Chapter 9
Malaria Parasites Detection Using Deep Neural Network

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ABSTRACT

Malaria is a dreadful infectious disease caused by the bite of female Anopheles mosquito, by the protozoan parasites of the genus Plasmodium. It's an epidemic disease and demands rapid and accurate diagnosis for proper intervention. Microscopic test on the thick and thin blood smear to detect the malaria and counts the infected cells is the gold standard for diagnosis of this disease. An automation process in the form of computer-aided diagnosis is much needed as it plays a vital role in fully or semi-automated diagnosis of diseases based on medical image information. Deep learning has vast ranging applications. This work is to build a convolutional neural network to expertly detect the presence of malaria parasitized cells in the thin blood smear. The authors construct the model as small and computationally efficient to obtain the highest level of accuracy possible.

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INTRODUCTION

Malaria is caused by protozoan parasites of the genus *Plasmodium*, single celled organisms that cannot survive outside of their host. It is a life-threatening infectious disease caused by parasites that are transmitted to individuals through the bite, mainly at night time of contaminated female Anopheles mosquitoes. The parasites grow within the vertebrate body, especially in liver, before entering the bloodstream to infect red blood cells (RBC). This ensuing destruction of host RBC can results in disease, called malaria. Over last 20th century, various species of malaria were discovered in various host and classified. The five species regularly infect humans are: *P. falciparum*, *P. malariae*, *P. ovale*, *P. knowlesi* and *P. vivax*. Among these, *P. falciparum* is the most dominant species of parasites and lethal in humans, resulting in hundreds of thousands of deaths per year. Typical symptoms of malaria include fever, fatigue, headaches, and, in severe cases, seizures and coma, leading to death .Most of the cases, it is preventable and curable with immunity to malaria increases after each malaria attack. According to the latest *World malaria report,* unleashed in November 2018 by World Health Organization (WHO), there were 219 million cases of malaria in 87 countries in the year 2017 and 217 million cases recorded in 2016. The estimated number of malaria deaths stood at 435000 in 2017, a comparable number to the previous year. Majority of these deaths are children from Sub-Saharan Africa. Approximately half of the world's population is at risk of malaria and most cases occur in sub-Saharan Africa, where 20% of childhood deaths result from this disease. African children have between 1.6 and 5.4 episodes of fever caused by malaria each year. Malaria is also an important cause of prenatal anemia, miscarriage, abortion, stillbirths and of preventable low birth weight. The WHO African region carries an excessively high share of the global malaria burden and in 2017; the area was home to 92% of malaria cases and 93% death due to malaria. This is because of the fact that, the habitat over there are suitable for breeding of mosquitoes, furthermore, the poor socio-economic situation which make difficult to access the health care and disease prevention resources (WHO, n,d; South Sudan, n.d.)

Hundreds of millions of blood films are examined every year for malaria, which involves manual counting of parasites and infected red blood cells by a trained microscopist. Accurate parasite counts are essential not only for malaria diagnosis. They are also important for testing for drug resistance, measuring drug-effectiveness, and classifying disease severity (Poostchi et al. 2018). Conventional microscopy, which is at present the gold standard for malaria diagnosis has sometimes proved inefficient since it is time consuming and results are difficult to reproduce. This method follows the blood film examination under the microscope. There are two kinds of blood films: thick and thin. The thick film is used for quick identification and quantification of parasites and the thin film is used for differentiation of parasite