FIU Engineering & Computing
Biomedical Engineering

GlycoBreath

Empowering Diabetes Care One Breath at a Time

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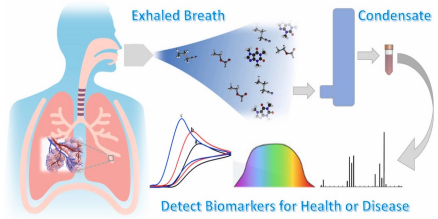
Problem

Type 2 Diabetes affects over 38 million adult Americans. Regular glucose monitoring is critical, yet 67% of patients avoid it due to the pain and invasiveness of current methods like finger pricks. This noncompliance can lead to poor outcomes. There is a pressing need for a monitoring method that is noninvasive, easy to use, and encourages consistent engagement in diabetes care.

Solution

To develop a breath-based biosensor that encourages regular glucose monitoring by eliminating needles. By detecting VOCs like acetone and ammonia in exhaled alveolar air, the device enables comfortable, user-friendly, and routine glycemic checks, increasing patient compliance.



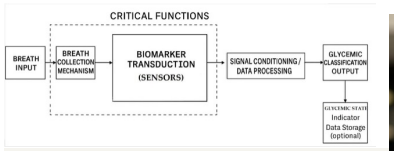
Current Systems

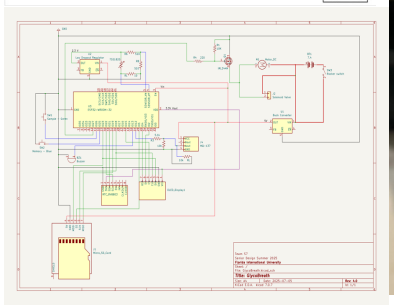
	Advantages	Disadvantages
Glucose Meter 	• Real-time glucose data • Clinically validated	• Requires frequent finger pricks; causes discomfort • Hard to use for older adults or people with limited hand control
Ketone Breath Monitors 	• No needles or blood • Multiple uses with no cost increase	• Lacks clinical validation • Inaccuracies due to hydration and breath technique.

Requirements

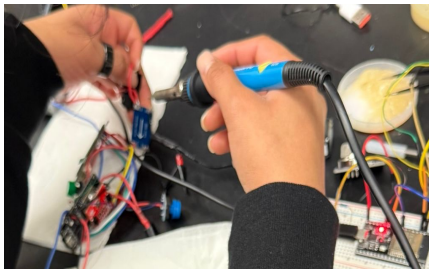
#	Market Requirements	Design Inputs
1	Detect hyperglycemia accurately via breath	Detect acetone (0.5–10 ppm) and ammonia (1–20 ppm) with LOD/LOQ of 0.2/0.5 ppm and 0.8/1.0 ppm, respectively. ±0.1 ppm resolution, $R^2 \geq 0.95$.
4	Comfortable to hold	Fit hand sizes 6.10–8.66" long, 2.68–3.95" wide.
5	Comfortable to use	0.05–0.851 psi to blow.
7	Support sampling throughout the day	Battery supports 10-15 full use cycles / day.
9	Data storage and retrieval	Storage stores ≥ 900 readings.
10	Resistant to contaminants.	≤ 95% humidity ingress, ≤ 5 µm pore size.

Design



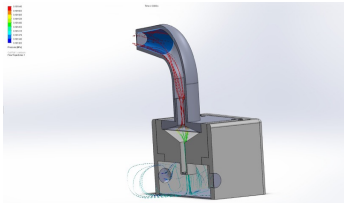


Implementation



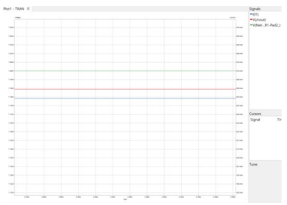
Simulations

Material Stress Test: Flow



Maximum Stress	1.01e-1 MPa
Yield Stress	2.6 MPa
Pass or Fail	Pass

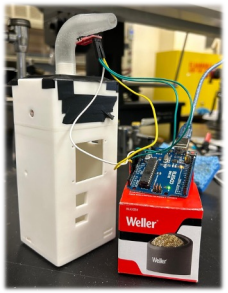
Electrical Circuit: Power

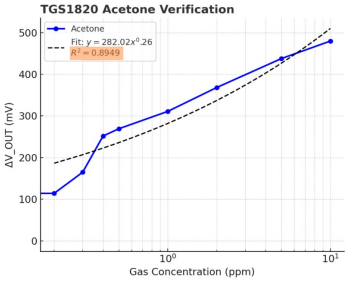


Start Time	7.4 V
Final Time	7.35 V
Pass or Fail	Pass

Verification

#	Verification Test	Test Result
1	Sensors Sensitivity	Passed: MQ-137 LOD 0.8ppm, LOQ 1.0ppm, resolution 0.1 ppm, $R^2 \geq 0.95$ for Ammonia Pending: TGS1820 sensor needs further testing for Acetone
4	Handheld Comfort	Passed: Hand sizes from 6.1—8.66" long and 2.68-3.95" wide fit on the device
5	Exhalation Comfort	Passed: Device needs 0.05-0.851 psi to blow
7	Battery Life	Passed: Device can run 10 samples
9	Data Storage/Retrieval	Passed: Device holds 900+ runs and takes 1 second to retrieve
10	Contaminant Resistance	Passed: No contamination observed and under 95% humidity





Summary

GlycoBreath is a user-friendly device that noninvasively monitors hyperglycemia by detecting acetone and ammonia in exhaled alveolar air. Its integrated pump and MOX sensors deliver clear three-level OLED feedback for easy results. By removing discomfort and simplifying testing, GlycoBreath aims to promote long-term patient compliance with diabetes monitoring.

Future Work

- Sensor array
- Injection molding MFG
- Miniaturized circuit
- Precision instruments
- Multi-language support
- Personalized decision making
- Machine learning
- Sensor coating

Acknowledgements

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