

Review on Intelligent Automated Systems for Vehicle Cleaning and Drying

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Abstract: *Manually cleaning a car requires significant time, effort, and water. Individuals frequently find themselves waiting in lengthy queues at service stations, where employees dedicate hours to washing and drying each vehicle. This project seeks to address that issue by developing an automatic car cleaning and drying machine utilizing an Arduino microcontroller.*

The system is engineered to clean vehicles autonomously. It employs sensors, motors, pumps, and fans to wash and dry the car through a systematic process. The core component of the system is the Arduino, which orchestrates all the elements and ensures seamless operation.

Upon a car's entry into the cleaning zone, it is identified by infrared or ultrasonic sensors. These sensors transmit signals to the Arduino, initiating the cleaning sequence. The vehicle progresses along a conveyor belt, where various cleaning stages occur automatically.

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The entire operation is managed by the Arduino, which adheres to a pre-programmed sequence. It activates and deactivates each component at the appropriate times, resulting in a process that is swift, efficient, and dependable.

A significant benefit of this system is its water conservation. Conventional 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.

Keywords: Arduino, IR Sensor, Dc Motor etc

I. INTRODUCTION

In the era of automation, there is a rapidly increasing demand for intelligent systems that minimize human effort and enhance efficiency. One area that is particularly open to innovation is vehicle maintenance—specifically, the processes of car washing and drying.

Conventional car cleaning techniques are labor-intensive, time-consuming, and frequently result in substantial water wastage. To tackle these issues, this project presents an Automatic Car Cleaning and Drying Machine powered by Arduino, which aims to provide a hands-free, efficient, and environmentally friendly solution.

The system employs an Arduino microcontroller to manage various components, including sensors, motors, pumps, and fans. When a car approaches the washing station, sensors recognize its presence and trigger a series of operations: water



spraying, detergent application, mechanical brushing, rinsing, and drying. Each phase is meticulously timed and regulated to guarantee comprehensive cleaning while reducing resource usage.

This project not only demonstrates the practical use of embedded systems and automation but also emphasizes the potential for Arduino-based solutions in real-life applications. It is especially well-suited for service stations, residential complexes, and commercial parking facilities where rapid and consistent car cleaning is crucial.

The system utilizes an Arduino microcontroller to coordinate various components such as sensors, motors, pumps, and fans. As a car enters the washing station, sensors detect its presence and initiate a sequence of operations: water spraying, detergent application, mechanical brushing, rinsing, and drying. Each stage is precisely timed and controlled to ensure thorough cleaning while minimizing resource consumption.

This project not only showcases the practical application of embedded systems and automation but also highlights the potential for Arduino-based solutions in real-world scenarios. It is particularly suitable for service stations, residential complexes, and commercial parking areas where consistent and fast car cleaning is essential.

By integrating mechanical design with intelligent control, the system represents a step forward in modernizing car care with affordable and scalable technology.

1 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.

Manually cleaning an automobile requires a lot of water, time, and work. At service stations, customers frequently have to wait in long lines while employees spend hours cleaning and drying every car. By using an Arduino microcontroller to create an autonomous car cleaning and drying system, this project seeks to address that issue. Cars can be cleaned by the system without assistance from a human. The car is pumps, and fans. The Arduino serves as the system's central nervous system, managing every component and ensuring seamless operation.

2.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-power dryers to achieve full automation of the washing process, vol. 17, no. 2, pp. 88–93, 2020.



S. N. Satbhai, P. R et al.[10] (2019), “Automatic Car Washing and Drying using Microcontroller 8051,” International Journal of Trend in Scientific Research and Development (IJTSRD), vol. 3, no. 3, pp. 1544–1546, Apr. 2019.

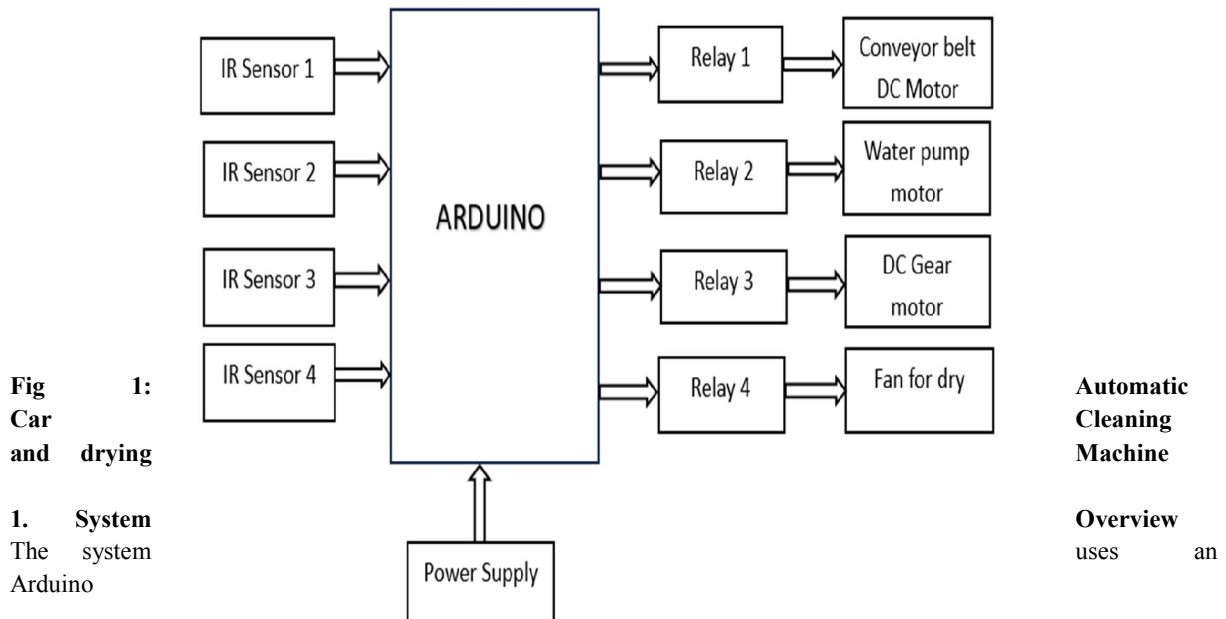
A. D. Popescu and A. M. Dinca et al.[11] (2020), “Educational Platform for Simulating the Operation of an Automatic Car Wash Machine,” in Proc. 2020 Int. Symp. Fundamentals of Electrical Engineering (ISFEE), Bucharest, Romania, Nov. 2020.

Y. Sawant and S. Vibhute et al.[12] (2023), “Review Paper on Automatic Car Washing System Using PLC,” International Journal of Novel Research and Development (IJNRD), vol. 2, no. 5, pp. 1–5, May 2023.

T. S. Pinjari et al[13] (2020), “Automatic Car Washing System Using Microcontroller,” International Research Journal of Engineering and Technology (IRJET), vol. 7, no. 6, pp. 4122–4126, Jun. 2020

Bambare T et al.[14] (2017), “Automatic Car Washing and Drying System,” International Research Journal of Engineering and Technology (IRJET), vol. 5, no. 2, pp. 2395–2399, Feb. 2017.

3. Proposed Methodology



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. Infrared Sensor

A multipurpose electronic gadget known as an infrared sensor (IR sensor) can identify infrared radiation, or light that is invisible to the human eye. Detects motion and heat by translating infrared light into electrical impulses.

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. Belt Conveyor



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.

3. Process Flow & Methodology

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.

4. Conclusion:

The development of an Arduino-based automatic car cleaning and drying machine demonstrates the potential of embedded systems in transforming traditional vehicle maintenance into a smart, efficient, and eco-friendly process. By integrating sensors, pumps, motors, and fans under a centralized control system, the project successfully automates the entire cleaning cycle—from detergent application and brushing to rinsing and drying.

This system not only reduces manual labor and water consumption but also ensures consistent cleaning quality, making it suitable for service stations, residential complexes, and commercial parking facilities.

The use of Arduino provides a cost-effective and scalable platform, allowing for future enhancements such as touchless operation, mobile app integration. In conclusion, this project offers a practical solution to modern car care challenges and highlights the growing role of automation in everyday applications.

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