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DESIGN AND DEVELOPMENT OF ARDUINO BASED AUTOMATIC PH RANGE MONITORING SYSTEM FOR OPTIMUM USE OF WATER IN AGRICULTURAL FIELDS

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Abstract

his research aim was the intelligent pH range control system in agricultural watering pump stations based on Adriano pro mini microcontroller automation control with GSM control. This kind of intelligent control system which combination the pump unit with a water filter. It helps to control the salt level of the field with a reverse osmosis plant and supply the water if required. In this research embedding a control system into an automatic water pump controller depend upon the pH range. The intelligent pH range control system in the agricultural fields designed in the research had wonderful effort of man-machine interface, it is straightforward, cheap and convenient high degree of an automation system. Not only that this system helps to prevent wastage of water. This system is a prototype, which makes this self-sufficient, watering itself from underground water. This system can use saltwater from underground waters and give chance to economize pure water this side of this system makes it more environment-friendly.

Key words: ATmega328, Arduino IDE, GSM D800, watering, salt water, pump stations, watering automation control system, pH sensor.

Introduction. According to a recent survey, water has become a big issue because of less rainfall, increase in population many cities are facing this problem people have to suffer from this problem they do not have a sufficient amount for their daily needs [1].

The increasing demands placed on the global water supply threaten biodiversity and the supply of water for food production and other vital human needs. Water shortages already exist in many regions, with more than one billion people without adequate drinking water. In addition, 90% of the infectious diseases in developing countries are transmitted from polluted water. Agriculture consumes about 70% of fresh water worldwide; for example, approximately 1000 liters (L) of water are required to produce 1 kilogram (kg) of cereal grain, and 43,000 L to produce 1 kg of beef. New water supplies are likely to result from conservation, recycling, and improved water-use efficiency rather than from large development projects [2].

Water is essential for maintaining an adequate food supply and a productive environment for the human population and for other animals, plants, and microbes worldwide. As human populations and economies grow, global freshwater demand has been increasing rapidly.

In addition to threatening the human food supply, water shortages severely reduce biodiversity in both aquatic and terrestrial ecosystems, while water pollution facilitates the spread of serious human diseases and diminishes water quality [3,4,5].

World agriculture consumes approximately 70% of the fresh water withdrawn per year. Only about 17% of the world's cropland is irrigated, but this irrigated land produces 40% of the world's food. Worldwide, the amount of irrigated land is slowly expanding, even though salinization, waterlogging, and siltation continue to decrease its productivity. Despite a small annual increase in total irrigated area, the irrigated area per capita has been declining since 1990 because of rapid population growth. Specifically, global irrigation per capita has declined nearly 10% during the past decade [6,7,8,9].

The practice of applying about 10 million L irrigation water per ha each year results in approximately 5 t salts per ha being added to the soil.The salt deposits can be flushed away with added fresh water, but at a significant cost. Worldwide, approximately half of all existing irrigated soils are adversely affected by salinization [10].

The amount of world agricultural land destroyed by salinized soil each year is estimated to be 10 million ha. In addition, drainage water from irrigated cropland contains large quantities of salt [11,12].

The accumulation of salts in areas that could potentially be used in agriculture is a worldwide problem, covering 340 million hectares in all over the world .[13]

In the region located in arid and semiarid zones, a lot of problems, associated with irrigation and land reclamation. Irrigated agriculture is the basis of agriculture in the region (Volga region

Russian Federation, Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, Azerbaijan).

On background of a wide variety of natural irrigated area conditions; poor water management at various functional levels of irrigation systems creates many problems that worsen soil fertility and land quality, in agricultural use, and also leads to aggravation of environmental problems, expressed in salinization and pollution of irrigated soils, groundwater and water sources.

Considering the above facts, monitoring of water quality is considered one of the issues of rural culture.

The main indicator of water for irrigation of agricultural products is pH. The pH value is determined by the quantitative ratio in water of H + and OH- ions formed during the dissociation of water. If OH- ions prevail in water - that is, pH> 7, then water will have an alkaline reaction, and with a high content of H + ions - pH <7- acidic. In distilled water, these ions will balance each other and the pH will be approximately 7. When dissolved in water, various chemicals, both natural and man-made, this balance is violated, which leads to a change in the pH level.

A pH meter should be used to track the activity of cations, as well as to study the redox potential (ORP) in solutions. Based on the research, we can conclude about the quality of food.

Typically, the pH level is within the range at which it does not affect consumer water quality. In river waters, the pH is usually in the range of 6.5–8.5; in marshes, water is acidic due to humic acids — there the pH is 5.5–6.0, and in groundwater the pH is usually higher. At high levels (pH> 11), water acquires a characteristic soapiness, an unpleasant odor, and can cause irritation to the eyes and skin. Low pH <4 can also cause discomfort. It also affects the life of aquatic organisms. For drinking and household water, the pH level in the range from 6 to 9 units is considered optimal [14].

To increase fertility, it is logical to assume that irrigation for arid zones is one of the main indicators in rural culture.

The proposed system has the ability to control the pH by combining the pumping unit with reverse osmosis.

The system determines the operation of the filter based on quality indicators of the water source.

The solution of problem. To reduce these impacts to a minimum level, a system that will give the ability to combine the process of irrigation and water supply of drinking water in a pump unit.

The design combines a diffusion mixer and a reverse osmosis filter for a centrifugal pump.

This design is installed in a pumping station for individual use, which are very relevant in the above regions.

The pump station is designed for individual use for portable use in small villages and rural areas to produce the irrigation of small plots of land and the implementation of water supply consumer th.

The design consists of a centrifugal pump, a differential pH sensor, a diffusion mixer, reverse osmosis, and four two-position solenoid valves, shown in Figure 1 [15].

The system has two operating modes, the upper mode is a mode in which only reverse osmosis is activated and is used to reduce salinity to drinking water standards.

The lower mode is the diffusion mixing mode. A tank is installed in this part of the structure, where the pipes are connected from the source, from where salted water comes from and from reverse osmosis, from which filtered water comes. The proportions of the water in the tank are measured using a conductivity sensor.

Conductometric sensor detects, operation switching valve and the by gives the ability to control the salt level inside the tank. At a certain volume of water in the tanks, the lower valve automatically activates, which delivers this water to the irrigated place. The ratio of salt and filtered water is compiled according to a given sketch of the microcontroller of the system.

The principle of operation of the system consists of determining the level of salt and on the basis of this indicator the volume of work is established as the proportion of salt and drinking water. Signal set to the source conductometric sensor, is compared with a predetermined parameter E and the controller determines the volume range of the predetermined value.

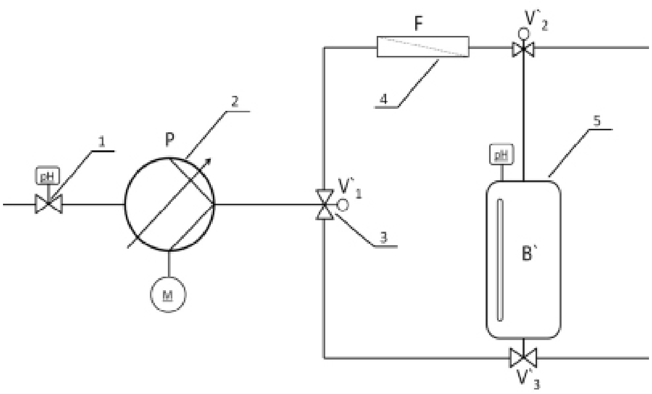
After determining the ratios, the proportion of water is controlled using valves to which a signal is supplied through the controller.

For the experimental stand, a board was assembled designed on the basis of Arduino elements in Fig. 2, and a diagram of the connection of the board elements is shown .

The board consists of an Arduino pro mini controller , an ULN 2003 amplifier for controlling two position valves, a SEN0116 conductivity meter, and a GSM SIM900D system for remote control and process monitoring [4].

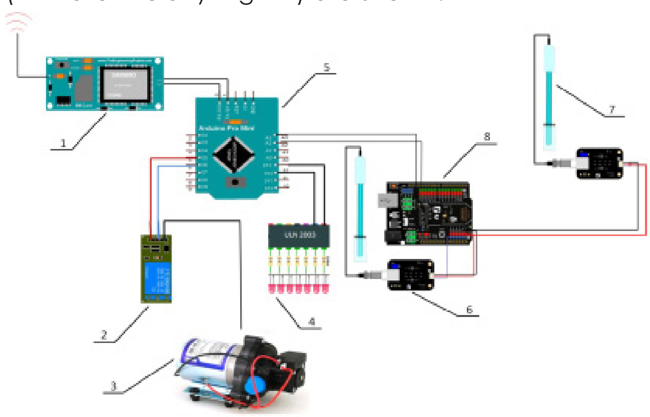
Arduino ID E software environment was used to calculate variable indicators by a sensor for comparing and compiling codes. The system responds to the command of the logical operation of comparison If variables are entered, the main parts of the sketch are shown on the Arduino ID E panel in Figure 3.

Comparison of the indicators of the sensors and the indicated values is compiled using the indicated aisles in the value operator, which is indicated by the sketch example in Figure 4, which shows all process changes. When comparing, the limits of pure water (`` Water Is neutral (safe) " ) and with increased acidity ( `` water Acidity High``) are shown.



1 - conductometric sensor; 2-pump unit ; 3- two position solenoid valve; 4- reverse osmosis; 5 tank diffusion mixer

Figure 1 . Scheme of an automatic diffusion mixing system.



1- SIM900D; 2- executive mechanism relay module; 3-pump unit; 4- amplifier; 5- controller Arduino Pro mini; 6- BNC connector ; 7- pH sensor; 8- sensor module.

Figure 2. From the circuit board of the automatic control system.

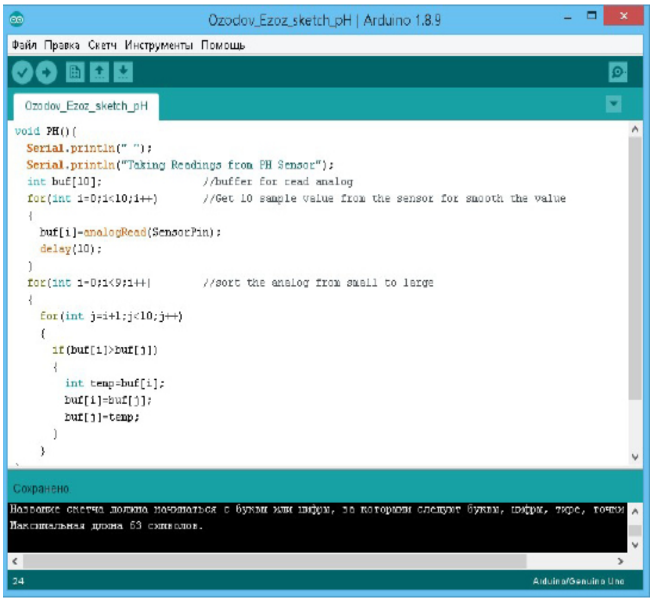


Figure 3. Code sketch of an automatic control system on the Arduino IDE platform

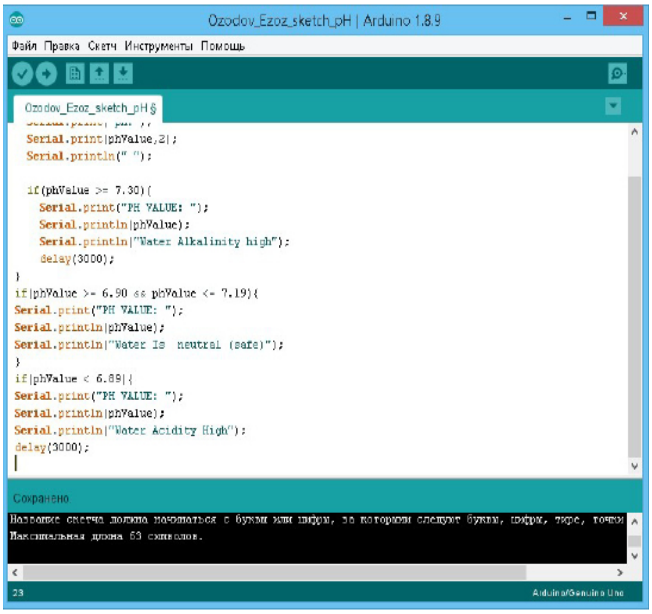


Figure 4. Sketch of code for comparing indicators on the Arduino IDE platform .

To increase the accuracy of the diffusion mixer in the Arduino IDE, the pH value and error are not more than 0.3 and compared with 7.00 and the difference was changed to "Offset" in the sample code. Correction was made using the operator "# define Offset 0.00" to "# define Offset (x)" the data value x is variable parameters with a tava waters s and further indicators of water are loaded into the controller [2] .

When calibrating , the equipment is connected in accordance with the schedule, that is, the pH electrode is connected to the BNC connector on the pH meter board, and then the connecting lines and pH meter boards are used when connected to the long port 0 of the Arduino controller . When the Arduino controller receives power, the sensitive element is activated. A sample code is downloaded to the Arduino controller based on the water composition of the region. The pH value of which is 7.00 or is adjusted at the input of the BNC connector [3].

The system is easily adaptable, for this, a base of the required value and calibration of the conductivity sensor are compiled, all indicators are loaded into the controller and the ranges of chapels of the required norms of sketch operators in the Arduino IDE are replaced .

Conclusion. This system is intended for small rural areas and for small populations. The design is designed to reduce the use of clean drinking water, but it should be noted that the minimum use of clean water depends on the salt in the water, which makes this system not perfect. The autonomous system compares the quality indicator and determines the ratio of liquids, which very favorably affects the fertility of the soil during irrigation.

In the absence of a developed system and the program is functional and within normal limits. Remote monitoring of the system makes it possible to collect data on the composition of water around the clock and when alerted, they will turn off the device.

The main problem of the system is the calibration of the sensors to the side of the optimal work point for which the dismantling of the controller is required.

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