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New Opportunities and Challenges to Information Technology Researchers and Professionals due to COVID-19

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***Abstract*: The COVID-19 pandemic has created a massive global public health crisis and has caused social upheavals, disrupted business and industry and has affected the economy, life and work worldwide. The spreading of contagious Corona virus fear has forced to follow social distancing and staying at home agenda and is forcing executives, managers and policy makers worldwide to quickly implement business and operational decisions. They are embracing technology to address the crisis in a fast pace. The fully automated digitization and online communication and transaction which could not been happened for the last ten years; that abrupt changes are happening all around the World in few months. COVID-19 has presented IT industry, professionals and researchers several new opportunities as well as new challenges. All are forced to live, work, learn, and socialize in a new environment with constraints. This paper is an attempt to review the increasing and varied role of AI in different spheres of business and operational decisions at this critical juncture of time and evaluate the new opportunities and challenges to be faced by IT Industries and Research Institute. This paper also gives an insight into COVID NET, a recent Deep Convolutional Neural Network Design which is the first open source network designs for COVID-19 detection.**

***Keywords*: AI, COVID-19, C-19, CNN, COVID-NET, Deep Convolutional Neural Network.**

1. Introduction

COVID -19 pandemics has become a 'timely' wakeup call and a great reset to everyone; every industry sector, every country, every economy. IT has become an epicentre of several operations in healthcare, business, education, governance, judiciary, community service, and more. Technology is helping companies and individuals everywhere to get through this unfortunate, unforeseen crisis. There was an emergency in digital transformation within days or 1-2 weeks. This led to sudden surges in demand for computing resources and digital infrastructure that powers transactions and communications. The pandemic impact on IT has been largely positive. Information Technology (IT), business, start-ups and individuals rose to the occasion in terms of innovation, competition, new business models, emergence of new business collaboration and new business strategies. However, there are new negative impacts such as increase of newer cyber security threats and risks, performance issues such as digital congestion due to significantly increased workload and business continuity and agility issues. But acceleration of the digital transformation was forced upon work, education and private life. High Performance Computing, Genomics Analytics, Tracking and Surveillance, Supply-Chain Elasticity, Remote Presence, Connectivity (5G), IP sharing are the major technological role players that need constant support of Artificial Intelligence. COVID-19 has brought many openings of new research opportunities.

COVID-Net, a tailored deep convolutional neural is designed for the detection of COVID-19 cases from chest X-ray (CXR) images that is open source and available to the general public. [1] COVID-Net is the first open source network designs for COVID-19 detection from CXR images and COVIDx is an open access benchmark dataset that are generated comprising of 13,975 CXR images across 13,870 patient cases.

2. Opportunities

Uses of Information technologies are becoming the necessity during this C-19 pandemic critical time and helping the fight against the C-19 by assisting health professionals and Governments. Information technologies are being harnessed in the following fields rigorously:

- Cloud computing
- Artificial Intelligence
- Drones
- Robots
- Telemedicine
- Geo–fencing based service
- Chatbots
- Autonomous systems
- Virtual dashboards
- The Internet and VPN
- IoT
- GPS
- GIS
- Big data
- Thermal cameras, and

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- Facial recognition.

Internet-connected exercise bike maker Peloton reported revenues increased by two-thirds in first quarter, as stay-at-home orders kept people from their normal purchasing and ordering online. Webcams were sold out everywhere. There were abrupt changes in buying patterns of consumers and some services were on huge demands. Video conferencing provider Zoom had 10 million daily participants before pandemic era and that has increased to 300 million daily participants by April and previously it was a tool used mostly by businesses, and currently has become a household word. Instacart, the online groceries provider, saw a hike in sales of $700 million per week in April, up 450 percent since December.

There was a change in buying and selling pattern of consumer goods according to the report of IEEE Spectrum (15th July, 2020) [3]. Mojo Vision had a study on 2000 responses and based on the top two choices of the respondents they found the changes in buying pattern and also in the usage of technologies.

Table 1.
Mojo Vision's study on 2000 consumers on buying/using Technology

	Buying/Using of Technology
Wearable Technology	17%
Health & Wellness	21%
Smart Home tech	13%
Alternative Transportation	7%
Voice activated AI devices	17%
Gaming and Entertainment	23%
Virtual Communication Tools	53%
Augmented Reality or Virtual Reality	7%
Online Delivery Services	43%

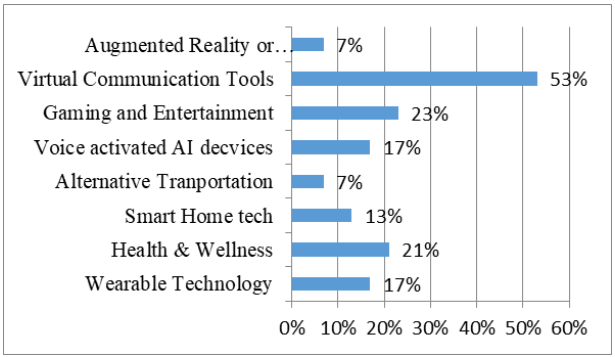

Fig. 1. Type of technology consumers have been buying and/or using since the onset of COVID-19, that they were not using or had little interest in before. (Tekla Perry/IEEE Spectrum, Source: Mojo Vision)

The research areas of AI which will be more focused in coming days are,

- AI Text
- AI Text to Speech
- AI Speech to Text
- AI Language Translation
- AI Physical Interface
- AI Avatar
- AI Vision Analysis
- AI NLP Text Mining
- AI Bias
- AI Deflate
- AI Auto
- AI Explainability
- AI Reproducibility
- AI Machine Learning
- AI Remote Execution
- AI Emotion Extraction
- AI Entity Extraction.

AI is a technique that enables computer to mimic human behaviour. Machine Learning (ML) is a subset of it. It is the ability to learn without explicitly being programmed. Deep Learning is a very recent concept under ML that extracts patterns from data which is impossible for human being and it works like the neurons of human body and that network is known as neural network.

AI Text Generator intakes a sentence or partial sentence and generates the paragraph of text and predicts the subsequent text from the input. Unsupervised language model is used to predict the paragraph of text and it is useful in many consumer services such as FAQ services etc. [4] GPT-3 was released in June 2020 by research lab OpenAI, which was beta version and the service went viral among entrepreneurs and investors, who excitedly took to Twitter to share and discuss results from prodding GPT-3 to generate memes, poems, tweets, and guitar tabs. [5]

AI Text to Speech and AI Speech to Text converts text into natural-sounding speech and vice versa and thus improves customer interactions with life like responses intelligently. This also engages users with voice user interface in their devices and applications and personalizes their communication based on user preference of voice and language. In speech synthesis, there are two specific methods for Text-to-Speech (TTS) conversion: Parametric TTS and Concatenative TTS. Concatenative TTS technique relies on high-quality audio clips and the generated speech audio is very clean and clear but it sounds emotionless but not natural. Concatenative TTS is very restrictive, so instead of a brute force method, a more statistical method was developed. Parametric TTS generates speech by combining parameters like fundamental frequency, magnitude spectrum etc. and processes them to generate speech. Deep Learning models have proved extraordinarily proficient at learning inherent features of data that aren't really human readable, but they are computer-readable, and they represent data much better for a model. [6] Siri is a virtual assistant that uses voice queries and a natural language user interface and processor (NLP) to provide many Internet services.

AI Avatar is the technology to create customized digital beings that can appear on displays or video games and could be designed to be TV anchors, spokespeople, or movie actors or even companions and friends. ObEN is an artificial intelligence company that is building intelligent 3D avatars that look, sound, and behave like the individual user. A Samsung lab released a digital avatar, an AI-powered "artificial human," claiming to be able to "converse and sympathize" like real people. In 2020 Star Labs, an independent Samsung unit produced a new kind of AI called NEON which is just digital avatars acting like a computer-animated human or 'artificial human' moniker as Siri.

[7]. Evie is a learning AI and an advanced, emotional chatbot avatar. She can speak several languages and has become rather popular on social media and YouTube. Evie uses a database when she needs to say something and she were learned from a human being at some point in the last 10 years. [8] Chatbot Avatars may be helpful in business world and media industry in near future.

AI Bias is an approach to mitigate the biases that are generated due to the training with data that contain implicit racial, gender, or ideological biases. Bias in AI systems could erode trust between humans and machines that learn. The MIT-IBM Watson AI Lab is putting efforts on shared prosperity on recent advances in AI. They are aiming to build machines that apply certain human values and principles in decision-making. IBM scientists developed an independent bias rating system which can determine the fairness of an AI system [9] AI deflate is somewhat related to AI bias which needs to be taken care of in coming days, as well.

AI Auto mining or Autonomous robot performs as standalone system. It has a built-in AI system that can learn from its environment and experience. Reinforcement modelling techniques of ML is used for its learning and it can be deployed in many places where human existence is impossible or is to be removed to reduce contamination of contagious diseases. Autonomous robotic nurses are deployed to serve COVID-19 patients in hospitals. [10]

AI Vision Analysis is image processing technique which uses deep learning technique under machine learning. It can assist doctors and medical practiceners to analyse the medical reports, diagnose diseases and prescribe medicines. In some cases, computer vision analysis gives accurate results and this can serve greater population in highly populated countries and under-developed countries where there is a big difference in proportion between the number of medical practiceners and the number of patients.

AI reproducibility is a challenge. Although reproducibility is essential component in scientific researches but ML is facing a reproducibility crisis. According to a survey conducted by journal Nature in 2016 on 1,576 researchers, more than 70 percent of researchers failed to reproduce others' experiments, and more than half were unable to reproduce their own experiment results. Henceforth research reproducibility in AI field is an area which needs attention in the coming future for the researchers. [11]

AI Emotion Extraction and AI Entity Extraction can be improved by deep learning approaches. A Cascade Feed-forward Artificial Neural Network model trained by a recent optimization algorithm called as Vortex Optimization Algorithm was used to extract emotions from facial expression [2]. These AI techniques can be used in police force, military force and in many security enforcement levels.

AI Remote Execution is the ability to run arbitrary computations on data which is inside a machine to which access and computation can be done remotely like cloud computation, Deep learning remote servers can be created remotely to access and provide intelligent services to remote clients. From the year 2015, Google has opened up their free ML platforms and technology (Tensorflow etc) to encourage more research works in AI field across countries, all around the world.

Deep Learning has different approaches (algorithm) such as Neural Network (NN), Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), Long/ Short Term Memory (LSTM) , Gated Recurrent Unit (GRU), Generative Adversarial Network (GAN), Auto Encoder (AE), Liquid State Machine (LSM), Deep Residual Network(DRN), Support Vector Machine (SVM), Neural Turing Machine (NTM), Deep Convolutional Network (DCN), Deconvolutional Network (DN), Extreme Machine Learning (EML), Echo State Network (ESN), Deep Residual Network(DRN) and some older models like Perceptron Model (PP), Feed Forward (FF), Deep Feed Forward (DFF).

3. Challenges

COVID-19 pandemics has also exposed weakness and vulnerabilities of our current IT systems and IT planning and implementation. According to the Check Point Research data, phishing campaigns, deceptive domains and malicious apps were just some of the tactics that have taken advantage of COVID pandemic situation to spread computer virus and its repercussions. [12] Thousands of corona virus – related domain names, banking Trojans, hacker's attacks on remote desktop applications were in the report of 'Cyber Attack Trends: 2020 Mid-Year Report'. The increase of newer cyber security threats and all kinds of threats took a peak in mid- April, 2020.

While digitally business models were inevitable, the infrastructures were not reliable even in the developed countries as well. The biggest role players in IT industry also accepted the fact that the digital infrastructures were not fully optimized. Quicker response and optimizing the IT models are to be taken care of since ISP customers are finding performance delays. Videoconferences are unstable with frozen screens and sound delays. Mobile calls are dropped frequently or there is no network (Internet) coverage. Online banking is getting delayed for network congestion. Microsoft's Research indicated that 25 million people are without broadband in the developed country like USA. According to the Pew Research 33 million Americans do not use Internet at all. [13]. Henceforth sudden complete transformation into digitization is a real challenge throughout the World.

Hence, more investments in digital infrastructure are required. Post Corona World must focus on the improvement of digital economy. Use of High Performance Computing is required for vaccine discovery. Agility and continuous learning of new model will be a challenge. The sudden acceleration of digital transformation was a force upon education, private and work life that caused stress. Adapting and learning new technologies, especially to the traditional users are biggest challenges.

There is a demand of Genomics Analytics research work, IP sharing, supply Chain management, restrictions in people movement and virus spread. According to the report of Hewlett Packard Limited, there will be high demands on HPC, 5G connectivity and IP sharing, Genomics Analysis, Food Production and delivery.

In 2016, there was a delay and slow adoption of Cloud Technology. But there was a massive surge in the use of computer networking and hiring of the cloud facilities in the beginning of 2020 due to this pandemic. Microsoft announced that there was an increase of 700% VPN clients after the lockdown had started. 85% of small and medium businesses never had digital disaster recovery planning but the mindset of small and medium business owners are now changing as an impact of COVID-19 lockdown crisis. The security will be another challenge. So while adopting Clouds and IT technologies, security issues should not be overlooked or compromised.

4. COVID-NET

The COVID-19 pandemic has a devastating effect on the global population and their economy, lifestyle and one of the key screening approaches is radiology examination of infected patients using chest radiography. COVID patient gets abnormalities in chest. COVID-Net, a deep convolutional neural network design tailored for the detection of COVID-19 cases from chest X-ray (CXR) images, is an open source network and available to the general public. COVID-Net was probably the first open source network designed for COVID-19 detection from CXR images at the time of initial release. The open source research community has introduced COVIDx, an open access benchmark dataset that has been generated comprising of 13,975 CXR images across 13,870 patient cases, with the largest number of publicly available COVID-19 positive cases. The researchers are investigating how COVID-Net could make predictions using an explainability method is an attempt to not only gain deeper insights into critical factors associated with COVID cases, which could aid clinicians in improved screening, but also could audit COVID-Net in a responsible and transparent manner to validate the decisions based on relevant information from the CXR images. Data scientists have accelerated the development of highly accurate yet practical deep learning solutions for detecting COVID-19 cases. [14]

The COVID-Net models are currently at a research stage and not yet intended as production-ready models for direct clinical diagnosis. So it is not to be used for COVID-Net self-diagnosis.

5. Conclusion

During post-Covid era people will be increasingly dependent on technologies, bots, AI, machine learning etc. Work from home, rise of virtual events, remote health care, flexible and on-demand resourcing, online supply chain management and logistic, online shopping, online business, online monetary transactions, use of plastic money and digitization etc will be more favourable in post COVID era. Conservative and fearful mindsets are adapting new systems comprising of AI, computer networking and cloud technologies. Henceforth R&Ds that address real-life problems that benefit people, industry and society are to be more prioritized. New research and work opportunities are flourishing for researchers, developers, and in the field of IT sectors. The prominent research/ work areas are autonomous systems, data analytics, robotics, AI/ML, supply chain management, deployment of cloud and edge technologies, network security and reliability in the IT Industry. This pandemic has helped aggressive technology evolution. 'Necessity is the mother of Invention'. New job profiles will be emerged whereas some outdated job profiles would be abolished. Technology Predictions are going to become increasingly useful and more investments on digital infrastructures are required. The new state of art neural network (COVID NET) can be a building block of other models. This paper can give some new research ideas on IT and AI fields to the aspirant future researchers.

References

[1] Wang, Linda., Wong, Alexander, COVID-Net: A Tailored Deep Convolutional Neural Network Design for Detection of COVID-19 Cases from Chest X-Ray Images. 2020
[2] Boz, Hakan, Köse, Utku, Emotion Extraction from Facial Expressions by Using Artificial Intelligence Techniques, BRAIN Broad Research in Artificial Intelligence and Neuroscience, vol. 9, no. 1, 2018.
[3] IEEE Spectrum website, https://spectrum.ieee.org/view-from-the-valley/consumer-electronics/gadgets/will-the-coronavirus-pandemic-make-early-adopters-of-us-all, last accessed 2020/07/20.
[4] DeepAI website, https://deepai.org/machine-learning-model/text-generator.
[5] Wired Site, https://www.wired.com/story/ai-text-generator-gpt-3-learning-language-fitfully/
[6] https://medium.com/@saxenauts/speech-synthesis-techniques-using-deep-neural-networks-38699e943861, last accessed 2017/10/21.
[7] https://techxplore.com/news/2020-01-samsung-unveils-ai-powered-digital-avatar.html, last accessed 2020/01/07.
[8] Eviebot homepage, https://www.eviebot.com/en/
[9] IBM website, https://www.research.ibm.com/5-in-5/ai-and-bias/
[10] The Hindu Net Desk, https://www.thehindu.com/news/cities/chennai/robotic-nurses-to-deliver-medicines-and-food-to-covid-19-patients/article31287955.ece, last accessed 2020/04/08.
[11] Synced wesite, https://syncedreview.com/2019/09/26/reproducibility-challenges-in-machine-learning-for-health/, 2019/09/26
[12] https://www.techrepublic.com/article/how-cybercriminals-have-exploited-the-coronavirus-pandemic/?, 2020/07/22.
[13] https://www.pewresearch.org/internet/2020/04/30/53-of-americans-say-the-internet-has-been-essential-during-the-covid-19-outbreak/, 2020/04/30.
[14] lindawangg/COVID-Net, https://github.com/lindawangg/COVID-Net, 2020/08/10.