Development of information support of the decision-making management system for emergency prevention based on distance video systems

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Abstract. The possibilities of identifying combustion from the mobile observation point located on an unmanned aircraft are considered. A qualifying sign of frequency fluctuations in the region of combustion was derived and presented in the form of a program filter of vyvyl-analysis in the temporary area. The frequency characteristics of the detectors and experimental data used in fire detectors were compared. A stable correlation was obtained confirming the conformity of the hypothesis existing tested data. It is proposed as a sign of defining burning to use the frequency of the color of the color of the pixels from the gama of fire to the color of the underlying surface. It is experimentally determined that combustion corresponds to the range from 12 to 30 Hz. The work takes into account the dynamic location of the observation point on an unmanned aircraft. The boundary conditions of the operation of the aviation system allowing to obtain relevant data for analysis are described.

1 Introduction

Digital video systems are quite effective for automated analysis of controlled parameters. The latest developments in the field of automation are automated systems operating on artificial neural networks implementing Deep Leaning results [1]. This allows you to solve nonlinear problems of video fixation of multi -parametric images [2]. The task of teaching such systems lies on the developers of the data marking. Interpretation of human perception data into the training unit occurs through data marking. Moreover, the system of computer vision may have functions that differ sharply from human capabilities [3]. The work considers the possibility of identifying a particular case of an emergency that may occur in connection with the occurrence of uncontrolled burning [4]. Fire as a physical phenomenon has many manifestations that can be identified and measured, but for video surveillance

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systems in one light range, these possibilities are limited [5]. The study analyzed the dynamic characteristics of the flame shape. Frequency fluctuations that occur during combustion are used to identify a fire in fire detectors of the flame [6]. The principle itself is intuitive, studied and used in the national economy. In his work, a hypothesis is built on its principle, about the possibility of measuring the dynamic characteristics of the edge of the tested area and the identification of a sustainable feature characterizing combustion.

When analyzing the image, a person perceives the object comprehensively, based on his internal experience and a complex system of internal representations. Technically, a change in the color of the edge of the region, changing with a frequency of 2 to 60 times per second, is not able to calculate and derive a numerical value, he sees fire in the complex without visible intermediate stages. The proposed decision management system allows you to distinguish a separate all-analysis factor in the temporary field allows you to establish a sign used by an intellectual algorithm to identify combustion.

The relevance of the study lies in the analysis of the possibility of using this approach from the dynamic observation point located on an unmanned aircraft. An example of a demanded industry, in which there is a request for remote security analysis, is the system of operation of main oil and gas pipelines. In it, control is complicated by a large length and inaccessibility of the layout of linear structures. In the existing practice, for the purposes of checking ecological, security and fire safety from the air, helicopter circles are used [7]. This method compared to operation for these purposes of unmanned aircraft is highly worth. Also, rented helicopters are not equipped with special monitoring devices. Control is carried out by inspectors through portholes, which worsens the conditions of observation and does not give quality materials based on the results of the examination. The creation of a aircraft capable of conducting such monitoring is a set of tasks and directions that go beyond the fire safety area [8].

The interval of the time with which the first filter of the program captures and processes the image affects the workload of the microprocessor and depends on the specific monitoring parameters. In the study, a aircraft type Supercam S350 was used in the study. For monitoring, the optimal operating conditions of BVS and the boundary conditions underlying the experimental base of the mathematical model are selected [9].

Based on the monitoring parameters, the image capture occurs every 21.7 m. The operating speed of an unmanned aircraft in the study is 50 km/h, but due to weather conditions (headwind), this parameter may vary significantly. Imagine the frequency of capture of the frame in the form of dependence on the speed for the interval from 20 to 70 km/h.

$$t_{f1} = 8{,}637 - 0{,}3305 \times s + 0{,}05239 \times s^2 - 0{,}00002935 \times s^3 \quad (1)$$

In accordance with the dependence received, the frame seizure interval for a speed of 50 km/h is 1.5 s.

The task of detecting flame should be solved taking into account the dynamic characteristics of the observation point. The aircraft moves in space and experiences vibrations due to the heterogeneity of the air masses and engine operation [10]. In the regular conditions of observation, the flight height is 40 m, speed - 50 km/h. Under such conditions, the combustion section is in the field of view of the camera for 3.12 s. For the purposes of detecting fire, a typical camera with a resolution of 1280 by 720 pixels, 60 frames per second is used, from which it follows that the studied video stream is 187 consecutive images. Modern video surveillance systems use the capture of video images to track people and machines, which is a generally accepted, common function. This principle is used in a free computer vision library with open source code of Russian OpenCV developers [11].

2 Mathematical modeling of the identification process

In the technique, the platform captures the zone to be analyzed and allows you to analyze the edges of the region with programmatic compensation for the bases of interference arising in connection with the movement and vibration. The proposed software filter is an ANALISISE in the temporary field. The combustion zone dynamically changes the shape in space, the edge of the flame over time repeatedly changes color value from the background to the color of the flame. In a simplified form - from the color of the flame to any other color. The study of the frequency component of liquefied hydrocarbon gas was carried out from a height of 40 m, the illumination is 300 lux, the speed of the apparatus is 50 km/h. At the same time, the distance between the camera and the burning source is changed due to a change in the exposure angle in the central part from 40 to 46 meters, which does not go beyond the limits of the experimental base.

The task of analyzing the color of the flame and the underlying surface is solved with the help of the database [12]. In accordance with this study, the color distribution of flame during the burning of liquefied hydrocarbon gas corresponds to the value of the center of symmetry at point 247, 231, 120, with a tolerance radius of 14 units. To process the materials of the experiment and determine the frequency component of combustion, vyvyl-analysis Figure 1 is used.

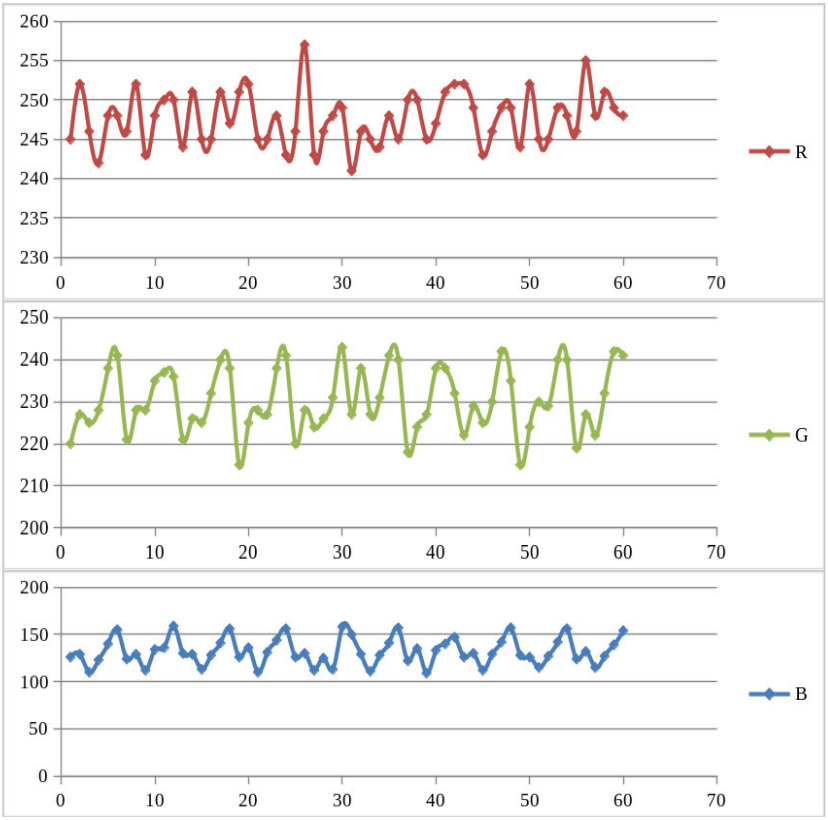

Fig. 1. Changing the color of the color of the flame over time for the component R, G, B.

The transition from the color of the flame to the color of the background for time is presented in Figure 2, if the radius exceeds 14 units, the color does not coincide with the

range of fire. The video camera, fixing 60 frames per second, can perceive the frequency range from 0 to 60 Hz.

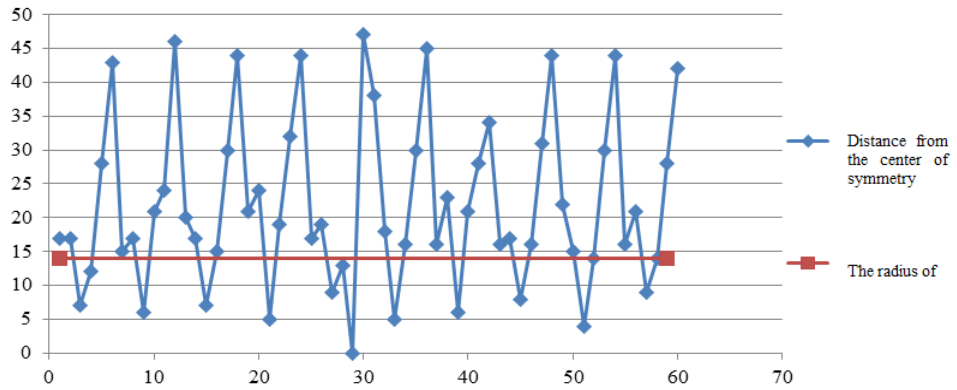

Fig. 2. Changing in time of the radius of tolerance relative to the center of symmetry for oil burning.

The red line with a horizontal line in Figure 2 indicates the boundary of the tolerance radius, the transition through it indicates a change in the color of the flame to the color of the background. From the graph it can be seen that the frequency is 20 Hz. An analysis of the frequency characteristics of the flame is used in fire sensors of the flame, where the operation range in modern models is from 2 to 20 Hz. The resulting experiment data is confirmed by scientific data [13]. According to the results of the test complex, the proposed software feature makes a positive decision when the frequency range is detected from 12 to 30 Hz.

The implementation of the owl-analysis requires the cost of large computing capacities, and in connection with this it is ranked last in the recognition system. The use of the analysis of frequency characteristics became possible due to the development of video cameras to the capture frequency of 60 frames. At the same time, such opportunities have mass amateur devices, which ensures the versatility and applicability of the developed methodology.

3 Conclusion

The use of unmanned aviation systems as a platform for decision management systems has proved its effectiveness in the military industry. However, the degree of automation of the processing of the information received is extremely low in both the military and in the civilian industry, calculating the number of unmanned aviation systems used. As before, a person to monitor the monitor for what is happening, controls and makes managerial decisions. A feature of monitoring the prevention of emergency situations is the duration of the process and the demand in the mechanisms of automation and reduction of the human factor. The proposed approach is based on experimental data obtained as a result of landfill studies.

Also, the use of this algorithm allows an unmanned aircraft to perform a flight mission in zones with limited communications, due to the mathematical processing of video images of an on -board microprocessor. This allows monitoring in real time and quickly respond to the accidents of linear oil and gas facilities.

We express gratitude for the information and technical support of the study of the spatial data of the space monitoring department of the Main Directorate of the National Management Center in Crisis Situations of the Russian Emergencies Ministry.

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