## **AI Pedigree Drawing & Analysis Tool — MVP Blueprint**

### **🔹 1. Functional Requirements (Core Pedigree Features)**

#### **1.1 Patient & Family Entry**

* Secure entry of **proband (index case)** details: Name, Unique ID, sex, age, diagnosis.
* Create and manage **family members** with links (mother, father, siblings, children).
* 🔜 **Future**: Auto-import from EMR or genetic counseling forms.

#### **1.2 Pedigree Drawing Canvas**

* Interactive canvas for **freehand drawing** using stylus/finger/mouse.
* Support for **pedigree shapes**: squares (males), circles (females), shading (affected).
* Support for **digital drawing** and **raw hand-drawing mode**.
* 🔜 **Future**: Advanced annotation, zoom/pan, keyboard-free workflows.

#### **1.3 AI Shape Recognition & Digitization**

* **Real-time shape recognition** to detect symbols and convert to digital format.
* **Manual override** in case of recognition errors.
* 🔜 **Future**: Confidence score display, suggest corrections.

#### **1.4 Upload / Scan Recognition**

* Allow uploading of PDFs, images, or camera-captured pedigrees.
* Use **AI (CV+OCR)** to convert scanned image to structured pedigree.
* 🔜 **Future**: Batch uploads, handwriting tolerance improvement.

#### **1.5 Inheritance Pattern Analysis**

* Detect common inheritance modes: AD, AR, X-linked, mitochondrial.
* Highlight affected clusters and obligate carriers.
* 🔜 **Future**: Consanguinity flagging, incomplete penetrance detection.

#### **1.6 Syndrome Prediction**

* Match inheritance + cancer types + age of onset → suggest possible syndromes.
* Display top matched syndromes (BRCA, Lynch, FAP, etc.)
* 🔜 **Future**: Confidence scores, cross-reference with NCCN/OMIM.

#### **1.7 Basic Report Generator**

* Auto-generate pedigree summary report (PDF) with:  
  + Digital pedigree image
  + Inheritance pattern
  + Suggested syndromes
* 🔜 **Future**: Custom logos, editable notes, export to EMR format (e.g., HL7 FHIR).

### **🔹 2. Platform/Cloud Requirements**

#### **2.1 Multi-User Support**

* Each counselor/lab has a secure workspace.
* 🔜 **Future**: Shared pedigrees between teams, audit controls.

#### **2.2 Uptime and Monitoring**

* Uptime target ≥ 99.5%
* Real-time system health dashboard
* 🔜 **Future**: SLA, autoscaling infrastructure, offline support.

#### **2.3 Logging & Tracking**

* Log every drawing, upload, and analysis session.
* Record changes per user.
* 🔜 **Future**: Full session playback, export logs.

#### **2.4 API-Ready Design**

* Internal design supports future REST API exposure.
* 🔜 **Future**: API for integration with EMR/LIS/genetic lab systems.

### **🔹 3. Future-Ready Architecture (Roadmap)**

#### **3.1 Modular Component Design**

* Each module: Drawing, Recognition, Analysis, Reporting
* 🔜 Future: Plug-in third-party models or tools (e.g., Google Teachable Machine, OpenAI Vision APIs)

#### **3.2 AI & ML Integration Layer**

* Support pluggable AI models (CV, OCR, NLP)
* 🔜 Future: ML model updates via remote API

#### **3.3 Data Model & Storage**

* JSON-based structured pedigree format
* 🔜 Future: HL7 pedigree export, FHIR-genomics compatibility

#### **3.4 Cancer Risk Analytics**

* Build base data pipeline for risk scoring (per user/family)
* 🔜 Future: Dashboards, ML models for mutation probability

#### **3.5 Genomics Integration (Advanced)**

* 🔜 Future: Accept VCF/genetic reports → cross-match with pedigree
* 🔜 Future: Polygenic risk score overlay