



Technical report

Real-Time Metro Sensing Hub

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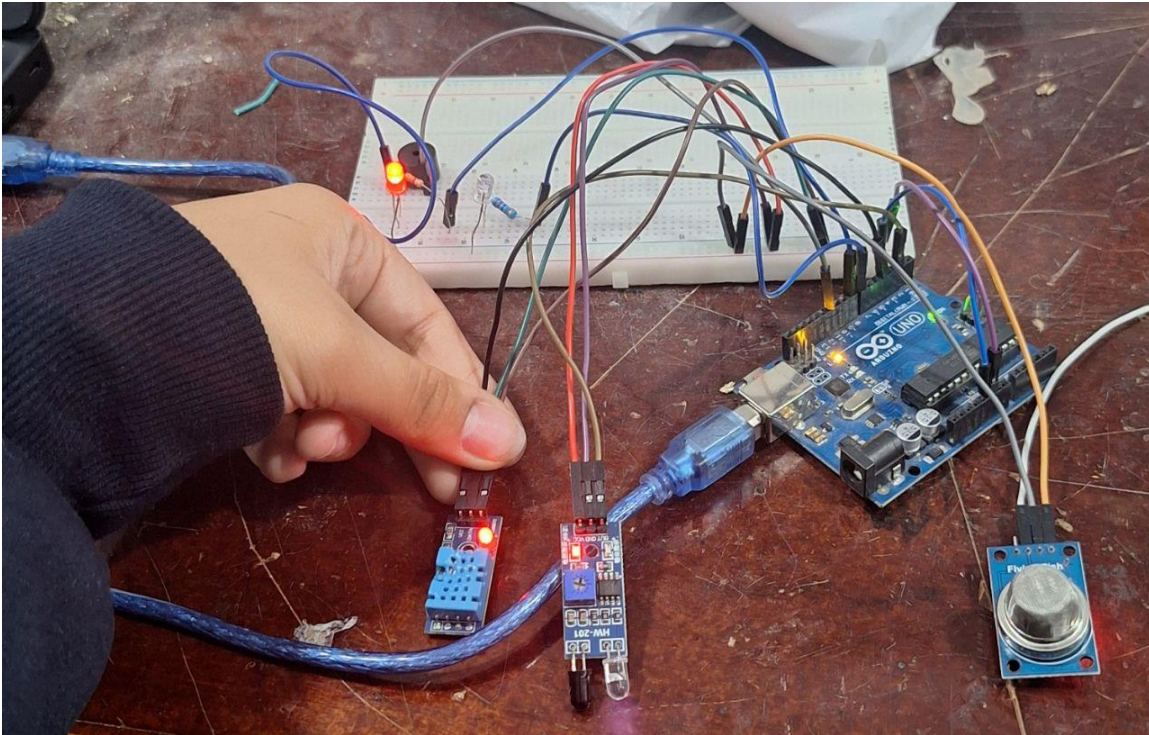
Mrs. Nardine Fayek/ G12 capstone leader

System idea

Addressing urban congestion challenge, a smart metro car prototype has been developed, integrating advanced sensors to enhance functionality and safety. The system employs an Infrared (IR) sensor to monitor passenger occupancy, activating a green LED when the number of people exceeds 20, ensuring optimal crowd management. An MQ-135 sensor monitors carbon dioxide (CO₂) levels, triggering a buzzer when concentrations surpass 418 ppm, providing an early warning for air quality concerns. Additionally, a DHT11 sensor measures temperature, activating a red LED when readings fall outside the 10–30°C range to maintain thermal comfort. Sensor outputs are visualized through an Excel dashboard for real-time monitoring and stored on a hard disk for further analysis. Powering the system is two 3.7V lithium-ion batteries, ensuring efficient and portable operation. The setup is housed in an acrylic box with dimensions of 0.20 m × 0.2 m × 0.14 m, simulating a metro car environment. Notably, the system demonstrates the interdependence of variables: CO₂ concentration rises proportionally with passenger numbers, while temperature increases over time with crowd density. This system updates data every 1 second providing accurate data for further research and analysis.

The whole system:

FIGURE 1 SENSORS

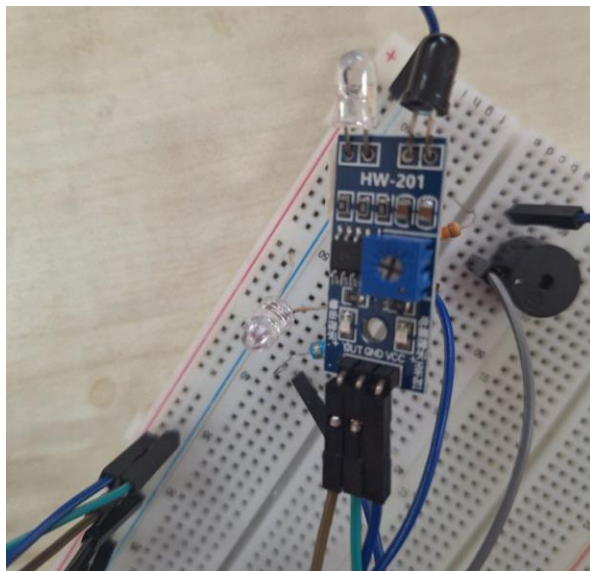


This Figure Demonstrates the Connection of the sensors

1- Sensors:

- **IR sensor connected with a green LED to count number of people.**

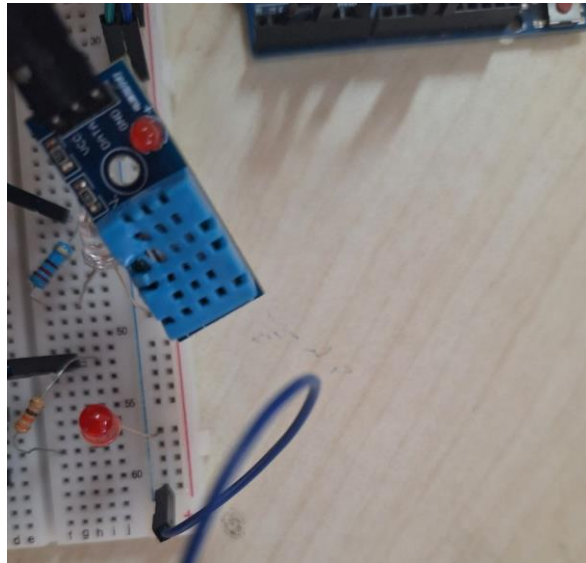
FIGURE 2 IR SENSOR



This Figure Demonstrates the IR sensor connected with a green LED

- **DHT11 sensor connected with a red LED to detect temperature.**

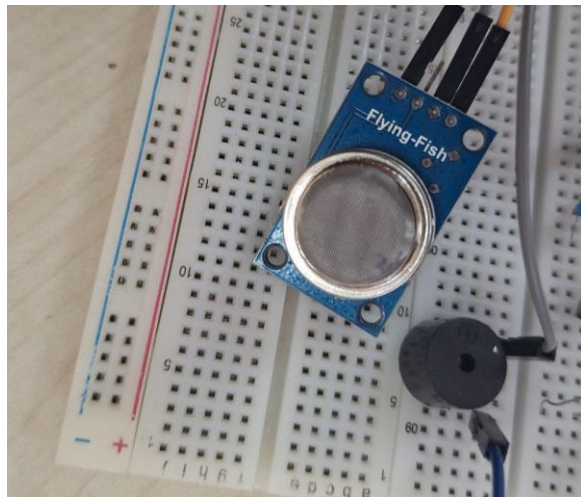
FIGURE 3 TEMPERATURE SENSOR



This Figure Demonstrates the temperature sensor connected with a red LED

- **MQ-135 sensor connected with buzzer to detect CO₂ level**

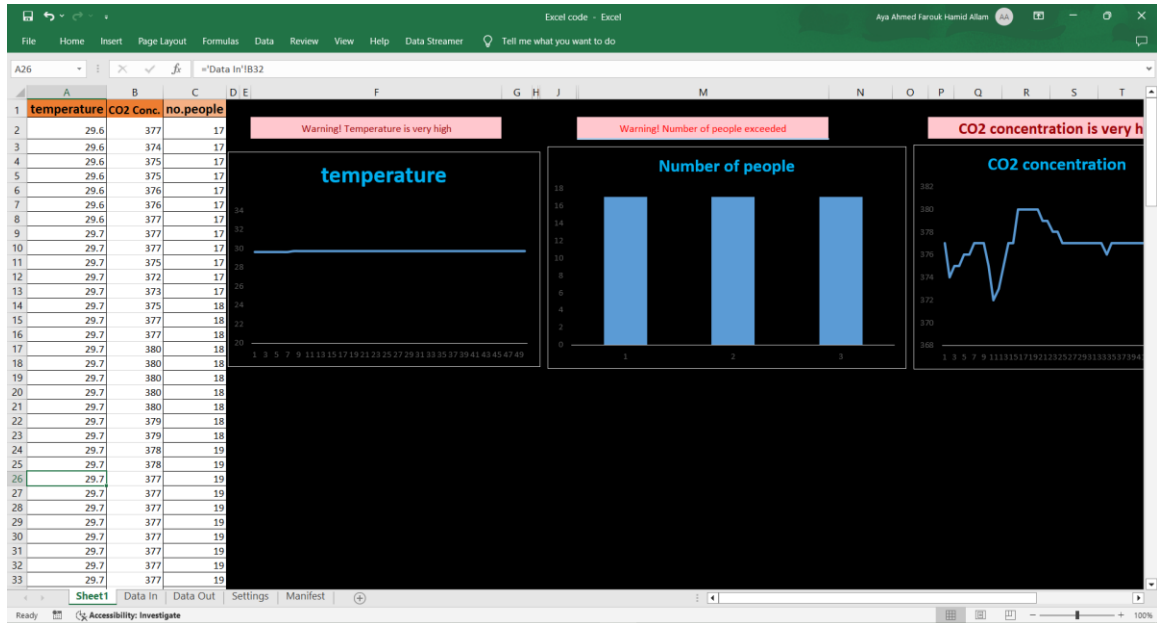
FIGURE 4 MQ-135 SENSOR



This Figure Demonstrates the MQ-135 sensor connected with a buzzer

2- Dash board:

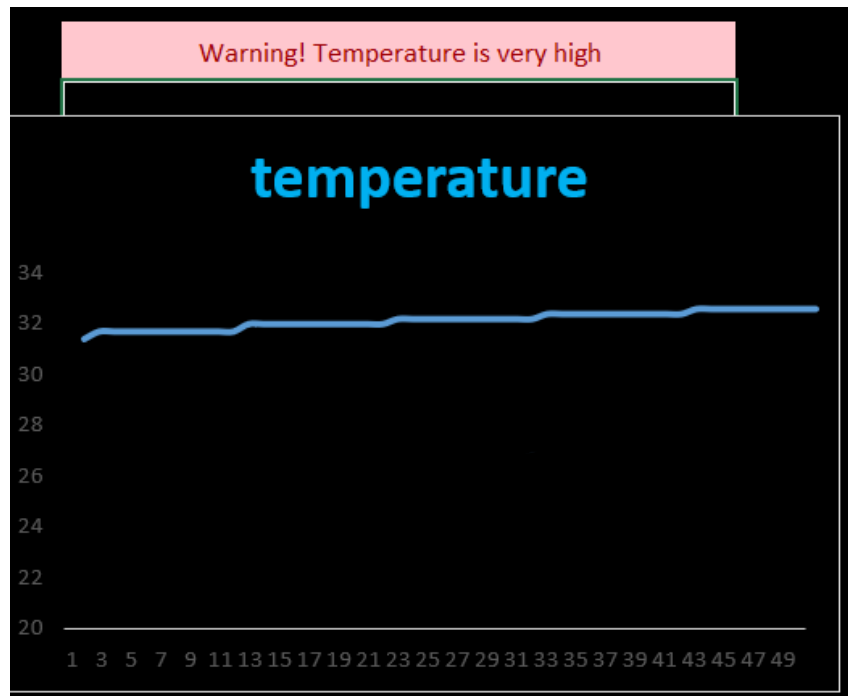
FIGURE 5 DASHBOARD



This Figure Demonstrates the Excel dashboard for data visualization

- **Temperature graph:**

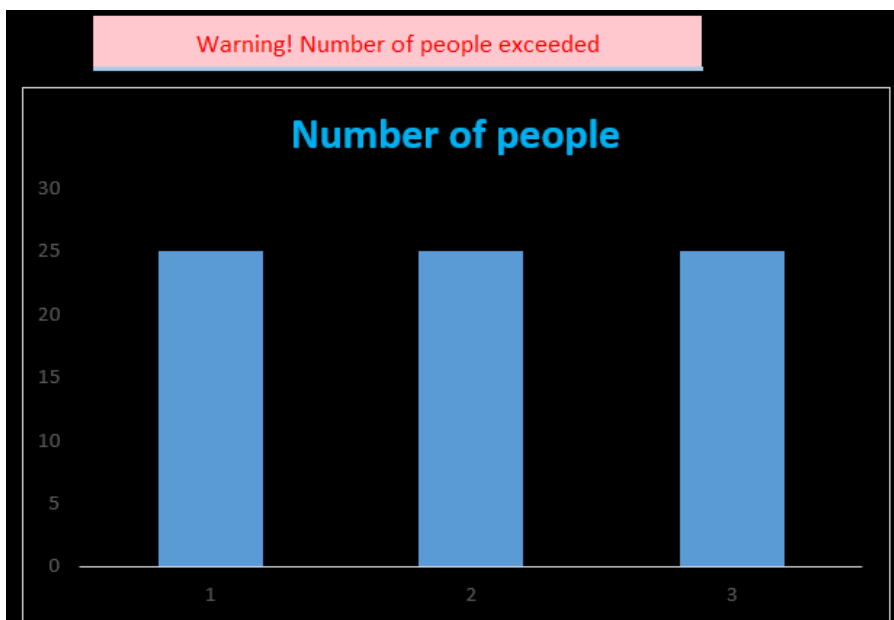
FIGURE 6 TEMPERATURE GRAPH



This Figure Demonstrates the temperature graph between temperature in Celsius(y-axis) and time in seconds(x-axis)

- **Number of people graph**

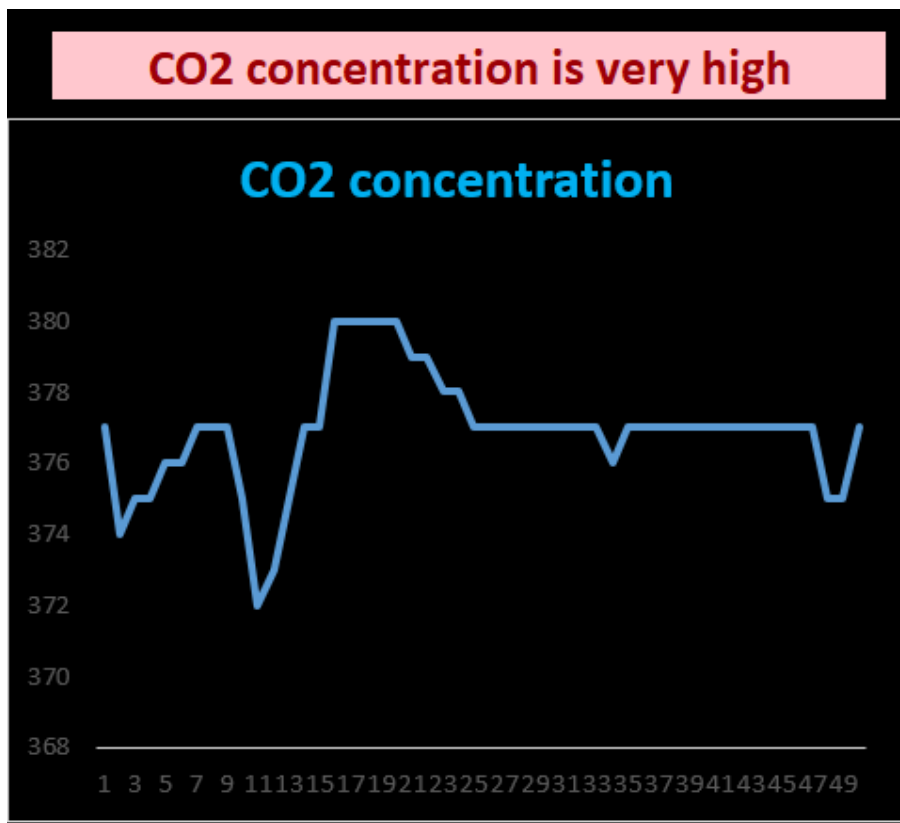
FIGURE 7 NUMBER OF PEOPLE GRAPH



This Figure Demonstrates the number of people graph between number of people(y-axis) and time in seconds(x-axis)

- CO₂ level graph

FIGURE 8 CO₂ GRAPH



This Figure Demonstrates the CO₂ concentration graph between CO₂ level in ppm (y-axis) and time in seconds(x-axis)