Automatic Harvested Crop Protection from Rain and Animals

G Indira Priyadarshini[1], A Sai Kiran Reddy[2], C Sai Deepak[2], G Akhil[2] S Vamshi Goud[2]

[1]Associate Professor, [2]UG Scholar
Dept. of Information Technology, Vidya Jyothi Institute of Technology,
Hyderabad, Telangana, India.

Abstract**—**This research introduces an innovative Agricultural-Based System designed to mitigate crop damage caused by excessive precipitation during rainy periods. The system's core function is to safeguard cultivated plants from both heavy rainfall and animal encroachment. Central to this mechanism is a rain sensor that controls automated roofing structures. The protective system comprises an auto-roof capable of enveloping the entire cultivated area. Upon detecting rainfall, the sensor triggers a DC motor, which promptly closes the roof. Conversely, when precipitation ceases, the sensor deactivates, prompting the roof to open automatically. It is worth noting that the incorporation of a direct power supply is feasible, though this modification may influence the system's overall construction costs.

Keywords**—***Rainy seasons, Crops, Direct power supply, DC motor, Heavy rains, Automatic roofs, Animals.*

I. INTRODUCTION

The introduction of innovative agricultural technologies plays a crucial role in addressing the challenges faced by farmers in managing crop production amidst unpredictable weather conditions. One such challenge is the potential damage caused by excessive rainfall during cultivation periods, which can lead to soil erosion, nutrient leaching, and increased susceptibility to plant diseases. These issues can significantly impact crop yields and overall farm productivity, highlighting the necessity for effective solutions to mitigate weather-related risks.

To address this critical issue, a novel Agricultural-Based System has been developed, focusing on protecting crops from both heavy precipitation and animal intrusion.

This system incorporates an automated roofing mechanism controlled by a rain sensor, providing a comprehensive solution for safeguarding cultivated plants. By offering protection against excessive rainfall, the system helps maintain optimal soil moisture levels, reduce the risk of waterlogging, and minimize the potential for crop damage due to heavy downpours.[1,3]

The primary components of this protective system include an auto-roof capable of covering the entire cultivated area, a rain sensor for detecting precipitation, and a DC motor for operating the roof. The auto-roof is designed to be durable, lightweight, and easily deployable, ensuring efficient coverage of the cultivated area when required.

The rain sensor, a critical element of the system, utilizes advanced technology to accurately detect the onset of rainfall, triggering the automated response mechanism. The DC motor, selected for its reliability and energy efficiency, powers the movement of the roof, allowing for rapid deployment and retraction as weather conditions change.

This research explores the design, functionality, and potential impact of this innovative system on crop protection and agricultural productivity. The study examines the technical specifications of each component, investigating how they work in concert to create a cohesive and effective crop protection solution. Additionally, the research investigates the system's adaptability to various crop types and farming environments, assessing its potential for widespread adoption in different agricultural settings. Furthermore, the study evaluates the economic implications of implementing this Agricultural-Based System, considering factors such as initial investment costs, potential yield improvements, and long-term benefits for farmers.[2,4]

By analyzing the system's effectiveness in real-world scenarios, the research aims to provide valuable insights into its practical applications and potential for enhancing agricultural resilience in the face of climate variability. The development of this innovative crop protection system represents a significant advancement in agricultural technology, offering a proactive approach to weather-related challenges in farming. By combining automation, sensor technology, and mechanical engineering, this system has the potential to revolutionize crop management practices, contributing to increased food security and sustainable agricultural practices.

The system's ability to protect crops from excessive rainfall addresses a critical issue in modern agriculture, particularly in regions prone to unpredictable weather patterns. By mitigating the risks associated with heavy precipitation, farmers can potentially reduce crop losses, improve yield consistency, and enhance overall farm profitability. This technology may prove especially valuable in the context of climate change, where extreme weather events are becoming more frequent and intense. In addition to its primary function of rainfall protection, the system's design also incorporates measures to prevent animal intrusion. [5,6]

This dual-purpose approach addresses multiple challenges faced by farmers, offering a comprehensive solution that can significantly reduce crop damage from various sources. The integration of animal protection features may be particularly beneficial in areas where wildlife encroachment is a persistent problem, potentially reducing the need for separate fencing or other deterrent measures.

The research also explores the potential environmental benefits of the Agricultural-Based System. By optimizing water management and reducing soil erosion, the system may contribute to more sustainable farming practices. This could lead to reduced use of fertilizers and pesticides, as crops protected from excessive rainfall may be less susceptible to nutrient leaching and certain diseases.[7]

The study examines these potential environmental impacts, considering how the system might contribute to more eco-friendly agricultural practices. Furthermore, the research investigates the scalability of the system, considering its applicability to different farm sizes and types. This analysis includes an assessment of the system's potential for modular design, allowing for customization based on specific farm layouts and crop requirements.

The study also explores the possibility of integrating this technology with existing farm management systems and precision agriculture tools, potentially enhancing its overall effectiveness and ease of adoption. The economic analysis of the Agricultural-Based System extends beyond immediate cost-benefit considerations to examine its long-term impact on farm economics. This includes an evaluation of potential reductions in crop insurance costs, as the system may significantly lower weather-related risks. Additionally, the study considers how the implementation of this technology might affect labor requirements and farm management practices, potentially leading to more efficient resource allocation and improved overall farm productivity. [9]

The research also delves into the potential societal impacts of widespread adoption of this technology. By enhancing crop yields and reducing weather-related risks, the system could contribute to improved food security, particularly in regions vulnerable to climate variability.

The study examines how this technology might influence rural economies, potentially creating new job opportunities in manufacturing, installation, and maintenance of these systems.

In conclusion, this comprehensive research on the Agricultural-Based System with its automated roofing mechanism represents a significant contribution to the field of agricultural technology. By addressing critical challenges in crop protection and management, this innovative system has the potential to transform farming practices, enhance agricultural resilience, and contribute to more sustainable food production systems. The study's multifaceted approach, examining technical, economic, environmental, and societal aspects, provides a holistic understanding of the system's potential impact and its role in shaping the future of agriculture in an era of climate uncertainty.[8,10]

II. Related Work

The survey conducted for this research project revealed significant limitations in existing products designed to protect vehicles and clothing during precipitation events. Primary concerns identified included the necessity for manual operation, rendering these products ineffective in the absence of an operator, and potential challenges for individuals with disabilities in utilizing such systems. These findings underscored the importance of developing a more inclusive and user-friendly solution capable of addressing the needs of a diverse user base.

This analysis prompted a reorientation towards developing an automatic system that eliminates manual intervention, utilizing precipitation sensors for autonomous operation. The proposed system aims to provide a seamless and effortless experience, ensuring that vehicles and clothing are protected from rainfall regardless of user presence or physical capabilities.

The literature review uncovered several relevant methodologies that informed the project's direction. These included an automatic sliding door system with an infrared sensor, designed for public building entrances, which demonstrated the efficacy of sensor-based automation in responding to environmental stimuli. Another pertinent innovation was an intelligent windshield system for vehicles that automates wiper control based on precipitation levels and particulate accumulation.[11]

This system exemplified the potential for integrating multiple sensors to create a more responsive and adaptive solution. Additionally, the review identified an embedded technology system for crop protection and rainwater conservation that utilizes precipitation and soil moisture sensors to control an automatic roof mechanism, illustrating the versatility of sensor-based automation in addressing environmental challenges across various domains.[12]

These existing technologies provided valuable insights into sensor-based automation and environmental responsiveness, which could be adapted and applied to the development of an automatic system for vehicle and clothing protection during precipitation events. By synthesizing the strengths of these various approaches, the project aims to create a comprehensive and efficient solution that addresses the limitations of current manual systems. [13]

The proposed automatic system would incorporate precipitation sensors strategically placed to detect the onset of rainfall. Upon detection, the system would activate protective measures such as deploying covers or extending shelters over vehicles and outdoor clothing lines. [14]

This automation ensures continuous protection, even in the absence of user intervention or in cases where manual activation is challenging. Furthermore, the system could be designed with additional features to enhance its functionality and user experience, such as a mobile application for remote monitoring, weather notifications, and manual override capabilities. [15]

This integration of smart technology would provide users with enhanced control and reassurance. The development of this automatic precipitation protection system represents a significant advancement in addressing the practical challenges faced by individuals in safeguarding their property from unexpected weather conditions. By leveraging cutting-edge sensor technology and automation principles, the project aims to create a solution that is not only effective but also accessible and convenient for all users.[16]

III. PROPOSED METHOD

The system's innovative design represents a significant advancement in agricultural technology, offering multifaceted benefits to farmers and crop production. It primarily functions as a protective barrier, shielding crops from excessive rainfall that could potentially damage or destroy harvests.

This feature is particularly crucial in regions prone to heavy precipitation or unpredictable weather patterns. Additionally, the system addresses one of the most pressing challenges in modern agriculture: water scarcity. By efficiently collecting and storing rainwater, it transforms a potentially destructive force into a valuable resource.

The collected water is then strategically utilized for irrigation during dry periods, ensuring a consistent water supply for crops even in the absence of regular rainfall. The implementation of this system promotes sustainable farming practices by reducing reliance on external water sources, such as groundwater or municipal supplies.

This approach not only conserves these often-limited resources but also potentially reduces operational costs for farmers. The stored rainwater can be utilized precisely when needed, optimizing water usage and minimizing waste. Furthermore, the system's design incorporates advanced technological features that enhance its functionality and user-friendliness.

The integration of remote access capabilities allows farmers to monitor and control the system from a distance, providing real-time data and enabling informed decision-making without physical presence in the field. This feature is particularly beneficial for large-scale operations or farmers managing multiple sites. Complementing the remote access feature is a manual override option, which adds an essential layer of flexibility and reliability to the system.

This feature proves invaluable in situations where automated sensors may malfunction or when sudden, unforeseen weather changes require immediate human intervention. The manual override ensures that farmers can maintain control over their irrigation systems, adapting to unique circumstances or emergencies as they arise.

The combination of these features – crop protection, water conservation, remote access, and manual control – creates a comprehensive solution that addresses multiple agricultural challenges simultaneously. This integrated approach not only improves crop yields and quality but also contributes to more sustainable and efficient farming practices, aligning with global efforts to enhance food security and environmental conservation in the face of climate challenges.

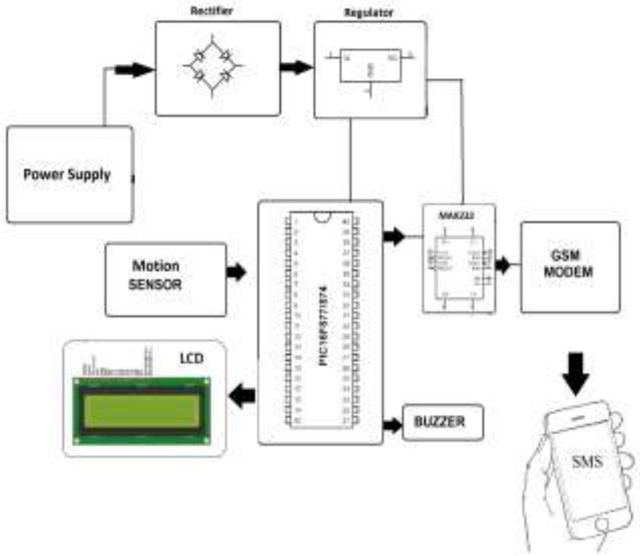


Fig1: Block Diagram

IV. IMPLEMENTATION

The proposed conceptual framework for an automated rain protection system in agriculture represents a significant advancement in crop management technology, offering a sophisticated yet accessible solution to one of the most pressing challenges faced by farmers worldwide. By utilizing a minimalist design centered around an Arduino microcontroller and a rain sensor, the system offers a cost-effective and efficient solution for protecting crops from excessive rainfall, which has become increasingly unpredictable due to climate change. At the heart of this innovative system lies the Arduino microcontroller, a versatile and programmable device that serves as the brain of the operation.

This microcontroller processes data from the rain sensor and makes real-time decisions based on predefined algorithms. The incorporation of a DC motor, controlled by the Arduino, allows for bidirectional rotation, enabling the smooth and precise deployment and retraction of a protective shelter based on real-time precipitation data.

This level of automation eliminates the need for constant human monitoring and intervention, freeing up farmers to focus on other critical aspects of crop management. The system's design criteria emphasize autonomy, rapid response, and low maintenance requirements, making it an attractive option for farmers seeking to optimize their agricultural practices in an increasingly competitive and challenging environment.

The autonomous nature of the system ensures that it can operate continuously, day and night, providing round-the-clock protection for crops. Its rapid response capability is crucial in mitigating the potential damage caused by sudden rainfall, which can be particularly detrimental during sensitive growth stages or harvesting periods.

The rain sensor module, a key component of the system, features a pad with exposed copper traces functioning as a variable resistor. This ingenious design allows for accurate and timely detection of precipitation, even in its earliest stages. The sensor's ability to detect minute changes in moisture levels enables the system to deploy protective covers within minutes of rainfall onset, effectively shielding crops from moisture-related diseases, waterlogging, and soil erosion.

This quick response time is critical in preventing water from accumulating on leaves and fruits, which can lead to fungal growth, bacterial infections, and other pathogenic issues that can severely impact crop health and yield. By preserving crop quality and maintaining production stability throughout the growing season, this automated rain protection system addresses critical challenges in modern agriculture. It offers a practical solution for enhancing crop resilience and overall farm productivity in the face of increasingly erratic weather patterns.

The system's ability to protect crops from excessive rainfall not only helps in maintaining the physical integrity of plants but also ensures optimal growing conditions by preventing nutrient leaching from the soil and maintaining ideal soil moisture levels.

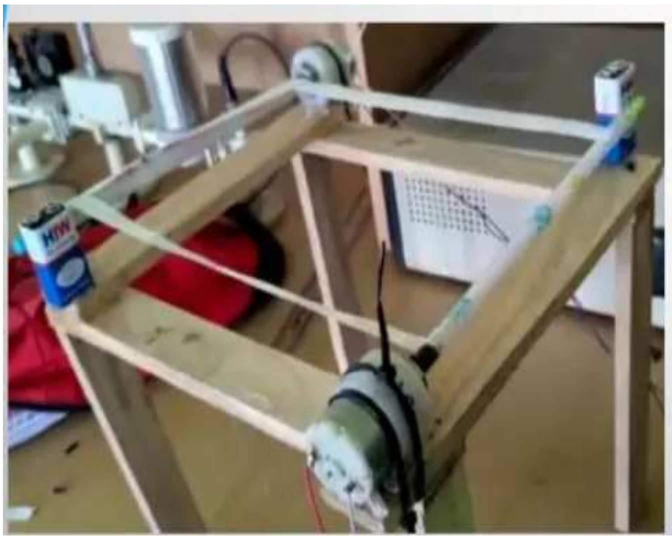


Fig 2: - Rain Protection system

Furthermore, the automated nature of the system contributes significantly to labor efficiency on farms. Traditional methods of crop protection often require manual intervention, which can be time-consuming, labor-intensive, and sometimes dangerous, especially during severe weather conditions. By automating this process, farmers can allocate their time and resources more effectively, focusing on other aspects of farm management that require human expertise and decision-making.

The economic implications of this system are substantial. By mitigating the risks associated with unpredictable weather patterns, farmers can potentially see a significant increase in crop yields and quality. This not only translates to higher revenues but also contributes to food security on a broader scale.

The system's ability to prevent crop losses due to excessive rainfall can lead to more stable food supplies and potentially lower food prices for consumers, creating a positive ripple effect throughout the agricultural supply chain. Moreover, the system's adaptability to various crop types and farming scales makes it a versatile solution for diverse agricultural settings. Whether implemented in small-scale family farms or large commercial operations, the automated rain protection system can be tailored to meet specific needs and environmental conditions. This flexibility ensures that farmers across different regions and with varying resources can benefit from this technology.

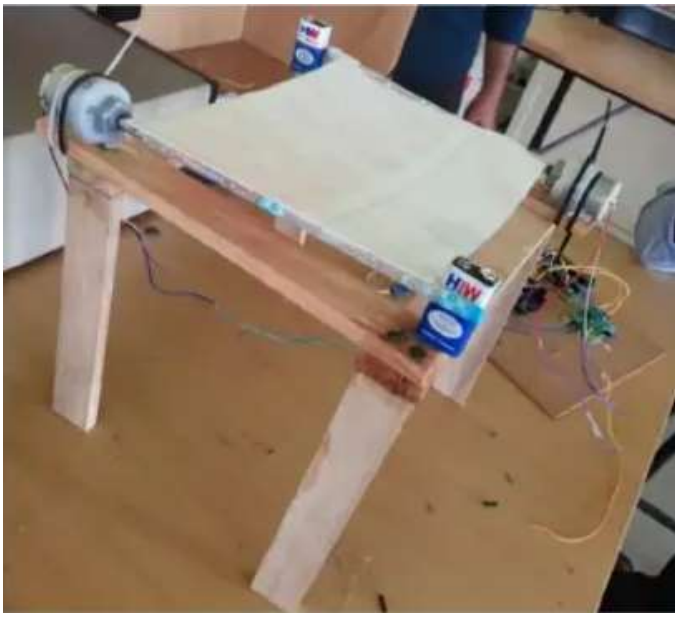


Fig 3: - Rain Protection system

In conclusion, the proposed automated rain protection system represents a significant leap forward in agricultural technology. By combining simplicity in design with advanced functionality, it offers a powerful tool for farmers to combat the challenges posed by unpredictable weather patterns. As agriculture continues to evolve in the face of climate change and growing global food demand, innovations like this automated rain protection system will play a crucial role in ensuring sustainable, efficient, and resilient farming practices for the future.

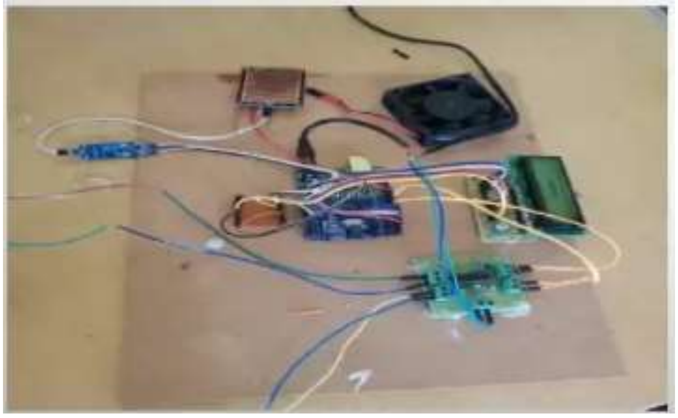
a. 

Fig 4: - Circuit Diagram

V. Conclusion

In conclusion, this innovative Agricultural-Based System presents a promising solution to protect crops from excessive rainfall and animal intrusion during rainy seasons. By integrating a rain sensor with an automated roofing mechanism, the system offers a responsive and efficient approach to safeguarding cultivated areas. While the current design relies on a DC motor and sensor-based activation, there is potential for further enhancements, such as incorporating a direct power supply. This research contributes significantly to the field of agricultural technology, paving the way for improved crop protection strategies and potentially increased yields. Future studies could focus on optimizing the system's cost-effectiveness and exploring its adaptability to various agricultural settings.

References

[1] S. Nagini, T. V. R. Kanth and B. V. Kiranmayee, "Agriculture yield prediction using predictive analytic techniques," 2016 2nd International Conference on Contemporary Computing and Informatics (IC3I), Greater Noida, India, 2016, pp. 783-788, doi: 10.1109/IC3I.2016.7918789.

[2] S. Ayyasamy, S. Eswaran, B. Manikandan, S. P. Mithun Solomon and S. Nirmal Kumar, "IoT based Agri Soil Maintenance Through Micro-Nutrients and Protection of Crops from Excess Water," 2020 Fourth International Conference on Computing Methodologies and Communication (ICCMC), Erode, India, 2020, pp. 404-409, doi: 10.1109/ICCMC48092.2020.ICCMC-00076.

[3] D. Kalra, P. Kumar, K. Singh and A. Soni, "Sensor based Crop Protection System with IOT monitored Automatic Irrigation," 2020 2nd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN), Greater Noida, India, 2020, pp. 309-312, doi: 10.1109/ICACCCN51052.2020.9362739.

[4] R. R. Thirrunavukkarasu, T. Meeradevi, S. Ganesh Prabhu, J. Arunachalam, P. Manoj kumar and R. Prasath, "Smart Irrigation And Crop Protection Using Arduino," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2021, pp. 639-643, doi: 10.1109/ICACCS51430.2021.9441867.

[5] S. S. Ramaprasad, B. S. Sunil Kumar, S. Lebaka, P. R. Prasad, K. N. Sunil Kumar and G. N. Manohar, "Intelligent Crop Monitoring and Protection System in Agricultural fields Using IoT," 2019 4th International Conference on Recent Trends on Electronics, Information, Communication & Technology (RTEICT), Bangalore, India, 2019, pp. 1527-1531, doi: 10.1109/RTEICT46194.2019.9016770.

[6] R. M. Joany, E. Logashanmugam, E. A. Devi, S. Yogalakshmi, L. M. Therase and G. Jegan, "IoT based Crop Protection System during Rainy Season," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), Coimbatore, India, 2022, pp. 1352-1356, doi: 10.1109/ICAIS53314.2022.9742845.

[7] A. S. Aashrith, C. Manaswini, G. Preetham, B. S. Panigrahi and P. K. Sarangi, "Automatic Crop Securing System Using IoT," 2022 5th International Conference on Computational Intelligence and Networks (CINE), Bhubaneswar, India, 2022, pp. 1-4, doi: 10.1109/CINE56307.2022.10037267.

[8] Cheripelli R, ChS, Appana DK. New Model to Store and Manage Private Healthcare Records Securely Using Block Chain Technologies. In: Bangabandhu and Digital Bangladesh. ICBBDB 2021. Commun. Comput. Inf. Sci. 2022, 1550.

[9] I. Nanda, C. Sahithi, M. Swath, S. Maloji and V. K. Shukla, "IIOT Based Smart Crop Protection and Irrigation System," 2020 Seventh International Conference on Information Technology Trends (ITT), Abu Dhabi, United Arab Emirates, 2020, pp. 118-125, doi: 10.1109/ITT51279.2020.9320783.

[10] Chlingaryan, A.; Sukkarieh, S.; Whelan, B. Machine learning approaches for crop yield prediction and nitrogen status estimation in precision agriculture: A review. *Comput. Electron. Agric.* **2018**, *151*, 61–69.

[11] Larsen, A.E.; Patton, M.; Martin, E.A. High highs and low lows: