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Design and Fabrication of an Electric Vehicle (EV) Cart for Vegetable Vendors

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Abstract: This paper presents a comprehensive study on the design, development, and fabrication of an Electric Vehicle (EV) cart specifically engineered for vegetable vendors. Traditional push carts require significant manual effort, limiting mobility and productivity. By integrating an electric propulsion system, ergonomic structure, and enhanced load-carrying capability, the proposed EV cart provides an efficient, sustainable, and low-cost solution. Detailed analysis covering conceptual design, material selection, fabrication processes, performance evaluation, and future scalability is discussed. The implemented model reduces physical strain, improves vendor efficiency, and supports eco-friendly urban logistics.
Keywords: Electric vehicle, mobility, fabrication, ergonomic design, sustainable transport, street vendors.

INTRODUCTION

Urban mobility challenges have increased significantly due to population growth, congestion, and rising fuel costs. Street vendors, particularly vegetable sellers, rely heavily on manual push carts, which limit daily productivity and lead to long-term health issues due to excessive physical strain. The introduction of lightweight electric mobility solutions has created new opportunities to replace manual vehicles with electric alternatives. Electric Vehicle (EV) technology has evolved rapidly with improvements in battery storage, brushless motors, and compact controllers. These advancements make it possible to design affordable EV carts suited for small-scale vendors while maintaining sustainability, efficiency, and reliability. The proposed project aims to address the shortcomings of traditional carts by developing a motorized EV cart with enhanced load capacity, reduced human effort, and improved operational flexibility.

LITERATURE REVIEW

Previous studies emphasize the growing use of electric mobility in last-mile delivery and urban transportation. Research highlights include:

1. EV Adoption Trends: Studies show a global shift towards electric mobility due to reduced fuel consumption and lower emissions.
2. Design of Light Electric Vehicles: Authors report that lightweight EVs enhance manoeuvrability and reduce energy consumption.
3. Vendor-Specific Mobility Needs: Research on micro-entrepreneur mobility reveals the need for upgraded transportation solutions for street vendors.

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4. Solar-Assisted EV Systems: Literature indicates that solar panels can extend operating time and reduce charging dependency.
5. Ergonomics in Utility Vehicles: Improved ergonomics significantly reduce fatigue and enhance productivity.
   However, limited work has focused on EV carts specifically designed for localized street vendors, motivating the need for this project.

Objectives

The primary objectives of this project include:

1. Designing a low-cost EV cart tailored for vegetable vendors.
2. Ensuring sufficient load-carrying capacity with better stability.
3. Integrating an electric propulsion system including motor, battery, and controller.
4. Enhancing ease of use, comfort, and ergonomics.
5. Reducing operational costs using energy-efficient and eco-friendly components.
6. Optionally incorporating solar charging for extended autonomy.
7. Evaluating performance through real-world testing.

METHODOLOGY

The project methodology consists of the following steps:

A. Problem Identification

Understanding the daily challenges faced by vendors such as fatigue, limited mobility, and low operating range.

B. Conceptual Design

Sketches and 3D modelling using AutoCAD were performed to finalize dimensions, weight distribution, wheelbase, and ergonomics.

C. Material and Component Selection

Selection was based on structural strength, cost, availability, and energy efficiency.

D. Design Analysis

Structural loads, stability analysis, factor of safety, torsional rigidity, and battery sizing were calculated.

E. Fabrication

Includes cutting, welding, grinding, assembling, wiring, painting, and testing.

F. Performance Testing

Measured speed, load capacity, battery discharge rate, motor temperature, and terrain adaptability.

Design and Material Selection

A. Chassis Design

The chassis was designed using mild steel angles for durability and low cost. A rectangular frame ensured weight balance and structural integrity.

B. Mechanical Components

Wheels: Pneumatic tyres for shock absorption.
Suspension: Basic spring suspension for smooth operation.
Steering: Handlebar-based mechanism for ease of control.

C. Electrical Components

Motor: 350W/500W BLDC motor.
Battery: Lead-acid or Li-ion battery (48V).
Controller: Brushless DC controller for speed regulation.
Throttle: Hall sensor throttle.

D. Safety Features

Overcurrent protection
Thermal cutoff
Fuses
LED headlight for night operation

CALCULATIONS

A. Load Capacity Calculation
Total load = Frame weight + Battery + Motor + Vegetables load.
B. Motor Power Requirement
Power (P) = Torque × Angular Velocity.
C. Battery Sizing
Battery capacity (Ah) = (Motor power × Operating time) / Voltage.
D. Chassis Strength Analysis
Stress = Force / Area; FoS ≥ 2 for safety.
E. Speed Estimation
Speed depends on motor RPM, wheel radius, and gear ratio.

Fabrication Process

The fabrication included:

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- Frame Preparation: Cutting and welding MS angles.
- Motor Installation: Fitting the rear-mounted BLDC motor.
- Battery Setup: Securing battery compartment.
- Wiring Integration: Controller, throttle, switches.
- Wheel Mounting: Fixing wheels with bearings.
- Painting: Applying antirust coating.
- Testing: Conducting trial runs.

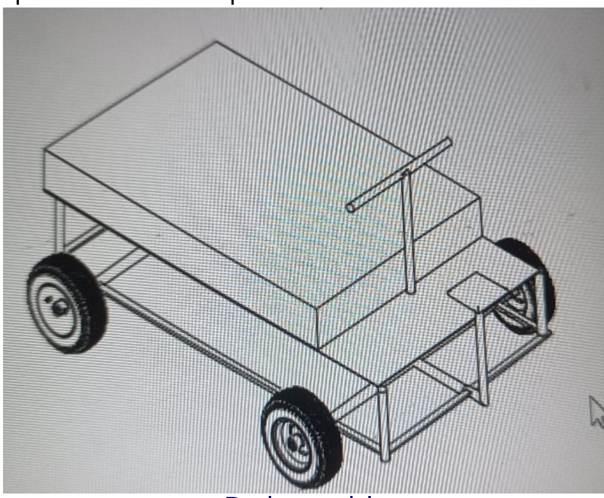
RESULTS AND DISCUSSION

Performance Observations:

Achieved smooth acceleration and reduced manual effort.
Load capacity supported up to 120–150 kg.
Achieved average speed of 15–18 km/h.
Battery lasted 3–4 hours per charge.
Improved vendor efficiency by 30–40%.

Challenges Identified:

Motor heating during prolonged uphill travel.
Heavy weight of lead-acid batteries.
Need for improved shock absorption.


Design model


Fabricated model

CONCLUSION

The EV cart successfully meets the mobility needs of vegetable vendors by enhancing transport efficiency while reducing physical strain. The project demonstrates a practical low-cost solution with significant social and economic impact. Future developments may include advanced suspension, lithium-ion battery integration, solar charging, GPS tracking, and modular storage.

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