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Ivan Kostuchenko, student, **Danylo Cherevko,** student, supervisor **Nochnichenko Igor,** PhD. Techn. Sc., Ass. Prof., **Dmytro Kostiuk,** PhD. Techn. Sc.
Igor Sikorsky Kyiv Polytechnic Institute, Kyiv, Ukraine

Automatic thermal stabilization of the electrolysis process

Annotation. *In this study, a control system based on ACS-712 and DS18B20 temperature sensor is designed for controlling electrolyser power consumption. Power consumption is controlled by the PWM method by the data from two sensors: current sensor ACS-712 and temperature sensor DS18B20 connected to Arduino Nano to reach desired power consumption. There is a potentiometer to set needed voltage, also Arduino monitor will show us occurred errors. Checking the operation of the device showed that this approach allows you to stabilize the mode of operation of the cell, prevent it from overheating and ensure long and safe operation in a rational mode.*
Keywords: *efficient energy in electrolysis, power maintenance in electrolysis*

INTRODUCTION

Depletion of natural resources and deterioration of the ecological situation in the world as a whole is a challenge to humanity in the use and production of energy in general. Therefore, there is a need for an environmentally friendly and efficient source of energy. One of the harmless methods of obtaining energy is the electrolysis of an aqueous solution (fresh and salt water). By separating water molecules under the action of an electric current into oxygen and hydrogen, it is possible to obtain an environmentally friendly fuel, the so-called Brown`s gas [1].

The electrolytic method has its advantages (simplicity of design) and disadvantages (low efficiency) in the use and transformation of energy, it requires a small volume of water with a power source and two electrodes that serve as an anode and cathode. But the use of the cell is associated with certain operational and operational aspects. External and internal operating conditions affect the electrolysis process as a whole due to changes in the electrical conductivity of the aqueous solution with changing temperature.

The main problem is how the current flows through the "reactor". The process is based on ion exchange, which occurs under the action of electric voltage. But unlike the current in a conventional resistor, the current in the cell - will increase with temperature due to increased activity of ions concentrated in water. This can lead to unintended consequences of the deterioration of the reaction stability, foaming and overheating of the reactor and reduced efficiency with accidents. At the constant voltage and increasing current will also increase energy consumption. Such an increase in power can potentially damage the power supply. This situation requires the use of feedback and is the key to managing its performance and performance. The second problem is the wear of the electrodes. Electrolysis slowly destroys the anode.

The goal of this development is to limit current changes in current depending on the temperature to maintain long-term safe and efficient use. The task is to ensure cyclic operation by changing the polarity of the cathode and anode, to reduce the destruction of the electrodes.

To achieve these goals, we will use a current sensor ACS-712 20A [4], Arduino Nano with microcontroller ATmega328P, potentiometer, temperature sensor DS18B20 [2, 3], power relay, PWM amplifier (Fig. 4) and a button.

Component overview**:** ACS-712 20A (Fig. 1) – current sensor capable of measuring 20 amperes in both directions with a sensitivity of 100 mV / A [5].

Arduino Nano (Fig. 2) is a development board with 7 analog inputs, 12 digital inputs and outputs and ATMEL – based ATmega328 microcontroller.

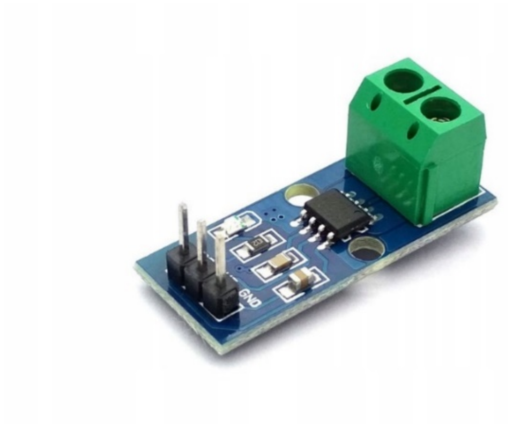

Fig.1. ACS-712 20A current sensor

Fig.2. Arduino Nano

DS18B20 (Fig. 3) temperature sensor (1-Wire) is a temperature sensor that converts temperature from -10 to +85 °C to a digital output with a resolution of 9-12 bits using the single-line communication protocol with an accuracy of ±0,5 °C.

Fig.3. DS18B20 temperature sensor

Fig.4. PWM amplifier

OPERATION CYCLE

The work cycle is shown in Figure 5. At start-up, the initial readings of the current sensors and temperature are read, then we adjust the current value to the value we need. If one of the switches is activated, the change in the potentiometer value is ignored. When the switch 1 is turned on, the current is measured and the voltage changes opposite to the current so that the power consumption does not change. When the switch 2 is turned on, the temperature is measured and the voltage changes opposite to the temperature so that the power consumption does not change. Switch 3 changes the direction of the current so that the wear of the electrodes is equal. After checking the on switches, the vital parameters are checked to make sure that the device is working properly. If one of them is incorrect, the voltage immediately turns off and an error pops up on the Arduino monitoring screen.

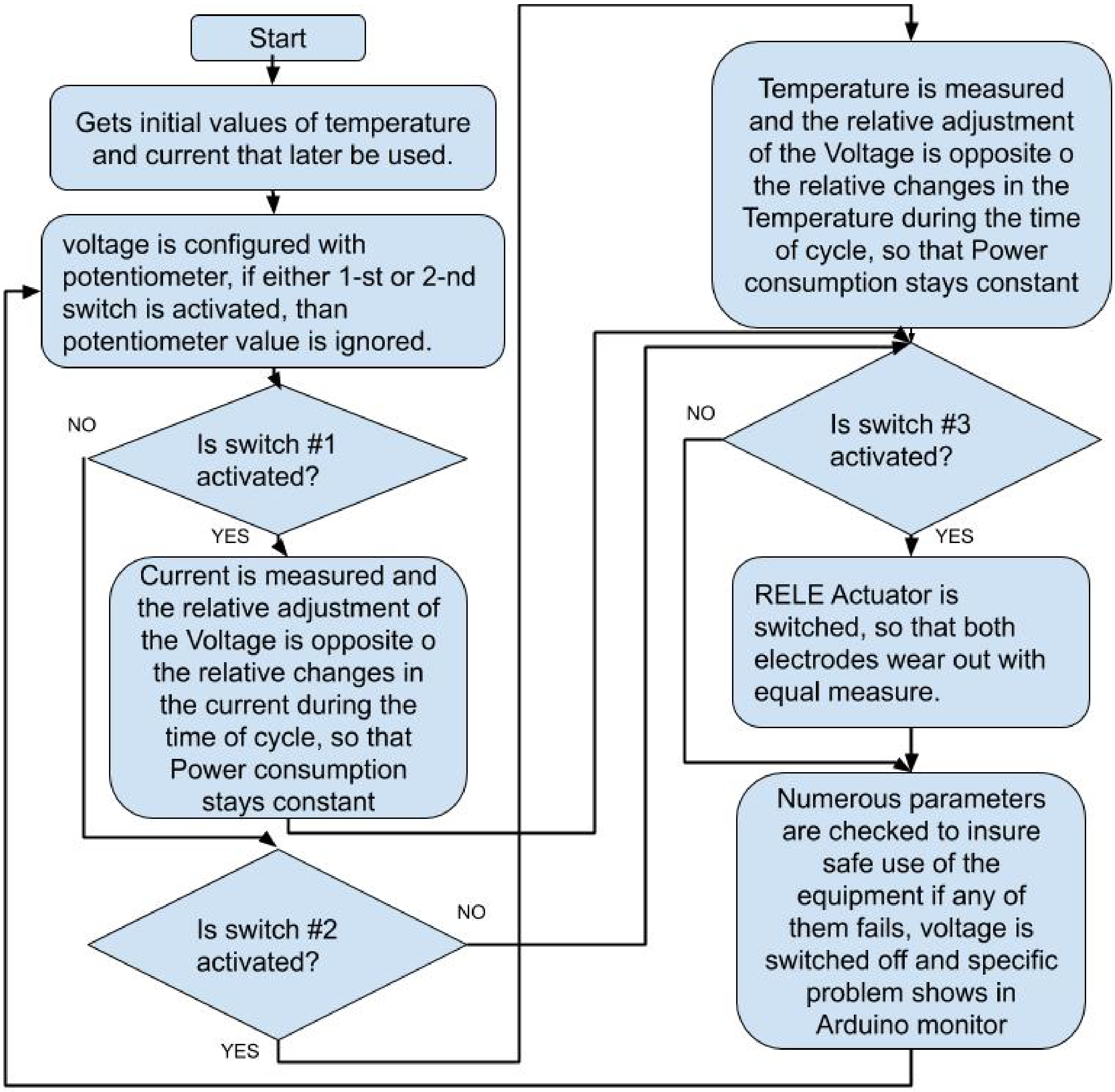

Fig.5. Operation cycle

Figure 6 shows a graph of a stress test of the system via an electrical heater. All the voltage behaviour is handled by simple equation U = U $+(-\frac{\Delta t}{t}\cdot U)$ or U = U $+(-\frac{\Delta I}{I}\cdot U)$ which is the solution of a series of differential equations. This way we don’t require any specific values and constants that different setups may have. As you can see, as the temperature rises, the control system reduces the voltage that is applied to the cell. This controls the operation of the device and stabilizes the temperature and power consumption.

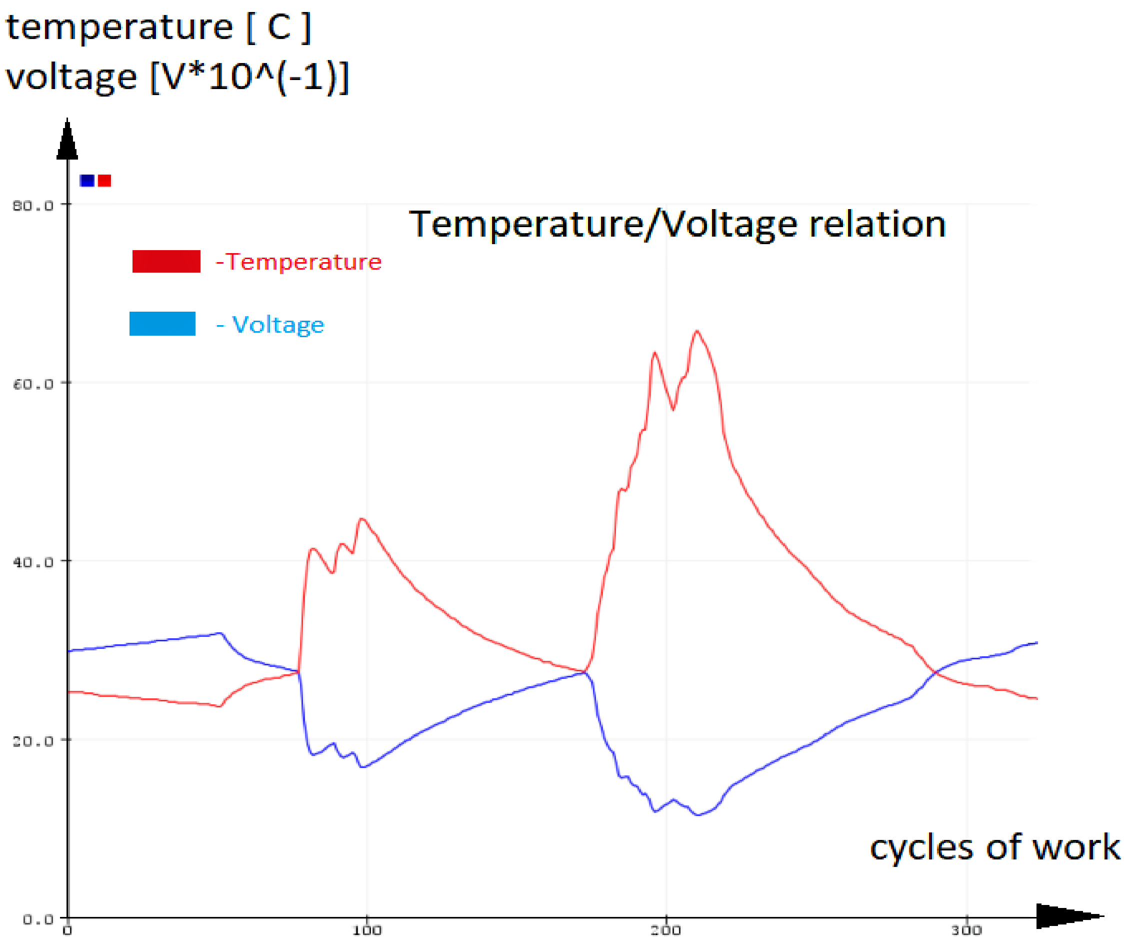

Fig. 6. Temperature and voltage graphs

CONCLUSION

The concept of stabilization of temperature mode of operation of the electrolyzer by means of the microcontroller and the PWM method is offered. Selected equipment for its implementation and created an algorithm for the system. The test showed the efficiency of this method, and its implementation will increase the efficiency of the cell in rational operating conditions and prevent overheating and unstable operation.

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