INTERNET OF THINGS(IoT)

TEAM PROJECT:

SMOKE DETECTION SYTEM

5th of October 2023

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ABSTRACT

This document aims to elaborate the creation and implementation of a combination of hardware and software tailored to exhibit the devices and sensors layer within the space of Internet of Things(IoT). Precisely the basis at which the smoke detection system project was created was through a Tinkercad simulation and some external academic resources.

The popularity of Tinkercad is quite ubiquitous and it enables prototype simulations to be developed which can be used to then create the actual system. In this regard, programmable Arduino circuit was used in combination with other components and a smoke detection system was erected which can notify the presence of gases by making sounds from a buzzer followed by some LED lights switching on and off.

INTRODUCTION

As the world turn its wheels of time, there has been a significant number of technologies, shaping how humanity operates and exist, particularly within the context of Artificial Intelligence era. Internet of Things (IoT) has been a force to be reckoned with and there is a possibility that IoT settings would contribute to an approximation of about $3 Trillion to $11 Trillion per year that is by 2025 (MacKinsey Global Institute, 2023).

A smoke detection system that we as a team managed to put together, is part of the IoT facets that is and has been used in households and commercial buildings as a measure of safety and to indicate the concentration of certain gasses in the air. The system can be tailor-made and can typically comprise of battery-powered devices, sensors, actuators, single board computers, printed circuit boards, alarms, buzzers, lights and so forth. These properties contribute to safety measures and technically even if there could be load shedding the system would be operating as normal and if truth be told the capabilities of galvanizing software and hardware creating smart systems is a notable contributing factor of IoT (Mouha, 2021).

PROJECT OUTLINE FRAMEWORK

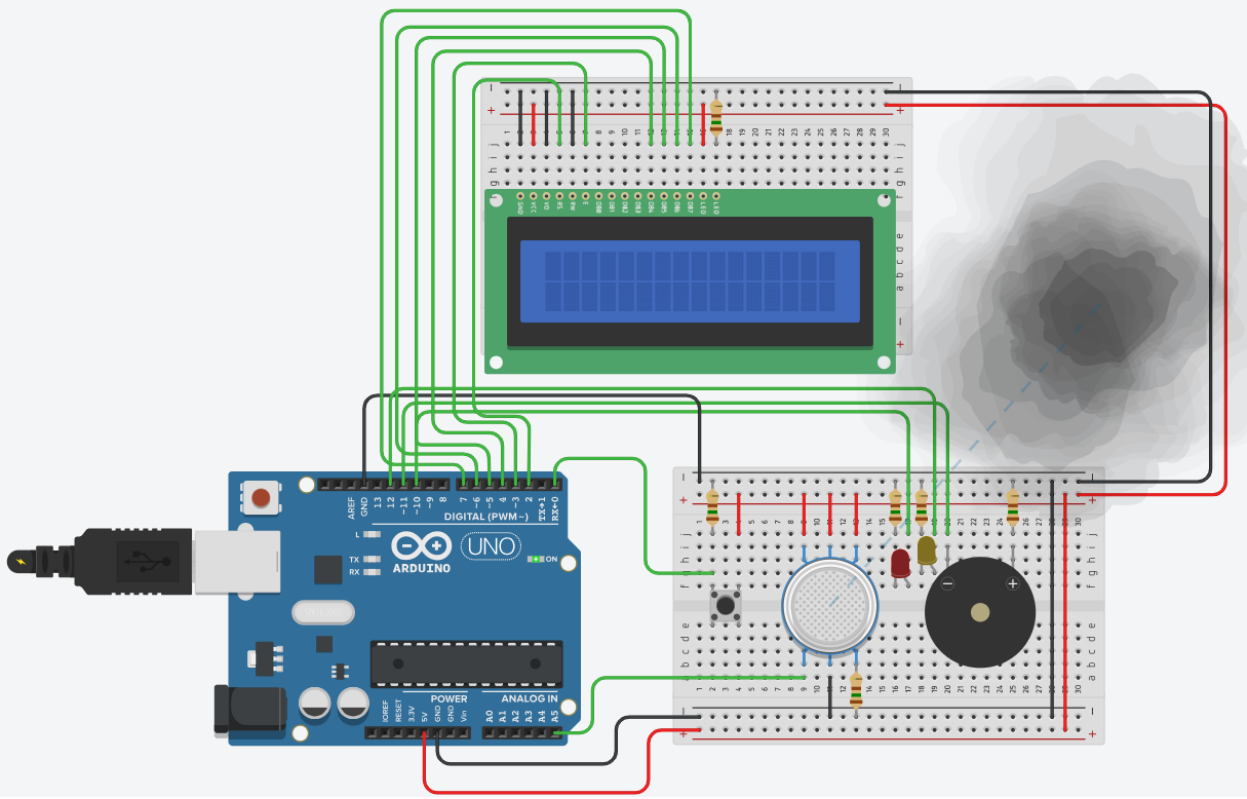

Figure 1: https://www.tinkercad.com/things/5s7yW1LiG7U-copy-of-iot281project/editel?sharecode=xOtyIN_MEtrGcQmFVn6QRsDdXw0nyQRipFZ0NUTvTlc

INDEX AND SYSTEM FUNCTIONS

The exhibited circuit on figure 1.1 is a combination of an Arduino Board, two LED Bulbs, a single button, smoke detection unit, five resistors a buzzer and an LCD Display. All these components make up a smoke detection system, it begins with the smoke detection unit sensing the presence of smoke then upon that encounter the buzzer will sound, and the LED bulbs will begin to flicker, thus a combination of sound and visual warning notifying the presence of smoke. The only time when the lights and the sound will be off is when the level of smoke subsided preferably undetectable. It is a complete system, already configured, ready to be deployed as is.

Potentially the above smoke detection system can be further connected to other systems and on the other hand allowing monitoring, control, automation, and optimization, which if reality speaks for itself is the essence of IoT (R Y Endra, 2019).

SYSTEM CODE

Find the code for the project under Appendix A.

GLOBAL VARIABLES:

Global Variables smokeDangerLvl as well as gasDangerLvl variables are used to hold predetermined hazard levels for smoke and gas. They are used to determine when alarms should be triggered.

SETUP() FUNCTION:

When the Arduino boots up, the setup() code is called once:

- It assigns the necessary modes (INPUT_PULLUP or OUTPUT) to the pins used for the push button (btnPin), LEDs (ledPinR and ledPinY), and the piezo buzzer (piezoPin).
- Initializes the LiquidCrystal library to operate the 16-column, 2-row LCD display.
- The display clears and thendisplays "System Boot" to signify that the system is booting up.
- As a system boot indication, the system turns on both the red and yellow LEDs (ledPinR and ledPinY) for 2 seconds.
- The LCD display is cleared to prepare it for the main loop.

LOOP() FUNCTION.

- Following the setup() function, the loop() function is performed indefinitely
- For both smoke and gas levels, reads analog readings from the gas sensor linked to gasPin.
- Checks for the presence of the reset button (attached to btnPin). If it is, the noAlarm() function is invoked to erase any alarms, and a 500 millisecond delay is added to prevent additional button pushes from being registered.
- The displayLevels() method is called to refresh the LCD display with the current smoke and gas levels.
- Checks if an alert condition is satisfied based on the established danger levels by calling the checkAlarms() method.

DISPLAYLEVELS() FUNCTION:

The displayLevels() method displays the current smoke and gas levels on the LCD display:

- The cursor is moved to the first row, and the text "Smoke: " is followed by the current smoke level.
- The cursor is moved to the second row, and the text "Gas: " is followed by the current gas level.
- To update the display at a suitable rate, there is a 500 millisecond delay.

CHECKALARMS() FUNCTION:

The checkAlarms() method determines whether an alarm situation exists based on the current smoke and gas levels:

- If the smoke level reaches the specified danger threshold (smokeDangerLvl), the LCD displays "DANGER SMOKE!" and a smoke alarm is triggered using the smokeAlarm() method.
- If the gas level reaches the specified danger threshold (gasDangerLvl), the LCD displays "DANGER GAS!" and a gas alarm is triggered using the gasAlarm() function.
- If neither condition is fulfilled, the noAlarm() function is used to remove any current alarms.

ALARM FUNCTIONS:

- smokeAlarm(): Activates the red LED (ledPinR), deactivates the yellow LED (ledPinY), and generates a 5000 Hz tone on the piezo buzzer (piezoPin) to signify a smoke alarm.
- noAlarm(): Deactivates both LEDs (ledPinR and ledPinY) and silences the piezo buzzer (piezoPin) to show that there is no alert.
- gasAlarm() activates the yellow LED (ledPinY), deactivates the red LED (ledPinR), and generates a 2500 Hz tone on the piezo buzzer (piezoPin) to signify a gas alarm.

CIRCUIT SCHEMATIC

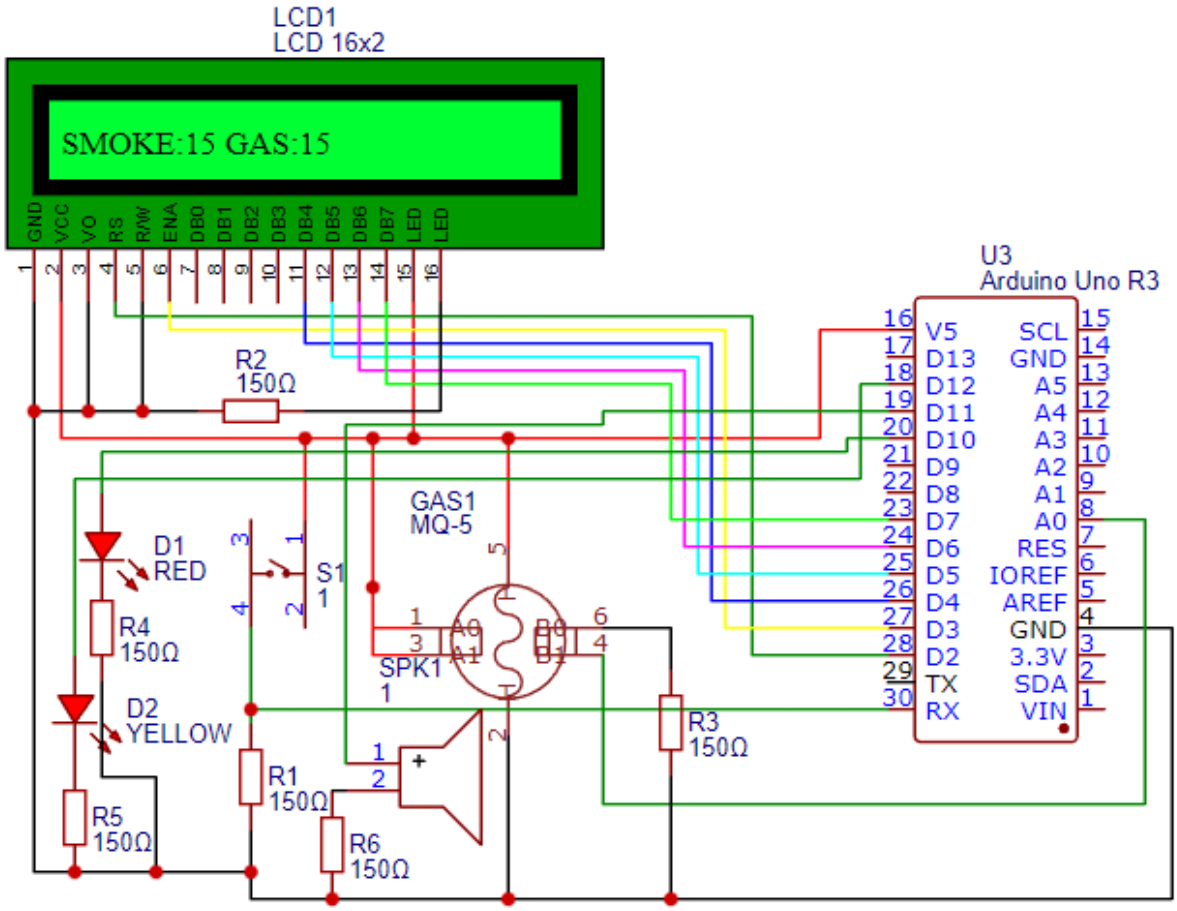

Figure 2: CIRCUIT SCHEMATIC

COMPREHENSIVE COMPONENTS LIST

Name	**Quantity**	**Component**
U1	1	Arduino Uno R3
S1	1	Pushbutton
GAS1	1	Gas Sensor
R1 R2 R3 R5 R6	5	150 Ω Resistor
PIEZO1	1	Piezo
D1	1	Red LED
U2	1	LCD 16 x 2
R4	1	154 Ω Resistor
D2	1	Yellow LED

Figure 3:COMPONENT LIST

COMPONENTS DESCRIPTION

- **ARDUINO**

  It is a programmable circuit board that is equipped with a variety of digital and analog pins that are used for interfacing breadboards, shields and other components and circuits, other models comprise of communication features such as Universal Serial Bus(USB) and other connectivity capabilities such as Bluetooth, Wi-Fi and many more.

- **PUSH BUTTON**

  A Push Button switch is a type of switch which consists of a simple electric mechanism or air switch mechanism to turn something on or off.

- **GAS SENSOR**

  The simple sensor has a conservative energy usage approach, it operates on 5Volts and uses Direct current(DC), the sensor can detect a variety number of substances including Smoke, Hydrogen, Carbon Monoxide, Methane, Propane, Alcohol and Liquefied Petroleum Gas(LPG). Therefore, within the smoke detection system it is the sole component that is responsible for gas detection.

- **RESISTOR**

  They are electrical components that regulates and limits the flow of electrical current within a circuit thereby providing a layer of protection which typically reduce or in some cases eradicate too much electrical current which can lead to components being blown up (TechTarget Contributor, 2021). Within the smoke detection system, there are several of these 150ohms resistors used to regulate electrical movement throughout the circuit.

- **PIEZO BUZZER**

  This is a simple component that is built with the sole purpose of producing a sound to alarm and notify the presence of dangerous gases detected. A very lightweight component and typically low cost but as equally important.

- **LED LIGHTS**

  Light-emitting diodes are semiconductor devices which are responsible for producing the visible light after the gas has been detected (Shuji Nakamura Nick Holonyak, Jr. Akasaki Isamu Amano Hiroshi, 2023). These diodes comprise of two terminals the anode which is the positive and the cathode which is the negative.

- **LIQUID CRYSTAL DISPLAY(LCD)**

  This is a type of flat panel display which make use of crystals and it is responsible for displaying relevant information with regards to smoke detection system. These LCD is popularly known for its 16 pin and there is a provision of liquid Crystal library which enables the control of what to display on the LCD (Söderby, 2021).

- **BREADBOARD**

  The board is made up of holes that allows a plethora of components to be mounted and connected throughout a circuit allowing electricity to move through the circuit (Crowell, 2019). Notably in our smoke detection system we used two breadboards for all the connectivity.

CONCLUSION

Safety is a fundamental aspect regardless of the setup, whether it is within the homestead or commercial buildings. Smoke detection systems are quite prevalent due to capabilities of implementation of IoT products to curb unnecessary and unwanted circumstances. Since several gases can be detected by the gas detector and the smoke detection system can be tailored to monitoring, controlling, automation and possibly optimization, it is quite advantageous and affordable to erect a smoke detection system such as we have built.

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Appendix:

```
// C++ code
// To Do
#include <LiquidCrystal.h>

LiquidCrystal lcd(2, 3, 4, 5, 6, 7);
const int btnPin = 0;
const int gasPin = A5;
const int piezoPin = 11;
const int ledPinR = 10;
const int ledPinY = 12;

int smokeDangerLvl = 40;
int gasDangerLvl = 25;

void setup() {

  pinMode(btnPin, INPUT_PULLUP);
  pinMode(ledPinR, OUTPUT);
  pinMode(ledPinY, OUTPUT);
  pinMode(piezoPin, OUTPUT);
  lcd.begin(16, 2);
  lcd.clear();
  lcd.print("System Boot");
  digitalWrite(ledPinR,HIGH);
  digitalWrite(ledPinY, HIGH);
```

```
  delay(2000);
  lcd.clear();
}

void loop() {
            //GET GAS/SMOKE LEVELS
  int smokeLevel = analogRead(gasPin);
  int gasLevel = analogRead(gasPin);

  //CHECK RESET BTN
  if (digitalRead(btnPin) == HIGH) {
    noAlarm();
    delay(500);
  }

  displayLevels(smokeLevel, gasLevel);
  checkAlarms(smokeLevel, gasLevel);
}

void displayLevels(int smokeLevel, int gasLevel) {

  lcd.setCursor(0, 0);
  lcd.print("Smoke: ");
  lcd.print(smokeLevel);
  lcd.print("  ");

  lcd.setCursor(0, 1);
  lcd.print("Gas: ");
```

```
  lcd.print(gasLevel);
  lcd.print("  ");
  delay(500);
}

void checkAlarms(int smokeLevel, int gasLevel) {
  if (smokeLevel > smokeDangerLvl) {
    lcd.setCursor(0, 1);
    lcd.print("DANGER SMOKE!");
    smokeAlarm();
  } else if (gasLevel > gasDangerLvl) {
    lcd.setCursor(0, 1);
    lcd.print("DANGER GAS!");
    gasAlarm();
  } else {
    noAlarm();
  }
}

void smokeAlarm() {
  digitalWrite(ledPinR, HIGH);
  digitalWrite(ledPinY, LOW);
  tone(piezoPin, 5000);
}

void noAlarm() {
  digitalWrite(ledPinR, LOW);
  digitalWrite(ledPinY, LOW);
```

```
  noTone(piezoPin);
}

void gasAlarm() {
  digitalWrite(ledPinY, HIGH);
  digitalWrite(ledPinR, LOW);
  tone(piezoPin, 2500);
}
```