An optical-based wearable for non-invasive continuous blood glucose monitoring (NI-CGM)

Jung Han, Professor of Electrical & Computer Engineering

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BLAVATNIK FUND FOR INNOVATION

We are an experienced team out of Yale with a track record of developing technology and IP in advanced optical sensors

Lead investigator: Jung Han, PhD

- William Norton Professor and Chair of Electrical & Computer Engineering
- National Academy of Inventors fellow, **co-founder of 3 Yale spinout startups**

Business lead: Richard Andersson, MEng

- Associate Director of Business Development at Yale Ventures
- Supported Prof. Han to file **14+ patents for this technology (10+ licensed)**

Clinical collaborator: Stuart Weinzimer, MD

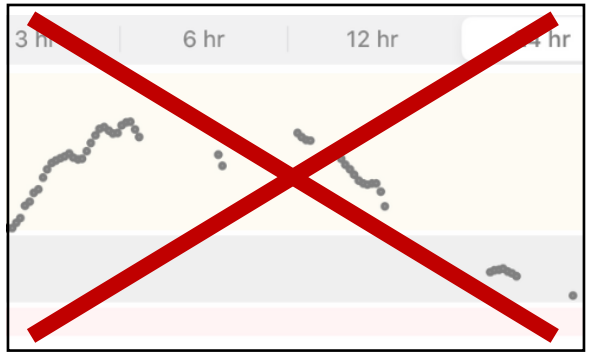
- Professor of Pediatric Endocrinology & Diabetes at Yale School of Medicine
- **20+ years of human research experience** in testing glucose sensor technologies

Reliable and accessible NI-CGM is a big need: our compact, accurate, cost-effective sensor will be the next frontier

All current solutions have one or more limitations

Uncomfortable

Error-prone



Bulky, expensive

Our technology unlocks all benefits

Non-invasive

Continuous, accurate

Miniaturized wearable

Enables personalized health insights and better outcomes for everyone

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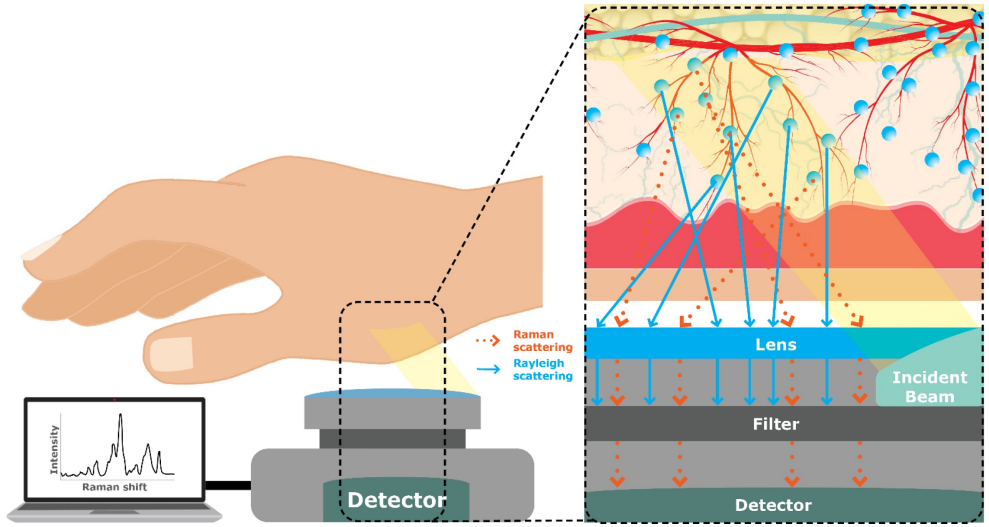
Two main challenges in NI-CGM after decades of studies: optical probes emerge the most promising

Challenge #1:
Glucose signal is hard to isolate
(Lots of other stuff! Water, fat, protein)



Challenge #2: High intra/inter-person data variance
(Chemical, biological, physical variables)

1994

Optical spectroscopy for *under-skin*, *molecular* probing of BG

2017

2024…

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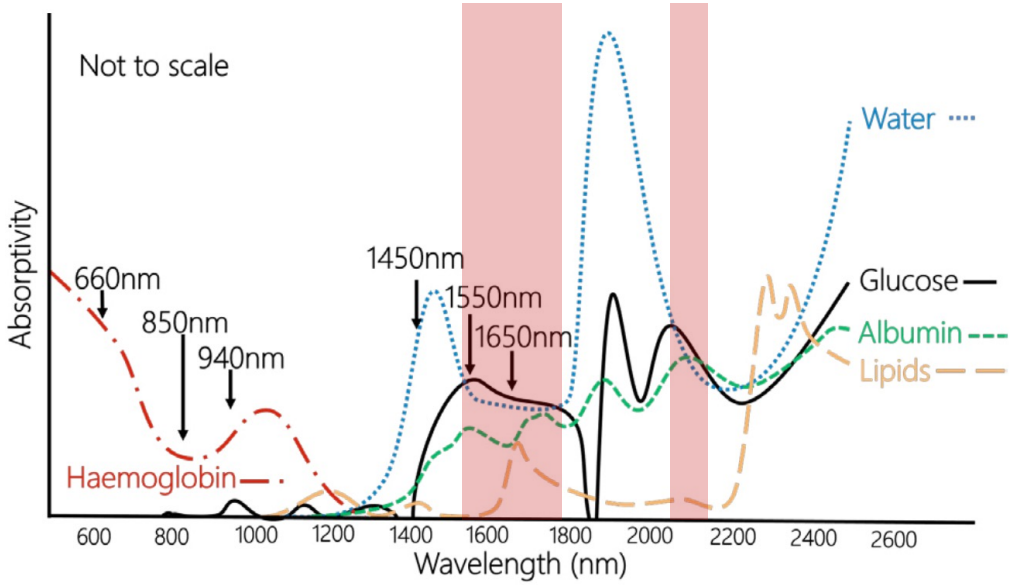
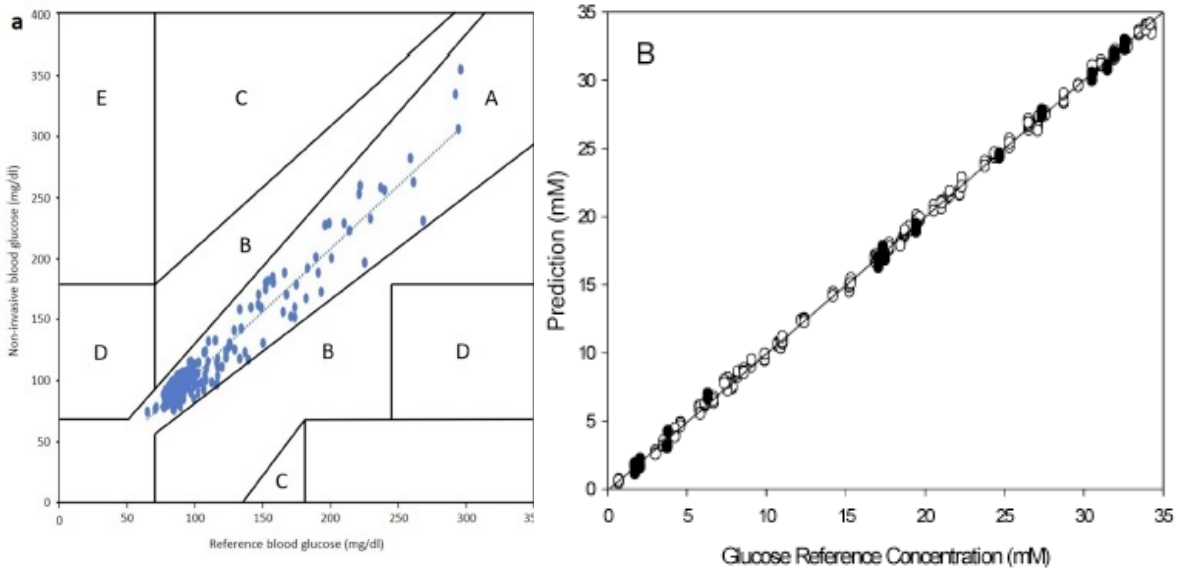
We have a right to win because we are solving two critical challenges: (1) Technological and (2) Analytical

Solution #1: Multiple short-wave infrared (SWIR) wavelength for glucose fingerprint



Why now? We have the first and only technology to make **compact and cost-effective SWIR micro-lasers**

Solution #2: Machine learning (ML) to analyze noisy data



Why now? Large AI models have enabled **precise, accurate, individualized analytics**

Campbell, et al. (2020) “Development of a discrete spectrometric NIR reflectance glucometer”; Srichan, et al. (2022). “Non-invasively accuracy enhanced blood glucose sensor using shallow dense neural networks with NIR monitoring and medical features.”

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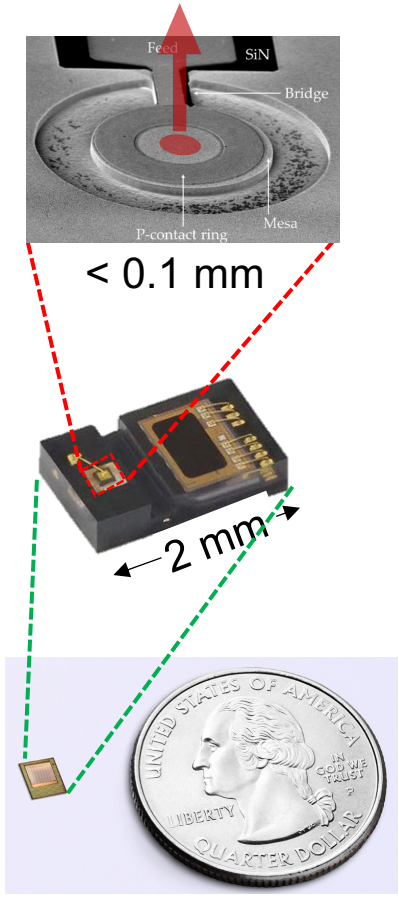
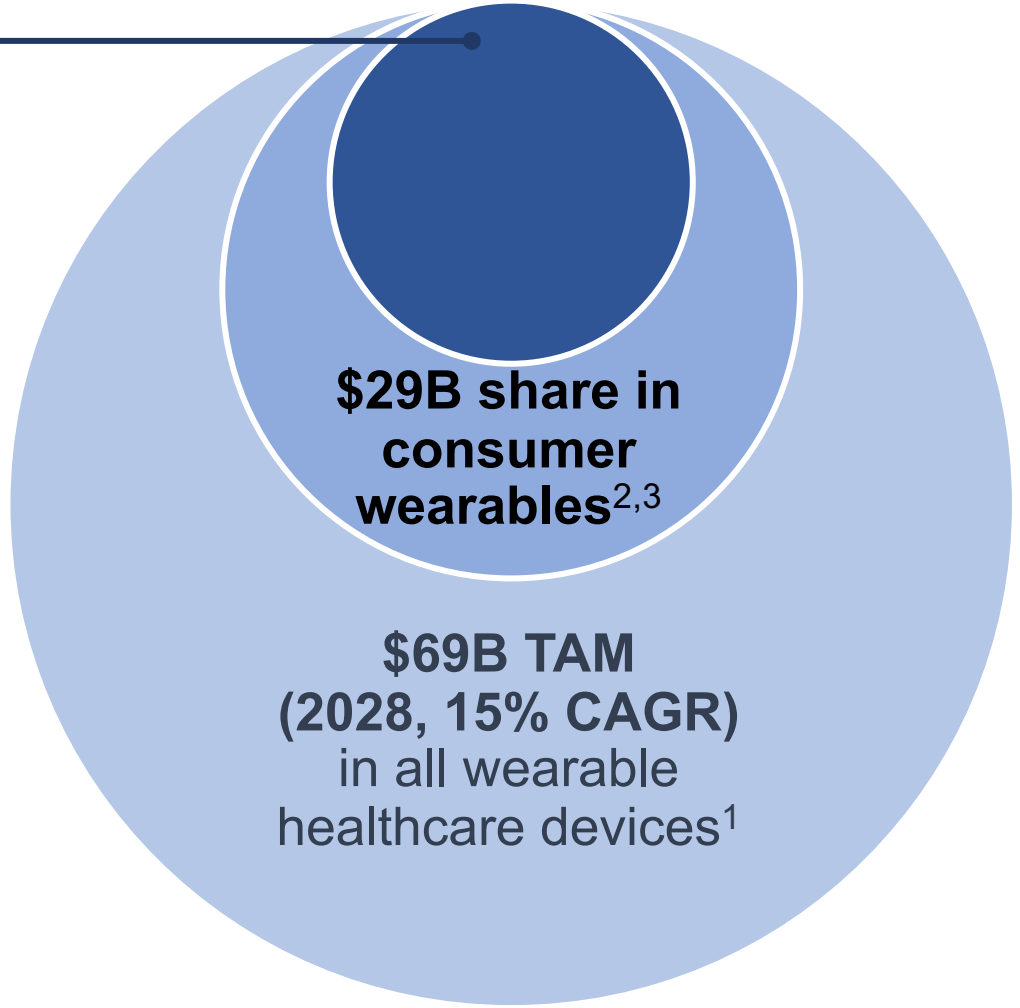
Our unique technology unlocks a multi-billion dollar need: large immediate market with huge growth potential

$1B Immediate Target (assume 2-3% penetration)



Our **patented component** can be put in any wearable (existing or new) – this is a very big TAM!

We have ready customers and partners waiting to license the **miniaturized module (new IP)** that we are developing



[1] "Wearable Healthcare Devices Market", Markets & Markets Report [2] Overall smartwatch market in 2023 (15.1% CAGR) [3] Markets.us report on Wearable devices

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We are the only solution that delivers all the specific features required for an optical NI-CGM

Design level	Our key property advantages	LED	NIR VCSEL	EEL
Material	• Laser (high radiancy) • 1300~2200 nm range	X Not laser (low radiancy)	X < 1000 nm only	
Component	• <$1 cost / unit			X High, > $10/unit
Device	• mm-scale footprint			X Big, ~cm scale
Application	• Any wearable form factor (smart device, patch, etc.)	X Needs thin skin-depth		X Limited by size

No other competing solution meets all these criteria!

Our technology (material, chip) is already well-protected by 14+ patents, with **room for IP creation as we move from component to device and application level**

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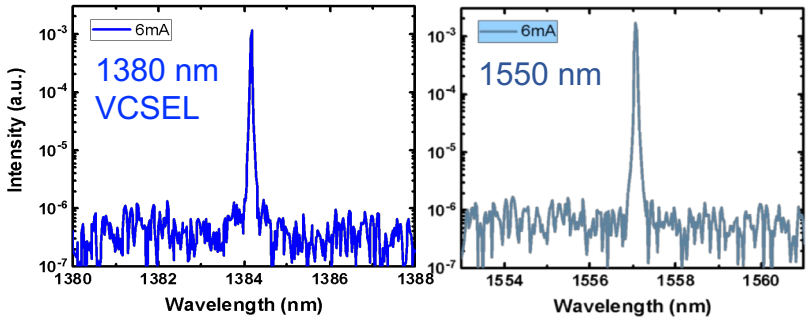
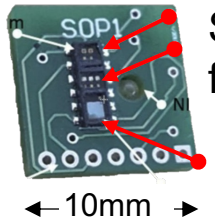
$300K enables us to develop a patented feasibility prototype, and the first step toward a better clinical tool

Develop chips
Month 1-6: $125K

- Develop chips @ 1800~2100nm (1300~1750 already achieved)
- Laser and PD Integration
- Design circuitry, ADC, driver



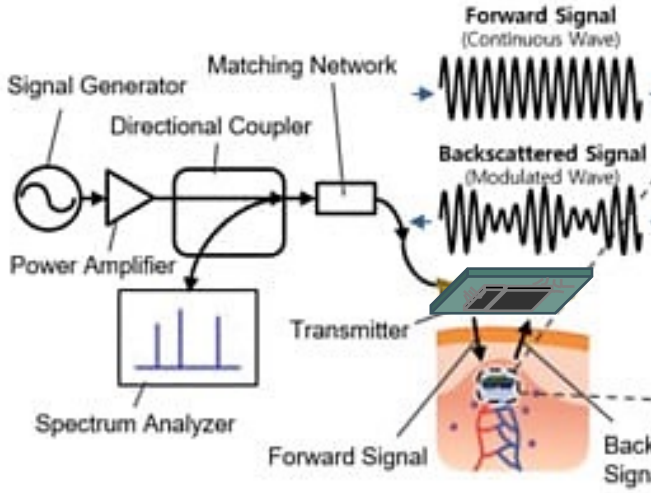


SWIR sensors: multi-wavelengths for unique glucose fingerprint

Photodiode (PD) detector

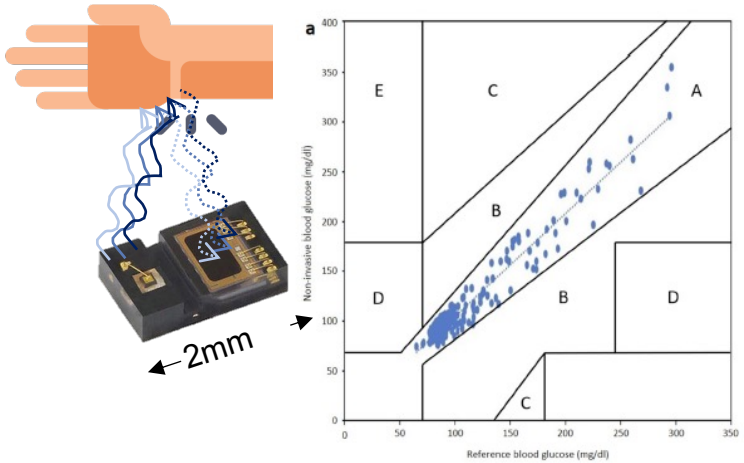
Develop device
Month 6-9: $75K

- Collect finger / wrist signal
- Analyze data with ML/AI, study sensing modality
- Refine electronics and sensor placement



Apply in-vivo
Month 10-15: $100K

- Partner with Yale clinician
- Collect continuous-wear signal and baseline
- Miniaturize sensor head and electronics



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Q&A