**1. Mobile App Development**

The mobile app will be the primary interface for users to find, unlock, ride, and pay for the electric bikes. It will need to be user-friendly, secure, and feature-rich. Here’s a breakdown:

**Core Features for the Mobile App (iOS & Android)**

1. **User Registration & Profile Management**

* **Sign Up/Login**: **Email and Phone Registration**: Users can sign up using their email address and phone number.
* **Data Collection During Registration**
  + **Phone Number**: Collect users' phone numbers for authentication and communication purposes (SMS alerts).
  + Implement **OTP verification** to verify the phone number during registration.
  + **Email Address**: Collect users' email addresses to send receipts, notifications, and account-related information.
  + Send a **verification email** to validate the email address during sign-up.
  + **Profile Photo Upload**: Allow users to upload a profile photo during registration. This will help identify users if needed.
  + Use formats like **JPEG/PNG** and set file size limits for efficient uploading.
  + **Government ID Proof**: Request users to upload a government-issued ID for verification purposes (Aadhar, passport, driver's license, etc.).
  + **Document Upload**: Allow users to upload documents in formats like **PDF** or **JPEG**.
  + **ID Verification**: Implement a verification system where the admin team manually or automatically verifies the ID before activating the user account.
  + **Bike/Scooter Locator & Map Integration**
  + **Real-time Map Integration**: Integrate with Google Maps (or other mapping services) to display available bikes nearby.
  + **Bike Details**: Users can see bike details such as battery level, distance from the current location, and estimated price for the ride.
* **Optional Student Authentication**

**College Email/ID Verification**: If you're offering student-specific pricing or features, allow users to verify their student status by providing:

* + **College Email**: Automatically verify via a college email domain (e.g., @collegename.edu).
  + **Upload College ID**: Optionally, allow users to upload their student ID card for manual verification by the admin team.
* **Profile Section**

Once registered, users can access their profile section to manage and update their information. The profile section should allow the following:

**Profile Information**

* **Profile Photo**: Users can change or update their profile photo at any time.
* **Phone Number**: Users can update their phone number, but require **OTP verification** for the new number.
* **Email Address**: Users can update their email address, but a **verification email** should be sent to confirm changes.
* **Government ID Proof**: Users can view their uploaded government ID and upload new documentation if needed.

**Ride History**

* Users can view a detailed history of their rides, including:
  + **Date, Time, and Duration** of each ride.
  + **Start and End Locations**.
  + **Fare** charged for each ride.

**Balance & Payments**

* **Balance Overview**: Users can check their current wallet balance or outstanding payments.
* **Payment Methods**: Add, update, or remove saved payment methods (credit/debit cards, UPI, etc.).
* **Subscription Plans**: If they have a subscription, show details of the active plan, renewal date, and the option to upgrade/downgrade.

**Document and ID Management**

* Users can view the status of their **ID verification** (pending, approved, rejected).
* **Re-upload Documents**: If necessary, users can re-upload their government ID or other verification documents.

**Additional Features for Security**

1. **Two-Factor Authentication (2FA)**:
   * Add an extra layer of security by offering two-factor authentication via **SMS OTP** or **email** during login.
2. **Profile Lock**:
   * Allow users to lock their profile with a **PIN** or **biometric authentication** (e.g., fingerprint or FaceID on mobile).
3. **QR Code Scanning to Unlock Bikes**
   * **QR Code Scanner**: Users scan the bike’s QR code to unlock the bike and start their ride.
   * **NFC Option (Optional)**: For future-proofing, allow bike unlocking via NFC for fast, contactless access.
4. **Ride Tracking**
   * **Real-Time GPS Tracking**: Display the user's route, distance, and current ride time.
   * **End Ride**: Allow users to manually end the ride once they park the bike in the designated area.
   * **Geo-Fencing**: Bikes can only be locked or parked in specific zones to ensure they are available in high-demand areas.
5. **Payment Gateway Integration**
   * **Multiple Payment Options**: Allow payments via UPI, credit/debit cards, net banking, and mobile wallets (Paytm, Google Pay, etc.).
   * **Prepaid Wallet**: Users can top-up their app wallet with funds for easy payments.
   * **Ride Cost Calculation**: Automatically calculate ride costs based on time or distance. Provide real-time fare estimates before starting the ride.
6. **Subscription Plans**
   * **Membership Options**: Weekly, monthly, or yearly subscription plans offering unlimited rides or discounted rates.
   * **Auto-Renewal**: Option for users to auto-renew their plans through the app.
7. **Push Notifications & Alerts**
   * **Ride Updates**: Notify users of ride start/end, low battery warnings, or when bikes are available in their area.
   * **Promotions**: Send special offers, discounts, and subscription deals via push notifications.
8. **Support & Feedback**
   * **Customer Support**: Integrate a chatbot or direct messaging for users to contact support.
   * **Report Issues**: Allow users to report problems like bike damage, issues unlocking, or payment failures.
   * **Ratings & Reviews**: Users can rate their experience with the bike and leave feedback.

**Backend Data Storage**

* **Data Storage Security**:
  + All user data, including photos, government ID, phone numbers, etc., should be stored in a **secure database** with encryption (e.g., AWS, Firebase, or Azure).
  + Implement **end-to-end encryption** for sensitive data like ID proofs and government documents.
* **Verification Workflow**:
  + Admin can view unverified profiles in the dashboard, review uploaded ID proofs, and mark them as verified.
  + Once verified, notify the user via email/SMS.

**2. Bike Display & IoT Integration**

To manage the bikes effectively and give users real-time updates, the bikes need an IoT device onboard that communicates with your system. Here's what you need:

**Bike IoT Features**

1. **GPS Module**
   * Each bike will have a **GPS tracker** to communicate its real-time location to the app and admin panel.
   * **Live Tracking**: Allows users to see available bikes nearby and lets you monitor the fleet.
2. **QR Code Display**
   * A **QR code** is displayed on the bike that the user scans to unlock.
   * **Secure Locking Mechanism**: The QR code links to an IoT-based locking system that unlocks the bike when the app sends the signal.
3. **Battery Monitoring**
   * The **IoT device monitors the bike’s battery levels** and sends real-time updates to the mobile app and admin panel.
   * Users will see battery levels before starting a ride, and the admin team can be alerted when bikes need recharging.
4. **Smart Locking System**
   * **Bluetooth/NFC Module**: Integrated for users to unlock bikes using the app via Bluetooth or NFC.
   * **Auto Locking**: When users finish a ride, they can manually lock the bike using the app, and the IoT device confirms the bike is locked.
5. **Crash Detection & Alerts**
   * The IoT device can detect when a bike falls or crashes and automatically send alerts to the admin panel.
   * **Ride Termination**: Automatically terminate rides in case of accidents and prompt the user to confirm their status.

**3. Admin Dashboard (Web Application)**

The admin panel is where you manage the fleet, monitor user activity, handle payments, and perform other operational tasks. Here’s what the admin dashboard should include:

**Core Features for Admin Dashboard**

1. **Fleet Management**
   * **Real-Time Bike Tracking**: View all bikes on a map, showing their location, battery levels, and current status (available, in use, or under maintenance).
   * **Geo-Fencing**: Create and manage virtual boundaries where bikes can be picked up or parked.
   * **Battery Monitoring**: Track bikes that are running low on battery and schedule them for charging or swap-out.
   * **Maintenance Alerts**: Receive automatic notifications when bikes are damaged, need servicing, or have low battery levels.
2. **User Management**
   * **User Profiles**: View user details, ride history, and payment activity.
   * **Blacklist Option**: Ban or restrict users who abuse the service (e.g., bike misuse, late returns).
   * **Subscription Management**: Manage active users, subscriptions, and refunds if necessary.
3. **Ride Analytics & Reporting**
   * **Ride Data**: Monitor total rides, average ride duration, peak usage times, and popular routes.
   * **Heat Maps**: Identify high-demand areas through a heat map, helping to adjust bike distribution.
   * **Revenue Tracking**: Track daily, weekly, and monthly revenue generated from rides and subscriptions.
4. **Payment Management**
   * **Transaction History**: View all completed payments, refunds, and pending transactions.
   * **Revenue Insights**: Generate reports on revenue based on usage, subscription plans, and additional services.
   * **Payment Gateway**: Manage and resolve payment issues from the admin side.
5. **Operational Logistics**
   * **Bike Rebalancing**: Analyze ride data to determine where bikes should be redistributed to ensure maximum availability.
   * **Support Tickets**: Manage customer complaints, issues, and feedback through a ticketing system.
   * **Workforce Management**: Assign tasks to field staff for bike maintenance, charging, and relocation.
6. **Promotions & Marketing**
   * **Discount Codes**: Create and manage discount codes or special promotions for users.
   * **Push Notifications**: Send out announcements, offers, or important updates to all users.
7. **Security & Permissions**
   * **Admin Roles**: Assign different levels of access to admin users (e.g., full access for managers, limited access for customer support agents).
   * **Audit Logs**: Maintain logs of all actions performed by admins for accountability and security.

**Tech Stack for Development**

1. **Mobile App (iOS & Android)**
   * **Frontend**: Flutter, React Native, or Swift (iOS), Kotlin (Android).
   * **Backend**: Node.js, Django, or Ruby on Rails for API management.
   * **Database**: Firebase, PostgreSQL, or MongoDB for user and ride data.
   * **Payment Gateway**: Razorpay, Stripe, PayPal.
   * **Maps API**: Google Maps, Mapbox for real-time location tracking.
   * **Push Notifications**: Firebase Cloud Messaging (FCM) or OneSignal.
2. **Admin Dashboard (Web)**
   * **Frontend**: React.js or Angular.js.
   * **Backend**: Node.js or Django for server-side logic.
   * **Database**: MySQL, PostgreSQL for fleet and user data management.
   * **Hosting**: AWS, Heroku, or DigitalOcean for cloud hosting.
3. **Bike IoT Integration**
   * **Microcontroller**: ESP32 or Arduino with GSM modules for communication.
   * **Sensors**: GPS, accelerometer, battery monitor for location and status tracking.
   * **Communication Protocol**: MQTT or HTTP for real-time data transfer between bikes and the server.