

**ABSTRACTS**

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**THE EDDY-CURRENT METHOD AND STRUCTURE OF HARDWARE  
FOR SEARCH OF A CONDUCTIVE BODY IN A ZONE OF HIGHWAY**

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The article discusses the proposed method and structure of hardware for finding local conductive bodies with diamagnetic and ferromagnetic properties, which may lie both under the canvas of the overpass and under its side. The search method is based on the well-known eddy current method. Approaches to detect bodies with diamagnetic and ferromagnetic properties differ.

The method of searching for bodies with diamagnetic properties is based on a static model of the interaction of the field- body-receiver system. The relative value of the component of the secondary magnetic field, which is quadrature to the component of the primary magnetic field, is measured. When the system moves slowly over the overpass, the appearance of an anomalous signal indicates the presence of a body with diamagnetic properties. The coordinate of the cross-section of the overpass and the roadside in which the body is located is determined at the time of the extreme of the anomalous signal. It is shown that the same device can be used to detect conductive bodies with ferromagnetic properties. This solution is not standard, since the search for a local body with ferromagnetic properties is complicated by the fact that the quadrature component of the secondary magnetic field is lower than the sensitivity threshold of the field receiver. Here, the absolute level of the single-phase (or anti-phase) component is much higher than the quadrature one. But the single-phase component of the secondary field cannot be distinguished from the component of the primary field, caused by instability of the amplitude of the generator and other destabilizing factors. Therefore, this variant has a high sensitivity threshold, which limits the depth and range of the roadside inspection. Because of this, it was important to identify the conditions under which hardware measuring the relative value of the quadrature component of a magnetic field can be used to detect bodies with ferromagnetic properties. The dynamic model of interaction of the mobile system of the exciter-receiver with the local conductive body with ferromagnetic properties is developed by the author, substantiates the appearance of the quadrature component of the secondary magnetic field from the ferromagnetic body in the form of one sinusoidal period. The first half-period of a sinusoid is caused by the approach of the pathogen - receiver to the ferromagnetic body, and the second – when removed from it. The higher the speed of movement, the greater the amplitude of this signal. The transition from the first half of the sine wave to the second occurs when the system passes over the body (if it is under the overpass) or to the side of the body (if it is on the sidelines). Thus, the ferromagnetic body will be placed in a perpendicular cross section of the overpass and the roadside corresponding to that moment. And the hardware structure is unchanged when searching for different bodies. Only speed will be different.

## LOGARITHMIC ADCs WITH VARIABLE BASIS TO LOGARITHM. CHOICE OF BASIS

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**Research methodology.** The methodological base of research is presented by principles of authenticity and scientific objectivity, that are base on priority of the published materials. For the exposure of the state of worked out of theme scientific methods - comparisons, generalizations, analysis and synthesis were used, that gave an opportunity to distinguish more substantial in all in separate editions and to provide integrity of consideration of questions.

**Results.** In undertaken a study principles of construction of logarithmic ADCs are generalized with variable basis to logarithm, dependences are analysed between the error of quantum, by basis to logarithm and by a source code. Drawn conclusion and generalizations the attracted list of original sources confirms.

**Novelty.** The scientific novelty of the got results consists in that conformities to law of change of basis are educed to logarithm in the process of converting into the dynamic range of entrance signals and going is entered to scientific turnover near the unambiguous estimate of errors of logarithmic ADCs with variable basis to logarithm.

**Practical Significance.** Results of the research allow to accuracy and speed of logarithmic ADCs with variable basis to logarithm, and also can be used in educational courses from planning of facilities of automation, telecommunication, informatively-measuring technique and others like that.

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## OBJECT TEMPERATURE ESTIMATION BASED ON THEIR NOISE CHARACTERISTICS WITH WAVELET SIGNAL TRANSFORM

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Noises methods have an important role in temperature measurement methods. The article analyzes such methods and developed their classification.

Among the existing methods, thermal noise is the greatest by temperature dependence. This dependence is almost linear.

For qualitative selection of informative noise in the work it is proposed to use wavelet signal transform. This conversion allows the analysis of signals in a wide frequency band. Since wavelet coefficients have an energy content, the change in temperature of the resistive converter is proportional to

the change in energy. This conversion makes possible error of measurement depends from temperature to reduce. Result of the temperature measurement can be obtained directly in the time-frequency domain. The advantages of this method are:

- the ability to analyze broadband noise signals;
- ability to estimate thermal noise;
- since wavelet coefficients have an energy content, their change leads to a proportional change in temperature;
- error of the temperature measurement of this method does not exceed: 0,5%

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### **DEVELOPMENT OF INTERACTIVE WEB APPLICATION USING NON-RELATIONAL DATABASE**

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The interactive web application which is presented in the form of an animal shelter has been developed. It consist of database, data warehouses, progressive mobile application and main web interface. It includes four main levels of access: presentation, business logic, access to information, and database.

The developed web application provides fast display and dynamic data management in interaction with the database. The web application was developed in the Visual Studio Code software design environment using ReactJS and Redux as user interface and Google Firebase as database and data warehouse.

The database in Firebase is a NoSQL class database that allows you to store and synchronize data between users in real time. A key value repository is a type of database. This repository uses a key to access the value. This approach removes all the limitations of the relational model (poor performance, time-consuming horizontal scaling) and facilitates data storage and access.

The developed web application uses the Firebase Cloud Storage. Cloud technologies provide access to personal files from any computer that has Internet access. This technology makes it much more efficient to manage, process and work with information by centralizing the same information.

The interactive web application gives an opportunity create, send and the other proceed users' requests and also review, change, delete and transfer component elements, manage additional functions which are not available for simple user. PWA functionality has been added to allow the application to work without the Internet.

Developed interactive web application can be used in different areas depending on the filling of the database. In addition, it is very flexible because it can run and quickly adapt to various operating systems: desktop (Windows, Linux, MacOS) and mobile (iOS, Android).

## DEVELOP A NETWORK CHAT WITH MESSAGE SECURITY FEATURES

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Online chat for messaging has been developed. The application code is written in Java, which is widely used for server applications. AES encryption algorithm was used to hide information sharing between individual users. Private messaging security is provided by an additional package in the project called security. This package has a class that provides encryption and decryption of messages using the AES algorithm. AES is a symmetric encryption algorithm. It uses the same key for encryption and decryption and enables large amounts of data to be encrypted [6–8].

Two encrypt and decrypt methods have been implemented for encryption, which in turn use standard Java programming libraries: Cipher and Base64. Cipher is for creating encryption mode and Base64 is actually for encryption and decryption. An additional method was also implemented for installing a cryptographic private key, which takes a simple tape to the input, converts it into bytes and sets it with an AES class key. This class is used on the client and server side. The server encrypts the messages if they are private, and the client module decrypts them accordingly. The block diagram of communication over an encrypted channel using the AES algorithm is presented.

Thus, when messaging, users can use both general and private messages. Use of private messages, protects the display of information for users who do not have a mechanism for decoding secure messages.

Using this client-server application will allow you to exchange secure messages in real time.

UDC 519.7

## A SIMPLE MODIFICATION OF THE FAST INVERSE SQUARE ROOT CALCULATION ALGORITHM FOR SINGLE-PRECISION FLOATING-POINT NUMBERS

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Many practical applications depend on the fast execution of square root and inverse square root operations. Various devices support such operations in software and/or hardware. Usually, square root instructions and library functions are available to provide full-precision result in accordance with the IEEE-754 standard. In case it is necessary to increase the performance of calculations, you can use fast hardware approximate reciprocal square root (RSQRT) instructions, if available on the device. They are usually based on lookup tables. To increase the accuracy of these approximate instructions, it is recommended to use the classic Newton-Raphson iterations after them. However, the drawback of this approach is that these SQRT and RSQRT instructions are platform dependent. Their performance and accuracy (in the case of RSQRT) can vary greatly between architectures. On the other hand, almost any device, even a simple one, can use library SQRT function, but it is very slow. That is why in this paper we propose a modification of the fast inverse square root (FISR) algorithm for single-precision floating-point numbers, which can serve as a fairly accurate and relatively quick alternative to the above functions. This algorithm uses a new approach, which consists in dividing the input interval into two sub-intervals and adjusting the

magic constant and the first modified Newton-Raphson iteration on these sub-intervals. Our research has shown that the proposed algorithm has a very low relative error after the first and after the second iteration and ensures almost complete accuracy of the result (23.57 bits).

UDK 681.325

## THE FEATURES OF MICROCONTROLLER SYSTEMS OF DIGITAL SIGNAL PROCESSING

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**Research Methodology.** The analysis of existing methods and means of construction of digital signal processing systems (DSP) is carried out. Based on the comparative analysis of software and hardware implementation of DSP, the possibility of using microcontrollers for the construction of such systems is determined. The primary characteristics of microcontrollers are considered and determined the correct choice, which will ensure the effective functioning of the DSP system.

**Results.** The scope of use of microcontrollers is limited by applications requiring low processing power. Microcontrollers can be adapted to the tasks of the DSP using the appropriate software. Useful characteristics of microcontrollers are the use of 8 or 16-bit data, the availability of program and data memory, I / O devices, timers, and a set of instructions. The advantage of using microcontrollers is the availability of programmable peripherals such as ADC and DAC that are not available on DSP processors.

**Novelty.** The scientific novelty of the obtained results is that the possibility of implementing algorithms of DWT in microcontroller systems of DSP has been discovered and processed. A comparative analysis of the Mallat algorithm and the lifting scheme is carried out. The performance of the lifting scheme was determined as the main advantage in the implementation of the DSP algorithms on the microcontroller.

**The practical significance.** The main area of effective use of microcontroller systems of DSP is monitoring, diagnostics, and control systems. The necessary steps for the software implementation of DWT algorithms are identified, and the use of preliminary modeling of the microcontroller system is proposed, which will allow providing the simplicity of implementation and efficiency of its operation.

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## DEVELOPMENT OF A MOVIE SELECTION SYSTEM

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A recommendation system for content-based movie search has been developed. Such systems are used in various fields and are most commonly recognized as generators of playlists for video and music services such as Netflix, YouTube and Spotify, product recommendations for services such as Amazon, or content recommendations for social media platforms such as Facebook and Twitter [1].

Weighted rating calculated. The next step is to determine the appropriate value for the minimum number of votes required to display the graph. Pairwise similarity estimates for all films were calculated based on their story descriptions for recommending films by this similarity index. To do this, the plots

were converted into word vectors and the TF-IDF for each survey was calculated. By frequency we mean the relative frequency of a word. The reverse frequency of documents is the relative number of documents containing a fixed term. The total value of each word in the documents in which they appear is  $TF * IDF$ . They use different approaches for different scenarios. The article uses cosine similarity to calculate the numerical magnitude of similarity between two films, since it is independent of magnitude and is relatively easy and fast to calculate.

The implementation of the task is made in Python programming language, used libraries for machine learning, user interface is developed using Angular, saving data in Mongo DB. The software implementation of the recommendation platform was investigated and a high-speed code was obtained for the successful operation of the service.

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### **MEASURES OF MEASUREMENT OF CONSTANT CURRENT ON THE BASIS OF QUANTUM MAGNETOMETRIC SENSORS**

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The possibility of constructing a mobile complex of equipment intended for calibration of measuring instruments of direct current of a class of accuracy higher than 0,01 is considered. The structures of the frequency-guided calibrator, measuring transducer and direct current (DC) comparator based on quantum magnetometric sensors (QMS) are proposed. The peculiarity of the proposed complex is the use of the universal structure of the QMS, for which only external commutations determine the type of device and its purpose. The accuracy and stability of such devices is ensured by the high accuracy of determination and stability of the atomic constants of the working substance used in the QMS, the stability of the magnetic primary converter (PC) direct current in the magnetic field induction and the degree of protection against the influence of external magnetic fields. Measuring converter based on QMS for the range of average values of current can be attributed to working current measuring instruments that have an experimentally confirmed basic relative error of conversion of not more than 0.005% in the range of input currents of 10 mA – 1.0 A and output frequencies of 100 kHz – 10 MHz. By using PCs with different values of the conversion factor (CF), it is possible to extend the range of current conversion from miliamperes to amperes. The conversion factor of the DC measuring converter is determined by the type of working substance QMS and the value of CF. The large value of the current-to-frequency conversion factor enables the measurement of the frequency of the output signal with high accuracy and speed. The overall dimensions and weight of the DC measuring converter based on the QMS are not larger than serial digital measuring instruments. The advantage of individual types of converters is the galvanic separation of the input, which allows you to measure the current in high-voltage circuits. The main relative error of the instability of the current of the frequency-guided calibrator reaches the value of  $\pm 0.0005\%$  in the current range of 10 mA – 1.0 A, with a discretion equal to the discrete frequency setting. The parametric resonance mode of the QMS is used in the construction of the DC comparator. This type of comparator can have a relative error of  $2-7 \cdot 10^{-7}\%$  in the current range of 10–100 mA. The parametric resonance mode of the QMS is used in the construction of the DC comparator. This type of comparator can have a relative error of  $2-7 \cdot 10^{-7}\%$  in the current range of 10–100 mA.

### **ACS TP RECTIFICATION COLUMN OF ALCOHOL REGENERATION WITH PID CONTROLLERS**

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The article discusses the development of an automated process control system for a distillation column for alcohol recovery with PID controllers. Using WinCC's SCADA system, a human-machine interface for the operator's workstation has been developed, which provides a wide range of tools for monitoring and managing the operation of the designed system. In particular, a special graphical user interface has been implemented, which facilitates and makes more efficient the work of engineering personnel with the PID controller. The PID controller is designed as a control system software unit, which simplified commissioning and also positively affected the overall speed of the control system. Using the steam pressure control as an example, the operational efficiency of one of the PID controllers used in the system is shown, which suggests that the distillation column for alcohol recovery developed by the authors of the automated process control system ensures the convenience and high quality of regulation.

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### **RECEIVER UNIT WIRELESS SECURITY SYSTEM**

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In this work a brief overview of existing security system receivers is given. The analysis of the characteristics of the receivers shows the perspective of wireless systems using GSM-modules.

The receiver of the wireless security system on the basis of the module ARF4001A is developed. Its structural and schematic diagram is presented. The technique of tuning and adjusting the receiver is offered.

There are two ways to improve encoding reliability: modifying the code with microswitches or individually adjusting the clock frequency.

The developed receiver enables the connection of the majority of sensors of the security systems: passive and active infrared, magnetocontact, seismic, combined detectors and others.

Advantages of the developed receiver over the market analogues:

- the ability to control the situation at long-distance objects (up to 18 km);
- the presence of enclosure protection against invasion;
- ability to combine several systems and connect them to one centralized control panel;
- ability to work autonomously;
- relatively low energy use.