system and writing the fine paper is only to inform the driver. For non attached fines the last process has not take place.

4. Evaluation and Experiments

The electronic fine system which was presented has led to high speed and accuracy, decreasing the expenses, and so on. In this section, we evaluate this system and then we describe the latest practical results that we have got in the implementation of the proposed fine system.

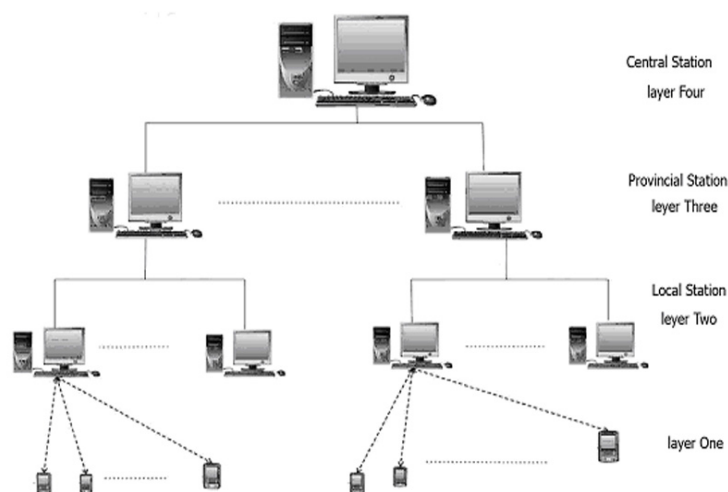


Figure 3. The information flow diagram

According to the structures which was introduced above the policy of making fines is presented below. At the moment of seeing a crime the traffic official take the fine device toward the vehicle and the beam will be radiate. Then the code of the vehicle which can be the number of the plaque can be seen on a device. After that the official pushes the suitable key and the electronic card on the device transfer the information with the

details of time and place to the local station. The local station transfer the information to

4.1 Evaluation

The advantages of the proposed fine system can be summarized as:

1. Accurate and rapid recording of information related to the automobile: The information transfer to the central system rapidly by pushing only a key, so a little time is spend, meanwhile according to the automatic process the legal problems will be decreased because the humanitarian errors will be eliminate.

In regard to take the vehicles information by fine device the claims of absence of the vehicle from the mentioned place is not acceptable.

2. Decreasing the expenses and the humanitarian energy and eliminating the paper system: In today's traditional system, after exerting the fine, the fine papers are gathered and insert to the system by employees that in addition to low speed and humanitarian errors it costs very much.
3. The possibility of computing the dynamic amount of the fine: In the fine system with regard that all the history of the crimes with its place and time is available in the central system, fixing the amount of the fine according to the defined functions and interest of the officials is possible. Even we can fix different fines for an especial day (such as New Year holidays in IRAN) or especial areas (such as eventfully areas)
4. Eliminating the problems of exerting the fine in a bad weather condition: In using this technology it is not necessary to radiate the reader directly. This system is useful in bad weather conditions like fog, rain and even obstacles like wall.
5. The suitable expense: The approximate expense of the electronic fine can be calculated as follows. The approximate expense for every tag 3 USD is anticipated that must be provided by the driver. The fine device is included a reader section with the approximate amount of 200 USD for the scope about 100m, a SIM card, about 5 USD and an electronic card which can be supply easily and with a low expense about 20 USD. So by average the expense of a fine device is about 225USD. About the expense of the network we should say with regard that the internet is throughout in the country and all the stations are equipped with computer system the new expenses is not too imposed. Pay attention that the above expense with the economies which is considered in not need a humanitarian energy for inserting the information to the system, verification to the complaint section, and

is easily acceptable. Meanwhile with spending the above expenses we can have a modern and regular country for everyone knows that with the progressed RFID technology no crime can be hidden from the officials and it bring about the possibility of dynamic fines which solve the major of the problem.

Here below we discuss the limitations and drawbacks of the proposed idea:

1. Although the cost of each fine device is not so high, police organizations usually cannot provide enough devices at once. It would take some time until each officer has a device.
2. In the proposed fine system, all tasks are performed electronically, except the last stage when the officer writes the amount of traffic fine in the fine paper and delivers it to the violator driver. We consider this undesirable because it is being performed manually. We are looking for a solution to this shortcoming.

4.2. Experiments

We presented our suggested method to the research and development department of the Iranian police. After some investigations they announced their interest in using it. In the first step, we designed the electronic card which is supposed to be installed on the fine device. This card consists of the following components:

1. The ATmega128L AVR microcontroller as the processor and central component of the system.
2. The SIM300cz GSM modem for sending and receiving SMS.
3. An LCD display.
4. Keypad.

Figure 4 shows the schematic of the card.

The other main component is the program we coded for the microcontroller. We used *CodeVision* which provides the ability to write programs for microcontrollers using C. Figure 5 displays the flowchart of the developed program.

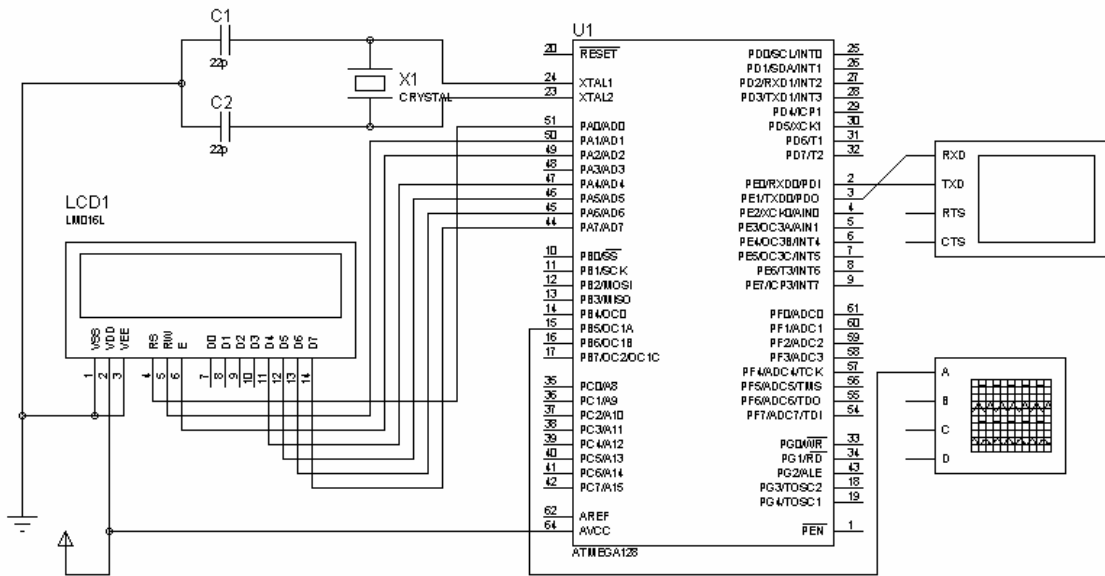


Figure 4. The Proteus schematic of card

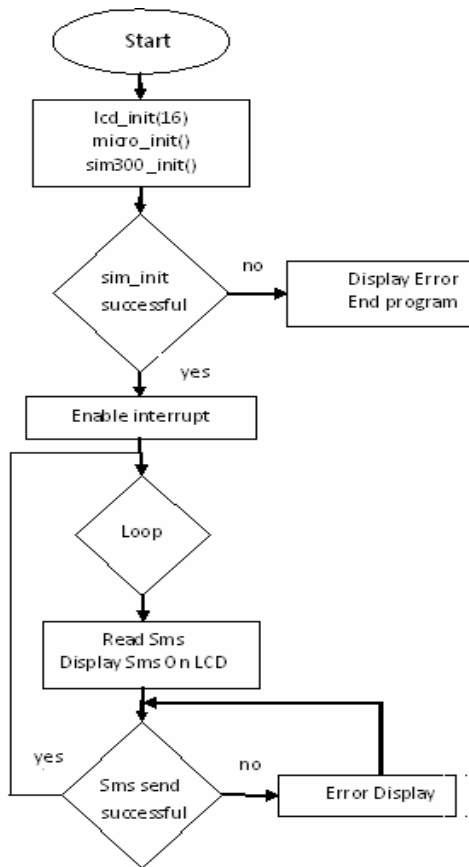


Figure 5. Flow chart of AVR Microcontroller program

The operations start with initializing the microcontroller using our *micro_init* procedure. It sets the output frequency to 8 mega Hertz, port A for connection to the LCD, and activates *send* and *receive* operations on USAER0 and the serial ports.

The *sim300_init* procedure initializes the SIM card, it turns the module (SIM300cz) on (a 30 second delay is considered for registration of the module in the GSM network).

The *wait_ok* procedure is responsible for receiving the OK / ERROR signal from the module making the corresponding decision, recognizing the network state and displaying it on the LCD, as well as changing the SMS send and receive mode to TEXT and changing the module mode to GSM.

The task of *sms-read* procedure is receiving data from the module. It activates the module for receiving SMS. Afterwards the module receives the SMS and sends the received data to micro by serial port. The *sms-read* procedure extracts the message from this data. Then information is shown on the LCD.

The *sms-sendf* procedure changes the mode of the module to "send mode", then it sends the requested data to the mentioned module. Finally, the module sends the data as an SMS through the GSM Network.

5. Conclusion and Future Works

In this article a new idea in originate using of the information technology for eliminating the problems of traffic fines was presented which nominated as an electronic fine. In this plan propose of the equipping vehicles with the intelligent tag was prepared. The structure and the details of the exerting device of the fine for getting the code of the vehicle and transferring it to the local stations was consider and also the structure of the network of transferring data and relating information was presented. The electronic fine system supplies the possibility of the solidarity and doing automatically the restoration of the fine information and exerting the amount of the fine dynamically. In summarize the electronic fine system will bring the following

advantages: increasing the accuracy and speed, decreasing the expenses, decreasing the humanitarian energy, the possibility of exerting a dynamic fine, eliminating the legal issues and the possibility of exerting the fine in a bad weather condition. It is essential to say that equipping the traffic officials with the tools which are related to the electronic fine system may have other applications such as tracing vehicles in any places, distinction of the accumulation of the vehicles in any place, and this can lead to increasing the efficiency of traffic officials.

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