**2. Project Objectives and Scope:**

The primary objective of this project is to design and

develop an autonomous robotic vehicle capable of navigating

dynamic environments using a sensor-driven control system.

The following key goals guide the design and implementation

phases:

• Autonomous Lane Following: Develop a reliable lane-

following mechanism using Infrared (IR) sensors. The

system should be capable of detecting and tracking pre-

defined lanes with precision, including handling curves

and intersections effectively.

• Obstacle Detection and Avoidance: Integrate ultrasonic

sensors to facilitate real-time obstacle detection. The

robotic vehicle should be able to measure distance to

nearby objects and initiate avoidance maneuvers au-

tonomously to prevent collisions.

• Color-Based Decision Making: Implement a color

recognition system to classify and respond to different

types of obstacles. For example, red objects may signal a

full stop, while green may indicate a clear path or require

an alternate route. This enables dynamic and context-

aware navigation.

• Modular and Power-Efficient Design: Design the hard-

ware to be modular, allowing easy replacement and

testing of individual components. Power efficiency will

be emphasized to prolong operational time, utilizing op-

timized power management strategies across all modules.

Scope of the Project

This project encompasses both hardware and embedded

software development, with a strong emphasis on reliability,

sensor fusion, and system integration. Key aspects of the scope

include:

• Hardware Integration and Mechanical Design: Selec-

tion, configuration, and interfacing of sensors (IR and

ultrasonic), motor drivers, microcontrollers, and power

supply units. Custom mechanical components—such

as sensor holders, battery enclosures, and structural

frames—were designed using SolidWorks. This CAD-

based approach allowed for accurate measurements, mod-

ularity, and efficient assembly of all physical parts.

• Software Development: Development of embedded

firmware to process sensor data, control actuators, and

execute decision-making algorithms. Emphasis will be

placed on efficient code structure, interrupt-driven design,

and real-time responsiveness.

• System Testing and Validation: Rigorous testing will

be conducted to evaluate the system’s performance under

different environmental conditions. This includes assess-

ing the accuracy of lane-following, obstacle detection

range, decision logic correctness, and overall system

robustness.

• Scalability and Extensibility: While the initial prototype

will demonstrate core functionalities, the system will be

designed with future enhancements in mind, including

potential wireless communication, machine learning in-

tegration, or advanced navigation algorithms.

In summary, this project aims to deliver a functional,

intelligent robotic vehicle by effectively integrating sensing,

decision-making, mechanical design, and control into a uni-

fied, modular, and energy-efficient system.