Hydroponics Greenhouse Automation

A Proposal submitted to the

Department of Electrical and Information Engineering

Faculty of Engineering

University of Ruhuna

Sri Lanka

On the 18th of April 2024

In partial completion of the module
EE6352 Embedded System Design

By

Kumarasiri L.I.N.	- EG/2020/4034
Kumari D.P.S.T.	- EG/2020/4035
Kumari H.M.M.S.	- EG/2020/4036
Kuruwitaarachchi K.A.D.T.T.	- EG/2020/4038
Lakpahana A.G.S.	- EG/2020/4040

Table of Contents

Table of Figures

1. INTRODUCTION

1.1 INTRODUCTION TO THE PROBLEM

Traditional farming methods face challenges such as soil depletion, limited space, and climate change impacts. Hydroponics offers a solution by allowing plants to grow without soil, using nutrient-enriched water instead. However, ensuring optimal conditions for plant growth in hydroponic systems can be complex and labor-intensive.

To address this, we propose the implementation of an automated greenhouse system. This system will monitor and control key parameters like temperature, humidity, water level, pH, and nutrient concentration in real-time. By automating these processes, we aim to create a more efficient and sustainable method of plant cultivation, leading to increased yield and quality of crops.

Through this proposal, we seek to explore the potential of hydroponic greenhouse automation in revolutionizing modern agriculture, making it more resilient and productive in the face of evolving environmental challenges.

1.2 OBJECTIVE OF THE PROJECT

The primary objective of our project is to develop an embedded system that automates the monitoring and regulation of crucial environmental parameters within a hydroponic greenhouse. By continuously monitoring factors such as temperature, humidity, water level, pH, and nutrient concentration, our system aims to create an ideal growth environment for plants, thereby optimizing their health and productivity.

1.3 SCOPE OF THE PROJECT

The scope of our project includes developing a prototype hydroponic greenhouse system suitable for small-scale applications. This system will be capable of monitoring and controlling parameters. Additionally, we aim to provide remote monitoring and control capabilities through a user-friendly interface. While our focus is on small-scale implementation, the project will be designed with scalability in mind for potential expansion to larger agricultural setups.

2. SPECIFICATIONS

2.1 Monitoring and regulation of plant growth factors

By employing various sensors strategically placed within the hydroponic greenhouse, we aim to continuously monitor these critical plant growth parameters such as temperature, humidity, pH level, water level, and nutrient concentration. Through analysis of sensor data gathered, we seek to create an optimal growing environment for plants, ensuring that each parameter remains within the ideal range for healthy growth.

2.2 Automated control of water pumps, fans based on sensor readings.

Using the data collected from the monitoring sensors, our embedded system will automatically adjust the operation of these actuators such as water pumps, fans to maintain the desired growing conditions. For instance, if the temperature rises above the optimal range, the system will activate the cooling fans to lower it back to the ideal level. Similarly, if the pH level deviates from the target range, appropriate actions will be taken to restore balance.

2.3 Remote monitoring and control through a user-friendly interface.

This feature enhances the usability and accessibility of the hydroponic greenhouse system, allowing users to remotely monitor environmental conditions, receive alerts for any anomalies, and make necessary adjustments to ensure optimal plant growth.

3. BLOCK DIAGRAM

3.1 PROPOSED SYSTEM

The hydroponics greenhouse automation system is built to enhance the growth conditions of plants cultivated within a controlled environment. This system consists with several essential components designed to optimize plant growth conditions. These components include an LCD display, various sensors, actuators, and a user interface, as illustrated in Figure 1.

3.2 SYSTEM BLOCK DIAGRAM

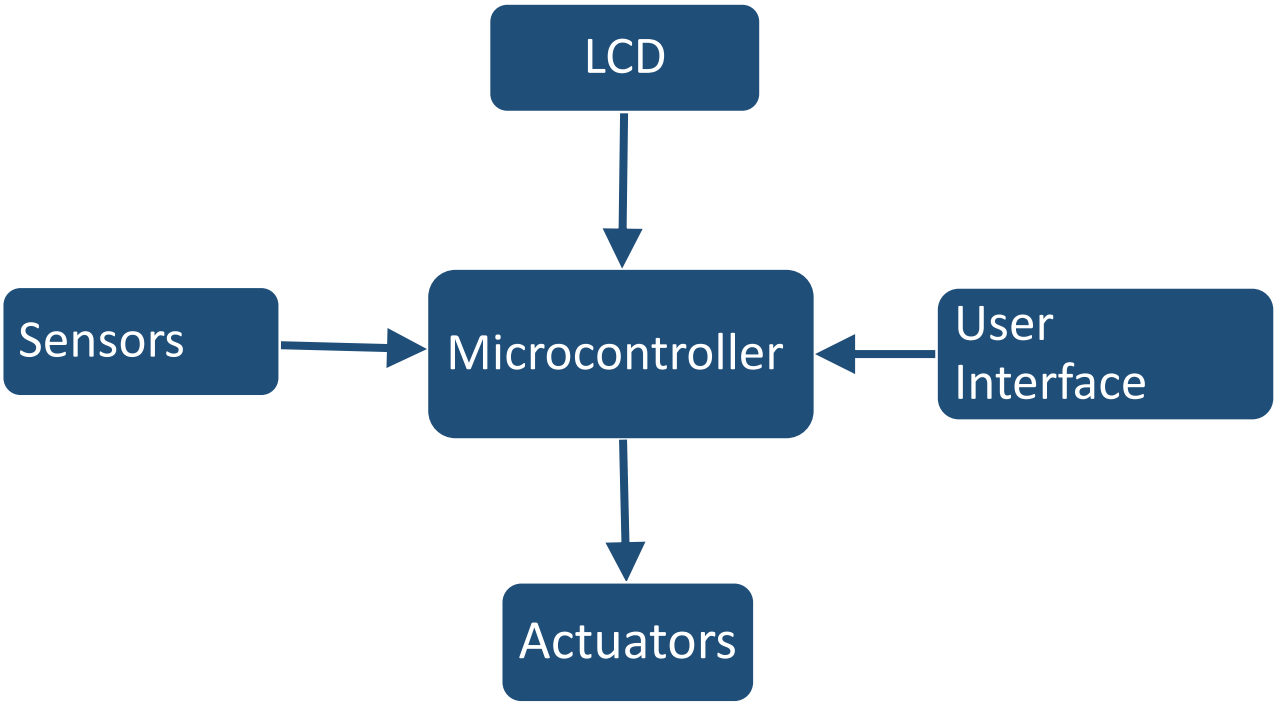

Figure 1: Block Diagram of the Hydroponics Greenhouse Automation

3.2.1 Microcontroller

The microcontroller acts as the CPU of the system, responsible for interpreting data from various sensors within the greenhouse. It processes this data to determine the environmental adjustments needed to maintain optimal growing conditions by controlling the actuators.

3.2.2. Sensors

This block includes temperature sensors to manage the greenhouse's heating and cooling systems, humidity sensors to control moisture levels, pH sensors to ensure the nutrient solution is optimally balanced, water level sensors to maintain adequate nutrient solution levels, and nutrient concentration sensors to adjust the mix of nutrients.

3.2.3 User Interface

Through a web app or mobile app, users can view real-time data and adjust settings, and receive alerts about the system's status. This allows users to make decisions and control the system manually when needed.

3.2.4 Actuators

This block includes water pumps that regulate the flow of the nutrient solution, fans that aid in temperature and humidity control, and heaters that adjust the temperature during colder periods. The actuators are responsible to respond to commands based on the microcontroller's analysis of sensor data and the make growth parameters optimal.

3.2.5 LCD

An LCD display shows the immediate feedback and system statuses. It displays data collected from the environment in real time. Additionally it shows statuses like "Fan On" or "Pump Off", “Pump Error” which helps in quick repairs and adjustments.

4. REFERENCES

1. Saraswathi, D. & Manibharathy, P. & Gokulnath, R. & Sureshkumar, E. & Karthikeyan, K.. (2018). Automation of Hydroponics Green House Farming using IOT. 1-4. 10.1109/ICSCAN.2018.8541251.
2. K. Kalovrektis, Ch. Lykas, I. Fountas, A. Gkotsinas, I. Lekakis, Development and Application Embedded Systems and Wireless Network of Sensors to Control of Hydroponic Greenhouses, International Journal of Agriculture and Forestry, Vol. 3 No. 5, 2013, pp. 198-202. doi: 10.5923/j.ijaf.20130305.02.