ISSN (ONLINE): 2456-5717
ISSN (PRINT): 2456-5717

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol. 12, Issue 10, October 2026

Automatic Rain Sensing Wiping System

Palniladevi Paulpandian*[1], Abarna Palanisamy[2], Rithani Sri Senthilkumar[3]

Assistant Professor (Senior Grade), Department of Electronics and Communication Engineering, Mepco Schlenk Engineering College, Sivakasi - 626005 [1]

BE student, Department of Electronics and Communication Engineering, Mepco Schlenk Engineering College, Sivakasi - 626005 [2]

BE student, Department of Electronics and Communication Engineering, Mepco Schlenk Engineering College, Sivakasi - 626005 [3]

***Abstract*— The objective of this project is to design an affordable and self-actuating system that enhances driver safety and convenience by automating the windshield wiping process. The design eliminates the need for a costly microcontroller by using a rain sensor to control the frequency of a 555 Timer IC. A Decade Counter IC manages these signals to provide structured wiper intervals, and a motor driver powers the DC motor. This approach offers a simple, cost-effective, and reliable solution for hands-free windshield wiping.**

***Index Terms*—Rain Sensor, 555 Timer IC, CD4017 Decade Counter, L293D Motor Driver.**

I. Introduction

A. Project Overview

The primary objective of this research is to automate the windshield wiping process in automobiles. Traditionally, drivers must manually toggle wiper switches and adjust speeds as rain intensity fluctuates. This manual intervention can lead to momentary distractions, which are critical at high speeds or in heavy traffic. Our system utilizes a resistive rain sensor to detect moisture and initiate a wiping cycle without human input. By using a 555 Timer IC in conjunction with a CD4017 Decade Counter, the system creates a hardware-based timing loop that simulates the "intermittent" mode found in modern cars, but with the added benefit of self-activation. Automotive safety systems have evolved significantly, moving from manual controls to sophisticated automated modules. Early research is [1] Design and Integration of Lane Departure Warning, Adaptive Headlight and Wiper system (G. Vijay, et al., IEEE Xplore 2019) Proposes an integrated module using Raspberry Pi and Arduino for real-time safety automation. It needs high computational power requirements and cost for mass-market vehicles. [2] Real Time Rain Sensing and Wind Shield Wiper Control System (S. Kumar, et al., ResearchGate 2020) Integrates rain sensors with cloud connectivity for geotagging. But it dependence on internet connectivity for basic safety functions. [3] Vision-Based Raindrop Detection and Wiper Control (H. Kurihata, et al., IEEE Transactions on Intelligent Transportation Systems 2020) Uses a deep-learning approach to recognize raindrop patterns via a camera to automate wiper speed. High computational cost; the processing delay of the image frame prevents the "instant-on" response required for sudden splashes from oncoming vehicles. [4] Design and Implementation of Automatic Sensing Car Wiper (J. Kaur, et al., Journal of Adv. Research 2020) Uses basic rain sensors to trigger a motor through a simple continuity tester. It Lacks multi-stage speed control (like CD4017 Decade Counter). [5] A Robust Rainfall Detection System Using Capacitive Sensing (M. S. Grewal, et al., IEEE Sensors Journal 2021) Proposes a capacitive sensor array that detects the change in dielectric constant on the windshield to trigger wipers. Susceptible to electromagnetic interference (EMI) from the vehicle's ignition system, which can cause phantom wipes or system lock-up. [6] Adaptive Windshield Wiper System Based on Intelligent Algorithm (K. V. Viswanadh, IJERT 2021) Focuses on pulse-width modulation (PWM) for motor longevity. It is Purely algorithmic approach with no hardware-level fail-safes. [7] Fuzzy Logic Based Speed Control for Windshield Wipers (A. K. Singh, et al., Elsevier/IEEE-Indexed Journal of King Saud University 2022) Uses a fuzzy inference system (FIS) to determine the optimal wiper frequency based on moisture levels. Software-heavy implementation; the Arduino-based controller can suffer from "code bloating," increasing the time between rain detection and motor actuation. [8] Automatic Rain Sensing Car Wiper Design using LDR and Opto-Sensors (Adarsh, et al., Taru Publication 2023) Uses Arduino and LDRs to automate wipers and lights based on visibility. But Arduino's analog-to-digital conversion. [9] Smart Wiper System Using Edge Computing and IoT (L. T. Nguyen, et al., IEEE Internet of Things Journal 2023) Integrates local sensors with edge processing to predict rainfall intensity and share data with other vehicles. Extreme integration complexity; the reliance on a stable OS kernel means any system update or software crash renders the safety equipment non-functional. It is slow in sudden heavy rainfall. [10] Automatic Rain Sensing Wiper Circuit using 555 Timer IC and L293D Driver (M. Bilawal, et al., IJTRS 2024) Uses NE555 for timing and L293D for driving the wiper motor. It Lacks the multi-speed logic provided by a Decade Counter (CD4017). [11] Energy-Efficient Automated Wiper Control via PWM (R. M. Deshmukh, et al., IEEE Access 2024) Focuses on reducing power consumption by using a Microcontroller-generated Pulse Width Modulation (PWM) signal to drive the motor. Unlike the CD4017 Decade Counter, this system lacks a physical hardware-step fail-safe, meaning a single bit-flip in the MCU memory can cause the motor to stall. [12] Development of an Automatic Rainfall Detection System (S. Mondal, et al., IEEE ICSCNA 2024) IoT-based rainfall sensing using multiple sensor fusion. Sensor data conflicts often lead to erratic wiper movements. [13] Machine learning based automatic windshield wiper (D. Dash, et al., AIP/IEEE indexed 2025) Uses neural networks to predict wiper speed. Extreme

ISSN (ONLINE): 2456-5717
ISSN (PRINT): 2456-5717

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol. 12, Issue 10, October 2026

computational latency; it takes longer to process the rain than for the hardware to react. Computational Latency; the time taken for the neural network to "predict" exceeds the time a simple 555 Timer takes to trigger, causing a dangerous delay during sudden heavy downpours. [14] Deep Learning-Based Predictive Windshield Wiper Control (D. Dash, et al., IEEE Transactions on Neural Networks and Learning Systems 2025) Uses a Recurrent Neural Network (RNN) to predict rain intensity based on past 10-second intervals to proactively set wiper speed. [15] Adaptive PWM Control for Wiper Motor Longevity (K. V. Viswanadh, et al., Journal of Electrical Engineering & Technology 2025) Uses a complex algorithmic PWM approach to minimize mechanical wear on the wiper motor brushes. High Integration Cost; the specialized micro-controllers needed for this "intelligent" PWM drive the unit cost per vehicle significantly higher than a standard IC-based Motor Driver solution. This research using the 555 Timer IC, CD4017 Decade Counter, and L293D Motor Driver eliminates the primary drawback found in all the above papers: Computational Latency and Software Instability. While modern research Dash et al. (2025) struggles with "processing lag," this hardware-logic design provides an instantaneous, fail-safe response at a fraction of the cost, making it the most robust solution for automotive safety.

B. *Problem Statement*

Standard manual wiper systems present three distinct challenges:

- Driver Distraction: Constant adjustment of wiper stalks takes the driver's eyes and focus off the road.
- Response Lag: There is a human delay between the onset of a sudden downpour and the manual activation of wipers, which can lead to temporary blindness.
- Energy Inefficiency: Wipers often remain active even after rain has ceased, leading to unnecessary wear on the motor and wiper blades, as well as energy waste.

C. *Motivation and Advantages*

The motivation behind this specific design is accessibility. High-end optical sensor systems are often proprietary and expensive. By utilizing readily available ICs like the 555 and 4017, this safety feature can be retrofitted into economic car models. Key advantages include: Cost-Effectiveness: Uses inexpensive analog components instead of expensive microcontrollers. Reliability: Hardware-based logic is less prone to software crashes or sensor lag. Safety: Automatically adjusts to rainfall, allowing the driver to maintain full concentration on vehicle control.

II. THEORETICAL FRAMEWORK AND COMPONENTS

A. *Resistive Rain Sensing Principle*

The sensor plate consists of two sets of copper tracks. Dry State: The air gap between tracks acts as an insulator, resulting in mega-ohm range resistance. The circuit interprets this as logic "LOW". Wet State: Rainwater, which contains trace minerals and ions, acts as a conductor. When a drop bridges the tracks, the resistance drops significantly (kilo-ohm range). This drop triggers a transistor to switch the system from standby to active mode.

B. *IC 555 Timer: The Pulse Generator*

The 555 IC is the "heartbeat" of the system, configured in Astable Multivibrator mode. It generates a continuous square wave signal. The frequency of these pulses controlled by the RC network (resistors and capacitors) dictates the timing of the wiping intervals. A variable resistor is included to allow for manual calibration of the base pulse rate.

C. *IC CD4017: Sequential Logic and Speed Control*

The CD4017 is a 5-stage Johnson decade counter. It receives pulses from the 555 Timer at Pin 14. Sequencing: For every incoming pulse, the HIGH state shifts from Q0 through Q9. Wiping Logic: By tapping specific output pins, we can control when the motor fires. Intensity Feedback: Heavier rain results in a lower resistance at the sensor, which provides a higher control voltage. This voltage can be used to reset the counter earlier (at Q2 for light rain and Q7 for heavy rain), thereby changing the frequency of the wipes.

D. *IC L293D: The Actuator Interface*

Since the logic ICs cannot provide enough current to drive a DC motor, the L293D Motor Driver acts as a current amplifier. It uses an internal H-Bridge configuration to allow the motor to rotate in both directions (forward and reverse), which is essential for the back-and-forth motion of a wiper blade. The list of components are listed below

- NE555 IC, 4017 IC, L293D IC
- Variable Resistor
- Capacitor 100uF
- DC Motor
- Rain Sensor Plate
- 9V Battery

ISSN (ONLINE): 2456-5717
ISSN (PRINT): 2456-5717

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol. 12, Issue 10, October 2026

- ON/OFF switch
- PCB 2*3 inch

Figure 2.1 Automatic Rain Sensing Wiping System Block diagram

From Figure 2.1, the system initiates with a 9V Battery as the primary power source, controlled by a manual Switch to activate the circuit. When water droplets fall on the Rain Sensing Plate, it triggers the 555 Timer IC, which generates a series of clock pulses. These pulses are sent to the 4017 IC (Decade Counter), which counts the signals and provides a sequential output to the L293D IC (Motor Driver). The motor driver then translates these logic signals into high-current power to drive the DC Motor, resulting in the precise, timed Wiper Movement across the windshield. Furthermore, the use of the Decade Counter allows for adjustable wiper speeds and intervals by varying the clock pulse frequency. Finally, the L293D IC provides the necessary H-bridge circuit to enable bidirectional rotation, ensuring the wiper blade can return to its original position effectively.

III. Methodology and Circuit Design

A. Circuit Integration

The circuit is divided into four stages:
1) Sensing Stage: Detects water and powers the system via a transistor switch.
2) Timing Stage: The 555 Timer generates stable clock.
3) Sequential Stage: The 4017 counter processes the clock to determine the "wipe" and "wait" intervals.
4) Driver Stage: The L293D provides the 9V-12V current necessary to move the physical wiper motor.

B. Working Principle

Rain Sensor: The sensor resistance changes based on the amount of water. Light Rain: High resistance. Heavy Rain: Low resistance. Voltage Divider/Transistor Control: The sensor is part of a voltage divider network. The output voltage from this network is proportional to the rain intensity. This variable voltage is fed to the control pins of the system, often through a transistor that acts as a switch to activate the circuit. Control Output to Counter: The variable voltage is connected to a circuit that selects a specific output pin (Qn) of the Decade Counter (CD4017) to connect to the Reset pin. This selection is the crucial step for variable speed: The lower the resistance (heavier rain), the higher the control voltage, which is configured to select a later output pin (Q7). The higher the resistance (lighter rain), the lower the control voltage, which is configured to select an earlier output pin (Q2). 555 Timer IC (Astable Mode): The 555 Timer generates a continuous, fixed-frequency stream of clock pulses (one pulse every two seconds). This acts as the steady "beat" of the system. Decade Counter IC (CD4017): The counter receives these clock pulses. For every pulse, it advances its output, sequentially setting Q0 HIGH, then Q1 HIGH, Q2 HIGH, and so on. When the counter reaches the output pin (Qn) selected by the rain sensor's control logic, that pin going HIGH triggers the motor activation and the counter's RESET pin. Heavy Rain (Reset on Q7): The wiper activates after 7 clock pulses, resulting in a short pause between wipes (fast intermittent speed). Light Rain (Reset on Q2): The wiper activates after only 2 clock pulses, resulting in a long pause between wipes (slow intermittent speed). Motor Trigger: The brief pulse generated by the controlled reset of the Decade Counter is the signal to run the motor. Motor Driver IC (L293D): This IC receives the low-power trigger signal and acts as a current amplifier (H-bridge). Wiper Sweep: The Motor Driver supplies the high current necessary to run the Wiper Motor for a short duration, causing it to complete one sweep across the windshield. The motor then turns OFF as the counter instantly restarts the count sequence, automatically.

ISSN (ONLINE): 2456-5717
ISSN (PRINT): 2456-5717

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol. 12, Issue 10, October 2026

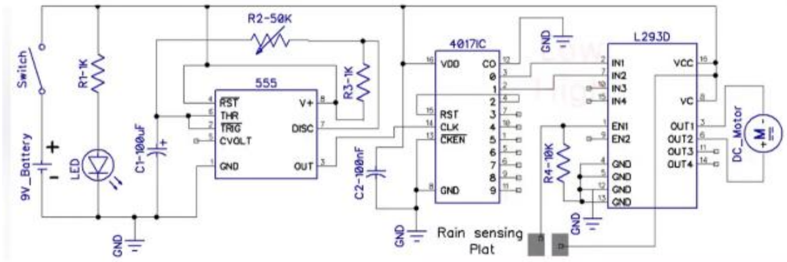

Figure 3.1 Automatic Rain Sensing Wiping System Circuit diagram

From Figure 3.1, the circuit illustrates the detailed electrical implementation of the automatic rain-sensing wiper system, beginning with a 9V Battery connected to a power-indicating LED and a manual Switch. A 555 Timer IC is configured with an external R1-50K potentiometer and R3-10K resistor to define its oscillation frequency. When the Rain Sensing Plate detects moisture, its varying resistance triggers the 555 timer to send a clock signal to the CLK pin of the 4017 IC (Decade Counter). The decade counter then cycles through its outputs to provide structured logic signals to the L293D Motor Driver IC. This configuration ensures that the motor can rotate in both directions to simulate a full wiper stroke, with capacitors like C1-100uF and C2-100uF gives necessary voltage stabilization and timing filtering throughout the process.

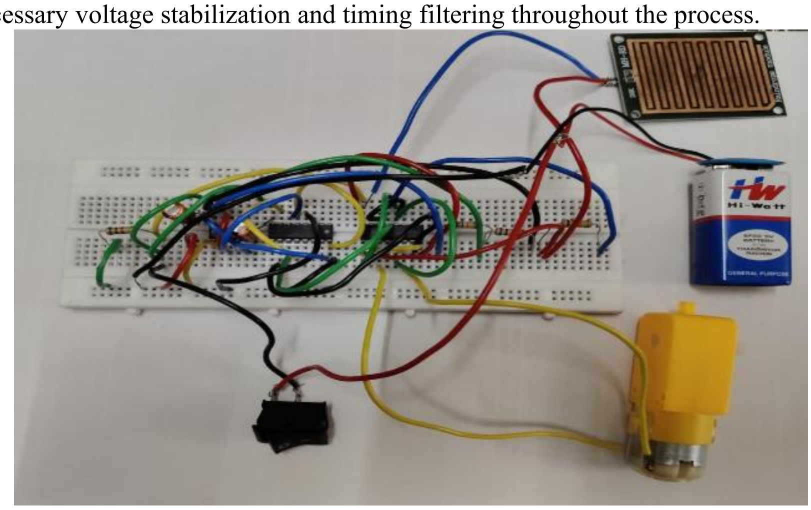

Figure 4.1 Bread board layout

Figure 4.1 illustrates the complete breadboard layout for wiping system. It is organized by placing the three primary integrated circuits (ICs) along the central divider for easy pin access. The NE555 Timer IC is typically placed first to generate the necessary clock pulses, with its output from pin 3 connected via a jumper wire to the clock input of the CD4017 Decade Counter. The decade counter is positioned in the middle, and its sequential output pins are wired to the input pins of the L293D Motor Driver IC, which is placed near the edge to facilitate direct connection to the DC Motor. The Rain Sensing Plate is connected to the breadboard through long external wires, allowing it to be positioned where it can detect moisture while the main circuit remains protected. Power is distributed through the breadboard's longitudinal rails, with a 9V battery supplying the positive and negative rails used by all ICs. Passive components, such as the R1-50K potentiometer and C1-100uF capacitor, are inserted in the rows corresponding to the 555 timer's timing pins to set the wiper's oscillation frequency.

C. Applications

Public Transportation: Essential for buses and trains to reduce driver fatigue and maintain high safety standards during long commutes in changing weather.

Aviation: Used in aircraft to clear moisture and debris from the pilot's windshield, ensuring optimal visibility during critical flight phases like take off and landing.

Maritime Vessels: Keeping boat and ship windshields clear of sea spray and rain to prevent "vision loss" during navigation.

Agricultural Machinery: Automates wiping on tractors and harvesters without manual distractions.

TABLE 3.1 COMPARISON AMONG EXISTING WORK

Reference	Core Technology	Primary Drawback	Latency	System Stability	Cost

Dash et al. (2025) [13, 14]	Neural Networks (RNN)	Processing Lag: Takes longer to "predict" rain than for hardware to react.	High	variable	High
Nguyen et al. (2023) [9]	Edge Computing & IoT	OS Reliance: A kernel crash or software update disables the wipers.	Moderate	Low	High
Grewal et al. (2021) [5]	Capacitive Sensing	EMI Sensitivity: Ignition noise causes "phantom" wipes or lock-ups.	Low	Moderate	Moderate
Kumar et al. (2020) [2]	Cloud Connectivity	Connectivity Gap: Fails in tunnels or remote areas with no signal.	High	Low	Moderate
Viswanadh (2021/2025) [6, 15]	Algorithmic PWM	Logic Vulnerability: A single bit-flip in MCU memory can stall the motor.	Low	Moderate	Moderate
Proposed Work	555 timer ic, decade counter ic, motor driver ic	None: Provides a physical, hard-wired safety logic path.	Zero	Extreme	Very low

IV. Conclusion and Future Scope

A. Conclusion

The objective of designing and implementing an Automatic Rain-Sensing Wiper System using readily available Integrated Circuits (ICs) was successfully achieved. By integrating a basic rain sensor with a decade counter IC and a 555 Timer IC configured in Astable mode, we created a functional, low-cost prototype. The system effectively demonstrated the ability to detect water on the sensor surface and translate that detection into a variable-speed intermittent action of the DC motor, simulating a car wiper. The use of potentiometers for both sensitivity calibration and speed control proves the circuit's adaptability to different rainfall intensities, confirming the viability of the analog IC approach for this automation task.

B. Future scope

Integration with Vehicle Speed Sensors: A future enhancement involves connecting the 555 Timer's control voltage (Pin 5) to the vehicle's Speedometer signal. As vehicle speed increases, the wiper frequency could automatically increase to account for more rain hitting the windshield per second. Solar Hybrid Powering: To make the system fully autonomous, a small Solar

ISSN (ONLINE): 2456-5717
ISSN (PRINT): 2456-5717

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol. 12, Issue 10, October 2026

PV cell could be integrated to trickle-charge a dedicated capacitor, allowing the rain-sensing system to operate even when the vehicle's ignition is off (useful for protecting parked cars).

REFERENCES

[1] G. Vijay, et al., "Design and Integration of Lane Departure Warning, Adaptive Headlight and Wiper system," in Proc. 2019 Int. Conf. Vision Towards Emerging Trends Commun. Netw. (ViTECoN), pp. 1–5, 2019.
[2] K. E. Supriya and R. R. Kanchi, "Real time rain sensing and wind shield wiper control system with cloud computing and geotagging applications," Int. J. Inf. Technol., vol. 12, no. 3, pp. 839–847, Sep. 2020.
[3] H. Kurihata, et al., "Vision-Based Raindrop Detection and Wiper Control," IEEE Trans. Intell. Transp. Syst., vol. 21, no. 12, pp. 5100–5112, 2020.
[4] J. Kaur, et al., "Design and Implementation of Automatic Sensing Car Wiper," J. Adv. Res., vol. 12, no. 2, pp. 138–144, 2020.
[5] M. S. Grewal, et al., "A Robust Rainfall Detection System Using Capacitive Sensing," IEEE Sensors J., vol. 21, no. 6, pp. 8542–8551, 2021.
[6] K. V. Viswanadh, "Adaptive Windshield Wiper System Based on Intelligent Algorithm," Int. J. Eng. Res. Technol. (IJERT), vol. 10, no. 5, pp. 412–417, 2021.
[7] A. K. Singh, et al., "Fuzzy Logic Based Speed Control for Windshield Wipers," J. King Saud Univ. - Comput. Inf. Sci., vol. 34, no. 8, pp. 5120–5130, 2022.
[8] Adarsh, et al., "Automatic Rain Sensing Car Wiper Design using LDR and Opto-Sensors," Taru Publ., vol. 44, no. 4, pp. 781–792, 2023.
[9] L. T. Nguyen, et al., "Smart Wiper System Using Edge Computing and IoT," IEEE Internet Things J., vol. 10, no. 14, pp. 12450–12462, 2023.
[10] M. Bilawal, et al., "Automatic Rain Sensing Wiper Circuit using 555 Timer IC and L293D Driver," Int. J. Tech. Res. Appl. (IJTRS), vol. 9, no. 1, pp. 45–50, 2024.
[11] R. M. Deshmukh, et al., "Energy-Efficient Automated Wiper Control via PWM," IEEE Access, vol. 12, pp. 15430–15445, 2024.
[12] S. Mondal, et al., "Development of an Automatic Rainfall Detection System," in Proc. 2024 Int. Conf. Smart Comput. Netw. Appl. (ICSCNA), 2024, pp. 112–117.
[13] D. Dash, et al., "Machine learning based automatic windshield wiper," AIP Conf. Proc., vol. 3142, no. 1, 2025.
[14] D. Dash, et al., "Deep Learning-Based Predictive Windshield Wiper Control," IEEE Trans. Neural Netw. Learn. Syst., vol. 36, no. 2, pp. 890–904, 2025.
[15] K. V. Viswanadh, et al., "Adaptive PWM Control for Wiper Motor Longevity," J. Electr. Eng. Technol., vol. 20, no. 1, pp. 245–255, 2025.