Deep Learning Mobile Application Towards Malaria Diagnosis

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Introduction

• Malaria is a life threatening disease transmitted by a bite of an infected female anopheles mosquito.

Who is at Risk?

• In 2017 nearly half of the world was at risk of malaria being the poorest and marginalized communities with the highest risk;

Death Burden

• 93% of the deaths caused by malaria was reported in Africa in 2017;
• 60% of the reported cases of death were children under 5 years;
• Malaria kills a child every 2 minutes!

Source: WHO malaria report 2018 showcasing malaria cases globally

The goal of this project is to reduce mortality rate related to malaria disease, particularly in marginalised communities.
Existing Strategies

- **Malaria is curable** and with a prompt diagnose and treatment can reduce death.

Common diagnosis tools for malaria

- *Microscope*
  - **Pros:** accurate.
  - **Cons:** takes time (15-30 mins), requires expert and labour in count of parasites.

- *RDT*
  - **Pros:** fast, portable, no need of expert, cheap.
  - **Cons:** can’t diagnose malaria at early stage, no quantitative analysis.

- Existing rapid diagnosis tests can’t identify the stage or count the number of parasites (quantitative diagnosis).

- But we can do so with object detection in Computer Vision.

Why Quantitative Diagnosis matters?

- Uncomplicated malaria patient receives oral antimalarial.

- Severe malaria patient receives parenteral antimalarial.

- In this study we have used computer vision to solve the challenges posed in these existing strategies.
A malaria diagnosis test using a mobile phone that is fast, can detect early stage of malaria, provides quantification of parasites and not expert dependent.
Methodology

Data Set

<table>
<thead>
<tr>
<th>Datasets</th>
<th>Number of patients</th>
<th>Number of thick blood smear images</th>
<th>Number of a bounded box of parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda</td>
<td>n/a</td>
<td>1182</td>
<td>7245</td>
</tr>
<tr>
<td>Tanzania</td>
<td>28</td>
<td>100</td>
<td>600</td>
</tr>
</tbody>
</table>

- The dataset was split into 80:10:10 ratio.
- We had a total of approximately 7800 bounded box of parasites.
- Model used: Facebook Detectron 2
Our Model

- We fine-tuned a coco-pretrained R50-FPN Mask R-CNN from our custom malaria dataset.
Results

- F1-score = 0.841
- AUC = 0.898

ROC and Precision-recall for malaria
Future Work

- Collect more data set (5000 Images) with both parasite and white blood cells labelled to improve the performance of the model and have a fully automated malaria diagnosis.
- To understand why the model made certain predictions such as false positive and false negative could also be valuable to improve the model performance.
- Training of a smaller network that can easily be deployed in a limited resource area such as a mobile phone will eliminate the need to deploy the model in a computer server.
• WHO malaria Diagnostic test, Retrieved on 1st March 2019 from https://www.who.int/malaria/areas/diagnosis/en/