

SMART HYDROPONIC AGRICULTURE

An IoT & AI-Driven Innovation for Sustainable Farming

Student Innovation Project
Aviratha Digital Labs Research

Transforming Agriculture Through Technology

June 26, 2025

 **Student Innovation for Sustainable Future** 

Academic Research & Development Project

Presentation Overview

- ① **Problem Statement** - Agricultural Challenges
- ② **Our Innovation** - Smart Hydroponic Solution
- ③ **Technology Stack** - IoT & AI Integration
- ④ **Live Demonstration** - Working Prototype
- ⑤ **Impact & Applications** - Real-world Benefits
- ⑥ **Future Research** - Roadmap & Enhancements



Innovation in Action

Agricultural Challenges in India



Critical Issues

- **90% water wastage** in traditional farming
- **Climate unpredictability** affecting yields
- Soil degradation and nutrient depletion
- **Limited arable land** availability
- **Knowledge gap** in modern techniques
- **Food security** concerns



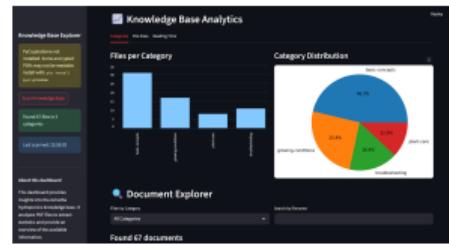
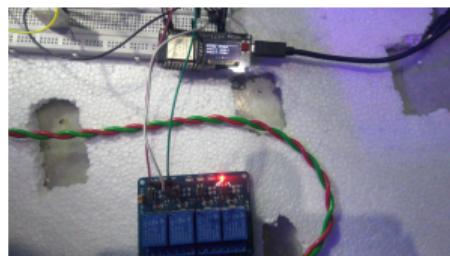
Innovation Needed

Smart Hydroponic Agriculture System

INTELLIGENT HYDROPOONICS

IoT + AI + Data Analytics = **Future of Farming**

Student-Designed & Developed Solution

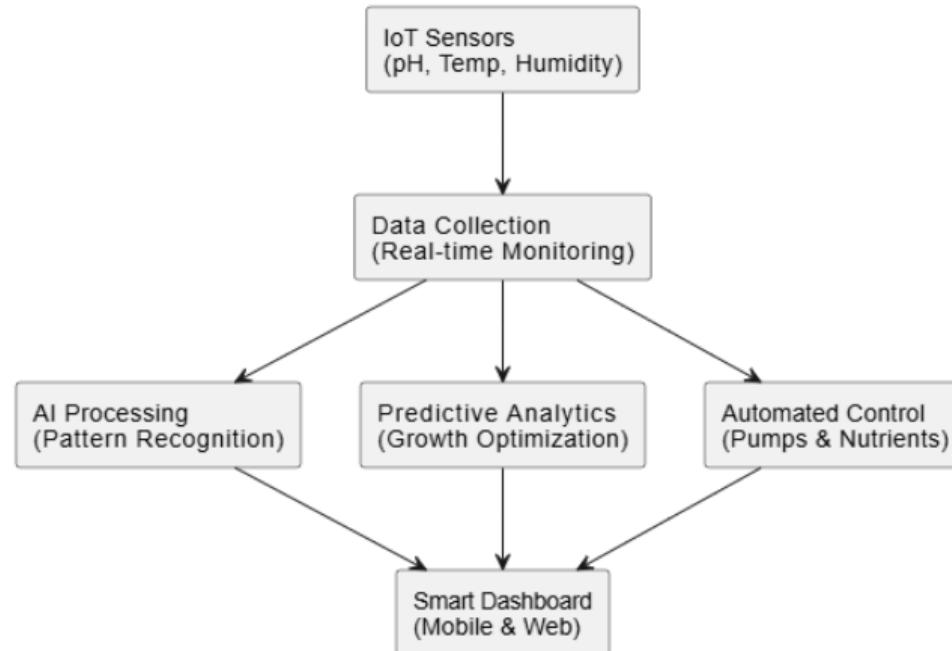


IoT Monitoring
Real-time Sensors

AI Analytics
Intelligent Insights

Soil-less Growth
Efficient Cultivation

Technology Architecture



Complete System Integration

Key Features & Innovations



Hydroponic System

- **Soil-less cultivation** technology
- **90% water savings** compared to traditional
- Year-round production capability
- **Higher yield density** per square meter
- **Controlled environment** agriculture



Smart Technology

- **Real-time monitoring** of all parameters
- AI-powered growth optimization
- Automated nutrient delivery system
- **Mobile app** for remote monitoring
- Data-driven decision making



Student Innovation Focus: Affordable, Scalable, Sustainable

Working Prototype - Hydroponic System

► LIVE DEMONSTRATION

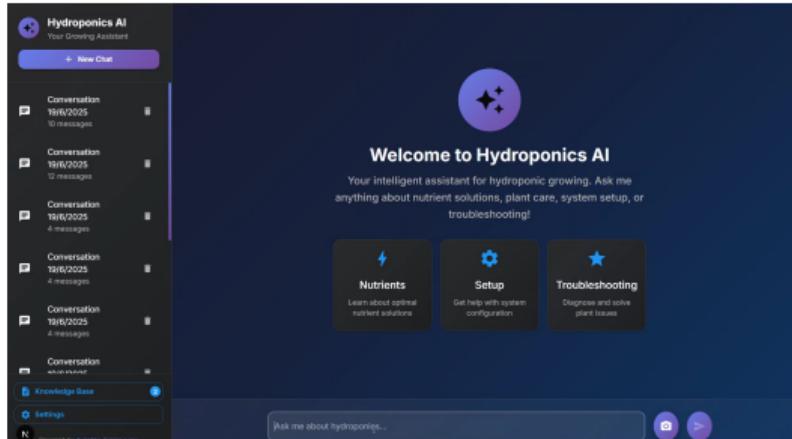
Our functional hydroponic system in action



Healthy root development, optimal growth conditions

Zero soil dependency, maximum efficiency

AI-Powered Plant Health Monitoring



AI Knowledge System

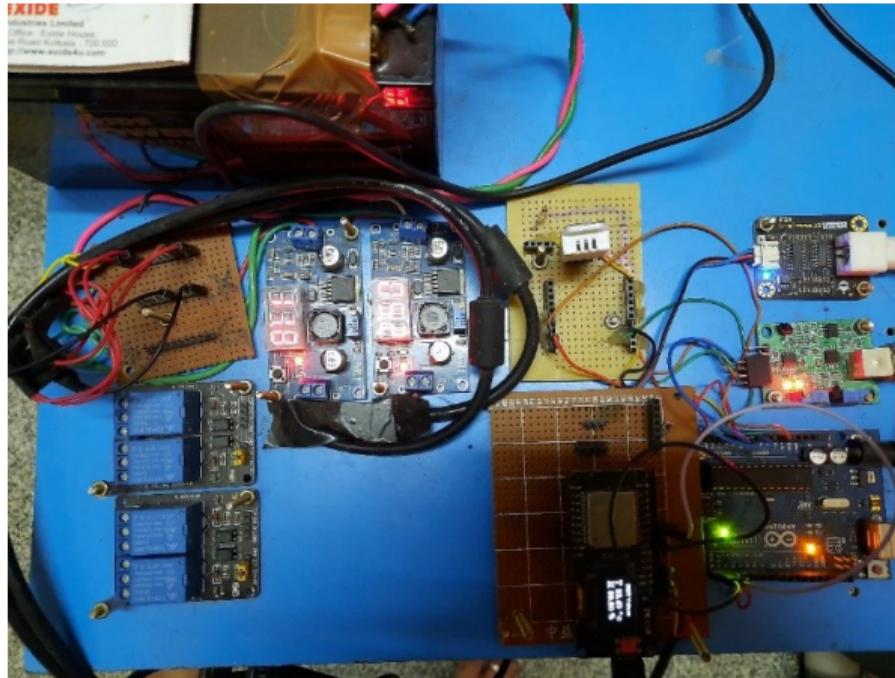
Custom-built for Indian crops

Student-developed AI model trained on agricultural data

AI Capabilities

- **Image-based** plant identification
- **Health assessment** from photographs
- Custom knowledge base for local crops
- **Real-time recommendations** system
- **Pattern recognition** for early disease detection
- **Growth optimization** algorithms

IoT Sensor Integration



Complete IoT Monitoring Dashboard

Research Impact & Benefits



Environmental Impact

- **90% reduction** in water usage
- Zero soil contamination risk
- Minimal pesticide requirement
- **Reduced carbon footprint**
- Year-round production efficiency



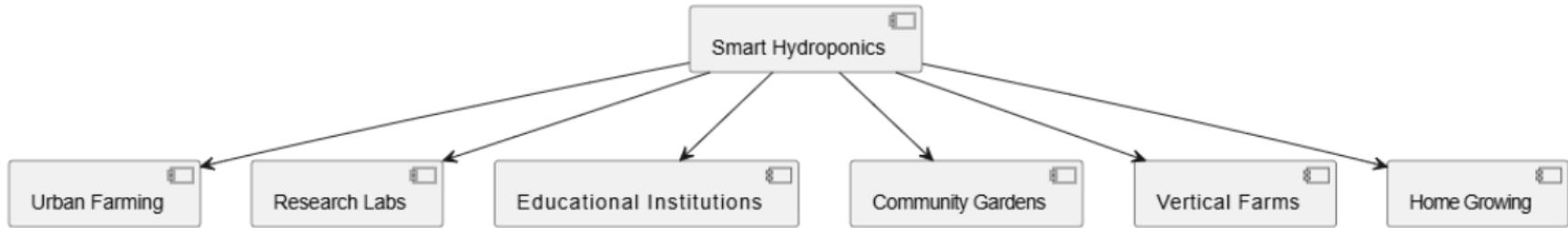
Social Applications

- **Urban agriculture** solutions
- Educational institutions adoption
- Research laboratories implementation
- **Community farming** projects
- Food security enhancement



Academic Contribution: Bridging Technology & Agriculture

Potential Applications



Wide Range of Implementation Possibilities

System Specifications



Hardware Components

- **Microcontroller:** ESP32/Arduino
- **Sensors:** pH, Temperature, Humidity
- **Pumps:** Water & Nutrient delivery
- **Growing Medium:** Rockwool/Perlite
- **Lighting:** LED grow lights



Software Features

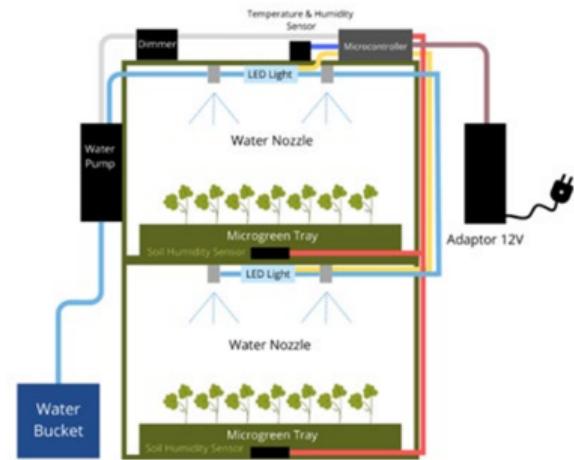
- **Mobile App:** Real-time monitoring
- **AI Model:** Plant health analysis
- **Database:** Historical data storage
- **Alerts:** Automated notifications
- **Dashboard:** Web-based interface

All components designed and integrated by student team

Future Research & Development

Research Roadmap

- **Phase 1:** 3D Plant Modeling integration
- **Phase 2:** Machine Learning enhancement
- **Phase 3:** Multi-crop system development
- **Phase 4:** Scalability research
- **Phase 5:** Energy optimization studies



Microgreens

Next Innovation Phase

ACADEMIC PARTNERSHIPS



Research Areas

- **Agricultural Engineering** optimization
- **Computer Science** AI applications
- **Environmental Science** sustainability
- **Data Science** predictive modeling
- **Biotechnology** plant nutrition



Collaboration Goals

- Joint research publications
- Knowledge sharing platforms
- Student exchange programs
- Technology transfer initiatives
- Innovation competitions

STUDENT INNOVATION IMPACT

Sustainable Agriculture Technology

AI-Driven Smart Farming

Environmental Conservation



Key Achievements



Technical Achievements

- **Functional prototype** development
- **AI model** successfully trained
- **IoT integration** completed
- **Mobile application** deployed
- **Proof of concept** validated



Innovation Impact

- Student-led research project
- Sustainable technology solution
- Practical agricultural application
- Educational value demonstration
- Future research foundation



Academic Excellence in Applied Technology

Thank You

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