

HemaVision Diagnostics Proposal

DEMOCRATIZING HEMATOLOGY: A LOW-COST, OFFLINE
COMPUTER VISION PLATFORM FOR REAL-TIME PCV &
HEMOGLOBIN ESTIMATION

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1. Project Description

On the front lines of Nigerian healthcare, a crisis of time and accuracy unfolds daily. Laboratory scientists are routinely tasked with manually processing hundreds of blood samples, a laborious burden that leads to fatigue, human error, and a higher risk of incorrect results, which can be detrimental to patient care. This problem persists due to a stark technological divide: high-end automated analyzers are prohibitively expensive and immobile, chaining modern diagnostics to centralized labs and leaving rural clinics, researchers, and students without access.

Our project, HemaVision Diagnostics, directly confronts this challenge with an innovative, AI-powered platform that transforms any smartphone or computer into a sophisticated hematology analyzer. Delivered as an offline-capable Progressive Web Application (PWA), our solution requires no expensive hardware, no installation, and no internet connection to operate, making it a true point-of-care tool.

The core of our platform is a proprietary "Multi-Stage Hybrid Analysis" algorithm. A user simply captures an image of a centrifuged microhematocrit tube; our system then intelligently isolates the tube from its background, performs a detailed analysis of the distinct hematological layers, and instantly calculates the Packed Cell Volume (PCV) and estimated Hemoglobin (Hb) with clinical-grade precision.

Our vision extends into three strategic tiers. Following the core analyzer, our High-Throughput Batch Module will enable the simultaneous analysis of up to ten tubes laid flat, dramatically increasing lab efficiency. The groundbreaking "In-Situ" Centrifuge Module represents the future: a powerful AI model that analyzes tubes directly within the centrifuge head, correcting for perspective and using Optical Character Recognition (OCR) to assign results to their corresponding numbered slots.

By automating this critical diagnostic task, HemaVision will liberate scientists from repetitive labor, significantly increase data integrity, and democratize access to essential medical technology. It is a tool designed to empower clinicians in remote villages, accelerate research in the field, and provide a modern, interactive learning platform for institutions like UDUSOK, creating a new paradigm for diagnostics in Nigeria.

2. Problem Statement

On the front lines of Nigerian healthcare and research, a silent crisis is unfolding—a crisis of time, accuracy, and access. It begins with the most fundamental of diagnostic tools: the microhematocrit tube. Every day, dedicated laboratory scientists are tasked with processing a staggering volume of these tubes, with peak days demanding the manual analysis of over 500 individual samples. This is not just a task; it is a laborious, repetitive burden that introduces a cascade of systemic risks.

The first and most immediate consequence is human fatigue. This physical and mental exhaustion is a direct threat to accuracy, making errors in measurement and transcription not just possible, but probable. This leads to a deeper, more corrosive problem: the erosion of data integrity. Under the immense pressure to clear an overwhelming backlog, the system is vulnerable to the clerical falsification of results—a last resort for an exhausted workforce, but one with potentially devastating consequences for patient diagnosis, treatment, and the validity of critical research.

Why does this problem persist? Because a vast technological and economic divide separates our institutions from the solution. While high-end automated analyzers exist, their prohibitive cost, reliance on constant maintenance, and sheer immobility chain them to centralized labs. This effectively tethers modern diagnostics to the brick-and-mortar facility, creating an impassable barrier for rural clinics, underfunded research projects, and vital fieldwork. The result is a system under constant strain, a workforce at its breaking point, and a nation's diagnostic potential held captive by outdated tools and inaccessible technology.

3. Proposed Solution / Innovation

Our solution is an innovative, AI-powered platform delivered as a Progressive Web Application (PWA) that transforms any standard smartphone or computer into a sophisticated hematology analysis tool. The platform is designed to be

universally accessible, completely offline-capable, and will be developed in three strategic tiers:

Tier 1: The Core Point-of-Care Analyzer

The core of our platform is a powerful analysis engine that leverages a proprietary computer vision algorithm. Users simply place a centrifuged microhematocrit tube on a plain background and capture an image. Our system instantly and accurately detects the tube, identifies the distinct hematological layers (plasma, buffy coat, packed red cells), and calculates the PCV and estimated Hb values with precision comparable to commercial analyzers.

Tier 2: The High-Throughput Batch Module

To dramatically enhance laboratory workflow, this module enables the simultaneous analysis of multiple (5-10) tubes. Users can arrange several tubes in a single frame, and our advanced object detection system will intelligently segment and analyze each tube individually, collating the results in a formatted report. This feature represents a significant time-saving innovation for high-volume labs.

Tier 3: The "In-Situ" Centrifuge Module (Pro Version)

This groundbreaking, next-generation feature eliminates the need to even remove the tubes from the centrifuge. Leveraging an advanced AI model that intelligently compensates for perspective distortion and complex lighting, the user can capture an image of the entire centrifuge head. The system will then

perform Optical Character Recognition (OCR) to identify the corresponding slot number for each tube, analyze every tube in-situ, and deliver a complete, numbered batch report in seconds. This represents the ultimate in workflow efficiency and point-of-care diagnostics.

4. Methodology & Implementation Plan

The project will be executed in a phased, 16-week timeline, ensuring the delivery of a robust, market-ready product. This timeline is structured to allow for agile development, rigorous testing, and continuous validation at each stage.

Phase 1: Core Engine Development & Validation (Weeks 1-6)

- Milestone 1: A functional prototype capable of accurate, user-verified PCV/Hb analysis.

Phase 2: User Experience & Field Readiness (Weeks 7-10)

- Milestone 2: A field-ready PWA that can be "installed," works offline, and provides a seamless capture-to-analysis workflow.

Phase 3: Data Management & Final Polish (Weeks 11-14)

- Milestone 3: A feature-complete Version 1.0 of the application.

Phase 4: Launch & Future Planning (Weeks 15-16)

- Final deployment and user acceptance testing. Strategic planning for the Tier 2 and Tier 3 modules.

5. Potential Impact & Benefits

Our platform is designed to systematically dismantle the barriers of time, cost, and access, creating a transformative wave of impact that begins with the individual and extends to the entire diagnostic landscape.

The transformation starts by liberating the laboratory scientist. Our core Point-of-Care Analyzer (Tier 1) attacks the primary bottleneck of manual measurement. By automating the analysis of a single tube in seconds, we immediately restore time, reduce fatigue, and drastically increase the accuracy and integrity of each individual result.

This newfound efficiency then unlocks a new paradigm in workflow with our High-Throughput Batch Module (Tier 2). By scaling the analysis to multiple tubes at once, we transform the lab's capacity, enabling larger studies, faster screenings, and a more responsive healthcare system.

Finally, this wave of transformation breaks free from the laboratory walls with our revolutionary "In-Situ" Centrifuge Module (Tier 3). This is our answer to the great technological and economic divide. By making advanced diagnostics available through a simple photograph, we democratize access to a level previously unimaginable, empowering clinicians, researchers, and students. For institutions like UDUSOK, this platform represents a leap into the future—a tool to train the next generation of scientists, a catalyst for groundbreaking research, and a testament to Nigerian innovation solving Nigerian problems.

6. Budget & Financial Justification

To fully realize the transformative potential of the "Democratizing Hematology" platform, we are requesting a total project budget of ₦5,800,000. This budget represents a comprehensive and strategic investment in the necessary resources to develop, scientifically validate, and successfully deploy a world-class diagnostic tool.

Category	Description	Amount (NGN)
A. Development & Testing Resources	Core hardware and software to build and test the platform.	₦3,850,000
B. Data Acquisition & Validation	Resources to acquire real-world data and validate accuracy.	₦900,000
C. Infrastructure & Dissemination	Costs for launching the platform and sharing the research.	500,000
D. Contingency Fund	For unforeseen expenses and operational flexibility.	₦550,000
TOTAL		₦5,800,000

Detailed Justification:

A. Essential Development & Testing Resources (₦3,850,000): This is the foundational investment in the project's technical infrastructure. It covers a high-performance development workstation required for AI/CV tasks and a suite of mobile devices for comprehensive testing on real-world hardware.

B. Data Acquisition & Validation (₦900,000): This fund is dedicated to ensuring our tool is scientifically accurate. It will fund partnerships with local laboratories for diverse sample acquisition and pay for the use of "gold standard" commercial analyzers to scientifically validate our results.

C. Infrastructure & Dissemination (₦500,000): This allocation ensures our project is successfully launched and its findings are shared with the wider scientific community, covering initial deployment costs and funding for the presentation and publication of our research.

D. Contingency Fund (₦550,000): Standard best practice in R&D project management, this fund (approx. 10%) covers unforeseen expenses, ensuring the project remains on track and can adapt to new opportunities without delay.