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INTELLIGENT HYDROPONIC CULTIVATION SYSTEM

MALA TC[1], PRAKRUTHI M[2], YASHWANTH S B[3], VASANTH KUMAR C[4], PROF.GAGANAMBHA[5]

[1]*Student(4VM19EE019), ELECTRICAL AND ELECTRONICS ENGINEERING, VVIET, MYSORE, INDIA*
[2]*Student(4VM19EE028), ELECTRICAL AND ELECTRONICS ENGINEERING, VVIET, MYSORE, INDIA*
[3]*Student(4VM19EE058), ELECTRICAL AND ELECTRONICS ENGINEERING, VVIET, MYSORE, INDIA*
[4]*Student(4VM20EE435), ELECTRICAL AND ELECTRONICS ENGINEERING, VVIET, MYSORE, INDIA*
[5]*Faculty, ELECTRICAL AND ELECTRONICS ENGINEERING, VVIET, MYSORE, INDIA*

Abstract: *The effects of global warming make it difficult to plant in an uncontrolled environment. In the traditional way of farming, farmers require quality soil with natural mineral strength. It also requires labour costs for ploughing and weeding, and also requires a large amount of space and water. In the case of seasonal crops, the yield does not meet the needs of customers and the expectations of farmers in terms of productivity. For these reasons, a management method is needed that requires less cost factor requirements and is also easy to maintain and control important factors such as light, water temperature and humidity throughout the year. This proposed work presents a hydroponic style of farming, which is a way of growing plants without soil or sunlight. In this method, plants are grown with only the roots exposed to a mixture of ash fertilizer and water instead of underground soil. This method is a type of indoor farming style that is independent of the weather and also avoids the cost of ploughing and labour. Irrigation and humidity control is done using a microcontroller kit connected to a wireless sensor network with internet that senses humidity, temperature and water level. Using this IOT technology, an authorized person could monitor the growth status of plants in real time from a remote location. This technology helps effectively in the development of agriculture with minimal use of resources.*

Key words: - IOT, Intelligent Hydroponic Style, Wireless sensor Network

1. Introduction

Hydroponics is a method in which crops are grown in the absence of soil, nutrients that are obtained from the soil are supplied to them artificially. The term hydroponics was taken from the Greek words "hydro" meaning water and "ponos" meaning work. This soilless culture of native crops often requires their roots to be submerged in a nutrient solution along with some gravel or perlite medium. The maximum yield is achieved by supplying a sufficient amount of nutrients, and the main goal of hydroponics is optimal microclimatic conditions. Since soil is excluded from the production process, there are no problems related to soil diseases, pests and weeds. By eliminating these problems, there is no use of harmful chemical plant protection products, so the hydroponic method is a fresh and healthy crop yield. Hydroponic setups only require limited space and a limited amount of water because they recirculate and reuse water. This eliminates the problems caused by the soil. This limited space requirement also favours hydroponics as it can be placed on patios, balconies and backyards. Thus, there is a high probability of growing crops in urban areas where arable land is limited. Hydroponics has no adverse effect on the quality of the fruits and flowers it produces. Hydroponics is an agricultural method of producing plants in an artificial environment without the use of soil - nutrients that are provided through water - and optimizing growing conditions to improve production. Hydroponically grown plants have a growth rate that is much faster and highly productive than soil grown plants. Because they are grown in containers, pest and disease control is optimal. Under natural conditions, soil itself functions as a reservoir of mineral nutrients, but is not essential for plant growth. The roots can easily artificially absorb the plant's water, then the plant no longer needs soil flourish. We can grow any land plant using this method. The method of growing plants using mineral nutrient solutions in water without planting in soil is known as hydroponics. Information and communication technology methods are used to simplify and automate many complex real-world tasks. The Internet plays a major role in the implementation of the information and communication technology industry. Communication on the Internet mainly includes client-server connections. Information and communication technology is moving to the next stage of creating and sharing information, where people rely on machines, such as weather monitoring system, etc. Nowadays, machine-to-machine (M2M) communication is also at the peak, where one machine receives information from other machines. In the future, everything around us could be connected and able to perceive and cooperatively communicate over the Internet, giving birth to the Internet of Things (IOT).

2. METHODOLOGY

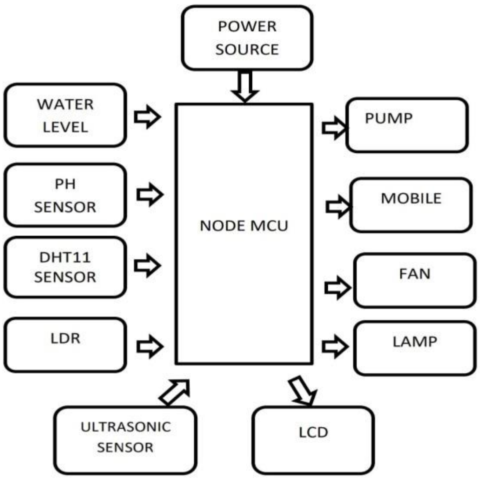

Fig 2.1 Block diagram

A domestic power source is used to power the system. After the crop selection is done, the water is pumped from the nutrient mixing tank to the pipe where the crop is placed, the water pump stops pumping once the water level is reached. In nutrient mixing tank, the water is mixed with the nutrients in appropriate proportions according to selected crop. After the completion of this process the user is notified through the mobile application. Users can also see level of pH value of nutrients present in water through his mobile application using pH sensor. The nutrient rich water is then flowed through pipe lines with the help of motor pump. The water level in the pipelines is controlled by placing the water level sensor. The temperature and humidity of the environment is measured by temperature sensor and the readings are shown in the mobile application. LCD is used to display the PH value, lamp ON/OFF, temperature value, water level in main tank and pipeline. The water level in nutrition tank is measured by using ultrasonic sensor. If the water level is low in the main tank the motor pump gets OFF. LDR is used to detect light intensity if the light intensity is too low lamp gets ON to maintain the light intensity.

2.1 HARDWARE REQUIREMENTS

The project consists of following hardware components

1. Node MCU
2. Water level sensor
3. pH sensor
4. DHT 11 sensor
5. LDR
6. LCD
7. Water pump
8. Fan
9. Relays
10. Ultrasonic sensor

2.2 SOFTWARE REQIREMENTS

The project consists of following software's

1. Proteus suite
2. Arduino IDE

3. IMPLEMENTATION

3.1 SOFTWARE IMPLEMENTATON

Here for simulation proteus software is used. In term of Node MCU we used Arduino UNO as a microcontroller. Following are the sensors that are connected to the respective input and output pins

- The water level sensor is fed to input A0 and its corresponding output is motor-1 which is taken from pin D5.
- The PH sensor is fed to the input A1 pin and its corresponding output is motor-2, which is taken from pin D4.
- The DHT-11 sensor is fed to the A2 pin input and its corresponding output is the fan, which is taken from the D3 pin. LDR is fed to input A3 and its corresponding output is LED which is taken from pin D2.

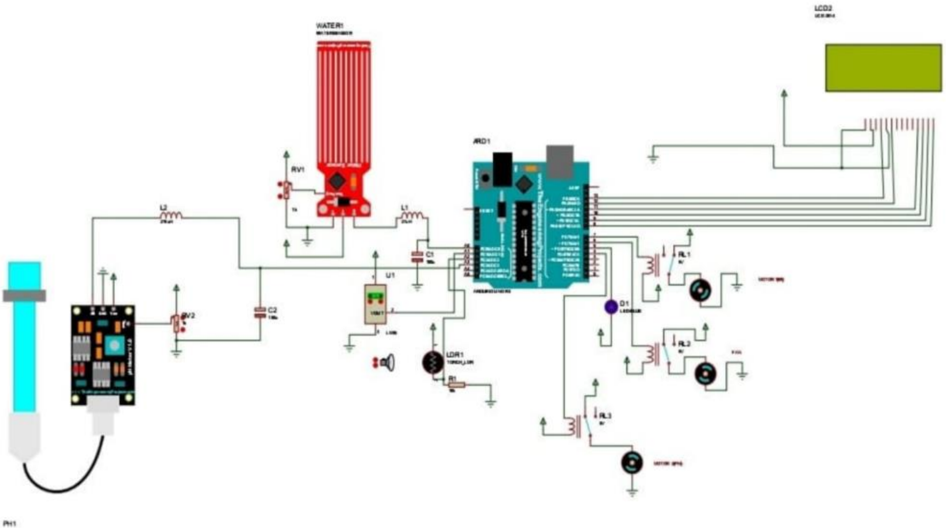

Fig 3.1 Software Implementation

3.2 FLOW CHART

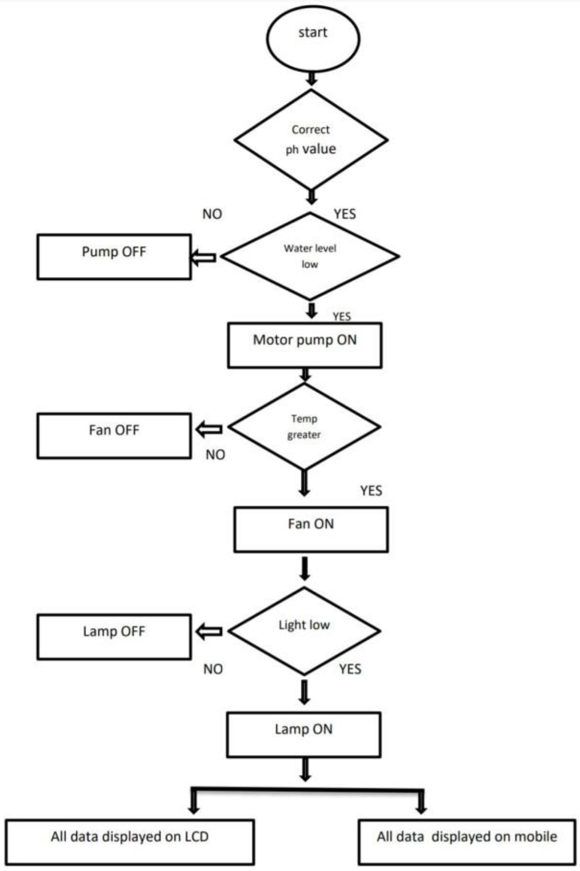

Fig 3.2 Flow chart

3.3 HARDWARE IMPLEMENTATON

The hardware implementation process is done after a complete analysis of the project circuit using simulation software such as proteus and confirmation that the model is 100% functional. The hardware components used are Arduino Node MCU, LCD, Water Level Sensor, DHT11 Sensor, LDR, Ultrasonic Sensor, Lamp, Ph Sensor, Fan and Pump. All sensors are connected to the respective MCU ports of the node. A tube with holes is mounted between the wooden square box. The plants are placed in the holes in the pots. The lamp, fan and control circuit are located on top. A water level sensor is placed inside the pipe to detect the water level in the pipe. The pump is located inside the water tank. PH sensor, LDR and DHT11 sensor are placed according to requirement. The control circuit consists of a node MCU, LCD and relay circuit. The lamp is powered from the mains. The temperature, light intensity, PH and water level in the container and pump status are continuously displayed on the LCD display.

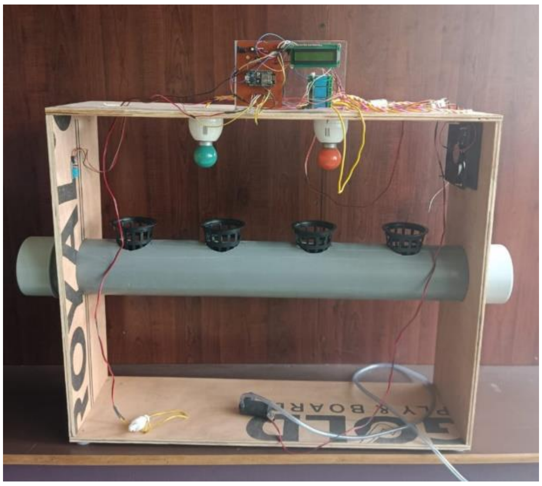

Fig 3.3 Hardware Implementation

4. RESULTS AND DISCUSSION

An IOT-based API called Adafruit is used to monitor the smart hydroponic farm method. Data such as temperature, humidity, water level and plant growth are received from the hydroponic farm by the Node MCU using various sensors such as ultrasonic, DHT11 and K0135, sent to the Adafruit app via the ESP8266 Wi-Fi module over the Internet. Adafruit is also an open-source cloud API for storing and retrieving data from things using HTTP over the Internet. Adafruit provides bi-directional control to turn the lamp, fan and water pump on and off.

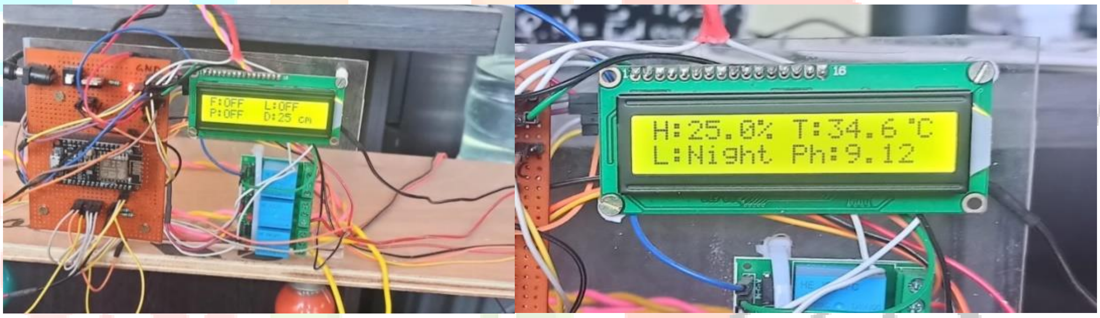

Fig 4.1 Values displayed on LCD of hardware model

Fig 4.2 pH value

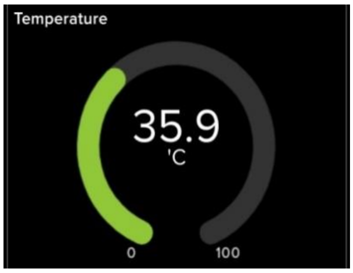

Fig 4.3 Temperature value

Fig 4.2 and 4.3 shows pH value and Temperature value respectively in IOT platform.

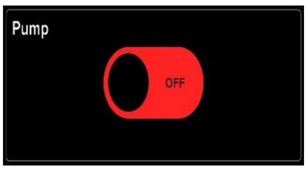

Fig 4.4 Pump off state

Fig 4.5 Pump ON state

Fig 4.4 and Fig 4.5 denotes the layout in adafruit which is used to ON and OFF the Pump through the mobile using Adafruit paltform.

Fig 4.6 Fan OFF state

Fig 4.7 Fan ON state

Fig 4.6 and Fig 4.7 denotes the layout in adafruit which is used to ON and OFF the fan through the mobile using Adafruit paltform.

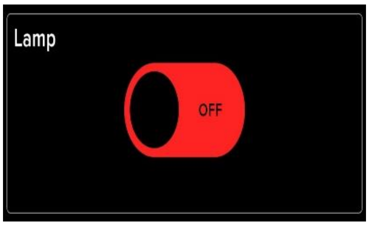

Fig 4.8 Lamp OFF state

Fig 4.9 Lamp ON state

Fig 4.8 and Fig 4.9 denotes the layout in adafruit which is used to ON and OFF the lamp through the mobile using Adafruit paltform.

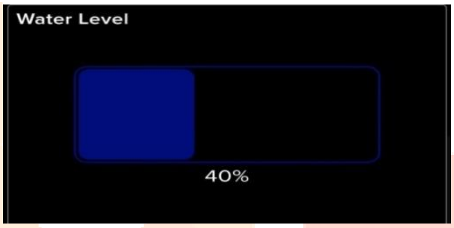

Fig 4.10 Water level

Fig 4.10 denotes the layout in adafruit which is used to display water level on the nutrients mixing tank through the mobile using Adafriut paltform

ADVANTAGES

- 50% faster growth compared to soil.
- Can be harvested throughout the year With Constant availability of nutrition for the plants.
- Water that is used in this system stays in the system itself which can be reused.
- Less landmass is required as it doesn't need any soil.
- Can grow indoors and outdoors throughout the year.
- No weeding required.
- More plants in less area.

APPLICATIONS

- In house gardening.
- For growing medicinal plants.
- Plant nursery

CONCLUSION

In this study, the crops are grown without the use of soil, instead the nutrients from the soil are directly given to the crops by water reservoir. The adequate nutrients that are required by the plants are measured and added to the water reservoir so that the crops get enough nutrients from the water as equal as from the soil. By the intervention of IoT this whole hydroponic system can be automated. All the data from the hydroponic system are sent to the cloud data for the automation purpose. A mobile application is developed for the user to get notified of the progression of the crops growth. The user also gets information about the hydroponic system with the help of the mobile application.

FUTURE SCOPE

In future the project can be implemented using automatic dual sun tracker for power upping all equipment using solar power and also having automation nutrients mixer tank and using DSP technique we can also find the disease Caused to plant if any and we can also have camera for visualizations of plants growth.

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