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International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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Fleet Management and Tracking System Using Lora

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ABSTRACT: The Fleet Management and Tracking System using LoRa is a long-range, low-power solution for monitoring and managing vehicle fleets. Each vehicle is equipped with a transmitter unit featuring an Arduino Nano, a GPS module, a switch, a buzzer, and a LoRa module. The GPS module provides real-time location data, which is sent to the receiver unit at the management center via LoRa. The receiver unit, based on an Arduino Uno, receives and processes this data, displaying vehicle locations and statuses on an LCD screen. The switch in each vehicle allows for emergency alerts, while the buzzer provides audible notifications for unauthorized movements or route deviations, enhancing fleet security. This system is scalable, allowing for easy integration of additional vehicles as needed. By leveraging LoRa technology, the system ensures efficient, long-range tracking and management, improving the overall safety and operational efficiency of fleet operations.

I. INTRODUCTION

Fleet management is crucial in transportation and logistics, encompassing the oversight of commercial vehicles like cars, trucks, vans, and buses. Traditional systems typically depend on cellular networks for real-time tracking, which can be expensive and may not cover remote areas effectively LoRa technology, a long-range, low-power wireless communication system, offers a cost-effective and reliable alternative for fleet management. LoRa technology enables long-range communication, with coverage extending up to 15 kilometers in open areas, making it ideal for managing fleets in remote regions where cellular coverage is sparse or unavailable. Its low power consumption allows the system to run for extended periods on battery power, minimizing the need for frequent recharges or constant connection to vehicle power sources. This is particularly advantageous for tracking stationary assets like construction equipment or trailers.

Compared to conventional GPS tracking systems that use GSM networks, a LoRa-based solution dramatically reduces operational costs by utilizing unlicensed frequency bands, thereby eliminating the need for expensive data plans. Additionally, LoRa's robust communication ensures reliable data transmission in challenging environments, such as dense forests or mountainous terrains, where traditional networks often fail.

II. LITERATURE SURVEY

1. "Long-Range Communications in Unlicensed Bands: The Rising Stars in the IoT and Smart City Scenarios" Centenaro, M., Vangelista, L., Zanella, A., &Zorzi,M.

This paper discusses the emerging technologies of Low-Power Wide-Area Networks (LPWAN), including LoRa, that are designed to provide long-range communication in unlicensed frequency bands. The study highlights the advantages of LPWAN technologies in terms of low power consumption, extended range, and their potential applications in the Internet of Things (IoT) and smart city scenarios. LoRa, in particular, is emphasized for its capability to offer robust communication over several kilometers, making it ideal for applications such as environmental monitoring, asset tracking, and smart metering..

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2. "A Study of LoRa: Long-Range & Low-Power Networks for the Internet of Things Augustin, A., Yi, J., Clausen, T., & Townsley, W. M.

This study provides an in-depth analysis of LoRa technology, focusing on its application in IoT networks. The authors explore the technical specifications of LoRa, including its modulation scheme, power efficiency, and data transmission capabilities. The paper discusses the trade-offs between communication range and data rate, illustrating how LoRa achieves long-range communication at low data rates, which is sufficient for most IoT applications. The study also covers the deployment scenarios of LoRa networks, from smart agriculture to urban sensing, showcasing the flexibility and adaptability of LoRa in various IoT environments.

III. EXISTING SYSTEM

Current fleet management systems commonly rely on GPS and GSM modules to monitor vehicle locations and transmit data to a central server. Although these systems are effective, they encounter several challenges, including expensive operational costs linked to data consumption, limited network coverage in remote or rural areas, and significant energy consumption, which shortens the battery life of tracking devices. Additionally, the dependence on cellular networks exposes these systems to risks such as network outages, congestion, and reliability issues.

DISADVANTAGES

- High operational costs
- Limited network coverage
- High energy consumption
- Vulnerability to network outages

IV. PROPOSED SYSTEM

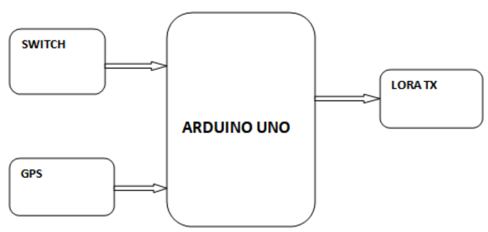
The proposed Fleet Management and Tracking System utilizes LoRa technology to address the challenges of current systems. It includes an Arduino Nano on the transmitter side, which gathers GPS data and transmits it via LoRa to an Arduino Uno on the receiver side. The receiver processes this data and displays the vehicle locations on an LCD screen. A switch can activate alerts, while a buzzer provides audible notifications, enhancing safety features. LoRa technology enables long-range communication with low power usage, making it ideal for vehicles in remote locations. The system is also designed to scale easily, allowing for the addition of more vehicles without significantly increasing costs.

ADVANTAGES:

- Long-range communication
- Low power consumption
- Cost-effective scalability
- Enhanced safety features

V. BLOCK DIAGRAM

Transmitter



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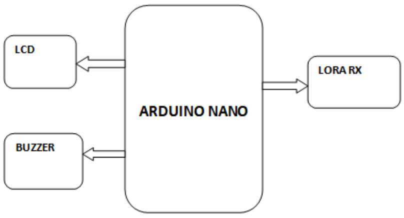
RECEIVER



VI. HARDWARE REQUIRED

- Arduino Uno
- Arduino Nano
- Lora Tx
- Lora Rx
- GPS
- Switch
- LCD
- Buzzer

VII. SOFTWARE REQUIRED

Arduino ide

VIII. HARDWARE DESCRIPTION

Arduino

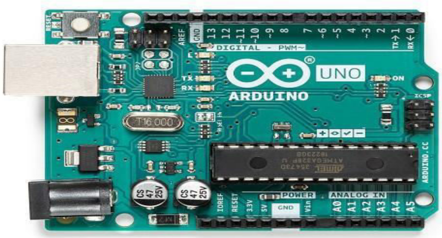


Fig: 1 ARDUINO UNO

The Arduino Uno is an open-source microcontroller board in light of the MicrochipATmega328P microcontroller and created by Arduino.cc. Sets of digital and analog input/output (I/O) pins are provided on the board, allowing it to interface with various expansion boards (shields) and other circuits. The board is programmable using the Arduino IDE (Integrated Development Environment) via a type B USB cable and has 14 digital and 6 analog pins.

Full similarity with Safeguard sheets (Adaptation 2 is the main Arduino board that isn't viable with Safeguard sheets because of tall parts and a mistaken ICSP header position);

- AVcc LP channel to bring down the degree of commotion in the ADC;
- auto-reset empower/handicap jumper to forestall inadvertent resets;
- pin that is appropriate for the Arduino Diecimila;
- pin 13 of the installed drove, with a resistor to restrict current;

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- Locally available TX and RX leds;
- power drove with fitting current limiter resistor (less 20mA of comsumption);
- jumper to handicap successive correspondence and to enable RX outside pull down resistor, to avoid "RX floating bumble". This part allows to use mechanized pin0 and pin1 as a regular pin, when consecutive correspondence isn't needed;
- "Every comparable part (diodes, semiconductors, leds, capacitors) have a similar direction on the board, simplifying mounting and lessening the probability of mistakes,"
- no wires between pads, more space between wires, greater wires, greater pads (better for cutting, restricting and entering, with no shortcircuits, securing expansions or open wires in utilization);

Arduino nano

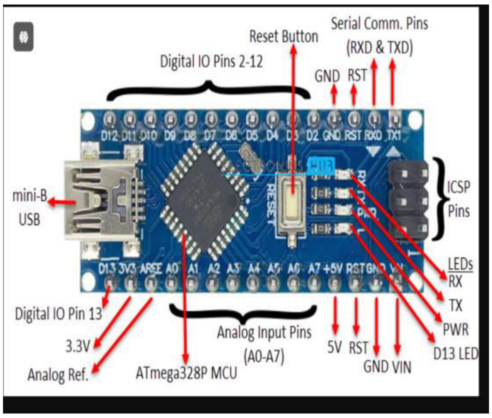

Fig: 2 ARDUINO NANO

The ATmega328P microcontroller is the foundation for the small, open-source Arduino Nano board, which was created by Arduino.cc. With a smaller size factor, it functions similarly to the Arduino Uno. A collection of digital and analog input/output (I/O) pins on the Nano board allow it to be interfaced with other circuits and expansion boards. It has eight analog and fourteen digital pins, and a Mini-B USB connector that may be used to program it using the Arduino IDE. The board may be powered by an external 7–12V power source connected by the VIN pin, or it can be powered via the USB connection. It requires voltages between 7 and 12 volts to function.

Digital Pin Usage: - The digital pins (D0 to D13) are used in digital input/output activities. - If necessary, analog input pins can also be set up to operate as digital pins.

Analyzing Digital Signals: - To
determine a digital pin's current state, use {digitalRead(pinNumber)}. Either {LOW~ (0V) or {HIGH~ (5V) is returned.

Writing Digital Signals: - To set a digital pin's state to either `LOW` (0V) or `HIGH` (5V), use `digitalWrite(pinNumber, value)}.

Signal States: - There are just two potential states for digital pins: {LOW} (0V) and {HIGH~ 5V

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GPS

Fig: 4 GPS

The Worldwide Situating Framework (GPS) is a satellite-based route framework comprised of no less than 24 satellites. GPS works in any weather patterns, anyplace on the planet, 24 hours every day, with no membership expenses or arrangement charges.

Specifications:

- **Receiver Type:** 50 channels, GPS L1 (1575.42 MHz)
- **Horizontal Position Accuracy:** 2.5 meters
- **Navigation Update Rate:** 1 Hz (5 Hz maximum)
- **Capture Time:**
  - Cool start: 27 seconds
  - Hot start: 1 second
- **Navigation Sensitivity:** -161 dBm
- **Communication Protocol:** NMEA, UBX Binary, RTCM
- **Serial Baud Rate:** 4800 to 230400 (default 9600)
- **Operating Temperature:** -40°C to 85°C
- **Operating Voltage:** 2.7V to 3.6V

LORA (LONG RANGE)

Fig: 5 LORA MODULE

LoRa (Long Range) is a low-power, long-range wireless platform used for IoT networks, introduced by Semtech. It uses spread spectrum modulation based on chirp spread spectrum (CSS) technology. Common frequencies include 433MHz, 915MHz, and 868MHz, enabling bi-directional communication over distances of 15-20km with minimal power consumption. LoRa supports public, private, and hybrid networks, offering greater range than cellular networks and facilitating low-cost, battery-operated IoT applications.

In LoRa technology, messages from devices are received by gateways and forwarded to a central network for processing. The LoRa Alliance, a non-profit organization, standardizes and advances this LP-WAN technology, driven by IoT demands.

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Features:

- LoRaTM spread spectrum communication
- +20dBm - 10mW. Stable RF output power when input voltage changed
- Half-duplex SPI communication
- Programmable bit rate can reach to 300KBPS

Lcd

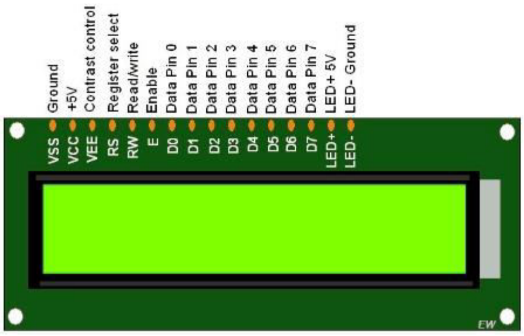

Fig: 6 LCD

An electronic display module known as an LCD (Liquid Crystal Display) screen is utilized in numerous contexts. A very fundamental module, a 162 LCD display is utilized frequently in numerous circuits and devices. These modules are liked north of seven portions and other multi section LEDs. These are the reasons: LCDs are prudent; effectively programmable; have no constraint of showing extraordinary and even custom characters (in contrast to in seven portions), activitys, etc.A 16*2 LCD has two such lines and can display 16 characters per line. In this LCD each character is shown in 5×7 pixel lattice. The Command and Data registers on this LCD are its two registers.

Features of 16×2 LCD module

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers

BUZZER

Fig: 7 BUZZER

An audio signaling device known as a buzzer or beeper can be piezoelectric, mechanical, or electromechanical. Alarm systems, timers, and confirmation of user input such as a mouse click or keystroke are typical applications for buzzers and beepers.

Specifications

- Rated Voltage: 6V DC
- Operating Voltage: 4-8V DC
- Rated current: <30mA

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- Sound Type: Continuous Beep
- Resonant Frequency: ~2300 Hz
- Small and neat sealed package
- Breadboard and Perf board friendly

IX. SOFTWARE DESCRIPTION

ArduinoSoftware(IDE)

Arduino is an open source, PC equipment and programming organization, task, and client local area that plans and makes microcontroller units for building computerized gadgets and intuitive items that can detect and control objects in the actual world. The venture's items are dispersed as open-source equipment and programming, which are authorized under the GNU Lesser Overall population Permit (LGPL) or the GNU Overall population Permit (GPL), allowing the production of Arduino sheets and programming conveyance by anybody. Pre-assembled Arduino boards can be purchased commercially or as DIY kits. The designs of Arduino boards make use of a variety of controllers and microprocessors.

The sheets are furnished with sets of advanced and simple information/yield (I/O) sticks that might be communicated to different development sheets (safeguards) and different circuits.

X. CONCLUSION

In remote and rural areas where traditional cellular networks may not be possible, the Fleet Management and Tracking System using LoRa offers a cost-effective, dependable, and scalable solution for monitoring and managing vehicle fleets. By utilizing the low-power and long-range abilities of LoRa innovation, this framework can fundamentally lessen functional expenses and upgrade the productivity of armada the board. For fleet management and real-time monitoring, the Fleet Management and Tracking System with LoRa provides a comprehensive solution. The system offers a scalable, cost-effective, and reliable alternative to conventional cellular-based tracking systems by making use of the advantages of LoRa technology. It is ideal for a wide range of fleet management applications due to its flexibility, low power consumption, and long-range communication capabilities, particularly in challenging and remote locations. As the interest for productive and practical armada the board arrangements keeps on developing, the proposed framework stands apart as a promising choice that can address the issues of present day armada tasks while supporting ecological and financial objectives.

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