UDC 528.8

Kolchevsky N. N.[1], Dudchik Yu. I.[1], Kolchevskay I. N.[1], Zhukava M. N.[1]

FLYING MEASURING STATION BASED ON DRONE DJI PHANTOM

[1]A. N. Sevchenko Institute of Applied Physical Problems of Belarusian State University, Minsk, Belarus

Measuring systems based on Arduino hardware platform and DJI Phantom 3 quadcopter are proposed. The results of processing of measuring information obtained in a series of flights are described. Processing photo / video material in software packages allows to build maps of the area, to measure distances and heights and to analyze visible objects. A gas analyzer based on MQ series sensors and the results of high-altitude measurements of atmospheric air are considered.

Usage of quadcopters is demanded by many industries: from mapping and high-altitude observations to environmental measurements and creation of measuring devices. One of the promising areas is the use of unmanned aerial vehicles (UAVs) in mapping. Using the flight capabilities of a quadcopter and its camera, allows to obtain very high-quality images and video. Identification of atmospheric impurities has great importance in practice, due to the increasing industrial activity of man. The movement of huge air masses containing gaseous pollution and dust particles contributes to the relatively rapid spread of pollution in the atmosphere. Information about the qualitative and quantitative composition of the air is necessary to determine and predict the degree of air pollution and to carry out environmental protection measures.

On the geobase of BSU "Western Berezina" was performed more than 60 flights with a total duration of about 20 hours, and received 20 GB of photos and video, GPS coordinates, technical files of the flight, recorded with DJI Phantom 3 Advanced quadcopter. The aerial photogtaphy of the DJI Phantom 3 Advanced quadcopter was used to create topographic maps and orthophotomaps.

Shooting was made at different altitudes (from 50 to 500 m) and with different illumination (time of day). Analysis of photos and video shows changes in the linear dimensions of the building with a red roof, but the relative positions of reference points and angles remain constant, that indicates the absence of geometric distortions of the onboard camera (Figure1). Performed a calculation to determine the scale of the obtained images and was obtained a table, on the basis of which you can determine the area of any objects in aerial photography (Figure 2).

A) B) C) D)

Figure 1 – Images obtained at altitudes A) 100 meters, B) 200 meters, C) 300 meters, D) 400 meters

Altitude	Digital scale from print calculation 600dpi	Calculation size 1500x1126 , pixels, m	1 pixel in the image corresponds to the distance on the ground	1 pixel^2 on the image corresponds to the area on the image
100	1: 78	500x370	0,33 meters	0,11 meters^2
200	1: 310	2000x1500	1,3 meters	1,7 meters^2
300	1: 400	2600x1900	1,7 meters	2,9 meters^2
400	1: 470	3000x2300	2,0 meters	4,0 meters^2

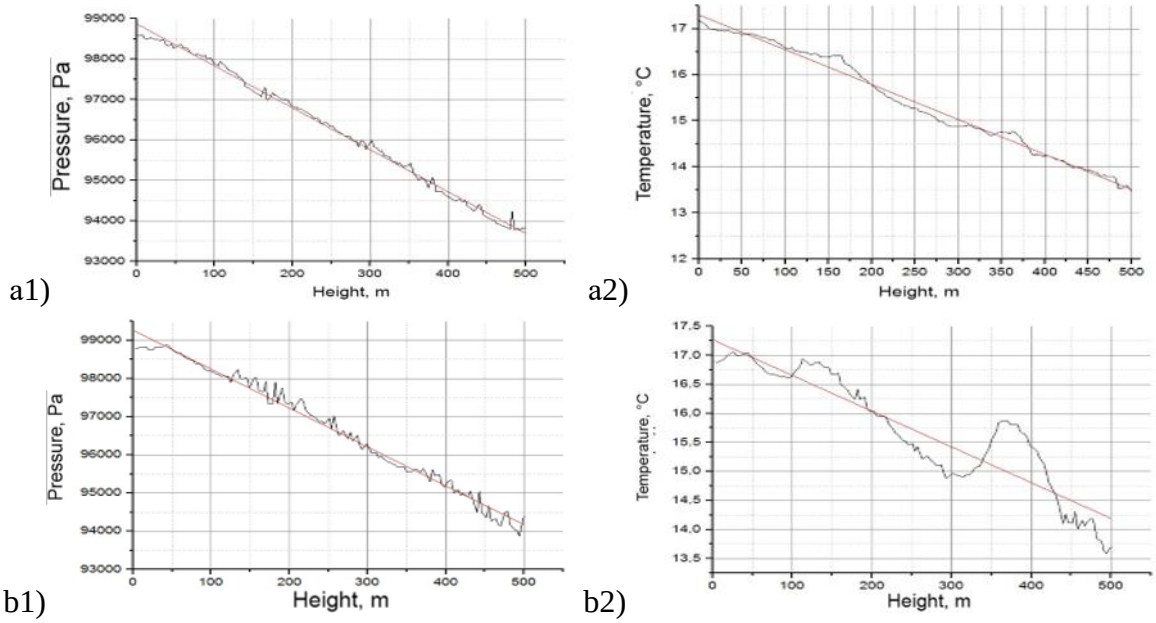
Figure 2 – Table of scales of digital topographic maps

Also, conducted an experiment to determine the lifting power of the quadcopter DJI Phantom 3 Advanced to determine the maximum mass of the cargo - 1.8 kg, from which was selected equipment for the development of measuring stations based on the UAV.

Developed lightweight (weighing less than 200g) measuring stations based on quadcopter DJI Phantom 3 Advanced (Figure 3). The measuring stations were used to monitor air composition at heights of up to 500 meters (troposphere) for the content of gases hazardous to humans. The experimental data are shown in Figures 4a-4b.

a) b) c)

Figure 3 – Images of the systems.



a1) a2)

b1) b2)

Figure 4 – Plots of measured values of air pressure (a1, b1) and temperature (a2, b2) by the barometer module BMP280. Graphs of measured data when the quadcopter is ascending (a) and when the quadcopter is descending (b).

Also, the software was developed to calculate sensor data from known gas concentrations and to plot the sensitivity characteristics of the sensors. According to the results of the program, it is possible to choose a suitable sensor for measuring the concentration of the required gas. Developed a method and program for determining the concentration of individual gases in the gas mixture under study using a set of sensors from the MQ series.

The introduction of innovative technology and related information resources contributes to the growth of efficiency indicators in various activities. Mobile quadcopters or drones are capable of remote environmental monitoring over a large area. The low cost and price of maintenance compared to manned aviation and traditional ground-based technology increases the importance and relevance of quadcopter-based research.

Reference

1. Official website of DJI on the Internet. [Electronic resource]. - Access mode: https://www.dji.com

2. Review of the DJI PHANTOM 3 ADVANCED quadcopter. [Electronic resource]. - Access mode: https://drongeek.ru/obzory/dji/phantom-3-advanced

3. Zulkarnaev V.U., Kamalova V.R. Practical application of unmanned aerial vehicles in the modern world // Innovations in science: coll. of papers on mater. No.4(53) (in Russian) // Innovation in science: article of IVI Intern. Part II. - Novosibirsk: SibAK, 2016. - p. 23-27.