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Smart Farming: IOT Based Sensors for Monitoring Agricultural Field Using Single Axis Solar Tracking

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ABSTRACT

Agriculture is the primary source of income for about 58 percent of India's population. Agricultural IoT is based on the collection of data for soil or plant can be used to analyze the fertility of the soil. As a result of the monitoring of the sun's location and the positioning of the solar panel, the aim of the project is to design an IoT-based automatic tracking and irrigation system. Solar power will provide a cost-effective solution to all of our energy needs. The solution for the Indian farmer is solar-powered smart irrigation systems. This device consists of a solar-powered water pump and a moisture sensor- controlled automatic water flow monitor. It is the proposed solution for Indian farmers' current energy crisis. This device saves energy by reducing the amount of grid power used and water by reducing the amount of water used. This system can monitor the status of the soil moisture. The monitoring system uses soil moisture sensor for monitoring soil moisture, DHT11 sensor for temperature humidity and methane sensor for measuring the levels of methane. The monitoring system is designed based on microcontroller and transfers the data to the Blynk application. The system can assist farmers in monitoring their fields and making treatment decisions based on the data. It has the potential to boost agricultural output efficiency while decreasing management and farming costs.

Index Terms— Agriculture, IoT, Solar, tracking, soil moisture sensor, DHT11, methane sensor.

I. INTRODUCTION

Agriculture is the major source of income for the largest population in India and is a major contributor to the Indian economy. However, technological involvement and usability must be grown and cultivated for India's agro sector. Although the Indian government has taken a few initiatives to provide farmers with online and mobile messaging services related to agricultural queries and agro vendor information. Based on the survey it is observed that agriculture contributes 27 percent to GDP, and employs 70percent of the Indian population. IoT is changing the agriculture domain and empowering farmers to fight the huge difficulties they face.

Agriculture must address growing water shortages and limited land availability while meeting the growing consumption demands of a global population.

These problems are being solved by new creative IoT applications Increasing agricultural production's efficiency, quantity, sustainability, and cost-effectiveness. Agriculture is the backbone of the Indian Economy. Agriculture consumes 85 percent of the world's freshwater capital, according to estimates, and this percentage will continue to be dominant in water consumption because of population growth and increased food demand. There is a pressing need to establish science and technology-based solutions for long-term sustainability use of water, including technical, agronomic, managerial, and institutional improvements.

Crop water requirement laws are used to direct Internet- based agricultural irrigation. By using Internet technology and sensor network technology we can control water wastage and maximize the scientific technologies in irrigation methods. As a consequence, it has the ability to dramatically increase water usage and efficiency. The Internet of Things (IoT) is a technology that allows a mobile user to control the environment function of a device. The Internet of Things (IoT) is concerned with linking interacting objects that are not connected to the internet installed at different locations that are possibly distant from each other. Internet of Things (IoT) is a type of network technology, which senses the information from different sensors and makes anything join the Internet to exchange information. A communication system will be included in the central processing unit to collect data from the sensors and transmit it to the user's device. This can be accomplished by the use of a higher-level networking system, such as a Wi-Fi module. This can be accomplished by the use of a higher-level networking system, such as a Wi-Fi module. The central module's data is translated into usable data and relayed to the user. A portable device, such as a cell phone or a tablet, may be used to display the data. Water shortage is a major problem for farmers these days. This project helps the farmers with an irrigation system based on a soil moisture sensor, MQ4 sensor, DHT11 sensor (temperature humidity), and Rain sensor with getting the power supply from a solar tracking system.

II. LITERATURE SURVEY

1. 1.N.V.Parasnis and A.P.Tadamalle "Automatic Solar Tracking System" Solar energy is a natural renewable energy source that is clean, free, and abundant. Capturing solar energy from nature is a cost-effective way to produce electricity. The trans- formation of solar energy into another form is a complicated process. For this purpose, Photo-Voltaic (PV) panels are used which convert energy from the sun to direct current (DC) electrical energy. Fixed-type PV panels extract the most energy between 12 and 2 p.m., which is when they are most effective results in less efficiency. PV panels have to be perpendicular to the sun for maximum energy extraction which can be fulfilled by automatic tracking. This project includes the design and development of a microcontroller-based automatic solar tracking system. LDRs (Light Dependent Resistors) are used to detect the strength of sunlight and hence the location of the sun in the sky. The AT89S52 microcontroller is used to monitor the movement of the PV plate. The PV panel is rotated by geared DC motors in this mechanism. DC motors are controlled by the microcontroller concerning signals from LDR. Zigbee transmitter-receiver pair is implemented to receive the data from a remote location (plant) i.e for data acquisition purpose. On-site, a Liquid Crystal Display (LCD) is used to display the output DC voltage and current, while data is acquired, stored, and displayed using Visual Basic (VB) at the supervising venue.

2. Iswadi Hasyim Rosma, Ery Safrianti, and Azriyenni Azhari Zakri, "Analysis of Single Axis Sun Tracker System to Increase Solar Photovoltaic

Energy Output in the Tropics." The utilization of a Solar Photovoltaic (SPV) generation system is generally installed at certain tilted angles; therefore it does not obtain the optimum solar radiation from the sun. The SPV generation system with a single axis sun tracker was developed and evaluated in this paper to resolve this weakness. Two LDR sensors are used in the sun tracker system to measure the sun's location. As a controller system, the Arduino Uno 3 was used The Arduino Uno 3 instructs a servo motor to drive the SPV panel from the east to the west to track the movement of the sun in a similar direction. It was compared to an SPV generation system mounted at a certain number of tilted angles to recognize the energy gain of a single axis sun tracker. The results show that the SPV generation system with a single axis sun tracker produces significantly more energy than the system without a tracker where its energy gain is up to 22 percent. As a result, it can be inferred that in tropical regions, when the SPV panel is fitted with a single-axis sun tracker, there is a promising potential increase in capacity.

3. "Smart Farming: IoT Based Smart Sensors Agriculture Stick for Live Temperature and Moisture Monitoring using Arduino, Cloud Computing, and Solar Technology". Internet of Things (IoT) technology has brought the revolution to every field of the common man's life by making everything smart and intelligent. IoT refers to a network of things that make a self-configuring network. The creation of Intelligent Smart Farming IoT-based devices is changing the face of agriculture production every day, not just by improving it but also by making it more cost-effective and reducing waste. The proposed product has been tested on live agriculture fields and has a data feed accuracy of over 98 percent. The aim of this paper is to propose a new smart IoT-based agriculture stick that will help farmers obtain real-time data (temperature, soil moisture) for efficient environmental monitoring. They will be able to do smart farming and improve their overall yield and product quality. The Agriculture Stick proposed in this paper is equipped with Arduino Technology, Brewery Technology, and Brewery Technology.
4. Prahlad Bhadani and Dr. Vasudha Vashisht "Soil Moisture, Temperature and Humidity Measurement Using Arduino" In- dia was the seventh-largest agricultural exporter in 2013, with 39 billion dollar in agricultural exports. All this data shows how big the agricultural industry in India is. To teach Indian farmers how to use smart farming techniques to accurately track key factors. The instrument calculates three of the most critical and fundamental plant growth parameters. The microcontroller is Arduino Uno. To test soil moisture and temperature, the FC28 Hygrometer and DHT11 sensors are used. The data is read by the sensors and transmitted to the microcontroller board. After that, the board processes and maps the data according to the code before eventually showing it on the LCD.
5. Prachi Rani, Omveer Singh and Shivam Pandey "An Analysis on Arduino based Single Axis Solar Tracker" On the Arduino Uno platform, a single-axis tracking device based on solar photovoltaic (SPV) cells. The key idea of this article is to implement an automatic single-axis solar tracking system. The best way to get the most solar radiation is to align the solar panel with the sun. This device keeps track of the light's full intensity in terms of peak strength (MPP). When the light intensity decreases, its alignment changed automatically for catching maximum light intensity. This article shows the implementation and analysis of single-axis solar trackers, while various solar axis trackers are available in the market. Meanwhile, the proposed technique will easily locate the axis and align it with the sun's rays to provide accurate results.

III. EXISTING SYSTEM

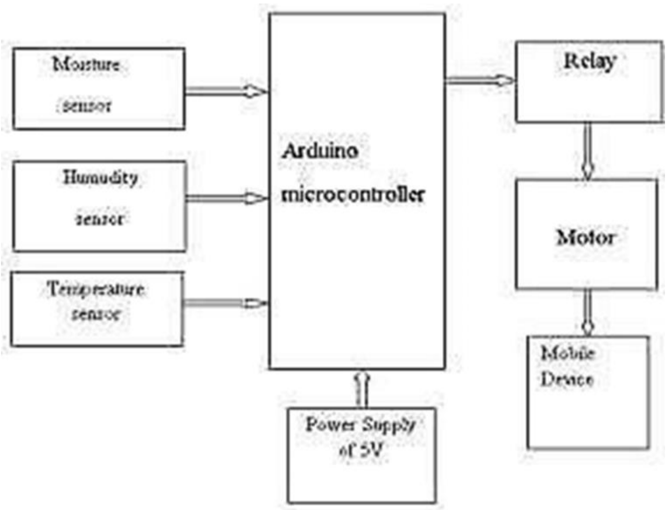

Fig. 1. Block Diagram of Existing System

A. Working of Existing System

The Existing systems are used to avoid the unnecessary water flow into the fields and it may cause the crop failure to avoid such kind of activities they develop and monitor the Moisture, temperature and humidity readings by using temperature, moisture and humidity sensor. These data are sent to the assigned protocol, which allows us to keep track of the current field situation. Once the soil moisture level, water level, humidity values are exceed the limit it turns the motor on, which is connected to the Arduino. This android application has 4 options. This is includes motor, temperature, humidity values and moisture values.

IV. PROPOSED SYSTEM

The proposed system is intended to reduce the amount of water that flows through agricultural fields unnecessarily. Temperature, moisture, humidity, methane and rain sensor readings are continuously monitored by using temperature, moisture and humidity sensor and these values are sent to the assigned IP address.

IoT application continuously collects the data from that assigned IP address. When the soil moisture values reach the stated level, the motor is operated by the relay, which is linked to the microcontroller. The IoT application is a simple menu driven application, with four options. This includes motor status, soil moisture, DHT11 (temperature humidity) and values. The current state of the pump is indicated by the motor status.

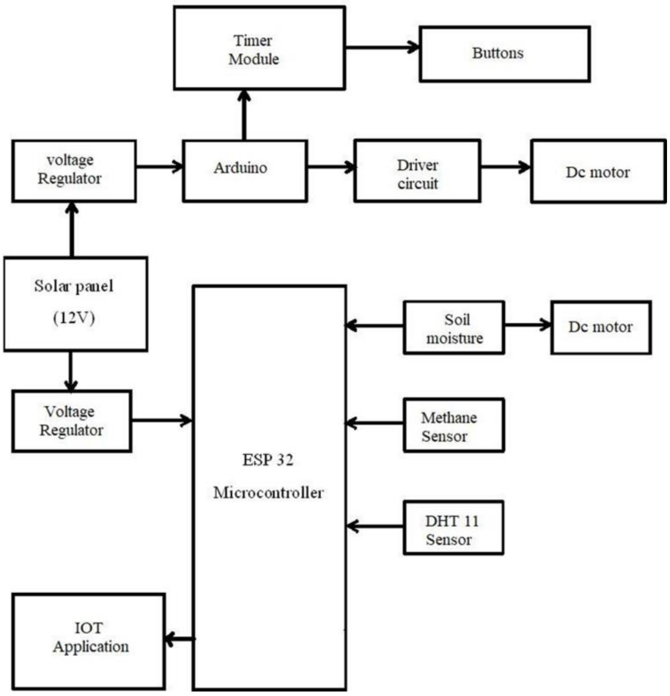

Fig. 2. Block Diagram of Proposed System

V. COMPONENTS

A. Arduino Genuino Uno

Arduino Uno is a microcontroller board created by the Arduino company which is an open-source electronics platform mainly based on AVR microcontroller ATmega 328. The first Arduino project was started in interaction design institute lvera in 2003 by David Cuartielles and Massimo Banzi to provide a cheap and flexible way for students and professionals for controlling several devices in the real a USB interface, 6 analogue input pins, and 14 I/O digital ports for connecting to external electronic circuits. Six pins of the 14 I/O ports can be used for PWM output. The microcontroller is ATMega328P operates at 5 volts, Can work on 7-20 volts of input voltage, has 14 digital i/o pins (6 for pulse width modulation output), 6 analog input pins. Direct Current per input/output pin: 0.020A, Direct Current for 3.3 volt pin: 0.05A, 32 KB of flash storage out of which boot loader uses 2 KB of Static random access memory(SRAM), 1 KB of Electrically erasable/programmable ROM, Processor frequency is 16 Mega Hertz, Dimensions: 6.86 cm × 5.34 mm, Weight: 25 g

Fig. 3. Arduino Uno

B. ESP32

ESP32 is the name of the chip that was developed by Espressif Systems. This provides Wi-Fi (and in some models) dual-mode Bluetooth connectivity to embedded devices. While ESP32 is technically just the chip, modules and development boards that contain this chip are often also referred to as "ESP32" by the manufacturer. The ESP32 is most commonly engineered for mobile devices, wearable tech, and IoT applications. While this reputation is not unmerited, the low-cost device can also be used in a number of different production systems, and its capabilities and resources have grown impressively over the past four years. The specifications of ESP32 are Microprocessor: Tensilica Xtensa LX6, Maxi- mum Operating Frequency:240MHz, Operating Voltage:3.3V, Analog Input Pins: 12-bit, 18 Channel, DAC Pins: 8-bit, 2 Channel, Digital I/O Pins :39 (of which 34 is normal GPIO pin), DC Current on I/O Pins: 40 mA, DC Current on 3.3V Pin: 50 mA, SRAM: 520 KB, Communication: SPI(4), I2C(2), I2S(2), CAN, UART(3), Wi-Fi 802.11 b/g/n, Bluetooth V4.2 – Supports BLE and Classic Bluetooth

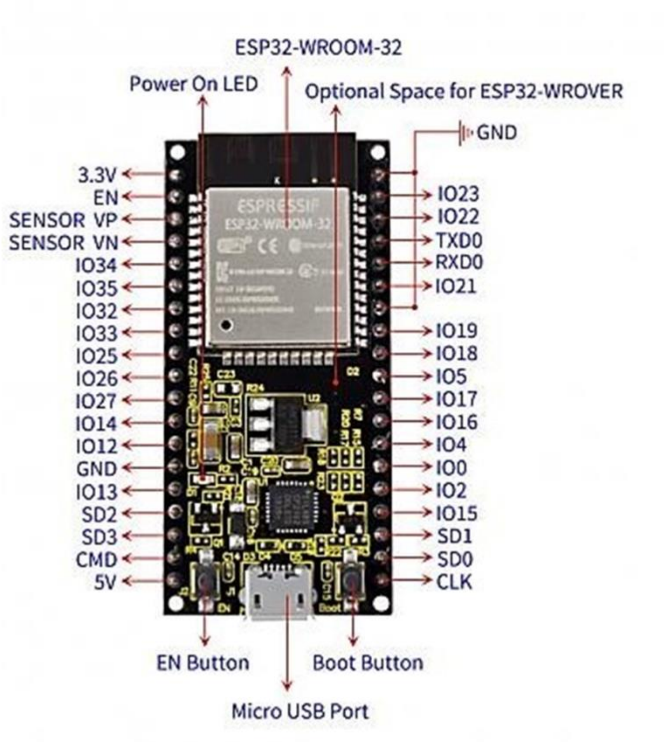

Fig. 4. Pin Diagram of ESP32

C. Solar Panel

Photovoltaic modules use light energy (Photons) from the sun to generate electricity through the photovoltaic effect. The majority of modules use Wafer based crystalline Silicon cells or thin-films cells. In this paper Thin film solar panel is used.

Fig. 5. Polycrystalline Solar Panel

D. Soil Moisture Sensor

Capacitance is used by the Soil Moisture Sensor to deter- mine the dielectric permittivity of the surrounding medium. The sensor produces a voltage that is proportional to the dielectric permittivity, and thus the soil's water content. The specifications are Voltage: 3.3V-5V and Soil Moisture Sensor Module Type: Hygrometer Detection Module

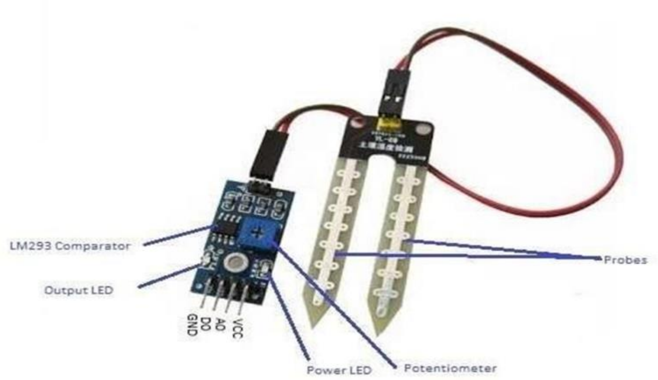

Fig. 6. Soil Moisture Sensor

E. DHT11 Sensor

The DHT11 is a simple digital temperature and humidity sensor with a low price tag. It measures the ambient air with a capacitive humidity sensor and a thermistor and outputs a digital signal on the data pin (no analogue input pins needed). The specifications are Operating Voltage: 3.5V to 5.5V, Op- erating current: 0.3mA (measuring) 60uA (standby), Output: Serial data Temperature Range: 0°C to 50°C, Humidity Range: 20 to 90 percent, Resolution: Temperature and Humidity both are 16-bit and Accuracy: ±1°C and ±1 percent

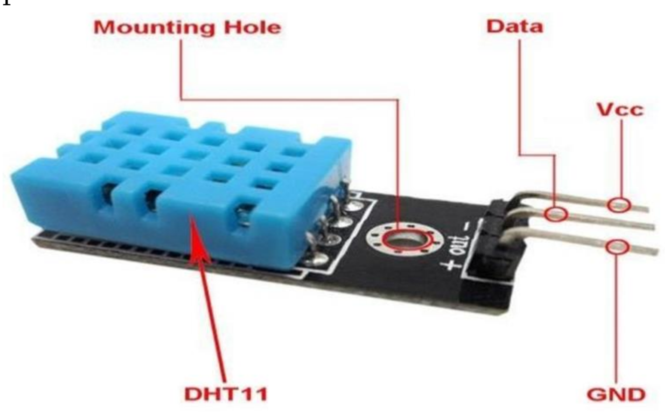

Fig. 7. DHT11 Sensor

F. Methane Sensor

A hydrogen flame is used to ionize the methane sensor in FIDs. An electrical current is produced by the ionized gas, which is calculated to determine the gas concentration. While FIDs are quick and precise, they require a hydrogen source, an open flame, and a clean air supply. The specifications are Sensor Type: Semiconductor, Power requirements: VCC - 5V±0.1, DO output: TTL digital 0 and 1 (0.1 and 5V), AO output: 0.1 – 0 .3 V (relative to pollution), the maximum concentration of a voltage of about 4V Detection Gas: Natural gas/Methane, Detection Concentration: 200-10000ppm (Natural gas / Methane), Interface: 1 TTL compatible input (HSW), 1 TTL compatible output (ALR) and Heater consumption: less than 750 mW

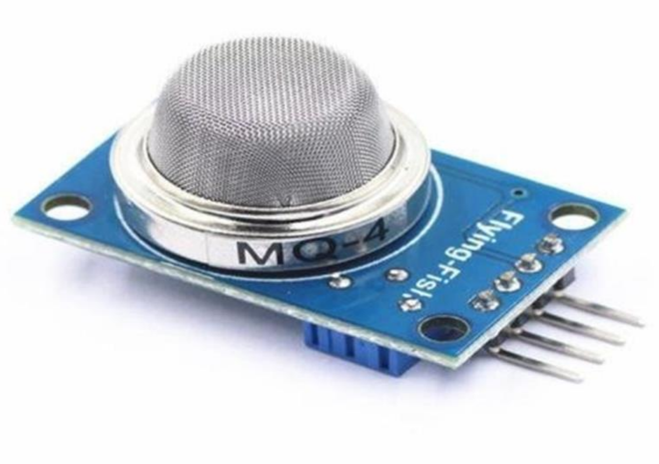

Fig. 8. Methane Sensor

G. DC Motor

The movement of the solar panel is regulated by a direct- current (DC) motor driver circuit in solar trackers. Traditional DC motor drivers used in solar tracking systems, on the other hand, do not have any speed or torque control options. As a consequence, the DC motor's fixed speed induces either too fast or too slow tracking movement. The specifications of DC motor are Operating Voltage (V): 12, Rated Speed (RPM): 200, Rated Torque (kg-cm): 1.5, Stall Torque (kg-cm): 5.4, Load Current (A): 0.3, No Load Current (A): 0.6

Fig. 9. DC Motor

H. Timer Module

The oscillator's pulses are counted by the electronic timer circuit, which activates certain acts after a certain number of pulses have been counted. . The circuit will then count seconds until a minute has elapsed before incrementing the minute clock.

Fig. 10. Timer Module

VI. RESULTS AND DISCUSSION

The following Tabular column shows the Result obtained from Temperature and Humidity sensors for 6 days

Table 1 Output of Temperature and Humidity Sensor

Days	Temperature	Humidity
11/3/21	33.100	57.000
12/3/21	33.200	57.000
13/3/21	33.300	57.000
14/3/21	33.500	57.000
15/3/21	33.800	58.000

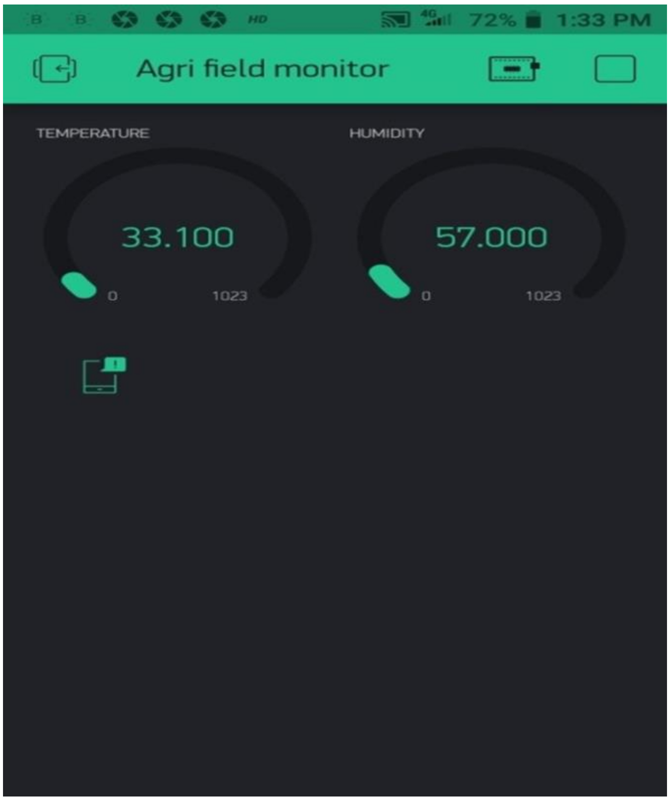

Fig. 11. Readings of Temperature and Humidity Sensor

SOIL MOISTURE SENSOR: If condition is dry, pump is ON

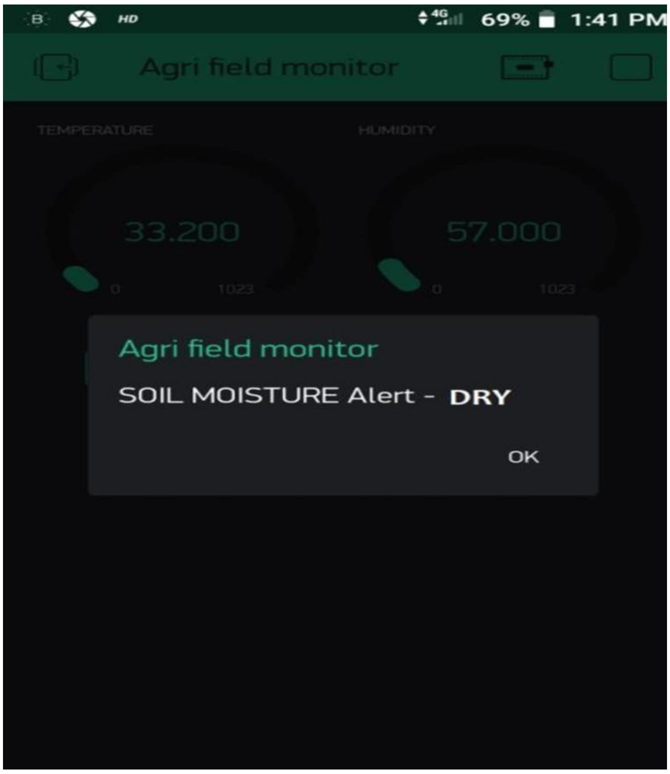

Fig. 12. Notification from Soil Moisture Sensor

If condition is wet, pump is OFF

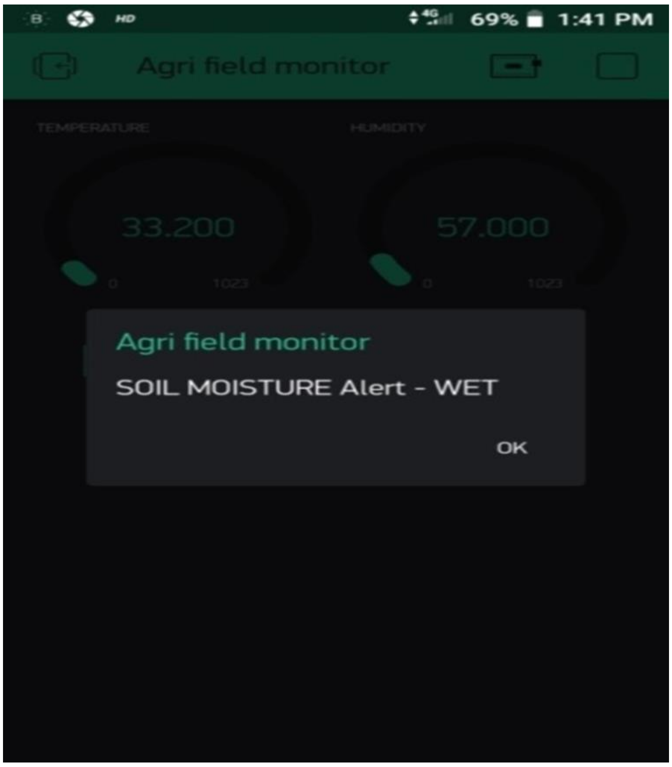

Fig. 13. Notification from Soil Moisture Sensor

METHANE SENSOR: If methane gas is not detected it gives a message (GAS NOT DETECTED)

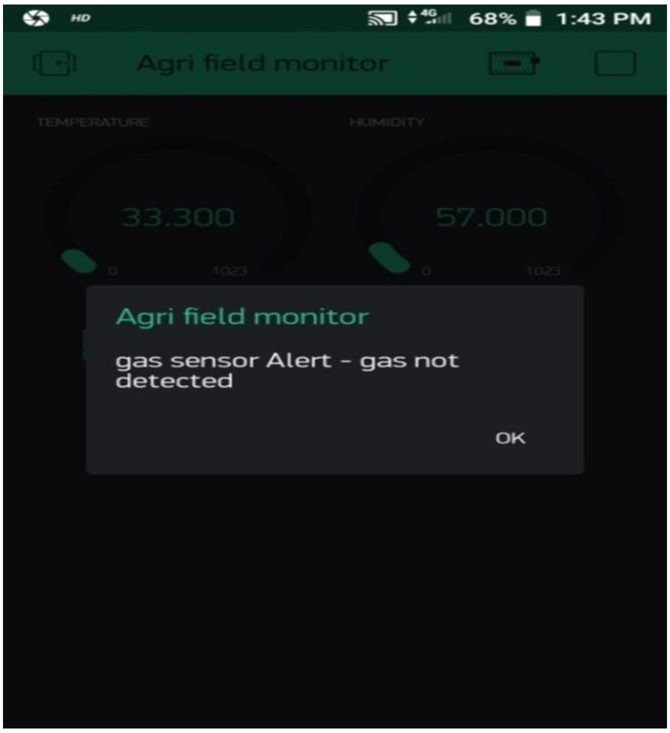

Fig. 14. Notification from Methane Sensor

If methane gas is detected it gives a message (GAS IS DETECTED)

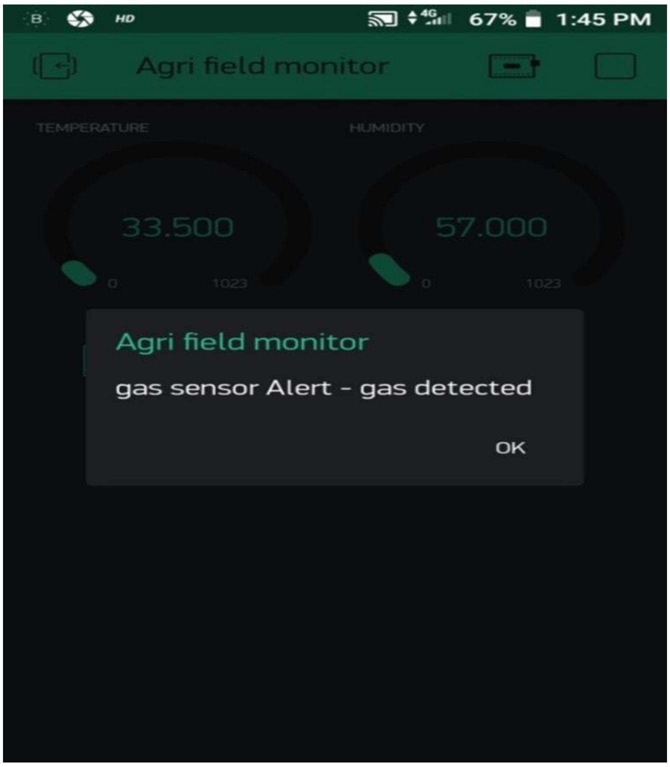

Fig. 15. Notification from Methane Sensor

Fig. 16. Hardware Setup

VII. CONCLUSION

We are busy with our daily routines and we are not ready to look after the environment. It is getting polluted day by day as a result of which soil gets depleted and causes soil contamination. So to avoid soil pollution, protecting our environment, this project has been implemented. This will be useful for protecting the field using IoT. It not only helps in protecting the field but also helps to get sensed data of humidity, temperature, soil moisture to identify the current scenario of our field. From this sensed data accordingly we decide whether motor has be turn on or off. In future IP address of mobile can be accessed and the data values can be monitored in it, because we have to get permission for mobile access nowadays.

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