Smart Medication Assistant System - Full Documentation

Overview

The Smart Medication Assistant System is a multi-module, AI-powered healthcare platform designed to help senior citizens adhere to their medication schedules. It integrates with family members and doctors to ensure safety, accuracy, and personalized care. The system consists of three modules:

1. **Senior Citizen Tablet App**
2. **Family/Caregiver Mobile App**
3. **Doctor Web Portal**

Module 1: Senior Citizen Tablet App

Purpose

- Provide scheduled voice-based medication reminders
- Enable AI-based pill verification
- Allow voice queries (e.g., "Did I take my pill?")
- Trigger emergency alerts if user feels unwell

Features

- Voice and visual medication reminders
- Repeated reminders until the user responds
- Speech recognition for confirmation ("I took it")
- Camera-based pill verification using TensorFlow.js / OpenCV
- Positive reinforcement after confirmation
- Support for special instructions (e.g., before/after food)
- Voice query system ("Did I take my diabetes pill today?")
- Emergency alert: "I'm not feeling well" triggers SMS/email/push notification

Tech Stack

- **Frontend**: Flutter / React Native (tab-optimized UI)
- **Speech Recognition**: Web Speech API / Flutter speech_to_text / Vosk (offline)
- **TTS**: flutter_tts / expo-speech / Web Speech API (TTS)
- **Pill Verification**: TensorFlow.js (MobileNet) / OpenCV / MediaPipe Hands
- **Camera Access**: Flutter camera / react-webcam
- **Database**: Firebase Firestore / Realtime DB
- **Push Notifications**: Firebase Cloud Messaging
- **Emergency Alerts**: Twilio (free credits) / EmailJS

Module 2: Family/Caregiver Mobile App

Purpose

- Monitor senior’s medication intake in real time
- Add/edit medication schedules remotely
- Receive alerts for missed doses, emergency symptoms, or low stock

Features

- Login via Firebase Auth
- Link to senior via QR code or unique ID
- Add/edit/delete medications with time, dose, special notes
- View logs of taken/missed pills
- View pill images (if uploaded by senior app)
- Refill management and stock tracking
- Alerts for emergencies and low stock
- Messaging capability to communicate with senior (optional)

Tech Stack

- **Frontend**: Flutter / React Native
- **Backend**: Firebase Firestore
- **Auth**: Firebase Authentication
- **Push Alerts**: Firebase Messaging / Twilio
- **Camera (optional)**: For uploading pill info or reminders

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Module 3: Doctor Web Portal

Purpose

- Allow doctors to monitor patient adherence
- Suggest medication changes
- Schedule virtual meetings with seniors

Features

- Login via Firebase Auth
- Dashboard with list of assigned patients
- Adherence logs, symptom reports, and pill image verification results
- Add/edit notes or schedule updates
- Schedule virtual meetings (Google Meet / Jitsi)
- Export PDF reports

Tech Stack

- **Frontend**: React.js
- **Backend**: Firebase / Node.js (optional functions)
- **Charts**: Chart.js / Recharts
- **Meeting Integration**: Jitsi Meet / Google Meet links

Linking Structure

User Roles

- **Senior**: Tablet App
- **Family**: Mobile App
- **Doctor**: Web Portal

Firebase Auth Role Assignment

- Each user is tagged with a `role` field: `senior`, `family`, or `doctor`

Linking Flow

1. **Family app generates a unique link code or QR code**
2. **Senior app scans or enters this code**
3. **Both accounts are linked in Firestore**:

```
"users": {
  "senior123": {
    "role": "senior",
    "linkedTo": ["family456"]
  },
  "family456": {
    "role": "family",
    "linkedSeniors": ["senior123"]
  }
}
```

1. **Doctors** are linked by an admin or requested by the family

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Firebase Structure (Example)

```
/users/{uid}
  - name
  - role: senior | family | doctor
  - linkedTo / linkedSeniors

/patients/{senior_uid}/medications/{med_id}
  - name
  - dosage
  - schedule
  - instructions
  - quantity_remaining

/patients/{senior_uid}/logs/{log_id}
  - med_id
```

```
  - status: taken | missed | error
  - timestamp
  - method: voice | camera | manual

/patients/{senior_uid}/symptomReports/{report_id}
  - symptoms
  - time
  - triggered_by: voice | button

/messages/
  - doctor ↔ family ↔ senior communications (optional)
```

Smart AI Features Summary

Feature	Tools Used
TTS for reminders	`flutter_tts`, `expo-speech`, Web Speech API
Speech-to-text	`speech_to_text`, Web Speech API, Vosk
Pill image verification	TensorFlow.js MobileNet, OpenCV, MediaPipe Hands
Hand movement detection	MediaPipe Pose/Hands
Voice query system	Regex NLP / Dialogflow (optional)
Emergency detection	Keyword triggers + Firebase Functions + Twilio

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Hosting / Deployment

- Firebase Hosting for doctor web portal
- Android deployment for both mobile apps
- Firebase Functions for background tasks (alerts, sync)
- Firebase Storage for pill image verification history

Security

- Firebase Auth + Firestore rules
- Role-based access:
- Seniors: read-only to medications, write logs
- Family: full access to linked seniors
- Doctors: limited read access to assigned patients

Future Enhancements

- Multi-language voice assistant

- Doctor chat integration
- Dynamic scheduling (AI learns best times)
- Wearable integration (heartbeat, BP feedback)
- EHR integration for hospital-grade data sync

Final Note

This documentation serves as the complete blueprint for building the Smart Medication Assistant System. Each module is designed for a distinct user type but remains tightly integrated through Firebase, ensuring real-time collaboration, smart tracking, and high usability — especially for elderly users. The inclusion of voice interaction, AI-based pill checks, and emergency escalation makes this system both technically impressive and socially impactful.