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Automatic Rain Sensing Windows

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ABSTRACT

The aim is to create an automatic rain-sensing window that closes when it rains. The concept of sensing rainwater to run a DC motor can be widely seen in the automobile industry. Wipers that start automatically after detecting rain are quite common in vehicles. However, not much research has been done regarding using this system for domestic use. By putting forward this idea we hope to incorporate these windows effectively in both homes and commercial buildings. Rain sensors, microcontrollers, DC motors, and Dual H-Bridge motor drivers are some of the components used in our work. The objective is to ensure that the technology behind these windows is reliable and increase the accuracy, accessibility, and dependability of the product by addressing any potential limitations or challenges that may arise.

Keywords — *Automatic Rain Sensing Window, DC Motor, Microcontroller, Motor Driver, Rain Sensor, Smart Home*

I. INTRODUCTION

In recent years, there has been a significant advancement in the field of technology and innovation. Our project, Automatic rain sensing window, is also a part of this revolution in automation and smart home technologies. Rain sensors, microcontrollers, motor drivers, DC motors, etc. are components used in this research work to react to the changes in the environment and open/close the windows according to the change detected.

[1] Dr. Mohan Kumar, "Development of Automatic Rain Sensing Window", International Journal of Engineering Research and Technology (IJERT), May-2023

Previous research done on this project has successfully offered an efficient system with the aid of cutting-edge ICs and evolving technology. The limitation found in their research work is the difficulty in installation and maintenance of the automatic rain-sensing window. It is found to be expensive and time-consuming.

[2] Gujar Vilas Dharma, Khairnar Yogesh Supadu, Aher Nitin Shantaram," Automatic Rain Sensing Window", International Journal of Research Publication and Reviews, May-2023

This research work has the limitation of stroke of the lead screw and design of the cap.

[3] Mukhtar Ibrahim Bello, "Components utilized in the Rain Detector Device's implementation", Global Journal of Research in Engineering and Computer Sciences, August-2023

This paper addressed the sensor sensitivity issues and suggested changing the PCB rain sensor to an internal refracting type sensor used in vehicles as the sensitivity of these sensors is high.

[4] Ms. P. DEVI, "Automatic Rain Sensing Wipers Using Arduino", International Research Journal of Engineering and Technology (IRJET), January-2022

In this research paper, an automatic wiper system was designed to detect rain and wipe the windows by moving the wiper. The key problem identified in the research paper was the accuracy and dependability of rain sensors, which might differ based on the type of ambient circumstances.

We addressed the limitations of prior research on this topic in our work. Other research works have utilized similar components but encountered issues with installation, maintenance, circuit overheating, high cost, and sensor sensitivity issues leading to false detection.

We have resolved the issues that were mentioned earlier, and our product is now functioning successfully. The issue of installation difficulty was solved by organizing the components in a neat and compact manner. We eliminated sensor sensitivity issues by using the FC-37 Rain sensor which allows us to set a threshold value. This way, the DC motor does not react to small water droplets that can also form due to humidity, and the window will only close in case of rain, eliminating false detection issues.

II. METHODOLOGY

We used the FC-37 rain sensor module and LM393 comparator IC module. The FC-37 rain sensor is a highly sensitive PCB Board with parallel conducting nickel strips. It can detect the smallest drop of water and react as quickly as possible which is very useful to reduce water damage to a minimum.

When water falls on the PCB Board, the circuit gets completed and signals are sent to the microcontroller. We used Arduino UNO microcontroller which is based on ATmega328P. The microcontroller collects information through the rain sensor and sends commands to the motor driver based on the output of the rain sensor. The L298N dual H-bridge Motor driver is used to rotate the motor shaft as per requirement depending on the signals from the microcontroller.

Our program is easy to understand. We used Arduino IDE 1.8.18 to write and execute our program. Proper logic is used to trigger the window to close when the rain sensor detects rain. The FC-37 rain sensor allows us to set a threshold value. When the resistance falls below this threshold due to the presence of moisture, the sensor triggers an output signal, indicating that it's raining.

Major components are:

A. Rain sensor

Rain Drop Sensor

The rain sensor consists of an FC-37 PCB Board and an LM393 Comparator IC Module. The PCB Board has parallel conducting nickel strips that detect the presence of water on the board, also known as the collector board. The resistance of the board changes according to the amount of water present on its surface. When the board is dry, the resistance is high and the conductivity of the board is low. When a water droplet falls on the board, the resistivity decreases resulting in increases in conductivity. The water droplets act as a conductor and complete the circuit. The criteria for selecting the FC-37 PCB board and LM393 comparator IC module for automatic rain-sensing windows involved considering various factors such as reliability, sensitivity, cost-effectiveness, and ease of integration.

The range of operating voltage of the LM393 comparator IC module is 3.3V to 5V. The sensitivity of the module can be adjusted with the help of the trim pot present in the module. The IC module has dual output modes, i.e. it provides both analog and digital output. The red LED present in the IC module is a power indicator while the green LED is a digital switching output indicator.

B. Arduino UNO Microcontroller

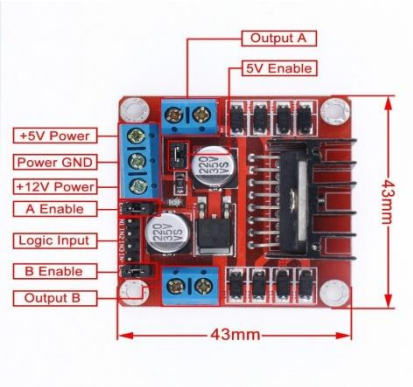
The Arduino UNO microcontroller is built around the ATmega328P microchip, which acts as the brain of Arduino. It executes the instructions of your program and interacts with attached components. The microcontroller has an operating voltage of 5V. The limit of input voltage ranges from 6V to 20V but the recommended range of input voltage is 7-12V. The board features a set of digital input/output pins and analog input pins. There is a total of 6 analog input pins and 14 digital I/O pins, out of which 6 provide PWM output.

ATmega328P:

The ATmega328P is a microchip commonly used in Arduino development boards. It is a high-performance, low-power 8-bit AVR (Advanced Virtual RISC) microcontroller developed by Microchip Technology.

1. Memory: It has 32KB of flash memory for storing the program, 1KB of EEPROM for data storage, and 2KB of SRAM for runtime data.
2. Clock Speed: It operates at a lock speed of 16 MHz. The ATmega328P strikes a balance between performance and power efficiency.

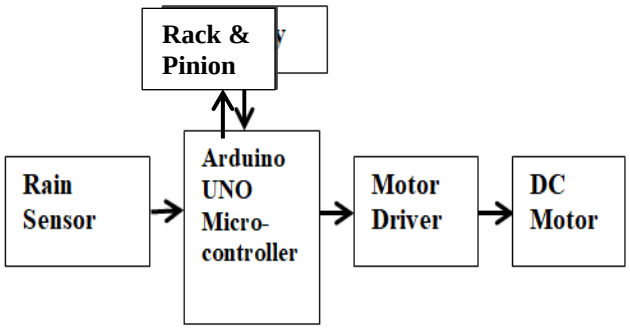
C. L298N Dual H-Bridge Motor Driver



LN298 is a motor driver widely used to control the rotation and speed of DC motors. It has several pins on its separate board like Enable, Input voltage, Input pins, Output pins, Logic input pins, and Ground. This board has the capacity to handle two different motors at a Single time. The Enable Pin (ENA) kicks things off, activating the motor driver, and the Input Voltage Pin is where we hook up the motor's power supply. Ground Pins (GND) are the common ground, and Motor Output Pins (Out 1, Out 2) connect to our DC motor for directional control. Logic Input Pins (IN1, IN2) are used to control the motor direction and speed. If we're into H-bridge action, set ENA high, play with IN1 and IN2, and let Out 1 and Out 2 connect with the motor.

D. 5V DC Brush Motor

Figure 1 Block Diagram of the system



Here a 9V Battery is connected to the Arduino UNO Microcontroller as an external power supply. The Rain Sensor is connected to the microcontroller with the help of jumper wires. This allows the rain sensor to send analog signals to the microcontroller. The microcontroller converts these analog signals to digital values with the help of ADC (Analog-to-Digital Converter) present in Arduino UNO. This information is then sent to the L298N Motor driver which further commands the DC motor to rotate in case of rain. The rotation of the DC motor causes the lead screw to rotate. As the lead screw rotates, it engages with the window mechanism, closing the window.

Table 1 Components used

Name	**Characteristics**
Microcontroller	Arduino UNO, ATmega328P, 8-bit RAM
H-Bridge motor driver	L298N, Dual H-Bridge
DC Motor	5V, 10rpm
Rain Sensor	FC-37 PCB Board, LM393 Comparator IC Module

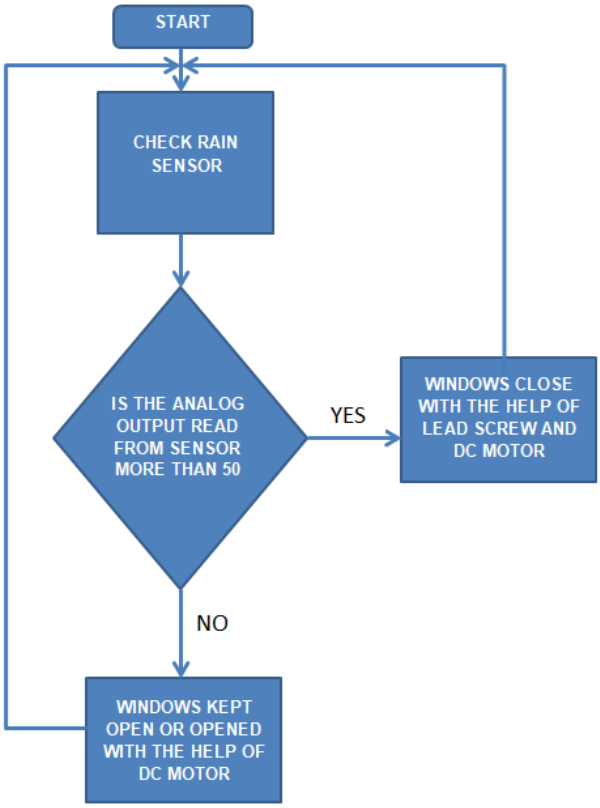
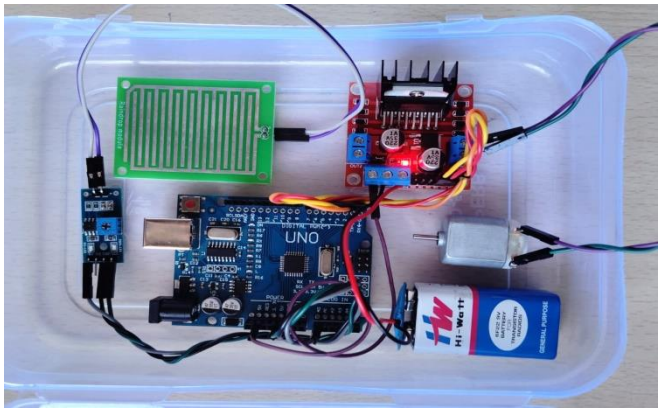


Figure 2: Flowchart of the system

Working Model



III. RESULTS AND DISCUSSIONS

In this project, we implemented an innovative automated rain-sensing window. This window system utilizes the FC-37 Rain sensor, which allows for precise rain detection by adjusting the threshold based on atmospheric conditions. This ensures accurate and reliable rain detection, eliminating false alarms.

Through rigorous testing, we have ensured the system's efficiency and accuracy. The response time of the window system aligns perfectly with our goal of providing safety and protection to the interior of the house during rainfall, ensuring the utmost convenience for users.

Furthermore, we value practical user experience and continuously strive for improvement. Active user feedback will help to enhance the system's efficiency and reliability, resulting in a more user-friendly design. We believe that incorporating user reviews will contribute to the overall enhancement of the system and address various environmental conditions that users may encounter.

Moreover, we understand the importance of energy efficiency. Our automated rain-sensing window system is designed to minimize energy consumption while providing optimal performance.

IV. FUTURE SCOPE

With the advent of technology, the future of automatic rain-sensing windows looks promising. It has the potential to revolutionize the way we interact with the environment in our homes, workplaces, and other areas.

In addition to detecting rainfall, automatic rain-sensing windows can be further developed to incorporate a range of features that enhance security and convenience. For instance, an intruder alert system can be integrated into the rain-sensing windows to track unwanted activities by intruders or animal break-ins, thereby making your home more secure.

Moreover, user experience is paramount when it comes to developing and evaluating automatic rain-sensing windows. The system's convenience, accuracy, and safety should be tested in a range of weather conditions to ensure dependability and effectiveness. This will help to ensure that the system can be relied upon to provide optimal performance under any circumstances.

V. CONCLUSION

The Automatic rain-sensing window is a technology that ensures your windows close automatically when it starts to rain. This innovative system is equipped with a rain sensor that detects the presence of raindrops. Once rain is detected, the rain sensor immediately sends signals to the Arduino UNO microcontroller, which acts as the brain of the system. The microcontroller processes the information received from the rain sensor and sends precise commands to the L298N motor driver.

The L298N motor driver plays a crucial role in controlling the DC motor that is responsible for the window's movement. By receiving commands from the microcontroller, the motor driver activates the DC motor, causing the lead screw to rotate. As the lead screw rotates, it engages with the window mechanism, smoothly and securely closing the window. This automated process ensures that you and your home stay protected from rain, without the need for manual intervention.

Looking ahead, it is clear that automatic rain-sensing windows have the potential to make a significant impact on society. These innovative windows are equipped with advanced sensors that detect raindrops and automatically activate the window's self-closing mechanism, keeping the interior of buildings dry and protected from the elements.

Moreover, the improved user experience offered by automatic rain-sensing windows enhances the comfort and safety of building occupants. By embracing this innovative technology, we can pave the way for a more efficient and sustainable future, where buildings are smarter, more responsive, and better equipped to adapt to changing weather patterns. Automatic rain-sensing windows are not just a window to the world, but a glimpse into the future of architecture and design.

VI. ACKNOWLEDGMENT

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Lastly, we extend my appreciation to all the individuals who directly or indirectly contributed to the completion of this project. Your collective efforts have made this project a reality, and we are grateful for the collaborative spirit that made it possible.

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