Sky Bus with Wireless Charging Using Solar Energy

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***Abstract*—The increasing traffic congestion in cities due to population growth and improper urban planning necessitates innovative transportation solutions. The proposed Sky Bus system offers a unique mass transit solution that can be deployed in congested urban areas, providing efficient and safe transportation without adding to traffic congestion. The Sky Bus operates on an elevated track with cars suspended below, offering a design that minimizes the risk of accidents or collisions. It is an eco-friendly and noise-free mode of transportation, making it an attractive option for urban mobility. This autonomous Sky Bus model is designed to shuttle passengers between three busy points continuously, reducing ground space utilization and alleviating traffic congestion on busy roads. The hanging compartments are equipped with special metal wheels driven by DC motors, ensuring precise movement and safety for passengers. Sensors identify destination points, allowing the coach to halt precisely at the designated locations. Mechanized doors controlled by servo motors ensure passenger safety and ease of access. The doors open automatically upon reaching the platform and remain open for a specific duration before closing. The demo module utilizes electro-mechanical components and is driven by DC motors with reduction gear mechanisms for efficient load handling. An Arduino microcontroller and H-Bridge IC control circuitry ensure smooth operation.**
Power is supplied by a rechargeable 12V battery, which is charged wirelessly from solar panels, highlighting the project's focus on sustainable energy solutions. Wireless power transmission technology enables efficient energy transfer without the need for conventional conductors. The Sky Bus system presents a promising solution to urban congestion and transportation challenges, offering a safe, eco-friendly, and efficient mode of mass transit powered by renewable energy sources.

***Keywords*—Sky Bus, Wireless Transmission, Solar Energy, Arduino Nano, Driverless Mechanism, Liquid Crystal Display(LCD)**

I. INTRODUCTION

The implementation of driverless technology in transportation systems involves sophisticated automation and control technologies. Careful consideration must be given to ensure safety and avoid accidents. Many advanced countries have adopted automated systems for passenger transportation, often using separate tracks underground or above ground, such as subways or metro lines. To explore and demonstrate the practical application of this technology, we have developed a basic module of a driverless "Sky Bus" that operates between two stations.

The Sky Bus, conceived by Indian technologist Mr. B Raja Ram offers an eco-friendly, noise-free, and cost-effective mode of transportation suitable for crowded cities worldwide. Falling under the tramway category according to the Constitution of India, the Sky Bus operates along existing roadways within municipal limits, making it exempt from the Indian Railway Act. Its suspended railway system design ensures stability and safety, eliminating the risk of derailments and collisions commonly associated with traditional metro rail systems.

The basic concept of the Sky Bus draws inspiration from the Sky-Wheels concept presented in 1989, utilizing the median of roads to support elevated tracks for the passage of suspended coaches. These coaches are designed to be lighter and safer, suspended from a powered bogie running on overhead sky-guides. Tremendous cost savings are achieved through innovative design and construction techniques.

The prototype module of the Sky Bus integrates various fields such as electrical, electronics, and mechanical engineering. Termed as a "Microelectronics controlled Electromechanical machine," the system incorporates an embedded

software component for autonomy. The project exemplifies the field of mechatronics, which encompasses the integration of mechanical, electrical, electronic, and digital components to create sophisticated systems capable of autonomous decision-making.

The core of the system is a microcontroller, specifically the Arduino Uno ATMEGA 328, which orchestrates the operation of the Sky Bus based on inputs from sensing circuits. These circuits, comprising magnetic switches and magnets, detect reference points and signals from the doors, enabling the microcontroller to execute predefined tasks. The program, written in Assembly language, ensures precise control of the DC motors responsible for propulsion and door operation.

The goal of this project is to provide insight into control theory relevant to the analysis and design of controlled systems, with a focus on practical implementation using microcontrollers. By leveraging digital control technology, the Sky Bus prototype demonstrates the potential for precise and efficient automation in transportation systems, paving the way for safer, more efficient urban mobility solutions.

II. LITERATURE REVIEW

The Sky Bus technology, pioneered by Mr. B. Raja Ram, represents a revolutionary advancement in transportation systems. Mr. Ram's extensive experience as a bureaucrat, engineer, scientist, manager, and inventor has played a pivotal role in the development and success of the Sky Bus concept. With a distinguished academic background from the prestigious IIT Kharagpur and decades of service in railway operations, research, and project management, Mr Ram brings a wealth of expertise to the field of transportation innovation.

The Sky Bus is a suspended railway system designed to address the shortcomings of traditional metro rail systems, such as derailments, collisions, and safety concerns. Drawing inspiration from the Sky-Wheels concept introduced in 1989, the Sky Bus utilizes a median in the middle of the roadway to support elevated tracks. These tracks, supported by pile foundations and concrete box structures, guide the Sky Bogies (bogies equipped with linear induction motor technology) carrying Sky Coaches (double-walled light shells with passenger amenities).

Key components of the Sky Bus system include:

Sky Way: Elevated tracks supported by columns along the roadway, guiding the Sky Bogies.

Sky Bogie: Standard two-axle bogies equipped with linear induction motors and braking systems.

Sky Coaches: Passenger compartments suspended from the Sky Bogies, featuring air-conditioning, automatic doors, and audio-visual passenger information systems.

Sky Stations: Computerized, access-controlled stations designed for efficient passenger boarding and alighting.

Traverser: Automated system for balancing loads, changing routes, and managing depot operations.

The design of the Sky Bus system emphasizes structural integrity, safety, and efficiency. With heavy rails placed at standard gauge and supported by columns at regular intervals, the Sky Bus ensures stable and reliable operation. Additionally, its aesthetic design and eco-friendly features make it a viable solution for crowded and congested cities worldwide. The Sky Bus represents a paradigm shift in urban transportation, offering a safer, more efficient, and environmentally friendly alternative to traditional metro rail systems. Mr. B. Raja Ram's visionary leadership and innovative contributions have propelled Sky Bus technology to the forefront of transportation innovation, with the potential to transform urban mobility in cities around the globe.

III. BLOCK DIAGRAM

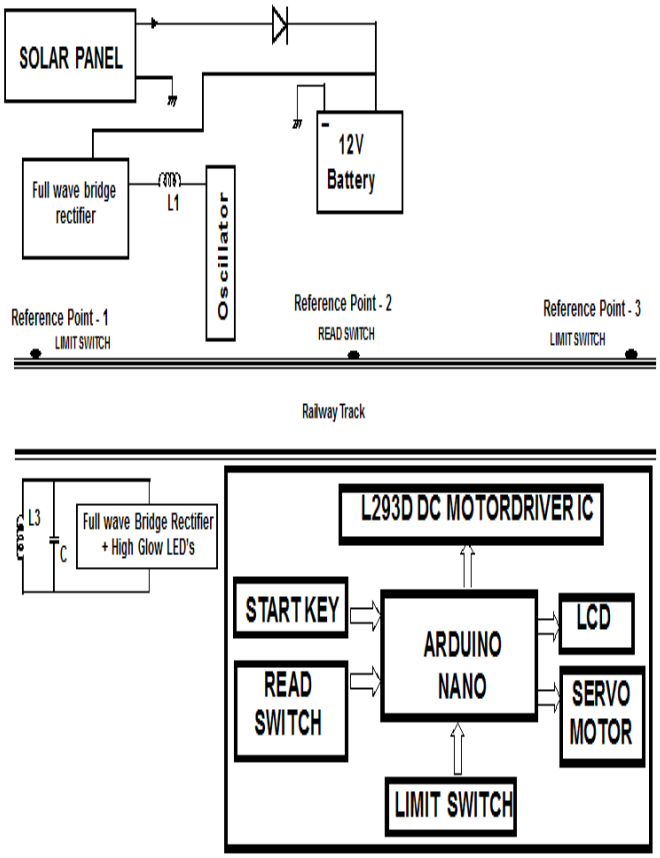

Figure 1: Block Diagram

A. Solar Power Generation

From Figure 1, the Solar panels installed on the rooftops of the Sky Bus harness solar energy and convert it into electricity. This generated power can be used to supplement the energy requirements of onboard systems such as lighting, air conditioning, and propulsion, reducing the reliance on conventional energy sources. By utilizing renewable solar energy, the Sky Bus contributes to reducing carbon emissions and environmental impact compared to traditional fossil fuel-powered transportation systems. This aligns with global efforts to mitigate climate change and promote sustainability. Excess solar energy generated during periods of sunlight can be stored in onboard batteries or capacitors. These energy storage systems ensure a continuous power supply for the Sky Bus, even during periods of low sunlight or at night, thereby optimizing operational reliability.

B. Wireless Power Transmission

The Sky Bus is equipped with wireless power transmission technology, which enables the transmission of electrical power without the need for physical connections. This technology utilizes electromagnetic fields to transfer energy between the power source and the receiving device. Within the Sky Bus, wireless charging pads are strategically placed to enable passengers to charge their electronic devices, such as smartphones and tablets, wirelessly. These charging pads can be integrated into seating areas, armrests, or designated charging stations within the vehicle. The wireless charging pads utilize inductive coupling to transfer power efficiently and safely. When a compatible device is placed on the charging pad, the pad generates an electromagnetic field, which induces a current in the receiver coil within the device. This current is then converted back into electrical power to charge the device's battery. The electricity used for wireless power transfer is sourced from the solar panels on the Sky Bus. This integration ensures that the wireless charging process is powered by clean, renewable energy, further enhancing the sustainability of the transportation system. As long as the Sky Bus is operating under sunlight, the solar panels continuously generate electricity, which can be utilized for both onboard systems and wireless power transfer. This enables passengers to charge their devices throughout their journey without depleting the vehicle's battery or relying on external power sources.

C. Sky Bus

The received solar energy powers the electric propulsion system of the Sky Bus, allowing it to continue its journey along its designated route. Solar energy powers various onboard systems, including lighting, HVAC (Heating, Ventilation, and Air Conditioning), and communication systems, ensuring passenger comfort and safety throughout the journey. Any excess solar energy not immediately utilized by onboard systems or for wireless charging is directed towards charging the onboard battery or energy storage system. This stored energy can be used during periods of low sunlight or during the night to maintain the continuous operation of the Sky Bus. The received solar energy is also used to power the wireless charging pads installed within the Sky Bus. These charging pads enable passengers to conveniently charge their electronic devices, such as smartphones or tablets, without the need for physical connections. By utilizing solar energy for propulsion and onboard systems, the Sky Bus reduces its reliance on fossil fuels, thereby lowering carbon emissions and contributing to environmental sustainability.

IV. OPERATING PROCEDURE

The project aims to revolutionize urban transportation by introducing an innovative and sustainable mode of travel powered by renewable energy sources like solar power. Its key objectives include reducing carbon emissions, addressing urban congestion and pollution, and offering a high-capacity transportation solution. The sky bus system operates on solar energy, minimizing environmental footprint and contributing to cleaner air quality in cities. Integration of wireless charging technology eliminates the need for conventional fuelling stations, enhancing passenger convenience and reducing logistical challenges. The project showcases technological innovation and promotes sustainable transportation practices globally. Challenges include initial investment costs, regulatory frameworks, and factors affecting solar energy generation. Overall, the sky bus with wireless charging using solar energy represents a significant advancement in greener and smarter urban transportation systems, with the potential to transform commuting and enhance the quality of life in cities.

Figure 2: Sky Track

As observed from the above Figure 2, the proposed method is implemented along with the sky track. The sky bus will be travelling on the sky track which will be covered in the below figures. The sky bus will be travelling from three different stations back and forth.

Simultaneously, charging will be in action only at a single station. From the below Figure 3, after switching ON the circuit we can observe that there is a 'WELCOME' note and a 2-second gap before the opening of the door and an 8-second time gap along with the buzzer ON is programmed in the Arduino Nano for station A.

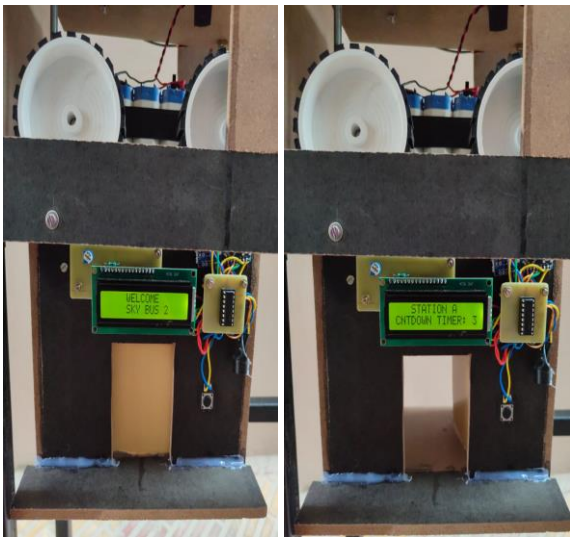

Figure 3: Sky Bus at Station A

The other two stations are also programmed with an 8-second time gap along with the buzzer ON and a 'HAPPY JOURNEY' note is displayed during the journey. Stations A and C are detected using the limiting switches whereas Station B is detected by using a read switch which is implemented around the Sky Bus.

V. CONCLUSION

The project successfully demonstrated the feasibility of a cost-effective, precise automatic driverless shuttle train, highlighting its potential advantages. Future efforts will focus on enhancing system capabilities and expanding applicability. The systematic approach laid a strong foundation for future advancements in autonomous transportation. The integration of solar energy harvesting and wireless charging in the sky bus system promises to revolutionize urban commuting by reducing reliance on fossil fuels and minimizing carbon emissions. Emphasis on smart infrastructure and energy efficiency ensures safe, reliable, and convenient travel experiences. Addressing limitations and fostering collaboration will drive continuous improvement and innovation. Ultimately, the sky bus project with wireless charging using solar energy represents a transformative initiative poised to shape sustainable urban transportation and improve quality of life worldwide.

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