An AI Approach to Disease Detection and Agronomic Support in Gymnema Sylvestre

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Abstract - This study presents an AI-based system for detecting leaf diseases in Gymnema sylvestre, including powdery mildew, aphid infestation, and leaf spot. The platform uses convolutional neural networks (CNN) on smartphone images and provides web-based diagnostic reports, cultivation guidance, product recommendations, and dosage instructions. Developed with TensorFlow and React, it supports sustainable cultivation and safe human consumption of Gymnema products.

***Key Words*:** Gymnema sylvestre, disease detection, leaf disease classification, CNN, powdery mildew, aphid infestation, leaf spot, agronomic support, dosage guidance, web application, medicinal plant management, plant health monitoring.

1. INTRODUCTION

Gymnema sylvestre, known locally as Madhunashini or Gurmar is a woody climbing plant that lives years. I have learned that Gymnema sylvestre can change how the body absorbs sugar and can calm sugar cravings. For centuries Ayurvedic practitioners have added Gymnema sylvestre to recipes that aim to control diabetes, metabolism problems and other health issues. Gymnema sylvestre grows in parts of India. Gymnema sylvestre can be found in forest areas and farmed areas of Karnataka. In those places people harvest Gymnema sylvestre to make powders, capsules, tablets, herbal extracts and raw leaf preparations. Gymnema sylvestre has been used as medicine for a time. People want more of Gymnema sylvestre, in the nutraceutical market. I have seen that Gymnema sylvestre still receives attention in farming research and new technology. Compared with food crops researchers have published studies on how to grow Gymnema sylvestre how diseases affect Gymnema sylvestre or how digital tools could help farmers who work with Gymnema sylvestre. Because of this growers, collectors and small producers often do not have advice, on watching for disease protecting Gymnema sylvestre growing Gymnema sylvestre in a sustainable way or giving safe use tips for the end consumer.

Gymnema sylvestre, like leaf plants can get many leaf diseases and insect attacks that lower leaf quality and the plant's healing value. Powdery mildew, leaf spot and aphid infestations are the problems that growers of Gymnema sylvestre see. Gymnema sylvestre usually shows these problems first on the leaves the part that people use for medicine and, for income. The leaves may develop patches, dead spots, white powdery growth, curling or groups of sap-sucking insects. Early detection matters because early detection of disease changes the amount of chemicals, the quality, after harvest the price and the safety rules for drug production. Farmers still find disease by looking at plants. Farmers also use experience. Listen to advice, from local input dealers. Manual inspection, personal experience and local input dealer advice often cause diagnosis, slow response, wrong chemical use and money loss for farmers who do not have much technical knowledge.

Artificial intelligence, in computer vision can automate plant health assessments using images. I have seen intelligence in computer vision train machine learning models on the leaf images. Machine learning models learn from the leaf images. Machine learning models detect disease patterns. Artificial intelligence in computer vision detects disease patterns consistently than inspection. Artificial intelligence in computer vision gives results in places, with few resources. I see that people use the AI-based systems a lot in the crops, like rice, wheat, tomato and fruit trees. I see that people do not use the AI-based systems for the plants. The medicinal plants, the Gymnema sylvestre get help from the AI-based systems. The gap happens because there are organized data sets. The records of the leaf diseases are not steady. The missing combined advice platforms also stop progress. The missing combined advice platforms would link the disease recognition with advice, for the growing the protecting of the plants and the way people use the plant.

We saw the need, for a tool like this. The team created the project titled "An AI Approach to Disease Detection and Agronomic Support, in Gymnema Sylvestre" to meet that need. The main goal of the project is to build an AI-driven ecosystem that can find the leaf diseases of Gymnema sylvestre and give support to the farmers the growers and the medicinal-plant stakeholders. The system uses a machine learning model that classifies Gymnema leaves into three disease categories— mildew, aphid infestation and leaf spot—and also recognizes leaves when the data set configuration includes healthy examples. The model chooses the diseases because the diseases occur often the diseases have signs and the diseases affect leaf health and medicinal quality. The classifier lives in a web interface. The web interface lets users upload images start detection and get feedback. I notice that the platform predicts the disease class. I also notice that the platform shows a summary. The short summary describes the disease, its usual symptoms and the possible effects, on plant growth and quality.

After each detection the system creates a report. The report shows the diagnosis the risk severity, the markers, the suggested management practices, the preventive guidance and the follow-up actions. I can download the report for my records for farm paperwork for talking with agronomists or for sending to extension centers. The platform does not stop at naming the disease. The platform includes an agronomic support module that gives step-by-step instructions for handling mildew, aphids and leaf spot on Gymnema sylvestre, in field conditions. The recommendations span practices, environmental changes, mechanical controls, biological choices and selective chemical use when needed. The recommendations are broken into steps. The platform turns the guidelines into steps that farmers can follow. The platform lets farmers, in Karnataka make decisions. The platform does not require training. The platform helps farmers choose the practice, for their field.

I built the system to close the gap, between recommendations and real use. The system has a selected products page that shows tools, plant care materials organic inputs, biological controls, equipment and medicinal Gymnema-based consumer products. The system connects information to solutions. The system lets farmers find inputs for disease management. The system lets consumers see the forms that Gymnema sylvestre is sold in such, as capsules, powders, tablets, extracts or processed leaves. I see that the organized structure supports the farm to product chain. I see that the platform is useful, for cultivators, for processors and, for end users.

The plant has a link, to metabolic health. I added a dosage guide for Gymnema-based products. The dosage guide tells the user who can take the plant. The dosage guide also tells who should avoid the plant or see a doctor and what dose is safe. The dosage guide lists dose ranges, for capsules, powders, tablets and raw leaf preparations. I have used the module. I see that the module does not replace healthcare guidance. I also see that the module fills an information gap. The module gives simple dosage information that is often missing from herbal markets.

When I open the system I notice that the built-in chatbot helps with navigation answers questions explains terminology and guides me through processes such, as uploading images or interpreting reports. The chatbot makes the platform easier to use for me and, for users who have digital experience.

The project places Gymnema sylvestre in the trend of agriculture, precision farming and AI powered medicinal plant research. The project gives a dataset that focuses on a disease. The project also gives a custom machine learning model that can tell Gymnema sylvestre from sick Gymnema sylvestre. The project builds an advice system with layers. The advice system links Gymnema sylvestre health to how we grow Gymnema sylvestre, which products we choose for Gymnema sylvestre and how people should use Gymnema sylvestre. From my point of view the project helps connect Gymnema sylvestre to farming decisions. By focusing on a medicinal plant that is both culturally significant and scientifically valuable—yet historically underserved by technological innovation—this work contributes a meaningful step toward modernizing the cultivation and utilization of Gymnema sylvestre. It demonstrates how AI can support the sustainability, economic value, and therapeutic reliability of an important medicinal species, offering benefits that extend from the farmer’s field to the end consumer’s health practices.

2. LITERATURE REVIEW

I notice that the fast growth of intelligence and machine learning has changed the way the farms work today and the biggest change shows up in plant health monitoring and disease management. Plant diseases still hold back the food production, around the world. Plant diseases cause money loss. Plant diseases lower the food and health value of crops. Plant diseases put the future of farming, at risk. Early detection is still key. Early detection means finding leaf problems at the sign. Early detection lets farmers act before plant diseases spread. Early detection protects the yield protects the quality and protects the use of resources. I have seen how traditional disease diagnosis works. Traditional disease diagnosis depends entirely on inspection and farmer expertise. Visual inspection and farmer expertise are visual inspection and farmer expertise change, from one grower to another. Many rural regions lack trained agricultural extension officers, inspection and farmer expertise become impractical. The lack of disease diagnosis creates gaps, in timely decision making. Small-scale farmers who grow medicinal and high-value crops feel the gaps every season. Small-scale farmers need a way to spot disease if small-scale farmers want to protect the livelihoods of small-scale farmers.

The challenges made me look for ways. The machine learning and the deep learning are now tools, for automated disease recognition with plant leaf images. The Convolutional Neural Networks (CNNs) and similar designs can pull out features from pictures. The Convolutional Neural Networks (CNNs) let us sort disease states quickly and with accuracy. The traditional machine learning needs people to pick features by hand. The deep learning models learn features, from raw images. The deep learning models work better when lighting, background or environment changes. Many studies show this trend. Kavitha et al. (2024) Showed that deep learning can identify plants in time. The deep learning method reached accuracy, for species. Mahmoud et al. (2023) Made a comparison of machine learning and deep learning for plant disease detection. Pointed out that deep learning models can work on new data and stay strong under different conditions. Mahmoud et al. (2023) Also noted that data changes, noisy environments and the need to adjust to settings make the task hard. Together the studies show that AI imaging systems, in agriculture are becoming more important.

I have read that Gymnema sylvestre is getting attention as plant recognition technology improves. This perennial woody climber, called Madhunashini or Gurmar sits at the heart of Ayurvedic medicine. Gymnema sylvestre can lower blood sugar can regulate metabolism and can support health. Tiwari, Mishra and Sangwan (2014) studied Gymnema sylvestre profile in detail. They found compounds such, as acids. Gymnemic acids show antidiabetic, antioxidant and anti-inflammatory effects.

Researchers still study Gymnema sylvestre a little. The research gaps include planned growing, farm practice improvement, disease management and using tools to watch the crop. I see that the gap shows up in places, like Karnataka, where Gymnema sylvestre is grown and collected for medicine. Farmers often do not have specific guidance, scientific help or modern tools to spot and handle leaf diseases.

I have seen diseases and pests cause problems, for Gymnema. Foliar diseases and pests pose a risk to Gymnema cultivation. Powdery mildew, aphids and leaf spot diseases are the challenges. Powdery mildew, aphids and leaf spot diseases can visibly damage the leaf surface. Powdery mildew, aphids and leaf spot diseases can reduce leaf biomass. Powdery mildew, aphids and leaf spot diseases can lower the amount of chemicals that give the plant its healing value. Potawale et al. (2008) Highlighted these threats. Potawale et al. (2008) Emphasized the need, for combined disease control plans that fit the farming environment. I notice that most advances, in the AI-driven disease detection systems focus on the staple crops like rice, wheat, maize or cotton. The AI-driven disease detection systems leave the plants without technology. The medicinal plants that have pharmaceutical relevance get left behind. This gap shows the need for plant-solutions, for the species Gymnema sylvestre.

I have read work in the field of plant identification. The recent work shows that the machine learning approach can work on the plant species that have not been studied much. Murari (2024) used the learning methods to classify plants. Murari (2024) got performance, on different data sets. Guleria (2023) did a research project at Jaypee University of Information Technology. Guleria (2023) explored the machine learning and deep learning for plant detection. Guleria (2023) shared tips on how to build the data set how to choose the model architecture and how to set up the deployment methods, for world use. Gupta et al. (2021) Detailed the importance of preprocessing, feature extraction and algorithm selection, for plant disease detection using image processing pipelines. I notice that Gupta et al. (2021) Highlighted how preprocessing, feature extraction and algorithm selection shape the image processing pipelines that drive plant disease detection. Vigneswari et al. (2024) Showed how machine learning-based medicinal plant identification systems can be scaled, validated and adapted to settings. I also see that

Vigneswari et al. (2024) Reinforced the growing use of automation, in botany.
Kumari (2024) talked about the traditional medicine importance of Gymnema sylvestre. Kumari (2024) gave a look, at the history of Gymnema sylvestre the healing uses of Gymnema sylvestre and the economic role of Gymnema sylvestre in Indian healthcare systems. The analysis provides justification for developing technology. A medicinal plant like Gymnema sylvestre deserves research, on how to grow Gymnema sylvestre how to keep Gymnema sylvestre healthy and how to use Gymnema sylvestre in a way. I think we need to study Gymnema sylvestre. Integrating deep learning-based disease detection with structured agronomic guidance and dosage support therefore aligns not only with modern agricultural innovation but also with public health needs and traditional knowledge systems.

The published literature shows a gap. Many studies discuss AI-driven plant disease detection. Other studies discuss the properties of Gymnema sylvestre. A few studies try to combine AI-driven plant disease detection and Gymnema sylvestre in a platform. I notice that researchers rarely build a platform that links AI-driven plant disease detection, with Gymnema sylvestre. I see that only a small number of researchers address disease diagnosis, agronomic support, product recommendation pathways and safe human dosage guidance together in one system for a plant. The lack of a system that includes disease diagnosis, agronomic support, product recommendation pathways and safe human dosage guidance, for Gymnema sylvestre is clear. The gap matters a lot because medicinal plants are used directly for consumption. Crop quality is critical. Contamination control is critical. Accurate dosing is critical.

The present work tries to close the gap by joining progress in intelligence, plant biology, agronomy and user design. The work builds an AI-enabled system, for Gymnema sylvestre disease detection and agronomic support. The AI-enabled system also includes product linkage and responsible dosage guidance. The work presents a multi-layered approach that supports the whole value chain of Gymnema sylvestre, an therapeutically significant plant. I see that the research directly addresses the gaps found in existing literature. I see that the research tries to broaden the options, for AI use, in the plant field.

3. SYSTEM ARCHITECTURE

3.1 System Overview

The proposed AI system for disease detection in Gymnema sylvestre is organized around a clear training and inference workflow that connects raw leaf images from the field to final disease predictions. The architecture focuses on the core deep learning pipeline: image acquisition, dataset curation, preprocessing, model training, validation, deployment, and prediction delivery to end users, without adding auxiliary advisory or recommendation modules that were not implemented in the project.

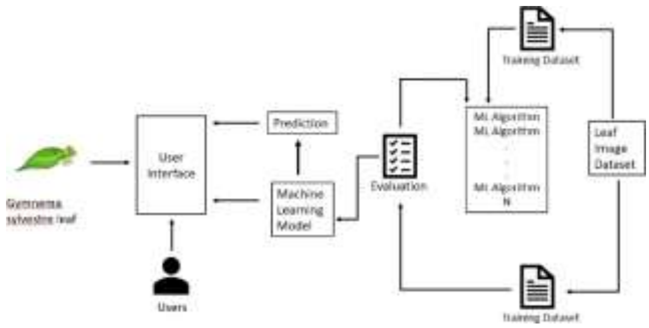

Fig. 1: Workflow Architecture for Gymnema sylvestre Disease Detection

In this workflow, farmers or researchers capture leaf images using standard smartphone cameras and contribute them to the dataset, where they are annotated and prepared for supervised learning. Before entering the network, images are resized, normalized, augmented, and batched so that the inputs remain consistent in size and scale while still reflecting the variability seen under real field conditions. The architecture then proceeds through model training, validation, and testing, allowing the CNN to learn disease-specific visual patterns and evaluate how well these learned patterns generalize to unseen images. The complete system follows a client–server design to keep the interface simple for users while concentrating computation on the backend. The client, implemented with a React-based web interface, lets users upload images and view prediction results, whereas the Python-based server handles preprocessing, model loading, inference, and response generation. This separation improves scalability and maintainability and ensures that devices with modest hardware and variable connectivity can still access the system reliably.

3.2 Deep Learning Model Architecture and Disease Detection Pipeline

3.2.1 Convolutional Neural Network Design

At the core of the pipeline is a custom Convolutional Neural Network designed specifically for classifying Gymnema sylvestre leaf diseases. The model is implemented in TensorFlow, which provides efficient support for defining network layers, using GPU acceleration, and preparing the model for deployment in production environments. The earlier convolutional layers focus on low-level structure, such as edges, contours, and basic texture patterns, while deeper layers capture higher-level disease characteristics, including lesions, fungal patches, discoloration, and local deformation of the leaf surface.

Each convolutional layer is followed by a Rectified Linear Unit (ReLU) activation to introduce non-linearity and allow the model to approximate complex decision boundaries between disease classes. Pooling layers are interleaved with convolutional blocks to reduce spatial resolution, concentrate salient information, and limit the number of trainable parameters, which in turn lowers the risk of overfitting. In combination, these design choices yield a CNN that can handle the variations in lighting, orientation, and background typically found in field-acquired images while keeping inference computationally feasible.

3.2.2 Classification Head and Output Layer

Once feature extraction is complete, the resulting feature maps are flattened and passed to a stack of fully connected layers that form the classification head. These dense layers integrate the learned features and transform them into class-specific scores, culminating in a final softmax output layer that produces a probability distribution over four classes: Healthy leaf, Powdery Mildew, Aphid Infestation, and Leaf Spot. The class with the highest probability is selected as the predicted disease category for the given image.

To improve generalization, dropout layers are placed between dense layers so that a random subset of neurons is temporarily deactivated during training, preventing the network from becoming too dependent on particular units. Batch normalization is also used to keep the distribution of intermediate activations stable across mini-batches, which helps the model train faster and reduces sensitivity to initialization and learning rate settings.

3.2.3 Training Methodology and Optimization

The CNN is trained using a labeled image dataset of Gymnema sylvestre leaves collected from multiple locations in Karnataka, capturing a range of disease conditions and environmental settings. The dataset is split into three parts: 70% of the images are used to train model parameters, 15% are reserved for validation during training, and the remaining 15% form an independent test set for final evaluation, which is a commonly adopted practice in supervised learning experiments.

Categorical cross-entropy is used as the loss function because it is well suited to multi-class classification tasks, and the Adam optimizer is chosen for its adaptive learning rate and momentum properties, which support stable and efficient convergence on complex image datasets. Hyperparameters such as learning rate, batch size, and number of epochs are tuned empirically, and early stopping is enabled so that training halts when validation performance no longer improves, reducing the likelihood of overfitting to the training set.

3.2.4 Model Serialization and Deployment

After training and validation, the best-performing model configuration is saved in HDF5 (model.h5) format so that both its architecture and learned weights can be restored without retraining. This file format is widely used in the TensorFlow and Keras ecosystem for packaging deep learning models in a manner that is portable across machines and operating systems.

During deployment, the backend server loads the serialized model into memory during startup and reuses the same loaded instance for all incoming requests. This strategy avoids the overhead of loading the model repeatedly and helps maintain consistent latency and reproducible predictions, both of which are important when the system is used in field environments that may have limited connectivity and time-critical decision needs.

3.2.5 Image Acquisition and Preprocessing

Users capture leaf images using common smartphone cameras, which makes the system accessible without dedicated hardware. Once an image is uploaded through the web interface, it is automatically resized to the input resolution expected by the CNN, for example 224 × 224 pixels, and its pixel intensities are normalized to a suitable numeric range so that the model receives inputs on the same scale as those used during training.

During the training stage, the system applies data augmentation techniques such as random rotations, horizontal flips, brightness adjustments, and small translations. By exposing the CNN to these plausible variations, the model becomes more robust to differences in viewpoint, illumination, and background clutter that occur naturally when farmers capture images in the field, which helps stabilize performance in real-world deployment.

4. AGRONOMIC SUPPORT MODULE

4.1 Disease-Specific Management Strategies

The agronomic support module functions as a structured knowledge layer that links the model's disease predictions to clear, scientifically grounded management guidance for Gymnema sylvestre foliar diseases. Once the detection model assigns a disease label to an input image, the system maps that label to a predefined set of management recommendations that are specific to the diagnosed condition and suitable for field application.

The figure presents representative Gymnema sylvestre leaves collected during field surveys in Karnataka, including both healthy and diseased specimens. By visually contrasting typical symptoms of Powdery Mildew, Aphid Infestation, and Leaf Spot with healthy foliage, the illustration helps readers relate the system outputs to the actual appearance of plants in field conditions.

Fig.2: Leaves, Flowers and Seeds of Gymnema sylvestre

4.1.1 Powdery Mildew Management

Powdery mildew, commonly associated with Oidium species, appears as a fine white, powder-like growth on the leaf surface that often starts on the lower side and gradually spreads across the lamina. As the infection progresses, photosynthetic area is reduced, plant vigor declines, and premature leaf aging can occur, which may ultimately affect both biomass and medicinal quality of the harvested leaves. Management begins with cultural practices that reduce humidity around the canopy, such as pruning lower branches, removing excess foliage, and maintaining plant spacing of about 1.5–2 m to promote air movement and limit the formation of prolonged leaf wetness.

Irrigation scheduling is adjusted to avoid wetting foliage in the late evening, thereby reducing the duration of conditions favorable for fungal growth. Infected leaves are removed and destroyed, and pruning tools are sanitized using 70% ethanol or similar disinfectants to prevent spread of conidia between plants. When chemical measures are required, sulfur-based fungicides are applied at recommended doses because they are effective against powdery mildew and widely used in medicinal crops. Neem-based formulations and potassium bicarbonate sprays provide additional options, particularly where low-residue or organic-compatible approaches are preferred.

4.1.2 Aphid Infestation Management

Aphids belonging to genera such as Aphis and Myzus feed on plant sap with piercing–sucking mouthparts, leading to leaf curling, chlorosis, stunting, and in severe cases, premature leaf drop. Their honeydew excretions support the growth of sooty mold, which further reduces photosynthetic efficiency and overall plant health. Effective management starts with regular field scouting to identify colonies early, followed by physical removal of heavily infested leaves or shoots and the use of directed water sprays to dislodge aphids from tender plant parts.

Sanitation practices such as weed removal around the field help eliminate alternative host plants that can sustain aphid populations. Biological control is encouraged by conserving and, where possible, introducing natural enemies such as ladybird beetles, lacewings, and parasitoid wasps, and by using entomopathogenic fungi like Beauveria bassiana, which can reduce aphid numbers without harming the crop. When chemical intervention becomes necessary, insecticidal soaps, neem oil formulations, and pyrethrin-based sprays are used according to label recommendations and with attention to residue requirements in medicinal crops. Preventive strategies such as avoiding excessive nitrogen fertilization, using reflective mulches, and installing yellow sticky traps help monitor and suppress aphid populations over time.

4.1.3 Leaf Spot Disease Management

Leaf spot diseases in Gymnema sylvestre, caused by fungi such as Colletotrichum and Cercospora as well as other fungal or bacterial agents, typically appear as circular or angular lesions with distinct margins on the leaf surface. Under favorable conditions, lesions may coalesce, causing extensive blighting, defoliation, and a noticeable decline in yield and leaf quality. Management emphasizes reduction of leaf wetness through the use of drip irrigation and the avoidance of overhead watering, combined with adequate spacing and pruning to enhance air circulation within the canopy.

Removal and destruction of infected leaves lowers the amount of inoculum, while cleaning pruning tools with 70% ethanol or a 10% bleach solution reduces the risk of pathogen transmission between plants. Maintaining field hygiene by collecting and disposing of fallen leaves and plant debris further limits the spread of spores. Good soil drainage is promoted through raised beds or soil amendments in poorly drained areas to prevent excessive humidity at the base of plants, and clean organic mulches are used to reduce soil splash during rainfall events.

When chemical control is warranted, copper-based fungicides offer broad-spectrum protection, while sulfur formulations and mancozeb are used for specific fungal leaf spot problems in line with recommended doses and intervals. Biological products based on Bacillus subtilis can be integrated into the spray schedule to suppress pathogens on leaf surfaces, especially in systems aiming to reduce synthetic inputs. Long-term prevention also includes selecting more tolerant planting material where available, implementing crop rotation to avoid continuous Gymnema cultivation on the same land, and conducting routine monitoring to detect early symptom development.

Table 1: Disease Management Strategies for Gymnema sylvestre

Powdery Mildew

Symptoms	Control Measures	Preventive Practices
White powder coating on leaves.	Sulfur spray, neem oil application, improve air circulation.	Monitor humidity, maintain spacing, ensure adequate ventilation.

Aphids

Symptoms	Control Measures	Preventive Practices
Yellowing, sticky residue, leaf curling.	Insecticidal soap, biological control (ladybugs, parasitoids), neem spray.	Regular monitoring, remove affected parts, companion planting.

Leaf Spot

Symptoms	Control Measures	Preventive Practices
Brown/black spots with yellow halo.	Copper-based fungicides, remove affected leaves, reduce leaf wetness.	Avoid overhead irrigation, improve drainage, sanitize tools.

4.2 Communication of Recommendations

All recommendations generated by the agronomic support module are presented in straightforward, field-oriented language so that they can be understood by users with varied technical backgrounds. The content of the module is strictly limited to the functions actually implemented in the system and does not claim additional advisory capabilities beyond disease-specific management guidance. For each diagnosed disease, the module provides a set of prioritized, actionable steps that correspond to the observed severity level, helping users translate model predictions into practical decisions for managing Gymnema sylvestre foliar health.

5. PRODUCT RECOMMENDATION AND RESOURCE LINKAGE MODULE

5.1 Disease Management Product Database

The product recommendation module maintains a structured list of agricultural inputs and consumer-oriented Gymnema products that align directly with the agronomic guidance provided by the system. The project is implemented using static HTML pages, so this module operates as an organized catalogue rather than a dynamic database, with each entry described in plain language and linked to an external, trusted vendor or information source for further details or independent purchase.

For disease management, the catalogue includes fungicidal options such as sulfur formulations, neem oil products, copper-based fungicides, and biological agents based on organisms like Bacillus subtilis or Bacillus licheniformis. Insect-focused entries cover neem-based insecticides, insecticidal soaps, pyrethrin formulations, and biological control products associated with beneficial insects such as parasitoid wasps and predatory beetles. Additional listings highlight plant growth promoters such as mycorrhizal inoculants, biostimulants derived from plants, and seaweed-based formulations, as well as soil amendments including composted organic matter, vermicompost, perlite, expanded clay, and sulfur powder for pH management. Equipment items such as pruning tools, sanitation solutions, sprayers, humidity meters, and sticky traps are also included to support practical field implementation.

The same module presents consumer-facing Gymnema products intended for personal health use. These entries cover standardized extract capsules in common strengths, tablet formulations often combined with supporting ingredients, powders made from dried leaves or extracts, raw dried leaves for traditional preparations, and processed leaf products such as fermented or partially oxidized forms. Each listing is accompanied by a brief description and a link to an external webpage, allowing users to review specifications, safety information, and pricing directly on supplier or marketplace sites.

5.2 Recommendation Linkage Algorithm

After the system identifies a disease and presents the corresponding management steps, the same page displays a set of related products drawn from the static catalogue. This linkage does not rely on machine learning, scoring functions, or real-time computation; instead, the associations between each disease condition and its relevant inputs are hard-coded into the HTML structure and triggered by simple user selections.

For powdery mildew, the interface groups items such as pruning shears, neem oil concentrate, sulfur-based fungicides, and humidity monitoring tools, reflecting the emphasis on canopy ventilation and sulfur-oriented disease control. When aphid infestation is selected, the page shows products like insecticidal soaps, neem sprays, yellow sticky traps, and biological predator or parasitoid options that support integrated pest management strategies. For leaf spot problems, the recommended list includes copper fungicides, soil drainage aids, disinfectants for tools, and basic spraying equipment to implement sanitation and targeted fungicide use. These sets are presented directly within the page layout so that users can quickly match the management recommendations with concrete product options.

5.3 E-Commerce and Resource Linking Structure

All product entries are linked externally to vendor or informational websites where users can review detailed labels, user feedback, and cost before making any decision. The system itself does not connect to payment gateways, shopping carts, or user accounts; it simply provides organized access to relevant resources and leaves all transactions to third-party platforms. Because the interface is built entirely with static HTML and CSS, it does not store user information or track activity, and its role remains limited to cataloguing and linking products that support the recommended disease management practices.

6. DOSAGE GUIDANCE AND HEALTH SAFETY MODULE

6.1 Intelligent Dosage Recommendation System

The dosage guidance module offers structured information for individuals who use Gymnema sylvestre for metabolic support, glycemic control, or general wellness, but it does not perform medical diagnosis or automated decision-making. Users interact with a static interface designed using HTML, CSS, and React, selecting their demographic profile and health context from dropdown menus, after which the module displays the corresponding predefined dosage and safety information. No predictive model or adaptive algorithm is involved; the system simply reveals content that has been prepared in advance for each category.

6.1.1 User Profiling and Health Screening

To make the guidance more relevant, users are asked to choose from categories that summarize key aspects of their health status. These include age group (for example, child, adolescent, adult, senior), pregnancy or lactation status, history of diabetes, kidney or liver health, current medications, and other relevant conditions. The interface also allows users to indicate whether they have known allergies, episodes of hypoglycemia, or other risk factors, and it then displays the static recommendations linked to the selected profile. All selections remain within the browser session and are neither stored nor transmitted, so the module functions purely as an on-page information filter.

6.1.2 Contraindication and Safety Screening

The module provides dedicated sections that summarize contraindications and safety considerations for Gymnema use in different groups. Absolute contraindications include Type 1 diabetes without direct medical supervision, advanced kidney or liver disease, known hypersensitivity to Gymnema, and pregnancy in the absence of professional guidance. Relative cautions are outlined for users with mild organ impairment, those on concurrent diabetes medications, individuals with autoimmune or chronic conditions, breastfeeding mothers, and those with a prior history of hypoglycemia. Potential interactions with oral antidiabetic drugs and medications metabolized by hepatic enzymes are highlighted, and users are advised to consult healthcare professionals before combining Gymnema with such therapies. All of this information is presented as static educational content and does not substitute for personalized medical advice.

6.1.3 Dosage Recommendations by Form and Population

Dosage information is organized by both product form and user group, summarizing ranges reported in the literature and in commercial health products. For healthy adults, the module displays guidance for standardized extract capsules in the approximate range of 500–750 mg once or twice per day, extract tablets taken according to manufacturer instructions, powders in teaspoon-level quantities, and traditional preparations using dried leaves. Suggested durations of use are typically in the order of several weeks to a few months for metabolic support, with an emphasis on periodic review rather than continuous unsupervised intake.

For adults with prediabetes or Type 2 diabetes not on medication, the content presents moderate dosing ranges, such as twice-daily capsule use or divided doses of powder across meals, along with reminders to monitor fasting and post-meal blood glucose during the initial phase of supplementation. For adults already taking antidiabetic medications, the module displays more conservative starting doses (for example, once-daily capsule use) and places stronger emphasis on frequent glucose monitoring and medical consultation to reduce the risk of hypoglycemia. In all cases, the guidance remains static, does not adapt to user behavior, and is framed as informational support rather than a replacement for professional clinical advice.

7. CONCLUSION

The developed AI-based system for disease detection and agronomic support in Gymnema sylvestre represents a practical application of deep learning and web technologies to a medicinal crop that often lacks specialized decision-support tools. By using a Convolutional Neural Network to classify key foliar diseases such as powdery mildew, aphid infestation, and leaf spot from smartphone images, the system supports earlier diagnosis and faster response, which can help limit yield and quality losses in cultivated plants. The web-based interface, built with modern front-end technologies, makes these capabilities accessible to users with varying technical backgrounds by providing an intuitive, image-driven workflow.

In addition to detection, the platform links model outputs to structured agronomic recommendations, product catalogues, and health-related dosage information, so users receive both a diagnosis and clear follow-up guidance. The agronomic and product modules translate technical management practices into concrete field actions and resource options, while the dosage and safety component summarizes current knowledge on Gymnema use and precautions without performing medical decision-making. Together, these modules turn the system into a practical support environment that connects AI-based classification with real-world decisions on crop protection and responsible consumption.

The modular design of the platform, combining TensorFlow-based machine learning with a React-driven client and static content modules, allows individual components to be updated or extended without reworking the entire pipeline. This architecture supports future enhancements such as new disease classes, revised management protocols, or redesigned user interfaces tailored to different farmer groups or regions. At the same time, the use of static pages for advisory, product, and dosage content keeps deployment simple and reduces infrastructure overhead, which is important for low-resource agricultural settings.

Looking forward, the system can be strengthened by adding more disease categories and incorporating environmental or sensor data to move from detection toward risk prediction and preventive management. Multilingual interfaces and region-specific content would further improve usability for diverse user communities and support wider adoption of best practices in Gymnema cultivation. Integration with additional datasets or feedback mechanisms could also help refine model performance and management recommendations over time, keeping the platform aligned with evolving agronomic knowledge.

Overall, the work illustrates how artificial intelligence can be embedded into practical, crop-specific decision-support tools for precision agriculture and medicinal plant management. By joining deep learning, structured agronomic knowledge, and accessible web interfaces, the system contributes to more timely disease control, more informed use of Gymnema-based products, and more sustainable cultivation practices in the field.

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