SmartDrop

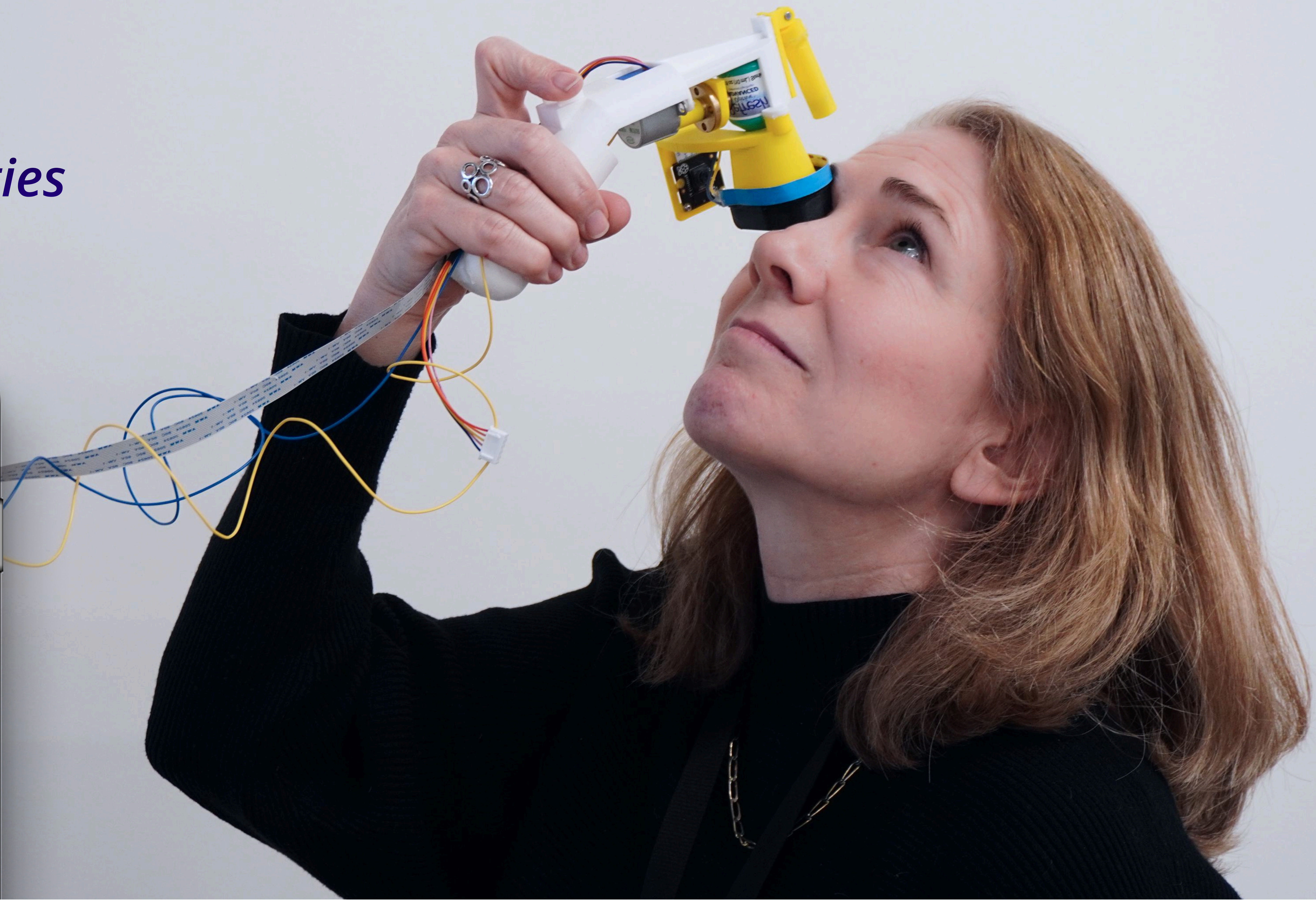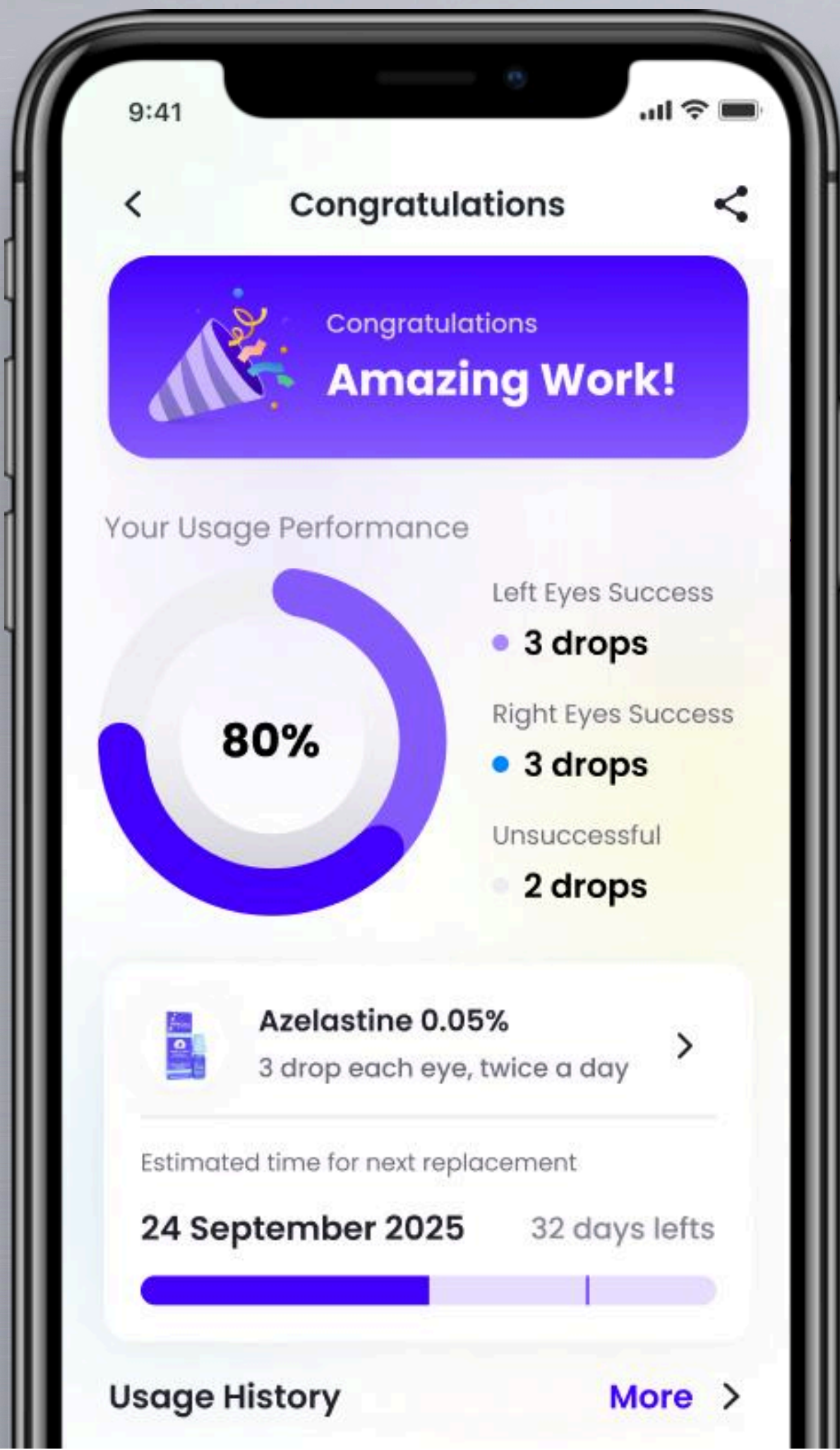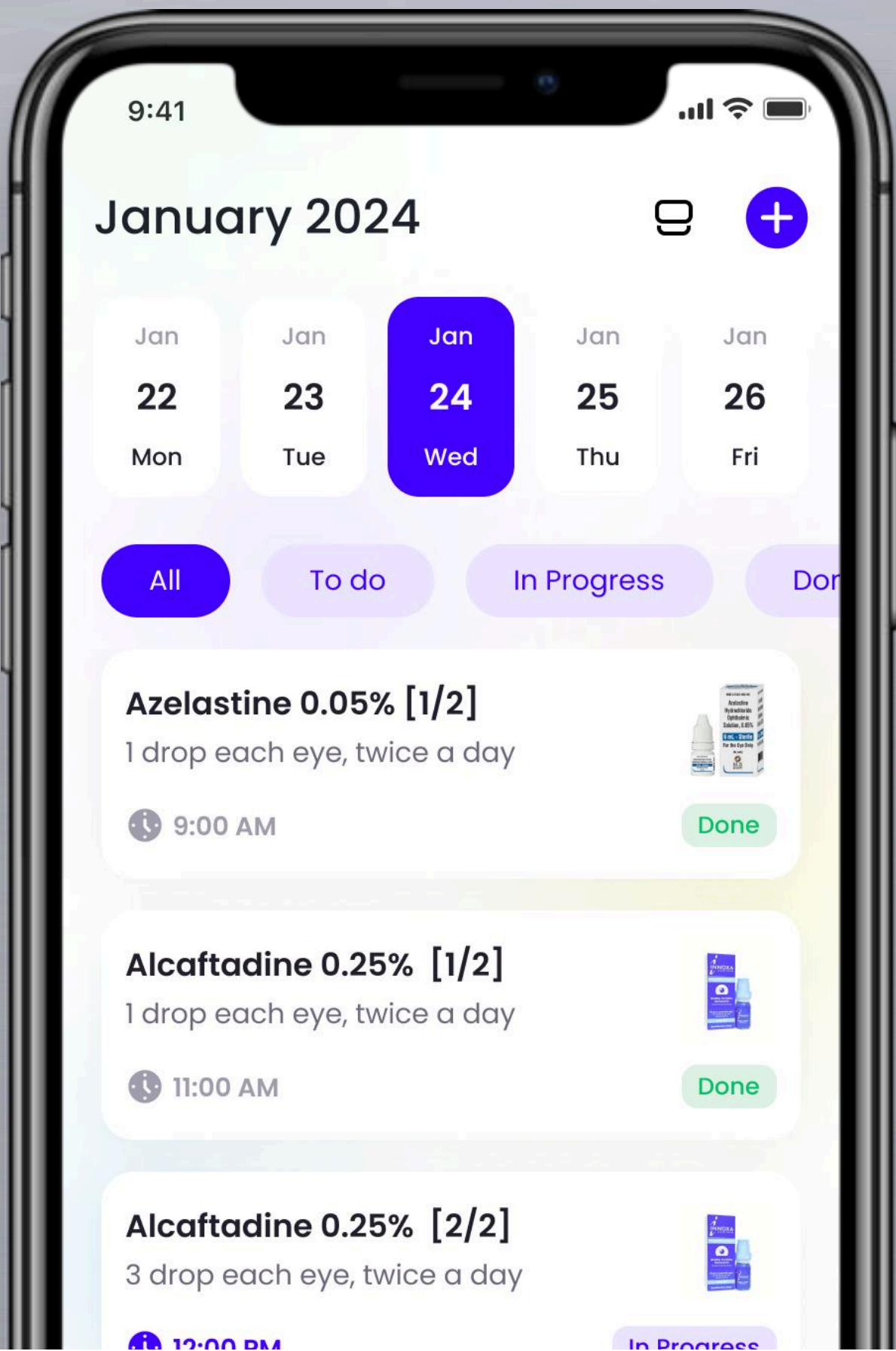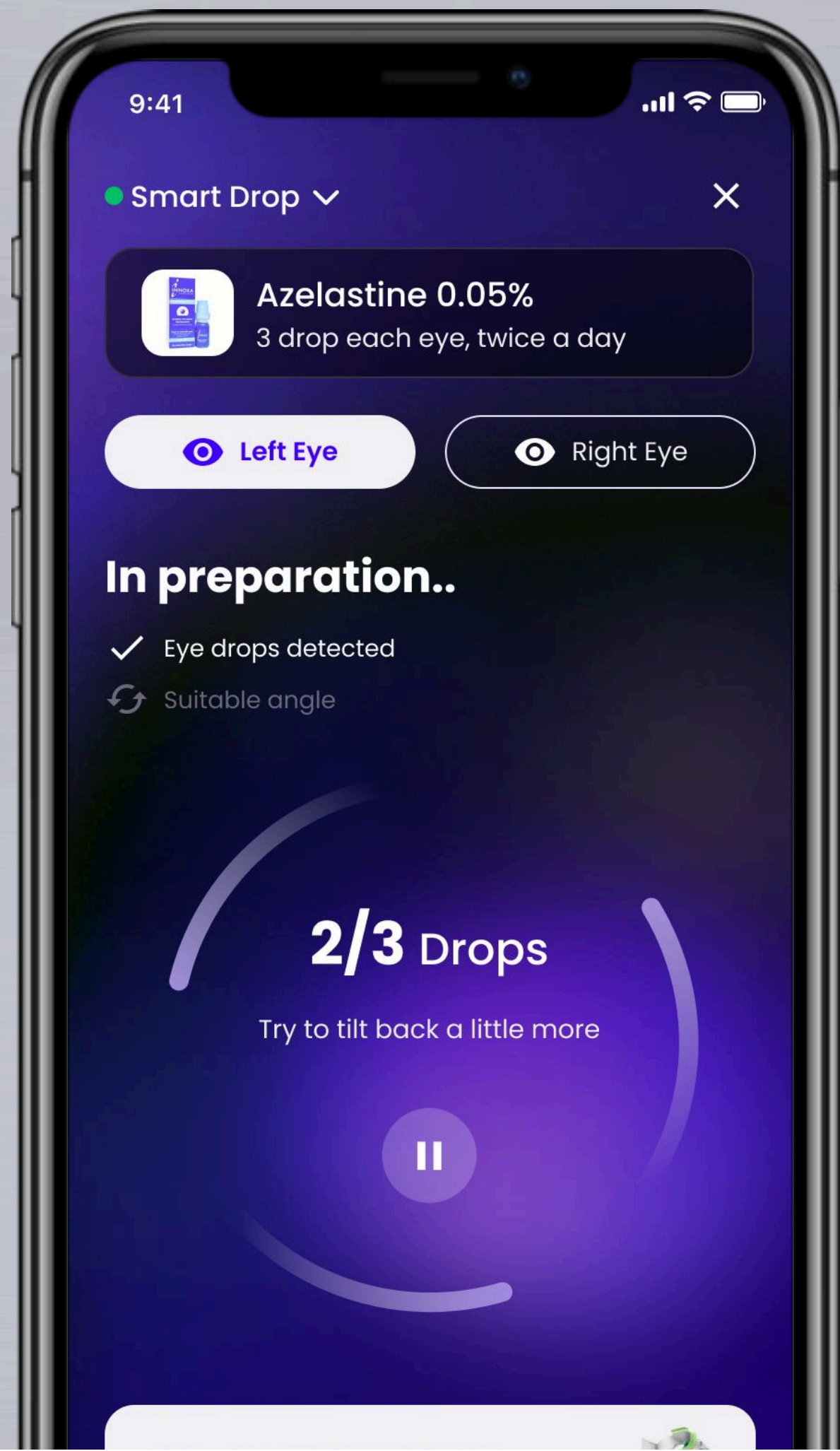## Improving Eyedrop Self-Administration for Individuals with Motor and/or Visual Disabilities

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Problem

Self-administering eyedrops should be simple, but for many older adults and those with vision or mobility issues, it can be frustrating and unreliable. **Hand tremors, poor vision, and difficulty tilting the head** often lead to missed drops or incorrect dosages, making it especially challenging to aim, squeeze, ensure proper drop placement, and adhere to medication schedules.

80%
Widespread difficulty in elderly

80% of the elderly require eyedrops, but over half of them struggle with it and lack proper techniques.
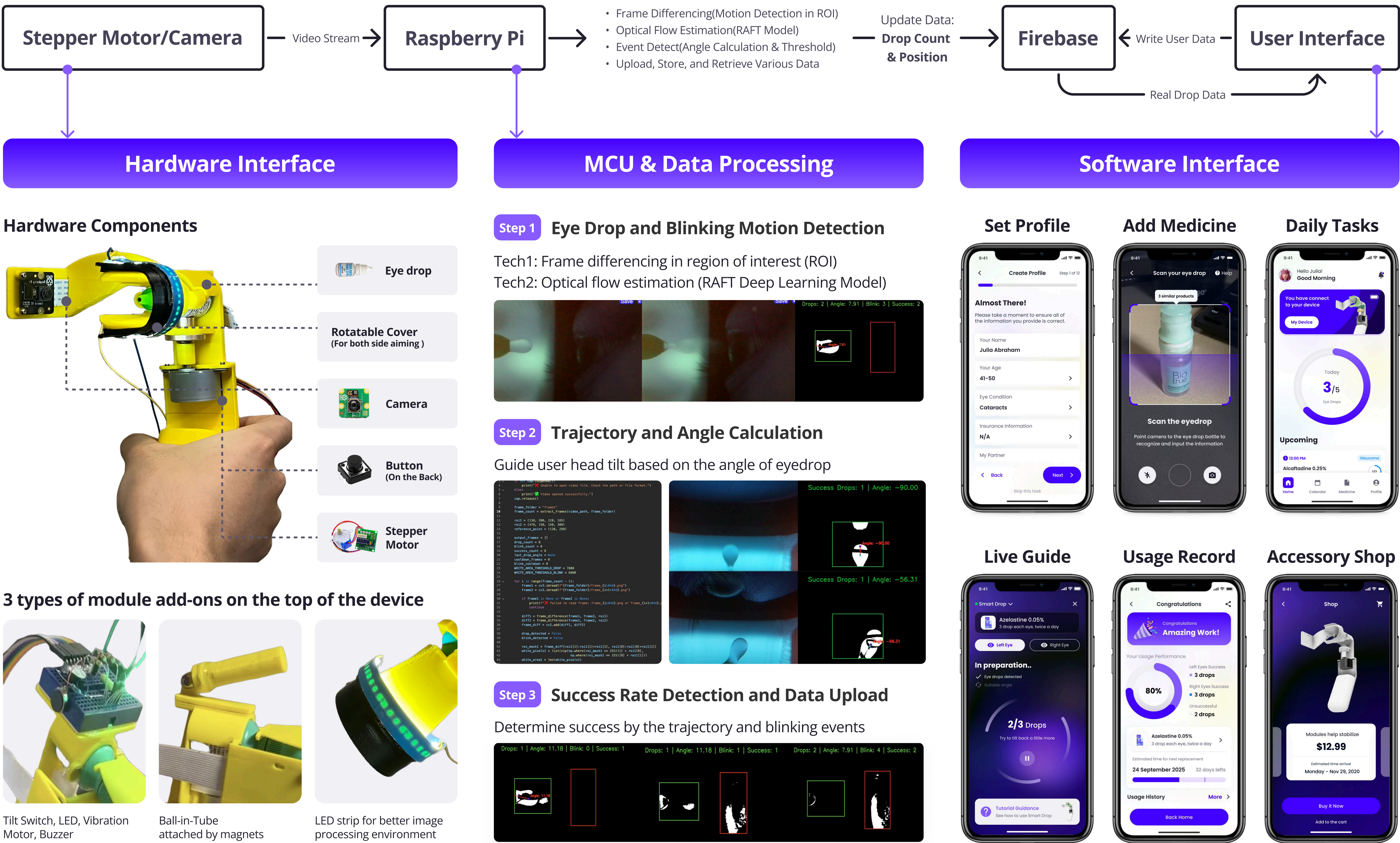
$67.52 Million
Massive waste and non-adherence

Around $67.52 million is wasted annually due to failed doses and expiration due to non-adherence.

Solution

Our system combines a **Handheld Device** and **Mobile App**, design to enhance independence and accuracy in user's medication delivery.

1. **Eye drop and blink detection** using Optical Flow and Deep Learning
2. **Real-time positioning guide**
3. **App-based adherence tracking**
4. **Auto-dispensing** for controlled use

System Diagram

Stepper Motor/Camera → Video Stream → Raspberry Pi

- Frame Differencing(Motion Detection in ROI)
- Optical Flow Estimation(RAFT Model)
- Event Detect(Angle Calculation & Threshold)
- Upload, Store, and Retrieve Various Data

Update Data: Drop Count & Position → Firebase → Write User Data → User Interface → Real Drop Data

Hardware Interface

Hardware Components

- Eye drop
- Rotatable Cover (For both side aiming)
- Camera
- Button (On the Back)
- Stepper Motor

3 types of module add-ons on the top of the device

Tilt Switch, LED, Vibration Motor, Buzzer

Ball-in-Tube attached by magnets

LED strip for better image processing environment

MCU & Data Processing

Step 1 — Eye Drop and Blinking Motion Detection

Tech1: Frame differencing in region of interest (ROI)
Tech2: Optical flow estimation (RAFT Deep Learning Model)

Step 2 — Trajectory and Angle Calculation

Guide user head tilt based on the angle of eyedrop

Step 3 — Success Rate Detection and Data Upload

Determine success by the trajectory and blinking events

Software Interface

Set Profile | Add Medicine | Daily Tasks

Live Guide | Usage Record | Accessory Shop

Process/Approach

Preliminary Study
In-person interviews with target users + SMEs

Triangulation Analysis
Thematic coding for each interview transcript

Prototyping
Explore diverse solutions tailored to each challenge

Functional Test
Test the full process functionality and iterate

Usability Test
Conducted 15 usability studies with target users

Ruiqing Wang | Researcher / Project Manager | March 2025
Sam Wong | Researcher / Front End Developer | March 2025
Leo Peng | HW / SW Developer | March 2025
Jassie He | UI / UX Designer | March 2025