HANDHELD VEHICLE SMOKE DETECTOR

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ABSTRACT

This project aims to increase environmental and road safety by using an innovative Internet of Things-based vehicle smoke detection system to detect smoke emissions from vehicles early on. The vehicle exhaust emissions are continuously monitored in real time by the system through the use of sophisticated sensors, microcontrollers, and wireless communication technologies. The main goal is to find abnormally high smoke levels, which could be a sign of an engine problem or environmental danger.The main parts of the suggested system are a wireless communication module that sends real-time data to a centralized server, a smoke sensor, and a microcontroller unit (MCU) for data processing. To distinguish between typical emissions and high smoke levels, the MCU evaluates the sensor data and applies a preset threshold. When a possible problem arises, the system instantly notifies the appropriate authorities and car owners, allowing for timely action. In line with the tenets of the Internet of Things (IoT), the suggested Vehicle Smoke Detection System offers an incredibly flexible and scalable way to integrate with the current infrastructures of smart cities. This approach seeks to promote sustainable transport behaviors and advance a safer and healthier urban environment by proactively managing car emissions.

INTRODUCTION

1.1 OBJECTIVE OF THE PROJECT

The primary objective of the suggested IoT-based Vehicle Smoke Detection System is to create a novel solution that makes use of state-of-the-art technology to address the urgent problems of air pollution and road safety. The main objective is to develop a proactive and effective system that can identify increased smoke emissions from moving cars early on, allowing for prompt repairs to minimize potential engine problems and lessen environmental risks.The goal of this initiative is multifaceted, encompassing the improvement of road safety, sustainable urban life, and environmental stewardship. The project aims to significantly improve the well-being of urban communities and the sustainable growth of our cities by tackling the issues related to vehicle emissions through technical innovation and data-driven insights.

SYSTEM ANALYSIS

2.1 PROPOSED SYSTEM

The proposed handheld vehicle smoke detection system offers a compact, portable solution for efficient on-the-go monitoring of vehicle emissions. Equipped with advanced smoke sensors and a user-friendly interface, the device provides real-time analysis of smoke levels. Integration possibilities with vehicle systems enhance accuracy, while a cost-effective design encourages widespread adoption by regulatory agencies and law enforcement. The system aims to promote environmental sustainability and road safety by swiftly identifying and addressing vehicles with excessive smoke emissions.

2.2 SYSTEM REQUIREMENTS

2.2.1 Software Requirements

- Operating System : Windows 11, Linux
- IDE : Arduino IDE
- Language : C++

2.2.2 Hardware Requirements

- Arduino nano
- MQ 135 gas sensor
- LCD 16 x 2 with Serial I2C LCD Display Adapter
- Piezo (Buzzer)
- LEDs
- Resistors (220 Ohm)
- Jumper cables
- Bread board

2.3 TOOLS AND TECHNOLOGIES

2.3.1 Arduino UNO

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

2.3.2 MQ 135 gas sensor

MQ135 gas sensor has high sensitivity to ammonia gas, sulfide, benzene series steam, and can monitor smoke and other toxic gases well. It can detect kinds of toxic gases and is a kind of low-cost sensor for many kinds of applications.

2.3.3 LCD 16 x 2

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments.

2.3.4 Serial I2C LCD Display Adapter

Serial I2C LCD display adapter converts parallel based 16 x 2 character LCD display into a serial i2C LCD that can be controlled through just 2 wires. Adapter uses PCF8574 chip that serves as I/O expander that communicates with Arduino or any other microcontroller by using I2C protocol. The default i2C address is 0X27 and may be changed to any of the following 0X20~0X27 via soldering A0 A1 A2 pins.

2.3.5 Piezo (Buzzer)

The piezo, also known as the buzzer, is a component that is used for generating sound. It is a digital component that can be connected to digital outputs, and emits a tone when the output is HIGH. Alternatively, it can be connected to an analog pulse-width modulation output to generate various tones and effects.

2.3.6 LEDs

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process. LEDs allow the current to flow in the forward direction and block the current in the reverse direction.

2.3.7 Resistors (220 Ohm)

A 220-ohm resistor is an electronic component that is used to resist the flow of electricity in a circuit. Resistors are used in a wide variety of electronic circuits to control the flow of current and protect other components from damage. The color bands on a 220-ohm resistor typically include red, red, brown, and gold.

2.3.8 Jumper cables

Jumper cables are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

2.3.9 Bread board

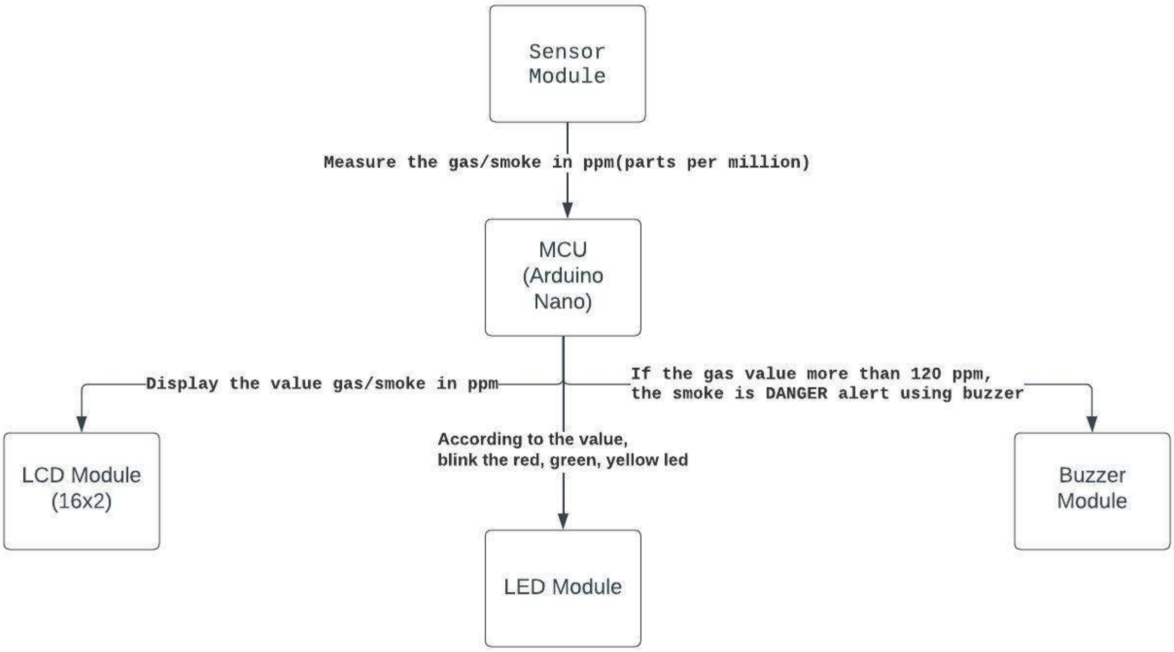
A breadboard is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to prototype (meaning to build and test an early version of) an electronic circuit, like this one with a battery, switch, resistor, and an LED (light-emitting diode).

2.3.10 Arduino IDE

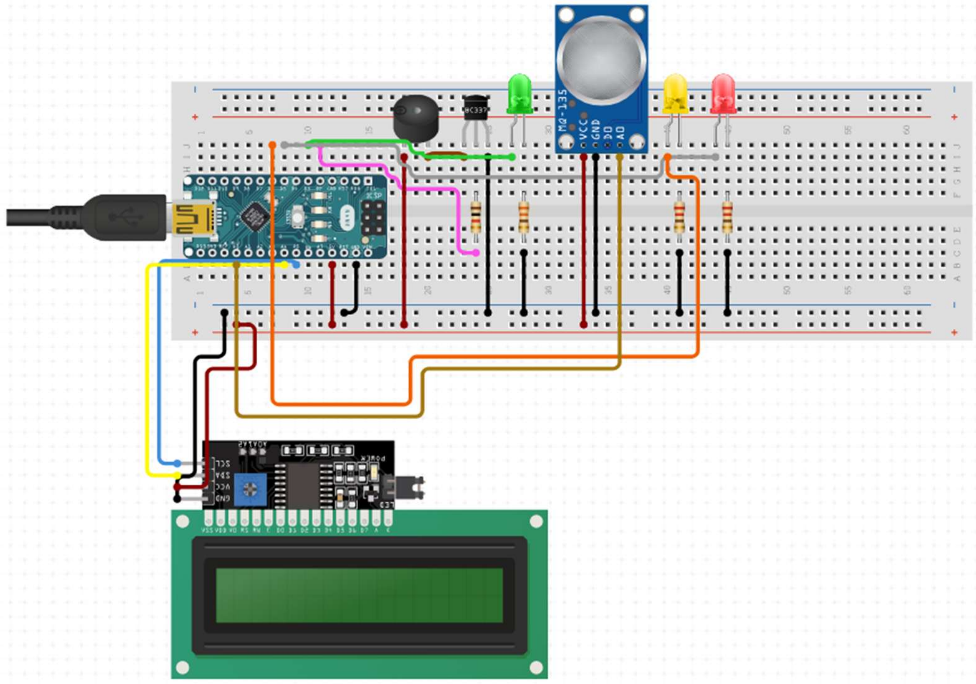
This IDE only supports C++ programming language to interface between software and hardware components. It contains a text editor for writing code, has common functions and a series of menus. Code written in this IDE is to control the microcontroller to do specified tasks. It connects to the Arduino hardware to upload programs and communicate with them.

SYSTEM DESIGN

3.1 System Architecture



3.2 Circuit Diagram



SYSTEM IMPLEMENTATION AND TESTING

4.1 Gas Sensor Module

The MQ-135 gas sensor is sensitive to a variety of gases, and its main applications involve detecting and measuring the concentration of several different types of gases such as Ammonia, Carbon-di-oxide, Benzene, Alcohol, Smoke to check the quality of air. Here, the main purpose of the sensor is to detect level carbon-di-oxide which is being emitted from the vehicles.

4.1.1 Indication Through LED

After the sensor detects the gas, it is then indicated through LEDs. In this system, three different LEDs—red, yellow, and green—are used. The different LEDs are employed according to how polluted the environment is with the gas. If the gas is closer to the sensor, it will indicate a red light; if the gas is near to the sensor, it will indicate a yellow light; and if the gas is farther away from the sensor, it will indicate a green light.

4.1.2 Indication Through Piezo Buzzer

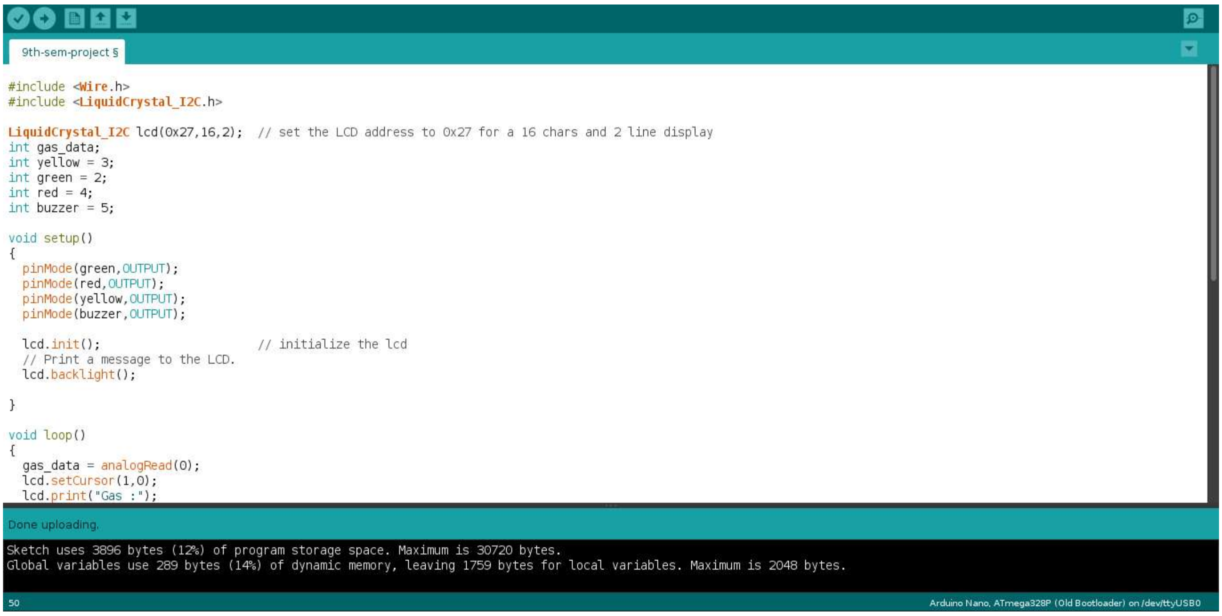
After detecting the gas, if the smoke value is more than 120 ppm, then the air is polluted and in danger. The red LED also turns on, signaling an alert through a piezo buzzer.

4.1.3 LCD Display

The 16x2 LCD is often used as a user interface component in embedded systems. It can display information such as status messages, sensor readings, or menu options. This LCD displays information from the gas sensor, indicating whether the gas is in a warning state, a good state, or a danger state. The gas readings are monitored in parts per million (ppm). Using a Liquid Crystal I2C library in the Arduino IDE simplifies the process of interfacing with LCDs, abstracts low-level details, and accelerates the development of projects involving displays.

4.2 SCREENSHOT AND IMAGES

4.2.1



```
9th-sem-project §

#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27,16,2);  // set the LCD address to 0x27 for a 16 chars and 2 line display
int gas_data;
int yellow = 3;
int green = 2;
int red = 4;
int buzzer = 5;

void setup()
{
  pinMode(green,OUTPUT);
  pinMode(red,OUTPUT);
  pinMode(yellow,OUTPUT);
  pinMode(buzzer,OUTPUT);

  lcd.init();                      // initialize the lcd
  // Print a message to the LCD.
  lcd.backlight();

}

void loop()
{
  gas_data = analogRead(0);
  lcd.setCursor(1,0);
  lcd.print("Gas :");

Done uploading.

Sketch uses 3896 bytes (12%) of program storage space. Maximum is 30720 bytes.
Global variables use 289 bytes (14%) of dynamic memory, leaving 1759 bytes for local variables. Maximum is 2048 bytes.

50                                                   Arduino Nano, ATmega328P (Old Bootloader) on /dev/ttyUSB0
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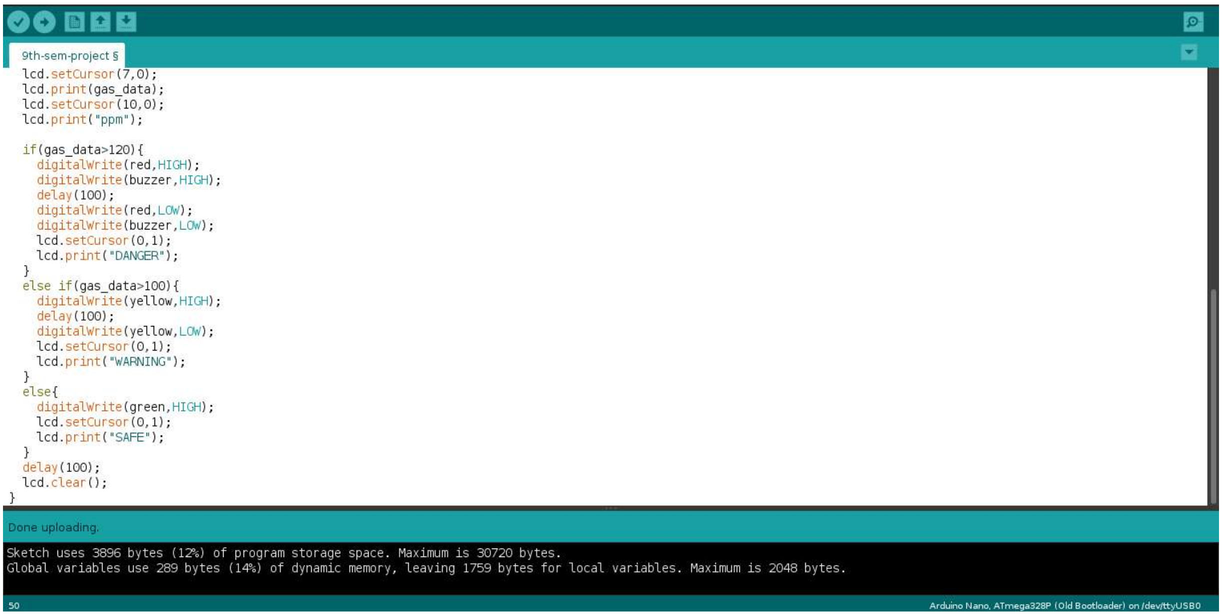

```
9th-sem-project §
  lcd.setCursor(7,0);
  lcd.print(gas_data);
  lcd.setCursor(10,0);
  lcd.print("ppm");

  if(gas_data>120){
    digitalWrite(red,HIGH);
    digitalWrite(buzzer,HIGH);
    delay(100);
    digitalWrite(red,LOW);
    digitalWrite(buzzer,LOW);
    lcd.setCursor(0,1);
    lcd.print("DANGER");
  }
  else if(gas_data>100){
    digitalWrite(yellow,HIGH);
    delay(100);
    digitalWrite(yellow,LOW);
    lcd.setCursor(0,1);
    lcd.print("WARNING");
  }
  else{
    digitalWrite(green,HIGH);
    lcd.setCursor(0,1);
    lcd.print("SAFE");
  }
  delay(100);
  lcd.clear();
}

Done uploading.

Sketch uses 3896 bytes (12%) of program storage space. Maximum is 30720 bytes.
Global variables use 289 bytes (14%) of dynamic memory, leaving 1759 bytes for local variables. Maximum is 2048 bytes.

50                                                   Arduino Nano, ATmega328P (Old Bootloader) on /dev/ttyUSB0
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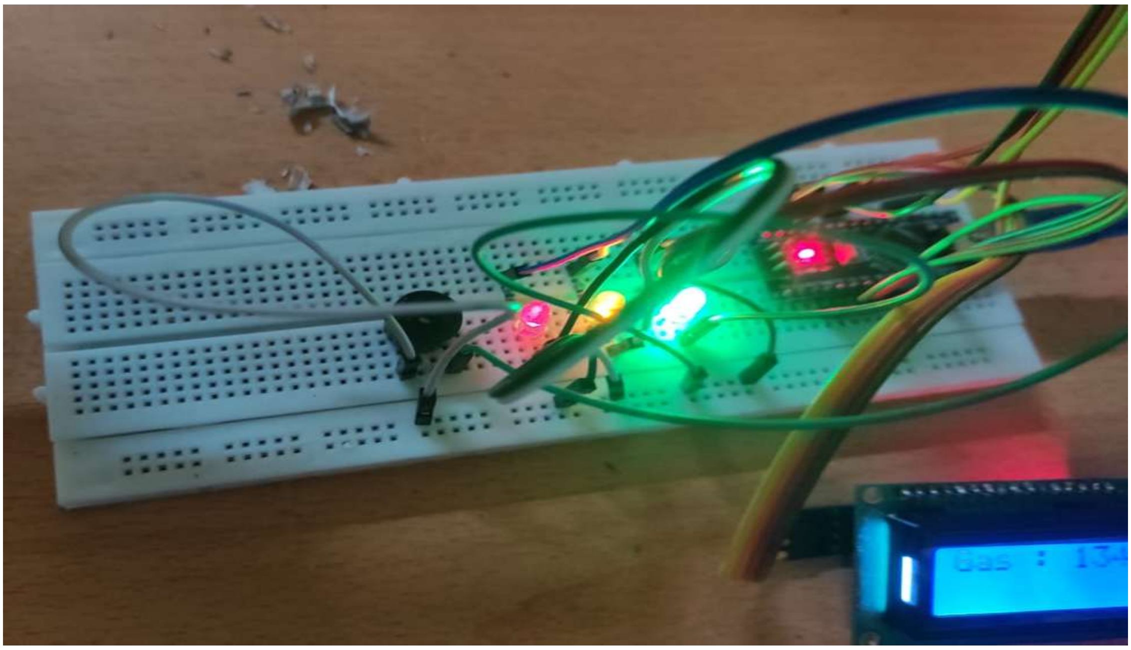
4.2.2




Gas : 168 PPM
DANGER

4.3 TESTING THE MODULES

4.3.1 Testing The Entire System With Gas Sensor Using Arduino Nano Microcontroller

The successful testing of the aforementioned modules validates their functionality and integration using the Arduino nano microcontroller. Together, they form a comprehensive smoke detector system that not only detects and measures gas concentrations but also provides intuitive visual and audible feedback through LEDs and a piezo buzzer. The Red LED is turned on and the smoke is in danger as its reading level is more than 120 ppm and signaled the alert through the piezo buzzer. The Yellow LED is turned on and the smoke is in warning state as its reading level is between 100 to 120 ppm. The Green LED is turned on and the smoke is in neutral as its reading level is less than 100 ppm. The 16x2 LCD enhances user interaction, presenting critical information about the gas environment in an easily understandable format. The 16x2 LCD displays the warning state, the danger state and the readings of the gas sensor. Adapter uses PCF8574 chip that serves as I/O expander that communicates with Arduino or any other microcontroller by using I2C protocol.Liquid crystals do not emit light directly but instead use a backlight or reflector to produce images in color or monochrome. The use of the Liquid Crystal I2C library ensures efficient interfacing, emphasizing the system's reliability and ease of integration in diverse applications.

CONCLUSION

The handheld vehicle smoke detection system presents a promising solution for mitigating air pollution and promoting road safety. With its compact design, advanced sensors, and real-time analysis capabilities, the system empowers regulatory agencies and law enforcement to swiftly identify and address vehicles with excessive smoke emissions. The potential integration with vehicle systems enhances monitoring accuracy. The cost-effective approach ensures broad accessibility. As a portable tool for environmental compliance, this project contributes to sustainable urban living. It signifies a step forward in addressing vehicular emissions, fostering cleaner air, and aligning with global efforts towards a greener and safer transportation landscape.

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