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CARBON FOOTPRINT DETECTION USING ESP8266

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Abstract : Using a specialized detector system, this project offers a cutting-edge Internet of Things (IoT) solution for tracking and visualizing carbon footprint. The MQ135 gas sensor, the ESP8266 microcontroller, and the Blynk mobile application make up the essential parts. The central processing unit (CPU) is the ESP8266, which interfaces with the MQ135 sensor to measure the concentration of carbon dioxide (CO_2) in parts per million (PPM) and detect ambient air quality. Through the use of the Blynk platform, an easy-to-use interface is created, allowing for the real-time visualization of the detected PPM levels on a mobile device.

Index Terms **- carbon footprint detector, ESP8266 microcontroller, Blynk, MQ135 gas sensor, air quality, components.**

I. INTRODUCTION

A person, place, thing, service, event, or organization's entire greenhouse gas (GHG) emissions, measured in carbon dioxide equivalent (CO2e), is called their "carbon footprint." Burning fossil fuels, clearing land, producing and consuming food, manufactured goods, materials, wood, roads, buildings, transportation, and other services can all release greenhouse gases, which include the carbon-containing gases methane and carbon dioxide.

Our project establishes an Internet of Things (IoT) based carbon footprint detector using an ESP8266 microcontroller, a MQ135 gas sensor, and the Blynk mobile app. Accurate air quality measurements are provided by the MQ135 sensor, and wireless connectivity to the Blynk server and smooth data collection are made possible by the ESP8266. Users can view historical trends, remotely monitor PPM levels in real-time, and receive alerts for threshold breaches through the Blynk app. This integrated system demonstrates the potential of IoT in addressing and proactively reducing carbon emissions while promoting environmental awareness and enabling users to make informed decisions for sustainable living.

II. MOTIVATION

It is common knowledge that high carbon dioxide (CO2) levels contribute to both acidity in water and global warming. Marine life is endangered by both products. Furthermore, these consequences have a negative long-term impact on human life. It is important to calculate carbon footprints both personally and for the entire company. Individual carbon footprint calculations can assist you in beginning to make conscious choices, such as avoiding plastic-packaged goods and using bicycles instead of cars whenever feasible. Adopting environmentally friendly, sustainable manufacturing practices is beneficial for an organization. These figures ought to compel business executives to alter their operations in order to lessen their carbon footprint. It is common knowledge that high carbon dioxide (CO2) levels contribute to both acidity in water and global warming. Marine life is endangered by both products. Furthermore, these consequences have a negative long-term impact on human life.

III. OBJECTIVES

- Develop a real-time monitoring system for carbon dioxide levels.
- Create an intuitive user interface through the Blynk app for easy accessibility.
- Enable users to track and visualize their carbon footprint.
- Identify patterns and trends in carbon emissions for informed decision-making.

IV. Methodology

- Assemble the Parts: Assemble the MQ135 sensor, power supply, optional microcontroller, ESP8266, and connecting wires.
- Recognize Pin Configurations: To determine the power, ground, and data pins for the ESP8266 and MQ135, consult the datasheets.
- Wiring Connections: Make that the ESP8266 and MQ135 are connected securely and correctly by connecting their power, ground, and data pins.
- Verify Wiring Integrity: To avoid problems like loose or improper wiring, double-check each connection.
- Mounting & Enclosure: If necessary, utilize an enclosure and mount components securely taking into account the deployment environment.
- Turn on the system, run some simple tests to make sure everything works as it should, and look for any issues.
- Configuring the ESP8266: Set up the ESP8266 to connect to Wi-Fi, read data from MQ135, and integrate with Blynk.
- Utilizing the acquired authentication token, integrate devices with the Blynk cloud server.
- Complete testing should be done in the end to make sure that the Blynk app is receiving data accurately.

V. Components Required

1) *Hardware*
- NodeMCU ESP8266
- MQ-135 Gas Sensor
- Jumper Wires
- Breadboard
- Battery

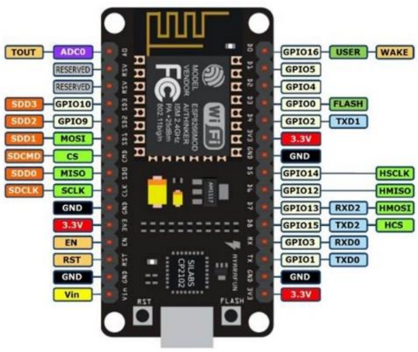
2) *Software*
- Blynk Application

NodeMCU ESP8266:

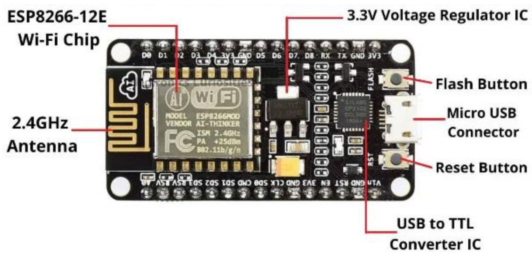
NodeMCU, an open-source firmware and development kit powered by the ESP8266 microcontroller, is based on the ESP8266 Wi-Fi module and offers a low-cost, low-power alternative with integrated WiFi. Often used in Internet of Things applications, it integrates seamlessly with MQTT, Blynk, and ThingSpeak platforms to enable IoT communication. Remote code updates are made simpler by the capability to update firmware over-the-air (OTA).

Figure(a) NodeMCU ESP8266

1) *NodeMCU ESP8266 pinout details:*



Figure(b) Pinout details of NodeMCU ESP8266



Figure(c) Representation of NodeMCU ESP8266

The Wi-Fi module is compatible with the 802.11 b/g/n standard at 2.4 GHz, has an integrated TCP/IP stack, 19.5 dBm output power, data interface (UART / HSPI / I2C / I2S / Ir Remote Control GPIO / PWM) and PCB antenna.

2) *Specifications of NodeMCU ESP8266 :*

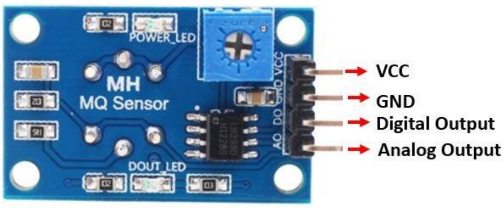
- Wireless Standard: 802.11 b/g/n
- Frequency range: 2.4 GHz - 2.5 GHz (2400M-2483.5M)
- Power supply: from 4.5 VDC to 9 VDC (VIN) or via micro USB connector
- Consumption: with continuous Wi-Fi transmission about 70 mA (200 mA MAX) - in standby < 200μA
- Operating temperature: from -40°C to +125°C

MQ-135 Gas Sensor

A flexible and reasonably priced instrument for identifying gases, such as carbon dioxide and volatile organic compounds, is the MQ135 gas sensor. It provides accurate measurements essential for environmental assessments and air quality monitoring because it operates on resistive changes. The chemical principles of the sensor are examined in this abstract, with a focus on its sensitivity to important gases. Applications for the MQ135 include industrial safety, indoor air quality monitoring, and Internet of Things projects integrating it with microcontrollers such as Arduino and ESP8266. In summary, the MQ135 sensor is essential to the advancement of environmental monitoring and the creation of healthier living environments.

It is used in air quality control equipments for buildings/offices, are suitable for detecting of NH3, NOx, alcohol, Benzene, smoke,CO2 ,etc.

Figure(d) MQ-135 Air Quality Sensor



Figure(e) Pinout details of MQ-135

1) *Specifications of MQ-135 Gas Sensor:*

- Circuit voltage (Vc) = 5V±0.1
- Load resistance (R_L) is adjustable.
- Sensing Resistance is 30KΩ-200KΩ (100ppm NH3)
- Standard Detecting Condition:

Temp: 20℃±2℃, Vc:5V±0.1
Humidity: 65%±5% , Vh: 5V±0.1

- Detection range: 10～1000ppm(ammonia gas, toluene, hydrogen, smoke)

Arduino IDE

The Arduino Integrated Development Environment (IDE) is a software platform designed to facilitate the uploading and programming of code to Arduino microcontroller boards. It provides an easy-to-use interface for writing, editing, and uploading code in the Arduino programming language—a streamlined variant of C/C++. The Arduino Development Environment (IDE) includes code editors with syntax highlighting, a compiler that translates code into machine language, and a bootloader that facilitates the uploading of compiled code to the Arduino board via a USB connection.

A compiler that translates written code into machine language that the Arduino board can run is included with the Arduino IDE. The integrated bootloader allows users to upload the compiled code to the Arduino board via a USB connection. The Arduino IDE also includes a serial monitor to view and debug data sent between the Arduino board and the computer.

The Arduino IDE is essential for hobbyists, students, and professionals who want to create a variety of electronic projects, from simple LED blinking to complex Internet of Things applications.

Blynk IoT software

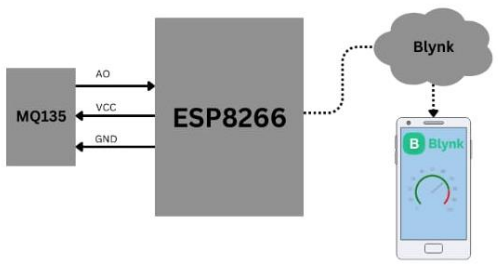
Blynk is an Internet of Things (IoT) platform that is easy to use and adaptable, making it simpler to create intelligent devices and connected applications. With support for numerous hardware platforms, a cloud server, and a mobile app, it provides a comprehensive ecosystem. Blynk doesn't require a lot of programming experience, so both inexperienced and seasoned developers can create Internet of Things applications.

The core of Blynk is its mobile app for iOS and Android, which serves as an adjustable interface for controlling and monitoring connected devices. Users can drag and drop widgets within the app to create interactive dashboards that facilitate seamless interaction with their IoT projects.

Blynk makes use of a cloud-based server to make communication between the mobile application and hardware devices easier. The platform supports numerous popular development boards, including ESP8266, Arduino, Raspberry Pi, and others, allowing users to choose the hardware that best suits their projects' requirements.

Among Blynk's main features are automation scenario creation, email alerts, push notifications, and real-time data visualization. Because Blynk makes IoT development easier, it's a great choice for makers, enthusiasts, and professionals who want to create connected solutions without having to set up a lot of infrastructure or code. Its adaptability and ease of use account for its popularity in the rapidly expanding IoT space.

VI. BLOCK DIAGRAM



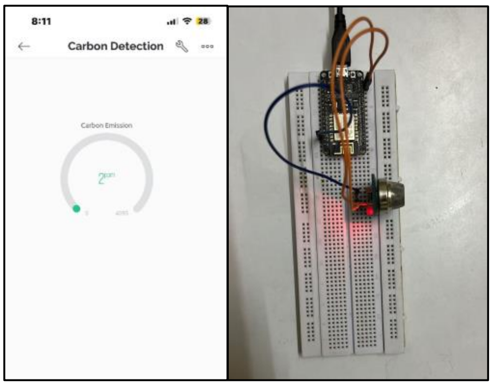
Figure(f) Block diagram of carbon footprint detector

The IoT Carbon Footprint Detector with MQ135, ESP8266, and Blynk functions by means of a carefully organized sequence of steps. The MQ135 gas sensor is connected to the ESP8266 board to start the hardware setup process, which ensures a steady power supply and proper wiring connections. The firmware is then programmed using tools like the Arduino IDE, which incorporates the necessary libraries to allow for a smooth interface with the MQ135 sensor and accurate data readings. The ESP8266 is configured to create a Wi-Fi connection, which is essential for this IoT system's internet connectivity.

The next important step is integration with the Blynk platform. A new project is set up in the Blynk app, and a Blynk account is made. The ESP8266 code then incorporates the authentication token created for this project, enabling communication with the Blynk server. The data from the MQ135 sensor is then read by the ESP8266, which focuses on the carbon dioxide parts per million (PPM) levels. The created Wi-Fi connection is then used to send this data to the Blynk server.

Real-time PPM levels are displayed on a customized dashboard that is created by the Blynk app. The convenience of remotely monitoring PPM levels is offered by the Blynk app, and the system can be set up to notify users or issue alerts when carbon footprint thresholds are surpassed.

VII. RESULTS



The system provides real-time monitoring of carbon dioxide ppm levels on Blynk application when CO2 is detected by MQ-135 Gas Sensor.

VIII. LITERATURE REVIEW

[1] This paper focuses on measuring air quality using MQ135 and MQ7 sensors, addressing environmental concerns. Utilizing IoT platforms like Thingspeak, it aims to raise awareness about pollution's impact. Machine learning enhances data analysis, and the system, accessible publicly, contributes to lowering component costs compared to existing solutions, aligning with government efforts to combat pollution. [2] In this reasearch paper, supply is given of 5VDC (minimum 200mA) to the MQ-135 sensor, preheated for 24 hours, adjusted trimpot for gas detection. Also, they have employed an LM393 IC driver circuit, connected to Arduino Uno for readings. Calibrating for specific gases,they have adjusted load resistor for sensitivity, ensuring accurate analog readings proportional to gas concentration. [3] In this research paper, they focused on MQ-135, a SnO2 semiconductor gas sensor, detects pollutants like CO, CO2, Ethanol, NH4, Toluene, and Acetone in ambient air. As human activities contribute to rising air pollution, employing this low-cost, low-power sensor aids in monitoring air quality, providing a cost-effective solution for pollution control measures. [4] In this reasersh paper, they focused carbon dioxide emissions and climate change, emphasizing the adverse effects on the environment. It discusses the methods to combat emissions, including reducing levels and trading carbon certificates. The Kyoto Protocol's effectiveness is questioned, and both mandatory and voluntary carbon markets are explored for emissions reduction.

IX. CONCLUSION

The IoT Carbon Footprint Detection System, which incorporates ESP8266, MQ135, and Blynk, represents a significant breakthrough in environmental sustainability and monitoring. The effective integration of these elements has increased user awareness of environmental issues while also enabling real-time tracking and visualization of carbon dioxide levels. One strategic advantage for reducing environmental impact is the system's ability to identify trends in carbon emissions, which can be used to implement targeted and proactive measures. Technology can be used to address environmental challenges, as demonstrated by the IoT Carbon Footprint Monitoring System.

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