IOT – Based Rain Detection and Automated Clothes Collecting System

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Abstract**—** *In many households, clothes are commonly dried in open areas such as balconies or terraces. Sudden and unexpected rainfall can cause clothes to get wet, resulting in inconvenience and additional effort. To overcome this problem, this paper presents an IoT-based rain detection and automated clothes collecting system using the ESP8266 microcontroller. The system continuously monitors environmental conditions using a rain sensor. When rainfall is detected, a DC motor controlled through a motor driver automatically pulls the clothes into a sheltered area. When the rain stops, the system pushes the clothes back outside for drying. Additionally, the system sends real-time email alerts to the user using Google Apps Script, providing notifications about the clothes' status. The proposed system is low-cost, reliable, energy-efficient, and requires minimal human intervention, making it suitable for smart home applications.*

Keywords*: IoT, ESP8266, Rain Sensor, Automation, Smart Home, Email Alert*

INTRODUCTION

Drying clothes outdoors is a common practice in many households due to limited indoor space and the availability of natural sunlight. However, during rainy seasons or unpredictable weather conditions, sudden rainfall can soak the clothes, leading to inconvenience, repeated washing, and time wastage. Manual monitoring of weather conditions is not always possible, especially when users are away from home or busy with daily activities.

With the rapid development of the Internet of Things (IoT), automation has become an effective solution to everyday problems. IoT enables real-time monitoring and control of devices through the internet, enhancing convenience and efficiency. This project utilizes IoT technology to develop an automated system that detects rainfall and protects clothes without human intervention. The system not only automates the clothes collection process but also provides real-time email notifications, improving reliability and user awareness.

LITERATURE SURVEY

Smart home automation systems have attracted significant research attention in recent years due to their potential to enhance convenience, efficiency, and safety in domestic environments. Researchers have proposed a wide range of solutions, from general Internet of Things (IoT) platforms to specialized sensor-based systems, each addressing different household challenges with varying levels of effectiveness.

IoT – Based Homes Automation:

Several studies focus on developing comprehensive IoT-based home automation systems that monitor and control multiple household appliances. For example,

Priya designed an IoT system to automatically control lights and fans based on environmental parameters such as temperature and occupancy. While such systems are effective for energy management and general automation, their broad design often overlooks specific practical issues, such as protecting clothes from sudden rainfall.

Dedicated Rain Sensor Systems:

Rain sensors have been widely studied and proven reliable for automated decision-making in various applications. Abdullah et *al*. demonstrated the effective use of rain sensors in the automotive sector, where rainfall detection is used to automatically activate windshield wipers. These studies confirm the accuracy and reliability of rain sensors; however, their applications are mostly limited to vehicular or industrial domains rather than household automation.

Basic Automated Clothes Collecting Systems:

Some researchers have specifically addressed the problem of protecting laundry during rainfall. Gorakhe proposed an automated clothes protection system using an Arduino microcontroller and a rain sensor to activate a servo motor that covers clothes with a protective sheet when rain is detected. Although functional, such systems are mechanically simple, often lack full retraction mechanisms, and do not provide real-time user notifications, limiting their practical usability.

Gap in Existing Works

From the review of existing literature, it is evident that while general IoT platforms provide powerful automation capabilities, they often fail to address niche household problems. Dedicated rain sensor applications validate sensor reliability but are rarely adapted for domestic use.

Moreover, most automated clothes collecting systems lack advanced mechanical control and communication features, leaving users unaware of the system's operational status.

Our Contribution:

The proposed system addresses the limitations of previous works by combining reliable rain detection with a complete automated clothes collection mechanism. Unlike existing solutions that rely on simple covering methods or lack user feedback, the proposed system employs a motor-driven retraction mechanism to move clothes into a sheltered area and integrates a communication module to provide real-time alerts to the user. This results in a robust, user-friendly, and practical solution suitable for smart home environments.

PROBLEM FORMULATION

Drying clothes in outdoor areas is a common household practice, but sudden and unpredictable rainfall often leads to clothes getting wet, causing inconvenience, repeated washing, and wastage of time and resources. Existing methods depend on manual supervision or basic alarm systems, which are inefficient and unreliable, especially when users are away or busy. Hence, there is a need for an automated system that can detect rainfall in real time, protect clothes without human intervention, and notify the user about the action taken.

PROBLEM DEFINITION

Traditional clothes-drying methods rely on manual monitoring and lack automation, making them ineffective during unexpected rainfall. These approaches fail to provide timely protection and require constant user involvement. The problem is to design a smart, automated, and cost-effective system that detects rain, automatically moves clothes into a sheltered area, and informs the user through remote alerts, thereby reducing human effort and improving reliability.

OBJECTIVE OF PROJECT

- To design and develop an IoT-Based automated system for detecting rainfall and protecting clothes dried in outdoor environments.
- To automatically control a motorized clothes collecting mechanism using a rain sensor, reducing the need for manual monitoring.
- To ensure timely retraction of clothes into a sheltered area during unexpected rainfall, preventing damage and repeated washing.
- To provide real-time user alerts through email notifications regarding the status of clothes movement.

• To minimize human intervention, save time and effort, and improve convenience using a low-cost and reliable smart home solution.

SCOPE OF PROJECT

The scope of this project is to develop an IoT-based system that automatically detects rainfall and protects clothes dried outdoors. The system uses a rain sensor to trigger a motorized clothes collecting mechanism and sends email alerts to notify the user about the clothes' status. It is designed as a low-cost, reliable solution for household applications and can be extended with advanced features in the future.

DRAWBACKS OF THE EXISTING SYSTEM

- Relies heavily on **manual monitoring**, making it inefficient and time-consuming.
- Fails to respond to **sudden and unexpected rainfall** promptly..
- Basic alarm-based solutions **do not provide physical protection** to clothes.
- Lack of **automation** increases user dependency and inconvenience.
- No **remote alert or notification mechanism**, leaving users unaware of cloth status.
- Results in **repeated washing, fabric damage, and wastage of water and energy**.

PROPOSED SYSTEM

The proposed **Rain Detection-Based Automatic Clothes Collector System** aims to provide an efficient and automated solution to protect clothes from unexpected rainfall. The system integrates a rain sensor, microcontroller, motor driver, and a motorized pulley mechanism to automatically retract clothes into a sheltered area when rain is detected. Upon sensing rainfall, the controller activates the motor to pull the clothesline inside, preventing clothes from getting wet. Additionally, a notification mechanism (Email-based alert) informs the user about the system status, ensuring awareness even when the user is away. This system eliminates manual monitoring, reduces effort, and offers a reliable and cost-effective solution for household laundry protection.

Key Features of the Proposed System

1. **Rain Sensor-Based Detection**

   A moisture-sensitive rain sensor continuously monitors environmental conditions and accurately detects rainfall.

2. **Automatic Clothes Retraction Mechanism**

   The motorized pulley system automatically pulls the clothesline into a sheltered area upon rain detection.

3. **User Notification System**

   Alerts are sent to the user via SMS or email when clothes are moved inside or pushed back outside.

4. **Limit Switch Controlled Operation**

   Limit switches ensure precise stopping positions, preventing over-rotation and mechanical damage.

5. **Real-Time Response**

   The system reacts instantly to sudden rainfall, ensuring continuous protection of clothes.

6. **Cost-Effective and Scalable Design**

   Uses low-cost components, making it suitable for homes, apartments, hostels, and small residential areas.

7. **User-Friendly and Low Maintenance**

   Requires minimal human intervention and maintenance, making it convenient for daily use.

SYSTEM DESIGN

The proposed system is designed to automatically protect clothes dried outdoors by detecting rainfall and retracting them into a sheltered area. The design integrates a rain sensor, ESP8266 microcontroller, motor driver, and a motorized pulley mechanism along with Wi-Fi connectivity to provide a reliable, cost-effective, and scalable household solution.

Key Components:

- **Rain Sensor Module:** Detects the presence of rainfall and provides a digital signal to trigger the system.
- **ESP8266 Microcontroller:** Acts as the central control unit, processing sensor inputs and controlling motor operations while enabling internet connectivity.
- **Motor Driver (L298N):** Interfaces between the microcontroller and DC motor, allowing safe and controlled motor movement.
- **DC Motor with Pulley Mechanism:** Physically retracts or extends the clothesline based on rain conditions.
- **Wi-Fi & Email Notification Module:** Uses internet connectivity to send real - time email alerts to notify the user about clothes status.

Architecture:

- **Rain Monitoring:** The rain sensor continuously monitors environmental moisture conditions.
- **Rain Detection:** When rainfall is detected, the sensor sends a signal to the microcontroller.
- **Clothes Retraction:** The microcontroller activates the motor via the motor driver to pull clothes into a sheltered area.
- **User Notification:** An automatic email alert is sent to inform the user that clothes are safely collected.
- **Reverse Operation:** Once rain stops, the system pushes the clothes back outside for drying.

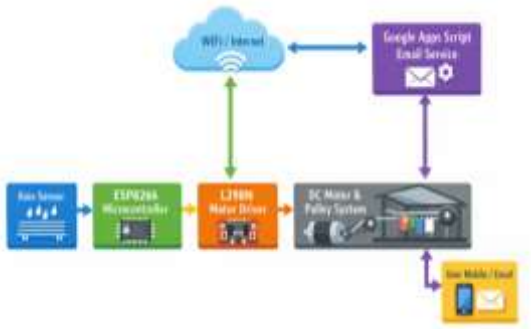

FIG 1:ARCHITECTURE DIAGRAM

WORKFLOW

1. The rain sensor continuously monitors rainfall conditions.
2. When rain is detected, the microcontroller activates the motor to retract the clothesline.
3. Clothes are moved into a sheltered area automatically.
4. An email alert is sent to notify the user about the clothes status.

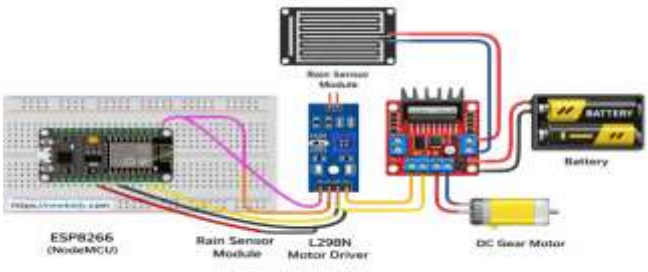

FIG 2: CIRCUIT DIAGRAM

METHODOLOGY

The Rain Detection-Based Automatic Clothes Collector System follows a systematic methodology to ensure reliable design, implementation, and operation. Traditional outdoor clothes drying methods depend on manual monitoring and are ineffective during sudden rainfall. The primary objective of this system is to automate rain detection, protect clothes from getting wet, and provide timely user notifications with minimal human intervention.

The system uses **a rain sensor, a Wi-Fi-enabled microcontroller, a motor driver, and a motorized**

pulley mechanism to perform automatic clothes retraction. The rain sensor continuously monitors environmental moisture conditions and sends real-time data to the ESP8266 microcontroller. The controller processes this input and determines the appropriate action based on rain detection.

During implementation, the hardware components are interfaced such that the rain sensor input controls the motor operation through the L298N motor driver. When rainfall is detected, the controller activates the DC motor to pull the clothesline into a sheltered area. Once the rain stops, the system can reverse the motor direction to extend the clothesline back outside for drying. A state variable is maintained to avoid unnecessary repeated motor operations.

For user notification, the system uses Wi-Fi connectivity to communicate with a cloud-based email service implemented using Google Apps Script. Upon successful clothes retraction or extension, an automatic email alert is sent to the user, informing them about the current status of the clothes.

Testing is carried out by simulating rainfall conditions to verify sensor accuracy, motor response, and the correct execution of control logic. The email notification mechanism is also tested to ensure the timely delivery of alerts. User testing helps validate system reliability, responsiveness, and ease of use.

Finally, the system is optimized based on testing results to improve efficiency and robustness. This methodology ensures an automated, cost-effective, and user-friendly solution for protecting clothes from unexpected rainfall.

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RESULT

The Rain Detection-Based Automatic Clothes Collector System was successfully designed, implemented, and tested, achieving its objective of protecting clothes from unexpected rainfall through automation. The system effectively combined rain-sensing technology, motorized control, and cloud-based notification to deliver a reliable and user-friendly solution.

The rain sensor accurately detected moisture in real time and triggered the system response without manual intervention. Upon detection of rainfall, the microcontroller immediately activated the motorized pulley mechanism, retracting the clothesline into the sheltered area. This rapid response prevented clothes from getting wet and eliminated the need for constant user monitoring.

The motor control mechanism operated smoothly in both retraction and extension modes. Tests conducted under different weather conditions confirmed reliable motor performance and proper directional control. The state-tracking logic ensured that the motor was not repeatedly activated during continuous rain, thereby reducing unnecessary power consumption and mechanical wear.

Email notifications were successfully delivered to the user after each operation. Alerts confirming that clothes were safely moved inside during rain and extended outside after rainfall provided clear system feedback. The integration of Google Apps Script proved to be effective for real-time notification without requiring paid services.

The system was tested under multiple scenarios, including sudden rainfall, prolonged rain, and rain cessation. In all cases, the system responded correctly by retracting or extending the clothesline as required. No false triggers were observed during dry conditions.

User testing highlighted reduced manual effort, improved convenience, and reliable protection of clothes as major advantages. The system demonstrated scalability and can be easily adapted for homes, apartments, hostels, and residential complexes with minimal modifications.

Overall, the experimental results confirm that the proposed system is efficient, cost-effective, and suitable for real-world deployment.

FIG 3: FINAL OUTPUT

CONCLUSION

The IoT-Based Rain Detection and Automated Clothes Collecting System successfully demonstrates an intelligent and practical solution for protecting clothes from unexpected rainfall. The system integrates a rain sensor, an ESP8266 microcontroller, a motor driver, and a motorized pulley mechanism to automate the clothes retraction process with minimal human intervention.

The experimental results confirm that the system accurately detects rainfall in real time and responds promptly by retracting the clothesline into a sheltered area. The integration of WiFi connectivity and Google Apps Script for email notifications enhances user awareness and reliability, even when the user is away from home.

Compared to traditional manual monitoring methods and basic alarm-based systems, the proposed solution provides complete automation, improved efficiency, and enhanced convenience. The system is low-cost, energy-efficient, scalable, and suitable for smart home applications.

Thus, the proposed system offers a reliable, cost-effective, and user-friendly solution for household laundry protection and contributes to the advancement of IoT-based smart home automation technologies.

FUTURE SCOPE

- Integration of a mobile application for real-time monitoring and alerts.
- Cloud connectivity for remote control, data storage, and system analysis.
- Use of weather forecasting APIs to predict rainfall in advance.
- Addition of sensors such as humidity, temperature, and wind for improved accuracy.
- Adoption of solar power to enhance energy efficiency
- Expansion to support multiple clotheslines in apartments and hostels.
- Integration with smart home and IoT platforms for centralized control.

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