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Radar Simulator Section

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Abstract

In recent years, radars have acquired a special importance in our society. Important radar applications may include areas such as military, aviation, security, and road traffic. The main purpose of this paper was to create an electronic module for displaying the numbers of vehicles using the human operator, and for reading numbers shown on the display with a wireless video camera.

Key words: *electronic systems, velocity measurements, position estimation.*

Introduction

Radar is the name dedicated to an electronic system that discovers and measures, using radio waves, the position and the velocity of objects evolving in a certain medium of propagation.

Radar uses the same principle as the human eye, with the difference that the latter receives light radiation reflected from objects, but the radiation that is emitted from another source. Radars are used in military, aviation, and security fields, with a special emphasis on those used in the road traffic.

The classification of radars is presented in the figure below [2].

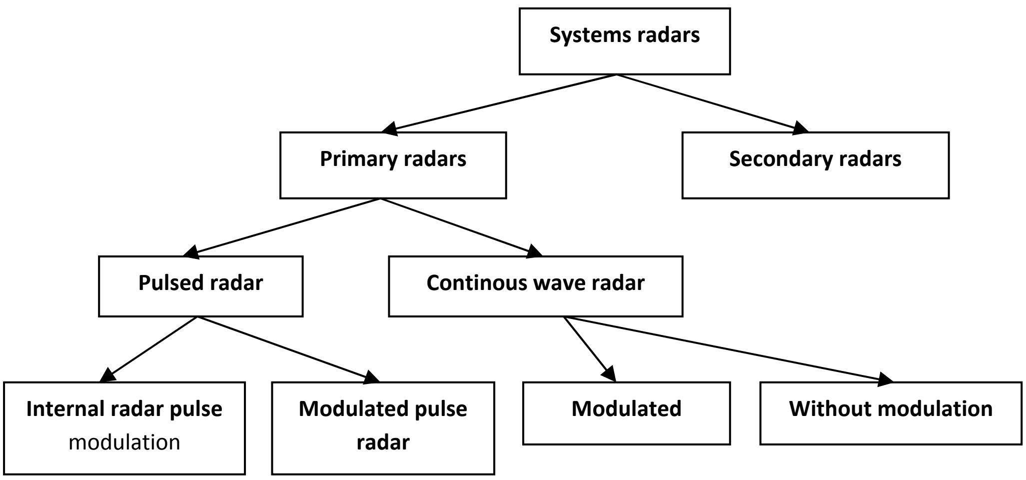

Fig. 1. Classification of radar systems [2].

Section Radar

Section radar, which is the subject of this paper, is similar to the radar system in cascade in which, on a certain section of the road, for several miles, cameras of high – performance radar are placed, in order to record the exact hour, minute and second they have captured a passing car.

Depending on the speed limit on that section, a central computer calculates the time needed for a vehicle to arrive from the first radar to the second one. If, after passing the first radar, the vehicle accelerates and exceeds the speed limit, it means that it will reach the second camera in a time shorter than the theoretical estimated one.

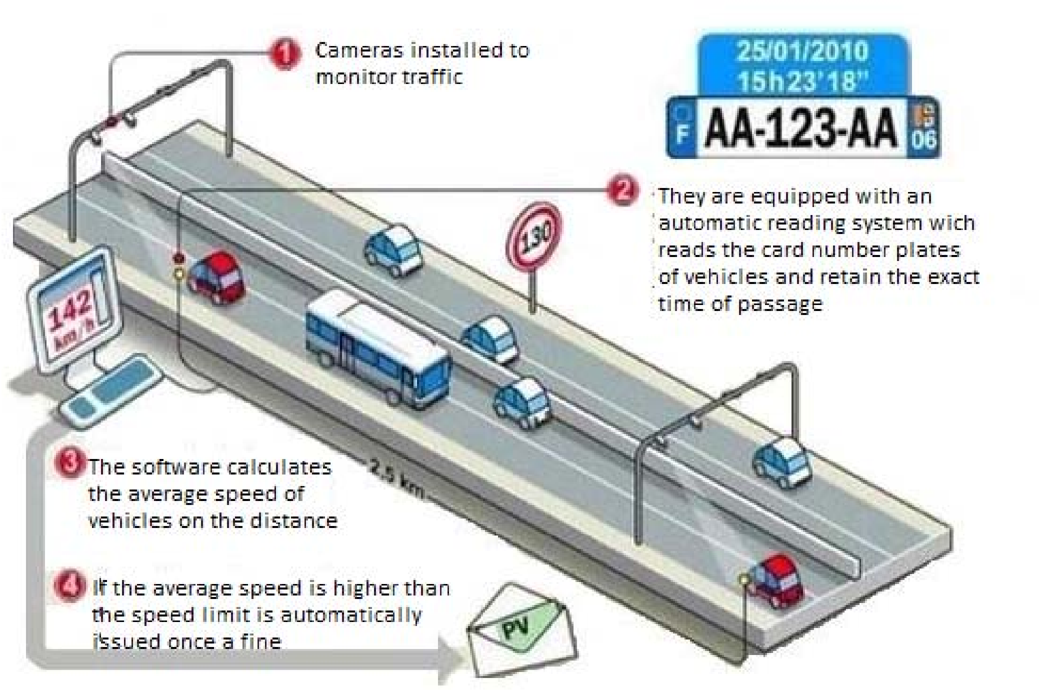

Fig. 2. Section radar [2].

At this moment, the computer automatically issues a speeding ticket, according to the theoretical limit excess. In such circumstances, all the radar detector can do is to warn the driver that he is approaching a "hot point" where the radar is installed.

The novelty of this system is the multitude of targets than can be identified simultaneously. The system is programmed to record vehicles that run on emergency lanes or those stationed in unauthorized places.

The first radar section was put into operation in France, in the Doubs, in the tunnel on the road RN57, near Beure, top speed being limited to 70 Km/h. By August, offenders will be fined, the system being in short testing phase.

The new radar section has other advantages: authorities say that, thus, one can spot more easily and in a shorter time stolen cars, can detect cars that change lanes without signal or trucks that do not respect their route.

The European Commission is very interested of the results of this section radars in France; in the future, one may even propose a law to implement these systems in other EU countries.

Examples of Section Radar

"Cordon" section radar

Peak Gain Systems Company has developed and launched a radar system called Cordon, able to simultaneously monitor the speed of all vehicles running on the road, regardless of direction of travel, up to four lanes.

The novelty and particularity of the Cordon radar systems is that it establishes and monitors continuously and simultaneously the speed, as the vehicles traverses throughout the area.

Cordon has a video camera with high resolution and automatic number plate system recognition and a touch-screen display for making settings. Video camera can identify up to 32 vehicles simultaneously. This device has also a GPS/GLONASS tracking system, so for the evidences provided one may establish the location where they were obtained. Data can be automatically saved on the SD memory card, and can be transmitted in real time to a central station via 3G, WiMAX, Wi-Fi, its software allowing data encryption.

TruCAM-LTI radar

The mobile radar device fitted to traffic police in Romania has an integrated laser and a high definition digital video camera, making LTI 20-20 TruCAM the most powerful speed measuring device available today.

The device memory card adds videos, detailed HD images, which may include details of vehicle license plate and even the facial features of the driver.

The model TruCAM LTI 20-20 is measuring the speed of a vehicle by means of laser beams that do not require more than 0.33 seconds to determine the speed, that being a time too short for the driver to react to any tone out of radar detection devices. The camera can be connected to a Geographic Information System, thus generating more extensive information about the exact location were the device was used.

LTI also has an independent system that measures time and speed of vehicles. TruCAM can record multiple speeds of more vehicles and even motorcycles that are hard to register with conventional radar devices.

Design and Implementation of the Electronic Module

The electronic module is composed of:

- a microcontroller that provides all the necessary data display, data received from the operator, and will receive instructions from him on a schedule based on artificial intelligence that will run the microcontroller providing a correct operation [3];
- a Bluetooth module in the 2,4 GHz band, which receives remote commands and a video sensor that reads the numbers on the display;
- 1602 BC display consisting of 16 characters x 2 lines, of yellow-green colors.

The experimental stall is composed of the following:

- Electronic board + display;
- Bluetooth Master-Slave module;
- Converter TTL-USB module;
- Wireless color camera + wireless receiver;

- Audio – video capture card;
- Computer.

All these components are presented in the block diagram from the figure below.

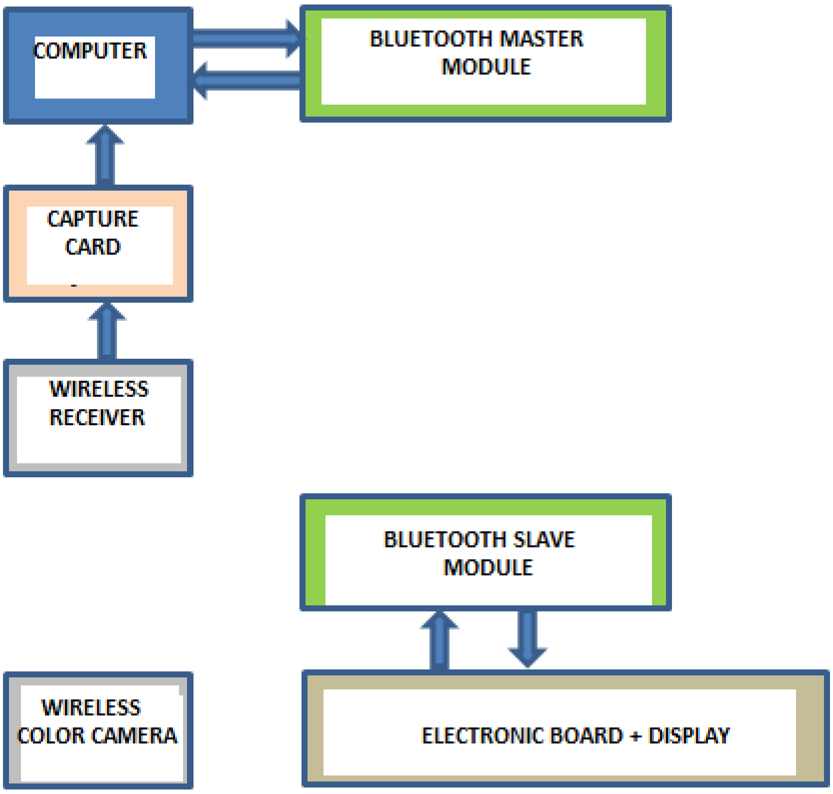

Fig. 3. Block diagram: communication between the computer and the electronic module.

Monitoring and Control System of the Radar Section

User interface. Lab View programming language used for this project is called the "G" graphic language [1]. Execution is determined by the structure block diagrams graphs that are linked together by a particular algorithm, that performs various programming functions.

The user interface is shown in Figure 4.

The role of the interface software is to send the numbers of vehicles through the Bluetooth module [4] and to acquire the numbers of video sensor for processing and displaying them in an Excel table.

Processing algorithm for character recognition. It consists of the following blocks: Original Image, Color Plane Extraction, OCR/OCV. Color Plane Extraction function is to extract a color image RGB (red green blue) into another image for a new conversion. OCR (Optical Character Recognition) is a tool for automatic identification which is used to read a random text string of a vision system. OCR can be used to test applications, to compare the contents of a string of text itself, with a given string. On the other hand, the OCV (Optical Character Verification) is a tool used to inspect print quality, brand and confirmation, so that, in addition to checking the actual content, it will inspect the contrast, sharpness and mark or reject poor quality codes.

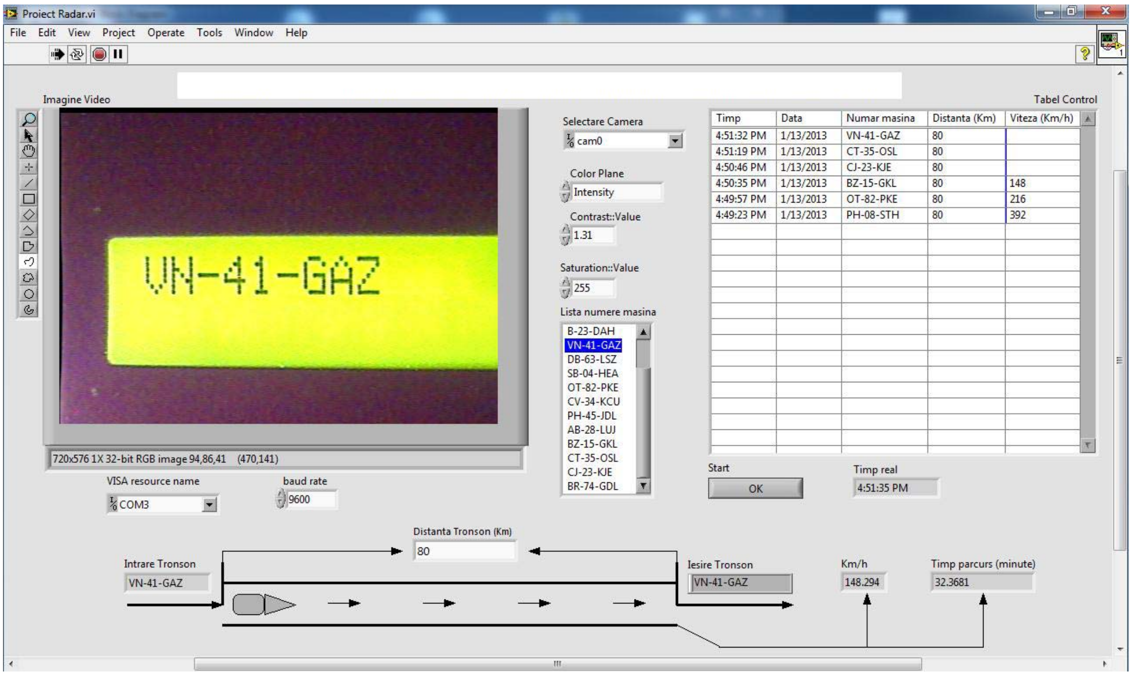

Fig. 4. User software interface.

OCR training network. This requires capturing driving the LCD screen repeatedly until the system is able to correctly recognize a character. Each time an image is processed, the system issues an LCD readout and converts it into the data format, which is then compared with a database OCR. If the data is incorrect, the correct OCR system is updated in the database, so that one learns each specific character. After reading an image repeatedly, the system is able to accurately reproduce the correct character. If one cannot correctly read repeatedly a character, it is possible to correct a particular area of interest within the software interface.

OCR learning network. Selects the specific areas of interest and the captured image is saved in a file. For these areas of interest, characters that correspond to each one are configured. These catches are designed to teach OCR network to easily identify certain characters that cannot be identified from the first read or repetitive attempts.

Operation. After setting, the proper execution of the program is released. The selected number is sent to the serial port and it will appear both on the LCD display and within the software interface. The number selected will automatically enroll in an Excel program with the following specifications: the time the number was transmitted, the date where the number was recorded, and the distance (in Km) that this vehicle has to go.

Conclusions

The main objective of this study was the practical implementation of software interfaces and an electronic module that comprises a wireless display and a wireless video camera, in order to simulate the operation of a radar section.

Reference number of vehicles is done through software interface wireless modules. The interface was developed in Lab View visual programming environment and is accessible for a human operator who may have limited knowledge in the field of human-machine interfaces.

The operation of this simulator is based on the following details: wireless display interface receives number of cars from software, wireless camera reads the numbers displayed on the display and sends to the software interface where they are video processed and recorded in an Excel table.

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Simulator al radarului tronson

Rezumat

În prima parte a acestei lucrări au fost prezentate generalități privind radarul tronson, precum și aplicațiile acestuia. Principalul obiectiv al lucrării a fost realizarea unei interfețe software si a unui modul electronic compus dintr-un display wireless și o cameră video color wireless, care realizează practic simularea funcționării radarului tronson.