ABOUT THE ORGANIZATION OF REGIONAL SITUATIONAL CENTERS OF THE INTELLECTUAL SYSTEM "CONTROL_TEE" WITH THE USE OF UAVS

Julia Pisarenko, Alexander Koval, Kateryna Melkumian, Alexander Kryachek, Olga Gavrilyuk,

***Abstract**: The basics of the principles of creation and filling of the technopark of unmanned aerial vehicles (UAV) are offered. The business process of UAV registration in the technopark of the situation center robots is described. The use of attributes (tags) to the UAV will increase the efficiency of a suitable device selection with a complete set that meets the task. It is proposed to organize regional situational centers, which will coordinate the work of state systems, urban life support systems, private services on the one hand and UAV on the other as executors. At this time, principles and methods of automatic selection of UAVs are being developed for the prompt solution of the given task. The system should be based on the classification of the UAV during registration and on the basis of the UAV compliance function to the specific task, key features of the UAV, the time required to complete the task, the distance to the task and the policy to involve the UAV in such tasks to select those devices, who can quickly perform tasks. The function of classification of a specific UAV by tasks is offered. The function takes into account the configuration of the UAV. For each task, experts and automation select weights that indicate how large the impact of certain typical modules to perform a particular task, and for each UAV in the database stores information about whether the UAV takes into account a certain characteristic, or there is a*

corresponding module. To update the approach to professional training today, one of the main tasks is to create interactive mock-up training systems in real physical space. The principles of building a basic laboratory stand, its equipment and the control system of a mobile modular robot, which helps to master the basic functions of a UAV or mobile operation of a ground base, are under development.

***Keywords**: UAV, situational center, traffic control, professional education.*

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Introduction

Obviously, the city of the future is a smart city, a city that in real time controls most of the processes that take place in its bowels automatically and does it optimally, a city where security is raised to a whole new level, and access to information, the benefits of civilization, city services, any necessary human things as simple as possible. And how will this city regulate the work of rapidly developing UAVs at the moment? After all, it is obvious that with the increase in the number of UAVs, if they begin to take over the routine functions of employees, we need a management system that will ensure safety and minimal accidents, regulate their movement, pave special air routes, simplify UAVs, standardize them, harmoniously integrates UAVs into the structure of the city, puts them at the service of the common good.

Formulation of the problem

Existing issues:

- the need to certify the movement of UAVs [1] in order to regulate it and prevent unauthorized actions. As a result, it is necessary to

build air routes with the formalization of their purpose, taking into account the adaptive management of traffic dynamics;

- the ability to automatically switch remote control in case of emergency: loss of signal from the UAV at the base [2], the actual transfer of UAV data about its pre-emergency condition, UAV interception, interference / protocol breakage, radio weather interference;
- automated data collection [3] in the monitoring process for learning neural networks and after gaining new knowledge for further forecasting, passive collection of information for specific purposes;
- selection of the communication channel and data transmission protocol between the triad "ground station information storage" + "UAV board" + "decision maker".

Topicality

Let's take a closer look at the issues that we are already slowly facing in the use of UAVs. There is no need for long explanations of the fact that an unmanned vehicle equipped with a good camera and image transmission equipment hanging in front of someone's room is both bad and illegal, that an unmanned carrier with a heavy parcel on board should probably not carry it over kindergarten or over crowds, because in the event of an accident, its consequences can be very serious. Therefore, UAVs in the transition to their widespread use require mandatory regulation of their movement, certification, accurate construction of routes and informing them about the services of a smart city in real time. Certified UAVs are likely to be able to quickly transfer control to a specialist or automated city system to deal with a variety of emergencies and assist city services. UAVs that are constantly scurrying here and there are likely to have to do some useful things for the city, directly serve the common good, such as passively or actively collecting data for monitoring, looking for people,

garbage, something unusual that needs intervention, find something which can be difficult to find with conventional stationary cameras, to provide communication. And in fact, it would be strange not to use the capabilities of flying cameras that capture the city from new angles. The use of communication channels for UAV control, various protocols, special software must be clearly regulated, the components of a smart city must work as a coherent mechanism and not interfere with each other.

To ensure the solution of the described requirements, the authors of the study propose to create a network of regional situational centers (RSC), and, in fact, ground stations covering a certain area, which provide comprehensive control of UAV traffic. These stations should be subordinated to the Central Situation Center (CSC), which will house the decision-making center [4] and the main information repository.

Figure 1 shows an illustration of the interaction of the UAV, the central situational center and the regional situational center.

The central situational center receives all information about the movement of UAVs in the city from the regional situational centers, it receives all requests for UAVs to perform certain actions via the Internet, this information is processed and decisions are made here, and all services necessary for communication are deployed here.

Regional situational centers (RSC), located in the protected perimeter, at the same time directly conduct radio exchange with UAVs in their area of operation, manage their area according to the general plan dictated by the CSC, perform all necessary calculations, store temporary information and have functionality for fully autonomous traffic control and execution of requests in the event of termination of communication with the CSC.

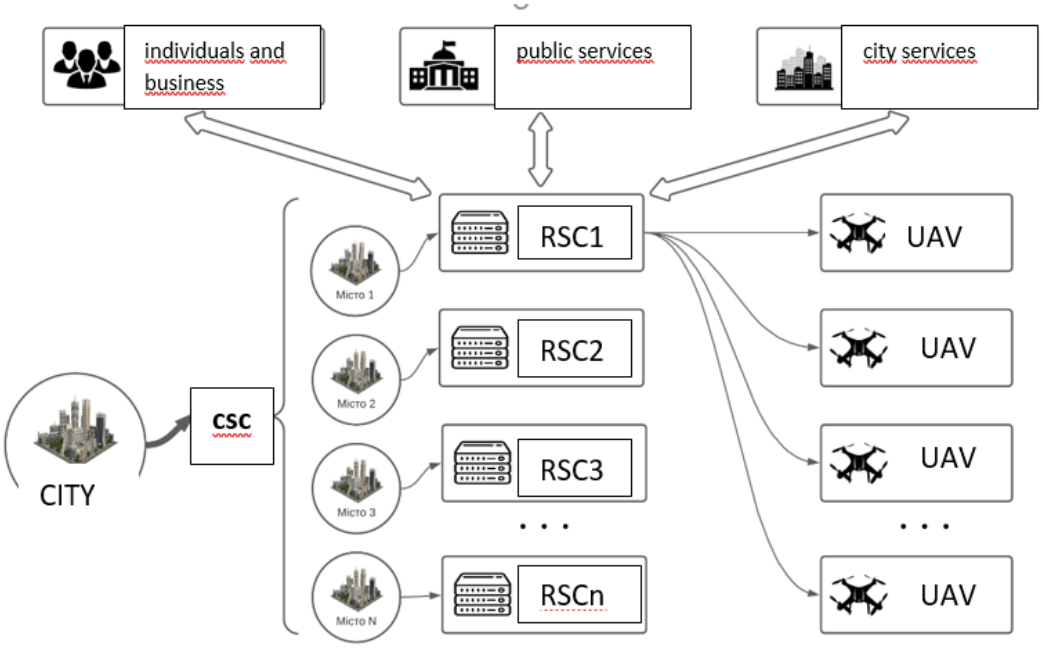

Fig. 1. The interaction structure of the UAV, the central situational center and the regional situational center

Thus, the UAV, flying through the city, is always in the coverage area of one or more RSCs controlling its movement, and thanks to the work of the CSC, it can be guided according to a single plan. A diagram of the interaction between the parts of the described system (the system itself, the UAV, various stakeholders) has been developed. Thus, the state, smart city services, private individuals and businesses turn to the RSC, directly to the CSC, with any requests and tasks they need, and the RSC gives answers, coordinates, controls, manages and selects a specific executor, if necessary.

Tracking information to be transmitted to the RSC:

1) Own coordinates transmitted on request or at certain intervals to build the exact path flown by the UAV

2) Displays the battery charge level and the rate of its consumption at each point of the route. Or similar information, which can be used to judge the time the UAV is in the air, to make predictions.

3) Displays of the main on-board instruments installed on the UAV - altimeter, accelerometer, gyroscope tied to coordinates. That is, at what height it was, where it was turned and how it moved at each point.

4) Information about the operation of the UAV manipulator or autonomous loading/unloading system.

5) The shooting vector of all the cameras installed on the UAV.

6) Information about the use of certain additional modules installed on a specific UAV.

7) Information about what is currently available to the user, what he sees, if the UAV is not flying in automatic mode, but under his control.

8) Information about the commands given by the user when the UAV is flying under his control.

9) Similar information about sound recording

10) Streaming video and photos from cameras. At intervals/on demand/continuously.

11) General information about the flight (start time, type of movement, type of mission, destination, who is the owner, Id of the UAV in the system, etc.).

Information that the RSC must transmit to the UAV:

1) Current map of air routes and zones above the city on request.

2) The optimal flight route on air routes (specific coordinates, speed limits, etc.).

3) Information in the dynamics about the presence of other UAVs in the vicinity, speed and vectors of their movement.

4) Information about a possible collision and commands/recommendations on how to avoid.

5) The command to intercept the control and the command of this control itself (and it is possible, taking into account how a person previously controlled this particular UAV, with some optimal control strategy for this model. The data transmitted from the UAV to the RSC precisely allows such a strategy to be developed).

6) Various text, audio, photo, video messages for the case when the UAV is controlled by a person. And with the ability to transmit the coordinates of the message in space, three-dimensional objects to create the effect of augmented reality.

7) Photos and video streams that have been post-processed to replace what the UAV cameras show (for example, looking out the windows and suddenly seeing a blurry picture...)

8) Corrective information about the flight (for example, clarification of coordinates based on express analysis of images from cameras).

9) General information about the flight, UAV, weather, etc.

In order to register a UAV with the RSC, information about it is required. An approximate list of it is given below.

1) The characteristics are related to the form of ownership, owner, type of UAV and other formalities.

2) Complete weight and size properties.

3) Full flight characteristics (speed, maneuverability, etc.).

4) Full battery and power consumption specs.

5) Characteristics of sound and photo-video recording devices.

6) Characteristics of manipulators and cargo unloading systems.

7) Characteristics of the UAV control device and modules providing communication.

8) Characteristics of the sensors installed on the UAV.

9) Characteristics of the software installed on the UAV, its autonomous flight capabilities.

Figure 2 shows a prototype of the interface of the described system (the program client part)

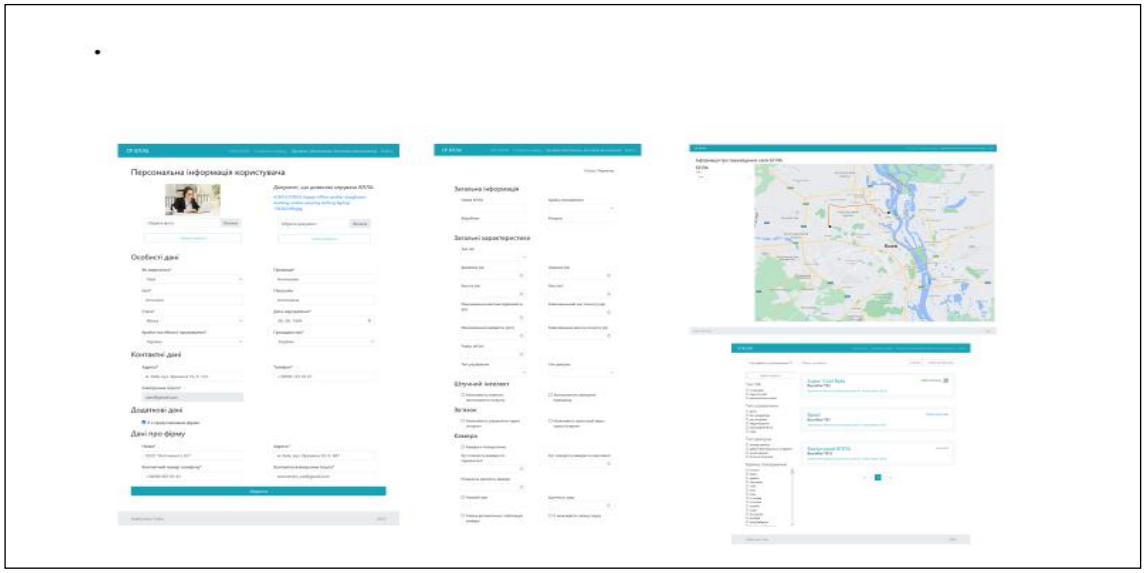

Fig. 2 The prototype of the described system interface

Laboratory stand:
At the moment, the authors are working on promoting the professional training of future UAV operators [5,6].

To update the approach to professional training today, one of the main tasks is to create interactive mock-up training systems in real physical space. The principles of building a basic laboratory stand, its equipment and the control system of a mobile modular robot, which helps to master the basic functions of a UAV or mobile operation of a ground base, are under development.

Fig. 3, 4. Working moments of training teenagers - future UAV management specialists and designers of robotic devices on courses initiated by scientists from the National Technical University of Ukraine "Ihor Sikorsky Kyiv Polytechnic Institute"

The creation of such educational complexes is preceded by the development of models and methods for solving the tasks of 4D surveying of the location by a mobile robot and synthesis of information, which bring the educational complexes as close as possible to real installations, ensure the unification of disparate audiovisual information, and allow system users to acquire correct and stable skills [6]. The charter of the sports federation of unmanned aviation of the sports and engineering direction has been developed. Relevant proposals were submitted to the draft Decision of the Verkhovna Rada of Ukraine on the state of readiness of the education system to counter and overcome real and potential threats to the national security and national interests of Ukraine in conditions of external and internal challenges.

Conclusion

By design, the situation centers described in the article should first of all be engaged in tracking UAVs in the city, preventing the commission of illegal actions with their help, developing and informing users and devices about the permitted areas for flights over the city, about airways, and controlling their use. The described system should deal with the certification of UAVs and placing them on the state register with the entry of the necessary information about them into the relevant databases. Well, and further operating with the described information, this system should become part of a smart city, which is responsible for the maximum effects of the use of UAVs.

Within the framework of this work, an analysis of possible ways of implementing the idea of creating an RSC in practice was carried out, the problems that would arise in this case were described, and possible ways of solving them were outlined.

The information that will have to be operated is described, in particular the information that the RSC should exchange with the UAV, it is analyzed how the RSC should control the space above the city, and the general vision is specified.

The authors are constantly working on promoting the professional training of UAV operators and robotics specialists, they have experience in this. The approach to the development of a special laboratory stand is described [5,6].

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Authors' Information

Julia Pisarenko *– V.M. Glushkov Institute of Cybernetics of the NAS of Ukraine; PhD, Senior researcher, Laboratory №236 of Virtual Environment Systems for Organization of Scientific Research*

E-mail: *jvpisarenko@gmail.com*

Major Fields of Scientific Research: *Multidimensional information systems, robotics*

Alexander Koval *– V.M. Glushkov Institute of Cybernetics of the NAS of Ukraine, dept. №265 of Mathematical Problems of Applied Informatics; National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», faculty of Informatics and Computer Engineering; assistant, Junior Researcher*

E-mail: *t70000s@gmail.com*

Major Fields of Scientific Research: *Multidimensional information systems, robotics*

Kateryna Melkumian *– National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», faculty of Informatics and Computer Engineering; PhD, Associate Professor of the Department*

E-mail: *e.melkumyan@ukr.net*

Major Fields of Scientific Research: *Multidimensional information systems, robotics*

Alexander Kryachek *– V.M. Glushkov Institute of Cybernetics of the NAS of Ukraine, dept. №265 of Mathematical Problems of Applied Informatics; National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», faculty of heat power engineer; PhD, Senior researcher*

E-mail: *alexandrkriachok@gmail.com*

Major Fields of Scientific Research: *Multidimensional information systems, robotics*

Olga Gavrilyuk *– V.M. Glushkov Institute of Cybernetics of the NAS of Ukraine, dept. №265 of Mathematical Problems of Applied Informatics; PhD, Senior researcher*

E-mail: *jvpisarenko@ukr.net*

Major Fields of Scientific Research: *Multidimensional information systems, robotics*