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# Design and Fabrication of Electrical Platform Trolley

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**Abstract- Efficient material handling in educational institutions is essential to reduce manual effort and improve workplace safety. Conventional trolleys require continuous human force, leading to fatigue and reduced productivity. This paper presents the design and fabrication of an electrical platform trolley powered by a 24V, 250W BLDC geared motor. The system incorporates a rechargeable battery, motor controller, and handle-mounted forward–reverse switching mechanism for smooth operation. A reinforced steel platform and rubber wheels provide structural strength and stability for load transportation within campus environments.**

**Keywords: Electric platform trolley, BLDC motor, Material handling, DC drive system, Battery-powered system.**

## I. INTRODUCTION

Material handling in educational institutions often relies on manual platform trolleys, which require continuous human effort and may cause fatigue and reduced efficiency. To overcome these limitations, this paper presents the design and fabrication of an electrical platform trolley powered by a 24V, 250W BLDC geared motor. The system integrates a rechargeable battery, motor controller, and handle-mounted forward and reverse control mechanism for smooth operation. A reinforced steel platform ensures structural strength and stability. The proposed system enhances ergonomics, reduces manual labour, improves operational efficiency, and provides a cost-effective solution for campus material transportation.

## II. LITERATURE REVIEW

Ramesh et al. (2012) designed and fabricated a battery-operated material handling trolley for industrial applications. The system utilized a 12V DC motor with a geared drive mechanism to transport moderate loads efficiently. Experimental results demonstrated reduced human effort, improved operational efficiency and enhanced safety in material handling processes, emphasizing the practicality of low-cost electric trolley systems.

Karthikeyan et al. (2015) developed a smart electric trolley integrated with a motor controller and rechargeable lithium ion battery system for warehouse operations. The study focused on energy efficiency and load optimization. Performance analysis showed improved battery backup, smooth speed control and reduced operational cost compared to conventional manual trolleys.

Sharma et al. (2023) proposed and tested a PMDC motor-based electric platform cart for campus and small-scale industrial use. The system incorporated forward and reverse control with a compact electrical layout. Results indicated improved manoeuvrability, reduced fatigue among operators and reliable performance under varying load conditions.

Vignesh et al. (2023) designed an ergonomic electric trolley with enhanced braking and safety mechanisms for laboratory material transport. The integration of a disc braking system and overload protection improved operational safety. Testing confirmed stable movement, better load balance and increased user convenience.

Pradeep et al. (2024) developed a cost-effective electric trolley using a 350W geared motor and lead-acid battery for short-distance transportation. The study evaluated power consumption, load capacity and durability. Findings revealed optimized energy usage, consistent torque delivery and suitability for institutional environments, supporting sustainable and efficient material handling solutions.

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## III. EXISTING SYSTEM

The existing system shown in the image is a conventional manual platform trolley commonly used in warehouses, workshops, It consists of a flat rectangular steel platform mounted on four caster wheels, along with a foldable push handle fixed at one arrangement.

Figure.1.Existing System

## IV. PROPOSED WORK EXPLANATION

The proposed work focuses on the design and fabrication of an electrical platform trolley to improve material handling efficiency within campus environments. The system replaces manual effort with an electrically driven mechanism using a 24V, 250W BLDC geared motor. A rechargeable battery supplies power to the motor through a motor controller, enabling controlled speed and directional movement. The handle-mounted forward and reverse switch ensure user-friendly operation.

**Block Diagram:**

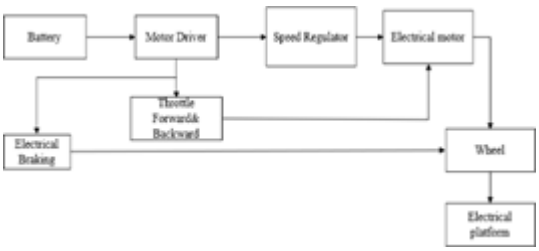


Figure.2. Block Diagram of Proposed System

**Flow Chart:**

Fiure.3. Flow Chart of Proposed System

**Explanation of flow chart:**

**Start**
The system begins when the main power switch is turned ON.

**Battery Supply Check (24V)**
- Check if battery voltage is available.
- If battery is low → Stop operation.
- If battery is sufficient → Continue.

**Controller Activation**
The motor controller receives
24V supply and becomes ready to operate.

**Direction Selection**
Using the handle switch:
- Forward
- Reverse
- Neutral

**Motor Drive**
If Forward/Reverse selected:
- Controller sends PWM signal
- Motor rotates accordingly
- Wheels move trolley

**Load Transportation**
Trolley carries load (0–100 kg as per design) on different surfaces.

**Stop Condition**
When:
- Switch is OFF
- Brake applied
- Battery low

**End**

## V. HARDWARE IMPLEMENTATION

The Electric platform trolley includes a 24V battery, 250W BLDC geared motor, motor controller, steel chassis, rubber wheels, control switches, and wiring system, Sharma et al. (2023).

**Hardware Components: (i)BLDC MOTOR:**

| parameter | Specification |
|---|---|
| Motor Type | BLDC |
| Rated voltage | 24V |
| Rated power | 250W |
| Rated Current | 10-11A |

**BATTERY (24V):**

| parameter | Specification |
|---|---|
| Battery Type | Lithium-ion |
| Rated voltage | 24V |
| Capacity power | 20Ah-25Ah |
| Max Discharge current | >30A |
| Charging Time | 5 hours |

**CONTROLLER:**

| parameter | Specification |
|---|---|
| Controller Type | BLDC motor Controller |
| Rated voltage | 24V DC |
| Rated Power | 250W |
| Continues current | 12A-15A |
| Peak Current | 18A-20A |
| Speed control | Throttle Based |

**METAL SPROCKET**

| parameter | Specification |
|---|---|
| Component Name | Metal Chain Sprocket |
| Material | Mild Steel (MS) |
| Chain Type | Roller Chain |
| Thickness | 5-8 mm |
| Surface Treatment | Black Oxide Coating |
| Keyway | Standard key slot |
| Hardness | 40-50 HRC |
| Pitch | 12.7mm |
| Bore Size | 10-15mm |
| Teeth | As per Required gear Ratio |

**WHEEL:**

| parameter | Specification |
|---|---|
| Wheel Type | Three Spoke |
| Tire Type | Moulded Solid Rubber |
| Core Material | Cast Iron |
| Diameter | 150 mm(6inch) |
| Width | 40-50 mm |
| Hub Type | Bearing Type Hub |
| Bearing | Double Ball Bearing |
| Bore Diameter | 12-15 mm |
| Load Capacity | >100 kg |

## VI. RESULTS AND DISCUSSION

The operational performance of the fabricated Electrical Platform Trolley was experimentally evaluated by analyzing the percentage voltage drop across the drive system under varying load conditions ranging from 0 kg to 100 kg. The study was conducted on four different surface profiles, namely solid surface, tile surface, tar road, and sand surface, to assess the influence of terrain-induced mechanical resistance on the electrical characteristics of the system. The experimental results reveal a direct correlation between applied load and voltage drop across all tested surfaces. As the payload increased, the voltage drops progressively increased, indicating elevated current demand from the DC motor. On the solid surface, the

system exhibited the lowest voltage drop throughout the loading range, increasing gradually from approximately 0.4% at no-load to about 1.6% at 100 kg. The reduced voltage drop signifies minimal rolling resistance, efficient wheel-ground interaction, and effective torque transmission.

**Graphical Representation and Equation:**

The developed low-cost electrical platform trolley is fabricated using a mild-steel frame with a rigid welded structure and reinforced support members. The trolley platform is designed to provide uniform load distribution and structural stability during transportation of materials. The mounted 24 V battery-powered BLDC geared motor enables smooth propulsion with adequate torque for carrying heavy loads.[6] The raised chassis with four-wheel arrangement ensures balanced movement and reduces rolling resistance, while the low center of gravity improves operational safety. The open platform layout allows case1 voltage drop, case2 Rolling resistance, and books, while the protective frame prevents load displacement during motion.

**Tabulation:(Case 1)**

| Load(kg) | Tiles(V) | Tar Road (V) | Sand (V) | Cement (V) |
|---|---|---|---|---|
| 0 | 0.5 | 0.6 | 0.8 | 0.4 |
| 20 | 0.7 | 0.8 | 1.1 | 0.6 |
| 50 | 1 | 1.1 | 1.6 | 0.9 |
| 70 | 1.3 | 1.4 | 2 | 1.1 |
| 90 | 1.8 | 2 | 2.8 | 1.6 |

Table.1: Voltage Drop

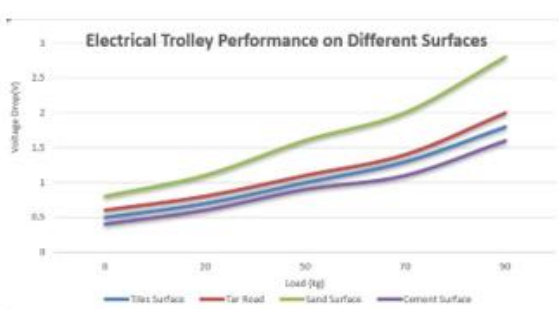


Figure.4: Graphical Representation Tabulation (case 2)

| Load(kg) | Tiles(A) | Tar Road (A) | Sand (A) | Cement (A) |
|---|---|---|---|---|
| 0 | 7 | 8 | 10 | 6 |
| 20 | 9 | 10 | 13 | 8 |
| 50 | 13 | 14 | 18 | 12 |
| 70 | 16 | 18 | 22 | 15 |
| 100 | 21 | 23 | 28 | 19 |

Table.2: Rolling Resistance

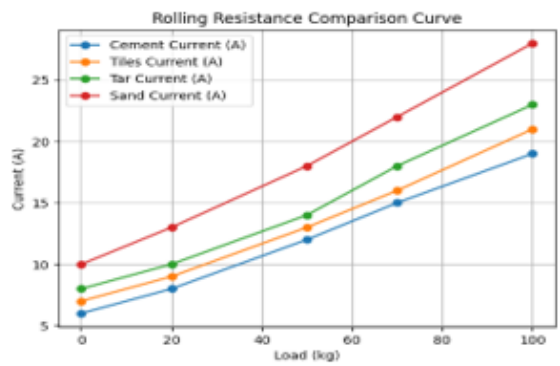


Figure.5: Rolling Resistance graphical represents

Figure.6: Hardware Implementation

**Rolling Resistance force:**

Rolling resistance force is the force that opposes the motion of a wheel rolling on a surface due to deformation of the wheel and floor. It acts opposite to the direction of motion and must be overcome by the motor to keep the trolley moving.[7]

$$Frr = \mu r \cdot m \cdot g$$

**Required torque at wheel:**
Required torque at the wheel is the rotational force needed to overcome rolling resistance and move the trolley.[5]

$$T = Frr \cdot r$$

**Motor Power Requirement:**
Motor power requirement is the mechanical power needed to move the trolley at the desired speed against resistance.

$$P = Frr \cdot v$$

**Required Wheel RPM:**
Required wheel RPM is the rotational speed the wheel must have to achieve the desired linear speed.

$$RPM = \frac{60 \cdot v}{2\pi r}$$

**Motor Current From 26V Battery:**
Motor current from a 26 V battery is the electrical current required to supply the motor's power demand.

$$I = \frac{P}{V}$$

**Tabulation:**

| Load(kg) | $F_{rr}(N)$ | TW($NM$) | MP ($W$) | RPM ($f$) | 26V B($A$) |
|---|---|---|---|---|---|
| 0 | 9.81 | 0 | 0 | 0 | 0 |
| 20 | 13.73 | 2.6 | 20 | 72.5 | 0.77 |
| 50 | 19.62 | 3.68 | 25 | 65 | 0.96 |
| 70 | 23.54 | 4.41 | 25.4 | 55 | 0.98 |
| 90 | 27.47 | 5.15 | 24.7 | 45.8 | 0.95 |

Table.3: Performance

**Discussion:**
The comparison of load–deflection results confirms that Cement surface shows the best performance, as it has the lowest total deformation (1.2 units at 90 kg), the smallest deflection rate (0.0133 per kg), and the highest stiffness (75 kg/unit). Tiles surface performs second, with slightly higher deformation (1.3 units) and lower stiffness (69.2 kg/unit). Tar Road shows moderate performance with 1.4 units of deformation and stiffness of 64.3 kg/unit. Sand exhibits the poorest performance, having the highest deformation (2.0 units), the greatest deflection rate (0.0222 per kg), and the lowest stiffness (45 kg/unit). Overall ranking: Cement > Tiles > Tar Road > Sand.

## VII. CONCLUSION

The design and fabrication of the Electrical Platform Trolley were successfully accomplished, and the developed was evaluated through experimental performance analysis. The study confirmed that the system operates reliably under varying load conditions across different surface profiles. The results showed that the percentage voltage drop increases with load, reflecting higher motor current demand caused by increased mechanical resistance. Future improvements such as advanced motor control strategies, regenerative braking, and mechanical design refinements can load-handling capability, and acceptable energy efficiency.

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