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IoT BASED CROP PROTECTION SYSTEM

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Abstract: Agriculture contributes one-third of India's gross domestic product, and a large portion of the population depends on agriculture for subsistence. The farmers face a difficulty in protecting their crops from rain, wind. Heavy rainfall can lead to water logging and soil erosion which further leads to soil degradation, since it reduces crop yields. Considering a statistical survey of farmers on the proportion of crop damage caused by rain and in existing system. The proposed system in which the rain is detected and the protective shield is used to covered the fields, the rain sensor, an intelligent micro controller and a servo motor are used. The rain sensor of such drying shed which protect the crop against rain and getting wet. To automate this task, a rain sensor senses the rain and data is passed to the micro controller. The micro controller processes the data and activates the DC motor control circuit and a protective shield is deployed on the top of the field. So we would like to present a project to implement a IoT Based crop protection shield, in that system in which the rain is detected and protective shield is deployed on the field. Stores the rain water for other agricultural purpose and also allows air circulation for the wellness of the crops.

I. INTRODUCTION

Agriculture contributes one-third of India's gross domestic product, and a large portion of the population depends on agriculture for subsistence. The farmers face. a difficulty in protecting their crops from rain, wind. Heavy rainfall can lead to water logging and soil erosion which further leads to soil degradation, since it reducing crop yields the most notable is tsunami, cyclonic storm, heavy rainfall used to destroy the harvest in agricultural farm field. To reduce the proportion of crop damage caused by extreme weather condition, in this project we would like to present to implement a loT Based crop protection shield that can be remotely controlled to protect crops from excess rainfall and collect excess water in a water storage system.

1.1 PROPOSED SYSTEM

A system in which the rains are detected automatically and protective shield is wrapped on the rooftop. To automate this task, a rain senses the rain and data is passed to the microcontroller. The microcontroller processes the data and activates the DC motor control circuit and a protective wrapper is wrapped on the roof top. Stores the rain water for other agricultural purpose and also allows air circulation for the wellness of the crops.

1. Sensors and devices: The system will consist of small, low-power sensors and devices installed in motors. These sensors will be able to detect impacts and other signs of an rain and send a signal to a central server.
2. Central Server: The central server will receive signals from sensors and devices installed in the field. The server processes the information and determines the heavy rain, heavy wind.

3. Emergency services integration: The system will be integrated with emergency services such as alarm, notification phone. This integration will allow a central server to immediately alert emergency services close the field.
4. Real Time Monitoring: The central server will provide real time monitoring of incidents. This will allow emergency services to monitor the status of the rain and respond appropriately
5. User Interface: A user-friendly interface will be provided for emergency services to view and manage rain information. This interface will allow emergency services to view the wind speed and rain prediction.
6. Data Analytics: A central server will store and analyze rain prediction data. This data will be used to improve the system, identify rain is coming or not, and support crop protection system.
7. Remote Management: The system will be managed remotely, allowing a central server to update and maintain the system remotely. This will improve system reliability and stability.

II. LITERATURE SURVEY

In India, agriculture plays a pivotal role in the economy, contributing significantly to the gross domestic product and providing livelihoods for a substantial portion of the population. However, farmers continually face the challenge of safeguarding their crops against adverse weather conditions such as heavy rainfall, wind, and storms. These weather events often result in waterlogging, soil erosion, and crop damage, posing a significant threat to food security. In response to these challenges, this literature survey explores the development and implementation of an IoT-based crop protection system aimed at remotely monitoring and mitigating the impact of extreme weather events on agricultural fields.

The proposed system integrates small, low-power sensors and devices within motors to detect impacts and signs of heavy rainfall. These sensors transmit data to a central server for processing and analysis, forming the backbone of the system's monitoring capabilities. At the core of the system lies a central server responsible for receiving signals from the field sensors, processing the information, and identifying occurrences of heavy rain and wind. This centralized processing enables real-time monitoring and response to weather events, enhancing the system's effectiveness in protecting crops.

Integration with emergency services, such as alarms and notification systems, allows the central server to promptly alert responders in the event of adverse weather conditions. This integration enhances the system's ability to mitigate damage and ensure timely assistance to farmers facing weather-related challenges. Real-time monitoring provided by the central server enables emergency services to assess the situation and respond effectively, facilitating proactive measures to protect crops and minimize losses, thus enhancing agricultural resilience.

A user-friendly interface is developed for emergency service personnel to access and manage weather information. This interface offers comprehensive data on wind speed, rainfall prediction, and other relevant parameters, empowering decision-makers with the information needed to respond effectively to weather-related emergencies. Additionally, the central server leverages data analytics to store and analyze historical weather data, improving predictive capabilities and optimizing crop protection strategies.

III. SYSTEM DESIGN

Requirement analysis is the process of examining a system or its components to identify its goals and how those goals can be achieved. In software development, system analysis is the first step in the software development life cycle. It involves gathering and defining requirements for a new system or modifying an existing one. The Systems Analyst is responsible for understanding business requirements and translating them into functional and technical specifications. Overall, system analysis plays a key role in ensuring that the system meets the needs of its users, is cost-effective, and can be successfully integrated into the existing environment.

3.1 SOFTWARE REQUIREMENTS

As we are doing an Embedded Project, the system mostly consists of hardware components and quite little software components. The software requirements are quite simple here. They are Running PC with Windows 7/arduino Codes for sending and receiving data.

3.1.1 ARDUINO IDE

The Arduino IDE platform is used to type, compile and run the program in this project. The Arduino IDE (Integrated Development Environment) plays a crucial role in the implementation of the remote-controlled crop protection shield project. The Arduino IDE is a software platform that provides a user-friendly environment for writing, compiling, and uploading code to Arduino-compatible microcontrollers, in this case, the NodeMCU. In the provided code snippet, the Arduino IDE is utilized to create and upload firmware that controls the behavior of the NodeMCU. The IDE simplifies the programming process by offering features such as syntax highlighting, auto-completion, and a serial monitor for debugging. Farmers and developers can use the Arduino IDE to open, edit, and upload the code to the NodeMCU, allowing for seamless integration with the Blynk application and the overall functionality of the remote-controlled crop protection shield. The simplicity and accessibility of the Arduino IDE make it an essential tool for translating the project's conceptual design into executable code that can be easily deployed on the hardware platform.

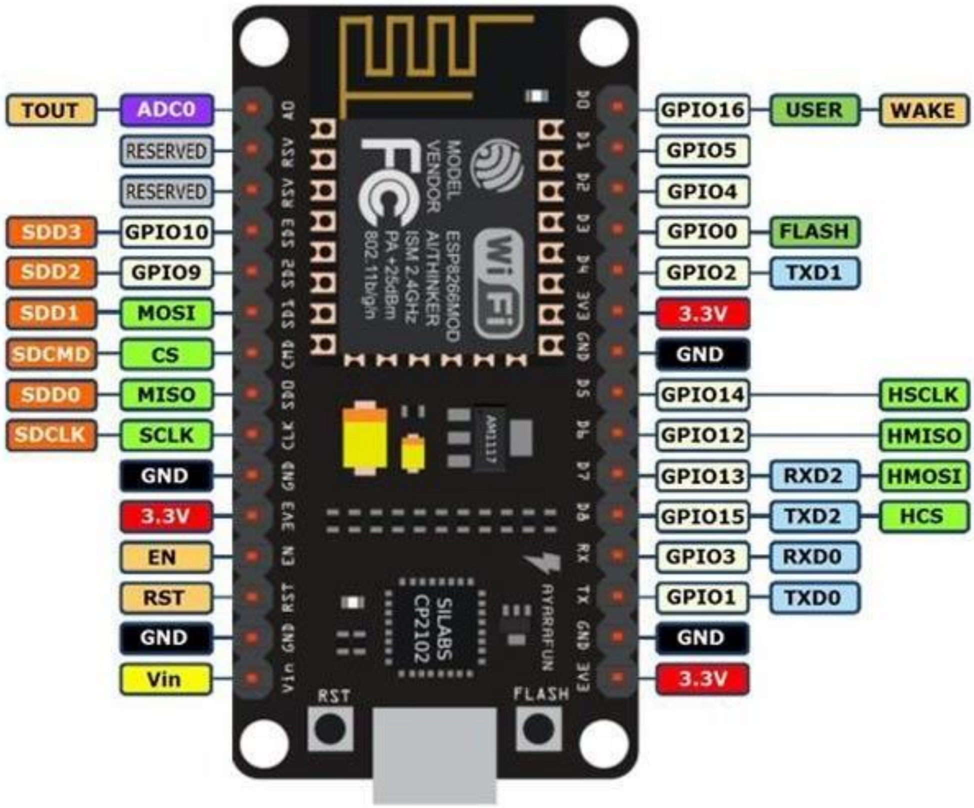
3.2 HARDWARE REQUIREMENTS

The proposed system consists of hardware components that are also very important & essential to access the system. The Hardware requirements are:

- NODE MCU
- ESP 32 CONTROLLER
- RAIN SENSOR
- MOTORS AND SENSOR
- BLYNK
- POWER SUPPLY

3.2.1 NODE MCU

The NodeMCU receives rainfall data from the Rain Sensor module. This data includes information about the intensity of rainfall. Based on the received rainfall data, the NodeMCU engages in a decision-making process. If the decision is to activate the protective shield (due to detected rainfall), the NodeMCU sends control signals to the Motor Control module. These signals instruct the Motor Control module to adjust the protective shield, ensuring that crops are shielded from excess rainfall. Simultaneously, the NodeMCU communicates with the Blynk Interface. It sends real-time updates on the system's status, including information about whether the shield is activated or deactivated.
It processes the data to determine whether protective measures need to be taken, such as activating or deactivating the protective shield. Node MCU is a low-cost open source IoT platform. Node MCU is a microcontroller development board with WIFI capability. Node MCU is used to control crop shield by getting signal from rain gauge and sending that signal to Node MCU controller and it sends to dc motor by which the shield open and close in field. The Node MCU is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266.



3.2.2 RAIN SENSOR

Here the rain sensor is used to detect rainfall in a certain amount of area, This is used in the proposed system detect rainfall. Many of us have witnessed a neighbor's sprinkler system running during a rainstorm. Rain sensors prevent this frustrating and wasteful occurrence. These devices are designed to temporarily shut off an irrigation system so it stops running when it detects rain. Rain sensors can be retrofitted on installed sprinkler systems. You may also see them referred to as rain shut- off devices or rain switches. The most common rain sensor models include an absorbent disk that swells when it gets wet, triggering an electrical switch that overrides the irrigation system. The disk shrinks as it dries out, allowing the system to operate normally.

3.2.3 MOTORS

The motors here are used control the opening and closing function of the protective shield. These motors can handle both forward and backward motion. This is a 100RPM 12V Motor, these motors are simple DC Motors featuring gears for the shaft for obtaining the optimal performance characteristics. They are known as Center Shaft DC Geared Motors because their shaft extends through the center of their gearbox assembly. 100RPM 12V DC geared motors for robotics applications. It gives a massive torque of 27Kgcm.

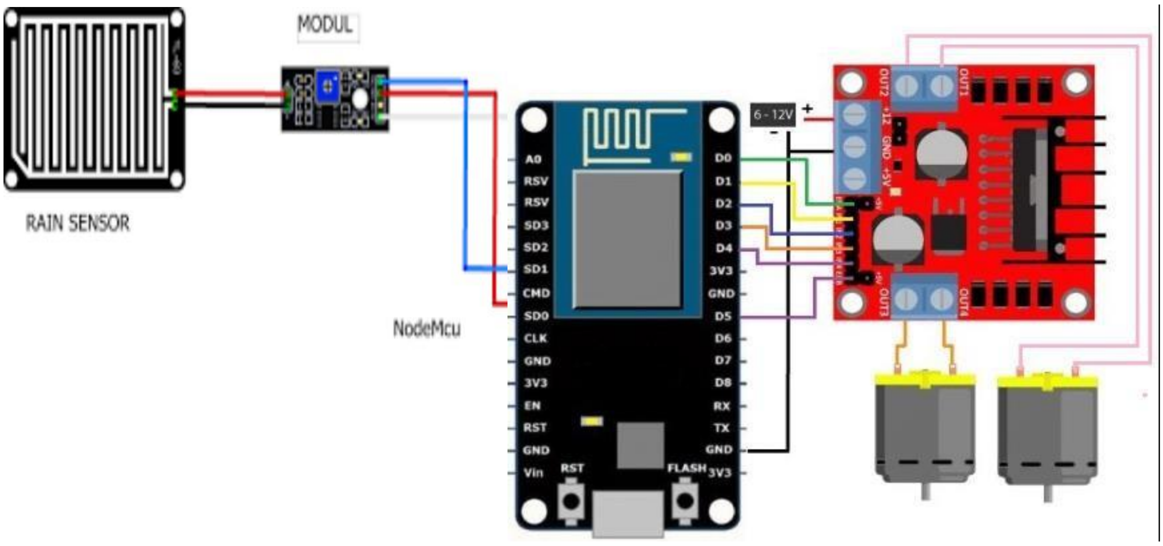
3.2.4 POWER SUPPLY

This power supply is used to power the NodeMCU and the motors, this is the main source of power in the proposed system. A 12V DC power supply is an adapter designed to supply precisely 12 Volts of direct current to a device. The voltage supplied must precisely match the requirements of the equipment. the input of the device should be the same as the output of the adapter. This includes polarity. If the device has a DC input of +12V / 5.4A, get an adapter with a DC output of +12V / 5.4A. If you have a universal adapter.

3.3 WORKING PRINCIPLE

1. A Motor system is used to control over roof it is a main part used to open and close in agriculture field. A type of motor that we used is L298N, it is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time.
2. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A.
3. A rain sensor is an instrument used by to detect the if there is any rainfall in the area it is placed to gather and measure the amount of rainfall over a predefined area, over a period of time.
4. NodeMCU is a low-cost open source IoT platform. NodeMCU is a micro controller development board with wifi capability
5. NodeMCU is used to control crop shield by getting signal from rain gauge and sending that signal to NodeMCU controller and it sends to dc motor by which the shield open and close in field.

3.4 CONNECTION DIAGRAM



the NodeMCU establishes connections with both the Rain Sensor and the Motor Driver to facilitate intelligent control of the protective shield. For the Rain Sensor, a dedicated digital pin, such as D2, on the NodeMCU is assigned for communication. The Rain Sensor is connected to this pin, with its signal wire linked to the NodeMCU's digital pin and the power and ground wires connected to the appropriate pins on the NodeMCU for a stable power supply.

Through this configuration, the NodeMCU continuously reads data from the Rain Sensor, processing it in the firmware to make informed decisions about activating or deactivating the protective shield based on current weather conditions.

Simultaneously, the NodeMCU is connected to the Motor Driver to control the motors responsible for adjusting the protective shield. Two digital pins, for instance, D3 and D4, are designated on the NodeMCU for this purpose. The Motor Driver's control pins are connected to these digital pins, while the power and ground wires of the Motor Driver are connected to the corresponding power and ground pins on the NodeMCU. The motors, in turn, receive their power through the Motor Driver. In the NodeMCU firmware, code is implemented to send control signals to the Motor Driver, allowing for the activation or deactivation of the motors based on the decision-making process derived from the Rain Sensor data. This comprehensive connectivity ensures a seamless interaction between the NodeMCU, Rain Sensor, Motor Driver, and motors, enabling an intelligent and responsive control system for the crop protection shield.

3.5 DATA FLOW DIAGRAM

A Data Flow Diagram (DFD) provides a graphical representation of the flow of data within a system. It illustrates how data is input, processed, stored, and output in a system.
Entities:
Rain Sensor: This is the entity responsible for sensing and providing data on rainfall intensity. NodeMCU (Central Processing Unit): The NodeMCU acts as the central processing unit that receives data from the rain sensor, processes it, and controls other components.
Motor Control: This entity is responsible for controlling the motors that physically adjust the protective shield based on the processed data.
Blynk Interface: The Blynk Interface serves as the user interface where the farmer can monitor the system and receive notifications.

Data Flows:
Rain Data Flow: From Rain Sensor to NodeMCU.
Decision Data Flow: From NodeMCU to Motor Control. Control Signal Flow: From NodeMCU to Motor Control.
Update and Notification Flow: From NodeMCU to Blynk Interface.

3.6 MODULE DIAGRAM

The module diagram provides an overview of the system's components and their interactions. In this case, the system involves a remote-controlled crop protection shield with various modules.

Rain Sensor Module:
Description: This module represents the rain sensor, which is a device responsible for collecting data on rainfall intensity.
Function: The rain sensor measures the amount of rainfall and provides this data to the central processing unit (NodeMCU) for further analysis.

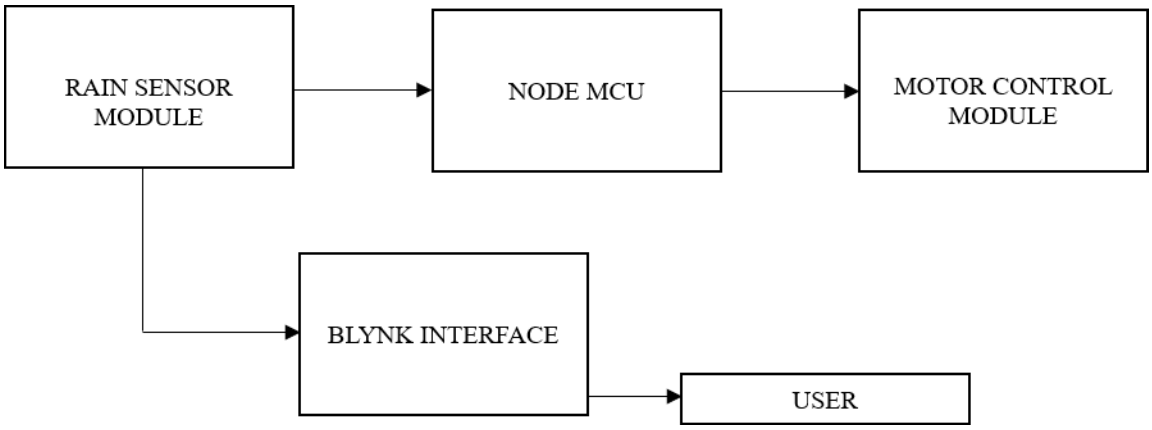
NodeMCU:
Description: The NodeMCU is the central processing unit in the system, acting as the brain that makes decisions based on the collected rain sensor data.
Functions: Receives Rain Data: NodeMCU receives rainfall data from the Rain Sensor Module. Processes Data: It processes the received data to determine whether the protective shield should be activated or deactivated.
Controls Motor: NodeMCU controls the Motor Control Module to physically activate or deactivate the protective shield.
Communicates with Blynk Interface: NodeMCU communicates with the Blynk Interface to provide real-time updates on the system's status and to send notifications to the user.

Motor Control Module:
Description: This module is responsible for controlling the motors that physically open and close the protective shield.
Function: Based on the decisions made by the NodeMCU, the Motor Control Module activates or deactivates the motors to adjust the protective shield accordingly.

Blynk Interface:
Description: The Blynk Interface is a separate component that allows users (farmers) to interact with and monitor the system remotely.
Functions: Receives Updates: Blynk Interface receives real-time updates from the NodeMCU regarding the status of the protective shield.

Allows Manual Control: Users can manually control the shield through the Blynk Interface. Receives Notifications: The interface receives notifications from NodeMCU, alerting users to changes in the system.

3.7 BLYNK MODULE



In the implementation of the remote-controlled crop protection shield, the Blynk module serves as a pivotal component facilitating seamless communication and control between the user and the hardware. Blynk is a versatile Internet of Things (IoT) platform that offers a user-friendly interface, making it an ideal choice for our project. The module essentially acts as a bridge between the NodeMCU hardware and the user's mobile device, providing a platform for real- time monitoring and control.

• Connection and Communication:

The Blynk module enables the establishment of a robust connection between the Blynk app on the user's smartphone or tablet and the NodeMCU embedded in the crop protection shield. This connection allows for bidirectional communication, ensuring that users can remotely control the deployment and operation of the shield while also receiving real-time data from integrated weather sensors.

• User-Friendly Interface:

The intuitive and user-friendly interface provided by the Blynk app simplifies the setup process for farmers. The 'New Project' creation feature allows users to customize their project, selecting the NodeMCU as the hardware model. The incorporation of widgets, such as buttons for control, is seamless, making it accessible for users with varying technical backgrounds.

• Real-Time Monitoring:

The Blynk module excels in real-time data visualization. Through widgets like gauges, graphs, and value displays, the module transforms the collected data from weather sensors into easily interpretable visuals on the Blynk app. This feature enables farmers to monitor weather conditions and the status of the crop protection shield in real-time, enhancing their ability to make informed decisions.

• Widget Configuration for Control:

Specifically, the 'Button' widget within Blynk becomes a critical interface element for our project. It allows users to remotely activate and deactivate the crop protection shield with a simple tap on their mobile device. The configuration options for the button, such as assigning a pin for 'OUTPUT' and defining 'On/Off' labels, ensure that the user has precise control over the hardware, enhancing the overall user experience.

In summary, the Blynk module plays a fundamental role in our remote-controlled crop protection shield project by providing a user-friendly interface, facilitating real-time communication, and offering control over the hardware. Its versatility and ease of integration make it an invaluable tool for farmers seeking efficient and accessible solutions to address the challenges posed by changing weather patterns.

IV. PROPOSED SYSTEM & IMPLEMENTATION

In this chapter, we will look into the center of the proposed solution. A system in which the rains are detected automatically and protective shield is wrapped on the rooftop. To automate this task, a rain senses the rain and data is passed to the microcontroller. The microcontroller processes the data and activates the DC motor control circuit and a protective wrapper is wrapped on the roof top. Stores the rain water for other agricultural purpose and also allows air circulation for the wellness of the crops. The proposed system involves the implementation of a remote-controlled crop protection shield to address challenges faced by farmers due to changing rain patterns. This system utilizes a user-friendly Blynk application for remote monitoring and control. Farmers can easily set up a project on the Blynk app, selecting their hardware, such as the NodeMCU, and connecting it through Wi-Fi or other available options.
The shield, constructed from durable materials, integrates weather sensors for real- time monitoring. Farmers can remotely deploy the shield to protect crops from excess rainfall and collect rainwater for irrigation during dry spells. The system's simplicity lies in the addition of a button widget on the Blynk app, allowing users to control the shield by assigning a pin for output and configuring labels for 'On' and 'Off' states.
This proposed system provides a cost-effective and scalable solution for farmers, offering protection against unpredictable weather and enhancing water resource management. Future enhancements could focus on advanced weather prediction, energy efficiency, and collaborative data sharing to further optimize its effectiveness in sustainable agriculture.

4.1 DESCRIPTION OF THE TECHNOLOGY

The remote-controlled crop protection shield is a sophisticated system designed to shield crops from the various effects of excess rainfall. It is constructed using a combination of durable, weather-resistant materials to ensure longevity and reliability in varying weather conditions. The shield has several key components and features:

Rain Sensor: The shield is equipped with advanced rain sensors, including temperature monitors, and wind gauges. These sensors continuously collect data to assess the current weather conditions.
Real-Time Data Processing: The collected data is processed in real-time to make informed decisions about the deployment of the shield. For example, when rainfall surpasses a certain limit, the system can automatically activate the shield's protective system.
Adjustable Design: The shield is designed to be highly adaptable. Its structure can be adjusted to fit different crop types and field sizes, providing flexibility for farmers to customize its configuration to meet their specific needs.

4.2 REMOTE MONITORING AND CONTROL

A fundamental aspect of the remote-controlled crop protection shield is the ability for farmers to be able to have remote control over the system. This is achieved through a user-friendly interface accessible via a smartphone app or a web page. The features of remote monitoring and control include:
Real-Time Status Updates: Farmers can receive real-time updates on weather conditions and the current status of the crop protection shield. This includes rainfall levels, wind speed, and temperature.

Deployment Control: Farmers can decide when to activate the shield based on weather forecasts or real-time data. The system can deploy or retract the shield automatically, reducing the need for constant monitoring.

Adjustment Capabilities: The application or web page allows the farmers to fine-tune the settings of the shield, such as the angle and height of the protective shield, ensuring it is optimized for specific crops and weather conditions.

4.3 WATER COLLECTION SYSTEM

One of the significant advantages of the remote-controlled crop protection shield is its integrated water collection system. Excess rainwater is captured and stored for later use, primarily for irrigation during dry periods. The water collection system includes the following components:

Rainwater Capture: The shield is designed to channel excess rainwater into a collection system. This water is prevented from coming into contact with crops, reducing the risk of water- related damage or soil erosion.

Storage Capacity: The collected water is stored in the storage facility which the farmer has access to, which can vary in size depending on the specific needs of the farm.

Irrigation Distribution: Farmers can access and use the collected rainwater for irrigation when needed, reducing their dependence on natural rainfall and conserving water resources.

4.4 IMPLEMENTATION

In the implementation of the remote-controlled crop protection shield, the Blynk module serves as a pivotal component facilitating seamless communication and control between the user and the hardware. Blynk is a versatile Internet of Things (IoT) platform that offers a user-friendly interface, making it an ideal choice for our project. The module essentially acts as a bridge between the NodeMCU hardware and the user's mobile device, providing a platform for real-time monitoring and control.

Connection and Communication: The Blynk module enables the establishment of a robust connection between the Blynk app on the user's smartphone or tablet and the NodeMCU embedded in the crop protection shield. This connection allows for bidirectional communication, ensuring that users can remotely control the deployment and operation of the shield while also receiving real-time data from integrated weather sensors.

User-Friendly Interface: The intuitive and user-friendly interface provided by the Blynk app simplifies the setup process for farmers. The 'New Project' creation feature allows users to customize their project, selecting the NodeMCU as the hardware model. The incorporation of widgets, such as buttons for control, is seamless, making it accessible for users with varying technical backgrounds.

Real-Time Monitoring: The Blynk module excels in real-time data visualization. Through widgets like gauges, graphs, and value displays, the module transforms the collected data from weather sensors into easily interpretable visuals on the Blynk app. This feature enables

farmers to monitor weather conditions and the status of the crop protection shield in real- time, enhancing their ability to make informed decisions.

Widget Configuration for Control: Specifically, the 'Button' widget within Blynk becomes a critical interface element for our project. It allows users to remotely activate and deactivate the crop protection shield with a simple tap on their mobile device. The configuration options for the button, such as assigning a pin for 'OUTPUT' and defining 'On/Off' labels, ensure that the user has precise control over the hardware, enhancing the overall user experience.

4.5 BENEFITS OF THE REMOTE-CONTROLLED CROP PROTECTION SHIELD

The crop protection shield offers a various types of benefits, including:
• Crop Protection:
Effective protection against excess rainfall, reducing the risk of crop damage, soil erosion and failure.

• Increased Yields:
The ability to monitor the shield's settings and water management leads to increased crop yields. Which is a huge benefit.

• Water Resource Management:
Efficient use of collected rainwater for irrigation, reducing water wastage and dependence on unpredictable rainfall.

• Environmental Sustainability:
Mitigation of soil erosion and conservation of water resources contribute to long-term environmental sustainability.

• User-Friendly:
This technology is designed to be user-friendly, making it accessible and reliable to a wide range of farmers.

Firstly, the integration of a weather prediction service allows the system to anticipate upcoming weather conditions, enabling proactive adjustments to the protective shield.
Additionally, the implementation of soil moisture sensors provides insights into soil health, allowing for optimized watering schedules and improved crop management.

To further enhance adaptability, the system integrates adaptive adjustment algorithms, dynamically modifying the protective shield based on current rain data, historical patterns, and evolving climate conditions. Incorporating visual monitoring, the system integrates remote cameras that users can access through the dedicated mobile application. This feature enables real-time visual assessment of crop health and the effectiveness of the protective measures. Machine learning algorithms form a critical component, continuously improving decision- making processes by learning from historical data. The system aims for sustainability by incorporating energy harvesting technologies, such as solar power or wind energy, reducing dependency on external power sources.

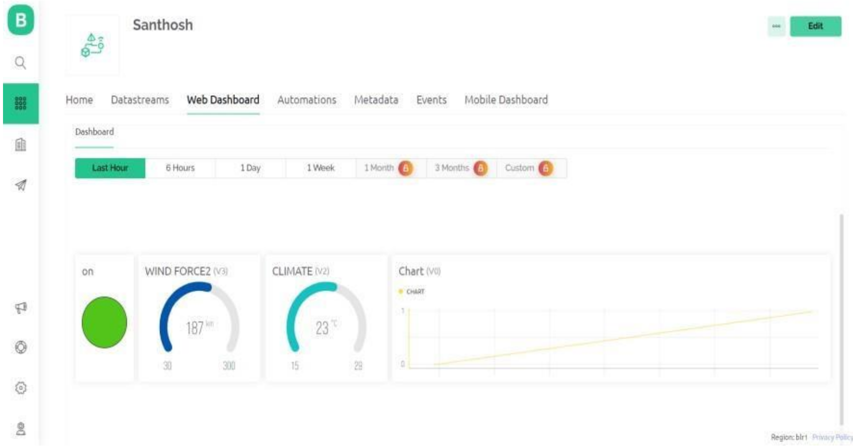
V. CONCLUSION

The introduction of the remote-controlled crop protection shield represents a significant stride towards addressing the mounting challenges faced by farmers in the wake of changing rain patterns. This innovative technology not only provides a reliable defense against excessive rainfall but also promises increased agricultural yields, efficient water management, and a boost in environmental sustainability. By embracing this user-friendly solution, farmers gain the capacity to adapt to unpredictable climate conditions, reducing the risks associated with crop failure and water wastage. As agriculture meets the era of technological advancement, the remote-controlled crop protection shield offers a beacon of hope, promising a resilient and sustainable future for farming communities. In the face of mounting challenges in the agricultural sector, the introduction of the remote-controlled crop protection shield emerges as a promising solution that extends far beyond immediate crop preservation. Its continuous evolution and adoption hold the potential to redefine the landscape of modern agriculture, fortifying it against the vagaries of climate change and ensuring food security for generations to come.

VI. FUTURE ENHANCEMENT

The horizon of possibilities for the future of remote-controlled crop protection shields is vast and promising. The continuous development of this technology offers a range of exciting prospects. First and foremost, integrating advanced weather prediction models and more sophisticated sensors can further enhance the system's precision and responsiveness to changing environmental conditions. Energy efficiency should remain a focal point, exploring renewable energy sources to power the system and reduce its carbon footprint. Scalability is key, with the technology being tailored to suit both small-scale and large-scale farming operations. Remote monitoring and alert systems can be developed, empowering farmers to keep an eye on their fields from anywhere and receive real-time information. Cost reduction measures should be at the forefront of future enhancements, making the technology affordable and accessible to a broader spectrum of farmers.

PROJECT OUTPUTS:



BLYNK INTERFACE

```
load:0x40080400,len:2972
entry 0x400805dc
The rain is NOT detected
Protective shield not opened
The rain is NOT detected
Protective shield not opened
```

OUTPUT

```
load:0x40080400,len:2972
entry 0x400805dc
The rain is detected
Protective shield open
The rain is detected
Protective shield open
```

PROJECT MODEL

REFERENCES

[1] P. Deekshith, P.L.N Varma, P. Tarun Krishna Vamsi “Automatic rain sensing harvested productprotector” International Journal of Electronics, Electrical and Computational System (IJEECS), ISSN 2348-117X, Vol. 7, Issue.4, April 2018.

[2] Ajay, Akash, Shivashankar, Patil Sangmesh “Agriculture crop protection with rain water harvesting and power generation” International Journal of Scientific Research and Review, ISSN No:2279-543X, Vol.07, Issue. 03, March 2022.

[3] J. Smith authored the paper titled "Smart Agriculture Monitoring and Controlling System Using IoT," published in May 27, 2017.

[4] N. K. Patel and V. M. Patel contributed to the paper titled "Wireless Sensor Network and IoT based Smart Agriculture Monitoring System," published on December 09, 2022.