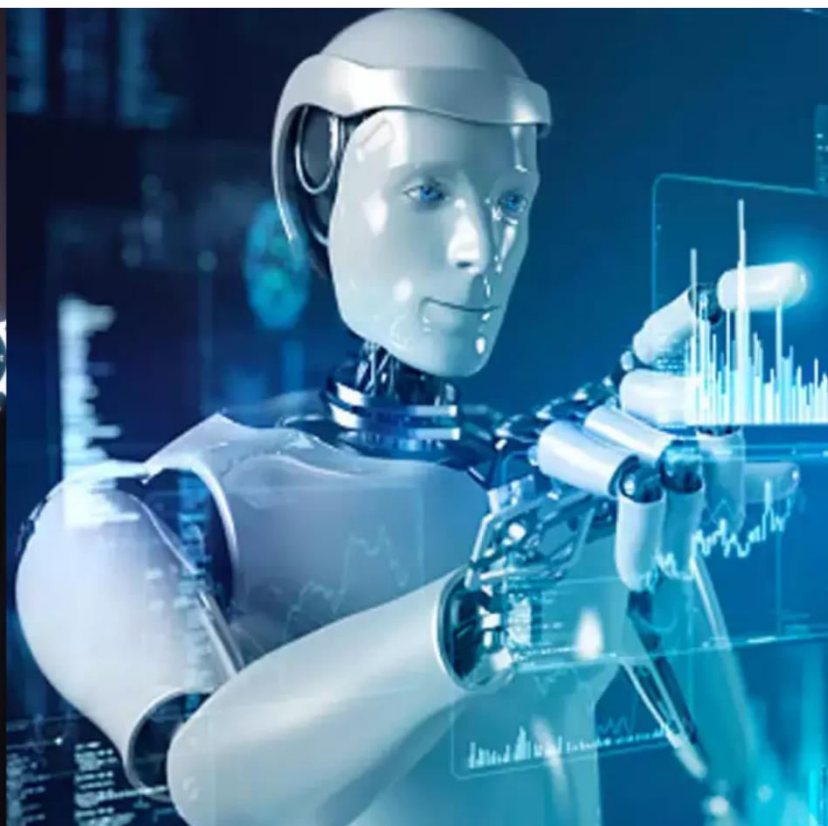




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Railbus-Green Mass Transportation System

Anuj Chandrakant Patil, Shreyash Santaji Dhage, Shantanu Madhukar Khade, Prof. Ajinkya B. Patil

Student, Department of Electrical Engineering, NMCOE, Peth, India

Student, Department of Electrical Engineering, NMCOE, Peth, India

Student, Department of Electrical Engineering, NMCOE, Peth, India

Assistant Professor, Department of Electrical Engineering, NMCOE, Peth, India

ABSTRACT: The growing demand for sustainable and energy-efficient transportation systems has prompted the exploration of innovative technologies that reduce dependency on fossil fuels and lower environmental impact. This study presents the design and development of a Solar-Powered Arduino-Based Rail Bus System aimed at providing an eco-friendly and cost-effective alternative for rural and urban short-distance transit. The system integrates photovoltaic solar panels to harness renewable energy, stored in high-capacity batteries, which powers the rail bus and its onboard systems. An Arduino microcontroller is employed as the central processing unit, managing various operations including speed regulation, direction control, obstacle detection, automated station halting, and passenger safety monitoring. Sensor arrays and motor drivers enable precise automation and real-time decision-making, ensuring reliable and efficient transportation.

I. INTRODUCTION

Transportation is a cornerstone of modern society, facilitating the movement of people and goods. However, traditional transportation systems heavily rely on fossil fuels, contributing to environmental degradation, climate change, and resource depletion. The increasing global emphasis on sustainability and clean energy has motivated researchers and educators to explore renewable energy solutions within transportation systems.

The Rail Bus project is a small-scale representation of a solar-powered transport vehicle operating on a dedicated rail system. It integrates solar energy harvesting with automation using Arduino microcontroller technology. The project demonstrates the practical application of green energy and embedded systems in transportation engineering, making it an excellent model for educational and research purposes.

II. LITERATURE SURVEY

The paper focuses on solar-powered trains, highlighting their environmental benefits, energy independence, and integration with existing rail infrastructure for sustainable transportation. [1] This paper focuses on designing a renewable energy-powered automatic railway crossing system in Bangladesh, utilizing infrared sensors and sustainable energy solutions. [2] It focuses on real-time decision support for battery-electric buses (BEBs) and their integration with renewable energy generators (REGs) for sustainable public transport. [3] It focuses on the design and performance evaluation of a solar-powered electric freight train for the Sudanese transport market, emphasizing automation and efficiency. [4] It focuses on integrating solar energy with IoT for railway applications, including solar panels on sleepers and real-time monitoring systems. [5] It focuses on integrating solar energy with IoT for railway systems, emphasizing sustainability through solar panels on railway sleepers and real-time monitoring. [6]

III. METHODOLOGY

The methodology of the Railbus project involves a multi-phase approach to developing a sustainable and efficient urban transport system. It begins with a feasibility study that assesses population density, travel patterns, and infrastructure capacity in target cities. Based on this data, engineers design lightweight, solar-powered carriages that run on elevated tracks, minimizing ground-level traffic disruption. Autonomous operation technology is integrated to reduce human error and operational costs. Pilot testing follows, ensuring the system's safety, reliability, and energy

efficiency under real-world conditions. Stakeholder engagement, including local governments and environmental agencies, ensures regulatory compliance and public support throughout the implementation process.

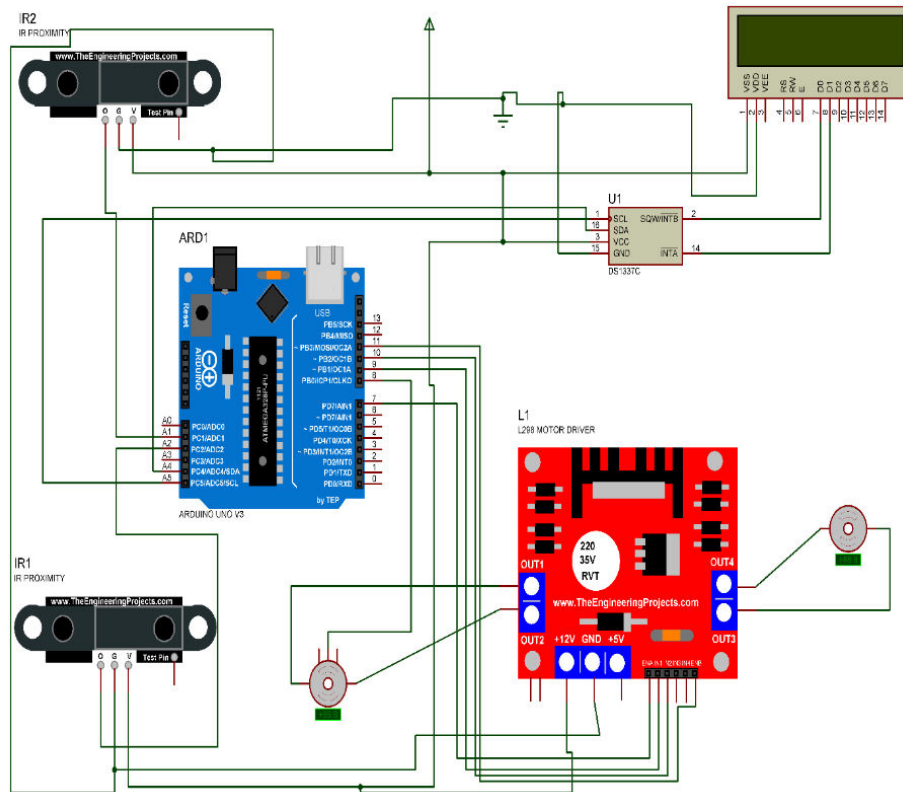


Fig: Simulated Circuit Diagram

IV. OBJECTIVES

- To design a rail bus system that is lightweight, energy-efficient, and suitable for operation on existing railway tracks.
- To develop a functional prototype of the rail bus, incorporating safety features and compliance with relevant regulations.
- To evaluate the performance of the rail bus under various operational conditions.
- To conduct an economic analysis of the rail bus system, assessing its feasibility for large-scale implementation.
- To assess the environmental impact of the rail bus system in comparison to traditional transportation methods.

V. RESULTS AND DISCUSSION

Track Movement: The rail bus moved steadily along a 2-meter track with good traction. **Obstacle Detection:** Magnet sensor reliably stopped the vehicle when a simulated obstacle (magnet) was placed beneath the track. **Reversing Logic:** Arduino correctly executed reversal code at the end-of-track position. **Solar Efficiency:** Continuous motion was possible in full sun with the assistance of a small 9V rechargeable backup battery.

The project demonstrates that solar energy can power low-load transportation systems using efficient energy harvesting and lightweight automation. Arduino's programmable control, paired with real-time sensor feedback, enables fully automated transit behaviour in a cost-effective manner.



Fig: Railbus Model

VI. CONCLUSION

The Solar-Powered Arduino Rail Bus offers a compact and sustainable solution to energy-efficient transportation. While primarily developed for academic and exhibition purposes, it carries significant implications for future green transit systems. The project not only demonstrates the potential of solar energy in motion systems but also the accessibility of Arduino-based automation for all levels of learners. Its success underlines the importance of integrating renewable energy with intelligent systems and opens doors to advanced prototyping in smart mobility.

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