

WVNet augmented diagnosis - the potential of deep learning to assist radiologists for faster and accurate decision making

An estimated 500K+ people tested positive worldwide and 20K+ people died from the Wuhan Covid-19 Virus (WV) originated in Wuhan province, China. It is spreading fast worldwide with no cure in sight. Unfortunately, medical specialists worldwide are overburdened with a huge influx of Wuhan Covid-19 Virus patients. We believe that deep learning can help doctors identify patients in need at a faster pace.

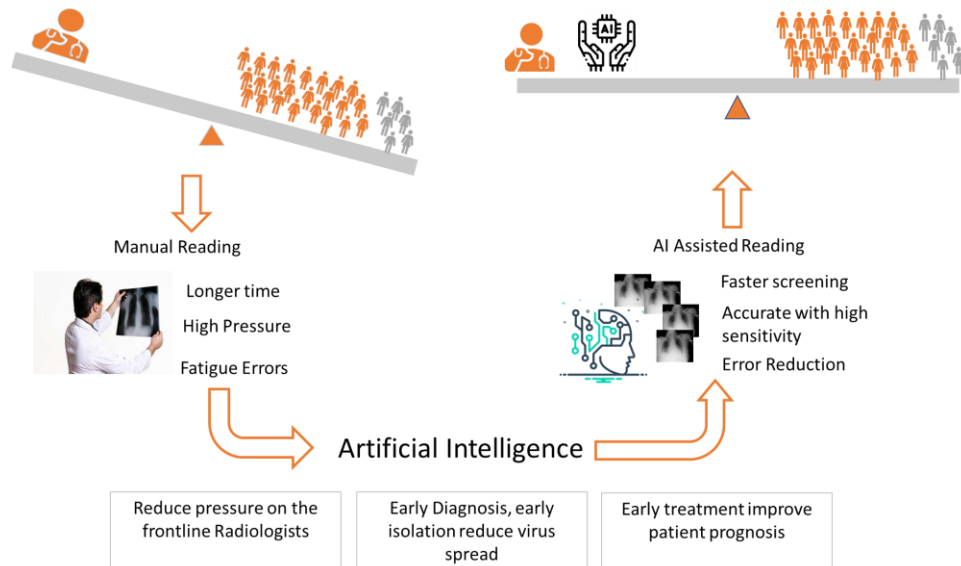


Fig1: An illustration of WVNet augmented diagnosis¹.

¹<https://github.com/ieee8023/covid-chestxray-dataset>

To facilitate screening and diagnosis of the covid-19 we develop a deep learning system known as WVNet (also known XNet system). Our results showed that the system can achieve an accuracy comparable to the radiologists in identifying Covid-19, Pneumonia, and Tuberculosis. This study highlights the potential of deep learning to assist radiologists to make a decision faster. Apart from this WVNet can produce reproducible results.

The chest X-ray is a discriminating element; if the clinical situation and the chest X-ray film are normal, patients can go home and wait for the results of the etiological test. But if the film shows pathological findings, patients are admitted to the hospital for observation. Usually the absence or presence of pathological findings on chest X-ray is determining to send the patient home or keep him/her under observation².

²<https://healthcare-in-europe.com/en/news/imaging-the-coronavirus-disease-covid-19.html>

With 10000 practicing radiologists across India³ AI plays a crucial role in augmenting the radiologists. There by reducing the burden of the radiologists in handling the massive surge in the number of Covid- 19 patients in the near future.

³ <https://globalhealthi.com/2017/04/20/medical-imaging-india/>

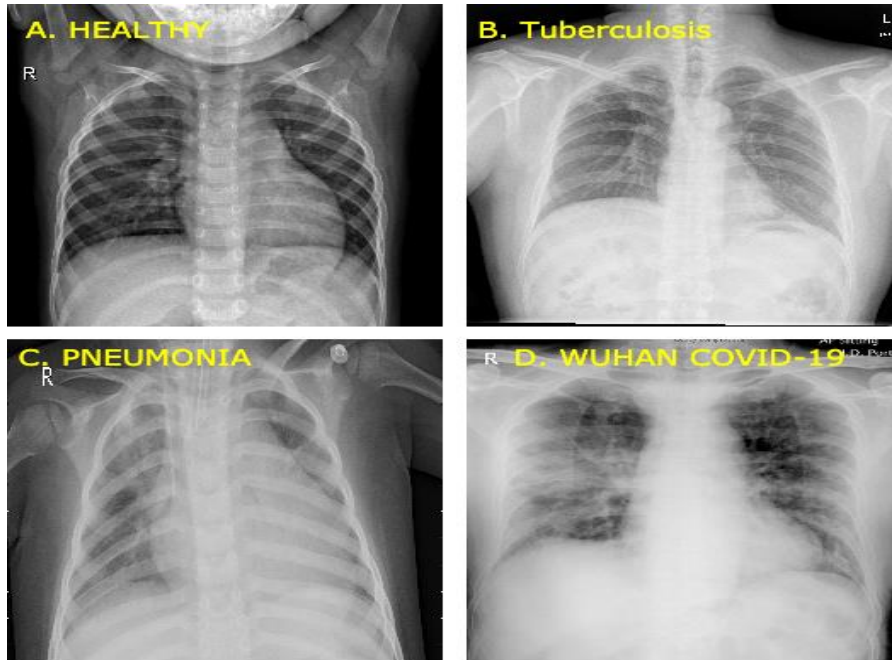


Fig 2: Examples of X-Ray photographs taken to diagnose patients. The image on the top left is of a healthy lung (A), whereas the image on the top right is a lung with Tuberculosis (B), the image on the bottom left is a lung with Pneumonia (C) and the image on the bottom right is a lung with Wuhan Covid Virus (D).

WVNet Design:

Radiologists often face ambiguous cases for which there is no definitive decision. For example, identifying pneumonia the radiologist has to know about related complications such as abscesses or pleural effusions. From labeled data, a deep learning algorithm can closely model the underlying data distribution to predict possible conditions.

WVNet takes an X-Ray photograph as input and produces a probability map over the possible conditions. WVNet uses a custom convolutional block-based deep network architecture to model pathological and benign features of the input image to correctly predict disease probability. In our study, we have used 19,234 images to develop and test the model.

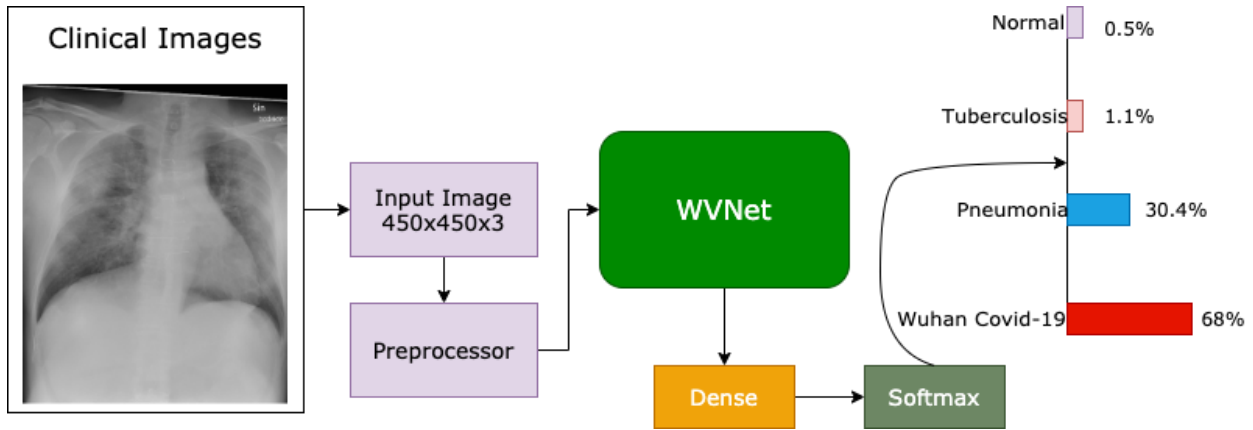


Fig 3: Schematic of the WVNet system to identify pathological conditions.

To assess the WVNet performance, we have calculated the sensitivity and specificity of the model on the test dataset. In total, the performance was computed on 5600 images. The WVNet achieved an average of 95.5% sensitivity and 85.7% specificity across conditions.

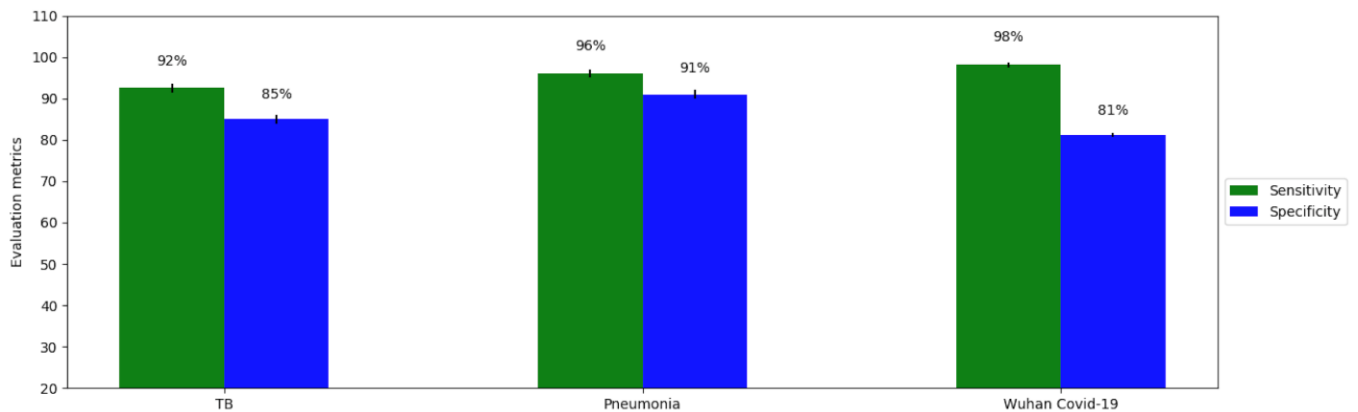


Fig 4: WVNet performance evaluated on the test set.

These are promising findings, but there is still a lot of work to do. Furthermore, interpretation of a 2D X-Ray, which we demonstrate in this study, is only one part of a multi-step process that leads to a diagnosis for the Wuhan Covid-19 Virus. In some cases, doctors use a 3D imaging technology, CT-Scan, to examine the lung in details.

An advanced deep learning system with high sensitivity have strong prospects to assist doctors in fast decision making to evaluate more patients and quickly routing those who need urgent care to a specialist.

We are working with doctors and radiologists to integrate our WVNet system into clinical workflow in a manner that is maximally efficient and beneficial to all.