

REVOLUTIONIZING AGRICULTURE: IOT-ENABLED GREENHOUSE TECHNOLOGY FOR CROP PROTECTION AND EFFICIENCY

M. Bala Sumanth, Department of Electronics and Communication Engineering, DVR & Dr.HS MIC College of Technology, Kanchikacherla , Andhra Pradesh, Email

sumanthmendamhala@gmail.com

K.Manasa Lakshmi, Assistant Professor, Department of Electronics and Communication Engineering, DVR & Dr.HS MIC College of Technology, Kanchikacherla , Andhra Pradesh, Email
manasalakshmiiece@gmail.com

B. Jaya Sri, Department of Electronics and Communication Engineering, DVR & Dr.HS MIC College of Technology, Kanchikacherla , Andhra Pradesh, Email jayasribollepalli31@gmail.com

M.Sai Bhargavi, Department of Electronics and Communication Engineering, DVR & Dr.HS MIC College of Technology, Kanchikacherla , Andhra Pradesh, Email majjisaibhargavi@gmail.com

M.Satish, Department of Electronics and Communication Engineering, DVR & Dr.HS MIC College of Technology, Kanchikacherla , Andhra Pradesh, Email mylasatish111@gmail.com

Abstract

Agriculture, the art and science of cultivating plants, holds a pivotal role in our country's economic development, serving as the primary livelihood for many generations. To enhance yield efficiency and minimize agricultural costs, smart agricultural techniques leveraging IoT technology are being increasingly adopted. One significant challenge faced by farmers is protecting crops during the rainy season. The integration of greenhouse technology addresses this challenge by creating an environment conducive to crop growth, incorporating features such as sensor-based monitoring, security measures, and protection against excessive rainfall through automated roof covering. Greenhouse operations are facilitated in two modes: automatic and manual, with communication with cultivators facilitated via platforms like Telegram, providing continuous updates on environmental factors. Sensor nodes strategically placed within the greenhouse monitor various parameters, with remote control and monitoring facilitated through internet services. The Arduino microcontroller acts as the system's central processing unit, receiving input from sensors such as rain and moisture sensors and controlling relays accordingly. Real-time data on humidity, temperature, rain, and moisture levels are displayed via an LCD screen, offering immediate feedback to users on the effectiveness of rain protection measures.

Keywords:

Agriculture, Greenhouse technology, IoT, Crop protection, Rainy season Smart agriculture, Sensor-based monitoring, Arduino microcontroller, Remote control, Environmental factors

1 Introduction

In agriculture, the capriciousness of weather patterns, particularly concerning rainfall, can wield a profound influence on crop cultivation and yield outcomes. While rainfall is indispensable for nourishing crops, the advent of excessive or poorly timed precipitation poses considerable threats, ranging from waterlogging and soil erosion to the proliferation of diseases and crop impairment. In response to these challenges, farmers consistently strive to adopt innovative strategies aimed at managing the quantity and timing of rainfall reaching their fields. By doing so, they aim to safeguard their crops against potential risks while optimizing growth conditions. These proactive measures often involve the utilization of advanced techniques and technologies tailored to regulate moisture levels effectively, thereby ensuring the resilience and productivity of agricultural endeavors. An innovative

approach to address this challenge is the integration of automatic shed systems, strategically engineered to shield growing crops from the impact of unwanted rainfall. These sophisticated systems represent a proactive solution, empowering farmers with unprecedented control over their cultivation environment. Through the deployment of automated mechanisms meticulously designed to regulate the exposure of crops to rain, farmers can effectively mitigate the adverse effects associated with excessive precipitation. By seamlessly adjusting the coverage of the shed in response to real-time weather conditions, these systems offer a dynamic and adaptive solution, ensuring optimal moisture levels for crop growth. Moreover, the implementation of such advanced technology not only minimizes the risk of waterlogging, soil erosion, and disease spread but also maximizes the benefits of controlled irrigation practices. By harnessing the power of automation, farmers can significantly enhance the resilience and productivity of their agricultural operations, ultimately fostering sustainable and profitable farming practices. This paper delves into the innovative realm of automatic shed systems designed to mitigate rain-related challenges in crop cultivation. It delves into the crucial importance of these systems within the framework of modern agriculture, addressing their pivotal role in revolutionizing traditional farming practices. The discussion spans across various dimensions, beginning with an exploration of the conceptual underpinnings of automatic shed systems. It delves into the intricate design considerations involved in their development, shedding light on the meticulous planning and engineering required to ensure optimal functionality. Operational mechanisms take center stage, as the paper elucidates the intricate workings of these systems. From sensor-driven adjustments to automated roof coverings, it offers a comprehensive overview of how these mechanisms operate seamlessly to protect crops from excessive rainfall. Furthermore, the paper meticulously examines the potential benefits that automatic shed systems offer to farmers. These range from mitigating risks associated with waterlogging and soil erosion to optimizing irrigation practices and ultimately enhancing crop yields. However, amidst the promise lie challenges that demand attention. The paper navigates through these obstacles, addressing issues such as technological complexities, cost considerations, and adaptability to diverse climatic conditions. Throughout the discourse, there is a palpable acknowledgment of the transformative role of technology in reshaping agricultural landscapes. Automatic shed systems epitomize this paradigm shift, offering a tangible demonstration of how innovation can bolster resilience against weather-related uncertainties. In sum, the paper underscores the significance of adopting automatic shed systems as a promising pathway towards sustainable and efficient crop production. It advocates for their widespread integration into agricultural practices, emphasizing their potential to empower farmers and fortify food security in the face of evolving climatic challenges.

2 Literature Survey

In recent years, researchers have spearheaded the development of intelligent rain shelters, equipped with sensor-based automation capabilities tailored to swiftly detect rainfall and deploy protective covers over crops. These advanced systems harness a sophisticated array of weather sensors, soil moisture sensors, and temperature sensors to meticulously monitor environmental conditions. By seamlessly integrating sensor data with predictive modeling algorithms and machine learning techniques, farmers can fine-tune the timing and duration of shelter deployment, effectively mitigating water stress and minimizing potential crop damage. Moreover, hydrological modeling studies have been instrumental in elucidating the multifaceted impact of rain shelters on soil moisture dynamics, runoff patterns, and groundwater recharge processes. Empirical findings gleaned from these investigations consistently underscore the beneficial effects of automatic shed systems. Notably, these systems have demonstrated remarkable potential in reducing soil erosion, enhancing water retention capacity within agricultural landscapes, and ameliorating drought-induced stress on crops. As a result, they play a pivotal role in fostering sustainable crop production practices and bolstering ecosystem resilience in the face of escalating environmental pressures. Furthermore, rigorous cost-benefit analyses have underscored the economic feasibility and viability of implementing automatic shed systems, particularly for smallholder farmers. These assessments meticulously evaluate the upfront investment costs against the anticipated long-term benefits, including enhanced crop yields, reduced losses due to adverse weather events, and improved risk mitigation strategies. Crucially, findings from such analyses consistently affirm the positive returns on investment associated with the adoption of

automatic shed systems, further validating their efficacy as a strategic tool for enhancing agricultural sustainability and economic prosperity. In sum, automatic shed systems have emerged as a transformative innovation in contemporary agriculture, offering a robust solution to mitigate the detrimental impacts of unwanted rain on crop cultivation. With a burgeoning body of research dedicated to refining and implementing these systems, there is palpable optimism regarding their potential to revolutionize agricultural practices, fortify food security, and nurture resilient farming communities in the face of evolving climatic uncertainties.

Ahmed et al [1] This review offers an expansive examination of diverse rain shelter techniques utilized in agricultural contexts, encompassing both manual and automatic systems. By meticulously scrutinizing the distinct features and operational mechanisms of each approach, the review provides a nuanced understanding of their respective advantages and limitations. One of the focal points of the review is the pivotal role played by automated systems in delivering timely and effective protection against adverse weather conditions. By delving into the intricacies of sensor technology and automation, the review elucidates how recent advancements in these domains have catalyzed the evolution of rain prevention systems towards greater efficiency and responsiveness. Furthermore, the review sheds light on the dynamic interplay between technological innovation and agricultural practices, underscoring the transformative impact of automation on enhancing the resilience and productivity of farming operations. Through an exploration of real-world case studies and empirical evidence, it substantiates the compelling rationale for prioritizing the adoption of automated rain shelter systems in modern agricultural settings. [2] Overall, this comprehensive review serves as a valuable resource for stakeholders across the agricultural landscape, offering invaluable insights into the spectrum of rain shelter techniques available and advocating for the widespread integration of automated systems as a cornerstone of sustainable and weather-resilient farming practices.

Kumar et al [3] The presented study delves into the intricate design and meticulous implementation of automated rain shelter systems aimed at safeguarding crops from the detrimental effects of rainfall. With a primary focus on exploring the efficacy of various sensor-based mechanisms for detecting rainfall and subsequently initiating the deployment of protective covers, this research endeavors to unravel the practical implications and potential benefits of such advanced agricultural technologies. Through a comprehensive evaluation of different sensor-based detection mechanisms, the study meticulously assesses their performance across key parameters such as accuracy, responsiveness, and reliability. By rigorously analyzing these factors in conjunction with real-world field conditions, the research seeks to discern the most effective and robust sensor configurations conducive to timely and precise rain detection. [4] Crucially, the study extends beyond the realm of sensor technology evaluation to investigate the holistic impact of automated rain shelter systems on crop cultivation practices. Through meticulous monitoring and data collection, the research meticulously quantifies the influence of these systems on critical metrics including crop yield, water conservation, and overall cost-effectiveness. [5] By synthesizing empirical findings and analytical insights, the study provides valuable guidance and actionable recommendations for farmers and agricultural stakeholders. It elucidates the practical applicability of automated rain shelter systems in optimizing crop protection strategies while simultaneously enhancing resource efficiency and economic viability. [6] Ultimately, this research serves as a pivotal contribution to the burgeoning field of precision agriculture, offering a robust framework for leveraging advanced sensor technologies to address contemporary challenges in crop cultivation. By elucidating the tangible benefits and practical considerations associated with automated rain shelter systems, the study paves the way for their widespread adoption, thereby empowering farmers to mitigate risks, optimize yields, and foster sustainable agricultural practices.

3 Methodology

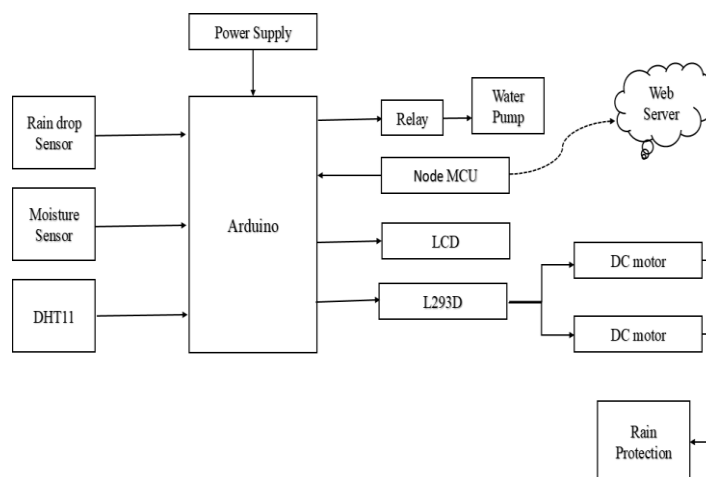


Fig 1 Block Diagram

The block diagram you sent depicts a solar-operated smart hydroponics system designed for growing fodder feed. Here's a breakdown of the components and their functionalities:

Power Supply

- This block represents the source of power for the entire system. It likely utilizes solar panels that convert sunlight into electricity to run the system.

Water Reservoir

- This tank stores the water solution that will be used to nourish the plants.
- **Rain Drop Sensor:** This sensor detects rainfall and can be used to regulate the water supply in the reservoir. If rain is detected, the system might suspend pumping water from the external source to prevent overwatering the plants.
- **pH Sensor:** This sensor monitors the acidity or alkalinity of the water solution in the reservoir. Maintaining a proper pH level is crucial for optimal plant growth.
- **Web Server:** This component likely refers to a software application that allows remote monitoring and control of the hydroponics system. Users can access the web server through a web interface or a mobile app to view sensor data (e.g., pH, moisture levels) and adjust settings (e.g., pump schedules, nutrient levels).
- **Relay:** This electronic switch is controlled by the Node MCU and is likely used to turn the water pump on or off based on the system's needs.
- **Node MCU:** This microcontroller board is the central processing unit of the system. It collects data from sensors, controls the water pump and DC motor through the relay, and might communicate with the web server for remote control.
- **Moisture Sensor:** This sensor monitors the moisture content within the hydroponic tank where the plants reside. The Node MCU likely uses the sensor readings to determine when to pump water into the tank to maintain optimal moisture levels for the plants.
- **DHT11 Sensor:** This sensor measures the ambient temperature and humidity around the plants. This data can be helpful for monitoring the overall growing environment and potentially be used to control auxiliary systems like ventilation fans (not shown in the diagram).
- **Arduino:** While the functionality of the Arduino in this specific system is unclear, Arduinos are programmable microcontrollers that can be used for various purposes in conjunction with other components. In some hydroponics systems, Arduinos might be used to control lighting or other environmental factors.
- **LCD (Liquid Crystal Display):** This display panel provides a local interface for viewing sensor data (e.g., pH, temperature, humidity) and system status.
- **DC Motor 1:** This motor likely controls the water pump, drawing water from the reservoir and pumping it into the hydroponic tank based on signals from the Node MCU.
- **DC Motor 2:** The purpose of this DC motor is unclear based on the diagram alone. It might be used to adjust ventilation or other environmental controls within the hydroponics system.
- **Rain Protection System:** This component is likely some form of shelter or covering to protect the hydroponics system from rain.

Overall, this block diagram depicts a solar-powered automated system that leverages sensors and microcontrollers to monitor and regulate the growth environment for fodder within a hydroponics system.

Result

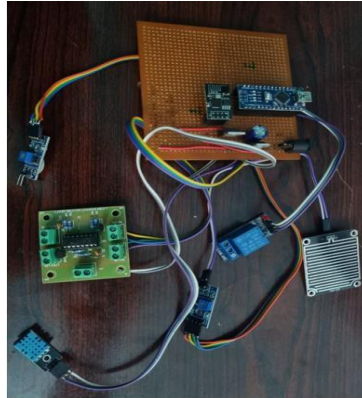


Fig 2 Overall Circuit Connections 1

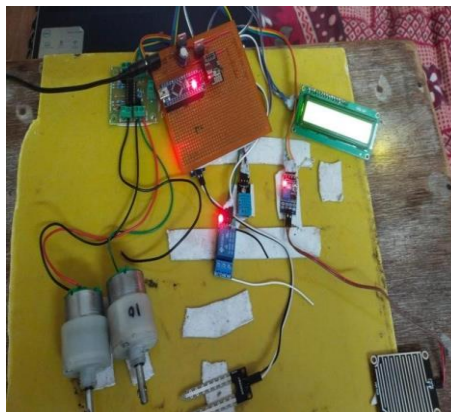


Fig 3 Circuit Design 2

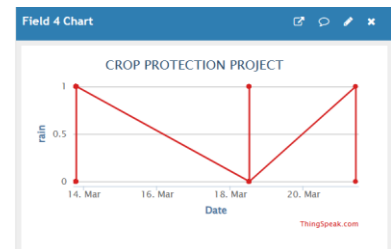
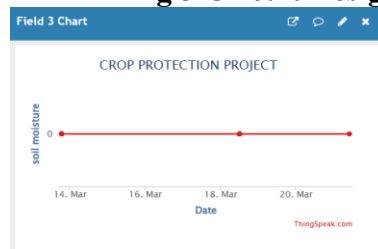
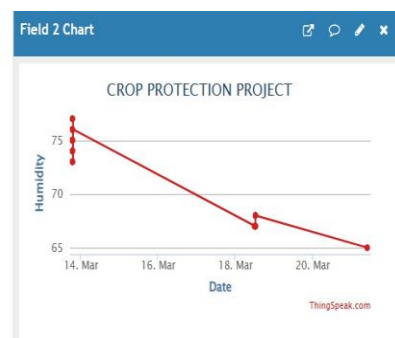


Fig: 4 Output of DHT11

Fig: 5 Output of Rain and Moisture Sensor

Conclusion

In conclusion, agriculture stands as a cornerstone of economic development, sustaining livelihoods across generations. The adoption of smart agricultural techniques, empowered by IoT technology,



reflects a progressive stride towards enhancing yield efficiency and minimizing costs in farming

practices. Despite the myriad benefits, farmers encounter significant challenges, particularly during the rainy season, where protecting crops becomes paramount. The integration of greenhouse technology emerges as a transformative solution to address this challenge. By creating a controlled environment conducive to optimal crop growth, greenhouse systems leverage sensor-based monitoring, security measures, and automated roof covering to shield crops from excessive rainfall. Operating in automatic and manual modes, these systems ensure proactive management of environmental factors, facilitated by communication platforms like Telegram. Strategically positioned sensor nodes within the greenhouse continuously monitor vital parameters, with remote control and monitoring facilitated through internet services. The Arduino microcontroller orchestrates these operations, receiving input from sensors and adjusting relays accordingly. Real-time data on humidity, temperature, rainfall, and moisture levels are readily accessible via an LCD screen, offering farmers immediate feedback on the efficacy of rain protection measures.

Feature Scope

The feature scope encompasses the comprehensive functionality and capabilities of a product or system, detailing its range of attributes, functions, and capabilities. It defines the core elements and functionalities that contribute to the overall utility and performance of the product, often delineating specific features, user interactions, and technical specifications. A well-defined feature scope serves as a blueprint for development teams, guiding the design and implementation process while aligning stakeholders' expectations with the intended outcomes of the project. It encompasses aspects such as user interface design, data management, security protocols, integration with external systems, and scalability considerations, providing a holistic overview of the product's functionality and ensuring alignment with the project's objectives and requirements.

References

- [1] Maryam Omar, Omar Bin Samin and Imran Ahmed, "Smartshed: An Automatic Shed System Based on Rain Temperature and Light Intensity", International Conference on Science Innovation and Management (ICSIM), pp. 20-24, 2020.
- [2] Ritik Bansod, prof. pravin Pisal, " Automatic Shed System to Prevent Unwanted Rain for Growing Crops ", International Journal of Engineering Res Sohel Parvez, "Rains damage crops", The Daily Star, April 2022, <https://www.thedailystar.net/business/rains-damage-crops-121330>. (IJERT), no. 04, pp. 2582-5208, April 2022.
- [3] The State of Food and Agriculture 2021. Making agrifood systems more resilient to shocks and stresses. Rome: Food and Agriculture Organization of the United Nations. 2021.
- [4] Yao, C., Li, Y., Ansari, M.D., Talab, M.A., Verma, A., 2022, Optimization of industrial process parameter control using improved genetic algorithm for industrial robot, Paladyn, 10.1515/pjbr-2022-0006
- [5] Ahmed, M., Ansari, M.D., Singh, N., Gunjan, V.K., B. V., S.K., Khan, M., 2022, Rating- Based Recommender System Based on Textual Reviews Using IoT Smart Devices, Mobile Information Systems, 10.1155/2022/2854741
- [6] Talab, M.A., Qahraman, N.A., Aftan, M.M., Mohammed, A.H., Ansari, M.D., 2022, Local Feature Methods Based Facial Recognition, HORA 2022 - 4th International Congress on Human-Computer Interaction, Optimization and Robotic Applications, Proceedings, 10.1109/HORA55278.2022.97999
- [7] Tripathy, P.K., Shrivastava, A., Agarwal, V., Shah, D.U., L, C.S.R., Akilandeewari, S.V., 2022, Federated learning algorithm based on matrix mapping for data privacy over edge computing, International Journal of Pervasive Computing and Communications, 10.1108/IJPC-03-2022-0113
- [8] Shareef, S.K., Sridevi, R., Raju, V.R., Rao, K.S.S., 2023, A Novel Framework for Secure Blockchain Transactions, Proceedings International Conference on Applied Artificial Intelligence and Computing, 2022 10.1109/ICAIC53929.2022.9792758
- [9] Sujihelen, L., Boddu, R., Murugaveni, S., Arnika, M., Haldorai, A., Reddy, P.C.S., Feng, S., Qin, J., 2022, Node Replication Attack Detection in Distributed Wireless Sensor Networks, Wireless Communications and Mobile Computing, 10.1155/2022/7252791