

Artificial Intelligence Based Domestic Plant Selection for Optimum Sustainability

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Abstract: In the era of environmental awareness and sustainability, the concept of "Go Green" has gained significant momentum. Urban households and indoor gardening enthusiasts often struggle to select suitable plants that can thrive in their specific environmental conditions, leading to poor plant growth and resource wastage. Existing solutions primarily rely on generic plant recommendation systems or manual selection based on experience, which may not ensure optimal sustainability. To address this challenge, this paper presents an Artificial Intelligence-based plant selection system that utilizes real-time environmental data, including temperature, humidity, and soil moisture, collected using sensors. The system employs a Random Forest algorithm to analyze these parameters and match them with a curated plant dataset, ensuring the selection of the most suitable plants for a given location. Experimental results demonstrate that the proposed approach enhances plant survival rates and promotes efficient resource utilization. This AI-driven solution provides an intelligent, automated, and sustainable method for plant selection, contributing to the broader goal of environmental conservation and urban greenery optimization.

Keywords: Artificial Intelligence, Plant Selection, Random Forest, Sustainability, Environmental Monitoring, Smart Gardening.

1. Introduction

Gardening has been an integral part of human civilization, providing aesthetic, environmental, and psychological benefits. However, maintaining a garden poses several challenges, particularly for individuals with limited knowledge of plant care and varying environmental conditions. Factors such as soil moisture, temperature, and humidity play a crucial role in plant sustainability, and improper selection of plants often leads to poor growth or plant mortality. The lack of guidance in choosing the right plant species for specific environmental conditions is a major hurdle in effective garden maintenance.

Furthermore, in today's fast-paced world, working professionals find it difficult to allocate time for regular plant care. A busy schedule often results in neglect, leading to improper watering, inadequate soil monitoring, and an overall decline in plant health. This issue highlights the necessity of an intelligent system that can assist users in selecting plants that require minimal maintenance while thriving in the given environmental conditions.

Sustainability has become a critical aspect of modern living, particularly in the current "Go Green" era, where environmental conservation is a global priority. Sustainable gardening not only enhances biodiversity but also reduces water consumption, minimizes the use of chemical fertilizers, and

contributes to ecological balance. The selection of appropriate plants based on environmental compatibility is essential to achieving sustainability in domestic gardening.

Garden maintenance presents several challenges, including improper plant selection, inadequate watering, and insufficient soil monitoring. Many individuals lack the necessary knowledge to choose plants that align with local environmental conditions, leading to poor growth and increased maintenance efforts. Additionally, working professionals often struggle to dedicate time to regular garden care, resulting in neglected plants and unsustainable gardening practices.

Sustainability has become a key focus in modern living, particularly in the context of environmental conservation. Sustainable gardening minimizes resource consumption, promotes biodiversity, and reduces dependency on chemical fertilizers. With climate change and urbanization affecting ecosystems, adopting eco-friendly practices is crucial in ensuring long-term environmental balance. The "Go Green" initiative further emphasizes the need for responsible gardening choices that contribute to ecological stability while requiring minimal maintenance.

2. Review of Various Domestic Plant

Domestic plant selection plays a vital role in promoting sustainability, especially in urban and residential areas where space and resources are often limited. Indoor plants, in particular, are gaining popularity due to their ability to enhance air quality and aesthetic appeal while requiring minimal space and maintenance. One of the most common indoor plants is the Spider Plant (*Chlorophytum comosum*), known for its ability to purify indoor air and adapt to indirect sunlight and moderate humidity. It is low-maintenance and propagates easily, making it an ideal sustainable choice. Another excellent indoor plant is the Snake Plant (*Sansevieria trifasciata*), which thrives in low-light conditions and requires very little water. It effectively removes toxins such as formaldehyde and benzene, contributing to a healthier indoor environment. The Peace Lily (*Spathiphyllum* spp.) is also favored for its air-purifying properties and elegant appearance. It thrives in moderate to low light but requires a bit more care due to its sensitivity to overwatering. Similarly, Pothos (*Epipremnum aureum*) is a fast-growing vine that can survive in low to medium light conditions. It is highly adaptable and easy to propagate, making it a sustainable and user-friendly choice for indoor gardening.

For outdoor domestic planting, especially in gardens and balconies, several sustainable species offer both beauty and ecological benefits. The Hibiscus (*Hibiscus rosa-sinensis*) is a tropical flowering plant that thrives in full sun and warm climates. It attracts pollinators such as bees and butterflies, thus supporting local biodiversity. Another vibrant and low-maintenance plant is Bougainvillea, which is highly drought-tolerant and performs well in arid conditions with minimal watering. Tulsi (*Ocimum tenuiflorum*), also known as Holy Basil, is a sacred plant in many Indian households. It requires warm, sunny environments and offers significant medicinal and air-purifying benefits. Marigold (*Tagetes* spp.) is another common outdoor plant valued not only for its bright flowers but also for its ability to repel pests naturally. It supports garden health and is easy to grow and maintain, making it a sustainable addition to any domestic garden.

In urban and apartment settings where space is limited, certain plants are particularly well-suited due to their compact size, low maintenance needs, and adaptability. The ZZ Plant (*Zamioculcas zamiifolia*) is extremely resilient, requiring minimal water and thriving in low-light conditions, making it perfect for indoor corners and office spaces. Aloe Vera is another urban favorite due to its medicinal properties and ability to grow in small pots on sunny windowsills. It requires very little water and can be harvested regularly for skincare and health uses. The Bamboo Palm (*Chamaedorea seifrizii*) adds a tropical touch to indoor spaces and also serves as a natural humidifier, thriving in indirect light and slightly humid environments. Additionally, growing culinary herbs such as mint, basil, and coriander in small containers on balconies or window sills is an excellent sustainable practice. These herbs grow quickly, require limited resources, and provide fresh ingredients for daily cooking while promoting a green lifestyle.

Selecting the right domestic plants based on environmental conditions is crucial for promoting sustainability, especially in homes and urban settings. Indoor plants like spider plants, snake plants, peace lilies, and pothos are popular for their air-purifying qualities and ease of care. Outdoor choices such as hibiscus, bougainvillea, tulsi, and marigolds offer aesthetic value while supporting local ecosystems and requiring relatively low maintenance. For urban or apartment living, compact and resilient plants like the ZZ plant, aloe vera, bamboo palm, and culinary herbs are ideal due to their

adaptability to limited space and minimal care needs. These plants not only enhance living spaces but also contribute to health, air quality, and ecological balance, aligning perfectly with sustainable living practices.

3. Literature Survey

According to the literature review, numerous studies have investigated AI- and IoT-based plant growth monitoring, with a focus on real-time data processing and collecting. Sensor-based monitoring, machine learning, and image processing are all common approaches. Long Short-Term Memory (LSTM) networks detect patterns in environmental data, whereas Convolutional Neural Networks (CNNs) are employed by certain researchers to track plant health through images. The challenges include a lack of standard frameworks, high sensor costs, limited data processing skills, and connectivity issues in remote places. The proposed solution boosts productivity by combining edge computing with AI-powered analytics. Future developments will focus on interoperability, scalability, and energy efficiency [1].

According to the literature review, using AI and machine learning to monitor plants and soil leads to better precision agriculture. Many studies on plant health assessment rely on sensor-based data collection, remote sensing, and deep learning algorithms. Machine learning algorithms provide predictive analysis, while Internet of Things sensors track soil temperature, moisture content, and nutrient levels. The disadvantages include limited connectivity in rural areas, high implementation costs, and concerns about data validity. The proposed solution uses edge computing and blockchain technologies to process data rapidly and securely. Scalability and energy efficiency remain critical problems for future smart agriculture solutions. [2]

The literature study looks at how wireless sensor networks (WSNs) and cloud computing can be combined to create intelligent gardening advice systems. Several studies have demonstrated that WSNs can be utilised to collect real-time data on environmental parameters such as temperature, humidity, and sunlight, despite the fact that data processing and storage are handled by cloud platforms. The idea is to place sensors in gardens, transfer data to the cloud, and then use AI-powered chatbots to deliver specific gardening suggestions. Managing large datasets, assuring reliable sensor data, and resolving network connectivity issues can be challenging. By better integrating cloud resources with AI algorithms, the proposed software aims to improve system adaptability and real-time decision-making [3].

The literature review emphasises computer vision and machine learning methods for automated plant health assessment, indicating an increasing interest in AI-powered plant growth monitoring systems. Deep learning models, such as CNNs, have been utilised in studies to find patterns, as well as other image processing methodologies for extracting plant metrics like leaf area, height, and width. Plant photos captured with a camera are examined to detect growth trends and develop algorithms for predicting plant health. Managing massive volumes of data, preserving accurate image quality under changing temperatures, and tailoring algorithms to specific plant species are just a few of the hurdles. The proposed method is intended to be effective and scalable for a wide range of agricultural applications [4].

The study's review focuses on the implementation of new controls in greenhouse settings to improve strawberry growth conditions. Several studies have looked into the integration of temperature, humidity, light, and ventilation sensors with microcontrollers, which use the information to control devices like heaters, fans, and pumps. The strategies emphasise the use of feedback loops to automatically adjust environmental variables. Some of the challenges highlighted include maintaining energy efficiency, developing autonomous systems that require little human intervention, and assuring sensor accuracy in a variety of scenarios. The proposed study intends to improve greenhouse automation and provide a sustainable and cost-effective strawberry farming solution by generating a self-regulating ideal environment [5].

4. Plant Database

Between 6 AM and 6 PM, the sunlight requirements for the 20 plants vary based on their environmental profiles. Most plants receive increasing sunlight intensity from early morning, peaking between noon and 2 PM, and then gradually declining toward the evening. Plants like Plant 1, Plant 2, and Plant 3 exhibit moderate sunlight intake throughout the day, suitable for partial shade conditions. In contrast, Plant 4 through Plant 10 show higher sunlight values consistently, indicating a preference for full-sun

exposure. Meanwhile, Plant 11 to Plant 15 register fluctuating sunlight values, implying they thrive in semi-sun or filtered light environments. Finally, Plant 16 to Plant 20 exhibit lower average sunlight values, suggesting they are adapted to shaded or indoor conditions. This variation highlights the diversity of plant requirements and the importance of tailoring sunlight exposure based on species-specific needs.

5. Random Forest Algorithm

Random Forest Algorithm

1. More Accurate: Instead of relying on one decision tree, it uses multiple trees for better predictions.
2. Handles Multiple Factors: It considers temperature, humidity, and soil moisture together.
3. Prevents Overfitting: Unlike a single decision tree, Random Forest avoids over-relying on one type of condition.

The Random Forest algorithm is used to identify the most suitable plants based on real-time environmental data such as temperature, humidity, and soil moisture. This algorithm works by creating a collection of decision trees, each trained on different parts of your plant dataset. The dataset includes various plant species along with the environmental conditions in which they thrive.

When a user inputs the current environmental conditions (either manually or from sensors), this data is passed through each decision tree in the forest. Each tree makes its own prediction about which plant(s) are suitable for the given conditions. The algorithm then combines the outputs from all the trees and selects the plant(s) that received the majority of votes. This final decision is then used to display the recommended plants that can grow well in the current environment.

By using multiple decision trees and averaging their results, the Random Forest provides more accurate and reliable recommendations compared to a single decision tree.

It provides high accuracy by combining multiple decision trees, leading to more reliable plant recommendations. The algorithm is effective in handling complex and varied input data such as temperature, humidity, and soil moisture. It also reduces the risk of overfitting, ensuring that the model performs well not only on the training data but also on new, unseen inputs. Additionally, Random Forest is robust against noisy or incomplete data, which is useful when working with real-time sensor inputs. Another benefit is its ability to highlight the importance of each environmental factor, helping to understand which conditions most influence plant suitability. Overall, its flexibility and scalability make it a strong choice for building a sustainable and intelligent plant selection system.

6. Environment Parameters Estimation of Test Location

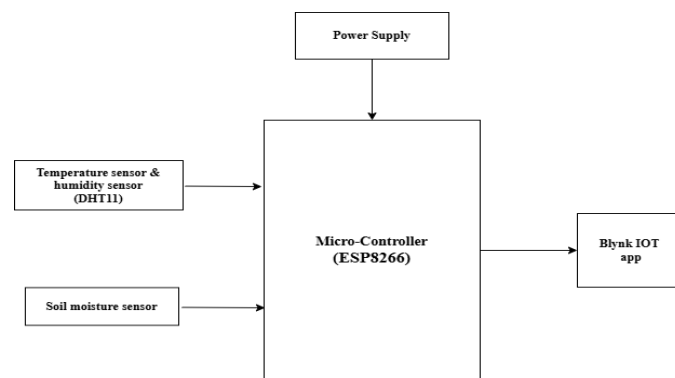


Fig 1

In this system, a DHT11 temperature and humidity sensor and a soil moisture sensor are installed in the user's gallery to monitor environmental conditions crucial for plant sustainability. Both sensors are connected to an ESP8266 microcontroller, which serves as the central unit for data collection and transmission. The DHT11 sensor continuously measures ambient temperature and humidity, while the soil moisture sensor detects the water content in the soil. These readings are captured at regular intervals from 6:00 AM to 6:00 PM, aligning with the period when environmental conditions are most variable and significant for plant health. The ESP8266 is programmed to send this real-time data to the Blynk IoT application over a Wi-Fi connection. Through Blynk, users can remotely access live updates of the temperature, humidity, and soil moisture levels in their gallery via a smartphone or web interface. This

setup allows seamless monitoring of the plant environment, ensuring that the collected data accurately reflects the daily microclimatic conditions. The gathered data is later used by the AI-based system to match the real-time conditions with a stored plant dataset, helping identify the most suitable plants for that specific environment.

7. Optimum Plant Selection Model

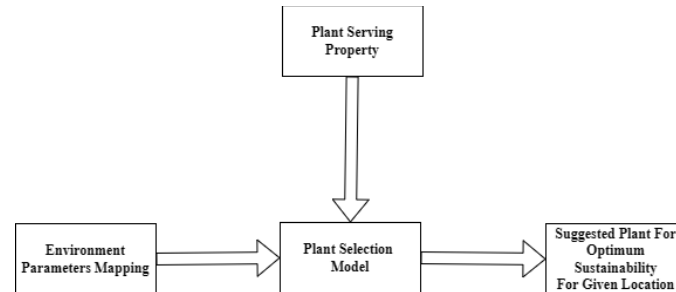


Fig 2

The research work "Artificial Intelligence Based Domestic Plant Selection for Optimum Sustainability" focuses on developing an intelligent system that recommends the most suitable plants for a user's indoor or domestic gallery environment. The core aim is to promote sustainable plant growth by matching real-time environmental conditions with plant requirements using artificial intelligence. To achieve this, the system collects environmental data such as temperature, humidity, and soil moisture from the user's gallery over a 12-hour period, specifically from 6:00 AM to 6:00 PM. These readings are obtained using a DHT11 temperature and humidity sensor along with a soil moisture sensor, both of which are connected to an ESP8266 microcontroller.

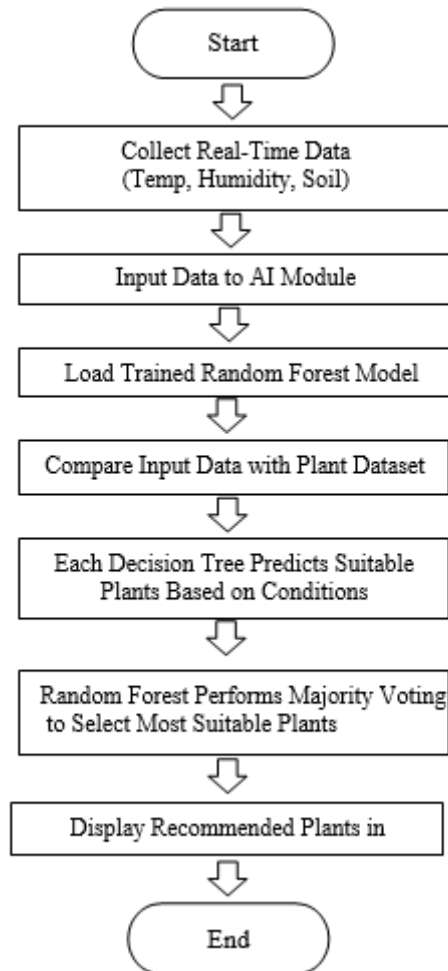
The collected environmental data is transmitted through the Blynk IoT platform, which enables remote monitoring and data logging. This data is then manually fed into an AI model developed as part of the system. The model is trained using the Random Forest algorithm, which is known for its robustness and accuracy in classification tasks. The algorithm uses multiple decision trees to evaluate and classify the input conditions, ultimately improving prediction accuracy by reducing the risk of overfitting and handling non-linear data relationships effectively.

A comprehensive plant database underpins the AI model. This database consists of various plant species along with their optimal growing conditions, including the preferred ranges of temperature, humidity, and soil moisture required for healthy growth. By comparing the user's environmental data with this database, the model can predict and recommend the most compatible plants that can thrive in the given conditions. This ensures that users are guided to select plants that are most likely to survive and flourish in their specific domestic setting.

The use of the Random Forest algorithm allows the model to handle variations in environmental data with greater precision, making it well-suited for real-world application in dynamic home environments. The recommendation system not only simplifies plant selection for the user but also promotes eco-friendly practices by ensuring that chosen plants are compatible with the natural microclimate of the gallery space. As a result, plant maintenance becomes easier, and resource usage such as water and artificial climate control is minimized.

Overall, this research work demonstrates a smart, AI-driven approach to sustainable indoor gardening. By leveraging sensor technology, IoT connectivity, and machine learning, it offers a practical solution to help users make informed decisions about plant selection, encouraging both sustainability and environmental awareness in everyday life.

8. Flowchart



9. Result

The Artificial Intelligence-Based Domestic Plant Selection system utilizes Scikit-learn to train its machine learning model. After processing the dataset, a classification model—such as Random Forest—is used to analyze the data and provide plant recommendations. The system determines the most suitable crops based on real-time sensor inputs, enabling optimal plant selection. Through data-driven decision-making, the AI enhances the efficiency and sustainability of home gardening. This project integrates sensor-based data collection with AI-powered plant recommendations to support sustainable gardening. One of the primary challenges was selecting appropriate plants based on fluctuating environmental conditions. The AI module addresses this issue by leveraging real-time data from soil moisture sensors and the DHT11, eliminating errors associated with manual assessments. Another significant challenge was managing a large and dynamic plant dataset. This was resolved by implementing a robust AI model capable of correlating environmental variables with plant sustainability requirements while efficiently organizing the data.

Additionally, sensor calibration can pose difficulties for users. To mitigate this, standardized data entry formats were introduced, simplifying the process. By ensuring flexibility in data handling and allowing manual input where necessary, the system effectively manages real-time data processing constraints. Ultimately, by optimizing plant selection for various environments, this AI-driven solution promotes sustainable, efficient, and adaptable gardening practices.

Components are assembled on a breadboard for modularity and ease of debugging. The Node MCU reads sensor data at regular intervals and transmits it to the Blynk cloud over Wi-Fi. The parameters are assigned to virtual pins (V1 for temperature, V2 for humidity, and V3 for soil moisture).

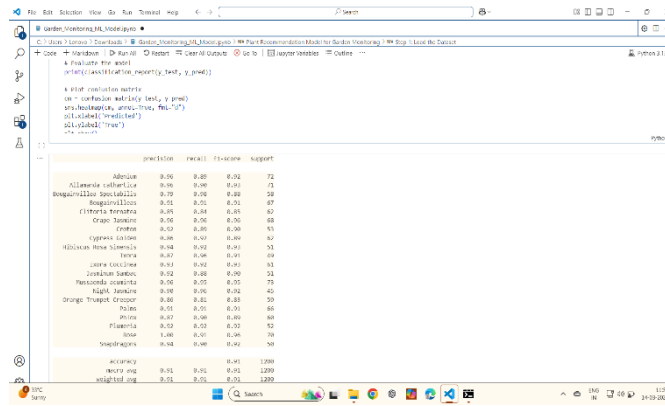


Fig 3. Training Process

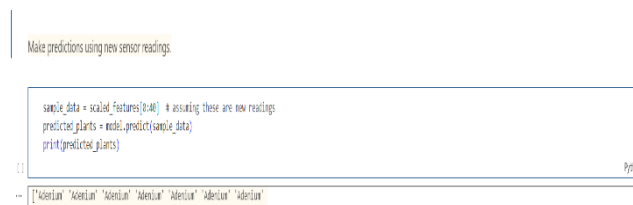


Fig 4. Sample recommendation

- Temperature and Humidity: The DHT11 sensor accurately provided real-time temperature and humidity data, which was displayed on the Blynk mobile app.
- Soil Moisture Levels: The soil moisture sensor reliably measured water content in the soil, updating its values on the app in percentage format.
- Data Transmission: The Node MCU seamlessly transmitted sensor data to the Blynk cloud with an average delay of less than 2 seconds.

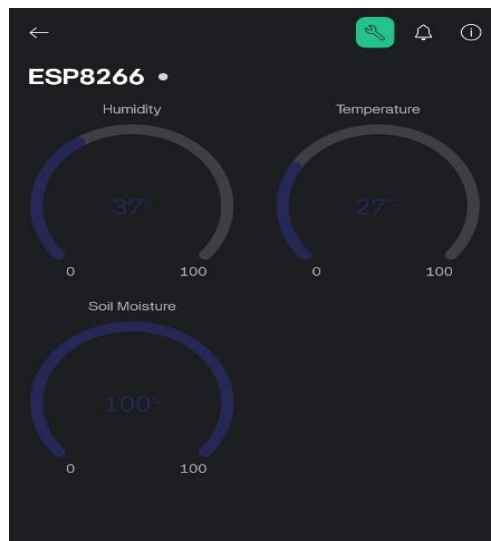


Fig 5. Blynk real time data

The user manually entered sensor readings from the Blynk app into the AI-powered web application. Key results include:

Data Processing: The AI system successfully processed input parameters (temperature, humidity, and soil moisture).

Plant Recommendations: Based on the input data, the AI model provided a list of five plants suitable for the recorded environmental conditions, ranked in order of priority. The recommendations were consistent with expected outcomes from the training dataset.

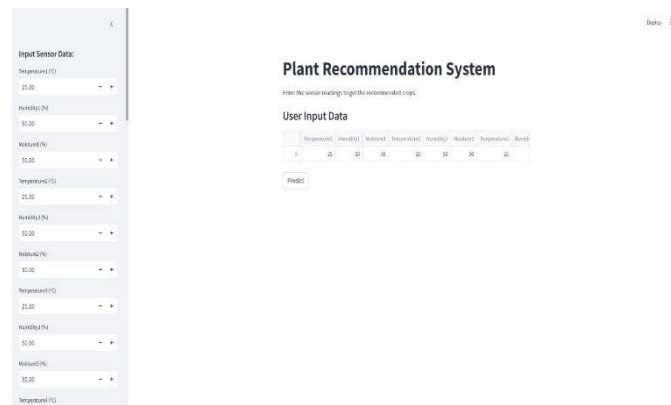


Fig 6. Output webpage

Input Values:

- Temperature: 28°C
- Humidity: 60%
- Soil Moisture: 45%

AI Output:

Recommended Plants: Basil, Tomato, Lettuce, Spinach, and Marigold

Priority Ranking: Based on environmental suitability, tolerance, and resource needs.

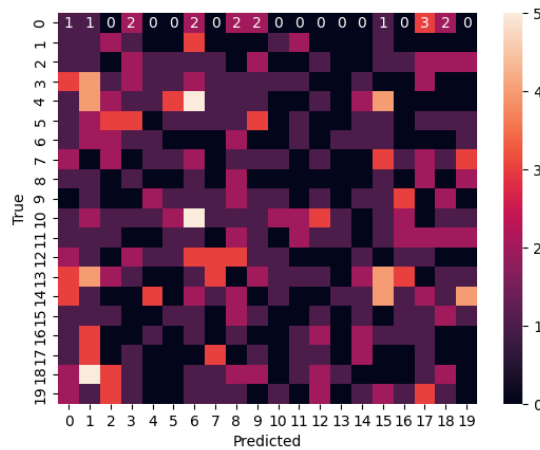


Fig 7: classification report

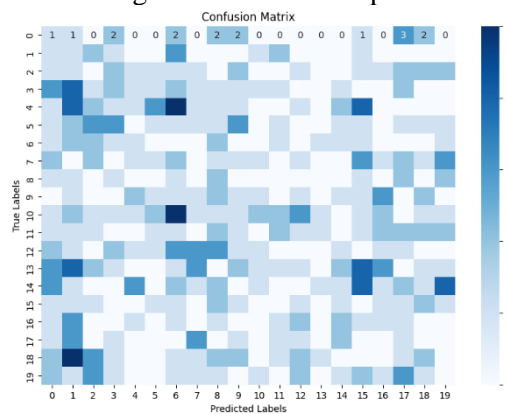


Fig 8. Confusion matrix

10. Conclusion

The proposed AI-powered home plant selection and care system seamlessly integrates sensors, microcontrollers, mobile applications, and machine learning algorithms to create an efficient and environmentally friendly indoor gardening solution. By automating essential plant care tasks, the system aims to simplify the process of maintaining optimal plant growth indoors.

The system's architecture incorporates sensors that continuously monitor key environmental factors such as temperature, light intensity, and soil moisture levels. The microcontroller processes this data and transmits it to a backend server via Wi-Fi. The backend server stores historical data for future reference and conducts real-time analysis. A smart phone application provides an intuitive interface for users, allowing manual adjustments, real-time monitoring, and notifications.

Future advancements in this research will explore deep learning models to enhance AI accuracy, further automate data collection through IoT integration, and expand the plant database for more precise recommendations. Additionally, incorporating augmented reality (AR) could improve the user experience by enabling visual plant placement and real-time updates through a mobile app. By continuously analyzing environmental data, the system offers accurate plant recommendations, ensuring that temperature, humidity, and soil moisture levels are optimized to enhance gardening efficiency.

References

1. Sharma, Ruchika, Pankaj Vaidya, and Brijbhushann Sharma. "A Review on Plant Growth Monitoring using Artificial Intelligence and the Internet of Things." In 2024 11th International Conference on Computing for Sustainable Global Development (INDIACom), pp. 140-145. IEEE, 2024.
2. Meenakshi, B., B. Sumathy, N. C. Haariharan, L. Krishnakanth, and M. Soumya. "Artificial Intelligence Enhanced-Plant and Soil Monitoring Systems." In 2023 Intelligent Computing and Control for Engineering and Business Systems (ICCEBS), pp. 1-6. IEEE, 2023.
3. Vimal, S. P., V. Srividhya, G. Kumar, Mohammed Jubair Meera Hussain, M. Rajmohan, and S. Sujatha. "An Intelligent Gardening Advisor System Empowered by Wireless Sensor Networks and Cloud Computing." In 2024 2nd International Conference on Device Intelligence, Computing and Communication Technologies (DICCT), pp. 244-248. IEEE, 2024.
4. Bhamare, Archana, Vivek Upadhyay, and Payal Bansal. "AI based Plant Growth Monitoring System using Computer Vision." In 2023 IEEE Technology & Engineering Management Conference-Asia Pacific (TEMSCON-ASPAC), pp. 1-5. IEEE, 2023.
5. Lei, Juan. "Design of Intelligent Controller for Strawberry Planting Greenhouse." In 2024 International Conference on Electrical Drives, Power Electronics & Engineering (EDPEE), pp. 172-175. IEEE, 2024.
6. Elbasi, Ersin, Nour Mostafa, Zakwan AlArnaout, Aymen I. Zreikat, Elda Cina, Greeshma Varghese, Ahmed Shdefat et al. "Artificial intelligence technology in the agricultural sector: A systematic literature review." IEEE access 11 (2022): 171-202.
7. Puri, Vikram, Sudan Jha, Raghvendra Kumar, Ishaani Priyadarshini, Mohamed Abdel-Basset, Mohamed Elhoseny, and Hoang Viet Long. "A hybrid artificial intelligence and internet of things model for generation of renewable resource of energy." Ieee Access 7 (2019): 111181-111191.
8. Abbas, Sagheer, Muhammad Adnan Khan, Luis Eduardo Falcon-Morales, Abdur Rehman, Yousaf Saeed, Mahdi Zareei, Asim Zeb, and Ehab Mahmoud Mohamed. "Modeling, simulation and optimization of power plant energy sustainability for IoT enabled smart cities empowered with deep extreme learning machine." IEEE Access 8 (2020): 39982-39997.
9. Hesami, Mohsen, and Andrew Maxwell Phineas Jones. "Application of artificial intelligence models and optimization algorithms in plant cell and tissue culture." Applied Microbiology and Biotechnology 104, no. 22 (2020): 9449-9485.
10. Tushar, Wayes, Nipun Wijerathne, Wen-Tai Li, Chau Yuen, H. Vincent Poor, Tapan Kumar Saha, and Kristin L. Wood. "Internet of things for green building management: disruptive innovations through low-cost sensor technology and artificial intelligence." IEEE Signal Processing Magazine 35, no. 5 (2018): 100-110.
12. Akyol, Sinem, and Bilal Alatas. "Plant intelligence based metaheuristic optimization algorithms." Artificial Intelligence Review 47 (2017): 417-462.
13. Nabavi-Pelesaraei, Ashkan, Shahin Rafiee, Seyed Saeid Mohtasebi, Homa Hosseinzadeh-Bandbafha, and Kwok-wing Chau. "Integration of artificial intelligence methods and life cycle assessment to predict energy output and environmental impacts of paddy production." Science of the total environment 631 (2018): 1279-1294.
14. Saheb, Tahereh, Mohamad Dehghani, and Tayebbeh Saheb. "Artificial intelligence for sustainable energy: A contextual topic modeling and content analysis." Sustainable Computing: Informatics and Systems 35 (2022): 100699.
15. Saheb, Tahereh, Mohamad Dehghani, and Tayebbeh Saheb. "Artificial intelligence for sustainable energy: A contextual topic modeling and content analysis." Sustainable Computing: Informatics and Systems 35 (2022): 100699.
16. Yigit, Enes, Kadir Sabanci, Abdurrahim Toktas, and Ahmet Kayabasi. "A study on visual features of leaves in plant identification using artificial intelligence techniques." Computers and electronics in agriculture 156 (2019): 369-377.