TumorScent Imaging (TSI)

We propose an imaging device based on the VOC (Volatile Organic Compounds) produced by the human body [1], which requires breaking the law: **Brownian Motion [2];** irregular wiggling motion of a particle caused by random bombardment of gas molecules against the particle.

Breaking this law will stop random VOCs diffusion so they maintain very high concentration as they travel in a linear and directed manner while they leave the body, which then can be used as a signal in the imaging process.

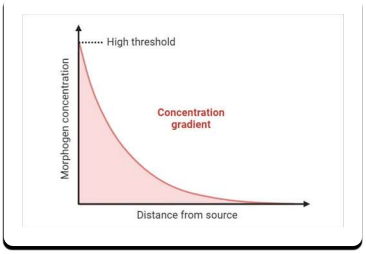

Figure 1. Concentration-distance relation.

Challenges:

The high concentrations of VOCs produced by the body, coupled with interference from environmental VOCs, create complex challenges for imaging. Excessive VOC levels risk overwhelming sensors, leading to detection saturation and reducing accuracy. Additionally, the presence of environmental VOCs introduces noise, complicating the separation and classification of VOC chemical signatures. The dynamic nature of VOC emissions, influenced by biological and environmental factors, further complicates consistent imaging. These factors collectively make it difficult to generate precise, reliable images without advanced detection techniques and signal-processing algorithms.

Imaging Process:

The imaging system utilizes Shimadzu's Comprehensive GCxGC-TOF MS [3] for precise detection and analysis of Volatile Organic Compounds (VOCs), assisted by a machine learning model trained to classify the unique chemical signatures of these compounds. The system is housed within an imaging capsule that is equipped with highly sensitive and dynamic sensor arrays, ensuring accurate VOC detection. This innovative setup allows for a cost-effective and safer imaging method as it is non-invasive. The focus is on detecting VOCs produced by the body, minimizing environmental interference as much as possible. This unique approach to imaging offers a novel method for monitoring and analyzing bodily processes in a controlled, encapsulated environment, opening new possibilities for non-invasive medical diagnostics.

The resulting image:

The VOCs produced by the body will be detected and analyzed, Imaging systems are used to visually represent VOC concentrations and chemical properties to generate a visual heatmap, like thermography images, where the chemical properties of the VOCs determine the color, and their concentration defines the shade of that color. This approach enables real-time imaging similar to ultrasound, where variations in VOC distribution and concentration are transformed into a heatmap-like representation, providing a detailed visualization of their source and behavior.

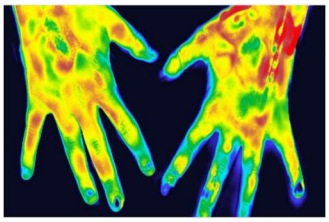

Figure 2. Heatmap produced by thermography

Conclusion:

This imaging system introduces an innovative approach to non-invasive medical diagnostics by focusing on the detection and analysis of VOCs produced by the human body. It addresses key challenges such as high VOC concentrations and environmental interference, offering a safer and cost-effective method for monitoring bodily processes. By leveraging advanced sensors, machine learning, and precise detection techniques, the system transforms VOC data into real-time visual representations. This breakthrough could pave the way for more efficient health monitoring and early detection of medical conditions with minimal patient disruption.

[1] Zou, Z., He, J., & Yang, X. (2020). An experimental method for measuring VOC emissions from individual human whole-body skin under controlled conditions. *Building and Environment*, *181*. https://doi.org/10.1016/j.buildenv.2020.107137

[2] FuseSchool - Global Education. What is Brownian Motion? | Properties of Matter | Chemistry | FuseSchool. (May 30, 2013). Accessed: Nov. 28, 2024. [Online video]. Available: https://youtu.be/4m5JnJBq2AU?feature=shared

[3] Phillips, M., Cataneo, R. N., Chaturvedi, A., Kaplan, P. D., Libardoni, M., Mundada, M., Patel, U., & Zhang, X. (2013). Detection of an Extended Human Volatome with Comprehensive Two-Dimensional Gas Chromatography Time-of-Flight Mass Spectrometry. *PLoS ONE*, *8*(9). https://doi.org/10.1371/journal.pone.0075274