🟥 Product Summary

Product Name (Tentative): *AI-Powered Luxury Watch Winder Cabinet*
Target Market: High-net-worth individuals, watch collectors, boutique hotels, executive lounges.

🔍 1. Product Summary

A luxury, AI-powered watch winder cabinet shaped like a modern globe, featuring a rotating wheel mechanism for 9+ watches. Each watch is stored in an individual winder module. The cabinet offers biometric access and intelligent retrieval based on the user's attire, schedule, or voice command.

🧩 2. Key Features

⚙️ Mechanical Features:

- **Rotating Winder Wheel**
  - Ferris wheel-like structure.
  - Smooth, silent rotation for precise positioning.
  - Motorized rotation with microstepping.
- **Actuated Watch Delivery System**
  - Fingerprint-verified access.
  - Small door opens to allow actuator or linear mechanism to hand the selected watch.
- **Fail-Safe Design**
  - Watch holders made from soft, non-abrasive materials (e.g., Alcantara, vegan suede).
  - No harsh magnets or exposed moving parts.
  - Emergency manual override to retrieve watches in case of full system failure.

🧠 Smart Features:

- **AI-Driven Watch Selection**
  - Suggests a watch based on:
    - Day of week / calendar events
    - Voice command (e.g., "Show me something classic")

        - Outfit detection via companion app or photo input (future integration).
- **OLED Touchscreen Interface**
    - Add/Edit/Delete watches
    - Map watch positions
    - Set preferences or schedule winders
- **Fingerprint Authentication**
    - Required for watch retrieval or UI modifications.
- **Voice Control (Local/Offline Option Preferred)**
    - Integration with local AI assistant (like Raspberry Pi + offline NLP models).
    - Commands like:
        - “Present my Chronograph.”
        - “Wind my travel watches.”

🧱 3. Hardware Requirements

Structure & Materials

- **Shape:** Circular globe (or elliptical variant), cutaway front with transparent glass or acrylic panel.
- **Materials:**
    - Outer shell: Polished wood or lacquered veneer.
    - Trim/accents: Brass or brushed stainless steel.
    - Internal mechanical parts: Non-magnetic, non-corrosive metals or composites.
    - Watch cushions: Microfiber, Alcantara, or vegan leather.

Motion & Actuation

- **Wheel Drive:**
    - NEMA 17/23 stepper motor with microstepping driver (e.g., TMC2209) for smoothness.
- **Watch Box Rotation (Winders):**
    - Individual micro-motor or shared belt drive for each slot.
- **Delivery Arm:**
    - Precision linear actuator or robotic arm with servo/gripper for pickup.
- **Door:**
    - Small servo-actuated swing or sliding panel.

Electronics

- **Touchscreen:** 3.5"–5" OLED capacitive touch module (e.g., Nextion or custom Raspberry Pi display).
- **Fingerprint Sensor:** Optical or capacitive module (e.g., R503 or FPC1020).
- **Microcontroller / SBC:**
  - ESP32 for base control or Raspberry Pi 5 for full smart interface.
- **Power:**
  - 12V/24V DC internal system with regulated step-downs.
  - Power-loss detection & shutdown watchdog system.

🔐 4. Safety & Redundancy

- **Watch Protection Features:**
  - No strong magnets near mechanical watches.
  - Soft cushioned enclosures.
  - Position sensors to detect incorrect placement.
- **Fail-Safe Protocols:**
  - Manual access mode in case of power or motor failure.
  - Non-destructive fallback positioning if watch retrieval fails.
  - Overcurrent protection on all motors.
  - Watch ID and position mapping saved in non-volatile memory (EEPROM or SD).

👨‍💻 5. Software Requirements

- **Embedded Software (Microcontroller/Pi)**
  - Watch mapping interface.
  - Watch selection algorithm (AI-based or rules-based).
  - Access control module (fingerprint, touchscreen PIN fallback).
  - Error handling and fail-safe triggers.
- **Optional Companion App**
  - Outfit-based watch suggestion (future AI feature).
  - Cloud sync (optional for high-end clientele privacy).
  - Remote access via secure encrypted channel.

🎨 6. Industrial Design Goals

- **Aesthetic Positioning:**
  - Furniture-grade elegance.
  - Seamless integration into high-end homes or offices.
  - Ambient internal lighting (soft LEDs) for nighttime presence.
- **Customization Potential:**
  - Modular or limited editions with custom materials (ebony, walnut, gold trim, etc.)

🛠️ 7. Development Phases

Phase 1: Prototype

- 3D printed chassis or CNC wood frame
- Basic motorized wheel with manual control
- OLED UI mockup
- Fingerprint sensor integration

Phase 2: Functional MVP

- Working winder wheel and delivery arm
- Watch mapping UI
- Voice and fingerprint access
- Safety protocols implemented

Phase 3: Final Product

- Full luxury enclosure
- AI-based selection logic
- Retail-ready electronics
- Production calibration, stress testing