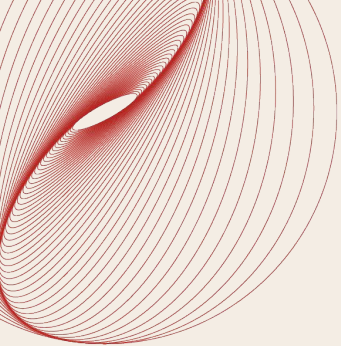




“Sticky-Free” Heart Rate Sensor

Specific for Eczema individuals who are at risk of Atrial Fibrillation

Winston, Jessie, Matthew, Hasna, Su Bin, Jenny, and Cindy
(THE BOBA HEARTS)



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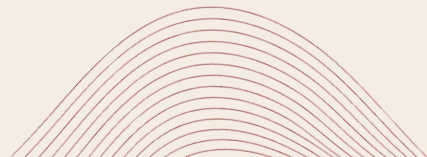
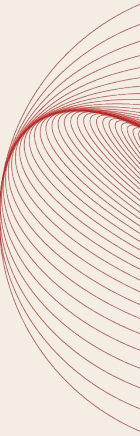
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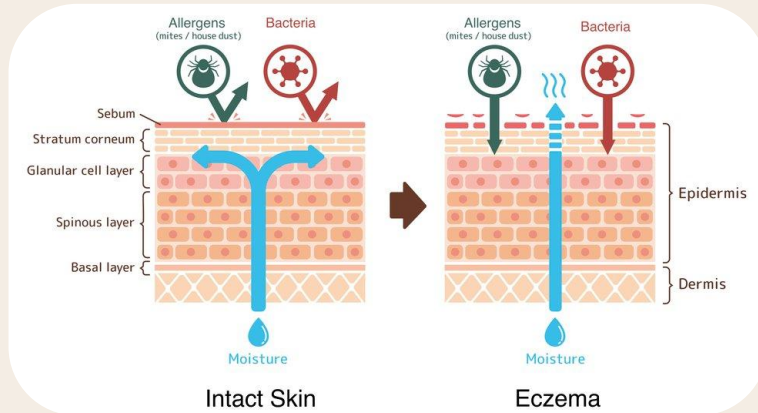
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of roles



Eczema

A type of Dermatitis, specifically Atopic Dermatitis

- A chronic skin condition that is the foundation of dry, itchy, and rashes on the skin [1]
- Could appear anywhere on the body
- Most common in children, but could occur in any age group
- Not contagious through contact [2]



Causes

- Genetics
- Exposure to certain environment
- Overactive immune system [2]

Symptoms [2]

- Itchiness
- Redness
- Dry and cracked skin
- Swollen skin with rash

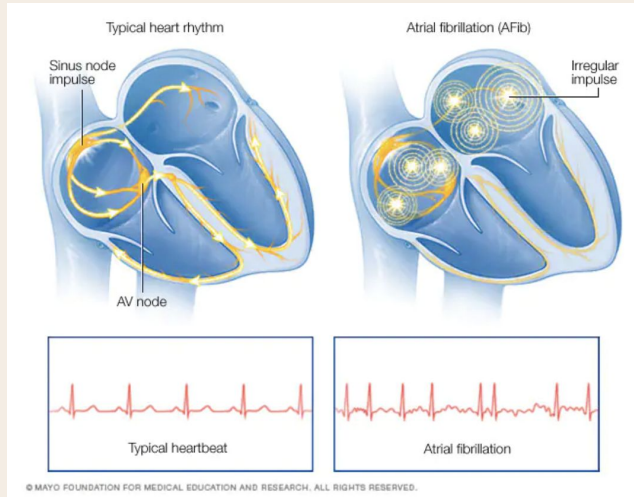
[1] Nebraska Medicine. (2024). Eczema. Eczema | University Health Center. <https://health.unl.edu/eczema#:~:text=Causes,to%20become%20red%20and%20inflamed.>

[2] What is eczema?. National Eczema Association. (2024, August 22). <https://nationaleczema.org/eczema/#:~:text=Some%20of%20the%20most%20common,to%20become%20dry%20and%20itchy.>

Atrial Fibrillation

Most common type of Arrhythmia

- An irregular, most commonly a faster heartbeat [3]
- Escalates the risk of stroke, heart failure, and other heart-related concerns [3]
- Common among individuals over the age of 60 [4]
- Heart rate up to 100 to 175 beats per minute [3]



[3]

Causes

- Family history
- Other medical conditions
- Heart surgery [4]
- Heart structural problem

Symptoms [3]

- Palpitations
- Dizziness
- Fatigue
- Shortness of breath
- Weakness

[3] Mayo Foundation for Medical Education and Research. (2024, March 8). *Atrial fibrillation*. Mayo Clinic. <https://www.mayoclinic.org/diseases-conditions/atrial-fibrillation/symptoms-causes/syc-20350624>

[4] Beckermen, J. (2024, August 7). *Who gets atrial fibrillation?* WebMD. <https://www.webmd.com/heart-disease/atrial-fibrillation/atrial-fibrillation-by-age-sex-and-more>



Statistics

31,600,000

This is the number of people in the US who have at least one form of Eczema (Benisek, 2022) [1]

20%

This is the increased risk of Atrial Fibrillation for people who have Eczema compared to others (Torjesen, 2019) [2]

158,000

This is the number of deaths due to Atrial Fibrillation a year (NCCDPHP, 2024) [3]

[1] Alexandra Benisek. "Eczema Can Affect Us All, but Some More than Others." *WebMD*, 1 Mar. 2022, www.webmd.com/skin-problems-and-treatments/eczema/eczema-epidemiology.

[2] Torjesen, Ulrid. "Atopic Dermatitis Linked to Increased Risk of Atrial Fibrillation." *Dermatology Times*, Dermatology Times, 20 Nov. 2019, www.dermatologytimes.com/view/atopic-dermatitis-linked-increased-risk-atrial-fibrillation. Accessed 25 Sept. 2024.

[3] CDC. "Atrial Fibrillation." *Heart Disease*, 2024, www.cdc.gov/heart-disease/about/atrial-fibrillation.html#cdc_disease_basics_res-resources. Accessed 25 Sept. 2024.

Current Treatments



Photoplethysmography (PPG)

A non-invasive optical technique that measures blood flow in the skin using light and a photodetector. [1]



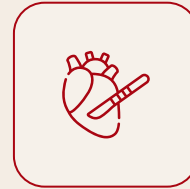
Wearable devices

Sensors fixed to the body such as watches and chest straps.



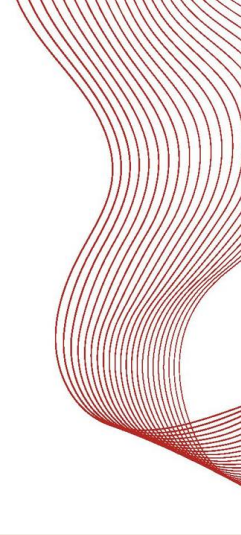
Implantable devices

Similar with a large needle buried under the skin of the chest or arm. Requires surgical implantation.



Limitations

Some of them track signals inaccurately during daily activities. The effects of long-term use of implantable sensors on the body are still unknown. [2][3]



[1] Denisse Castaneda et al., "A review on wearable photoplethysmography sensors and their potential future applications in health care." *PubMed Central*, Published online 6 Aug 2018. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6426305/>
[2] Samprit Banerjee et al., "Long-term active surveillance of implantable medical devices: an analysis of factors determining whether current registries are adequate to expose safety and efficacy problems." *BMJ Journals*, Accessed 3 Jul 2019. <https://sit.bmj.com/content/1/1/e000011>
[3] Pietro Palmisano et al., "Rate, causes, and impact on patient outcome of implantable device complications requiring surgical revision: large population survey from two centres in Italy" *PubMed*, Published online 13 Feb 2013. <https://pubmed.ncbi.nlm.nih.gov/23407627/>

3 Design Criterias - Justification addressing the problem



Long Battery Life

The device should also have a long life on batteries, necessitating fewer or no frequent removals that may cause skin irritation, and it should be lightweight enough for comfortable wear over the course of a day.



Non-Adhesive and Skin-Friendly Design

Patients with eczema need a device that would avoid adhesives; these can further irritate sensitive skin. The best design would be non-invasive, such as a wristband or a clip-on made from hypoallergenic materials.



Continuous, Real-Time Monitoring

Since Atrial Fibrillation is quite unpredictable, the sensor needs to continuously monitor heart rate (Camm, 2014) [1]; alarms should be given in real time to ensure timely detection.

Limitations of Design Criteria



Non-Adhesive and Skin-Friendly Design

Many non-adhesive designs' signal quality are prone to be affected due to external factors such as spontaneous and micro-movements and a shallow penetration to light. This can be impacted by varying skin tones, body-mass index, and skin temperature (Lapas et al., 2014) [1].



Long Battery Life

Unlike photoplethysmography (PPG) monitors which have a low energy consumption (Burrello et al., 2022) [2], electrical bioimpedance (EBI) -based monitors, they tend to have a higher power consumption, leading to shorter battery life (Lapas et al., 2014) [1].



Continuous, Real-Time Monitoring

If the other limitations were to occur, the data recorded would not be entirely accurate.

For example, if signal quality is affected, the data would not be accurate to the true quantity. In addition, if the monitor happens to run out of battery, important data could be missed while charging.

Citations & Table of Roles

Overview of Eczema and Atrial Fibrillation (Jenny's slide)

[1] Nebraska Medicine. (2024). *Eczema*. Eczema | University Health Center.

<https://health.unl.edu/eczema#:~:text=Causes,to%20become%20red%20and%20inflamed.>

[2] *What is eczema?*. National Eczema Association. (2024, August 22).

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[3] Mayo Foundation for Medical Education and Research. (2024b, March 8). *Atrial fibrillation*. Mayo Clinic.

<https://www.mayoclinic.org/diseases-conditions/atrial-fibrillation/symptoms-causes/syc-20350624>

[4] Beckermen, J. (2024, August 7). *Who gets atrial fibrillation?*. WebMD. <https://www.webmd.com/heart-disease/atrial-fibrillation/atrial-fibrillation-by-age-sex-and-more>

Statistics (Winston's slide)

[1] Alexandra Benisek. "Eczema Can Affect Us All, but Some More than Others." *WebMD*, 1 Mar. 2022, www.webmd.com/skin-problems-and-treatments/eczema/eczema-epidemiology.

[2] Torjesen, Ingrid. "Atopic Dermatitis Linked to Increased Risk of Atrial Fibrillation." *Dermatology Times*, Dermatology Times, 20 Nov. 2019, www.dermatologytimes.com/view/atopic-dermatitis-linked-increased-risk-atrial-fibrillation. Accessed 25 Sept. 32024.

[3] CDC. "About Atrial Fibrillation." *Heart Disease*, 2024, www.cdc.gov/heart-disease/about/atrial-fibrillation.html#cdc_disease_basics_res-resources. Accessed 25 Sept. 2024.

Current treatments (Cindy's slide)

[1] Denisse Castaneda et al., "A review on wearable photoplethysmography sensors and their potential future applications in health care." *PubMed Central*, Published online 6 Aug 2018. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6426305/>

[2] Samprit Banerjee et al., "Long-term active surveillance of implantable medical devices: an analysis of factors determining whether current registries are adequate to expose safety and efficacy problems." *BMJ Journals*, Accessed 3 Jul 2019. <https://sit.bmj.com/content/1/1/e000011>

[3] Pietro Palmisano et al., "Rate, causes, and impact on patient outcome of implantable device complications requiring surgical revision: large population survey from two centres in Italy" *PubMed*, Published online 13 Feb 2013. <https://pubmed.ncbi.nlm.nih.gov/23407627/>

Design criteria (Hasna's slide)

[1] Camm, A. J. (2014). The Role of Continuous Monitoring in Atrial Fibrillation Management. *Arrhythmia & Electrophysiology Review*, 3(1), 48–50. <https://doi.org/10.15420/aer.2011.3.1.48>

Limitations (Jessie's slide)

[1] Lapsa, D., Janeliukstis, R., Metshein, M., & Selavo, L. (2024). PPG and Bioimpedance-Based Wearable Applications in Heart Rate Monitoring—A Comprehensive Review. *Applied Sciences*, 14(17), 7451. <https://doi.org/10.3390/app14177451>

[2] Burrello, A., Pagliari, D. J., Rapa, P. M., Semilia, M., Risso, M., Polonelli, T., Poncino, M., Benini, L., & Benatti, S. (2022). Embedding Temporal Convolutional Networks for Energy-efficient PPG-based Heart Rate Monitoring. *ACM Transactions on Computing for Healthcare*, 3(2), 1–25. <https://doi.org/10.1145/3487910>

Basic Info	Statistics	Current Treatments	Design Criteria and Limitations	Webpage
Jenny	Winston	Cindy	Hasna and Jessie	Matthew and Su Bin



Thank you!

Do you have any questions?

<https://you.stonybrook.edu/heartratesensor>

Sticky Free Heart Rate Sensor

Background Information Design of Solution Limitations
Our Design Process Possible Testing References
Solution of Focus and Criteria The Team The Topic and Goal

Sticky-Free Heart Rate Sensors

Topic: The use of "sticky-free" heart rate sensors in monitoring Eczema patients who have a high risk of Atrial Fibrillation

September 23, 2024

mkuan

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