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Smart Prediction of Flower Blooming Using Machine Learning

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Abstract: Flowering is a biological process in the flowering plants depending on the climate factors like temperature, humidity, rainfall, sunlight, and season. It is necessary to forecast flower blooming precisely since flower blooming timing is vital in many agricultural processes such as agriculture, horticulture, floriculture firms, botany laboratories, greenhouses, and even flowers supplies during the festive seasons. Traditionally, there have been inaccuracies in forecasting flower blooming dates based on observation, seasonal predictions, and farmer's experience, which is not precise in predicting the blooming dates considering the changing climate situations. Therefore, this project aimed at establishing a reliable prediction model using machine learning for flower blooming dates. The development of the model entailed using historical data of the environmental factors for predicting the number of days for blooming. Environmental factors included temperatures, humidity, rainfall, sunshine hours, and blooming time for determining the number of days for flower blooming. The algorithms for the accurate predictions of blooming time include Random Forest Regression and Decision Tree Regression. Web-based platform will be designed for users to enter environmental factors and pictures of flowers. The output will give flower blooming categorization and number of blooming days. Conclusion: Flower blooming predictions can be done through machine learning algorithms accurately.
Index Terms: Machine Learning, Flower Blooming Prediction, Random Forest, Smart Agriculture, Predictive Analytics, Environmental Factors, Floriculture.

I. INTRODUCTION

Blossom is one of the life processes undergone by plants from budding to flower development. It serves many purposes ranging from pollination, seed production, plant reproduction, and beautifying landscapes. Predicting the blooming period of flowers is crucial since it affects reproduction, seed production, flower harvesting, transportation, beautification for different occasions including festivals, weddings, and flower exhibitions.

For commercial purposes, flower growers must predict the blooming period of flowers to plan their activities accordingly. They have to know when to harvest flowers, transport them, decorate events or churches, and even make business plans. Failure to predict the correct blooming period may lead to early harvesting or wastage of resources.

Traditional ways of predicting the blooming period include estimation through experiences, observations, and making guesses based on seasons. These are effective but not always reliable, especially in times of unpredictable climate. Inaccurate predictions arise due to sudden weather change including rainfall, temperature, and humidity.

Nowadays, using machine learning models and artificial intelligence technology, we can develop predictive systems capable of analysing historical environment data and predicting accurately the blooming period of flowers. ML models learn implicit relationships between environmental inputs and flowering outputs and improve with time.

In this project, we will develop a predictive system capable of estimating the period taken by flowers to reach full blossoms based on environmental data analysis, selecting the right stage using images, and machine learning prediction model.

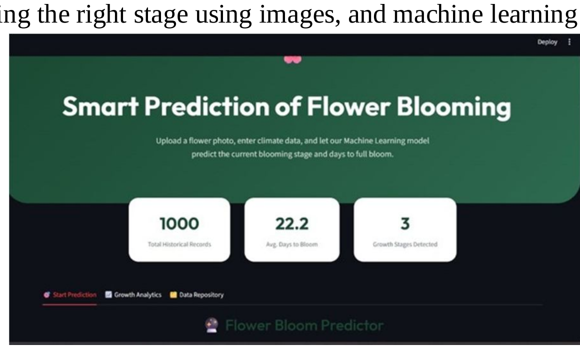

Fig 1. Home Page of Smart Flower Blooming Prediction System

II. LITERATURE REVIEW

Incorporating machine learning (ML) into agriculture and horticulture has become a growing interest of many academic scholars. They have resorted to using data-driven approaches to improve prediction accuracy, optimize crop management, and promote intelligent farming. [1][4].

Biological literature demonstrates that changes in climatic parameters greatly affect budding, blooming period, and flower quality. Therefore, analysing climate data becomes crucial for predicting blooming behaviour accurately [4][6].

Several machine learning techniques have shown efficiency in solving agricultural forecasting problems. The Decision Tree model is favoured due to its simplicity, interpretability, and capability of modelling nonlinear relationships between the features in datasets. Quinlan proposed Decision Tree as an efficient classifier and predictor that forms rule-based models based on the inputs' variables [2]. This model is ideal when understanding decision rules in the environment is necessary.

The Random Forest model proposed by Breiman is one of the commonly used ensemble learning models. It combines several decision tree models to increase prediction power and prevent overfitting. Random Forest models have proven their effectiveness in dealing with noise in agricultural datasets and discovering hidden relationships between variables. Many scholars show that Random Forest models consistently outperform conventional statistics models in predicting environmental phenomena [1].

The Support Vector Machine, Neural Network, and Deep Learning algorithms have also been used in predicting plant growth and crop production. Although these algorithms perform well with large datasets and higher computing power, Random Forest and Decision Tree models still prove to be efficient in dealing with moderate-size structured datasets [3][5].

Though a lot of work has been done in predicting crop yields, identifying crop diseases, soil qualities, and optimal irrigation, fewer research studies have focused on blooming prediction. Bloom prediction becomes particularly important in floriculture, botanical gardens, greenhouses, nurseries, and flower events where bloom timing becomes crucial for quality and commercial purposes [5][6].

Conventionally, predicting blooms depends on the knowledge of the farmers, seasons, and visual inspection of buds. Though these methods prove informative in some cases, they become unreliable when the climate changes fast. In such cases, developing automated bloom prediction systems becomes necessary. Fortunately, ML provides an excellent opportunity since it learns from past experiences and gives evidence-based predictions [4].

III. METHODOLOGY

A. Data Acquisition

A collection of around 1,000 historical samples was utilized, featuring the following attributes:

- Temperature
- Humidity
- Precipitation
- Sun Exposure
- Time Until Flowering

B. Data Preprocessing

The obtained data was pre-processed before building the machine learning algorithm. Data preprocessing involved:

- Elimination of missing values
- Outlier detection
- Normalization of features
- Data conversion
- Splitting of the dataset into training and testing sets

C. Algorithm Design

Two algorithms were created:

- Decision Tree Regression: Creates decision rules based on environmental factors.
- Random Forest Regression: Generates predictions by combining outputs from multiple decision trees.

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D. Web Application Design

A front-end interface was constructed, offering users the ability to perform the following actions:

- Upload flower photograph
- Choose flowering stage (Bud / Half Blooming / Fully Bloomed)
- Manipulate climate-related sliders
- Obtain predictions

E. Prediction Procedure

The trained model analyses environmental parameters and rapidly predicts the duration until full bloom.

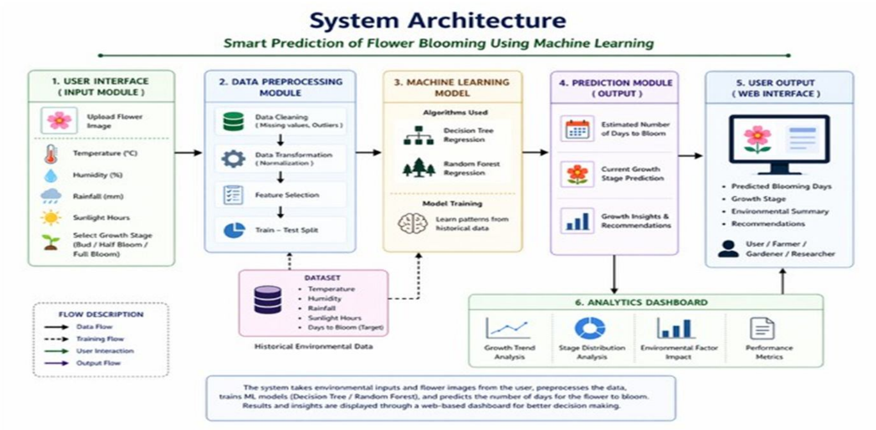


Fig 2. Proposed System Architecture of Smart Prediction of Flower Blooming Using Machine Learning

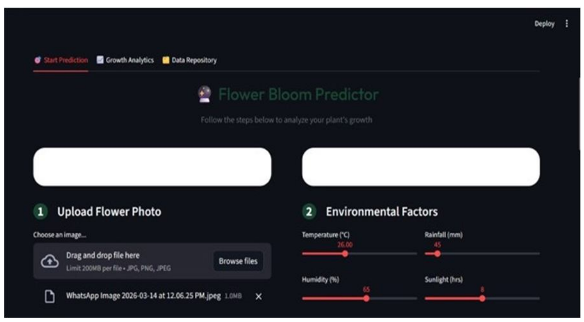
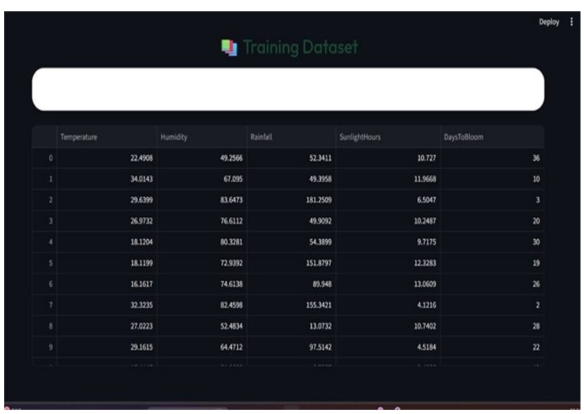


Fig 3. User Input Interface for Bloom Prediction



	Temperature	Humidity	Rainfall	SunlightHours	DaysToBloom
0	22.4908	49.2566	52.3411	10.727	36
1	34.0143	67.095	49.3958	11.9668	10
2	29.6399	83.6473	181.2509	6.5047	3
3	26.9732	76.6112	49.9092	10.2487	20
4	18.1204	80.3281	54.3899	9.7175	30
5	18.1199	72.9392	151.8797	12.3283	19
6	16.1617	74.6138	89.948	13.0609	26
7	32.3235	82.4598	155.3421	4.1216	2
8	27.0223	52.4834	13.0732	10.7402	28
9	29.1615	64.4712	97.5142	4.5184	22

Fig. 4. Historical Training Dataset Used for Model Development

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IV. RESULT AND DISCUSSION

This approach succeeded in developing bloom time predictions from the data provided by the user.

A. Sample Prediction

Stage at Present: Bud Stage
Temperature: 26°C
Humidity: 65%
Rainfall: 45 mm
Sunshine: 8 hours
Expected Bloom Time: 27.9 days

B. Dashboard Information

• Average Bloom Time: 22.2 days
• Number of Historical Data Points: 1,000
• Growth Stages Observed: 3

C. Graphical Visualization

From scatter plots, there were some cases where higher temperatures had an inverse relationship with bloom time. The distribution graphs helped in knowing the class distribution.

Fig. 4. Predicted Blooming Days Output Generated by System

Fig. 6. Analytics Dashboard Showing Growth Trends and Stage Distribution

V. SYSTEM ARCHITECTURE

The proposed architecture includes the following components:

1) User Input Module – Takes input from flower images and environment sensors.
2) Databases Module – Stores all training datasets used before.
3) Data Preprocessing Module – Deals with data cleaning, normalization, and missing entries.
4) Machine Learning Algorithm Execution – **Applies the random forest or decision tree algorithm.**
5) Prediction Module – Displays flower development stages and estimated days for blooming.
6) Analytics Module – Displays charts showing growth pattern analysis.

A. Input Variables

1) Temperature (°C)
2) Humidity (%)
3) Rainfall (mm)
4) Sunlight (Hours)
5) Flower Development Stage

B. Output

1) Bloom Days
2) Stage Identification
3) Development Analysis

VI. CONCLUSION

Blooming period prediction in flowers has become a necessary component of current agricultural and floricultural practices. Conventional techniques are no longer viable considering the variations in the environment. The results obtained from the machine learning approach have proven that past climatic information can be utilized to predict the blooming period more accurately.

Through a combination of environmental analysis, prediction modelling, and an intuitive web-based interface, the system presents practical applications. The study concludes that machine learning can be relied upon for accurate flower blooming prediction.

VII. ACKNOWLEDGMENT

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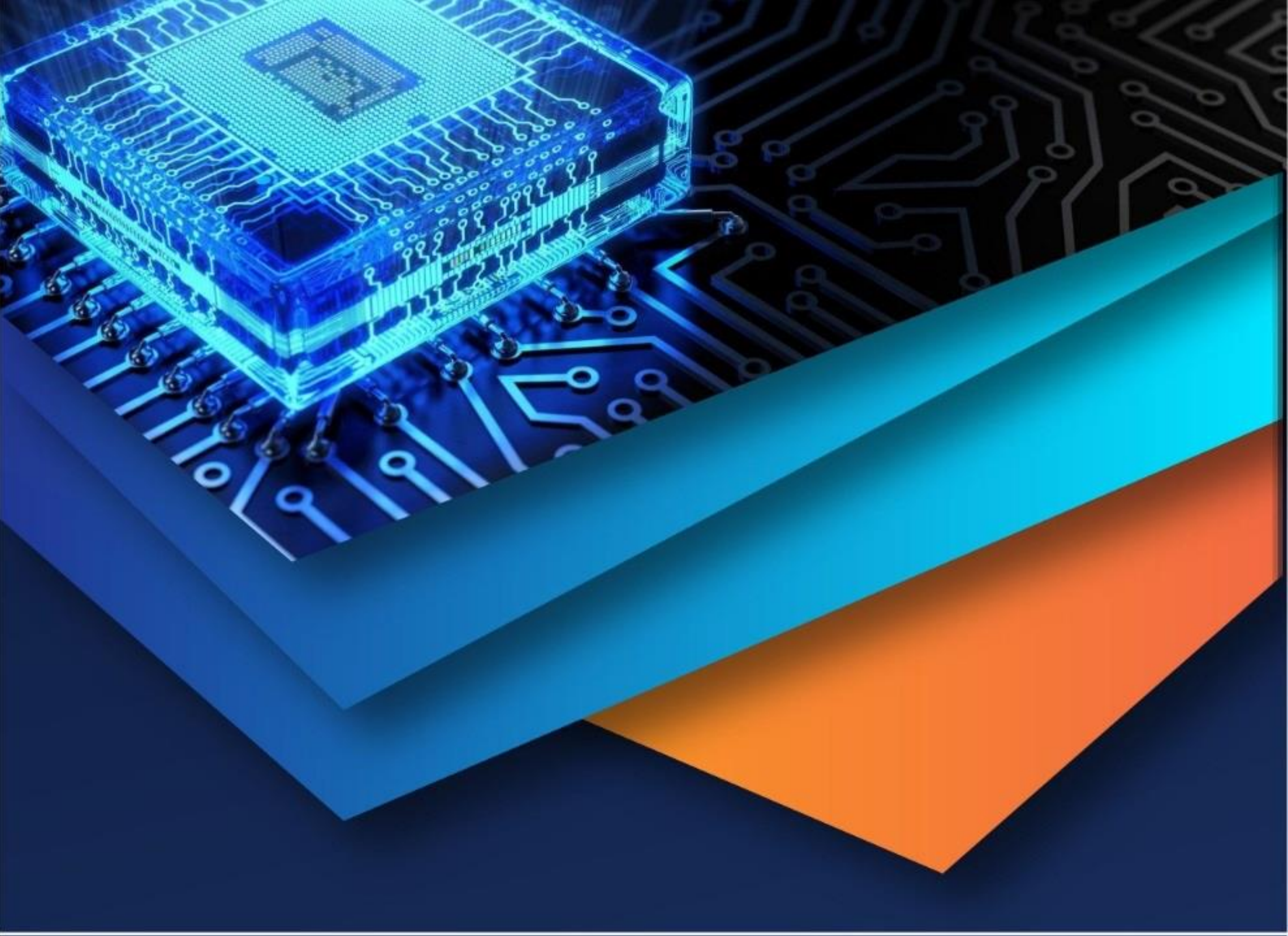

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