MICHIGAN STATE UNIVERSITY

Project Plan Presentation

Surgical OR Instruments and Needle Tracking

The Capstone Experience

Team Stryker IST

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Fall 2024

From Students…
…to Professionals

Project Sponsor Overview

- Founded by Dr. Homer Stryker, an orthopaedic surgeon, in 1941
- Global leader in medical technologies, impacting more than 150M patients annually
- Promoting access, affordability, and safety to ensure quality healthcare for all

Project Functional Specifications

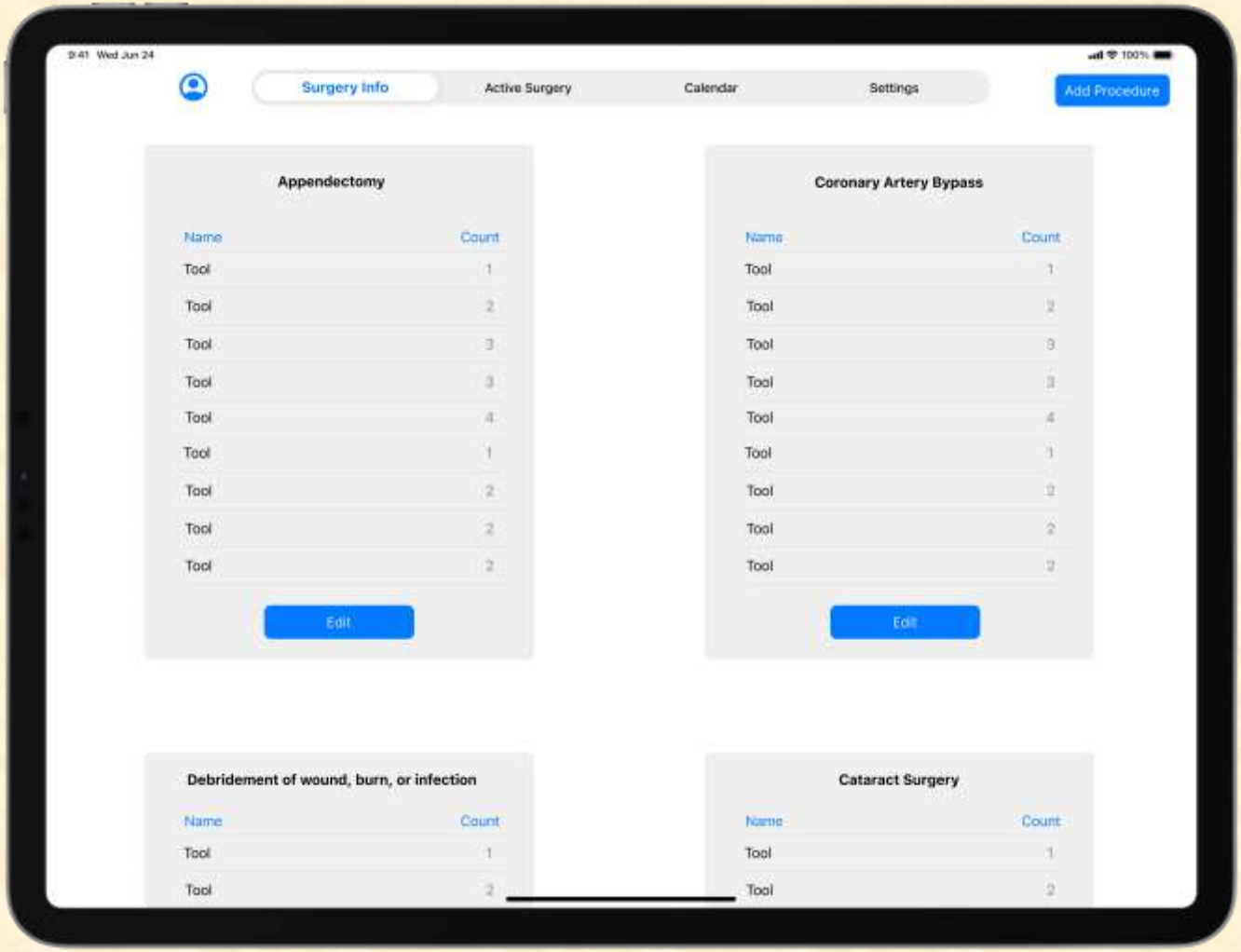
- Problem
  - Risk of Retained Surgical Items (RSIs)
  - High risk of human error in manual tracking
- Solution
  - Develop an AI/ML-driven tracking system
  - Utilize existing iPads in operating rooms
- Benefit
  - Significantly reduces error and RSIs
  - Saves time and enhances surgical efficiency

Project Design Specifications

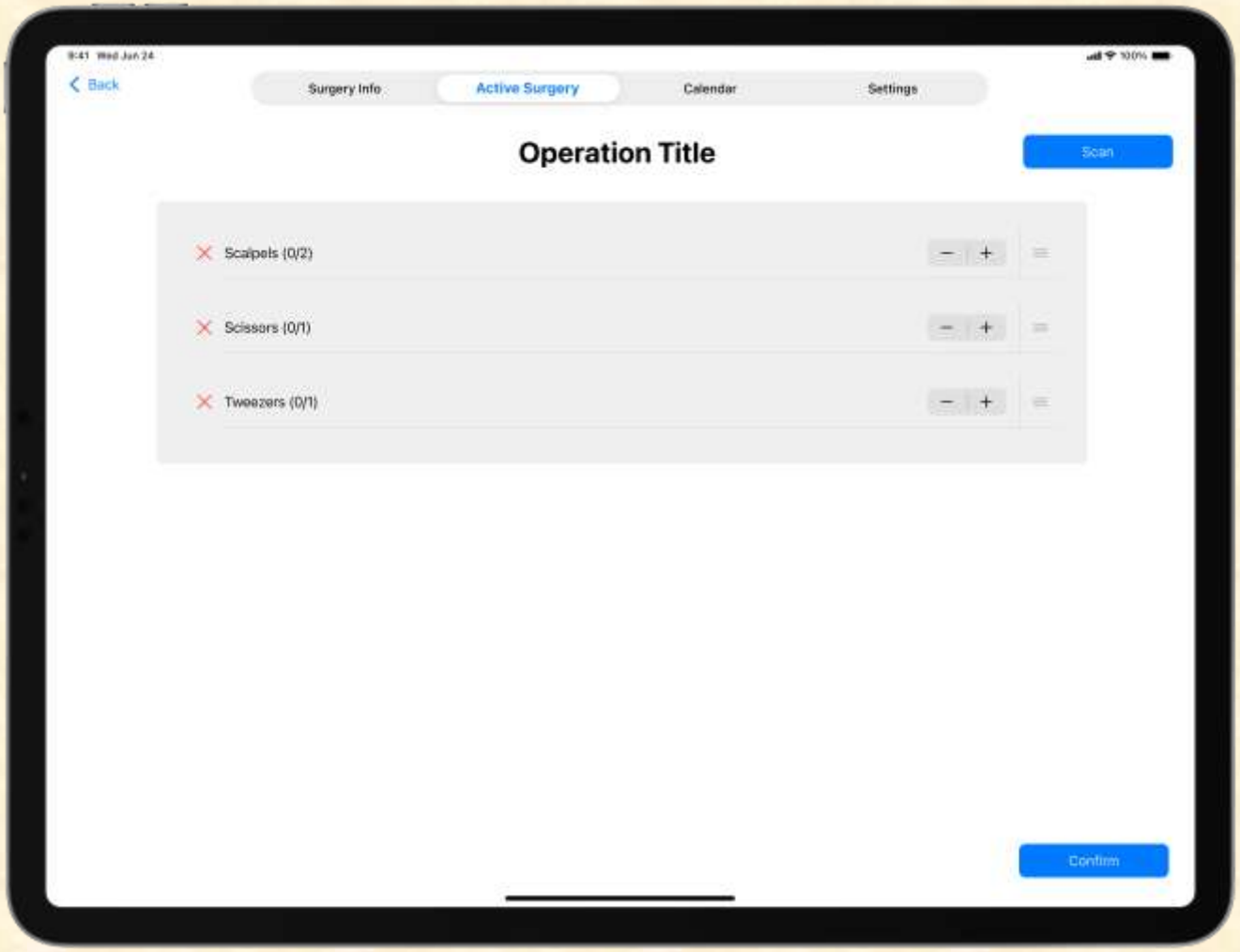
Surgical OR Instrument and Needle Tracker iOS App

- Uses a object detection machine learning model for real-time surgical instrument tracking
- Intervention points for Human Verification of Instrument Counts
- Reports instrument status logs post procedure
- Surgical Schedule Integration

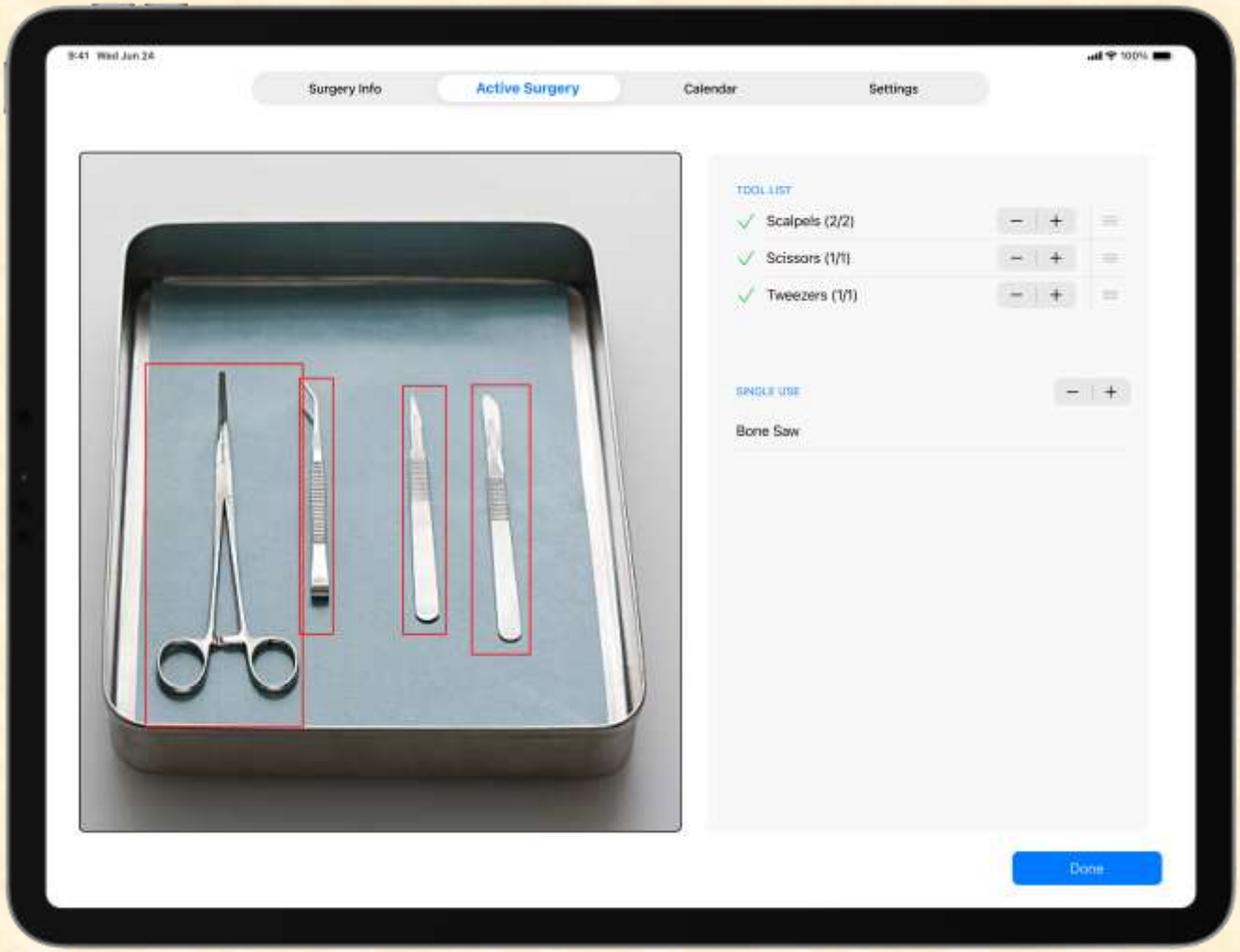
Screen Mockup: Procedures and tools



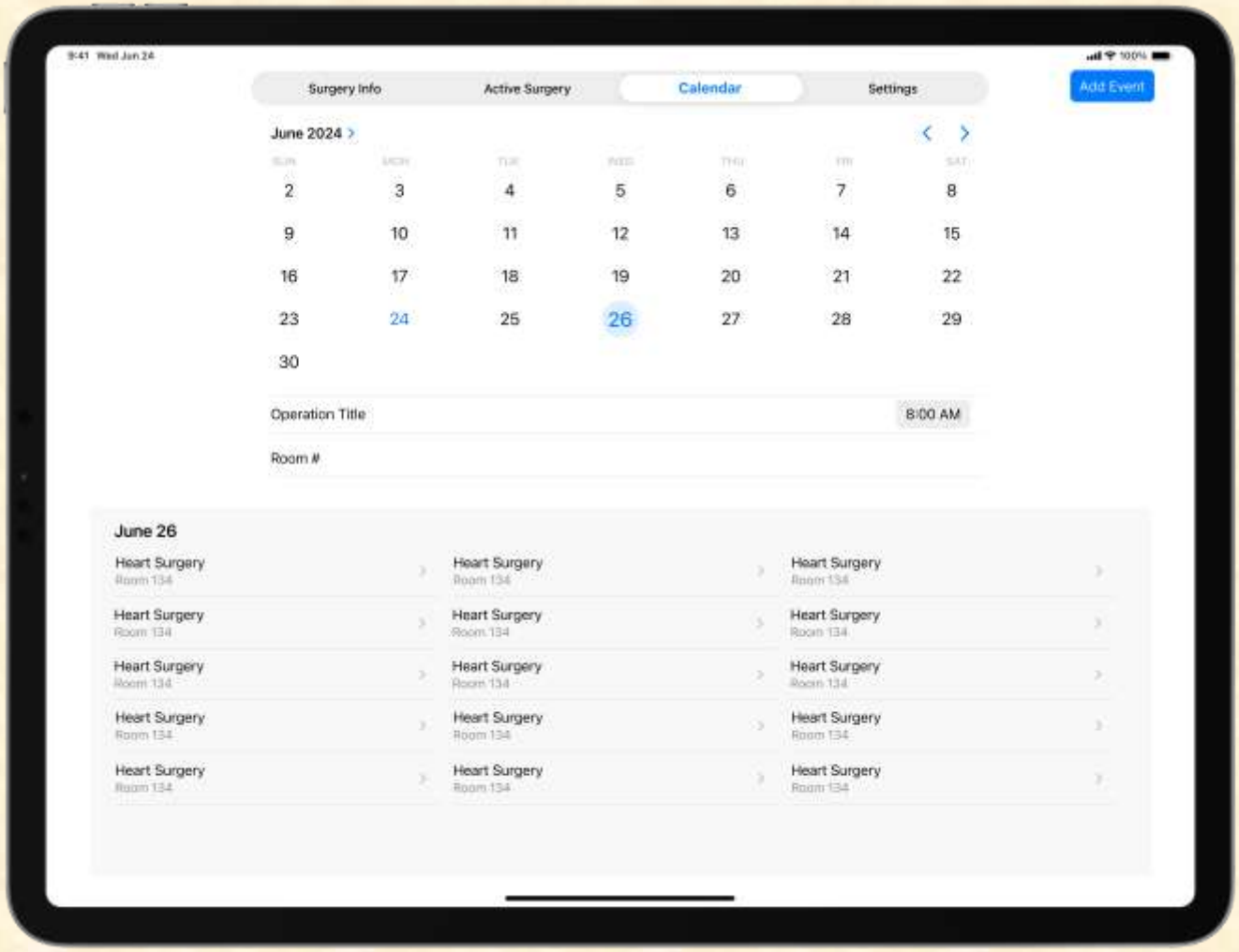
Screen Mockup: Tool check-in



Screen Mockup: Continuous live camera feed during surgery



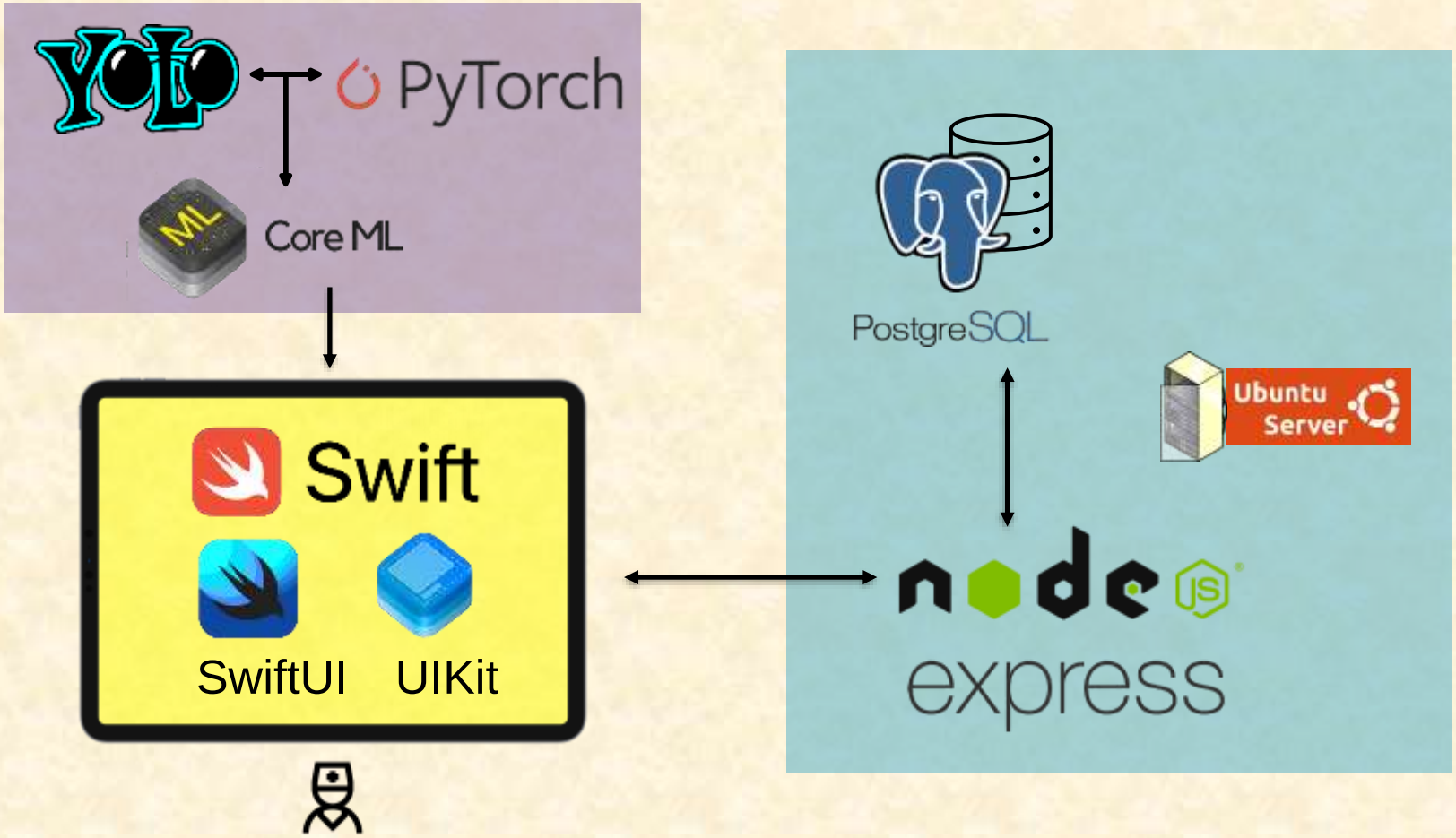
Screen Mockup: Calendar



Project Technical Specifications

- Xcode with Swift, SwiftUI, and UIKit for frontend development
- Node.js environment with Express.js framework for backend. Hosted on Ubuntu Server
- PostgreSQL database connected to Node environment
- YOLO and PyTorch for ML model design. Integrated with CoreML

Project System Architecture



Project System Components

- Hardware Platforms
  - Ubuntu Server for hosting
  - iOS Devices for deployment
- Software Platforms / Technologies
  - PostgreSQL as main database management system
  - Docker for assurance of application consistency across multiple environments
  - YOLOv8 for object detection to categorize surgery instruments
  - PyTorch for building and training surgery instruments detection application
  - CoreML for integrating image detection into main application
  - Node.JS for creating backend server and facilitating connection between server and database; Express.JS for allowing backend to receive and respond HTTP Requests
  - Xcode + Swift + SwiftUI + UIKit for providing user interface development
  - Python for Machine Learning tasks

Project Risks

- Dataset Acquisition
  - Finding a well-annotated dataset for surgical instruments is difficult due to limited availability and standardization issues
  - Sponsor is looking into company-provided datasets. Exploring public options, and developed a tool for manual annotation if needed
- Selecting Our Base Model
  - Balancing model accuracy with the iPad's computational limits is crucial as heavier models can cause lag. Additionally, licensing must comply with Stryker's requirements
  - We are developing a testing suite to benchmark models for speed and accuracy to find an ideal balance while ensuring the models meet the licensing requirements
- Individual Instrument Tracking
  - Differentiating between visually similar surgical tools may lead to misclassification, impacting the procedural efficiency and safety
  - We're using a high-quality dataset and designing the app and model to assist nurses. Exploring LiDAR solution for increased accuracy

Questions?