

Malaria Diagnostic Kit

User Manual

IISER Pune's iGEM team

12 October 2020

Introduction

This is a review edition for the diagnostic kit user manual. It's meant to introduce the end user to the concept of a point-of-care diagnostic tool that can potentially detect the presence of malarial parasites in blood smears. This user manual is kept as simple as possible with easy to follow along video tutorials and demos such that anyone can understand it. This requires the end user to have a minimum set of the following skills:

1. Understanding of how a microscope works.
2. How to prepare a light blood smear on a glass slide.
3. Working proficiency in English (as the video tutorials are in English).

The objective of this diagnostic kit is to identify whether a sample of blood is infected or not without the presence of a laboratory or an expert. The AI software used has been trained to classify RBC images as *Infected* or *Non-infected*.

What the Malaria Diagnostic Kit consists of:

1. Foldscope
2. Paper Centrifuge
3. Mobile app/Website for analysis of smear images.

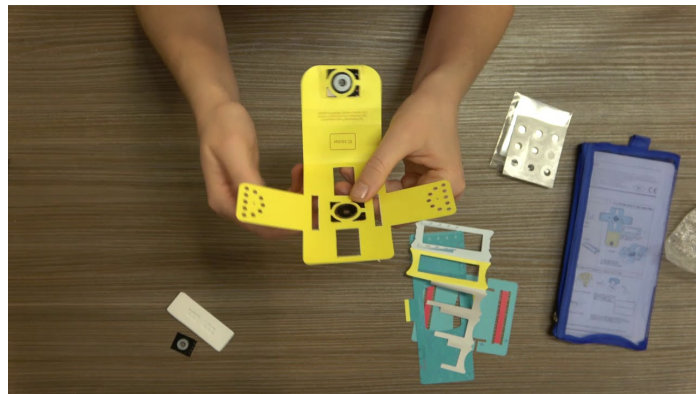
The Foldscope was invented by Prof. Manu Prakash and Jim Cybulski at Stanford University [1]. The Paper Centrifuge has been developed as an ultralow-cost way of solving the critical bottleneck caused by expensive, bulky and electricity powered commercial centrifuges [2]. The software for analysing the blood smears was developed by IISER Pune's iGEM team based on deep learning models for image recognition. The Foldscope and Paper

centrifuge replaces the need for a laboratory while the deep-learning software replaces the need for an expert to identify infected RBCs.

This review is divided into three sections. The **first section** is to review the feasibility of the Foldscope. The **second section** deals with the paper centrifuge and making a smear after spinning down the blood. The **third section** is about reviewing the software interface of the of the program developed to analyse the red blood cells.

Section 1 - Foldscope

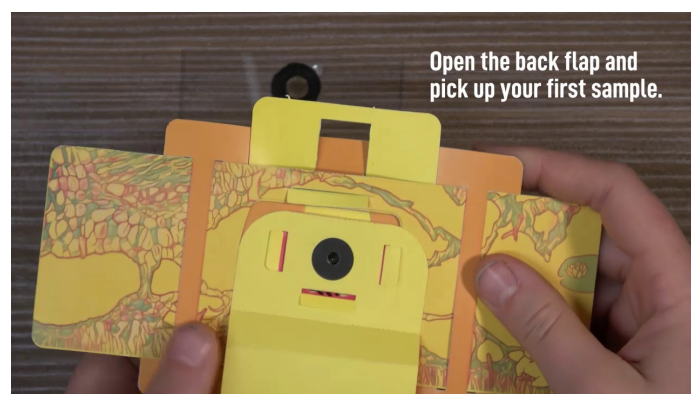
1. How to assemble the Foldscope [12 min] - <https://youtu.be/L-tFJRGQBlo>



2. How to mount your smartphone camera on the Foldscope [5 min] - <https://youtu.be/OiRCceGCGus>



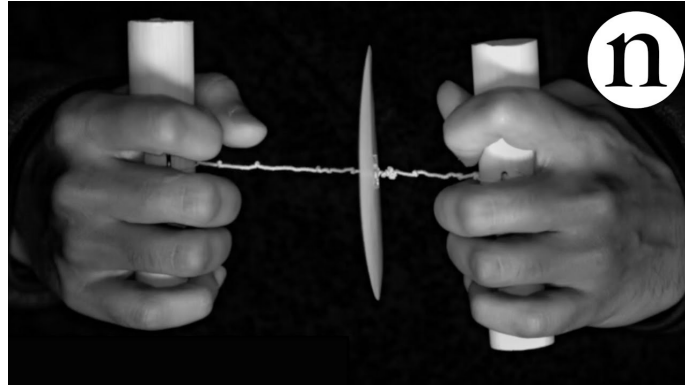
3. How to mount a Glass Slide on the Foldscope [13 min] - <https://youtu.be/z4qLuXhl3pl>



- - End of Section 1 - -

Section 2 - Paper Centrifuge and Blood Smear

1. The concept of the Paper Centrifuge [2 min] - <https://youtu.be/isMYGtCFIjc>



2. The paper centrifuge can reach speeds of up to 125,000 rpm. Malarial parasites are generally found in a layer called the “buffy coat region”. To obtain this, 15 min of constant centrifugation is required [2]. This layer can then be extracted and mounted on a glass slide.
3. Preparation of Thin Smear [First 6 min only] - <https://youtu.be/acoALifVvb8>



- - End of Section 2 - -

Section 3 - RBC Analysis Software (Test Version)

1. Website View [1 min] - <https://drive.google.com/file/d/1DDPAEPbd-6JHGLqax99ltAJogxXKdTec/view?usp=sharing>
2. Mobile View [1 min] - <https://drive.google.com/file/d/1MWE0oPVU1aXDwWJ90IbzSc2VvxS0r5RN/view?usp=sharing>

- - End of Section 3 - -

References

- [1] Cybulski, J. S., Clements, J., & Prakash, M. (2014). Foldscope: Origami-Based Paper Microscope. *PLoS ONE*, 9(6), e98781. <https://doi.org/10.1371/journal.pone.0098781>
- [2] Bhamla, M., Benson, B., Chai, C. et al. Hand-powered ultralow-cost paper centrifuge. *Nat Biomed Eng* **1**, 0009 (2017). <https://doi.org/10.1038/s41551-016-0009>