SMART IRRIGATION WITH ANIMAL DETECTION: A SURVEY

[1]Prof. Leena Shruthi H M, [2]Prerana B S, [3]Punya S, R [4]Varnashree, Rohit
[1]Professor, [2,3,4]Students
Department of CSE
East West Institute of Technology
Bengaluru, India

Abstract*—*Water requirement for agriculture purposes is large. The farmers are unable to meet the water requirements due to the limited amount of rainfall. Under- or over-irrigation of irrigated land in a conventional irrigation system can result in adverse crop effects and water wastage. The urgent requirement is for an automated system. During the monsoon season, farmers are confronted with a problem as animals have infested agricultural fields, leading to increased yields. Smart Agriculture (SA), a field that leverages ICT to optimize resource usage and crop yield enhancement, is becoming increasingly popular.

The need for reliable and efficient automatic smart farming systems has increased as a result of rapid technological advancements in IoT-based agriculture technology. This research presents a comprehensive solution for optimizing irrigation practices through the integration of advanced technologies. Additionally, the system incorporates a novel approach for animal detection using a laptop camera and machine learning algorithms. The combination of Arduino-based hardware and machine learning for smart irrigation and animal detection contributes to a versatile and scalable solution applicable to a variety of agricultural settings.

Keywords— Internet of Things (IoT),Arduino,Smart Agriculture(SA),Precision Farming.

I. INTRODUCTION

Agriculture is the back bone of India. it ranks second in the global context in farm output. Irrigation accounts for 55-70% of water usage in India. Water is the basis and the main engine of life on earth. Humans use water for industrial purposes, sanitation, and irrigation. In the last decades, the annual water withdrawal ranged between 1,10,00,000 billion and 1,50,00,000 m^3 per year, out of which 69 % is utilized for agriculture.
Unfortunately, most of this water is wasted because of inadequate irrigation control systems. Availability of water has been decreasing. The increase in food demand and the rapid increase in population are causing an urgent need for optimal water table and energy usage in sustainable agriculture. The irrigation activity involves supplying water to agricultural land by augmenting rainfall. The irrigation systems range has been implemented. Water conservation isn't a significant objective of the irrigation system. Additionally, the water requirement of the crop is affected by the soil type, crop, and environmental factors such as temperature and humidity. The traditional irrigation method results in land being irrigated too little or too much. Plant growth and development are prevented by scarcity.
Excessive water has a detrimental effect on the growth of plants. A traditional irrigation system requires human intervention, which becomes a time-consuming process. Smart irrigation system solutions are now accessible through the Internet of Things.

Agriculture is an integral aspect of our human community. It has been upgraded with time to increase agricultural yields Technology has advanced in the field of agriculture, horticulture, and forestry to better monitor plant growth, disease transmission patterns, and also as pest population control. AI and IoT have numerous burgeoning scopes in agriculture to solve various issues like soil conditions, weather status, pest detection, determination of harvesting time, and so on.
Traditional irrigation methods often rely on fixed schedules, leading to overuse of resources like water or inadequate moisture levels for crops. Additionally, the unpredictable nature of animal intrusion poses a significant threat to crop yields. By integrating advanced sensors and control mechanisms, our Smart Irrigation system aims to enhance resource utilization and safeguard crops from unwanted external factors.
In the previous few years, research on Wireless Sensor Networks (WSN) has been concentrated in many sectors and applications. The issue of animal intrusion is a significant concern in Bihar, Chhattisgarh, Uttarakhand, and the vicinity of forested areas. The government and the farmers are dealing with this issue. Farmers who depend on their crops for sustenance during the non-monsoon season lose their main source of income, which is rice and wheat. This is a serious issue for the farming industry.
Villages have attempted to use traditional methods to solve the problem, indicating the necessity for a system designed to monitor intelligently that can automatically identify the intruding animal and alert farmers.

A. Deep Learning and Machine Learning in Agriculture:

Machine learning is the general use of algorithms and data to create autonomous or semi-autonomous machines. Deep learning is just one aspect of machine learning that uses ANN to mimic the learning process of the human brain. These include prediction of soil parameters such as organic carbon and moisture content ,crop yield prediction ,disease and detecting weeds among the crops ,species detection, crop management

processes, farming conditions management, livestock management.

Machine learning makes agricultural applications incredibly efficient and simple. Data acquisition, model building, and generalization are the three stages of the machine learning process. Traditional machine learning is improved by Deep Learning by adding additional complexity to the model and changing the input with numerous functions that enable hierarchical data representation. Applications of ML and DL help to discover and resolve problems that crop growth encounters. In agriculture, the production of crops can be enhanced by applying deep learning and machine learning methodologies. These techniques demonstrate the rapid advancement of technology in the agriculture sector.

ANNs and DL are the most often used models in agriculture. Potential risks are identified by analyzing video feeds using machine learning algorithms.

Upon detection, the system triggers appropriate responses, such as activating deterrent devices or sending alerts to the farmer. The combination of Arduino-based hardware and ML for animal detection contributes to a versatile and scalable solution applicable to a range of agricultural settings.

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B. IoT in Smart Agriculture:

IoT solutions in agriculture are being used to improve farm productivity and resources by analyzing agricultural data. IoT sensors, software, and data enable farmers to monitor the field and livestock conditions, and to additionally make informed decisions regarding the same. IoT technologies also help farmers to reduce waste generation and improve productivity. Some examples of IoT technologies in agriculture are drones, soil sensors, water pumps, and machines.

IoT coupled with various smart sensors assist the farmers for better management of crops and vegetables in a larger area and brief time. With the rapid advancement in ICT, today's era has left the idea of the internet far behind, and a new concept has emerged: the IoT. There are many definitions of IoT set by many organizations working globally.

Even though IoT is mainly about connecting and automating things (objects) over the internet, this concept is only possible because of human intervention.The currently adopted irrigation methods are somewhat advanced and depend on watering at specific times, which doesn't demand a lot of human intervention. Furthermore,it involves a high degree of guesswork and this possibly is a huge waste of water and energy. Some field parts are under or over irrigated even with modern irrigation systems.

Besides, although farmers would stop irrigation systems when expected to rain, sometimes they do not check the weather to adjust their schedules accordingly. An intelligent irrigation system can take all of this into account using precision farming methods and IoT-enabled sensors that monitor soil moisture levels, humidity, and temperature everywhere in the field.

In agronomic applications, to forecast crop health, WSNs are utilized to remotely monitor soil and ambient conditions. Using WSN as a forecasting approach, the watering schedule of agricultural fields can be predicted. WSN acquire data from external variables such as pressure, humidity, and temperature, as well as soil moisture, salinity, and conductivity.

By integrating advanced sensors and control mechanisms, our Smart Irrigation system aims to enhance resource utilization and safeguard crops from unwanted external factors. The main components of the system include a network of sensors for real-time monitoring of environmental conditions.

Hence by using the concept of IoT in the field of agriculture sector we not only can achieve conservation of water by managing the water usage efficiently but we also ensure that the crop are properly irrigated.

C. Precision Farming:

Agriculture , as a cornerstone of human civilization, has been continuously evolved with technological advancements to fulfill the demands of a growing global population. In that context, precision agriculture has evolved into a revolutionary technique that utilizes cutting-edge technologies to improve farming methods. The smart irrigation systems are crucial in this advancement as they intelligently handle water resources for crop production. However, the challenges posed by environmental variables and unexpected factors, such as animal intrusion, underscore the necessity for integrated and adaptive solutions.

Precision agriculture (PA) or the precision farming is a farming management strategy based on observing, measuring and responding to temporal and spatial variability to improve agricultural production sustainability. It plays an important role in both crop and livestock production.

Satellite and aerial imagery, weather forecasting, variable rate fertilizer application in agriculture, and crop health indicators were the first steps in the precision agricultural revolution.

Another group utilizes machine data to give more detailed data concerning the plants, land uses, and soil types.

Precision farming employs IoT based technologies to monitor agricultural factors. IoT provides real time vital data about the crop, soil, water, and air conditions for better protection of environment and continued sustainability of agricultural production. Irrigation can be transformed into the smart irrigation system to escalate the irrigation process in a short period of time.

PF(precision farming) is a farming method that employs information technology to make sure that the crops and soil are given the necessary nutrients for optimal growth. Rather than utilizing the same inputs across the field, the idea is to distribute them on a site-by-site basis to maximize cost savings and avoid waste.

Like conservation agriculture, PF is a blend of different technologies rather than a one-off approach and allows for site-specific management (SSM) to efficiently utilize their resources and get economic gains. An essential component of PF is comprehending natural and learning about variation within the farm.

Basically what precision farming does is that it employs data from multiple sources to improve crop yields and increase the cost-effectiveness of crop management strategies.

II. LITERATURE SURVEY

Title	Authors	Year	Objectives	Advantages	Disadvantages
Smart Agriculture: An IoT-based Framework	A. Khedekar, P. Pagar , S. Pattalwar	2018	Integration of the IoT devices , including soil moisture sensors and actuators, for collection of data and also automated irrigation.	The solution offered manages water very efficiently through real time monitoring system.	This paper has limited focus on animal detection.
IoT-Based Smart Agriculture: Towards Making Farming Smarter	A. Raut, S. Chavan	2019	Employed IoT devices for monitoring soil moisture, temperature, and humidity; focused on enhancing the irrigation practices.	Improved crop yield through the precise irrigation scheduling	This paper lacks of animal detection mechanism.
Development of an Automated Irrigation System Using IoT	N. Singh, S. Sharma.	2020	This paper explains how to utilize IoT devices for soil moisture sensing and automated irrigation control.	Water conservation through optimized irrigation.	Absence of animal detection mechanism.
A Review on Smart Agriculture Monitoring System Using IoT	S. Mishra, V. Kumar.	2020	Comprehensive review of various IoT-based systems for agriculture, highlighting the need for integrated solutions.	Provides insights into the importance of integrated systems for smart agriculture.	Does not present a specific solution with both irrigation and animal detection components.
Smart Farming System Using IoT	S. Yadav, N. Goyal	2021	IoT-based system with soil moisture sensors, temperature, and humidity sensors for real-time control and monitoring of the data.	Real-time data for efficient irrigation management.	No provision for animal intrusion detection.
IoT based smart irrigation monitoring and controlling system	S. B. Saraf and D. H. Gawali,	2021	Sensor modules are used to improve productivity in the commercial agriculture sector	Practical implement--tation for efficient monitoring and controlling of the agriculture systems	Does not present an adaptive solution for animal intrusion.

This study's literature review is presented in tabular style, offering a thorough summary of pertinent research publications. The table encompasses crucial details like the name of the study, author(s), publication year, research objectives, and key advantages and disadvantages identified in each work.

Title	Authors	Year	Objectives	Advantages	Disadvantages
Intelligent Animal Detection System Using Machine Learning	S. Patel, K. Shah	2021	Focused on machine learning for animal detection using the cameras, without the integration with the agriculture systems	This papers offers accurate animal detection using machine learning algorithms.	.Does not address irrigation or the agriculture system integration.
Automated Crop Monitoring and Smart Irrigation System	A.Sharma, N.Tyagi	2022	Combined IoT sensors for soil health monitoring with a smart irrigation system.	Enhanced crop health and yield through automated irrigation	Lack of consideration for animal interference in this system.

III. CONCLUSION

The suggested system regarding the irrigation is highly efficient and reliable solution. With the regular monitoring of soil and environmental conditions, it becomes effortless to analyze data and determine the appropriate amount of water needed during each day. In conclusion, the integration of smart irrigation with animal detection using a diverse set of technologies, including Arduino, sensors, machine learning, and actuators, represents a significant leap forward in modernizing agricultural practices.

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