

Automatic Car Cleaning and Drying Machine

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Abstract: *The Arduino-powered Automatic Car Cleaning and Drying Machine is a groundbreaking system that fully automates the car wash process, encompassing washing, rinsing, and drying, with minimal human involvement. An Arduino microcontroller powers the system, managing various components like ultrasonic sensors, DC motors, servo mechanisms, water pumps, and blower fans. When a vehicle enters the washing area, sensors identify its presence and begin the cleaning procedure. Rotating brushes and water jets wash the car's exterior, followed by an air-drying system that effectively eliminates moisture. The automation logic guarantees consistent cleaning, optimized water usage, and time efficiency. This project combines mechanical design, electronics, and embedded programming to develop a compact and environmentally friendly solution.*

The Arduino-based Automatic Car Cleaning and Drying Machine is engineered to efficiently automate the car washing process. This system employs an Arduino microcontroller to manage sensors, motors, and pumps that carry out washing, rinsing, and drying autonomously. Ultrasonic sensors identify the presence of a vehicle, while water jets, rotating brushes, and blowers ensure a uniform clean and drying of the surface. This machine reduces human labor, conserves water, and shortens cleaning duration. It represents a cost-effective and environmentally friendly solution suitable for both car service stations and personal use, showcasing the integration of automation and embedded systems in daily life.

It conserves time, finances, and resources while delivering uniform and top-notch cleaning. With continued advancement, it could become a standard element in cities and simplify car maintenance for everyone..

Keywords: Arduino, IR Sensor, Dc Motor etc

I. INTRODUCTION

In our rapidly moving world, keeping vehicles clean and presentable has become a crucial part of everyday life. Conventional car washing techniques demand considerable manual labor, time, and large amounts of water. Given the rising preference for automation and advanced technologies, there is an increasing necessity for a streamlined and user-friendly vehicle cleaning system that reduces human effort.

The Arduino-powered Automatic Car Cleaning and Drying Machine has been created to tackle these issues by automating the entire car washing procedure. This system employs an Arduino microcontroller to manage various components like ultrasonic sensors, DC motors, water pumps, and blower fans to systematically carry out washing, rinsing, and drying. When a vehicle is sensed, the sensors activate the cleaning process automatically, ensuring consistent washing and drying.

This automated solution minimizes labor and conserves time while also encouraging environmentally friendly practices through effective water management. The incorporation of embedded systems and mechatronics in this initiative demonstrates how contemporary automation can ease common tasks. The suggested design is ideal for small service centers

car washing consumes a substantial amount of water, whereas this machine utilizes only what is necessary. Additionally, it diminishes the reliance on human labor, leading to reduced costs for service stations.



This machine is applicable in various settings, including car service centers, residential complexes, commercial parking facilities, and even automotive manufacturing plants. It is particularly advantageous in locations where numerous vehicles require cleaning on a daily basis.

It conserves time, finances, and resources while delivering uniform and top-notch cleaning. With continued advancement, it could become a standard element in cities and simplify car maintenance for everyone.

II. LITERATURE SURVEY

Lin et al.[1], “Arduino Based Automatic Car Washing System,” International Journal of Trend in Scientific Research and Development (IJTSRD), vol. 3, no. 5, pp. 1224–1227, 2019.

S. Kshirsagar et al.[2](2019) proposed a Smart Car Washing Center using IoT where the authors designed a system that integrates IoT-based monitoring and control, vol. 7, no. 5, pp. 261–264, 2019

Patil et al.[3] (2022) proposed a Three-Stage Industrial Car Washing System that integrates RFID for customer identification, IR sensors for vehicle detection, and a conveyor belt mechanism for movement. The system is controlled using Arduino, which manages the foaming, washing, and drying stages, vol. 9, no. 6, pp. 123–128, 2022.

Satbhai et al.[4] (2019) proposed an Automatic Car Washing and Drying System using Microcontroller 8051. The system was designed to automate the foaming, washing, brushing, and drying processes through sequential programming of the 8051 microcontroller, vol. 3, no. 3, pp. 1544–1546, Apr. 2019.

Cho et al.[5] (2019) designed and implemented a Mini Car Washing System using Arduino as the main controller. The system incorporated various sensors such as IR, flame, and gas sensors to ensure safety and automation during operation, vol. 3, no. 5, pp. 1662–1665, Aug. 2019.

Zhang et al.[6] (2019) proposed an Automatic Car Washing Machine System based on Image Processing. The system utilized image processing algorithms to detect dirt and dust on vehicle surfaces, enabling selective and efficient cleaning, vol. 2, no. 4, pp. 30–35, 2019.

Researchers et al.[7] (2016) presented a CFD-Based Drying System for Rollover Carwash Machines, published in the Journal of Computational Design and Engineering. The study applied computational fluid dynamics (CFD) to analyze and optimize airflow in car wash dryers, vol. 3, no. 4, pp. 398–404, 2016.

Authors et al.[8] (2016) developed a Touchless Automatic Carwash System that used sensor-based object mapping to detect vehicle dimensions and contours. Based on this mapping, the system adaptively controlled the positioning of spray nozzles to ensure efficient coverage without physical contact, pp. 54–59, Dec. 2016.

Researchers et al.[9] (2020) presented a PLC-Based Automatic Car Washing System that employed a conveyor mechanism, automated wrap-around brushes, and high-powerdryers to achieve full automation of the washing process, , vol. 17, no. 2, pp. 88–93, 2020.

III. PROPOSED METHODOLOGY

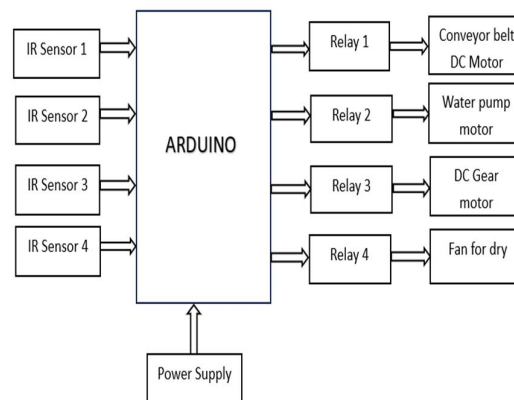


Fig 1: Automatic Car Cleaning and drying Machine



1. System Overview

The system uses an Arduino microcontroller to coordinate sensors, motors, pumps, and fans to perform sequential tasks:

- Detect car entry
- Wash with water and soap
- Scrub using rotating brushes
- Rinse and dry with air jets

2. Components Required

1. IR Sensor

An IR sensor (Infrared Sensor) is a versatile electronic device that detects infrared radiation—light that's invisible to the human eye. Detects heat and motion by sensing infrared light and converting it into electrical signals.

2. PLC

PLCs are specialist computers used to operate and control machinery and manufacturing processes. It stores instructions and performs operations including timing, counting, sequencing, arithmetic, data handling, and on/off control using a programmable memory.

3. Conveyor Belt

One common type of mechanical handling equipment is a conveyor system. That transports stuff between locations. In applications where large or bulky products need to be transported, conveyors are extremely helpful. A large range of commodities may be transported quickly and effectively with conveyor systems.

4. Water Pump

It is a machine that is controlled by electricity. The two port water pump is the best option for our needs. Usually, a manual valve is replaced with it.

5. Motor

The armature of a DC motor revolves under a magnetic field. The fundamental idea behind a DC motor is that any time a current-carrying conductor is positioned within a magnetic field, the conductor will feel mechanical forces. Most DC motors operate on the same basis. Our project will make use of a 24 V DC relay. Two dc motors will be used to move the conveyer belt.

III. PROCESS FLOW & METHODOLOGY

Step 1: Car Detection

Sensor Used: IR or ultrasonic sensor at entry point

Action: When a car is detected, the Arduino activates the conveyor motor to move the car into position.

Step 2: Pre-Wash (Water Spray)

Sensor Used: Ultrasonic sensor at water booth

Action: Water pump is activated via relay for a fixed time (e.g., 10 seconds) to rinse off loose dirt.

Step 3: Soap Application

Sensor Used: Ultrasonic sensor at soap booth

Action: Soap pump is activated; brushes start rotating to scrub the car. Timers control duration.

Step 4: Rinse

Sensor Used: Ultrasonic sensor at rinse booth

Action: Water pump reactivates to rinse off soap. Brushes may continue rotating briefly.

Step 5: Drying

Sensor Used: Ultrasonic sensor at drying booth

Action: Fans or air blowers are turned on via relay to dry the car. Timed operation ensures efficiency.

Step 6: Exit Detection

Sensor Used: Limit switch or ultrasonic sensor

Action: Once the car reaches the exit, the system resets for the next vehicle.

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4. Control Logic

Arduino Code: Uses if conditions and millis() or delay() for timing.

Sequential Execution: Each booth activates only when the car is detected.

Safety Features: Emergency stop switch and manual override for each stage.

5. Optimization & Future Enhancements

Add temperature sensors to monitor overheating of motors

Use PLC-based Arduino controllers for industrial-grade reliability

Integrate touchscreen interface for user selection (e.g., water-only, soap+wax)

Implement water recycling system for sustainability

The Automatic Car Cleaning and Drying Machine utilizing Arduino represents a contemporary solution aimed at expediting the car washing process, making it more convenient and efficient by eliminating the necessity for manual labor. In conventional car washing, individuals invest considerable time and effort scrubbing, rinsing, and drying vehicles, which often results in excessive water consumption and variable cleaning outcomes. This project addresses these issues by employing an Arduino microcontroller to autonomously manage the entire cleaning procedure. The system is constructed around a conveyor belt mechanism that transports the car through various cleaning phases. As the vehicle enters the washing zone, infrared or ultrasonic sensors identify its presence and transmit signals to the Arduino, which subsequently initiates the cleaning sequence. Initially, water is sprayed onto the car using DC pumps to eliminate loose dirt. Following this, liquid detergent is applied to dissolve grease and grime. Subsequently, rotating brushes driven by DC motors gently scrub the car's surface to prevent damage. Once the brushing phase is finished, the car is rinsed with clean water, and ultimately, high-speed fans expel air to thoroughly dry the vehicle. Each phase is meticulously timed and regulated by the Arduino to guarantee seamless operation and uniform results. The system is designed to be modular, allowing for easy upgrades or replacements of individual components.

IV. RESULTS

1. When water spreads into the car

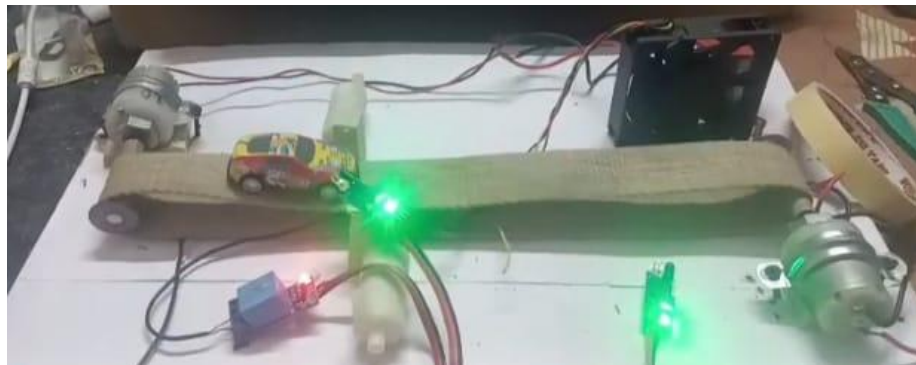


Fig : water spreads into the car

As the car model advances on the conveyor belt and arrives at the cleaning area, the IR sensor identifies its presence and relays a signal to the Arduino controller. In response, the Arduino activates the water pump motor, which releases water onto the car's surface via a nozzle. This replicates the automatic car washing procedure found in real-world systems. The LEDs illuminate to show that the water spraying stage is currently in progress. Once the car moves past this area, the water flow ceases automatically. This feature illustrates the successful automation of the washing process, ensuring that water is sprayed solely when a car is detected, thereby minimizing waste and enhancing efficiency.



2. When car drying



Fig: Car Drying

Once the car has finished the washing procedure, it advances along the conveyor belt towards the drying section. Upon detection by the subsequent IR sensor, a signal is sent to the Arduino, prompting the activation of the drying fan motor. The fan then circulates air over the vehicle's exterior to eliminate any residual water, mimicking the automatic drying process found in a genuine car wash system. The LED indicator lights up during this phase, indicating that the drying process is underway. As soon as the car leaves the drying area, the sensor registers its absence, leading to the automatic shutdown of the fan. This functionality demonstrates that the system is capable of drying the car effectively without the need for human involvement.

IV. CONCLUSION

The initiative titled "Arduino-Based Automatic Car Cleaning and Drying Machine" demonstrates a practical, cost-effective, and automated solution for car washing. It removes the necessity for manual labor by utilizing sensors, motors, and a microcontroller to autonomously manage the cleaning and drying processes. The prototype successfully identifies the vehicle, applies water for washing, and initiates the fan for drying, illustrating the idea of automation in vehicle upkeep. This system lowers the demand for human effort, conserves time, and reduces water consumption. In summary, the project showcases the possibilities of automation and embedded systems in creating intelligent, environmentally friendly, and efficient technologies for everyday applications.

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