PREMIER UNIVERSITY, CHITTAGONG

Department of Computer Science & Engineering

PROJECT PROPOSAL

Course Code: CSE 3568

Course Name: Computer Networks Laboratory

Project Name	:	Smart Agricultural Greenhouse Management System
Semester	:	6^{th} B
Batch	:	42^{nd}
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Project Title: Smart Agricultural Greenhouse Management System

Project Overview

With the rise of smart agriculture and the increasing need for sustainable farming practices, integrating computer networking into greenhouse management can revolutionize the sector. The "Smart Agricultural Greenhouse Management System" is a network-focused project designed to automate, monitor, and control greenhouse conditions through a robust, scalable, and secure network infrastructure. Though IoT components are involved, the core emphasis is placed on networking design, configuration, communication protocols, and real-time data flow using computer networking concepts.

Objectives

- Create a centralized and scalable network that can monitor and control greenhouse conditions in real time.
- Implement essential network services like DNS, DHCP, and a Mail Server for communication and alerts.
- Use subnetting to separate different parts of the system for better performance and security.
- Enable remote control through secure, authenticated commands sent via email.
- Follow a client–server model for smooth data flow between sensors, controllers, and actuators.
- Meet all Computer Networks Laboratory course learning outcomes (CLO1–CLO6).

System Architecture

Network Setup

- Multiple routers to create separate network segments for greenhouse control systems, IoT devices, and remote access.
- DHCP server to handle automatic IP assignment.
- DNS server to map easy-to-remember names like mail.greenhouse.local to IP addresses.
- Mail server to send system alerts and process remote commands.
- Firewalls with ACLs to control which devices can talk to each other.
- A Syslog server to collect and store activity logs from all devices.

Processing Units

- Arduino MCU: Reads sensor data.
- Raspberry Pi SBC: Runs the control logic, talks to the actuators, and hosts the network services.

Sensors

- Soil moisture, temperature, humidity, and light sensors for environmental monitoring.
- Motion and smoke sensors for security and safety.

Actuators

- Sprinkler, air cooler, heater, dimmable LED lights, LCD display.
- Smart LED speaker, emergency door opener, alarm system.

Methodology and Implementation

Network Configuration

- Star topology with routers linking all major parts of the system.
- Three main subnets: one for greenhouse management, one for IoT devices, and one for remote access.
- Firewalls and ACLs to keep each subnet secure and only allow necessary traffic (e.g., HTTP, HTTPS, MQTT).
- Remote access via SSH and HTTPS, restricted with ACLs.
- Mail server using SMTP for sending alerts and IMAP for reading incoming commands.

Sensor & Actuator Communication

- Sensor data → Arduino → Raspberry Pi (via HTTP/Socket) → Logged and analyzed → Actuators triggered via GPIO.
- Remote email command → Raspberry Pi → Parsed → Action carried out (e.g., DOOR_OPEN, LIGHTS_DIM_50).etc

Security Features

- WPA2 encryption for wireless networks.
- Role-based permissions for email command execution.
- IDS to detect intrusions, with alerts sent by email.
- Automatic emergency responses if smoke or motion is detected.

Monitoring & Logging

- All devices send logs to the Syslog server.
- Security alerts go straight to the administrator’s email for quick action.

Implications and Applications

Implications:

- Promotes sustainable farming through smart technology.
- Reduces manual labor, water, and energy waste.
- Enhances food security through controlled farming environments.

Applications:

- Smart greenhouses for urban farming.
- Research facilities in agricultural universities.
- Scalable solutions for commercial agriculture.

Timeline

Week	**Activities**
Week 1-2	Requirement analysis and finalizing project features and components
Week 3-4	Planning & Research
Week 5	Proposal Submission
Week 6-7	Network Design & Hardware Setup
Week 8-9	Programming
Week 10	Testing & Troubleshooting
Week 11	Final Integration
Week 12	Final Documentation & Presentation

Possible Outcomes

- Real-time environmental data monitoring and control via network.
- Secure, scalable network infrastructure for agricultural automation.
- Automated alert system for fire/smoke/intrusion using mail servers.
- Energy and water-efficient farming through precision irrigation and lighting control.

Limitations

- **Simulation Limits:** Virtual tools may not fully represent real-world performance.
- **No Full Hardware Use:** Limited or no deployment on physical devices.
- **Basic Automation:** Simplified control logic for irrigation, lighting, and climate.
- **Security Gaps:** Lacks advanced intrusion detection or encrypted IoT communication.
- **Scalability Issues:** Designed for a single greenhouse; may need upgrades for larger farms.
- **Environmental Factors:** Extreme weather or outages not fully addressed.

Conclusion

This project presents a networking-intensive approach to greenhouse automation, leveraging key computer networking technologies like DNS, DHCP, Mail Servers, and IP-based communications. While IoT enables the sensing layer, the backbone remains a robust, secure, and manageable network that enables automation, monitoring, and control in real-time. This proposal not only aligns with all CNLab course outcomes but also serves as a sustainable innovation in smart agriculture.

Complex Engineering Problem Attributes (P1 - P7)

Attribute	Project Alignment
P1: Depth of Knowledge	This project uses advanced networking concepts, IoT integration, and automation for agriculture. It demonstrates understanding of how networking technologies, servers, and communication protocols work together to create a secure and scalable greenhouse network.
P2: Wide-Ranging or Conflicting Issues	The system balances environmental monitoring, automation speed, security, and operational efficiency. All components must work together without disrupting network communication or control processes.
P3: Abstract Thinking & Analysis	The design requires logical thinking to plan the network, configure servers (DNS, DHCP, Mail), interpret sensor data, and decide automated responses to conditions such as low soil moisture, temperature fluctuations, or security breaches.
P4: Infrequently Encountered Issues	Implementing a smart agricultural network with integrated IoT control is uncommon, requiring unique solutions for challenges like real-time data delivery, remote command execution, and environmental reliability.
P5: Adherence to Standards	The network follows standard networking protocols, IP addressing schemes, and email communication protocols (SMTP, IMAP), ensuring compliance with good practices for automation, data security, and service reliability.
P6: Stakeholder Conflicts	Different stakeholders (farm owners, security staff, technical operators) have varying access needs. VLANs, ACLs, and role-based email commands help avoid conflicts by controlling permissions and actions.
P7: Independent Sub-Problems	All parts of the project — network infrastructure, IoT device control, automation logic, and security — are interconnected. A failure in one component could affect the entire system, so each must be carefully designed and tested.