ANALYSIS OF MULTISENSORY INTELLIGENT PLATFORM MIP-11 NETWORKED WITH THE C4ISR SYSTEM

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Abstract: In recent years, there has been significant growth in the development of multisensor optoelectronic systems networked in modern C4ISR (Command Control Communication, Computer, Information, Surveillance and Reconnaissance) systems with the aim of timely data collection (from sensors or other sources), their processing (command center) and distribution to users, ie exchange between potential users. The most important group of sensors in combat systems are optoelectronic sensors. The paper presents an analysis of a mobile multisensory intelligent platform networked with the C4ISR system in order to equip military units
Key words: *multisensor intelligent platform, C4ISR, reconnaissance, detection, reconnaissance surveillance system*

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1. INTRODUCTION

The development of multisensor optoelectronic systems in the world has created the need for their construction for the needs of the Serbian Army. These systems connected to the C4ISR (Command Control Communication, Computer, Information, Surveillance and Reconnaissance) [1] system enable timely collection of data from the battlefield, their processing and sending to end users. The most important group of sensors in combat systems are optoelectronic sensors (television, thermo vision, image amplifiers and laser devices) (rangefinders, target markers, irradiators and laser radiation detectors). And sensors for the detection of chemical agents.

The reconnaissance surveillance system of the company Rheinmetall Defense Electronics is in the operational use of the German army. In the U.S. military, the

Raytheon Long Range Advanced Scout Surveillance System - LRAS3 is installed on an armored personnel carrier and off-road vehicle and enables reconnaissance and detection of enemy targets, handling and fire control in all land and weather conditions in real time. In the French military, Thales has installed a multi-sensor platform on the armored personnel carrier, which also allows reconnaissance and detection of enemy targets and the handling and management of fire. For the needs of the Serbian Army, two variants of the multisensory intelligent platform have been developed, the first variant is stationary, and the second is mobile installed on an off-road vehicle.

2. TECHNICAL SOLUTION OF MULTISENSOR INTELLIGENT PLATFORM MIP – 11

The main purpose of the MIP-11 system is observation, passive reconnaissance and acquisition of movable and immovable objects, in all weather conditions. The system consists of several different sensors that simultaneously observe the defined space and form its image. The obtained multispectral image corresponds to the real situation in space and can be sent to other users in real time via the communication network. Complementary sensors are integrated into the system, which provide the possibility of further processing of their partial data in order to obtain more reliable information for more efficient solving of tasks of observation, reconnaissance and acquisition of targets. [2]

A sensor system is integrated on the remote-controlled carrier platform. The system integrates a passive sensor for the visible part of the spectrum (video camera), a passive sensor for the IR spectrum (thermal imaging camera), [3] an active source and a passive laser radiation sensor for measuring the distance to the object (laser rangefinder), GPS for determining its own coordinates and digital compass for orientation. It is also possible to integrate: radar, sound metry for precise determination of sound sources, radar, IR or laser radiation detector and chemical and biological detector.

The MIP -11 system enables: detection, identification, geo-locating, active introduction of location and object data into the geographic information system and further distribution of data to the higher level command information system.

The multisensory platform kit integrates sensor subsystems, multisensor platform startup subsystem, communication subsystem, command and control subsystem with appropriate software, power supply subsystem, telescopic support column and motor vehicle.

The mobile version of the MIP -11 system contains a block of integrated sensors (TV camera, thermal imaging camera, laser rangefinder, GPS receiver, electronic compass and corresponding electronics) located in the sensor box. The sensor box block is mounted on an unstabilized subsystem for moving in the direction and elevation of the multisensor platform. Movement in the direction is unlimited, and in the elevation ± 90 °. Height-adjustable telescopic pole (up to 6 m),

power supply system for sensors, computers, network equipment and telescopic pole start system are installed in the motor vehicle.

The multisensor platform collects direct and reflected radiation from the observation zone. Its performance in terms of range detection, recognition and identification of targets and their geo-location are conditioned in the built-in technological and technical solutions of sensors, but even more so in climatic-atmospheric and topographic conditions of use.

The constituent subsystems of the MIP-11 system are: Digital magnetic compass, GPS receiver, motorized sensor carrier and operator control panel. The block diagram of MIP-11 is shown in Figure 2. [2]



Figure 1.- Mobile version MIP-11

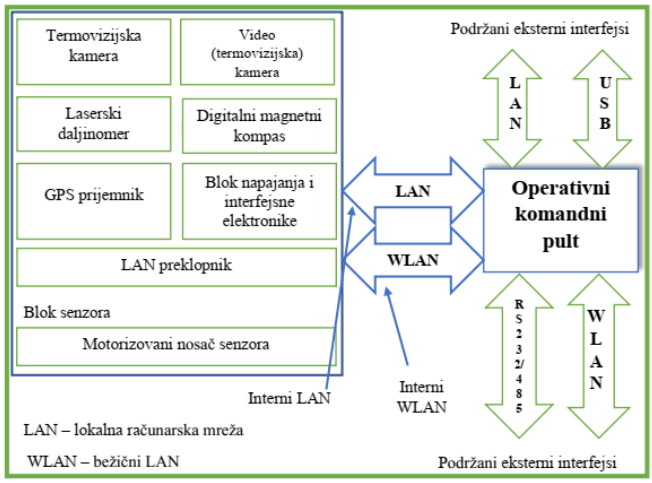


Figure 2.- Block diagram MIP-11

A LAN network with three computers has been installed in the MIP-11 vehicle, where the sensor subsystem control application is running on the sensor operator's computer, while the GIS application is running on the other operator's computer. An insight into the work of both operators is provided on the commander's computer. The overall functionality of MIP-11 is achieved by developing dedicated application software according to the requirements of remote monitoring, reconnaissance and acquisition of targets. This application allows you to control the sensors and receive data from them.

The MIP-11 application software is a unique application with a graphical user interface that provides intuitive operation with all sensor subsystems. Figure 3 shows the user interface of the application. The application provides access and adjustment to each sensor individually. The display of the image from the television and thermal imaging camera is continuous. [2]

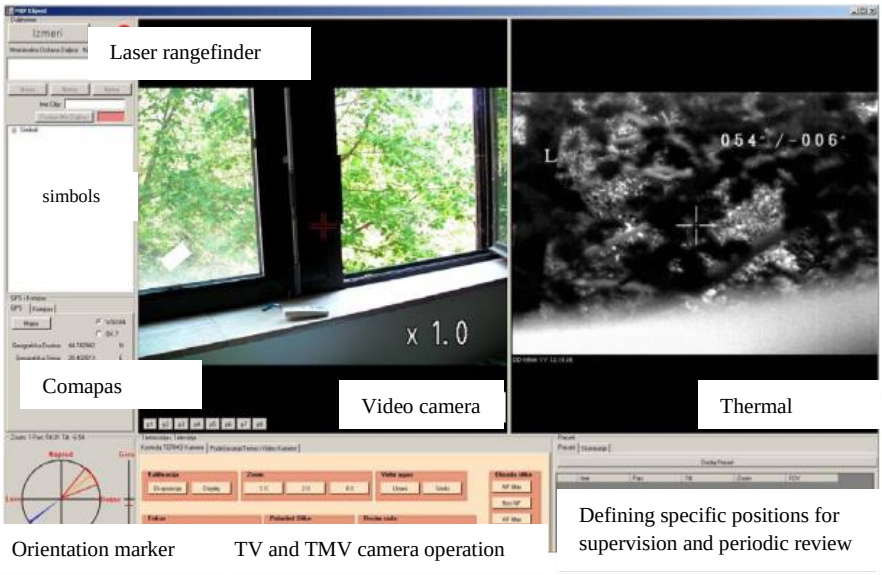


Figure 3.- User interface

Application software allows connection to digital maps according to the format generated by the Geographic Information System (GIS). Before referring to the task, it is necessary to generate maps from the GIS system for the area of operation where the MFA system is sent. After initializing the application, calibrating the digital compass, establishing GPS data reception and loading the obtained map, the position of the MIP-11 system according to the data from the GPS receiver, the north orientation according to the digital compass data and the current orientation of the sensors are automatically entered. [2]

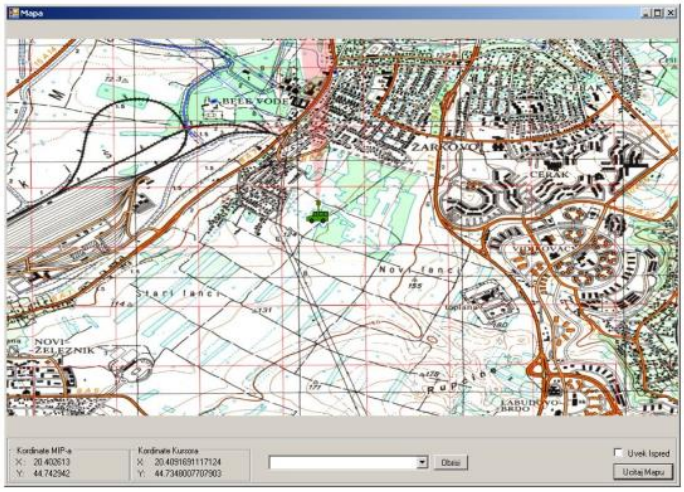


Figure 4. Position of MIP-11 system and current sensor orientation

In order to increase the reliability of the system, there is the possibility of manual data entry in case of failure of a sensor. It is possible to manually enter your own position in case of failure or obscurity of the GPS receiver, orientation in case of failure of the digital compass, the estimated distance to the destination in case of failure of the laser rangefinder. The application allows continuous visual display of the current space seen by video sensors. The television camera has a continuous optical zoom, and the thermal television has two viewing angles - wide and narrow. For the optionally installed radar, a program for processing the obtained data was written, and it is shown in Figure 6. [2]

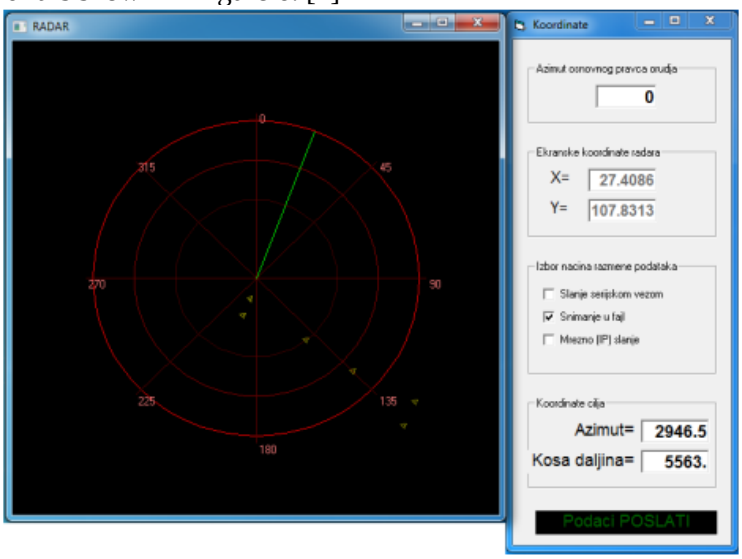


Figure 6.- Appearance of the radar data processing program

3. ANALYSIS OF THE USE OF MIP-11

Sensor orientation is achieved in several ways, such as continuous joystick guidance where its deflection defines the direction and speed of the carrier, continuous guidance with the keyboard, arrow keys, position selection on the map - when the pointer is placed on the map and the position is selected, the sensors are automatically steer towards a defined position. Searching for predefined positions is a special mode in which the operator selects multiple positions. The selected positions can be selected individually or the system will automatically analyze them in a given rhythm and defined order, which is a "patrol or scanning" mode.
Continuous recording of video content from cameras and their archiving is provided, where it is possible to subsequently view the recorded material and forward it to other users who need it. The application allows you to save images while recording. The recordings can be transmitted via a computer network or via appropriate magnetic media.
The distance to the selected target is measured with a laser rangefinder. The built-in rangefinder provides measurement accuracy with an error of ± 5 m. In one

measurement it is possible to measure 3 distances to the target if the targets are collinear. The laser rangefinder enables the function of setting a minimum distance below which objects are not detected, but their distances are measured. When distance is measured, both azimuth and elevation are measured. Based on the measured distances and angles, it is possible to geo-reference the position of the target in space in relation to the coordinate system of the sensor. The built-in algorithm converts the relative position of the targets into a position on the map so that the position of the target is automatically entered on the map.
The MIP-11 system provides the ability to connect to other computer systems. Multiple spatially distributed MIP-11 systems can form a sensor network that covers a larger area of operation. In this way, multiple short-range systems can replace one (expensive) long-range optoelectronic system. The price of optoelectronic systems according to the declared ranges of detection, recognition and identification is growing exponentially. The advantage of distributed MFA-11 systems is lower cost, flexibility and reliability of the entire reconnaissance system. [2]

4. INTEGRATION OF C4ISR SYSTEM ON MIP-11 AS A SUPPORTING SYSTEM

GIS is widely used in almost all the branches of the modern society. Capabilities that use GIS are following: Command and Control, Defense mapping organizations, Base operations and facility management, Force protection and security, Military engineering, Mine clearance and mapping, Mission planning, Terrain analysis etc.
C4IRS defines a Command, Control, Communication, Computer, Information system, Reconnaissance and Surveillance. Geo-reconnaissance determine specific type of information gathered from the visual observation or other detection methods, which give us information’s about the terrain, geographical elements of it, objects on that specific area, that can help us to create a better picture for the enemy and the resources they are using. So, one of the ways of data gathering is by aerial photographs and space images. Advantage of these kinds of collecting data is the possibility of gaining information without getting any contact with the earth surface directly, but with contacting a mediatory unit carrying information about the surface. As that kind of mediatory unit which carries an assessing equipment to gain information are today's popular drones and unmanned aerial vehicle (UAC) [4] commonly known as a drone. With proper equipment they can be used to observe and make live photographs of the terrain affected by some type of crises. This method will reduce the usage of people risking their life for the purpose of collecting information.[5]
The Geo-reconnaissance and commanding (GRC) information system is based on the GIS usage for both Geo-reconnaissance and C4IR - Command, Control, Communication, Computer, Information and Reconnaissance. So through the wide utilization of GIS we want to create one completely defined information system which will help soldiers, commanders and strategic decision makers, for easily observation of their current situation, their future actions and of course after the end

of the mission, feedback and analyzing of the mistakes and creating directions for further improvement.

1st step into creating of this kind of complex system is equipping the direct participants i.e. soldiers and vehicle with proper equipment for geo locating, and that will be an emitter which will constantly send signals. The receiving device, because sometimes the terrain is not accessible for all kinds of vehicles, will be set on the drone and it will forward the signals to commander. The device set on this drone also will be in a role as an emitter, so it will sent various kind of signals to the soldiers on the battlefield.

2nd step is receiving the information about the location of the vehicle and the soldiers in the commanding unit. In this unit, the commander with the help of the staff (headquarters) based on the locations of the soldiers shown on the monitor using GIS software (we use Arc-GIS and Geo-Rover), decides what actions will be taken. In this section, biggest impact on the functioning of the information system has GIS usage for C4IS, described already in the previous topic. Arc-GIS capabilities help in the decision making process, giving to commanding unit various kind of information, from situational picture on the field, to decisions made by other commanders, visualization of unit deployment, reports, and of course information received from the geo-reconnaissance.

Geo-reconnaissance actually is the parallel step to the geo-location step. Geo-reconnaissance, in fact is the major element of this information system. With aerial photography, infrared sensors, space images, the command gets data and information about the situation on the enemy territory, about the enemy's soldiers, objects in the deep of the enemy line, fortification obstacles, and other information that can be beneficial later in the decision making process.

Geo-locating and Geo-reconnaissance give the input values in the information system. Than human factor, make a decision, which represent an output from the system. This output can be in a form: directions about the movement, usage of weapons, withdrawal, locations of IED’s. The orders are transferred to lower instances, and at the end every soldier has a specific task to finish. If the "output" represents specific directions about the movement, that order via GPS is shown on the GPS navigator which is a part of the equipment of every vehicle already mention above.

As an integrated part of the information system is the recording and live streaming section. A camera is set on the drone above the battlefield, so it records the real action. The video is transferred to the command, which can help to make a better decision, if the information received from other sources (geo-reconnaissance, geo-location, radio devices). Also the video material can be used later for analyzing the mission or the battle. Drones are controlled from the command, and their location and movement depends on the requirements of the mission.

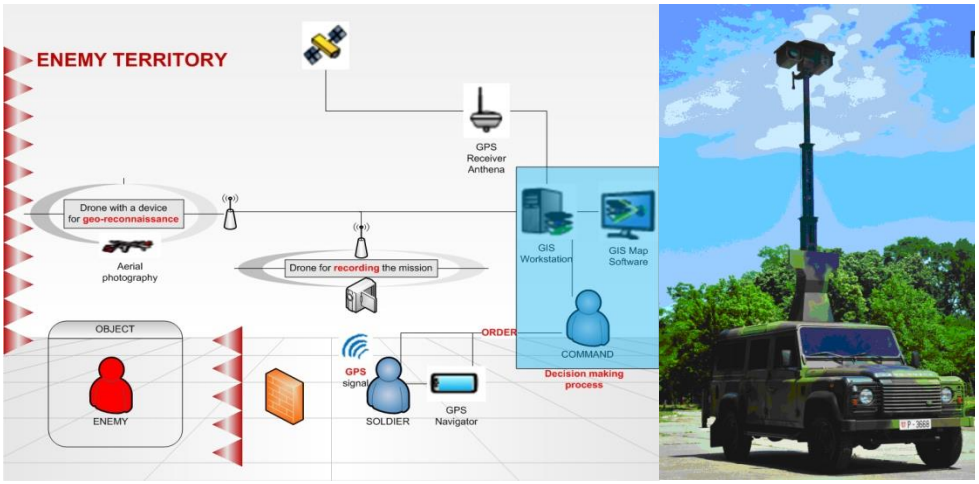


Figure 7: Model of Geo-reconnaissance and commanding (GRC) information system intergrated on MIO - 11 as a supporting system

5. CONCLUSION

The modern way of conducting combat operations and the operational environment have conditioned the development and application of new means and systems for successful observation, reconnaissance and acquisition of targets. The paper presents an analysis of the multisensor platform MIP 11 produced in the Republic of Serbia, which is networked with the C4ISR system, and presents certain possibilities of this platform when networked with the C4ISR system. An analysis of the characteristics was performed and the possibilities of the mentioned multisensor platform are listed. The application of this platform networked with the C4ISR system significantly increases the combat capabilities of units and the ability to transmit information and images in real time, which significantly contributes to a better and more reliable decision-making process of military leaders. Continuation of research should focus on the analysis of the operation of this system in real combat conditions and the integration and networking of drones [6] with this system.

6. LITERATURE

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