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Smart Geo-Tracking for Advanced Jammer Solution

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Abstract

Efficient transportation and logistics management help reduce costs by providing real-time updates on the precise location of vehicles such as buses and trucks. The Anti-Theft Wheel Lock Tracking System serves as an effective tool for preventing unauthorized vehicle encroachment in restricted parking areas. Designed with the goal of developing a GPS-based anti-theft wheel lock activity tracker, this system can assist in identifying vehicles parked in no-parking zones while streamlining the process of revenue collection.This innovative system plays a crucial role in monitoring rule-violating vehicles. It features a wheel lock mechanism, specifically designed to facilitate inspections of illegally parked vehicles. The integrated hardware is strategically installed within the wheel lock, enabling it to function based on its locked or unlocked state. This hardware includes a GPS module that is linked to a central server, operating discreetly to transmit location data either continuously or upon system activation to a monitoring unit.Once the wheel lock is applied to a vehicle, the system records its location data and transmits GPS coordinates to a designated server, ensuring that traffic authorities remain informed about the vehicle's status. Additionally, tracking the locked and unlocked states of the wheel lock provides insights into the frequency of its usage, the duration for which it remains engaged, and the corresponding location.

INTRODUCTION

Efficient transportation and logistics play a vital role in cost reduction by enabling real-time tracking of vehicles such as trucks and buses. The Anti-Theft Wheel Lock Tracking System is an innovative tool designed to prevent unauthorized parking and vehicle encroachment in restricted areas. The objective of this system is to design and implement a GPS-based anti-theft wheel lock activity tracker that helps monitor vehicles parked in no-parking zones while simplifying the process of revenue collection.This system provides an effective solution for tracking rule-violating vehicles. It incorporates a wheel lock mechanism**,** which is commonly used for inspecting improperly parked vehicles. The system's hardware is integrated within the wheel lock, allowing it to function based on its locked or unlocked state. A GPS module is embedded in the hardware and connected to a central server, enabling it to discreately transmit location data either

continuously or upon system activation to a monitoring unit .When the wheel lock is applied to a vehicle, the tracking system records its location and sends GPS coordinates to a designated server. This ensures that traffic authorities remain updated on the vehicle's status. Additionally, monitoring the wheel lock's lock/unlock state provides insights into its frequency of use, the duration of active engagement, and the specific locations where it was applied.utilizes GPS technology and potentially other sensors to detect pinpoint the location of GPS jammers,enabling rapid countermeasures and restoring reliable navigation services.the user plug the jammer into the installed GPS tracker. A GPS jammer is different though in that it sends out radio signals noise with the same frequency as the GPS device. The system's hardware is integrated within the wheel lock, allowing it to function based on its locked or unlocked state. A GPS module is embedded in the hardware and connected to a central server, enabling it to discreately transmit location data either continuously or upon system activation to a monitoring unit.locked or unlocked state. A GPS module is embedded in the hardware and connected to a central server, enabling it to discreately transmit location data either continuously or upon system activation to a monitoring unit.When the wheel lock is applied to a vehicle, the tracking system records its location and sends GPS coordinates to a designated server. This ensures that traffic authorities remain updated on the vehicle's status. Additionally, monitoring the wheel lock's lock/unlock state provides insights into its frequency of use, the duration of active engagement, and the specific locations where it was applied.utilizes GPS technology and potentially other sensors to detect pinpoint the location of GPS jammers,enabling rapid countermeasures and restoring reliable navigation services.the user plug the jammer into the installed GPS tracker. A GPS jammer is different though in that it sends out radio signals noise with the same frequency as the GPS device. The system's hardware is integrated within the wheel lock, allowing it to function based on its locked or unlocked state. A GPS module is embedded in the hardware and connected to a central server, enabling it to discreately transmit location data either continuously or upon system activation to a monitoring unit.

LITERATURE SURVEY

Several research studies have explored the integration of IoT, cloud computing, GPS tracking, and advanced security mechanisms in parking management and enforcement systems.[1]. In a smart parking management system utilizing IoT sensors and cloud computing was developed to enable real-time data collection for efficient parking space utilization and traffic flow optimization [2]. The study highlighted the role of cloud computing in remote monitoring and dynamic resource allocation, emphasizing its impact on reducing congestion and promoting sustainable urban development [3].Additionally, examined the implementation of advanced anti-theft mechanisms in parking security, integrating biometric access controls and tamper-proof locking systems to prevent unauthorized access and vehicle theft [4]. The study emphasized the psychological impact of enhanced security measures in fostering trust among vehicle owners while reducing vehicle-related crimes and associated costs. Similarly, introduced an intelligent wheel lock system with automated monitoring and remote control, streamlining parking enforcement and improving compliance with regulations [5]. The study demonstrated its potential in reducing unauthorized parking, alleviating traffic congestion, and promoting eco-friendly urban mobility.Another study explored the integration of GPS technology with electronic locking mechanisms for efficient parking enforcement.[6]. By utilizing real-time GPS tracking, the system enabled effective monitoring of parking violations, minimizing disputes and improving traffic management. The study also highlighted the potential for enhanced revenue collection through automated enforcement mechanisms.[7] Furthermore, investigated advanced vehicle tracking and security measures, incorporating real-time surveillance and tracking systems to deter theft and vandalism in urban parking spaces[8]. The study emphasized the role of these security measures in supporting law enforcement agencies while contributing to a safer urban mobility ecosystem.These studies demonstrate the transformative potential of IoT, GPS tracking, and intelligent security systems in parking management[9]. The proposed system builds on these findings by integrating advanced technologies to enhance monitoring, security, and enforcement, ultimately improving urban transportation efficiency.[10].

OBJECTIVE

The primary objectives of this project aim to enhance the effectiveness of urban transportation through the integration of advanced technologies. By focusing on the development and implementation of a sophisticated monitoring system, the project seeks to address the challenges faced by current bus transportation and parking management.

To Enhance Monitoring: Develop a comprehensive system for recording and monitoring the usage of wheel locks/jammers, providing accurate data for operational analysis and decision-making.
To Improve Security: Integrate advanced anti-theft mechanisms, including biometric access controls and tamper-proof systems, to enhance the security of vehicles in urban parking spaces.
To Facilitate Real-Time Tracking: Implement a geo-location sensor for real-time tracking of vehicles, allowing for efficient management and immediate response to unauthorized usage.
To Optimize Parking Management: Utilize IoT and cloud computing technologies to streamline parking operations, improve compliance with regulations, and reduce instances of unauthorized parking.
To Minimize Congestion: Promote smoother traffic flow and reduce the time spent searching for parking through better resource allocation based on real-time data.
To Foster Sustainable Practices: Encourage eco-friendly urban transportation by decreasing emissions associated with unnecessary driving and optimizing parking resource usage.
To Support Data-Driven Decisions: Utilize collected data to inform stakeholder about usage patterns and areas for improvement in urban parking and transportation systems.

PROPOSED WORK

The need of Anti-Theft Wheel Lock Systems is to monitor the use of traditional devices for vehicles are encroached in parking places. The system will monitor by collecting the data of the number of times the wheel lock/jammer was used on a specific day. The Anti-Theft Wheel Lock Tracking System would consist of the wheel lock which has enhanced performance-based design and also efficient technical performance which lacks in traditional equipment. The Anti-Theft Wheel Lock Tracking System would also consist of processing, communication, tracking modules which are composed of Arduino, Sim module, GIS module.

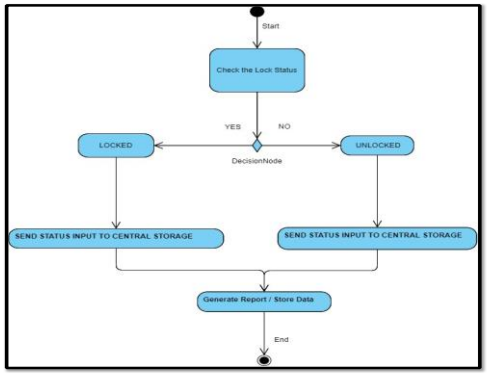


Fig 1: Activity diagram of the proposed system

METHODOLOGY

The development of the Advanced Wheel Lock/Jammer System follows a structured approach that integrates modern technologies to enhance vehicle monitoring and security in urban transportation. The design phase focuses on creating a 3D-printed wheel jammer casing that houses essential electronic and mechanical components. The system is powered by a rechargeable battery with a Mini DC Digital Voltage Meter to display live voltage levels.A DC motor with a worm gear mechanism is employed to control the opening and closing of the wheel lock. The motor is driven by a DC motor driver, which is connected to an Arduino Uno microcontroller for efficient operation. To enable wireless control, the system integrates an HC-05 Bluetooth module, allowing communication between the wheel jammer and a mobile application.

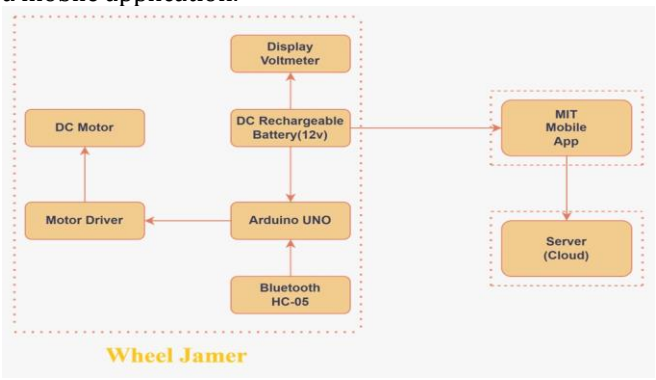


Fig2: Block diagram

Fig: Flowchart

The methodology for developing this system involves the following steps:

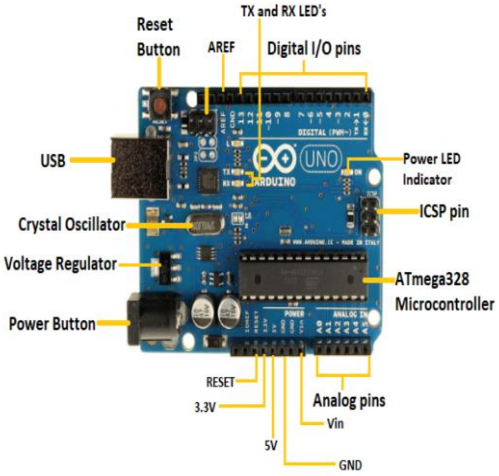
1. Arduino UNO Microcontroller Board: A popular microcontroller board based on the ATmega328P, featuring 6 analog input pins, 14 digital I/O pins, a USB port, and an IDE-based programming environment.

2. MIT App Inventor: MIT App Inventor is an online platform for creating mobile applications using a visual, block-based coding system. It allows users, even beginners, to develop fully functional Android and iOS apps without prior programming knowledge. The platform supports real-time testing through the MIT AI2 Companion app. Developed by MIT's CSAIL team, it aims to democratize software development by making app creation accessible to everyone.

3. Bluetooth HC-05: Enables wireless communication using Bluetooth 2.0 + EDR over a 2.4 GHz ISM band.
Modes:
Data Mode: Enables communication between paired devices.
Command Mode: Allows configuration using AT commands.

HARDWARE AND SOFWARE REQUIREMENT

Hardware Requirements



- Arduino UNO
- GPS+GSM module
- Mini Limit-Switch
- ATmega 328Microcontroller
- Digital I/O Pins (D0–D13)
- TX and RX LEDs
- AREF Pin
- Reset Button
- 12v DC motors
- GND Pins
- Bluetooth Module (HC-05)

Software Requirements

- MIT App Inventor
- Arduino software for computing platform

Applications, Advantages, And Limitations Of Trackable Intelligent Wheel Jammer

Applications:

- Traffic Law Enforcement – Helps traffic police efficiently monitor and control illegal parking.
- Smart Parking Management – Can be integrated with city-wide parking enforcement systems.
- Vehicle Immobilization – Used to prevent vehicle movement in case of non-payment of fines.
- Digital Record Keeping – Stores parking violations in the cloud database for future reference.
- Fleet Management – Can be adapted to restrict unauthorized vehicle movement in logistics and corporate fleets.

Advantages:

- Real-Time Tracking – Uses mobile internet-based GPS to provide live location of immobilized vehicles.
- Wireless Operation – Allows Bluetooth-enabled locking/unlocking through a mobile app.
- Cloud Data Storage – Ensures violation records are stored securely for enforcement reference.
- Automation – Eliminates the need for manual ticketing, reducing human error.
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- Automation – Eliminates the need for manual ticketing, reducing human error.

Limitations:

- Bluetooth Range Limitation – Effective only within 10 meters, making remote operation difficult.
- Dependency on Mobile Internet – Requires continuous internet connectivity for cloud updates.
- Manual Activation Required – The system still requires police officers to manually attach the jammer.
- Mobile GPS Accuracy Issues – Location accuracy depends on the smartphone's GPS quality.
- No Auto-Detection of Violations – Unlike AI-based systems, it cannot detect violations autonomously.

RESULT AND DISCUSSION

The Anti-theft wheel lock tracking system comprises of Design, Networking Hardware and Tracking
Design: The new design of the tool is adjustable and supportable to different sizes of wheels of various vehicles. This new design mechanism gives accurate status of wheel lock to the central

server when the mechanism detects pressure by the surface of the wheel.
Networking: The continuous flow of data will be stored in the central server/central storage unit communicates to the central server via a wireless connection channel.

The **Anti-Theft Wheel Lock Tracking System** was developed to enhance parking management and vehicle security by integrating **IoT, GPS, and cloud computing**. The system successfully **monitors and records** the usage of wheel locks in real-time, providing **traffic authorities** with valuable data to track parking violations.

Fig 4: Project Hardware with Mobile App and Cloud Dashboard

The system consists of a 3D-printed wheel jammer casing housing a DC motor, motor driver, Arduino Uno, rechargeable battery, and Bluetooth module (HC-05). The system is controlled through a mobile application, allowing traffic police to lock/unlock the jammer A worm gear-driven DC motor enables secure locking and unlocking. The Mini Limit-Switch detects whether the wheel lock is engaged, updating the system's status accordingly.

3. Mobile App Interface & Internet-Based Tracking
The MIT App Inventor-based mobile application allows users to lock/unlock the jammer via Bluetooth.

- When the jammer is locked, the traffic officer enters the vehicle number into the app.

- The app fetches the phone's live location using the mobile's internet-based GPS and uploads the vehicle number and location to the Traffic Management Cloud Server.

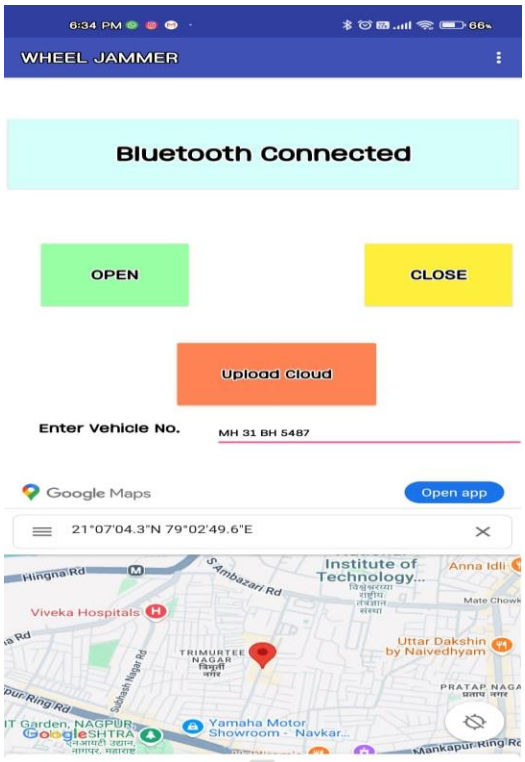

Fig 5: Traffic Police Mobile App

CONCLUSION

The implementation of the advanced wheel lock/jammer system, integrated with geo-location tracking and communication capabilities, represents a significant advancement in the management and security of urban transportation. By enabling real-time monitoring and recording of the wheel lock's usage, the system provides critical evidence to improve operational control and enhance safety. Drawing insights from existing literature, the integration of IoT sensors, cloud computing, and GPS technology has been shown to optimize parking management, reduce congestion, and foster a safer urban environment. The emphasis on automated monitoring and anti-theft mechanisms aligns with contemporary trends in smart city initiatives, paving the way for more efficient resource allocation and better compliance with parking regulations.
Moreover, this system's ability to communicate during network failures ensures reliability and robustness, making it a valuable tool for both vehicle owners and parking authorities. The anticipated outcomes, including enhanced user experience, reduced vehicle-related crimes, and improved operational efficiency, underscore the transformative potential of the technology. By leveraging advanced solutions like RFID for attendance tracking and GSM alerts for route deviations, the system aims to alleviate parental concerns regarding student safety during transportation. Overall, the comprehensive integration of these technologies signifies a

progressive step towards a secure and efficient urban mobility framework, fostering trust and confidence among users.

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