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Jasmine Crop Cultivation using IoT Integrated with Datamining

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Abstract:

In agriculture Jasmine plant cultivation plays precise role in environment and to achieve good quality of flowers, yield of flowers it suitable for precision solutions plant farming. In olden days cultivation of Jasimine plants on monitoring in real time, lacking result in resources utilization is inefficient and productivity reduction. Maintaining these conditions is challenging and also leads to not consistent yield. Now a days real time monitoring and automation using trends IOT becomes emerging technology and it reduce the interference of human, however large volume of data is generated when compared traditional.

This paper proposes of Jasmine crops with smart farming IOT enabled integrated with datamining techniques. The data collects from sensors and applies classification algorithm to predict optimize irrigation, detect diseases , reduces usage of water, enhanced productivity , support data driven and decision making in farming of Jasmine crops.

Keywords: Jasmine Crop Cultivation, Smart Agriculture, Internet of Things (IoT), Data Mining, Precision Agriculture, Smart Farming, Sensor-Based Monitoring, Irrigation Optimization, Disease Detection, Crop Yield Prediction, Agricultural Data Analytics, Resource Optimization, Sustainable Agriculture, Classification Algorithms, Real-Time Monitoring.

1.Introduction

Nowadays, modern agriculture is emerging with progressive techniques used in jasmine agriculture for the expansion of our country and many other countries [6][13]. Among many flowering crops, jasmine is commercially valuable due to its importance in preparing perfumes, cosmetics, traditional functions, decorative purposes, and bridal uses [1]. Tamil Nadu is one of the leading producers of jasmine flowers in India [2].

Agriculture plays a major role in jasmine cultivation in Tamil Nadu and other countries because of the admirable scent and commercial importance of jasmine flowers [3]. Jasmine cultivation requires environmental monitoring such as soil moisture, atmospheric temperature, humidity, and sunlight exposure [4][10]. Uneven irrigation and unfavourable climatic conditions affect the quality and yield of jasmine flowers [5]. Usually, farmers monitor field conditions manually [17].

The Internet of Things (IoT) technology has transformed old-style agriculture into smart farming systems [6]. IoT devices enable real-time monitoring of environmental conditions through organized sensors and communication networks [11][15]. However, constant monitoring generates huge amounts of agricultural data that require smart analysis [8].

Data mining techniques play an important role in mining useful patterns, trends, and predictions from agricultural sensor data [9]. The integration of IoT and data mining allows smart agricultural systems capable of automatic irrigation, predictive analysis, crop management, yield estimation, and disease monitoring [14][22].

This paper proposes an IoT-based smart jasmine agriculture framework enhanced with data mining techniques to improve cultivation efficiency, optimize irrigation, and support data-driven agricultural decision-making [12][23].

2.Literature Review

In recent years, the use of IoT and data mining technologies in agriculture has increased significantly due to the growing demand for smart farming methods and workable crop management practices [6][9]. Modern agricultural systems aim to improve productivity, conserve resources, and support efficient decision-making through automation and real-time monitoring [12][13].

Many researchers have developed IoT-enabled smart irrigation systems that monitor soil moisture levels and automatically regulate water supply [14]. These systems help minimize unnecessary water usage and improve irrigation efficiency [5]. Various sensor-based agricultural monitoring systems are also used to gather important environmental parameters such as temperature, humidity, soil moisture, and light intensity from cultivation fields [10][16].

Wireless Sensor Networks (WSNs) play an important role in agricultural monitoring applications [11][18]. In these systems, multiple sensor nodes are placed across the farming area to collect environmental information and send the data to centralized servers or cloud platforms for further processing [15]. Although these monitoring systems improve data collection and field management, many existing models focus mainly on sensing and communication rather than smart prediction and analysis [17].

Data mining techniques have become increasingly important in agricultural research for analysing large volumes of farming data [9][22]. Different algorithms are used for crop prediction, soil condition analysis, disease identification, and productivity estimation [19]. Classification methods such as Decision Trees and Support Vector Machines are widely used for detecting plant diseases, while regression techniques are applied for crop yield prediction [23][25]. Clustering algorithms help identify environmental similarities and growth patterns in agricultural fields [20].

Even though significant progress has been made in smart farming, most research studies are concentrated on major crops such as rice, wheat and maize [21]. Comparatively fewer studies focus on floriculture crops, especially jasmine cultivation [1][3]. In addition, several existing systems do not effectively combine IoT technology with advanced data mining methods for real-time prediction and smart farming decision-making [22]. The proposed research attempts to overcome these limitations by developing a jasmine farming framework that integrates IoT-based environmental condition monitoring with data mining techniques for predictive analysis and efficient farm management [12][23].

3. Problem Statement

Traditional jasmine cultivation methods rely heavily on manual field monitoring and conventional irrigation practices. These approaches suffer from several limitations including

There is no efficient water management

Time Delay for environmental monitoring

Time taken to identification of climatic conditions favourable or not

Absence of predictive analytics for estimation of yield

Cost increased for manual labour and operational

Limited technological support for jasmine-specific farming

These limitations reduce productivity and resource efficiency. Therefore, there is a need for an intelligent and automated farming system capable of continuously monitoring field conditions and supporting data-driven agricultural decisions.

4. Objectives

The primary objective of the proposed research is to develop an intelligent IoT-based smart farming system integrated with data mining techniques for efficient jasmine cultivation. The system is designed to support real-time environmental monitoring, smart irrigation management, and predictive agricultural analysis to improve productivity and sustainability.

The detailed objectives of the proposed work are as follows:

4.1 Enhance IoT-Based Monitoring System for Jasmine Farming

The objective of research is to design and implement an IoT-enabled monitoring continuously observing environmental conditions in jasmine fields. The system uses sensors to collect real-time information related to soil moisture, temperature, humidity, and light intensity. Continuous monitoring to understand the yield conditions accurately and enables timely decisions.

4.2 To Collect Environmental data

Another objective is to collect the data using interconnected sensor devices. The collected sensor data provides information about environmental conditions that directly influence jasmine plant growth and flower production. data acquisition improves monitoring accuracy and supports farming practices.

4.3 To perform Data Preprocessing

The collected sensor data may contain noise, duplicate values, missing information or inconsistent readings. the proposed system to preprocess the raw farming data using techniques such as noise removal, normalization and missing value handling. Data preprocessing improves quality of data and increases the efficiency of data mining algorithms.

4.4 To Apply Data Mining Techniques for Analysis

The proposed research aims to use data mining algorithms for analyzing farming datasets and extracting useful information. Classification algorithms are used to identify plant health, water stress and irrigation required or not. These analytical methods improve decision-making and insights for jasmine cultivation.

4.5 To Implement Smart Irrigation

Efficient water management is one of the major objectives of the proposed system. The research aims to develop an intelligent irrigation recommendation mechanism based on soil moisture analysis. The system automatically identifies low moisture conditions and generates irrigation alerts or recommendations. This helps reduce water wastage and improves irrigation efficiency.

4.6 To Predict Jasmine Flower Yield

The work focuses on jasmine flower yield using environmental conditions and historical agricultural data. Predictive analysis helps agriculture estimate production levels and perform best market planning. Yield prediction supports efficient farm management and improves overall agricultural productivity.

5. Methodology

The proposed work presents a smart jasmine cultivation framework that combines Internet of Things (IoT) technology with supervised machine learning techniques. The system continuously observes environmental conditions in the jasmine field and processes the collected data, identifies plant conditions using classification techniques and also it delivers smart irrigation recommendations.

The methodology includes environmental sensing, wireless data transmission, preprocessing, cloud storage, Decision Tree classification, irrigation analysis, yield estimation, and farmer notification services. The aim of the proposed framework is to care accuracy agriculture, improve flower productivity and optimize water utilization in jasmine farming.

5.1 Environmental Data Achievement

In the proposed framework, IoT sensor nodes are deployed across the jasmine cultivation area to monitor environmental and soil conditions continuously. Since jasmine plants are highly sensitive to climatic variations, incessant observation is essential for keeping healthy growth and flowering.

The sensing unit includes:

- Soil moisture sensor
- Temperature sensor
- Humidity sensor
- Light intensity sensor

The soil moisture sensor measures the water content present in the soil. The temperature and humidity sensors monitor atmospheric conditions surrounding the crop, while the light sensor measures the intensity of sunlight available to the plants.

The environmental dataset is represented as:

$$D = \{S, T, H, L\}$$

Where:

- S= Soil Moisture
- T= Temperature
- H= Humidity
- L= Light Intensity

The sensed information is periodically transferred to the processing unit for further analysis.

Example

Table 1:

Soil Moisture	Temperature	Humidity	Light Intensity
32	36°C	75%	400 lux

The above values indicate low moisture conditions combined with high atmospheric temperature, which may affect jasmine flowering performance.

5.2 Wireless Data Transmission

After environmental monitoring, the collected sensor values are transmitted to the cloud platform through wireless communication technologies such as Wi-Fi, GSM, or LoRa.The microcontroller gathers environmental readings from multiple sensor nodes and forwards them to the centralized server.

The transmitted data structure is represented as:

$$P = \{IS, T, S, TE, H, L\}$$

Where:

- IS= Sensor identification number
- T= Timestamp
- S= Soil Moisture
- TE= Temperature
- H= Humidity
- L= Light Intensity

Wireless communication enables remote accessibility and real-time environmental monitoring.

Example

$$P = \{100,\ 10{:}40AM,\ 32,\ 36,\ 75,\ 400\}$$

This packet represents environmental information transmitted from a sensor node installed in the jasmine cultivation field.

5.3 Data Preprocessing

The environmental data collected from sensors may contain abnormal values, incomplete records, communication errors, or duplicated information. Therefore, preprocessing operations are necessary before applying machine learning algorithms.The preprocessing stage improves the consistency, reliability, and quality of the agricultural dataset.

5.3.1 Elimination of Abnormal Readings

Abnormal sensor values that deviate significantly from normal environmental conditions are treated as noise.

Example

$$32,\ 33,\ 145,\ 31$$

In this case, 145°C is considered an abnormal value because it exceeds realistic agricultural temperature limits.

The Moving Average technique is applied to smooth environmental variations.

Formula

$$MA = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{n}$$

Where:

- $x_1, x_2, x_3, \ldots, x_n$represent environmental readings
- $n$represents the number of observations

Calculation Example

$$MA = \frac{32 + 33 + 31}{3}$$
$$MA = \frac{96}{3}$$
$$MA = 32°C$$

After removing the abnormal reading, the corrected average temperature becomes 32°C.

5.3.2 Handling Missing Data

Environmental sensors may occasionally fail to transmit readings due to network failures or hardware issues. Missing values reduce analytical accuracy and therefore must be replaced appropriately.

The proposed system uses mean substitution for handling incomplete records.

Formula

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{n}$$

Example

Humidity readings:

$$65,\ NULL,\ 70$$

Calculation

$$\bar{x} = \frac{65 + 70}{2}$$
$$\bar{x} = \frac{135}{2}$$
$$\bar{x} = 67.5$$

Therefore, the missing humidity value is replaced with 67.5%.

5.3.3 Data Scaling

Environmental parameters are measured using different units and ranges. Therefore, normalization is performed to convert all sensor readings into a common scale before classification.

Formula

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

Where:

- X= Current value
- X_{min}= Minimum value
- X_{max}= Maximum value

Example

Assume:

- Current soil moisture = 32
- Minimum moisture = 20
- Maximum moisture = 80

Calculation

$$X_{norm} = \frac{32 - 20}{80 - 20}$$
$$X_{norm} = \frac{12}{60}$$
$$X_{norm} = 0.2$$

Thus, the normalized soil moisture value becomes 0.2.

5.4 Cloud-Based Data Storage

After preprocessing, the refined environmental dataset is stored in a cloud database for future analysis and monitoring. The cloud platform acts as a centralized storage system that maintains both real-time and historical agricultural information.

Cloud storage supports:

- Continuous access
- Record maintenance
- Centralized monitoring
- Recovery and backup mechanisms

The stored information is later used for classification analysis, irrigation management, and productivity estimation.

Example:

Table 2

ID	Soil Moisture	Temperature	Humidity	Class
101	32	34	65	Water Stress

The stored dataset helps analyse environmental conditions affecting jasmine cultivation.

5.5 Classification Analysis

The proposed system applies supervised machine learning techniques to identify the condition of jasmine plants based on environmental parameters.

The Decision Tree algorithm is selected because it produces understandable decision rules and performs efficiently for agricultural classification tasks.

The environmental conditions are categorized into:

- Healthy Condition
- Water Stress Condition
- Disease Risk Condition

The Decision Tree model uses environmental attributes such as soil moisture, temperature, humidity, and light intensity as input variables.

5.5.1 Decision Tree Classification Algorithm

The Decision Tree algorithm generate decision structures using environmental sensor data. Each internal node represents a condition, while branches represent decision paths. The leaf nodes indicate the final classification output.

Algorithm Steps

Algorithm: Decision tree classification algorithm

Step 1: Start the process

Step 2: Collect the data from environmental sensors as input

Step 3: Data preprocessing that is removal of noise, Handling missing values suing mean values, Normalizing data using min-max normalization.

Step 4: Preparing training dataset with class labels.

Step 5: Sub set the data by splitting from dataset based on the attribute of data.

Step 6: if all the records belonging to the same data--→ create the leaf node

Else select the correct attribute and repeat the steps 5 to 7.

Step 7: Continue the steps until all the records are classified.

Step 8 : Built the decision tree in same steps

Step 9 : for new data reverse the tree from root to leaf node and assign the class labels

(Healthy, Water stress, Disease Risk)

Step 10: Generate the irrigation which recommended from class

Step 11:Stop the process

Decision Tree Example:

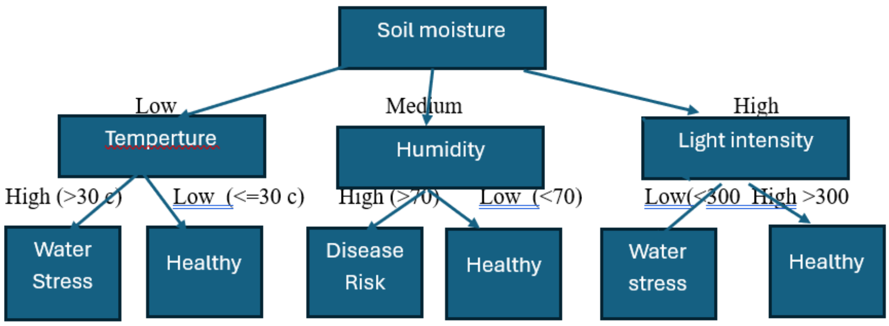


FIG 1: Classification Example

Assume:

- Soil Moisture = 28
- Temperature = 36
- Humidity = 80

Since the soil moisture level is low and the temperature is high, the Decision Tree algorithm classifies the field condition as:

$$Class = Water\ Stress$$

This result indicates insufficient water availability in the jasmine field.

5.6 Smart Irrigation Analysis

The proposed framework automatically generates irrigation recommendations based on environmental conditions and classification results.

The soil moisture level is continuously compared with a predefined threshold value.

Irrigation Rule

$$If\ S < Threshold \rightarrow Irrigation$$

Where:

- S= Soil Moisture value
- Threshold = Minimum required moisture level

Example

Assume:

- Soil Moisture = 27
- Threshold = 36

Since:

$$27 < 36$$

The system generates the following output:

$$\textbf{Irrigation Required}$$

Alert for irrigation is then delivered to the farmer.

5.7 Yield Prediction

The proposed system estimates jasmine flower productivity using environmental and historical agricultural data.

The prediction process considers:

- Soil moisture variation, temperature, conditions for humidity, flowers reports

Yield Efficiency Formula

$$Yield\ Efficiency = \frac{Actual\ Yield}{Expected\ Yield} \times 100$$

Example

Assume:

- Actual Yield = 90 kg
- Expected Yield = 100 kg

Calculation

$$Yield\ Efficiency = \frac{90}{100} \times 100$$
$$Yield\ Efficiency = 90\%$$

This result indicates that the current productivity level of the jasmine field is 90%.

5.8 Farmer Notification Module

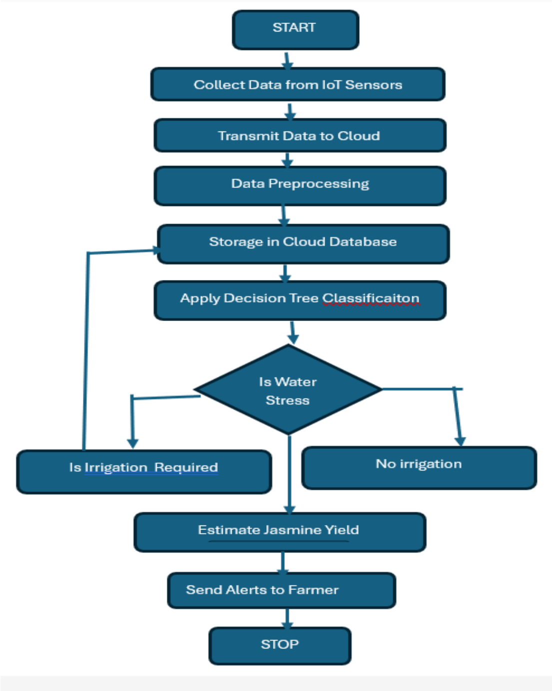
The analyzed information and recommendations are delivered to farmers through:

Mobile applications ,SMS alerts ,Cloud dashboards   YES

The notification system provides:

- Alters of irrigation, condition of Water stress, disease notifications, productivity crop

6. Flowchart:



7.Comparative Statement with Other Algorithms

The proposed smart jasmine farming system uses the Decision Tree classification algorithm for environmental monitoring and irrigation prediction. Different machine learning algorithms can also be applied in smart agriculture; however, each algorithm has its own advantages and limitations. A comparative analysis is performed to identify the most suitable algorithm for the proposed IoT-based jasmine cultivation framework [22].

Decision Tree algorithms are commonly used in agricultural systems because of their simple structure and easy interpretation [24]. They help classify environmental conditions based on parameters such as soil moisture, humidity, and temperature [10][18]. Decision Trees require less computational power and provide faster execution. However, they may produce lower prediction accuracy when the agricultural dataset becomes large and complex [22].

Support Vector Machine (SVM) algorithms are effective for classification problems in smart farming applications [23]. SVM provides high accuracy in crop disease detection and environmental prediction by separating data into different categories using hyperplanes [19]. Although SVM offers better classification performance, it requires higher memory and computational resources, especially for large IoT sensor datasets [8].

K-Nearest Neighbor (KNN) algorithms are used for agricultural pattern recognition and environmental similarity analysis [26]. KNN works by identifying neighbouring data points with similar characteristics. The algorithm is simple and suitable for small agricultural datasets. However, KNN requires more processing time when the dataset size increases because all data points must be compared during prediction [20].

Naïve Bayes algorithms are probabilistic classification methods widely used in agricultural data analysis and disease prediction [25]. These algorithms provide faster processing speed and work efficiently with large datasets [9]. Naïve Bayes performs well in handling uncertain agricultural data collected from IoT sensors [16]. However, the algorithm assumes that all input attributes are independent, which may reduce prediction accuracy in complex farming environments [17].

Artificial Neural Network (ANN) algorithms are highly suitable for smart agriculture systems because they can analyse nonlinear and complex environmental relationships [23]. ANN models provide improved prediction accuracy for crop yield estimation, irrigation control, and disease identification [7]. These algorithms can learn from historical agricultural data and support intelligent decision-making [12]. However, ANN requires large training datasets and higher computational complexity compared to traditional algorithms [8].

Compared with existing algorithms, the proposed IoT-based jasmine cultivation framework integrates environmental monitoring and intelligent data analysis to support efficient irrigation management, predictive analysis, and improved jasmine crop productivity [6][22]. The system focuses specifically on jasmine cultivation and aims to provide better decision-making support for farmers through real-time agricultural monitoring [4][14].

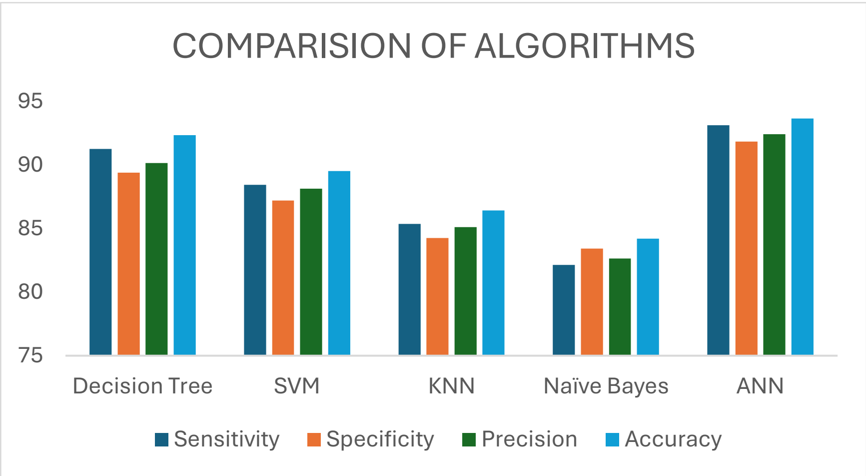
The comparison indicates that the Decision Tree algorithm provides a balanced combination of:

- Simplicity [24]
- Fast prediction [22]
- Low computational complexity [8]
- Easy interpretation [24]
- Efficient real-time performance [15]

These characteristics make the Decision Tree algorithm highly appropriate for IoT-based jasmine farming applications involving environmental monitoring, smart irrigation management, and plant condition prediction [13][22].

Table 3: Comparision with Other Algorithms

Methods	Sensitivity	Specificity	Precision	Accuracy
Decision Tree	91.25	89.4	90.15	92.34
SVM	88.43	87.21	88.14	89.52
KNN	85.36	84.25	85.12	86.43
Naïve Bayes	82.14	83.42	82.65	84.21
ANN	93.12	91.84	92.41	93.65



Conclusion

The proposed IoT-based jasmine cultivation system integrated with data mining techniques provides an efficiency solution for modern smart agriculture. The sensors continuously monitor important environmental parameters such as soil moisture, temperature, humidity, and light intensity. The collected data for farmer is processed and analyzed using the Decision Tree classification algorithm to identify plant conditions such as mainly water stress, water stress, and disease risk. Compared with other machine learning algorithms with Decision Tree algorithm offers simple implementation, fast processing speed, low computational complexity, easy interpretation its highly suitable for IoT-based jasmine farming applications.

The proposed smart irrigation management system in jasmine farming helps reduction of water wastage by automatically recommending irrigation when soil moisture levels fall below required threshold. It increases water utilization efficiency and supports sustainable farming. It predicts jasmine productivity using environmental conditions and historical agricultural data, helping agriculture improvement of production planning and market management. This supports farmer receive notification services through cloud platforms, mobile applications and SMS alerts. It also updates regarding irrigation requirements, environmental changes, disease risks, and Flower conditions which reduces manual monitoring effort and improves management efficiency.

Overall, the proposed system established that integration of IoT technology with data mining techniques can frequently improve jasmine productivity, irrigation efficiency, environmental monitoring and smart agricultural decision-making. The system provides a trusted, low-cost, and friendly solution for sustainable jasmine cultivation. Future improvements include the integration of deep learning algorithms, weather forecasting systems, drone-based monitoring, and advanced cloud analytics to further prediction accuracy and smart farming performance.

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