Frugal Science: Hacking a Fitness Tracker for Continuous Bacterial Growth Monitoring

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Tell us about yourself.

I studied M.Sc. Physics from Banaras Hindu University and M. Tech in Applied Optics from Indian Institute of Technology (IIT) Delhi. As part of my Master's thesis, I built a confocal microscope for direct laser lithography set-up at Technical University Berlin, Germany. Later, I moved on to pursue Ph.D. in Physics at the University of Exeter in the UK. During my Ph.D., I investigated SiC photonic crystals and metamaterials to achieve near-perfect absorption in the infrared regime. Soon after my Ph.D., I joined as a research fellow in the nanophotonics group at the University of St Andrews, UK. I am currently working as a Marie-Curie Career-Fit Research Fellow at the CAPPA research group in Munster Technological University (MTU) with Dr. William Whelan-Curtin. I supervise students, work on national and international projects, and collaborate with industrial partners and world-leading universities such as Stanford University. My research interests include silicon photonics, photonic crystals, synthetic biology, and biomedical devices.

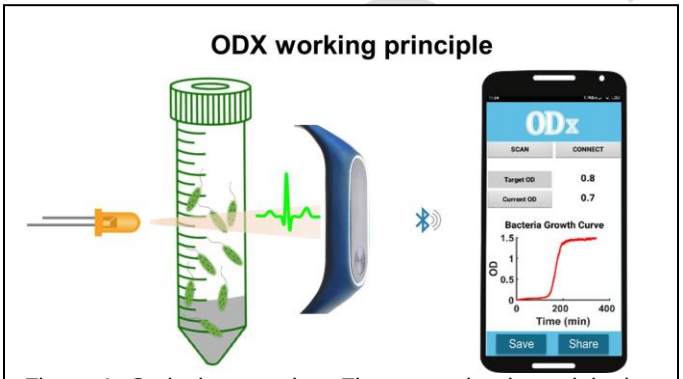

Figure 1: Optical sensor in a Fitness tracker is exploited to make a continuous bacterial growth monitoring device (ODX) that will save enormous time, cost and resources in biology labs.

How did you develop the idea of repurposing a fitness tracker for an optical density measuring device?

During the last 5 years, I developed some close collaborations and a working relationship with a biologist (Vamsi, first author on ODX). We frequently share our ideas to improve automation and instrumentation for biomedical applications. I visit him in his laboratory regularly and almost always find him in front of the spectrophotometer. I soon learned that a spectrophotometer is used heavily in life sciences and yet the design and work around it are highly repetitive and mundane.

My interests lie in robotics and the miniaturization of hardware. Naturally, we found a problem we could fix together. I am fascinated by compact electronics packed inside a fitness tracker and I decided to exploit components from a fitness tracker to build a handheld OD measuring device. They have built-in Bluetooth, microcontrollers, LEDs, optical sensors, charging circuit, rechargeable battery and an OLED screen. Most importantly, fitness trackers are very cheap as they are manufactured in high volumes. A key feature of all fitness trackers is the ability to monitor heart rate. This is done using an optical sensor and I immediately thought we could use this to monitor optical density.

The ODX device began more from frustration. It is frustrating for every biologist to measure OD every 20-30 minutes. Soon, we approached Uday (co-first author) about the idea. Uday is an engineer and is highly skilled in making miniature electronics. In the following 6-7 months, three of us teamed up to build a prototype device and optimize it.

Can you explain the applications of your device?
ODX is a handheld optical device that can measure the optical density of a solution. We demonstrated the capability of the device to measure the growth of bacteria. This is a day-to-day activity in many microbiology, synthetic biology and genetic engineering laboratories settings. Optical density is also used as a parameter in quality control in the food and beverage industries. The optical density of a solution can tell information such as the purity of a sample solution or when to stop a certain process. ODX also has extended applications in various other fields such as environmental sensing for water quality monitoring, clinical pathology for urinary analysis, etc.

What are your plans to exploit your innovation?
We have necessary IP arrangements in place through the Technology Transfer Office at MTU. Recently, we have received funding from Enterprise Ireland to bring ODX from prototype to market ready product. In the forthcoming few months, we will be exploring more opportunities to accelerate the commercial product development.

How will your innovation contribute to the healthcare market?
Optical density can provide crucial information on body fluids (such as Urine and saliva). ODX is currently being tested for urine pathology. In many places worldwide, this is now performed manually by trained personnel and having a device like ODX to automate this would be a big step ahead. Further, with added capabilities, the device can also play a key role for startups focusing on drug development and microbiome applications.

Seeing the fastest growing healthcare startups, have you ever thought of making the leap to entrepreneurship?
Yes, the ODX team is highly interested and excited about entrepreneurship opportunities. Our mentors at CAPPA research group and technology transfer office at MTU and the commercialisation experts at Enterprise Ireland have been supporting our ambition to bring ODX to the market through a spinout company or a startup.

Team

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Reference

Venkata V. B. Yallapragada, Uday Gowda, David Wong, Liam O'Faolain, Mark Tangney, and **Ganga C. R. Devarapu*** (2019). ODX: A Fitness Tracker-Based Device for Continuous Bacterial Growth Monitoring. *Anal. Chem.*, 91, 19, 12329–12335.