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(71)**Name of Applicant :**

1)St. Martin's Engineering College

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secundrabad ---------- ----------

Name of Applicant : NA

Address of Applicant : NA

(72)**Name of Inventor :**

1)Dr. B. Rajalingam Associate Professor, CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

2)Dr. R. Santhoshkumar Associate Professor and Head, CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

3)Dr. P Santosh Kumar Patra Professor, Dept. of CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

4)B. Madhava Rao Assistant Professor, CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

5)Dr. G.Jawaherlalnehru Associate Professor, CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

6)M. Chandrika Student CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

7)Geethika Student CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

8)Meghana Student CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

9)Sana Fathima Student CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

10)B. Rupa Student CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

11)Sai Kiran Student CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

12)U.V. Sireesha Student CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

13)B. Vasanthi Student CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

14)Anshitha Adepu Student CSE

Address of Applicant :St.Martin's Engineering College, Dhulapally Kompally Secunderabad ---------- ----------

(57) Abstract :

This work investigates the possibility of automated malaria parasite detection in thick blood smears with smartphones. We are developing the first deep learning method that can detect malaria parasites in thick blood smear images and can run on smartphones. Our method consists of two processing steps. First, we apply an intensity-based Iterative Global Minimum Screening (IGMS), which performs a fast screening of a thick smear image to find parasite candidates. Then, a customized Convolutional Neural Network (CNN) classifies each candidate as either parasite or background. Together with this invention, we make a dataset of 1819 thick smear images from 150 patients publicly available to the research community. We used this dataset to train and test our deep learning method, as described in this work. A patient-level five-fold cross-evaluation demonstrates the effectiveness of the customized CNN model in discriminating between positive (parasitic) and negative image patches in terms of the following performance indicators: accuracy (93.46%±0.32%), AUC (98.39%±0.18%), sensitivity (92.59%±1.27%), specificity (94.33%±1.25%), precision (94.25%±1.13%), and negative predictive value (92.74%±1.09%). High correlation coefficients (>0.98) between automatically detected parasites and ground truth, on both image level and patient level, demonstrate the practicality of our method. Conclusion: Promising results are obtained for parasite detection in thick blood smears for a smartphone application using deep learning methods. Significance: Automated parasite detection running on smartphones is a promising alternative to manual parasite counting for malaria diagnosis, especially in areas lacking experienced parasitologists.

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