Project Title

Efficient Interpretation of Chest X-rays using Artificial Intelligence: RadiLogic Solution

Project Lead and Members

Project lead: Adjunct Associate Prof Tan Cher Heng

Project members:

- Dr Ting Yong Han
- Dr Jordan Sim
- Mr Chen Wen Xiang
- Dr Huang Weimin
- Dr Teo Soo Kng
- Dr Cui Yingnan

Organisation(s) Involved

Tan Tock Seng Hospital, A*STAR

Healthcare Family Group Involved in this Project

Medical, Allied Health

Specialty or Discipline (if applicable)

Radiology, Diagnostic Radiography

Project Period

Start date: February 2020

Completed date: August 2020

Aims

To leverage on artificial intelligence (deep learning) to develop a specific tool to diagnosis COVID-19 pneumonia on CXR, prioritising the positive cases for urgent radiologist review

Background

See poster appended / below

Methods

See poster appended / below

Results

See poster appended / below

Lessons Learnt

- AI can be a useful tool if deployed in the appropriate context.
- In innovation, teams must be ready to challenge their initial assumptions and pivot according to clinical need and technical constraints.
- Support from HOD and senior management was crucial to expedite development.
- There was pre-existing collaboration between TTSH and A*STAR. Hence, the mutual understanding and trust between the teams allowed us to be nimble and effective in developing the solution.

Conclusion

See poster appended / below

Additional Information

- 2020 National Healthcare Innovation and Productivity (HIP) Best Practice Medal – Automation, IT & Robotics Innovation

The COVID-19 pandemic brought about the need for rapid innovative solutions in all aspects from diagnosis to treatment to prevention. We are pleased that RadiLogic was able to contribute to the nationwide fight against the pandemic. This project has strengthened our team dynamics and made us more confident in taking artificial intelligence into the Radiology workflow. We are grateful for the kind support from senior management of TTSH and A*STAR, and the readiness of colleagues from NCID, IHiS and Emergency Department to support our work. The key factor was a common goal of wanting to ensure that we could provide optimal care for our patients in spite of manpower and technical constraints.

Project Category

Technology, Digital Health, Data Analytics, Artificial Intelligence, Care & Process Redesign, Access to Care, Turnaround Time, Value Based Care, Productivity

Keywords

Chest X-rays, Artificial Intelligence, RadiLogic Solution, CXR diagnosis, COVID-19 Pneumonia

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Efficient Interpretation of Chest X-rays using Artificial Intelligence: RadiLogic Solution

Tan Tock Seng Hospital
National Healthcare Group

TTSH team: Adj A/Prof Tan Cher Heng, Dr Ting Yong Han, Dr Jordan Sim, Chen Wen Xiang

Background and Aim

Background

•When National Centre for Infectious Disease (NCID) became the designated national screening facility for COVID-19 Suspect cases, radiologically-proven pneumonia was embedded into the admission criteria

•TTSH DDR saw a surge in demand for CXR diagnosis leading to a strain on manpower resources, diagnostic quality and turnaround time

•More than 500 CXRs a day at the peak of the pandemic, on top of patients that presented to the A&E for non-COVID related illnesses

•Qualified manpower could not be rapidly augmented as residents require months of training before being able to independently interpret CXRs

Aim

•Work with A*STAR team to create an innovative solution that leverages on Artificial Intelligence (deep learning) for medical imaging (CXR) diagnosis.

•Algorithm must diagnose COVID-19 pneumonia accurately, in order to prioritise the positive cases for urgent radiologist review

•This would accelerate the imaging diagnostic process for positive cases and prevent Radiology from becoming a bottleneck in the screening centre.

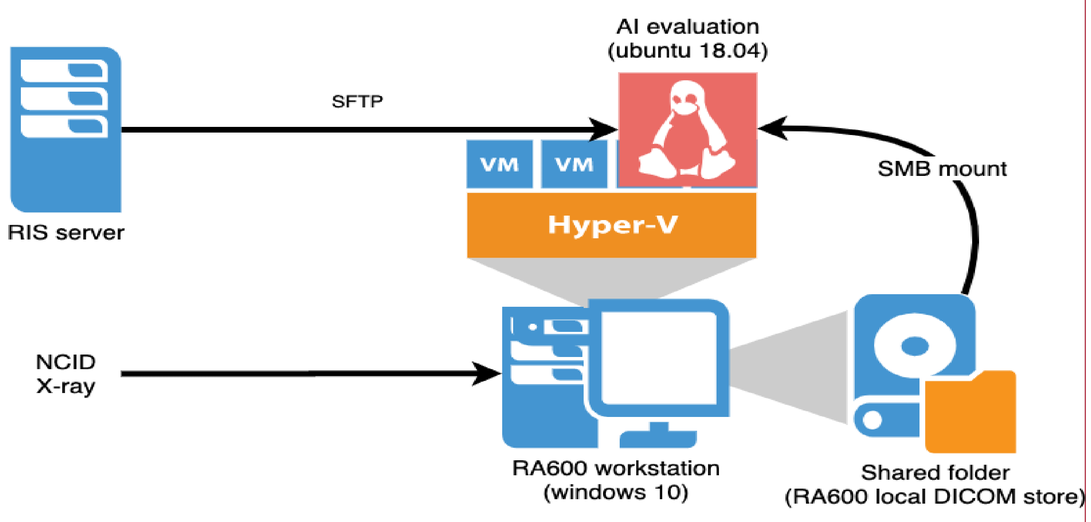
Strategy for Change

Model Development

•Utilising more than 5000 datasets from CXRs done in NCID and TTSH, the team worked with A*STAR to create RadiLogic, an AI solution analyses each CXR within three seconds with an accuracy of up to 96%

•The team was keenly involved with the scientists in the development of the model every step of the way, to ensure that the AI performed up to clinical standard

Model Deployment



RadiLogic trial deployment architecture

•A copy of each film taken (at NCID X-ray) is sent to the RA600 workstation from which the extracted image data is analysed and an output from the AI evaluation is pulled from the RIS server. Every CXR that goes through the AI solution is deleted immediately after processing to minimise risk of unauthorised access to patient's identifiers in the virtual machine.

Quality Assurance

- In 2020: Project started in February and prototype was develop by early April. Proof of Concept implemented in late April and official deployment in June
- Clinical Proof-of-Value was carried out till August 2020 to ensure model accuracy and no model drift
- Regular communications were sent out to our radiologists to ensure clarity of the workflow and to consolidate feedback that would be useful for fine-tuning the workflow.

Results

Quantitative

•Average reduction of 20% in turnaround time for cases in June 2020 compared to March 2020 (peak caseload before deployment)

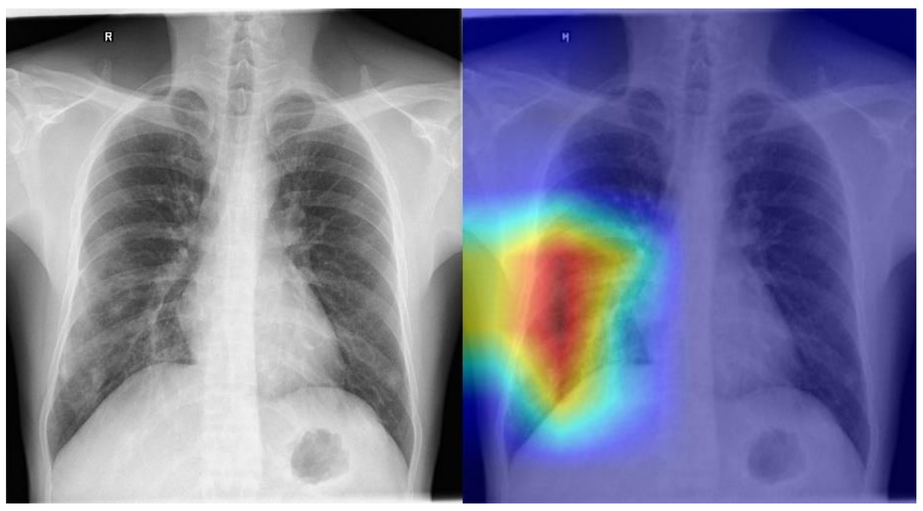
•Weekly review of RadiLogic's performance saw no degradation of diagnostic accuracy – maintained at 96%

Qualitative

•Number of false positives reported by residents and detected by manual audit carried out by senior radiologists declined over the period of deployment

•Junior residents found the tool useful and that it increased their level of diagnostic confidence

•Increased productivity contributed to our department's preparedness to heighten our response for subsequent surges in demand



Example of COVID-19 pneumonia diagnosed by RadiLogic

Lessons Learnt

•AI can be a useful tool when deployed in the appropriate context.

•In innovation, teams must be ready to challenge their initial assumptions and pivot according to clinical need and technical constraints.

•Support from senior management of TTSH, readiness and cooperation of our colleagues from NCID, IHiS and TTSH Emergency Department were paramount to our success

•Collaboration between TTSH and A*STAR pre-existed. Mutual understanding and trust between the teams on the ground allowed us to be nimble and effective.