AfriVoice MVP Scope

Lablab Surge Hack: AI Meets Robotics (Feb 6-15, 2026)

🎯 Executive Summary

One-liner: Voice-controlled agricultural robot assistant that understands Swahili commands to detect crop diseases and guide farmers — bridging the gap between AI and Africa's 33M+ smallholder farmers.

Hackathon Scope: A working demo showing voice-in → robot action → visual analysis → voice-out pipeline in Swahili, running in simulation with a clear path to physical deployment.

🔍 Problem Statement

The Challenge

- **600M+ people** in Africa depend on agriculture
- **33M+ smallholder farmers** in East Africa alone
- Crop diseases cause **30-40% yield losses** annually
- Most AI agricultural tools require:
  - Literacy (many farmers have limited formal education)
  - English/French proficiency
  - Smartphone expertise
  - Reliable internet

The Gap

Existing solutions don't work for a 55-year-old Swahili-speaking farmer in rural Kenya who:

- Prefers voice over typing
- Speaks Swahili/Kikuyu, not English
- Has a basic phone, not smartphone
- Needs hands-free operation while working

Your Unique Position

- Kenyan origin → authentic problem understanding
- Robotics + AI expertise → technical capability
- VLA model knowledge → cutting-edge approach
- MSc research context → academic rigor

🚀 MVP Definition

Core Use Case: Voice-Guided Crop Disease Detection

Scenario: A farmer approaches their tomato plants. They speak to the AfriVoice robot:

```
Farmer (Swahili): "Angalia nyanya zangu" (Check my tomatoes)

Robot: [Navigates to tomato area, captures images]

Robot (Swahili): "Nimeona ugonjwa wa madoa ya majani kwenye mimea mitatu.
                  Napendekeza kutumia dawa ya shaba."
                 (I detected leaf spot disease on 3 plants.
                  I recommend using copper-based fungicide.)

Farmer (Swahili): "Nionyeshe mimea iliyoathirika" (Show me affected plants)

Robot: [Navigates to first affected plant, highlights diseased areas on display]
```

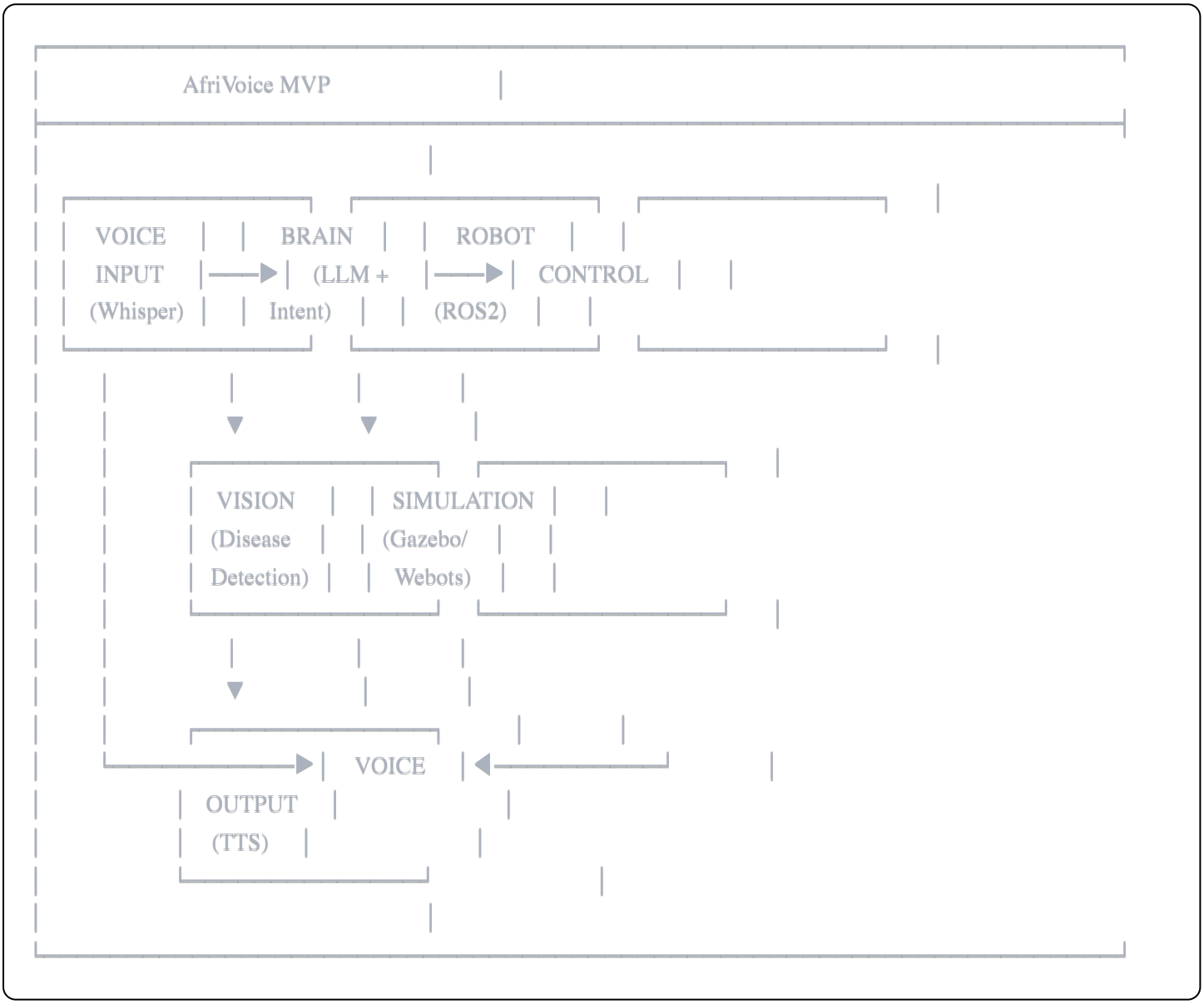
What Makes This an MVP (Not Full Product)

MVP Scope ✅	Future Scope ❌
1 language (Swahili)	52 African languages
3-5 crop diseases	Full disease database
1 crop type (tomatoes)	Multiple crops
Simulation environment	Physical robot deployment
Pre-defined navigation	Autonomous field mapping
5-10 voice commands	Natural conversation
Basic TTS responses	Expressive voice synthesis

MVP Scope ✅	Future Scope ❌
Single robot	Multi-robot coordination

🏗️ Technical Architecture

System Overview



Component Stack

Component	Technology	Why
Speech-to-Text	OpenAI Whisper (large-v3)	Best Swahili support, open-source
Intent Recognition	Claude API / GPT-4	Robust understanding, function calling
Robot Control	ROS2 Humble	Your existing expertise, industry standard

Component	Technology	Why
Simulation	Gazebo Harmonic or Webots	ROS2 integration, realistic physics
Vision/Detection	YOLOv8 + PlantVillage dataset	Fast inference, pre-trained crop models
Text-to-Speech	Coqui TTS / gTTS	Swahili voice synthesis
Robot Model	TurtleBot3 or Custom agricultural bot	Well-documented, easy to simulate
Frontend	React + WebSocket	Real-time demo interface

Data Flow

```
1. AUDIO INPUT
   └── Microphone → WAV file → Whisper API
      └── Output: "Angalia nyanya zangu"

2. INTENT PARSING
   └── Swahili text → LLM with function calling
      └── Output: {
          "intent": "inspect_crop",
          "crop_type": "tomato",
          "action": "navigate_and_scan"
        }

3. ROBOT ACTION
   └── Intent → ROS2 Action Server
      └── Navigation to crop zone
      └── Camera activation
      └── Image capture sequence

4. VISION ANALYSIS
   └── Images → YOLO Disease Detection
      └── Output: {
          "disease": "leaf_spot",
          "confidence": 0.87,
          "affected_plants": 3,
          "bounding_boxes": [...]
        }

5. RESPONSE GENERATION
   └── Analysis + Context → LLM
      └── Output: Swahili response with recommendations

6. VOICE OUTPUT
```

```
└── Swahili text → TTS → Speaker
    └── Audio: Disease report + recommendations
```

📅 9-Day Development Plan

Phase 1: Foundation (Days 1-3)

Feb 6-8, 2026

Day 1: Project Setup & Voice Pipeline

- [ ] Set up development environment (ROS2, Python, Node.js)
- [ ] Implement Whisper integration for Swahili STT
- [ ] Test with 10-20 Swahili agricultural phrases
- [ ] Set up Coqui TTS for Swahili output
- [ ] Create basic voice-in → voice-out loop

Deliverable: Working Swahili voice transcription and synthesis

Day 2: Intent Recognition & LLM Integration

- [ ] Define command schema (5-10 intents)
- [ ] Set up Claude/GPT API with function calling
- [ ] Create Swahili prompt templates
- [ ] Build intent parser with structured output
- [ ] Test intent recognition accuracy

Deliverable: Swahili commands correctly parsed to structured intents

Day 3: Simulation Environment

- [ ] Set up Gazebo/Webots with agricultural scene
- [ ] Import or create simple robot model (TurtleBot3 base)
- [ ] Add simulated tomato plants (3D models or textured boxes)
- [ ] Configure robot camera and sensors
- [ ] Test basic teleoperation

Deliverable: Robot navigating in farm simulation environment

Phase 2: Integration (Days 4-6)

Feb 9-11, 2026

Day 4: Robot Control via Voice

- [ ] Create ROS2 action server for navigation
- [ ] Connect intent parser → ROS2 actions
- [ ] Implement "go to crop zone" navigation
- [ ] Add camera capture on arrival
- [ ] Test full voice → navigation pipeline

Deliverable: "Angalia nyanya" triggers robot to navigate to tomato zone

Day 5: Disease Detection Vision

- [ ] Fine-tune or adapt YOLOv8 on PlantVillage dataset
- [ ] Focus on 3-5 tomato diseases:
  - Leaf spot (Septoria)
  - Early blight
  - Late blight
  - Leaf mold
  - Healthy (control)
- [ ] Integrate detection with robot camera feed
- [ ] Generate structured detection results

Deliverable: Robot captures image → detects disease with bounding boxes

Day 6: Response Generation & Full Loop

- [ ] Create response templates in Swahili
- [ ] Connect detection results → LLM → Swahili response
- [ ] Implement TTS for detection results
- [ ] Add visual feedback (highlighted images)
- [ ] Test complete pipeline end-to-end

Deliverable: Full voice → action → detection → voice response loop working

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Phase 3: Polish & Demo (Days 7-9)

Feb 12-14, 2026

Day 7: Demo Interface & UX

- [ ] Build web dashboard showing:
  - Live robot camera feed

- Voice waveform visualization
- Detected diseases with annotations
- Swahili transcript

- [ ] Add visual command suggestions
- [ ] Implement error handling and fallbacks
- [ ] Create demo "reset" functionality

Deliverable: Polished demo interface ready for presentation

Day 8: Testing & Edge Cases

- [ ] Test with various Swahili accents (if possible)
- [ ] Handle misrecognition gracefully
- [ ] Add conversational fallbacks
- [ ] Stress test the pipeline
- [ ] Record backup demo video

Deliverable: Robust system with graceful error handling

Day 9: Pitch Preparation

- [ ] Record 3-minute demo video
- [ ] Prepare pitch deck (problem, solution, demo, market, team)
- [ ] Practice live demo
- [ ] Prepare for Q&A
- [ ] Submit before deadline

Deliverable: Pitch materials ready for on-site presentation

On-Site Phase (Feb 14-15)

- Live demo to judges
- Networking with investors/mentors
- Pitch presentation
- Q&A session

🗣️ Supported Voice Commands (MVP)

Primary Commands (Must Have)

Swahili Command	English	Robot Action
"Angalia nyanya zangu"	Check my tomatoes	Navigate to tomato zone, scan for diseases
"Nenda shambani"	Go to the field	Navigate to starting position
"Piga picha"	Take a photo	Capture current camera view
"Tathmini afya ya mimea"	Assess plant health	Full scan and disease report
"Nionyeshe ugonjwa"	Show me the disease	Highlight affected areas on display
"Rudi nyumbani"	Go home	Return to charging/base station
"Simama"	Stop	Emergency stop

Secondary Commands (Nice to Have)

Swahili Command	English	Robot Action
"Eleza zaidi"	Explain more	Detailed disease information
"Pendekezo la dawa"	Treatment recommendation	Suggest remedies
"Hali ya hewa"	Weather status	Report environmental conditions
"Rekodi ripoti"	Record report	Save session for later review

🌱 Disease Detection Scope

Target Diseases (Tomato Focus)

Disease	Swahili Name	Visual Indicators	Recommendation
Early Blight	Ukungu wa mapema	Dark spots with rings	Fungicide, remove affected leaves
Late Blight	Ukungu wa kuchelewa	Water-soaked lesions	Copper spray, improve drainage
Leaf Spot	Madoa ya majani	Small dark spots	Fungicide, crop rotation

Disease	Swahili Name	Visual Indicators	Recommendation
Leaf Mold	Ukungu wa majani	Yellow patches, fuzzy mold	Improve ventilation
Healthy	Afya njema	Green, no lesions	Continue current care

Training Data

- **PlantVillage Dataset:** 54,000+ images of healthy and diseased crops
- **Subset for MVP:** ~5,000 tomato images (healthy + 4 diseases)
- **Augmentation:** Rotation, brightness, simulate field conditions

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🎬 Demo Scenario Script

2-Minute Live Demo Flow

```
[SCENE: Web dashboard showing farm simulation, robot at base station]

PRESENTER: "Meet AfriVoice — the first agricultural robot that speaks Swahili."

[Speaks into microphone in Swahili]
PRESENTER: "Angalia nyanya zangu"

[Dashboard shows voice waveform, transcript appears]
[Robot begins navigating to tomato zone in simulation]

NARRATOR: "The farmer asked to check their tomatoes. AfriVoice understands
        natural Swahili commands — no app, no typing, no English required."

[Robot arrives, camera feed shows tomato plants]
[YOLO detection runs, bounding boxes appear on diseased plants]

ROBOT (Swahili TTS): "Nimeona ugonjwa wa madoa ya majani kwenye mimea mitatu.
                Napendekeza kutumia dawa ya shaba mara moja."

[Dashboard shows: Disease detected, 3 plants affected, confidence 87%]

PRESENTER: "Nionyeshe mimea ya kwanza"

[Robot navigates to first affected plant, zooms in]
[Highlighted image shows disease regions]

ROBOT (Swahili TTS): "Hii ni mmea wa kwanza ulioathirika. Ugonjwa unaonekana
```

kwenye majani matatu ya chini."

PRESENTER: "With AfriVoice, we're bringing AI to the 33 million smallholder farmers in East Africa — in the language they speak, using voice they're comfortable with, on robots they can afford."

[END DEMO]

📊 Technical Risks & Mitigations

Risk	Probability	Impact	Mitigation
Whisper Swahili accuracy low	Medium	High	Pre-test with target phrases; add phonetic fallbacks
Simulation performance issues	Low	Medium	Use lightweight robot model; pre-record backup video
Disease detection accuracy	Medium	Medium	Focus on high-confidence detections only; show confidence scores
TTS sounds unnatural	Medium	Low	Use gTTS as backup; pre-record common phrases
Integration complexity	High	High	Build modular; test each component independently first
Time overrun	High	High	Cut secondary features first; have "minimum viable demo" ready by Day 6

Fallback Plan (If Behind Schedule)

Day 6 Checkpoint — Minimum Viable Demo:

- Voice input → fixed response (scripted demo)
- Pre-recorded robot navigation
- Static disease detection on sample images
- Live TTS output

This ensures you have SOMETHING to show even if integration fails.

🧰 Resources & Tools

APIs & Services

- **OpenAI Whisper API** or local whisper.cpp
- **Anthropic Claude API** (for intent parsing)
- **Google Cloud TTS** or Coqui TTS (Swahili voice)

Datasets

- **PlantVillage:** https://github.com/spMohanty/PlantVillage-Dataset
- **Swahili Speech Corpus:** Mozilla Common Voice Swahili
- **Agricultural terminology:** FAO multilingual glossary

ROS2 Resources

- **TurtleBot3 Simulation:** https://emanual.robotis.com/docs/en/platform/turtlebot3/simulation/
- **Nav2 (Navigation):** https://navigation.ros.org/
- **Gazebo Garden/Harmonic:** https://gazebosim.org/

Pre-trained Models

- **YOLOv8:** https://github.com/ultralytics/ultralytics
- **Whisper:** https://github.com/openai/whisper
- **Coqui TTS:** https://github.com/coqui-ai/TTS

💡 Pitch Deck Outline

Slide 1: Hook

"What if AI could speak to Africa's 600 million farmers — in their own language?"

Slide 2: Problem

- 30-40% crop losses from preventable diseases
- Existing AI tools require English, literacy, smartphones
- 33M+ East African farmers left behind

Slide 3: Solution

- AfriVoice: Voice-first agricultural robot
- Understands Swahili (and 51 more African languages planned)
- Detects diseases, provides recommendations
- No app, no typing, just natural conversation

Slide 4: Demo

[Live demonstration]

Slide 5: Technology

- Whisper STT → LLM Intent → ROS2 Robot → YOLO Vision → TTS Response
- Built on open-source, designed for low-cost hardware

Slide 6: Market

- $48B African agriculture market
- 33M smallholder farmers in East Africa
- $500M AgriTech investment in Africa (2023)

Slide 7: Business Model

- B2B2C: Partner with agricultural cooperatives, NGOs
- Subscription: $10-20/month per cooperative
- Hardware: Low-cost robot ($200-500 target)

Slide 8: Traction & Validation

- [Any user interviews conducted]
- [NAO robot research from coursework]
- [Personal connection to Kenya agriculture]

Slide 9: Team

- You: MSc AI & Robotics, 7+ years SWE, Kenyan origin
- [Teammates if any]

Slide 10: Ask

- "We're building the voice of African agriculture. Join us."
- Looking for: Investment, pilot partners, technical mentorship

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✅ Pre-Hackathon Checklist

Environment Setup (Do Before Feb 6)

- [ ] ROS2 Humble installed and tested
- [ ] Gazebo/Webots working with TurtleBot3
- [ ] Python environment with Whisper, OpenAI/Anthropic SDK
- [ ] Node.js environment for frontend
- [ ] GPU access for YOLO inference (local or cloud)
- [ ] API keys obtained (OpenAI, Anthropic, Google Cloud)

Research & Prep

- [ ] Test Whisper Swahili accuracy with 20 agricultural phrases
- [ ] Download PlantVillage dataset (tomato subset)
- [ ] Find/create 3D tomato plant models for simulation
- [ ] Record yourself speaking Swahili commands for testing
- [ ] Draft Swahili response templates

Logistics

- [ ] Register on Lablab.ai
- [ ] Join Discord, introduce yourself
- [ ] Clear calendar for Feb 6-15
- [ ] Prepare backup demo recording capability

🎯 Success Metrics

Hackathon Success = Demo that shows:

1. ✅ Swahili voice command correctly transcribed
2. ✅ Intent correctly parsed to robot action
3. ✅ Robot navigates to target in simulation
4. ✅ Camera captures and analyzes image

5. ✅ Disease detected with reasonable accuracy (>70%)
6. ✅ Swahili voice response delivered
7. ✅ Compelling story that resonates with judges

Bonus Points:

- Multi-turn conversation (follow-up questions)
- Multiple disease types detected
- Beautiful demo interface
- Clear path to physical robot deployment
- Business model articulated

🚀 Post-Hackathon Roadmap (If You Win/Progress)

Month 1-2: Pilot Preparation

- Partner with 1-2 Kenyan agricultural cooperatives
- Deploy on physical robot (TurtleBot or custom)
- Expand to 5 more crops

Month 3-6: Field Testing

- 10 farmer households in pilot
- Add 3 more Kenyan languages (Kikuyu, Luo, Kamba)
- Iterate based on farmer feedback

Month 6-12: Scale

- 100+ farmers in Kenya
- Expand to Tanzania, Uganda
- Seek seed funding ($500K-1M)

Good luck, Nicanor! You've got a compelling project, authentic story, and the technical chops to pull this off. 🚀🌍