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Smart Greenhouse with IOT: Live Horticulture Data Insights

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Abstract - This project introduces horticultural methods that have been transformed by the incorporation of Internet of Things (IoT) technology into greenhouse farming, also referred to as the "smart greenhouse", which allows for automation, data-driven decision-making, and real-time monitoring. Our platform offers both a shopping experience and a learning platform by combining the capability of smart IoT-enabled greenhouses with a vast variety of plants. With the help of real-time data insights from modern sensors, we provide a selection of premium plants that flourish in the perfect growing environment, whether they are indoor, outdoor, herbs, or flowers. In addition to our plants, there is an information about the Organic and Synthetic Fertilizers on the platform to be used for the plants with this our educational resources will guide you through appropriate plant care techniques, the function of fertilizers, and how smart technology can improve your gardening experience, regardless of your level of gardening information. This review paper looks into the use of IoT in smart greenhouses with a focus on collecting, processing, and analyzing real-time horticulture data to help plants grow better, produce more crops, use resources more efficiently, and know more about the plants and fertilizers.

Key Words: IoT in Agriculture, Eco-friendly Gardening Solutions, Balanced Fertilizers.

1. INTRODUCTION

A Smart Greenhouse is an environmentally friendly gardening and innovative technology combination. Through the integration of modern Internet of Things (IoT) technology with a wide range of premium plants and fertilizers, our platform is dedicated to improving the way you take care of your plants. In addition to plants, our platform provides an experience with our smart gardening solution, which leverages real-time data from our IoT-enabled greenhouses to optimize growth conditions. Precision agriculture is made possible by this proactive strategy, which minimises waste and its negative effects on the environment by using inputs like water, fertiliser, and pest control techniques more effectively. Stakeholders can remotely monitor and manage greenhouse conditions from any location by using online or mobile applications. Predictive maintenance is further improved by AI-driven analytics, which makes smart greenhouses an effective and sustainable option for modern horticulture. In smart and data-driven greenhouse horticulture, growers can monitor and control operations remotely, based on (near) real-time digital information instead of direct observation and manual tasks on site. IoT-enabled greenhouses can therefore create dependable and affordable farming solutions to increase productivity with the least amount of work. Farmers can better manage their farms and maximize their resources in this way. Future fruit and crop cultivation in an Internet of Things-based greenhouse is expected to be entirely automated and controlled remotely. The user receives alerts, in case of any (expected) issues, and can inspect the greenhouse situation behind their desk or smartphone by viewing a rich digital image of the plants or equipment concerned with real-time horticulture data an e-commerce platform to improve customer direct sales and plant growth.

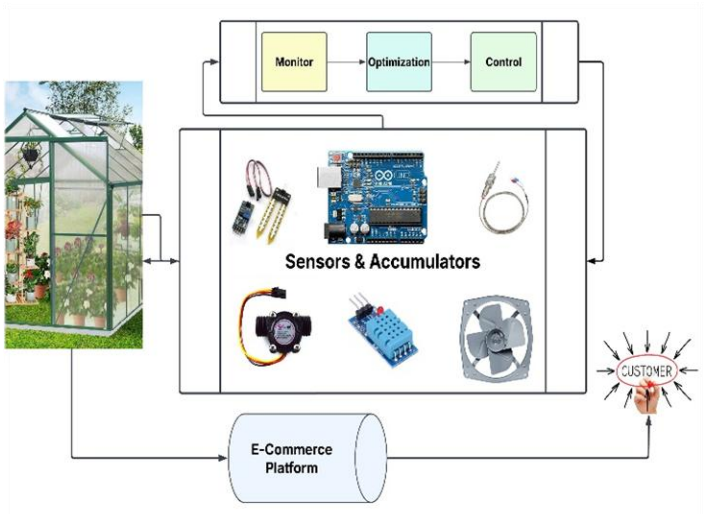

Fig 1: - Greenhouse

2. METHODOLOGY

The approach explains how an IoT-powered smart greenhouse can connect real-time horticulture data with an e-commerce platform to improve customer direct sales and plant growth.

The methodology includes: -

1. IoT-Powered Configuration at Greenhouse:- The sensors are installed in the greenhouse to monitor and observe Real-time Data analytics, with this, the automated systems are used to control the motors or fans.
2. Data Insights & Dashboard:- The data insight and dashboard are used to monitor the real-time plant health and the temperature and moisture present in the soil, with which the accumulator can also be operated.
3. E-Commerce Website Synchronization: display product listings with a variety of plants, plant care tips, and fertilizers required for the plants for their growth.

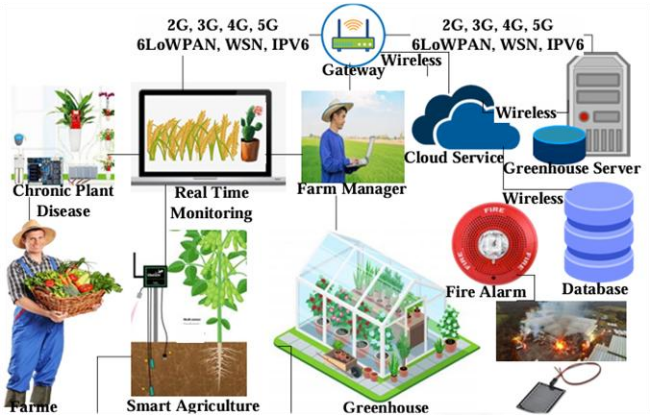

Fig.2.1: - Greenhouse Working & Components

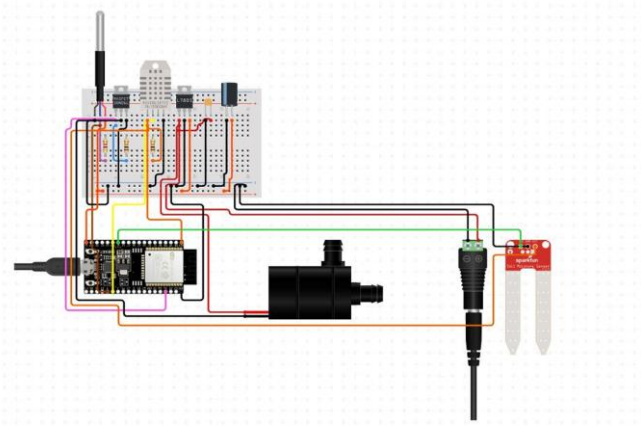

Fig.2.2 – Circuit Diagram

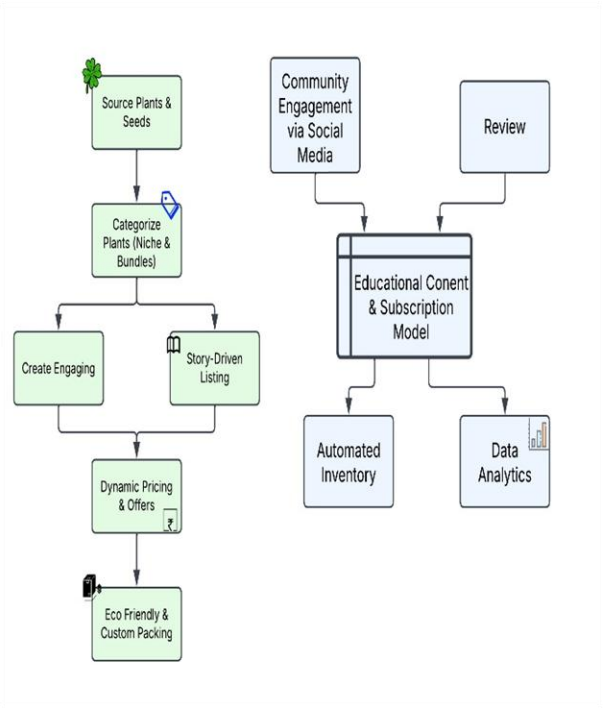

Fig 2.3. Working Block Diagram of Proposed Model

i. **Source Plants, Seeds & Categories of Plants** variety of plants, like indoor and outdoor plants, with the available quantities at the greenhouse and plant nursery, can be seen on the dashboard. Also display real-time insights of the indoor and outdoor plants, the temperature & water required for the plants, with the best quality of fertilizers to be used for the plants for good growth.

ii. **Story-Driven Listing & Engaging**: The webpage dashboard will show Recommendations for plants to engage customers and show their preferences about the plants, how to nourish them with the best fertilizers, and the number of seeds and buds required for a yield for the plantation.

iii. **Dynamic Pricing & Offers:** As per the plants, the seasonal offers and dynamic pricing range will be provided to the customers.

iv. **Eco-Friendly Packing:** As per the order placed by the customer through the website, Options for local pickup, doorstep delivery, and provided links to live plant care data.

Future Scope: -

Optimized Plant Health: - Live data insights ensure the best-growing conditions.

Enhanced Customer Trust: - Customers see real-time care insights before purchasing.

Scalability & Innovation: -Expand the smart greenhouse and connect with urban farming trends.

3. ANALYSIS AND RESULTING

a) Analysis Advantage

1. **Resource Efficiency:** Sustainable agriculture is promoted by automated monitoring and control, which minimises the waste of energy, water, and fertilisers.
2. **Labour Reduction:** Farmers can concentrate on other important duties and cut expenses by using automation to replace manual labour.
3. **Data-Driven Decision Making:** Farmers may make better crop management decisions and implement more productive horticultural techniques by having access to both historical and current data.
4. **Scalability:** IoT and e-commerce together create opportunities for subscriptions, urban farming advances, and larger-scale sales.

b) Results

Fig. 3.1 – Home page

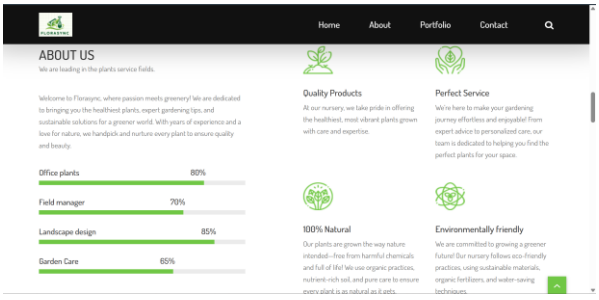

Fig. 3.2- About Page

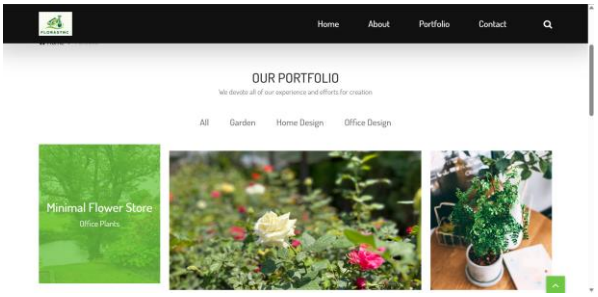

Fig.3.3- Portfolio

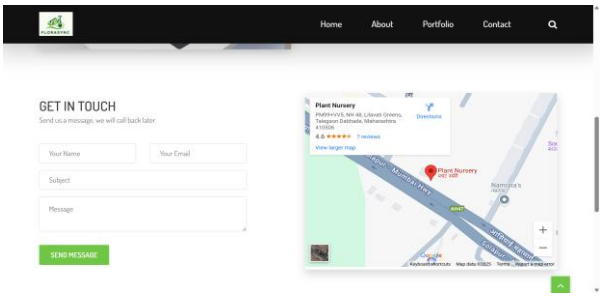

Fig. 3.4-Contact Page

4. CONCLUSIONS

In conclusion, the modern plant production and sales are revolutionized by the combination of an e-commerce platform and IoT-powered smart greenhouses. This strategy guarantees healthier plants, more efficient use of resources, and improved consumer involvement by utilizing real-time horticulture data, automated care systems, and a smooth online buying experience.

This intelligent horticulture ecosystem transforms the way consumers interact with and buy plants by combining technology and nature. It also enhances plant quality. This approach transforms plant sales into an engaging, data-rich, and future-proof experience for home gardeners, plant collectors, and major distributors.

Adopting this strategy would enable businesses to stay ahead of the curve, reduce their effect on the environment, and provide plant lovers worldwide with an enjoyable, reliable buying experience as the globe shifts to smart agriculture and digital commerce.

5. LITERATURE REVIEW

The development of an IoT-based smart greenhouse system by Arcel Christian H. Austria, John Simon Fabros,[8] for hydroponic gardens can yield several

impactful results, enhancing productivity, resource efficiency, and crop quality. The greenhouse management system is one of the core components of smart farming. The greenhouse management system collects and processes data used to manage and control farming operations thoroughly the author MUHAMMAD SHOAIB FAROOQ [3] states the potential IoT-enabled greenhouse farming solutions focus on the four major applications of farming namely enhanced fertilization and irrigation, infection and disease control, maintenance of an ideal environment for healthy growth of plants, and enhanced security solutions. In his study, Natasja Ariesen-Verschuur [2], Digital Twins can be seen as a new phase in smart and data-driven greenhouse horticulture. Using Digital Twins as a central means for greenhouse management enables the decoupling of physical flows from their management. *Dharunjayavi Nayak R, Charanya G* [10] Automated internal climate control, which ensures optimal temperature, humidity, and light levels for crop growth. Solar power generation, reducing reliance on non- renewable energy sources] Growers can plan, monitor and control greenhouse operations remotely, based on (near) real-time digital information instead of direct observation and manual tasks on-site by *Natasja Ariesen-Verschuur, Cor Verdouw* [2] the important role of fertilizers in increasing crop yields and ensuring global food security will likely be highlighted. The increasing demand for fertilizers due to the growing world population and the need to produce more food on limited arable land was discussed. Environmental challenges associated with fertilizer use, such as nutrient pollution, greenhouse gas emissions, and soil degradation, were also covered by *Muhammad Zaib, Muhammad Zubair* [4] in their study. The application of organic fertilizers represents a recent innovation that has been embraced in sustainable agriculture in the *Yitian Yu, Qi Zhang, Jian Kang, Nuohan Xu* [1] study that this shift is in response to the increasing global food demand, the unpredictable nature of the environment, and the detrimental effects associated with the excessive use of chemical fertilizers, including environmental degradation, soil fertility reduction, and pollution.

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