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R.V. COLLEGE OF ENGINEERING, Bengaluru-560059
(Autonomous Institution Affiliated to VTU, Belgaum)

PRECISION IRRIGATION
EXPERIENTIAL LEARNING REPORT

Submitted by

1. **RVCE22BCS005 KHUSHI GUPTA khushigupta.cs22@rvce.edu.in**
2. **RVCE22BCS025 KSHITHI RAMESH kshithir.cs22@rvce.edu.in**
3. **RVCE22BCS223 MANASA S manasas.cs22@rvce.edu.in**

Submitted to

Dr. Mahesh R (Department of Chemistry)

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DEPARTMENT OF ELECTRONICS AND COMMUNICATIONS ENGINEERING

CERTIFICATE

It is certified that the **Experiential learning** titled **Precision Irrigation** is carried out by **Khushi Gupta, Manasa S, Kshithi R** who are bonafide students of R.V College of Engineering, Bengaluru, during the first semester, in the year **2022-2023**. It is also certified that all corrections/suggestions indicated for the Internal Assessment have been incorporated in the report. The report has been approved as it satisfies the academic requirements in respect of experiential learning.

Signature of Staff In-charge

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Introduction

Irrigation

•Irrigation is the supply of water to crops by artificial means.

Smart irrigation

• Smart irrigation systems tailor watering schedules and run times automatically to meet specific landscape needs.

Impact of Smart irrigation

•Smart irrigation can save irrigation water and improve yield at the farm level, consequently leading to improved food security for the global population.

•It is an advanced technology that contributes to water conservation, energy savings, soil stability, and cleaner water resources for wildlife.

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PROBLEM SURVEY

•Loss of water- Traditional irrigation practices face the loss of water through seepage and lack of adequate extension services reduce its coverage and cause uneven distribution.

•Staffing Shortages – Traditional irrigation practices face the problem of staffing shortage. Efficient and productive workers and cattle that are skilled in economical irrigation are necessary.

•Wastage – Unregulated irrigation can lead to wastage of precious fresh water and can wash away the fertile top layer of soil, change the Ph of the soil, the important nutrients and fertilizers get wasted.

•Waterlogging - Waterlogging is an issue on uneven land.

There are too many dimensions a user has to be aware of which is depicted in the below picture:

And makes it complex for the user to really know which area to focus o

What all should I focus on?

LITERATURE SURVEY

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MOTIVATION

- Smart irrigation is a topic of great importance as it addresses a critical global issue: water conservation and management. With the world's population growing rapidly and demand for water increasing, it's crucial to find ways to optimize the use of this finite resource.
- Smart irrigation systems use sensors, weather data, and advanced algorithms to adjust watering schedules and amounts, ensuring that crops receive the right amount of water at the right time. This results in more efficient use of water, which not only conserves this valuable resource but also leads to better plant health, growth, and productivity.
- Another factor that has contributed to the increasing popularity of smart irrigation is the need for more sustainable and environmentally friendly farming practices. With the effects of climate change becoming increasingly apparent, it's more important than ever to adopt technologies that help reduce the carbon footprint of agriculture. Smart irrigation systems can help achieve this by reducing water waste and allowing for more precise water use.

Overall, smart irrigation is a timely and relevant topic with significant impacts on agriculture, water management, and the environment

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OBJECTIVES

This project, an interdisciplinary approach to Smart Irrigation, aims to :

- To design and develop a smart irrigation system that is able to optimize water use and conserve water resources.
- To evaluate the efficiency and effectiveness of the smart irrigation system in terms of water savings, crop health and yield, and energy use.
- To investigate the impact of smart irrigation on the environment, including water quality, soil health, and greenhouse gas emissions.
- To explore the potential for integrating smart irrigation systems with other agricultural technologies, such as precision agriculture, remote sensing, and greenhouse automation.
- To identify and address technical, economic, and social challenges associated with the implementation of smart irrigation systems.
- To educate and raise awareness among farmers, policymakers, and the general public about the benefits of smart irrigation and the importance of water conservation and management.

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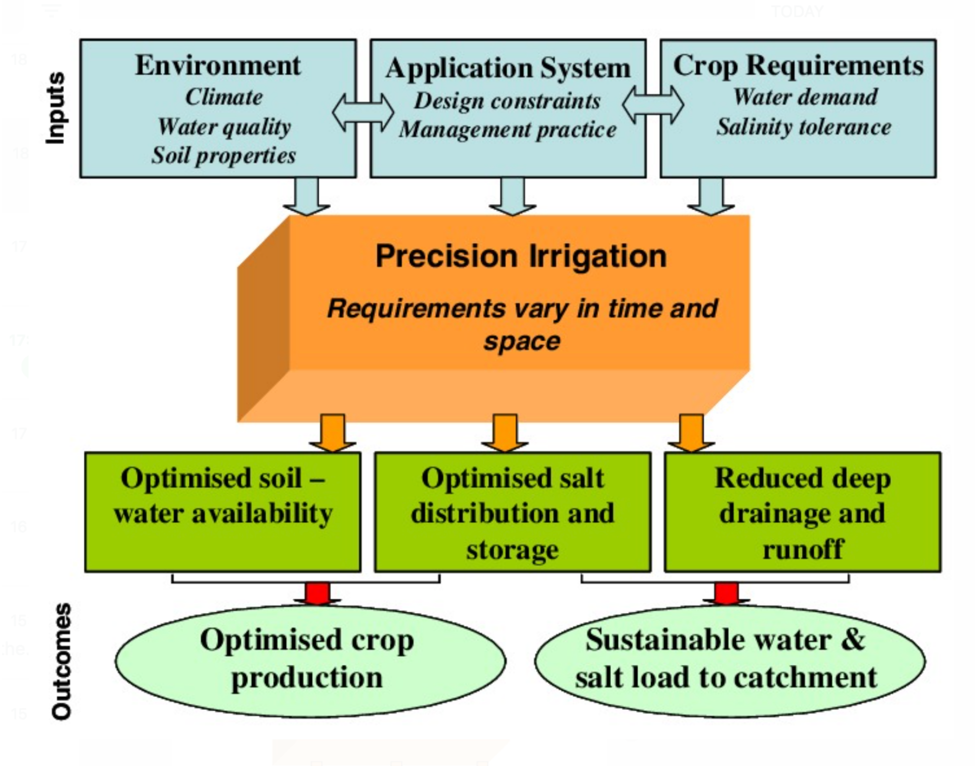
METHODOLOGY

Precision irrigation is considered as a solution to the various challenges listed for the user. Precision Irrigation is a system that would consider various factors like environment, crop requirements and helps the end user with optimized crop production while at the same time providing it in environmentally sustainable ways. The below diagrams depict the workflow of the precision irrigation system and how the end user will ultimately use it.



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CHEMISTRY COMPONENT IN SMART IRRIGATION

1**. pH Monitoring**: pH is one of the most important factors in soil fertility. Smart irrigation systems can monitor the pH levels of soil and adjust the irrigation accordingly.

2. **Soil Moisture Monitoring**: Smart irrigation systems can measure and monitor the moisture levels in the soil, and adjust the amount of water needed for optimal plant health. This involves using sensors to measure the water content of the soil, and the data collected can be used to determine when and how much water should be applied to the soil.

3. **Nutrient Monitoring**: Smart irrigation systems can monitor the nutrient levels in the soil and adjust irrigation accordingly. Nutrient application control involves using sensors to measure the nutrients in the soil, and the data collected can be used to determine when and how much fertilizer should be applied

4. **Temperature Monitoring**: Smart irrigation systems can measure the temperature of the soil and adjust the amount of water needed for optimal plant growth.

5. **Salinity Monitoring**: Smart irrigation systems can measure the salinity of the soil and adjust the amount of water needed for optimal plant health.

POLYMERS USED IN SMART IRRIGATION

- Smart polymers are **those that undergo rapid, reversible phase changes in response to small changes in environmental conditions.**
- They work when the protein to be separation forms a bioconjugate – a stable covalent link between the biomolecule and another molecule – with a polymer and precipitated with the polymer when the environment is changed.
- Polymers that are used in drip irrigation include **HDPE, LDPE and LLDPE.**

  Example: Ista and Lopez employed poly(N-isopropylacryl-amide) (PNIPAAM), a polymer that is soluble in water below, but insoluble above, 32°C

- Smart irrigation technologies can also involve the use of water-soluble polymers to help retain water near the roots of plants.
- These polymers absorb and store water in the soil, making it available to plants when needed
- The use of polymers can help to reduce the amount of water required for irrigation, as the water is released slowly into the soil.
- Finally, smart irrigation technologies can also include the use of various control systems, such as valves and pumps, to regulate the flow of water. This helps to ensure that the right amount of water is being applied to the soil in the right areas

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IMPORTANCE OF CHEMISTRY IN SMART IRRIGATION

- Water Quality: The water quality should be tested to determine the pH level, total dissolved solids (TDS), electrical conductivity (EC), and the presence of any contaminants such as salts, minerals, or heavy metals. This information is used to determine the suitability of the water for irrigation and to adjust the water quality as needed.
- Soil Chemistry: The soil chemistry should be analyzed to determine the nutrient content, pH level, and the presence of any contaminants such as salts, minerals, or heavy metals. This information is used to determine the suitability of the soil for growing plants and to adjust the soil chemistry as needed.
- Fertilizers: Fertilizers can be added to the irrigation water to provide the plants with the necessary nutrients for optimal growth. The type and amount of fertilizer used will depend on the specific requirements of the plants and the soil chemistry
- Chemicals: Certain chemicals, such as biocides, can be added to the irrigation water to control pests and diseases. The use of chemicals should be carefully monitored and regulated to ensure that they do not have a negative impact on the environment or the plants.

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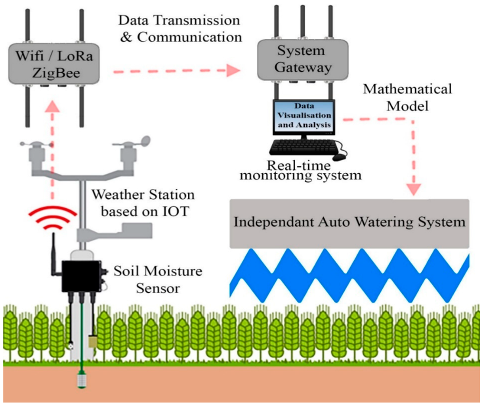
MATHEMATICAL COMPONENT IN SMART IRRIAGTION

A real-time monitoring and auto-watering system based on predicting mathematical models that efficiently control the water rate is needed. It gives the plant the optimal amount of required water level, which helps to save water. It also ensures interoperability among heterogeneous sensing data streams to support large-scale agricultural analytics.

The mathematical model is embedded in the Arduino Integrated Development Environment (IDE) for sensing the soil moisture level and checking whether it is less than the pre-defined threshold value, then plant watering is performed automatically. The proposed system enhances the watering system's efficiency by reducing the water consumption by more than 70% and increasing production due to irrigation optimization. It also reduces the water and energy consumption amount and decreases the maintenance costs.

The use of sensors helps to use water efficiently and reduce the water consumption and energy needed for irrigation, reducing the need for labor to turn the motor ON and OFF, controlled by the automated irrigation system based on renewable energy.



Automatic water sprinkler

- Number of neighbors: If the number of neighbors exceeds the number of hops (from the destination).
- Low traffic: If the node has not received a message for a specific time t = 2

$$(t = 2) \tag{3}$$

- Inactive paths: If there are no active paths in the routing,

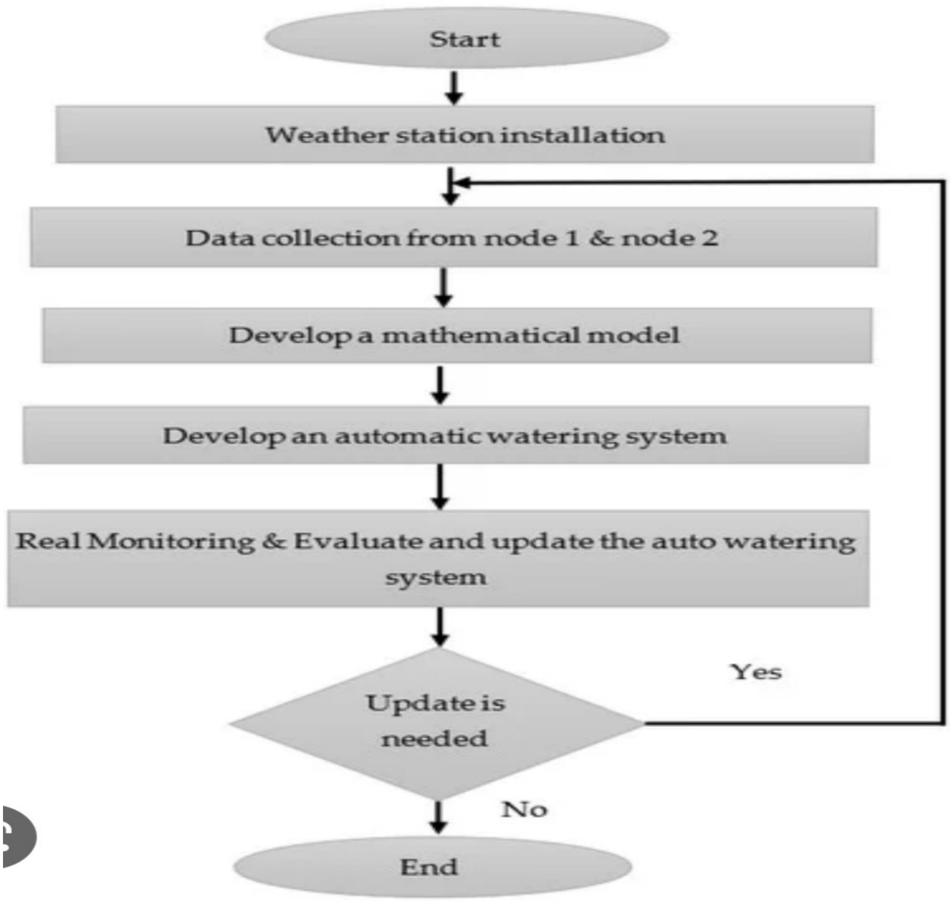
$$\sum (actifpath)_t = 0 \tag{4}$$

- Isolated node: If the size of the neighbors table is empty,

$$\sum (N_{neighbors})_t = 0 \tag{5}$$

Unstable Node: a node is called node unstable when there is changing of its neighbors in a period of time t, or $t > 3$.

- The unstable nodes are detected by the following algorithm:



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ARDUINO CODE

```
int sensor_pin = A0; // Soil Sensor input at Analog PIN A0
int output_value ;
void setup() {
  // put your setup code here, to run once:
  pinMode(4,OUTPUT);
     Serial.begin(9600);
   Serial.println("Reading From the Sensor ...");
   delay(2000);
}


  // put your main code here, to run repeatedly:

  void loop() {
   output_value= analogRead(sensor_pin);
 output_value = map(output_value,550,10,0,100);
   Serial.print("Mositure : ");
   Serial.print(output_value);
   Serial.println("%");
   if(output_value<0){
      digitalWrite(4,HIGH);
     }
     else{
            digitalWrite(4,LOW);
     }
   delay(1000);
}
```

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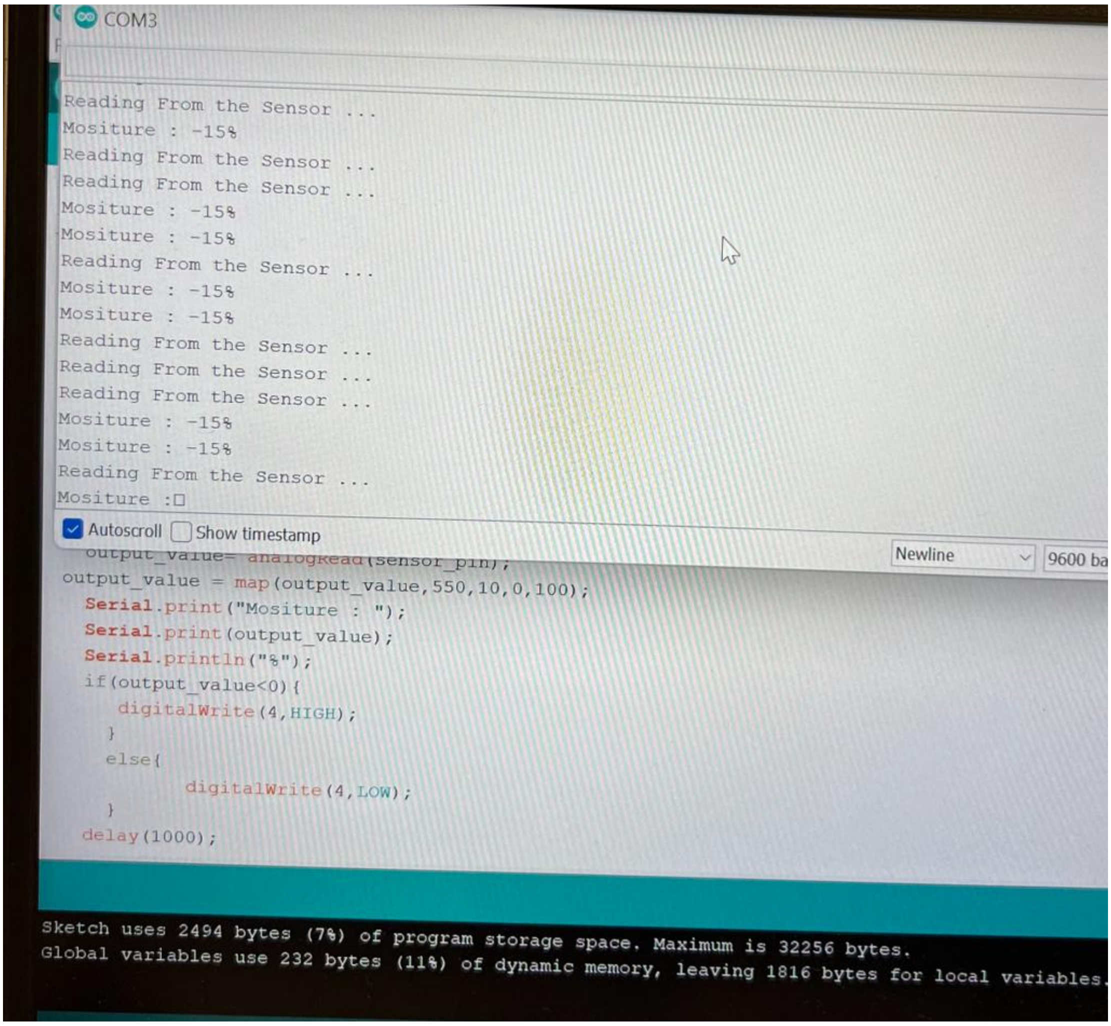
RESULTS AND DISCUSION



NEGATIVE VALUE – WATER WILL COME OUT OF THE PIPE
POSITVE VALUE – WATER WILL NOT COME OUT OF THE PIPE

RECOMMENDATION OF SMART IRRIGATION

Smart irrigation systems are a recommended solution for many agriculture and landscaping applications. The key benefits of smart irrigation systems include:

1. Water Conservation: Smart irrigation systems use water more efficiently and can reduce water waste by up to 50%. This is because the system is designed to provide the plants with the exact amount of water they need, based on real-time data.
2. Improved Plant Growth: By providing the plants with the right amount of water and nutrients, smart irrigation systems can improve plant growth and increase crop yields.
3. Cost Savings: By reducing water waste and improving plant growth, smart irrigation systems can help to lower operating costs and increase profitability.
4. Remote Monitoring: Smart irrigation systems can be monitored remotely, which allows for real-time monitoring of water usage and soil moisture levels. This makes it easier to identify potential issues and make adjustments to the system as needed.
5. Ease of Use: Smart irrigation systems are user-friendly and easy to operate, making them accessible for farmers and landscapers of all skill levels.

DRAWBACKS OF SMART IRRIGATION

While smart irrigation systems have many benefits, there are also some potential drawbacks to consider:

1. Cost: Smart irrigation systems can be expensive to install and maintain, especially for large-scale operations. The cost of equipment, such as sensors and control systems, can be high, and there may also be ongoing costs for maintenance, software upgrades, and data analysis.
2. Technical Challenges: Smart irrigation systems require sophisticated technology and software to function effectively, and there can be technical challenges in ensuring that the system is working optimally. There may also be compatibility issues with existing systems, which can be time-consuming and expensive to resolve.
3. Maintenance: Regular maintenance and upkeep are required to ensure that the system is functioning optimally, and problems can arise if the system is not properly maintained. This can result in reduced efficiency and water waste.
4. Data Accuracy: The accuracy of the data collected by the sensors is crucial for the effective operation of a smart irrigation system. If the data is inaccurate, it can result in the plants receiving too much or too little water, which can negatively impact plant growth.
5. Reliance on Electricity: Smart irrigation systems rely on electricity to operate, which can be a problem in areas with limited or unreliable power supplies. This can result in system failures or reduced efficiency.
6. Limited Flexibility: Smart irrigation systems are designed to operate based on specific algorithms, which may not be suitable for all types of plants or soils. This can limit the flexibility of the system and reduce its effectiveness in certain conditions

FUTURE SCOPE IN AREA

- Precision irrigation is a modern technique of irrigation that aims to use water efficiently and effectively in agriculture. As technology continues to advance, there are several areas of future scope for precision irrigation. Here are a few:

- Artificial intelligence and machine learning: The use of AI and ML can help in predicting crop water requirements, identifying areas of water stress, and optimizing irrigation scheduling. This technology can help in reducing water waste and improving crop yields.

- Remote sensing and satellite imagery: The use of remote sensing and satellite imagery can help in identifying crop water needs and monitoring the distribution of water in real-time. This technology can also help in identifying crop stress and nutrient deficiencies, which can improve crop yields.

- Sensor technology: The use of sensor technology can help in monitoring soil moisture, temperature, and other environmental factors in real-time. This information can help in optimizing irrigation scheduling and reducing water waste.

- Internet of Things (IoT): The use of IoT can help in automating irrigation systems and making them more efficient. IoT sensors can be used to monitor soil moisture levels, weather conditions, and other environmental factors, and can communicate with irrigation systems to ensure that crops receive the right amount of water at the right time.

- Drones: The use of drones can help in mapping crop health and identifying areas of water stress. Drones can also be used to deliver water and nutrients to crops in a precise and efficient manner.

Overall, precision irrigation has a bright future with the continued advancements in technology. The use of AI, ML, remote sensing, sensor technology, IoT, and drones can help in making irrigation systems more efficient and effective, leading to improved crop yields and reduced water waste.

CONCLUSION

In conclusion, precision irrigation is a modern irrigation technique that uses technology to optimize water use in agriculture. With the increasing global demand for food and water scarcity, precision irrigation has become an essential tool in sustainable agriculture. By using technology such as artificial intelligence, remote sensing, sensor technology, IoT, and drones, precision irrigation can help in reducing water waste, improving crop yields, and minimizing the environmental impact of agriculture.

Precision irrigation also offers benefits such as reduced labor costs, increased efficiency, and improved crop quality. By providing crops with the right amount of water at the right time, precision irrigation can help farmers achieve better yields while conserving water resources.

However, the implementation of precision irrigation requires investment in technology, education, and infrastructure. The costs of these technologies and the need for specialized knowledge can be a barrier for some farmers. Nonetheless, with continued innovation and advancements in technology, precision irrigation has the potential to become a standard practice in agriculture, contributing to sustainable food production and water management.

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To conclude…

We really liked doing this experiential learning project as it gave us exposure to real life challenges of the users. Thank You