MOSH Gas Sensor

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Our project revolves around the integration of a gas sensor, developed during a training period at AIME. Aligned with the objectives of the Innovative Smart Systems major, we undertook the entire process—from conception and creation in the AIME laboratory to schematic design, routing, wiring, programming, and addressing wireless communication and network aspects.

This project serves as an overall test of our proficiency in key areas, including network knowledge, programming skills, and electronics expertise. The core objective is to send sensor data over a LoRa network to a dashboard for visualization and analysis. In this report, we will succinctly outline each step taken, highlighting the challenges addressed and the refined skills acquired to achieve our final results.

Integration of the Lora Network

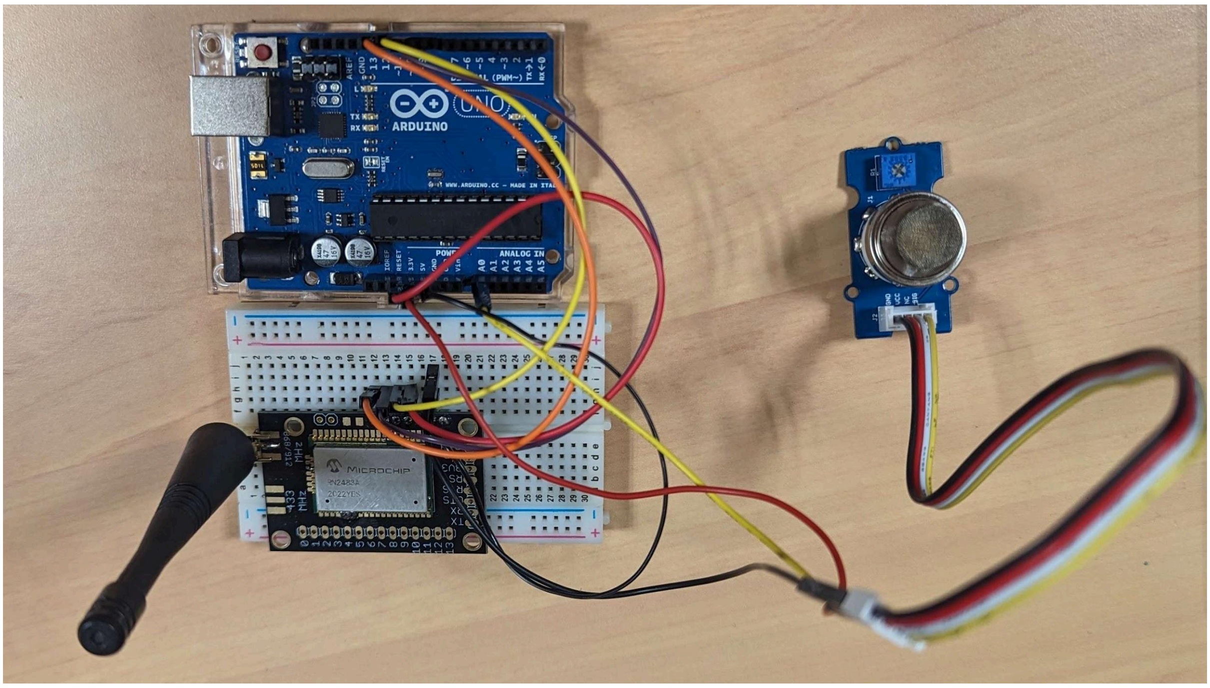
To initiate our project, we initially attempted to link an Arduino with the Lora network. This was accomplished using a Microchip-manufactured RN2483 chip, a module that is capable of Lora network communication. Given that this chip is equipped with only small connectors, it was necessary to solder the component onto a board that has larger connectors to facilitate communication with the Arduino.

RN2483 Module soldered on the board

Following this step, we successfully connected our Arduino to the INSA's Lora network. This connection allowed us to integrate our device into the network infrastructure, enabling communication and data exchange using the established Lora technology.

Integration of the MQ-3B gas sensor

Once the connection with the gateway was successfully established, our next goal was to transmit data to it. This step is crucial for retrieving and displaying data on a dashboard. For our prototype, we chose the MQ-3B gas sensor, known for its capability to detect gas concentrations, and integrated it with our Arduino system. This sensor was ideal for our application's requirements. The final setup included the Arduino board, the RN2483 module for LoRa communication, and the MQ-3B sensor. This assembly created a functional circuit capable of detecting and wirelessly transmitting gas concentration data to the gateway.

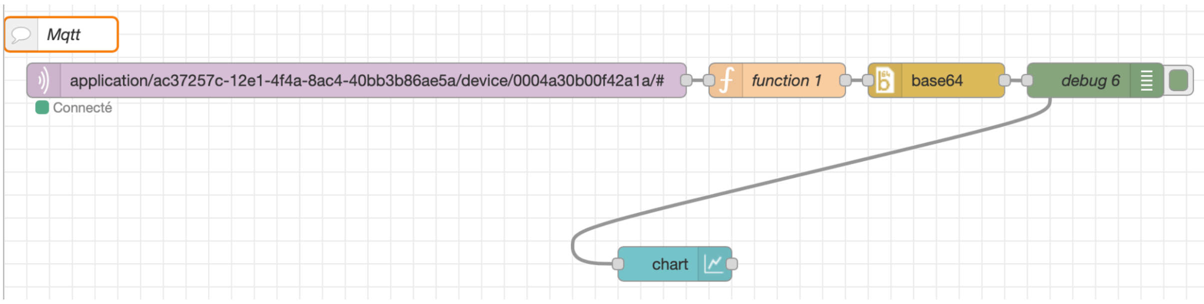


Montage of the circuit

Development of a node-red application

Node-RED is a flow editor that operates within a web browser, facilitating the easy connection of different data flows.

In our application, we used Node-RED's MQTT subscribe block to receive data from ChirpStack. This data is initially encoded in base64 by ChirpStack. To handle this, we piped the incoming data into a JavaScript function block specifically designed to decode the base64 format. Once decoded, this data is then routed to a dashboard block within Node-RED. This final step allows us to visually represent and monitor the data in a clear and accessible manner on the dashboard.

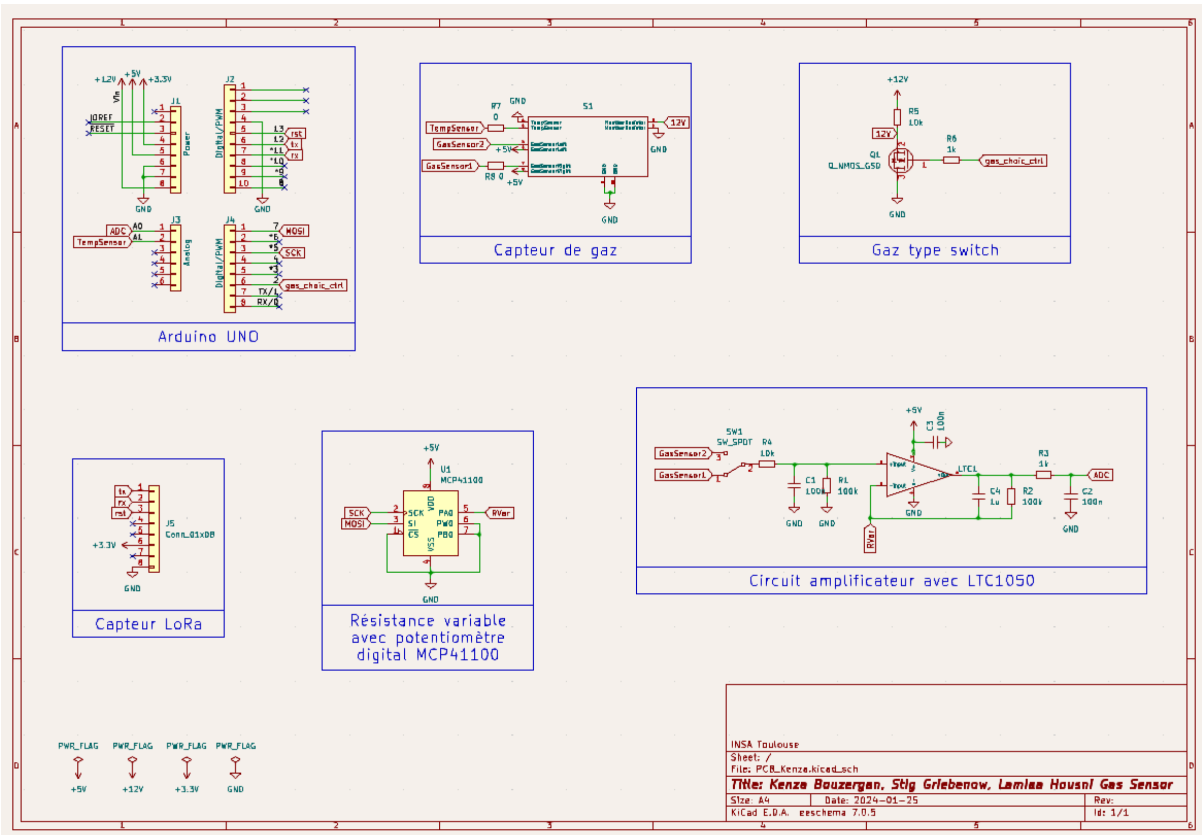


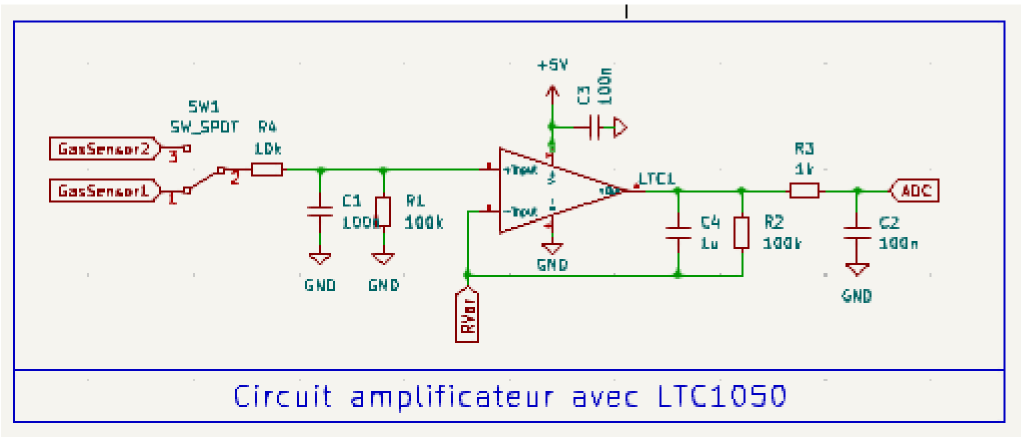
The node-red flow

Our circuit

- The amplifier

In our project, the initial step in processing sensor data involves using a transimpedance amplifier. This amplifier is crucial as it conditions the signal to be compatible with the Arduino's ADC. We conducted simulations of this circuit using LTSpice, which allowed us to evaluate the performance of various filters and the transimpedance amplifier itself. The design and functionality of this amplifier are critical in ensuring accurate signal detection and processing in our system.

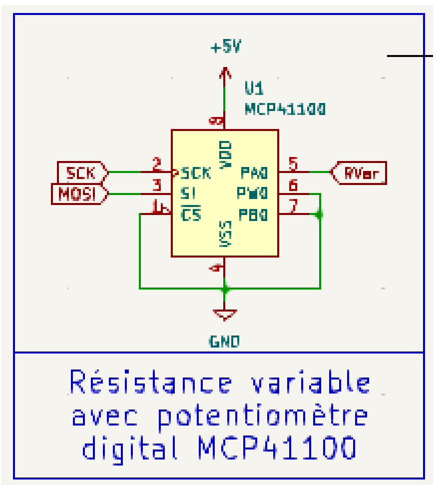




Our amplifier

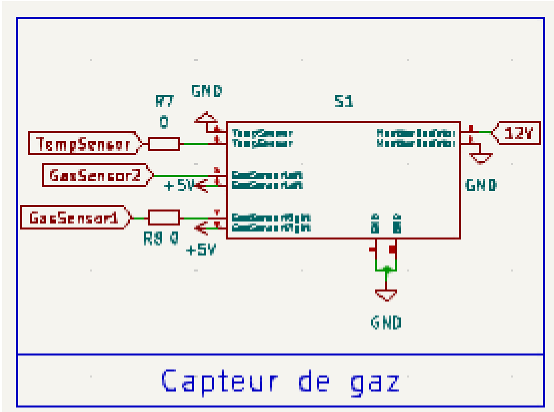
- The digital potentiometer

In our setup, we integrated a digital potentiometer to function as a variable resistor, selecting the MCP41100 model. This particular component is powered by a 5V supply and is controlled by the Arduino through the SPI. The use of a digital potentiometer like the MCP41100 allows for precise and programmable control over resistance.



Montage for the digital potentiometer

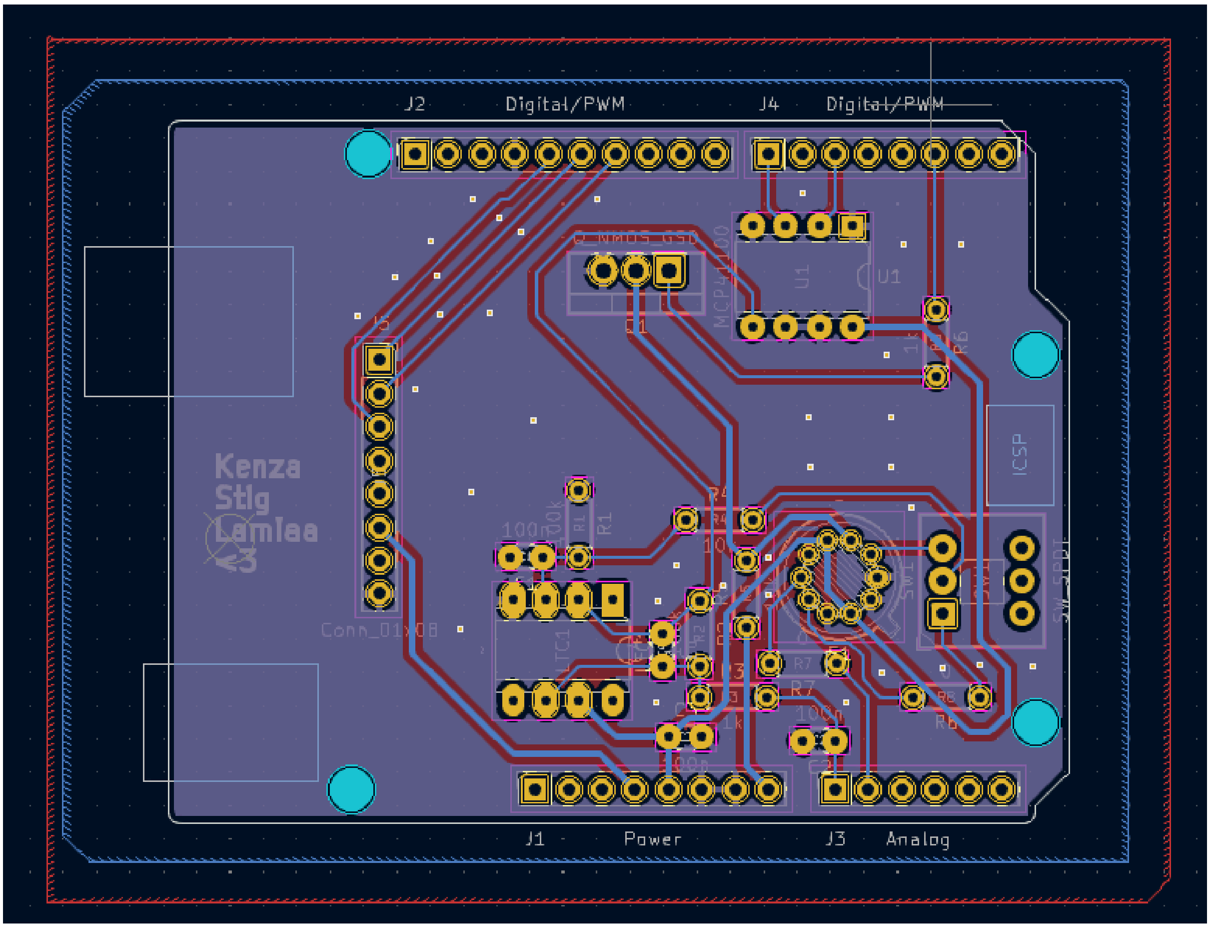
- Sensor connections



Our gas sensor connections on the schematic

PCB design

To bring together all the components of our sensor system, we designed a dedicated Printed Circuit Board. This PCB integrates all these stages into a cohesive unit, providing an efficient layout for our sensor system. The design of this PCB is detailed in the figure below.



Our PCB for sensor integration

Future work

Moving forward with our project, the next crucial steps would include manufacturing the designed PCB, soldering all the components, and testing the electrical circuits. Additionally, we need to develop software for controlling the heating resistor and potentiometer. We would also tes the sensor's reactivity to NH_3 and C_2H_6O, followed by a test to evaluate the LoRa data transmission and the integration with the Node-RED application. This approach will ensure the realibility of our system in real-world scenarios.

Conclusion

This project offered a thorough initiation into the world of sensor technology, covering all stages from the initial creation to the final application of displaying data on dashboards. It made us improve our skills in various domains such as LoRa communication, Node-RED application creation, and PCB design.