Project Title:

Hybrid Real-Time Speedo Bus Tracking & Arrival Notification System (Web + SMS)

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1. Project Overview

A hybrid system that provides real-time tracking of Speedo buses via a web platform for users with internet access, and SMS-based arrival notifications for users without internet access. Users register with their phone number, allowing the system to deliver personalized SMS updates when needed. The project aims to enhance commuter convenience in Pakistan's Speedo bus network by integrating modern web technologies with accessible SMS communication.

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2. Problem Statement

Speedo buses lack an accessible real-time tracking and arrival prediction system. Many commuters don't have consistent internet access to use online tracking tools. This creates inefficiencies and inconvenience. The project addresses this by combining a web interface and an SMS notification service, ensuring that users stay informed regardless of internet availability.

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3. Objectives

- Develop a web application showing real-time Speedo bus locations, routes, stops, and arrival times.
- Enable user registration with phone numbers to personalize notifications.
- Implement an SMS notification system sending arrival updates to users when they lack internet access.
- Provide a fallback SMS query feature allowing users to request live info via SMS.
- Build an admin panel for route and bus management.
- Demonstrate integration of IT fundamentals, databases, system administration, and networking concepts.

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4. Scope

- Focus on Speedo buses in a specific city/region.
- Use GPS simulation if real GPS hardware is unavailable.

- Support both web users (with internet) and SMS users (without internet).
- Limit SMS notifications to personalized, timely updates.
- Basic security: user authentication, data validation.

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5. Technologies & Tools

Layer	Tools / Technologies
Frontend	HTML, CSS, JavaScript, Bootstrap
Backend	Node.js with Express (recommended) or PHP/Flask
Database	MySQL / PostgreSQL
Mapping API	Google Maps API or OpenStreetMap
SMS Gateway	Twilio, Nexmo, or local telecom SMS API
Hosting	Local server or cloud (Heroku, AWS free tier)
Version Control	Git / GitHub

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6. Key Features

Web Application (for users with internet):

- User geolocation to show nearby Speedo buses on map.
- Real-time bus position updates on map.
- Visualization of Speedo routes and bus stops.
- Estimated arrival times at selected stops.
- User registration/login with phone number input.
- User dashboard for setting preferred stops for SMS notifications.

SMS Service (for users without internet):

- Automated SMS alerts on estimated bus arrival at user's preferred stops.
- User-initiated SMS query to get current bus location/arrival times.
- SMS content optimized for concise, clear info.
- Registration via web app mandatory to link phone number to preferred stops.

Admin Panel:

- Manage Speedo routes, stops, and buses.
- Monitor bus location updates.
- Manage SMS notification settings and logs.

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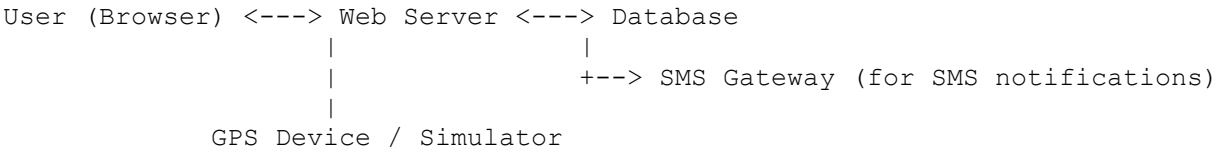
7. System Architecture



- **Frontend**: Web app running in browser (HTML/CSS/JS), interacting with backend REST API.
- **Backend**: REST API handles user requests, bus location updates, SMS sending, and admin functions.
- **Database**: Stores users, routes, stops, buses, location logs, SMS logs.
- **SMS Gateway**: Third-party service integrated to send/receive SMS messages.

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8. Database Design (Sample Tables)

Table Name	Description	Key Fields
users	Stores registered users	user_id, name, phone_number, preferred_stop_id
buses	Speedo bus details	bus_id, bus_number, route_id
routes	Bus routes	route_id, route_name
stops	Bus stops	stop_id, stop_name, route_id, latitude, longitude
bus_locations	Real-time location logs	location_id, bus_id, latitude, longitude, timestamp
sms_logs	Sent/received SMS details	sms_id, user_id, message, direction (in/out), timestamp

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9. Arrival Time Prediction Logic

- Use current bus GPS coordinates.
- Calculate distance to user's preferred stop.
- Estimate arrival time = distance / average bus speed.
- Update arrival times regularly based on new location data.

10. User Flow

For Online Users:

- Visit website.
- Allow geolocation permission.
- View Speedo buses on map with routes and stops.
- Register/login, enter phone number.
- Select preferred bus stops for SMS alerts.
- See real-time arrival predictions.

For Offline Users:

- Register via web app with phone number.
- Receive automated SMS alerts about bus arrival times at preferred stops.
- Send SMS query (e.g., “STATUS XYZ”) to get current bus location or arrival time.
- Receive SMS response with concise info.

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11. Implementation Plan & Timeline

Week(s)	Tasks
1-2	Requirement analysis, technology stack finalization, project plan
3-4	Database design and setup
5-7	Backend API development (user auth, bus data, SMS integration)
8-9	Frontend development (map integration, UI design)
10	Arrival time prediction algorithm implementation
11	Integration testing and debugging
12	Documentation, presentation preparation

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12. Challenges & Solutions

Challenge	Solution
Lack of GPS devices on buses	Use GPS data simulation for prototype

Challenge	Solution
Cost of SMS	Optimize SMS to send only essential updates
SMS delivery delays	Use reliable SMS gateway and monitor logs
User registration complexity	Simple registration with phone number as key
Network security	Use HTTPS, sanitize inputs, secure API endpoints

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13. Future Enhancements

- Mobile app for better offline and push notifications.
- Real-time traffic integration for better arrival time accuracy.
- USSD service for users without smartphones.
- Multi-language support (Urdu, English).
- Integration with local transport authorities.

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14. Why This Project is Innovative

- Unique hybrid model ensuring access regardless of internet availability.
- Solves a significant local transportation problem.
- Integrates multiple IT concepts: web dev, databases, networking, system admin, SMS technology.
- Customizable and scalable for other public transport systems.

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15. Summary

This project offers a practical and innovative solution for Speedo bus commuters by merging web technology with SMS communication. It's designed with inclusivity in mind, ensuring users with and without internet access can benefit equally. The project demonstrates comprehensive IT skills and will have tangible local impact.
