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Ultrasonic oscillating temperature sensor for operation in air

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Video brief
https://youtu.be/GQrjmeBWM5U

Outline

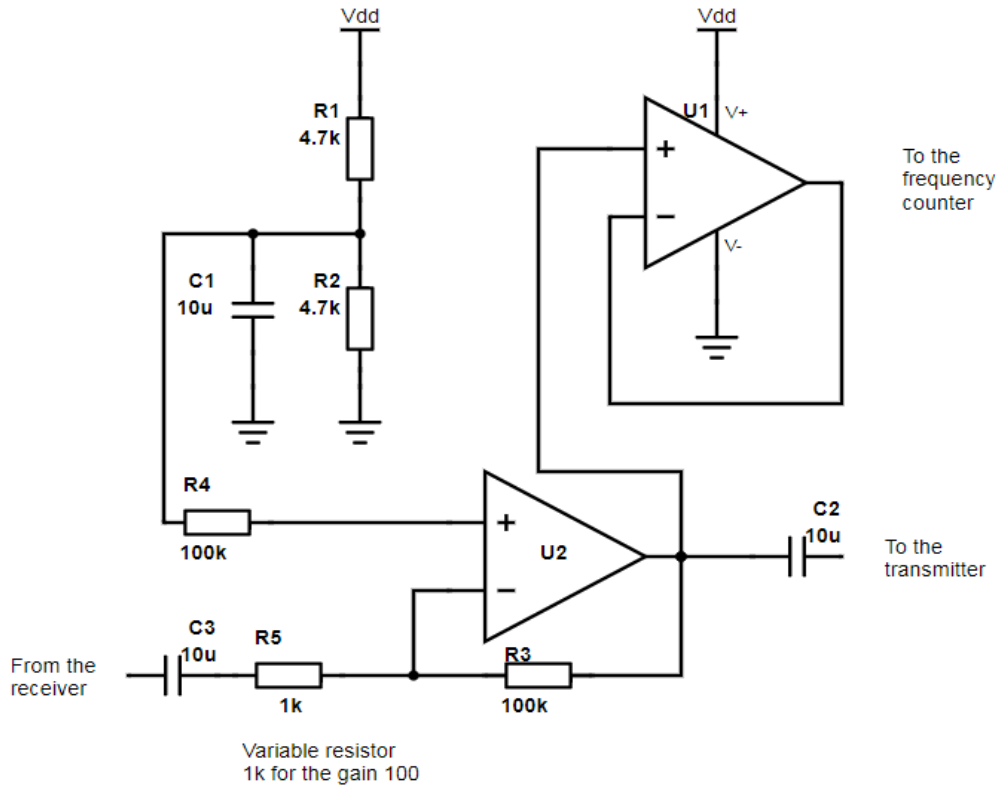
- Why an UOTS for sensing temperature
- Design and implementation of an airborne UOTS
- The experimental procedure
- Experimental results
- Summary and conclusions

Motivation for the research

- ‘In the US, 38% of greenhouse gas emissions from residential housing are produced from heating and cooling rooms… It is estimated that 19% of the UK’s greenhouse gas emissions come from warming up the places we live and work …’ [2]
- ‘the global market size for temperature sensors was estimated at 6.3 billion USD in 2020, with a projected annual growth of 4.8% through 2027’ [3]
- Several temperature sensors are required to measure temperature that varies within a room
- Ultrasonic oscillating temperature sensor (UOTS) for air

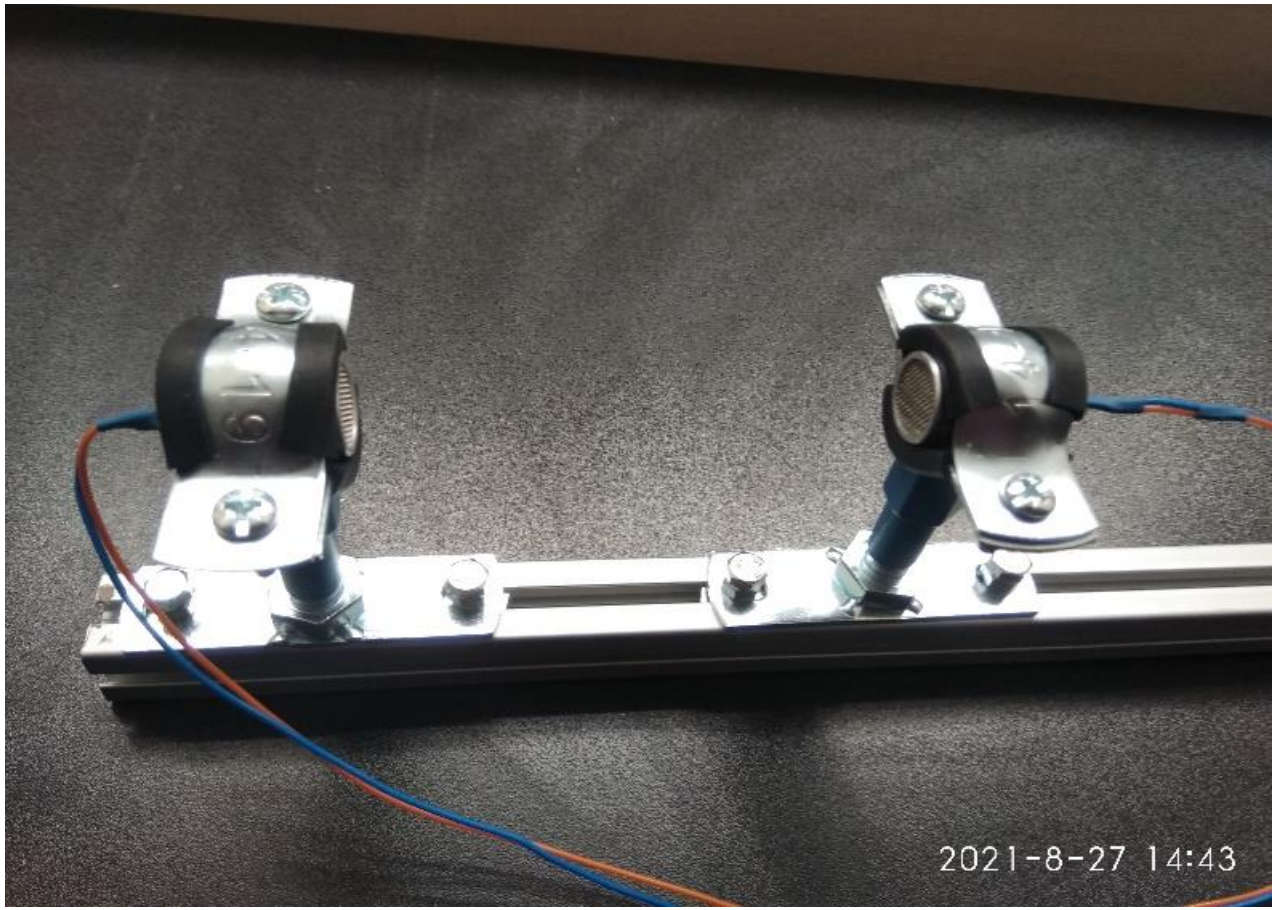
Airborne UOTS (1)

- An UOTS consists of a pair of ultrasonic transducers and an electronic driver (an amplifier)



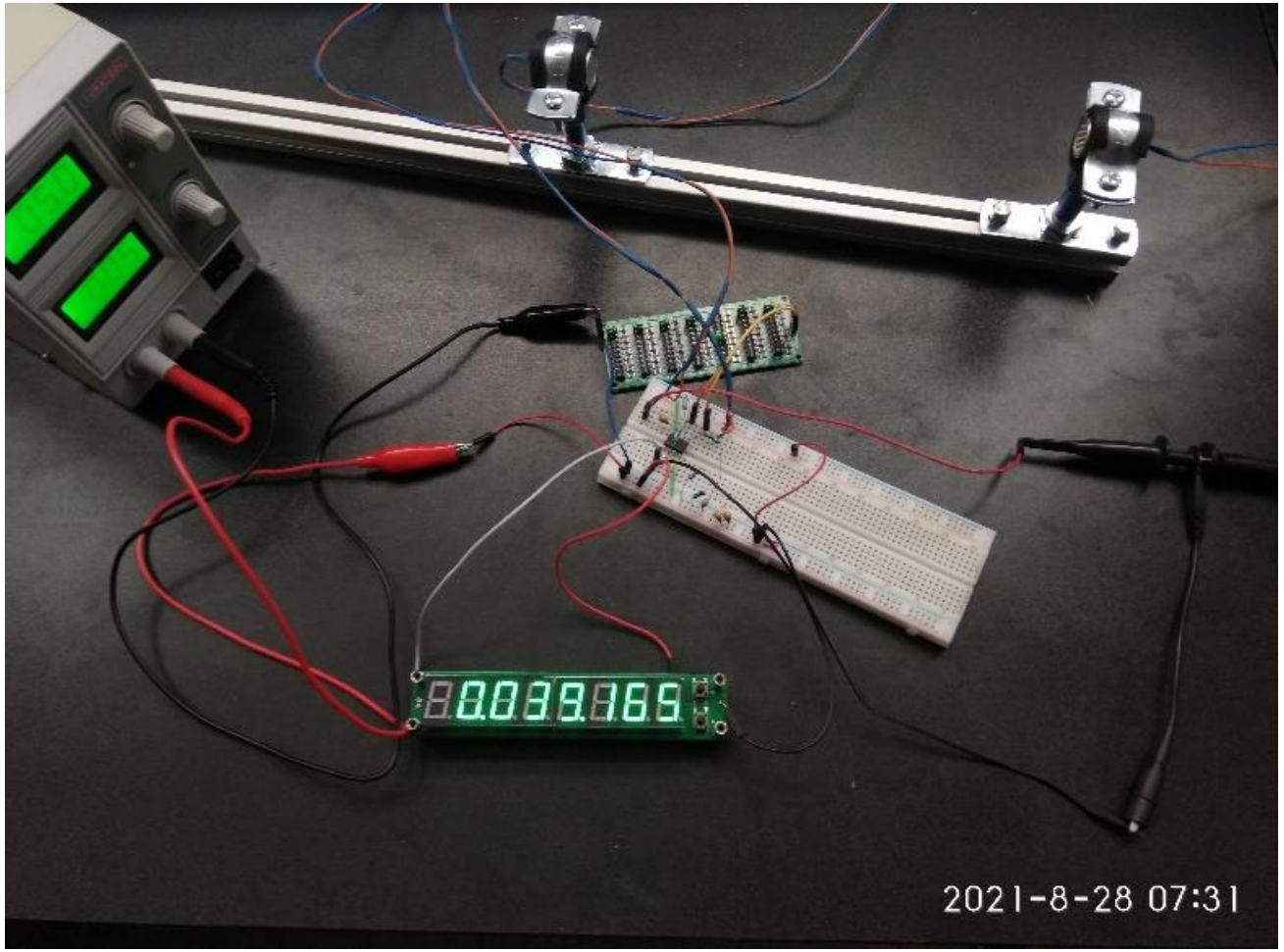
Airborne UOTS (2)

- The transducers were mounted on an aluminium 20x20 profile using Munsen rings



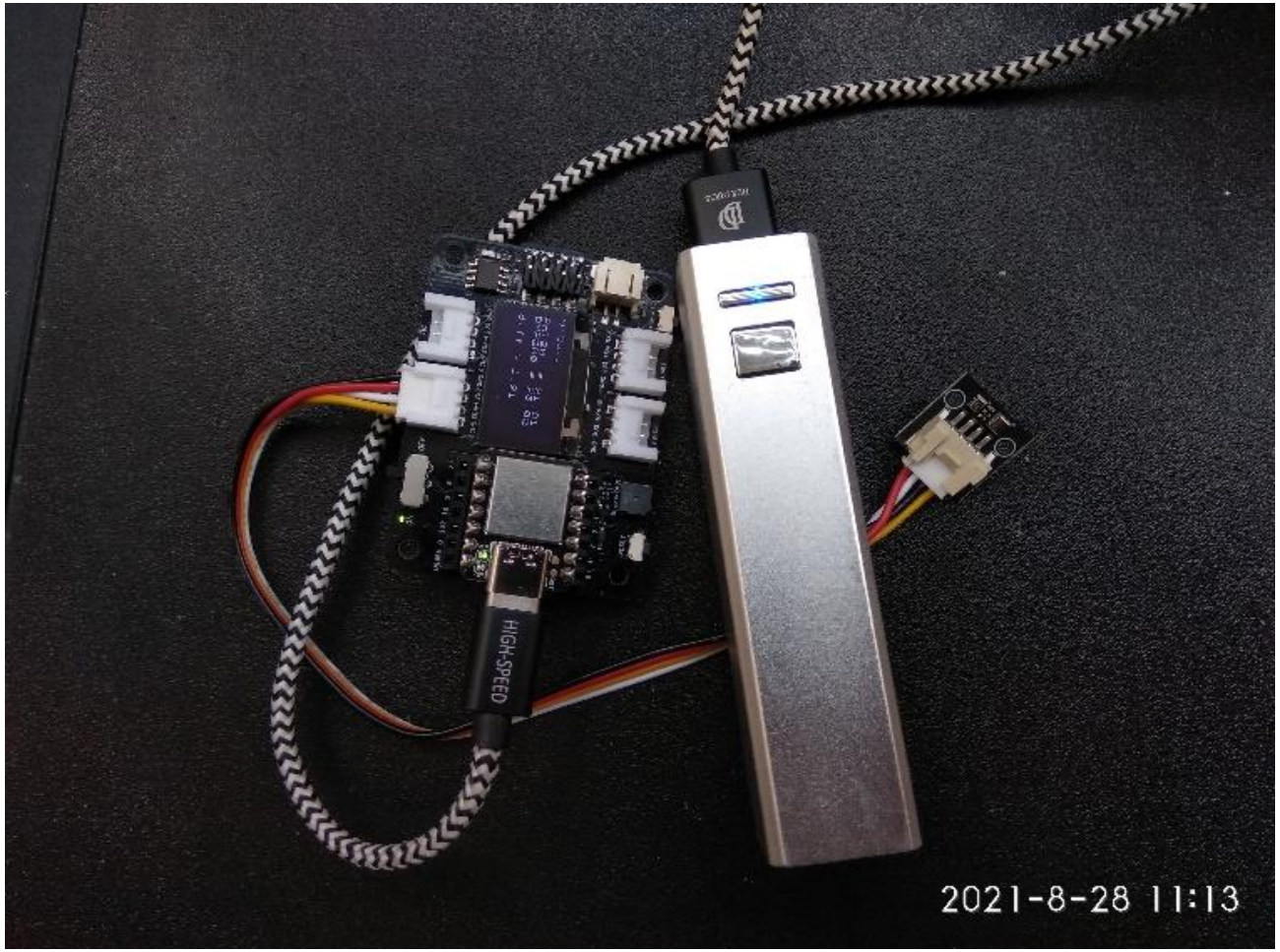
Airborne UOTS (3)

- The complete UOTS



Conventional temperature measurement

- AHT20+BM280 board and Seeeduino Xiao



The setup out of the enclosure

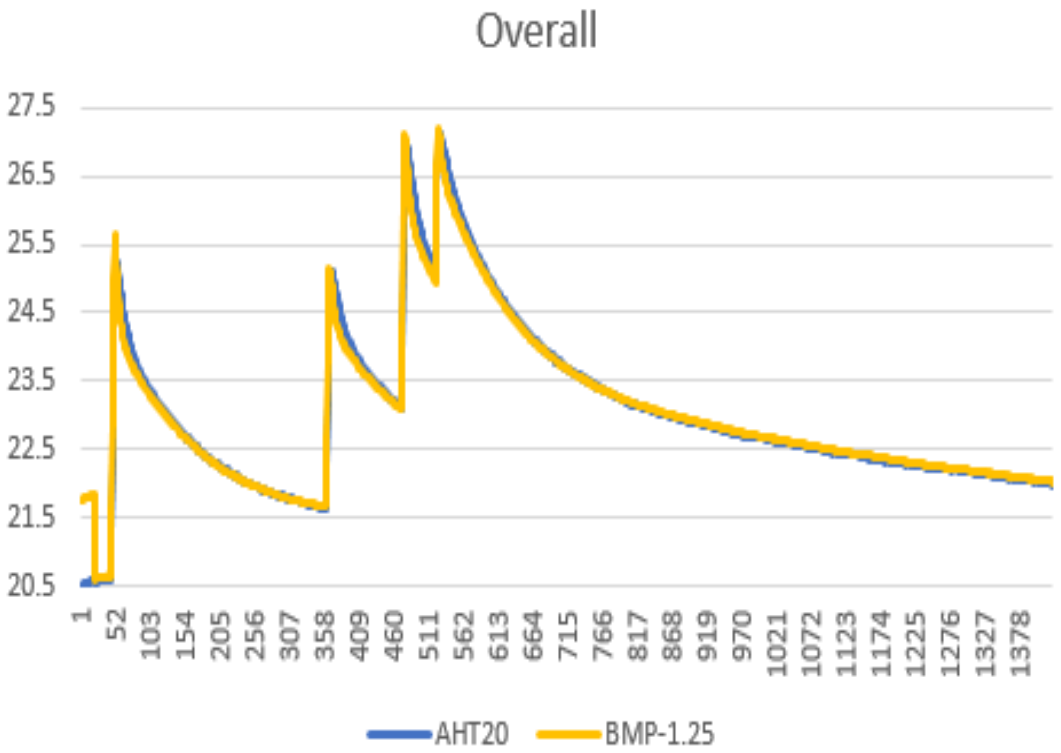
- The enclosure helped creating the step change

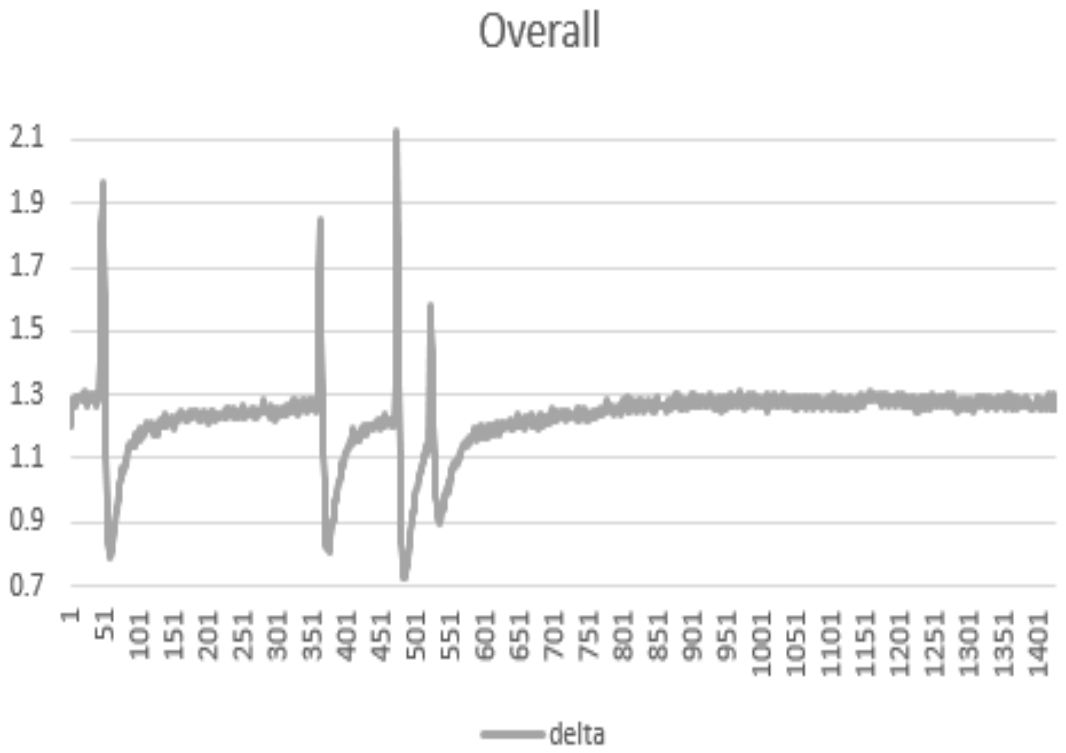
The setup inside the box

- The opening of the box was covered

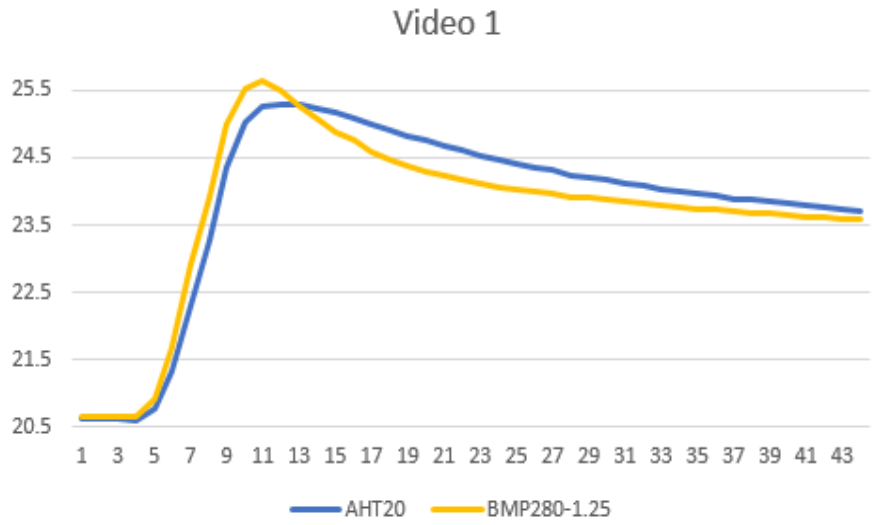
Experimental results: temperature

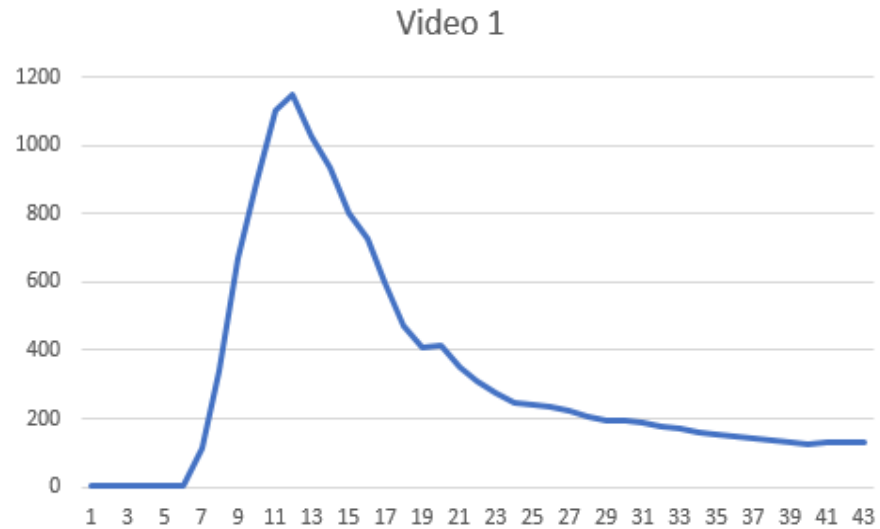
- Difference in the response times of the sensors

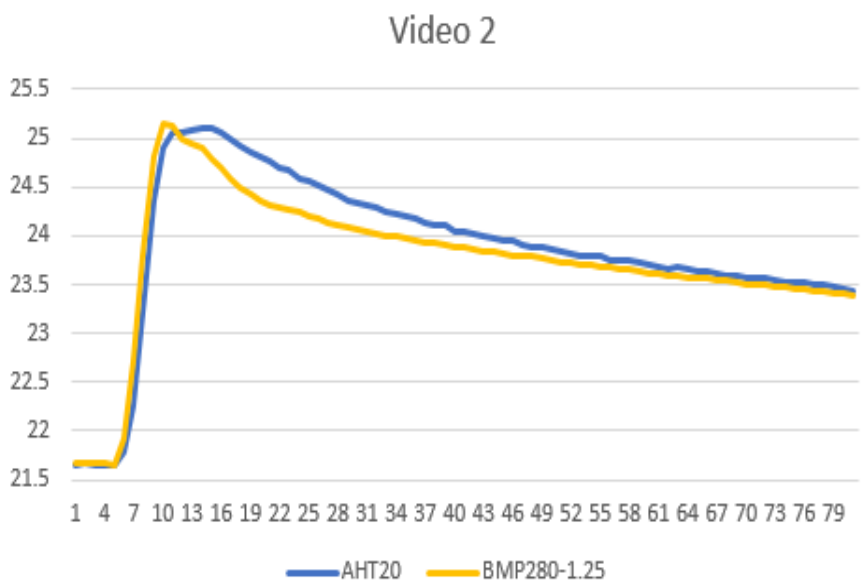




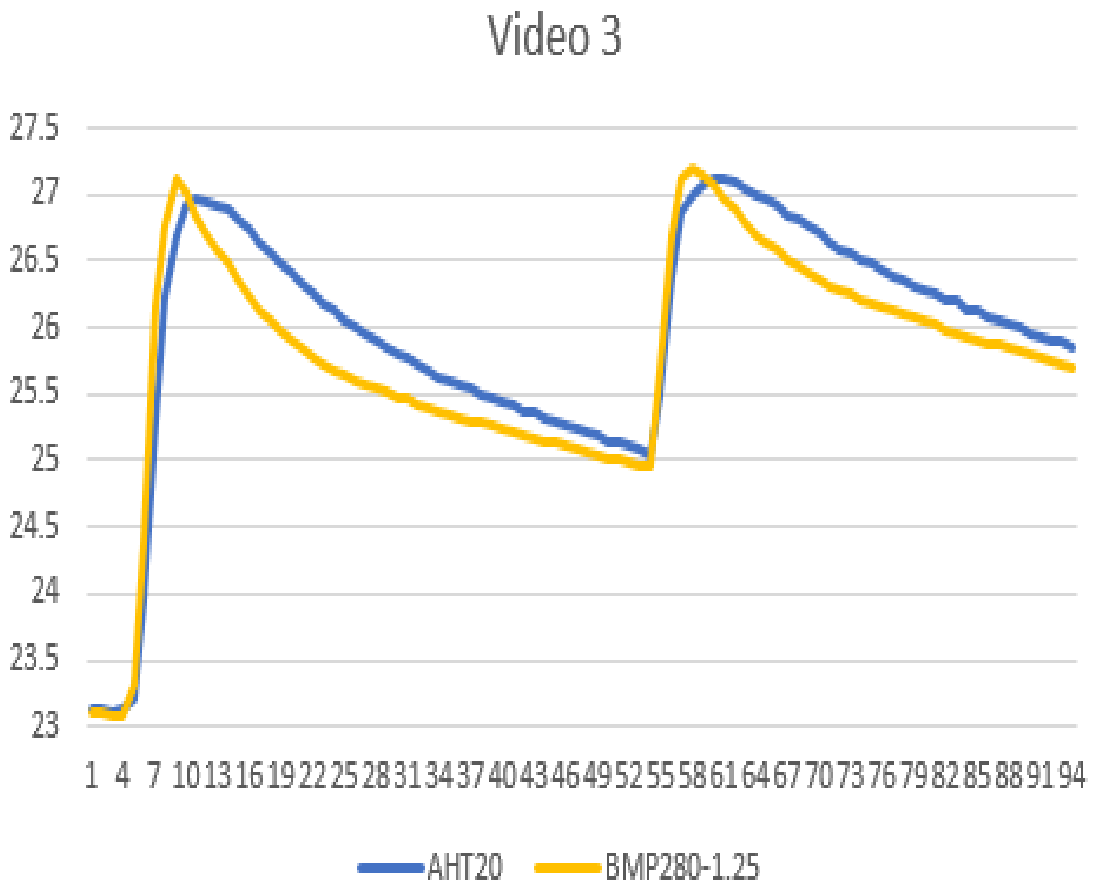
Experimental results: UOTS vs AHT20/BMP280

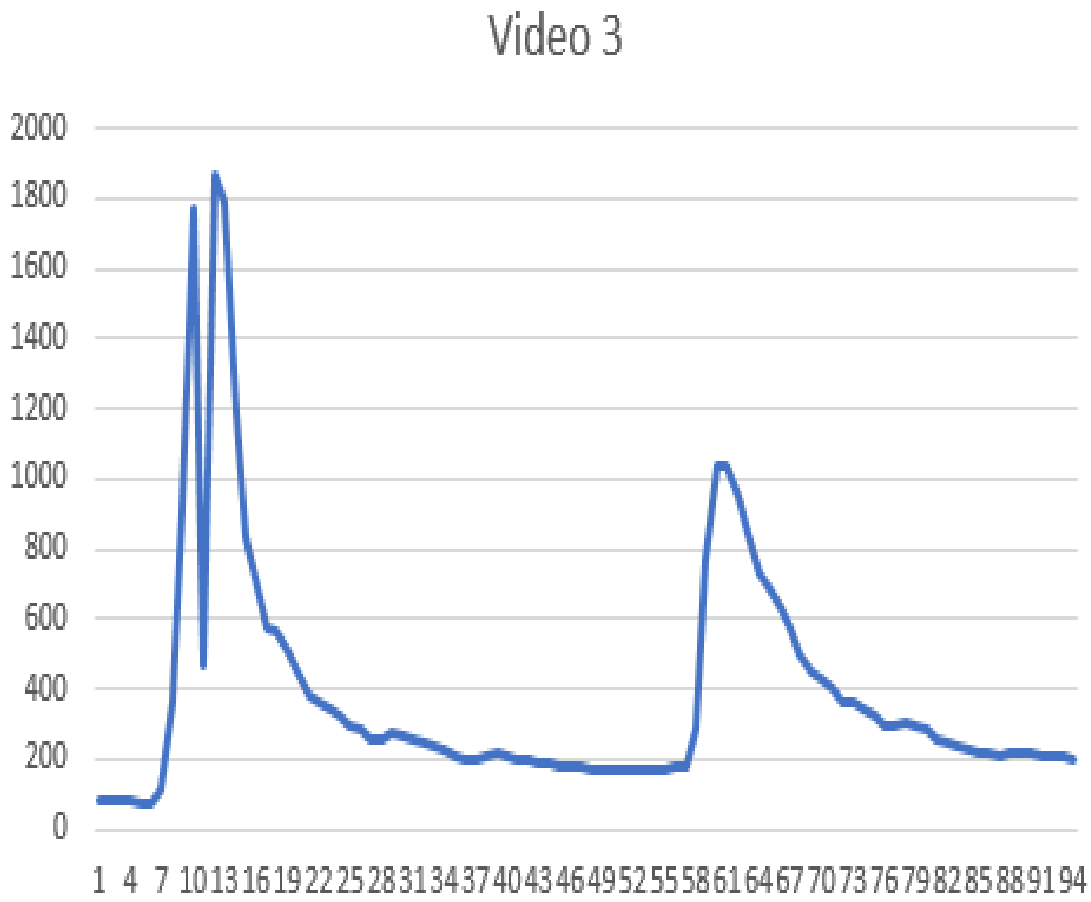






Experimental results: UOTS vs AHT20/BMP280





Summary and conclusions

- We described the developed airborne UOTS and compared its response to the temperature step changes with AHT20 and BMP280 sensors.
- All the sensors reported sharp increase in the temperature when the 2 kW heat source was turned on.
- The UOTS returned to the pre-step readings rather quickly whilst the conventional temperature sensors took substantial time for that, which qualitatively confirm the faster response time of the former.
- We identified ways of improving the design of the setup in order to quantify differences in the sensors' response times.