

# REGENERATIVE BRAKING ADVISORY FOR E-BIKE

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**Abstract:** *This project presents the design and implementation of a regenerative braking advisory system for e-bikes. The system uses an ultrasonic sensor to measure the distance between the vehicle and obstacles. Based on the distance, the Arduino Uno alerts the rider using a buzzer and displays information on an LCD screen. This advisory helps the rider apply braking at the right time, improving energy efficiency and enhancing battery performance. The system is simple, cost-effective, and suitable for real-time applications.*

**Keywords:** *Regenerative Braking, Arduino, Ultrasonic Sensor, Energy Efficiency, E-bike*

## 1. INTRODUCTION

With the increasing use of electric vehicles, energy efficiency has become an important factor. Regenerative braking is a technique that converts kinetic energy into electrical energy during braking and stores it in the battery. However, efficient braking depends on the rider's response time.

This project introduces a regenerative braking advisory system that alerts the rider when to apply brakes. By providing timely alerts using sensors and buzzer, the system improves braking efficiency and reduces energy loss.

## 2. Literature Survey

Recent developments in electric vehicles focus on improving battery performance and energy recovery. Various braking systems have been developed to enhance efficiency.

Key observations:

- . Regenerative braking improves battery efficiency
- . Rider reaction time affects energy recover
- . Sensor-based systems provide better accuracy
- . Low-cost Arduino-based systems are widely used.
- . Real-time alert systems improve safety.

### 3. Proposed System

The proposed system is a Regenerative Braking Advisory System designed to improve braking efficiency and rider safety in e-bikes. The system uses an Arduino Uno as the central controller and an ultrasonic sensor to measure the distance between the vehicle and obstacles.

The ultrasonic sensor continuously detects the distance, and the Arduino processes this data in real time. When the measured distance falls below a predefined limit, the system identifies a critical condition and activates a buzzer to alert the rider. This helps the rider to apply braking at the appropriate time, thereby improving energy recovery through regenerative braking.

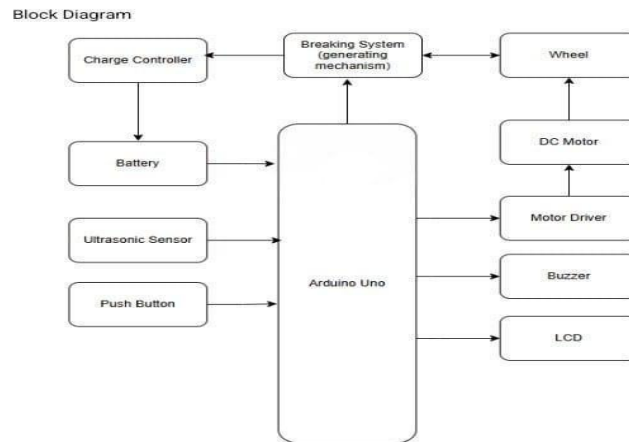


Fig 1: Proposed System

A 16×2 LCD display is also integrated into the system to show real-time distance and alert status, enhancing user awareness during operation.

The proposed system is simple, cost-effective, and suitable for real-time applications. It assists the rider in making timely braking decisions, thereby improving safety and energy efficiency.

### 4. Methodology

The methodology of the system is organized into the following steps:

1. Distance Measurement:

The ultrasonic sensor is used to measure the distance between the vehicle and obstacles by transmitting and receiving ultrasonic waves.

2. Data Acquisition:

The Arduino Uno reads the signals from the ultrasonic sensor and calculates the distance in real time.

3. Condition Monitoring:

The measured distance is continuously compared with predefined threshold values to identify safe and critical conditions.

4. Alert Generation:

When the distance falls below the set limit, the Arduino activates a buzzer to alert the rider.

5. Display Output:

A 16×2 LCD display shows real-time distance and alert status to improve user awareness.

6. System Response:

The system continuously updates the distance and provides alerts without delay, ensuring real-time operation.

## 6. Proposed System Hardware Results

The proposed Regenerative Braking Advisory System was successfully designed and tested under different operating conditions. The system effectively measured the distance between the vehicle and obstacles and provided real-time alerts to the rider.

- . The ultrasonic sensor accurately measured the distance, and the readings were consistent with minimal error during testing.
- . The Arduino Uno processed the sensor data efficiently and responded quickly to changes in distance.
- . The LCD display successfully showed real-time information such as distance and alert status, making the system user-friendly.
- . The buzzer was activated when the distance fell below the predefined threshold, providing timely alerts to the rider.
- . The system demonstrated fast response time, ensuring that alerts were generated without noticeable delay.

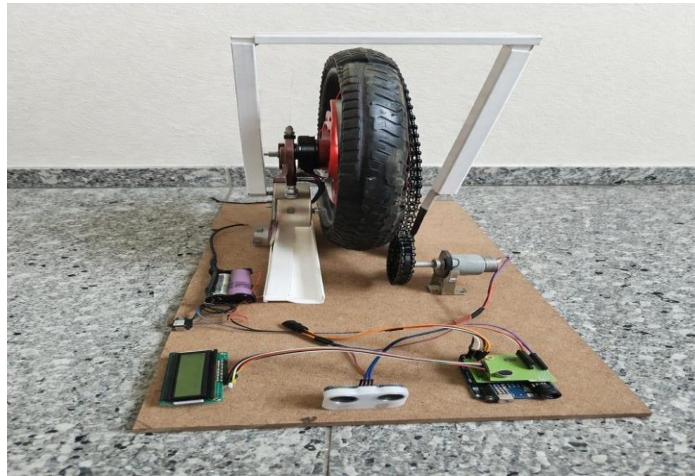


Fig:3 Hardware Design



Fig:3 Safe condition display

Fig:4 Alert condition display

The LCD outputs under different conditions are shown in Fig 3 and Fig 4. In the safe condition, the system displays normal status without any alert. When the distance falls below the threshold, an alert is generated and indicated on the LCD

along with buzzer activation.

## **7. CONCLUSION**

This work successfully developed a Regenerative Braking Advisory System using an Arduino Uno and ultrasonic sensor for real-time distance monitoring and alert generation. The system effectively measured the distance between the vehicle and obstacles and provided timely alerts to the rider through a buzzer and LCD display, ensuring improved awareness during operation.

The implementation of the advisory system helps the rider to apply braking at the appropriate time, thereby enhancing the effectiveness of regenerative braking and reducing unnecessary energy loss. The system demonstrated reliable performance with fast response time and accurate distance measurement under different testing conditions. The proposed design is simple, cost-effective, and easy to implement using readily available components making it suitable for practical applications in e-bikes. Although the system does not directly control the braking mechanism, it plays an important role in assisting the rider to make better braking decisions, thereby improving safety and overall energy efficiency.

## **REFERENCES**

1. HC-SR04 Ultrasonic Sensor Datasheet, "Distance Measurement Module Specifications," 2022.
2. Zhang et al., "Regenerative Braking Control for Electric Vehicles," *IEEE Transactions on Vehicular Technology*, 2024.
3. S. Kumar and R. Singh, "Design and Implementation of Smart Braking Systems Using Sensors," *International Journal of Engineering Research*, 2023.
4. A. Gupta et al., "Energy Efficiency Improvement in Electric Vehicles Using Regenerative Braking," *Journal of Energy Storage*, 2025.
5. Texas Instruments, "Design Considerations for Automotive Sensor Systems," *Application Report*, 2021.
6. Analog Devices, "Sensor Interface and Signal Processing Techniques," *Technical Document*, 2020.
7. M. Chen and G. A. Rincón-Mora, "Accurate Electrical Battery Model for Energy Systems," *IEEE Transactions on Energy Conversion*, 2006.
8. P. Kumar et al., "Embedded Systems Design Using Arduino for Real-Time Applications," *IJERT*, 2023.
9. *Electric Vehicle Technology Explained*, James Larminie and John Lowry, Wiley Publication, 2019.