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Authenticated Access Control for Vehicle Ignition System and Long Range Vehicle Monitoring System based on LoRa WAN Protocol

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Abstract: ***The development of LPWAN technology is gradually becoming an evolution for its significant improvements of signal sensitivity and noise tolerance. At present, however, many IoT applications, such as Gsm location tracking , are still using the communication technology of traditional mobile network, which consumes considerable power and suffers from high communication cost. In this project a long-range vehicle monitoring system, based on the LoRaWAN protocol[1]. We clarify the system parameters and determine its communication range. This prototype system is implemented to track the vehicle route in real time, to monitor the health of vehicle, biometric authentication for ignition of vehicle . With the data collected from the prototype system, the relationship between the Packet Delivery Rate(PDR) and Signal to Noise Ratio(SNR) is built. Considering the impact of signal contention, a model is theoretically verified to decide the PDR under different node count and duty cycle. Finally, the communication range is concluded and a solution is proposed for setting up a Authenticated Access Control for Vehicle Ignition System and Long range Vehicle monitoring system based LoRaWAN protocol. This system in the real by LoRaWAN, which reduces power consumption and eases gateway deployment[1].***
. ***Keywords: LoRaWAN Protocol, SNR, RSS, Transmitter and Reciever***.

I. INTRODUCTION

LoRaWAN, as one of state-of-the-art open source LPWAN protocols, creatively introduces LoRa in its Physical Layer. LoRa is based on CSS (Chirp Spread Spectrum) modulation, efficiently avoiding the interference from both multipath transmissions and Doppler effect.

As a result, the decode efficiency of signals is guaranteed. Take LoRa SX1276 transceiver as an example: its tolerance of LoRa signal RSSI and SNR are as low as -148dBm and -20dB respectively[1].

Semtech , the patent holder of the LoRa chip, has been applying this technology to various IoT applications.

Using the LoRaWAN technology as the medium of communication ,the model is proposed with a transmitter and receiver which are interfaced with microcontroller each. Each parts consists of LoRaWAN module ,transmitter having RFID reader , finger print sensor and ignition system (Motor & motor driver) proposes the authenticated access control for vehicle ignition system . A GPS module proposes the long range vehicle monitoring system based on LoRaWAN protocol. In addition vehicle will not be accessed if alcohol detected with driver and regarding message will be received by owner ,also engine temperature and user information will be received and displayed.

Objectives aims to explore the feasibility of LoRaWAN to reduce the power consumption. Aim to develop the communication range of LoRaWAN to satisfy the vehicle monitoring and authentication system in real.Deploying LoRaWAN protocol to monitor and access the vehicle[2] .Aim to develop the vehicle location tracking system using LoRaWAN protocol.To check or verify LoRaWAN system be better than the present mobile network[2].

II. METHDOLOGY AND IMPLEMENTATION

The proposed system represents a vehicle tracking and monitoring system utilizing a LoRaWAN communication protocol. The system consists of two main parts: the transmitter (installed in the vehicle) and the receiver (located remotely for monitoring purposes).

A. Transmitter Part:

Components:

Arduino Unit: The central processing unit that interfaces with various sensors and modules.

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LoRaWAN Module(sx-1278): Facilitates long-range communication with the receiver.

Block diagram:

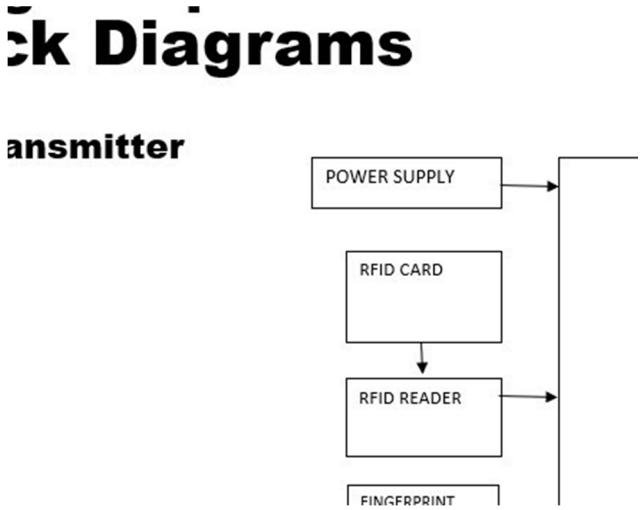


Fig 1. Transmitter –Proposed system using unique identity

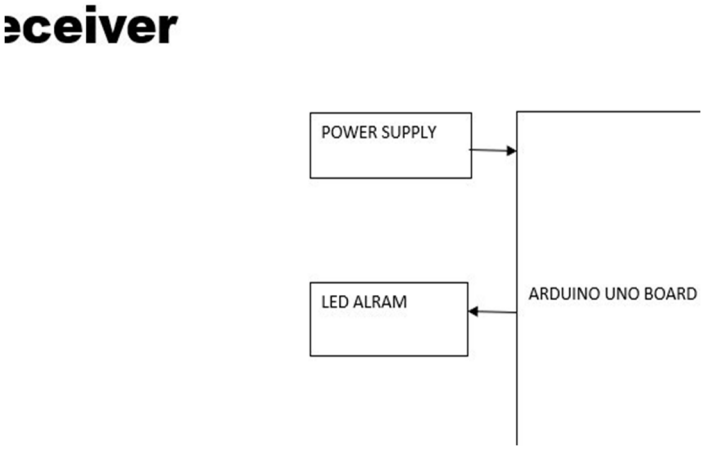


Fig 2. Receiver – Proposed system for monitoring

GPS Module(Neo-6M): Provides real-time location data of the vehicle[2]. RFID Reader: Identifies the driver or authorized personnel[3] Fingerprint Module(R307S): A biometric sensor that scans and recognizes fingerprints for authentication[5]. Sensors: Various sensors to monitor different parameters such as engine temperature and the rider's intoxication status[4].

Functionality: The Arduino unit gathers data from the GPS module, RFID reader, and sensors. The data is then transmitted wirelessly via the LoRaWAN module to the receiver part.

B. Receiver Part

Components: LoRaWAN Transceiver: Receives data transmitted by the transmitter[1].

Display Device: This can be an LCD display or a computer/Android device used to monitor and display the received data.

Functionality: Receives the data sent by the transmitter regarding the vehicle's status and location. Displays critical information such as the vehicle's location, engine temperature, and the rider's intoxication status.

Communication: The transmitter and receiver parts are connected through the LoRaWAN protocol, which allows for long-range, low-power communication. This setup enables real-time monitoring of the vehicle's status and location remotely.

Use Case: Vehicle Monitoring: At the receiver end, users can monitor important parameters such as the vehicle engine temperature and the rider's drunk status using a computer or an Android device. This ensures better management and safety of the vehicle.

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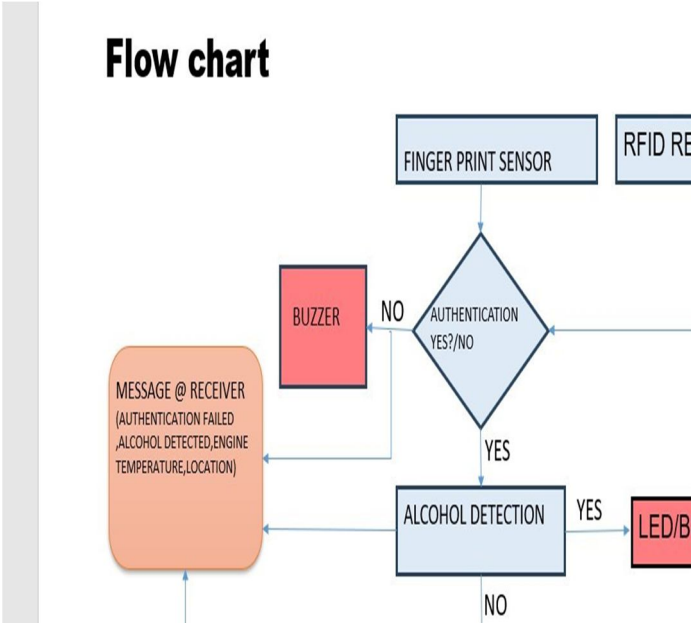


Fig 3. Flow diagram for the Proposed system

III. RESULTS AND DISCUSSION

Summary:

Based on the results obtained in the project, here is a structured results and discussion :

Authentication-Fingerprint Verification: The system successfully authenticates the driver's identity using a fingerprint sensor. This ensures that only authorized personnel can start and operate the vehicle, enhancing security and preventing unauthorized use.

1) Temperature Monitoring and Control
2) Temperature Monitoring: The vehicle's engine temperature is continuously monitored. If the temperature exceeds a predefined threshold, the system triggers an alert to prevent potential damage to the engine.
3) Control of Motor Driver: The motor driver is controlled to operate within the safe temperature range. When the temperature crosses the threshold, appropriate measures are taken to either cool down the engine or shut it down to avoid overheating
4) Alcohol Detection-Alcohol Detection Messages: The system effectively detects the rider's intoxication status. If the rider is found to be drunk, a message is sent to the receiver end to notify the concerned authorities or stakeholders, ensuring safety and compliance with regulations.
5) GPS Tracking-GPS Tracking:The system tracks the vehicle's location using GPS modules, providing real-time longitude and latitude coordinates. This tracking is effective under suitable outdoor conditions, allowing for precise location monitoring and navigation assistance.

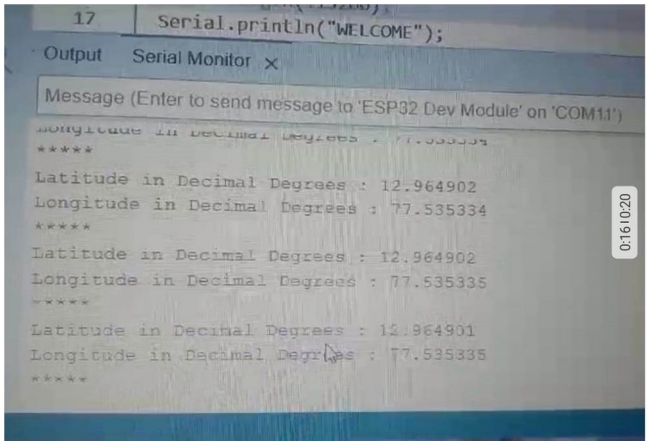


Fig 4. Results showing GPS location coordinates

Communication and Notifications-LoRaWAN

Communication: Data from the transmitter (vehicle) is transmitted to the receiver end using the LoRaWAN protocol. This long-range, low-power communication ensures reliable data transfer even over extended distances.

Notifications: Critical notifications, such as temperature alerts and alcohol detection messages, are promptly sent to the receiver. These notifications can be viewed on an LCD display, computer, or Android device, enabling timely responses to any issues.

Summary

This system allows for efficient tracking and monitoring of vehicles by integrating GPS, RFID, and various sensors with Arduino and LoRaWAN modules. The real-time data transmission and remote monitoring capability make it suitable for applications such as fleet management, theft prevention, and ensuring driver safety.The integrated system combines multiple sensors and modules to enhance vehicle monitoring and safety.Fingerprint authentication ensures only authorized use.

Temperature monitoring and motor control prevent engine damage by maintaining operation within safe limits. Alcohol detection contributes to safety by notifying about intoxicated driving. GPS tracking provides real-time location data, which is crucial for navigation and fleet management.LoRa WAN protocol ensures efficient and reliable communication between the vehicle and the remote monitoring station.

This system's implementation can significantly improve vehicle security, operational efficiency, and safety, making it valuable for applications such as fleet management, personal vehicle security, and compliance with safety regulations.This system allows for efficient tracking and monitoring of vehicles by integrating GPS, RFID, and various sensors with Arduino and LoRa WAN modules. The real-time data transmission and remote monitoring capability make it suitable for applications such as fleet management, theft prevention, and ensuring driver safety.

Rx-Receiver

1) LoRa Sx1278
2) .Arduino Uno
3) .Buzzer Tx-Transmitter 1.LoRa Sx1278,
4) Neo-6M GPS
5) Fingerprint sensor
6) ESP 32
7) Motor
8) Temperature sensor
9) LCD display.

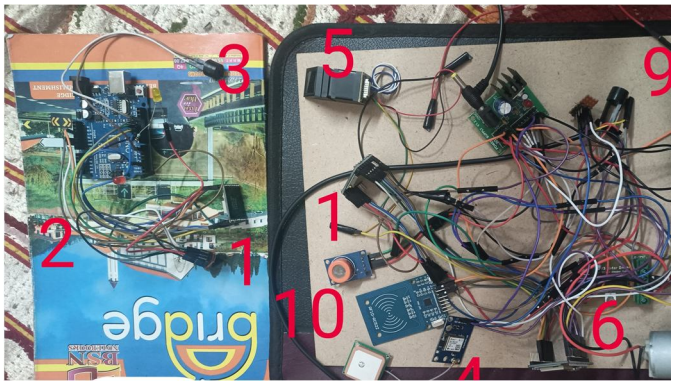


Fig 5. LCD display showing temperature

IV. CONCLUSION

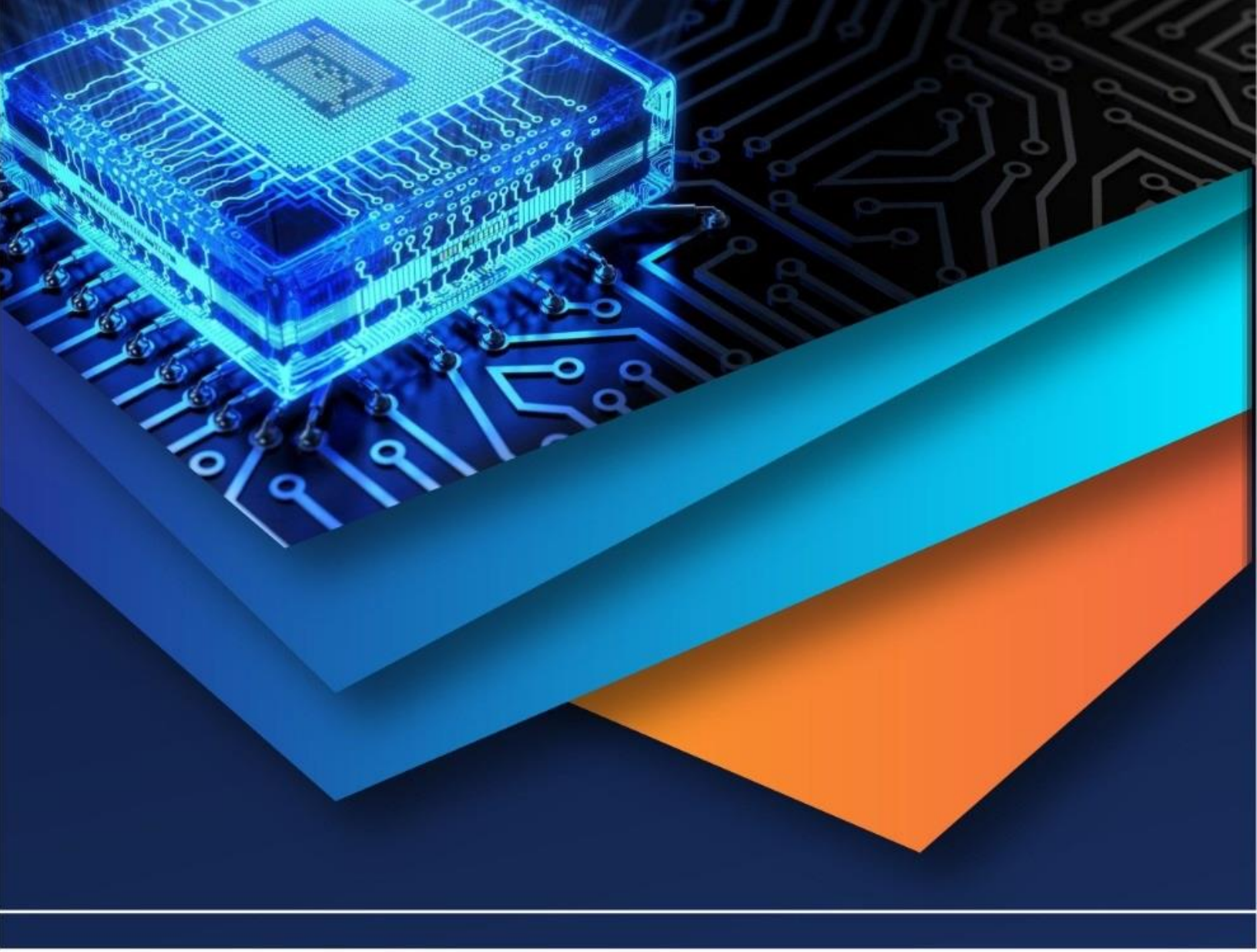
The proposed vehicle tracking and monitoring system uses LoRaWAN for long-range, low-power communication between a vehicle-installed transmitter and a remote receiver. The transmitter, consisting of an Arduino unit, GPS module, RFID reader, and various sensors, gathers data on engine temperature, rider intoxication, and location. This data is wirelessly sent to the receiver, which includes a LoRaWAN transceiver and a display device for monitoring. The system ensures only authorized use, real-time vehicle tracking, and safety monitoring. It is suitable for fleet management and personal vehicle security, offering an efficient, userfriendly solution for enhanced vehicle management.

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