IDENTIFICATION OF SOIL CHARACTERISTICS FOR CROP PRODUCTION USING LORA

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Abstract - The agricultural industry became more important than ever in the next few decades. Farmers and agricultural companies are turning to the level of reserves to meet demand. Since we have to do the measurements manually all the time, it takes a lot of time. So with this smart agriculture, we can efficiently take measurements in less time to identify soil pH level and soil moisture. Monitoring soil parameters is an emerging trend that has the potential to change agricultural practices and increase productivity. PH value, temperature, humidity, soil dryness and soil moisture are the basic parameters that help in the characterization of the soil and therefore in the correct decision on the application of fertilizers and the selection of sown crops. In this work, the TDS Sensor is used to measure pH and the moisture sensor to determine the moisture content of the soil, the inverse relationship between soil resistance and soil moisture was used, and the corresponding circuits were developed. Determining the temperature and humidity of the climate is done using the DHT11 sensor. The moisture sensor will monitor the soil moisture level. The supply of water is poured according to the dryness of the soil. The system is integrated in the transmitter, which transmits the data to the farmer via the TX transmitter. Using the RX receiver, data on humidity, temperature, and soil moisture and soil pH level will be monitored using the Lora device. The Lora Rx will receive data from the Lora TX and save the data to a text file. The farmer can see the soil level and climate data whenever needed. Through the LCD display, we can see the pH level of the soil, the climatic conditions and the crops to be grown. The entire work of the device is controlled by a microcontroller. Where Lora device plays a major role in wireless data transmission through TX and RX. Here, LoRa is a long-range, low-power wireless platform for frame data transmission.

Keywords: TDS sensor, DHT11 sensor, Lora device, LCD display, microcontroller, Lora TX, Lora RX, humidity sensor and IoT technology.

I.INTRODUCTION

Crop production depends on the interaction between soil and plant properties. The maximization of crop production is reflected in the biological, physical, chemical state of the soil. The root absorbs the necessary amount of nutrients and water from the soil, where biochemical reactions take place. The rate at which nutrients are absorbed by the plant depends on the minerals available in the soil. Crop production degrades with insufficient supply of necessary nutrients. Although the need for specific nutrients is determined by the plant in the soil, some nutrients are essential to all plants in large amounts, known as macromol or macronutrients. A plant's root environment can be changed by supplying nutrients from outside the soil, known as fertilization. However, proper distribution of fertilizer is necessary for proper crop production. Excessive and insufficient supply of fertilizer can significantly reduce the rate of crop production. The traditional fertilization system in Tamilnadu relies on farmers' experience with

cultivation and weather conditions. This type of manual fertilization without proper justification of the soil condition is prone to error. To meet the increasing demand of the growing population over the years, there is a need to increase food production. Improper use of fertilizers in turn results in poor fruit quality, and vegetables lag behind in size, taste, quality, and quantity. The amount of NPK depends on the type of crop and the growth status of the plants. The amount of fertilizer to be used also depends on the current NPK nutrient content of nitrogen, phosphorus and potassium in the soil. Since macronutrients vary even on a small scale in a cultivated field, many researchers have tried to develop a sensor to map the content of these nutrients. In order to get the right amount of nutrients supplied and to select the right crop for multiple crops on the same soil, we need to measure the actual amount of nutrients present in the soil. To achieve sustainable agriculture and to minimize any country's economic losses and environmental impacts, proper management of essential soil nutrients plays a vital role. Technology plays a purposeful role in improving the environment and achieving economic goals.

II.OBJECTIVE

- To enable smart agriculture to be produced with more accurate andefficient use of IoT-enabled technologies.
- This project will help to find the pH level of the soil where some farmers will not be aware of the soil quality, so the crops grown will be damaged and result in a huge loss of crops without knowing the pH level, avoid such loss and save the time of the farmers to check the soil quality. For this purpose, we have developed this device to know the pH level of the soil.
- With the help of soil moisture level, soil type and soil quality depending on climate change, farmers can decide which type of crop is suitable for a particular soil to get profit instead of using traditional time consuming methods.
- Soil fertilization can be given according to soil moisture.
- The main objective of this project is to grow crops according to climatic conditions, soil pH level and water supply accordingto soil moisture level of the soil.
- Recall data at any time and analyze it for growing crops according to climatic conditions and soil pH level

Changes in soil acidity can alter the availability of various nutrients to plants in a number of ways. As soil pH increases, ions such as iron, aluminum, manganese, copper, and zinc become less soluble. The neutralization of the soil thus makes the conditions more favorable for the growth of bacteria and accelerates the processes by which nutrients are made available to the plants. [1] One way to achieve this is by integrating renewable energy into the ICT infrastructure. Specifically, solar energy can be used to make various sensor nodes, actuators, and gateways energy efficient. [2] He developed an automated soil sampling system that was mounted on a stem and had a pH meter with a flat surface electrode. They used linear regression to calibrate their results with soil pH obtained by standard laboratory tests. [3] Doing time consumption manually would be more for larger areas. To overcome these e-agriculture applications were developed that were based on the knowledge base for the framework. [4] A thorough study of soil moisture management is key for farmers to make irrigation management decisions. The best approach for optimal root zone water management involves maintaining irrigation water and maintaining soil moisture. Advances in soil moisture retention technology make it a cost-effective risk management tool. [5].

III.EXISTING SYSTEM

Important soil parameters to monitor for irrigation planning are soil temperature and soil moisture as implementedin the existing system as follows:

- Estimating soil moisture is a direct way to schedule irrigation and soil temperature helps predict irrigation needs.
- An intelligent sensor node for soil condition monitoring consists of a temperature sensor, a soil moisture sensor, a processing unit and a LoRa module for communication at the locationof the deployed sensor node.
- The soil sensor node provides soil condition data to the weather.
- In the existing system, only temperature, humidity and humidity data are transmitted to farmers.

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• Knowing these two data, we cannot grow crops, according to which it is necessary to know the pH of the soil and complete data for condition analysis.

IV.THE PROPOSED SYSTEM

• Our system provides knowledge to modern agricultural farmers to realize their soil properties, suitable crops and pesticides.

• If they notice abnormalities, they can immediately notice their soil and use pesticides to overcome.

• A TDS meter is used to indicate the total amount of dissolved solids in a solution, usually water, and this TDS sensor will indicate the pH level of the soil by knowing the pH level, farmers can know which crops can be grown according to the pH level. Soil.

• DHT-11 digital temperature and humidity sensor is used as a capacitive humidity sensor and a thermistor to measure the ambient air, and it spreads a digital signal on the data pin (no analog input pins are needed), through which the farmer can equalize the temperature of his field condition and they can grow crops according to temperature and climate.

• A moisture sensor will sense the soil moisture level and automatically deliver water to the field where human needs will be reduced.

• The Lora TX will transmit soil pH and climate data to the Rx receiver. With this, a farmer can gather information about the field's condition and can grow crops as appropriate.

V.ARCHITECTURE DESIGN

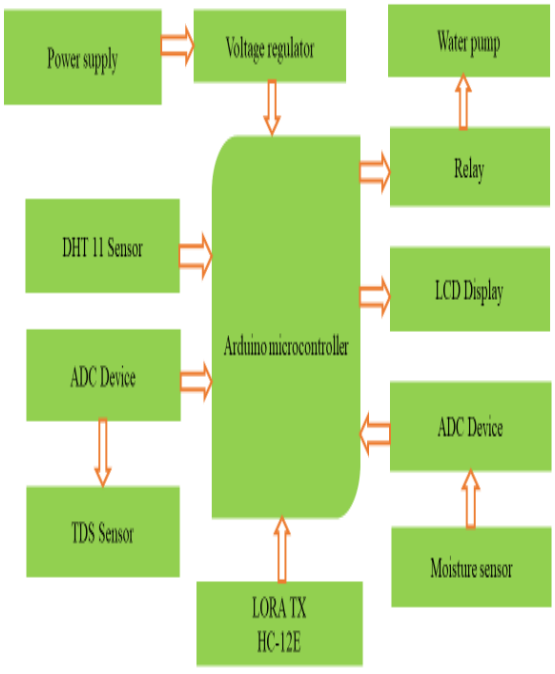

Fig. No.1. TX Block diagram

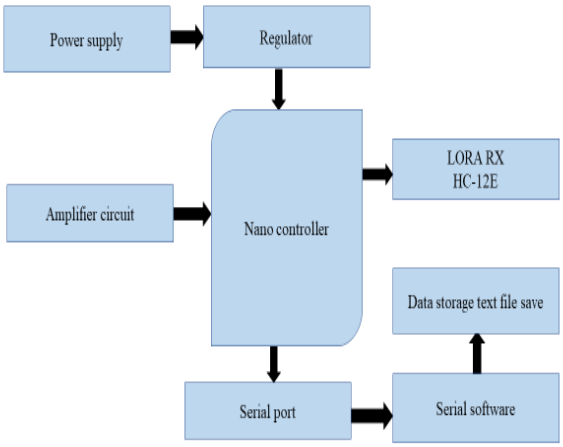

Fig no 2. RX block diagram

VI.MODULE

The following are five modules

• Input module
• Broadcast module
• Sensing module
• Receiver module
• Data storage module

6.1 INPUT MODULE:

The 12V voltage regulator is powere3d in this module.This voltage regulator will provide a constant 5V supply to the arduinomicrocontroller.constant power will be distributed to the entire device to operate the sensor.

6.2 BROADCAST MODULE:

In the transmitter module, the information received from the sensor will be sent to the receiver. The information received from the sensor is sent using the microcontroller. A microcontroller that plays a major role in sending information to the LORA TX HC-12E transmitter and the receiver.

6.3 SENSING MODULE:

In the DHT11 sensor module, the sensor will monitor the temperature and humidity of the agricultural field, the TDS sensor will monitor the pH of the soil, The signal received from the TDS sensor will be converted to an analog-to-digital converter and send the information to the microcontroller, the moisture sensor will monitor the soil moisture level by converting the analog to digital signal will be this moisture sensor monitor the moisture level in the soil, if

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the soil is very dry, the motor will automatically turn on and throw water into the soil. Humidity, TDS sensor and DHT11 sensor are sensing module

6.4 RECEIVER MODULE:

In the receiver module, all the data about the temperature, humidity and pH level of the soil will receive information through LORA RX according to the received information about the crop to be cultivated, it will be displayed on the LCD display. Crop prediction is done using a coding microcontroller that sends information about suitable crop based on humidity, temperature and pH level. The LCD display will show the humidity, temperature and pH level of the soil content.

6.5 DATA STORAGE MODULE:

In this module, the data of humidity, temperature and soil level can be monitored through the serial port by a software application, and this application also saves the data to a text file. We can verify the data at any time because the data will be stored in a text file.

VII.HARDWARE SPECIFICATION

1. ARDUINO MICRO CONTROLLER

Arduino is an open-source electronics prototyping platform based on easy-to-use hardware and software In a nutshell, Arduino is a microcontroller based prototyping board that can be used in developing digital devices that can be read inputs like a finger on a button, a touch on a screen, a light on a sensor, etc. and convert them into an output like turning on an LED. , turning a motor, playing songs through a speaker, etc. An Arduino board can be programmed to do anything by simply programming the microcontroller on the board with a set of instructions, for which the Arduino board consists of a USB connector to communicate with your computer and a bunch of connection sockets that can connect to external devices such as motors, LEDs, etc. Arduino's goal is to introduce the world of electronics to people who have little to no experience with electronics, such as hobbyists, designers, artists, etc. Arduino is based on a open source electronics project, i.e. all design specifications, schematics, software are openly available to all users. So Arduino boards can be purchased from vendors as they are commercially available or you can build your own board if you wish i.e. you can download the schematic from the official Arduino website, buy all the components as per the design specification, assemble all the components and create your own board.

Fig no: 3 Arduino microcontroller

2. NANO CONTROLLER

The Nano board is designed to make it very easy for beginners to get started with microcontrollers. This board is particularly board friendly and very easy to handle. Let's start by powering the board.

Powering You Nano:

There are a total of three ways you can power your Nano.

USB CONNECTOR:

Connect the mini USB connector to your phone charger or computer with a cable and it will draw the power needed for the board to function properly with the USB connector.

VIN PIN:

The VIN pin supplied with an unregulated 6-12V to power the board..If you have a regulated +5V supply, you can directly provide that on the +5V pin.In addition to serving their purpose, these pins can also be used for special purposes, which are described below with the pins inserted

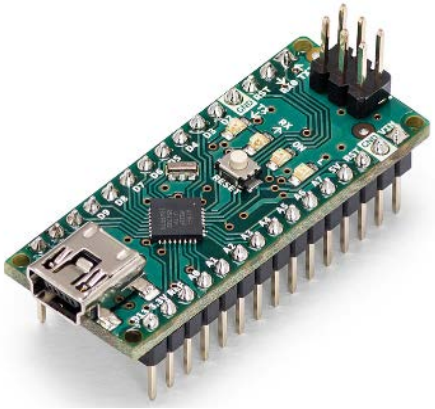

Fig no: 4 Nano microcontroller

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3. LCD DISPLAY
LIQUID CRYSTAL DISPLAY

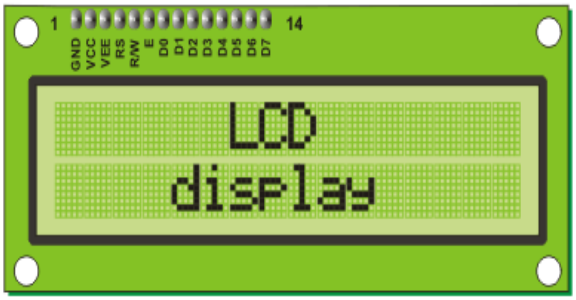

Fig no: 5 LCD display

LCD stands for Liquid Crystal Display. LCD is widely used to replace LEDs (seven-segment LEDs or other multi-segment LEDs) for the following reasons. The model described here is the most commonly used in practice due to its low price and great options. It is based on the HD44780 microcontroller (Hitachi) can be display messages in two lines of 16 characters each. It displays all alphabets, Greek letters, punctuation marks, mathematical symbols, etc. In addition, it is possible to display symbols that the user creates himself. Useful features include automatic shift notification on the display (left and right shift), pointer appearance, backlight, etc.
These components are "specialized" for use with microcontrollers, meaning they cannot be activated by standard ICs. They are used to write various messages on a miniature LCD.

4. 7805 VOLTAGE REGULATOR
A regulated power supply is essential for any electronic device because these devices use semiconductor material with a fixed voltage and current rate. If there is any difference in the fixed rate of voltage and current, the device will be damaged. Batteries are one of the main sources of DC power, but we cannot use them in sensitive electronic circuits over time because they lose their potential and eventually discharge. Batteries provide different voltage ranges such as 1.2V, 3.7V, 9V and 12V. Most ICs work with 5V power supply, so we require a device to supply a reliable 5V power supply called a voltage regulator. Here, the 7805 voltage regulator comes from the 78XX series of linear voltage regulators. This regulator generates a 5V regulated output.

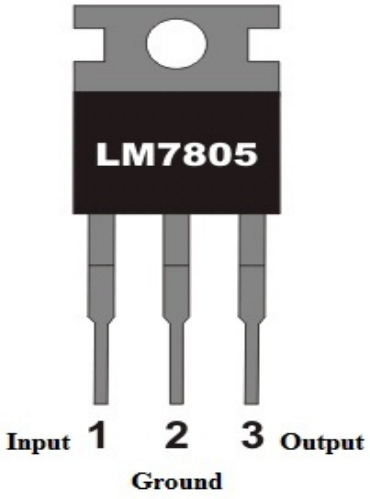

Fig no: 6 voltage regulator

5. RADIO FRQUENCY TRANSMITTER AND RECEIVER
In general, the designer of wireless systems has two main constraints: they must work over a certain distance and transmit a certain amount of information within a transmission rate. RF modules are very small in size and have a wide operating voltage range, i.e. 3V to 12V.
Basically RF modules are 433 MHz RF transmitter and receiver modules. The transmitter consumes no power when transmitting a logic zero while fully suppressing the carrier frequency, so it consumes significantly less power when running on batteries. When a logic one is sent, the carrier is fully on at about 4.5 mA with a 3 volt supply. Data is sent serially from the transmitter, which is received by a tuned receiver. The transmitter and receiver are properly interfaced with two microcontrollers for data transfer

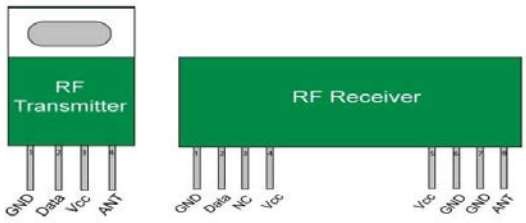

Fig no: 7 transmitter and receiver

6. SOIL MOISTURE SENSOR:
Soil moisture plays a vital role in field irrigation as well as in plant gardens. Nutrients in the soil provide plants with food for their growth. Water supply to plants is also necessary to change plant temperature. A plant's temperature can be changed by water using a method such as transpiration. And plant root systems also develop better when they grow in moist soil.

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Extreme levels of soil moisture can lead to anaerobic situations that can promote both plant growth and soil-borne pathogens. This article discusses an overview of the soil moisture sensor, its operation, and its applications. A soil moisture sensor is one type of sensor used to measure the volumetric water content of soil. Since the direct gravimetric measurement of soil moisture needs elimination, drying and also weighing of the sample. These sensors measure the volume content of water not directly using some other rules of the soil, such as dielectric constant, electrical resistivity.

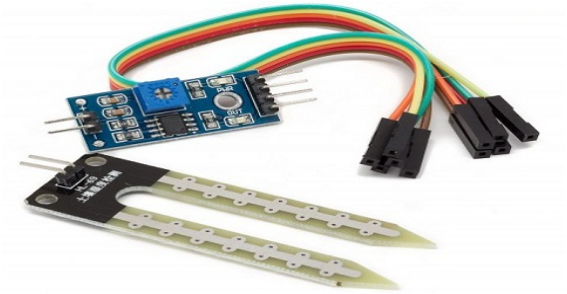

Fig no: 8 soil moisture sensor

7. PUMP MOTOR

The R385 6-12V DC Diaphragm Mini Aquarium Water Pump is an ideal non-submersible pump for a variety of liquid moving applications. It has enough pressure to be used with a nozzle to create a spray system. The pump can handle heated liquids up to a temperature of 80°C and with a suitable power supply it can suck water through a tube from up to 2m and pump water vertically up to 3m.

Possible uses/projects include; a small aquarium pump, an automatic plant watering system, creating a water feature or musical water dancing features to name a few. When pumping liquid, the pump runs very quietly. The pump is also capable of pumping air, although when pumping air the pump is quite noisy in comparison. The pump can handle the pumping of heated liquids up to a temperature of 80C and with a suitable power supply it can suck water through a tube from up to 2m and pump water vertically up to 3m.

Fig no:9pump motor

8. POWER SUPPLY

This chapter introduces the operation of power supply circuits built using filters, rectifiers and then voltage regulators. Starting with an AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to a DC level, and finally regulating to obtain the desired fixed DC voltage. Regulation is usually obtained from a voltage regulator IC unit that takes the DC voltage and provides a somewhat lower DC voltage that remains the same even as the input DC voltage changes or the output load coupled to the DC voltage changes.

9. RELAY

This is a High-level 4-channel trigger relay, applicable for Arduino and Raspberry Pi, The relays are suitable for controlling high-power electronic devices such as lights, electric fans and air conditioners, there are two solder points for 5V and GND of the module on both ends. So it is enough to weld other relay modules to it and have a relay module with multiple channels whose signals are independent of each other. If you want to disconnect the device with the module after the experiment, just disconnect the connectors and you don't have to unscrew the wires in the socket. Kind reminder: Be careful with your fingers when disconnecting the heads. Sending HIGH level to SIG; the NPN transistor is excited and the relay coil is electrified. Thus, the normally open relay contact is closed, while the normally closed relay contact will be open. Send LOW to SIG; the transistor will be deactivated and the relay will return to its initial state.

Fig no:10 Relay

10. ADC DEVICE

An analog to digital converter is a circuit that converts a continuous voltage value (analog) to the binary value (digital) can be understood by a

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digital device, which could be used for digital calculation. These ADCs can be found as individual ADC ICs by themselves or embedded in a microcontroller. They are called ADCs for short.

Fig no: 11 ADC Device

Modern electronics are all digital - the good old days of analog computers are gone. Unfortunately for digital systems, the world we live in is still analog and full of color, not just black and white.

11. TDS SENSOR

A TDS meter measures the number of total dissolved solids such as salts, minerals and metals in water. As the number of dissolved solids in the water increases, the conductivity of the water increases, allowing us to calculate the total amount of dissolved solids. Because dissolved ionized solids as salts and minerals increase the conductivity of solution, the TDS meter measures conductivity of the solution and estimates the TDS from this value

Fig no: 12 TDS Sensor

12. DHT11 SENSOR

The DHT11 temperature and humidity sensor includes a calibrated digital signal output with a complex of temperature and humidity sensors. Its technology ensures high reliability and excellent long-term stability..A high-performance 8-bit microcontroller is attached. This sensor contains a resistance element anda temperature sensor of a wet NTC device is connected with the pins is figured below

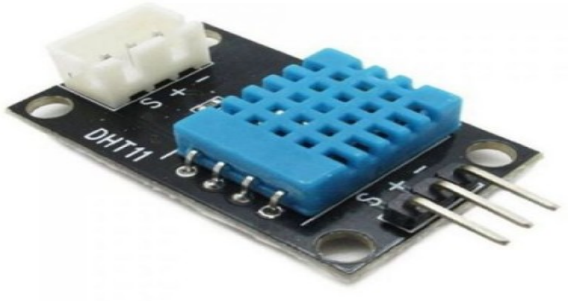

Fig no: 13 Temperature and humidity sensor

Each DHT11 sensor features extremely accurate humidity calibration chamber calibration. Calibration coefficients stored in the memory of the OTP program, internal sensors detect signals in the process and we should call them calibration coefficients. A one-wire serial interface system is integrated to make it quick and easy. Small size, low power, signal transmission distance up to 20 meters, which makes it suitable for various applications and even the most demanding applications. Convenient connection, special packages can be provided according to used needs.

VIII.RESULTS

Every time cultivating crops based on humanity, temperature and soil pH level will be difficult. So,we have designed model with a scalable system to monitor and control agriculture field, temperature,humidity, and moisture sensors of LoRa based framework for Smart agriculture monitoring system forchoosing best crop for cultivating. Based on the problems identified, the tentative objectives havebeen framed and identifies which crop is best. This system helps framer to cultivate best cropsaccording to humidity, temperature and pH level of soil. Framers can see field condition at anytimethrough data storage text file for more strong analyzing.

In future scope, according to the findings of this work, we can intend to implement an automatedsystem that allows field control, a harmful condition that affects agricultural production in the area.We can combine both crop prediction and automated field management system together, so that this will be very easy to predict crop and management of field, with less human power and lots of time can also be saved.

IX.CONCLUSION

Every time cultivating crops based on humanity, temperature and soil pH level will be difficult. So, we have designed model with a

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scalable system to monitor and control agriculture field, temperature, humidity, and moisture sensors of LoRa based framework for Smart agriculture monitoring system for choosing best crop for cultivating. Based on the problems identified, the tentative objectives have been framed and identifies which crop is best. This system helps framer to cultivate best crops according to humidity, temperature and pH level of soil. Framers can see field condition at any time through data storage text file for stronger analyzing.

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