**Smart School Bus Monitoring and Safety System**

This project is a comprehensive school bus monitoring and safety solution designed for nursery and primary schools to improve student safety, parent trust, and school efficiency. It combines mobile applications for drivers, attendants, and parents with a web dashboard for school administrators, offering real-time visibility and enhanced safety during daily transportation.

**How the System Works**

* **GPS Tracking & Route Mapping**  
  Each bus is equipped with GPS, allowing parents and schools to track live locations and routes in real time.
* **Student Attendance Logging**  
  Students check in and out of the bus using **QR codes** or **NFC cards**, creating an automatic and accurate attendance record.
* **Notifications & Alerts**  
  Parents receive instant notifications when their child boards or leaves the bus, as well as alerts for delays or schedule changes.
* **Emergency SOS Button (New)**  
  Drivers and attendants can press an emergency button to immediately notify the school administration and parents in case of accidents, breakdowns, or safety concerns.
* **Geofencing Safety Feature (New)**  
  The system automatically triggers alerts if a bus leaves its assigned route or enters a restricted zone, ensuring children are always on the correct path.
* **School Dashboard**  
  Administrators access a central dashboard to monitor all buses, student attendance, and trip details, and to review safety alerts and emergency events.

**Key Benefits**

**For Parents**

* Peace of mind with real-time bus tracking.
* Instant alerts for boarding, drop-off, delays, or emergencies.
* Extra security with SOS alerts and geofencing.

**For Schools**

* Automated attendance records synced with trips.
* Access to safety alerts for faster emergency response.
* Route compliance and accountability through geofencing.
* Detailed trip history and punctuality analytics.

**For Bus Staff**

* Easy check-in/out of students via QR or NFC.
* SOS button for emergency reporting.
* Safer operations with clear route monitoring.

**Data Analysis (New Section)**

The system not only tracks buses and students but also **collects and analyzes transportation data** to help schools improve operations and safety:

* **Punctuality Analysis**
  + Track on-time vs. delayed trips.
  + Identify recurring late arrivals and optimize schedules.
* **Route Performance**
  + Analyze travel times across different routes.
  + Detect congested areas or frequent delays.
  + Recommend optimized bus routes for efficiency.
* **Attendance Trends**
  + Generate reports on student bus usage (daily/weekly/monthly).
  + Identify students who frequently miss the bus or leave early.
* **Safety Insights**
  + Record and analyze all SOS/emergency button triggers.
  + Detect high-risk zones where buses often deviate or face incidents.
* **Driver Behavior & Compliance**
  + Combine GPS and geofencing data to monitor route adherence.
  + Highlight unsafe driving patterns (overspeeding, route deviation).
* **Reports & Visualization**
  + Interactive dashboards with charts, heatmaps, and timelines.
  + Exportable reports (PDF/Excel) for school management and parent communication.

**Why This Matters**

This system goes beyond simple tracking — it focuses on **safety first and data-driven improvement**. With features like an **emergency SOS button**, **geofencing**, and **analytics**, schools can **respond quickly to risks, optimize routes, improve punctuality, and make informed decisions**. Parents gain stronger confidence in their child’s daily commute, while schools benefit from **transparency, accountability, and operational efficiency**.