GRANARY MANAGEMENT SYSTEM

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19Z604 - EMBEDDED SYSTEMS

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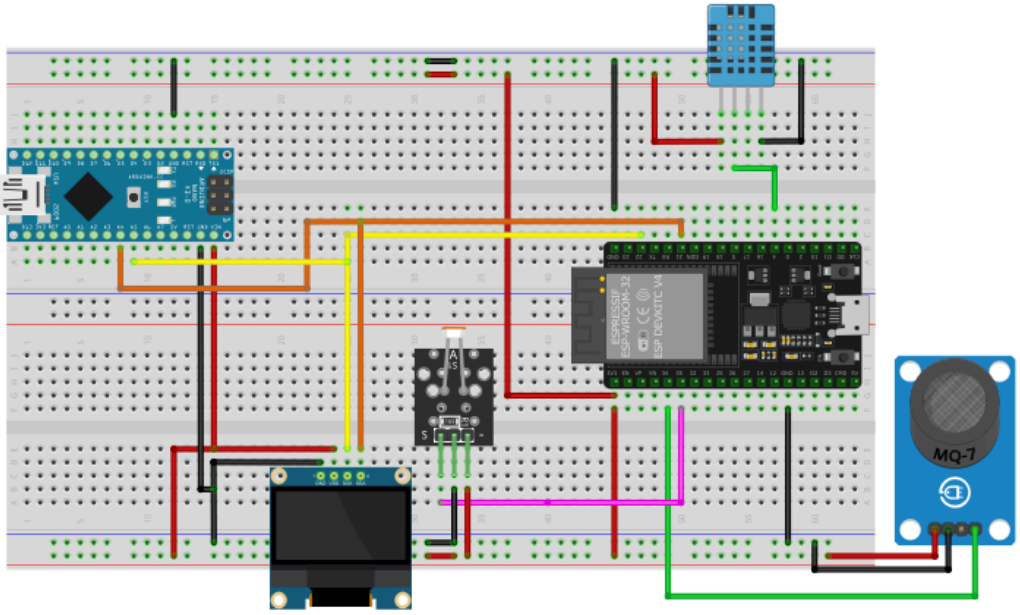
PROBLEM STATEMENT

Agriculture sector being the backbone of the Indian economy deserves food security. Today, food preservation is very important to fulfill the food supply chain needed by developing countries like India. There is a huge need for preservation, protection, storage, distribution and consumption of food at a later stage. Nowadays farmers are facing huge losses due to some storage requirements which are not being fulfilled and due to lack of access to affordable refrigeration systems. In our country, food grains are stored at warehouses using traditional technology which leads to problems such as rain, flood, variation in temperature and humidity, attacks of rodents, insects etc. Hence we have come up with a project to address the above issues related to the storage of food grains.Basically this project uses a microcontroller as well as server and sensors like temperature, humidity, smoke and a light sensor. All these sensor values can be easily monitored through a web application using IoT. The ambient atmospheric conditions for proper food grain storage parameters can be monitored from remote locations. The notifications can be delivered in the real time based on information analysis and processing without human intervention.

COMPONENTS REQUIRED:

1. Arduino Nano
2. Esp32-Wroom (8mb flash - 38 pins)
3. OLED 128x64
4. DHT 11
5. MQ - 2
6. LDR Sensor
7. Bread Board
8. Jumper Wires

SCHEMATIC DIAGRAM:



CODE:

```
#include <WiFi.h>
#include <WebServer.h>
#include <DHT.h>
#include <Adafruit_SSD1306.h>
#define DHT_PIN 4
#define SMOKE_SENSOR_PIN 34
#define IR_SENSOR_PIN 35
#define OLED_SDA 21
#define OLED_SCL 22
#define OLED_WIDTH 128
#define OLED_HEIGHT 32
const char *ssid = "ESP32-AP";  // SSID of the ESP32 soft AP
const char *password = "password"; // Password for the ESP32 soft AP
DHT dht(DHT_PIN, DHT11);
Adafruit_SSD1306 display(OLED_WIDTH, OLED_HEIGHT, &Wire, -1);
WebServer server(80);
float temperature = 0;
float humidity = 0;
int smokeLevel = 0;
bool lightDetected = false;
void setup() {
  Serial.begin(115200);
  Wire.begin(OLED_SDA, OLED_SCL); // Initialize I2C communication for the OLED display
  if (!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
    Serial.println(F("SSD1306 allocation failed"));
    while (1);
  }
  pinMode(IR_SENSOR_PIN, INPUT);
  dht.begin();
  WiFi.softAP(ssid, password);
  IPAddress IP = WiFi.softAPIP();
  Serial.print("AP IP address: ");
  Serial.println(IP);
  server.on("/", handleRoot);
  server.begin();
```

```
void loop() {
  temperature = dht.readTemperature();
  humidity = dht.readHumidity();
  smokeLevel = analogRead(SMOKE_SENSOR_PIN);
  lightDetected = digitalRead(IR_SENSOR_PIN);

  updateDisplay();
  server.handleClient();
}
void handleRoot() {
  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();
  int smokeLevel = analogRead(SMOKE_SENSOR_PIN);
  bool lightDetected = digitalRead(IR_SENSOR_PIN);
  // Check if smoke level exceeds threshold
  bool smokeDetected = (smokeLevel > 150);
  // Generate the HTML response
String webpage = "<!DOCTYPE html><html><head><title>ESP32 Sensor Readings</title>";
webpage += "<style>";
webpage += "body {";
webpage += "  font-family: Arial, sans-serif;";
webpage += "  background-color: #f0f0f0;";
webpage += "  margin: 0;";
webpage += "  padding: 0;";
webpage += "}";
webpage += "#container {";
webpage += "  width: 80%;";
webpage += "  margin: 20px auto;";
webpage += "  background-color: #fff;";
webpage += "  border-radius: 10px;";
webpage += "  padding: 20px;";
webpage += "  box-shadow: 0 0 10px rgba(0, 0, 0, 0.1);";
webpage += "}";
webpage += "h1 {";
webpage += "  color: #333;";
  webpage += "p {";
  webpage += "  color: #666;";
  webpage += "}";
  webpage += "#smoke-status {";
  webpage += "  color: red;";
  webpage += "  font-weight: bold;";
  webpage += "}";
  webpage += "</style>";
  webpage += "</head><body>";
  webpage += "<meta http-equiv='refresh' content='2'>";
  webpage += "<div id='container'>";
  webpage += "<h1>ESP32 Sensor Readings</h1>";
  webpage += "<p>Temperature: " + String(temperature) + " °C</p>";
  webpage += "<p>Humidity: " + String(humidity) + " %</p>";
  webpage += "<p>Smoke Level: " + String(smokeLevel) + "</p>";
  webpage += "<p>Light Detected: " + String(lightDetected ? "No" : "Yes") + "</p>";
  // Add smoke detection status
  if (smokeDetected) {
    webpage += "<p id='smoke-status'>Smoke Detected</p>";
  } else {
    webpage += "<p id='smoke-status'>No Smoke Detected</p>";
  }
  webpage += "</div>";
  webpage += "</body></html>";
    // Send the HTML response
    server.send(200, "text/html", webpage);
  }
  void updateDisplay() {
    bool smokeDetected = (smokeLevel > 150);
    display.clearDisplay();
    display.setTextSize(1);
    display.setTextColor(SSD1306_WHITE);
    display.setCursor(0, 0);
    display.println("Temperature: " + String(temperature) + " C");
    display.println("Humidity: " + String(humidity) + " %");
```

```
  if (smokeDetected) {
    display.println("Smoke Detected");
  } else {
  display.println("Smoke Level: " + String(smokeLevel));
  }
  if (lightDetected == LOW) {
    display.println("Light Detected");
  }
  display.display();
}
```

OUTPUT:

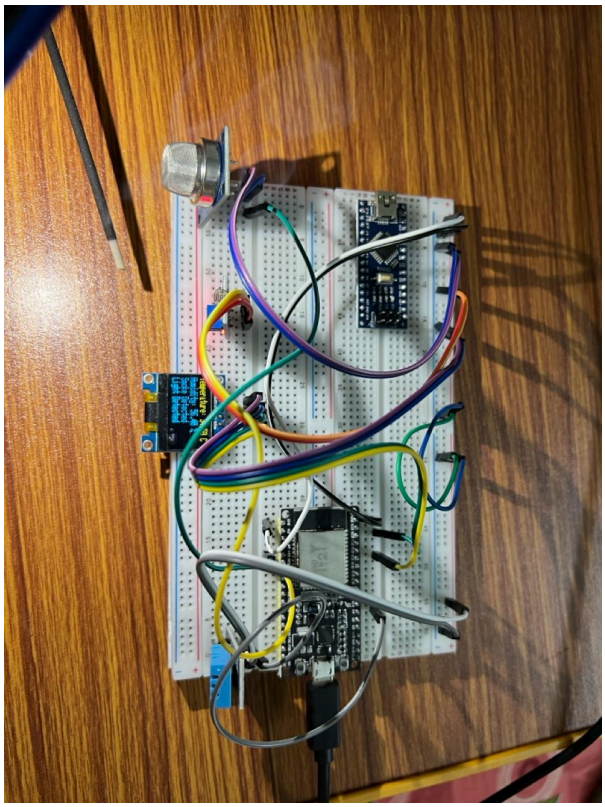


Fig. 1. Smoke and Light Detected

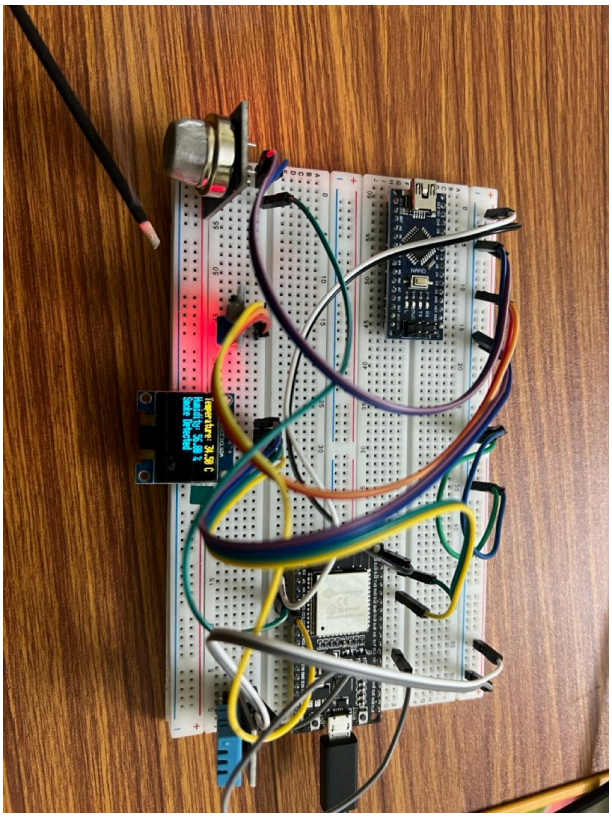


Fig. 2. Smoke Detected

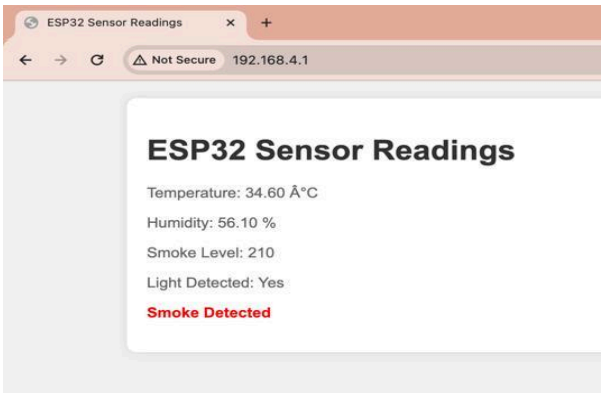


Fig. 3. Smoke & Light Detected in web page

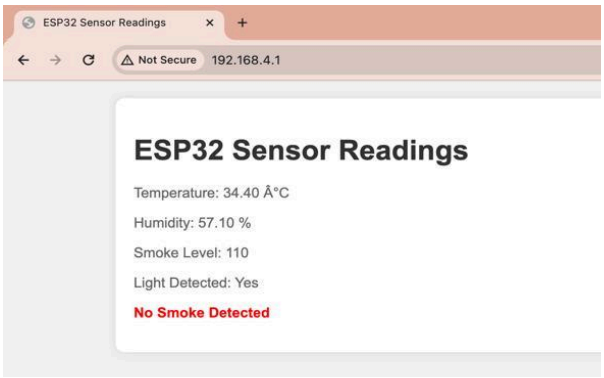


Fig. 4. Light Detected in web page

RESULT:

The project addresses India's food grain storage challenges by employing microcontrollers, sensors, and IoT connectivity. Real-time monitoring of temperature, humidity, and other vital parameters ensures optimal storage conditions. Remote accessibility via a web application allows stakeholders to monitor storage facilities from anywhere, while automated notifications alert them to deviations without human intervention. By mitigating losses due to environmental factors and pests, the project enhances food security. Cost-effective and scalable, it offers a sustainable solution to modernize food grain storage practices, benefiting farmers, warehouse operators, and consumers, thereby bolstering India's agricultural sector and economy.