**SAFETY TRANSPORT SYSTEM FOR SCHOOL CHILDREN USING RFID TECHNOLOGY BASED ON LORA TECHNOLOGY**

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**Abstract-** **SAFETY TRANSPORT SYSTEM FOR SCHOOL CHILDREN USING RFID TECHNOLOGY BASED ON LORA TECHNOLOGY," aims introduces a robust "Safety Transport System" tailored for school buses, incorporating School and Bus Units. Leveraging RFID, GPS, and LoRa technologies, the system ensures seamless child monitoring and swift emergency response. The Bus Unit integrates RFID for efficient entry/exit logging, LoRa for seamless data transmission, and GPS for precise location tracking. In case of emergencies, an alarm system promptly notifies both the Bus Unit and parents. At the school end, the LoRa Receiver Unit utilizes SPI for communication, facilitated by the Hercules software for real-time monitoring and analysis. Through its comprehensive features, this system significantly bolsters child safety during school commutes, fostering parental confidence.**

***Keywords*: Keywords: Safety Transport System, school buses, RFID, GPS, LoRa technology, real-time tracking, emergency response, entry/exit logging, alarm system, Hercules, parental confidence.**

**I.INTRODUCTION**

In the intricate tapestry of modern education, the safety of students during their daily commute stands as an uncompromisable priority. The conventional methods of ensuring school bus safety have been besieged by persistent challenges, with concerns ranging from accurate attendance tracking to the real-time monitoring of school bus locations. The urgency of addressing these challenges was underscored by a recent incident, emblematic of the safety concerns that inspired the genesis of our transformative project.

Our project transcends the limitations of traditional safety paradigms. We introduce Radio-Frequency Identification (RFID) for precise attendance tracking, mitigating the risks associated with manual record-keeping.

The integration of Global Positioning System (GPS) technology transforms the safety landscape by providing location monitoring. Picture a situation where a school bus deviates from its route, and school authorities are immediately alerted, averting potential risks.

In the realm of communication, our project relies on the potent combination of Long Range (LoRa) and Global System for Mobile Communications (GSM) technologies. Envisage a situation where, in areas with limited network coverage, the LoRa technology seamlessly transmits critical data, ensuring uninterrupted communication between the school bus and the central unit. In parallel, GSM serves as a robust backup, stepping in to guarantee data transmission reliability even in challenging network conditions.

As we embark on this transformative journey, our commitment is not just to the integration of technologies but to a profound reassurance—a promise to parents that their children are in safe hands, a commitment to school authorities for seamless operations, and a dedication to creating a transportation environment where the unexpected is anticipated, and safety is not a compromise but an assurance. In the ensuing sections, we delve into the components of our proposed system, seeking to revolutionize school bus safety and inspire a new era of secure and intelligent transportation solutions.

# II.RELATED WORK

Several research works have been conducted on RFID based safety transport system using GSM. However, RFID combined with LoRa and GPS is a promising technology for safe and secure transportation, but still extensive research is required.

Anwaar Al-Lawati et al [1] proposed a successful implementation of an RFID-based system tailored to bolster safety in school children transportation. The system adeptly detects child boarding and leaving events, maintains a central database with updated information, and issues alerts promptly when necessary. This demonstration underscores the system's potential to markedly improve overall transportation safety standards.

Yosuke Miyanishi et al [2] introduced a bus location system harnessing LoRa technology. This system showcases seamless communication between bus stops without requiring additional repeaters, offering a practical and cost-effective solution for real-time monitoring of bus locations. This research furnishes valuable insights into the application of LoRa technology for bolstering safety in school transportation systems, enriching the discourse on innovative solutions for ensuring child safety during commutes.

Khairul Shafee Kalid et al [3] proposed a system integrating GPS and RFID hardware along with a web interface for real-time data visualization. The system aims to enhance the safety of schoolchildren during their commute by allowing parents to monitor real-time information about their children's whereabouts.

Tun Mohamad Aqil Mohamad Fadzir [4] proposed a school bus security system leveraging RFID and GSM technologies. The system utilizes RFID for tracking and GSM for real-time messaging, along with GPS for location tracking. It demonstrates successful implementation of features like real-time messaging and attendance tracking, enhancing child safety during transportation in the Klang Valley area.

Syed Nabeel Ali [5] proposed a smart school bus tracking system utilizing RFID and GPS technologies. The system enables real-time tracking of school buses, ensuring the safety of children during transit.

Priyanka Singh [6] proposed a solution for enhancing school bus safety using RFID and IoT technologies. The system facilitates efficient tracking of school buses and ensures timely communication with parents, thereby improving child safety.

Rajesh Kumar [7] explored the integration of RFID and biometric systems for school children transportation safety. By combining RFID-based tracking with biometric authentication, the system enhances security and ensures accurate identification of children during transit.

A. Narmatha et al [8] presented a real-time monitoring and control system for school buses leveraging RFID and GPS technologies. The system provides comprehensive tracking capabilities and enables efficient management of school bus fleets, thereby improving safety and operational efficiency.

Assma Abdullah Habadi [9] introduced an innovative safety system for school buses. The system integrates RFID technology for passenger tracking and carbon dioxide (CO2) detection to prevent suffocation incidents. By utilizing RFID for efficient passenger monitoring and CO2 detection for early warning of potential suffocation risks, the proposed system aims to enhance safety measures and ensure the well-being of school children during their commutes.

# III.DESIGN METHODOLOGY

This research project seeks to revolutionize school bus safety by employing a holistic and integrated approach that combines Radio-Frequency Identification (RFID), Long Range (LoRa) communication, and Global System for Mobile Communications (GSM) technologies. The primary objective is to establish a robust system for accurate student attendance tracking, real-time location monitoring, and efficient data transmission between the school bus and the school unit.

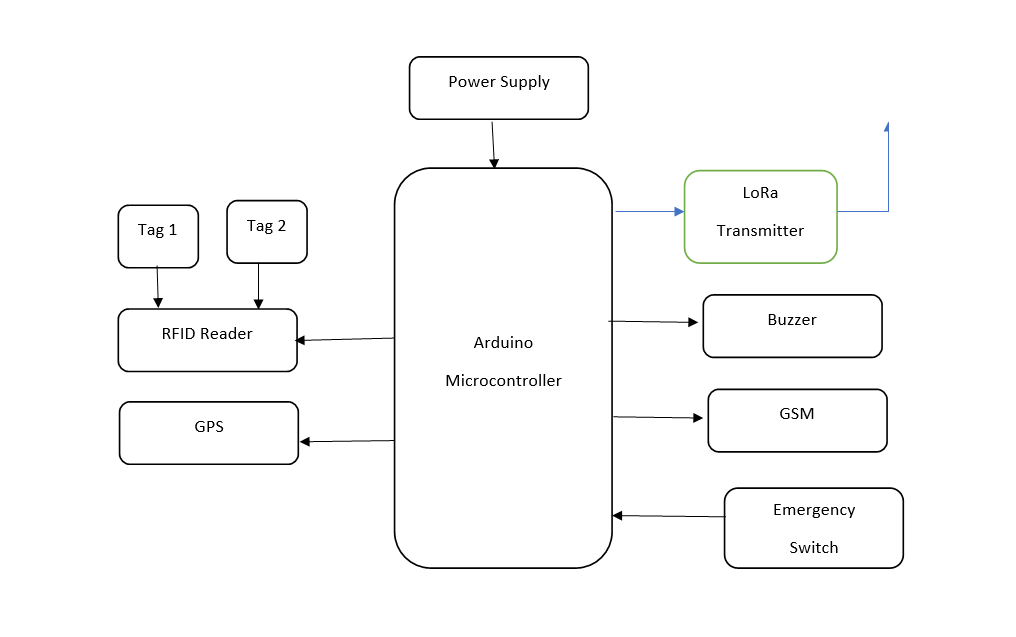


Fig 1: Block diagram of transmitter

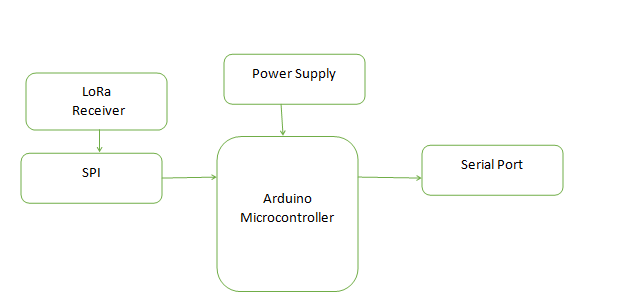


Fig 2: Block diagram of receiver

**Atmega328P Microcontroller:**

One type of Advanced Virtual RISC microprocessor is the ATmega328. Eight bits of data processing are supported. 32KB of built-in flash memory is present. This has an accessible 1KB EEPROM. This feature demonstrates that even in the event of a power outage, the microcontroller is still capable of storing data and producing output. It accomplishes this by needing energy to be replenished. Additionally, the ATmega-328 has a 2KB SRAM. We'll talk more about the other traits later on. The ATmega 328 is the most well-known product on the market right now due to its numerous unique features. These characteristics include an independent oscillator real-time clock, six PWM pins, an adjustable Serial USART, a programming lock for software security, low power consumption, effective operation, and throughput of 20 MIPS.

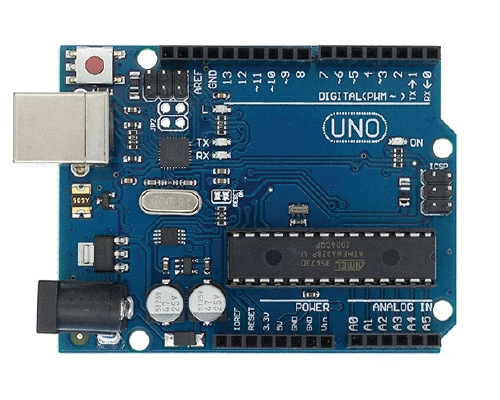


Fig 3: Arduino UNO

**3.1 RFID-Based Attendance Tracking:**

Each student is provided with a unique RFID tag for seamless and automated attendance tracking upon boarding the school bus. RFID readers are strategically positioned at the entrance of the school bus. As students board, the RFID readers capture data from their tags, automating attendance tracking and eliminating the need for manual processes. The captured RFID data is seamlessly integrated into a centralized database, maintaining an accurate and up-to-date record of student attendance. The EM-18 RFID Reader module operating at 125kHz is an inexpensive solution for RFID based application. The Reader module comes with an on-chip antenna and can be powered up with a 5V power supply. Power-up the module and connect the transmit pin of the module to receive pin of the microcontroller.

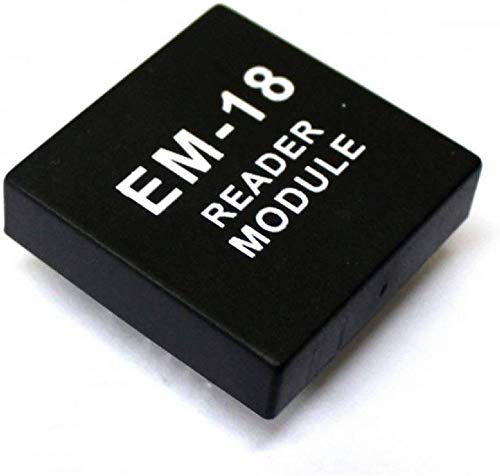


Fig 4: RFID Reader Module

**3.2 GPS-Enabled Real-Time Location Monitoring:**

A Global Positioning System (GPS) module is integrated into the school bus to continuously track its location in real-time. This module provides precise latitude and longitude coordinates, contributing to enhanced safety measures and facilitating efficient route planning.



Fig 5: GPS Module

**3.3 LoRa Communication Network:**

A LoRa transmitter is strategically positioned on the school bus, acting as the primary conduit for wireless communication. This device is equipped to transmit critical data, including RFID-based attendance records and GPS location information, to the central school unit. Operates at frequency of 433 MHz. LoRa provides reliable wireless data transmission. This reliability is paramount for ensuring that attendance records and location data reach the central school unit without interruption. LoRa's low-power characteristics contribute to the overall efficiency and sustainability of our school bus safety system. The school unit is equipped with a LoRa receiver that captures the transmitted data. This receiver ensures a reliable and long-range communication link between the school bus and the central monitoring system.

At the school unit, a dedicated LoRa receiver is in place to capture and interpret the transmitted data from the school bus. This receiver acts as the gateway for seamlessly integrating the received information into the Hercules SETUP utility for real-time data display.

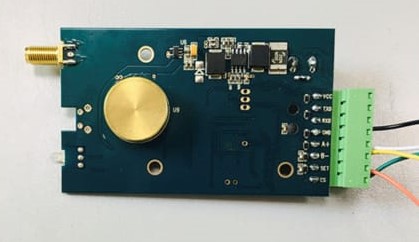


Fig 6: LoRa Module

**3.4 GSM Redundancy and Data Transmission:**

Operating in parallel with LoRa, a Global System for Mobile Communications (GSM) module provides redundancy for data transmission. It ensures that RFID and GPS data are efficiently relayed to the central monitoring system, offering a fail-safe mechanism during potential network fluctuations or interruptions.

The system incorporates data integrity checks during GSM transmission to guarantee the accuracy and completeness of the transmitted information. SIM 800C GSM Module is used in this project.

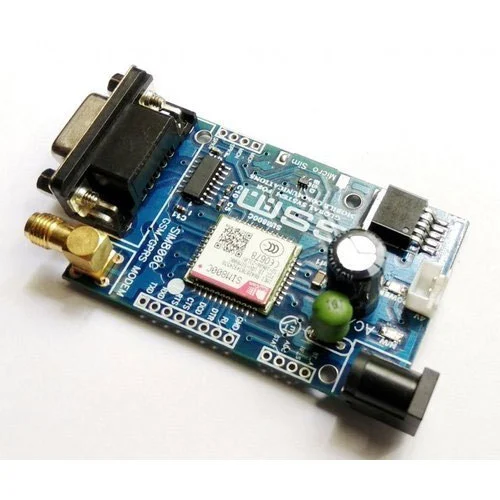


Fig 7: SIM 800C GSM Module

**3.5 Hercules Software for Real-Time Data Display:**

The Hercules SETUP utility serves as a serial terminal for capturing LoRa-transmitted data at the school unit.

The software processes and displays real-time data, offering school authorities an intuitive and user-friendly interface to monitor student attendance and the location of the school bus. Hercules can be configured to generate alerts for specific events, such as deviations from the predefined route or unexpected stops, enhancing situational awareness.

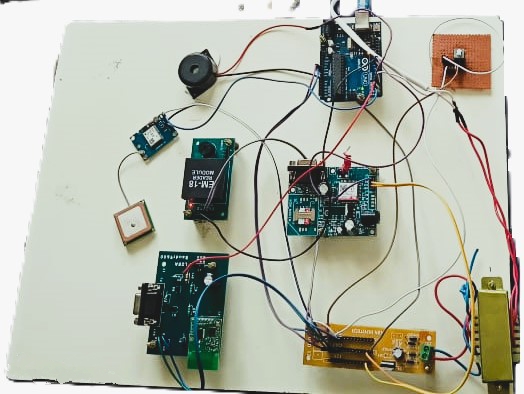


Fig 8: Hardware Setup

# IV.RESULT AND DISCUSSION

The implementation of the proposed RFID, LoRa, and GSM-based school bus safety system has yielded significant and promising outcomes, advancing the state-of-the-art in student transportation safety. The following key results have been observed.

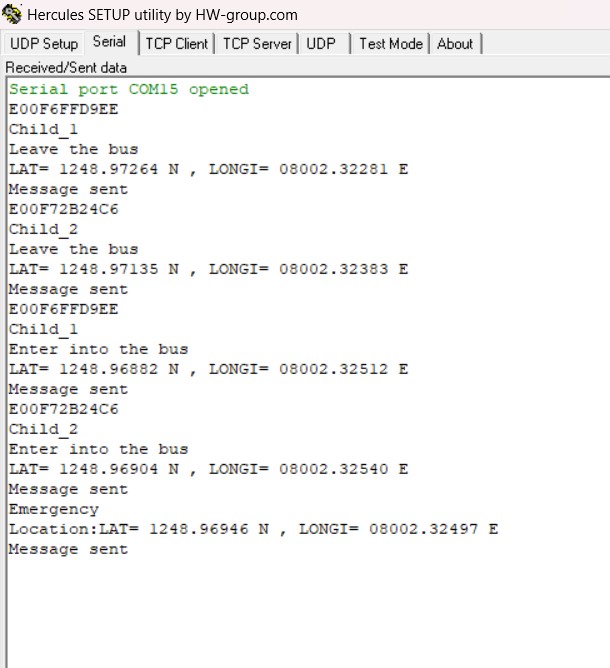


Fig 9: Data in Hercules Software

Figure 7 illustrates the user-friendly interface setup using Hercules where the school authorities can monitor and record the attendance of the children and real-time recording of student entries and exits onto the bus. The integration of GPS technology enabled continuous and real-time monitoring of the school bus's location. School authorities could access accurate location data, improving operational efficiency and enhancing student safety.

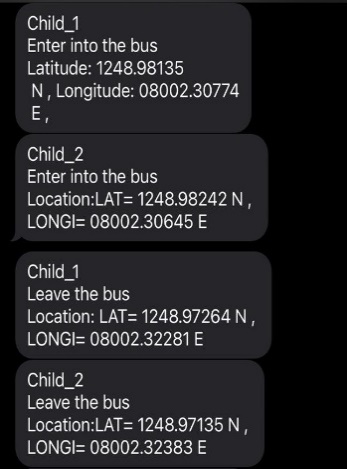


Fig 10: Messages in the recipient’s mobile

Figure 8 illustrates the messages sent to the parent’s mobile regarding the entry and exit of their child’s location.

The observed results underscore the transformative impact of the RFID, LoRa, and GSM-based school bus safety system on various facets of student transportation.

**V.CONCLUSION**

RFID, LoRa, and GSM-based school bus safety system represents a significant advancement in enhancing student transportation. Through accurate attendance tracking, location monitoring, and redundant communication channels, the system has streamlined operational efficiency and bolstered safety measures. The user-friendly interface of the Hercules SETUP utility facilitates seamless data display, empowering school authorities with immediate insights. The success of this project not only addresses current challenges but also paves the way for future innovations, such as predictive analytics and route optimization. In essence, the system stands as a model for intelligent, secure, and sustainable school bus safety solutions, promising a safer and more efficient future for student transportation.

# VI.FUTURE ENHANCEMENTS

Future enhancements for the safety transport system utilizing RFID and LoRa technology in school buses may evolve gradually, reflecting the pace of technological adoption in transportation and child safety. Integration of novel safety measures, akin to climate statistics for ranch advisories, may require time for experimentation and widespread adoption. Utilizing AI and machine learning algorithms could enable predictive analytics to anticipate safety risks, facilitating proactive alerts to relevant stakeholders. Further integration of sensors and IoT devices within buses could enhance safety by detecting environmental hazards. Integration with smart city initiatives like traffic management and emergency response networks could optimize traffic flow and improve emergency responses. Continued research and development efforts should prioritize enhancing RFID and LoRa technologies for seamless operation across various conditions. Ultimately, a holistic approach involving technological innovation, regulatory frameworks, and community engagement will be vital to ensure the safety of school children during their daily commutes.

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