Department of Electrical, Electronics, and Communication Engineering
GITAM School of Technology,
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Extended Abstract PROJ3999 (Major Project)

Title: ZYNQ-Disease Detect: Precision Agriculture Solutions and Comparative Studies with AI Technologies

Project Supervisor: Dr. M. ARUN KUMAR
Cluster Name (AI/ML, VLSI, Comm., CSP, Power Systems): VLSI Communication
Project Coordinator:
(If Interdisciplinary, share details)
Dr. M. ARUN KUMAR
Associate Professor
Department of EECE

Mini Project (PROJ2999) Outcome: (Summary in 3-6 bullet points)

Completed Work Summary:

- Developed an image processing-based system in MATLAB to detect plant diseases, focusing on tomato leaves.
- Enhanced leaf images and applied Otsu's method and K-means clustering for effective segmentation of healthy and diseased regions.
- Utilized Sobel and Canny edge detection techniques to accurately identify diseased areas.
- Achieved successful differentiation between healthy and affected regions, validating the proposed approach.
- Results provide a solid foundation for further enhancements and integration into advanced systems.

Extended Project Abstract (up to 300 words)

Plant diseases significantly threaten agricultural productivity, affecting crop quality and quantity. Millions of tons of crops are lost annually due to various diseases, resulting in economic losses and food security concerns. Traditional management methods, such as chemical treatments, crop rotation, and disease-resistant crop varieties, have limitations, including environmental impact, resistant pathogens, and long development times for resistant varieties.To address these challenges, a real-time computer vision-based system for detecting plant diseases is proposed. It leverages the Xilinx ZYNQ SoC FPGA for rapid processing of high-resolution images, enabling accurate disease detection and timely intervention to minimize crop loss. The FPGA's parallel processing capabilities and low-latency performance are ideal for addressing the computational demands of such applications.

The system integrates edge AI technology to process data locally, reducing dependence on centralized servers, improving response times, and enhancing system reliability in diverse field conditions. Comparative studies with traditional methods and AI-based solutions will evaluate the benefits of FPGA-based implementation, focusing on accuracy, cost-effectiveness, and processing efficiency. These studies aim to highlight the advantages of integrating FPGA and edge AI technologies over standalone AI models or conventional practices.This FPGA-based system, enhanced with edge AI, offers a practical solution for protecting agricultural productivity and advancing smart farming practices.

Keywords: Plant diseases, Xilinx ZYNQ SoC FPGA, Crop loss minimization, Edge AI technology, Comparative AI Studies, Smart agriculture.

Extended Project Objectives (up to 2-4 Bullet points)

- To utilize the ZYNQ 7000 SoC for processing plant leaf images and videos, enabling edge detection and real-time analysis.
- To develop and integrate external AI models for accurate classification of plant diseases based on processed data.
- To ensure real-time performance, reliability, and adaptability under varying agricultural conditions.
- To benchmark the ZYNQ 7000 SoC's processing and AI capabilities against other platforms for performance evaluation

Ghent chart for Extended Project PROJ3999-

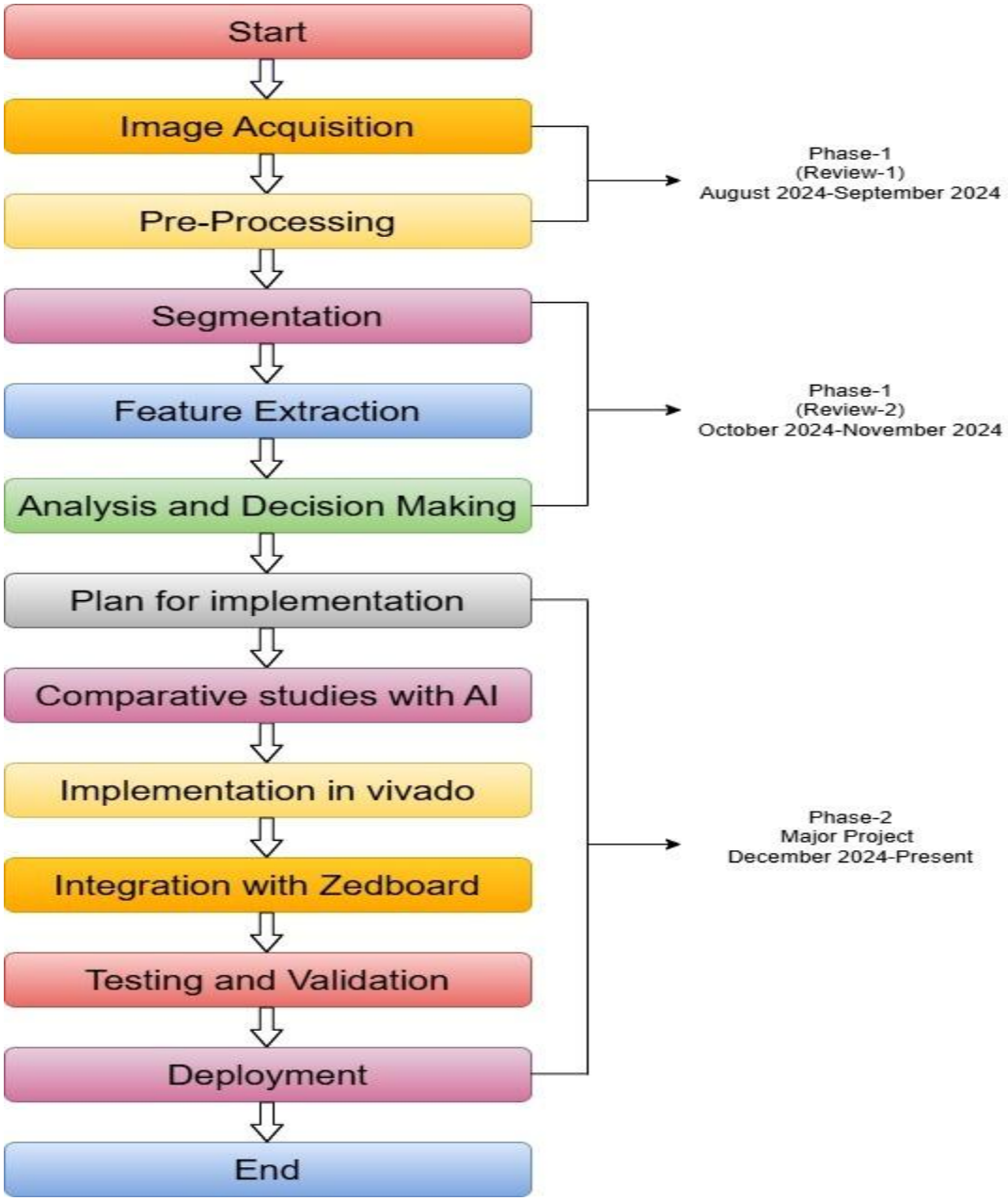

FIG 1: Workplan of the Proposed System

Mini Project (PROJ2999)

Phase 1: Data Collection & Processing (Completed)

- Collected tomato leaf images under various conditions using high-resolution sensors.
- Pre-processed images in MATLAB, extracting features like color, texture, and shape.

Phase 2: Analysis & Segmentation (Completed)

- Applied OTSU and K-Means methods for segmentation to isolate diseased areas.
- Used Sobel and Canny edge detection for clear boundary mapping of diseased regions.

Comparative Studies (Ongoing)

- Comparing traditional computer vision techniques (OTSU, K-Means) with AI models like CNNs in terms of accuracy, efficiency, and adaptability.
- Investigating the integration of Edge AI to reduce latency and improve reliability in field conditions.

Future Work (Ongoing)

- Implement the system on ZYNQ-7000 SoC for real-time detection with FPGA and Edge AI.
- Extend detection capabilities to other crops and diseases.
- Develop user-friendly interfaces for real-time disease management.

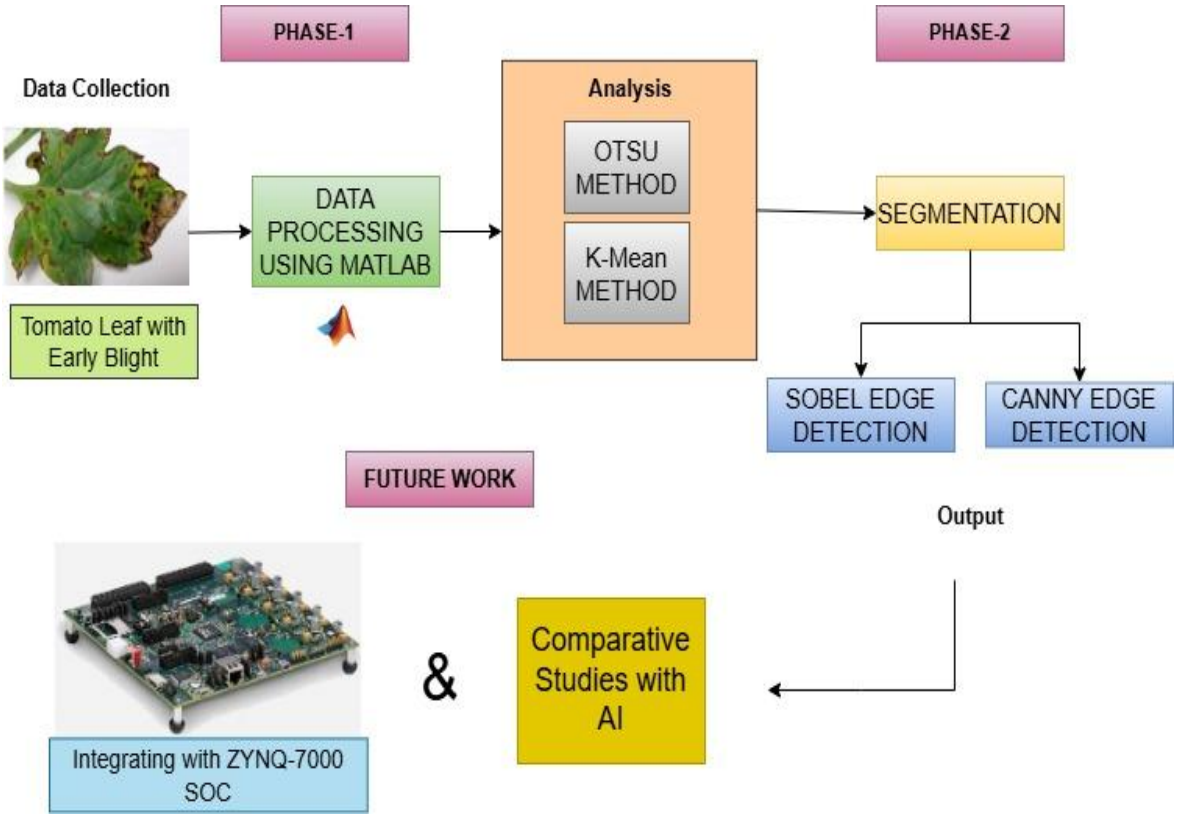

Fig 2. Circuit Implementation of the proposed system

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Suggest 2 IEEE Conference targets-

1. IEEE INDISCON 2025

- **Hosting Institute:** National Institute of Technology (NIT), Rourkela.
- **Theme Areas:** Smart Technologies for Next Generation Connectivity
- **Submission Date:** April 30, 2025
- **Conference Dates:** 21-23 August, 2025
- **Publication:** All accepted and presented papers will be published in IEEE Xplore.

2. IEEE Conference on Electronics, Computing and Communication Technologies (CONECCT) 2025

- **Hosting Institute:** IEEE Bangalore Section
- **Theme Areas:** Advances in Electronics, Computing, and Communication Technologies
- **Full Paper Submission Date:** 15 March 2025
- **Final Paper Submission Date:** 15 June 2025
- **Conference Dates:** July 10-13, 2025
- **Publication:** Accepted papers will be considered for publication in IEEE Xplore.

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Sign with date