

Sensing System for Leaf Respiration: Measuring Vital Signatures in Plants

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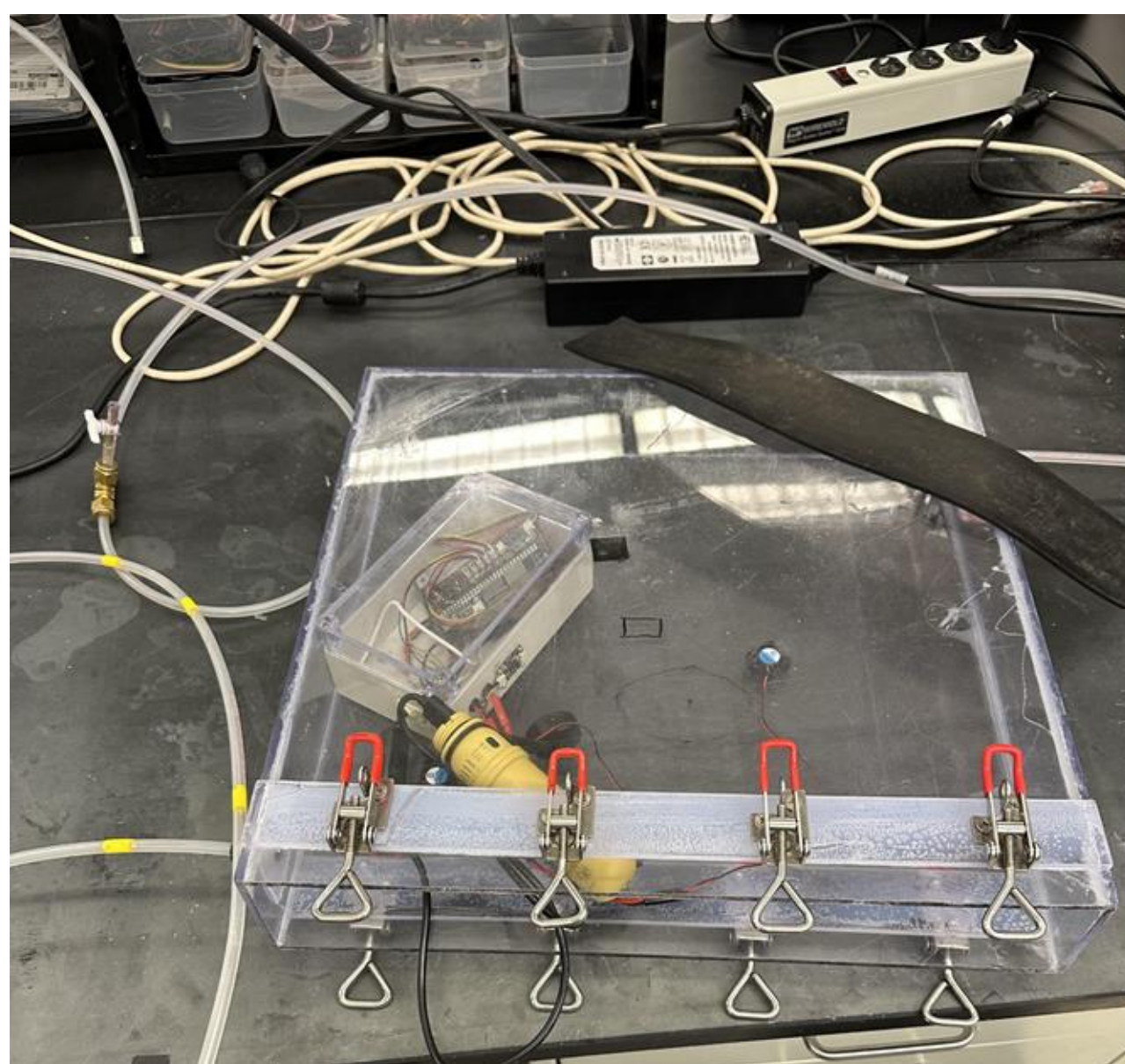
Project Mentor: Dr. Josh Hihath

Background:

- The Amazon Rainforest produces 8% of global methane emissions
- Home to thousands of indigenous peoples
- 10% of known species in the world
- Climate change/deforestation greatly impact the health of the rainforest, necessitating research action

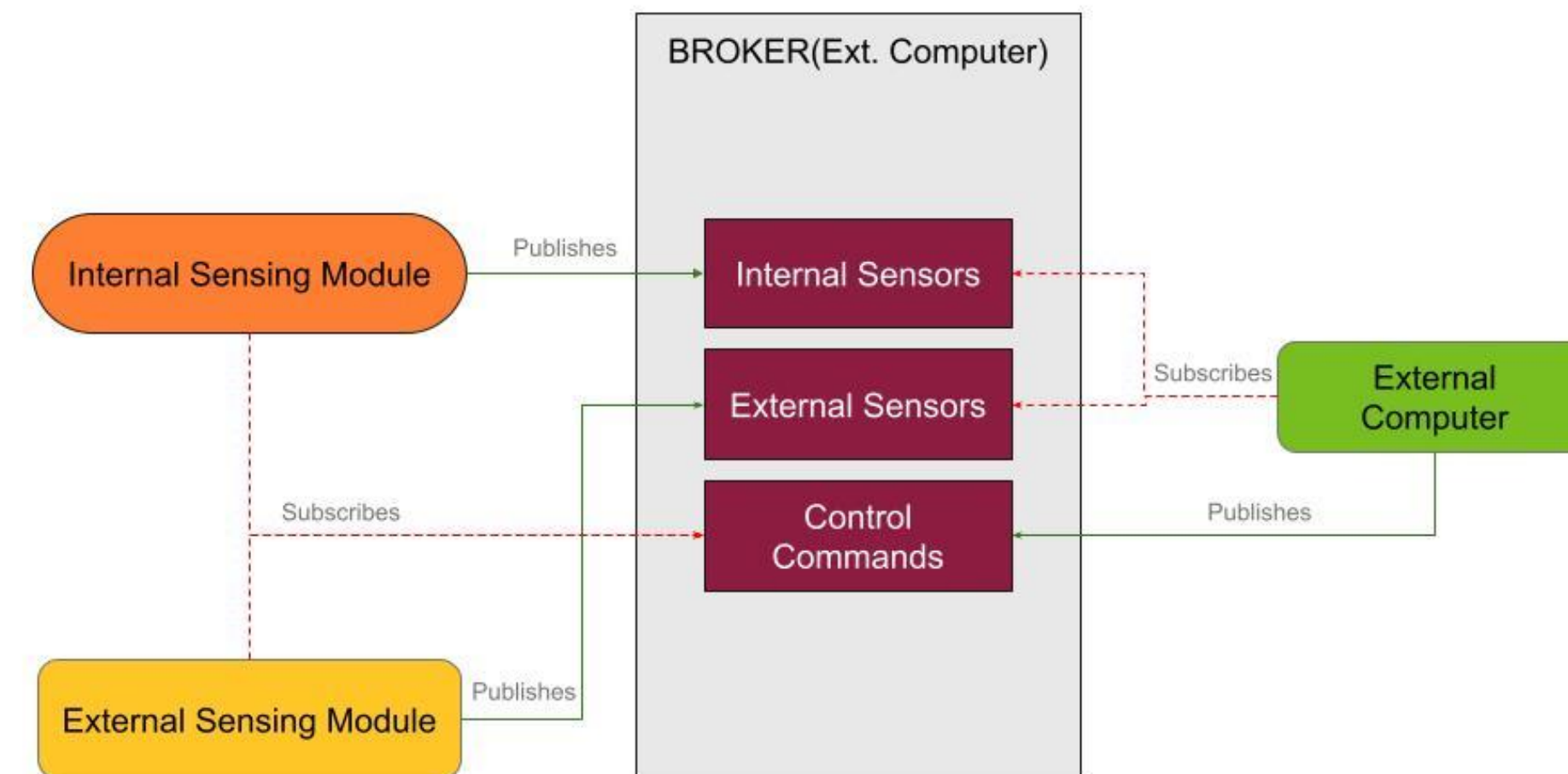
Project Goals and Customers:

- Design a sensing/controls system tracking temperature, humidity, photosynthetically active radiation, and carbon dioxide within an isolating chamber
- Primary customer Professor Hinsby Cadillo-Quiroz
- He and his team are interested in interactions between microbes/their ecosystems. This team will be using our system to support research in the Amazon Rainforest.



Project Design

MQTT Framework



Testing Results

| Timestamp | avg_temp(A°C) | ambient_temp(A°C) | obj_temp(A°C) | TC_Temp1(A°C) | r.h.1(%) | TC_Temp2(A°C) | r.h.2(%) | CO2(ppm) | parValue | TVOCl(ppb) | ppm rawH2(d) | rawEthanol(d) | |
|----------------|---------------|-------------------|---------------|---------------|----------|---------------|----------|----------|----------|------------|--------------|---------------|-------|
| 4/6/2026 18:23 | 22.72 | 23.39 | 22.25 | 22.36 | 35.59 | 22.42 | 35.06 | 701 | 0 | 0 | 400 | 13972 | 13923 |
| 4/6/2026 18:23 | 22.72 | 23.39 | 22.27 | 22.34 | 35.62 | 22.4 | 35.08 | 701 | 0 | 0 | 400 | 13967 | 13912 |
| 4/6/2026 18:23 | 22.71 | 23.39 | 22.28 | 22.34 | 35.62 | 22.4 | 35.08 | 701 | 0 | 0 | 400 | 13967 | 13912 |
| 4/6/2026 18:23 | 22.72 | 23.39 | 22.25 | 22.36 | 35.58 | 22.41 | 35.09 | 701 | 0 | 0 | 400 | 13971 | 13902 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.27 | 22.36 | 35.58 | 22.41 | 35.09 | 701 | 0 | 0 | 400 | 13971 | 13902 |
| 4/6/2026 18:23 | 22.71 | 23.4 | 22.23 | 22.34 | 35.61 | 22.4 | 35.11 | 701 | 0 | 0 | 400 | 13968 | 13909 |
| 4/6/2026 18:23 | 22.71 | 23.39 | 22.21 | 22.34 | 35.61 | 22.4 | 35.11 | 701 | 0 | 0 | 400 | 13968 | 13909 |
| 4/6/2026 18:23 | 22.71 | 23.39 | 22.25 | 22.34 | 35.56 | 22.41 | 35.08 | 701 | 0 | 3 | 405 | 13968 | 13911 |
| 4/6/2026 18:23 | 22.71 | 23.39 | 22.23 | 22.34 | 35.56 | 22.41 | 35.08 | 701 | 0 | 3 | 405 | 13968 | 13911 |
| 4/6/2026 18:23 | 22.73 | 23.39 | 22.25 | 22.36 | 35.58 | 22.43 | 35.1 | 701 | 0 | 0 | 400 | 13977 | 13918 |
| 4/6/2026 18:23 | 22.73 | 23.39 | 22.21 | 22.36 | 35.58 | 22.43 | 35.1 | 701 | 0 | 0 | 400 | 13977 | 13918 |
| 4/6/2026 18:23 | 22.72 | 23.39 | 22.21 | 22.35 | 35.63 | 22.41 | 35.06 | 701 | 0 | 9 | 407 | 13969 | 13979 |
| 4/6/2026 18:23 | 22.72 | 23.39 | 22.24 | 22.35 | 35.63 | 22.41 | 35.08 | 701 | 0 | 9 | 407 | 13969 | 13979 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.28 | 22.35 | 35.62 | 22.4 | 35.1 | 701 | 0 | 1 | 400 | 13969 | 13917 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.26 | 22.35 | 35.62 | 22.4 | 35.1 | 701 | 0 | 1 | 400 | 13969 | 13917 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.26 | 22.34 | 35.61 | 22.43 | 35.12 | 701 | 0 | 8 | 402 | 13970 | 13911 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.23 | 22.34 | 35.61 | 22.43 | 35.12 | 701 | 0 | 8 | 402 | 13970 | 13911 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.19 | 22.35 | 35.62 | 22.42 | 35.08 | 701 | 0 | 0 | 400 | 13975 | 13919 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.24 | 22.35 | 35.62 | 22.42 | 35.08 | 701 | 0 | 0 | 400 | 13975 | 13919 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.27 | 22.35 | 35.63 | 22.41 | 35.11 | 701 | 0 | 7 | 404 | 13968 | 13912 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.29 | 22.35 | 35.63 | 22.41 | 35.11 | 701 | 0 | 7 | 404 | 13968 | 13912 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.3 | 22.35 | 35.61 | 22.42 | 35.08 | 701 | 0 | 9 | 408 | 13966 | 13907 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.3 | 22.35 | 35.61 | 22.42 | 35.08 | 701 | 0 | 9 | 408 | 13966 | 13907 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.26 | 22.35 | 35.62 | 22.4 | 35.05 | 701 | 0 | 8 | 413 | 13965 | 13906 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.26 | 22.35 | 35.62 | 22.4 | 35.05 | 701 | 0 | 8 | 413 | 13965 | 13906 |
| 4/6/2026 18:23 | 22.73 | 23.41 | 22.31 | 22.35 | 35.6 | 22.42 | 35.1 | 701 | 0 | 15 | 411 | 13969 | 13903 |
| 4/6/2026 18:23 | 22.73 | 23.41 | 22.23 | 22.35 | 35.6 | 22.42 | 35.1 | 701 | 0 | 15 | 411 | 13969 | 13903 |
| 4/6/2026 18:23 | 22.73 | 23.4 | 22.31 | 22.36 | 35.6 | 22.41 | 35.12 | 701 | 0 | 12 | 408 | 13967 | 13911 |
| 4/6/2026 18:23 | 22.73 | 23.4 | 22.3 | 22.36 | 35.6 | 22.41 | 35.12 | 701 | 0 | 12 | 408 | 13967 | 13911 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.31 | 22.35 | 35.62 | 22.41 | 35.1 | 701 | 0 | 10 | 404 | 13971 | 13915 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.32 | 22.35 | 35.62 | 22.41 | 35.1 | 701 | 0 | 10 | 404 | 13971 | 13915 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.32 | 22.35 | 35.62 | 22.42 | 35.1 | 701 | 0 | 18 | 403 | 13969 | 13905 |
| 4/6/2026 18:23 | 22.72 | 23.4 | 22.28 | 22.35 | 35.62 | 22.42 | 35.1 | 701 | 0 | 18 | 403 | 13969 | 13905 |
| 4/6/2026 18:23 | 22.72 | 23.41 | 22.29 | 22.34 | 35.61 | 22.42 | 35.06 | 701 | 0 | 9 | 411 | 13966 | 13905 |
| 4/6/2026 18:23 | 22.72 | 23.41 | 22.27 | 22.34 | 35.61 | 22.42 | 35.06 | 701 | 0 | 9 | 411 | 13966 | 13905 |

