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Design And Development of Farmer Friendly Autonomous Agri-Bot with Soil Moisture and Light Intensity Detection for High Crop Yield using Digital Image Processing Techniques

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Abstract:- **Agriculture plays an important role in the life of the Gross Domestic Product (GDP) of every country. Farmers in the previous years used simple timers and switches to control the irrigation mechanism irrespective of the weather conditions or moisture content present in the soil hence it became necessary to adopt some smart techniques.**

Smart farming is combining agriculture methodologies with technology using Sensors, Microcontrollers, IoT-Internet of Things, Artificial intelligence [AI], Machine learning, Wireless sensor networks, Cloud computing to increase the quantity and quality of products while optimizing the human labor required.

This Agri Bot detects the soil moisture of the sample field, with constant updation of real-time data on the smartphone application. The bot not only detects the soil moisture, it also immediately switches on the water pump just as the value of soil moisture falls below the required range. Our smartphone application also provides recommendations to the farmers about the crops that could be grown in the particular soil type.

The objective of this study and implementation of the Mini Project is to collect some of the recent research related to smart farming technologies and to present the readers with scope for future improvements which can be made in smart farming technology that could potentially benefit the agricultural sector

Key Words: Agriculture, Smart System, Autonomous System, Digital Image Processing, Light Intensity Detection

The idea of the invention of the Soil Moisture Detector was conceived solely to build a bot which proves to be a helping hand for farmers all over the country. The reduction of manual labor is an essential factor which we wished to incorporate in our bot. The construction of the Bot primarily comprises a soil moisture sensor which is a directly connected DHT sensor, the integration of the sensors enables the water pump motor to be switched on or off depending upon the readings detected by the sensors. Giving a glimpse about what DHT sensors are, DHT sensors are made of two parts, a capacitive humidity sensor and a thermistor. There is also a very basic chip inside that does some analogue to digital conversion and spits out a digital signal with the temperature and humidity. The digital signal is fairly easy to read using any microcontroller, here we've used Arduino, because of the simplicity in coding it.

The Arduino will be coded such that within a certain range of soil moisture, the water pump motor will be turned off, indicating sufficient moisture as needed the crops sown in the sample region, beyond which the pump must be turned on as irrigation becomes necessary.

Additional Features:

- Since, smartphones have become an instrumental part of all our lives, building an Application which receives temperature detected by the combination of sensors as the input, in order for it to be monitored after a specified interval of time, such as 1 second, to plot a dynamic graph of time versus moisture of the soil, would indeed prove to be supremely useful. This would in turn enable the farmers to have a real-time detection of the soil moisture of their land, which is directly correlated with the fertility of their soil.

- Application would also recommend the type of soil present in the piece of land dedicated by the farmers and various other members revolving around the occupation of agriculture and hence, suggest the crops that can be grown in the particular soil. The recommendation would be such that it would include the names of the crops which would provide the best yield under such climatic and soil conditions.

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● The recommendations made by the Application would be obtained as the output on the Application itself with the soil moisture considered as the input.
● The data achieved and indicated on the Application would include the following:

○ Temperature

○ Humidity

○ Soil Moisture (as detected by the interfaced sensors)

⇒ LITERATURE REVIEW

1. C. Kumar Sahu and P. Behera, "A Low-Cost Smart Irrigation Control System,"
2015 2nd International Conference on Electronics and Communication Systems (ICECS), 2015, pp. 1146-1152, doi: 10.1109 ECS.2015.7124763. This paper focuses on a smart irrigation system which is cost effective, and a middle-class farmer uses it in farm fields. Today we are living in the 21st century where automation is playing an important role in human life. Automation allows us to control appliances with automatic control. It not only provides comfort but also reduces energy, efficiency and time saving. Today industries use automation and control machines which are high in cost and not suitable for using in a farm field. So here we also design a smart irrigation technology at low cost which is usable by Indian farmers. The objectives of this paper were to control the water motor automatically and select the direction of the flow of water in the pipe with the help of soil moisture sensor. Finally send the information (operation of the motor and direction of water) of the farm field to the mobile message and g-mail account of the user.

2. Sultana, Atia & Hasan, Md & Akhund, Tajim Md. Niamat Ullah. (2019), “An approach to Create IOT based Automated Smart Farming System for Paddy Cultivation”.
doi: 10.13140/RG.2.2.13443.04647.
In Bangladesh, paddy can be grown 2-3 times in a year. Paddy fields need to be irrigated, once with nature's water and the rest of the time with a machine 1-2 times through a water pump. This project named IOT Based Smart Farming monitoring system for paddy fields is a smart system that can monitor the condition of a paddy field and automatically controls the water level of the field. The system has several sensors to measure the water level, moisture, temperature, and humidity of the field. Then it will show the collected data to an LCD monitor. By the value of the collected data, it will turn on or off the relay module to control the water pump. When the field needs water then the motor will turn on automatically. If the field is not in need of water, then the pump will be turned off. The automation will be done based on the ambient temperature, humidity, water level and moisture level, which data were collected via the sensors.

3. Dona Jose, Taniya John, B. Nithya, “Smart Water Management System using Arduino”, National Conference on Emerging Trends in Electrical, Electronics and Computer Engineering (ETEEC-2018), April 2018, e-ISSN: 2455-5703
Smart water management system is one of the necessities in the present scenario. Solar energy is the best green energy generation in India. Solar power operated agriculture pumps are available in the market today. The problem is in the effective usage of solar power, water, and their savings. So, it is necessary to store solar power in the battery and water quality and level indicating techniques are used to effectively manage the water system. The pure water is given to the domestic purposes and impure water is given to the agricultural purposes according to the quality of the water. The level indicator warns the user about the level of water in the underground and overhead tanks. The solar powered water pump automatically switches on or off according to the level of the water in the tank. The impure water is sprayed into the field according to the moisture and temperature level in the water. All these techniques are controlled using Arduino. Using the controller, it will send the notification to the user. Users can save the energy and water by sensing and analyzing the information via mobile applications

4. S. Praveen, Dr. N. Shenbaga Vadivu, “IoT based multiple sensor (DHT11, Soil Moisture Sensor) Monitoring System”, Volume 6, Issue 2, April – June 2019 e-ISSN: 2348 –1269
Agriculture is the backbone of developing countries like India; hence this field should be given utmost care and attention using latest technological advancements like Internet of Things (IoT). Implementation of smart ways for better agriculture has paved the way for this emerging field of Smart Agriculture. Smart Agriculture enables farmers to do agriculture by monitoring the field for pests, insects, sudden change in environment due to global warming, etc from remote areas like their houses. But some factors like cost should not become a burden for farmers by using such technologies. The aim of this paper is to implement a low cost and flexible means of using IoT for agriculture. The Internet of Things provides an entirely advanced dynamic network that enables us to be connected anytime and anywhere. The three major parts of our system are (Arduino, DHT11, soil moisture sensor), software development (Android), and internet connectivity (ESP-8266). The aim is to build and combine all three components together. This paper designs an internet of things-based temperature, humidity, and moisture level monitoring system for smart agriculture. The collected sensor data about the temperature, humidity and soil moisture percentage will be sent over the wireless sensor network to the ThingSpeak cloud, through which data will be uploaded via Wi-Fi. Then anyone can make a real-time inquiry on the monitoring system through an Android mobile application.

I. MAIN COMPONENTS

1. Soil Moisture Sensor FC-28:

This sensor measures the volumetric content of water inside the soil and gives us the moisture level as output. The sensor is equipped with both analog and digital output, so it can be used in both analog and digital mode. In this article, we are going to interface the sensor in both modes. Working of

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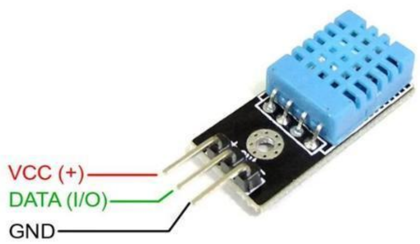
Sensor: The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value. When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower. This sensor can be connected in two modes: Analog mode and digital mode. First, we will connect it in Analog mode and then we will use it in Digital mode.

2. DHT 11 SENSOR:

The DHT11 is a commonly used Temperature and humidity sensor that comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

DHT11 Pinout Identification and Configuration:



Sl No.	Pin Name	Description
1	Vcc	3.5V to 5.5V
2	Data Pins	Data Outputs both Temperature and Humidity through Serial Data
3	NC	No Connection and hence not used
4	Ground	Connected to the Ground of the circuit

DHT11 Specifications:

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-Bit
- Accuracy: ±1°C and ±1%

3. ARDUINO UNO R3:

Arduino Uno R3 is one kind of ATmega328P based microcontroller board. It includes the whole thing required to hold up the microcontroller; just attach it to a PC with the help of a USB cable and give the supply using an AC-DC adapter or a battery to get started. The term Uno means “one” in the language of “Italian” and was selected for marking the release of Arduino’s IDE 1.0 software. The R3 Arduino Uno is the 3rd as well as most recent modification of the Arduino Uno. Arduino board and IDE software are the reference versions of Arduino and currently progressed to new releases. The Uno-board is the primary in a sequence of USB- Arduino boards, & the reference model designed for the Arduino platform.

Specifications:

- It is an ATmega328P based Microcontroller
- The Operating Voltage of the Arduino is 5V
- The recommended input voltage ranges from 7V to 12V
- The input voltage (limit) is 6V to 20V
- Digital input and output pins-14
- Digital input & output pins (PWM)-6

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- Analog input pins are 6
- DC Current for each I/O Pin is 20 mA
- DC Current used for 3.3V Pin is 50 mA
- Flash Memory -32 KB, and 0.5 KB memory is used by the boot loader
- SRAM is 2 KB
- EEPROM is 1 KB
- The speed of the CLK is 16 MHz
- In Built LED
- Length and width of the Arduino are 68.6 mm X 53.4 mm
- The weight of the Arduino board is 25 g

4. RELAY:

2-Channel 5V Relay Module is a relay interface board, it can be controlled directly by a wide range of microcontrollers such as Arduino, AVR, PIC, ARM and so on. It uses a low-level triggered control signal (3.3-5VDC) to control the relay. Triggering the relay operates the normally open or normally closed contacts. It is frequently used in an automatic control circuit. To put it simply, it is an automatic switch to control a high-current circuit with a low-current signal. 5V relay signal input voltage range, 0-5V. VCC power to the system. JD-VCC relay in the power supply. JD-VCC and VCC can be short circuited.

Relay Pin Configuration:

Pin Number	Pin Name	Description
1	Coil End 1	Used to trigger (On/ Off) the Relay, Normally one end is connected to 5V
2	Coil End 2	Used to trigger (On/ Off) the Relay, Normally one end is connected to 5V and the other end to ground
3	Common (COM)	Common is connected to one End of the Load that is to be controlled
4	Normally Close (NC)	The other end of the load is either connected to NO or NC. If connected to NC the load remains connected before trigger
5	Normally Open (NO)	The other end of the load is either connected to NO or NC. If connected to NO the load remains disconnected before trigger

Features of 5-Pin 5V Relay

- Trigger Voltage (Voltage across coil): 5V DC
- Trigger Current (Nominal current): 70mA
- Maximum AC load current: 10A @ 250/125V AC
- Maximum DC load current: 10A @ 30/28V DC
- Compact 5-pin configuration with plastic moulding
- Operating time: 10msec Release time: 5msec
- Maximum switching: 300 operating/minute (Mechanically)

5. WATER PUMP MOTOR:

Water Pump DC 3V-5V, can be easily integrated into your water system project. The water pump works using a water suction method which drains the water through its inlet and releases it through the outlet.

Specifications:

1. Input Voltage: DC 3V-5V
2. Flow Rate: 1.2-1.6 L/mz
3. Operation Temperature: 80 °
4. Operating Current: 0.1-0.2A
5. Suction Distance: 0.8 meter (Max)
6. Outside diameter of water outlet: 7.5mm
7. Inside diameter of water outlet: 5.0 mm
8. Diameter of water Inlet: 5.0 mm
9. Wire Length: 200 mm
10. Size: 45 x 30 x 25 mm
11. Weight: 30g

6. LDR SENSOR (LIGHT DEPENDANT RESISTOR)

A Light Dependent Resistor (LDR) is also called a photoresistor or a cadmium sulfide (CdS) cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases. This optoelectronic device is mostly used in light varying sensor circuits, and light and dark activated switching circuits. Some of its applications include camera light meters, streetlights, clock radios, light beam alarms, reflective smoke alarms, and outdoor clocks.

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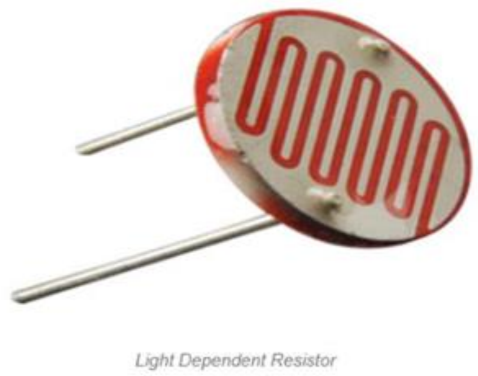


II. METHODOLOGY

THINGSPEAK:

ThingSpeak is an open source IoT Analytics platform that allows us to analyze data in the cloud. To understand the procedure behind setting up the ThingSpeak cloud, which will eventually help us understand more about how instrumental ThingSpeak has been in our project.

- Step1: To use the ThingSpeak cloud we must first create an account.

- Step2: Once our account on ThingSpeak is created, we must add a new channel with two fields namely the temperature and soil moisture fields.

- Step3: The API key from ThingSpeak cloud must be copied in our code.

A. Phase I:

In Phase I we connect and program the Arduino, Soil moisture sensor, DHT11 and ESP8266 to sense the temperature, humidity, Soil moisture level. Also, to upload sensor data automatically to the cloud.

Figure 1. Setting up ThingSpeak cloud

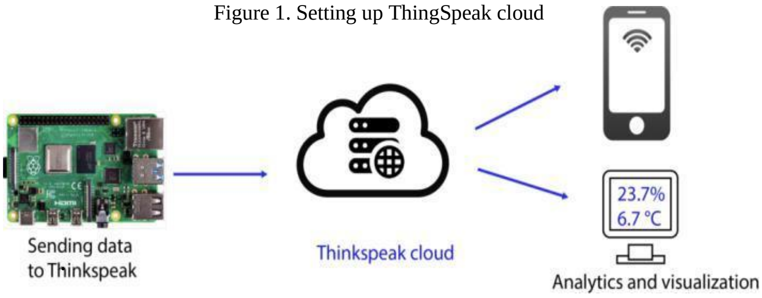
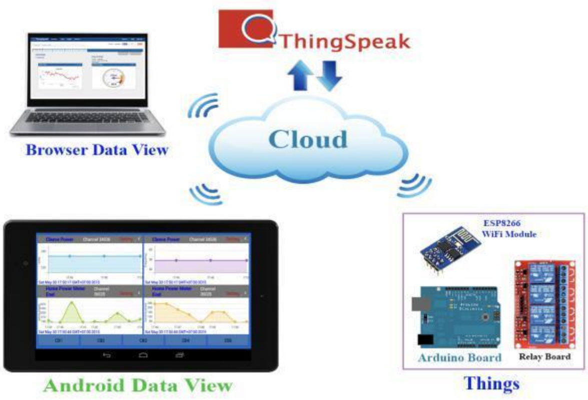
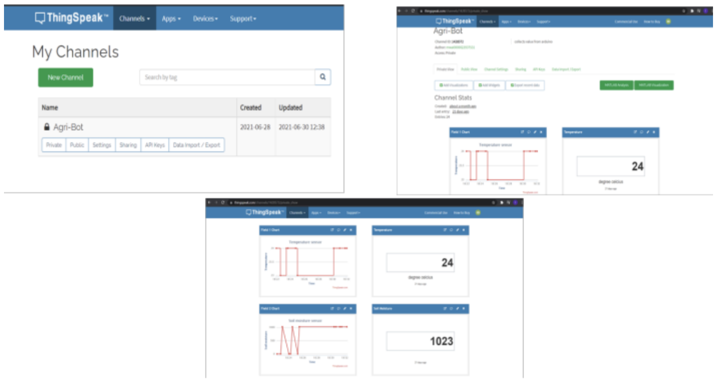


Figure 2. Working of a ThingSpeak cloud



B. Phase II:

Simulation of ThingSpeak:



MIT APP INVENTOR:

MIT App Inventor is an innovative beginner's introduction to programming and app creation that transforms the complex language of text-based coding into visual, drag-and-drop building blocks. As the App Inventor lets develop applications for Android phones using a web browser and either a connected phone or an emulator therefore, we have selected the inventor to suffice our purpose. It seeks to democratize software development by empowering all people, especially young people, to move from technology consumption to technology creation. Moving onto the Interfacing of Arduino Uno and ESP8266 with MIT app as shown in the figure:

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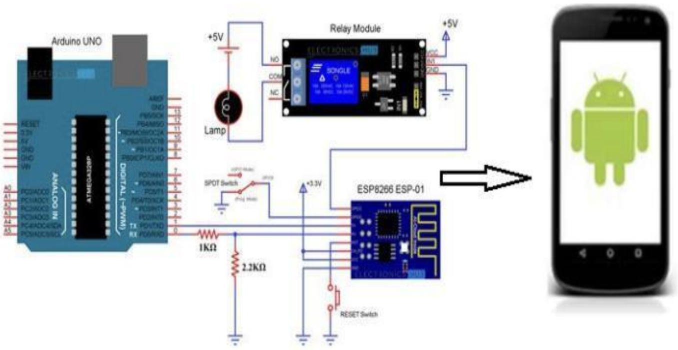
Phase I:
It includes 4 procedural steps:
Step 1 -> Prepare the software part.
Step 2 -> Prepare the hardware part.
Step 3 -> Install ESP8266 Plug-in onto your Arduino Uno.
Step 4 -> Then go to the tools menu click onto the board, then change from Arduino Uno to Generic ESP8266 Module.



In this project we're going to build an Android app using the MIT App Inventor software that allows us to control the ESP8266 GPIO's. In the MIT App Inventor, we will be displaying the following things, which are:

We will be displaying a link, which will take us to the ThingSpeak page, which will display the real time values (Temperature, Humidity, Soil Moisture) and display the graphs of Temperature vs Time and Soil Moisture vs. Time.

Moving ahead with the software part of our project,

We have used the MIT App Inventor to develop our Mobile Phone Application, along with ThingSpeak, where the data is transmitted through the ESP8266 Wi-Fi module. The two software have proven to be extremely useful in bringing our project together and making our project a success by helping us achieve our desired results.

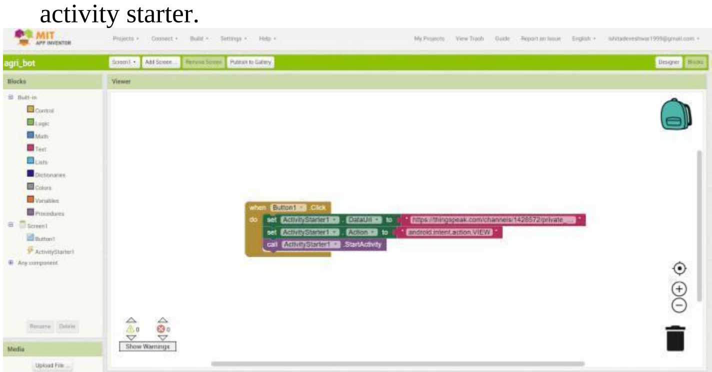
Simulation of MIT App Inventor:

PROCEDURE FOR INTERFACING of MIT APP INVENTOR:

First open the MIT app Inventor-> click on user interface-> we need a button, just drag, and drop we can use text or a picture in the button, then click on connectivity->drag an activity starter and that's all we need here now.

Moving on to the block >click on control> then drag button1, then go to the activity starter >select setdata URI and place the text box next to it which shows the link of thingspeak page.

Again select activity starter>select action and place a text box having the command android.intend.action.VIEW and lastly select call activity starter.



METHODOLOGY *(Step-by-Step):*

Step 1: The Soil Moisture Sensor gathers input from the abstracts such as the soil and the atmosphere of the sample which has been taken into consideration and hence, passes it to the Arduino.

Step 2: On the basis of the input, Arduino UNO R3, the brain of the Bot, compares the data acquired incessantly with the given range (provided as input by the programmer); the range is embedded in the code as, '1023' indicates that the soil is dry, while '0' indicates that the soil is good, this data helps the Arduino decide whether the switch of the water pump motor must be turned on or off. This is the decision-making statement in the source code of TinkerCad.

Step 3: DHT11 Sensor, which is a commonly used Temperature and humidity sensor, fetches data on the Temperature and Humidity of the sample taken into consideration and displays the very same on the 16, 2 LCD Screen, as visualized on the simulation.

Step 4: The data is uploaded on the ThingSpeak cloud from where the user can analyze the soil moisture vs time and temperature vs time, the real time values directly. The data is displayed in the form of graphs, i.e., Temperature v/s time and Soil Moisture v/s time.

Step 5: The same data can be accessed by the smartphone application which has been built using the platform, the MIT App Inventor, upon clicking on a link displayed on the

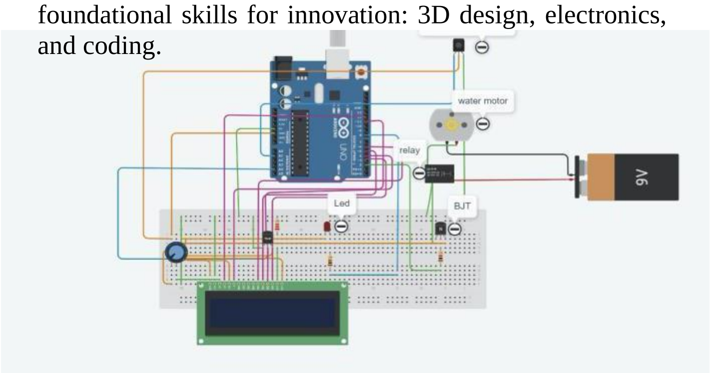
Application, it straightaway takes us to the ThingSpeak page for manual data analysis by the user.

Thus, with our current bot, regardless of the type of the soil, the bot analyses the values of the Agri Bot and detects the soil moisture of the field, with constant updation of real-time data, which is further processed and displayed on the smartphone application.

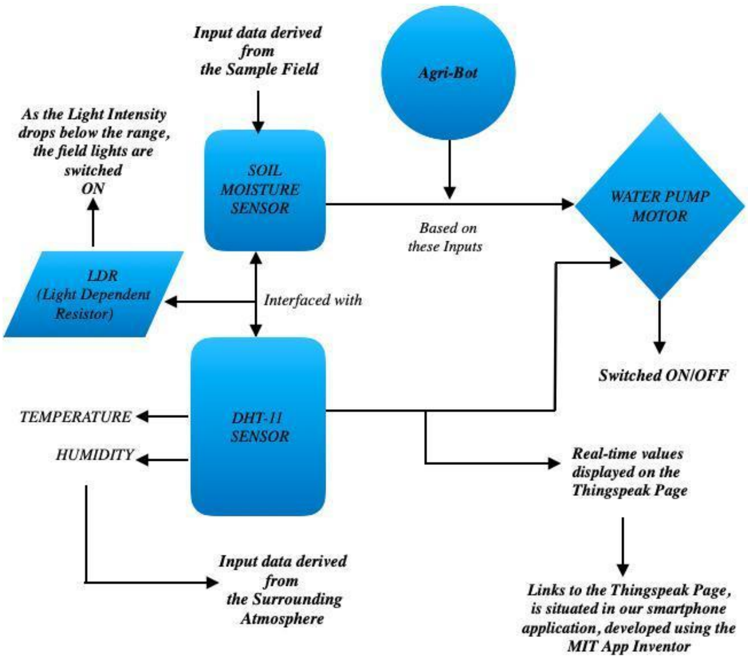
We aspire to modify the app by adding recommendations of the crops that could potentially be grown in the field of the user and hence increase their yield, this is solely done based on the input received by the Agri-Bot. Another aspiration we hold is that in case our demographic fails to have a smartphone we would send the necessary data in the form of a text message.

TINKERCAD:

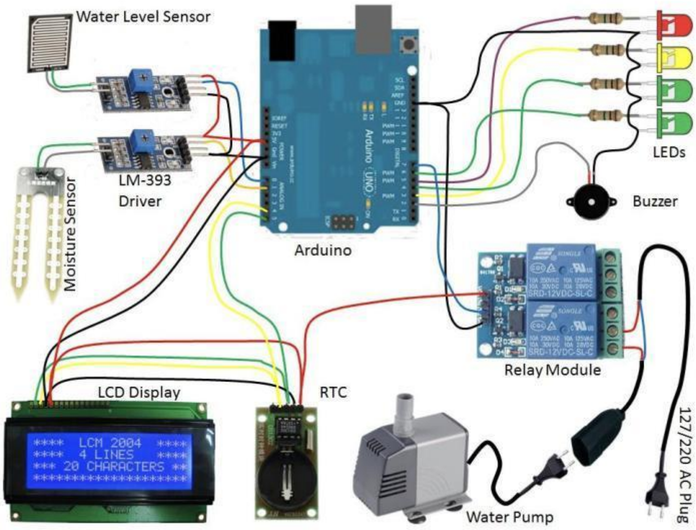
TinkerCad is a free, easy-to-use web app that equips the next generation of designers and engineers with the foundational skills for innovation: 3D design, electronics, and coding.



III. WORKING



IV. HARDWARE SETUP

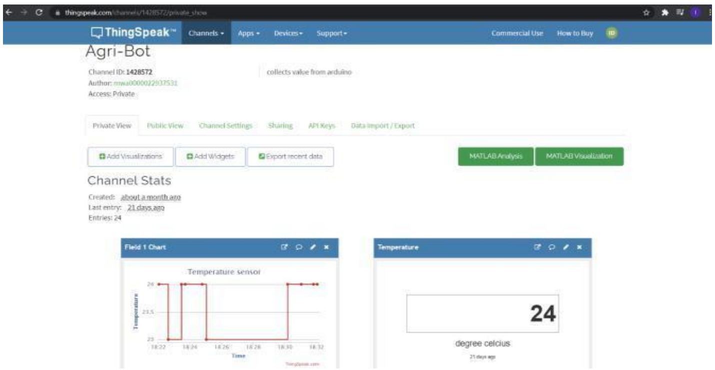


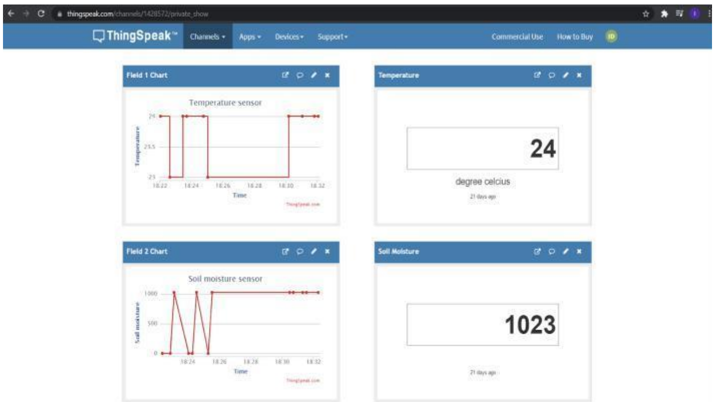
V. RESULTS AND GRAPH

Our proposed model was successfully completed with the following results:

1. We successfully enabled the Soil Moisture Sensor to gather input from the abstracts such as the soil and the atmosphere of the sample, taken into consideration and hence, passed it to the Arduino.
2. We made sure that solely based on the input, the Arduino UNO R3, compares the data acquired incessantly with the given range, the range is embedded in the code as, '1023' indicates that the soil is dry, while '0' indicates that the soil is good, this data helps the Arduino decide whether the switch of the water pump motor must be turned on or off. This is the decision-making statement in the source code of TinkerCad.
3. The DHT11 Sensor, which is a commonly used Temperature and humidity sensor, is made to fetch data on the Temperature and Humidity of the sample taken into consideration and display it on the 16, 2 LCD Screen, as visualized on the simulation.
4. The data is uploaded on the ThingSpeak cloud from where the user can analyse the soil moisture vs time and temperature vs time, the real time values directly.
5. The same data is made to be accessed by the smartphone application which has been built using the platform, the MIT App Inventor, upon clicking on a link displayed on the Application, it straightaway takes us to the Thingspeak page for manual data analysis by the user.

Outputs: The output obtained can be determined in the form of the graphs given below:





VI. APPLICATIONS AND ADVANTAGES

Applications of the System:

A. Monitoring of soil moisture percentage, temperature, humidity to prevent crop damages. We can use this system to monitor any kind of crop.
B. Use this system to monitor concrete settings.
C. Use this system to monitor building moisture levels.
D. Monitoring of room temperature like vegetable and fruits warehouses.

E. Monitoring the temperature of machines in factories to prevent machines from being damaged

Advantages of the Agri-Bot:

Delving into the various advantages of our project:

We have already observed that by incorporating various sensing and controlling techniques, we can see an increased crop production. And the other advantages include:

➔The farmer has access to Real-Time Data and Production Insight.
➔On prevention of over watering or lack of watering we can reduce soil erosion and nutrient leaching.
➔And thereby conserving water resources.

Thus, there is a need for wireless technologies and automation in the agricultural industry.

VII. FUTURE WORK

The possible future work could include focusing on interfacing different soil nutrient sensors with Arduino UNO and analyzing the result to get correct and better results, it will further reduce the production cost, utilization of water and fertilizer. The collection of data from various farmlands, and analyzing the data based on data mining algorithms would be suitable for agriculture.
Big data analysis can also be used for getting the desired outcome. The outcome data can be sent to farmers and agro industries to know the requirement of seed, fertilizer, and water according to the data.

How can big data help agriculture?
To counter the pressures of increasing food demand and climate changes, policymakers and industry leaders are seeking assistance from technology forces such as IoT, big data, analytics, and cloud computing. IoT devices help in the first phase of this process — data collection. Sensors plugged in tractors and trucks as well as in fields, soil, and plants aid in the collection of real-time data directly from the ground. Second, analysts integrate the large amounts of data collected with other information available in the cloud, such as weather data and pricing models to determine patterns. Finally, these patterns and insights assist in controlling the problem. They help to pinpoint existing issues, like operational inefficiencies and problems with soil quality, and formulate predictive algorithms that can alert even before a problem occurs. The adoption of analytics in agriculture has been increasing consistently; its market size is expected to grow from USD 585 million in 2018 to USD 1236 million by 2023, at a Compound Annual Growth Rate (CAGR) of 16.2%.

Top 4 use cases for big data on the farm:
The scope for big data applications is large, and we've only just begun to explore the tip of the iceberg. The ability to track physical items, collect real-time data, and forecast scenarios can be a real game changer in farming practices. Let's look at a few use cases where big data can make a difference.

1. Feeding a growing population

This is one of the key challenges that even governments are putting their heads together to solve. One way to achieve this is to increase the yield from existing farmlands.

Big data provides farmers granular data on rainfall patterns, water cycles, fertilizer requirements, and more. This enables them to make smart decisions, such as what crops to plant for better profitability and when to harvest. The right decisions ultimately improve farm yields.

2. Using pesticides ethically

Administration of pesticides has been a contentious issue due to its side effects on the ecosystem. Big data allows farmers to manage this better by recommending what pesticides to apply, when, and by how much. By monitoring it closely, farmers can adhere to government regulations and avoid overuse of chemicals in food production. Moreover, this leads to increased profitability because crops don't get destroyed by weeds and insects.

3. Optimizing farm equipment

Companies like John Deere have integrated sensors in their farming equipment and deployed big data applications that will help better manage their fleet. For large farms, this level of monitoring can be a lifesaver as it lets users know of tractor availability, service due dates, and fuel refill alerts. In essence, this optimizes usage and ensures the long-term health of farm equipment.

4. Managing supply chain issues

McKinsey reports that a third of food produced for human consumption is lost or wasted every year. A devastating fact since the industry struggles to bridge the gap between supply and demand. To address this, food delivery cycles from producer to the market need to be reduced. Big data can help achieve supply chain efficiencies by tracking and optimizing delivery truck routes. With our current project, it can be concluded that using technology in agriculture will significantly reduce water wastage and human intervention in the field of farming.

CONCLUSION

The paper implements a simple and low-price monitoring system by means of temperature & humidity sensor DHT11, Soil moisture sensor, ESP-8266 (Wi-Fi module) and Arduino Uno board to collect environment changes and transmit this data to the cloud through Wi-Fi And monitor the real time progress through our developed android application. As an important constituent part of the IoT, sensor networks provide us with a new multidisciplinary model to observe and interact with the physical world that was unobtainable before. This paper reports on the sensor networks design that enables connecting to the IoT. The connection sets up links among agronomists, farms and crops regardless of their geographical differences and thus improves the production of agricultural products based on observing the agricultural parameters and making decisions, based on parameters. Sensor nodes are required with reliability, cost effectiveness along with application specific features. In this work we designed the customized sensor node that senses agricultural parameters and displays the same on the screen. Our future work will be focusing on interfacing different soil nutrient sensors with Arduino UNO and analyzing the result to get correct and better results, it will reduce the production cost, utilization of water and fertilizer. The collecting of data from various farmlands, analyzing the data based on data mining algorithms suitable for agriculture. Big data analysis can also be used for getting the desired outcome. These outcome data can be sent to farmers and agro industries to know the requirement of seed, fertilizer, and water according to the data.

The implemented smart irrigation system is cost effective. The automatic watering system reduces the wastage of water. Real-time update to the cloud helps to view the current water condition in the plant. With this project, it can be concluded that using IOT in agriculture reduce water wastage and human intervention

The conclusion can be summarized as follows:

1. The project implements a simple and low-price monitoring system by means of a temperature & humidity sensor which is the DHT11 sensor, Soil moisture sensor, ESP-8266 (Wi-Fi module), and Arduino Uno board.

2. An important constituent of our project is sensor networking which provides us with a new multidisciplinary model to observe and interact with the physical world and abstracts, which wasn't readily available to our demographic.

3. Our bot basically sets up links amongst the agronomists, farms, and crops regardless of their geographical differences and thus improves the production of agricultural products based on observing and making decisions based on the agricultural parameters.

4. The interfaced sensor nodes provide the factor of reliability, cost-effectiveness along with application-specific features to our project.

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