

Hot Watch: Wearable Heatstroke Detection System

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Introduction

- **Student athletes face warmer fall sports seasons**, leading to heat injury and heatstroke.
- According to the Korey Stringer Institute at the University of Connecticut, at least **58 football players have died from exertional heatstroke** between 1992 and 2024.
- From June 1 to July 18, 2024, there were **18 heat advisories issued** in Pennsylvania – 13 more than the average for the time over the last two decades.
- If left untreated, heatstroke can quickly **damage the brain, heart, kidney, and muscles** through uncontrolled swelling and breakdown.

Click [here](#) for more information about heatstroke in young athletes.

Click [here](#) for a video describing our need statement.

Goals/Constraints/Unique Value Proposition

Goal: To provide a safer environment for athletes and prevent heat-related illnesses with real-time detection and alerts to encourage timely intervention.

Constraints: Threshold data to train machine learning models, size of the band, availability of materials, cost of smaller materials

Unique Value Proposition: Hot Watch provides unique value to school districts and youth sports teams by being a simple, affordable solution to a major risk.

Engineering Design Process

Human Design

- The chest area was one area we initially considered due to its proximity to the body's core.
- We determined that the **wrist-based design** would best meet our needs since it is much less **intrusive**.
- To more accurately assess heat injury, we also plan to track the **humidity and temperature of the external environment** along with their **heart rate**, especially spikes.
- To ensure that we can effectively warn the user, our design will have a **vibrating, beeping warning system**.

Code

- Our algorithm uses real-time **signal processing** and **multi-sensor data fusion** to analyze heart rate variability, skin temperature gradients, and heat index trends. By applying **adaptive thresholding and anomaly detection**, through basic **machine learning** models, it identifies early physiological stress markers, triggering alerts upon a **potential heat stroke**.

Links



Click [here](#) for our business partner acknowledgement.



Click [here](#) for References.

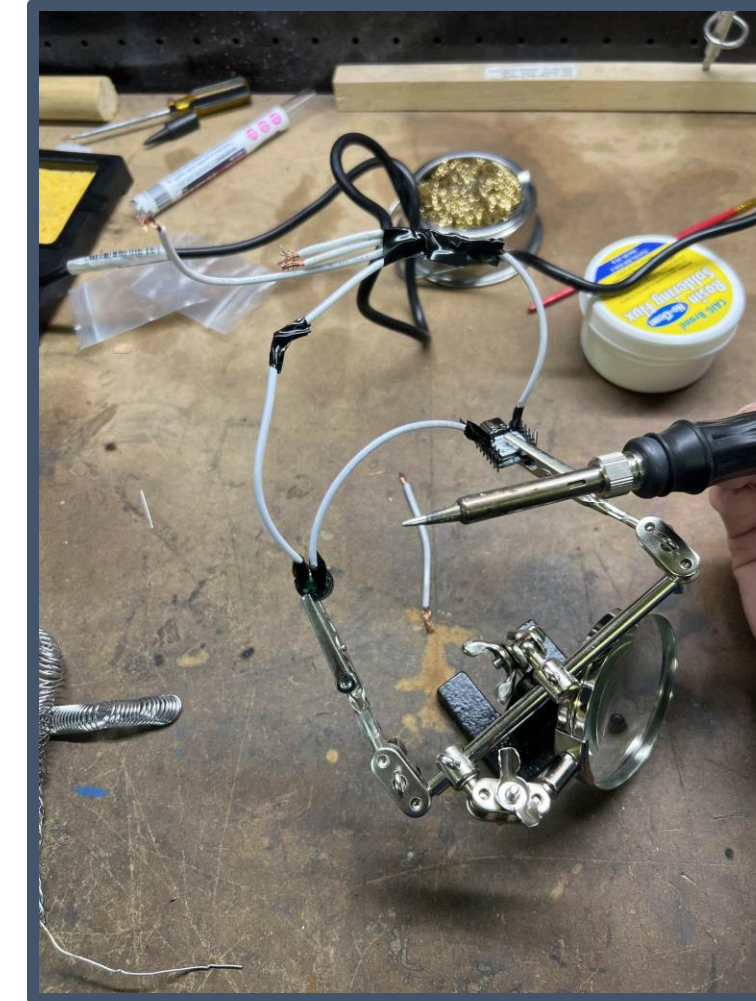


Click [here](#) for the project budget.

EDP Cont'd

Parts

- External temp. and humidity sensor
- Heart rate sensor
- Skin temp. sensor
- 3-D printed enclosure
- Battery



Click [here](#) for a video describing our engineering process.

Conclusion

If schools or youth sports teams implement Hot Watch, coaches can better surveil their athletes for heatstroke. Hot Watch's non-intrusive design ensures that its user's performance is unaffected while still providing effective warnings of potential heat injuries. Continued research and development is needed to further refine Hot Watch's design.

Future Improvements

Utilize the Bluetooth capability of the microcontroller to send risk alerts to a central device, ex. phone.

Refine temperature and heart rate data with improved sensors.

Revise algorithm to be more robust and personalized to a user's biometrics, such as preexisting health conditions or age.

Redesign wristband to be more user-friendly, including reducing size

Reduce production costs by buying parts in bulk.

Universal Design Principles

1. **Equitable Use:** The simple design with affordable components ensures accessibilities for school districts.
2. **Flexibility in Use:** The band can be worn on either wrist.
3. **Simple and Intuitive Use:** The device does not require setup.
4. **Perceptible Information:** The band will vibrate on the user's wrist when heat injury or risk is present.
5. **Tolerance for Error:** There is low risk for injury. In the future, the enclosure may be waterproofed.
6. **Low Physical Effort:** The band is not physically intrusive to athletes or workers. The only effort required is application.
7. **Size and Space for Approach and Use:** The band is clearly visible on athletes' wrists. If it is hidden under a glove for example, then the vibration can alert the user.