

To understand the principle of operation of the system it is necessary to explain the mechanism of each block, its purpose and how it impacts further selection of specific devices and definition of their parameters.

Secondary electric power supply

It is a device that is designed to supply other devices with electrical power by converting the energy of different power supply sources of AC voltage of 220V.

Helmholtz coil with orthogonal components

Helmholtz coil with orthogonal components represent a plastic coil that has copper wires on the outside surface of the coil. Using them a magnetic field is created. It is based on the principle of Helmholtz coils. [2]

Magnetometer

It is a block containing a special sensor. Due to the fact that one of the main requirements for the designed system is its high sensitivity, it is necessary to use a flux-gate magnetometer in the research. It is an instrument for measuring and evaluating magnetic fields (constant or slowly varying magnetic fields) and their gradients.

Encoder

This device converts linear or angular movements into a sequence of signals that allow determining the amount of movement. [3] In our system, the encoder is required for external impact: offset of the calibrated magnetometer in the coil is performed by shaft rotation.

Microcontroller

A microcontroller is a special electronic chip for controlling different types of electronic devices. In the created system, a microcontroller will be used to ensure stepper motor control. The control will be carried out due to external impact on the encoder that converts the angle of rotation of its shaft into electrical signals that subsequently are transmitted to the microcontroller.

Display

It is an electronic device for displaying digital, alphanumeric or graphic information electronically. The display that is used for the designed system should display the value of the angle of rotation of the shaft encoder that is calculated by the microcontroller, and up/down arrow indicating the direction of movement of the calibrated sensor.

Stepper motor driver

The stepper motor driver is a powerful power supply scheme of the motor windings. [4] The stepper motor driver is selected based on the model of the stepper motor.

Stepper motor

It is an electromechanical device that converts a control signal into an angular (or linear) movement of the rotor. This movement passes with its fixation in a predetermined position without feedback. [5] The stepper motor of the designed system rotates clockwise or counter-clockwise, depending on the signal incoming from the microcontroller.

Belting

It is a device that enables transmission of mechanical energy using a flexible element due to the frictional forces or forces of engagement (power grip belts). [6]

Shaft with crown wheel

The shaft has two gear hills. When the first gear hill (part of belting) sets in motion the second gear hill starts rotating because it is on the same shaft. They will drive the staff with toothed.

Tooth gear

It is a gear wheel that is necessary for rigid fixation of toothed staff.

Staff with toothed

It is a staff that has daps for gearing. The magnetometer is clipped at the end of the staff that moves in the cavity of the coil.

Conclusion

By the end of 2015, the final version of the product – a system of automatic calibration for deep-water magnetometer – will have been created. By the stated time, the system will be debugged and adjusted through identification of all its defects. Currently we have already made analysis of the working capacity for the automatic calibration, prepared and analyzed engineering documentation; all the necessary resources and facilities have been attracted.

The final product will be used, as it was mentioned earlier, for deep-water robots and submarines. It is assumed that the main customers will be factories that produce submarines or radar systems.

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References

1. Magnetometer: operating principle, types, usage. [Electronic source]. Access mode: http://qualitytest.ru/katalog_produkcii/magnitoporoshkovyj_kontrol/magnitometr. Free.
2. Helmholtz coils. [Electronic source]. Access mode: <http://www.ngpedia.ru/id95551p1.html>. Free.
3. Encoder. Types, usage, principles. [Electronic source]. Access mode: <http://robocraft.ru/blog/technology/734.html>. Free.
4. "Stepper motor controller". Catalog of circuit schematics. [Electronic source]. Access mode: <http://kazus.ru/shemes/showpage/0/843/1.html>. Free.
5. Actuator. Step motor. [Electronic source]. Access mode: <http://electroprivod.ru/stepmotor.htm>. Free.
6. Belting. [Electronic source]. Access mode: <http://dic.academic.ru/dic.nsf/ruwiki/169401>. Free.
7. GOST (Standard) 2008 – 2.701. Unified system of design documentation. Schemes: kinds and types. The general requirements for implementation. [Electronic source]. Access mode: <http://ohrana-truda11.ru/pdf/2/2.701-2008.pdf>. Free.