1. Introduction

The advancement of smart irrigation systems using machine learning (ML) is a significant technological innovation aimed at enhancing water efficiency in agriculture. As global water resources become increasingly scarce, optimizing water use in agriculture through smart technologies is critical. This review will explore the literature on smart irrigation systems, examine the data requirements for such systems, and provide an overview of the ML technologies that can be applied.

2. Literature Review

Recent studies have focused on the development of intelligent irrigation systems that predict water needs based on environmental data.For precision agriculture, Khalil Ibrahim Mohammad Abuzanouneh et al. developed a novel IoTML-SIS to make efficient use of farmland's water resources. Three distinct processes are involved in the proposed model: data collection, classification based on LS-SVM, and parameter adjustment based on AAA. A series of sensors were used to detect the farmland characteristics during the data gathering phase, and the measurements are sent into the machine learning model for classification. The LS-SVM model is used as a classifier to ascertain the necessary water level. In addition, AAA is used to optimise the LS-SVM model's parameters in order to improve classification performance. The suggested IoTMLSIS technique's performance validation guaranteed superior performance over the compared approaches in terms of a number of evaluation factors.

Salim et al. introduced a state-of-the-art smart irrigation system that uses machine learning, data analysis, and the Internet of Things (IoT) to find the most effective times and ways to apply and schedule water for irrigation.The use of a well chosen dataset called "Crop Irrigation Scheduling," obtained from Kaggle, is the foundation of the creative system. Six essential attributes are included in this dataset: temperature, humidity, irrigation, crop type, crop days, and soil moisture. The metadata of the collection includes a detailed description of these qualities, which offer the fundamental data needed for accurate irrigation control.

3. Data Overview

The data used in smart irrigation systems typically include soil moisture levels, weather data (e.g., temperature, humidity, rainfall), and crop-specific information.The Smart Farming 2024 (SF24) dataset is a comprehensive collection of agricultural data gathered from various farms across California, designed to enhance crop health monitoring and environmental stress assessment.

4. Technology Overview

Technology Overview

Machine learning technologies, particularly supervised learning algorithms, are central to smart irrigation systems. These include regression models, decision trees, and neural networks, which are trained to predict water requirements based on input data. IoT devices, such as soil moisture sensors and weather stations, provide real-time data that feeds into these ML models. Cloud computing platforms are often used to manage the large volumes of data and perform real-time processing and analysis.

Relevance to Your Project

The technologies reviewed are directly relevant to the development of a smart irrigation system. By leveraging ML algorithms, the system can address the challenge of optimizing water use in agriculture. IoT devices will enable real-time data collection, while cloud computing will provide the necessary computational power for processing and analysis.

Comparison and Evaluation

Among the ML techniques, decision trees offer interpretability and ease of use, making them suitable for systems where understanding model predictions is important. On the other hand, neural networks, while more complex, can handle non-linear relationships and are better suited for more complex datasets. IoT technologies vary in cost and scalability; choosing devices that are cost-effective yet reliable is essential for widespread adoption.

Despite the success of smart irrigation systems, challenges remain, such as the high cost of IoT devices and the need for robust data preprocessing pipelines. There is also an opportunity to explore the integration of remote sensing data and the development of more generalized models that can adapt to different crop types and regions.

5. Conclusion

In summary, the integration of machine learning and IoT technologies in smart irrigation systems holds great promise for enhancing water efficiency in agriculture. The reviewed technologies provide a strong foundation for developing a system that can make real-time irrigation decisions, ultimately contributing to sustainable agricultural practices.

6. References

https://www.researchgate.net/publication/375212442_Smart_irrigation_system_using_IoT_and_machine_learning_methods

https://cdn.techscience.cn/ueditor/files/cmc/TSP_CMC-72-1/TSP_CMC_22648/TSP_CMC_22648.pdf