

An-Najah National University

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Faculty of Engineering and Information Technology

Computer Engineering Department

Graduation Project II

**Automated Car Washer**

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**A report submitted in partial fulfilment of the  
requirements for the degree of Bachelor of Science in  
Computer Engineering**

January 29, 2024

## Acknowledgements

First, last and always, thanks and gratitude to God, had it not been for his blessing that accompanied us in every step we took, we would not have completed this project successfully.

Our dear parents and my beautiful family, thank you for all the support that always raised our spirits, and for the beautiful words that have always been a wall on which to lean and strengthen us. our great supervisor, Dr. Hikmat Darawshi, thanks for the advice that was always in the right place, and thanks for the enrichment, comments, and constructive criticism that contributed to increasing the project's features. All thanks to the Computer Engineering Department at An-Najah National University, and to the friends who accompanied us on this journey. Last but not least, thanks to everyone who had a hand in providing any kind of help, it means the world to us.

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## Abstract

This graduation project presents the design and development of an Automated Car Wash Machine, aimed at providing efficient car cleaning services. The system combines automation, cost analysis, and remote monitoring to create an innovative solution for car owners and businesses alike. The main components of this project include a conveyor belt system that guides the car through various stages of the washing process. The car is first subjected to a water splash to remove loose dirt, followed by the application of soap for a thorough cleaning, and then another water splash to clean off the soap. The automated process ensures consistent and high-quality results, reducing the need for manual washing. The project contains a cost analysis component. By measuring the amount of water and soap used during each car wash cycle, the system calculates the cost of the service. This helps car wash businesses optimize their resource utilization, to make their analysis for the profits. The system also includes remote monitoring capabilities. An integrated camera system captures real-time footage of the car wash process, which can be accessed via a mobile application. This feature enables car wash administrators to monitor operations remotely, ensuring smooth functioning and addressing any issues promptly. The system will contain sensors to realize the position of the car on the belt, these sensors should verify that the process walked correctly, in case any of the three processes didn't happen correctly, or the car was stuck on the belt.

# 1 Introduction

## 1.1 Problem :

The problem addressed in this project is that traditional car washing methods are often time-consuming and manual, requiring the physical effort of the vehicle owner. Also its very costly and needs a lot of human attention and energy. In response to this, we have developed an automated car washing system aimed at providing a seamless and convenient solution for car owners.

## 1.2 Objectives of the work

The primary objective of our project is to design, develop, and implement an automated car washing system that addresses the limitations of traditional car washing methods while offering a user-friendly and efficient solution. To achieve this overarching goal, we have defined several specific objectives:

- **Automation and Convenience:** To minimize water wastage by incorporating smart water pumps that deliver the required amount of water at each stage of the washing process. Also to optimize the usage of cleaning agents and detergents, ensuring effective cleaning while minimizing environmental impact.
- **Effective Cleaning:** To design a car washing system that delivers consistent and high-quality cleaning results, surpassing the capabilities of traditional methods.
- **User Identification and Security:** To implement RFID technology for user identification, enhancing the security and exclusivity of the car washing system.
- **Drying Efficiency:** To incorporate powerful fans for efficient drying, eliminating the need for manual drying or leaving water spots on the car's surface and to ensure that the drying stage completes the car washing process effectively, leaving the vehicle clean and ready for use.

## 1.3 Organization of the report

# 2 Theoretical Background and Previous Work

## 2.1 Theoretical Background

The theoretical foundation of our Automated Car Washer project is rooted in the field of automation and robotics. Automation refers to the use of technology and control systems to perform tasks with minimal human intervention. Robotics involves the design and creation of machines (robots) capable of performing various tasks with precision and accuracy. In our project, automation

and robotics principles are applied to streamline the car washing process, from user identification to the final drying stage.

## 2.2 Previous work

Numerous automated car washing systems and technologies have been developed in recent years. These systems vary in complexity and functionality but share the common goal of automating the car washing process. Previous work in this area has led to innovations such as touchless car washes, conveyor-based systems, and advanced water recycling techniques. Our project builds upon these previous developments by incorporating RFID technology and optimizing resource usage for a comprehensive and eco-friendly solution.

## 3 Methodology

### 3.1 Hardware components

- Arduino Uno: It was used to control the system, receive commands, and move other components accordingly.



Figure 1: Arduino Uno

- ESP32-CAM: The ESP32-CAM module is responsible for capturing images and videos during the car washing process. It provides visual feedback to users and ensures that the car wash is proceeding as expected. Its Wi-Fi capabilities allow for remote monitoring and control of the car washer.



Figure 2: ESP32-CAM

- Stepper Motor :A stepper motor is utilized to drive the belt system that moves the vehicle through each stage of the car wash. The precise control provided by the stepper motor ensures the car's proper positioning at each washing station.



Figure 3: Stepper Motor

- Driver TB6600: The TB6600 driver is used to control the stepper motor. It allows for precise control of the motor's speed and direction, ensuring smooth movement of the car through the washing stages.

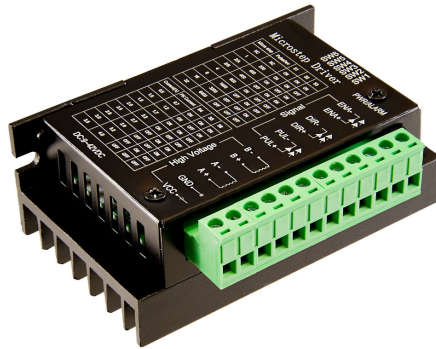


Figure 4: Driver TB6600

- DC Motors: DC motors are employed to power the water pumps responsible for splashing water and soap onto the car's surface. These motors offer efficient and adjustable flow rates, allowing for precise water and soap delivery.



Figure 5: DC Motors

- **Water Pumps:**Water pumps are essential for supplying water to the car washing system. They are responsible for delivering water during the initial rinse, soap application, and final rinse stages, ensuring thorough cleaning while conserving water resources.



Figure 6: Water Pumps

- **Relays:**Relays are used to control various components, including the water pumps and fans. They act as switches that are controlled by the Arduino Mega, enabling the precise activation and deactivation of these devices at the appropriate stages of the car washing process.



Figure 7: Relays

- Fans: Three fans are incorporated into the drying stage of the car wash. These fans provide powerful airflow to efficiently dry the car's surface, preventing water spots and leaving the vehicle in pristine condition.



Figure 8: Fans

- RFID :RFID technology is employed for user identification and access control. Each user is provided with an RFID tag that must be scanned to initiate the car washing process. This adds a layer of security and exclusivity to the system.



Figure 9: RFID

## 3.2 Structure

The system's structure can be visualized as a linear process, beginning with the RFID stage at the entrance of the car wash. As the vehicle enters the system, the RFID technology is employed to identify the user and grant access to the car washing service. Once access is granted, the car progresses through the various stages of the automated car wash.

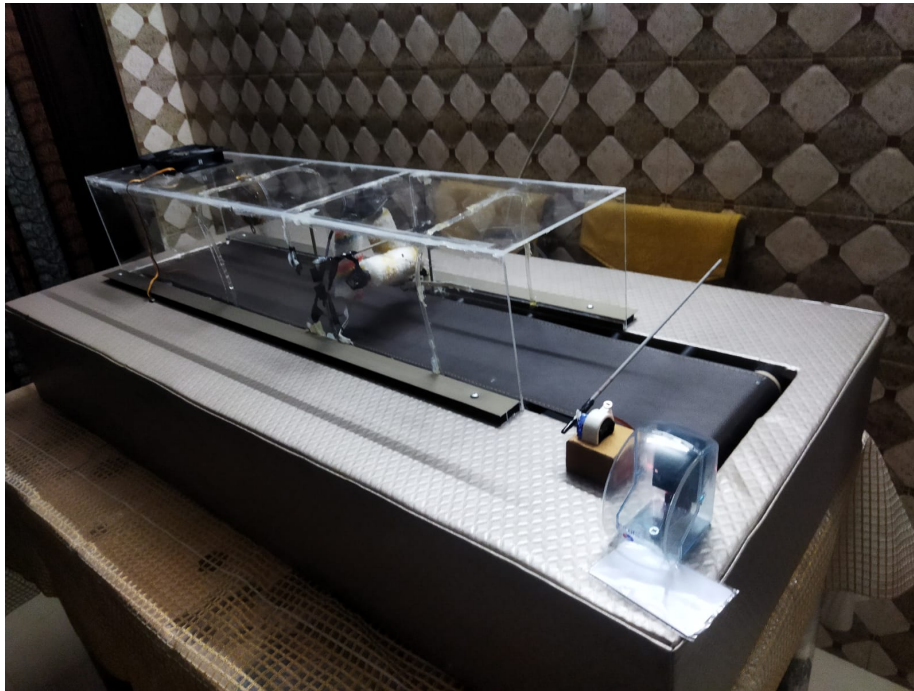


Figure 10: Structure

### 3.2.1 RFID Stage:

At the start of the belt, there is an RFID reader and antenna that scans the RFID tags affixed to the user's vehicle. The RFID reader communicates with the central control unit (Arduino Mega) to verify the user's identity and initiate the car washing process.



Figure 11: RFID usage

### 3.2.2 Water Splash Stage:

Following the RFID stage, the vehicle proceeds to the first water splash stage. Here, a water pump is activated, spraying a controlled amount of water onto the car's surface. This initial rinse is designed to remove loose dirt and debris, preparing the vehicle for the soap application.

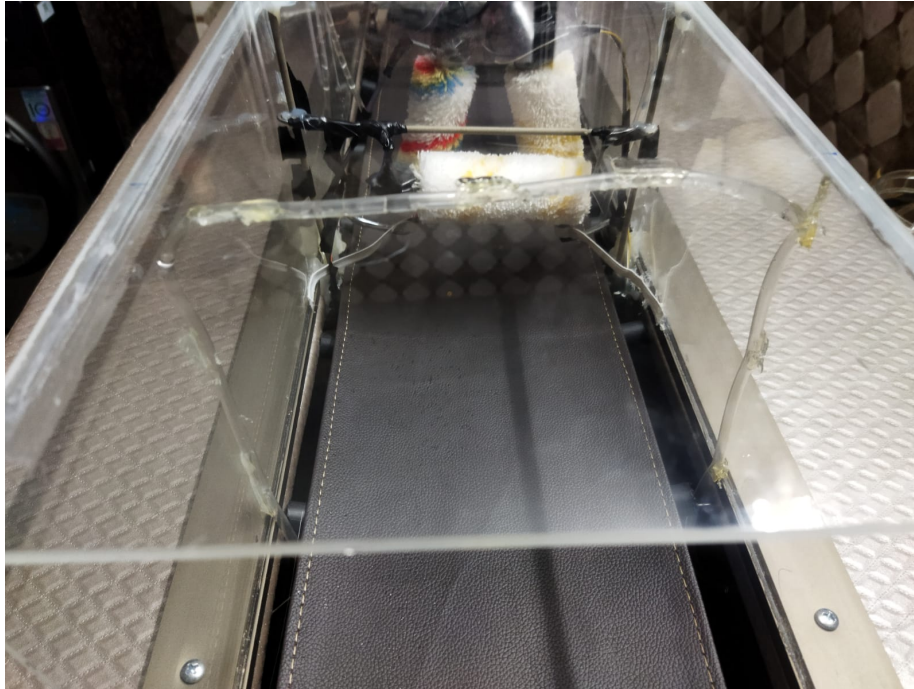


Figure 12: Water Splash

### 3.2.3 Soap Application Stage:

After the splash stage, the vehicle advances to the soap application stage. Another water pump is engaged, this time to distribute soap the car. The soap application ensures a thorough and effective cleaning process.

### 3.2.4 Roller Cleaning Stage:

Subsequently, the car moves to the roller cleaning stage. A cleaning roller equipped with brushes or other cleaning mechanisms rotates and makes contact with the car's surface. The roller, in combination with the soap, removes dirt, grime, and contaminants, leaving the vehicle clean and refreshed.

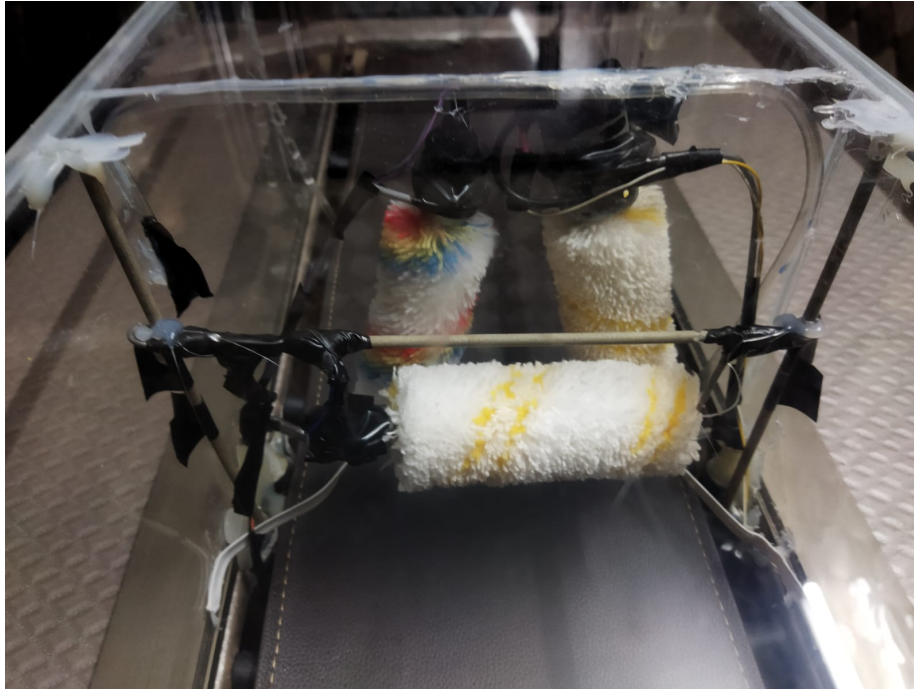


Figure 13: Soap Splash and Rollers

### 3.2.5 Water Splash Stage (Again):

Following the roller cleaning, the vehicle undergoes another water splash stage. This rinse removes the soap residue and any remaining dirt from the car's surface, ensuring spotless finish.

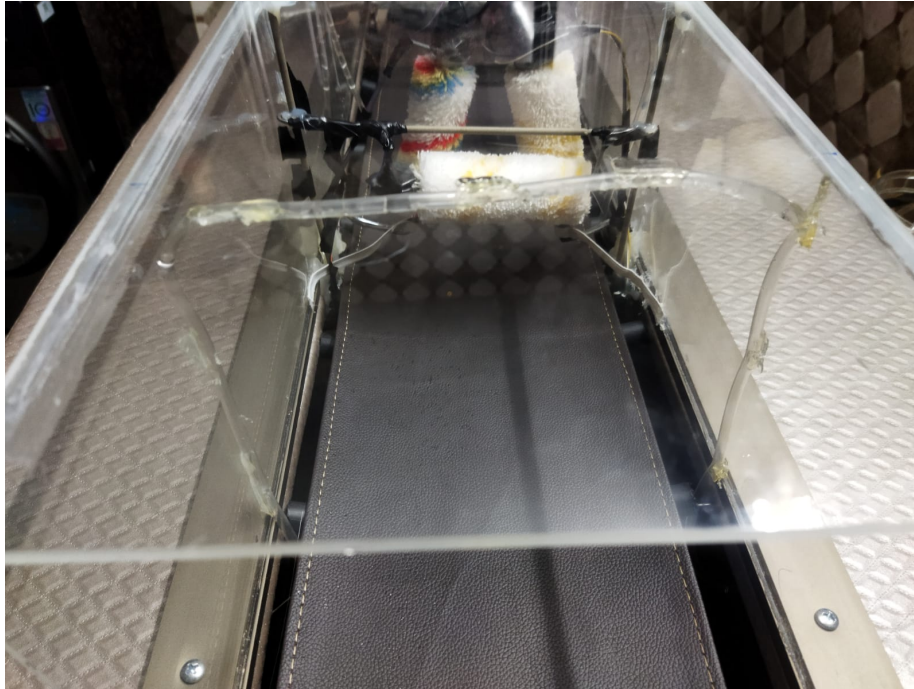


Figure 14: Water Splash

### 3.2.6 Drying Stage:

Finally, the car reaches the drying stage, where three powerful fans are activated. These fans blow high-velocity air onto the vehicle, efficiently drying it and preventing water spots. The drying stage completes the car washing process, leaving the vehicle clean, dry, and ready for use.

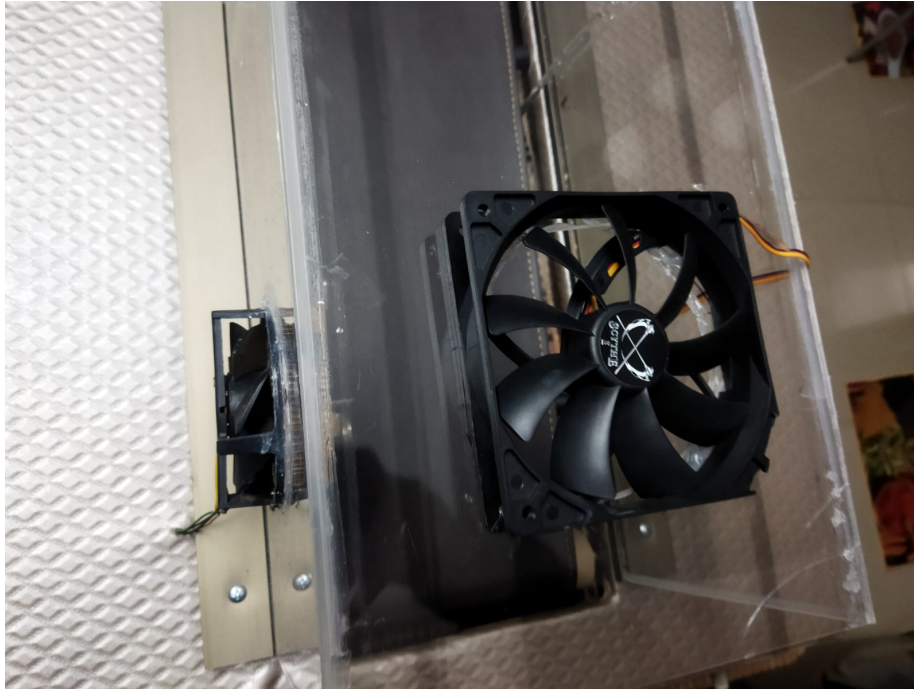


Figure 15: Drying Fans

### 3.2.7 Mobile Application

Over the system, there is a CAM that streams into the admin's page, providing a real time monitoring and watching for the purpose of monitoring the system .

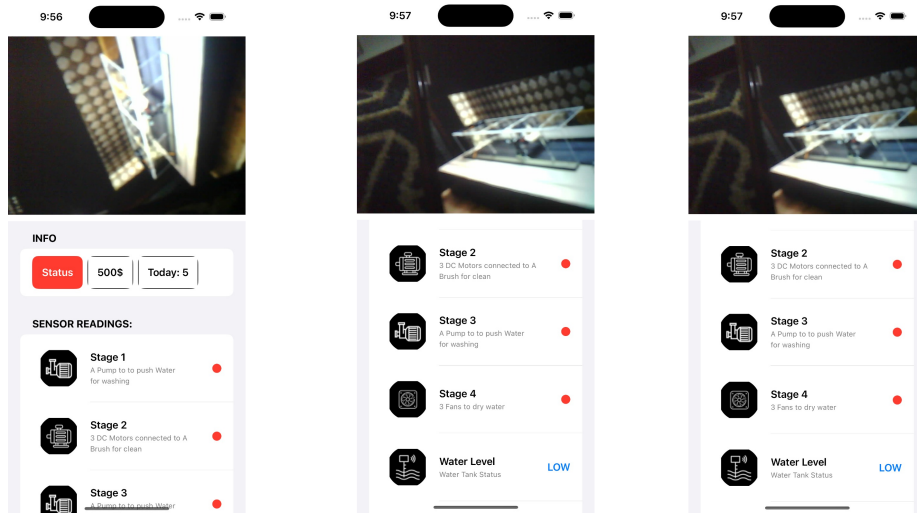


Figure 16: App UI

## 4 Results and Analysis

The implementation of our automated car washing system has yielded promising results across various key aspects. In the RFID Identification and Access Control stage, the system demonstrated robust performance with a high rate of successful RFID tag recognition, ensuring secure and exclusive access to the car wash facility. Moreover, our system excelled in optimizing resource usage, as evidenced by the efficient control of water and soap consumption. Comparative analysis with traditional manual car washing methods revealed a significant reduction in resource utilization, aligning with our sustainability objectives. The cleaning effectiveness of the system was also commendable, with vehicles emerging visibly cleaner, free from dirt, grime, and contaminants. Users reported a high level of satisfaction, praising the convenience and user-friendly interface of the automated car washing process. The drying efficiency, achieved through three powerful fans, proved effective in preventing water spots and expediting the drying process. Furthermore, the cost analysis underscored potential economic benefits for both car owners and businesses. The system's reliability and performance demonstrated consistent uptime, with minor technical issues that were promptly addressed. User feedback provided valuable insights for enhancements, and future updates will address these suggestions. Our system's positive environmental impact, driven by water conservation and eco-friendly cleaning agents, contributes to our commitment to environmental sustainability. In summary, our automated car washing system excels in resource efficiency, user satisfaction, and environmental responsibility, providing a superior alternative to traditional car washing methods.

## 5 Discussion

The primary problem addressed in this project was the inefficiency and inconvenience of traditional car washing methods. Our automated car washing system successfully resolves this problem by offering a streamlined, efficient, and user-friendly alternative. Users no longer need to expend physical effort, and the system minimizes water and soap wastage, contributing to resource conservation and cost-effectiveness.

Our project makes several significant contributions to the field of automated car washing systems. First and foremost, we introduce a comprehensive and eco-friendly approach that optimizes water and soap usage, aligning with the growing emphasis on environmental sustainability. Moreover, the system's consistent and high-quality cleaning results surpass traditional methods, while the powerful fans in the drying stage eliminate the need for manual drying and prevent water spots.

## 6 Conclusions

In summary, our automated car washing system has demonstrated remarkable success in addressing the challenges associated with traditional car washing methods. The key findings can be summarized as follows:

- **Efficiency and Convenience:** The system offers a more efficient and convenient car washing experience, reducing the need for manual effort and conserving resources.
- **Resource Optimization:** Through smart water and soap pumps, the system optimizes resource utilization, minimizing wastage and contributing to cost-effectiveness.
- **Cleaning Effectiveness:** The automated process consistently delivers high-quality cleaning results, surpassing the capabilities of manual washing methods.
- **User Identification and Security:** RFID technology enhances security and ensures user exclusivity, contributing to a safe and user-friendly car wash environment.
- **Drying Efficiency:** Powerful fans effectively dry vehicles, preventing water spots and eliminating the need for manual drying.
- **Cost Analysis:** The system offers potential cost savings for car owners and businesses, making it economically viable.

### 6.1 What we learnt

- Using Arduino to control our system.
- Make actions using Esp32-CAM (WIFI and Camera stream).
- How to build a full design hardware and software.

### 6.2 Future Work

- Make a mobile application for the user.
- Add payment process.