Mid-Infrared Spectroscopy Device for Malaria Diagnosis with Machine Learning

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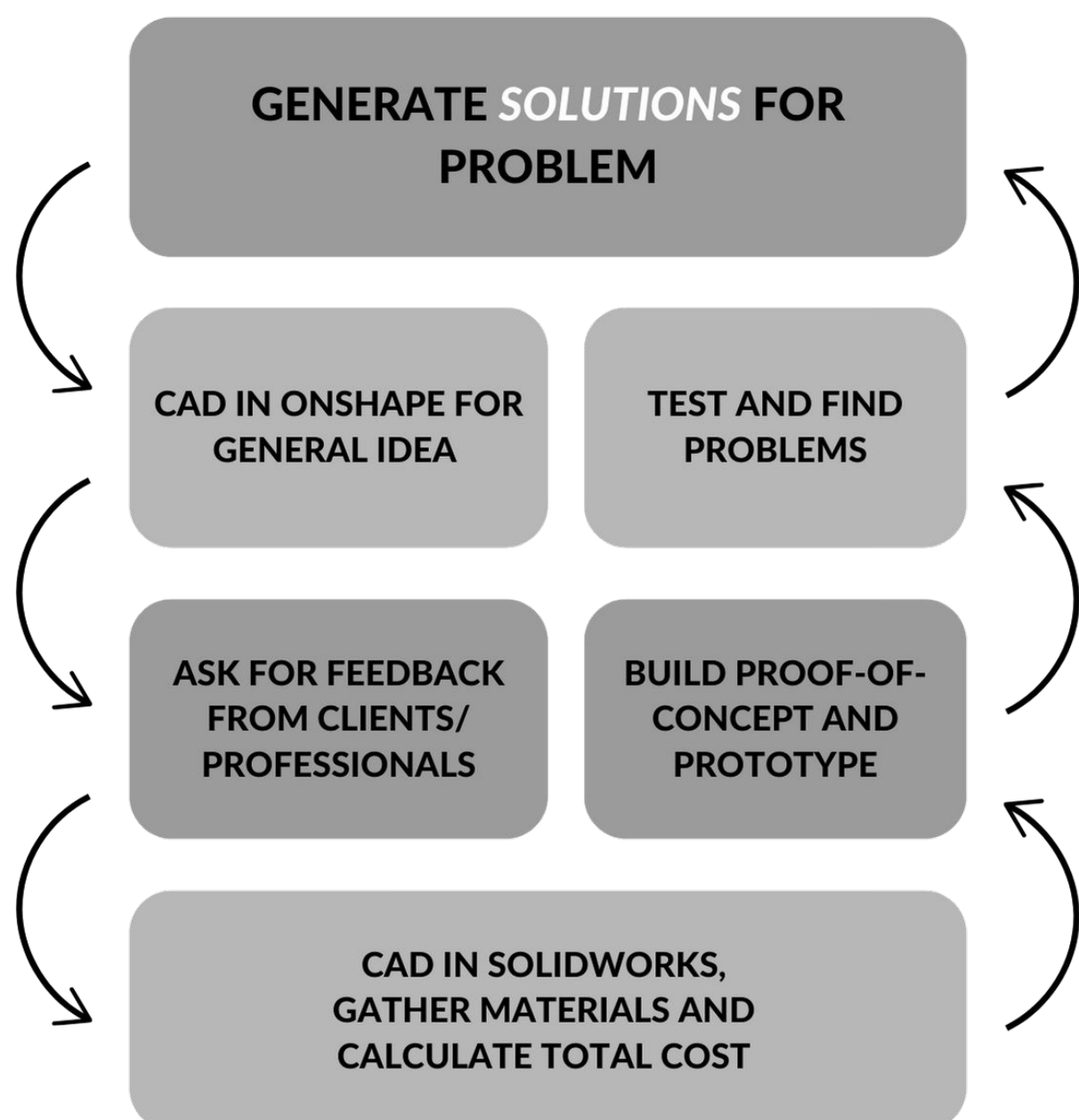
ACCESSABILITY
DETECTION AND PREVENTION

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.**
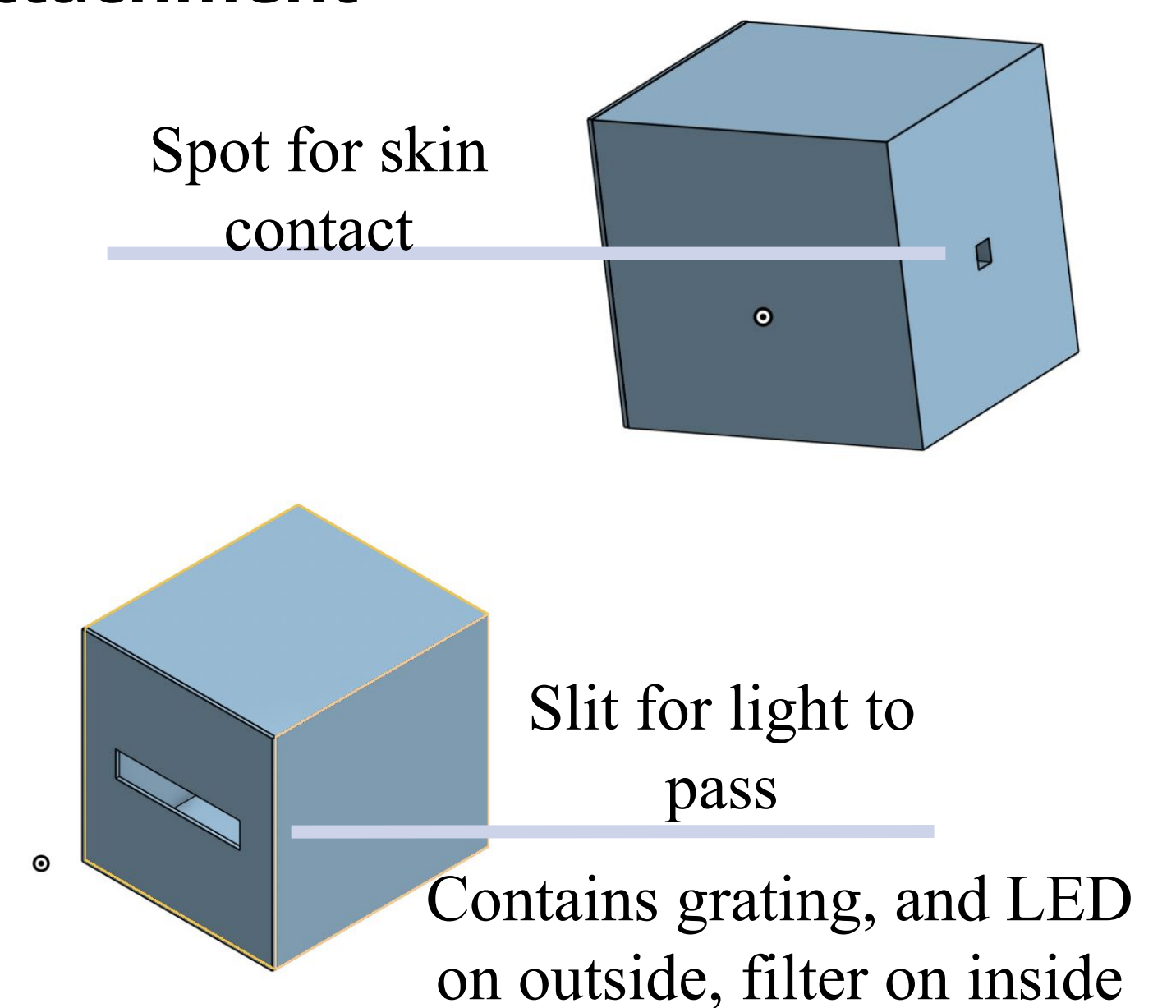
Methodology

- GENERATE *SOLUTIONS* FOR PROBLEM
- CAD IN ONSHAPE FOR GENERAL IDEA
- TEST AND FIND PROBLEMS
- ASK FOR FEEDBACK FROM CLIENTS/ PROFESSIONALS
- BUILD PROOF-OF-CONCEPT AND PROTOTYPE
- CAD IN SOLIDWORKS, GATHER MATERIALS AND CALCULATE TOTAL COST

Our Current Design

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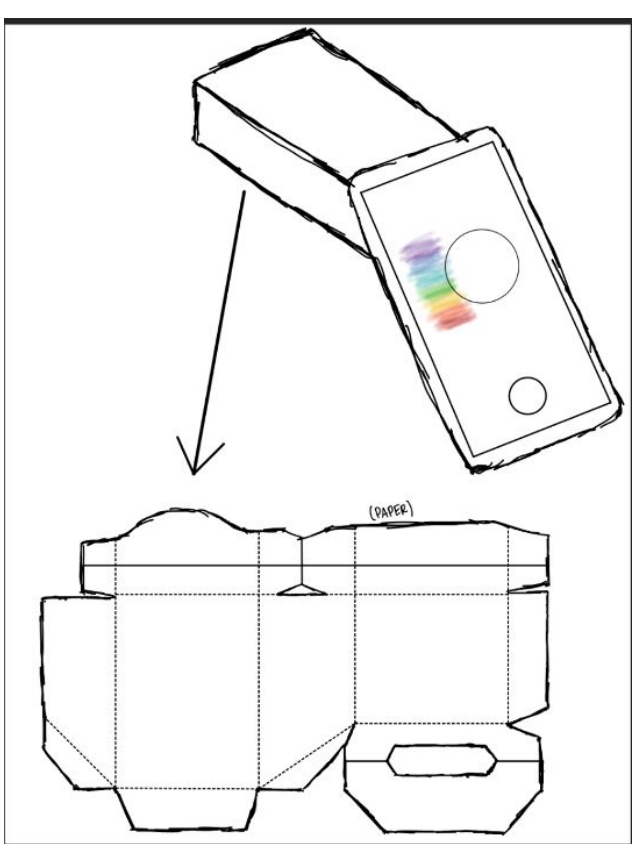
Requirements:
- Accuracy ≥ 85%
- No **assembly** required
- Weight < 200 grams
- Length < 15.7 cm
- **Non-invasive** diagnosis
- Visible **spectra** in camera
- No technological knowledge required
- Device can be used **at home**

Spot for skin contact

Slit for light to pass

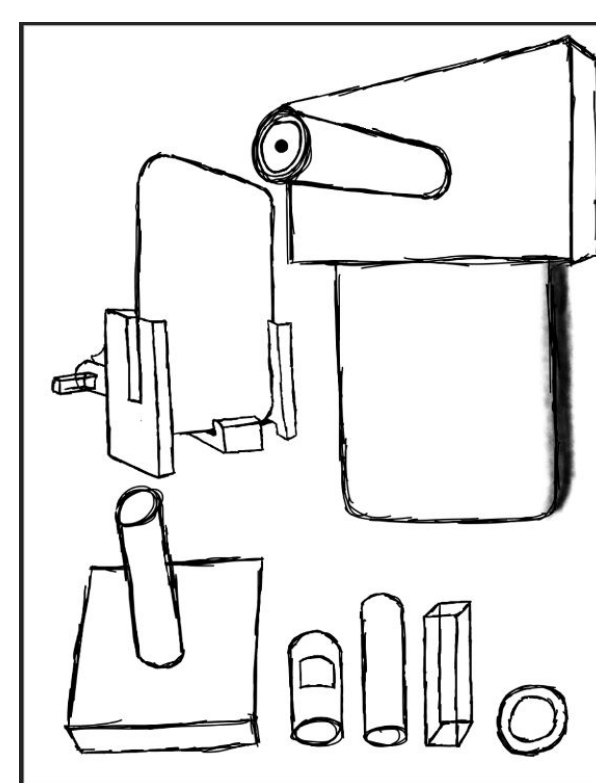Contains grating, and LED on outside, filter on inside

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
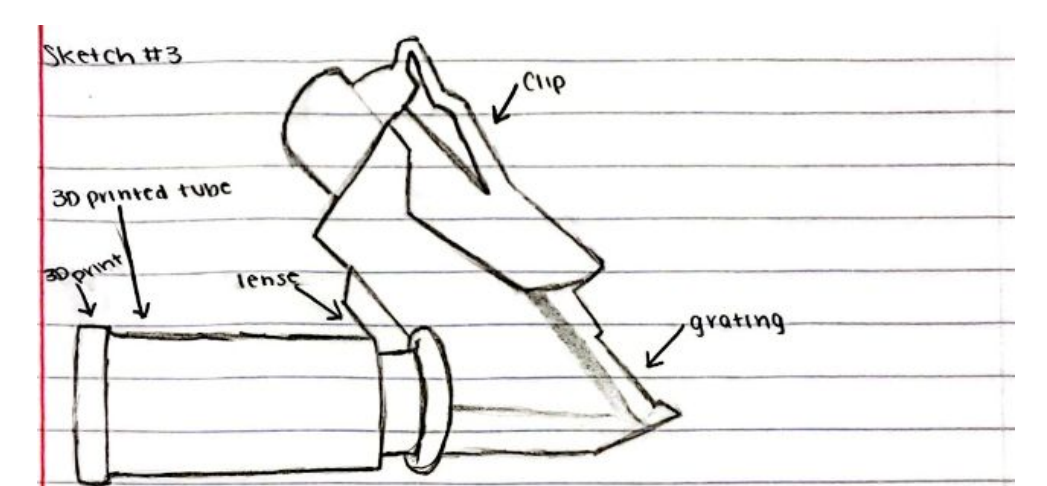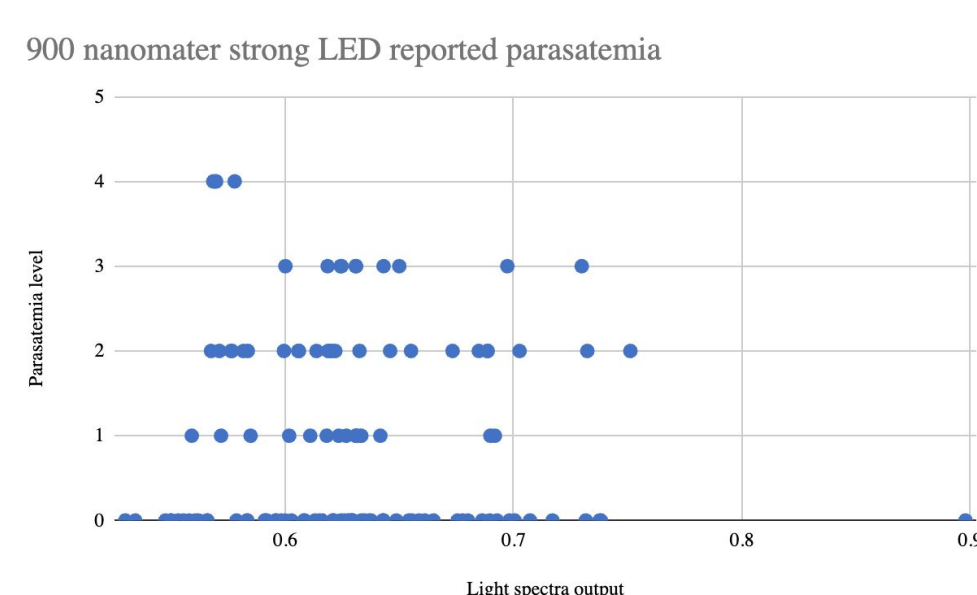
Design Study I

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.

900 nanomater strong LED reported parasitemia

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.

Parasitemia Levels Depending on Age Group
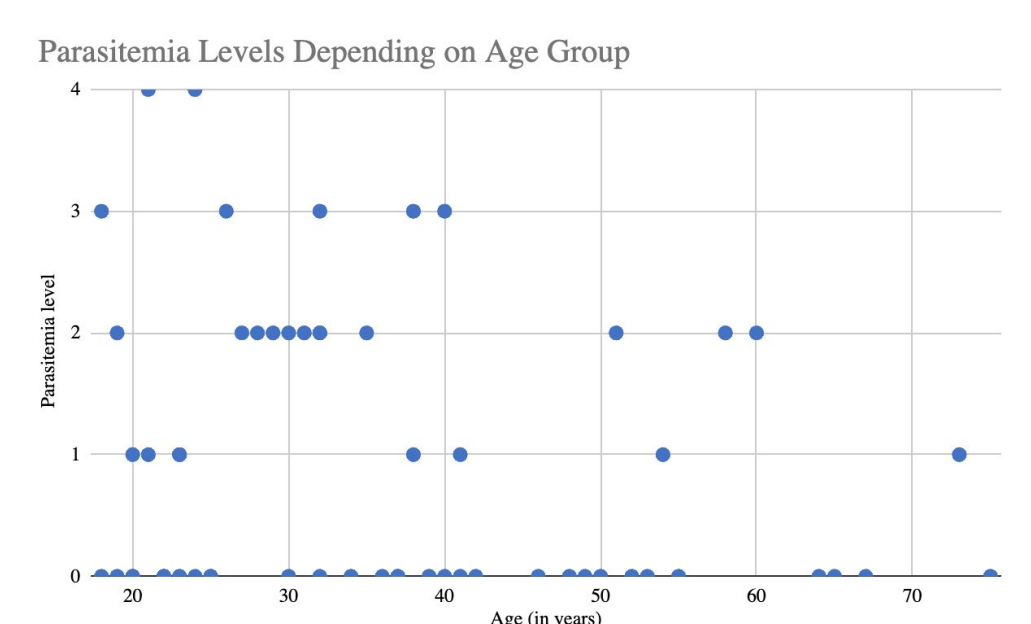
Conclusions & Future Work

- 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