CHLOROPHYLL - AN APP-BASED PLANT MONITORING SYSTEM

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Keywords:

IoT, Plant Monitoring, Automated Irrigation, Smart Agriculture, React Native

Introduction/Background:

In an age of increasing urbanization and time constraints, traditional methods of plant care often prove to be inefficient and inconsistent. Many plant enthusiasts, especially those new to gardening, struggle to maintain optimal conditions for plant growth due to a lack of time, knowledge, and proper monitoring tools. *Chlorophyll* addresses these challenges by leveraging IoT technology to automate and simplify plant care. By integrating sensors, cloud computing, and user-friendly applications, the system provides real-time data, automated irrigation, and educational resources. Its modular and scalable architecture makes it suitable for a variety of users including home gardeners, hydroponic farmers, and educational institutions. This project aims to demonstrate how technology can bridge the gap between humans and plants, promoting sustainability and efficient agriculture practices.

Objectives:

- To design and implement an IoT-based system for real-time plant monitoring.
- To automate irrigation based on soil moisture levels.
- To develop an intuitive mobile and web application for user interaction.
- To promote sustainable gardening by reducing water waste.
- To provide educational content and an integrated marketplace for plant care resources.

Methodology:

The system consists of both hardware and software components working in tandem:

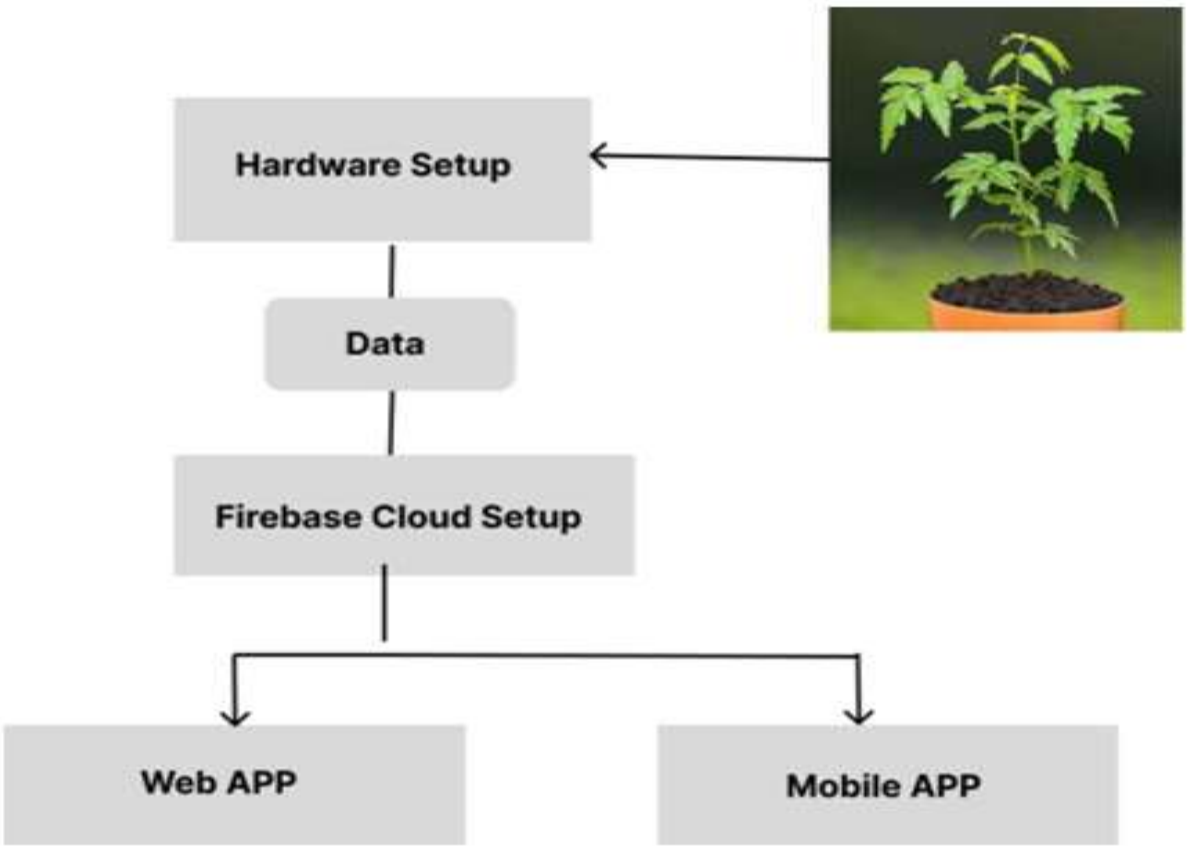
Hardware:

- **ESP32 Microcontroller**: Collects and processes data from sensors and controls the water pump.
- **Soil Moisture Sensor**: Measures the water content in the soil.
- **Temperature Sensor**: Monitors environmental conditions.
- **Relay and Water Pump**: The relay is controlled by ESP32 to automate watering based on sensor input.

Software:

- **Firebase Cloud Database**: Stores sensor data and synchronizes it in real-time across devices.
- **Web App**: Built with Next.js, HTML, CSS, and JavaScript to provide an interactive dashboard.
- **Mobile App**: Developed in React Native, includes push notifications, offline access, and educational blog.
- **User Interface**: Offers live monitoring, watering control, and a marketplace for supplies.
- **Educational Blog**: Delivers expert tips and gardening guides for users.

Working Model Diagram:



Results & Conclusions:

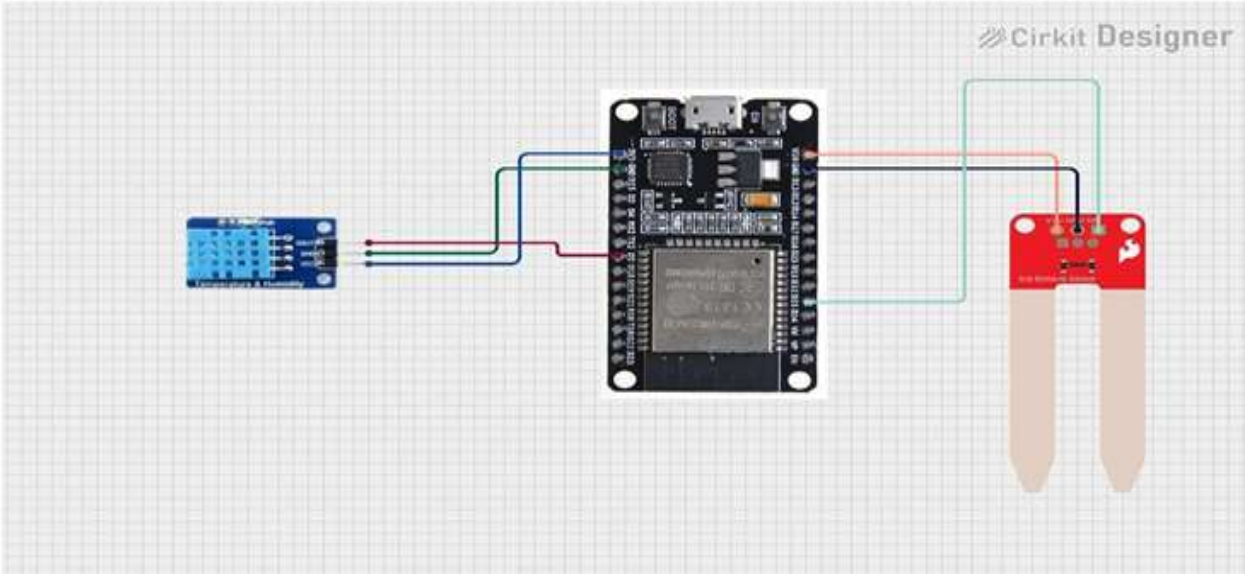
- Real-time monitoring significantly reduced plant neglect and overwatering issues.
- Automated irrigation led to water savings and healthier plant growth.
- Users were able to remotely manage their gardens effectively via the app.
- The educational blog empowered novice users to better understand plant care.
- The system proved scalable by integrating additional sensors such as humidity and pH.

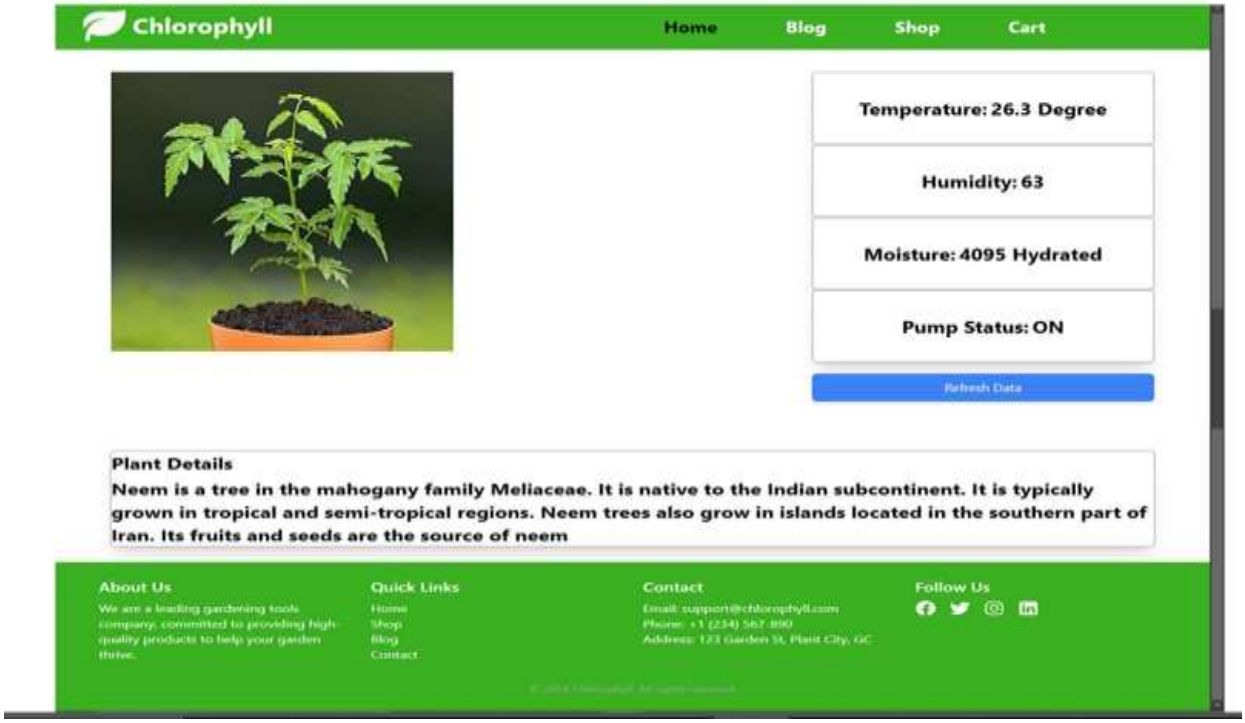
Project Outcome & Industry Relevance:

Chlorophyll presents a scalable, affordable, and practical solution for smart agriculture. Its application extends from personal gardening to urban farming and commercial hydroponics. The system aligns with the growing demand for sustainable agriculture and resource optimization. With potential for commercialization, this project could support industries in home automation, smart farming, and green tech.

Working Model vs. Simulation/Study:

Working Model – A fully functional prototype was developed with both hardware and software integration.





Project Outcomes and Learnings:

- Learned to integrate IoT hardware with real-time cloud-based applications.
- Gained experience in full-stack development using React Native and Firebase.
- Understood the challenges in hardware-software interfacing and sensor calibration.
- Developed project management, debugging, and teamwork skills.

Future Scope:

The Chlorophyll system can be enhanced by integrating additional sensors for humidity, light intensity, and pH monitoring to cater to more diverse plant care requirements. Machine learning algorithms can be incorporated for predictive analysis of plant health and irrigation needs. Future versions may include voice assistant integration, remote camera monitoring, and expanded marketplace features. The project can also be scaled for larger agricultural setups and be used in research institutions and smart city initiatives to promote urban greening and sustainability.