Exploring Heat Management in Ommie: A Human-Robot Interaction Perspective

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ABSTRACT

Ommie is a robot designed to help individuals with anxiety practice deep breathing through physical contact and nonverbal audio guidance. The current Ommie model includes several new components that not only increase heat production but also operate less efficiently at elevated temperatures. Because of this, heat management becomes a critical factor.

We found that during extended use without cooling fans, Ommie's internal temperature stabilizes within an acceptable range. We also tested two fan configurations to evaluate their ability to regulate temperature.

We also aim to explore heat management capabilities to better accommodate users' needs, operating under the assumption that different users, such as children and elderly individuals, may require warmer or cooler temperatures due to individual sensory sensitivities.

INTRODUCTION

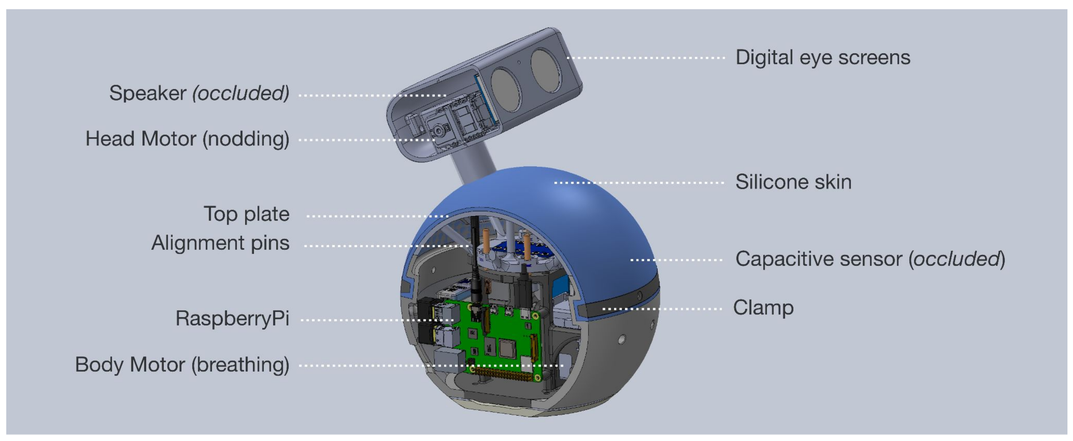
Socially Assistive Robotics (SAR) is a field of robotics that supports a broad range of therapeutic activities, Ommie [1] is one such device. Ommie's primary role is to provide **guided deep breathing for individuals with anxiety.**

Ommie guides deep breathing by utilizing a motor to raise and lower a mechanical plate in the cadence of deep breathing while a user places their hands on it. This haptic system provides tactile feedback so that the user can breathe with Ommie as they feel it "breathe" with them.

We are currently working on building and testing an updated version of Ommie for use in homes for weeks or months at a time. Prior study has shown the robot's efficacy in single-session use. For instance, breathing with Ommie [2] was observed as effective for calming children in a hospital allergy testing environment, where they were exposed to known allergens to test for an anaphylactic response.

Effective heat management is critical in any robotic system. With the addition of new features and processing capabilities, Ommie generates more heat from its updated sensors and components. This heat must be properly dissipated to ensure the components function efficiently and do not burn out.

THE OMMIE ROBOT



CAD Model of Ommie With Internal Components

RESEARCH GOALS

Objective: Test and evaluate Ommie's heat production and thermal management. The following components **will shut down or overheat** if these temperatures are met:

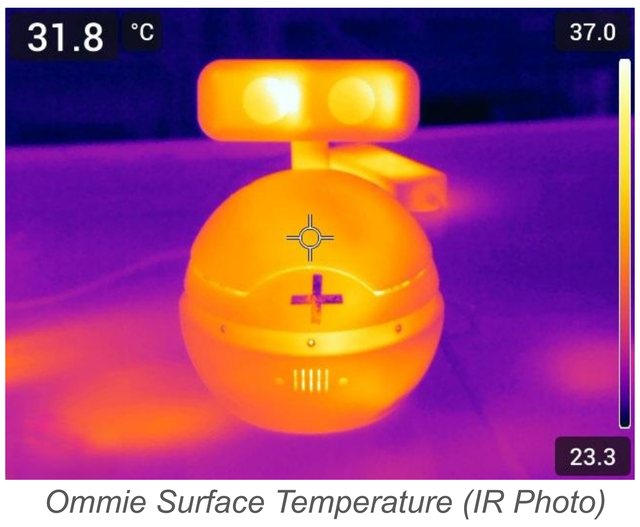
- CPU: 80 C°
- Head Motor: 70 C°
- Body Motor: 80 C°

Hypotheses: Ommie will overheat without active cooling due to extensive heat buildup. Fans will be required to cool the system, increasing the total cost of the unit.

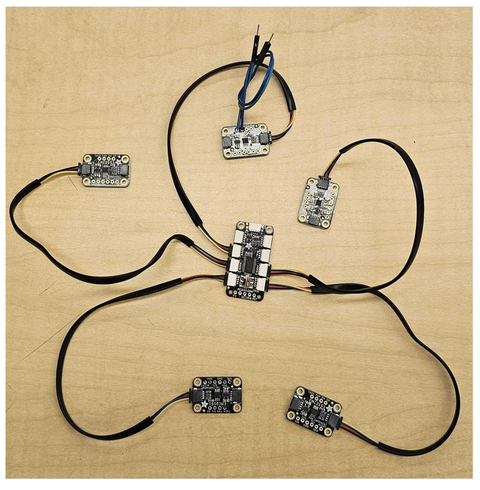
RESEARCH METHOD

To determine Ommie's temperature baseline, **we ran Ommie through several stress tests** without any of its insulative layers (silicone sleeve, sweater). We used a thermal imager to capture hot spots and placed sensors at those locations while keeping fans off for this test.

After placing sensors, we installed Ommie's silicone sleeve and sweater and began the intensive 10 hour stress test, with and without fans. We monitored heat measurements every 10 seconds and set alarms to warn of abnormal conditions.



Ommie Surface Temperature (IR Photo)



"Octo" Sensor Suite of multiple temperature sensors. Sensors were placed in hot spots.

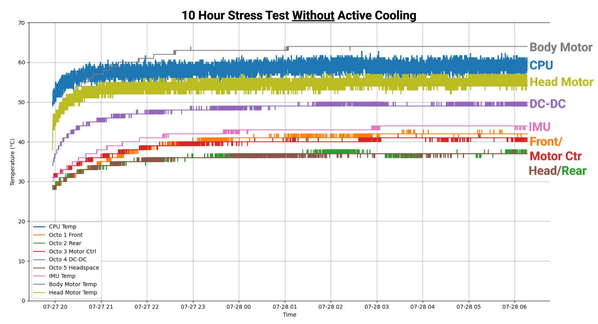
RESULTS

We found that despite the exhaust ports being covered by the sweater and a silicone sleeve added to Ommie, **temperatures with the fans were on average approximately 4 °C cooler than without.** However, even without fans, no major component came within 15 °C of its overheating threshold.

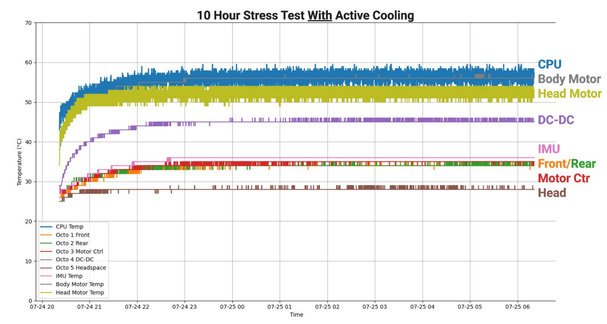
Primary results:

- **Without** any thermal management: Temperatures are safely below limits.
- **With** dual fan management: Temperatures are more stable, though not drastically different.

Design takeaways: With the current design, Ommie is capable of running at above expected lengths of time without risk of components overheating. Fans can be used to maintain stable heat levels and potentially maximize comfort.



*Stress Test Results **Without** Active Cooling*



*Stress Test Results **With** Active Cooling*

FUTURE WORK

With the 4 °C range enabled by fan use, we aim to explore the relationship between internal and surface temperatures in Ommie. In addition to achieving stabilized thermal management, we also seek to assess the potential for accommodating individuals who may require warmer or cooler surface conditions due to sensory sensitivities.

REFERENCES

[1] Matheus, K. (2023, March). Socially Assistive Robotics for Anxiety Reduction. In *Companion of the 2023 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 739-741).
[2] A. Chun *et al.*, "Breathe Easy: Harnessing Robots for Stress Reduction During Pediatric Oral Challenges," *J. Allergy Clin. Immunol.*, vol. 155, no. 2, p. AB49, 2025.