AI System in Expediting Diagnosis of COVID-19

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- **Urgent need to a quick diagnosis of COVID-19**

The outbreak of COVID-19 is becoming a serious global concern. Nowadays, in many areas, the rapid growth of the cases is beyond the capability of doctors and hospitals that could deal. A large number of patients, they may be COVID-9 patients, or influenza patients, or other diseases, gathered in the hospital to wait for diagnosis and treatment. It is critically important to quickly screen out COVID-19 patients and take early quarantine and treatment, to avoid further cross infections and seize the opportunity to save lives. Time is the key!

The current standard method of COVID-19 diagnosis, the reverse transcription-polymerase chain reaction (RT-PCR), although with high specificity, suffers relatively long detection time and low sensitivity. According to "Diagnosis and treatment plan for COVID-19 virus infection (seventh edition)", released by National Health Commission, China, CT based diagnosis is recommended as a major clinical examination. Although a CT scan takes only a few minutes, reading the CT images and making the correct decision need experienced doctors using some tens of minutes. However, in many areas where the virus spread quickly, there are not enough experienced medical workers. In a shortage of experienced medical workers, the situation becomes worse. It is reported that high fatality rate results from running out of medical resources, lack of medical workers, more than the virus themselves. Therefore, the urgent challenge is how to break through the bottleneck of time of diagnosis and assist the doctor in making the quick and correct decision by using proper technical tools.

Scientists and engineers worldwide are working very hard to develop quick detection methods for COVID-19. Hereby we are reporting a good practice of using AI System to expedite the diagnosis provided by *Infervision Technology Co.* with collaboration with *Nankai University*. That is easy to deploy with little effort and has proven significantly helpful.

- **CT+AI system can quickly screen for COVID-19**

Before the outbreak of COVID-19, this AI system has been used in many hospitals to assist doctors in reading CT images of lungs to detect cancer. After the COVID-19 outbreaks, engineers use the CT images from early patients of COVID-19 confirmed by RT-PCT test to train the system, so that the system is learned to recognize the characteristics of COVID-19 infection to the patient's lung by deep learning. This learned system could then perform like an experienced doctor in image recognition of the COVID-19 infected lung, and much quicker.

When viewing the patient's CT image on the doctor workstation, the AI system can automatically prompt to indicate whether the current patient is suspected of COVID-19 infection and give a corresponding warning. Figure 1 shows an example of the AI system diagnosing an anonymous patient. The AI result of this case came out much earlier than the RT-PCR result, and the AI had given a high-risk warning, which had been later proven to be consistent with the result of the RT-PCT test.
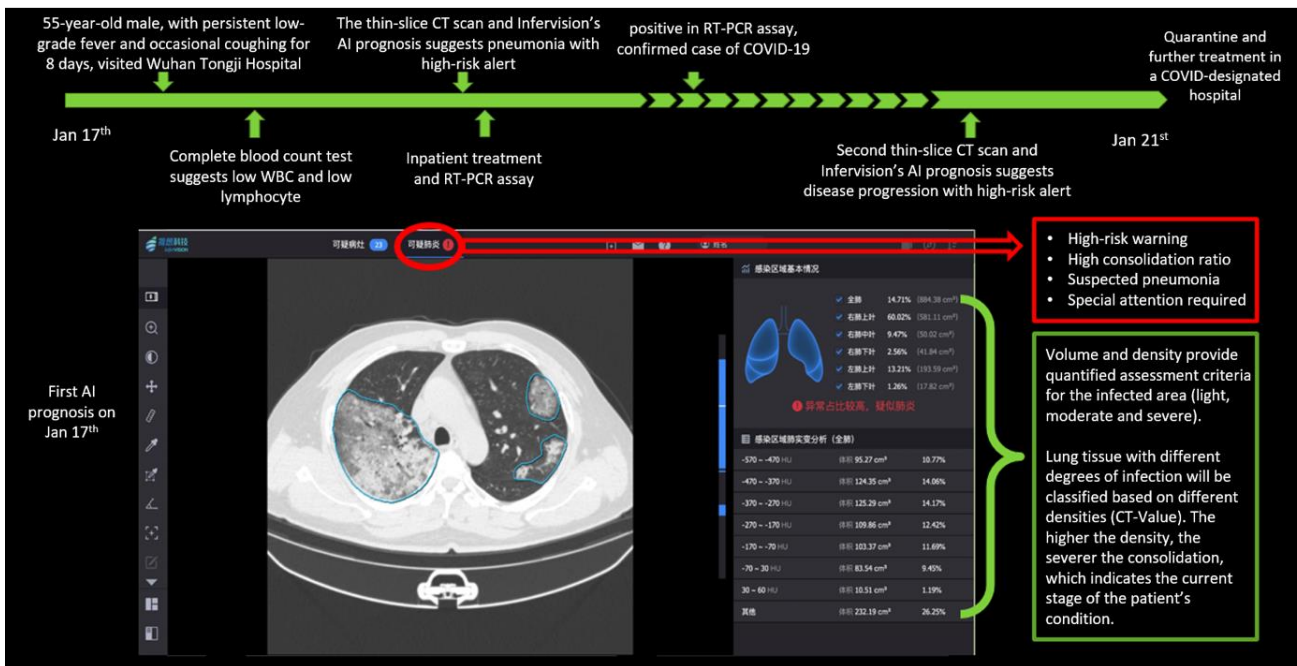

Figure 1: Interface of the AI system with an anonymous case.

Having learned from a large amount of CT images carefully labeled by experienced doctors in China, this AI system could detect COVID-19 patients with high sensitivity. After 1000+ cases of clinical tests, their model performed well with a sensitivity of 98%.

The AI system is capable of reading hundreds of high-resolution CT images of a single patient in 10 seconds, which typically requires tens of minutes for an experienced doctor. Besides its function of rapid screening and alert, the AI system could also compare the CT images of the same patient over different time periods, and quantitatively measure the affected areas, providing objective data to support medical treatments.

After opening the patient's CT series, the doctor can use the AI system for lung segmentation, while checking and segmenting the inflammatory areas in the lung field. The AI system will also give the number of affected lung lobes and the degree of lung infection, assisting doctors in assessing the patient's lung infection, and in providing a basis for diagnosis and treatment.

It is shown that the CT+AI system does provide a powerful solution of clinical examination to a quick screen for COVID-19. Combined with the RT-PCR test, the measures formed a more sensitive and complete examination procedure. Furthermore, the data based on CT+AI is objective and unified, which is conducive to the formation of a rapid direct reporting system. It has, therefore, become an important decision-making basis for current epidemic monitoring and control.

● **How can medical workers use AI systems in their hospitals?**

The AI system reported is a Web-based application. All AI functions could be enabled by a single computer connected to the internet for CT images input and for reporting to relevant ones when necessary. The system does not need a qualified medical worker for operation.

When the images from CT scans have been uploaded to the system, it automatically recognizes the infection of the COVID-19, indicating the suspected areas of the patient's lung to the doctor and

giving suggestions for diagnosis. The diagnosis is finally made by the doctor in charge, with the help of the automatic area localization and suggestions from the system. The AI-aided screening function could greatly extend the capability to identify suspicious cases by a doctor in a limited time.

As of March 26, this system named *InferRead CT Pneumonia* has been deployed in 52 Chinese hospitals and has screened more than 153,608 cases of suspected pneumonia. The system has already been used in Italy, Japan, Russia, and the USA.

Dr. Haibo Xu, head of Radiology in Zhongnan Hospital of Wuhan University, shared his experience of using the AI system in the frontline combatting the epidemic. He said, "InferRead CT Pneumonia can identify the signs of the virus, help doctors diagnose suspected cases more quickly, make quarantine or treatment decisions as soon as possible, and relieve the pressure of doctors."

Figure 2: Doctors in Wuhan Hospitals are using InferRead CT Pneumonia daily

As Mr. Chen Kuan, the CEO of *InferVision*, said, "AI could go faster than the virus to more countries and hospitals to help doctors. That is exactly the magic part of AI, which can go beyond the borders to help different nations".

By reporting this effort, WFEO is calling for global attention to utilize engineering efforts to prevent the spread of the COVID-19. This is by no means only the business of the medical workers but deals with everyone. Engineering could give a big help to medical workers and protect people from the virus.