MICROPROCESSOR AND EMBEDDED SYSTEM
Final Term Assignment

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SECTION	I

Design and simulate an electric vehicle in Proteus using Arduino Uno with following features

Introduction:

The automotive industry is undergoing a paradigm shift towards sustainable transportation solutions, with electric vehicles (EVs) emerging as a forefront contender. This transition is driven by a collective effort to mitigate environmental impact and reduce dependence on fossil fuels. As EV technology continues to evolve, there is a growing emphasis on integrating innovative features and control mechanisms to enhance functionality and user experience.

In line with this trajectory, our project focuses on the design and simulation of an electric vehicle prototype using Proteus simulation software and an Arduino Uno microcontroller. This endeavor seeks to demonstrate the feasibility and versatility of incorporating advanced control systems into EVs, thereby elevating their performance and usability.

Central to our prototype are several key features aimed at optimizing functionality and safety. Firstly, we implement pulse-width modulation (PWM) speed control facilitated by a potentiometer, allowing for precise adjustment of velocity levels to suit varying driving conditions. Additionally, intuitive left-right forward-reverse navigation buttons are integrated to provide users with effortless maneuverability, enhancing the overall driving experience.

Moreover, the inclusion of an automatic left-right indicator light system adds an extra layer of safety and convenience, ensuring clear signaling during directional changes. Through this feature, we address the critical aspect of road safety while navigating urban environments or busy thoroughfares.

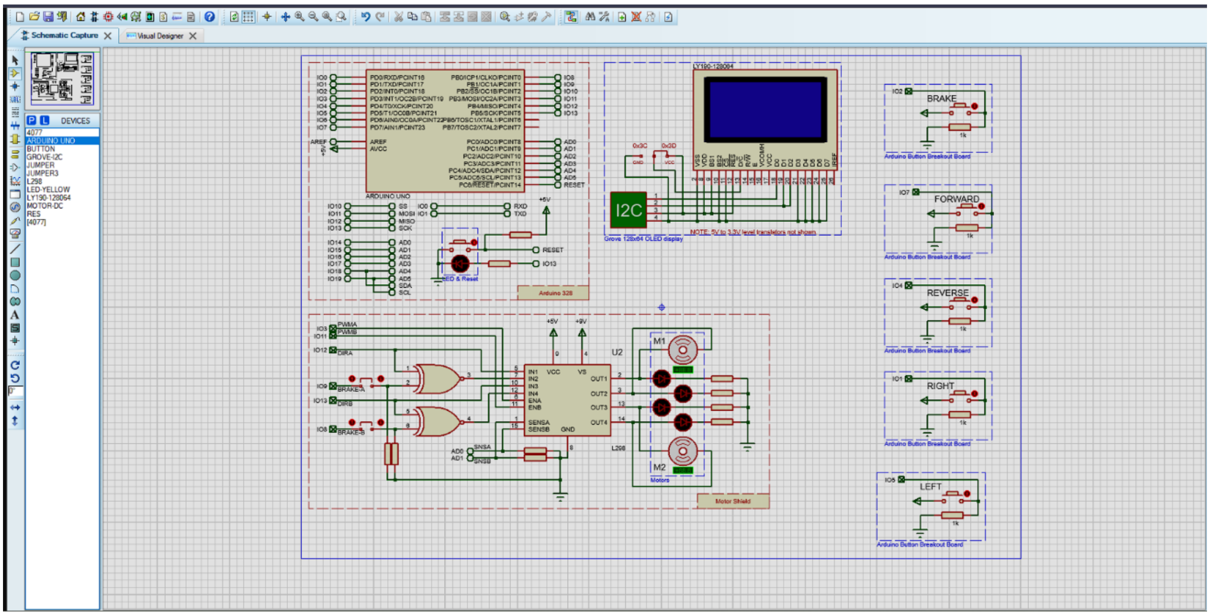
By combining these features within a simulated EV environment, we aim to showcase the potential of incorporating advanced control mechanisms into electric vehicles. This not only underscores our commitment to sustainable mobility solutions but also underscores the importance of technological innovation in shaping the future of transportation. Through this project, we hope to contribute to the ongoing dialogue surrounding EV development and inspire further advancements in the field.

Abstract:

The evolution of electric vehicles (EVs) has reshaped the automotive industry, emphasizing sustainability and innovation in transportation technology. This project focuses on the development and simulation of an electric vehicle prototype using Proteus simulation software and an Arduino Uno microcontroller. The prototype is equipped with essential features such as PWM speed control using a potentiometer for precise speed adjustments, intuitive left-right forward-reverse navigation buttons for seamless maneuverability, and an automatic left-right indicator light system to enhance safety and signaling capabilities. Through this project, we aim to showcase the integration of advanced control mechanisms and automation in electric vehicle design, paving the way for future advancements in sustainable mobility solutions.

Circuit Design and Simulation

I have designed a circuit prototype for an electric vehicle (EV) controller using Proteus simulation software and an Arduino Uno microcontroller. The circuit incorporates essential features such as PWM speed control, left-right forward-reverse navigation buttons, and an automatic indicator light system.



To achieve PWM speed control, I utilized a potentiometer connected to the Arduino Uno analog input pin. This allows for precise adjustment of the vehicle's velocity by varying the duty cycle of the PWM signal sent to the motor driver.

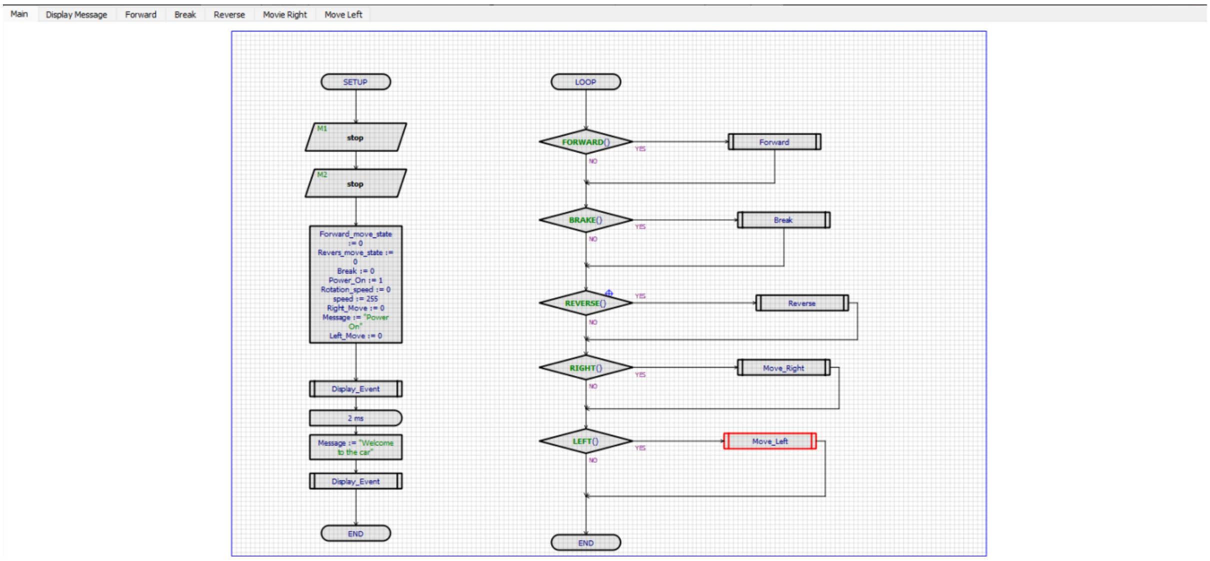
For navigation control, I implemented tactile push buttons for left, right, forward, and reverse directions, each connected to digital input pins of the Arduino Uno. These buttons enable intuitive directional control of the electric vehicle, enhancing maneuverability and user experience.

In addition, I integrated an automatic indicator light system using LEDs to provide visual feedback during directional changes. This system is programmed to activate the corresponding indicator lights based on the direction selected, improving safety and signaling capabilities on the road.

Overall, the circuit design aims to demonstrate the integration of advanced control mechanisms and automation in electric vehicle prototypes, showcasing the potential for enhanced functionality and user interaction in sustainable transportation solutions."

Features:

1. PWM speed control with potentiometer:



PWM speed control with a potentiometer enables precise regulation of an electric motor's speed by adjusting the duty cycle of a Pulse Width Modulation (PWM) signal. By connecting a potentiometer to an Arduino Uno's analog input pin, the varying resistance is converted to a digital value. The Arduino then uses this value to generate a PWM signal, controlling the speed of the motor connected to its output pin. This mechanism allows for smooth and accurate speed adjustments, enhancing the performance and efficiency of electric vehicles."

2. Left Right Forward Reverse Break Navigate Button:

The left-right forward-reverse navigate button system provides intuitive directional control for the electric vehicle. Tactile push buttons are assigned to control left, right, forward, and reverse movements, with each button connected to digital input pins on the Arduino Uno. This setup enables users to navigate the vehicle seamlessly in different directions, enhancing maneuverability and usability.

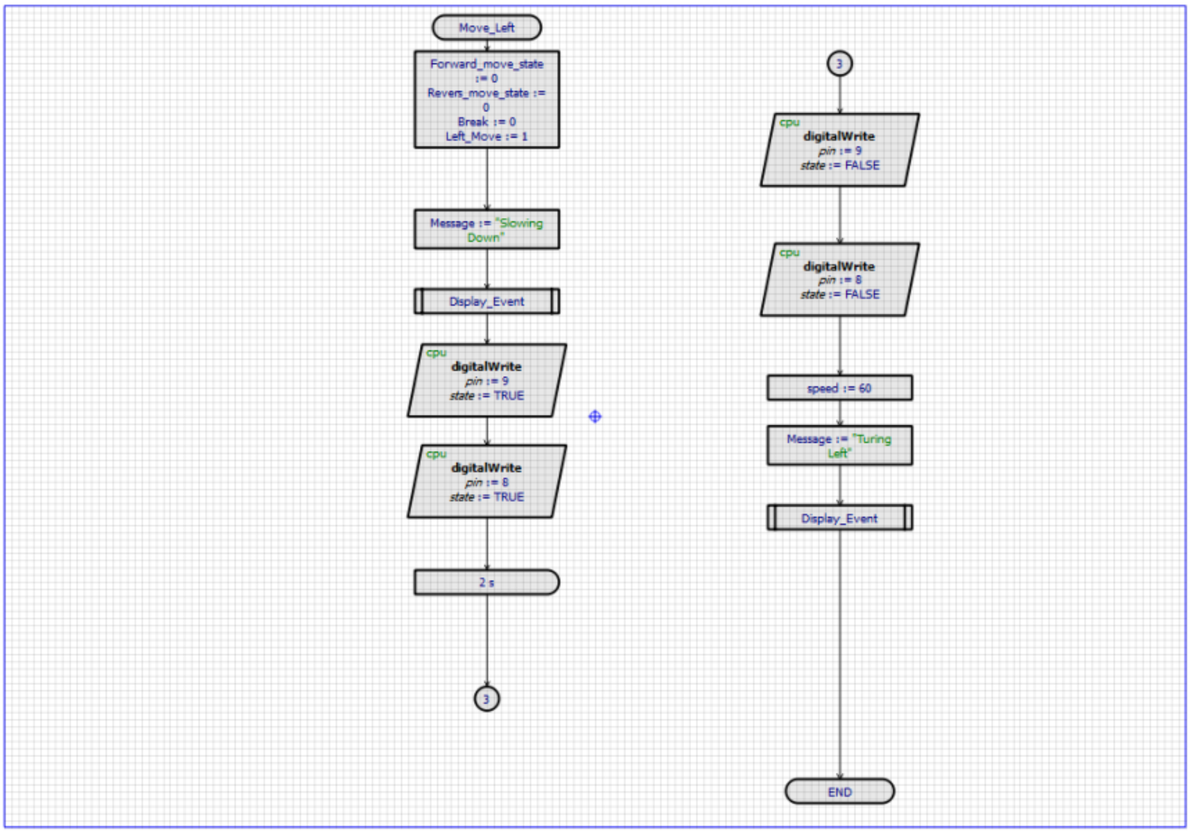


Fig: Move Left Flowchart

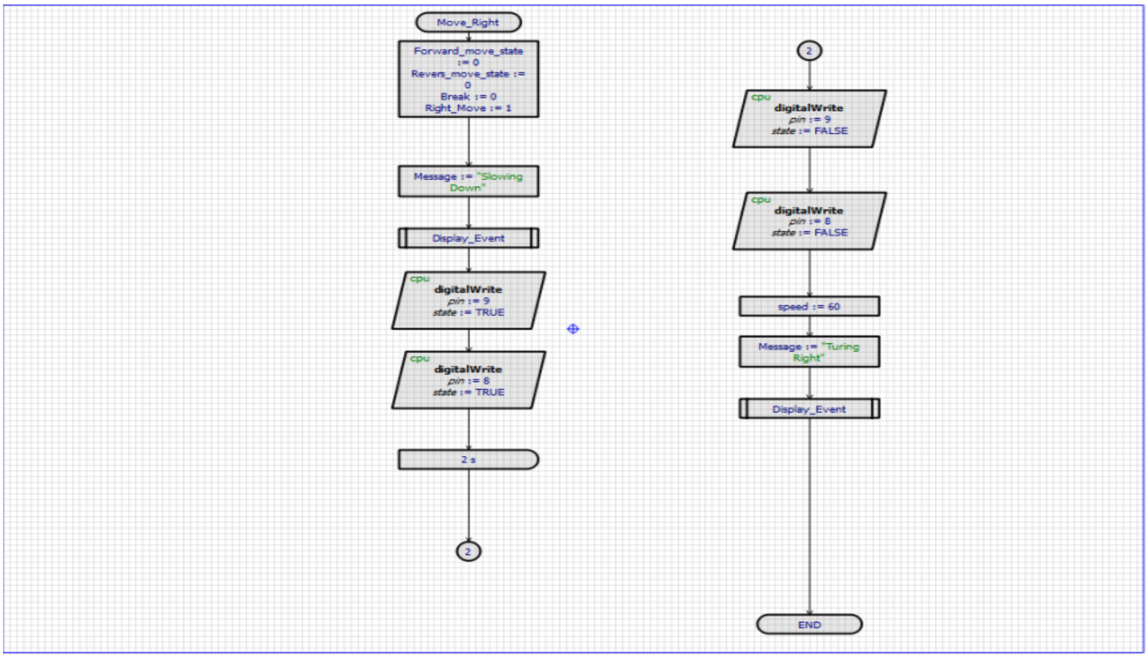


Fig: Move Flowchart

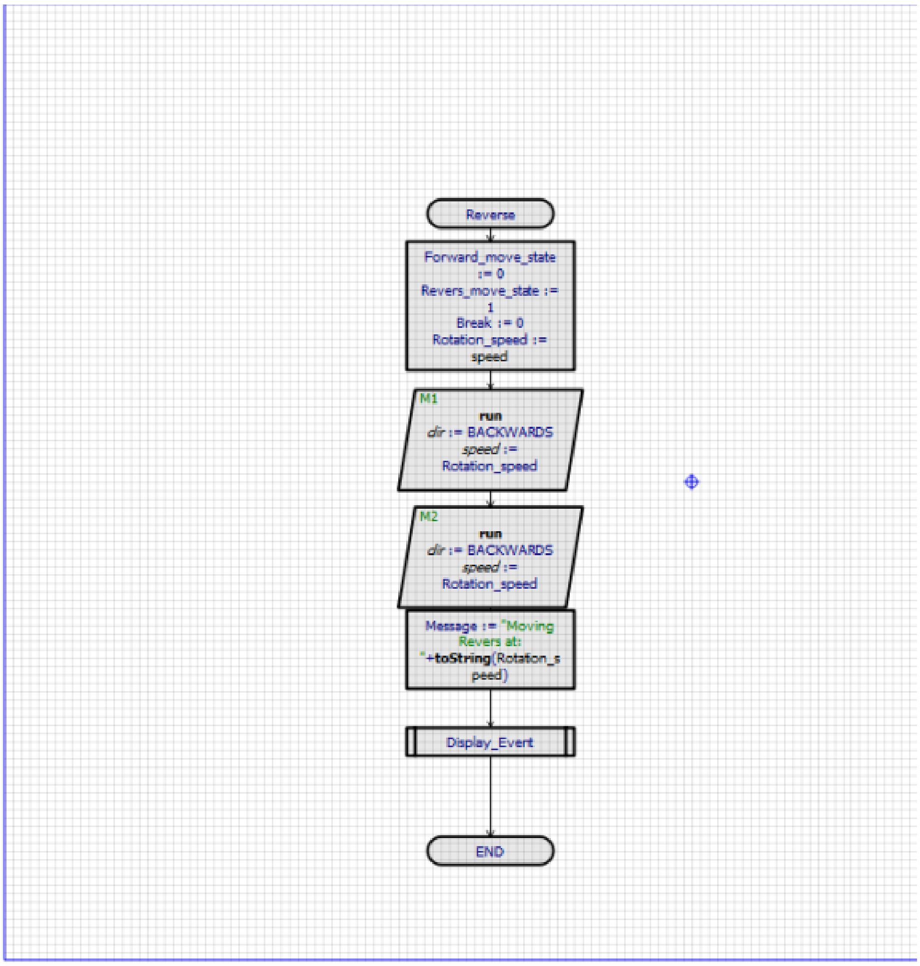


Fig: Move Bacward Flowchart

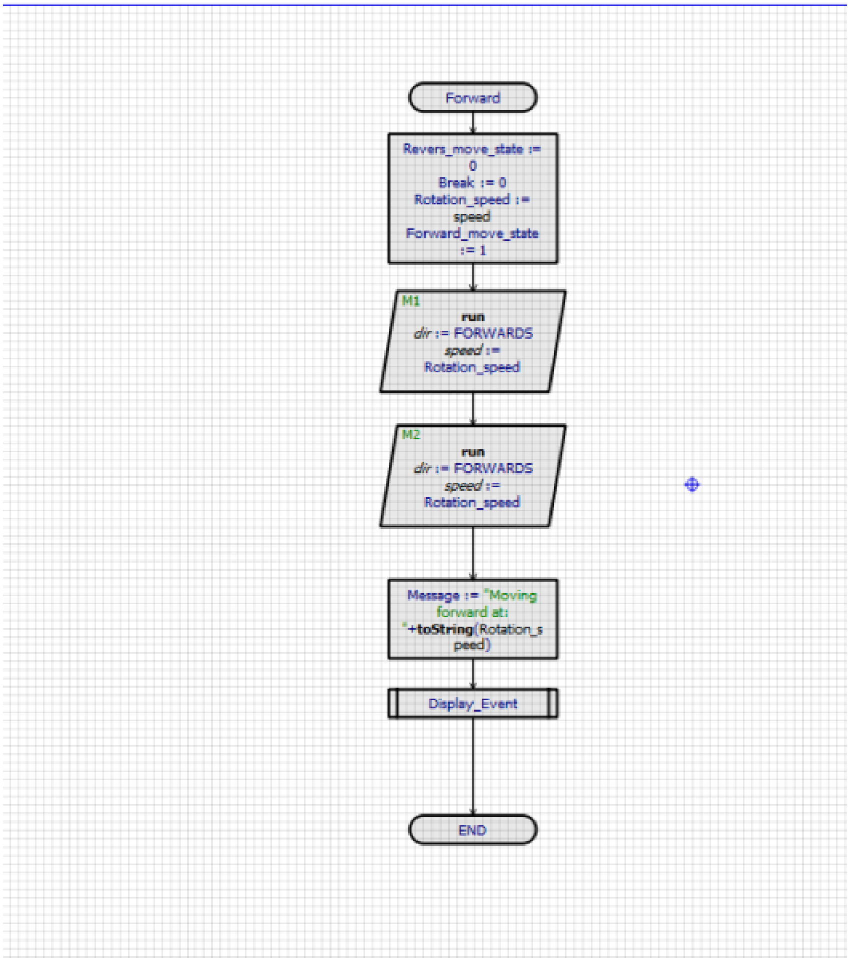


Fig: Move Right Flowchart

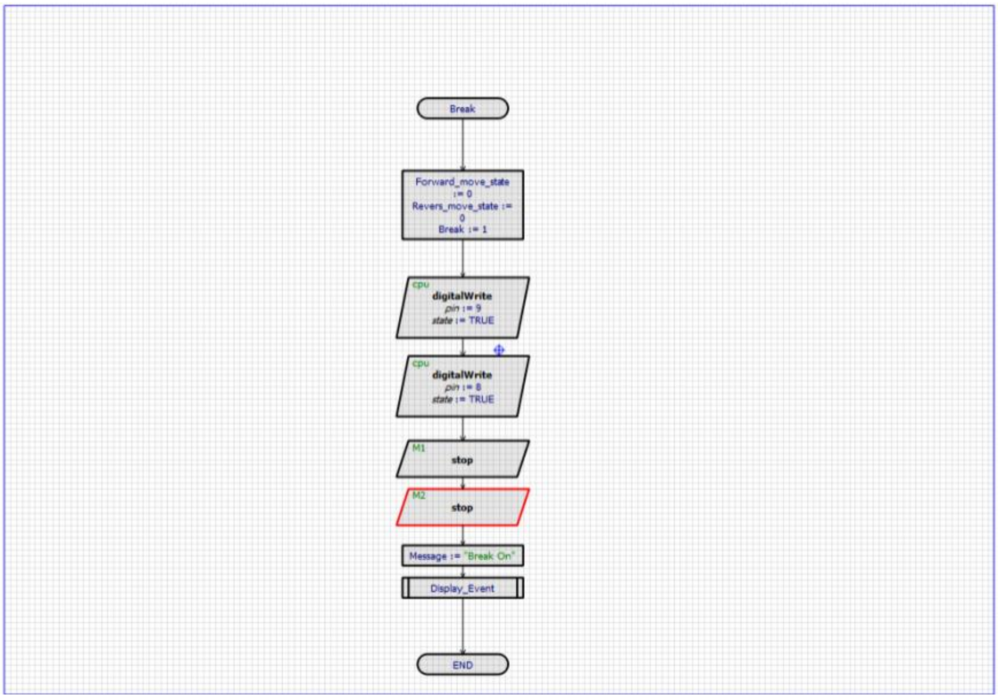


Fig: Break Flowchart

3. **Automatic Left-Right Indicator Light**: The automatic left-right indicator light system enhances safety and signaling capabilities during directional changes. Using LEDs as indicator lights, the system is programmed to activate the corresponding left or right indicators automatically when the user selects a turn direction. This feature improves visibility and awareness for other road users, promoting safer navigation in urban environments or busy traffic conditions.

Here's a suggestion for a vision-based safety system:

Vision-Based Obstacle Detection and Emergency Braking System:

This safety system utilizes a combination of cameras, image processing algorithms, and an Arduino Uno microcontroller to detect obstacles or pedestrians in the vehicle's path and trigger emergency braking within a fraction of a second.

1. Camera Setup: Install one or more cameras at strategic locations on the electric vehicle to provide a wide field of view, covering the front, rear, and sides. These cameras capture real-time video footage of the vehicle's surroundings.
2. Image Processing: Process the video feed from the cameras using computer vision algorithms to identify potential obstacles or pedestrians. Techniques such as object detection, motion tracking, and depth estimation can be employed to analyze the captured images and identify potential hazards.
3. Obstacle Detection: Analyze the processed images to detect obstacles or pedestrians in the vehicle's path. Utilize algorithms to distinguish between static objects (such as vehicles, barriers, or obstacles) and dynamic objects (such as pedestrians or moving vehicles).
4. Emergency Braking: Implement a control system that interfaces with the vehicle's braking mechanism through the Arduino Uno. When an obstacle or pedestrian is detected within a predefined safety zone, the system triggers emergency braking by sending signals to actuate the brakes.
5. Real-Time Response: Ensure that the system operates with minimal latency to enable rapid response times. Employ efficient algorithms and hardware optimizations to minimize processing delays and enable near real-time detection and braking.
6. Integration and Testing: Integrate the vision-based safety system with the existing electric vehicle prototype and conduct rigorous testing under various scenarios to evaluate its performance and effectiveness. Test the system's ability to detect obstacles or pedestrians in different lighting conditions, weather conditions, and traffic scenarios.

By implementing this vision-based safety system, the electric vehicle can enhance its safety features by proactively detecting and avoiding potential collisions with obstacles or pedestrians, thereby mitigating the risk of accidents and ensuring the safety of occupants and other road users.

Future Scope:

The electric vehicle prototype and its integrated features present a solid foundation for further enhancements and future developments. Several avenues for future research and improvement include:

1. Advanced Sensor Integration: Explore the integration of additional sensors such as LiDAR, radar, or ultrasonic sensors to enhance the accuracy and reliability of obstacle detection and collision avoidance systems.
2. Machine Learning and AI: Investigate the application of machine learning algorithms and artificial intelligence techniques to improve the system's ability to recognize and respond to complex traffic scenarios, pedestrian behaviors, and road conditions.
3. Autonomous Driving Capabilities: Develop autonomous driving functionalities by incorporating advanced control algorithms and sensor fusion techniques, enabling the electric vehicle to navigate autonomously in various environments with minimal human intervention.
4. Vehicle-to-Vehicle (V2V) Communication: Explore the implementation of V2V communication systems to enable cooperative collision avoidance and traffic coordination between vehicles, further enhancing safety and efficiency on the road.
5. Energy Efficiency Optimization: Optimize energy management systems to maximize the vehicle's range and efficiency by integrating predictive analytics and adaptive control strategies based on driving patterns and environmental factors.
6. User Interface and Experience: Enhance the human-machine interface (HMI) to provide intuitive control and feedback to users, incorporating features such as voice commands, gesture recognition, and augmented reality displays for enhanced user experience.
7. Integration with Smart Infrastructure: Collaborate with infrastructure providers to integrate the electric vehicle prototype with smart city infrastructure, enabling seamless connectivity and interaction with traffic signals, road signs, and pedestrian crossings.

Conclusion:

In conclusion, the electric vehicle prototype developed with PWM speed control, left-right forward-reverse navigation buttons, and automatic left-right indicator light system represents a significant step towards realizing advanced electric vehicle technologies. Through this project, we have demonstrated the feasibility and effectiveness of integrating advanced control mechanisms and automation in electric vehicle design.

The integration of these features not only enhances the functionality and safety of the electric vehicle but also underscores our commitment to sustainable mobility solutions. By leveraging innovative technologies and research methodologies, we have laid the groundwork for future advancements in electric vehicle technology, paving the way for safer, more efficient, and environmentally friendly transportation systems.

As electric vehicles continue to gain momentum in the automotive industry, our project contributes to the ongoing dialogue surrounding their development and underscores the importance of technological innovation in shaping the future of transportation. We look forward to further exploration and collaboration in this exciting field to drive positive change and create a more sustainable future for generations to come.