# Board 4 - Sensor Shield Report                    (05/01/2022) Rishab Shah

## Project Overview/Definition of work:

A 4-layer board with following sensors is to be made along with the care for each sensor if applicable is mentioned

- A temperature-humidity sensor  -- GPIO line
- A Hall effect magnetic field sensor – Connected to ADC
- A CO, carbon monoxide sensor (MQ-7)
- A microphone  A3 of arduino
- At least 4 smart or digital LEDs – GPIO line with a 1K ohm resistor in series
- A buzzer – GPIO line with PWM
- A 16 bit ADC – ADDRR grounded for address selection
- A 12 bit DAC  - D0 of Arduino Uno
- A heartbeat sensor – LED's are on the opposite side and are bright and Red in color – 47 Ohm resistor, Connected to ADC

16-bit ADC to measure the heartbeat sensor and the CO sensor as single ended voltages and the Hall effect sensor as a differential signal. The schematics for each of the sensor is referred from the digikey as well as lecture notes.SCl ,SDA should have a 10K pull-up.Man care is that the headers should be aligned with the arduino uno as well as the shield should not cover the board completely otherwise there will be an access issue to the board.
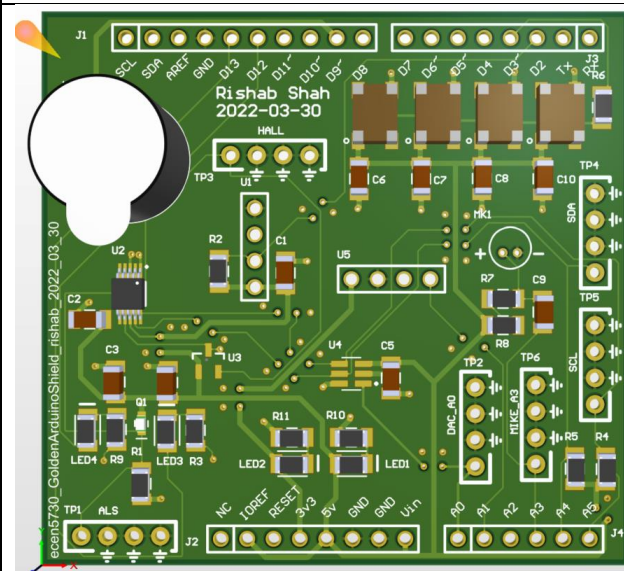
## Schematic:
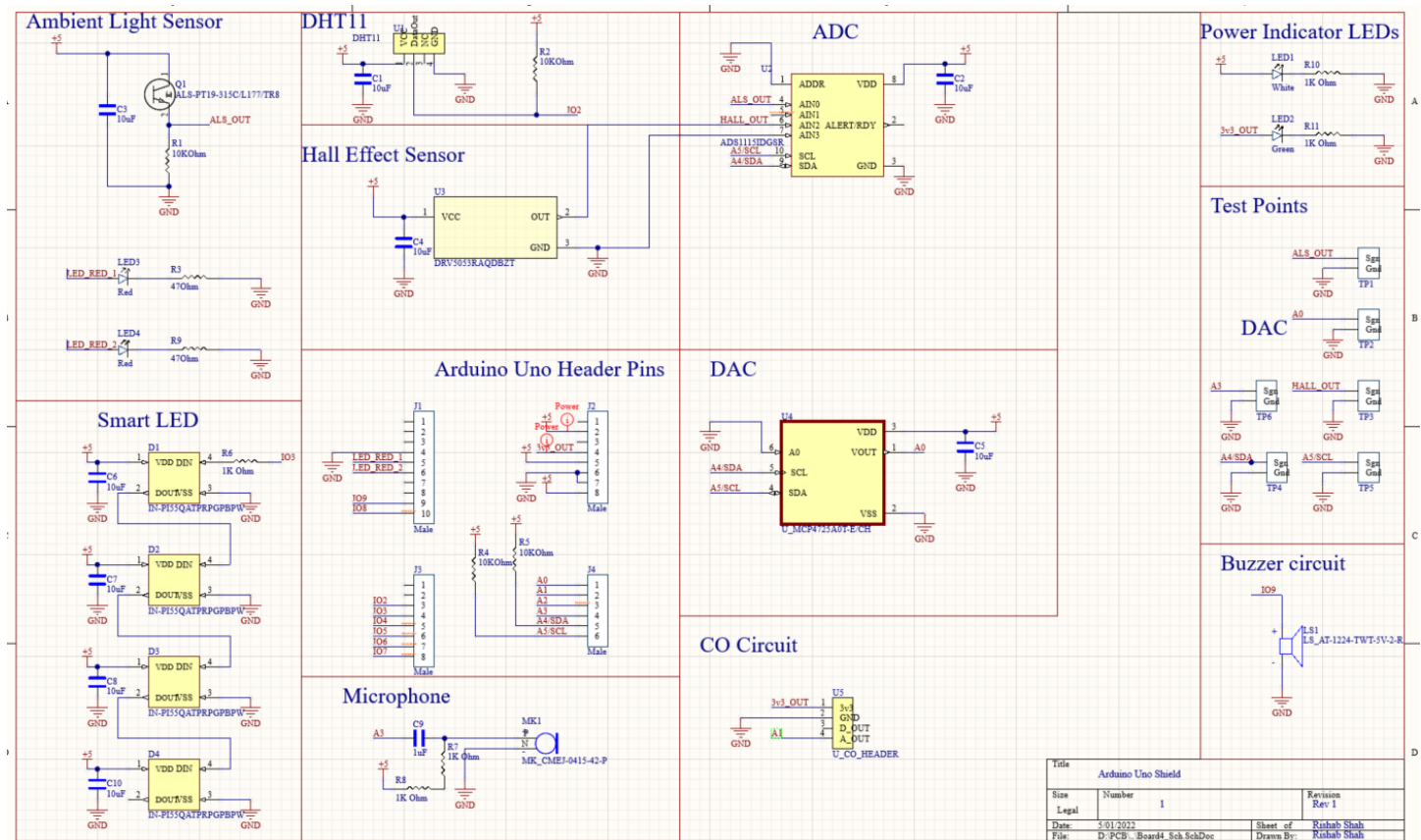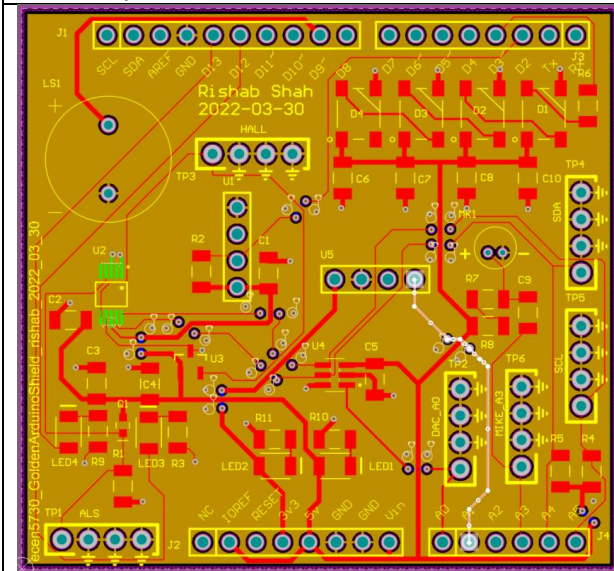
| Board Layout | 3D view of the board |
|---|---|
|  |  |

**Code:** Online arduino library and sample codes were referred to combine and demonstrate the final working code.



Arduino_Uno_Brd4_co
de.txt

**Application:** Sense the humidity values and a humidity value above the threshold will tur off the smart LEDs where as in default mode will continuously emit a pattern. DHT11 would give out humidity at 2 second interval.The hall effect sensor would emit two different types of buzzer sound patterns on detecting a magnet based upon which way the magnetic fields are going towards the Hall effect sensor. A single ended measurement is done for the same. The CO sensor would give out a graph plot for the values it senses in the environment.

**Measurements:**

```
10:17:40.603 -> CO : 280
10:17:40.650 -> Hall-effect : 333
10:17:40.650 -> humidity : 35
10:17:43.559 -> CO : 280
10:17:43.606 -> Hall-effect : 334
10:17:43.606 -> humidity : 35
10:17:46.519 -> CO : 279
10:17:46.519 -> Hall-effect : 333
10:17:46.566 -> humidity : 35
10:17:49.479 -> CO : 278
10:17:49.479 -> Hall-effect : 333
10:17:49.526 -> humidity : 35
10:17:52.436 -> CO : 277
10:17:52.436 -> Hall-effect : 334
10:17:52.436 -> humidity : 34
10:17:55.390 -> CO : 278
10:17:55.390 -> Hall-effect : 334
10:17:55.390 -> humidity : 43
10:17:58.350 -> CO : 277
10:17:58.350 -> Hall-effect : 334
10:17:58.350 -> humidity : 41
```

**Best practices:**
The via's are placed near each cross under to reduce the noise and ground bounce in a 4 later board as well as Signal-Ground-Ground-Signal was used for best performance.

**Improvement/Care for next time:**

Better sensor placement is layout. Current layout has two sensors close to each other.CO and TH sensor.

**Picture of Working Board:**

| Bare board | Working board |
| --- | --- |
|  |  |
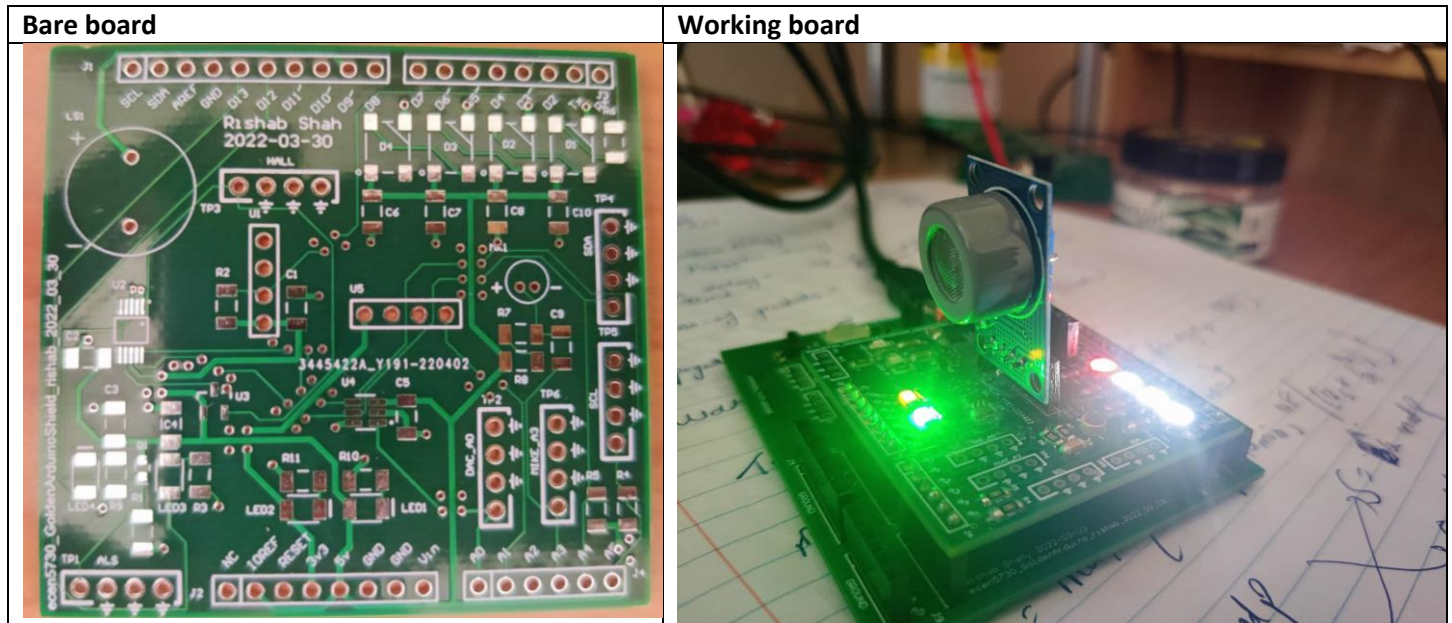
**Analysis of your project:**
Q. What worked and you did well and want to do in future design
• Labelling every component and division of the blocks beforehand helped to visualize and breakdown tasks.

Q. What did not work, and you will want to do differently in future designs.
• Better sensor placement

Q. Were there any hard errors- why did they go wrong
• No hard errors

Q. Were there any soft errors that you would like to do differently next time?
• Better routing and creative placement of smart LED's instead of an array strip as well as addition of a switches to increase the application combinations like a menu driven program based upon interrupt. Addition of a bar code for fun.