Sustainable pesticide utilization for precision farming using IoT

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***Abstract*—This project aims to ensure that pesticides are used effectively. We have developed a low cost IoT system which can be used to detect pests in an area using varous sensors and spray pesticides when there are too much pests.**

***Index Terms*—Iot, pesticide, nodemcu, pest control, sensors, agri-tech**

I. Introduction

Pesticides and insecticides are often mishandled by farmers. They might not know the side effects of them to humans and the environment.Often in large farms, people spray large quantities of pesticides over the fields at a particular time interval. This might lead to a lot of wastage. It is all about spraying at the right time to spray the pesticides to keep the pests away. Therefore we look at the IoT technology and look to implement a system which can spray pesticides only when needed.

II. Objective

Our objective in this project is to be able to automatically apply pesticides to crops only when it is required using data acquired from the sensors, unlike where farmers use pesticides periodically even if its not required. This excess use causes harmful side-effects to the environment, animals and us humans. Our aim is also to make use of the weather conditions to predict the right time for the application of pesticides on the crops. Advantage of knowing the right weather can prevent the runaway of the pesticides to avoid soil and water contamination.

III. Existing Methods

There are several existing methods to get rid of pests like use of insect growth regulators which is used as insecticides to regulate the populations of harmful pests. The problem with this is that it is not handled properly, it can have negative side effects of the plants and the humans who consume it. There are also methods where small pests are threatened away by use of high frequency waves produced by ultraviolet sensors which are unbearable for the pests. Other methods use Thermal Imaging to locate pests of all sizes which are causing harm to the crops, but they tend to be too expensive. Pesticides are also sprayed over crops by agricultural drones or tractors weekly, but they do not tend to be economical as it amounts to a lot of wastage.

IV. Our Method

We are placing sensors like acoustic sensor, humidity sensor, gas sensor and temperature sensors around the field in uniform regions and monitor regular activity which can be accessed remotely using Thingspeak and can be analysed. We have used Nodemcu as our programmng board and its inbuilt wifi integrated circuit ESP-12E is used to communicate with thinkspeak. If we sense high pest activity in a region, then pesticides can be sprayed in that region alone. The weather conditions should also be suitable such as it shouldn't be raining and should preferably be a sunny weather condition. We use the acoustic sensor to sense noses from pests. The temperature and humidity sensor is used to know the weather conditions and the gas sensor is used to measure the co2 levels as it is proven that the co2 levels tend to increase if there a lot of pests present. We set various threshold values. The threshold values are: acoustic sensor- , humidity sensor-, gas sensor-, temperature sensor-. If any of these values cross the threshold, then the pesticides will be sprayed. We have used a servo motor that represents the pesticide spraying machine. We have also used LEDs to indicate if the thresholds are crossed. WE plot the values as graphs in thinkspeak. We can also export the data into a excel file and save it as a .csv file, which can further be used for certain machine learning or data science processes.

With this project , we will be able to provide farmers with various insights that can help them to use pesticides at the right place and at the right time in a sustainable manner. Therefore

Identify applicable funding agency here. If none, delete this.

we can reduce the excess usage of pesticides in farmlands to result in better and healthier environments. Pesticides also result in biomagnification which cause harmful side-effects to us humans. We can also integrate it with the more common IoT watering systems quite easily, therefore it would be an advancement modern agriculture.

V. Block Diagram

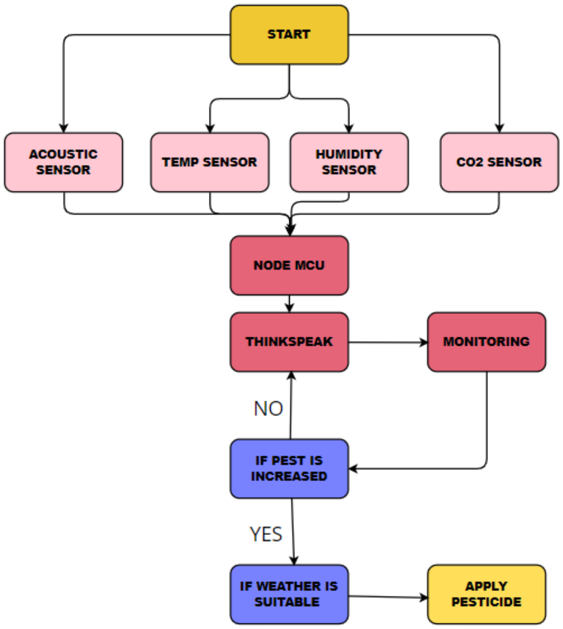


Fig.1- Block diagram of the project

VI. Hardware Circuit

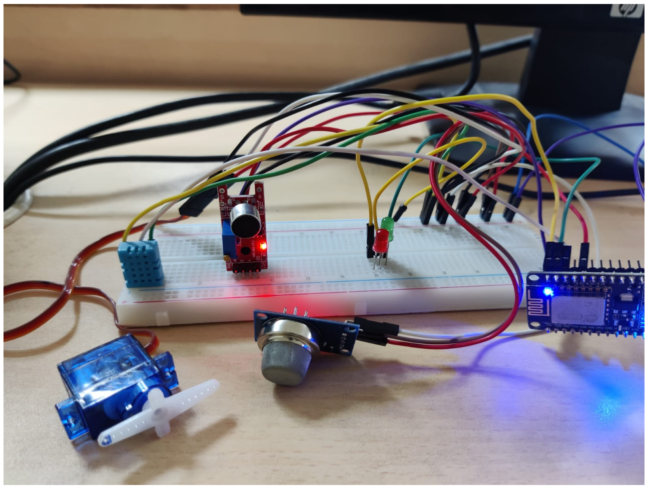
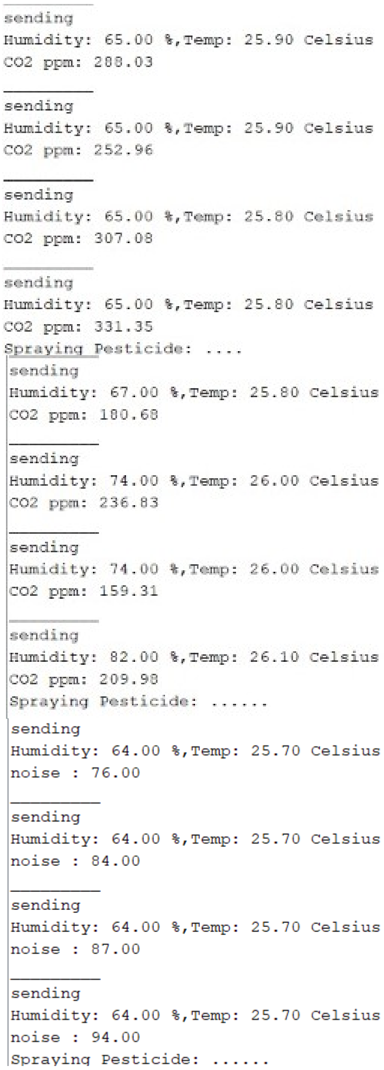


Fig.2- Hardware Circuit of the project

VII. Output



```
____________
sending
Humidity: 65.00 %,Temp: 25.90 Celsius
CO2 ppm: 288.03

____________
sending
Humidity: 65.00 %,Temp: 25.90 Celsius
CO2 ppm: 252.96

____________
sending
Humidity: 65.00 %,Temp: 25.80 Celsius
CO2 ppm: 307.08

____________
sending
Humidity: 65.00 %,Temp: 25.80 Celsius
CO2 ppm: 331.35
Spraying Pesticide: ....
sending
Humidity: 67.00 %,Temp: 25.80 Celsius
CO2 ppm: 180.68

____________
sending
Humidity: 74.00 %,Temp: 26.00 Celsius
CO2 ppm: 236.83

____________
sending
Humidity: 74.00 %,Temp: 26.00 Celsius
CO2 ppm: 159.31

____________
sending
Humidity: 82.00 %,Temp: 26.10 Celsius
CO2 ppm: 209.98
Spraying Pesticide: ......
sending
Humidity: 64.00 %,Temp: 25.70 Celsius
noise : 76.00

____________
sending
Humidity: 64.00 %,Temp: 25.70 Celsius
noise : 84.00

____________
sending
Humidity: 64.00 %,Temp: 25.70 Celsius
noise : 87.00

____________
sending
Humidity: 64.00 %,Temp: 25.70 Celsius
noise : 94.00
Spraying Pesticide: ......
```

Fig.3- Arduino output terminal The first time it sprays because the co2 levels exceed the threshold, then for the second time humidity level exceeds the threshold. In the last case, the noise level exceeds and sprays the pesticides.

VIII. Thingspeak Output

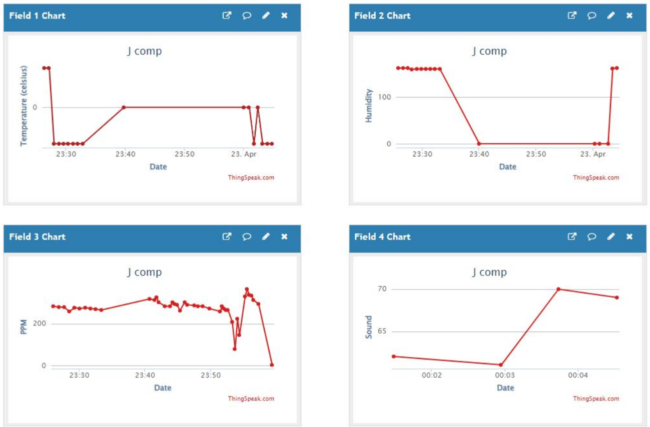


Fig.4- Thingspeak Graphs

IX. Arduino Code

```
#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <ESP8266HTTPClient.h>
#include <ArduinoJson.h>
#include <DHT.h>
#include ”MQ135.h”
#include <Servo.h>

DHT dht(D2, DHT11);
Servo servo;
int l=0;
float nlvl;
float ppm;
float hum;  //Stores humidity value
float bhum;
float temp; //Stores temperature value
float btemp = 0.00;

const char *ssid = ”network name”;
const char *pwd = ” password ”;
String host = ”api.thingspeak.com”;
String key = ”V15P11238WDCP8LG”;
String apiKey= ”Your API”;
String location= ”torino,IT”;
char *server = ”api.openweathermap.org”;
WiFiClient client;
WiFiClient client1;

void dht11(){
  hum = dht.readHumidity();
  temp= dht.readTemperature();
  if(!isnan(temp) && !isnan(hum)){
  bhum = hum;
  btemp = temp;
   Serial.print(”Humidity: ”);
   Serial.print(hum);
   Serial.print(” %,Temp: ”);
   Serial.print(temp);
   Serial.println(” Celsius”);
   delay(150);
   }
   else{
   Serial.print(”Humidity: ”);
   Serial.print(bhum);
   Serial.print(” %,Temp: ”);
   Serial.print(btemp);
   Serial.println(” Celsius”);
   delay(150);
   }
   return;
}
void led(int a){
   if(a == 1){
     digitalWrite(D0, HIGH);
     digitalWrite(D1, LOW);
   }
   else{
     digitalWrite(D1,HIGH);
     digitalWrite(D0, LOW);
   }
}
void pesti(){
  servo.write(180);
  delay(1000);
  servo.write(0);
  delay(1000);
}
void gas(){
  /*ppm = analogRead(A0);
  Serial.print(”Co2 level : ”);
  Serial.println(ppm);*/
  MQ135 gasSensor(A0,32.18);
  ppm = gasSensor.getPPM();
  Serial.print (”CO2 ppm: ”);
  Serial.println (ppm);
  delay(150);
  return;
}
void noise(){
  nlvl = analogRead(A0);
  Serial.print (”noise : ”);
  Serial.println (nlvl);
  delay(150);
  return;
}
void getWeather() {
 Serial.println(”\nStarting
 connection to server...”);
 if (client.connect(server, 80)) {
   Serial.println(”connected to server”);
   client.print(”GET /data/2.5/forecast?”);
   client.print(”q=”+location);
   client.print(”&appid=”+apiKey);
   client.print(”&cnt=3”);
   client.println(”&units=metric”);
   client.println(”Host: api.openweathermap.org”);
   client.println(”Connection: close”);
   client.println();
 } else {
   Serial.println(”unable to connect”);
 }
 delay(1000);
 String line = ””;
 while (client.connected()) {
   line = client.readStringUntil(’\n’);
   //Serial.println(line);
   Serial.println(”parsingValues”);
   StaticJsonBuffer<5000> jsonBuffer;
   JsonObject& root = jsonBuffer
   .parseObject(line);
   if (!root.success()) {
     Serial.println(”parseObject() failed”);
     return;
   }
   String weather = root[”list”][0][”weather”]
   [0][”main”];
   Serial.println(weather);
   return;
 }
}
void setup() {
  Serial.begin(9600);
  delay(10);
  pinMode(A0, INPUT);
  pinMode(D0, OUTPUT);
  pinMode(D1, OUTPUT);
  servo.attach(D4);
  servo.write(0);
  Serial.println();
  Serial.print(”Connecting to ”);
  Serial.println(ssid);
  WiFi.begin(ssid, pwd);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(”.”);
  }
  Serial.println(””);
  Serial.println(”WiFi connected”);
  led(0);
  //getWeather();

}
void anydata(int field, int val){
  if(client.connect(host, 80)){
    String http = ”GET /update?api_key=
    ” + key + ”&field” + String(field)
    + ”=” + String(val) + ” HTTP/1.1\r\n”;
    client.print(http);
    client.println(”Host: api.thingspeak.com”);
    client.println(”Connection: close”);
    client.println();
  }
}
void loop() {
  Serial.println(”reading”);
  dht11();
  noise();
  gas();
  anydata(1,btemp);
  delay(15300);
  anydata(2,bhum);
  delay(15300);
  anydata(4,nlvl);
  delay(15300);
   if((nlvl > 63.00)||(btemp > 35.00)||
   (hum > 75.00)||(ppm>320.00){
      led(1);
      Serial.print(”Spraying Pesticide: ”);
      for(int i =0;i<3;i++){
        Serial.print(”..”);
        delay(1000);
      }
      pesti();
      Serial.println();
    }
    else{
      led(0);
    }
    Serial.println(”______”);
    delay(2000);
}
```

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