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THE BLYNK GRAIN TESTING ROBOTIC CAR

[1]Shravani Sunil Darote,[2]Sana Ibrahim Pathan, [3]Sakshi Baban Nabage,[4]Mr. Tribhuvan S.B.

[1]UG Scholar, Mechatronics Dept. Samarth Polytechnic, Belhe
[2]UG Scholar, Mechatronics Dept. Samarth Polytechnic, Belhe
[3]UG Scholar, Mechatronics Dept. Samarth Polytechnic, Belhe
[4]HOD Mechatronics Dept. Samarth Polytechnic, Belhe

ABSTRACT- An inventive agricultural automation project called the Blynk Grain Testing Robotic Car aims to enhance the effectiveness, precision, and security of grain quality monitoring in fields and storage facilities. Food production depends heavily on agriculture, and preserving grain quality is crucial to avoiding losses brought on by moisture, temperature fluctuations, pests, and subpar storage conditions.Conventional grain testing techniques are labor-intensive, time-consuming, and sometimes imprecise, which can result in lower grain quality and financial losses. The Blynk Grain Testing Robotic Car was created as a clever and automated way to remotely monitor grain conditions in order to address these issues. This project's primary goal is to create a robotic vehicle that can navigate grain storage locations and gather crucial environmental data, including temperature, humidity, moisture content, and gas concentration.

These parameters are crucial for maintaining grain quality and preventing spoilage. The robotic car is equipped with multiple sensors that continuously monitor the grain storage environment and transmit real-time data to users through a mobile application. This system allows farmers, warehouse operators, and agricultural professionals to track grain conditions without physically visiting the storage area

Keywords - IoT, Grain Storage Monitoring, Blynk IoT, ESP8266 NodeMCU, Fire Detection, Temperature Sensor, Moisture Sensor, Robotic Car, Smart Agriculture, Warehouse Monitoring

I. INTRODUCTION

The primary interface for operating and keeping an eye on the robotic vehicle is the Blynk mobile application. Users may monitor sensor data in real time and remotely control the robot's movements using the Blynk platform. Using orders from the mobile application, the robotic automobile can travel left, right, forward, and backward. The system is very adaptable and practical due to its remote control capabilities, particularly for big warehouses and storage facilities where challenging. A microcontroller like an Arduino or ESP8266, a motor driver module, DC motors, wheels, sensors, and a wireless connection module like Wi-Fi usually make up the system. Temperature and humidity sensors, moisture sensors, gas sensors, and obstacle detection sensors might all be employed in this project.

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wheels, sensors, and wireless communication module such as Wi-Fi. The sensors used in this project may include temperature and humidity sensors, moisture sensors, gas sensors, and obstacle detection sensors. These sensors collect data and send it to the microcontroller, which processes the information and transmits it to the Blynk application through Wi-Fi connectivity. Additionally, the robotic car may include a camera module for visual inspection, further enhancing monitoring capabilities. This project also improves safety by reducing human exposure to hazardous storage environments such as dusty or poorly ventilated grain storage areas. It helps in early detection of unfavorable conditions that may cause grain damage, such as excessive moisture or temperature rise. By providing real-time monitoring and remote control, the system enhances decision-making and reduces manual labor.

II. OBJECTIVES

- To Effectively Monitor Grain Quality
- To Cut Down on Manual Inspection Work
- To Offer Monitoring and Control in Real Time
- To Boost Grain Testing Accuracy
- To Reduce Grain Loss in Storage
- To Make Remote Monitoring Possible
- To Increase Productivity in Agriculture

III. SYSTEM OVERVIEW

- The Blynk Grain Testing Robotic Car uses sophisticated sensors, wireless connection, and automatic mobility to keep an eye on grain quality and storage conditions. In order to conduct effective grain inspection, the system's operating concept is built on combining sensing, processing, communication, and motion control components. The ESP8266 NodeMCU, a 360-degree camera, a fire sensor, a moisture and temperature sensor, servo motors, a gear linear actuator, an L298N H-bridge motor driver, DC motors, a battery, and a charger make up the system. Every part is crucial to the grain testing robotic car's seamless operation. The power supply part is where the system starts to function. The battery serves as the robotic device's primary power source.
- car. It provides the required voltage to the ESP8266 Node MCU, sensors, motor driver, and other components. The charger is connected to recharge the battery when its power level drops. This ensures continuous operation of the system without interruption. The battery management helps maintain system reliability and improves the mobility of the robotic car within grain storage areas such as warehouses, godowns, and storage units. The ESP8266 NodeMCU functions as the central controller of the system. It receives input signals from various sensors and processes them accordingly.

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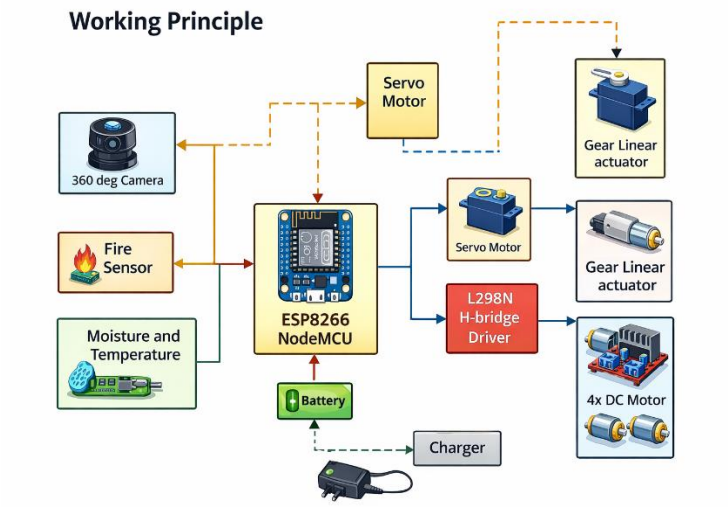

Fig.1- Proposed System

The Node MCU also connects to Wi-Fi, allowing communication with the Blynk mobile application. Through this connection, users can remotely monitor grain conditions and control the robotic car from anywhere. The ESP8266 processes commands received from the Blynk application and sends control signals to motors and actuators. This enables remote operation and automation of the system. The 360-degree camera is used for visual monitoring of the grain storage environment. It captures real-time images and videos from all directions, allowing users to observe grain condition, storage layout, and possible issues. The camera sends the captured data to the ESP8266, which transmits it to the user through the Blynk platform. This helps in remote inspection without requiring manual presence.

IV. HARDWARE COMPONENTS

- **ESP8266 Microcontroller**

The ESP8266 Microcontroller plays a vital role in the Blynk Grain Testing Robotic Car by acting as the central processing and communication unit of the entire system. It controls all sensors, motors, and communication modules to ensure smooth operation of the robotic car. The ESP8266 is selected for this project because it offers built-in Wi-Fi and Bluetooth connectivity, high processing speed, multiple GPIO pins, and low power consumption, making it ideal for IoT-based automation applications. In this project, the ESP8266 microcontroller receives input data from various sensors such as moisture and temperature sensors and fire sensors. These sensors continuously monitor grain storage conditions. The ESP8266 processes the collected data and compares it with predefined threshold values. If abnormal conditions such as high moisture, increased temperature, or fire detection occur, the ESP8266 immediately triggers alerts and sends notifications to the user through the Blynk IoT mobile application. This allows users to monitor grain conditions remotely in real time.

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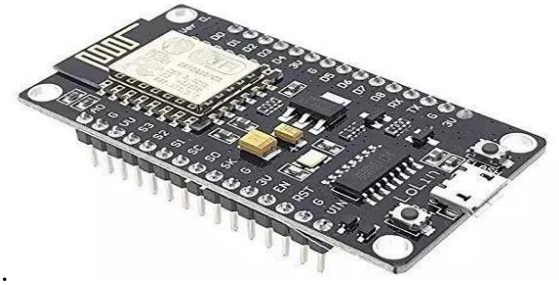

Fig.2- ESP8266 microcontroller

- **7.4V Li-ion Battery**

The 7.4V Lithium-ion Battery plays an important role in the Blynk Grain Testing Robotic Car by providing a stable and reliable power supply to the entire system. This battery is selected due to its lightweight design, high energy density, and rechargeable capability, making it suitable for portable robotic applications. In this project, the 7.4V battery supplies power to the ESP8266 microcontroller, sensors, servo motors, motor driver module, and DC motors. The consistent voltage output ensures smooth operation of all components and prevents system malfunction due to power fluctuations. To enhance safety and battery performance, a Battery Management System (BMS) is integrated with the battery. The BMS plays a crucial role in maintaining battery health and improving operational safety. It protects the battery from overcharging, deep discharging, short circuits, and overheating conditions. These protection features increase battery lifespan and ensure reliable performance during long-duration operations. The BMS also maintains balanced charging and discharging cycles, which improves overall efficiency and stability of the robotic system.

Fig.3- Solar Charge Controller

- **Fire Sensors**

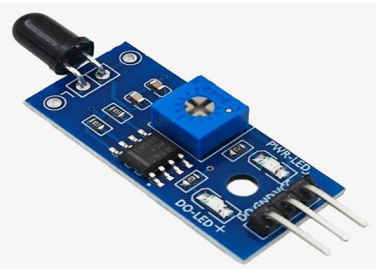

Fig.4- Fire Sensor

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The Fire Sensor Module plays an important role in the Blynk Grain Testing Robotic Car by providing safety and early fire detection in grain storage areas. Grain warehouses are highly vulnerable to fire hazards due to the presence of dry grains, dust particles, and electrical components. The fire sensor module is designed to detect flames, smoke, or sudden increases in temperature and alert the system before a major accident occurs. This helps in preventing damage to stored grains and infrastructure.

The fire sensor module works based on infrared (IR) flame detection technology. It detects infrared radiation emitted by flames within a specific wavelength range. The sensor continuously monitors the surrounding environment while the robotic car moves across the grain storage area. When a fire or high heat source is detected, the sensor immediately generates a signal. This signal is sent to the ESP8266 Node MCU, which acts as the central controller of the system.

- **Blynk App**

Fig.5- Blynk App

The Blynk IoT app plays a crucial role in the Blynk Grain Testing Robotic Car by enabling remote monitoring, control, and real-time data visualization. The Blynk application acts as the user interface between the robotic system and the operator. It allows users to monitor grain storage conditions such as temperature, moisture level, and fire detection from anywhere using a smartphone. This makes the system highly efficient and suitable for large grain warehouses and storage areas.

The working of the Blynk app begins when the ESP8266 NodeMCU connects to a Wi-Fi network and communicates with the Blynk cloud server. The ESP8266 sends sensor data such as moisture, temperature, and fire detection values to the Blynk server. The Blynk app installed on the user's smartphone receives this data and displays it using widgets like gauges, value displays, graphs, and notifications. These widgets help the user understand grain conditions in real time and take appropriate action when required.

- **Temperature & Moisture Sensor**

The Temperature and Moisture Sensor Module plays a vital role in the Blynk Grain Testing Robotic Car by continuously monitoring environmental conditions that directly affect grain quality. Grain storage requires controlled temperature and moisture levels because excess humidity and heat can cause fungal growth, insect infestation, and grain spoilage. This sensor helps detect such conditions early and enables timely action to protect stored grains. The working of the temperature and

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moisture sensor begins when the robotic car moves inside the grain storage area. The sensor continuously measures temperature and moisture levels in the surrounding environment. The sensor detects moisture using humidity sensing elements that respond to changes in water vapor present in the air. Similarly, the temperature sensing element detects ambient temperature variations. These values are converted into electrical signals and sent to the ESP8266 Node MCU, which acts as the central controller of the system. Once the ESP8266 receives the sensor data, it processes and compares the values with predefined safe limits programmed into the system.

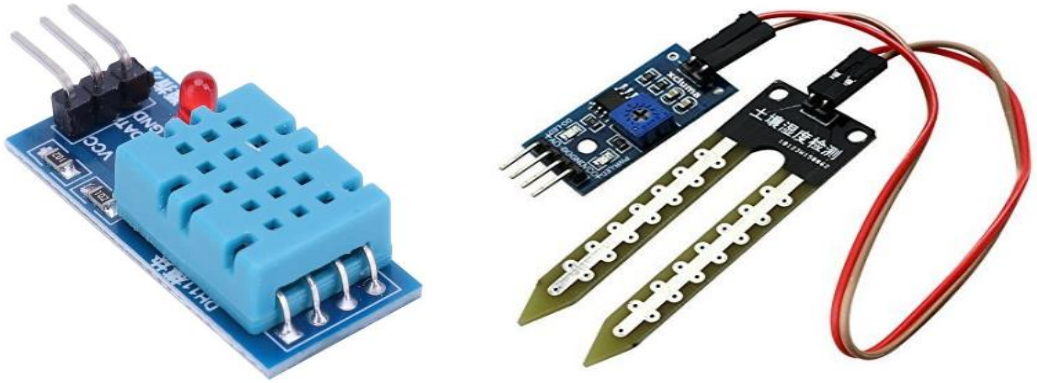

Fig.6- Temperature & Moisture Sensor

- **SG90 Servo Motor**

The SG90 Micro Servo Motor plays an important role in the Blynk Grain Testing Robotic Car by providing precise angular movement for camera positioning and sensor adjustment. The SG90 servo motor is widely used in robotic applications because of its compact size, lightweight design, and accurate positioning capability. In this project, the SG90 servo motor is used to control the 360-degree camera movement and gear linear actuator, allowing the robotic car to inspect grains from different angles and positions. The SG90 servo motor operates using Pulse Width Modulation (PWM) signals generated by the ESP8266 NodeMCU. The servo motor has three wires: VCC (power supply), GND (ground), and signal pin. The ESP8266 sends PWM signals to the signal pin of the servo motor. Based on the width of the pulse, the servo motor rotates to a specific angle, typically between 0° and 180°. For example, a 1 ms pulse rotates the servo to 0°, 1.5 ms moves it to 90°, and 2 ms moves it to 180°. This precise angle control helps in positioning the camera and sensors accurately.

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Fig.7- SG90 Servo Motor

V. WORKING PRINCIPLE

The clever and automated Blynk Grain Testing Robotic Car uses mobile-based control and Internet of Things technologies to monitor grain storage conditions. The project's circuit diagram illustrates how various parts, including the ESP8266 Node MCU, fire sensor, moisture and temperature sensor, servo motors, gear linear actuator, L298N motor driver, DC motors, battery, and 360-degree camera, are linked to create a fully functional system. The ESP8266 Node MCU serves as the system's core controller.

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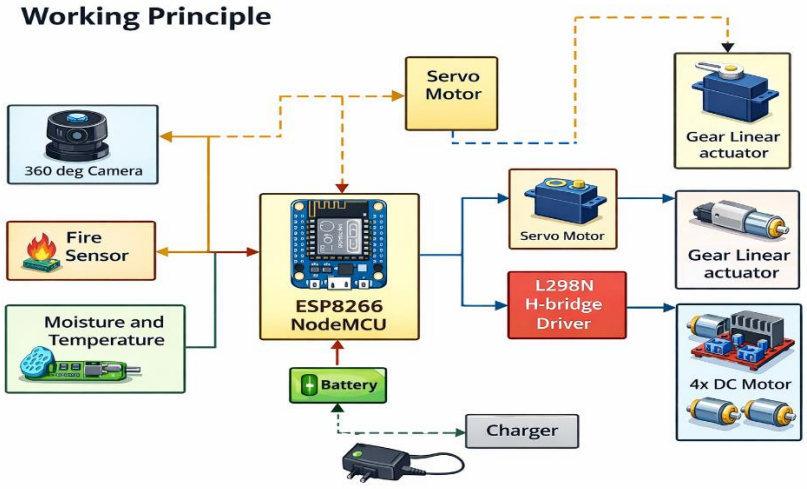

Fig.8- Proposed System

In this circuit diagram, the moisture and temperature sensor is connected to the input pins of the ESP8266 Node MCU. This sensor continuously monitors environmental conditions inside the grain storage area. If the moisture level increases beyond the safe limit, it may indicate grain spoilage or fungal growth. Similarly, temperature variation may indicate poor ventilation or heating conditions. The sensor sends real-time data to the Node MCU, which then transmits the information to the Blynk mobile application through Wi-Fi. This allows remote monitoring of grain quality from anywhere. The fire sensor is also connected to the Node MCU and acts as a safety component. When fire or

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abnormal heat is detected, the sensor sends a signal to the controller. The Node MCU then sends an alert notification to the user via the Blynk application and can also stop the movement of the robotic car for safety.

Circuit Diagram:-

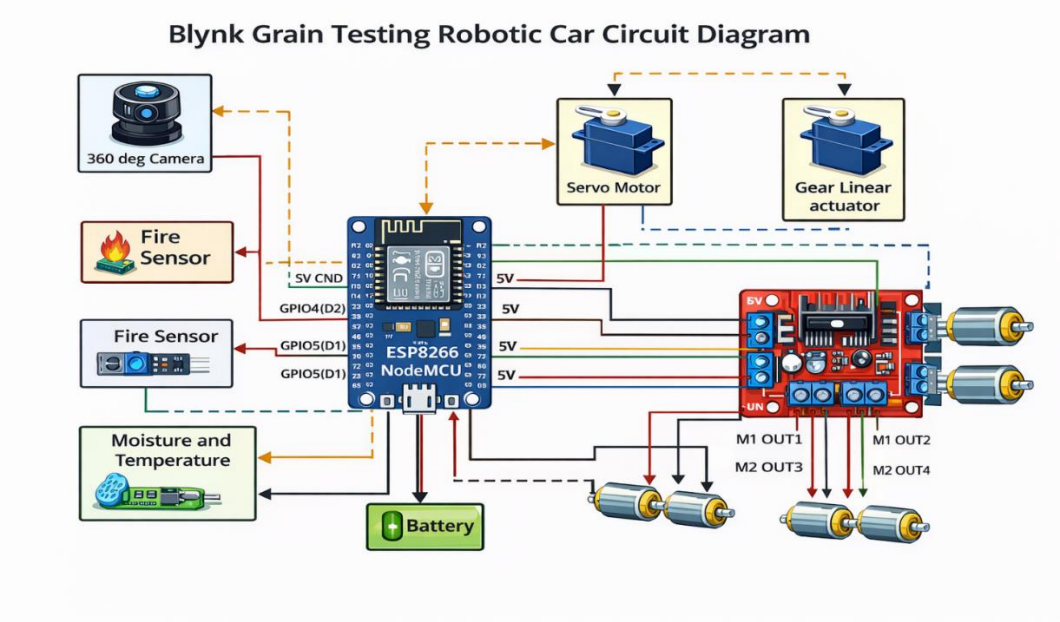

Fig.9- Circuit Diagram of the System

The 360-degree camera is connected to the controller to provide real-time video monitoring of the grain storage area. The camera is mounted on a servo motor, which is controlled by the Node MCU. This arrangement allows the camera to rotate in all directions, providing complete coverage of the storage area. The servo motor receives PWM signals from the Node MCU for controlled rotation. Additionally, another servo motor is connected to the gear linear actuator. The gear linear actuator converts rotational motion into linear motion and is used to adjust the position of sensors or camera. This mechanism allows the robotic car to inspect grains at different heights and positions.

Flow Chart of the System

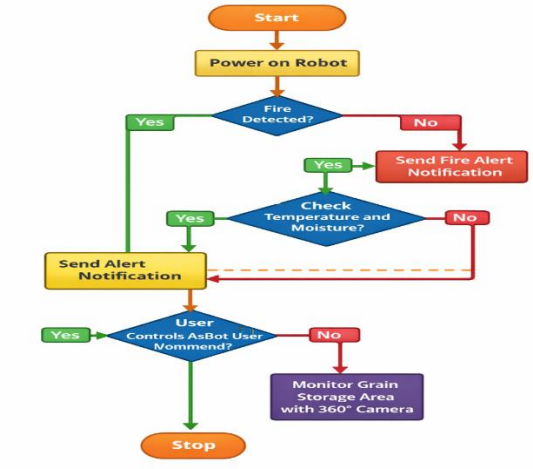

Fig.10- Flow Chart of the proposed system

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The flow chart of the Blynk Grain Testing Robot Car represents the working principle of the system using a Yes/No decision-making process. This flow chart explains how the robotic system monitors grain storage conditions, detects hazards, and allows user control through an IoT-based platform. The process begins when the system is powered on and continues through various decision stages until the monitoring process is completed. The flow chart starts with the Start block, which indicates the beginning of the robotic system operation. Once the system starts, the next step is Power ON Robot, where the battery supplies power to all components including the ESP8266 Node MCU, sensors, camera, motor driver, and motors. After powering on, the system moves to the first decision block: Fire Detected?. At this stage, the fire sensor continuously monitors the environment for flame, heat, or smoke. If the answer is Yes, meaning fire is detected, the system immediately moves to Send Alert Notification. The ESP8266 Node MCU sends an alert message to the user through the Blynk mobile application. This alert helps the user take immediate action to prevent damage to stored grains and storage infrastructure. After sending the alert, the system proceeds to check further environmental conditions. If the answer to Fire Detected? is No, the system proceeds to the next step Check

Experimental Set up

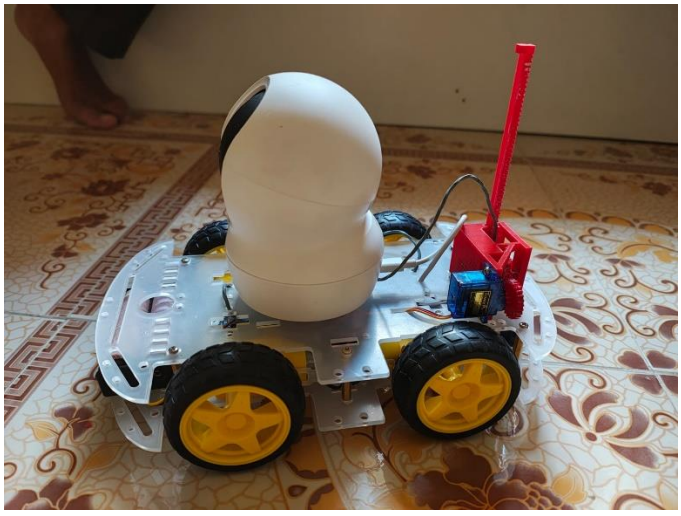

Fig.11- Experimental Set up

VI. RESULT AND DISCUSSION

The picture displays the findings from the Blynk Grain Testing Robot Car, which keeps track of temperature (°C) and moisture (%) levels for a full day.

The moisture trend is depicted by the green line, while the temperature fluctuation is represented by the red line. The graph shows that the temperature varies between 26°C and 30°C, peaks between 3 and 6 PM at about 30.5°C, and then progressively drops during the night. In the meantime, the moisture content ranges from 70% to 87%, rising gradually until the afternoon and peaking between 3 and 6 PM.

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temperature and 55–80% for moisture. The results highlight how environmental factors change throughout the day, affecting stored grains. The higher afternoon temperature and moisture levels may increase the risk of spoilage or fungal growth if not controlled. The robot car effectively captures and transmits this data to the Blynk IoT platform, allowing real-time monitoring and analysis.

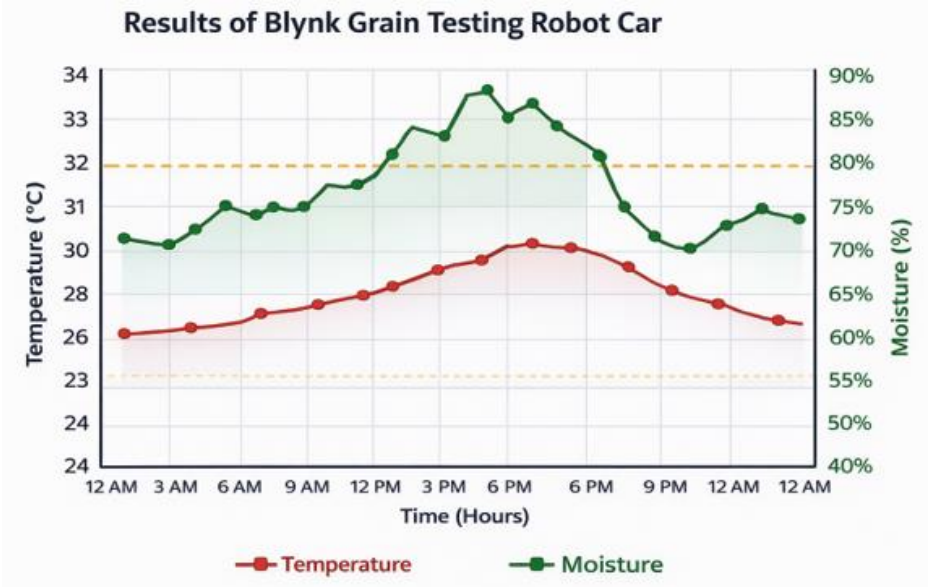

Fig.12- Result Analysis

Beyond this graph, other results from the Blynk Grain Testing Robot Car project include successful automation and mobility in field testing

VII. CONCLUSION

Using IoT and automation technologies, the Blynk Grain Testing Robot Car is a creative and effective way to enhance grain storage monitoring. To enable comprehensive monitoring of grain storage settings, the system combines a number of sensors, such as temperature, moisture, and fire detection modules, with a 360-degree camera. In order to gather real-time data and send it to the Blynk IoT platform for remote monitoring and control, these parts collaborate with the ESP8266 Node MCU microcontroller. This makes it possible for users to get crucial information from any location, which enhances decision-making and minimizes the need for human scrutiny. The robotic car can travel smoothly between various storage places thanks to its four DC motors, which are managed by an L298N motor driver.

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