E-Bike Speed Controlled and Theft Identification Using GPS and GSM

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Abstract- ***The speed of the electric bike motor is managed by the speed organizer. It effectively controls the speed of the electric motor by converting the manually operated throttle's incoming input into an electrical signal using a microcontroller. By preventing losses in the system, the controller is used to transmit energy efficiently, which is essential for extending the electric bike's battery life and range. The MOSFETs serve as drivers in the circuit, which is essential for delivering power to the motor instantly. Due of the extra capabilities like GPS, GSM, and display, careful consideration went into choosing such a potent microcontroller. The implementation and design greatly influence the overall performance. of the motor speed controller for an electric bike. The motor immediately provided the anticipated speed control, and the GPS module continuously monitors the car's position. In the event that a potential theft is identified, the GSM module notifies the vehicle owner.***

Indexed Terms- E-bike, GPS, GSM, Arduino UNO, Theft Prevention, Energy Efficiency

I. INTRODUCTION

Because natural gas, diesel, and gasoline supplies are running low, one of the biggest issues facing the world today is the energy crisis. The problem of vehicle-induced pollution in metropolitan areas and urban areas is growing steadily, and the use of natural gas and oil has been rising significantly every ten years. In the upcoming years, this trend is probably going to continue and result in the total depletion of natural resources. Therefore, the ideal course of action would be to combine the two problems, encourage environmental improvement, and provide an affordable alternative. The growing interest in alternative (unconventional) car powering techniques is influenced by ecological and increasingly economic factors.

The utilization of electric motorcycles is one of the intriguing possible answers. An electric bike's primary benefits over combustion vehicles are its emission-free nature, simplicity of parking, affordability, and reduced commuting expenses. An electric motor has been attached to a conventional motorbike in place of an engine to assist move it forward, making it an electric bike.

Due to the innovative solution that electric vehicles provided to meet the necessary needs, it began to flourish after overcoming the obstacle. One of the most attractive aspects of the D.C. battery is stored there. Because the e-bike will be powered by a battery, the motor will provide the power needed to drive the other The electric bike's ability to reduce noise pollution is another reason to support it. It operates on the basis of an electromotive force generated by a DC motor that draws power from a DC battery. When the e-bike is powered by a battery, the motor provides the power needed to drive the other gear-related components. An electric bike can be made out of a vintage motorbike, which lowers system status and building costs.

It is necessary to have a bike that is constructed appropriately, meaning that the motor, battery, controller, and other parts can be assembled. The primary reason for utilizing this e-bike is that it is affordable, practical, and easy to operate. This system is unquestionably more efficient than traditional forms of transportation, yet vehicle theft is a major issue that costs car owners money and causes them inconvenience. In spite of conventional security measures like automobile alarms and immobilizers,

more sophisticated security systems are required to deter auto theft and give owners real-time notifications and position tracking.

II. PROPOSED SYSTEM

- Speed Control: By processing throttle inputs through a motor driver circuit, the Arduino UNO effectively regulates motor speed.
- Real-Time Tracking: The e-bike's GPS module detects its location and notifies the owner's mobile device in real- time.
- Detection of Theft: When the GSM module detects attempts at theft, it sends out alerts and permits remote engine locking by SMS commands.

Data Display: An OLED display allows the rider to monitor the system status, speed, and throttle position in real time. Energy Efficiency: By reducing battery use and increasing range, optimized power management guarantees environmentally responsible vehicle operation.

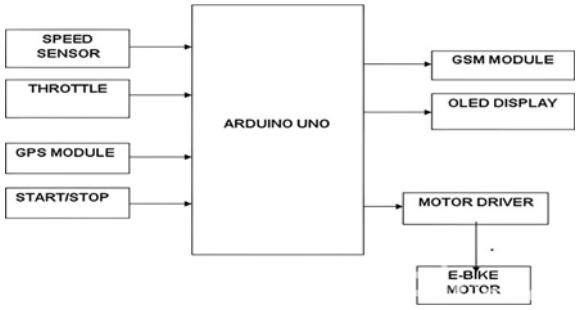


Fig1. Block Diagram

Using pre-established safety criteria to regulate motor speed, the Arduino serves as the primary controller, handling inputs from GPS and GSM modules.

- GPS Module:

Tracks the e-bike's location continuously in real time. Both route tracking and theft detection use this data. The owner receives SMS warnings from the GSM module in the event of theft or unlawful movement. It offers status and location updates for the e-bike.

- LCD Display:

Provides the user with real-time local monitoring by displaying critical data like status, GPS coordinates, alarms, and current speed.

- Speed Control System:

This system tracks and adjusts the motor speed in real time. The technology automatically restricts the speed if it over the predetermined level in order to provide safe riding conditions.

- Power Efficiency: The system is designed to run on a rechargeable battery with efficient power usage to support prolonged field operation.

III. EXISTING SYSTEM

Integrated security and intelligent speed control methods are absent from traditional e-bike systems. Without GPS-based tracking or theft detection, the majority of electric bikes are susceptible to theft and unauthorized use. When it does exist, speed control is often manual rather than condition-based. The majority of current solutions rely on external GPS trackers or simple locking mechanisms that don't communicate directly with the e-bike's motherboard. The absence of an immediate alert system to alert the owner in the event of theft slows recovery and raises the possibility of irreversible loss.

One of these systems' main drawbacks is that it doesn't integrate real-time tracking with the bike's control system, nor does it have clever communication modules like GSM for immediate notifications.

In order to close these gaps, the suggested system incorporates GPS and GSM modules for real-time tracking and alerting. Additionally, automated speed limitation is used to improve rider safety and stop abuse.

IV. METHODOLOGY

This project uses a systematic development process to build and construct an intelligent e-bike system that uses GPS and GSM modules to identify theft in real time and regulate speed. The following key phases comprise the methodology:

1. System Design and Component Selection:

The Arduino UNO is chosen as the main microcontroller for controlling every component

because of its dependability and simplicity of integration.

A GPS module (such as the NEO-6M) is selected to give precise real-time position tracking of the e-bike, which is necessary for recovery and theft detection.

In the event of theft or illegal use, the owner can receive real- time information on the bike's location and condition via SMS alerts sent via a GSM module (such as the SIM800L).

To dynamically monitor and regulate the e-bike's speed, a motor driver and speed sensor are combined. The device makes sure the bike stays within reasonable speed ranges.

Rechargeable lithium-ion batteries, chosen for their size, output stability, and energy requirements, power the system.

2. Hardware Implementation:

The hardware system is put together with a focus on both functional precision and energy efficiency.

A well-thought-out circuit connects every part, including the Arduino, GPS, GSM, speed sensor, and display, to guarantee steady functioning.

The motor may be enabled or disabled by an electrical switch or relay in response to speed infractions or theft detection.

For e-bikes to remain reliable in outdoor environments, proper soldering and insulation are essential.

3. Firmware Development:
To control different system functions in real-time, the Arduino is programmed using the Arduino IDE.

There are several functional blocks in the firmware:

Speed Monitoring and Control: Constantly monitors speed sensor data and controls motor output when speed surpasses predetermined thresholds.

- GPS tracking: records the bike's position and sends or stores it as needed. Wi-Fi data transfer to the Blynk platform.
- Unauthorized motion or ignition is detected by the theft detection algorithm. When it is discovered, an alert system is activated.
- GSM Alert System: Notifies the owner by SMS when there is a suspicion of theft, including the e-bike's current GPS location.
- LCD Updates: For user awareness, the display's speed, status, and alerts are updated on a regular basis.
- Power Optimization: To prolong battery life, the system incorporates fundamental power-saving strategies, such as turning off modules when not in use.

4. System Testing and Evaluation:
Testing for speed control: Confirmed by modeling overspeed scenarios to make sure the system efficiently restricts motor output.

In order to verify that alarms are set off and GPS location is transmitted via GSM, the theft simulation is tested by starting unapproved movement or power-on events.

Accuracy of Location: GPS data is examined for precision and reaction time.
SMS Alert Validation: Guarantees that the messages are delivered on time and include accurate data.

Power Consumption Monitoring: To determine any energy bottlenecks and determine how long the system can operate on a full charge, battery usage is tracked.

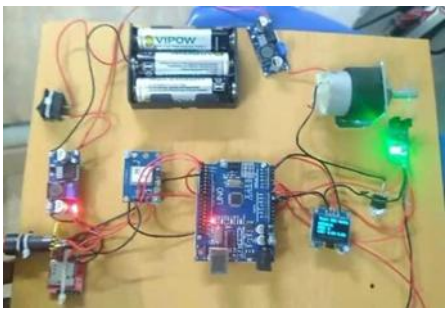
V. RESULT AND DISCUSSIONS

- The suggested e-bike system uses GPS and GSM technology to combine real-time theft recognition with sophisticated speed control. The objective is to improve vehicle security and rider safety while maintaining system usability and efficiency.

Results:

Real-Time Theft Detection and Location Tracking:

- The E-bike's illegal access is successfully detected by the system. It instantly notifies the owner's mobile number by SMS of any suspicious activity, including with the vehicle's current GPS coordinates. This makes it possible to respond quickly and maybe recover.
- Speed Monitoring and Regulation: The e-bike's speed is constantly tracked. In order to assist prevent accidents and guarantee safe operation, the motor control unit limits or slows down the vehicle if the speed over a certain safety threshold.
- Accurate GPS Tracking: For the purposes of route monitoring and theft tracking, the GPS module consistently delivers location data. During tests, the system's correctness was confirmed by the close match between the coordinates obtained via SMS and actual sites.
- Within seconds of a security breach, the GSM module efficiently notifies the registered mobile number by SMS. This allows for instant alert communication. The ability to communicate in real time is essential for tracking and preventing theft.
- LCD-based on-device monitoring: The LCD gives the rider up-to-date information on their speed, GPS status, and alerts. This guarantees the user stays up to date on the E-bike's functioning status.
- Efficient Power Usage: The system is made to increase the battery's operating time by selectively activating modules as needed, reducing excessive power consumption even if it lacks deep sleep like the ESP32.



Discussion:

- The results of the project demonstrate the effectiveness of combining GPS and GSM modules with Arduino-based control for enhancing E-bike safety. The theft detection mechanism provides quick alerts and accurate location data, significantly improving the chances of recovering stolen vehicles.
- The intelligent speed control system contributes to rider safety by automatically managing speed limits. This feature is particularly useful in environments with varying terrain or speed restrictions.
- Power management, though not as advanced as sleep modes in ESP32-based systems, has been implemented at a basic level by deactivating idle modules. Future upgrades could explore power optimization through advanced microcontrollers or sleep functions.
- The system's ease of use and real-time updates make it highly practical for everyday users. It also offers a scalable solution for rental or public bike systems where tracking and security are crucial.
- Overall, this project showcases a cost-effective and impactful approach to modernizing E-bike functionality with embedded smart features, making it a strong candidate for real-world applications in personal, urban, and shared mobility solutions.

CONCLUSION

The performance and efficiency of an electric bicycle are mostly controlled by the motor speed controller. To maximize the whole riding experience and efficiently control the power delivery to the motor, it makes use of a number of parts and technology. In order to effectively manage power MOSFETs, which in turn control the current flowing to the motor windings, MOSFET drivers must be integrated. This makes switching easier and maximizes power transfer while reducing losses. Moreover, the MOSFET driver guarantees appropriate gate drive voltage and current, enabling fine- grained control over the motor's torque and speed. Electric- bike motor speed controllers that use BLDC motors also offer a number of benefits, including increased efficiency, reduced maintenance needs, and smoother performance. These motors and

the sophisticated control algorithms of the controller provide theft protection.

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