International Journal of Computer Applications Technology and Research
Volume 13–Issue 12, 14 – 18, 2024, ISSN:-2319–8656
DOI:10.7753/IJCATR1312.1003

DOCTOR'S COMPANION: A Support Vector Machine Image Classifier to Enhance Decision Making

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Abstract: An ailing child depends on the parents to detect that the child is not feeling well through observations and a doctor (pediatrician) to know exactly what the problem is and administer medication for such child to get well in the shortest possible time. It has been observed, that the number of doctors in hospitals are not enough to manage the number of patients that need medical attention. These doctors can at some point be overwhelmed by the number of cases they handle on daily basis and therefore require some assistance. The assistance would reduce the work load on the doctor and help the doctor to make accurate diagnosis as the wrong diagnosis could be very disastrous. This work used support vector machine, a machine learning technique to classify X-ray images to enable the doctor make better decisions in administering medications to the patient as wrong diagnosis leads to wrong medications which might lead to death eventually. This work employed object oriented and analysis design methodology in order to model software objects after real world objects. The dataset used for model training was chest X-ray dataset from Kaggle. 70% of the data was used for training while 30% of the data was used for testing. RESNET 50 was used for feature extraction while tensorflow were used as framework for model learning development and computer vision library respectively. The performance metrics used for this work are accuracy, precision, recall and F1. The result is a doctor's companion that that has a high accuracy of 97% which will help doctor to make better decisions in image analysis.

Keywords: ailing, SVM, RESNET50, companion

1. INTRODUCTION

In Africa, child bearing is seen as an important part of the society and a blessing to young couples. When these children are born, they are nurtured to adulthood by their parents. This nurturing consists of selective feeding and adequate medical care. Medically caring for a child is very difficult as kids are unable to explain how they are feeling. It takes rapt attention of parents to know when a kid is not feeling well by taking note of the child's behavioral pattern. Once parents notice that the child is not as active as usual, they check the child's temperature, give first aid and then take the child to hospital to see a pediatrics doctor. A pediatrician is a doctor that treats infants and those yet to enter adulthood. A pediatrician does the following;

a. Conducts physical examination on the patient
b. Prescribe medications and give vaccines
c. Listens to parents' concerns and educate them in the process
d. Refer families to specialists when needed.

The workload of doctors cannot be over-emphasized. This could lead to a doctor being fatigued. Fatigue impacts heavily in the decision making of a doctor. Every action taken **by** a doctor requires spot-on decisions. Any wrong decision could lead to the death of the child.

In its unrelenting efforts to offer quality services to ailing individuals, the healthcare industry embraced artificial intelligence (AI) technology in order to aid doctors make accurate decisions while diagnosing their patients. AI technology has had a very big impact in the world by increasing throughput in its areas of application as shown in the increase in the rate of its patronage (Safavi and Kalis, 2019). AI based applications have also done excellently in image processing and classification. The use of convolutional neural network (CNN) and support vector machine (SVM) have been tremendous in that aspect.

Kalaiselvi and Deepika (2020) posited that ML has excelled in medical imaging diagnostics, personalized treatment, crowd-sourced data gathering, smart health records, ML based behavioural modification, clinical trials and research. ML has also improved forecasting. Bak et al (2021) noted that the first ML system developed could forecast critical toxicities for patients undergoing radiation therapy for head and neck cancers.

A diagnostic tool known as reverse transcription-polymerase chain reaction (RT-PCT) is used to diagnose breath related ailments. This tool is however very expensive and may not be able to provide accurate results especially for diseases with similar symptoms. Identifying this shortcoming, chest X-rays can be accurately classified the use of machine learning tools.

This work focuses on the use of machine learning technique to improve decision making by helping the doctor to accurately classify X-ray images. If a doctor makes a wrong analysis/classification of images, a different prescription would be recommended that would likely lead to complications and eventually death of the patient being treated. This work uses SVM to classify chest X-ray images accurately to enable the doctor make the right prescriptions for the patient.

2. LITERATURE REVIEW

Qilong and Xiaohong (2018) posited that extracting image feature points and classification method are important to content based image classification. They extracted image points using scale invariant feature transform (SIFT) algorithm and then clustered the features with K-means clustering algorithm and bag of work (BOW) of each image constructed. They finally used SVM classifier and got an accuracy of 90%.

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Deep learning in healthcare finds complicated patterns automatically in radiology and assists radiologists in making decisions while analyzing images from PET, MRI, CT Scans, radiology reports and conventional radiography (Sarker, 2021).

Qi et al (2023) reviewed comprehensively the use of machine learning in healthcare industry. They looked at classification, restrictions, opportunities and challenges of using machine learning. They reviewed several machine learning algorithms in healthcare applications. They concluded that with the far reaching capabilities of these techniques, the choice on which one to use lies on the specific task, data availability and resources. They believe that as healthcare data grows, machine learning would be essential in improving patient's outcomes and advancing medical research. They however identified data privacy, ethical issues and that the requirements for validation and regulations are very rigorous.

Narin, Kaya and Pamuk (2021), developed a system capable of detecting COVID-19 using chest X-rays. They employed convolutional neural network for the classification of images (from dataset). They segmented the images into COVID-19, Pneumonia and normal during the training phase. They used 100 images to test and got an accuracy of 93.5%.

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3. METHODOLOGY

The methodology used for this work is object oriented analysis and design methodology. This is to model software objects used after real world objects. Chest X-ray dataset was selected from Kaggle for model training

4. DESIGN AND IMPLEMENTATION

The dataset used is chestX-Det-Dataset for pediatrics from Kaggle. Figures 1.1 through 1.5 show the first forty images from each of the ailment modeled.

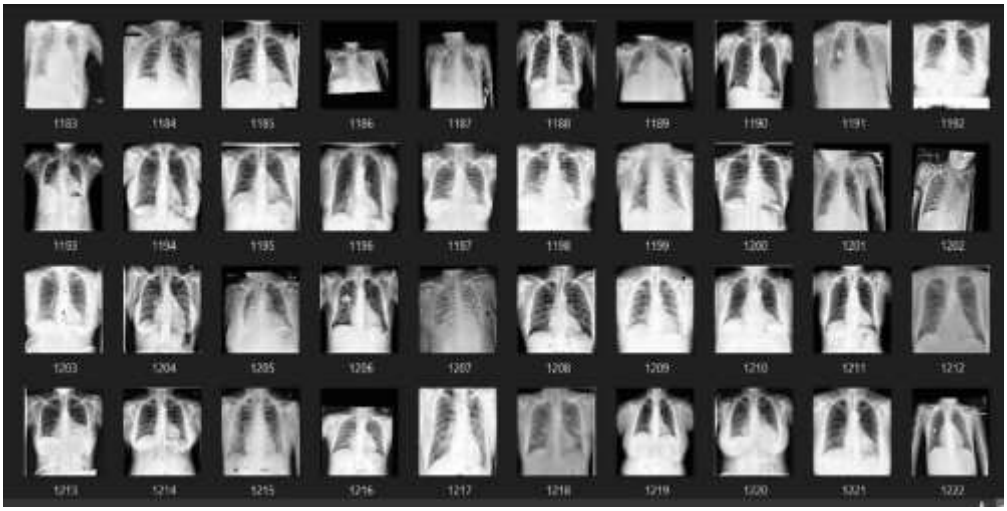

Fig.1.1: First 40 X-ray images of cardiomegaly dataset

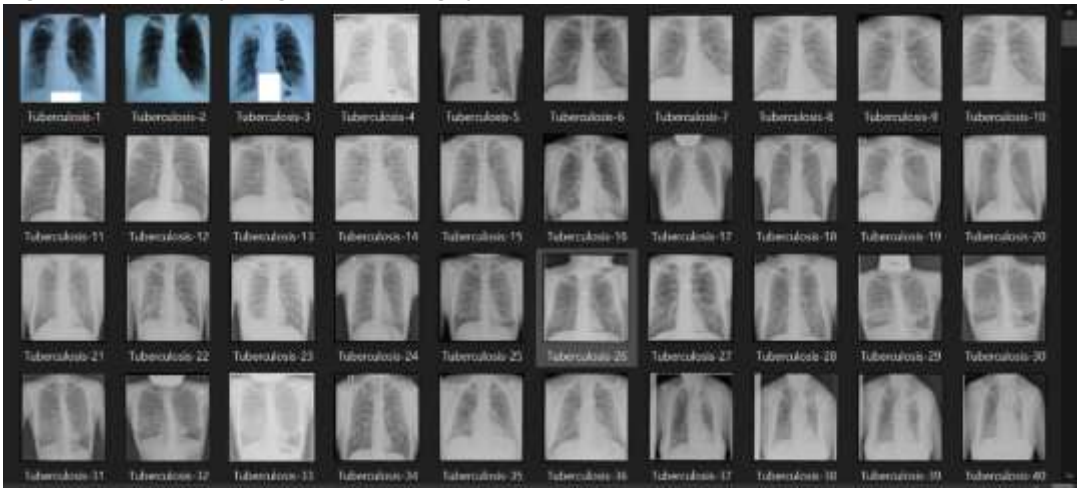

Figure1.2: First 40 X-ray images of tuberculosis dataset

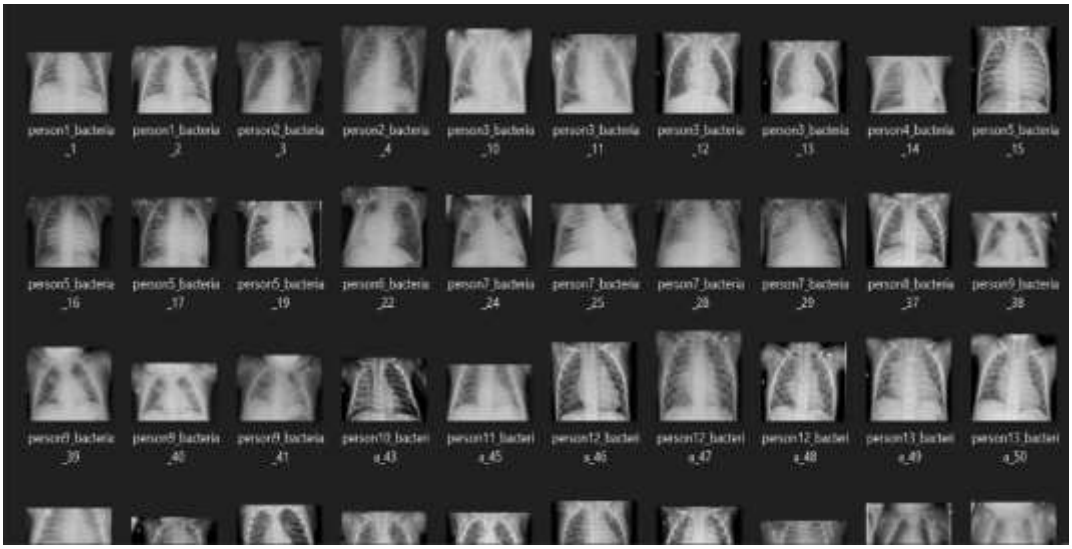

Figure 1.3: First 40 X-ray images of pneumonia dataset

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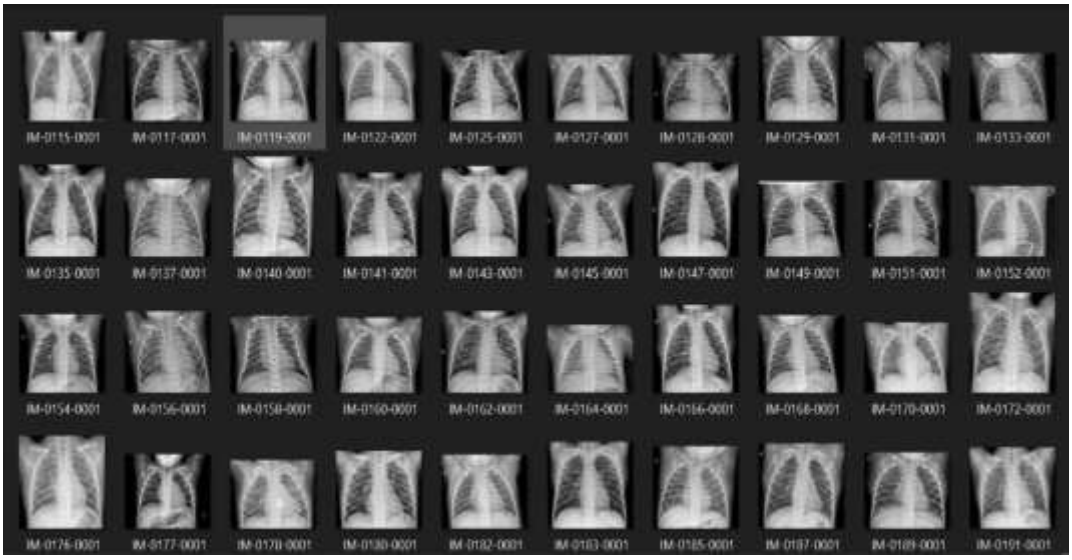

Figure1.4: First 40 X-ray images of normal dataset

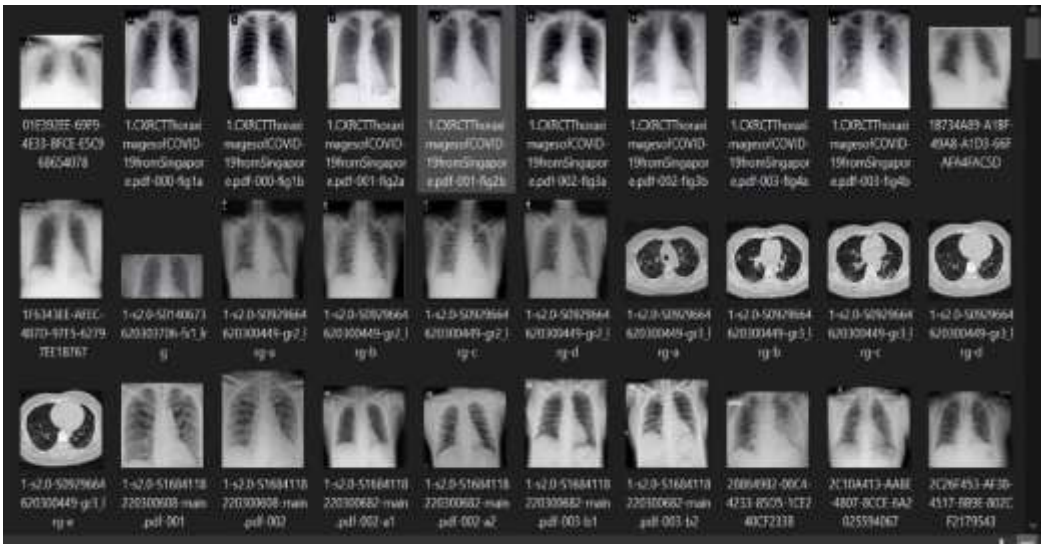

Figure 1.5: first 30 X-ray images of COVID dataset

After data collection, the model is trained with the preprocessed data. Pre-processing is done to ensure that the data used is unbiased. Chest X-ray images usually have pixel value range of 0 to 255. The required value for model training is 0 to 1. Therefore, the data is transformed into the required range. The size of the image was also resized to 224*224 pixel for best results.

The dataset is now split into two; the training set (70%) and the testing set (30%). Feature extraction takes place here. Then, the ML classifier classifies the image. Figure 1.6 shows the architecture of the model developed.

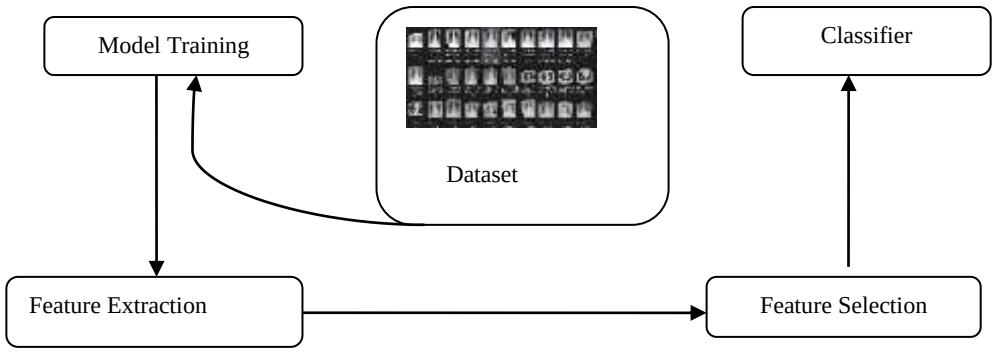

Figure 1.6: Architecture of the model

5. Results and Discussion

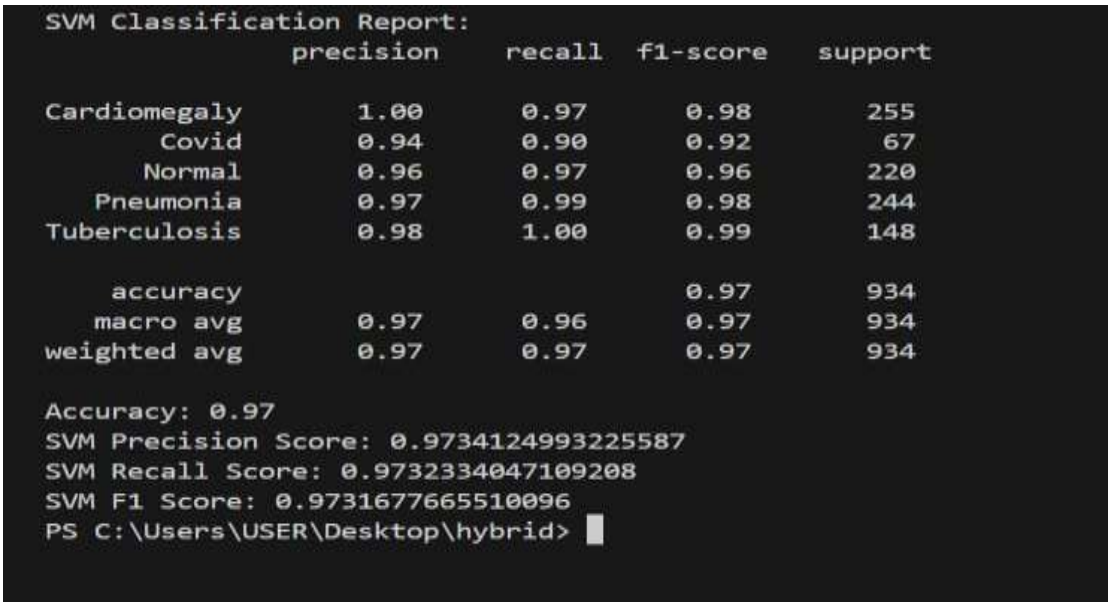

Figure 1.7: SVM Classification Report

Figure 1.7 shows the classifier report. This report shows that with the use of SVM, an accuracy of 97% was achieved. This is a significant improvement on the work of Narin, Kaya and Pamuk (2021) who used convolutional neural network for classification and got an accuracy of 93.5%. It is also an improvement of the work of Qilong and Xiaohong (2018) who got an accuracy of 90% using SVM for classification.

6. CONCLUSION

There are few doctors compared to the volume of job they have on daily basis. A doctor who consults with many patients on daily basis needs a "companion" to enhance the doctor's decision making in classifying X-ray images. A wrong decision could be disastrous and may lead to death. Hence, the use of SVM for X-ray classification is recommended to doctors as companions.

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7. REFERENCES

An, Q., Rahman, S., Zhou, J., & Kang, J. J. (2023). A Comprehensive Review on Machine Learning in Healthcare Industry: Classification, Restrictions, Opportunities and Challenges. *Sensors*, *23*(9), 4178. https://doi.org/10.3390/s23094178 K. Kalaiselvi, M. Deepika, Machine Learning for Healthcare Diagnostics, in:Machine Learning with Health Care Perspective, Springer, Cham, 2020, pp. 91–105, https://doi.org/10.1007/978-3-030-40850-3. *(PDF) Machine learning applications in healthcare sector: An overview*. Available from: https://www.researchgate.net/publication/357162853_Machine_learning_applications_in_healthcare_sector_An_overview

Bak, B., A. Skrobala, A. Adamska, J. Malicki, What information can we gain fromperforming adaptive radiotherapy of head and neck cancer patients from the past 10 years?, Cancer/Radiothérapie (2021 Nov 9), https://doiorg/10.1016/j.canrad.2021.08.019

Narin, A., Kaya, C., and Pamuk, Z. (2021). Automatic detection of coronavirus disease (COVID-19) using X-ray images and deep CNN. Pattern Analysis and Applications. 24(3); 1207-1220. https://doi.org/10.1007/s10044-021-00984-y

Qilong, L, Xiaohong, W. "Image Classification Based on SIFT and SVM," 2018 IEEE/ACIS 17th international conference on computer and information science (ICIS), Singapore, 2018; PP 762-765, doi: 10.1109/ICIS.2018.8466432

Safavi, K., Kalis, B. How AI can change the Future of Healthcare. Harv. Bus. Rev. 2019. Available online: https://hbr.org/webinar/2019 (Accessed October 10, 2024)

Sarkar, A. Deep Learning in Medical Imaging. Knowledge Modelling and BigData Analytics in Healthcare: Advances and Applications, 2021 Dec 9:107.