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Automatic Three Stage Industrial Car Washing System

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Abstract : The use of car wash systems makes it possible to do a completely automated car wash in a very short length of time. In this demonstration, we exhibit a smart vehicle wash system that enables a car cleaning procedure that is entirely automated. A tiny belt that is similar to a conveyor is what makes up the system, and it is attached to the automobile. It is possible to determine whether or not a car has been parked in the system by using an infrared sensor. Upon detection, the system initiates the movement of the belt through the use of a motorized system. The vehicle then moves to the first stage, where it begins brushing the car for a period of time. The conveyor then begins moving again. In the second stage, cleaning services are utilized to clean the vehicles. In the third stage, the fan is activated, which causes the vehicle to dry out and stops the conveyor belt, allowing the vehicle to leave the cleaning location.

IndexTerms **- Automation, car washing system, conveyor, PLC.**

I. INTRODUCTION

The significant increase in vehicle production during the fiscal year 2021 indicates India's rising significance as a global manufacturing powerhouse. This is reflected in the dynamic environment of India's automotive sector. India's position as a prominent participant in the worldwide automotive market is strengthened by the country's production of 22.7 million vehicles, which includes a wide variety of autos ranging from passenger cars to commercial vehicles. During the year beginning in April 2021 and ending in October 2021, the automotive industry achieved a particularly remarkable output volume of thirteen million cars, demonstrating its durability and adaptability in the face of adversity. During the same time period, the automotive export sector in India had a strong performance, with a total of 4.1 million automobiles being exported in the fiscal year 21. The export capabilities of India are illustrative of the country's competitiveness on the world scene and its capacity to satisfy the varied requirements of foreign markets.

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The necessity for effective automobile maintenance solutions has been increasingly obvious in light of the fact that production and export numbers have been growing at a rapid pace. In today's fast-paced urban lifestyles, customers place a premium on convenience and efficiency, and they are looking for methods to retain the aesthetics of their automobiles without sacrificing quality. As the number of people who own cars continues to rise and urbanization continues to speed up, there has never been a greater demand for auto care solutions that are both easy and save time. It is in this context that the technology of automated car washing emerges as a game changing solution, delivering a combination of efficiency, effectiveness, and environmental sustainability.

The washing process is streamlined by automated vehicle wash systems, which give comprehensive and consistent results in a fraction of the time compared to traditional manual methods of cleaning. The utilization of cutting-edge technology like high-pressure jets, foam sprayers, and automated brushes allows these systems to provide complete cleaning while simultaneously reducing the amount of water used and the amount of trash produced. This environmentally responsible method of washing automobiles is in line with the objectives of global sustainability and resolves issues regarding the conservation of water and the impact on the environment.

In addition, the history of automated vehicle washing can be traced back to the pioneering efforts of visionaries such as Archie, Dean, and Eldon Anderson. Their innovative innovation, which was made in Seattle, Washington, in 1951, represented a turning point in the practices of automotive maintenance. The revolutionary machine that they developed completely altered the manner in which individuals washed their automobiles, hence paving the path for the widespread use of automated car wash technology around the globe. Automated vehicle wash systems have seen substantial development in recent years, adding cutting-edge features like as touchless washing, water recycling, and sophisticated cleaning chemicals. These characteristics have enabled these systems to give excellent results while leaving a low impact on the environment.

In essence, the significance of automated vehicle washing technology is highlighted by the growth of India's automotive sector as well as the increasing need for solutions to the problem of automobile upkeep. It is anticipated that automated car wash systems will play a vital part in determining the future of automotive care in India and beyond. These systems provide an alternative to conventional methods of washing automobiles that is not only more convenient, but also more efficient and less harmful to the environment.

II. PROBLEM STATEMENT

The prevalence of manual car washing methods in India persists despite the global trend towards automated systems, primarily due to factors such as infrastructure limitations, cost considerations, and traditional practices. While developed countries have embraced automated car wash technology for its efficiency and environmental benefits, India's car wash industry remains largely reliant on manual labor and rudimentary equipment. This reliance not only results in substantial water wastage but also contributes to environmental pollution and resource depletion.

In many parts of India, particularly in rural and semi-urban areas, the lack of access to sophisticated car wash facilities and equipment necessitates the use of manual methods. Hand washing and the use of high-pressure water guns are common practices, often conducted in makeshift setups along roadsides or within residential premises. This informal approach to car cleaning underscores the need for more advanced and sustainable solutions that align with global best practices and environmental regulations.

Furthermore, the absence of stringent regulations and enforcement mechanisms exacerbates the environmental impact of manual car washing practices. Without proper guidelines and oversight, there is little incentive for car owners or service providers to adopt more sustainable alternatives. As a result, the status quo persists, perpetuating inefficiencies and environmental harm.

In addition to water wastage, manual car washing poses risks to both vehicles and workers. The use of high-pressure water guns, if not properly controlled, can damage vehicle surfaces and paintwork, leading to costly repairs and maintenance. Moreover, the labor-intensive nature of manual car washing requires significant manpower, leading to higher operational costs and slower turnaround times.

To address these challenges, there is a growing need for awareness campaigns, regulatory interventions, and investment in automated car wash infrastructure. By promoting the adoption of automated systems and encouraging eco-friendly practices, India can significantly reduce water wastage, mitigate environmental pollution, and improve the overall efficiency of the car wash industry. Moreover, embracing automation in car care can lead to job creation, skill development, and economic growth, further underscoring the benefits of transitioning towards more sustainable practices.

III. OBJECTIVE

The development of a completely automated car wash system is the major purpose of our project. This is designed to solve the inefficiencies and environmental issues that are linked with the practice of manually washing automobiles. Due to the fact that washing cars by hand requires a big amount of water, one of our primary objectives is to dramatically cut down on water use. By assessing the water needs for washing cars based on the size of the vehicle and adopting automation, our goal is to maximize the amount of water that is used while minimizing the amount of trash that is produced.

The installation of an automated car wash system is another objective, with the goal of increasing efficiency while simultaneously saving time and energy. The act of washing a car manually is laborious and time-consuming; however, automation has the potential to expedite the process and minimize the total amount of time that is necessary for cleaning a car over time. Additionally, automation will assist in reducing the dependency on human labor, which will result in cost savings and an improvement in operational efficiency.

Additionally, we intend to investigate and validate the differences between manual vehicle wash systems and automated systems with regard to the amount of water used and the amount of time needed to complete the process. We intend to demonstrate the improved performance of automated vehicle wash systems as well as the environmental advantages they offer via the use of empirical testing and analysis.

In order to accomplish these goals, we want to develop the automated vehicle wash system by utilizing programmable logic controllers (PLCs), which are well-known for their low impact on the environment and their intuitive user interface. In addition, we want to implement water filtration systems in order to recycle and reuse water, which will further reduce the amount of water that is consumed and will promote sustainability.

As an additional measure, we want to make use of machine vision technology in order to guarantee comprehensive cleaning and quality monitoring. By employing cameras and image processing algorithms, we are able to check whether or not the vehicle has been cleaned in the appropriate manner, so guaranteeing that the client is satisfied and that high standards of cleanliness are maintained.

To summarize, the overarching objective of our project is to revolutionize the car wash business by presenting a solution that is sustainable, efficient, and automated. This solution will reduce the negative impact on the environment, save time and energy, and improve the whole experience of cleaning a car.

IV. BLOCK DIAGRAM

A. car washing system

The Arduino microcontroller, which functions as the system's central processing unit, is located at the very center of this installation. This assures that it will continue to function

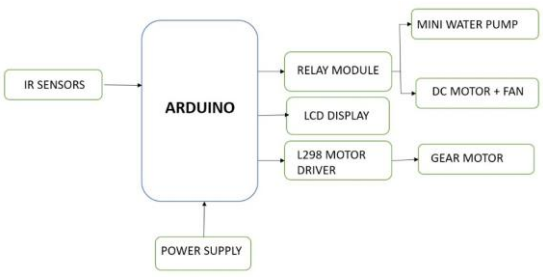

Fig. 1. Block Diagram.

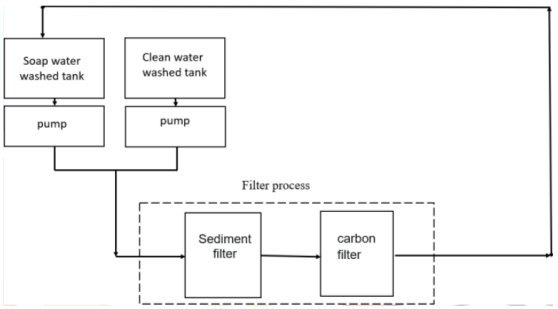

Fig. 2. Filter block diagram.

properly because it is powered by an external power supply. Infrared (IR) sensors provide the system with its input, which is then sent to the Arduino for further processing.

There is a relay module that we come across as we move to the right side of the figure. This module functions as a switchboard, allowing for the control of a variety of components such as a Mini Water Pump, a DC Motor and Fan, an LCD Display, and a Motor Driver.

B. water filtering

Water filtering is a critical process that ensures the removal of impurities and contaminants from water, making it safe for consumption and various applications.

V. PROCESS FLOW

Each component of the automobile washing system is depicted in figure 3. In this system, the car will be placed on the conveyor, and as soon as the sensor detects the car, the first stage of cleaning will take place. After that, the car will move to the next station, which is the brushing station. Here, the cleaning of the car will take place. Once the cleaning process is complete, the car will move on to the next stage, which is the clean water wash, and finally, the drying of the car will take place at the final stage. This technique is used for washing automobiles. In the following step, the water that has been utilized will be saved, and its subsequent reuse will be accomplished through the utilization of the filtering process.

VI. METHODOLOGY

1) Washing with Soap: One of the most important stages in an automated car washing system is the cleaning of the vehicle. This first step involves washing the vehicle

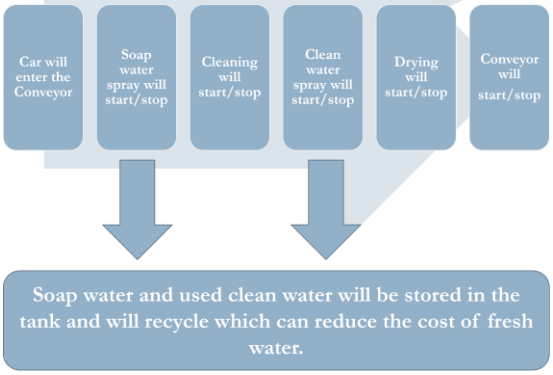

Fig. 3. Filter block diagram.

with a spray of soap and water in order to remove any dirt or dust that may be present on the outside of the vehicle as well as on the wheels. At the moment, this procedure is currently carried out manually in garages or repair facilities for automobiles. When the automobile is detected on the conveyor belt by the proximity sensor, our project will make use of an automated system that will send a signal to the programmable logic controller (PLC). The PLC will then direct the solenoid valve to open, which will result in water being sprayed over the car. Washing with foam is performed at this step in order to eliminate any dirt that may be present. Following the completion of this step, the vehicle will be pushed along to the subsequent station.

2) Purification: After washing, the following step in this method is called Cleaning, and it is the procedure that follows. For the purpose of cleaning, the sensor is used to detect the vehicle, and the mechanism of the motor that is equipped with a brush is utilized for cleaning. In order to clean the top, front, and back of the cars, a series of horizontal brushes is utilized. There are

two sets of side brushes that clean the area surrounding the cars, and there is another set of wheel brushes that ensure the wheel is clean. The water is removed by rinsing. The vehicle will proceed to the subsequent station after the cleaning is complete.

3) Washing with Water: Once the cleaning process is complete, the following step in an automated automobile system is to wash the vehicle with clean water. This is the step in which the automobile needs to be cleaned with clean water spray in order to remove any soap that may have left on the outside of the vehicle as well as on the wheels of the vehicle. At this time, this procedure is carried out manually at garages or service stations for automotive drivers. When the automobile is detected on the conveyor belt by the proximity sensor, our project will make use of an automated system. This

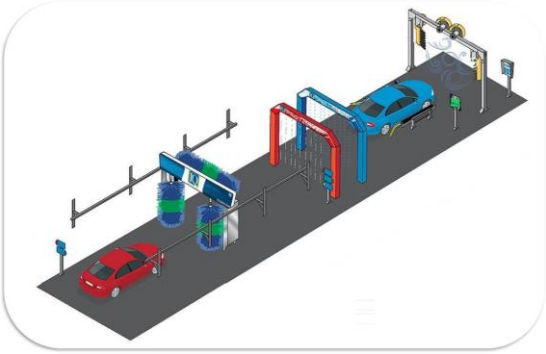

Fig. 4. Car Washing System.

system will send a signal to the programmable logic controller (PLC), which will then direct the solenoid valve to open. As a result, water will be sprayed into the car. To eliminate any soap or grime that may have been present, washing is performed with clean water at this point. As soon as this particular stage is over, the automobile is dispatched to the subsequent station.

4) Getting dry: Currently, this is the final level of our system. Following the water cleaning step, the subsequent procedure is referred to as drying. While the automobile is drying, the proximity sensor will detect its closeness to the vehicle. The proximity sensor will then transmit a signal to the power supply, which will then activate the drier and fans. The removal of water vapor from compressed air, which is a regular occurrence in a broad variety of commercial and industrial establishments, is accomplished by the utilization of a compressed air drier or fan. Because of this, the dryers will be used to dry the automobile. Following the completion of this stage, the automobile is cleaned, and as a result, the conveyor belt is started. The automobile is then taken off the conveyor belt.

VII. RESULTS AND DISCUSSION

A. Before Cleaning the car

- The LCD display exhibits the message ”Car Arrived” upon the detection of the vehicle’s presence, signifying the readiness for the commencement of the automated brushing process.
- The purpose of this notification is to provide a clear indication to operators and users that the vehicle has arrived at the pre-brushing stage of the car wash system.

B. Cleaning the car

- In this stage, rotating brushes gently scrub the surface of the vehicle to remove dirt and debris, aided by the addition of soap water for enhanced cleaning effectiveness. A gear motor is responsible for rotating the brushes, ensuring effective cleaning without causing damage to the vehicle’s paint. Throughout this process, an infrared

Fig. 5. Before Cleaning the car.

Fig. 6. Cleaning the car.

sensor monitors the vehicle's position to ensure complete coverage.

- Upon the vehicle's arrival at the cleaning stage, the LCD display prominently showcases the message "Cleaning," serving as a visual cue to operators that the system is actively engaged in the cleaning process.

C. Washing the car

- After the Cleaning stage, the vehicle undergoes a final rinse with fresh water to remove any remaining cleaning agents and debris. A mini water pump pumps fresh water onto the vehicle, ensuring thorough rinsing. The infrared sensor continues to monitor the process, adjusting water flow as necessary to achieve optimal cleanliness.

Fig. 7. Cleaning the car.

- Upon the vehicle's arrival at the water washing stage, the LCD display prominently showcases the message "Washing the Car," serving as a visual indicator to operators and users that the system has begun the washing process.

D. Drying the car

- In the final stage, a powerful fan generates airflow to evaporate water droplets from the vehicle's surface, leaving it dry and streak-free. A DC motor with a fan directs the airflow across the vehicle, ensuring uniform coverage. Nozzles are strategically positioned to ensure efficient drying, while the infrared sensor monitors the drying process to ensure complete drying before the vehicle exits the system.
- Upon the vehicle's arrival at the drying stage, the LCD display prominently showcases the message "Drying the Car," serving as a visual cue to operators that the system has initiated the drying process.

E. After Drying the car

- Following the drying stage, the LCD display prominently showcases the message "Washing complete," providing a clear indication that the entire washing process has finished.
- The "Washing complete" notification plays a crucial role in enhancing user experience by providing clear and timely communication, indicating the readiness of the vehicle for the next steps.

VIII. CONCLUSION

The advantages of the prototype for an automated automobile washing system will be discussed. The unique technology not only reduces the amount of water that is used, but it also reduces the amount of time that is needed for the washing process. In comparison to the conventional techniques of washing by hand, the results indicate that it is possible to achieve an impressive 87% reduction in the amount of water that is used. It takes around two to three minutes to complete the operation, which guarantees that the automobile will be fully cleaned. The utilization of filtered water and the reduction of manual work are two of the ways in which this automated technique helps to the conservation of resources, including water, time, energy, and people.

Fig. 8. Drying the car.

Fig. 9. After Drying the car.

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