Background & Market Research

Shivani Gupta, Anika Karre, Isha Nagireddy, Abhikhya Sonti

Problem: Real-time malaria detection is not easily accessible to those in rural areas efficiently and cost-effectively. This results in physical and mental strain on those needing access to diagnosis.

Task: Design a portable near-infrared spectroscopy device to accurately detect malaria infection through the skin.

Client Requirements:

- No bigger than a phone
- Accuracy of 85%
- Cost-effective (no greater than $250)
- Durable
- Non-invasive
- No technical knowledge is required

No portable spectroscopy devices to detect malaria are made for the general public. People must travel far out of their rural communities if possible to detect malaria. If not, they are forced to suffer from the infection, which can also result in death. Portable methods for spectroscopy are being engineered, as are methods for malaria detection using spectroscopy. In blood, at a wavelength of 2214 nanometers, is the band for Deoxyribose DNA from the parasite. Through the skin, there are multiple peaks as highlighted in the article "Malaria absorption peaks acquired through the skin of patients with infrared light can detect patients with varying parasitemia" (Garcia et al., 2022). The peaks for the malaria hemozoin protein are present at 1636, 1640, and 1642 nanometers (Garcia et al., 2022). However, no innovations have been made to combine both aspects.

Competitors

Do-it-yourself functional near-infrared spectroscopy (DIY-fNIRS) headband

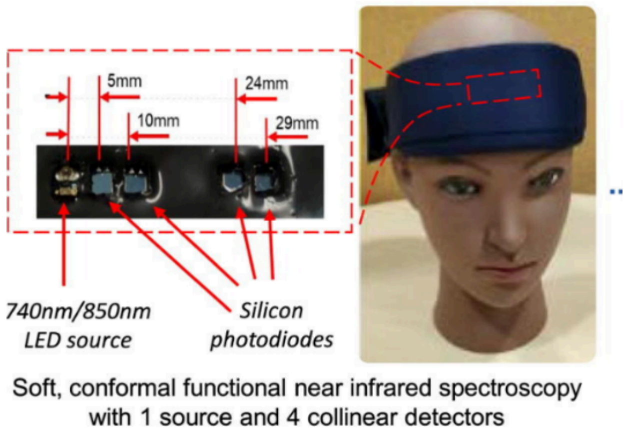

Figure 1: Image of the headband device and its outer appearance.

Pros	Cons	Improvements
- Small and lightweight - No technological experience necessary to operate device	- Head Movements can disrupt the fNIRS signal, which can lead to skewed data. - Total cost was up to $23,000 - Single channel system limits information collected	- Alter the shape so that it can be attached to a phone - Substituting for more cost-friendly hardware and electronics

nlir mid IR spectrometer, 2-5µm

Figure 2: This image displays the shape and relative size, as well as the overall appearance of this product

Pros	Cons	Improvements
- Plug and play, requires no set up - -80 dBm/nm sensitivity	- Only 2-5µm range and limited analysis ability - Inferred to be expensive - Not a portable device	- Use a wider range of light, and target more functional groups - Smaller in size without compromising analysis

Mid-IR PAT with 10 meter fiber probes

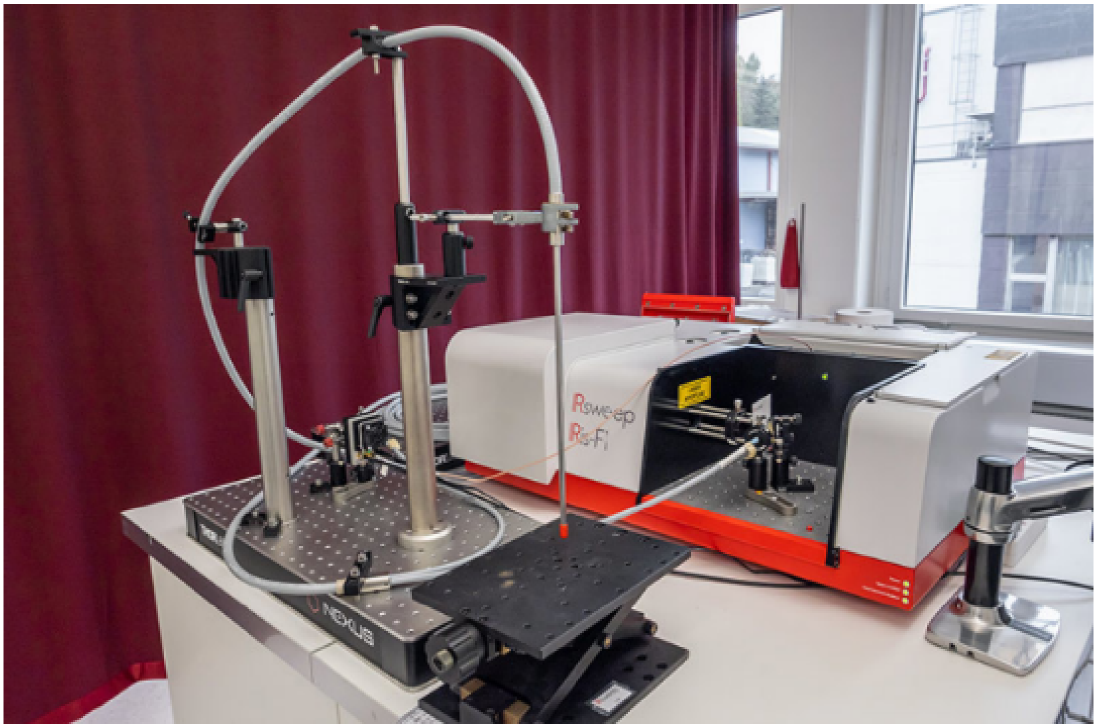

Figure 3: The MIR device with 10m probes

<u>Pros</u>	<u>Cons</u>	<u>Improvements</u>
- Perfect accuracy - Can detect a wide variety of functional groups	- Too large for at-home use - Requires an experienced technician to operate the device	- Make it more cost-effective by using less and cheaper alternatives (ie. a CD for the diffraction gradient)

Competitor Summary:

Overall, most competitors lacked the cost-effective aspect of their spectrometer. Additionally, it either failed to cover the range necessary to detect malaria, or it was not portable and easily operated, making it more difficult for people with challenges to use. To combat this, the AccessAbility team will improve the breadth of the portable spectroscopy device while taking methods to obtain accurate results from the other competitors.

Written by Shivani Gupta [4/27/24]
Edited by Anika Karre [4/28/24]

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