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REVIEW ARTICLE **OPEN ACCESS**

Smart Farming Using IOT: The Surveillance and the Regulation of Agricultural Area

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ABSTRACT
Agriculture plays an important role in the economic foundation of the Indian population. Thus, the farmers should have good control over the livestock raising process and the growth of the crops.Using the advantages of novel technologies such as Internet of Things (IOT) and CC3200 board, it is possible to develop smart farming. The main feature of the proposed device is to provide better farming conditions in accordance with the environmental conditions like atmospheric temperature and humidity. The system is capable of checking the quality of the soil and growth progresses of crops using the sensors in CC3200 chip. The camera interfaces with the CC3200 will capture the images and the same will be sent as an MMS to farmer's mobile number through Wi- Fi. The sensors in CC3200 board can identify the requirement of the pesticides and fertilizers. Adoption of the evolving technologies like IoT solutions for the agriculture has great impacts like reduction in man power and labor cost, especially during this COVID – 19 pandemic situations as there is shortage of qualified workers. The smart agriculture will open a gateway to avoid all the challenges and issues, which may arise during the farming processes.
Key Words: *Internet of Things (IoT), CC3200, Sensors, Image Processing*

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INTRODUCTION

In this new era Internet of Things will be one of the emerging technologies. It is the collection of many interconnected objects, services, humans and devices, which can communicate each other. E-Health, agriculture, energy production and distribution, smart home, smart city etc are the different implementation domains of Internet of Things. IoT (Internet of Things) is capable of analyzing the sensed information and the same will be processed and then transmitted to the user. So that IoT will be having good application in agriculture.

For the last several years it has seen that the number of technological-transformations in farming, which makes the farming more industrialized as well as technology-driven one. Thus, the farming becomes more predictable and efficient.

As agriculture is the basis for the human species, it has a great role in the growth of country's economy. It opens employment opportunities to the people. The yield of crops will be low as the farmers are following traditional methods. Thus, the implantation of novel technologies can novel technologies can increase the yield ([1] – [5]). By using Internet of Things, it is expected to have good production with low cost through the analysis of several environmental conditions.

Agriculture modernization can be done by combining traditional methods as well as the novel technologies like Internet of Things. The sensors will collect the real time data. So, it is possible to provide correct treatment on time. Also, it is expected to avoid the declination of yield due to climate change as well as improper water management. The implementation of the proposed system can overcome the above-mentioned problem as it has the capability of weather monitoring.

RELATED WORKS

The paper [6] is discussing the possible solutions for the reduction in transport cost for all agricultural products and also it predicts the rate of the crops based on the previous information as well as present market values. This system helps to provide a good communication between farmers and agricultural product buyers.

Paper [8] is describing about the wireless control system [7] for agriculture motor. Based on the water requirement of the field, the system will send the Short Message Service (SMS) to the mobile number which is programmed in the system. It provides the provision to deal with the weather condition.
Paper [9] is discussing about wireless sensor-based crop monitoring system for agriculture using Wi-Fi network dissertation. Several sensors are coupled with wireless technologies to monitor the parameters like temperature, humidity and moisture. All sensors are connected to Central Monitoring Station through a Wi-Fi. It connects to the Global Positioning System (GPS) to the send massage to the central monitoring station. Based on the value of the sensor output, the water sprinkler will get turned on or off.
Thing Worx [10] is a new IoT platform, which offers good security and scalability. It offers the rapid development of the tool support cloud [11] deployments. So that It can be provided in IoT agriculture solutions with a minimum effort.
In paper [13], it is proposed a solution that can be used in precision agriculture. So that the farmers can get the relevant data for taking necessary decisions, which leads to the enhancement of their productivity in business and profitability.
To know the entire lifecycle of the agricultural processes, a smart agriculture solution from Hexagon [14] has proposed. It will assist the entire crop management through digital work flows which is created from geo-enabled data.
A fuzzy control system is designed for the irrigation and water conservation in agricultural field is described in paper [15]. It describes a fully automated irrigation system and the development of a protocol for its field implementation. In paper [16] a greenhouse monitoring system based on agriculture IoT is proposed. In the above systems sensors are installed for collecting all the information periodically. Few more systems are proposed based on agricultural IoT. They are described in [17] [18] [19]. In this, systems are equipped with two different types of sensors. One is to measure the parameters like humidity, temperature etc. The other component is an image sensing node, which will take the images of the crops.
Paper [20] gives an explanation about the scope of IoT in agriculture. It deals with the application of IoT at different stages of agricultural plantations.

PROPOSED SYSTEM MODEL

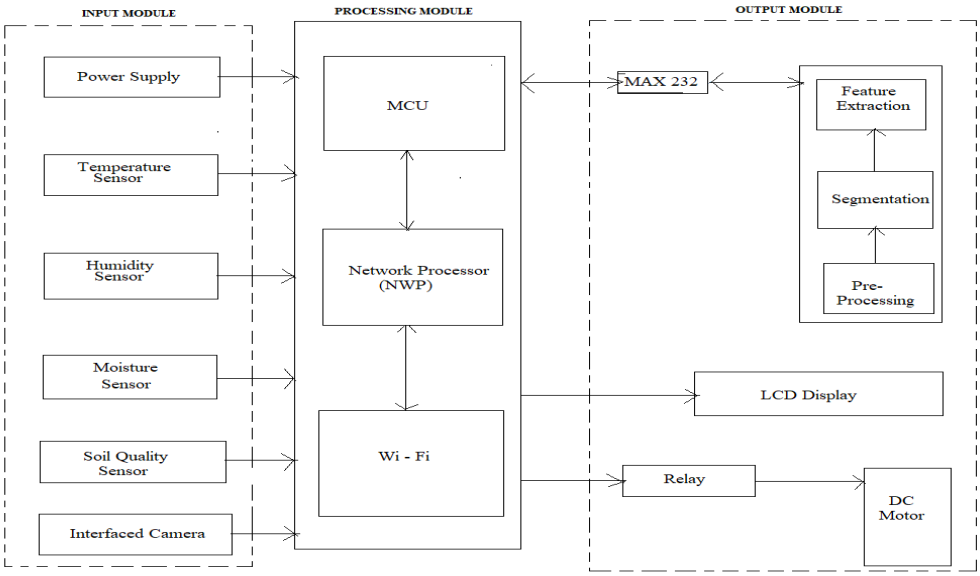


Figure-1 shows the block diagram of the proposed system. It consists of 3 modules named input module, processing module and output module.

The main block of the system is CC3200 board with in built micro controller unit, network processor and a Wi – Fi unit. It is a fast-portable board with additional advantages of security and speed.
Several sensors are connected to monitor the environmental conditions of the crop field to ensure the optimal growth and health of the plants. Temperature sensor, Humidity sensor, water level sensor, and moisture sensor are the different sensors in the input module to check the atmospheric status. The outputs of all the sensors will be displayed in the liquid crystal display (LCD), which is interfaced through the output module. The same data can be used to know the status of your business in general as well as the performance of the staff, efficiency of the equipment used, etc. So that the farmers can take decisions

to improve their work in every aspect. During dry surface detection, the motor will become active through the relay and the same will be providing water in its required quantity. The images of the particular agricultural area will be captured using the camera interfaced with CC3200 board. The captured image will send to farmer's mobile phone through GPRS.

SYSTEM DESIGN

CC3200 Launchpad

It is a single chip with which a microcontroller, network processor *(NW*P) and a Wi-Fi module are integrated. It is one of the first high performance wireless microcontroller enabled with user-programming functions. Peripheral devices like parallel camera, ADC, SPI, UART, I2C, PWM, I/Os, built-in power management and RTC are associated with the CC3200 board. It provides some security features like security boot, device identity, software IP protection, network security (WPA2). The power mode of the microcontroller can be controlled through the networking sub-systems. Many numbers of add-on boards are available in CC3200 to interface the peripherals like graphical displays, antenna selection, environmental sensing etc. 802.11bgn is the Wi-Fi technology used in CC3200. It is provided with 6 secure sockets and 4- STA's.

TEMPERATURE SENSOR- LM 35

LM 35 is a high precision integrated circuit, in which the output voltage will be in proportion to the temperature in centigrade. So LM35 provides better performance than the linear temperature sensor. It is not required to subtract a large constant voltage value from the output of the temperature sensor to obtain a convenient centigrade scaling. It can assure the accuracy as well as minimum expenditure by avoiding the external calibrations.

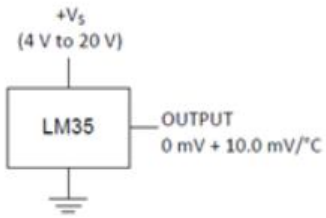


Figure 2: Temperature Sensor- LM 35

MOISTURE SENSOR

To effectively manage the irrigation system, it is necessary to effectively monitor the soil moisture content. The two large pads are provided in the sensor to act as probes. It can also be acted as a variable resistor.

Figure 3: Moisture Sensor

If the water content in the soil is more, then the conductivity between the pads will become high. It results in lower resistance. The quantity of moisture content will be displayed in the LCD.

HUMIDITY SENSOR

Humidity sensor will measure the environmental humidity and convert the obtained output into corresponding electrical signal. In this system we are using a capacitive sensor. It is an absolute humidity sensor which uses two electrodes to monitor the capacitance of a thin metal plate, which is placed in between the electrodes. Increment or decrement in the capacitance of the metal will be directly proportional to the humidity of the atmosphere where it is placed. The difference in voltage will be sent to the board.

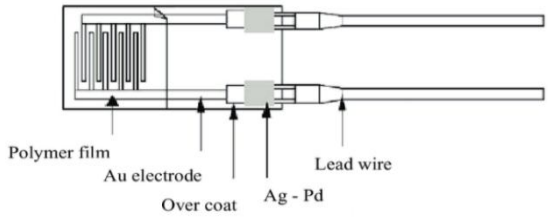


Figure 4: Capacitive (Absolute) Humidity Sensor

SOIL QUALITY SENSOR

Electromagnetic sensors are used to check the soil quality as well as the requirement of fertilizers and pesticides. As the non- contact the soil quality sensor is used, the sensor will have interface with the CC3200 board.

DC MOTOR PUMP

A DC motor pump is given to provide irrigation when the system finds dry or less moisture content. Output of the sensor will be compared with a reference voltage. If it is less than the reference voltage, the motor will get triggered and starts to supply the required quantity of water.

LIQUID CRYSTAL DISPLAY

Seven segments or other multi segments liquid crystal displays can be used for showing the output status. Liquid crystal displays are ae easy to program**.** The data to be displayed on the liquid crystal display will be stored in data register. The character which is to be displayed on theLCD screen will be stored as ASCII value in the data register.

IMAGE PROCESSING

The images captured by the camera will be processed using MAT lab. The data base of the captured image will be stored as binary files. After extracting the features, it will be compared with the data base stored in the library files. Based on the comparison results the output will be displayed in the liquid crystal display either as dry, wet and diseased leaf.

TESTING AND IMPLEMENTATION

In the system CC3200 is connected to a power supply and all the sensors. The system will feed all the required parameters and capture the timely image of the field, as well as the leaf, and are fed to the image processing to check whether all parameters are within the threshold range. The status is monitored in the IoT based web server and the control system provides the necessary action to be taken to overcome the deficiency in any parameters.

Figure 5: Dry Surface

Figure 6: Wet Surface

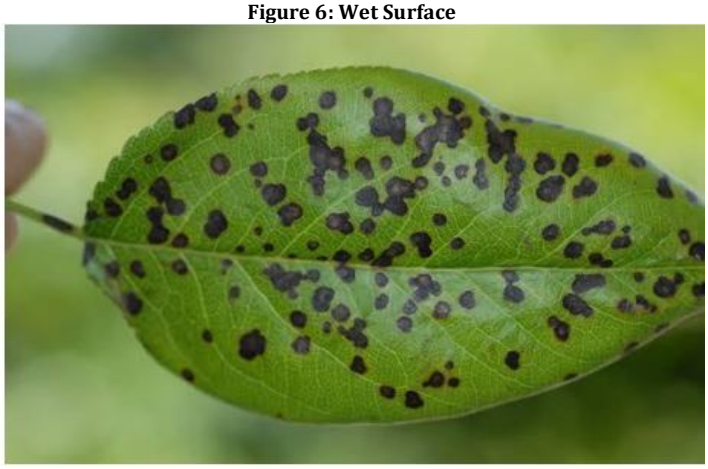


Figure 7: Diseased leaf

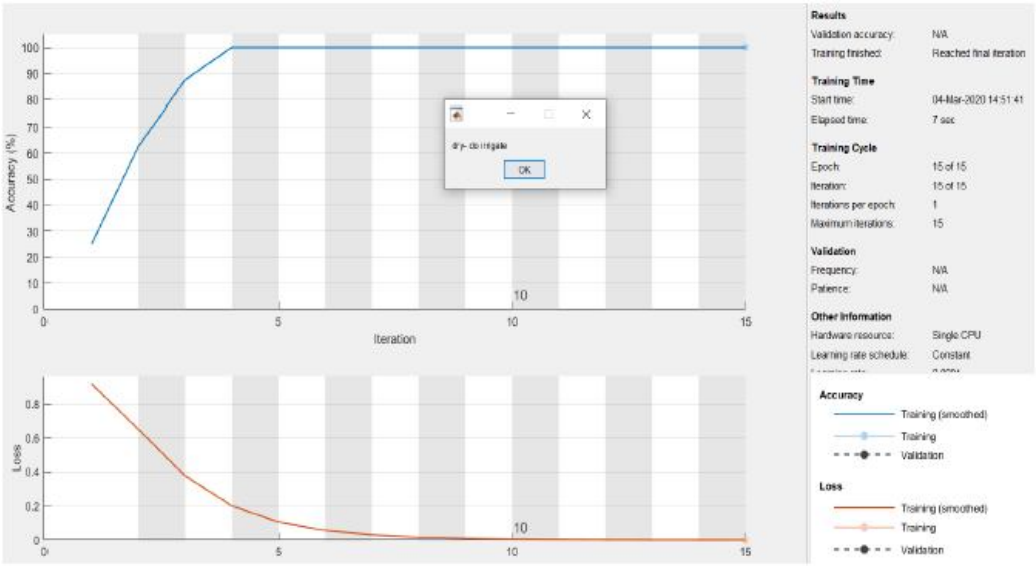


Figure 8: Display of message says: "dry surface does irrigation"

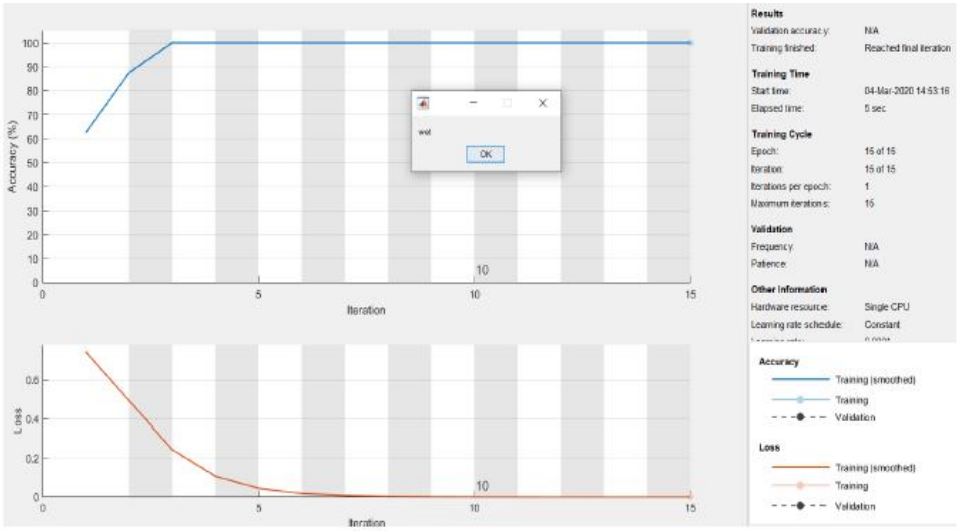


Figure 9: Display of message which says: "wet surface"

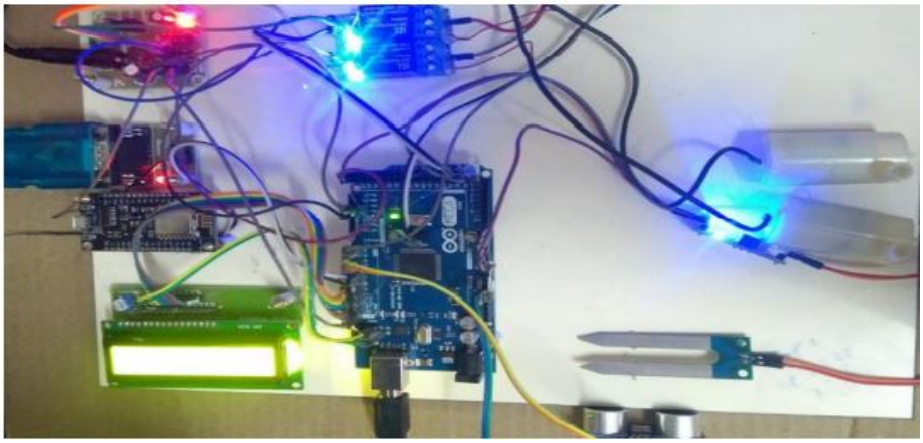
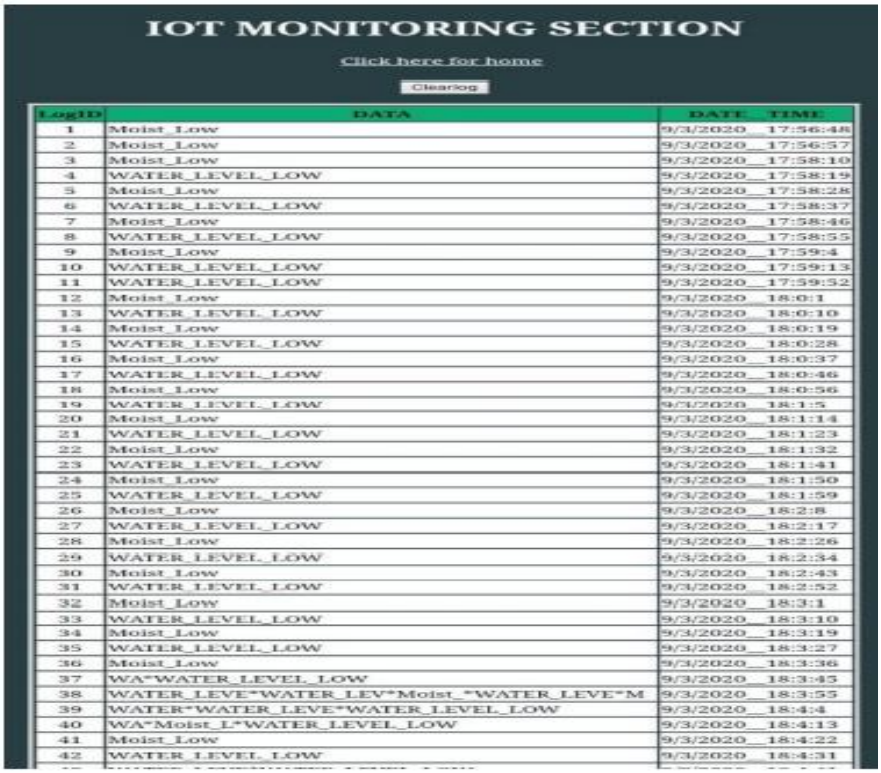


Figure 10: Testing and Implementation



IOT MONITORING SECTION

Click here for home

ClearLog

LogID	DATA	DATE_TIME
1	Moist_Low	9/3/2020__17:56:44
2	Moist_Low	9/3/2020__17:56:57
3	Moist_Low	9/3/2020__17:58:10
4	WATER_LEVEL_LOW	9/3/2020__17:58:19
5	Moist_Low	9/3/2020__17:58:28
6	WATER_LEVEL_LOW	9/3/2020__17:58:37
7	Moist_Low	9/3/2020__17:58:46
8	WATER_LEVEL_LOW	9/3/2020__17:58:55
9	Moist_Low	9/3/2020__17:59:4
10	WATER_LEVEL_LOW	9/3/2020__17:59:13
11	WATER_LEVEL_LOW	9/3/2020__17:59:52
12	Moist_Low	9/3/2020__18:0:1
13	WATER_LEVEL_LOW	9/3/2020__18:0:10
14	Moist_Low	9/3/2020__18:0:19
15	WATER_LEVEL_LOW	9/3/2020__18:0:28
16	Moist_Low	9/3/2020__18:0:37
17	WATER_LEVEL_LOW	9/3/2020__18:0:46
18	Moist_Low	9/3/2020__18:0:56
19	WATER_LEVEL_LOW	9/3/2020__18:1:5
20	Moist_Low	9/3/2020__18:1:14
21	WATER_LEVEL_LOW	9/3/2020__18:1:23
22	Moist_Low	9/3/2020__18:1:32
23	WATER_LEVEL_LOW	9/3/2020__18:1:41
24	Moist_Low	9/3/2020__18:1:50
25	WATER_LEVEL_LOW	9/3/2020__18:1:59
26	Moist_Low	9/3/2020__18:2:8
27	WATER_LEVEL_LOW	9/3/2020__18:2:17
28	Moist_Low	9/3/2020__18:2:26
29	WATER_LEVEL_LOW	9/3/2020__18:2:34
30	Moist_Low	9/3/2020__18:2:43
31	WATER_LEVEL_LOW	9/3/2020__18:2:52
32	Moist_Low	9/3/2020__18:3:1
33	WATER_LEVEL_LOW	9/3/2020__18:3:10
34	Moist_Low	9/3/2020__18:3:19
35	WATER_LEVEL_LOW	9/3/2020__18:3:27
36	Moist_Low	9/3/2020__18:3:36
37	WA"WATER_LEVEL_LOW	9/3/2020__18:3:45
38	WATER_LEVE"WATER_LEV"Moist_"WATER_LEVE"M	9/3/2020__18:3:55
39	WATER"WATER_LEVE"WATER_LEVEL_LOW	9/3/2020__18:4:4
40	WA"Moist_L"WATER_LEVEL_LOW	9/3/2020__18:4:13
41	Moist_Low	9/3/2020__18:4:22
42	WATER_LEVEL_LOW	9/3/2020__18:4:31

Figure 11: Monitoring sensor's output and display of the result

CONCLUSION

Internet of things play an important role to get better yield production in agriculture. The proposed agriculture monitoring system will be very much reliable as well as efficient. So corrective actions as well as proper decisions can be made on time. It helps to reduce the man power as it is having capability to give information about all atmospheric condition and the same will be forwarded to farmer's mobile phone as MMS. The proposed system is expected to be cost effective. Power consumption will also be less. Hence it will be beneficial for farmers. Future improvements can be made by providing an efficient irrigation system.

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