IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 7, July 2024

DOI: 10.17148/IJIREEICE.2024.12719

Water Quality Control for Clever Watering with Arduino UNO

Tejas Sai.S[1], Kundan[2], Syed Umar[3], Lingraj[4]

Student, Department of Electrical and Electronics Engineering, Dayananda Sagar Academy of Technology and Management (DSATM), Bengaluru.[1,2,3,4]

Abstract: The Smart Irrigation System we're looking at has some real benefits. It saves water, helps crops grow better, and cuts down on work costs. By using IoT tech and microcontrollers, this system gives farmers a way to do precise farming without breaking the bank, and it can grow with their needs. Down the road, we might see it hook up with weather forecasts to plan watering ahead of time. It could also start using machine learning to adapt how it controls things.

As water becomes scarce and farms need to work smarter, this project looks into a system that manages water quality and waters crops using Arduino Uno. The setup brings together different sensors to keep an eye on water quality and how wet the soil is. These include sensors for pH how clear the water is, and soil moisture. The Arduino Uno, which acts as the brain of the operation, takes in all this information from the sensors. It then uses this up- to-the-minute data to change when and where water goes making sure plants grow well and water isn't wasted. This smart watering system offers a long- lasting answer for today's farming using water more while keeping crops healthy and productive.

Keywords: Smart Irrigation System ,Water Conservation ,Precision Farming, IoT Technology, Microcontrollers, Cost-Effective Farming, Scalable System,Weather Forecast Integration, Machine Learning in Agriculture, Water Management System, Arduino Uno

I. INTRODUCTION

1.1 Intension of the Project

The project aims to create a new watering system that saves water and keeps it clean for farming. It uses Arduino Uno and sensors to reach several main goals: save water by using a smart watering system that turns on when the soil needs it, which cuts down on waste; help crops grow better by giving them the right amount of water and checking things like pH and how clear the water is; make farming more eco-friendly by using less water and reducing its impact on the environment; make things run smoother by automating watering, which means less manual work and more time for other farm jobs; let farmers check on things from far away by using wireless tech, so they can see data and get alerts without being there; and offer a cheaper option that more farmers can afford, bringing advanced water management to more people.

II. LIST OF COMPONENTS

-

❖ Arduino UNO
- **Operating Voltage:** 5V
- **Microcontroller:** ATmega328P
- **Digital I/O Pins:** 14 (of which 6 can be used as PWM outputs)
- **Analog Input Pins:** 6 (with a resolution of 10 bits)
- PWM Output: 6 pins

❖ Turbidity Sensor
- **Operating Voltage:** 5V DC
- **Operating Current:** 40 mA
- **Response Time:** Less than 500 ms
- **Signal Type:** Analog

❖ Soil moisture sensor
- **Operating Voltage:** 3.3V to 5V DC
- **Operating Current:** Less than 20 mA

DOI: 10.17148/IJIREEICE.2024.12719

- **Signal Type:** Analog
- **Output Resolution:** Dependent on the analog-to-digital converter used in the microcontroller

❖ Dc motors

- **Operating Voltage:** 3V to 12V DC (common range)
- **Nominal Voltage:** 6V or 12V (depending on the specific motor)
- **No-Load Speed:** 1000 to 5000 RPM (Rotations Per Minute) (varies widely by model)
- **No-Load Current:** 50 mA to 200 mA
- **Stall Current:** Up to 2A or more (varies by motor size and design)
- **Rated Torque:** Typically measured in N·m (Newton-meters) or kg·cm (kilogram-centimeters); small hobby motors often range from 0.01 to 1 kg·cm

❖ Batteries (7v)

- **Nominal Voltage:** 3.6V to 3.7V per cell
- **Capacity:** Typically ranges from 100 mAh to several thousand mAh (milliampere-hours)
- **Energy Density:** High, around 150-200 Wh/kg (Watt-hours per kilogram)
- **Charge Voltage:** 4.2V per cell (maximum)
- **Discharge Voltage:** 3.0V to 3.2V per cell (cutoff)
- **Charge Current:** Typically 0.5C to 1C (C is the capacity of the battery; e.g., 1000 mAh battery, 1C = 1000 mA)
- **Discharge Current:** Varies; typically up to 2C to 5C for standard cells, but can be higher for high-drain applications
- **Cycle Life:** 300 to 500 cycles (depends on usage and care)
- **Safety:** Requires protection circuits for overcharge, over-discharge, and short-circuit protection

III. LITERATURE SURVEY

• **Paper 1: Mehmeti, Andi & Canaj, Kledja. (2022). Environmental Assessment of Wastewater Treatment and Reuse for Irrigation: A Mini-Review of LCA Studies. Resources. 11. 94. 10.3390/resources11100094**

Water is essential for agricultural production and plays an important role in food security. Food consumption is increasing in most parts of the world as a result of population growth and dietary changes, which has a direct impact on agricultural resource scarcity and distribution. As pointed out by the FAO farming accounts for almost 70 percent of all water withdrawals, and up to 95 percent in some developing countries.

By 2050, irrigated food production will have to increase by more than 50 percent . Climate change is expected to exacerbate water scarcity and competition for water resources. Wastewater is frequently regarded as a valuable resource of the emerging circular economy approach. It may be helpful in alleviating water scarcity in arid and semi-arid Mediterranean countries . It is appealing for toilet flushing, agricultural and landscape irrigation, industrial processes, and replenishing/recharging of groundwater basins

Paper 2 Hashem, M.S.; Qi, X.Treated Wastewater Irrigation—A Review. Water 2021, 13, 1527. https://doi.org/10.3390/w13111527

Water, the most crucial resource for life, has been a key topic on the global stage for many years. Still, the world's clean freshwater supply keeps shrinking due to large-scale farming needs for irrigated lands. This means we need to use water more and boost the use of non-traditional water sources, like Treated Wastewater (TW). Reusing TW could offer another way to increase water resources. Because of this many countries have decided to turn wastewater into a resource for irrigation to help meet city needs and tackle water shortages. But, given the nature of this water, its use in irrigation might cause problems. Some main worries include health risks, salt build-up, and toxic hazards. This in-depth literature review aims to highlight the value of using TW for irrigation as an alternative to freshwater and to evaluate how it affects soil fertility other soil traits, plants, and public health. The review shows that TW reuse has become part of the plan to improve water resource use. However, using these waters without control can harm both soils and plants over time.
To lessen these bad effects when using TW for irrigation, people should follow proper guidelines for wastewater reuse and management to reduce negative impacts.

DOI: 10.17148/IJIREEICE.2024.12719

Paper 3: Slobodiuk, S.; Niven, C. Arthur, G.; Thakur, S.; Ercumen, A. Does Irrigation with Treated and Untreated Wastewater Increase Antimicrobial Resistance in Soil and Water: A Systematic Review. Int. J.Environ. Res. Public Health 2021, 18,11046. https://doi.org/10.3390/ijerph1821110

- Population growth and water scarcity make it necessary to find new ways to farm, like using wastewater to water crops. For hundreds of years many poor and dry countries have used household wastewater for watering, and now rich countries are doing it more to add to their water supply as the climate gets drier. Wastewater cleaning doesn't get rid of all the bad stuff, like bacteria that can fight off drugs (ARB) and genes that can resist drugs (ARGs). People who've looked at how watering with wastewater affects drug resistance (AMR) in the environment haven't come to a clear answer, and they looked at cleaned wastewater. We did the first big study to see how watering with both cleaned and uncleaned household wastewater affects ARB and ARGs in soil and nearby water. We looked at the titles and summaries of 3002 papers then read 41 in full, and ended up using 26 in our study. Thirteen of these looked at watering with uncleaned wastewater, and nine found it had a link to more ARB/ARGs in soil. Out of thirteen studies on cleaned wastewater, six found a link to more ARB/ARGs while six found mixed or no links. What we found shows that watering with uncleaned wastewater leads to more AMR in soil. This means farm workers, their families, and people who eat the food need to be careful when uncleaned wastewater is used to water crops. The effect of watering with cleaned wastewater wasn't as clear in the studies we looked at. This shows we need to understand better how much AMR spreads through this way of watering. Future research should look at things that change how wastewater watering affects AMR in soil, like how much and what kind of cleaning the wastewater gets, and how long and how much watering is done. This will help make rules for using wastewater to water crops.

IV. METHODOLOGY

Here's how you can lay out the steps to manage water quality and set up smart irrigation with an Arduino Uno:

1. Figuring Out the Problem and Setting Goals:
- Spot the need to use water in farming.
- Set clear aims: use water better, keep water clean, and make watering plants happen on its own.

2. Planning the System and Picking Parts:
- **Arduino Uno:** Pick Arduino Uno as the main control unit because it's simple, cheap, and flexible.
- **Sensors:**
- **Soil Moisture Sensors:** Check how wet the soil is to figure out when to water.
- **Water Quality Sensors:** Add pH and turbidity sensors to keep an eye on water quality.
- **Actuators:** Put in solenoid valves or pumps to manage water flow based on what the sensors say.
- **Communication Modules:** Think about using Wi-Fi or GSM modules to monitor and control things from far away.
- **Power Supply:** Come up with a good power system maybe using solar panels or batteries if you're not near a power grid.

3. System Integration:
- **Hardware Assembly:** Join sensors and actuators to the Arduino Uno. Make sure you wire them and provide the right power supply.
- **Software Development:**
  - Create Arduino sketches (programs) to read sensor data, process it, and control actuators.
  - Add algorithms to make decisions, like when to water plants based on soil moisture levels and water quality factors.
  - Add communication protocols to access and control data from afar.

4. Testing and Calibration:
- **Sensor Calibration:** Calibrate sensors to get accurate readings. Use standard solutions for pH and known soil moisture conditions.
- **System Testing:** Test the whole system in controlled conditions. Check sensor accuracy, actuator response, and how well the system performs overall.

5. Data Collection and Analysis:
- Gather data from the sensors over time to assess how the system performs.
- Look at the data to see how well water is used how healthy the crops are, and if water quality is managed .

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁙ Peer-reviewed & Refereed journal ⁙ Vol. 12, Issue 7, July 2024

DOI: 10.17148/IJIREEICE.2024.12719

6. Optimization and Refinement:

- After initial tests and data analysis, improve the system to make it more accurate, efficient, and reliable.
- Make the hardware, software, and algorithms better as needed.

7. Deployment and Monitoring:

- Put the system into action in a real farm setting.
- Keep an eye on how the system performs and tweak it when needed.

8. Documentation and Reporting:

- Write down everything about the project, from its design and setup to its testing and outcomes.
- Create a full report that explains the methods used, what we found out, and ideas to make things better down the road.

9. Evaluation and Future Work:

- Check how much the system helps save water, keep crops healthy, and work better overall.
- Spot areas where we could do more research or make improvements, like adding more sensors, using less energy, or making the system work for bigger farm

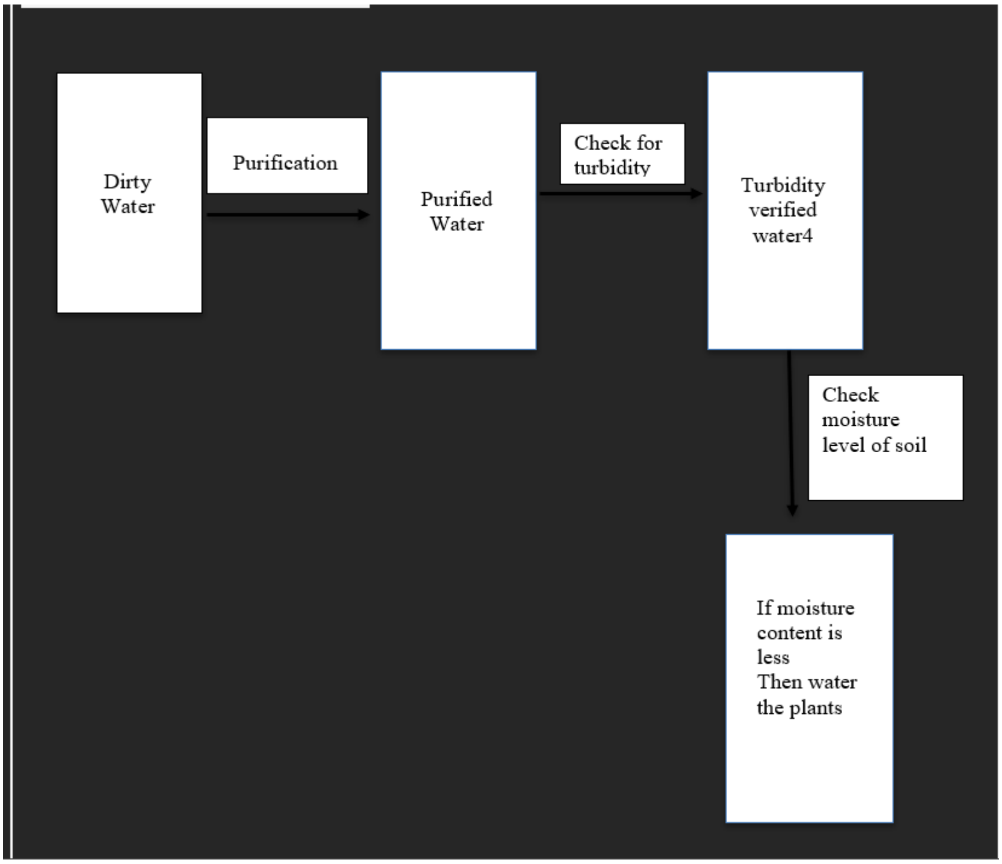

Fig 1- BLOCK DIAGRAM OF SMART IRRIGATION SYSTEM MODEL

The figure-1 shows the block diagram of how the irrigation system works and how the water is purified The water is purified using the softner principle which consists of large stones ,sand , coal and tissue where the water coming out is fully clear and its purity is measured by the turbidity sensor.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁂ Peer-reviewed & Refereed journal ⁂ Vol. 12, Issue 7, July 2024

DOI: 10.17148/IJIREEICE.2024.12719

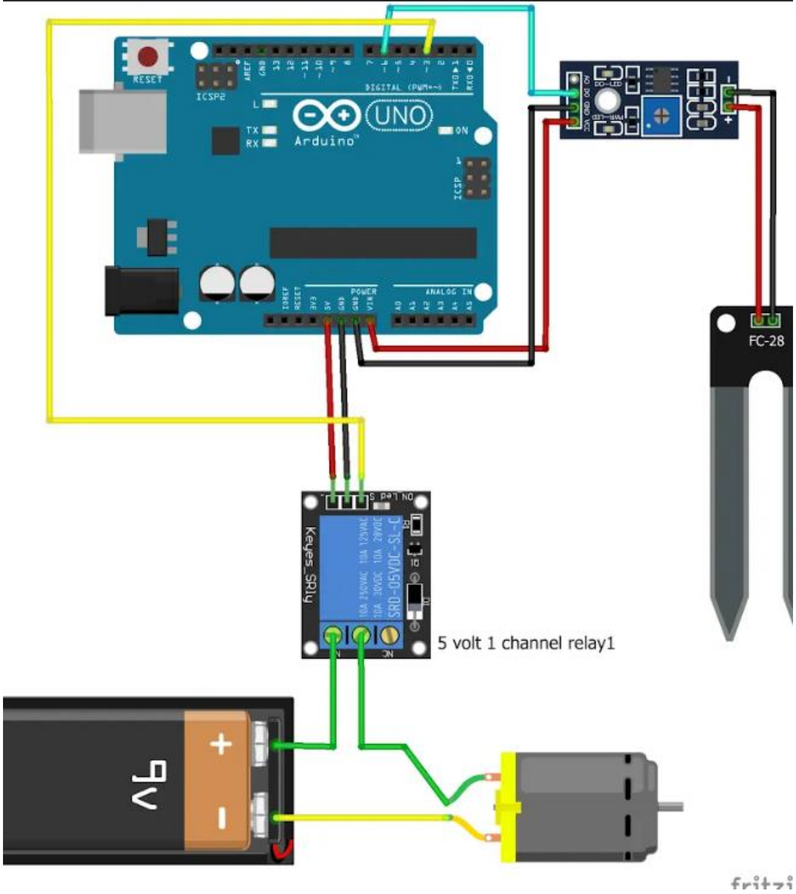

Fig 2- CIRCUIT DIAGRAM OF SOIL MOISTURE SENSOR FOR SMART IRRIGATION SYSTEM MODEL

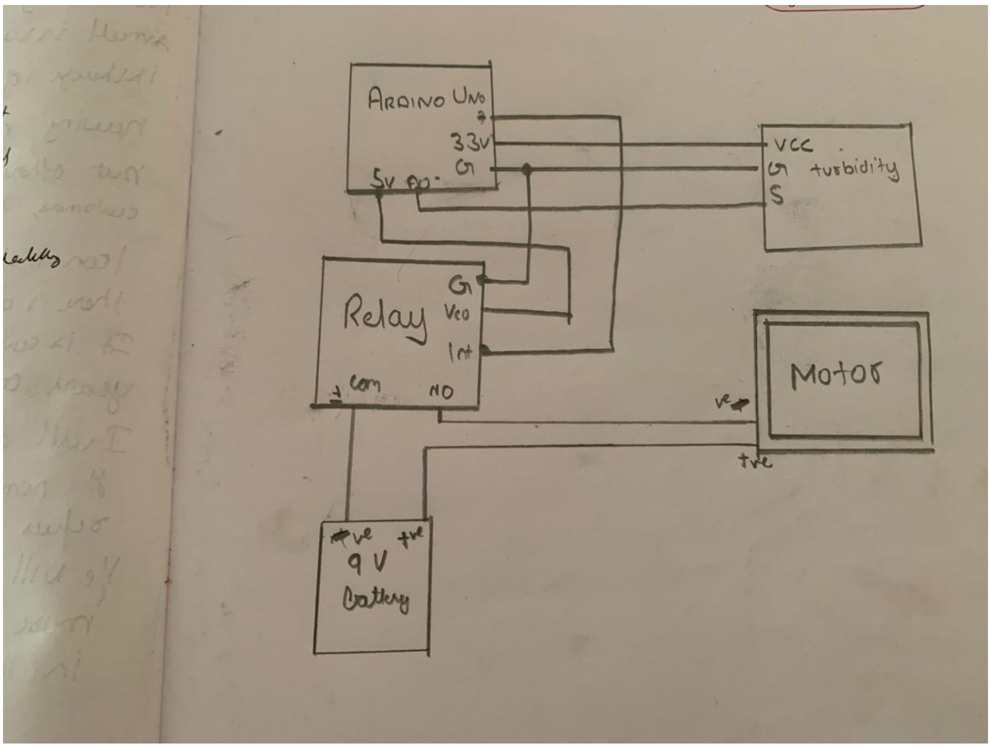

Fig 3- CIRCUIT DIAGRAM OF TURBIDITY SENSOR FOR SMART IRRIGATION SYSTEM MODEL

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁙ Peer-reviewed & Refereed journal ⁙ Vol. 12, Issue 7, July 2024

DOI: 10.17148/IJIREEICE.2024.12719

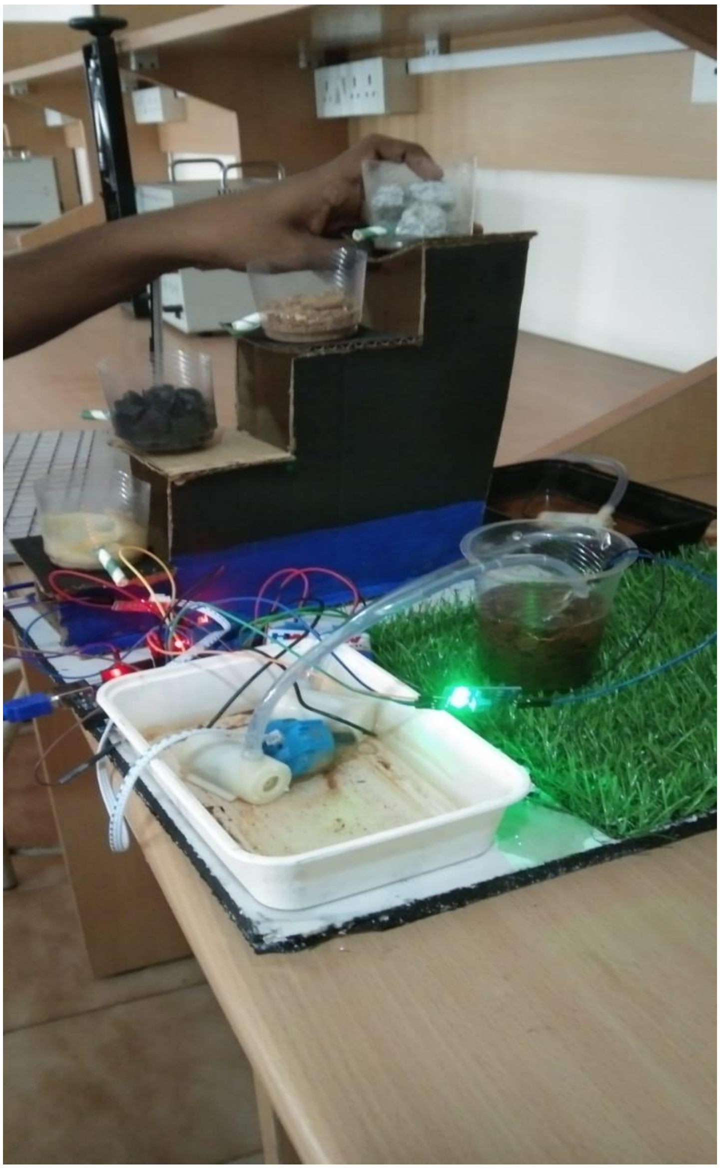

Fig 4- Water Quality Control for Clever Watering with Arduino UNO

V. CONCLUSION

The project on water quality management and smart irrigation using Arduino Uno showed how modern tech can improve farming. By putting together soil moisture sensors, water quality sensors, and automatic controls, the system offered a full solution to use water better and keep water quality high when irrigating.

The project accomplished these main things:

- Smart Water Use: The smart irrigation system kept an eye on how wet the soil was and changed when to water based on this. This cut down on wasted water and made sure plants got just the right amount.
- Healthier Crops: By always checking things like how acidic the water was and how clear it was, the system helped keep the best conditions to grow plants. This stopped possible harm from bad water.
- Easy and Automatic: Setting up controls that work on their own and maybe even watching from far away made things easier and more efficient. This meant less need to do things by hand and better use of resources.
- Scalability and Flexibility: Using Arduino Uno and modular sensor parts gives the system the ability to grow and change for different farm settings, from little gardens to big farms.

DOI: 10.17148/IJIREEICE.2024.12719

- Cost-Effectiveness: The project showed that cheap easy-to-get tech could make water management better bringing advanced solutions to more people.
- To wrap up, our project hit its goals by creating a strong and productive smart watering system. By combining real-time checks and automatic control, we didn't just make water use better - we also pushed for farming methods that can last. Looking ahead, we could work on making the system do more, like using more advanced ways to crunch numbers, making sensors more accurate, and adding in other things to measure such as how hot or humid it is. This project lays the groundwork for more new ideas in smart farming and using resources.

REFERENCES

[1]. Mehmeti, Andi & Canaj, Kledja. (2022). Environmental Assessme nt of Wastewater Treatment and Reuse for Irrigation: A Mini-Review of LCA Studies. Resources. 11. 94. 10.3390/resources11100094

[2]. Hashem, M.S.; Qi, X.Treated Wastewater Irrigation—A Review. Water 2021, 13, 1527. https://doi.org/10.3390/w13111527

[3]. Slobodiuk, S.; Niven, C. Arthur, G.; Thakur, S.; Ercumen, A. Does Irrigation with Treated and Untreated Wastewater Increase Antimicrobial Resistance in Soil and Water: A Systematic Review. Int. J.Environ. Res. Public Health 2021, 18,11046. https://doi.org/10.3390/ijerph182111046

[4]. Laura García, Lorena Parra, Jose M. Jimenez, Jaime Lloret, Pascal Lorenz. IoT-Based Smart Irrigation Systems: An Overview on the Recent Trends on Sensors and IoT Systems for Irrigation in Precision Agriculture. Sensors, 2020, 20 (4), pp.1042. ff10.3390/s20041042ff. ffhal-03671933f

[5]. Gomathy, C K. (2022). THE SMART IRRIGATION SYSTEM USING IOT. 2395-0056

[6]. Karpagam, J. & Merlin, I.Infranta & Bavithra, P. & Kousalya, J.. (2020). Smart Irrigation System Using IoT. 1292-1295. 10.1109/ICACCS48705.2020.9074201

[7]. Rohith, M. & Sainivedhana, R & Fatima, Naveed. (2021). IoT Enabled Smart Farming and Irrigation System. 434-439. 10.1109/ICICCS51141.2021.9432085

[8]. Reddy, V. & Harivardhagini, S. & Sreelakshmi, G.. (2024). IoT and Cloud Based Sustainable Smart Irrigation System. E3S Web of Conferences. 472. 10.1051/e3sconf/202447201026.

[9]. Shukla, Ashish, and Bhupendra Verma. "Smart Irrigation System: A Review on IoT Based Implementation." International Journal of Engineering Trends and Technology (IJETT) 48, no. 4 (2017): 168-173