Keiland Pullen
CSC 578 sect. 901 – Spring 2022
Final Project – Survey Paper

INTRODUCTION

In 2019 a virus, named Severe Acute Respiratory Syndrome – Coronavirus (SARS-CoV2) , was discovered to have originated in Wuhan, China and it is recognized as the cause of a severely infectious disease. It is the SARS-CoV2 virus that catalyzes the deadly COVID-2019 disease. Since its initial outbreak, the COVID-2019 disease has spread globally and was labeled an official pandemic by the World Health Organization (WHO). COVID-2019 is a respiratory disease that has been responsible for millions of deaths worldwide in addition to an untold number of people that have been infected and survived.

The symptoms of the diseases are wide-ranging from mild to moderate symptoms such as coughing to tiredness, which may not require hospitalization to more severe symptoms such as shortness of breath, chest pain and respiratory illnesses which require hospitalization. Prior to the development of the COVID vaccines, there were no methods to detect the virus and no treatments. Methods of prevention were limited to people taking precautions of hand washing, facial covering and staying home. Today, the standard detection method is the reverse transcription-polymerase chain reaction (RT-PCR) test. There are a number of issues with the RT-PCT tests, among them are the number of false-positives, false-negatives, and the return time for the results.

Unfortunately, we have witnessed this disease slow the world down to a standstill. Since its discovery, researchers have put forth immeasurable efforts and equal struggles to find better methods of detection, treatment and prevention of the deadly disease.

Worldwide, researchers have been working on a number of projects to combat COVID-19. Some of their research includes the use of deep learning and machine learning techniques to predict, detect and treat COVID-19. This paper will summarize two such research papers that address the problems and suggest potential solutions.

ARTICLE REVIEW I

The first article is “COVID-19 Prediction and Detection Using Deep Learning” from the International Journal of Computer Information Systems and Industrial Management Applications. This article was published in May 2020.

In this article, the authors present a COVID-19 detection method based on a convolutional neural network (CNN). The following three prediction (forecasting) algorithms were used; the prophet algorithm (PA), autoregressive integrated moving average (ARIMA) and long short-term memory (LSTM). The data set consisted of 1000 chest x-rays of real patients from the countries of Australia and Jordan. The prediction window was seven days and the prediction variables were the numbers of COVID-19 confirmed cases, recovered cases, and deaths. The metrics used to evaluate the models were the standard metrics of accuracy, precision, recall, f-measure, root mean square error and correlation coefficient.

Keiland Pullen
CSC 578 sect. 901 – Spring 2022
Final Project – Survey Paper

The article begins by providing background information about the COVID-19 disease and the numbers of patients that have been infected and unfortunately died. The detection methods of PCT, x-rays and ct-scans (computed tomography) are discussed. The article states that of the three methods, ct-scans have a highest accuracy of detecting COVID-19, especially in certain areas of the lungs. The problem with using ct-scans is the cost, access, and number of radiologists and assistants needed to administer them. X-rays are considered a cheaper, quicker and much safer. For these reasons, the authors chose use chest x-rays.

The article also discusses related research projects which used a number of different learning models, each with favorable results above 95% accuracy. However, it is noticed that the data sets for these projects were significantly smaller. One project reported a data set of 100 X-ray images, another used 50 images and one used 40. The article also includes research using ct-scans to predict.

While the article does provide a definition of each network, it doesn't go into great detail discussing how the models were constructed. There is mention of the stacking of convolution layers with 3x3 filters, batch size and learning rate.

The performance results for the prediction models are displayed in the tables below:.

Table 3 Results of three prediction algorithms in Australia

Prediction Algorithm	***Correlation Coefficient***	***Accuracy***	***RMSE***
PA confirmed cases	0.99	99.94%	03.94
PA (recovered cases)	0.99	90.29%	47.83
PA (death cases)	0.98	94.18%	01.55
ARIMA (confirmed cases)	0.99	92.33%	497.55
ARIMA (recovered cases)	0.98	63.52%	260.12
ARIMA (death cases)	0.98	78.02%	07.26
LSTM (confirmed cases)	0.99	94.16%	337.18
LSTM (recovered cases)	0.99	86.44%	97.36
LSTM (death cases)	0.98	92.76%	02.07

Table 4 Results of the three prediction algorithms in Jordan

Prediction Algorithm	***Correlation Coefficient***	***Accuracy***	***RMSE***
PA (confirmed cases)	0.99	99.08%	03.51
PA (recovered cases)	0.94	79.39%	11.42
PA (death cases)	-	86.82%	00.78
ARIMA (confirmed cases)	0.95	97.59%	11.30
ARIMA (recovered cases)	0.93	57.79%	39.26
ARIMA (death cases)	--	12.87 %	05.59
LSTM (confirmed cases)	0.85	93.23%	25.02
LSTM (recovered cases)	0.94	37.33%	11.42
LSTM (death cases)	--	39.97%	03.04

In Australia, the best model was the PA while the worse was ARIMA. In Jordan, the best model was PA while LSTM delivered the worse performance.

There was a CNN diagnosis model built based on VGG16. The VGG16 is stated as one of the best architectures available. This model resulted in a F-score of 99%.

In conclusion, the authors state that their future work will include the VGG16 based model and a larger number of data sets.

Keiland Pullen
CSC 578 sect. 901 – Spring 2022
Final Project – Survey Paper

ARTICLE REVIEW II

The article is “Artificial Intelligence and COVID-19: Deep Learning Approaches for Diagnosis and Treatment” from IEEE Special Section on Emerging Deep Learning Theories and Methods for Biomedical Engineering. This article was published in June 2020.

In this article, the researchers suggest that Artificial Intelligence (AI) based methods can be used to support and accelerate the current methods of diagnosis and treatment that relate to COVID-19. The authors propose several models that could accomplish this; an extreme learning machine (ELM), a long-short term memory network (LSTM), a generative adversarial network (GAN) and a recurrent neural network (RNN).

This figure from the article is a flowchart which is used to illustrated how AI methods and strategies can be used to address the COVID-19 challenges.

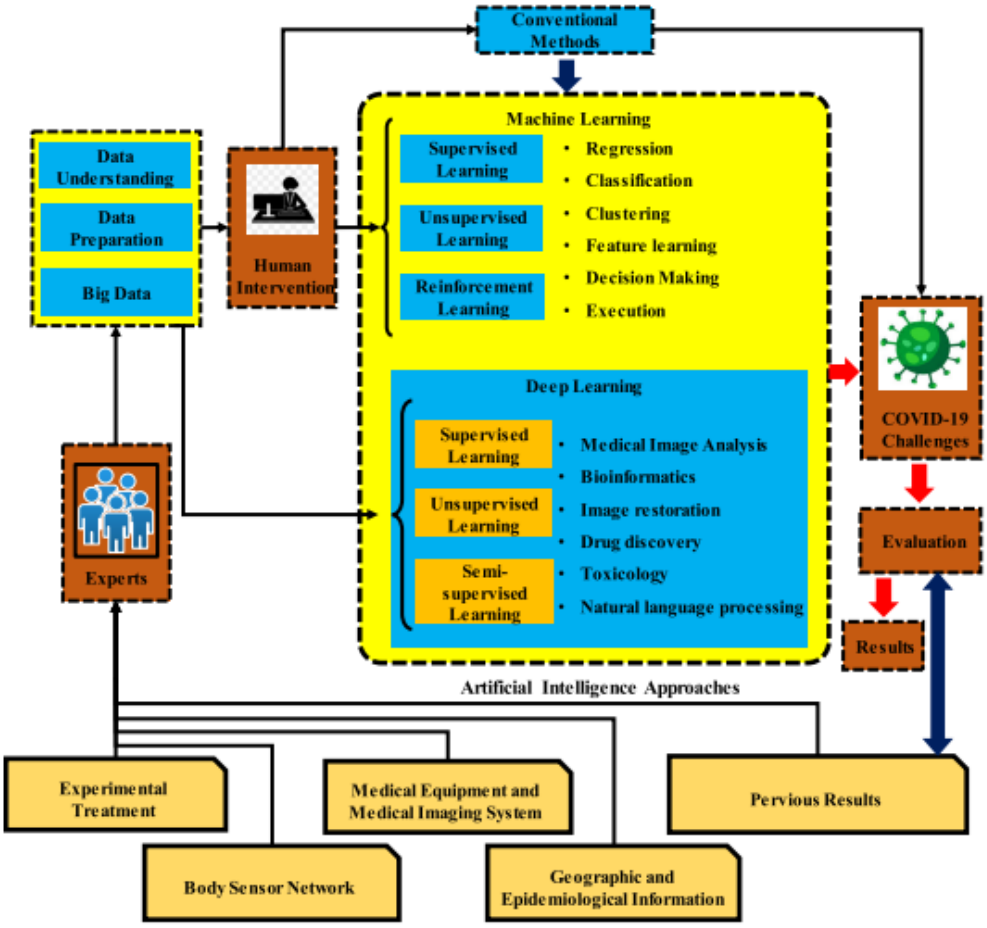

FIGURE 1. The process of application of AI-based methods to conquer challenges associated with COVID-19.

The authors suggest that an ELM can be used to assist in the prediction of drugs for patients that have developed cardiovascular complications such as cardiac arrhythmias, vascular inflammation, and/or myocarditis stemming from their COVID-19 infection. The authors then explain how COVID-19 affects the cardiovascular system, but leave out how ELM would work with the data for prediction. The LSTM is stated as the best network to precisely predict the best treatment for COIVD-19. The article describes the GAN network as "two networks are trained at the same time while one is focused on generating images, and the other performs discriminating" (Jamshidi, Mohammad, et al., 2020). The use of the GAN is proposed to address the issue of detection after traditional methods. In short, its use may be that of error-checking. The researchers suggest using a RNN network to predict the epidemiology (the distribution, control, and outbreak) of the disease.

In summary, this article discusses the possibility of how deep learning models and systems can support current medical efforts at combating COVID-19.

DISCUSSION

The first article discusses the research methods and model building techniques that were used to detect COVID-19. This article was published in 2020 and since that time, the virus has unfortunately propagated exponentially. Hopefully, other researchers have been able to use this research as a building block for more accurate and precise models, such as the suggested VGG16.

The second article is more of a proposal for future research as it suggests models that can be used and provides a rationale for each. It is optimistic as it explores the unlimited potential of how AI can be coupled with modern day methods to produce solutions in today's healthcare system. As this paper is more theoretical in nature, there is no mention of an actual data set or actual project. This article suggests that data can be generated from Computed Tomography Scans (CT Scans), Magnetic Resonance Images (MRI), Optical and Digital Microscopic Imaging Techniques, Pathology applications, and Positron Emission Tomography (PET).. Unfortunately, the article does not state the cost (financial and time) or practicality of collecting these patient data sets.

CONCLUSION

In summary, since the detection of the SARS-CoV2 virus, which causes the COVID-19 disease, researchers have worked at proposing potential solutions that can assist with fighting this modern day plague. It is hopeful in knowing that research in deep learning continues and will hopefully be used alongside medical and health experts to create additional methods or techniques to slow down and maybe eradicate this deadly disease.

REFERENCES

Alazab, Moutaz, et al. "COVID-19 prediction and detection using deep learning."
International Journal of Computer Information Systems and Industrial Management Applications
12.June (2020): 168-181.

Jamshidi, Mohammad, et al. "Artificial intelligence and COVID-19: deep learning approaches
for diagnosis and treatment."
Ieee Access 8 (2020): 109581-109595.