Protecting Automatons: Intellectual Property and the Use of Artificial Intelligence in the War Against COVID-19

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I. What is Artificial Intelligence?

A. Definitions of Artificial Intelligence

While the existence and use of artificial intelligence (AI) in the world today is ubiquitous, there is yet to be a universally accepted legal definition of what AI is.[1] In Assembly Bill No. 511 of the Nevada Legislature, AI was defined to be "*the use of computers and related equipment to enable a machine to duplicate or mimic the behavior of human beings.*"[2] On the other hand, the United States (U.S.)' Future of Artificial Intelligence Act of 2017 defines it as "*any artificial systems that perform tasks under varying and unpredictable circumstances, without significant human oversight, or that can learn from their experience and improve their performance.*"[3] Meanwhile, Lauri Donahue of the Harvard Law School Journal of Law & Technology defines AI as "*the term used to describe how computers can perform tasks normally viewed as requiring human intelligence, such as recognizing speech and objects, making decisions based on data, and translating languages. AI mimics certain operations of the human mind.*"[4] The World Intellectual Property Organization (WIPO) recently defined AI as

> a discipline of computer science that is aimed at developing machines and systems that can carry out tasks considered to require human intelligence, with limited or no human intervention. ... AI generally equates to 'narrow

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1.   Daniel Faggella, What is Artificial Intelligence? An Informed Definition, *available at* https://emerj.com/ai-glossary-terms/what-is-artificial-intelligence-an-informed-definition (last accessed Sep. 30, 2020).

2.   Nev. Rev. Stat. § 482A.020 (2011) (emphasis supplied).

3.   H.R. 4625, 115th Cong., § 3 (a) (1) (A) (1st Sess. 2017) (emphasis supplied).

4.   Lauri Donahue, A Primer on Using Artificial Intelligence in the Legal Profession, *available at* https://jolt.law.harvard.edu/digest/a-primer-on-using-artificial-intelligence-in-the-legal-profession (last accessed Sep. 30, 2020) (emphasis supplied).

AI' which is techniques and applications programmed to perform individual tasks. Machine learning and deep learning are two subsets of AI.[5]

Although the foregoing definitions of AI differ slightly from one another, the common factors in the definitions appear to be (i) the involvement of computers or systems, and (ii) the AI's capacity to replicate some aspect of human behavior.

There is a lack of consensus as to how intelligence is defined.[6] The following behaviors have been considered as present for something to *act intelligently*: (a) appropriate action relative to the circumstances and goals; (b) flexibility to changes in the environment and goals; (c) learning from experience; and (d) appropriate choices given limitations in perception and computing abilities.[7]

In a technical sense, the aim of AI is "to imbue software with the ability to analyze its environment using either predetermined rules and search algorithms, or pattern recognizing machine learning models, and then make decisions based on those analyses."[8] In order to simulate human intelligence, AI programming focuses on three cognitive skills: (a) "[l]earning processes ... [which focus] on acquiring data and creating rules or algorithms for turning data into actionable information[;]" (b) "[r]easoning processes ... [that choose the correct rules] to reach the desired outcome[;] and (c) "[s]elf–correction processes" which review and revise the rules to ensure accurate results.[9]

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5.   WIPO Secretariat, *Revised Issues Paper on Intellectual Property Policy and Artificial Intelligence*, ¶ 11, WIPO/IP/AI/2/GE/20/1 REV (May 21, 2020) (emphasis supplied).

6.   *See* Faggella, *supra* note 1.

7.   Brian Wahl, et al., Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings? at 1, *available at* https://gh.bmj.com/content/bmjgh/3/4/e000798.full.pdf (last accessed Sep. 30, 2020) (citing DAVID L. POOLE & ALAN K. MACKWORTH, ARTIFICIAL INTELLIGENCE: FOUNDATIONS OF COMPUTATIONAL AGENTS 4 (2010)).

8.   Techopedia, Artificial Intelligence (AI), *available at* https://www.techopedia.com/definition/190/artificial-intelligence-ai (last accessed Sep. 30, 2020).

9.   SearchEnterpriseAI, artificial intelligence, *available at* https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence (last accessed Sep. 30, 2020).

B. Brief History of Artificial Intelligence

On the one hand, the idea of intelligent non-human beings can be traced to the time of the ancient Greeks.[10] Greek mythology contained stories of the giant *Talos*, the first robot to walk the earth who was created by the Greek god of invention, Hephaestus.[11] Even Pandora, the mythical individual who let loose the miseries of the earth, was initially depicted as an artificial being who was ordered by Zeus to come down to earth to punish human beings for discovering fire.[12]

Buddhist texts, on the other hand, depict automaton warriors made by Visvakarman, the Hindu engineer god, guarding Buddha's relics.[13] Burmese tradition tells of a Western land with highly developed robot technology used for trade and faming.[14] The "[r]obot makers [in this tale] were forbidden to ... reveal their secrets[,]"[15] on pain of death,[16] marking early ideas on trade secrets and intellectual property protection.

Creation of an early prototype computer machine, which he called the *Analytical Engine* was started in 1837 by Charles Babbage.[17] Babbage's friend Ada Lovelace, daughter of the poet Lord Byron, prepared the first computer

10. Tanya Lewis, A Brief History of Artificial Intelligence, *available at* https://www.livescience.com/49007-history-of-artificial-intelligence.html (last accessed Sep. 30, 2020).

11. Adrienne Mayor, Gods and Robots: Myths, Machines, and Ancient Dreams of Technology, *available at* https://press.princeton.edu/books/hardcover/9780691183510/gods-and-robots (last accessed Sep. 30, 2020).

12. Alex Shashkevich, Greek Myths Have Some Scary Ideas About Robots and A.I., *available at* https://www.futurity.org/artificial-intelligence-greek-myths-1999792 (last accessed Sep. 30, 2020) & Alex Shashkevich, Stanford researcher examines earliest concepts of artificial intelligence, robots in ancient myths, *available at* https://news.stanford.edu/2019/02/28/ancient-myths-reveal-early-fantasies-artificial-life (last accessed Sep. 30, 2020).

13. Adrienne Mayor, Robots Guarded Buddha's Relics in a Legend of Ancient India, *available at* https://www.ancient-origins.net/artifacts-ancient-technology/robots-guarding-buddhas-relics-0011632 (last accessed Sep. 30, 2020).

14. *Id.*

15. *Id.*

16. *Id.*

17. Encyclopedia Britannica, Charles Babbage: British inventor and mathematician, *available at* https://www.britannica.com/biography/Charles-Babbage (last accessed Sep. 30, 2020).

program[18] that was planned to run on the machine. Babbage died, however, before completing his prototype.[19]

It was not until the 1950s, however, when the concept was formally conceived and named *artificial intelligence*.[20] One of the scientists, mathematicians, and philosophers exploring the idea of AI at that time was Alan Turing.[21] In his paper *Computing Machinery and Intelligence*, he discussed the creation of intelligent machines and the manner of testing their intelligence.[22] In 1956, the *Logic Theorist* was presented at the Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI) by Allen Newell, Cliff Shaw, and Herbert Simon.[23] The *Logic Theorist* was a program which was designed to duplicate the problem solving skills of humans.[24] It was during the same conference that the term *artificial intelligence* was coined by John McCarthy, the host of the DSRPAI.[25] It was also during this era that Alan Turing came up with a test for a machine's intelligence, the Turing Test, which is still being used.[26]

Throughout the 1960s, 1970s, and 1980s, progress in the study and development of AI was volatile.[27] Funding and technological advancements were two of the primary reasons driving this volatility. In other words, there

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18. ThinkAutomation, A history of automation: the rise of robots and AI, *available at* https://www.thinkautomation.com/bots-and-ai/a-history-of-automation-the-rise-of-robots-and-ai (last accessed Sep. 30, 2020). *See also* Computer History Museum, A Brief History, *available at* https://www.computerhistory.org/babbage/history (last accessed Sep. 30, 2020).

19. Computer History Museum, *supra* note 18.

20. Chris Smith, et al., The History of Artificial Intelligence, at 4, *available at* https://courses.cs.washington.edu/courses/csep590/06au/projects/history-ai.pdf (last accessed Sep. 30, 2020).

21. *Id.* at 5.

22. Rockwell Anyoha, The History of Artificial Intelligence, *available at* http://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence (last accessed Sep. 30, 2020) (citing Alan M. Turing, *Computing Machinery and Intelligence*, 49 MIND 433 (1950)).

23. History of Information, Newell, Simon & Shaw Develop the First Artificial Intelligence Program, *available at* http://www.historyofinformation.com/detail.php?id=742 (last accessed Sep. 30, 2020).

24. *Id.*

25. Anyoha, *supra* note 22.

26. ThinkAutomation, *supra* note 18.

27. *Id.*

were years when AI flourished as a result of funding and technological advances, but there were also years when a lack thereof would result in *AI winters*[28] when it stepped out of the limelight.[29] The era had its share of developments though, such as *SCARA*, the assembly line aide, and *RB5X*, the learning robot.[30] The phrases *virtual reality* and *augmented reality* were also coined during this era while hyperlinks and hypertexts were invented as precursor to its use in the World Wide Web.[31]

By the 1990s and 2000s, several goals of AI technology were achieved.[32] One of the more popular developments in AI came in 1997, when IBM's *Deep Blue*, a chess-playing computer program, beat world champion and grand master Gary Kasparov.[33] *Sojourner*, the first autonomous robotics system of NASA, was deployed during this era.[34] As the Internet developed, *web crawlers* as well as other AI data extraction programs were increasingly deployed.[35] Recently in 2011, IBM's computer *Watson*, beat the reigning champions in the quiz show Jeopardy![36] Also in 2011, Apple released *Siri* which paved the way for a new wave of AI driven assistants.[37]

Today, AI is everywhere and has made its way into technologies we use every day. People welcome the use of AI because it makes life easier, more convenient, and more efficient by performing tasks which would normally require great human effort and long periods of time.[38] Some examples of AI

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28. *Id.*

29. *Id.*

30. *Id.*

31. *Id.*

32. Anyoha, *supra* note 22.

33. *Id.*

34. Think Automation, *supra* note 18.

35. *Id.*

36. Lewis, *supra* note 10.

37. Think Automation, *supra* note 18.

38. *See, e.g.*, Kevin Gardner, Six Ways AI Improves Daily Life, *available at* https://www.digitalistmag.com/improving-lives/2019/05/28/6-ways-ai-improves-daily-life-06198539 (last accessed Sep. 30, 2020).

people enjoy today are e-mail spam filters,[39] robotic vacuums,[40] virtual assistants such as *Siri* or *Alexa*,[41] and to a lesser extent, self-driving cars.[42]

II. HOW IS ARTIFICIAL INTELLIGENCE USED AGAINST COVID-19?

Homo sapiens view pandemics as an expected and recurring threat, often resulting in a widespread health crisis and concomitantly, an economic crisis. Ideally, as the available technology develops, so too should human responses to such outbreaks and other natural calamities evolve to squarely face the threat. Achieving this ideal, however, requires innovative application of available technologies, coupled with continual creation and development of novel technologies to meet the crisis. One such technology currently being used to address pandemics is AI technology, whose power lies in the "ability to find patterns in huge amounts of data."[43]

AI technology has been placed in the spotlight in recent times due to COVID-19, finding use in the prevention and control of acute respiratory infections (ARI) of international health concern.[44] As the situation progresses, we can expect to see the technology's continued development, evolution and application to old and novel problems alike arising from the pandemic.

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39. James Vincent, Gmail is now blocking 100 million extra spam messages every day with AI, *available at* https://www.theverge.com/2019/2/6/18213453/gmail-tensorflow-machine-learning-spam-100-million (last accessed Sep. 30, 2020).

40. Raghav Bharadwaj, Artificial Intelligence in Home Robots - Current and Future Use-Cases, *available at* https://emerj.com/ai-sector-overviews/artificial-intelligence-home-robots-current-future-use-cases (last accessed Sep. 30, 2020).

41. Bernard Marr, Are Alexa and Siri Considered AI?, *available at* https://bernardmarr.com/default.asp?contentID=1830 (last accessed Sep. 30, 2020).

42. Micron, On the Road to Full Autonomy: Self-Driving Cars Will Rely on AI and Innovative Memory, *available at* https://www.micron.com/insight/on-the-road-to-full-autonomy-self-driving-cars-will-rely-on-ai-and-innovative-memory (last accessed Sep. 30, 2020).

43. Ariel Bleicher, Demystifying the Black Box That Is AI, *available at* https://www.scientificamerican.com/article/demystifying-the-black-box-that-is-ai (last accessed Sep. 30, 2020).

44. *See generally* Keith Darlington, How Artificial Intelligence Is Helping Prevent the Spread of the COVID-19 Pandemic, *available at* https://www.bbvaopenmind.com/en/technology/artificial-intelligence/how-ai-is-helping-prevent-the-spread-of-the-covid-19-pandemic (last accessed Sep. 30, 2020).

A. Early Warnings of the Emerging Pandemic

Much like an oracle, AI has the capability to predict events and forecast outcomes, when given the proper data.[45] In the context of the current COVID-19 pandemic, AI technology was considered instrumental in the early recognition of the emergence of a potential pandemic.[46] The first reports of COVID-19 cases were allegedly detected by the AI-automated HealthMap system at Boston Children's Hospital[47] as well as by an AI-driven algorithm owned by Canadian company, *BlueDot*, nine days before the World Health Organization first reported the emergence of COVID-19.[48] As explained by Kamran Khan, an infectious disease physician who is also *BlueDot*'s founder and CEO, the algorithm uses natural language processing and machine learning in order "to track over [a hundred] infectious diseases [through] [analysis of approximately] 100,000 articles [written] in 65 [different] languages [each] day" to give the company's clients advance warnings of potential danger zones.[49]

The exhibited ability of AI in the prediction and early recognition of ARI could make AI handy and essential in alerting relevant populace for the purpose of stemming the transmission of diseases before they can rise to levels of an epidemic or pandemic. AI like *BlueDot* and *Metabiota* use "*natural-language processing to evaluate online reports about a potential disease*[.]"[50] *BlueDot*, in particular, uses data such as information on traveler itinerary and flight paths,

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45. Bleicher, *supra* note 43.

46. Sathian Dananjayan & Gerard Marshall Raj, Artificial Intelligence during a pandemic: The COVID-19 example, *available at* https://onlinelibrary.wiley.com/doi/10.1002/hpm.2987 (last accessed Sep. 30, 2020) (citing Eric Niller, An AI Epidemiologist Sent the First Warnings of the Wuhan Virus, *available at* https://www.wired.com/story/ai-epidemiologist-wuhan-public-health-warnings (last accessed Sep. 30, 2020)).

47. Ian A. Scott & Enrico W. Coiera, Can AI help in the fight against COVID-19? (A Pre-print Article in the Medical Journal of Australia) at 2, *available at* https://www.mja.com.au/system/files/2020-06/Scott%20mja20.00636%20-%2019%20June%202020.pdf (last accessed Sep. 30, 2020).

48. *Id.* & Kai-Fu Lee, Covid-19 Will Accelerate the AI Health Care Revolution, *available at* https://www.wired.com/story/covid-19-will-accelerate-ai-health-care-revolution (last accessed Sep. 30, 2020).

49. Rebecca Heilweil, How AI is battling the coronavirus outbreak, *available at* https://www.vox.com/recode/2020/1/28/21110902/artificial-intelligence-ai-coronavirus-wuhan (last accessed Sep. 30, 2020).

50. *Id.*

as well as environmental information such as climate, temperature, and local livestock to predict the likelihood of an outbreak in a particular area.[51] In 2016, *BlueDot* successfully predicted the presence of the Zika virus in Florida six months before it was confirmed in the state.[52] Similarly, *Metabiota*, an epidemic-monitoring company, was able to predict through flight data the first countries where COVID-19 would initially spread.[53]

B. Artificial Intelligence in Patient Triage

Predictive AI also finds use in patient diagnosis and triage. The *eCART*, or the *Electronic Cardiac Arrest Risk Triage*, uses an AI system which can allegedly predict which patients will likely go into cardiac arrest, which patients will need to be transferred to the intensive care unit, and which patients will die regardless of medical intervention, by synthesizing and analyzing vital signs, laboratory, and demographic data[54] to provide risk scores of patients.[55]

Another example of its use in patient triage is the AI diagnostic system developed by researchers at King's College London, Massachusetts General Hospital and ZOE, a health science company.[56] Their symptom studies application was able to show that anosmia, or loss of the sense of smell, was a stronger predictor of COVID-19 than fever.[57] Further, the combination of symptoms that include anosmia, fatigue, persistent cough, and loss of appetite, could be used together in order to identify individuals with COVID-19.[58] Their diagnostic system, which has exhibited 80% accuracy, is designed to

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51. *Id.*

52. *Id.*

53. *Id.*

54. Eliza Strickland, AI Can Help Hospitals Triage COVID-19 Patients, *available at* https://spectrum.ieee.org/the-human-os/artificial-intelligence/medical-ai/ai-can-help-hospitals-triage-covid19-patients (last accessed Sep. 30, 2020).

55. *See generally* Bartlomiej Bartkowiak, et al., *Validating the Electronic Cardiac Arrest Risk Triage (eCART) Score for Risk Stratification of Surgical Inpatients in the Postoperative Setting*, 269 ANN. SURG. 1059 (2019).

56. King's College London, New AI diagnostic can predict COVID-19 without testing, *available at* https://www.eurekalert.org/pub_releases/2020-05/kcl-nad051120.php (last accessed Sep. 30, 2020).

57. *Id.*

58. Cristina Menni, et al., *Real-time tracking of self-reported symptoms to predict potential COVID-19*, 26 NAT. MED. 1037, 1037 (2020).

identify which patients are likely to have COVID-19 based on their symptoms, age, and sex.[59]

C. Artificial Intelligence in COVID-19 Diagnosis

Researchers from Princeton University have also developed a diagnostic tool which uses AI to identify subtle signs of COVID-19 lung damage on chest x-rays which would otherwise be impossible for doctors to detect.[60] The differentiation required is based on two conditions for COVID-19 cases, one type exhibiting pneumonia in its familiar form with "the lining of the sacs of the patient's lungs [ ] stiff and heavy with fluid[ ]" and the second type with lungs working quite well and breathing is nearly normal.[61] For the first type, treatment involves a ventilator while for the second type, use of ventilators can damage the lungs.[62] It is in this differentiation of chest x-ray images that AI can assist so that the doctors can make better treatment decisions.[63]

A similar AI system was also developed by *DarwinAI* and the University of Waterloo, called the COVID-Net, which was designed to help radiologists differentiate COVID-19 infections from other forms of infections by analyzing chest x-rays.[64] They were also able to compile *COVIDx*, a dataset of around 6,000 chest radiography images across approximately 3,000 patient cases gathered from public sources.[65] These examples of AI-powered machine learning and analysis from large amounts of data can provide faster, more

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59. King's College London, *supra* note 56.

60. Scott Lyon, AI tool gives doctors a new look at the lungs in treating COVID-19, *available at* https://www.princeton.edu/news/2020/05/21/ai-tool-gives-doctors-new-look-lungs-treating-covid-19 (last accessed Sep. 30, 2020).

61. *Id.*

62. *Id.*

63. *Id.*

64. Isabelle Kirkwood, DarwinAI, University of Waterloo Develop Neural Network for COVID-19 Detection, *available at* https://betakit.com/darwinai-university-of-waterloo-develop-neural-network-for-covid-19-detection (last accessed Sep. 30, 2020) & Tasneem Akolawala, COVID-Net AI Tool Can Help in Identifying COVID-19 in Chest X-Rays, *available at* https://gadgets.ndtv.com/others/news/covid-net-ai-tool-19-coronavirus-test-chest-x-rays-2201028 (last accessed Sep. 30, 2020).

65. Sheldon Fernandez, COVID-Net: an open source neural network for COVID-19 detection, *available at* https://medium.com/@sheldon.fernandez/covid-net-an-open-source-neural-network-for-covid-19-detection-48b8a55e6d44 (last accessed Sep. 30, 2020).

convenient, and less expensive alternatives to the computed tomography (CT) scans typically used to diagnose suspected COVID-19 patients.[66]

Further, an AI-enabled rapid diagnostic method for patients with COVID-19 was developed at the Massachusetts General Hospital and Icahn School of Medicine, using CT findings, exposure history, and laboratory testing that has a sensitivity at par with a senior thoracic radiologist.[67] Further, the AI was able to sift through apparently normal CT scans, correctly identifying which ones were COVID-positive.[68] AI-based systems that can process CT scans at high speeds have similarly been developed by scientists from China.[69]

D. Artificial Intelligence in COVID-19 Monitoring

AI is currently part of the digital healthcare revolution, and is now also being used for contact tracing, patient surveillance, monitoring and isolation, and enforcement of social distancing measures.[70] For example, South Korea uses a location-based messaging application which alerts nine out of ten South Koreans when they are near a confirmed case.[71]

In the Philippines, the government-promoted *StaySafe.ph*, which is a website and mobile application which "uses geolocation ... to facilitate contact tracing[,]" and provides heatmap analytics and a monitoring and response

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66. Jessica Kent, Artificial Intelligence Tool Identifies COVID-19 in CT Scans, *available at* https://healthitanalytics.com/news/artificial-intelligence-tool-identifies-covid-19-in-ct-scans (last accessed Sep. 30, 2020).

67. Xueyan Mei, et al., Artificial intelligence-enabled rapid diagnosis of patients with COVID-19, at ⋆5, *available at* https://www.nature.com/articles/s41591-020-0931-3.pdf (last accessed Sep. 30, 2020).

68. Nature Medicine, Machine learning: Rapid diagnosis of patients with COVID-19 using an AI model, *available at* https://www.natureasia.com/en/research/highlight/13339 (last accessed Sep. 30, 2020).

69. Elise Mak, China uses AI in medical imaging to speed up COVID-19 diagnosis, *available at* https://www.bioworld.com/articles/433530-china-uses-ai-in-medical-imaging-to-speed-up-covid-19-diagnosis (last accessed Sep. 30, 2020).

70. *See* Wim Naudé, Artificial intelligence vs. COVID-19 in developing countries, *available at* https://www.wider.unu.edu/publication/artificial-intelligence-vs-covid-19-developing-countries (last accessed Sep. 30, 2020).

71. Lee, *supra* note 48.

system available to frontliners and LGUs allows targeted response, among other functions.[72]

Consolacion, a northern town in Cebu province in the Philippines, is using its own AI-powered application, *Conan*, to "track[ ] residents within the municipality during the general community quarantine (GCQ)" to aid in contact tracing efforts.[73] The *app* is used to scan the QR codes of residents passing through checkpoints, which catalogues movement of residents.[74]

AI may also be utilized in healthcare systems, such as in the use of tele-medicine. In the Philippines, *RxBox*es were deployed in the Philippine General Hospital (PGH) as well as in other hospitals in order to remotely monitor COVID-19 patients, thereby decreasing risk of infection for the frontliners.[75] Patients' vital signs such as temperature, blood pressure, pulse rate, oxygen saturation, and electrocardiogram readings are relayed to the nurse's stations and signals are generated for patients requiring urgent care.[76] The *RxBox* was initially conceptualized and deployed by the PGH in order for remote first responders to be able to relay to hospital teams accurate information on a patient's clinical status even before the patient arrives at the

72. MultiSys Admin, All-in-one: Eight elaborate features of contact tracing platform StaySafe.ph, *available at* https://www.multisyscorp.com/news/all-in-one-eight-elaborate-features-of-contact-tracing-platform-staysafeph (last accessed Sep. 30, 2020) & Manila Standard, *StaySafe.ph mobile app with contact tracing, scan area features now on Google Play*, MANILA STAND., May 15, 2020, *available at* https://manilastandard.net/tech/gadgets/323804/staysafe-ph-mobile-app-with-contact-tracing-scan-area-features-now-on-google-play.html (last accessed Sep. 30, 2020).

73. Marel Floreen Baluyos, Consolacion lauded for using hi-tech tracker app amid GCQ, *available at* https://sugbo.ph/2020/consolacion-using-hi-tech-app (last accessed Sep. 30, 2020).

74. Delta Dyrecka Letigio, *Consolacion town has application to monitor movements of residents while under GCQ*, CEBU DAILY NEWS, May 22, 2020, *available at* https://cebudailynews.inquirer.net/312134/consolacion-town-has-application-to-monitor-movements-of-residents-while-under-gcq (last accessed Sep. 30, 2020).

75. Currie Cator, DOST to deliver 'RxBox' telemedicine to hospitals to aid frontliners amid COVID-19 fight, *available at* https://cnnphilippines.com/news/2020/4/24/dost-rxbox-telemedicine-hospitals-health-workers-covid-19.html (last accessed Sep. 30, 2020).

76. *Id.*

hospital.[77] It has been repurposed by the Philippine Department of Science and Technology for continuous monitoring of multiple patients diagnosed with COVID-19 in order to reduce contact of patients with healthcare workers.[78]

E. Artificial Intelligence in Drug Development

AI is being used to assist in the selection of drug candidates in a more efficient and cost-effective manner. Instead of a trial-and-error drug discovery approach, treatments are sought based on the specific mechanisms that cause the disease.[79]

Several research projects which are developing AI to look for drugs that fight other diseases have been repurposed to work on searching for medications for COVID-19.[80] One of these is *BenevolentAI*, a drug discovery company based in London.[81] The company uses AI to "*digest large volumes of scientific literature and biomedical research to find links between the genetic and biological properties of diseases and the composition and action of drugs.*"[82] Further, *Matchmaker*, an AI-enabled technology for drug repurposing is being used to check for "non-obvious relationships between [antiviral activity of all existing drugs]."[83]

Healx, a Cambridge-based company, has used its AI system to find a list of candidates for COVID-19 treatments from a list of 4,000 approved drugs currently on the market, which means "eight million possible [drug] pairs and

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77. Jo. Florendo B. Lontoc, Unboxing the RxBox, *available at* https://www.up.edu.ph/unboxing-the-rxbox (last accessed Sep. 30, 2020).

78. Jwynne Gwyneth Macan, PGH to use DOST's RxBox for COVID-19 in-patient monitoring, *available at* http://www.pchrd.dost.gov.ph/index.php/news/6527-pgh-to-use-dost-s-rxbox-for-covid-19-in-patient-monitoring (last accessed Sep. 30, 2020).

79. Nic Fleming, How artificial intelligence is changing drug discovery, *available at* https://www.nature.com/articles/d41586-018-05267-x (last accessed Sep. 30, 2020).

80. Jo Best, AI and the coronavirus fight: How artificial intelligence is taking on COVID-19, *available at* https://www.zdnet.com/article/ai-and-the-coronavirus-fight-how-artificial-intelligence-is-taking-on-covid-19 (last accessed Sep. 30, 2020).

81. *Id.*

82. *Id.* (emphasis supplied).

83. Vector Institute, COVID-19 Updates, *available at* https://vectorinstitute.ai/covid-19-updates (last accessed Sep. 30, 2020).

10.5 billion triple-drug combinations[.][84] Similarly, the U.S.' Northeastern University's Barabasi Labs, Harvard Medical School, the Network Science Institute, and Scipher Medicine are also looking for drugs that can be repurposed to cure COVID-19, using network medicine, "a method that views a disease via the complex interactions among molecular components."[85] Even IBM's *Summit*, the world's fastest supercomputer, has been used to simulate reactions of various compounds with the virus and has discovered 77 possible compounds that may impair the virus' infectivity.[86]

In the field of novel drug design, *COVID Moonshot* was launched based on chemical fragments that attach to COVID-19 proteins identified by Diamond Light Source in collaboration with Post-Era, a machine-learning company which uses AI algorithms to map drug synthesis routes.[87] Thousands of submissions were crowdsourced from drug design chemists and several collaborators have stepped up to physically make the compounds.[88]

F. Artificial Intelligence in Vaccine Development

AI is also being used extensively for vaccine development.[89] Developing vaccines comes with a hefty price tag, a huge portion of which is effectively wasted on candidates who fail the clinical trial and regulatory approvals phase.[90]

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84. Jane Wakefield, Coronavirus: AI steps up in battle against Covid-19, *available at* https://www.bbc.com/news/technology-52120747 (last accessed Sep. 30, 2020).

85. *Id*.

86. Anthony Cuthbertson, Coronavirus: World's Fastest Supercomputer Quickens Path to Effective COVID-19 Vaccine, *available at* https://www.independent.co.uk/life-style/gadgets-and-tech/news/coronavirus-vaccine-supercomputer-ibm-summit-ai-covid-19-a9413411.html (last accessed Sep. 30, 2020).

87. Megan Scudellari, COVID Moonshot: Can AI Algorithms and Volunteer Chemists Design a Knockout Antiviral?, *available at* https://spectrum.ieee.org/the-human-os/artificial-intelligence/medical-ai/covid-moonshot-can-ai-algorithms-and-volunteer-chemists-design-a-knockout-antiviral (last accessed Sep. 30, 2020).

88. *Id*.

89. Jessica Kent, New Initiative Uses Artificial Intelligence for Vaccine Development, *available at* https://healthitanalytics.com/news/new-initiative-uses-artificial-intelligence-for-vaccine-development (last accessed Sep. 30, 2020).

90. *Id*.

There are three major types of vaccines which may be developed against a virus: (1) whole pathogen vaccines that use non-viable or attenuated (weakened) viruses; (2) subunit vaccines that utilize only a portion of the virus, such as a protein component; and (3) nucleic acid vaccines that inject genetic material to stimulate an immune response.[91] Various approaches to vaccine development are currently underway.[92]

AI projects use machine learning to identify components of the virus that produce a good immune response such that they would make good candidates for vaccines.[93] The regions of the viral proteins are scanned to check for strong antibody targets and high degree of presentation in the host cell.[94] One such AI developed in Stanford University is *MARIA (MHC Analyzer with Recurrent Integrated Architecture)* which is able to identify immunogenic portions that may be valuable for vaccine development.[95] It predicts the likelihood that a peptide is presented on the cell surface, making it a target for the immune system.[96]

The "University of Washington's Institute for Protein Design [is using] … 3D atomic-scale [computer] of the SARS-CoV-2 spike protein[,]" shown to attach to human cells, to create new proteins that will in turn stick to the spike protein to prevent the virus from infecting cells.[97]

Traditionally, developing a drug or a vaccine costs a lot of time, effort, and money, primarily due to the necessary trials they need to undergo. With AI, however, "*scientists can use machine learning to model thousands of variables and how their compounded effect may influence the responses of human cells.*"[98] Thus, the use of AI in drug and vaccine development would cut down on the time, effort, and cost it would take to eventually completely eradicate COVID-19.

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91. Oren Etzioni & Nicole Decario, AI Can Help Scientists Find a Covid-19 Vaccine, *available at* https://www.wired.com/story/opinion-ai-can-help-find-scientists-find-a-covid-19-vaccine (last accessed Sep. 30, 2020).

92. *Id.*

93. Ethan Fast & Binbin Chen, Can artificial intelligence help us design vaccines?, *available at* https://www.brookings.edu/techstream/can-artificial-intelligence-help-us-design-vaccines (last accessed Sep. 30, 2020).

94. *Id.*

95. Binbin Chen, et al., *Predicting HLA class II antigen presentation through integrated deep learning*, 37 NAT. BIOTECHNOL. 1332, 1332 (2019).

96. The MARIA Team, MARIA: Not binding, but presentation!, *available at* https://maria.stanford.edu/about.php (last accessed Sep. 30, 2020).

97. Etzioni & Decario, *supra* note 91 (emphasis omitted).

98. Lee, *supra* note 48 (emphasis supplied).

G. Artificial Intelligence in Public Health and Decision-Making

Modeling and forecasting using AI trained on SARS virus data allowed the prediction of consequences of measures instituted by China to contain the spread of the infection, such as mass quarantine, travel restrictions, tracing, and monitoring.[99] It was found that a mere "five-day delay in implementation of [the quarantine] would have increased the epidemic size [in mainland China by] three-fold."[100] Predictions were also made regarding consequences of lifting the quarantine.[101]

Lists generated through AI using de-identified health plan datasets were used to warn vulnerable populations and for authorities to prioritize healthcare resources deployment.[102]

The U.S. Centers for Disease Control developed a specialized COVID-19 bot which handles public concerns and inquiries on the disease by going through symptom checks and recommendations for millions of concerned consumers.[103] In Singapore, information about the disease and government initiatives were disseminated to the public through *WhatsApp.*[104]

The University of Vienna in collaboration with Facebook AI is generating area projection on where and how fast infections are spreading in Austria.[105] The initiative builds upon their previous forecasting project for New York and New Jersey in the United States of America for use in planning and decision-making including allocation of resources such as protective equipment, ventilators, hospital, and ICU demand.[106]

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99. Zifeng Yang, et al., *Modified SEIR and AI prediction of the epidemics trend of COVID-19 in China under public health interventions*, 12 J. THORAC. DIS. 165, 166 (2020).

100. *Id.* at 172-73.

101. *Id.* at 172.

102. Scott & Coiera, *supra* note 47, at 8.

103. Tom Lawry, What COVID-19 has taught us about the power and possibilities of AI in health, *available at* https://cloudblogs.microsoft.com/industry-blog/microsoft-in-business/health/2020/05/29/what-covid-19-has-taught-us-about-the-power-and-possibilities-of-ai-in-health (last accessed Sep. 30, 2020).

104. Daniel Shu Wei Ting, et al., *Digital technology and COVID-19*, 26 NAT. MED. 459, 459 (2020).

105. Facebook AI, Using AI to help health experts address the COVID-19 pandemic, *available at* https://ai.facebook.com/blog/using-ai-to-help-health-experts-address-the-covid-19-pandemic (last accessed Sep. 30, 2020).

106. *Id.*

Meanwhile, the Singapore University of Technology and Design is able to come up with a projection of the infection curve in a region and when COVID-19 will end in a certain area using an AI algorithm and the COVID-19 statistics and population data of a country.[107]

The Australian Census-based Epidemic Model (*ACEMod*) uses age, occupation, gender, and other factors in predicting outcomes of public health control measures.[108] It showed that "a combination of international arrival restrictions, case isolation[,] and social distancing for at least 13 weeks, with compliance rates 80% or above, was the best approach to suppressing the pandemic."[109]

Since AI can track and forecast viral infections from available data sources such as social media, it can inform users regarding possible spread of the infection and identify the more vulnerable populations to aid in public heath decision making.[110] Final epidemic sizes and peaks are estimated to aid in forecasting health maintenance requirements.[111]

III. INTELLECTUAL PROPERTY ISSUES CONCERNING ARTIFICIAL INTELLIGENCE

The COVID-19 pandemic has shown that we may increasingly rely on AI for efficient and effective detection, mitigation, and eventually, resolution of health crises. AI is being used to supplement, improve, and in some cases, provide alternative or altogether new responses to problems and issues arising in each aspect of our response to the circumstances presented by COVID-19, from ARI detection and identification to actual drug and vaccine development. As the COVID-19 situation progresses, it is more than evident that continued development of AI technology should be encouraged and pursued so as to greatly benefit from the technology.

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107. Trixie Zabal-Mendoza, Singaporean AI Predicts When COVID-19 Will End in the Philippines, *available at* https://www.msn.com/en-ph/news/national/singaporean-ai-predicts-when-covid-19-will-end-in-the-philippines/ar-BB13pXCB (last accessed Sep. 30, 2020).

108. Scott & Coiera, *supra* note 47, at 8.

109. *Id.*

110. Raju Vaishya, et al., *Artificial Intelligence (AI) applications for COVID-19 pandemic*, 14 DIABETES METAB. SYNDR 337, 339 (2020).

111. Milan Batista, Estimation of the final size of the coronavirus epidemic by the logistic model, at 1, *available at* https://www.medrxiv.org/content/medrxiv/early/2020/02/20/2020.02.16.20023606.full.pdf (last accessed Sep. 30, 2020).

Technology development and utilization however, especially since it requires time, effort, and costs, brings with it the concomitant issues of protection and ownership. In the first place, are AI and AI-generated inventions and works protected as intellectual property? What about the data from which machine learning was generated? And if these are protected, who owns the intellectual property? Moreover, how does the government handle IP protection of necessary technologies in the context of a pandemic and similar public crises?

A. Intellectual Property Protection of Artificial Intelligence per se and Artificial Intelligence Systems

The Philippine Intellectual Property Code (IP Code) defines patentable inventions as "any technical solution of a problem in any field of human activity which is new, involves an inventive step[,] and is industrially applicable[.]"[112] Section 22 lists inventions that are non-patentable, which is further expounded to include "programs for computers" under Section 22.2 of the IP Code and Rule 202 of the Revised Implementing Rules and Regulations of Patents, Utility Models, and Industrial Designs.[113] Under Section 171.4 of the IP Code, a computer program is defined as "a set of instructions expressed in words, codes, schemes or in any other form, which is capable when incorporated in a medium that the computer can read, of causing the computer to perform or achieve a particular task or result[.]"[114] Hence, if the AI being considered is the computer program per se which would fall under the foregoing IP Code definition, then it is among the list of unpatentable matter.

However, on 17 January 2018, the Philippine Intellectual Property Office (IPOPHL) issued its *Guidelines on the Examination of Information Communications Technology and Computer Implemented Inventions* (ICT Guidelines) as a result of increasing demand for patent protection in the fields of ICT and computer

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112. An Act Prescribing the Intellectual Property Code and Establishing the Intellectual Property Office, Providing for its Powers and Functions, and for Other Purposes [INTELL. PROP. CODE], Republic Act No. 8293, § 21 (1997) (as amended).

113. INTELL. PROP. CODE, § 22 & Intellectual Property Office, Rules and Regulations Implementing an Act Prescribing the Intellectual Property Code and Establishing the Intellectual Property Office, Providing for its Powers and Functions, and for Other Purposes, Republic Act No. 8293, rule 202 (e) (2011).

114. INTELL. PROP. CODE, § 171.4.

technology.[115] While the ICT Guidelines do not have the force and effect of law, they do recognize the patentability of various inventions in the ICT field, including artificial intelligence systems.[116]

On the requirement of a technical aspect, the ICT Guidelines provide that a computer program per se is not patentable, irrespective of content.[117] "If[,] however[,] the subject-matter as claimed[,] makes a technical contribution to [a] known art, patentability should not be denied merely on the ground that a computer program is involved in its implementation."[118] In other words, software or computer programs may overcome the hurdle of patentability if it is linked with hardware, i.e., a physical entity or concrete product, tangible components such as apparatus and device, showing practical and technical application.[119]

However, the question of whether there is a *patentable* invention as defined through exclusion under the Section 22 list of the IP Code, is separate and distinct from the questions under Section 21 of the IP Code on whether the subject-matter is susceptible of industrial application, is new and/or involves an inventive step. Therefore, AI that have been repurposed to identify possible COVID-19 cures may be questioned on the basis of novelty and/or inventive step even if they are not excluded from patentability under Section 22 of the IP Code. The other COVID-19 related AI, such as those for triage, diagnosis, contact tracing, surveillance, and monitoring, will thus need to be assessed independently with respect to the existence of novelty and inventive step to determine if they are capable of issuance of a patent.

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115. Managing IP Correspondent, The Philippines: Examination guidelines for ICT and computer related inventions, *available at* https://www.managingip.com/article/b1kbppgth03vn7/the-philippines-examination-guidelines-for-ict-and-computer-related-inventions (last accessed Sep. 30, 2020). *See also* Intellectual Property Office, Guidelines on the Examination of Information Communications Technology and Computer-Implemented Inventions (Jan. 2018).

116. *Id.* at 3.

117. *Id.* at 9 (citing INTELL. PROP. CODE, § 22).

118. Guidelines on the Examination of Information Communications Technology and Computer-Implemented Inventions, at 12.

119. Amit Goel, et al., Protecting AI and machine-learning inventions, *available at* https://www.lexology.com/library/detail.aspx?g=a621be57-f4bd-4f76-aa4c-a1b7f20607ba (last accessed Sep. 30, 2020).

Applying the WIPO's definition of AI,[120] which involves *machines and systems* capable of independently carrying out tasks that require human intelligence, it is arguable that certain AI are patentable under the IP Code. However, many of the technologies used during the COVID-19 pandemic and touted as "AI" or "AI-supported" appear to be pure algorithms. Hence, perhaps the more important question to resolve in determining and granting appropriate protection over AI is what actually constitutes or defines an *AI*.

Algorithms are defined to be "[*a*] *process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer*[,]"[121] thereby falling squarely into the Section 22 list of non-patentable subject matter in the IP Code. Looking at an AI in the concept of a computer program applied to an existing system or hardware makes it non-patentable but more appropriately entitled to copyright protection instead.[122] On the upside, copyrightable works are protected by the sole fact of their creation and from the moment they are created.[123]

B. Intellectual Property Protection of Data

The functionality of AI largely depends on data.[124] It is therefore also important to determine whether this data, or compilations and variations thereof, is protectable under intellectual property laws. While a compilation or an arrangement of data is copyrightable, the raw data itself is not.[125] Presently, the WIPO is still in the process of determining whether new rights should be created in data to respond to the "*new significance that data have assumed as a critical component of AI.*"[126]

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120. *Revised Issues Paper on Intellectual Property Policy and Artificial Intelligence*, *supra* note 5, ¶ 11. Artificial intelligence is defined as "a discipline of computer science that is aimed at developing machines and systems that can carry out tasks considered to require human intelligence, with limited or no human intervention." *Id.*

121. Lexico, algorithm, *available at* https://www.lexico.com/definition/algorithm (last accessed Sep. 30, 2020) (emphasis supplied).

122. INTELL. PROP. CODE, § 172.1 (n).

123. *Id.* § 172.

124. Darrell M. West & John R. Allen, How artificial intelligence is transforming the world, *available at* https://www.brookings.edu/research/how-artificial-intelligence-is-transforming-the-world (last accessed Sep. 30, 2020).

125. *Revised Issues Paper on Intellectual Property Policy and Artificial Intelligence*, *supra* note 5, ¶ 33.

126. *Id.* ¶ 34 (emphasis supplied).

It must be noted that Section 175 of the IP Code lists "*mere data as such*" among unprotectable subject matter in terms of copyright protection, "*even if they are expressed, explained, illustrated*[,] *or embodied in a work*[.]"[127] Section 173 of the IP Code, however, protects "*compilations* of data and other materials *which are original by reason of the selection or coordination or arrangement of their contents*."[128] Hence, although data *per se* is not protectable, if a compilation of data is original due to its selection, coordination, or arrangement then it becomes protectable. Further, Section 177 of the IP Code provides that "economic rights shall consist of the exclusive right to carry out, authorize or prevent the following acts: ... [r]ental of the original or a copy of ... a compilation of data[.]"[129] However, if a private reproduction of a compilation of data is made in a single copy, exclusively for research and private study, said reproduction is allowed even without authorization of the copyright owner, in view of Section 187 of the IP Code.[130]

C. Intellectual Property Protection of Artificial Intelligence Output

As with all useful technology, the development of AI is limited by both time and available resources. It is undeniable that investment into new technologies is usually dictated by their commercial profitability. Thus, ownership over AI technology, with the resulting right to exclusively exploit the same, is another driving factor in its development.

One of the biggest issues currently being tackled by the WIPO is the ownership of the intellectual property with regard to the output or products created by AI.[131] In such a case, can AI be considered a creator or inventor for purposes of intellectual property protection?

The U.S. Patent and Trademark Office's (USPTO) position is that only humans can be owners of copyright and that only humans have standing to sue under the Copyrights Act[132] and has, in fact, already refused to recognize *DABUS*, a type of AI, as an inventor.[133] Similarly, in the U.K., the rule is that

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127. INTELL. PROP. CODE, § 175 (emphases supplied).

128. *Id.* § 173 (emphases supplied).

129. *Id.* § 177.

130. *Id.* § 187.

131. *Revised Issues Paper on Intellectual Property Policy and Artificial Intelligence*, *supra* note 5, ¶ 35.

132. *See* Naruto v. Slater, No. 16-15469, 888 F.3d 418, 426 (9th Cir. 2018) (U.S.).

133. Daniel Basov & Mark Montague, Patent Law Alert — AI Machines Are Not Human Inventors, *available at* https://www.lexology.com/library/

the person who arranges for the AI to create the work is considered the author.[134] This would mean that either the programmer or the human user of the AI would be considered the author of a work created by that AI.[135]

Echoing the U.S. and U.K.'s approach, the current wording of the IP Code prevents AIs from being recognized as inventors or authors. The IP Code provides that "[t]*he right to a patent belongs to the inventor, his heirs, or assigns.*"[136] Further, Chapter VII of the IP Code is entitled "*Remedies of a Person With a Right to a Patent*[.]"[137] Similarly, the provisions on copyright state that the "*copyright shall belong to the author of the work*"[138] and that an *author* shall mean a "*natural person* who has created the work."[139]

For the moment, the issue of intellectual property ownership over AI-generated works in the Philippines appears to be a shut case although changes may be made through future revisions of the IP Code. Whether the Philippines will follow the rule that the person who arranges for the AI to create the work is considered as the author, and whether the programmer or the direct human user of the AI shall be considered as author or inventor of output produced by AI have yet to be tested.

IV. INTELLECTUAL PROPERTY PROTECTION OF ARTIFICIAL INTELLIGENCE IN THE PHILIPPINES DURING THE COVID-19 PANDEMIC

More relevant, in the meantime, is the Philippines' stance on the protection of technologies, such as AI, used in response to the COVID-19 pandemic. Due to the COVID-19 situation, the IPOPHL issued several memorandum circulars providing for the suspension of its operations and the extension of deadlines for various filings for the registration and maintenance of IP rights.

On 20 April 2020, however, the IPOPHL issued Memorandum Circular No. 2020-010 which states that the extension granted filings of papers,

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detail.aspx?g=b63e2f06-5144-4494-91d5-7855e230cb2f (last accessed Sep. 30, 2020).

134. Copyright, Designs and Patents Act, 1988 c. 48, § 9 (3) (U.K.).

135. Leigh Smith, AI and IP: copyright in AI-generated works (UK law): Can copyright subsist in an AI-generated work?, *available at* https://talkingtech.cliffordchance.com/en/ip/copyright/ai-and-ip--copyright-in-ai-generated-works--uk-law-.html (last accessed Sep. 30, 2020).

136. INTELL. PROP. CODE, § 28 (emphasis supplied).

137. *Id.* ch. VII (emphasis supplied).

138. *Id.* § 178.1 (as amended) (emphasis supplied).

139. *Id.* § 171.1 (as amended) (emphasis supplied).

pleadings, documents, and payments will not apply to Third Party Observations for invention applications and Adverse Information for utility model and industrial design applications for Personal Protective Equipment, medical/health care equipment/devices, and pharmaceutical products urgently needed to contain and address the COVID-19 situation, as it would cause delay in the processing of these applications.[140] Memorandum Circular No. 2020-010 shows a clear government policy to fast track the registration procedure for useful technologies during the pandemic, and a continued respect for private ownership of intellectual property.

On the other hand, the Inter-Agency Task Force has directed the Department of Health and Multisys Technology Corporation, the developer of the *StaySafe.PH* app, to sign a Memorandum of Agreement regarding the donation and use of the app, including the source code, data ownership, and intellectual property involved.[141] IATF Resolution No. 45 dated 10 June 2020 was issued in response to concerns on data privacy and other confidentiality laws in relation to the use of the contact tracing functions of *StaySafe.PH*.[142]

Notwithstanding the foregoing, the Philippine government has a proven track record for respecting and protecting intellectual property rights, which should apply even during crises. Protection of AI inventions and/or programs, while subject to limitations under the IP Code, are guaranteed subject to the requirements of patentability and/or copyrightability of the AI.

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140. Intellectual Property Office, Advisory on Deadline for the Filing of Written Third Party Observation (TPO) for Invention Applications and Adverse Information (AI) for Utility Model and Industrial Design Applications, for Personal Protective Equipment, Medical/Health Care Equipment/Devices, and Pharmaceutical Products, Memorandum Circular No. 2020-010 [Memo. Circ. No. 2020-010], ¶¶ 1 & 2 (Apr. 20, 2020).

141. Melva C. Gayta, Data collected on StaySafe PH stays with government, *available at* https://pia.gov.ph/news/articles/1044696 (last accessed Sep. 30, 2020).

142. *Id.*