A Car Monitoring System for Self Recording Traffic Violations

Ahmed M. Elmahalawy
Computer Science and Engineering Department, Faculty of Electronics Engineering, Minufiya University
Menouf, 32952, El-Minufiya, Egypt
Email: ahmed.elmahalawy@el-eng.menofia.edu.eg; a_elmhalaway@hotmail.com

***Abstract*—Cities today face many common transport problems and implement similar urban traffic management solutions. One of these problems is the recording traffic violations. This paper presents self recording traffic violations system which provides safety for all car drivers. The main target is replacing the old method of recording the traffic violations as increasing the speed limit by a new system. This system depends on both hardware (micro controller as embedded system) and software (rule based system for intelligent decision and database for recording violation of drivers). In near future, a smart road monitoring system will be built, where it will record speed violations with the help of a smart car that can understand and act with the system to reach high efficiency. The system will monitor the roads and cars on the roads 24/ 7 (all week long all day long) and record violations without any faults. Also, a smart car can alarm the drivers to reduce their speed to prevent recording the violations.**

***Index Terms*—embedded system, intelligent speed adaptation, smart car, speed limit, traffic violations.**

I. Introduction

Many car drivers try to reach the car's speed limit in public roads by driving in high speeds. With the absence of road monitoring or old method for monitoring the speed limits, this will cause dangers in road and other drivers. An efficient system is needed to monitor the roads and cars on the roads and record violations without any faults.

Many technologies have been proposed to improve commercial vehicle operations (CVO). These include automatic vehicle identification, weigh-in-motion, automatic vehicle classification, and electronic placard ding/bill of lading. For commercial vehicle freight operations, the benefits include fewer required stops, reduced paperwork burden for interstate operations, and improved safety performance. [1]

As an example, in British, Road users will buy and display a smart-card which stores details of how much credit a vehicle has with the system. The smart-card will be inserted into an in-vehicle-unit fitted to the car windscreen, and be read and written to remotely as the vehicle travels through the toll area. A complete system comprises two major sub-systems which must operate together in a fully integrated operational manner but which ought to be considered as sufficiently independent. These two major sub-systems are: 1) the transaction subsystem and 2) the enforcement subsystem. [2]

Another example is video technology applications for traffic management and safety. This technology offers both tangible and intangible benefits. Video technology requires a substantial up- front investment costs for the purchase and installation of equipment and training of staff. Due to the complexity of video systems and the rapid pace of change related to this technology, agencies may overlook some applications while using resources to implement less valuable applications. [3]

Over the last few years there has been a growing interest in Intelligent Speed Adaptation (ISA), to solve the problem of exceeding the speed limits. ISA has the potential to significantly reduce the incidence and severity of road trauma in many countries all over the world. [4], [5]

The remainder of this paper is organized as follows: Section 2 gives a background of previous work in this field. Overview of Self Recording Traffic Violations system is presented in Section 3. In Section 4, the proposed System's Structure is shown. In Section 5, the Experiments and Results for running the system are presented. Finally a conclusion and future work are briefly described in the last Section 6.

II. Previous Work

In many countries, traffic violations leading to car crashes results in thousands of deaths each year, most of which occur because of breaking speed limits and unauthorized overtaking. So making a smart system which could record these violations and dispatch them for higher authorities has become a need in today's world. Making such a system drivers would feel the police presence on roads and as a result they will obey traffic laws more than ever.

There are many system used in this field as follows:

- The system is designed via RFID and M-RFID technology. This system has been designed on the basis of two traffic signs i.e. no overtaking sign and speed limit sign. The aforementioned system is also equipped with line and speed tracking sensors and is used for dispatching traffic violations to traffic department servers in real time. Therefore, this cycle forms a smart violation

Manuscript received November 12, 2013; revised March 22, 2014.

doi: 10.12720/jtle.2.3.164-171

recording system. By means of the system, drivers will be under police control in each time and there will be no conspiracy between police officers and violator. You can also reduce human factors involved in car crashes and increase supervision on law enforcement. [6]

- The presented system (Unicam) offers a complex state-of-the-art machine vision equipment and technology to provide automated video image vehicle detection devices dedicated for traffic monitoring applications. The system provides real time video image capturing, digital signal processing, compression, storage, and transmission over communication interfaces. According to the users' needs, the system can be used for detection of red-light violations at road intersections, speed measurement, traffic data collection, video recording, or surveillance. Yet another possible application of the system is surveys based on license plate recognition for transportation engineers, stolen car searching, or toll-tag data collection. The system functionality has been improved by coupling camera sensors with specialized real-time processing units and adding networking capability. [7]
- An in-vehicle system for traffic violation alert and management consists of a combination of an on-board computer vision system for traffic sign detection and recognition with a data recorder device for traffic violation alert and management. The system is designed to warn drivers about potential traffic violations by emitting acoustical messages through vehicle loudspeakers. These messages are issued with sufficient notice to provide the driver with enough time to react to the oncoming traffic situation. However, when a traffic violation is committed, the corresponding offence information such as vehicle speed, GPS location, and other driving parameters, are saved in a database for off-line analysis. In addition, an auxiliary application permits the registered traffic violations to be represented as a standard Google Earth map. [8]

III. System's Overview

Self Recording Traffic Violations (SRTV) system consists of software techniques and hardware models to monitor and record samples of traffic law violations. These samples include, but are certainly not limited to speed violation and seat-belt violation. SRTV assists the department of traffic police in Egyptian ministry of interior by recording traffic violations automatically 24 hours/ 7days eliminating the human errors in recording violations as in Radar system.

SRTV is designed to achieve its goals in three phases:

- Acquiring phase collects car speed; receive allowed speed from server, and seat-built status.
- Processing phase get all output data of acquiring phase and compare both car speed and allowed speed to determine if there is a speed violation or not (speed violation). Also it determines if the driver wears seat-built or not (seat-built violation).
- Recording phase is responsible for sending violations to server according to connection status between car and server (i.e. car located at the coverage area of any active spot of wireless connection system or not). If there is a connection, car will send violation immediately. In the case of losing connection, violations will be temporarily stored in a local database until connection is restored. Once the connection is restored, all violation in local database will be sent.

The system's scenario is as follows:

- Receiving the rated speed at the start of road.
- Measuring the speed of car.
- Displaying the speed to the driver.
- Comparison between rated speed and speed of car.
- Giving an alarm to the driver if he exceeds the rated speed.
- Recording violations, if the driver doesn't slow down.
- Storing it temporarily if there is no connection with the server.
- Sending the violation ticket to traffic administration. Also, there will be a database to store the violations for each car in traffic administration side. A web application is build to allow site visitor queries for violations of the car.

IV. Structure of the System

The system monitors the cars speed and decides the action according to the driver reaction. If the driver drives his car at high speed, the system can advise the driver to slow down his car's speed at first, and if he doesn't reduce the car's speed then it forces the driver to slow down.

The system contains an embedded computer which has the ability to process data (as max allowed speed depend on the type of the vehicle as a start) sent by the server. This data is controlled by traffic police department. The embedded computer records violations and sends it back to the traffic police department immediately after happing.

The System can be implemented in all types of vehicles (old, modern, private or commercial vehicles, taxis, trucks) by fitting a sensor system that gets digital readings from the analog and mechanical meters of the car, then sending the data to be processed by the min computer.

The system is divided into two subsystems:

A. The Server Part Contains:

1) Server C# program which has the following benefits

- The heart of the server.
- Responsible for broadcasting data to the car systems.
- Receiving violations from the cars.

2) Database is build by SQL server. It has the information stored on the server. Also, it holds the data of the cars, drivers, server users and the violations recorded by the car's system.

3) Web application is build using ASP.Net from Microsoft to be combatable with the whole system. It is the user interface to deal with the server to enable cars' owners or drivers to look up their violations. Also, it enables employees of the traffic department to add, edit or delete car data.

B. The Car Part Consists of:

1) Sensors. The system uses 2 kinds of sensors as:

- Speed sensor measures the current car speed and sending the values to USB interface which will forward the data to the car management system, which will process the whole data from all terminals. Its schematic diagram is shown in *fig.*1
- The seat belt is an important safety device in the car as it is responsible for 70% of the accident survival. Seat-Belt sensor checks if the driver is wearing the seat belt or not. Sending the status of the seat belt to the car's system to determine whether to record the violations or not. Seat-Belt sensor operates as in Fig. 2.
- Sensor tests the engine's status (on/off).

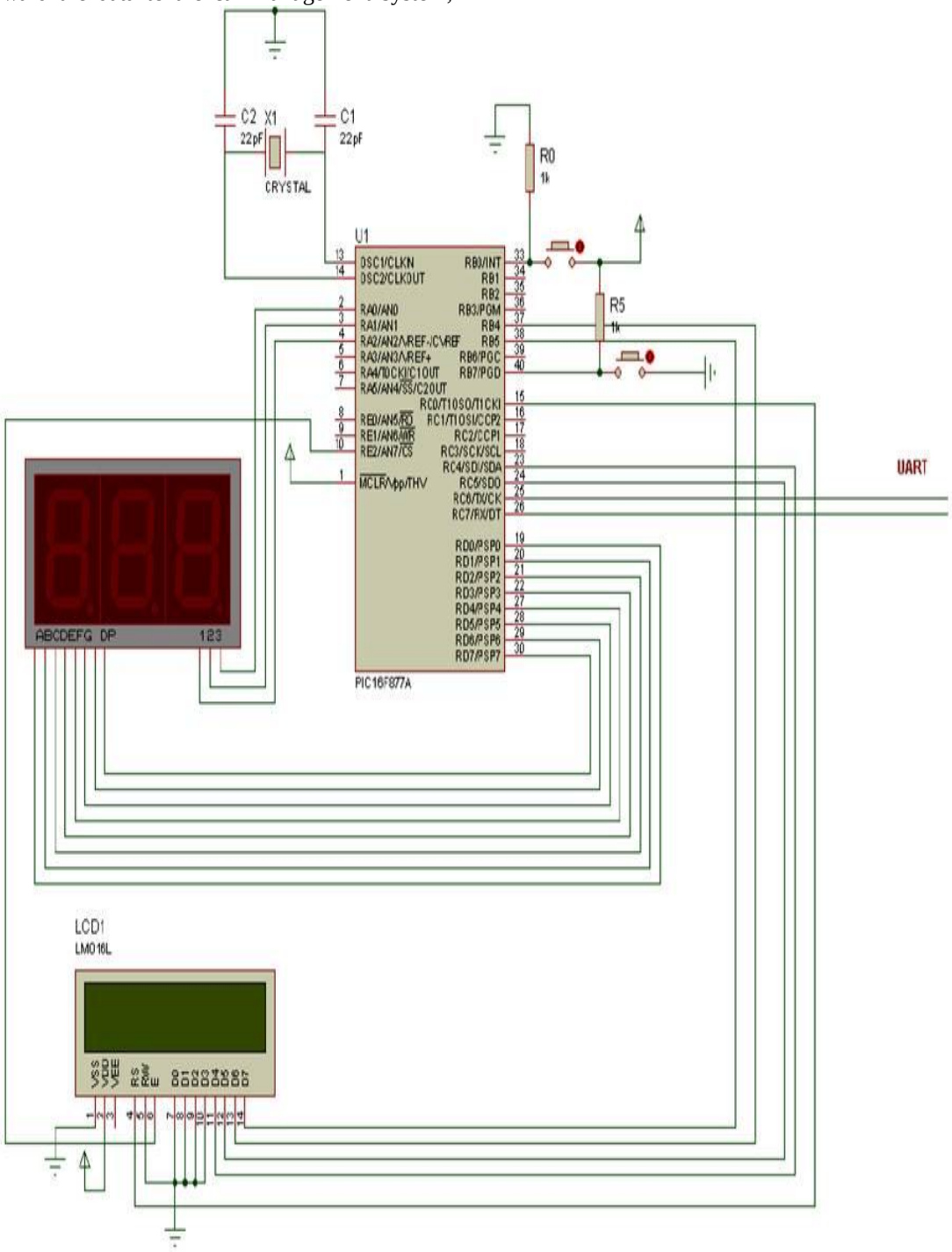

Figure 1. The schematic diagram of speed sensor.

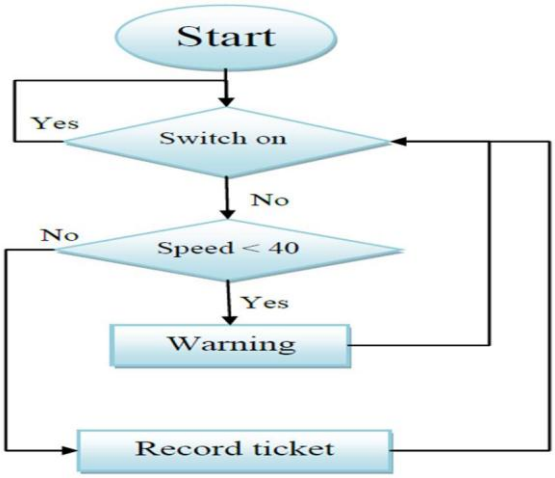

Figure 2. The flow chart of seat-belt sensor.

2) USB interface is used for connection between the sensors and the embedded computer in the car. It is chosen because there is a need of high speed data rate, easy to program, available libraries and higher reliability. The USB interface's schematic diagram is shown in Fig. 3.

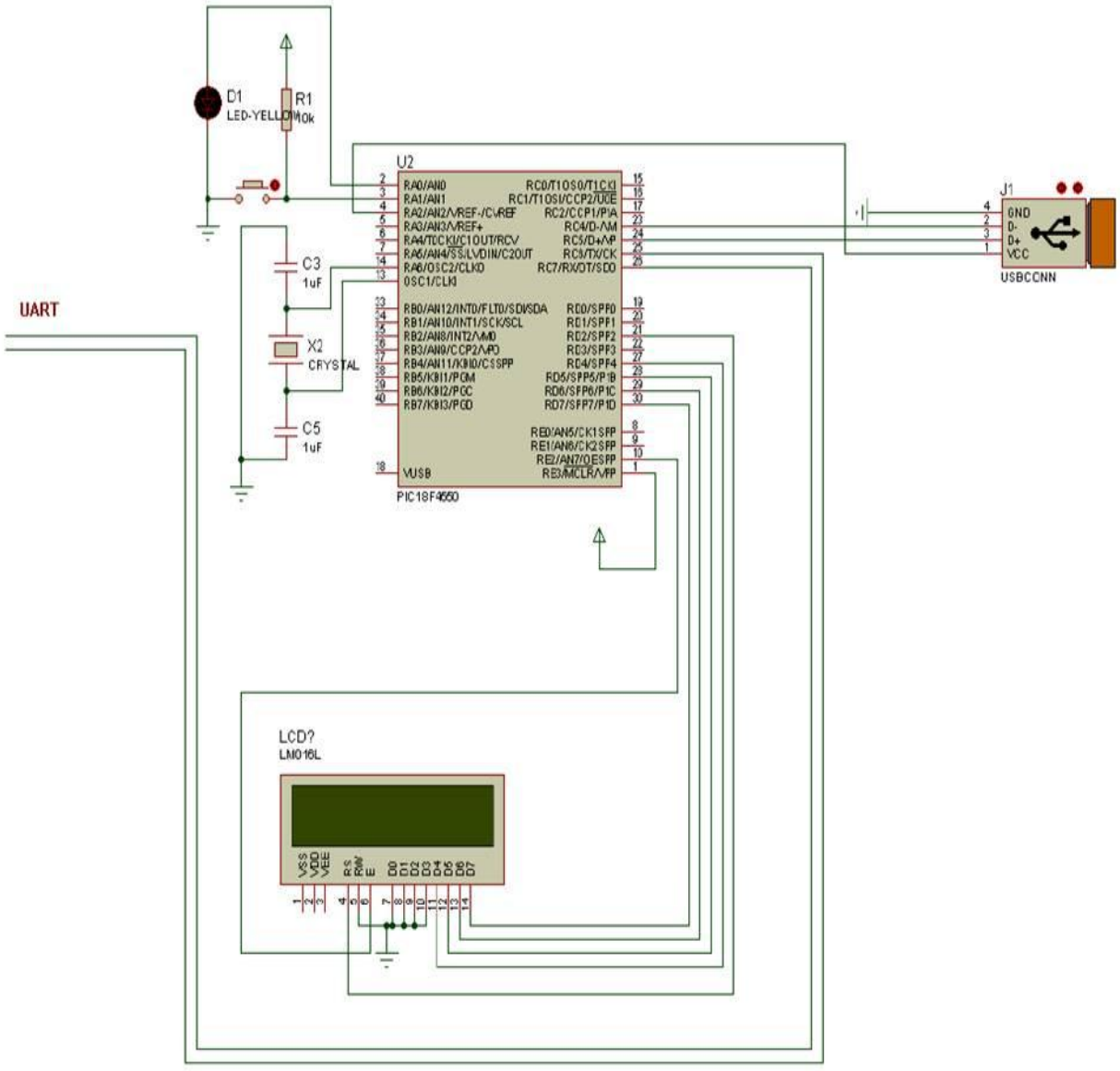

Figure 3. The schematic diagram of usb interface.

3) Client C# program is run on the embedded computer in the care to process the data received from the car's sensors and the data received from the server. It gets information about both the road and the car. Also it shows the driver the status of the system. The Client C# program operations as in Fig. 4 (a, b).

4) On board computer is the heart of the car's system. It gets the status of the car, compares it with the incoming data from the server, and takes the action of recording a violation or just warning the driver.

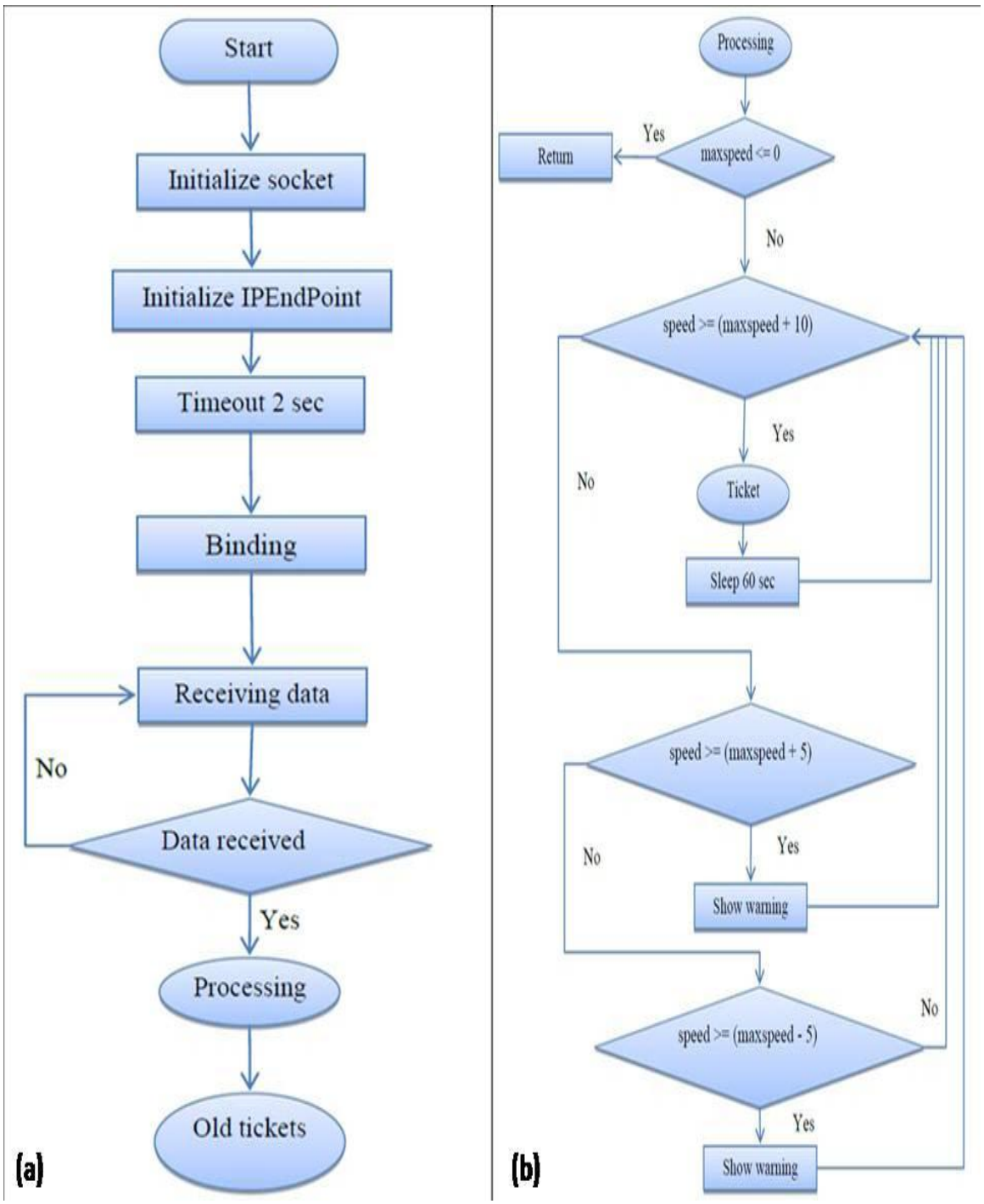

Figure 4. The flow chart of client C# program.

V. Experiments and Results

This section introduces the experiments and the results of installing the system in the private car and then run all over the system.

This system is not only a modeling or simulation but it is a practical system which is implementing in a private car as shown in Fig. 5.

Fig. 6(a) shows the query about the car's violation by the license number. Fig. 6(b) represents the administrator

and users (moderators) pages. According to the login name and password, It will determine which page will show if the login success (administrator or moderator pages)

Figure 5. The system's implantation in the private car.

Figure 6. Automatic traffic ticket system site.

The following Fig.7 shows the results for running the system as follows:

- Fig. 7(a) shows the system's screen when the client received the broadcast and getting ready.
- When the car is moving, the system's screen is illustrated as in Fig. 7(b). Note that the care is in safe zone but there is a warning about a seat belt ticket is on.
- After a period of time you don't wear a seat belt, the system records a ticket for you as presented in Fig. 7(c).
- Fig. 7(d) shows the system's state when the car is near the speed limits. The ticket isn't recorded but a warning show up to alert the driver for reducing his speed.
- When the car is just at the speed limits, ticket isn't recorded but the warning level is up. Fig. 7(e) illustrates this state of the system.
- Fig. 7(f) presents the system's state when the car is exceeding the speed limits so the speed ticket is recorded and sent to the server.

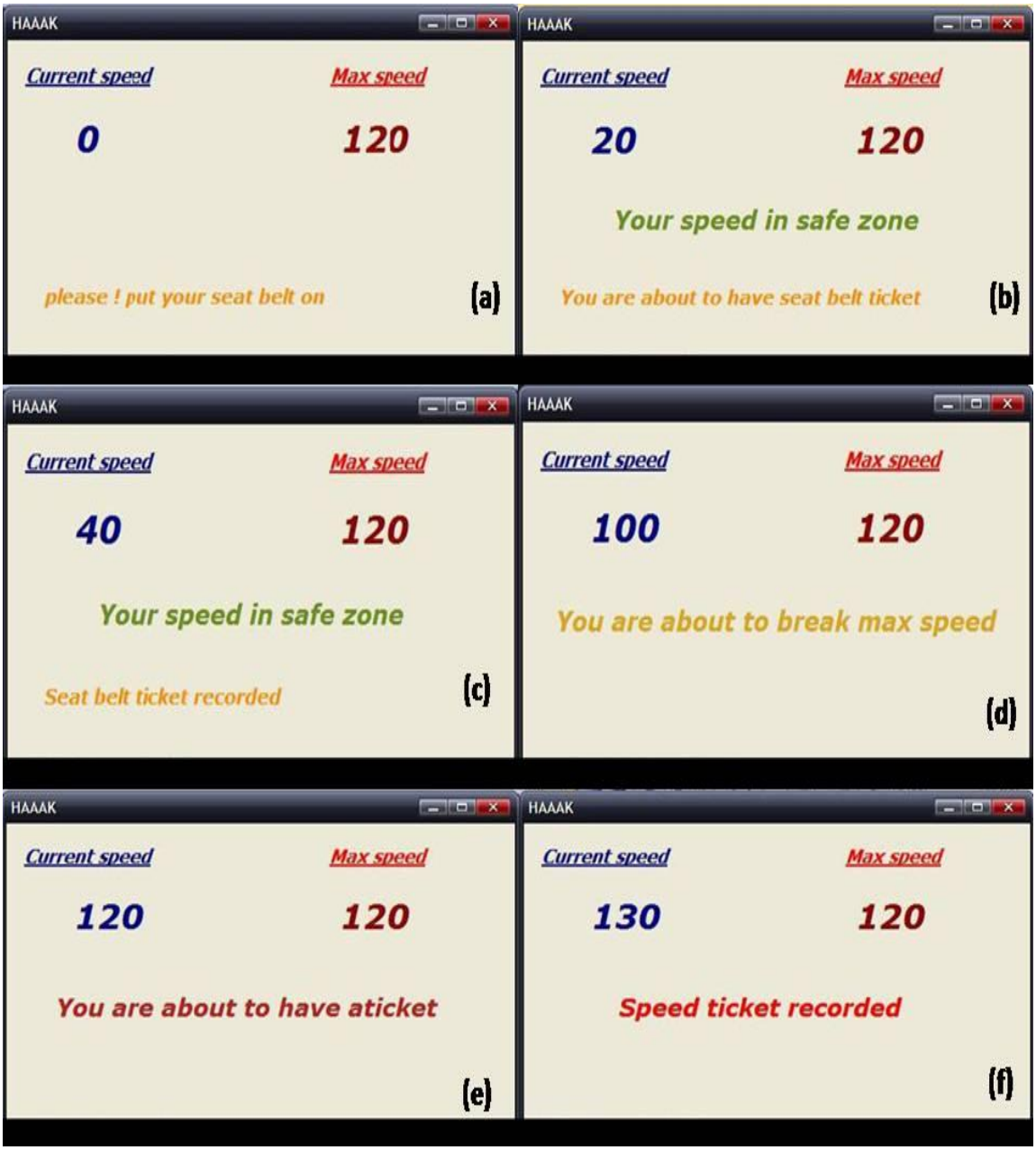

Figure 7. The client received the broadcast to start and get ready.

VI. Experiments and Results

According to this system for Self Recording Traffic Violations, there are many benefits of using it as:

- Using Self Recording Traffic Violations' system, the car will have a system (Hardware and software modules) of automatic recording of traffic tickets.
- Making roads safer than ever been by monitoring the roads throughout the day.

- Recording violations become more efficient and human error free.
- Reducing human errors and adding assistance in the car.
- Solving the problem of limited radar coverage.
- Also the companies that have cars can have the following benefits:
  - Making their drivers is committed with rates speeds to keep them safe.
  - Saving money which paid for violations.
  - Preventing miss use of their vehicles.

The future work of this simple system is focusing on growing it to be more and more complex system. As some control can be included in it as follows:

1) In the client system

Algorithms will be added to the system's software to make it intelligent enough to drive the car or help driving the car as the driver may want.

- A range meter may be implemented to keep safe distance between cars.
- Automatic dial for help in case of accident.
- Active break system based on the range meter it can stop the car if something intercepted its way or if the traffic just stopped.
- Auto driver may be implemented also.

2) In the server side

The server may use data from the clients (cars) to determine crowded roads based on such information:

- The server may redirect traffic to less crowded roads.
- The server may reduce the speed limits in areas near schools and so.
- Help the rescue teams to get to the accident location by redirecting traffic away or slowing the traffic to give the rescue teams the ability to move freely.
- Every period of time an e-mail of the recorded violation may be sent to every car owner.
- Car owners may be able to online pay for the violations.

ACKNOWLEDGEMENTS

I'm grateful to Eng. Moktar Ahmed and his group for their helping in developing this system.

REFERENCES

[1] R. Byrne and J. Berry, "Enhancements to commercial vehicle inspections," Commercial Vehicle Architecture Systems Study Volume II: Task Reports, SAND93- 1582, Unlimited Release, pp. A1-1-A1-8, 1993.

[2] J. Turner and R. Day, "Tolling applications using infra-red technology and the highest priority requirement: The enforcement system," in *IEE Colloquium on Electronic Techniques for Road Pricing and Tolling*, London, UK, March 8, 1995, pp. 1-6.

[3] A. Graettinger, J. McFadden, M. Govindu, and R. Kilim, "Potential applications of video technology for traffic management and safety in Alabama," University Transportation Center for Alabama, UTCA Technical Report Number 00463, 2002.

[4] K. Young and M. Regan, "Intelligent speed adaptation: A review," in *Proc. Australasian Road Safety Research Policing and Education Conference*, 2002, pp. 445-450.

[5] N. Agerholm, "Intelligent speed adaptation - the effect of incentives," in *Proc. Intelligent Speed Adaptation Conference*, Sydney, New South Wales, November 10, 2009, pp. 20-21.

[6] O. Nejati, "Smart recording of traffic violations via M-RFID," in *Proc. 7th International Conference on Wireless Communications, Networking and Mobile Computing*, Wuhan, China, September 22-23, 2011, pp. 1–4.

[7] O. Fucik, P. Zemcik, P. Tupec, L. Crha, and A. Herout, "The networked photo-enforcement and traffic monitoring system Unicam," in *Proc. 11th IEEE International Conference and Workshop on the Engineering of Computer-Based Systems*, Brno, Czech Republic, May 24-27, 2004, pp. 423 – 428.

[8] N. Aliane, J. Fernandez, S. Bemposta, and M. Mata, "Traffic violation alert and management," in *Proc. 14th International IEEE Conference on the Intelligent Transportation Systems*, Washington, DC, USA, Oct 5-7, 2011, pp. 1716–1720.

Dr. Eng. Ahmed M. Elmahalawy had earned his PhD from Czech technical university in 2009. He works as a lecturer in Computer Engineering and science Department, Faculty of Electronic Engineering, Minufiya University. His interest is in Artificial Intelligence mainly Agent technology and multi Agent System and machine learning. He had many publications in these fields. He is a reviewer in many journals according to his specialist.

