Modern Agriculture Farmer Assistant

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Abstract

IoT Technology is bringing a revolution in many fields of human endeavour. By making everything smart and creating a space of automation between devices to work intelligently, Iot based devices are transforming our working methods by making them more efficient and reliable. When used in agriculture, this technology can give many benefits to the people involved in farming activities. Smart farming is enabled by using such automation based IoT devices in agriculture. In order to increase productivity in farms, certain parameters to be considered include soil characteristics like moisture, temperature, humidity, etc., which help a farmer make decisions based on specific values. Various sensors deployed in the field measure these parameters based on which the Arduino Board microcontroller takes decisions to provide different functionalities like irrigation, smoke and intruder detection, etc. Farmers are provided on time and accurate information through web pages. Crop Suggestion Module in these systems is an additional benefit for the farmer.

Keywords: - *IOT (Internet of Things), Agriculture, Arduino board, Sensors, DHT11, PIR Sensor, Automation, Irrigation*

INTRODUCTION

One of the main factors of human survival is food, which depends on a country's agriculture. The major source of income for 70% of population in India is agriculture. Most of the farmers are unaware of the prevailing modern technology and thus are continuing with traditional farming.

Traditional farming is laborious and necessitates greater involvement of the farmer in on-field activities. It is overall a hectic process to monitor different parameters essential for achieving required productivity.

As agriculture is the most critical sector of our country, it is essential to bring automation in this field which could enhance crop yield and helps to develop economy. Considering this problem we can bring automation forward and implement it to reduce the workload of farmers. We could rely on automation based devices for smart management. Even if introduced in only irrigation process, automation can bring about enhanced efficiency in utilising water resources.

Similarly, here this system is used for automation and remote monitoring of different aspects of the field. It monitors the parameters remotely through web page help and automatically manages irrigation, smoke, and human detection. The Iot based System also works for crop suggestion and provides detailed information. Our device is used to increase efficacy of farming techniques. It will gradually help farmers to reduce their workload and provide efficient usage of resources.

RELATED WORK

In [1], [6], [10] B. Sridhar, Dr M. Yuvaraju, Sudarshan KG has proposed an automated system using Raspberry Pi with the concept of Cloud Computing which increases the cost factor. In [2],[19], Dr N. Suma, Kalyani Bhole et al. proposed an agricultural system using PIC16F877A microcontroller with a manual irrigation mode. In [3],[4],[5] proposed Smart Crop Monitoring System uses Arduino ATmega 328, but it is limited to crop-monitoring only, and video surveillance system is an additional feature, but the cost factor is impacted. In [8] Nikesh Gondchawar, Dr R. S. Kawitkar proposed IOT based Smart Agriculture system providing real-time sensing of parameters with an additional water-level sensor. In [12],[16],[18] proposed project uses Raspberry Pi, which increases cost factor. In [17] Sinitambirivoutin Embrik proposed Smart Irrigation and Fertilization System using NRF24L01 transmitter and receiver to send data to web-application. In [7], [20] B. Shweta, Srishti Rawalet. al proposed IOT based Irrigation system using Arduino Uno and Thing Speak for sensor data.

PROPOSED WORK

In this proposed work, we aim to develop an automated system which provides precised real-time data for various parameters using different sensors deployed in the field. Also automatic Irrigation process is taken into consideration which depends on the sensed value of moisture of the soil. This process can be useful in terms of reducing the wastage of water resources. Also PIR sensor is used to detect any animal/human intrusion in the field.

Our proposed system also includes the gas detection if any in the field so to avoid any gas-leakage which can cause fire and damage to the crops. This system also displays all the sensor data on a very user-friendly web-page so as farmer can take decisions correctly. Our system also consists of Crop Suggestion Module which is useful for the farmer to gain knowledge about the crops and his farming techniques.

Table 1: Comparison of Existing and Proposed Work

References	Technology	Frequency	Cost
Reference[1]	Wifi Module	2.4GHz - 5GHz	High
Reference[2]	GSM	900-1800MHz	High
Reference[3]	NRF24L01 Module	2.4GHz	Low
Reference[4]	GSM SIM 800L	850-1900MHz	Med
Reference[5]	Zigbee	2.4GHz	High
Reference[6]	NFC	13.56MHz	-
Reference[7]	GSM	900-1800MHz	High
Reference[8]	Zigbee	2.4GHz	High
Proposed Work	**ESP8266 Module**	**2.4GHz**	**Low**

HARDWARE DESCRIPTION

Arduino Mega 2560:

An open-source microcontroller is basically built on microcontroller ATmega 2560. It is used in the proposed project to take decisions based on the values of parameters. This Arduino Uno board supports 54 digital I/O pins. It has 16 analogue I/O pins, and its board can be programmed with the help of Arduino IDE. It also consists of a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It also has other components like crystal oscillator, serial communication, voltage regulator, etc., to support the Arduino Mega board.

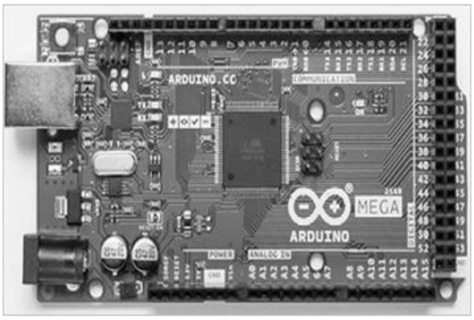

Fig: 1 Arduino Mega 2560 Board

ESP8266 Wifi Module:

The ESP8266 is a low-cost and very user-friendly module to provide an internet connection to your system. Programming it with Arduino IDE makes it more user-friendly. Even though it is low-cost and compact still is a powerful Wifi module. It has 512 Kb Flash Memory. This module has a self-contained integrated TCP/IP protocol stack that can be easily interfaced to any microcontroller to gain access over any Wifi network. ESP8266 has great onboard storage and processing capabilities that allow it to manage data transfer over different devices.

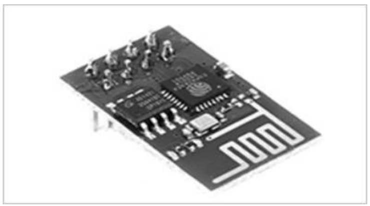

Fig: 2 ESP8266 Wifi Module

PIR Sensor:

It is used for the detection of Animal/Human being in the field. It is a small, cheap and easy to use the sensor. Known as Passive Infrared Sensor, it is an electronic sensor that measures infrared light radiating from different things coming in its field of view. The sensor is made of a pyroelectric material that is used to detect different levels of infrared radiation. Its range of detection is from 25 cm to 20 meters. It has two triggering mode which can be changed according to the requirement. It has two potentiometers; one is for adjusting the off-time control for the PIR, and the other one is for adjusting the sensitivity of the PIR sensor. There are two types of triggering modes in PIR: H and L Mode. The H mode is the Repeatable Mode in which the pin will go high when a thing is detected within the range and goes low after a particular time set by the off-time control. In this mode, the pin will go off irrespective of the presence of the thing. L mode is the Non-repeatable Mode. The PIR sensor will be high in this mode as long as the item stays in the field. This mechanism is used in our proposed system. As long as the item is in the field, the PIR will detect the human/animal presence and display it on the Web-page.

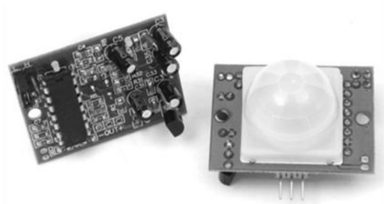

Fig: 3 PIR Sensors

Submersible Mini Water Pump:

This Submersible Mini Water Pump is used in our proposed system to draw out the water for irrigation. It is a low-cost, small submersible pump that can be operated from a 2.5V – 6V power supply. It can take up to 120 litres of water per hour with a very low current consumption of just 220mA. To carry out our Irrigation process, we need to connect the tube pipe to the pump outlet, submerge it in water properly and switch it ON. It will be controlled by our microcontroller upon sensing the moisture parameter.

Fig 4: Submersible Mini Water Pump

DHT11 Sensor:

It is the most commonly used temperature and humidity sensor. This sensor is used in our proposed project to measure the temperature and humidity of the field. It is using a capacitive humidity sensing element for humidity and a thermistor to read the temperature. It can be easily interfaced with any microcontroller. It requires a power supply of 3.5V to 5.5V. The temperature and humidity output data is in serial fashion. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%.

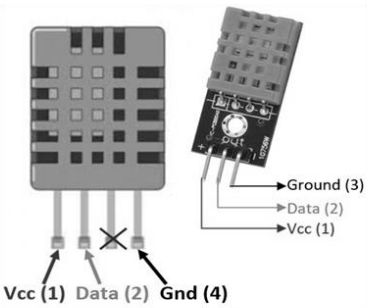

Fig: 5 DHT11 Sensor

Soil Capacitive Sensor:

This sensor is used to detect the fertility of the soil in our system. It does not measure the moisture content; instead, it measures the ions that are dissolved in the soil's moisture. Adding fertilizer will decrease the resistance of the soil, but this capacitive measuring will actually detect the dielectric that is formed in the soil and the moisture in the soil will produce this dielectric. Thus the output will be the presence of ions in the soil.

Fig 6: Soil Capacitive Sensor

MQ-6 Gas Sensor:

This gas sensor is actually used in our system to detect the presence of any gas leakage in case to prevent any fire in the field. This sensor has a high sensitivity to LPG, butane, propane and LNG. It can also be used to detect the presence of cooking fumes, cigarette smoke, etc. It can be easily interfaced with Arduino, Raspberry Pi. It has high sensitivity and a fast response time.

Fig 7: MQ-6 Gas Sensor

Soil Moisture Sensor:

This sensor is used in our system to invoke the Irrigation process as per its reading automatically. This moisture sensor is used to gauge the volumetric content of the water of the soil. It mainly utilizes capacitance to gauge the water content (dielectric permittivity). The working temperature of this sensor is between 10-30C. It actually has two probes that allow the current to pass through the soil, and then it gets the resistance value to measure the moisture content.

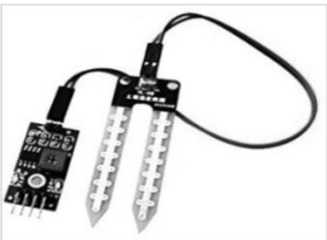

Fig 8: Soil Moisture Sensor

CIRCUIT DIAGRAM DESCRIPTION

Circuit Diagram:

The Arduino Mega2560 is connected with all the required components to make our proposed system and invoke its functionality. Firstly the ESP8266 Wifi Module is connected with the Arduino Mega 2560 Board. The connection of all the pins is appropriately made. Now we connect the PIR Sensor to the Arduino Mega Board. PIR sensor is a digital sensor consisting of three pins, namely GND, Dout and VCC. The GND of PIR is connected to the Ground, VCC is connected to the 5V supply, and the Dout is connected to the digital pin number 12 of the Arduino Mega Board. Now we connect the DHT11 with the Arduino Mega Board. The DHT11 sensor consists of 4 pins, out of which one pin is not used. The VCC of the DHT11 is connected to the 5V supply, the DATA pin is connected to pin 9 of Arduino, and the GND of DHT11 is connected to the ground. Then we connect the Moisture Sensor, MQ-6 Gas Sensor and Capacitive Soil sensor to the Arduino Board at respective pins. Finally, the connection of Submersible Water Pump is made to draw out water from the water tank for the Irrigation purpose.

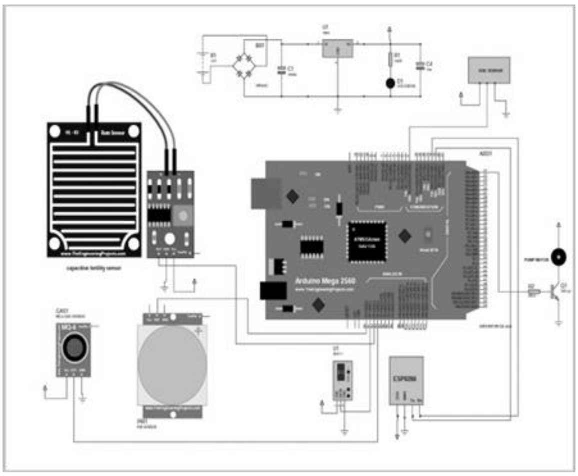

Fig 9: Circuit Diagram

RESULTS AND DISCUSSION

The designed hardware prototype is shown in Fig 10. This prototype contains an Arduino Mega 2560 Microcontroller, ESP8266 Wifi Module, PIR sensor, DHT11 Sensor, Soil Capacitive Sensor, MQ-6 Gas Sensor, Soil Moisture Sensor and Submersible Mini Water Pump. The individual connections of the PIR sensor, ESP8266 module and DHT11 are shown in figure 11, 12, 13, respectively. The PIR sensors show the detection in graphs. The DHT11 sensor captures the surrounding temperature and humidity. Fig 14, 14.1 shows the implemented code done in Arduino IDE. Fig 15, 15.1 shows the web page viewing the real time data of parameters and also guidance to the farmer about crop suggestion is displayed on the same web page.

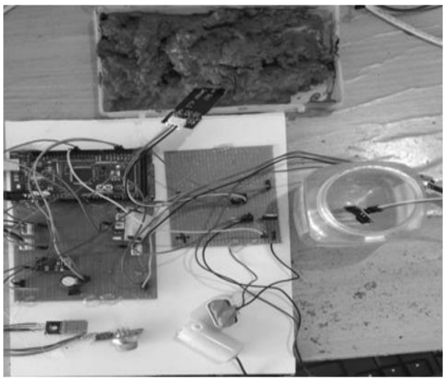

Fig 10: Hardware Prototype of our System

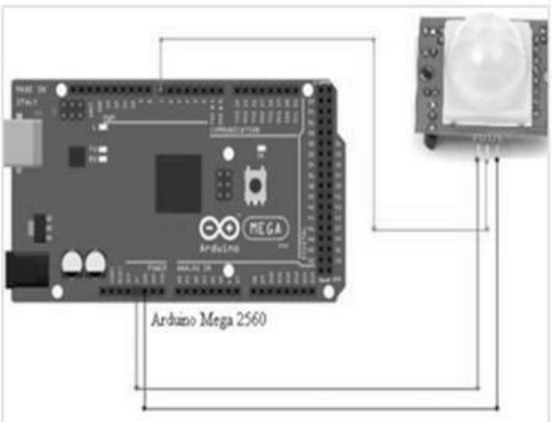

Fig 11: Connection of PIR sensor with Arduino Mega Board

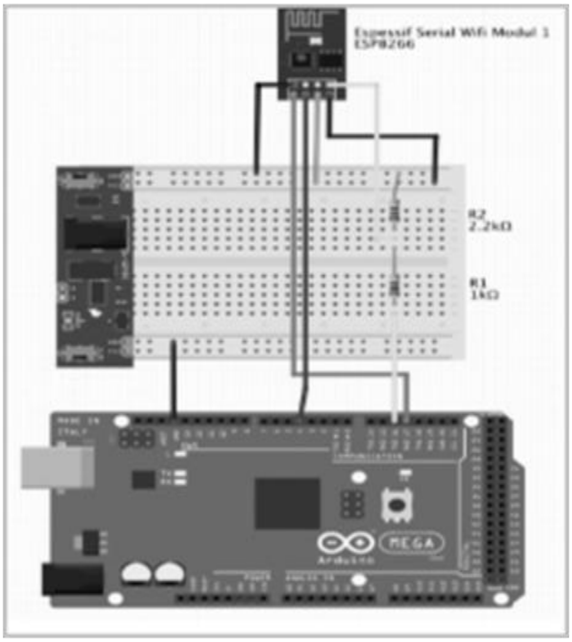

Fig 12: Connection of ESP8266 with Arduino Mega Board

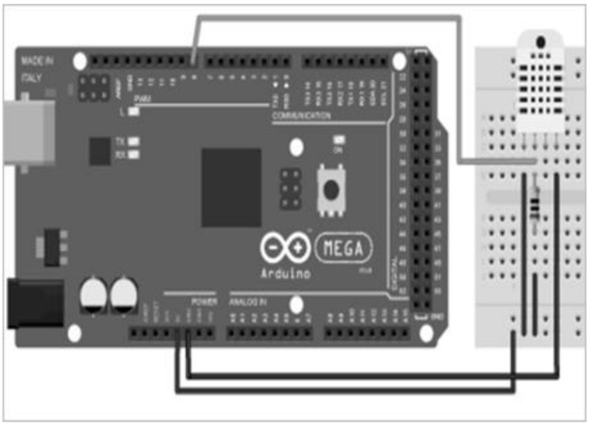

Fig 13: Connection of DHT11 with Arduino Mega Board

```
#include <dht.h>
dht DHT;
#define DHT11_PIN 5
#define PUMP 6
#define Mosture A0
#define GAS A1
#define PIR A2
#define Capacitive A3
int i;
float Mosture_V1,GAS_V1,PIR_V1,Capacitive_V1;
String apiKey = "XHN06KEI8629C2XW";     // replace with your channel's thingspeak WRITE API key   J0HKWDP9IATER3QB

//String ssid="WIFI NAME";    // Wifi network SSID
//String password ="WIFI PASSWORD";  // Wifi network password

String ssid="EMBESYS";    // Wifi network SSID
String password ="yellowiris725@@";  // Wifi network password

boolean DEBUG=true;

//====================================================================== showResponce
void showResponse(int waitTime){
    long t=millis();
    char c;
    while (t+waitTime>millis()){
      if (Serial1.available()){
        c=Serial1.read();
        if (DEBUG) Serial.print(c);
```

Fig 14: Implemented Program of Our System

```
void loop() {
  for(i=0;i<15;i++){
    int chk = DHT.read11(DHT11_PIN);
    Mosture_V1 = analogRead(Mosture);
    GAS_V1 = analogRead(GAS);
    PIR_V1 = analogRead(PIR);
    Capacitive_V1 = analogRead(Capacitive);
    Capacitive_V1 =80-Capacitive_V1 /10;
    Mosture_V1=( 100-( Mosture_V1/10 - 2 ) );
    GAS_V1=GAS_V1/10;
   // digitalWrite(PUMP, HIGH);
    if(Mosture_V1<=40.0)
     digitalWrite(PUMP, HIGH);
    else
     digitalWrite(PUMP,LOW);
     Serial.print("Temp="+String(DHT.temperature)+" *C  ");
     Serial.print("Humidity="+String(DHT.humidity)+" %  ");
     Serial.print("Mosture="+String(Mosture_V1)+" %  ");
   Serial.print("GAS="+String(GAS_V1)+" %  ");
   Serial.print("Soli Fertility="+String(Capacitive_V1)+" %  ");
   Serial.println("PIR="+String(PIR_V1)+" %  ");

   delay(1000);
  }
  thingSpeakWrite(DHT.temperature,DHT.humidity,Mosture_V1,GAS_V1,Capacitive_V1,PIR_V1);
}
```

Fig 14.1: Implemented Program of our System

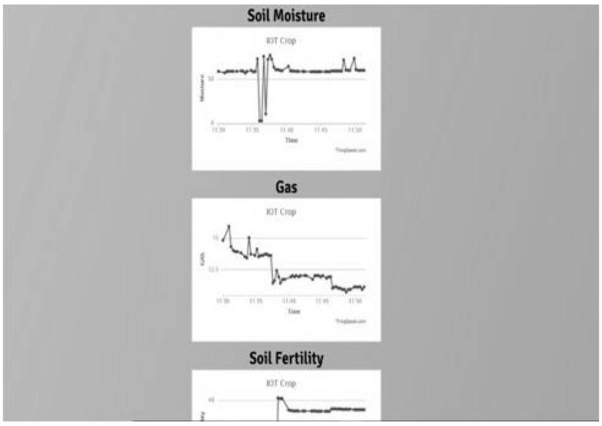

Fig 15: Web-page displaying Various Parameters

Crop	Temperature (Celsius)	Humidity
Wheat	12-25	50-60 %
Rice	24-30	<14 %
Orange	12-37	50-70 %
Sugarcane	20-27	80-85 %
Tomato	15-32	80-90 %
Cotton	21-37	55-80 %

Crop Suggetion

After analyzing real time data & above parameters , our system suggests you to choose the crop of orange or cotton but needs more water supply to maintain the soil & crop conditions. Also you can take decisions on your own after gone through our chart and parameters. So that your crop will give you the best out put.
We have always there for you. You can contact us for any query/problem/information.

Fig 15.1 Web Page Displaying Crop Suggestion Module

CONCLUSION

Many farmers in India still follow the old traditional way of farming. This method increases their workload and efforts to gain outputs. And also, some farmers are unaware of the right choice of crops according to their field conditions.

By using our system, farmers can reduce their workload as they can monitor different parameters remotely. Also, they can detect the presence of any Intruder in their field with the help of a PIR Sensor. Also, they won't be required to go to the field in order to water their fields. The Irrigation process will be automatically done because of the drop in moisture content of the soil. Crop Suggestion Module can also help farmers to increase their knowledge about farming. This system also helps in reducing the wastage of water in fields.

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