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**TECHNICAL**

**REPORT ON THE**

ENGINEERING STRATEGIES FOR HANDLING COVID-19 FOR ENVIROMENTAL HEALTH AND ECONOMIC SUSTAINIBLITY

BY

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1. **ABSTRACT**

Throughout history , nothing has killed more human beings than infectious disease. Covid-19 shows how vulnerable we remain – and how we can avoid similar pandemics in the future.

Covid-19 marks the return of a very old – and familiar – enemy. Throughout history, nothing has killed more human beings than the viruses, bacteria and parasites that cause disease. Not natural disasters like earthquakes or volcanoes. Not war – not even close.

The coronavirus disease 19 (COVID-19) is a highly transmittable and pathogenic viral infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which emerged in Wuhan, China and spread around the world. Genomic analysis revealed that SARS-CoV-2 is phylogenetically related to severe acute respiratory syndrome-like (SARS-like) bat viruses, therefore bats could be the possible primary reservoir. The intermediate source of origin and transfer to humans is not known, however, the rapid human to human transfer has been confirmed widely. There is no clinically approved antiviral drug or vaccine available to be used against COVID-19. However, few broad-spectrum antiviral drugs have been evaluated against COVID-19 in clinical trials, resulted in clinical recovery. In the current review, we summarize and comparatively analyze the emergence and pathogenicity of COVID-19 infection and previous human coronaviruses severe acute respiratory syndrome coronavirus (SARS-CoV) and middle east respiratory syndrome coronavirus (MERS-CoV). We also discuss the approaches for developing effective vaccines and therapeutic combinations to cope with this viral outbreak.

1. **INTRODUCTION**

Coronaviruses belong to the Coronaviridae family in the Nidovirales order. Corona represents crown-like spikes on the outer surface of the virus; thus, it was named as a coronavirus. Coronaviruses are minute in size (65–125 nm in diameter) and contain a single-stranded RNA as a nucleic material, size ranging from 26 to 32kbs in length . The subgroups of coronaviruses family are alpha (α), beta (β), gamma (γ) and delta (δ) coronavirus. The severe acute respiratory syndrome coronavirus (SARS-CoV), H5N1 influenza A, H1N1 2009 and Middle East respiratory syndrome coronavirus (MERS-CoV) cause acute lung injury (ALI) and acute respiratory distress syndrome (ARDS) which leads to pulmonary failure and result in fatality. These viruses were thought to infect only animals until the world witnessed a severe acute respiratory syndrome (SARS) outbreak caused by SARS-CoV, 2002 in Guangdong, China. Only a decade later, another pathogenic coronavirus, known as Middle East respiratory syndrome coronavirus (MERS-CoV) caused an endemic in Middle Eastern countries .

1. **LITERATURE REVIEW**

**ENGINEERING STRATEGIES FOR HANDLING COVID-19**

The question of how computers can contribute to controlling the COVID-19 pandemic is being posed to experts in artificial intelligence (AI) all over the world.

AI tools can help in many different ways. They are being used to predict the spread of the coronavirus, map its genetic evolution as it transmits from human to human, speed up diagnosis, and in the development of potential treatments, while also helping policymakers cope with related issues, such as the impact on transport, food supplies and travel.

But in all these cases, AI is only effective if it has sufficient examples to learn from. As COVID-19 has taken the world into unchartered territory, the "deep learning" systems, which computers use to acquire new capabilities, don’t necessarily have the data they need to produce useful outputs.

“Deep learning is good at predicting generic behaviour, but is not very good at extrapolating that to a crisis situation when almost everything that happens is new,” cautions Leo Kärkkäinen, a professor at the Department of Electrical Engineering and Automation in Aalto University, Helsinki and a fellow with Nokia’s Bell Labs. “If people react in new ways, then AI cannot predict it. Until you have seen it, you cannot learn from it.”

Despite this caveat, Kärkkäinen says robust AI-based mathematical models are playing an important role in helping policymakers understand how COVID-19 is spreading and when the rate of infections is set to peak. “By drawing on data from the field, such as the number of deaths, AI models can help to detect how many infections are in the dark,” he adds, referring to undetected cases that are still infectious. That data can then be used to inform the establishment of quarantine zones and other social distancing measures.

It is also the case that AI-based diagnostics that are being applied in related areas can quickly be repurposed for diagnosing COVID-19 infections. Behold.ai, which has an algorithm for automatically detecting both lung cancer and collapsed lungs from X-rays, reported on Monday that the algorithm can quickly identify chest X-rays from COVID-19 patients as ‘abnormal’. This instant triage could potentially speed up diagnosis and ensure resources are allocated properly.

**Identifying what’s working and what isn’t**

The urgent need to understand what kinds of policy interventions are effective against COVID-19 has driven various governments to quickly award research grants to harness AI. One recipient is David Buckeridge, a professor in the Department of Epidemiology, Biostatistics and Occupational Health at McGill University in Montreal. Armed with a grant of C$500,000 (€323,000), his team is combining natural language processing technology with machine learning tools, such as neural networks (a set of algorithms designed to recognise patterns), to analyse more than two million conventional media and social media reports about the spread of the coronavirus from all over the world. “This is unstructured free text – classical methods can’t deal with it,” Buckeridge said. “We want to extract a timeline from online media, that shows systematically what’s working where.”

The team at McGill is using a mixture of supervised and unsupervised machine learning methods to distil the key pieces of information from the online media reports. Supervised learning involves feeding a neural network with data that has been annotated, whereas unsupervised learning simply employs raw data. “We need a framework for bias – different media sources have a different perspective and there are different government controls,” says Buckeridge. “Humans are good at spotting that, but it needs to be built into the AI models.”

The information derived from the news reports will be combined with other data, such as COVID-19 case reports, to give policymakers and health authorities a much more complete picture of how and why the virus is spreading differently in different countries. “This is applied research in which we will look to get important answers fast,” Buckeridge noted. “We should have some results of relevance to public health in April.”

**Unknown infections**

AI can also be used to help identify individuals who might be unknowingly infected with COVID-19. Chinese tech company Baidu says its new AI-enabled infrared sensor system can monitor the temperature of people in the proximity and quickly determine whether they may have a fever, one of the symptoms of the coronavirus. In an 11 March article in the MIT Technology Review, Baidu said the technology is “being used in Beijing’s Qinghe Railway Station to identify passengers who are potentially infected, where it can examine up to 200 people in one minute without disrupting passenger flow.” A report from the World Health Organization on how China has responded to the coronavirus says the country has also used big data and AI to strengthen contact tracing and the management of priority populations.

AI tools are also being deployed to better understand the biology and chemistry of the coronavirus and pave the way for the development of effective treatments and a vaccine. For example, start-up Benevolent AI says its “AI-derived knowledge graph” of structured medical information has enabled the identification of a potential therapeutic. In a letter to The Lancet, the company described how its algorithms queried this graph to identify a group of approved drugs that could inhibit viral infection of cells.  Benevolent AI concluded that the drug baricitinib, which is approved for the treatment of rheumatoid arthritis, could be of use in countering COVID-19 infections, subject to appropriate clinical testing.

Similarly, US biotech Insilico Medicine is using AI algorithms to design new molecules that could limit COVID-19’s ability to replicate in cells. In a paper published in February, the company says it has taken advantage of recent advances in deep learning to remove the need to manually design features and learn nonlinear mappings between molecular structures and their biological and pharmacological properties. “A total of 28 machine learning models generated molecular structures and optimised them with reinforcement learning” using a scoring system that reflected the desired characteristics, the researchers said.

Some of the world’s best-resourced software companies are also grappling with this challenge. DeepMind, the London-based AI specialist owned by Google’s parent company Alphabet, believes its neural networks can speed up the often-laborious process of solving the structures of viral proteins. It has developed two methods for training neural networks to predict the properties of a protein from its genetic sequence. “We hope to contribute to the scientific effort … by releasing structure predictions of several under-studied proteins associated with SARS-CoV-2, the virus that causes COVID-19,” the company said. These can help researchers to build understanding of how the virus functions and be used in drug discovery.

The pandemic has led enterprise software company Salesforce to diversify into life sciences, in a study demonstrating that AI models can learn the language of biology, just as they can do speech and image recognition. The idea is that the AI system will then be able to design proteins, or identify unknown proteins, that have specific properties, which could be used to treat COVID-19.

Salesforce fed the amino acid sequences of proteins and their associated metadata into its ProGen AI system. The system takes each training sample and formulates a game in which it tries to predict the next amino acid in a sequence.

“By the end of training, ProGen has become an expert at predicting the next amino acid by playing this game approximately one trillion times,” said Ali Madani, a researcher at Salesforce. “ProGen can then be used in practice for protein generation by iteratively predicting the next most-likely amino acid and generating new proteins it has never seen before.” Salesforce is now seeking to partner with biologists to apply the technology.

1. **METHODOLY**

Real-time data query is done and visualized in our website, then the queried data is used for Susceptible-Exposed-Infectious-Recovered (SEIR) predictive modelling. We utilize SEIR modelling to forecast COVID-19 outbreak within and outside of China based on daily observations. We also analyze the queried news, and classify the news into negative and positive sentiments, to understand the influence of the news to people’s behavior both politically and economically. Findings: At the time of writing this paper, the number of confirmed cases is expected to exceed 76000 cases, and reach the peak of this outbreak before 20 February 2020. The average Infected-Suspected ratio was found to be 2.399 which we used to initialize the number of Exposed individuals as a product of the number of Infected individuals on 20 Jan 2020. This outbreak is assumed to reach its peak in late May 2020 and will start to drop around early July 2020. Based on the news queried in our system, we found that there are more negative articles than positive articles, and displayed similar words for both negative and positive sentiments. The top five positive articles are about collaboration and strength of individuals in facing this epidemic, and the top five negative articles are related to uncertainty and poor outcome of the disease such as deaths. Conclusions: COVID-19 is still an unclear infectious disease, which means we can only obtain an accurate SEIR prediction after the outbreak ends. The outbreak spreads are largely influenced by each country’s policy and social responsibility. As data transparency is crucial inside the government, it is also our responsibility not to spread unverified news and to remain calm in this situation. The CoronaTracker project has shown the importance of information dissemination that can help in improving response time, and help planning in advance to help reduce risk. Further studies need to be done to help contain the outbreak as soon as possible

1. **CONCLUSION**

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