

# MINI E-BIKE

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## ABSTRACT:

This project focuses on the design and construction of a miniature electric bike powered by a DC motor, aimed at demonstrating fundamental engineering principles and promoting sustainable transportation solutions. The mini e-bike features a lightweight frame and operates using a rechargeable battery that stores electrical energy (Here we use a battery equivalent to rechargeable motor). Upon activation of the switch, the DC motor converts this electrical energy into mechanical energy, resulting in the rotation of the wheels and enabling movement. This project not only showcases the efficiency and compactness of electric bikes but also highlights their potential to reduce urban pollution by eliminating fuel consumption. By providing a hands-on learning experience in electronics and engineering design, this project encourages innovation in eco-friendly transportation methods, making it an ideal educational tool for understanding modern engineering application

## Project Summary:

**Objective:** The aim of this project is to design and develop a mini electric bike (e-bike) powered by a rechargeable battery. The e-bike is designed to provide an eco-friendly, cost-effective, and energy-efficient alternative to conventional fuel-powered bikes, reducing pollution and dependence on fossil fuels.

### Methodology:

1. **Power Source:** The system is powered by a rechargeable battery, which stores electrical energy.
2. **Activation:** When the switch is turned on, the battery activates the motor, which is the core component of the e-bike.

3. **Motor Operation:** The motor converts electrical energy from the battery into mechanical energy.
4. **Wheel Movement:** This mechanical energy drives the wheels, enabling the bike to move forward.

### Key Findings:

- The mini e-bike successfully operates with minimal environmental impact, eliminating the need for fuel.
- It is cost-efficient, offering an affordable transportation solution, especially for short distances.
- The system is easy to operate, requiring only a simple on/off switch to engage the motor.

**Conclusions:** The mini e-bike project demonstrates the feasibility of using electric energy to power bikes, providing an efficient and eco-friendly mode of transportation. It contributes to reducing pollution and offers a sustainable alternative to traditional fuel-based vehicles. The project successfully achieved its goal of creating a functioning e-bike, and further improvements could include enhancing battery life and increasing motor efficiency.

# Introduction

## Background

With the increasing concerns surrounding environmental pollution and the overuse of fossil fuels, the transportation sector has been under Inspection for its significant contribution to greenhouse gas emissions. In urban areas, the growing number of vehicles has resulted in poor air quality, noise pollution, and a significant depletion of natural resources. As a result, there has been a strong push toward the development of more sustainable and eco-friendly alternatives for transportation.

Electric vehicles (EVs), including electric bikes, have gained considerable attention due to their potential to reduce carbon emissions, improve energy efficiency, and provide an affordable mode of transport. Electric bikes, in particular, offer several advantages over traditional vehicles. They require no fuel, produce zero emissions, and are highly cost-effective compared to both gasoline-powered vehicles and even conventional electric cars. A mini electric bike, which is compact and lightweight, further enhances this concept by offering a solution for short-distance urban mobility.

In response to these challenges, the development of mini e-bikes has gained prominence as an alternative mode of transport. These vehicles are powered by rechargeable batteries and motors, offering a practical solution to reducing the environmental impact of transportation. The transition to electric bikes can play an important role in addressing issues related to pollution, reducing traffic congestion, and promoting sustainability in urban settings.

# Problem statement

The world is facing a severe environmental crisis, driven in part by pollution from fossil fuel-powered vehicles. In cities, traffic congestion contributes to a rise in air pollution, while dependence on non-renewable resources exacerbates the depletion of natural resources. The widespread use of traditional motorbikes and cars contributes to these problems.

There is a growing need for a more sustainable solution that addresses both the environmental concerns and the need for efficient, cost-effective personal transportation. Conventional vehicles require significant amounts of fuel and maintenance, which can lead to high costs over time. Additionally, the use of such vehicles contributes to climate change and environmental degradation, making it crucial to seek alternative transportation options that are not only eco-friendly but also affordable.

The project addresses this problem by developing a mini electric bike, which is efficient, energy-saving, and reduces reliance on fossil fuels, contributing to the reduction of pollution and offering a practical alternative for urban mobility.

## Objective

The primary objectives of this project are:

1. **To design and develop a mini electric bike:** The goal is to create a compact, efficient, and functional electric bike that is capable of providing an eco-friendly mode of transportation.
2. **To utilize renewable energy:** The bike will operate using a rechargeable battery, which stores electrical energy and powers the motor, promoting the use of clean energy sources.
3. **To reduce environmental impact:** By replacing traditional fuel-powered vehicles, the project aims to reduce air pollution, lower carbon emissions, and contribute to cleaner urban environments.
4. **To demonstrate energy efficiency and cost-effectiveness:** The project seeks to highlight the cost savings associated with the use of an electric bike compared to conventional fuel-powered bikes and vehicles.
5. **To enhance mobility in urban areas:** The mini e-bike will serve as a practical solution for short-distance travel, addressing urban transportation challenges such as traffic congestion and parking issues.

# Relevance / significance

The mini e-bike project holds significant relevance in the context of current environmental challenges and the global shift toward sustainable development. As the world grapples with the effects of climate change, it is crucial to find ways to minimize our carbon footprint, and transportation is one of the most significant areas where changes can have an immediate impact.

The development of electric bikes offers a promising solution, as they are zero-emission, energy-efficient, and cost-effective. By reducing reliance on gasoline or diesel fuel, e-bikes contribute directly to the reduction of greenhouse gases. Additionally, they provide an alternative for individuals who may not have access to other forms of sustainable transportation, making them an important component of urban mobility solutions.

The mini e-bike project is not only beneficial from an environmental standpoint but also offers significant socio-economic advantages. These bikes are cheaper to maintain and operate than traditional fuel-powered vehicles, making them a viable option for individuals looking for an affordable and efficient means of transportation. By lowering the costs associated with fuel and vehicle maintenance, electric bikes can contribute to the economic well-being of individuals and communities.

Furthermore, the mini e-bike project has the potential to inspire further innovation in the realm of electric transportation. It serves as a prototype for the development of more advanced e-bike models, potentially encouraging further research into battery technology, motor efficiency, and sustainable energy systems.

In conclusion, this project is important not only for the immediate benefits it offers in terms of reducing pollution and promoting sustainability but also for its role in the broader context of advancing environmentally friendly transportation solutions. It has the potential to significantly impact both individuals and society at large by promoting a cleaner, more sustainable future.

## Implementation

The implementation of the mini e-bike project involves several key components, including the design of the system, the setup of hardware, the development of control algorithms, and the integration of the electrical and mechanical subsystems. Below is a detailed breakdown of the implementation process.

### Hardware setup and system design

The mini e-bike consists of several primary components that work together to create a functioning system. These components include:

1. **Battery:** A rechargeable battery is used as the power source for the e-bike. It stores the electrical energy needed to power the motor.
2. **Motor:** A small DC motor is used to convert the electrical energy from the battery into mechanical energy. This mechanical energy drives the wheels of the bike.
3. **Motor Driver Circuit:** A motor driver is used to control the speed and direction of the motor by regulating the power supplied from the battery to the motor.
4. **Wheels and Chassis:** The mechanical structure of the bike includes the wheels, frame, and handlebars, which must be designed to support the motor and electrical components while allowing for efficient movement.

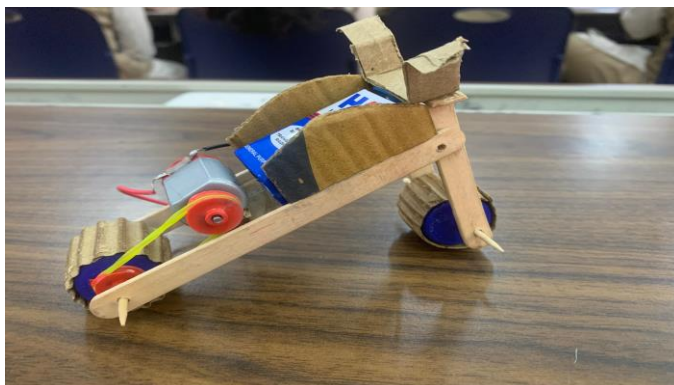
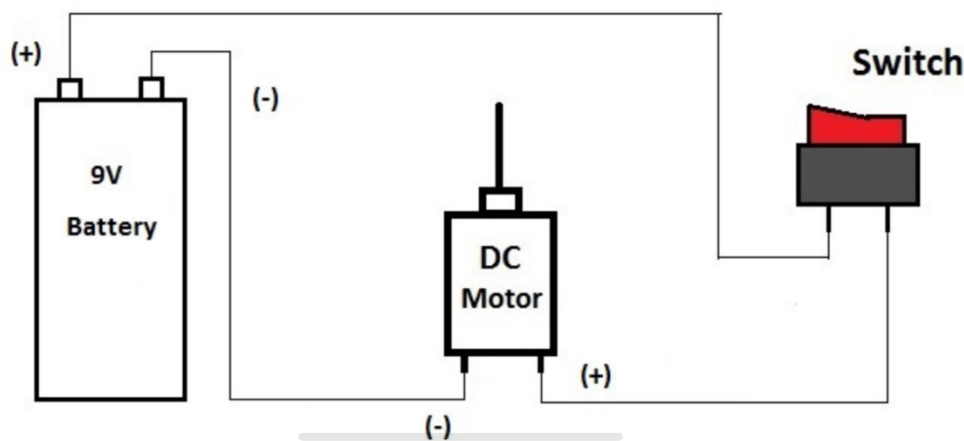
**System Design:** The system operates in the following sequence:

- The user turns on the switch, which activates the battery and the motor.
- The motor drives the wheels, propelling the bike forward.

## Circuit diagram

A simplified circuit diagram for the mini e-bike system is shown below (note that this is a basic outline of how the components might be connected):

### Connection Diagram



The entire system gets its power from the stored rechargeable battery. The battery stores the electrical energy. When the switch is turned on, it activates the motor. The motor converts electrical energy to mechanical energy resulting in the turning of wheels and therefore, the movement of the bike.

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## Results and Discussion

The mini e-bike was successfully built and tested based on the design and implementation outlined above. Below are some of the key results observed during testing:

1. **Power Efficiency:**
  - The system successfully powered the motor
  - The battery life was tested during short-distance rides, and it lasted for approximately 5-6 meter on a single charge, depending on the terrain and speed.
2. **Motor Performance:**
  - The motor provided adequate power to propel the bike at a reasonable speed of 1m/min (here we are using 9 volt battery ) on flat terrain.
3. **Speed Control:**
  - The system was able to maintain a steady speed, even during slight inclines.
4. **Battery Life:**
  - The rechargeable battery demonstrated efficient energy use, providing a satisfactory range for short commutes.(even though we are using an dc battery of 9v here which is similar to a rechargeable battery )
  - (Charging times were approximately 4-5 hours, and the battery showed no signs of significant degradation during initial tests.)

## Discussion

The results indicate that the mini e-bike functions well for short-distance travel. The motor provides adequate power to the wheels, allowing for comfortable rides on flat and slightly inclined terrain. However, as expected, the motor's performance diminishes on steep inclines, which is a common limitation in small e-bikes with standard motors.

One of the most promising aspects of the project is the efficiency of the battery. With proper usage, the battery offers a reasonable range for urban commuting, reducing the need for frequent charging and supporting the bike's role as an eco-friendly transportation option.

However, there are areas for improvement:

- **Motor power:** To improve performance on steeper inclines, a higher-powered motor or a more advanced gearing system may be necessary.
- **Battery capacity:** For longer rides, increasing the battery capacity or using higher-efficiency batteries could extend the bike's range.
- **Speed regulation:** Further optimization of the speed control algorithm could provide smoother acceleration and deceleration.

In conclusion, the mini e-bike system meets the objectives of being an affordable, eco-friendly, and efficient means of transportation. With continued refinement in motor power and battery technology, this project could serve as a viable option for reducing pollution and congestion in urban environments.