**Arduino Controlled Smart Hydroponic Modular System**

The Arduino Controlled Smart Hydroponic Modular System is a project aimed at creating an automated and intelligent hydroponic growing environment. Hydroponics is a method of growing plants without soil, using nutrient-rich water solutions. This project utilizes Arduino microcontrollers to monitor and control various parameters critical to plant growth, such as pH level, nutrient concentration, temperature, and humidity.

**Problem in Brief**

Traditional agriculture faces challenges related to unpredictable weather conditions, soil quality, and resource consumption. Hydroponic systems address some of these challenges but introduce the need for meticulous monitoring and control. Maintaining optimal levels of water, pH, oxygen, humidity, and temperature is crucial for the success of hydroponic cultivation. Manual management of these parameters is time-consuming and prone to errors, highlighting the need for an automated solution.

The device allows to control the state of the plants by sensing several parameters:

* Air temperature and humidity
* pH
* Water Level
* Nutrient Level
* Light Level

We use different types of actuators to modify the state of the plants by irrigating them, activating lights or releasing nutrients:

* Water pump
* Growing light
* Nutrient feeder

The device periodically sends the information to a web server using Wi-Fi. We have also designed an App that allows this data to be visualized from an Android device. We use GSM module to inform user or farmer, about water level in tank and readings of temperature and humidity.

**Advantages**

1. Land preservation
2. Water conservation
3. Faster growth
4. Minimal use of Fungicide and Pesticide
5. Less labour and maintenance costs
6. Climate control
7. Time saving

**Model Structure**

 In the lower part there is a tank in which the water of the system falls and through which different components can be added to the water.

A diagram of a plant growing process

Description automatically generated

A diagram of a greenhouse

Description automatically generated

**Components:**

* Arduino Mega
* Arduino Clock
* LCD display
* Water Pump
* Plant Lights
* PH Sensor
* EC Sensor (Electrical Conductivity) / TDS sensor
* Temperature Sensor
* Humidity Sensor
* Light Sensor
* Water level sensor
* DC Pump
* Relay
* Small Fan
* PVC Pipes

A diagram of a system

Description automatically generated

**Operation:**

* Monitoring: The Arduino continuously monitors sensor data, including pH, EC, temperature, and humidity.
* Control Logic: Based on predefined thresholds and control algorithms, the Arduino activates actuators to adjust parameters as needed. For example, if the pH deviates from the optimal range, the pH dosing system is activated to correct it.
* User Interaction: Users can interact with the system through the display and buttons to view real-time data, adjust settings, and monitor plant health.
* Automation: The system automates tasks such as nutrient delivery, lighting control, and environmental monitoring, reducing the need for manual intervention.

**Sensors:**

1. pH sensors: Measures the acidity or alkalinity of the nutrient solution. This data helps ensure the pH remains within optimal ranges for plant growth.
2. EC Sensor: Measures the electrical conductivity of the solution, providing an indication of nutrient concentration. This helps maintain nutrient levels for plant health.
3. Temperature and Humidity Sensor: Monitors environmental conditions within the growing area, ensuring optimal growing conditions.
4. Light Sensor: Optionally, a light sensor can monitor ambient light levels, triggering artificial lighting if need.

**Actuators:**

1. Water Pump: Controlled by the Arduino to deliver nutrient solution to the plants at scheduled intervals.
2. Nutrient Dosing System: Dispenses additional nutrients into the solution as needed, based on EC sensor readings.
3. Grow Light Control: Optionally, the Arduino can control artificial grow lights to supplement natural light or provide illumination in indoor growing environments.

**Display and User Interface:**

An LCD or OLED display provides real-time data on pH, EC, temperature, humidity, and other parameters.

User input buttons allow users to navigate menus, set parameters, and adjust settings.

**Data Logging:**

Implement data logging functionality to record sensor readings over time. You can store this data locally on an SD card or send it to a cloud-based platform for analysis.

**Budget**

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| **Component** | **Price(Rs.)** |
| Arduino Mega NodeMCU | 5180 |
| Arduino Clock DS1302 | 220 |
| LCD display | 1000 |
| Water Pump | 700 |
| Plant Lights | 1150 |
| Ph Sensor | 5250 |
| TDS Sensor | 3350 |
| Mini Thermometer Hygrometer | 600 |
| Light Sensor | 110 |
| DC Pump | 1500 |
| Relay x () |  |
| Small Fan | 600 |
| PVC Pipes x 10m (63RRJ) |  |
| Gum |  |
| HM500 Grey Thermal Grease Thermal Conductive Paste | 230 |
| TEC1-12706 DC12V 60W Peltier Thermoelectric Cooler | 720 |
| 80x50x11mm Aluminium Heat Sink Heat Sink Radiator | 420 |
| 50x50x10mm DC 12V Brushless 7-Blade Cooling Fan 5010 | 340 |
| Other |  |