IoT Implementation Of Automatic Environment Control For Indoor Farming

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Abstract-- Currently, we are witnessing how extreme the weather and temperature, soil and drying lands, that play a major role in agriculture making food production harder and harder. Indoor farming is practice of growing crops in room or closed environment. It uses artificial lights for the crop growth. There'll be no worry about temperature, moisture. The purpose of this project is to build a system to monitor the level of moisture in soil, to provide sufficient light and heat artificially through a light source, temperature, to provide water automatically monitor through a web browser on laptop or mobile.

Keywords: Indoor Farming, Artificial light, Moisture Sensors, Internet of Things.

I. INTRODUCTION

Farming has been an outdoor activity. Plants need sunlight, soil to get water from. Farmers in traditional farming have to spent more time to harvest a crop. It causes less number of goods even though it takes a lot of time and labour. Pesticides are also used to prevent pests from crops. It needs a large space. If heavy rains occur, traditional farming may get affected however indoor farming is not like that.

The term Indoor defines growing a crop within a closed space with providing sufficient artificial light, water and temperature which is required for the growth of crop. Indoor farming has greater yield when compared to traditional farming. In indoor farming there is no usage of pesticides and fungicides so the food is safer to consume. The food grown in indoor farming is highly nutritious.

Implementation of IoT for indoor farming gives us the data about the temperature, water and soil conditions of the plant. It uses artificial light source to provide light for the plant, soil moisture sensors, temperature sensors and submersible water pump.

Using of IoT in indoor farming controls the usage of water, light, moisture level of soil, temperature automatically. It reduces the need of human interventions. They ensure only right amounts of water, light and minerals to the plant.

II. LITERATURE REVIEW:

Indoor farming has been developing in recent years, it is an effective form of farming and the application of indoor farming is increasing. Climate changes drastically, the indoor stabilizes the conditions year round. The new technologies can be used for implementing, developing and planning for innovative methods for farming. The temperature conditions, heating and cooling system, required intensity of light, moisture level, water these all can be controlled automatically.

III. METHODOLOGY

A. **Components used :**

NodeMCU is an open source microcontroller platform majorly used in IoT, it runs hardware supported to ESP8266.this works based on ESP-12 Module. It is low cost and helpful in firmware with Wi-Fi included and for webservers.

Fig.1 NodeMCU ESP 8266

LM35 is used to measure the temperature of indoor environment.It produces output as analog signal which is proportional to current temperature.

Fig.2 LM35 Temperature sensor

Soil moisture sensor is used to measure the volumetric water content in soil.

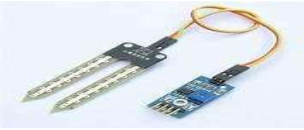

Fig.3 Moisture sensor

Dimmer module is used to turn power ON/OFF for heating elements and also used to lower the brightness of light.

Fi. 4 Dimmer Module

Cooling fan is used to take away excessive heat absorbed in the room. The cooling fan absorbs heat and heat is blown away.

Fig.5 cooling fan

Submersible water pump works on DC. It is also called as electric submersible pump is a pump that can be fully merged in water.

Fig.6 Submersible water pump

Relay is a switch which is used to connect or disconnect two circuits. An electrical signal is applied to relay, which in turn connects or disconnects another circuit.

Fig.7 Relay

The incandescent light bulb is a source of light which emits light by heating the filament.

Fig.8 Incandescent light source

B. Flow Chart:

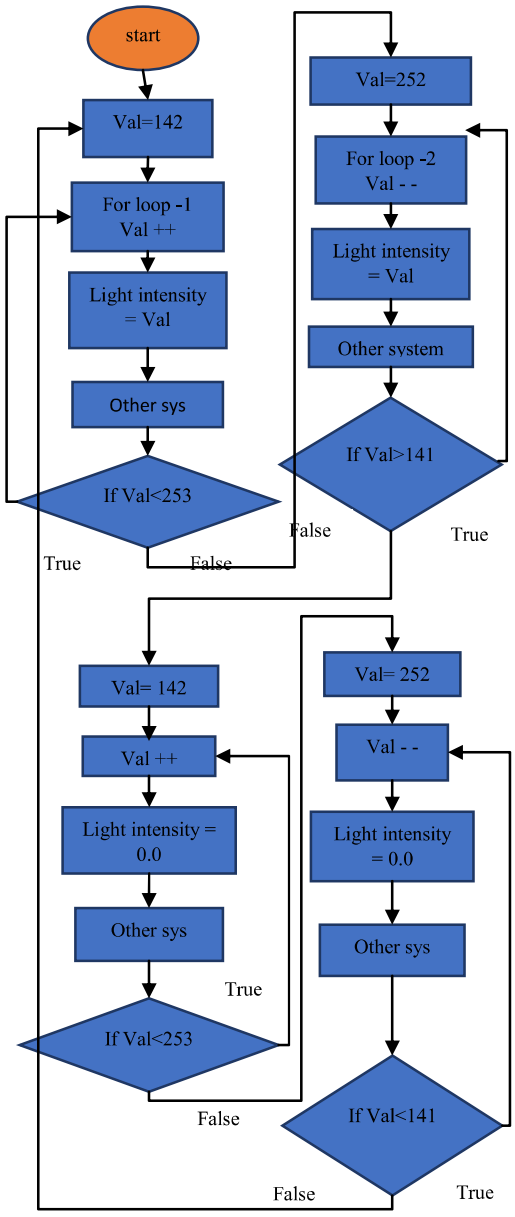

Fig.9 Flow chart of Hardware design

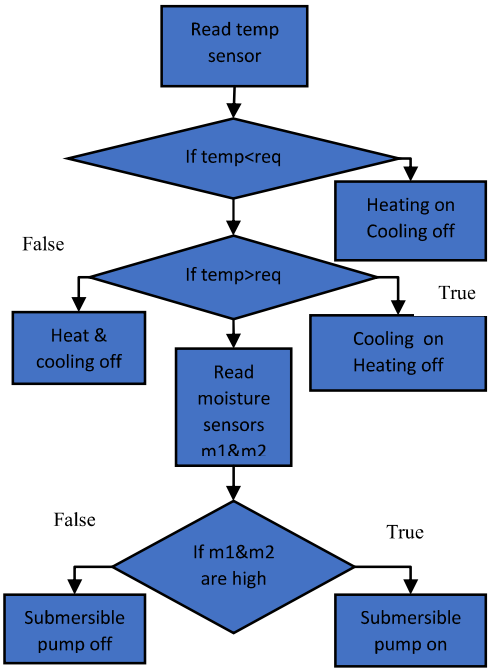

Fig.10 Flow chart of other system function from the main program

Fig.9 &Fig.10 are the flowcharts of this project. Temperature sensor senses the temperature and based on the required temperature conditions the heating, cooling systems will be ON or OFF. The submersible pump will be ON or OFF based on moisture sensor readings and other systems also runs respectively like intensity of light. The intensity of light changes when the value changes.

C. Design of Hardware:

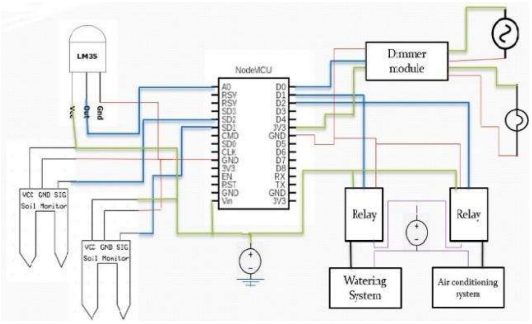

Fig.11 Circuit diagram of hardware

Fig.11 shows the circuit diagram of this project. The hardware design focuses on light intensity, temperature sensor, moisture sensor, watering system, cooling system, heating system. Code runs in NodeMCU for 24 hours. Code for measuring moisture level, water, temperature, cooling, light intensity are runs simultaneously. When room temperature is higher than required temperature then heating system will be off, cooling system will be on and vice versa when temperature is low. When moisture level is high then submersible water pump will be in OFF state and vice versa when moisture level is low. Light intensity changes based on value. Light intensity increases gradually from morning to afternoon and decreases from afternoon to evening. At night, light will be OFF. The whole process automatically runs and will be monitored through a web browser in mobile or laptop.

IV. RESULTS

In this project, the results of hardware and web browser are varying at different time periods are shown in figures. The same network is provided for both NodeMCU Wi-Fi module and mobile or laptop.

Fig.12 At starting

Fig.12 is the result of hardware and monitoring it through a web browser at initial stage. Light intensity initially starts from 55. Required temperature (21.85) and room temperature (38.99) which is higher than required temperature so, the cooling system is ON and heating system is OFF. The moisture level in soil is sufficient so, the watering system is OFF.

Fig.13 At 3 hours

After 3 hours the light intensity changes to 75. Required temperature (29.54) is lower than room temperature (38.67) so, heating system is OFF and cooling system is ON. Moisture level is sufficient so, the watering system is OFF.

Fig.14 At 6 hours

After 6 hours light intensity increases to 94. Room temperature (36.42) is less than required temperature (37.23) then both heating and cooling system are OFF. Moisture level is sufficient hence watering system is OFF.

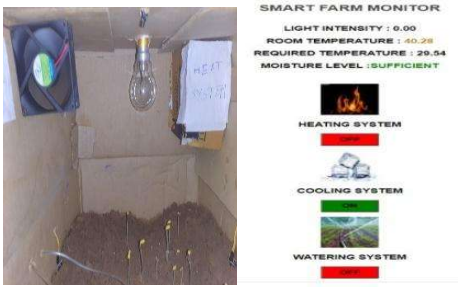

Fig.15 At 24 hours

Fig.15 is the result at 24 hours which has the light intensity 0 and moisture level is high so, watering system is OFF. Room temperature (40.28) is greater than required temperature (29.54) so, heating system is OFF, cooling system is ON.

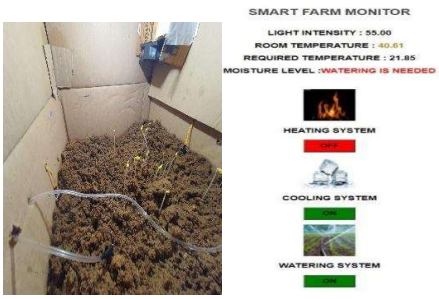

Fig.16 Watering system ON

As shown in Fig.16 the moisture level is low hence the watering system is ON.

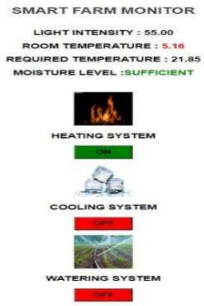

Fig.17 When room temperature is lower than Required temperature

As shown in Fig.17 room temperature is less then required temperature then heating system is On and cooling system is OFF.

V. CONCLUSION

Farming plays a major role for our living and it is very important for future life. Farmers are facing many challenges in various phases of agriculture. Implementation of IoT device for farming will be more efficient and gives better results. It should have better environmental conditions for plant growth. The given paper reduces problems using IoT which built a system to monitor and control the environmental conditions like light intensity, temperature, moisture automatically and monitor those through a web browser in mobile or laptop.

FUTURE SCOPE

Future work focuses on adding some fault alarming systems which checks whether the system is properly working or not. Thus it will make system more accurate. It can be used for plant researching and also can be used for monitoring the plant growth.

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