Mid-Infrared Spectroscopy Device for Malaria Diagnosis with Machine Learning

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ACCESSABILITY
DETECTION AND PREVENTION

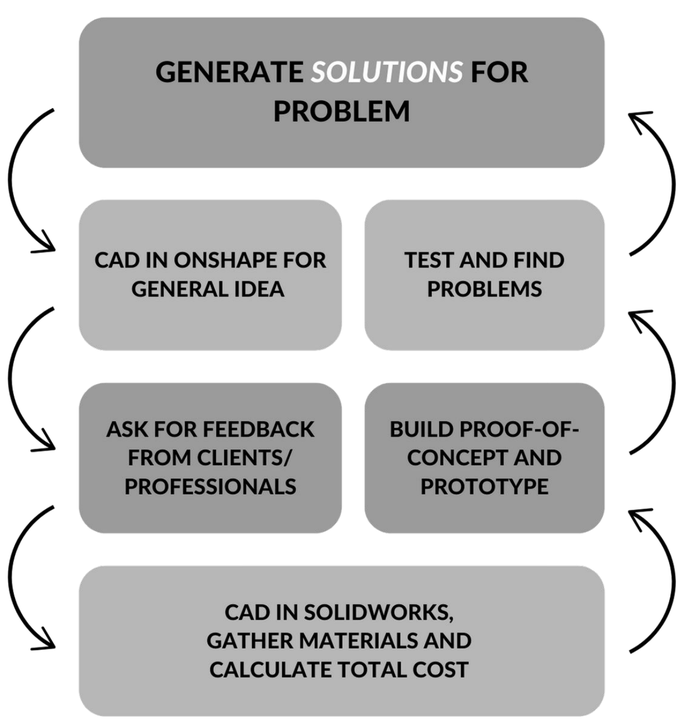
Problem Statement

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.

Engineering Goal

The goal is to design a **portable** near-infrared **spectroscopy** device to accurately detect malaria infection **through the skin.**

Methodology

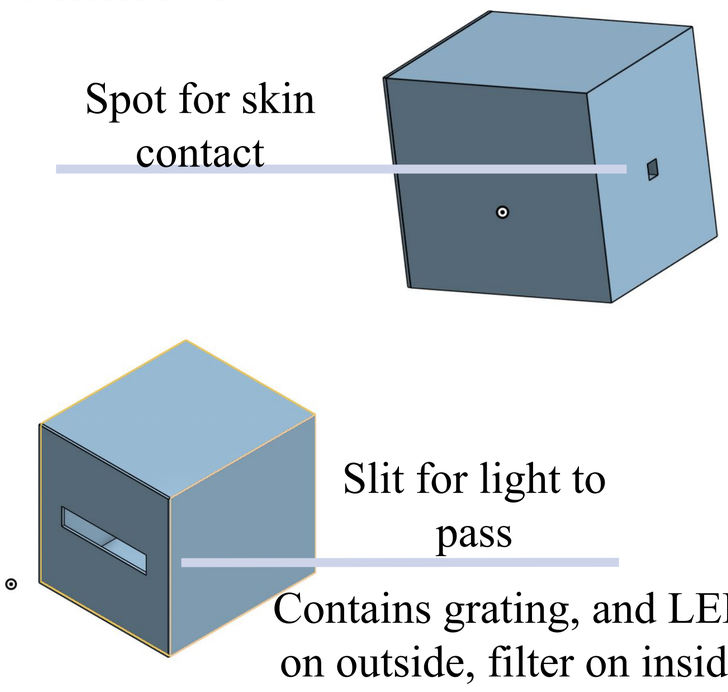


Our Current Design

Box Phone Attachment

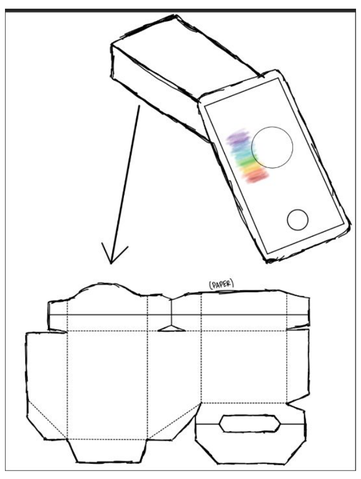
Requirements:

- Accuracy ≥ 85%
- No **assembly** required
- Weight < 200 grams
- Length < 15.7 cm
- **Non-invasive** diagnosis
- Visible **spectra** in camera
- No technological knowledge required
- Device can be used **at home**



Design II

Body Attachment System



Pros

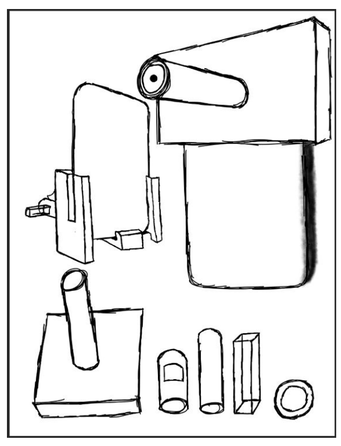
- Simple design
- Easy to make
- Very cost effective

Cons

- Not durable at all
- Less clarity in the readings due to the simple materials

Design III

Rotational Selfie Stick



Pros

- Easy to move around and take anywhere
- Visually appealing with a simple and digestible design

Cons

- Not very easy to make when just given the materials
- Not as cost friendly as other models

Design IV

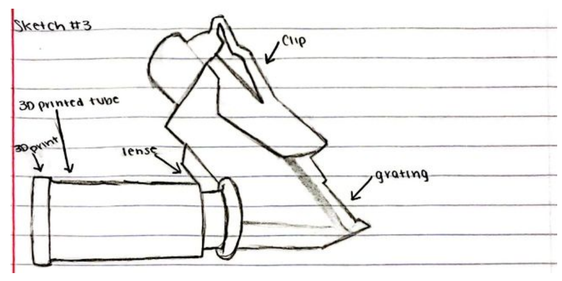
Three-Axis Gimbal, Version I

Pros

- Easy to use and does not require an expert in the field to operate

Cons

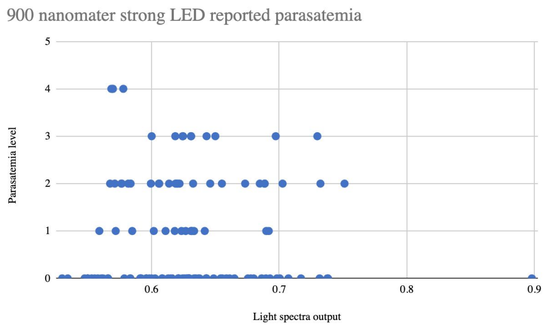
- A bulkier device that won't be as portable in comparison to the other designs
- Requires more complicated machinery to make the parts



Design Study I

Relationship of Light spectra and Parasitemia

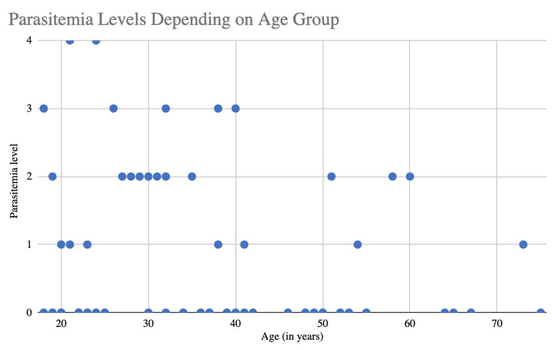
Purpose*:* To determine which range of light spectra was related to the different levels of parasitemia when a 900 nm LED light is shone.
Independent Variable: Light spectra value.
Dependent Variable: Parasitemia value.
Conclusion: Level 4 parasitemia only shows up with a light spectra under 0.6. The other levels seem to be evenly spread out across all spectral levels.



Design Study II

Relationship of Age and Parasitemia

Purpose*:* To determine whether there is a relationship between the age of a patient and their parasitemia level.
Independent Variable: Age
Dependent Variable: Level of parasitemia
Conclusion: The younger a patient, the more likelihood of higher levels of parasitemia.



Conclusions & Future Work

- The most challenging part was creating a **portable spectrometer**
- The machine learning model **tests accuracy**, and outputs if the user has Malaria
- Adding additional wavelengths of LED's to the spectrometer to **improve accuracy**
- Create a **mobile application** that implements the machine learning model to diagnose Malaria