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Design of Universal Automatic Robot for Nutrition Management in Controlled Agriculture

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Abstract: ***The advanced electronic and information technologies, in various sensing systems have been developed for crop production. These technologies can be helpful for increasing crop yield, analyzing soil properties, crop nutrients, water management. These available technologies can be implemented for greenhouse productions to fulfill the specific demand of crops. Automation machines that could move and operate autonomously in such closed environment can be implemented. The introduction of robotics in closed agriculture. Autonomous robots can be implemented for nutrient management.***

Keywords: PIC16F877, LCD (16x2), Nutrient Management.

1. Introduction

Due to lack of nutrients or malnutrition of plants the agriculture yield is poor. The major reason behind this problem is due to uncontrolled amount of feeding of the nutrients in excess or in very less amount even without satisfying the needs of plants .So it turns results into poor quality in crop yield. Also nutrients required are in micro and major amount so a precise control is must which must be maintained throughout the crop production, which is only the solution to obtain good yield. For this nutrient management is essential.

So the proposed system will perform some soil test for testing nutrient deficiency and water requirement. Depend on these result it can auto fulfill the requirement by providing the nutrient and water in its tanks. It can also be able alert farmer to give fertilizer to crops.

A. General Plant Nutrition

There are 16 elements required by all plants are carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulfur, calcium, magnesium, iron, boron, manganese, copper, zinc, molybdenum, and chlorine. The elements C, H, and O are supplied largely from air and water. The remaining 13 elements, usually referred to as mineral nutrients, are supplied from by the grower from fertilizers. The nutrients N, P, K, S, Ca, and Mg are referred to as the macronutrients because they are required in larger quantities by the plant compared to the remaining elements. The other seven elements are referred to as micronutrients because they are required in small amounts, usually a few parts per million (ppm) in the plant tissue.

B. Roles of Elements in Plant Growth

Carbon is “fixed” from CO2 from the atmosphere by photosynthesizing plants. Carbon is a component of all organic compounds such as sugars, proteins, and organic acids. These compounds are used in structural components, enzymatic reactions, and genetic material, among others. The process of respiration degrades organic compounds to provide energy for various plant processes. The normal level of CO2 in the atmosphere is about 350 ppm. Research on many crops has shown that if the ambient level of CO2 is increased to 800 to 1000 ppm, increased plant growth and yield will result. Injection of CO2 is a standard practice in winter greenhouse vegetable production in northern climates. In these climates, high CO2 levels can be maintained because the greenhouses are closed during the winter.

Hydrogen also is a component of the organic compounds where we find C. Hydrogen ions are involved in electrochemical reactions to maintain charge balances across cell membranes. Oxygen is the third element in typical organic molecules such as simple sugars. The presence of O is important for many plant biochemical reactions.

2. Literature View

Bachkar Yogesh Ramdas proposed a system which can provide the efficient amount of water through drip irrigation and phosphorus for plant by collecting sensors information. It just control the water flow and to provide K nutrient it have to provided through another pipeline. Used a very costly system to fulfill the nutrient requirement. They used separate pipeline supply for water and K nutrient from a fixed point. Uniform supply of water and K supplied to each area.

Kolapkar M. used multi-nodal sensor network. It is used for the collection of greenhouse related parameters at different locations inside and outside the greenhouse. They used a computer system to communicate with sensor through microcontroller to get sensor data. As sensor are at fixed position so number of sensor required is more.

Heman,Reema designed a mobile robot used is for watering indoor potted plants placed on an even surface. Used sensor at each pot which cost more.There system is useful in gardens at home. Not in green houses.

Seema Ajay Agarkar designed a microcontroller [PIC16LC74A] based WSN which is used to measure the

plastic house environment parameter humidity and temperature measurement. A person have to move the system in whole area and have to take decision by himself to fulfill requirement of plant. S.Sumeetha designed a system which uses two phones one in farm and other with owner. This system provide only water supply just by turning on and off water pump. This can also make wastage of water.

3. Overview of System

This section shows the complete block diagram and its functional description.

Power Supply
It supplies power to different components present in this unit. All the hardware components work on dc supply of 5V. As PIC16F877 required power supply of 5v. Also this can serve supply to LCD, Buzzer.

Microcontroller
We use PIC16F877 as a core controller. It read the data from sensor through inbuilt ADC. Also used to control the motor of robot. The sensed data will be sent by micro-controller on LCD module.

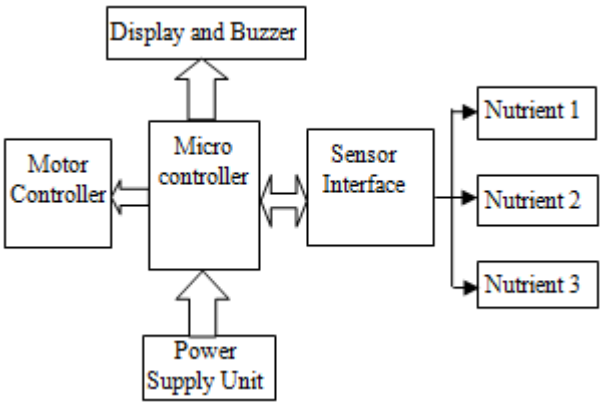

Figure 1: Block Diagram

LCD module [16x2]:
A LCD JHD162 module is interfaced with micro-controller work's as an output device. This provides information about sensor data.

Buzzer
This an output device used to alert the farmer if and only if the water is below certain level. And also can alert in some critical condition also of farm environmental condition.

MG822 Sensor
CO2 Gas Sensor is used in gas detection equipment for detecting carbon Dioxide gas. It has high sensitivity to Carbon Dioxide gas.

LM35 Sensor:LM35 is a precision IC temperature sensor with its output proportional to the temperature. It is used to measure temperature inside green house. It also possess low self heating and does not cause more than 0.1 ^{o}C temperature rise in still air.

HC201 Sensor
HC201 is a capacitive humidity sensor used to measure relative humidity inside green house .this low cost ideal solution for large volume cost-effective applications in indoor climate control.

Submersible Water Pump
A low cost, small size submersible pump motor which can be used to control the humidity inside green house. Just by connecting tube pipe to the motor outlet, submerge it in water and power it.

DC Motor
DC motor of 150 rpm is used to move system in controlled area. Supplied with 12VDC supply from rechargeable battery.

Buzzer
This also an output device used to alert the farmer if and only if the fertilizer or water is below certain level. And also can alert in some critical condition also.

4. Flow Chart

The firmware dumped in microcontroller should use following flow chart logic. It should perform following tasks as follows:
1. Select the distance between the plants manually.
2. It should move in controlled area.
3. It must take accurate readings from the area.
4. It shows the nutrient requirement on LCD module.
5. It should fulfill the need of the plants.

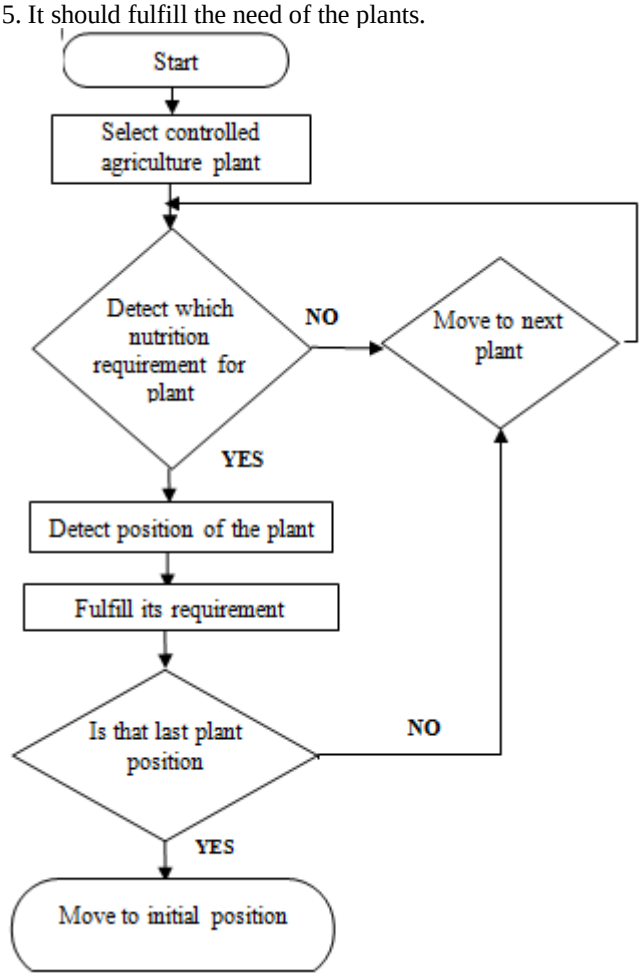

Figure 2: Flow Chart

Working Principle

The system will work in three steps as define in flow chart fallows:

The designed system move in the controlled area with the help of DC motor 150RPM and high torque. Path of the robot is controlled by the microcontroller just by controlling motor direction.

The input for deciding stop point in the path is given by the handler of system. Robot will stop in the multiple of that input distance.

When robot stops at decided stop point then it starts readings of environmental parameters relative humidity, temperature, and CO_2 concentration.

After completion at appoint it will move on next point and take further reading for next location stop point. When it finish taking all reading from start to stop point microcontroller performance calculation of average its reading of Humidity, Temperature, and CO_2. And display it on LCD for user interface. According to difference between calculated and required amount of environmental parameter.

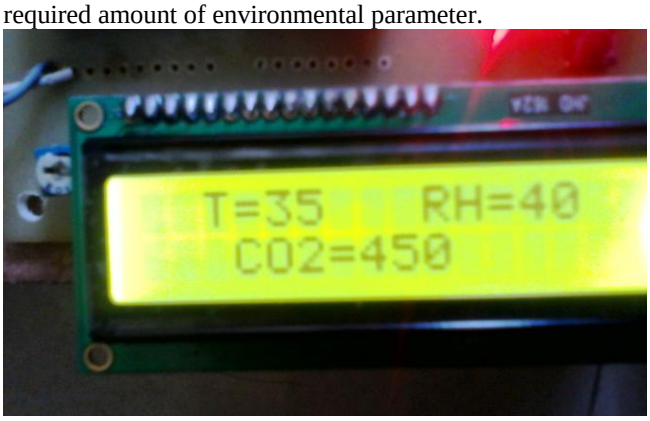

Figure 3: Average Values Calculated

5. Conclusion

This system can be helpful to increase crop production due to accurate fertilization. So no wastage of fertilizer. The Universal Automatic Robot for Nutrition Management can be helpful to save water, decreases extra wages from framer. Also it can work in night also so helpful in time saving.

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