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An Adaptive Technique For Soil Moister Control and Nutrient Monitoring Using Wireless Sensor Network

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Abstract—**Routine monitoring of soil moisture is an essential task for proper cultivation of plants. Wireless sensor network will play important role to eliminate agriculture sector'shindrances especially remote monitoring of plants, timely reporting the condition of plants etc. Ultra-latency and high reliability of wireless sensors in the field is major concern in future wireless network. In this article, automatic sensing of soil pH level and reporting technique has been proposed which will enhance the productivity of plants. Also, a detail case study based results have been projected based on the proposed technique.**

Key Words—pH, Internet of things, Wireless Sensor network, Moister sensor

I. INTRODUCTION

Wireless sensor network and Internet of things supposed to be integral part of future network to help agriculture sector. Regular monitoring of soil moisture can help treat the soil with its water needs at better time slots. This helps prevent depleting ground water level as well as canal water and can solve water crisis [1,2,3]. Further study of specific nutrients of soil can lead to higher productivity and yield by treating it with necessary manure and fertilizers based on pH value measured. pH stands for Potential of Hydrogen, it is an important parameter to decide alkalinity or acidity of soil. Regular detection of unwanted species (Birds) when the farmer is not around and saving crops from damage is another complimentary service of this product. First, Soil Moisture sensor detects moisture level of land and based on this moisture level irrigation system is activated/de-activated. Second, pH level is collected to monitor nutrients requirement of soil. Also, moisture level as well as pH value are displayed to the user via webpage. Third, PIR sensor detects unwanted species (Birds) and through the technology responds with an irritating sound to the unwanted species. Fig.1. shows various aspects of IOT based smart agriculture system [3,4,5].

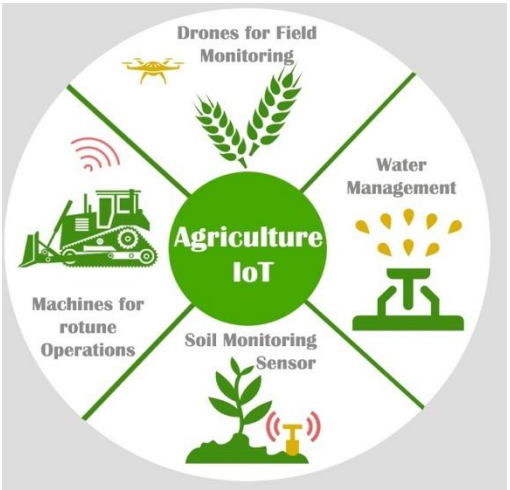

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Fig. 1. Smart agriculture using WSN and IOT Network

II. PROPOSED TECHNIQUE

This paper demonstrates a cost-effective solution for the farmers to monitor their agricultural field remotely. The list of components used to make the proposed design has been given in table1.

S. No	COMPONENT NAME	QUANTITY
1.	Arduino	1
2.	Soil Moisture Sensor	1
3.	LM393	1
4.	Ph sensor	1
5.	Ph sensor ADC	1
6.	PIR Sensor	1
7.	DC Pump	1
8.	9V Battery	1
9.	Bread Board	1
10.	Relay 5V DC	1
11.	Buzzer	1
12.	Wi-Fi ESP 8266 Module	1
13.	Wires	-

Table 1.1 List of Components

Arduino IDE has been used for making the program code. Details has been given in Fig.2.

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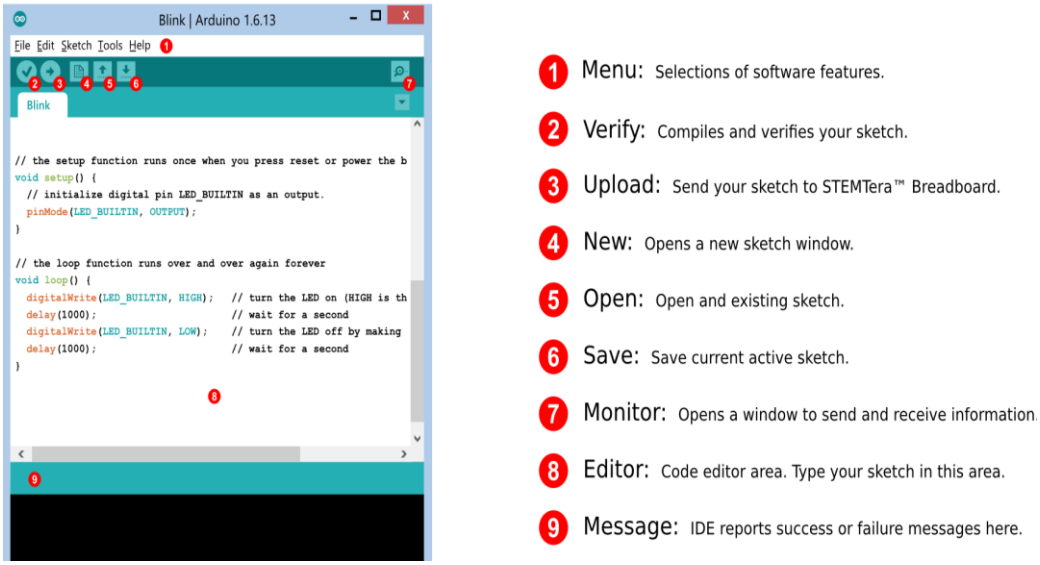

Fig.2. Arduino IDE

A detail circuit diagram of the proposed technique has been illustrated in Fig.3.

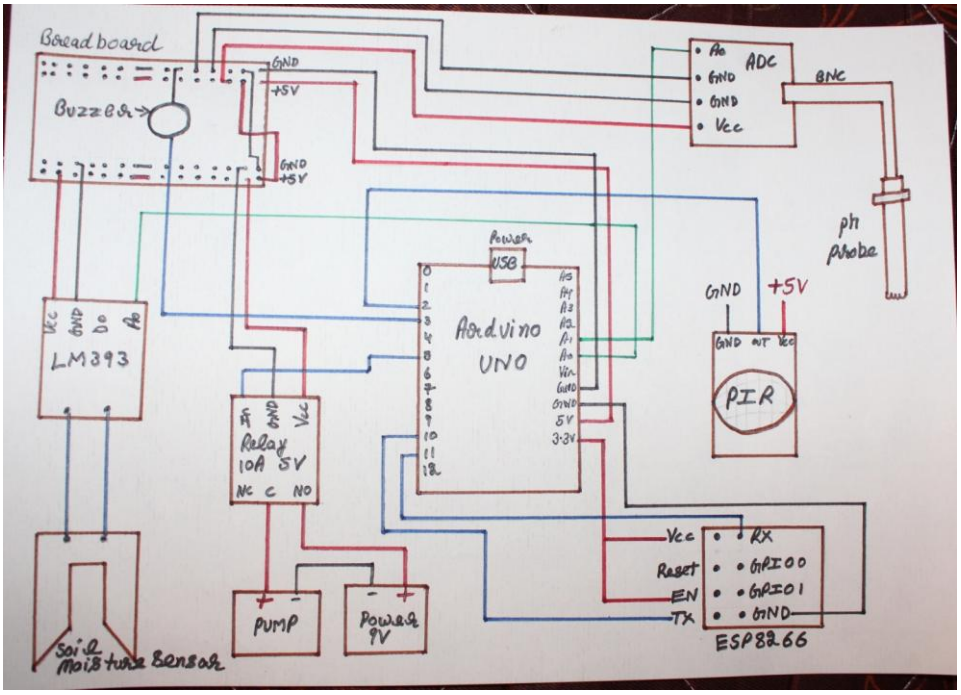

Fig.3. Circuit Diagram of proposed technique

Soil Moisture sensor detects the Moisture level of land and based on this moisture level irrigation system is activated/de-activated. Also, this moisture level is displayed to the user via webpage.There are threeprocesses in the Soil Moisture Circuit.Soil Moisture Sensor Circuit has been formed by attaching two data pins with positive and negative input pins of LM393 module. Further 3 pins fromLM393 i.e. 2 supply pins take power from Arduino(3.3v-5v). As shown in Fig.3. Switch signal output or the AO pin from LM393 gives output to Arduino via A0 pin of Arduino.Soil Moisture sensor is dipped into the soil and based on the Moisture of soil an input is taken through resistive nodes. This input collected from soil is fed to LM393. LM393 is dual differential comparator which after processing the data collected

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from soil moisture sensor gives output to Arduino via AO(LM393) to A0(Arduino). Also, a Relay with Pump Circuit has been formed. Relay pin connected to 5V power supply. The Control pin is out from D5 of Arduino and attached to S pin of Relay module. Now Pump is supplied source power from DC source and control input via NC and COM of Relay.As per the input collected by Arduino, if the moisture level is lower than 10% then the D5 pin is turned HIGH otherwise it gives LOW signal. Relay according to control signal collected, Switches the Pump ON/OFF. Thus full-filling the water requirements of Soil.Wi-Fi Output Circuit is also formed. Rx,Vcc,GND,Tx,CH_PD pins of ESP8266 are connected with D11, 3.3v, GND, D10,3.3v pins of Arduino respectively. Output from soil moisture mechanism is shown at specific IP address on users Mobile/Desktop interface. pH sensor Circuit has been designed to measure the pH level. The cable attached to pH sensor is attached to ADC. The PO probe GND, power GND, Vcc are connected with A1, GND,GND,5V of Arduino respectively sensor is dipped into the ground and output is collected by Analog to Digital convertor. After conversion, the pH value is fed to the Arduino. pH level is collected to monitor nutrients requirement of soil. Also, this pH level is displayed to the user via webpage.There are twoprocesses in pH mechanism.In PIR sensor detects unwanted species and through the technology responds with an irritating sound to the unwanted species. Thus, saving the crops from damage.There are twoprocess with PIR mechanism.

- PIR SensorCircuit: pin1 +DC,pin2 Output,pin3 Ground are connected with 5v, D2, GND of Arduino respectively sensor collects input as soon as some object is in the range of its detection i.e Sensing range: less than 120 degree, within 7 meters. This output is fed to Arduino.
- Buzzer/ Unwanted species repelled circuit: Buzzer pin +ve, pin -ve is connected with pin D3, pin GND of Arduino respectively sensor detects some unwanted object/ within its sensing range and gives output to Arduino. Arduino on detection of signal from PIR quickly responds by triggering a buzzer or a sound that is irritating to the unwanted object.

III. RESULTS

Reading from soil moister sensor has been taken for four days and results are plotted as per Fig.4.

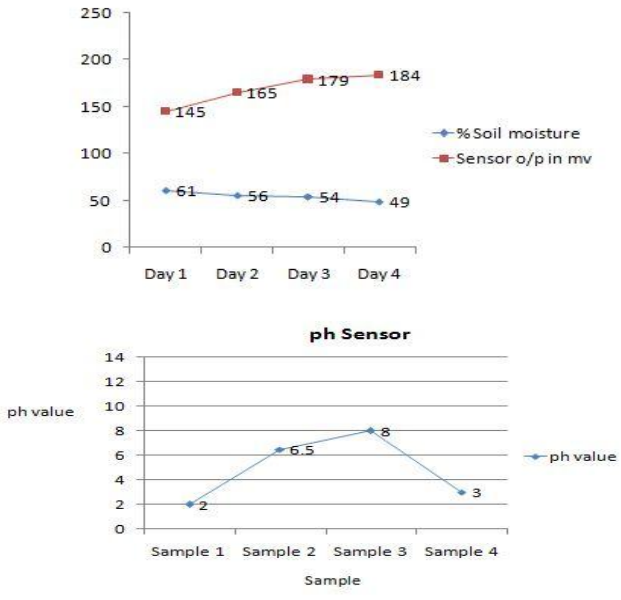

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Fig.4. Day wise moisture value of the field and pH reading

Table 2. Description of PH value

Soil Ph	Plant Growth
Threshold > 8.3	alkaline nature of land
Threshold =7.5	Alkane nature with less iron
Threshold=7.2	6.8 to 7.2 – neutral behavior
Threshold=7.0	6.0 to 7.5 – default accepted range
Threshold=6.8	
Threshold=6.0	
Threshold=5.5	microbial activity reduced drastically for soil
Threshold < 4.6	Acidic nature of land

Relative water holding capacity of soil can be evaluated and based on this result a changed agriculture process can be implemented.Sufficient supply of nutrients to soil improves the farming patterns by providing necessary nutrients on successive farming cycles.The requirement of PH in soil is an important parameter for the development of plants. PH need to be 5 to 7 for majority of plants. PH also determines whether the land will be alkane or acidic. A detail of pH and its description has been provided in above table. This is a huge possibility if used along with Soil Moisture can take agriculture to higher levels.Regular detection of unwanted species (Birds) when the farmer is not around and saving crops from damage is another complimentary service of this product.This helps farmer take less of mental tensions about the unsecured farms and saves time for him. There are certain limitations. pH sensor is basically used for measuring liquids and not solids Audience who is not in touch with emerging technologies will find it hard to use. There are security challenges of the sensors because of open unfenced fields. In future, there is a scope to improve in this area. In below section details program codes has been illustrated.

Program code details:

```
int L = 13;
intinP = 2;
int PIR_S = 0;
intbpin=3;
int V= 0;
const byte Ppin = A1;
float P;
#include Software_Serial esp8266(10,11);
#define DEBUG true
```

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```
void setup() {
pinMode(LED, OUTPUT);
pinMode(buzzpin, OUTPUT);
pinMode(motorpin, OUTPUT);
Serial.begin(9600);
esp8266.begin(11200);
sendData(&quot;AT+RST\r\n&quot;1500,DEBUG);
sendData(&quot;AT+CWMODE=2\r\n&quot;,1000,DEBUG);
sendData(&quot;AT+CIPSERVER=1,80\r\n&quot;,1000,DEBUG);
}
void loop(){
P= 1023 - analogRead(Ppin);
P = map(Po, 0, 1023, 0, 14);
output_value= analogRead(sensor_pin);
output_value = map(output_value,550,0,0,100);
if(output_value&lt;0)
{
output_value=0;
}
if(output_value&lt;10)
{
digitalWrite(5,HIGH);
}
else
{
digitalWrite(5,LOW);
}
V = digitalRead(inP);
if (V == HIGH) {
digitalWrite(L, HIGH);
if (PSTATE == LOW) {
digitalWrite(bpin, HIGH);
PSTATE = HIGH;
```

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```
}
}
else {
digitalWrite(L, LOW);
if (PSTATE == HIGH){
PIR_STATE = LOW;
digitalWrite(buzzpin, LOW);
}
}
```

IV. Conclusion:

Regular monitoring of soil moisture can help to treat the soil with its water needs at better time slots. This prevents depleting of ground water level as well as canal water. Further study of specific water requirements of crop can lead to higher productivity. Therefore,it improves profitability of farmers and reduce time requirement for monitoring plantations. All this can lead to better GDP or wealth of country. Sufficient supply of water to soil improves the farming patterns by providing necessary mineral water (45% of a soil particle) on successive farming cycles.

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