INTELLIGENT SYSTEM FOR MONITORING THE IRRIGATION PROCESS BASED ON THE INTERNET

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Abstract

Uzbekistan is located in a semi-arid region with a hot dry arid climate and severe water scarcity. Irrigation of agricultural crops is carried out mainly by hand and in accordance with established traditional methods. The technical level of existing irrigation systems remains at a low level. Therefore, scientific and practical research aimed at saving the use of water in the irrigation process is becoming more and more relevant every year. Most water-saving technologies and irrigation systems in agriculture are very expensive, which makes it impossible to implement this type of system in small farms. Water savings can be achieved by the widespread use of intelligent irrigation technologies. Smart irrigation technology uses soil moisture and weather data to determine crop irrigation needs. In this paper, the issues of using internet technology to automate the control of the irrigation process by monitoring and analyzing the state of soil moisture and weather conditions are considered. By controlling soil moisture levels, the smart irrigation system allows farmers to automate irrigation processes and reduce water consumption.

Keywords: Internet of Things, smart water, real-time, Thing speak, Wi-Fi network

Introduction. Uzbekistan is a state located in a semi-arid region with a hot dry arid climate and for the needs of agriculture, uses water from two main Trans Boundary Rivers - the Syr Darya and Amu Darya, as well as internal rivers and underground sources [1].

Irrigated agriculture in Uzbekistan is of key importance for livelihoods. According to [2], Uzbekistan at the beginning of 2021 ranked 25th out of 164 in the ranking of countries suffering from water stress.

The lack of water in Uzbekistan is largely a consequence of not only climatic and geographical conditions, but also the irrational use of available water resources. The main problem is that Uzbekistan is the most populous country in Central Asia and about 80% of the water that is used in the republic is formed in the territories of neighboring states. Therefore, in matters of water, the republic is highly dependent on neighboring states.

According to [1], irrigation is the largest water consumer in the country and today uses more than 90% of all water resources in Uzbekistan, although the volume of water withdrawal for irrigation in the country has decreased by more than 13 billion m^3 since 1980, and the volume of water consumed water per hectare in the republic - from 18 thousand m3 / ha in 1991 to 10.2 thousand m3 / ha in 2018. However, the industry is increasingly competing with industrial and drinking water supply, hydropower and especially the consumption of the natural complex.

As noted in [3], today the irrigation of crops on existing irrigation systems, despite the measures taken, remains insufficiently effective, due to their low technical level, lack of quality management of water use and water distribution processes, large water losses, leading to a rise in groundwater levels by irrigated areas, processes of salinization and waterlogging of soils.

Therefore, the primary task of improving the technical level of irrigation systems is to develop a set of measures to minimize or completely eliminate technological losses.

Today, in the agriculture of developed countries, modern intelligent information, communication and digital technologies come to the aid of farmers and farmers in increasing yields and reducing water consumption. Big data (Big Data) collected using IoT technology and their analysis help to determine the favorable time for planting or harvesting, calculate the fertilizer supply scheme, monitor, predict the harvest, and much more [4-8].

As elsewhere in the world, Uzbekistan is also implementing comprehensive measures to actively develop the digital economy, as well as the widespread introduction of modern information and communication technologies in agriculture. In particular, the Ministry of Agriculture of Uzbekistan has been tasked with a large-scale digital transformation of the country's agricultural industry, aimed at ensuring a technological breakthrough in the agro-industrial complex, strengthening food security, efficient management of water and other resources in order to achieve productivity growth in agricultural enterprises. To successfully solve these problems, it is necessary to widely introduce "smart" agriculture, which allows you to automate agricultural activities as much as possible.

In connection with the ongoing reforms in the agricultural sector of the Republic of Uzbekistan, collective forms of land use have been replaced by independent farms. The areas of their farms in the vegetable and garden zones mainly range from several units to several tens of hectares of land. Water use planning on these farms is currently being carried out using recommendations that are designed to ensure maximum crop yields. In most farms, the plants are irrigated by furrows, which is the most common method of gravity-fed surface irrigation. In terms of its effect on soil and plants, the creation of water, air and nutrient regimes, it is applicable not only in vegetable growing, but also in field crops. Furrowing of the surface makes it possible to apply irrigation on almost all soils, reliefs and slopes of the terrain with small amounts of planning work. Irrigation furrows are cut simultaneously with the sowing or plowing of row spacing of agricultural crops, that is, the cutting of furrows is well linked with the technology of sowing and caring for crops.

However, the existing furrow irrigation technology used in farmer farms located in the foothill zone does not allow efficient use of water due to the lack of technical means of water distribution on lands with elevated slopes. There are problems of distribution of water between farms in case of its deficit in the most stressful periods of the irrigation season. Old agricultural machinery is not adapted to work on small areas of farmer farms, and farmer does not have the funds to purchase small-sized machines. The lack of mineral and organic fertilizers does not allow to obtain the yield provided for in the planning of water use and, accordingly, to achieve the necessary economic efficiency of water use.

Taking into account world experience, very serious and effective measures have been taken in Uzbekistan in recent years to develop the agricultural sector, introduce

modern innovative technologies into agriculture. Further progress in this direction will increase the competitiveness of the sector and turn the existing challenge into new opportunities. But this requires the development and implementation in Uzbekistan of the already existing range of agricultural technologies and innovations that are used today in other countries of the world. However, in the agriculture of Uzbekistan, the level of automation is still at the beginning of the road. Of course, a lot has changed in irrigation automation over the past 20 years. Nevertheless, the variety, accuracy of sensors, and most importantly, their availability for agricultural producers remain at a low level.

One such innovative smart farming technology is the Internet of Things (IoT). This technology is a system of interaction and information exchange between various devices and machines, which allows you to automate the management and control processes through various "smart devices" and significantly reduce human participation in them. Examples of the application of IoT technology in irrigation automation are very limited [9-12].

In this paper, the issues of using IoT technology to automate the control of the irrigation process by monitoring and analyzing the state of soil moisture and weather conditions are considered.

In irrigation, it is necessary to find a middle ground: insufficient amount of moisture leads to a reduction in yields, an overabundance - to the appearance of diseases and a decrease in quality. Therefore, the irrigation strategy, not only for each crop, but also for a single region, should be different and take into account many factors. Among them are the type of soil and its ability to retain moisture, weather conditions and daily evaporation, the type of crop and the stage of its development, the ability of the irrigation system to apply water, etc. By analyzing this information, you can decide how much moisture the plant will need in the coming a few days so that the culture does not enter a state of stress and do not lose in yield and quality.

Application of the Internet of Things technology to automate the management of the irrigation process.

For centuries, farmers around the world have had to be creative to overcome water scarcity in the absence of rain and maximize their crops. They used technologies such as irrigation systems. However, irrigation systems were not always efficient. In it, about half of all irrigation water is wasted due to runoff, wind and evaporation. This is because most irrigation systems rely on targets approved in official distribution water planning documents - hydro modules, which are developed on the basis of formal regulatory documents. A much more efficient approach is to use water only when needed and apply exactly the amount needed.

In this, among other things, farmers are helped by the intelligent technology of the Internet of Things - IoT. This technology makes crop irrigation management smarter, allowing farmers to increase efficiency through the smart use of limited water resources. The smart irrigation system can accurately provide the right amount of water at the right time, which can save a lot of water.

Smart irrigation technology uses weather and soil moisture data to determine crop irrigation needs. Smart irrigation technology includes sensors (sensors) that are installed in the ground at control points. Sensors and sensors placed in the field at a considerable distance, which are combined into a network, make it possible to obtain information about the state of fields and crops, in particular, about humidity, temperature, etc., without going to the site. Temperature, wind, solar radiation and humidity indicators are used to calculate watering needs.

Smart watering technology uses digital sensors to get real-time or on-demand watering data and change watering schedules to improve efficiency. A block diagram of such an intelligent irrigation technology is shown in Fig. 1

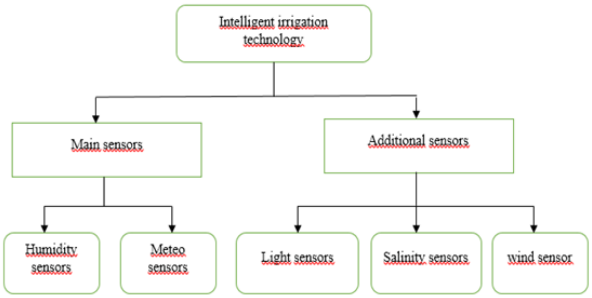

Figure 1. Block diagram of smart irrigation technology

The block diagram of the algorithm for the functioning of the system for monitoring and controlling an object or things using the Internet of Things technology is shown in Fig. 2.

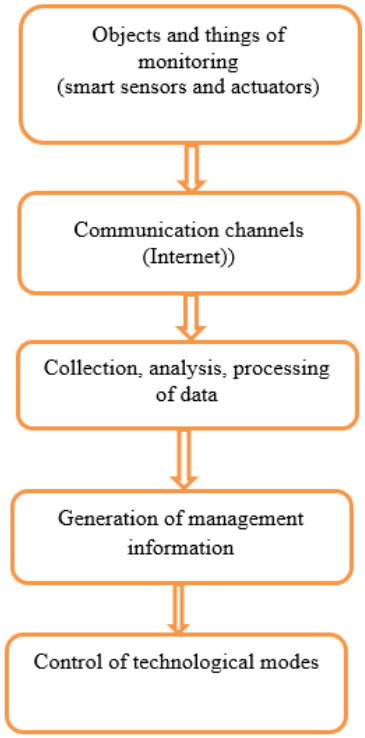

Figure 2. Block diagram of the algorithm for the functioning of the system based on the "Internet of Things"

Soil sensors collect the necessary data on the volumetric water content, salinity, electrical conductivity and other important soil parameters. Positioned at key points in the field, these sensors feed data into the smart irrigation system to help farmers quickly understand soil conditions and predict irrigation needs.

The application of a wireless (web-based) smart IoT platform to control water flow based on soil moisture provides real-time remote monitoring for owners who are far from the field.

We have developed a laboratory prototype of an IoT-based intelligent irrigation monitoring system that will be able to collect data important for irrigation management and send it to a cloud-based IoT platform called Thing speak in real time, where the data can be recorded and

analyzed. A block diagram of an intelligent system for monitoring the irrigation process based on IoT is shown in Fig.3.

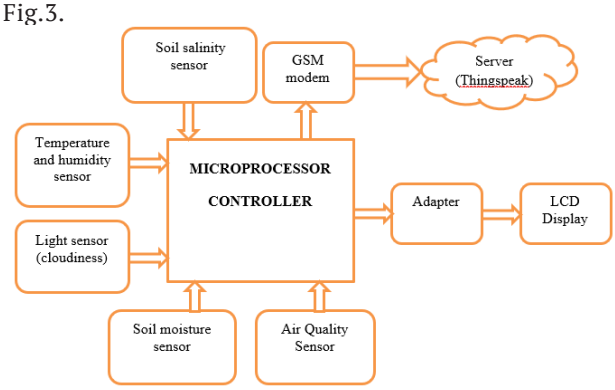

Figure 3. Block diagram of an intelligent irrigation monitoring system based on IoT

This prototype is based on an Arduino board with its own processor and memory used as a microprocessor controller and 5 sensors that measure six different environmental factors that affect the growth and nutrition of crops:

1) Temperature and humidity sensor.
2) Air quality sensor.
3) Light sensor (cloudiness).
4) Soil moisture sensor.
5) Soil salinity sensor.

We also use a SIM 800 / 900 GSM module in the GSM circuit, which can connect to the GPRS Internet to send sensor data to the thing speak server.

The 16x2 LCD will display the data of the sensor that is connected to the I2C adapter module to reduce the number of wires connecting the Arduino to the LCD.

A general view of the laboratory prototype of an intelligent system for monitoring the irrigation process based on IoT is shown in Figure 3.

Soil moisture can be measured using the sensor shown in the figure, which has two pins (electrodes) inserted into the topsoil. This is an analog sensor that will output analog values to the Arduino. We will only use the analog output of this sensor, like the other analog sensors mentioned here; the output is converted to a 10-bit digital value and finally to a percentage of 100.

0% means the soil is dry 100% means the soil is wet. But with this sensor, we found that between 50% and 70%, the soil was completely wet.

A general view of the laboratory prototype of an intelligent system for monitoring the irrigation process based on IoT is shown in Fig. 4.

In this project, we used a GSM modem to access the GPRS internet, because our project will be located outdoors, for example, in the middle of an agricultural field, where it can be difficult to provide Wi-Fi, and even if we set the Wi-Fi network to open air, anyone can hack the network. For these reasons, we use the cellular network to connect the project to the internet.

Such an intelligent information and analytical system allows you to analyze each site and determine the amount of moisture needed, avoiding water overruns. This allows you to minimize the cost of irrigation water and at the same time get high yields.

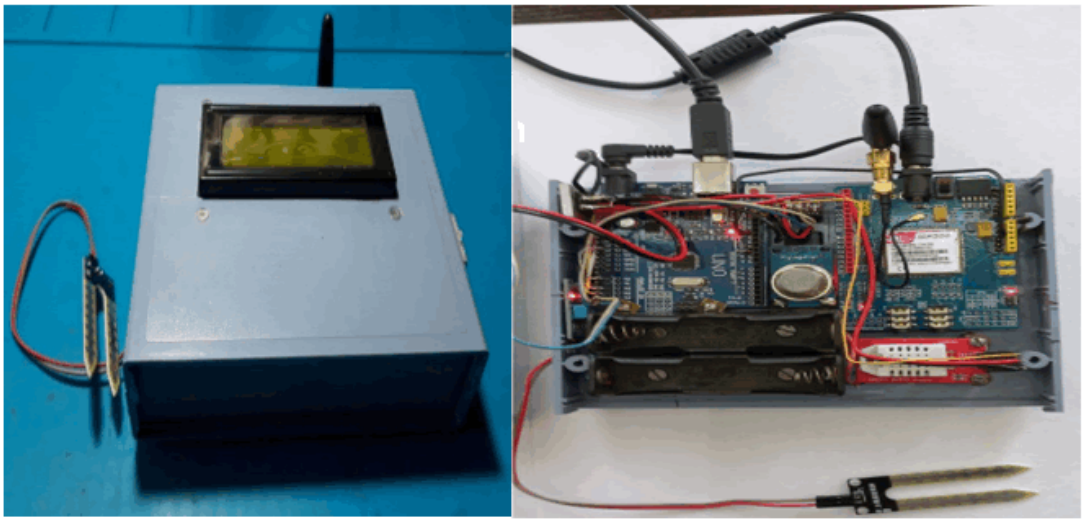

Figure 4. General view of the laboratory prototype of an intelligent system for monitoring the irrigation process based on IoT

References:

[1] Kontseptsiya razvitiya vodnogo xozyaystva Respubliki Uzbekistan na 2020 — 2030 gody 2020
[2] Aqueduct Water Risk Atlas. https://www.wri.org/applications/aqueduct/water-risk-atlas/
[3] Oligarenko I V 2013 Avtoreferat dissertatsii na soiskanie uchyonoy stepeni doktora texnicheskix nauk.
[4] Kola Murali and B. Sridhar 2021 J. Phys.: Conf. Ser. 2062 012010 A smart Agriculture Irrigation System using sensor array based IoT.
[5] Zhang Siyuan and Qian Yue 2016 4th International Conference on Machinery, Materials and Computing Technology Applications of Technologies of Internet of Things in Computer Monitoring System.