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# PROGRAMMING THE ATMEGA2560 MICROCONTROLLER FOR AN AUTOMATIC CONTROL SYSTEM OF WATER TREATMENT PROCESS IN REGIONS WITH HIGH SALT CONTENT

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**Abstract**

The process of water treatment for irrigation in regions with high salinity is one of the important components of agricultural production. Using the automatic water treatment process control system contributes to the efficiency of the water treatment design. This article discusses the problem of constructing an algorithm of actions for an automatic process control system and its implementation in code form, taking into account the design feature of the topology of the control board for the ATmega 2560 microcontroller.

**Key words:** automation, irrigation, water treatment, programming, electronics, schematization.

**Introduction.** The primary aim of irrigation is to provide a crop with adequate and timely amounts of water, thus avoiding yield loss caused by extended periods of water stress during stages of crop growth that are sensitive to water shortages. However, during repeated irrigations, the salts in the irrigation water can accumulate in the soil, reducing water available to the crop and hastening the onset of a water shortage. Understanding how this occurs will help suggest ways to counter the effect and reduce the probability of a loss in yield [1].

Soil salinization is widespread: saline and soda soils cover 932.2 million hectares globally, and are one of the main threats to soil degradation worldwide, with ineffective irrigation management affecting 34.19 million hectares or more than 10% from the total area of irrigated land [2].

In Uzbekistan, the economic and demographic burden on land, especially for agricultural purposes, is increasing from year to year. Of the 17.8 million hectares representing the total agricultural land in the republic, only 25% is arable land [3]. Over the past 15 years, the area of agricultural land has decreased by more than 5%, and per capita - by 22% [4].

Over the past 30 years, the area of irrigated land per capita has decreased by about 25%, i.e. from 0.23 ha to 0.16 ha. Naturally, the above data indicate that farmers reduced to flat out for work, and thereby their incomes mourned. The process of anthropogenic desertification, that is, associated with human activity. Soil erosion and soil salinization processes are continuing. Over 3 million hectares of land suffer from wind and water erosion - for the season the average loss of the fertile layer, for this reason, reaches 80 tons per hectare[5].

Considering the above factors, a decrease in the level of water mineralization is very important in the production of agricultural products; in addition, a decrease in the level of soil salinity contributes to an increase in productivity. At the moment, the most relevant and developing method of water purification is mechanical or membrane purification, this method is much more effective and much more intensively purifies water than other existing methods.

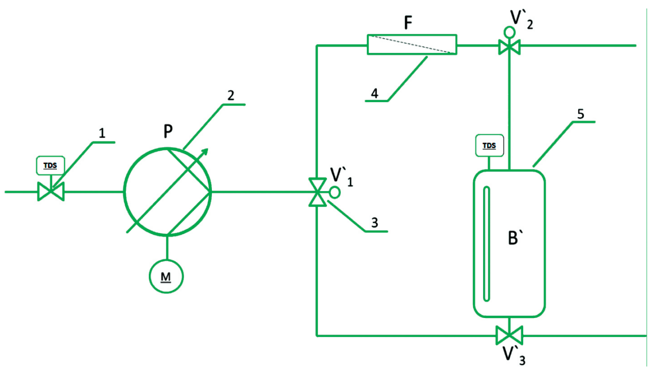
The filter breaks down very quickly, given that, a large volume of water use in agriculture, and the use of this method is economically impractical. To eliminate the above problems, special designs developing taking into account the load and the selective selection of the flow of transferring water for irrigation. A structure of this type could be intensively use with an existing automatic system; without an automatic system, the implementation of this structure is technically impossible. [6].

This article discusses the issue of creating a program for a microcontroller in order to create an automatic control system of water treatment.

**Research method**. The programming technique based on the design features of the device and taking into account the technical parameters of the measuring instruments. The creation of control and interaction commands is based on a given flowchart algorithm. [7].

*Object of research*. The object of research is construction for the selective choice of purification or direct supply of water to the mixing capsule.

The basic principle of operation of the proposed design is to create the required concentration of water with an acceptable salt content inside the tank and then transfer it for irrigation[8]. The device consists of 5 parts; 1- conduct metric sensor that will be installed in the water source to determine the salt content in the source, 2- centrifugal pump for water transfer, 3- on-off solenoid valves for water distribution, 4-reverse osmosis to lower the salt level in the water, 5- capsules for collecting water (see Figure 1) [9].




*1-conductometric sensor; 2-pump unit; 3- two position valve; 4- reverse osmosis; 5- diffused capsule.*

**Fig. 1. Diffusion mixing design**

The principle of operation of the design is that the electromagnetic control valve V1 distributes water for cleaning using reverse osmosis, valve V2 is use to supply purified water to the capsule, valve V3 is use to supply mixed water for irrigation. The valve operating time and the volume of water flow distribution for cleaning and for direct transfer to the capsule depends on the salinity of the water source. The data that is transmitted from the 1st sensor goes to the controller and then the controller, based on the built-in algorithm, sets the operating time of the on-off valves. The level of reverse osmosis load depends on the salinity of the water source and thus it is possible to extend the level of operation of reverse osmosis by creating an individual regime depending on the degree of salinity of the water [10].

*Algorithm and control method*. To implement the work of the equation and the block diagram will be using a circuit architecture based on the Arduino line. The logic equation will uploaded to the ATmega 2560 microprocessor because of which the microprocessor solution will transmitted to the executive body in the form of a relay module. Relay modules will transmit voltage to the two-position solenoid valve (see figure 2)[11].

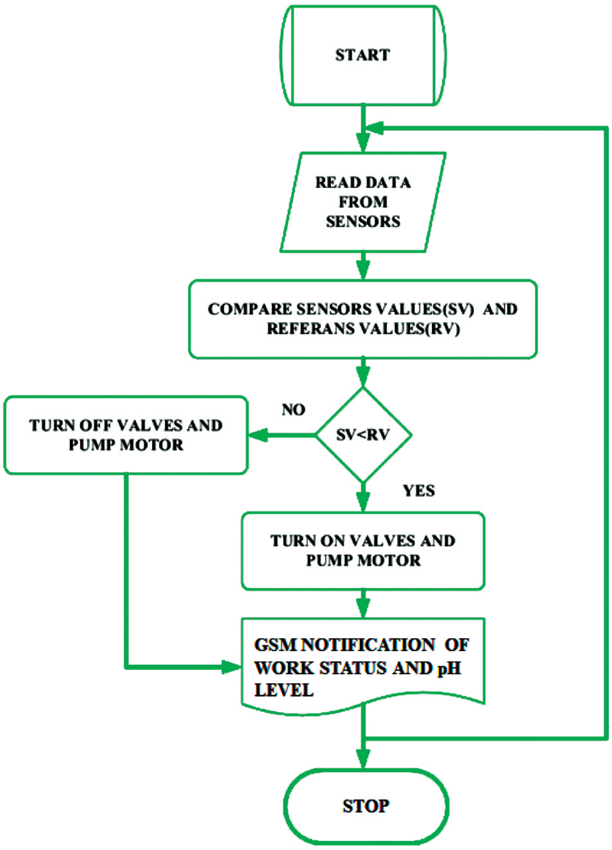



**Figure.2. Block diagram of the control system algorithm**

**Results of research.** To implement the program, the definition and display values will set to make an indication of input signals as shown in the sketch below (see figure 3). Main control information takes from TDS sensor and will analyze to make decision.

For remote control and notification, codes with the designation with indication {"SWS?", "FWS?", "WLS?", "WCS?", "WCSS?"}. All commands value link to operation work in changing of physical value of technology process program will react and give notification to set phone number in SMS (short message service) form.

// Enter the phone number to send the data

String phonenumber = "+ 998xxxxxxxxx";

// Commands given to perform certain actions.

String allcomms [] = {"SWS?", "FWS?", "WLS?", "WCS?", "WCSS?"};

// Here:

// SWS? - The salinity of the water in the spring.

// FWS? - The salinity level of the water leaving the filter (Indicates how the filter works.

// WLS? - Water level in the water tank.

// WCS? - The amount of water in the water tank.

// WCSS? - The salinity of the water in the water tank.

// These commands can be changed on demand

The operation of the valves for moving the flow of water and the switching on and off of the pump unit is carried out by comparing the value of the salt content, which is indicated with the help of this operator (see figure 4).

LSW = (RV - getSens(1)) / (getSens(2) - getSens(1));

LSW = NW * abs(LSW);

HSW = NW - LSW;

The whole operation is based on the comparison of the analysis of the salinity sensor which is located inside the capsule and inside the source. The operator performance of valve switching is shown as follows (see figure 5).

This sketch take acount of indicators of sensor and

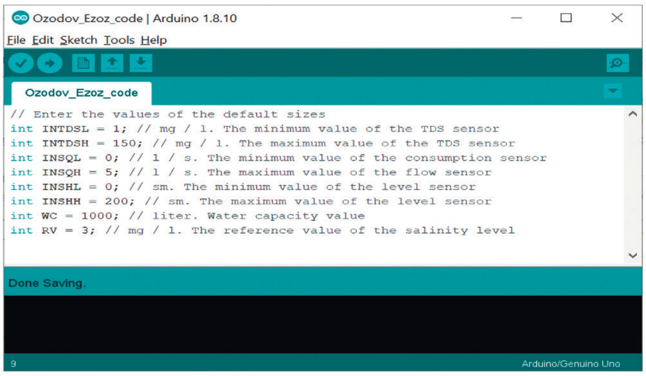



**Fig. 3. Sketch of values indication**

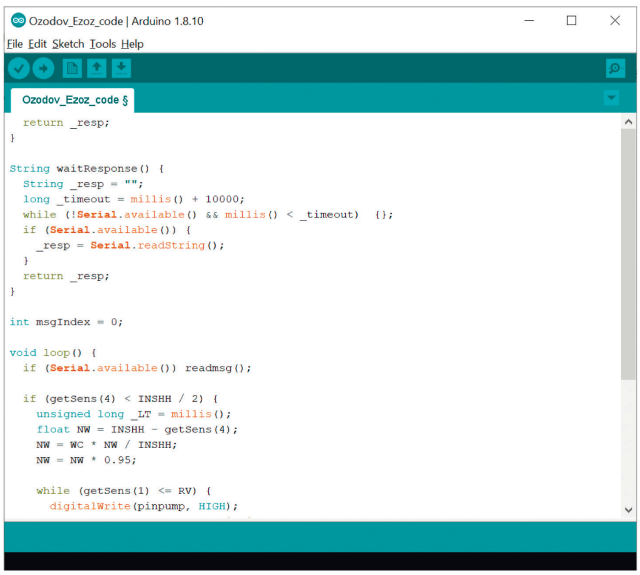



**Fig. 4. Sketch of comparing salt value and selection of correct operation**

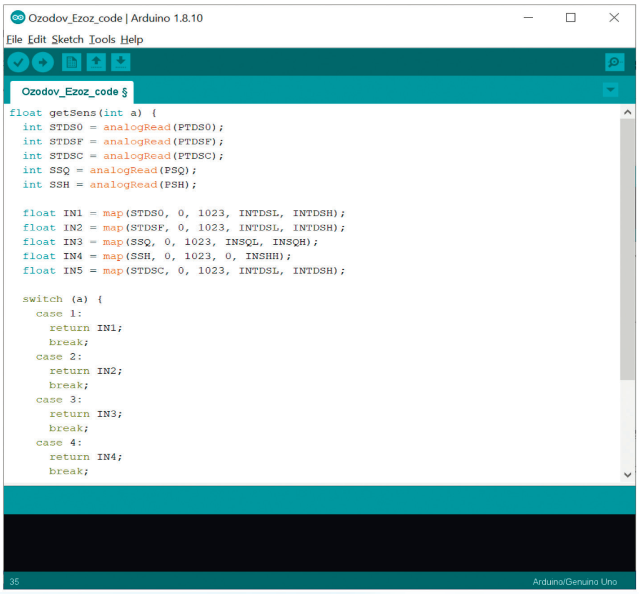



**Fig. 5. Sketch structure of decision-making part**

hold paramets till it is stay stabile. If parametrs change program will select correct operation according to algorithm and switch it to true or false as shown below.

```
avoid readmsg(void) {
  digitalWrite(LEDinfo, HIGH);
  _response = waitResponse();
  _response.trim();
  if (_response.indexOf("+CMT:") > -1) {
 do{_response=sendATCommand("AT+CMGL=\"REC UNREAD\"", true);
    if (_response.indexOf("+CMGL: ") > -1) {
```

**Conclusion.** This program use to construct the analysis of water quality and then make the correct decision based on the algorithms given by the device. The programming platform based on the Arduino IDE has support for microcontrollers similar to the production line.

This program has the following advantages.

1. The program is adapted to the design of the water treatment and aimed at optimizing the filter and its operational period.

2. The system accurately indicates the process change and has a notification system for each operation.

3. The program takes into account the parameters of water quality in case of dissimilarity of indicators, the system turns off the work, which protects the soil and plants from high salinity water.

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