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Smart Car Covering System Using Embedded Technology

Ms. Shruti G. Chopade[1], Ms. Purva R. Sarode[2], Ms. Pranjali A. Kharche[3], Ms. Sakshi M. Narkhede[4] , Mr. Mahesh V. Shastri[5]

[1,2,3,4] *Student of polytechnic 3rd year, Computer Science & Engineering, Padmashri Dr.V.B.Kolte College of Engineering Malkapur, Maharashatra, India*

[5] *Head of Department, Computer Science & Engineering, Padm.Dr.V.B.Kolte College of Engineering Malkapur, Maharashatra, India*

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ABSTRACT

With the increasing availability of automobiles, protecting vehicles from environmental factors such as sunlight, rain, dust, mud, and minor scratches has become essential, especially in open parking conditions. Conventional car covers require manual effort, are time-consuming, and often inconvenient to use. To overcome these limitations, this project presents the design and development of an Automatic Smart Car Cover System that deploys and retracts itself automatically with minimal human intervention.

The proposed system utilizes an Arduino (ATmega328P) microcontroller as the central control unit, integrated with an HC-05 Bluetooth module to enable wireless operation through a smartphone application. Motorized mechanisms controlled via an L298N motor driver allow smooth and bidirectional movement of the car cover. The cover is stored compactly inside the vehicle's trunk and can be deployed or restored at the press of a button on the mobile application. Sensors such as IR or ultrasonic sensors can be incorporated to ensure obstacle detection and safe operation.

The system is designed using a lightweight yet durable covering material capable of protecting the vehicle from harsh weather conditions and minor physical damage. Real-time status updates and remote accessibility enhance user convenience, while the adaptable design allows compatibility with different car sizes and shapes. By automating the car covering process, the system reduces manual effort, improves vehicle safety, extends automobile lifespan, and minimizes maintenance costs. This project demonstrates a practical and cost-effective smart parking solution, with future scope for weather-based automation and enhanced sensor integration.

Keywords:- Automatic Car Cover, Bluetooth Control, Arduino, HC-05 Module, L298N Motor Driver, Smart Parking System, Vehicle Protection

1. INTRODUCTION

A car cover plays a vital role in protecting a vehicle from environmental factors such as dust, sunlight, humidity, rain, bird droppings, and chemical pollutants, which can damage the exterior paint and interior materials over time. In humid and coastal regions, prolonged exposure accelerates corrosion and reduces vehicle lifespan. Car covers also act as a security measure by concealing the vehicle and discouraging theft.

However, traditional car covers require significant manual effort and are time-consuming to use, leading many users to avoid regular application. To overcome these limitations, the proposed Automatic Smart Car Cover System automates the covering process using an Arduino microcontroller, Bluetooth (HC-05) communication, and a

motorized mechanism controlled by an L298N driver. The system enables easy deployment and retraction of the cover through a smartphone, reducing manual effort while enhancing convenience, efficiency, and vehicle protection. The proposed system emphasizes durability, energy efficiency, and user-friendliness while ensuring compatibility with different car sizes. Sensor-based feedback mechanisms ensure precise control and prevent mechanical damage. By automating a traditionally manual task, the system reduces effort, saves time, enhances vehicle protection, and improves overall user experience. This project represents a practical application of embedded systems and wireless technology, offering a smart and affordable solution for modern vehicle maintenance, especially in urban environments with unpredictable weather conditions.

1.1 Objective

An objective of the Project is:

- To design and develop an automatic car cover system that protects vehicles from environmental factors such as sunlight, rain, dust, humidity, and minor physical damage.

- To reduce manual effort and time consumption involved in traditional car covering and uncovering processes by automating the entire mechanism.
- To implement wireless control using Bluetooth technology, enabling users to deploy and retract the car cover remotely through a smartphone application.
- To utilize an Arduino microcontroller as the central control unit for processing commands and managing the coordinated operation of motors and sensors.
- To ensure smooth and reliable motor operation using an L298N motor driver for controlled and bidirectional movement of the car cover.
- To incorporate sensor-based feedback mechanisms to detect the fully opened and fully closed positions, ensuring precise operation and preventing mechanical damage.
- To design a compact, lightweight, and durable mechanism that can be conveniently integrated into a vehicle without affecting its usability or aesthetics.
- To improve vehicle safety and longevity by minimizing exposure to harmful environmental elements and reducing wear on exterior paint and interior materials.
- To develop an energy-efficient system suitable for daily use without excessive power consumption.
- To provide a cost-effective and user-friendly solution that can be adapted for different vehicle sizes and parking conditions, especially in urban environments.

2. BLOCK DIAGRAM

The block diagram of the Automatic Smart Car Cover System consists of a power supply, Arduino microcontroller, Bluetooth module, sensors, motor driver, and motorized cover mechanism. The power supply provides energy to all components. The Arduino acts as the main control unit, receiving commands from the smartphone through the HC- 05 Bluetooth module and processing sensor inputs. Based on these signals, the Arduino controls the servo motor driver, which drives the motor to deploy or retract the car cover smoothly. Sensors provide feedback to ensure accurate and safe operation of the system.

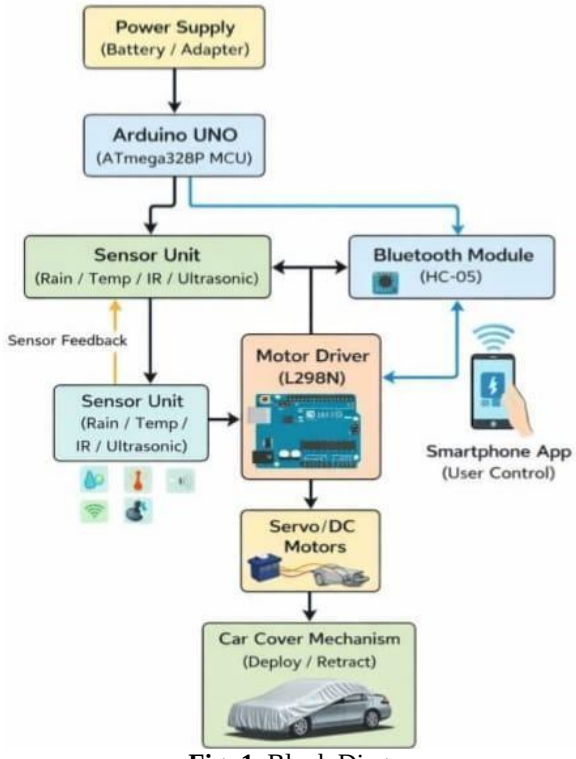

Fig -1: Block Diagram

3. HARDWARE AND SOFTWARE COMPONENTS

➢ Hardware Components

1. Arduino UNO – Controls the overall system.
2. Rain Sensor – Detects rainfall.
3. DHT11 Sensor – Measures temperature and humidity.
4. Servo Motor (SG90) – Moves the car cover.

5. Bluetooth Module (HC-05) – Enables wireless control.
6. 16×2 LCD – Displays system status.
7. Voltage Regulator (LM2596) – Maintains stable voltage.
8. Power Supply (12V Adapter) – Supplies power to the system.

➢ Software Components

1. Arduino IDE – Used for coding and uploading programs.
2. Embedded C / Arduino Language – Implements control logic.
3. Bluetooth Mobile App – Used for manual operation.
4. Windows OS – Development and testing platform.

4. WORKING

The system works in a series of steps:

1. System Initialization
2. The system is powered on using a battery or the vehicle's electrical supply, activating the Arduino microcontroller and all connected components.
3. User Command
4. The user sends a signal to either deploy or retract the car cover through a smartphone application.
5. Bluetooth Signal Reception
6. The HC-05 Bluetooth module receives the command and transmits it to the Arduino for processing.
7. Command Processing
8. The Arduino interprets the command and determines whether the cover should extend or retract.
9. Motor Control
10. The Arduino sends control signals to the L298N motor driver, which regulates the motor's direction and speed.
11. Cover Movement
12. The motor moves the car cover to either deploy it over the vehicle or retract it into the trunk.
13. Sensor Feedback
14. Sensors such as limit switches or IR sensors detect when the cover has fully opened or closed.
15. Motor Stop
16. The Arduino stops the motor once the cover reaches its intended position to prevent overrun or mechanical damage.
17. Operation Complete
18. The vehicle is now either protected with the cover deployed or ready for use with the cover retracted, all automatically with minimal manual effort.

5. ADVANTAGES

- Reduces manual effort
- Saves time
- Protects from rain, dust, and sunlight
- Prevents paint fading and scratches
- Wireless Bluetooth control
- Energy efficient
- Improves vehicle safety
- Cost-effective solution

6. CONCLUSIONS

The Automatic Smart Car Cover System provides an efficient and convenient solution for protecting vehicles from environmental hazards such as dust, rain, sunlight, and humidity, while also offering additional security benefits. By integrating an Arduino microcontroller, Bluetooth communication, motor drivers, and sensors, the system automates the deployment and retraction of the car cover, significantly reducing manual effort and time. Its compact, durable, and energy-efficient design ensures compatibility with various vehicle sizes and smooth operation. This project demonstrates how embedded systems and wireless technology can be applied to everyday tasks, enhancing user convenience, preserving vehicle aesthetics, and extending the lifespan of automobiles. Overall, the system offers a practical, innovative, and cost-effective approach to modern vehicle maintenance and protection.

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