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Project Identity

Project Title

Calyx-Probe: *A 360° AI-Driven Diagnostic Ecosystem for Gender-Equal Healthcare*

Submission Category

Category 2: Solutions that meet the needs of women and girls.

Target Region

Primary Focus: Sub-Saharan Africa (Nigeria) Secondary Focus: Global Export Markets (United Kingdom, European Union, United States)

Project Vision Statement

To eliminate the global 'Screening-to-Action' gap by providing every woman—regardless of geography or economic status—with immediate, private, and life-saving cervical health data through design-led innovation and AI-integrated diagnostics.

UN Sustainable Development Goal (SDG) Alignment

SDG 3: Good Health and Well-being – ***Target 3.4:*** Reduce mortality from non-communicable diseases and promote mental health.

SDG 5: Gender Equality – ***Target 5.b:*** Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women.

SDG 9: Industry, Innovation, and Infrastructure – Promoting sustainable industrialization and fostering innovation through the "Consortium Partnership" model.

The Problem (The "Why")

The Cervical Cancer Crisis

In Nigeria, cervical cancer is the second most common cancer among women. Approximately 14,000 new cases are diagnosed annually, and more than 7,000 women die every year from this preventable disease.

The "Silent" Stage: 94% of these cases are diagnosed at late, advanced stages (Stages 3 and 4) where treatment is rarely effective and mortality is nearly 100%.

The Awareness Gap: Research shows that over 80% of Nigerian women have never utilized any form of cervical screening.

The Infection & Misdiagnosis Trap

The crisis extends beyond cancer. Millions of women suffer from Vaginitis (Bacterial Vaginosis, Candidiasis, and Trichomoniasis) and Pelvic Inflammatory Disease (PID), which are often poorly managed.

Clinical Inaccuracy: Studies in Nigeria have shown that among women attending gynecological clinics, misdiagnosis rates at the primary healthcare level can be as high as 42.8% to 68%.

The "Emergency" Pivot: Because general practitioners often lack specialized imaging tools, many infections are dismissed as "minor" until they become emergencies.

9.3% of all gynecological emergencies in major Nigerian hospitals are caused by Acute Pelvic Inflammatory Disease (PID) that was caught too late.

72.8% of late-stage presentations are attributed to systemic delays, including misdiagnosis and prolonged investigation times at first contact.

The Root Causes

The current healthcare infrastructure fails women due to:

Geographic Barriers: Specialist gynecologists are concentrated in cities, leaving rural women with no access to accurate internal exams.

Privacy & Stigma: The invasive nature of traditional exams prevents many women from seeking help early.

Data Fragmentation: Without a digital "history," doctors are forced to guess based on symptoms rather than visual evidence, leading to the "hit-or-miss" diagnosis cycle.

Technical Description (Hardware)

Device Architecture: The "Fly-Eye" Dual-Lens System
Unlike traditional colposcopes that require a fixed, external line of sight, the Calyx-Probe utilizes a proprietary Dual-Lens "Fly-Eye" Architecture integrated into the tip of a slim, ergonomic wand.

Lens A (Wide-Angle Panorama): A fixed 160° wide-field lens that provides an immediate high-definition overview of the vaginal vault and external cervix. This allows for rapid orientation and initial detection of major abnormalities.

Lens B (360° Micro-Zoom): A motorized, internally rotating lens capable of a full 360° orbital scan of the cervical fornices. This lens captures high-resolution video and imagery of the transformation zone—the area where over 90% of cervical cancers originate—ensuring no "blind spots" remain.

Multi-Spectral Lighting Array
To solve the problem of misdiagnosis, the probe features a ring of high-intensity, multi-spectral LEDs. The software automatically toggles between three specific light modes to highlight different biological markers:

Mode 1: Natural White Light (Standard): For general visual inspection of the tissue color and discharge.

Mode 2: Narrowband Green Light (Vascular): Hemoglobin absorbs green light, making atypical blood vessel patterns (angiogenesis) associated with tumors stand out in high contrast.

Mode 3: Fluorescence Blue Light (Biochemical): Highlights changes in tissue autofluorescence, allowing for the detection of precancerous lesions that are invisible to the naked eye under standard light.

Ergonomics and Materials
The probe is designed in two distinct tiers to ensure affordability and safety:

Calyx-Pro (Clinical Model): Encased in medical-grade, surgical-grade stainless steel and glass. It is fully compatible with standard autoclave sterilization and high-level disinfection protocols for high-volume clinic use.

Calyx-Home (Personal Model): Constructed from high-impact, medical-grade BPA-free polymers. It features a simplified interface and a "Soft-Touch" textured grip for comfortable, private self-use.

Integrated Safety & Connectivity

Proximity Sensors: Ensures the imaging system only activates when the probe is in the correct anatomical position, protecting the optical sensors from glare.

Onboard Processing: A low-latency image processor handles the high-definition video feed before encrypting it for transmission to the mobile app via Bluetooth 5.0.

Technical Description (Software and Data)

The "Secure Handshake" Token System

To prevent unauthorized use and ensure a sustainable revenue model, the Calyx-Probe requires a Software Handshake to activate a scanning session. A unique, time-sensitive digital token is generated upon payment, which then communicates via Bluetooth Low Energy (BLE) to unlock the probe's sensors for a single-use session.

The Calyx-Pro Desktop Suite: Clinical Patient Management

The Desktop Suite is designed for healthcare providers to act as a command center for cervical health.

Digital Patient Folders: Every woman is assigned a unique, encrypted digital folder. This replaces the prone-to-loss paper filing system common in many clinics.

Longitudinal Record Keeping: The system automatically archives every 360° scan, AI report, and doctor's note in chronological order. This allows doctors to compare a woman’s current scan with her results from a year ago to detect subtle tissue changes.

Data Search & Filter: The "Enterprise Master Patient Index" (EMPI) allows staff to search by name, biometric data, or unique ID to instantly pull up a full medical history, preventing duplicate records and ensuring continuity of care.

The AI "Diagnostic Brain" & Heatmap Overlay

Triage Score: The AI analyzes the 360° video feed in under 120 seconds, assigning a risk level (Low, Medium, or High).

AI Visual Overlay: On the desktop suite, the software places a real-time Heatmap Overlay on the live video. This highlights areas of "vascular suspicion" or "lesion probability" in red/yellow, acting as a second pair of eyes for the clinician during the exam.

The Calyx-Mobile App: Patient-Facing Interface

The "Health Vault": A secure mobile area where women can access their own scan reports, view simplified AI explanations, and store vaccination records (e.g., HPV vaccine).

Guided Self-Scanning: For "Home" users, the app uses Voice-Guided AI and on-screen orientation markers to ensure the probe is positioned correctly without professional help.

Automated Reporting & Compliance

Direct-to-Patient Pipeline: Reports are instantly sent via Email (Full PDF) or SMS (Summary).

Standards & Security: The software is built on HL7 FHIR standards for hospital inteInstructionsroperability and uses AES-256 encryption to comply with the Nigeria Data Protection Act (NDPA) and global HIPAA standards.

Proposed Virtual Clinic and Follow-up Ecosystem

Bridging the "Screening-to-Action" Gap

A primary goal of the Calyx-Probe project is to solve the "Loss-to-Follow-up" crisis in Nigeria. The project proposes a digital referral pipeline that ensures no woman is left stranded with a high-risk result.

Proposed Triage-Response Protocol

The software is designed to trigger specific actions based on the AI-generated risk level in the Digital Patient Folder:

Low Risk: Automated "Clear" report and a digital reminder for a routine rescan.

Medium Risk: The system will flag the file for a review by a Tele-Health Nurse to provide counseling and schedule a preventive consultation.

High Risk: The system is built to trigger an immediate Virtual Specialist Consultation to bypass traditional hospital wait times.

Strategic Partnership Goals (The Specialist Network)

The project envisions seeking a formal partnership with the Society of Gynaecology and Obstetrics of Nigeria (SOGON) and the Gynaecological Oncology Society of Nigeria (GOSON).

The Objective: To create a dedicated "Specialist Queue" where verified gynecologists can opt-in to review flagged scans virtually.

Visual Review: Through the Desktop Suite, specialists will be able to view the 360° scan and AI heatmap remotely, allowing for an accurate second opinion without the patient traveling to a distant city.

Community Follow-up Framework

To reach women in rural areas with limited internet access, the project proposes a **Community Ambassador Program:**

Automated Alerts: The system will be capable of sending SMS alerts in local languages (Hausa, Yoruba, Igbo, Pidgin) to designated local health workers.

The "Last Mile" Support: These workers will be tasked with visiting patients in person to explain the findings and provide a digital referral to the nearest physical treatment hub for further care (biopsy or treatment).

Impact Goal

By providing a clear, digital path from detection to specialist review, this ecosystem aims to raise treatment adherence in Nigeria from current low levels to over 85%.

Implementation and Global Strategy (The Business Model)

The Manufacturing Framework: The ***"Consortium Model"***
To ensure rapid scalability and low initial capital expenditure, the project proposes a Consortium Manufacturing Strategy. Rather than building a new factory, the plan envisions forming strategic alliances with established industrial partners:

Hardware Assembly: Partnering with existing ISO-certified electronics manufacturing firms in Nigeria to handle the assembly of the Calyx-Probe.

Specialized Optics: Outsourcing the ***"Fly-Eye"*** dual-lens components to global precision-lens manufacturers to ensure medical-grade diagnostic quality.

Complementarity: This model allows the project to leverage the existing infrastructure of partners, reducing time-to-market and ensuring high manufacturing standards from Day 1.

The Cross-Subsidy Financial Model
The project is designed to be self-sustaining through a ***"Social-Enterprise"*** pricing strategy. This involves splitting the market into two distinct zones:

Zone A: The Local Impact Market (Nigeria & Sub-Saharan Africa)

Goal: Maximum accessibility.

Pricing: The ***"Clinic-Pro"*** scan is priced at a ***"Bus Ticket"*** rate (Approx. ₦4,500 – ₦6,500). This covers the basic operational cost of the software token and the nurse's time, making it affordable for the average woman.

Zone B: The Global Wellness Market (UK, EU, USA)

Goal: High-margin revenue generation.

Pricing: The ***"Calyx-Home"*** personal probe is proposed for export as a premium "Fem-Tech" preventive device, priced at international market rates ($150 – $250 USD).

The ***"Robin Hood"*** Effect: Profits generated from one international sale are designed to subsidize the cost of 20 free or highly-subsidized scans for women in rural Nigerian communities.

Market Entry & Export Strategy
The project envisions a three-phase rollout:

Phase 1 (Pilot): Implementation of the ***"Clinic-Pro"*** in select Nigerian urban centers to gather data and prove the AI's accuracy.

Phase 2 (National Scale): Expansion into rural LGAs through the Community Ambassador Program.

Phase 3 (Global Launch): Seeking CE (Europe) and FDA (USA) regulatory approval to begin exporting the personal probe to the international "Wellness" market.

Intellectual Property & Brand Equity
The project intends to secure patents for the 360° orbital lens rotation and the Multi-Spectral LED diagnostic sequence. By maintaining ownership of the "AI Brain," the project ensures long-term value and the ability to license the technology to global health organizations.

Job Creation and Economic Impact Proposal

The Human-Centric Growth Model

The Calyx-Probe ecosystem is designed to be a significant engine for job creation. By decentralizing healthcare, the project proposes the employment of a diverse workforce across the technology, medical, and community sectors.

Proposed Direct Job Opportunities

The project envisions the creation of several new professional roles:

Community Health Ambassadors (CHAs) and Role: Local women trained to operate the probe in rural areas and explain results to patients in their native languages.

Impact: This creates thousands of "micro-entrepreneurial" opportunities for women in villages to become frontline health leaders.

Tele-Health Nursing Corps and Role: Licensed nurses employed to monitor the digital dashboard, provide virtual counseling, and manage the "Medium Risk" follow-up alerts.

AI Data Curators & Tech Support and Role: Local tech graduates tasked with maintaining the software database, troubleshooting clinic hardware, and ensuring the AI "Diagnostic Brain" stays updated with local data trends.

Logistics & Maintenance Technicians and Role: Specialized teams to manage the distribution of probes and perform regular calibration of the optical sensors in the field.

Indirect Economic Stimulation

Beyond direct employment, the project is designed to stimulate the broader economy

Local Manufacturing Support: By using a Consortium Model, the project proposes providing consistent contracts to existing Nigerian plastic and electronic assembly factories, sustaining industrial jobs.

Supply Chain Growth: Opportunities for local logistics companies to manage the "last-mile" delivery of tokens and hardware to remote clinics.

Women's Economic Empowerment

Because the Calyx-Probe focuses on women's health, its primary economic impact is workforce retention.

Preventing Disability: By catching infections and cancer early, the project ensures that thousands of women remain healthy enough to continue their trades, farming, and businesses, preventing the "poverty trap" that occurs when a female head of household falls ill.

Projected Impact Goal

The long-term vision for the project is to create an ecosystem capable of supporting over 5,000 direct and indirect jobs within the first five years of national rollout in Nigeria.

Sustainability and SDG Alignment

Environmental Sustainability (Green Design)
The Calyx-Probe project proposes a design philosophy that minimizes medical waste:

Durability over Disposability: Unlike many diagnostic tools that are single-use plastic, the Calyx-Pro is designed for a 10-year lifespan with autoclave-safe materials (stainless steel and medical glass).

Low-Power Consumption: The probe is engineered to run on low-voltage lithium batteries, rechargeable via solar power in rural clinics with unstable electricity.

Paperless Ecosystem: By utilizing Digital Patient Folders and email/SMS reporting, the project proposes to eliminate thousands of tons of paper waste and chemical film processing used in traditional imaging.

Financial Sustainability (The "Circular" Model)
The project is designed to be self-funding after the initial pilot phase:

Token Revenue: The "Software Handshake" token system ensures a continuous stream of micro-payments that cover server costs, AI updates, and technical support.

Global Export Profits: As outlined in the Global Strategy, high-margin sales in international "Wellness" markets provide the capital needed to maintain and repair the infrastructure in low-income regions.

Alignment with UN Sustainable Development Goals (SDGs)
The Calyx-Probe ecosystem is a multi-impact solution that targets specific global goals:

Goals	Specific Target & Contribution
SDG 3: Good Health	Target 3.7: Ensuring universal access to sexual and reproductive healthcare services. Calyx brings screening to the "doorstep" of the underserved.
SDG 5: Gender Equality	Target 5.b: Using enabling technology to empower women. The project gives women ownership of their health data through the "Health Vault."
SDG 8: Decent Work	Target 8.5: Creating jobs for women and youth through the Community Ambassador and Tele-Health Nursing programs.
SDG 9: Innovation	Target 9.5: Enhancing scientific research and industrial innovation in developing countries through the "Consortium" manufacturing model.
SDG 10: Reduced Inequality	Closing the "Diagnostic Gap" between urban wealthy populations and rural low-income populations.

Long-Term Evolution

The project is not a static tool. The vision includes a "Feedback Loop" where anonymized data (with patient consent) is used to help researchers understand disease patterns in Sub-Saharan Africa, leading to better-targeted public health interventions in the future.

The Pilot Roadmap (The 12-Month Plan)

Phase 1: Prototype Refinement & Stakeholder Mapping (Months 1–3)
Objective: Finalize the ***"Fly-Eye"*** lens calibration and formalize the industrial ***"Consortium"*** strategy.

Key Actions:

Complete high-fidelity technical blueprints for the 360° motorized tip.

Draft a formal Expression of Interest (EOI) for the Society of Gynaecology and Obstetrics of Nigeria (SOGON) to provide clinical advisory for the pilot.

Vet potential local partners for ISO 13485 (Medical Device Quality Management) certified assembly.

Phase 2: AI Training & Software Compliance (Months 4–6)
Objective: Polish the ***"Diagnostic Brain"*** and ensure strict data privacy.

Key Actions:

Conduct a Data Protection Impact Assessment (DPIA) to ensure the ***"Digital Patient Folders"*** comply with the Nigeria Data Protection Act (NDPA) 2023.

Refine the AI Heatmap Overlay using localized datasets to ensure high accuracy for diverse skin tones and tissue variations.

Beta-test the ***"Voice-Guided AI"*** on the mobile app to ensure it is intuitive for non-medical users.

Phase 3: The ***"Alpha Pilot"*** Deployment (Months 7–9)
Objective: Real-world validation in a controlled clinical environment.
Key Actions:

Deploy 20 Calyx-Pro units across three selected pilot locations (one teaching hospital, one private clinic, and one rural primary health center).

Conduct specialized training for the first cohort of Tele-Health Nurses and Community Health Ambassadors.

Monitor the ***"Software Handshake***" token system to ensure 100% security and zero unauthorized access.

Phase 4: Impact Analysis & Export Readiness (Months 10–12)
Objective: Proving the impact and preparing for the global ***"Cross-Subsidy"*** launch.

Key Actions:

Audit the ***"Screening-to-Action"*** success rate (Targeting >80% follow-up for high-risk cases identified by the AI).

Compile a comprehensive ***"Clinical Performance Report"*** to demonstrate the reduction in misdiagnosis.

Initiate the application process for CE Marking (Europe) and UKCA (UK) to prepare for international export in Year 2.

Key Performance Indicators (KPIs)
Diagnostic Accuracy: Achieving a 95%+ correlation with traditional Pap smear/colposcopy results.

Economic Stability: Proving the ***"Bus Ticket"*** token fee covers cloud processing and maintenance costs.

Inclusivity: Ensuring 100% of reports are available in English and at least one local Nigerian language.

Conclusion

The Calyx-Probe began as a response to a clear and heartbreaking gap in healthcare accessibility. As a designer, my goal was to create a bridge between high-end AI technology and the everyday needs of women in regions like mine. This submission represents a complete architectural blueprint for a more equitable future. While the road to implementation requires the collaboration of medical bodies and industrial partners, the vision is clear: a world where no woman's health is determined by her geography. I am presenting this solution as a catalyst for change, hoping to provide the spark that ignites a new standard of care for women everywhere.