**🌍 Smart Waste Management System App - Roadmap**

**(Flutter + Dart)**

**🔧 Phase 1: Planning & Requirement Gathering**

**✅ Key Objectives**

* Smart waste reporting and management.
* Real-time communication between Citizens, Municipality & Drivers.
* Data-driven decision-making for optimized waste collection.

**👥 Stakeholders**

* **Citizens**: Report waste, track status.
* **Municipality**: View complaints, assign tasks, track efficiency.
* **Drivers**: Receive assigned routes, report completion.

**🎨 Phase 2: UI/UX Design**

**📱 Dashboards**

1. **Citizen Dashboard**
   * Upload image of dump area.
   * Auto-capture location via GPS.
   * View complaint status.
   * Notifications (complaint received, in progress, resolved).
2. **Municipality Dashboard**
   * Real-time map of complaints.
   * Assign drivers.
   * Analytics (frequent complaint areas, response time, etc.).
   * Notifications on new complaints and task completions.
3. **Driver Dashboard**
   * List of assigned locations.
   * Route optimization via maps.
   * Mark task as completed.
   * Notifications (new task assigned, reminders).

**📐 Tools**

* Wireframing: Figma / Adobe XD
* Component Library: Flutter Material / Cupertino Widgets

**🧠 Phase 3: Backend Development**

**⚙️ Backend Stack**

* **Firebase** (Recommended for rapid development)
  + Firebase Auth (Login & Role-Based Access)
  + Firebase Firestore (Real-time Database)
  + Firebase Storage (Image Uploads)
  + Firebase Cloud Messaging (Notifications)
  + Firebase Functions (Automations)

OR

* Node.js + Express + MongoDB + Firebase Messaging

**👨‍💻 Phase 4: Frontend Development (Flutter)**

**📲 Modules**

1. **Authentication**
   * Role-based login: Citizen, Municipality, Driver
2. **Citizen Features**
   * Image picker + Camera integration
   * Location Services (Geolocation API)
   * Complaint submission form
   * Notification handler
   * Complaint status tracker
3. **Municipality Features**
   * Real-time dashboard with map view (Google Maps API)
   * List of complaints + filters
   * Assign driver option
   * Analytics (charts using charts\_flutter)
4. **Driver Features**
   * View assigned locations (map + list)
   * Directions using Google Maps
   * Mark location as cleaned
   * Notifications for task updates
5. **Notification System**
   * Firebase Cloud Messaging integration
   * Topic-based push (new complaint for driver, update for citizen, etc.)

**🧠 Phase 5: Smart Features & Enhancements**

**🧠 AI/ML Integrations (Future Scope)**

* **Image Classification** to detect waste severity using ML model.
* **Smart Routing** using AI-based optimization for multiple destinations.

**📊 Admin Analytics (Municipality)**

* Waste heatmaps for urban planning.
* Response time tracking.
* Driver performance dashboard.
* Feedback analysis.

**🧠 Auto-Assign Logic**

* Based on driver proximity and load.

**🧪 Phase 6: Testing**

* Unit Testing (Flutter Unit Test)
* Widget Testing
* Integration Testing
* Firebase Emulator Suite for mock testing
* Location & Notification testing on real devices

**🚀 Phase 7: Deployment & Monitoring**

* App: Publish to Play Store & App Store
* Firebase Hosting (Optional for web dashboard)
* Crashlytics for monitoring
* Analytics for user behavior

**🔮 Bonus Features to Make It Smarter**

|  |  |
| --- | --- |
| **Feature** | **Description** |
| ♻️ Waste Category Picker | Citizens choose the type of waste (biodegradable, plastic, etc.) |
| 🔁 QR Code for Bins | Scannable bins for tracking waste collection frequency |
| 📢 Voice Complaint Option | Voice-to-text waste complaint for accessibility |
| ⏰ Reminder System | Reminders for periodic reporting or garbage days |
| 💬 Chatbot Assistant | Basic chatbot to guide users through complaint process |
| 🌦️ Weather-Aware Routing | Avoid bad-weather areas for driver safety |