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MOBILE VIDEO SYSTEM FOR SURVEILLANCE OF ROADWAY AND ROADSIDE ENVIRONMENT

Introduction. *Today, in Ukraine there is no centralized scalable system for collecting and processing video data, which would allow controlling the roadway and roadside environment.*

Problem Statement. *Video surveillance systems, as a rule, use stationary cameras. Since there are many cameras employed in this kind of systems, there are problems related to transferring information (creating and maintaining a data network) and processing (creating datacenters for processing and storing received data).*

Purpose. *The purpose of this research is to create a video collection system for control of a roadway and roadside environment, as well as an environment into the municipal transport to help detect crimes committed in the surveillance zones.*

Material and Methods. *In this research, there has been used a smartphone and a camera for testing the functions and algorithms of our proposed system. To reduce the size of data to be processed, we have used the methods for the selective perception of video information, the detection of moving objects, the parallel and conveyor processing of video information to accelerate its processing, as well as the methods and means of rapid release of informative patterns for searching and recognizing objects.*

Results. *The concept and structure of the hardware and software of the mobile video surveillance system have been developed, the system has been protected by the patent of Ukraine for a utility model; a new type camera for shooting and analyzing video data has been designed and created (in cooperation with a partner); the software components of the system for the automatic detection of license plates and their recognition and the automatic detection of people without a masks inside a public transport for the further data analysis have been developed.*

Conclusions. *Using mobile systems of this type allows expanding video surveillance zone in cities and outsides and reducing costs of road video surveillance systems.*

Keywords: video systems, real-time systems, mobile systems, and intelligent video cameras.

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Currently, there has been no centralized scalable video data collection and processing system in Ukraine, which would allow monitoring both urban areas and outsides. First of all, it concerns monitoring the most dangerous areas near highways and roads, that is, the general roadway and roadside conditions. The existing video surveillance systems at individual enterprises and institutions [1], as well as on some sections of city roads [2] do not allow solving the problems of global video surveillance with the subsequent automated processing of video data.

Similar systems are being developed in many countries of the world. As a rule, they use stationary cameras, which is an effective but expensive solution, given their large amount. This approach of installing hundreds of thousands or even millions of video cameras in cities, creating communication channels and the appropriate infrastructure for collecting video data is quite expensive and requires significant funds for the purchase of foreign systems and their maintenance. In addition, such a large amount of cameras entails the problem of information transmission (the need to create and to maintain a large network of video data transfer) and processing (the creation of large processing centers and storage of the received video data).

The approach proposed by the authors of this research can be a solution to the two above-mentioned problems. It is based on the use of mobile video cameras installed on public and municipal transport vehicles, which are much more informative as compared with stationary video cameras, as they travel hundreds of kilometers per shift, record video information from the front, back, at stops and inside the vehicles. This makes it possible to significantly reduce the number of video cameras and, at the same time, to collect video information in the most dangerous places, which cannot be obtained from stationary video cameras. Appropriate devices for positioning and orientation of video cameras ensure that video information is linked to the location of the vehicle and the time of record, which allows combining information from different vehicles and organizing the search for information by the place and time of the event. In order to reduce the volume of information, it is suggested to make shooting at a given pace and to use the methods for selective perception of video information developed by the authors of the research, the methods and means of quick selection of informative signs for searching and recognizing objects, the methods for determining moving objects and their parameters, the methods for parallel and pipeline processing of video information to speed up its processing [3, 4]. At the request of authorized bodies, it is possible to organize direct access to devices for collecting and analyzing information on motor vehicles and to receive relevant information about the situation on the road in real time.

In the future, such a system can be integrated with existing stationary video surveillance systems, provided that the specific components of the implementation of the proposed system are supported (i.e., support of the methods for video stream data reduction and processing of accompanying data from sensors).

The purpose of this research is to create a system for collecting video data on roadway and roadside conditions, as well as conditions in public transport, on a city, regional or national scale, for more effective investigation of crimes and terrorist acts, which occur in video surveillance areas.

The field of application of the proposed system is urban and suburban vehicles, which record video images of the roadway and roadside situation at a given time interval, as well as the situation inside public transport, with reference to the time and place of recording. The number of video devices and their orientation are determined by the customer of the system. There are prospects for significantly expanding the functions of the video system in terms of recognizing license plates, people's faces, dangerous situations, etc.

THE SYSTEM STRUCTURE AND FUNCTIONS

The proposed system is structured as shown in Fig. 1.

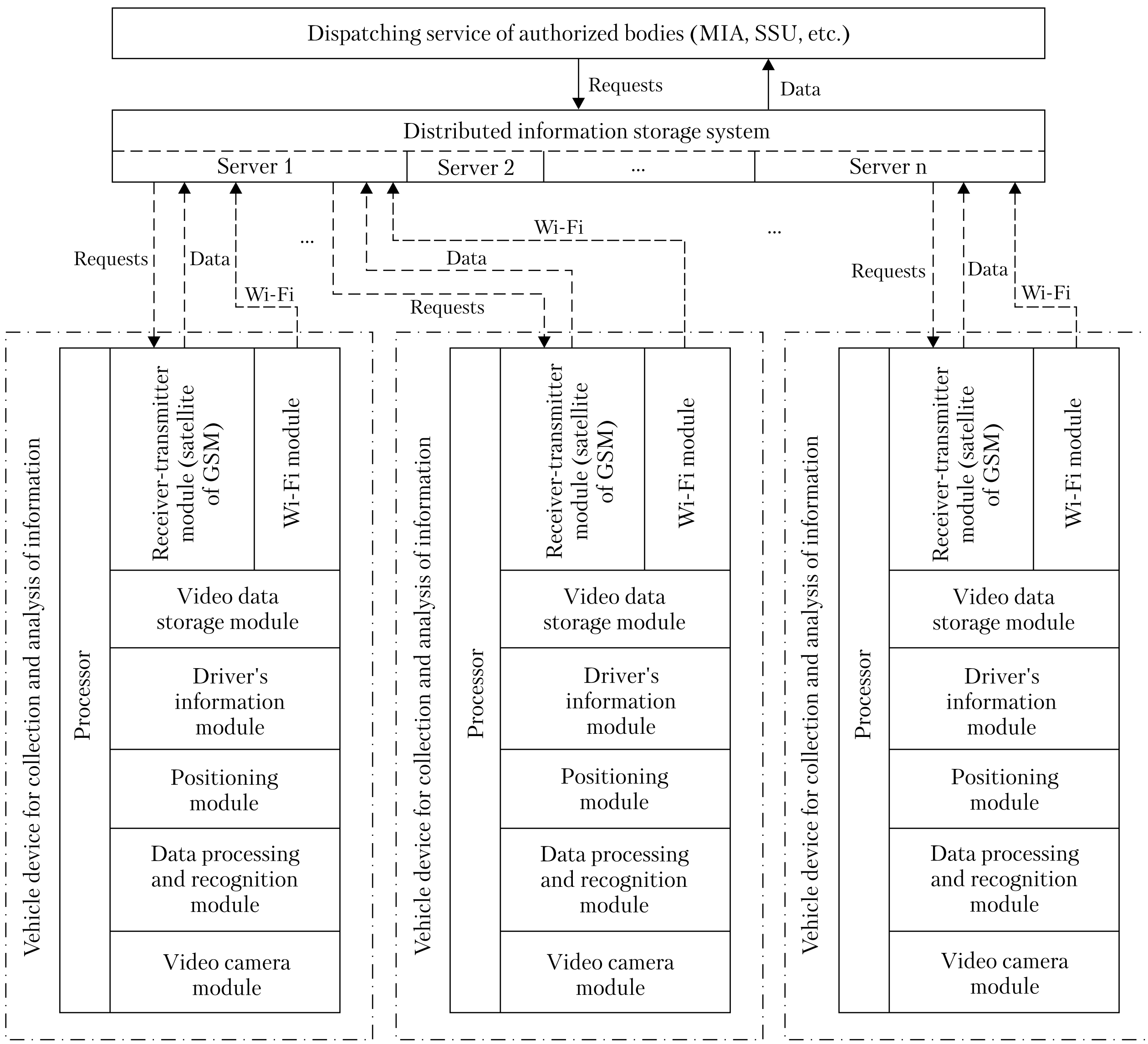

Fig. 1. Video data collection and processing system

The system operates as follows. In the vehicle information collection and analysis device, video data from the video camera module periodically are sent to the processing and recognition module that assigns the received video data to time, coordinates in space, and other data from the positioning module and forms an information packet at a given time interval and transfers it to the video information storage module for further transmission to the servers of the distributed information storage system and the driver's information module, to inform the driver about the current situation. The saved array of generated data packets is transmitted by the vehicle in the parking places of the vehicle through Wi-Fi network to the servers of the distributed information storage system, where the information is stored for a specified period of time, during which it can be selectively read by the dispatching service of the authorized bodies. Only the necessary filtered information is read from specific vehicles of various motor transport companies, which were in a specified place and at a specified time.

In addition, at the request of the authorized bodies, the system has the ability to track and to identify vehicle numbers in real time, to search for people, to detect and to analyze violations of traffic rules (the fact of a car entering a public transport lane and the license plate of such a car, etc.), violations of quarantine restrictions and abnormal situations in transport and at stops. Such information is transmitted from the vehicles via satellite or GSM communication. For this, the dispatching service of the authorized bodies sends a request to the distributed storage system of motor vehicle enterprises to obtain direct access to the devices for collecting and analyzing motor vehicle information and receives relevant information about the situation on the road in real time.

Such a system significantly widens the functionality of known video surveillance systems. In particular, it becomes possible to receive generalized information from all vehicles of various motor transport enterprises at a specified place and time from the dispatching services of authorized bodies, to form a request for information on vehicles, wanted people, abnormal situations on the road and receive in real time the results of analysis of the situation by request. In addition, the use of a Wi-Fi network in parking lots significantly reduces the cost of transmitting information to the servers of the distributed storage system, as compared with expensive satellite or GSM communication.

Practically, the result is ensured by combining servers into the distributed information storage system and connecting to it dispatching services of authorized bodies, by using the devices for collecting and analyzing vehicle information, which include the processor and the following modules connected to processor with the help of appropriate interfaces: the video camera module, the positioning module (with GPS sensors, gyroscope, and magnetometer), the driver information module, the module for transmitting information from the devices in the parking places of the relevant motor vehicle enterprises through a local Wi-Fi network, the module for receiving requests from the servers of the distributed information storage system and transmitting the analysis results to the servers through GSM or satellite communication.

THE SYSTEM HARDWARE

A serial smartphone and a block of special "microcomputer"-based video cameras are used as devices for collecting and analyzing vehicle information. The developers use *Samsung Galaxy A31* smartphone based on *Android* 10 operating system and a specialized video camera developed and implemented on the basis of the *Orange Pi Lite* microcomputer and *Ubuntu* operating system to develop the system.

The selected smartphone has the following specifications [6]:

Dimensions (H × W × D): 159.3 × 73.1 × 8.6 mm;
Weight: 185 g;
RAM: 4 GB;
Built-in memory: 64 GB;
The maximum capacity of the supported microSD memory card is 512 GB;
Front cameras: 1 (20 MP, aperture f / 2.2);
Main cameras: 4 (48 MP, f / 2.0 + 8 MP, f / 2.2 + + 5 MP, f / 2.4 + 5 MP, f / 2.4);
Navigation: BDS, GPS, GLONASS, A-GPS;
Communications: 3.5 mm Mini-Jack, Bluetooth 5.0, NFC, USB Type-C, Wi-Fi (IEEE 802.11 a/b/g/n/ac).

Thanks to its small dimensions and weight, the smartphone can be placed on the windshield to capture the surrounding environment and to analyze the situation inside the cabin. The main camera with a resolution of 48 megapixels and three additional cameras allow taking high-quality pictures and analyzing them according to the assignments, for example, highlighting the license plate of the violator or monitoring the number of passengers in public transport and whether they are wearing medical masks. The existing GSM communication standards allow the exchange of information with the vehicle in real time. The

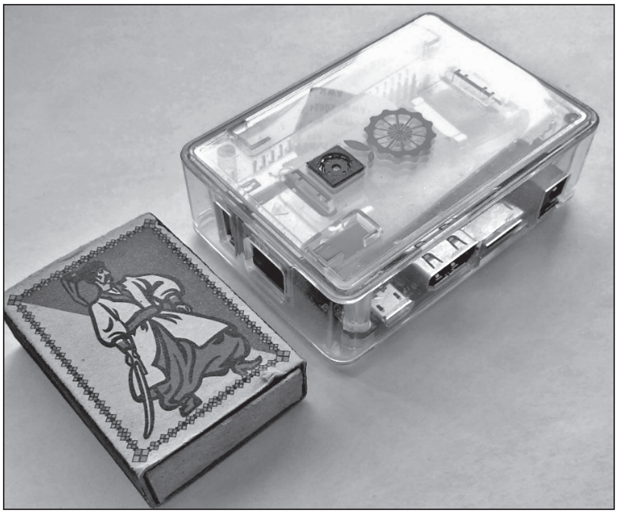

Fig. 2. Special video camera based on *Orange Pi Lite* microcomputer and OV5640 sensor

Wi-Fi standard (IEEE 802.11ac) enables transferring a large amount of accumulated data at a significant speed of up to 6.77 Gbit/s.

A special video camera based on *Orange Pi Lite* is mainly intended for taking photos of the surrounding environment and automatically analyzing them. It is simpler and does not have such a wide range of peripherals as a smartphone. Receiving geolocation data and transferring video data to the server are realized through connection to the smartphone and the use of its resources via the Wi-Fi interface.

Orange Pi Lite is based on the *SoC Allwinner* H3 that contains four *Cortex-A7* cores (1.2 GHz) and a *Mali* 400MP2 video core (600 MHz). The image received via CSI interface from a camera with a resolution of up to 5 megapixels can be output to HDMI port. *Orange Pi Lite* has 40 General Purpose Inputs/Outputs (GPIO) fully compatible with *Raspberry Pi B+*. The microcomputer also has two SPI inputs for connecting compatible peripherals.

Like the vast majority of computers with ARM processors, *Orange Pi Lite* supports a wide range of operating systems. In addition to special *Raspbian* and *Pidora*, these are *Android* 4.4, *Linux* distributions (from *Arch* to *Kali*), *OpenWrt*, *FreeBSD*, *IPFire*, and others. The dimensions of *Orange Pi Lite* are 69 mm × 48 mm, the weight is 36 grams. Figure 2 shows a video camera based on *Orange Pi Lite* microcomputer and OV5640 sensor.

This product uses a OV5640 sensor manufactured by *OmniVision* (USA). OV5640 is a 5-megapixel system-on-a-crystal (SOC) with a built-in JPEG compressor and autofocus control [7]. It has a MIPI/CSI port for data transmission. OV5640 supports the picture-in-picture (PIP) protocol that allows multiple cameras to be connected via a single MIPI/CSI port. Built on *OmniVision's* OmniBSI™ 1.4 micron pixel architecture, OV5640 captures 720p HD video at 60 frames per second and 1080p HD video at 30 frames per second with customizable options for both video encoding and output. The sensor supports 2 × 2 hardware binning that may significantly increase sensitivity and improve signal-to-noise ratio (SNR). There is also a post-reflection filter feature that removes zigzag artifacts around beveled edges and minimizes spatial artifacts for sharper color images. The sensor supports the following output formats: YUV, YCbCr422, RGB565/555, RGB565/444, and RAW.

THE SYSTEM SOFTWARE

According to the system structure, the software consists of the three main components:

- On-board software;
- Server software; and
- Client software.

Also, for automatic analysis of data stored in the database or directly in real time on the vehicle, additional software has been partially developed and partially may be purchased and integrated into the system.

THE ON-BOARD SOFTWARE

The on-board software operates in vehicle's information collection and analysis devices.

The smartphone applications have been developed on *Android Studio* 3.4.2 platform in the *Java* language with the use of *OpenCV* library (Open Source Computer Vision Library) that includes image processing functions and algorithms.

The smartphone has enough memory to store the amount of data accumulated during a shift of transport operation. The data are photos or videos made with the smartphone camera during the vehicle's motion. The smartphone enables making photos and videos of different quality (up to 48 megapixel photos for the mentioned smartphone).

During the operation of the application on the smartphone, a folder is created in the internal memory, the name of which includes the license plate number of a public transport vehicle on which it is installed, the number of the public transport route, and the date of record. Also, photos in .jpg format taken with at a given frequency and resolution are recorded in this folder. The name of each photo is the time when it is made. A text file is also created in this folder. Each record of the file, which contains information about the license plate of public transport vehicle, route number, date and time of photo, coordinates (latitude and longitude) where the photo is taken, as well as the name of the photo, corresponds to a certain photo located in this folder. In order to start recording, the driver shall enter the license plate number of the public transport vehicle and the route number and press "create a folder" and "start recording" buttons. Photographs are taken at a specified frequency from the moment when the vehicle leaves the park at the beginning of the shift until the vehicle enters the park at the end of the shift.

In addition, on the driver's request, a photo of traffic violator can be taken and placed in a separate folder of violators. Figure 3 shows a photo of a violator who parked his/her car on a public transport lane. This photo is ultimately sent to the relevant services of the Ministry of Internal Affairs for the imposition of fines on violators. The corresponding legislation has come into in force in Ukraine.

At the end of each shift, when the vehicle returns to the parking place, all the accumulated data are automatically transferred via Wi-Fi (at a certain time when the smartphone is near the server) to the computer, thanks to the synchronization of the computer and the smartphone via Wi-Fi through the SMB1 protocol.

Fig. 3. Photo with a violator on a public transport lane

Also, thanks to GSM and LTE communication, the smartphone can receive commands from the outside to perform such tasks as distinguishing license plate numbers and people's faces for the necessary analysis and other assignments in real time.

Built-in GPS is used to determine the place and to obtain coordinates of the photo. GOOGLE MAPS is used as a provider.

THE SERVER SOFTWARE

To store accumulated data from a large number of vehicles, it is planned to use servers of the distributed information storage system located in public transport parking lots. *Microsoft* SQL Server 2019 and *Microsoft* SQL Server management studio 2018 are installed on these servers.

The advantages of a database created in SQL Server are as follows:

- convenient and accessible interface;
- password protection;
- the possibility of connecting a large number of users;

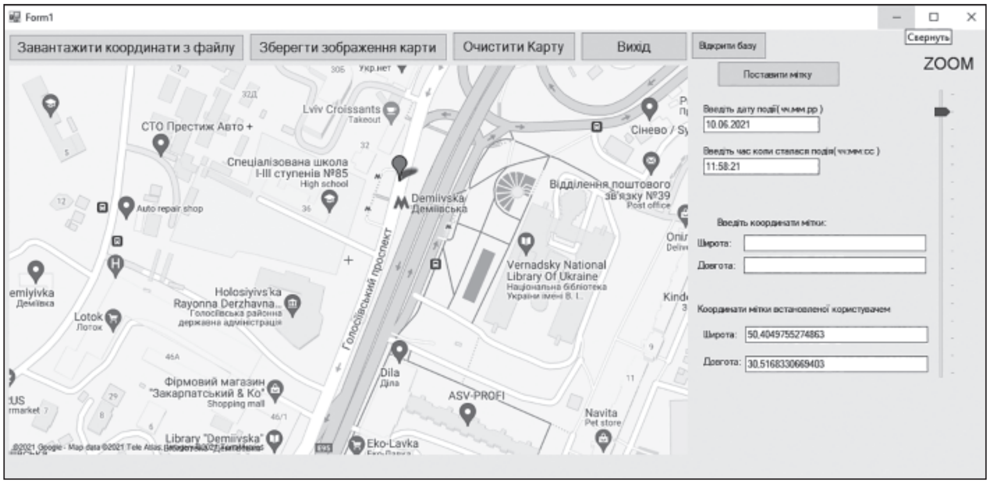

Fig. 4. The main window of the client software application

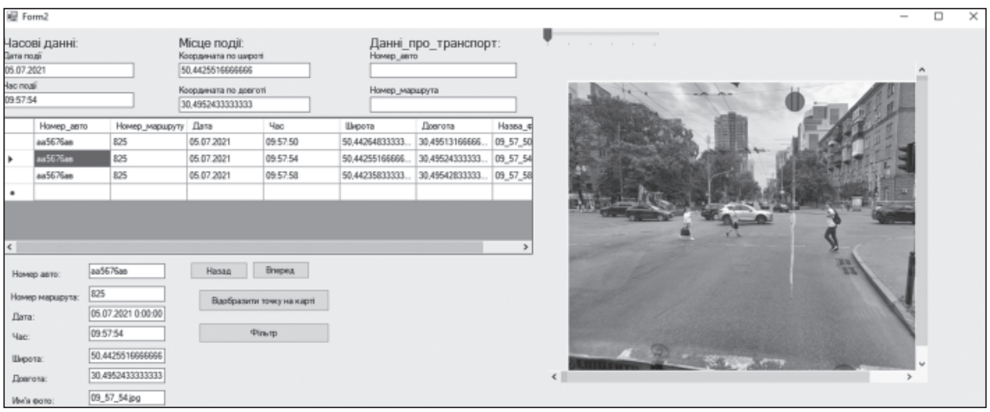

Fig. 5. Interface window for working with the database

- fast search and filter algorithms for a large amount of data;
- remote work with the database.

THE CLIENT SOFTWARE

The client software is developed as a *Windows* application in *Microsoft Visual Studio* 2017, in the *C#* language, with the use of *Windows Form* and its elements. For the possibility of working with *Google Maps*, the "Gmap.net" library is connected to the project. A database created in *Microsoft* SQL SERVER 2019 is also connected to the project.

The main window of the client application is shown in Fig. 4.

In the main window of this application, the user can perform the following actions.

It is necessary to enter the date and time of the event that took place and put a mark on the map where exactly it took place. This data is required for further filtering of the database with a selection of records that meet the specified parameters. It is also possible to load an array of coordinates from a text file and to display them. The user also has the option to enter the coordinates of a label and to display it instead of setting the label manually.

Having entered the selection parameters, the user can open the database and to make filtering. The interface window for working with the database is presented in Fig. 5.

Having filtered the data, the client receives a list of records that match the filtering parameters and can view the photos that correspond to these records, as well as analyze the photos and get information about the route, vehicle, time, and place where and when the photos are taken.

The user can also use the "forward" and "back" buttons to navigate through the table, while viewing records. If necessary, the user can display the label of the desired record on the map.

So, the application has two forms for working with the database and the received information.

THE ADDITIONAL SOFTWARE

The additional software has been developed to perform such functions as highlighting license plates on the image and recognizing them, selecting people's faces for subsequent automatic analysis. In addition, for implementing the recognition system, it is planned to purchase high-quality commercial programs available on the market.

The developed additional software of the proposed system is based on a set of libraries under open licenses (LGPL3, MIT, *Apache* 2.0, and others), in particular, *OpenCV* 3.4, for processing the graphic data; *Open*ALPR, for distinguising the numbers to be fixed; and *Tesseract* OCR 4, for recognizing the characters.

It should be noted that since the smartphone operates under *Android* 10 operating system, and the special video camera operates under *Ubuntu* operating system, the above-mentioned programs and libraries shall be compatible with these operating systems.

OpenCV (Open Source Computer Vision Library, open source computer vision library) is a library that contains image processing functions and algorithms. Currently, the major version of this library is version 3.4.

OpenCV library is a basic element of the system software. Other programs and libraries use the methods and functions that are available in this library.

OpenALPR (Open Automatic License Plate Recognition) is a library based on *OpenCV* functions, which analyzes images and video streams for license plate recognition. The result of the operation is the presentation of any license plate symbols as text.

To recognize license plates, *OpenALPR* uses *OpenCV* algorithms, in particular, the Kenny [8] and Huff [9] algorithms, for line recognition, and the HOG algorithm [10], for the highlighting of object contours, the Hoare cascades [11] and the Viola-Jones method [12], for searching the "license plate number" object.

Tesseract OCR is a text recognition program that allows converting a graphic image of a character into equivalent text format. The program supports many recognition languages (including English and Ukrainian) and many text formats (including UTF-8).

The resulting "license plate" graphic object is transferred to this program that converts it to a sequence of UTF-8 characters. The basic functions of graphic data processing (Gaussian filter, Kani algorithm, etc.) are taken from *OpenCV*, while the determination of a fixed gap between letters and words, the separation and classification of symbols, and the recognition of letters and words are the algorithms of *Tesseract* program itself.

The modern municipal transport on which it is proposed to install cameras is usually already equipped with GPS trackers to control their movement; the cost of upgrades to such trackers and other individual sensors (e.g. gyroscopes and magnetometers) is rather small as compared with the cost of the cameras and their software. It should be noted that the proposed solution does not use real-time online services for recognizing license plates (only library sets under "open" licenses are used). The satisfactory recognition depends on the quality of the camera sensor and its optical system, as well as on the position of the camera on municipal transport. That is why tests with the use of certain video cameras fixed at certain places in the vehicle are necessary to obtain the quantitative characteristics of the system.

An example of *OpenALPR* operation is shown in Fig. 6.

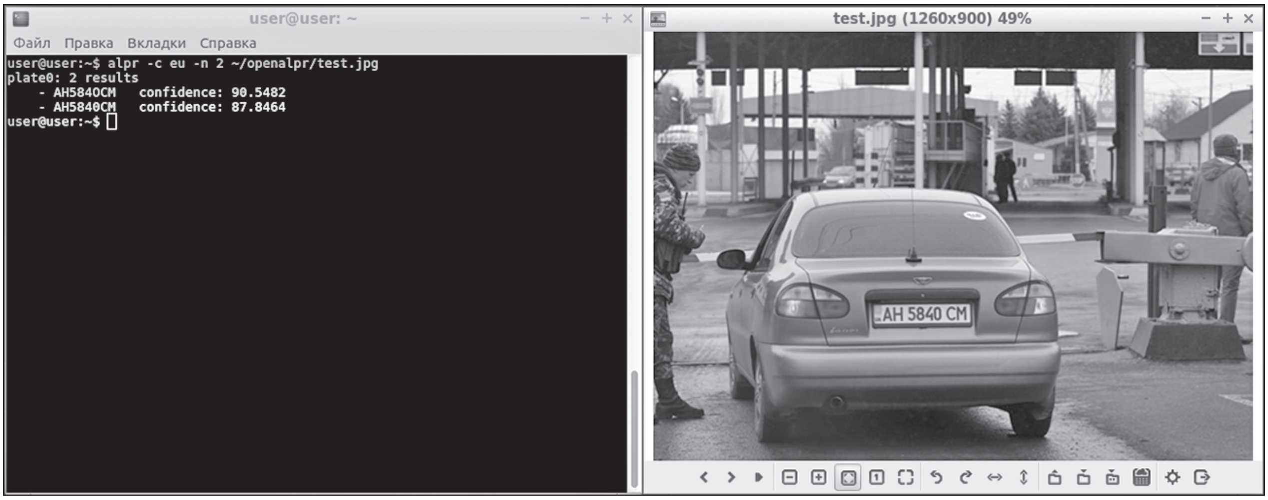

Fig. 6. An example of the operation of *OpenALPR* program

Fig. 7. The result of the work of smartphone application for automatic detection of human faces and monitoring of mask wearing

On the right, there is a photo with a car and a license plate in sight. On the left, there is the result of license plate search and recognition.

To realize the video recording, we use the algorithm and the application for the selection of human faces and the monitoring of whether they are wearing masks, which are based on the functions of *OpenCV* library and the Hoare cascades [13], according to the Viola-Jones method, as well as the algorithms for coding and analysis of contours [14, 15]. Figure 7 presents the result of the work of smartphone application for automatic detection of human faces and monitoring of mask wearing.

On Fig. 7, there are the results of automatic analysis of a video image: the selected faces are marked with frames, and the faces without masks are marked with crossed lines.

As a result of the research, the authors have proposed the mobile video surveillance system described above. The main research and practical results are as follows:

- the concept and structure of the hardware and software of the mobile video surveillance system have been developed; the structure of the system has been protected by a patent of Ukraine for a utility model;
- a special video camera for recording and analyzing video data in a vehicle has been designed and manufactured with the help of partner (PJSC *Magnit Electromechanical Plant*, *Magnitprilad* LLC);
- the main components of on-board, server, and client algorithms and software have been developed;
- additional algorithms and software for the automatic detection of license plates and their recognition, as well as for the automatic selection of people's faces and the monitoring of masks wearing for the subsequent computer analysis have been developed.

In general, the use of mobile systems of this type allows expanding the area of video surveillance in cities and outside the city and reduces the costs of implementing road video recording systems. The system enables the detection and monitoring of gatherings of people in various places to prevent the threat of terrorist acts and contributes to the investigation of possible crimes.

The research has been conducted at the stage of design and development of the main hardware and software components of the system. The operation of software components is planned to be studied at the stage of system implementation in real conditions, with the use of video data received.

The further expansion and improvement of additional software and the centralization of video data in the distributed database will significantly increase the analytical capabilities of the system.

The research funding. The research has been conducted within R&D project *Development of a System for Mobile Video Surveillance of Roadway and Roadside Conditions,* under support of the *Program of R&D Projects Based upon the Results of the General Academic Competition of R&D Projects,* upon the order of the Presidium of the National Academy of Sciences of Ukraine dated 20.01.2021 No. 31 on approval of the list of R&D projects to be implemented in 2021. The partner is PJSC *Magnit Electromechanical Plant*, *Magnitprilad* LLC, Kaniv, Cherkasy Oblast.

REFERENCES

1. *Patent of Russia RU № 2326445*. Kudelkin V. A. A method and system of video surveillance from a vehicle located in motion. Date of application 27.06.2006, publ. 06/10/2008. Bul. No. 16 [in Russian].
2. *Patent of Ukraine for a utility model UA № 71967*. Chubaty D. A.Visual information system for highways "VISAD". Date of application 05.06.2012, publ. 25/07/2012. Bul. № 14 [in Ukrainian]
3. Boyun, V. P., Voznenko, L. O., Malkush, I. F. (2019). Principles of Organization of the Human Eye Retina and Their Use in Computer Vision Systems. Cybernetics and Systems Analysis. *Springer Nature*, Jan 1, 3—17. https://doi.org/10.1007/s10559-019-00181-0
4. Boyun, V. P. *The Principles of Organizing the Search for an Object in an Image, Tracking an Object and the Selection of Informative Features Based on the Visual Perception of a Person*. (2020). Copyright HolderName Springer Nature Switzerland AGSpringer Nature Switzerland AG S. Babichev et al. (Eds.): DSMP 2020, CCIS 1158, 22—24. https://doi.org/10.1007/978-3-030-61656-4_2
5. *Patent of Ukraine for a utility model UA № 147969*. Bahatskyi O. V., Boyun V. P., Sabelnikov P. Y., Sabelnikov Y. A. System of mobile video surveillance of the road situation. Date of application 06.02.2021, publ. 23/06/2021. Bul. No. 25 [in Ukrainian].
6. SAMSUNG GALAXY A31. URL: https://www.gsmarena.com/samsung_galaxy_a31-10149.php (Last accessed: 16.07.2021).
7. OV5640 1/4 "Color CMOS QSXGA (5 Megapixel) Image Sensor. URL: https://cdn.sparkfun.com/datasheets/sensors/lightimaging/sensors/Lightimaging/ov5640_Datasheet.pdf (Last accessed: 04.11.2021).
8. Image processing — Kenny's borders detector (CANNY). URL: https://robocraft.ru/blog/computervision/484.html (Last accessed: 16.07.2021) [in Russian].
9. Hauf Transformation. URL: https://robocraft.ru/blog/computervision/502.html (Last accessed: 16.07.2021) [in Russian].
10. Dalal, N., Triggs, B. (2005). Histograms of oriented gradients for human detection". *IEEE Computer Society Conference on Computer Vision and Pattern Recognition* (*CVPR'05*) (20—25 June 2005, San Diego). 1, 886—893. CA, USA. https://doi.org/10.1109/CVPR.2005.177.
11. Viola, P., Jones, M. (2001). Rapid Object Detection Using a Boosted Cascade of Simple Features. *Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR)*. 1, 511—518. Hawaii, USA.
12. Viola, P., Jones M. (2001). Robust Real-time Object Detection. Second International workshop on statistical and computational theories of vision — modeling, learning, computing, and sampling (July 13, 2001,Vancouver), 1—3. Canada.
13 Releases. OpenCV — 3.4.2. Android URL: https://opencv.org/releases/page/4/ (Last accessed: 12.07.2021).

14. Sabelnikov, P. Yu. (2016). Parallel encoding of objects of objects in binary images and calculating their moments of inertia. *Artificial Intelligence*, 2(72), 35—45, URL: http://dspace.nbuv.gov.ua/bitstream/handle/123456789/132047/04-Sabelnikov.pdf?sequence=1 (Last accessed: 12.07.2021) [in Ukrainian].
15. Sabellnikov, P. Yu. (2014). The algorithm of geometric comparison of contour is made objects. *Journal of QAFQAZ University. Mathematics and Computer Science* (*Baku*), 2(2), 166—175 [in Russian].

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СИСТЕМА МОБІЛЬНОГО ВІДЕОНАГЛЯДУ ДОРОЖНЬОЇ ТА ПРИДОРОЖНЬОЇ ОБСТАНОВКИ

Вступ. На сьогодні в Україні не існує централізованої масштабованої системи збору й обробки відеоданих, яка б дозволяла контролювати дорожню та придорожню обстановку.

Проблематика. Зазвичай для систем контролю використовують стаціонарні камери. Оскільки камер необхідно багато, виникає проблема передачі інформації (створення та обслуговування розгалуженої мережі передачі даних) та її обробки (створення центрів обробки та зберігання отриманих даних).

Мета. Створення системи збору відеоданих за дорожньою та придорожньою обстановкою, а також обстановкою в транспорті загального користування для розкриття злочинів, що відбулися в зонах відеонагляду.

Матеріали й методи. Використано смартфон та відеокамеру, на яких було протестовано функції й алгоритми розробленої авторами системи. Для зменшення об'ємів інформації застосовано методи селективного сприйняття відеоінформації, визначення рухомих об'єктів, методи паралельної та конвеєрної обробки відеоінформації для прискорення їхньої обробки, методи й засоби швидкого виділення інформативних ознак для пошуку та розпізнавання об'єктів.

Результати. Запропоновано концепцію та структуру апаратного й програмного забезпечення системи мобільного відеонагляду, структуру системи захищено патентом України на корисну модель. Розроблено та створено за участі партнера спеціалізовану відеокамеру для зйомки й аналізу відеоданих, а також компоненти системи для реалізації функцій автоматичного детектування на зображенні номерів автомобілів та їх розпізнавання, автоматичного виділення облич людей з визначенням відсутності на них масок для подальшого комп'ютерного аналізу.

Висновки. Використання мобільних систем зазначеного типу дозволить розширити зону відеонагляду в містах і поза містом та зменшить затрати на впровадження дорожніх систем відеофіксації.

Ключові слова: відеосистеми, системи реального часу, мобільні системи, інтелектуальні відеокамери.