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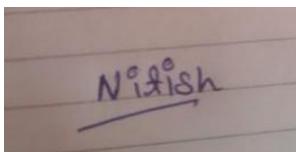
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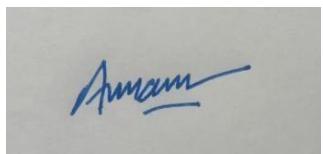
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## Invention Disclosure Form (IDF)

A) Please enlist the **Key concepts and terms/Keywords/Synonyms used in the Invention?**

S. No	Keywords for invention which has to be search	Synonyms
1	<i>Hydroponic farming</i>	<i>Water-based cultivation, Soilless agriculture, Nutrient film technique</i>
2	<i>Automated monitoring system</i>	<i>Smart sensing, IOT-based control ,Autonomous management</i>
3	<i>AI agricultural advisor</i>	<i>Intelligent Chabot, Machine learning assistant, Digital agronomist</i>
4	<i>Multilingual interface</i>	<i>Multi-language support, Regional language system, Vernacular interface</i>
5	<i>Soil analysis recommendation</i>	<i>Crop suitability prediction, Soil-based advisory, Land assessment system</i>
6	<i>Real-time nutrient management</i>	<i>Automated fertilization, Dynamic nutrition control, Precision feeding</i>
7	<i>Disease detection</i>	<i>Plant health monitoring ,pest identification, Crop pathology analysis</i>
8	<i>Mobile cloud integration</i>	<i>Remote farm management ,Cloud-based analytics ,Smartphone dashboard ,Edge computing</i>
9	<i>Drip irrigation precision</i>	<i>Micro-irrigation ,Targeted water delivery, Root zone watering, Emitter-based system</i>

## Invention Disclosure Form (IDF)

### 1. TITLE OF INVENTION- 15 words max

*Integrated AI-Powered Hydroponic and Soil-Based Smart Agriculture System with Multilingual Advisory Platform*

### 2. BACKGROUND OF THE INVENTION- prior art search, tell what was the problem in past and how your invention overcome it. Compare your invention with closet prior art.

Traditional agriculture faces deep limitations that reduce productivity, sustainability, and farmer income. Its biggest weakness is total dependence on soil quality—farmers can grow only what their soil allows, forcing mono-cropping that depletes nutrients and increases the risk of crop failure. Poor or degraded soils trap farmers in cycles of low yields and poverty.

#### Key Problems in Traditional Soil-Based Farming:

- **Soil Dependency:** Poor or damaged soil limits crop choices and is expensive and slow to improve.
- **Water Inefficiency:** Traditional irrigation wastes water and causes stress, disease, and groundwater depletion.
- **Limited Crop Diversity:** Soil conditions force repeated cropping, increasing pest risk and price crashes.
- **Lack of Scientific Access:** Small farmers lack modern knowledge, tools, and timely guidance.
- **High Labour Demand:** Constant manual monitoring limits scale and efficiency.
- **Late Disease Detection:** Problems are noticed only after visible damage, causing major losses.
- **Language & Digital Barriers:** Most tools are not accessible in local languages or voice formats.
- **Market Uncertainty:** Farmers lack real-time price and demand insights, leading to unstable income.
- **Climate Vulnerability:** Crops are exposed to extreme and unpredictable weather.
- **Input Waste & Environmental Harm:** Uniform fertilizer and pesticide use wastes money and damages ecosystems.

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### **Prior Art Analysis and Limitations:**

Although hydroponics removes soil dependency, existing solutions fail to meet the needs of typical farmers.

#### **1. DIY Hydroponic Systems**

Low-cost systems require daily manual nutrient mixing, pH/EC testing, and technical chemistry knowledge. They offer no automation, alerts, disease detection, multi-crop support, or advisory guidance, making them as labor-intensive as soil farming.

#### **2. Commercial Hydroponic Systems**

Large vertical farms are extremely expensive, designed for indoor warehouses, require stable electricity and trained staff, support single crops only, and target premium markets.

#### **3. IoT Farm Monitoring Tools**

Collect large amounts of data but provide raw readings, not actionable advice. They focus only on soil farming, lack hydroponic support, market insights, multilingual interfaces, and predictive alerts.

#### **4. Agricultural Advisory Apps**

Provide generic advice and post-damage disease detection but lack real-time integration, automation, voice interfaces, multi-language support, and economic analysis.

#### **5. Smart Irrigation Systems**

Automate only watering, ignoring nutrients, disease, crop selection, or profitability, and work only with soil-based farming.

#### **6. Soil Testing Services**

Provide slow, technical reports with little interpretation, no crop ranking, no profitability analysis, and no alternatives when soil is unsuitable.

### **Comprehensive Analysis: Critical Gaps in Existing Technology**

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- **No Unified Dual-Mode Platform** – No system integrates automated hydroponics *and* soil-based farming advisory.
- **No AI Harvest Prediction** – No precise harvest date notifications based on growth analysis.
- **No True Multilingual AI** – No support for 10+ regional languages with voice input/output.
- **No Market-Integrated Revenue Optimization** – No real-time price integration for profit-maximizing decisions.
- **No Real-Time Sensor–AI Integration** – Advisory is disconnected from actual field conditions.
- **No Multi-Crop Hydroponic Support** – Cannot grow 5–10 different crops simultaneously.
- **No Intelligent Water Recycling** – No AI-controlled purification with zero-waste systems.
- **No Soil-to-Hydroponic Transition** – No pathway from problematic soil to alternatives.
- **No Pre-Symptomatic Disease Detection** – Detection occurs only after visible symptoms, missing the 5–10 day early window.
- **No Intelligent Daily Reporting** – Raw data requires technical interpretation instead of vernacular summaries.

### How The Invention Solves All Problems

#### (A) World's First Dual-Mode Integrated Platform

Seamlessly combines automated hydroponics with AI-powered soil-farming advisory. Farmers operate both simultaneously or transition gradually with continuous expert support.

#### (B) Complete Automation

Automates water recirculation (90–95% savings), nutrient injection, pH control, environmental monitoring, disease detection, harvest prediction, and daily mobile reporting—no physical visits needed.

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### **(C) Multilingual Conversational AI**

Natural language chatbot in 10+ regional languages with voice input/output provides soil analysis, revenue-optimized recommendations, disease diagnosis, and weather planning in the farmer's native language.

### **(D) Market Intelligence**

Real-time price tracking, cost calculation, yield estimation, net profit computation with weekly updates for economically optimal decisions based on market conditions.

### **(E) Intelligent Soil Analysis**

Automated report interpretation with crop-soil matching; suggests hydroponic transition with cost-benefit analysis when soil quality is poor.

### **(F) Unified Architecture**

All components share real-time data: sensors feed AI, weather integrates both methods, market prices influence both systems, single mobile dashboard, disease detection across both cultivation types.

### **3. OBJECTIVE OF THE INVENTION**

## Invention Disclosure Form

(IDF)

- **Eliminate absolute soil dependency** by providing fully automated hydroponic cultivation system enabling farmers to grow any crop regardless of land soil quality, eliminating monoculture constraints.
- **Achieve 90-95% water savings** through intelligent closed-loop water recycling with automated purification, nutrient replenishment, and pH regulation compared to traditional irrigation methods.
- **Enable simultaneous dual-mode farming** allowing farmers to operate automated hydroponic systems for high-value crops while receiving AI guidance for traditional soil-based plots, supporting gradual transition or permanent parallel operation.
- **Provide early disease detection** 5-10 days before visible symptoms using computer vision analysing chlorophyll degradation, leaf texture changes, and growth anomalies, enabling preventive treatment.
- **Deliver intelligent revenue-optimized crop selection** through AI analyzing soil test results, real-time market prices across 50+ mandis, cultivation costs, and yield projections, ranking crops by expected net profit margins.
- **Bridge agricultural knowledge gap** with truly multilingual AI assistant supporting Hindi, Punjabi, Bengali, Tamil, Telugu, Marathi, Gujarati, Kannada, Malayalam, Odia, and Assamese with voice input/output, delivering personalized guidance regardless of literacy level.
- **Optimize farm revenue through diversified multi-crop cultivation** enabling simultaneous growth of 5-10 different crop species with independent nutrient management, allowing continuous weekly harvests rather than seasonal bulk harvests.
- **Minimize labor requirements** achieving 80% reduction through complete automation of irrigation, nutrient delivery, pH adjustment, environmental monitoring, and disease detection, freeing farmers from constant physical presence.
- **Enable scalable implementation** through modular expandable architecture supporting small household installations (4-6 plants, ₹15,000-25,000) through commercial operations (1000+ plants, ₹2-5 lakh) with identical technology.
- **Integrate weather intelligence** connecting to meteorological APIs providing 7-day forecasts with automated irrigation scheduling, disease risk alerts, planting timing guidance, and harvest timing recommendations based on upcoming conditions.



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### 4. NOVEL ASPECTS OF THE INVENTION (Point out the new parts used in the invention which make it different from the other existing inventions or prior arts).

#### 1. Integrated Dual-Mode Farming Platform

**Invention:** Unified mobile platform integrating automated hydroponic cultivation with AI-powered soil-based farming advisory, enabling bidirectional data sharing, comparative yield/revenue analysis, and cross-method disease detection within a single application.

**Novelty:** First system bridging soilless and traditional farming domains; prior art addresses each exclusively.

#### 2. AI-Driven Predictive Harvest Scheduling

**Invention:** ML algorithms analyzing daily computer vision data (growth velocity, morphological indicators, species markers) to predict precise harvest dates 15-20 days in advance with automated countdown notifications.

**Novelty:** Provides specific date predictions vs. generic timeframes; integrates weather-adjusted projections.

#### 3. Multilingual Voice-Enabled Agricultural AI

**Invention:** NLP chatbot supporting 10+ Indian regional languages with bidirectional voice I/O, understanding agricultural terminology, local crop names, and maintaining contextual conversation memory.

**Novelty:** Enables illiterate farmer access via voice; prior art requires literacy and offers limited language support.

#### 4. Market-Integrated Revenue Optimization Engine

**Invention:** Recommendation system integrating real-time prices from 50+ markets, historical trends, cultivation costs, and yield projections to generate profit-ranked crop recommendations updated weekly.

**Novelty:** Computes net profit margins; prior art provides compatibility-only recommendations without economic analysis.

## Invention Disclosure Form (IDF)

### 5. Intelligent Zero- Discharge Water Recycling

**Invention:** Closed-loop system with multi-stage purification (sediment filtration, UV sterilization), automated nutrient replenishment via EC monitoring, and self-regulating pH buffering (5.5-6.5 range).

**Novelty:** Enables 3-6 month water reuse without manual intervention; prior art requires frequent replacement.

### 6. Pre-Symptomatic Disease Detection

**Invention:** Computer vision analyzing daily photographs for chlorophyll degradation, micro-texture changes, and growth anomalies to detect diseases 5-10 days before visible symptoms, triggering treatment alerts.

**Novelty:** Early warning capability; prior art identifies only visible symptoms after extensive spread.

### 7. Modular Multi-Crop Cultivation Architecture

**Invention:** Independent container modules with separate nutrient reservoirs enabling simultaneous cultivation of 5-10 crop species with varying requirements, each receiving customized automated nutrient delivery.

**Novelty:** Supports diverse crops simultaneously; prior art requires uniform nutrient solution limiting to single crop type.

### 8. Automated Soil-to-Hydroponic Transition Analysis

**Invention:** Engine processing soil test reports to generate compatibility scores, identify constraints, and when inadequate, recommend hydroponic alternatives with comparative cost-benefit analysis and payback calculations.

**Novelty:** Bridges soil analysis with hydroponic alternative recommendations; prior art treats each domain separately.

### 9. Intelligent Prioritized Alert System

## Invention Disclosure Form (IDF)

**Invention:** Automated system analyzing sensor data and crop health to generate natural-language daily reports with prioritized alerts (critical/warning/information) delivered via mobile notifications in regional languages.

**Novelty:** Translates technical data into actionable vernacular guidance; prior art displays raw data requiring interpretation.

## Invention Disclosure Form (IDF)

**5. DETAILED DESCRIPTION OF THE INVENTION - Be sure to use as much space as needed, and be as detailed as you can in this section, as anything that is not covered here will not be protected under the patent we may obtain.**

**\*\*\*Note: please explain your invention step wise in sequential order and how it works and duly explain all the parts of the device in sequential order with its functionality.**

1. In case of software embedded with the device; - explain step wise how the software works with the device and its functionality, with flow chart and diagram. \*\*\*
2. In case the invention is related to product, device and apparatus, detail of parts of the device, apparatus, product in bullet points
3. In case the invention is related to process, composition, explain the steps of process, composition in bullet p

### System Architecture Overview

Dual-subsystem platform: (1) Automated soilless water-based cultivation (2) AI multilingual advisory for traditional farming. Unified cloud infrastructure and mobile interface.

#### 1. Water-Based Cultivation System

##### Physical Components

- **Containers:** Coconut fiber-filled modules (12-18" diameter) with drainage, scalable 4-100+ units
- **Water System:** Closed-loop with reservoir (100-500L), pump (30-50W), PVC network, drip emitters
- **Nutrients:** Three automated tanks (calcium nitrate; potassium/magnesium; micronutrients) with precision pumps
- **pH Control:** Auto-adjustment maintaining 5.5-6.5 range with acid/base injection

##### Sensors & Monitoring

- **Water:** pH, EC, oxygen, temperature, level sensors (15-min logging)
- **Environment:** Air temp/humidity, light (PAR), weather integration
- **Plants:** Daily 8-12MP imaging with computer vision analyzing growth, disease, pests, harvest readiness

##### Automation & Intelligence

## Invention Disclosure Form (IDF)

- **Control:** Microcontroller processing inputs, executing algorithms, cloud logging, WiFi/4G remote access
- **Algorithms:** Adaptive water circulation, EC-based nutrient management (0.8-2.5 mS/cm by stage), pH regulation, environmental response
- **Disease AI:** Neural network trained on 10,000+ images; pre-symptomatic detection; treatment protocols (organic/chemical)
- **Harvest Prediction:** Daily growth tracking, species-specific maturity models, 7-day advance notifications

### Multi-Crop Features

- Three nutrient groups (leafy greens, herbs, fruiting vegetables) with dedicated loops
- Staggered planting cycles for continuous weekly/bi-weekly harvests
- Rotation recommendations preventing monoculture

## 2. AI Agricultural Advisory

### Soil Analysis

- **Processing:** OCR extraction from uploaded reports (pH, NPK, micronutrients, texture)
- **Assessment:** Automated classification, problem identification (deficiencies, toxicities, salinity)
- **Recommendations:** 150+ crop database with compatibility scoring, yield projections, amendment specifications

### Market Intelligence

- **Data:** API integration with AGMARKNET, 100+ crops, 50+ markets, daily updates, 3-year trends
- **Analysis:** Comprehensive cost modeling (inputs, labor, transport), net profit calculations, risk scenarios
- **Outputs:** Crops ranked by profitability with detailed projections (example: lettuce ₹4.5L/ha, tomatoes ₹5.6L/ha)

### Multilingual AI Chatbot

- **Languages:** 10+ Indian regional languages (Hindi, Punjabi, Tamil, Telugu, etc.)
- **Interface:** Voice input/output, natural conversation, hands-free operation
- **Knowledge:** 150+ crops, 200+ pests, 300+ diseases; region-specific guidance
- **Features:** Intent recognition, context maintenance, image-based disease diagnosis

## Invention Disclosure Form (IDF)

### Disease Management

- **Diagnosis:** Photo upload with computer vision identifying disease type, severity, confidence scoring
- **Treatment:** Organic and chemical protocols with application instructions, safety, follow-up monitoring
- **Prevention:** Risk assessment based on weather, preventive measures, rotation guidance, resistant varieties

### Weather Integration

- **Forecasts:** 7-day data from IMD (temp, rainfall, humidity, warnings)
- **Recommendations:** Irrigation scheduling, disease risk alerts, planting/harvest timing, crop protection
- **Climate Analysis:** Historical patterns, seasonal averages, adaptation strategies

## 3. Mobile Application

### Interface Features

- **Dashboard:** Unified view of both systems, real-time status, quick actions
- **Monitoring:** Live sensor gauges, 24-hour trend graphs, plant inventory, growth progression, alerts
- **Chatbot:** WhatsApp-style interface, voice buttons, photo/document attachments, language selector
- **Analysis Screens:** Visual soil results, ranked crop recommendations, market price charts, comparison tools

### Configuration

- Profile/farm settings, notification preferences, system configuration, manual overrides, help/support

## 4. Cloud Infrastructure

### Data Management

- **Storage:** Time-series sensor data (1-year retention), user profiles, soil reports, disease records, market prices

## Invention Disclosure Form (IDF)

- **APIs:** Weather, market prices, payment, SMS gateway integrations
- **AI Models:** Disease detection CNNs, harvest prediction, multilingual NLP, voice recognition/synthesis

### Security

- End-to-end encryption, HTTPS communication, multi-factor authentication, role-based access, privacy compliance

## Invention Disclosure Form (IDF)

### 6. DRAWINGS OR SUPPORT MATERIAL

. Figure 1: System Architecture Diagram

#### 1. Hydroponic System

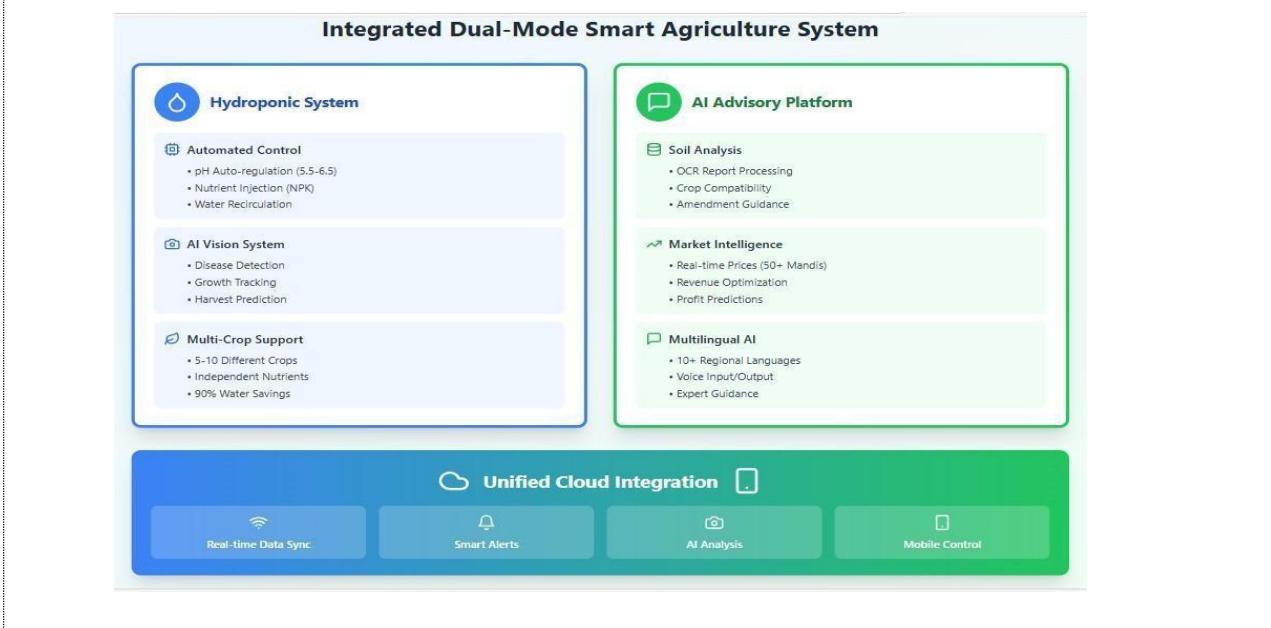
- Automatically controls pH, nutrients, and water.
- AI detects plant diseases, tracks growth, and predicts harvest.
- Supports 5–10 crops at once with independent nutrients.
- Saves up to 90% water.

#### 2. AI Advisory Platform

- Analyzes soil reports and suggests crop suitability.
- Guides on fertilizers and soil improvements.
- Provides market insights: prices, profit, and revenue predictions.
- Speaks 10+ regional languages and offers voice guidance.

#### 3. Unified Cloud Integration

- Syncs data in real-time.
- Sends smart alerts.
- Performs AI analysis.
- Allows mobile control from anywhere.



## Invention Disclosure Form (IDF)

.Figure 2:Work flow

### • Data Collection & Local Processing

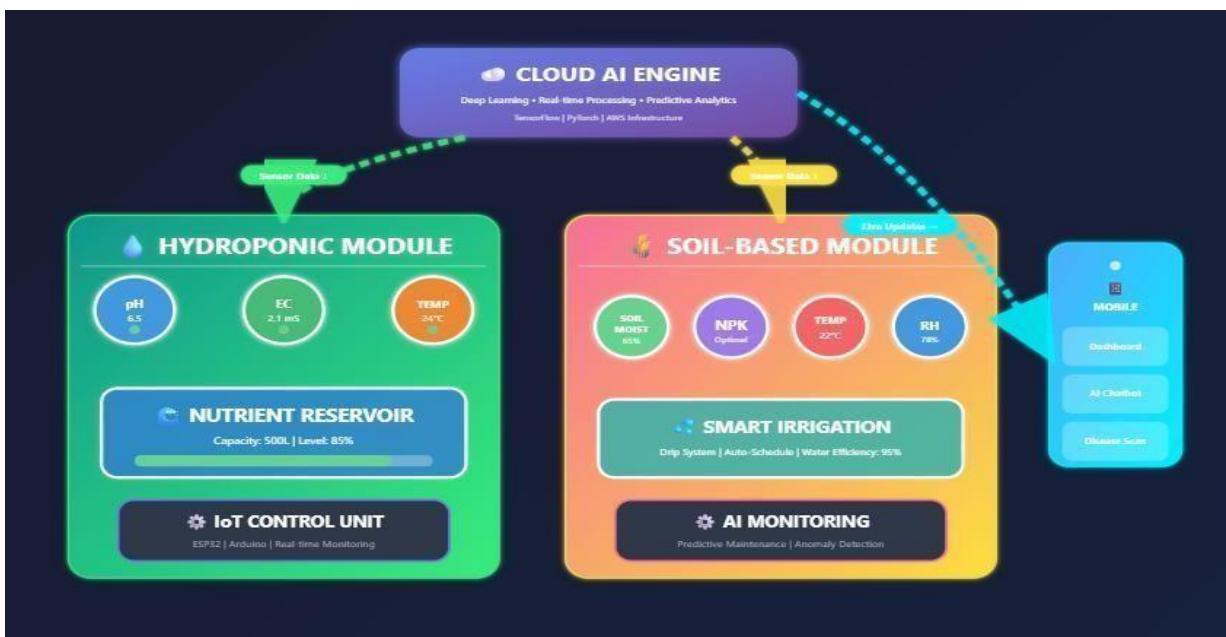
Field devices measure farm conditions and send to local controller  
 Local unit combines readings, stores temporary copies, checks for urgent issues  
 Basic control happens here without waiting for internet

### • Secure Cloud Transfer & AI Analysis

Data is protected and sent to cloud servers  
 Cloud system combines farm data with weather information, market prices, and past records  
 AI analyzes everything to make smart decisions

### • Alert Creation & Delivery

System creates notifications about problems, harvest times, and opportunities  
 Decides best way to send each alert based on urgency and farmer preference  
 Sends alerts to mobile app, SMS, and dashboard



## Invention Disclosure Form (IDF)

. Figure 3: Disease Detection and Analysis

- **Image Capture**

A user takes a photo of a plant leaf or crop using a smartphone or camera.

- **Pre-Processing**

The raw image is cleaned, resized, normalized, and filtered to highlight important features before analysis.

- **Secure Transmission**

The prepared image is encrypted and sent over the network to the central processing system.

- **AI Analysis Engine**

A deep learning model (CNN) analyzes the image and identifies patterns associated with plant health or disease.

- **Disease Identification**

The system calculates likelihoods for different disease types (e.g., fungal, bacterial, healthy) and selects the most likely outcome.

- **Instant Notification**

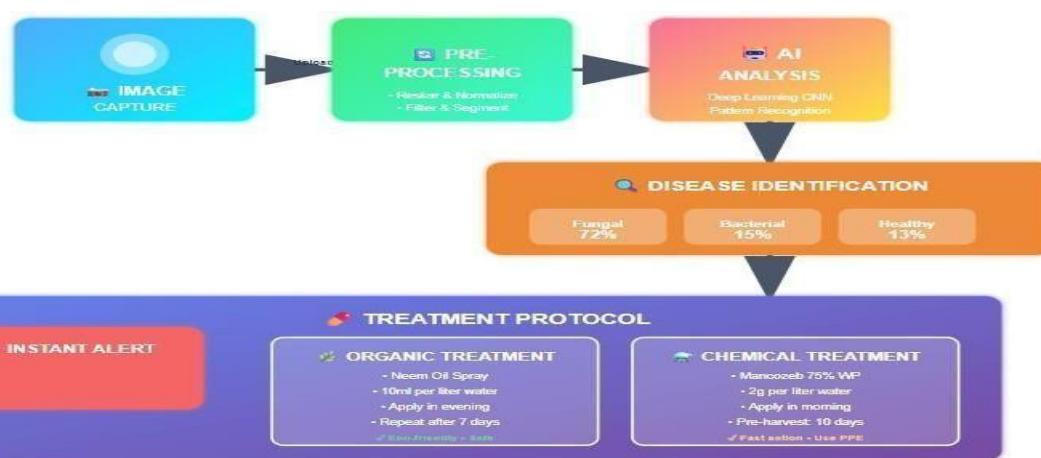
The user receives a quick alert with the diagnosis result so they can act without delay.

- **Treatment Recommendation**

Based on the identified condition, the system suggests a suitable treatment plan — either organic methods or chemical sprays with dosage and safety advice.

- **Feedback & Learning Loop**

User responses (treatment results) are collected and used to update and improve the AI model over time.



. Figure 4: AI based crop recommendation and profit optimization workflow

## Invention Disclosure Form (IDF)

### **. Step 1: Soil Analysis Input**

The farmer uploads a soil test report (PDF or image). This is the starting point of the system.

### **. Step 2: OCR & Data Extraction**

The system uses OCR to read the soil report and extract key values like pH, NPK, micronutrients, and soil texture. AI validates and processes the soil chemistry data.

### **. Step 3: Compatibility Scoring**

The extracted soil data is matched against requirements of 150+ crops. The system calculates pH match, NPK adequacy, and texture fit, then generates a compatibility score from 0–100% for each crop.

### **. Step 4: Revenue Optimization**

Real-time market prices and demand data are integrated. The system estimates expected yield and market price, subtracts costs (seeds, fertilizer, labor, transport), and calculates net profit.

### **. Step 5: Ranked Recommendations**

Crops are ranked based on compatibility and profit. The final output shows top crop options with compatibility percentage, expected profit, and crop duration (days), helping the farmer choose the best option.

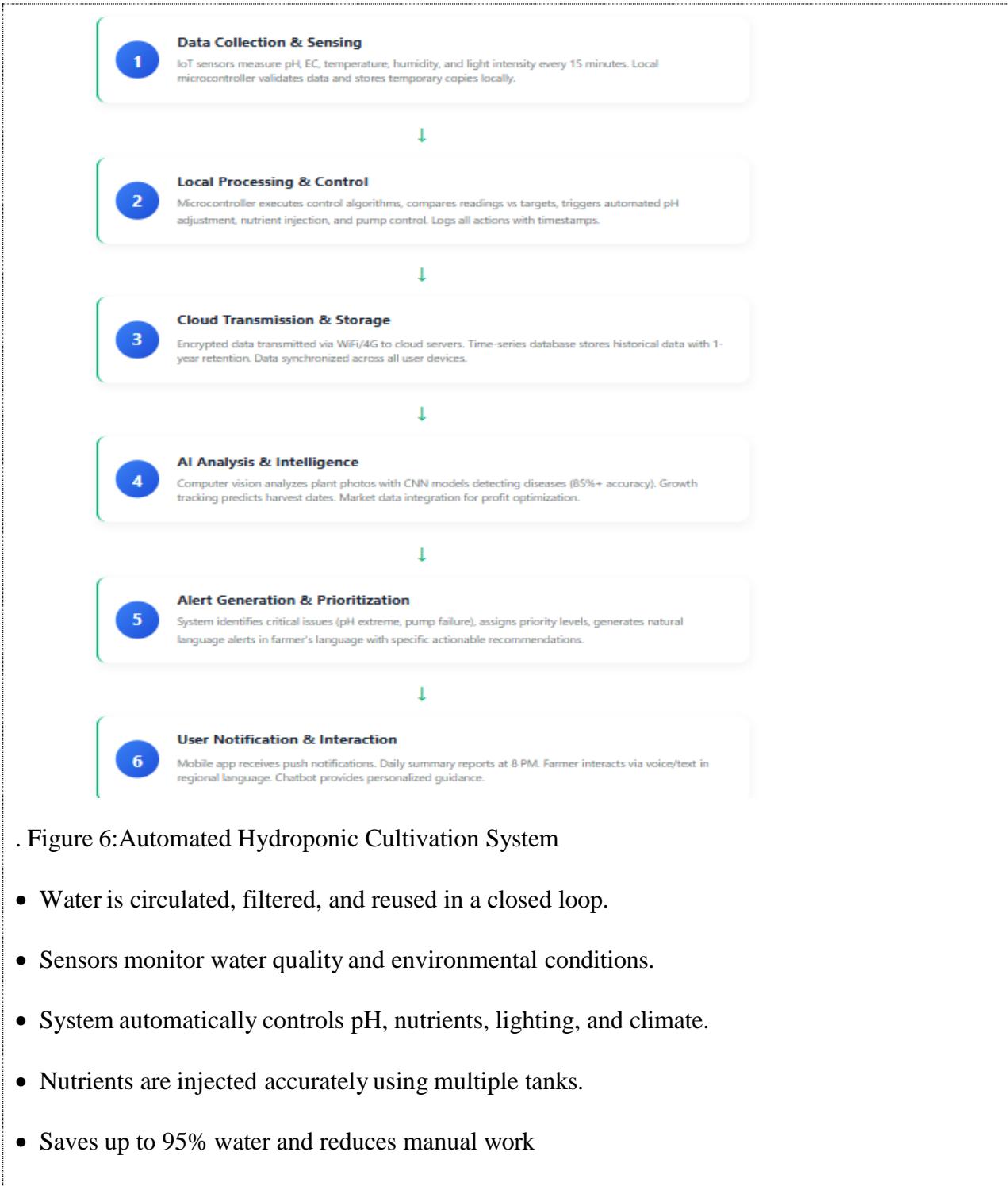


## Invention Disclosure Form (IDF)

. Figure 5: System flow diagram

- Sensors collect farm data like pH, temperature, and humidity.
- Controller processes data and automatically controls pumps and nutrients.
- Data is securely sent to the cloud and stored.
- AI analyzes plant health, growth, and market trends.
- System generates smart alerts in the farmer's language.
- Farmers receive notifications and control the system via mobile app.

## Invention Disclosure Form (IDF)



. Figure 6:Automated Hydroponic Cultivation System

- Water is circulated, filtered, and reused in a closed loop.
- Sensors monitor water quality and environmental conditions.
- System automatically controls pH, nutrients, lighting, and climate.
- Nutrients are injected accurately using multiple tanks.
- Saves up to 95% water and reduces manual work

## Invention Disclosure Form (IDF)

 **Closed-Loop Water Circulation System**



```

graph LR
    A[Main Reservoir  
100-500L Tank] --> B[Pump]
    B --> C[Plant Containers  
Coconut Fiber]
    C --> D[Filtration  
UV Sterilization]
    D --> A
    style A fill:#d9e1f2,stroke:#333,stroke-width:1px
    style B fill:#fff,stroke:#333,stroke-width:1px
    style C fill:#e1f5fe,stroke:#333,stroke-width:1px
    style D fill:#fce4ec,stroke:#333,stroke-width:1px
    
```

 **IoT Sensor Network & Automated Control**

Water Quality Sensors	Environmental Sensors	Automated Controls
<ul style="list-style-type: none"> <li>✓ pH Sensor (5.5-6.5)</li> <li>✓ EC Sensor (Nutrients)</li> <li>✓ Dissolved O<sub>2</sub></li> <li>✓ Temperature (18-24°C)</li> <li>✓ Water Level</li> </ul>	<ul style="list-style-type: none"> <li>✓ Air Temperature</li> <li>✓ Humidity (RH%)</li> <li>✓ Light Intensity (PAR)</li> <li>✓ Weather Station</li> <li>✓ CO<sub>2</sub> Levels</li> </ul>	<ul style="list-style-type: none"> <li>✓ pH Auto-adjust</li> <li>✓ Nutrient Injection</li> <li>✓ Water Circulation</li> <li>✓ Climate Control</li> <li>✓ LED Lighting</li> </ul>

**Nutrient Injection System**

Tank A: Calcium Nitrate Ca + N Supply	Tank B: K-Nitrate + Mg-Sulfate K + N + Mg Supply	Tank C: Micronutrients Fe, Mn, Zn, Cu, B, Mo
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**Key Benefits**

- ✓ **90-95% Water Savings**  
Closed loop recycling
- ✓ **Soil-Independent**  
Grow any crop anywhere
- ✓ **80% Labor Reduction**  
Complete automation
- ✓ **Multi-Crop Cultivation**  
5-10 simultaneous crops

### 7. ABSTRACT (150 words)



## Invention Disclosure Form (IDF)

An intelligent dual-mode agricultural system integrating automated water-based cultivation with AI-powered multilingual farming advisory. The system features complete automation through IOT sensors monitoring pH, electrical conductivity, nutrients, temperature, humidity, and light, with self-regulating control of water circulation, nutrient injection, and pH adjustment. Computer vision algorithms provide pre-symptomatic disease detection and predictive harvest scheduling with specific cutting-day notifications. An AI Chabot supporting 10+ regional Indian languages with voice input/output delivers soil analysis interpretation, revenue-optimized crop recommendations integrating real-time market prices, and personalized farming guidance. The system enables simultaneous multi-crop cultivation using modular coconut fiber containers with independent nutrient management, achieving 90-95% water savings through closed-loop recycling. Farmers receive automated daily reports and prioritized alerts via mobile application, eliminating manual monitoring requirements while optimizing yields and revenues through scientific precision management accessible to small-scale farmers.

**8. BRIEFLY EXPLAIN THE STEPS, FLOW CHART, FUNCTIONALITY OF INVENTION RELATED TO SOFTWARE, EMBEDDING WITH MACHINE, DEVICE, APPRATUS.**

**\*\*\*Note: Explain the functionality of software embedded with the device\*\*\***

## Invention Disclosure Form (IDF)

### Software System Workflow and Functionality

#### MODULE 1: Sensor Data System

- **Monitoring:** 15-min intervals for pH, EC, temperature, humidity, PAR, water level
- **Processing:** Microcontroller reads via GPIO/I2C/SPI, validates data, flags sensor faults
- **Storage:** WiFi/4G cloud transmission, 1+ year time-series database retention

#### MODULE 2: Automated Control

- **PH Regulation (5.5-6.5):** Auto-inject acid/base, circulate 15min, re-measure, repeat as needed
- **Nutrient Management:** EC-triggered injection from 3 tanks (growth stage-specific ratios), 30min circulation, verification
- **Environmental Control:** Temp >26°C (shading/cooling), humidity >80% (ventilation), low light (LED activation)
- **Logging:** All actions timestamped with reason and outcome

#### MODULE 3: AI Disease Detection

- **Workflow:** Daily photos → cloud upload → preprocess (1024x1024, normalize, segment) → CNN analysis
- **Detection:** Texture/color pattern analysis, probability scoring with confidence levels
- **Pre-Symptomatic:** 7-day comparison detects chlorophyll drop >15% or texture roughness >20% (5-10 days before visible symptoms)
- **Output:** Disease ID, severity, organic/chemical treatment protocols with application details

#### MODULE 4: Harvest Prediction

- **Tracking:** Daily CV-based measurements (leaf count, size, fruit count/diameter, stem dimensions)
- **Calculation:** 7-day average growth rate, current % of target size, weather-adjusted prediction ( $\pm 10\%$  for temp variations)
- **Notifications:** 7-day advance, daily countdown, harvest day, quality decline alerts

## Invention Disclosure Form (IDF)

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### **MODULE 5: Multilingual AI Chatbot**

- **Input:** Voice/text in 10+ Indian languages, speech-to-text with accent/noise handling
- **Processing:** Auto language detection → intent classification (soil/disease/market/weather/guidance) → entity extraction
- **Response:** Query-specific processing (soil analysis, price retrieval, disease diagnosis), natural language generation in regional language, text-to-speech output
- **Features:** Hands-free operation, conversational tone, actionable advice

### **MODULE 6: Soil Analysis Engine**

- **OCR Processing:** Extract parameters from uploaded reports, validate values
- **Assessment:** Classify nutrients (deficient to excessive), identify problems, plain language interpretation
- **Scoring:** 150-crop database compatibility (pH 30%, NPK 40%, other 30% weighted), 0-100% scores
- **Economic Analysis:** Top 10 crops analyzed for yield, costs (seeds/fertilizers/labor/transport), revenue, net profit; re-ranked by profitability
- **Output:** Ranked recommendations with compatibility %, yield, profit, duration, risk

### **MODULE 7: Daily Auto-Reports**

- **8 PM Generation:** Sensor/system status, automated actions, crop health/growth progress
- **Delivery:** Natural language in regional language, push notification, stored history

### **MODULE 8: Alert Prioritization**

#### **Levels:**

- Critical (immediate): pH <5.0 or >7.0, pump failure, high-confidence disease, malfunctions
- Warning (24hr): Low nutrients, sensor drift, extreme weather forecast, declining growth
- Informational: Harvest approaching, maintenance reminders, price changes
- **Delivery:** Multi-channel (push/SMS/call for critical), logged with timestamp