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MESSAGE FROM THE VICE CHANCELLOR

"

University of Engineering and Technology is an institution which has always nurtured its students to set and achieve lofty goals by providing them the freedom to polish their skill set through curricular and co-curricular activities. A commendable product of such efforts and skills is Elektron, a magazine by the Department of Electrical Engineering, produced by the Student Chapter of IEEE, UET Lahore. Elektron reflects the creative minds of the students of Electrical Engineering and their abilities to breathe life into their innovative ideas.

To make this magazine a constant source of guidance and inspiration for the masses, the work done by the team Elektron is indeed worthy of appreciation. The efforts put forth by the team Elektron should serve as a motivation for other students of UET Lahore to embark upon similar initiatives. I wish them best in their future endeavors.

"

Prof. Dr. Syed Mansoor Sarwar,
Vice Chancellor,
University of Engineering and Technology, Lahore.

MESSAGE FROM THE CHAIRMAN

"

Universities have always been the centers of research and development since the known history of knowledge. Students get inspired from their teachers in the learning environment of universities and the motivation of getting published gives oxygen to the spark of the competent and enthusiastic students. Departmental magazines provide teachers and students a platform to present their research, innovative ideas, and their observations and comments on existing research.This opens a gateway to the junior students towards the horizons of knowledge.

IEEE UET Elektron magazine, which is a publication of the Department of Electrical Engineering of UET Lahore, is one such platform.

I wish the best of luck to the hard working team of the magazine from Department of Electrical Engineering and IEEE UET Lahore.

"

Prof. Dr. Khalid Mahmood ul Hasan
Chairman, Department of Electrical Engineering
University of Engineering and Technology, Lahore.

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اَلَّذي خَلَقَ السَّماواتِ وَالأَرضَ وَما بَينَهُما في سِتَّةِ أَيّامٍ ثُمَّ استَوىٰ عَلَى العَرشِ ۚ الرَّحمٰنُ فَاسأَل بِهِ خَبيرًا ۝

"He who created the heavens and the earth and what is be-tween them in six days and then established Himself above the Throne. He is the Lord of Mercy; He is the Best Informed."

"

Article 1

Introduction to Deep Learning and Its Applications

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ABSTRACT

Deep Learning, a sub-field of machine learning, refers to training a neural network of multiple layers to enable computers acquire knowledge and learn different tasks from experience. It gained popularity recently due to advancements in technology and availability of large datasets. Today, it is one of the hottest areas of research and development and has been used to solve many complex tasks. This article introduces the reader to the field of Deep Learning and its applications with a few simple examples.

INTRODUCTION

Human beings have long desired to build machines that can think. This desire has been there, perhaps from the time of ancient Greece. When the concept of programming computers was conceived, people began to think whether these machines can be as intelligent as human beings.

Today artificial intelligence (AI) can be seen helping us carry out complex labor tasks automatically, understand images or speech, diagnose health related problems, develop vaccines and so on. In the early days, AI solved problems that were difficult intellectually for human beings but easier for computers. Usually these problems were easily described by a list of mathematical rules. Today the challenge in AI is to solve problems that human beings solve easily, automatically and intuitively like recognizing an image, understanding speech etc. To solve this challenge, the approach adopted by computer scientists is to train the computers to acquire their own knowledge, learn from experience and understand the world. This capability of the computers is called Machine Learning. Learning from experience eliminates the need to program all the required knowledge into the computer to solve problems.

Different algorithms are used to implement learning in the machines. Most popular algorithms in the classical machine learning era are linear regression, logistic regression,

support vector machines, online learning, anomaly detection algorithms and artificial neural networks. Around the year 2013-14, a sub-category of machine learning called Deep Learning gained popularity. Deep Learning uses neural networks to train computers, similar to what a human brain does using biological neurons. A neuron is the basic unit of the brain responsible for transmitting messages to/from the brain from/to the other parts of the human body.

A neural network (NN) is a network of inter-connected neurons (represented by circles) that maps inputs to the outputs as shown in fig. 2. This neural network has 3 hidden layers. Neural networks with a few hidden layers are termed as "shallow" neural networks while NNs with numerous hidden layers are termed as "deep" neural networks. As shown in fig. 2, the deep neural network identifies the image to be of a person, car or animal by first identifying the edges from the pixels of the image, then identifying the corners and contours, and then finally identifying each object in the image. The first hidden layer performs a simple task of identifying edges, the second layer performs a relatively difficult task to find contours and corners from edges and the third layer identifies objects from contours and corners which is the most complex of all the tasks. So, this deep learning NN identifies objects using two concepts i.e. edges and corners and contours, where each concept is built from the previous simpler concept in the previous layer.
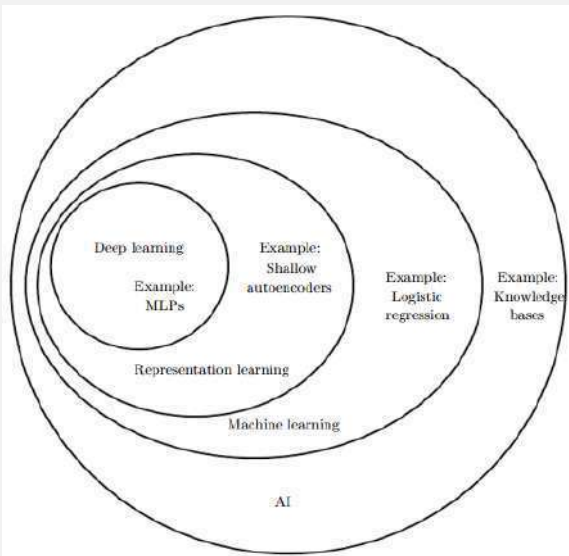

Figure 1. Venn Diagram Illustrating the Sub-Fields of AI, *Source: "Deep Learning", authored by I. Goodfellow, Y. Bengio, and A. Courville, MIT Press, 2015*

APPLICATIONS OF DEEP LEARNING

Deep Learning has revolutionized the field of computer vision, natural language processing, healthcare, digital marketing, autonomous vehicles, and recommender systems. Some of the applications are discussed below.

Computer Vision

Computer Vision is the field of AI in which computers are trained to extract useful knowledge from digital images and videos. For example, Deep Learning can be used to detect car accidents. Information like the location of the accident, the type and color of the car, the severity of the accident can be detected and the relevant departments like police, health and rescue could be informed about the accident. An example of Deep Learning applied to identify objects in an image is shown in fig. 3a.

Natural Language Processing

Natural language processing is the field of AI which enables computers to understand, interpret and manipulate human language. For example, deep learning can be used to convert human handwriting to machine-readable format as shown in fig. 3b. This is particularly useful in FIR lodging scenario where due to ambiguities in the handwritten FIR, appropriate actions are not taken against the accused.
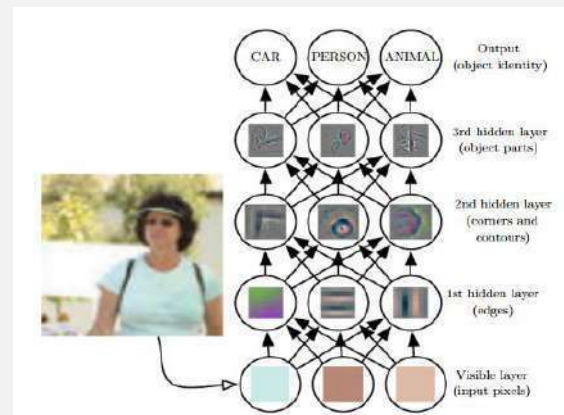
Figure 2. A Deep Neural Network for Object Identification, *Source: "Deep Learning", authored by I. Goodfellow, Y. Bengio, and A. Courville, MIT Press, 2015*

Health Care

In health care, deep learning can be used in the diagnosis and prognosis of different cancers, tumors, and other health related problems. For example, deep learning applied to an X-ray image can help identify bone-related diseases as shown in fig. 3c. Deep learning has also been used to accelerate the development of vaccines.

(a)

(b)

(c)

(d)

(e)

(f)
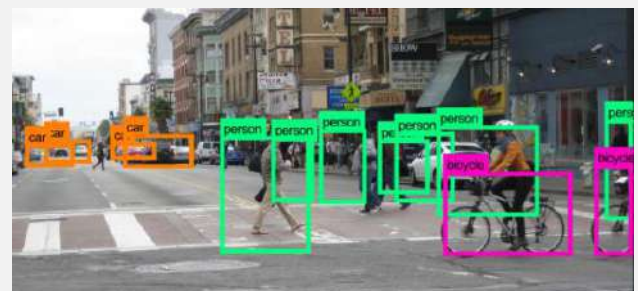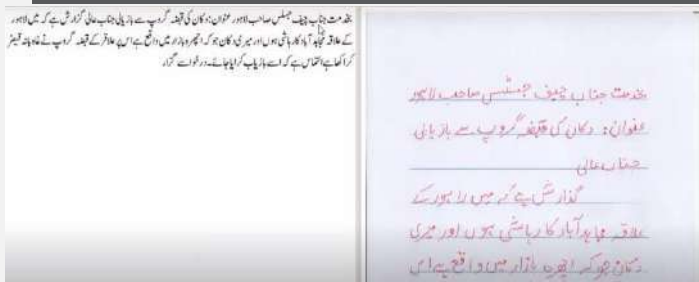
Figure 3. a) An Example of Computer Vision
b) An Example of Natural Language Processing[2]
c) An Example of Deep Learning Implemented on X-Ray Images
d) An Example of Deep Fakes [3]
e) An Example of Fault Identification [4]
f) An Example of Non-Intrusive Load Monitoring [5]

Deep Fakes

Another area where deep learning is gaining much attention is Deep Fakes. It refers to using Deep Learning to create fake images and videos. It is feared that Deep Fakes could be used to influence politics, blackmail people and spread offensive material in the society. Deep Fakes has also been used positively, for instance to spread the awareness of malaria [3] (See fig. 3d).

Deep Learning in Electrical Engineering

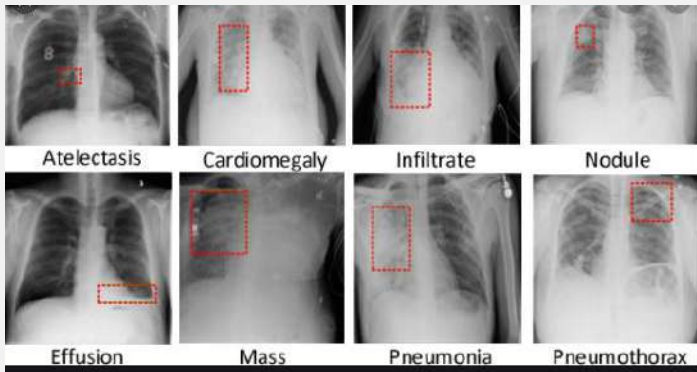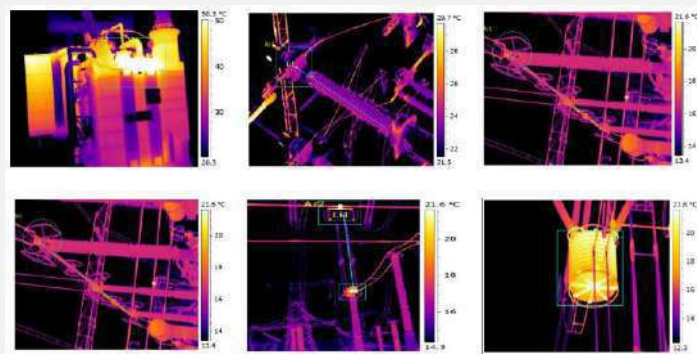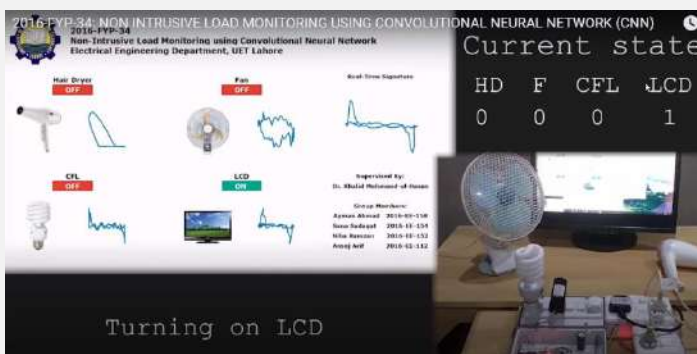In Electrical Engineering, deep learning has been used to detect electricity theft, monitor load non-intrusively process signals, forecast electrical loads, detect and identify faults in motors, generators, transformers, transmission lines and power electronics systems. The authors in [5] used thermal imaging camera along with Deep Learning to identify faults in different power equipment (fig. 3e). The authors in [4] used Deep Learning to detect whether an appliance, within a house, is in ON or OFF state (fig. 3f).

THE RISE OF DEEP LEARNING

Deep learning gained popularity after the year 2010 due to two main reasons;

1. The availability of powerful CPUs, GPUs (Graphical processing units) and TPUs (Tensor processing units).

2. The availability of tremendous amount of data, usually known as Big Data, made possible by Internet of Things (IoT) devices.

The powerful processors allowed the development and training of large and deeper neural networks with numerous hidden layers. Recently Microsoft won the ImageNet computer vision challenge in which a deep neural network with 152 layers were used. Fig 4. shows the number of connections per neuron in living beings and man-made neural networks, which used to be less in the past due to hardware limitations.

The availability of large data sets improved the performance of deep neural networks. Advances in software libraries like Theano, PyLearn2 and TensorFlow have also accelerated the use of Deep Learning.

Today Deep Learning is being used by top technology companies like MICROSOFT, GOOGLE, FACEBOOK, BAIDU, APPLE, NETFLIX and ADOBE. It is one of the hottest areas of machine learning right now and will continue to revolutionize other areas in the future.
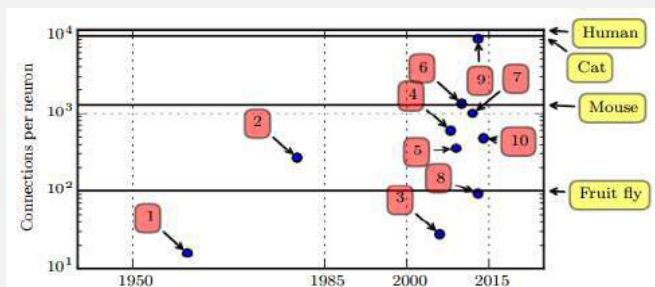
Figure 4. Number of connections per neuron in living beings, *Source: https://dmitry.ai/t/topic/202, Credit: Dmitry Fedyuk*

DEEP LEARNING PRE-REQUISITES AND RESOURCES

Anyone interested to acquire deep learning skills must have sufficient knowledge of calculus, linear algebra, probability theory and Python language. Numerous online courses are present where people can study about the Deep Learning. In my opinion, the Coursera course by Andrew NG is the best of all the online courses and suitable for beginners. For more advanced topics and in-depth study, [1] and online video lectures posted by Stanford University on YouTube are very useful resources. The research paper [6] presents a review of recent trends and applications of Deep Learning in greater detail.

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Article 2

Latest Technological Innovations in the World

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ABSTRACT

New technologies have become an inevitable part of our everyday lives. They have infiltrated every facet of our lives and have become part of us. These technologies will certainly make it easier, quicker, and less expensive for all people to communicate with one another. They may contribute to the globalization of not only trade and commerce and to greater international political, social and cultural integration and a move away from the tribal and ethnic conflicts that have dominated human history. Furthermore, mechanisms to manage technological changes have been historically unsuccessful, as technological development has always out passed the ability of governments or business to regulate its use.

INTRODUCTION

We are living amidst technology. This is an era of AI, scientific research and innovations. This time of the fourth industrial revolution has brought many changes in the lifestyle as well as thinking-style. Everyone is a runner in this race of modernization. The ONES who cannot meet the standards will be left behind. Man seeks for betterment. Nowadays, technology is developing in a glimpse of an eye. Human-made his first car in the year 1803, and now after just two centuries, we have vehicles that can fly; Trains that can travel faster than the speed of sound. It was in 1876 when Graham Bell invented the first phone. Now, we have phones that can do everything we will need. They are used in computing, keeping our record safe and connecting with

others. You can easily call anyone on the other side of Earth with a mobile phone that weighs less than 10 grams.

If we talk about the recent past, human thirst is not fulfilled. He has been opening new doors to innovation and modernization of society. I will give some examples regarding the latest steps by mankind in the field of technology.

MIRACLES OF TECHNOLOGY

5G Data Networks

The fifth generation of mobile internet connectivity is set to give us a super-fast experience of download and internet streaming. It will take the Internet of Things (IoT) to the next level. According to research, 5G can provide a download speed of 1GBps that is remarkable. When 5G stepped-in in 2019, it was expensive and unreachable. However, now, 5G devices are getting common around the world. The increased bandwidth will enable the robots, machines, and autonomous vehicles to transfer data quickly, resulting in a super-fast technology experience.

Artificial Intelligence expanding its roots

Artificial has been changing humans' lifestyle from the last decade, but recently due to immense investment in business sectors, it is taking sky-high jumps. AI-based systems are becoming common. Apart from enhancing the lifestyle of humans, AI is performing great in the research sector. Recently, Kattie Bauman, a student from MIT, developed the first-ever picture of a Blackhole. Moreover, recently, AI has created the sketch of Pharaoh. Autonomous driving is also gaining popularity among the people. Waymo has completed a trial of Autonomous taxis in California. In just a year or two, Autonomous vehicles will become very common among people.

Figure 1. AI-based gadgets are becoming an integral part of our lives, *Source: "An ode to Artificial Intelligence", https://www.indiaaccelerator.co/blog/an-ode-to-artificial-intelligence-and-its-adoption/*

Personalized and Predictive Medicines

Better health care is becoming possible because of technological innovation. Data capturing from smart watching is becoming common and more realistic. Every person can check his temperature, Blood Pressure, and heartbeat in a glimpse of an eye. Although these gadgets are not introduced recently, advanced studies of genomics and AI has introduced modern concepts in these devices. They can compare the body behavior of different people to present precise result.

Brain-Computer Interface

Recently, researchers have operated small toy cars with the mind. In a few years, we will be on the doorstep of mind-controlling the world. Elon Musk said in an interview that obsolete mouse and keyboards would be ordinary in future. Moreover, ingestible medical devices are also stepping into the market.

Figure 2. A Brain-Computer Interface testing session, *Source: https://wiharper.com/brain-computer-interface-company-neuracle-raises-rmb-60-million/*

CONCLUSION

This article is just a microscopic view of technology that is stepping into our lives. The future is much more innovative than this. The primary purpose of all these devices and inventions is to make Human life easier. Nevertheless, weapons and other toxics are also spreading more due to these inventions. We have bombs that can kill thousands of people in seconds. All of this depicts the dark side of the picture. However, in a few years, we have to see where this innovative rocket of humans' land. Will it be in favor of humanity or a strategy against it!

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Article 3

5G-The Next Wireless Standard

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ABSTRACT

The article summarizes the innovations 5G is about to bring in our world. Though other data networks have served mankind to the fullest in the respective eras, 5G will not only bring better and faster data networking but will also invoke researchers to find more and better ways to improve the existing technologies. In comparison to other data networking generations, 5G will be demanding the design of flexible enough system concept platform that will improve the integration and management of various technologies.

INTRODUCTION

We are living in an era where one cannot even breathe without the use of technology. This fact highlights its importance and how much we are dependent upon it. Why do we even need these technologies? They directly help us in several ways, like the blessings such as of calls, text messages, and social media. These technologies require medium to flow. This is where a network of connections comes in.

WHAT IS A NETWORK?

Generically speaking, a network is a group of people where they can share and communicate information. In computer and technology, a computer network is a group of computers that use a communication protocol for information transfer across boards.

GENERATIONS OF TECHNOLOGY

First Generation (1G)

It all began when in the 1980s, 1G technology was introduced.1G refers to the first generation of wireless cellular technology (mobile telecommunication).1G was dependent upon the analog radio systems, which means that one could only make a phone call using this technology. No text sending or receiving. But it was a new thing, so it was a boom at that time. In the beginning, only Japan and the USA had the privilege to use this technology, but later it spread to every part of the world. But it had its limitations like cell

coverage would drop, and its hacking was pretty easy.

Second Generation (2G)

Then **2G** barged in after 1991. Now in 2G technology, everything was being shifted to digital system. So, its

security and capacity were improved by many bounds. Now people started sending SMS and MMS. Then after few years, GPS was introduced, and then a new feature of emails was introduced, and it had a significant impact on the people, but everything has its boundaries; Similarly, 2G required strong digital signals to maintain phone calls. No network coverage implies weak, and systems could also not handle complex data, like online streaming, which includes videos.

Third Generation (3G)

Then Third Generation mobile networks (3G) got introduced, and it is still in use. Some highlighting points about 3G are that it is much faster than 2G, and it transmits a fantastic amount of mobile data. These include video calls, file sharing, watching videos online, and also internet surfing. 3G technology allows location-based services, which provides weather reports on mobile, but the plans for implementing 3G networks are severely expensive.

Fourth Generation (4G)

Fourth generation (4G) technology went one step forward, which was in terms of speed, and it had five times faster rate than 3G. 4G is the era of mobile broadband. Mobile technology released after 2013 had this fourth-generation (4G). It was better in every way, from video quality to streaming quality, faster downloads, and so on.

Figure 1. Businesses are expecting the roll-out of 5G to unlock global economic output of up to USD$12.3 trillion in 2035.
Source: Designed by freepik,
https://www.irishexaminer.com/sponsored/arid-40073000.html

AN EPOCH OF FIFTH-GENERATION (5G)

5G is a global wireless standard and the most advanced to date. This enables a new kind of network to connect virtually with everyone and everything, including machines, objects, and devices. 5G is meant to deliver higher multi-Gbps peak data speeds, more reliability, massive network capacity, and a more uniform user experience to more users. Higher performance and improved efficiency empower new user experience and connect new industries. Furthermore, this advanced network will also prove useful in the advent of Cloud and IoT technologies, thus making them more user-friendly and user accessible.

WHO INVENTED 5G?

It is not a person who gave life to this technology, but several companies played their part and crafted this technological masterpiece. **Qualcomm** had a significant contribution to inventing the many foundational technologies that drove the industry forward and made up 5G, the next wireless standard. 3GPP navigates many essential inventions across all aspects of 5G design, from the air interface to the service layer. Other 3GPP 5G members range from infrastructure vendor, and component/devices manufactures to mobile network operators and services providers.

COMPARISON OF 5G WITH ITS PREDECESSORS

Several advantages of 5G are that it is:
- faster than all of its predecessors combined
- carries more bandwidth in terms of capacity
- lag-resistant as compared to 4G
- remarkably advanced in spectrum usage

PERKS OF 5G

5G has a significant impact on the world today. The earlier we familiarize ourselves, the better. 5G is designed to do various things that can transform our lives, including faster downloads, higher speed, minimum lag, more capacity, and connectivity for billions of devices, especially in the area of Virtual reality (VR), IoT, and Artificial Intelligence (AI). Additionally, communication of devices with Cloud Servers will speed up too.

Both domestic and commercial users will benefit from this technology. 5G can normalize automation while reducing the noise and gearing up the communication rate, thus leading to faster processes in lower times.

Figure 2. 5G- The new future
Source: https://www.freepik.com/free-vector/people-using-smartphone-app-back-view_6993859.html

CONCLUSION

Even though a more empowered and connected world would result from extended 5G, health experts believe that the technology's hazards will be tremendous. Minimizing health hazards, maximizing capability utilization, and ensuring complete and thorough user-access will be among other challenges in the upcoming time.

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An Insight into Modern Day Genetic Programming

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ABSTRACT

Computers were designed to solve problems that became difficult for humans to solve. As time passed and technology evolved, programming techniques grew stronger and became more comprehensive in their ability to address underlying problems. This study covers the role of Genetic Programming (GP) in effective problem solving. It will also highlight associated facts and terminologies. Genetic Programming is one of the techniques used to solve problems for human beings. It is void of biasing and human weaknesses. Each type is entitled and entrusted to consider bigger problems and end up with acceptable and implementable solutions.

INTRODUCTION

Genetic programming (GP) is a derivative from the behavior of genes and genetic activity in biology or bio-genetics. It runs on the foundations of Genetic Algorithms (GA). GP is a technique of evolving programs, ranging from a population of unfit (usually random) programs, acceptable for a specific task by applying operations similar to natural genetic processes to the population of programs. This technique solves complex machine-learning related problems and determines the best solution for them.

STAGES OF GENETIC PROGRAMMING

In this process random genes are selected; these randomly selected genes are processed through a series of operations and operators. Five steps for generation of a GA for Genetic Programming are as under:

1. Initialization
2. Fitness function
3. Selection
4. Crossover

5. Mutation

The fittest coded gene survives, and the process reiterates. This leads to the best possible and available solution at the machines disposal.

ABSTRACT DATA TYPES (ADT) IN GENETIC PROGRAMMING

ADTs are used in GP just as they are used in every other normal coding technique for storing and processing data.

Arrays

These are used for the representation of genetic data elements. Moreover, genetic data sorting is also an additional feature associated with the use of arrays in GP. Despite the fact that arrays are used in GP which functions on the concept of "evolution", an array itself is void of this feature. It consumes extra space too. All this adds to its limitations for full-scale effective capability utilization.

Linked Lists

Linked Lists are dynamic and hence fulfill the concept of evolution according to space adjustment however, the increased cost of storage and list traversal makes operations expensive and time consuming.

Binary Search Trees

Binary Search Trees are used to store all sorts of data and are very useful. Apart from that a very prominent advantage is its use in the Automatic Interaction Detection (AID) technique in which relationships are determined between forecaster variable and the reliant-on variable. Moreover, Binary search trees can also be formulated while using sideways/parallel GAs. However, the tree should be balanced otherwise operational cost can get non-logarithmic in addition to chances of degeneration.

Hash Tables

Genetic Algorithms are all about evolution. However, when evolution increases, diversity lessens resulting in the possible appearance of the same coded genes. Thus, hash-tables come into play for storing these coded genes that have been evaluated in the latest time frame. A hash table (hash map) is a data structure that implements an associative array abstract data type, a structure that can map keys to values. This leads to scaled improvement in the performance of Genetic Algorithms. In another application, improved hash functions can be generated for given hash-tables in order to prevent maximum number of collisions. There is one factor that should be considered. A Hash-Table undoubtedly improves the quality of a GA, but the collisions are unavoidable. In case the number of collisions exceeds and

becomes unmanageable, the performance of GA gets restricted.

OPTIMIZATION

Optimization is the process to determine the best outcome for a given problem or a situation by changing variables involved in the process. This technique is useful for obtaining maximum output efficiency from a given set of problem(s). For the process of optimization, we always use evolution algorithms (EA) as they have the capability to evolve over time and experimentation.

CONCEPT OF PARALLEL PROGRAMMING IN GP

Tasks to be executed are scheduled first and then taken care of. However, if the number or the complexity of tasks exceeds the processors capability then it slows down. In the case of Genetic Programming, parallel computing is used which maximizes the task scheduling and executing ability. The application of this technique uses the mechanism of a Directed Cyclic Graph in its implementation.
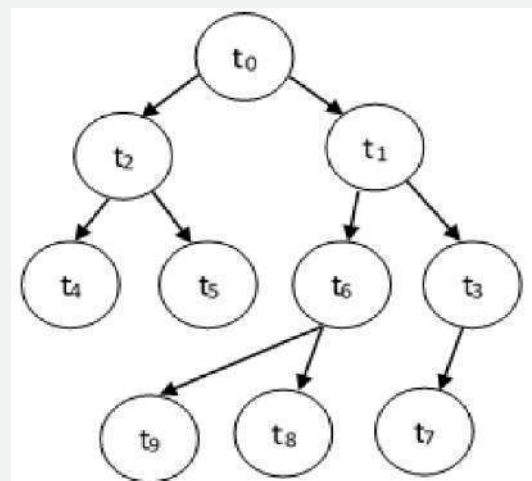
Figure 1. Paralleling in Genetic Programming
Source: "Hard Real-Time Task Scheduling in Cloud Computing Using an Adaptive Genetic Algorithm",
https://www.mdpi.com/2073-431X/6/2/15

APPLICATIONS

Applications of GP are immense such that their entire potential is yet to be discovered. Nevertheless, Machine Learning will be the biggest and by-far the largest source of GP application. Additionally. GP has also allowed the maximum capability utilization in the field of bio-informatics and bio-genetics. From DNA sampling to sequencing and matching, GP has produced trustworthy and concrete results.

CONCLUSION

Genetic Programming is an evolutionary way to create a program. It does most of the work itself, by utilizing previous random programs. It saves time and computational power, by doing most of the work itself. Furthermore, it also improves the accuracy of results by optimizing the data structures, as seen earlier in this research assignment. Different parameters can lead to different results in a genetic algorithm. However, choosing the most suitable parameters will always give us the desired result.

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Article 5

Cloud Computing Hits "The Edge"

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ABSTRACT

Response time to users is a definitive feature for any machine. Cloud Processing adopts a similar pattern. Propagation delay is never appreciated among users thus engineers have found the solution in the form of cloud computing. With the processing of data in real time, edge computing has really given cloud computing an edge!

INTRODUCTION

Cloud computing is the availability of storage and processing resources when needed by the user without him managing the data storage and computational operations actively. Different types of services are provided over the internet and data and programs are stored and accessed over the internet, instead of the hard drive of the user. The user can access his data when needed by accessing the cloud storage that is physically located somewhere else around the world. Research has been done to introduce an infrastructure that is more reliable for the user in terms of response time that is required for the data, which is either stored or accessed by the user. The infrastructure that is being introduced is called Edge Computing. Edge Computing is a distributed computing paradigm that brings computation and data storage closer to the location where it is needed, to improve response times and save bandwidth.
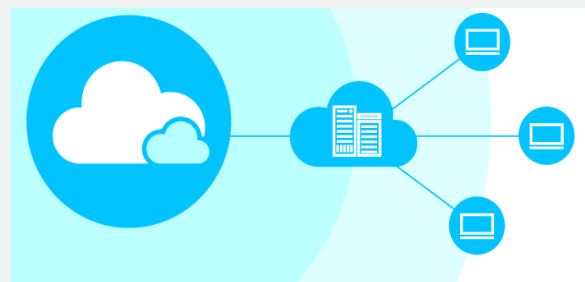
Figure 1. Cloud Storage, *Source: "Edge Computing and Industrial IoT", https://medium.com/@arus_ishkhanyan/edge-computing-and-industrial-iot-for-dummies-bb134c7bd9db*

INFLUENCE OF CLOUD COMPUTING ON SERVICE OPERATIONS

Cloud Computing not only reduces the cost that could possibly be spent on the IT system of the user but also minimizes the problem of storing a limited amount of data on the hard drive that can potentially be lost in case of any hardware or Operating System (OS) issue. It provides disaster recovery and is mobile and flexible. Also, it provides insight regarding the data that is stored in the data centers available

at the centralized locations. Microsoft Azure, Amazon Web Services (AWS), Google Cloud, Alibaba Cloud, IBM Cloud and VMWare are the top Cloud Computing service providers that are famous. Cloud processing also enables user to get their applications to market quickly.

THE NEED OF AN UPGRADED INFRASTRUCTURE

Cloud computing is one of the hottest technologies nowadays in which processing units are offered as "a service" leveraging virtualization. Technology companies like Amazon, Microsoft and Alphabet not only provide Cloud Computing infrastructure on personal level but also to government and corporates. With all this development, they are seeking for an upgraded infrastructure.

The question is does there lie any need of an upgraded model when Cloud Computing is already facilitating us in many ways? Actually, in many cases, computing resources lie quite far from where the user wants to use them to store and access data. In this technological era, IoT devices are becoming more common and consume more processing power. A vast amount of data generated by these devices is passed on to a central network server. Thus, there lies some physical distance between edge device and the center of processing. The distance causes some delay in the travelling time of data from the source to destination in each case, when data is either stored or accessed by the edge device. The response time might be influenced by a few milliseconds, but it can be critical for giant service providers. Secondly, all that data traveling back and forth between the edge and the center of the network puts tremendous strain on bandwidth. This combination of distance and high-volume traffic can slow the network down to a crawl. Since IoT devices experience some network issues such as high response time, and increased bandwidth causes high latency too, so technology giants are looking forward to an infrastructure that provides real-time response required by IoT devices so as to reduce the propagation delay that devices have to withstand in case of cloud computing.

MOVING TO THE EDGE-CLOUD-OF-THINGS

The era we are living in is an era of technological innovations. Everyday new advances in technology are brought to give us a better version of previous technologies. Similarly, the issue of propagation delay in case of Cloud Computing is not affordable by technological companies. An infrastructure has been proposed to overcome the weaknesses that are highly unendurable by big companies since technology has already excelled in the fields of Artificial Intelligence (AI), Machine Learning (ML) and 5th

generation network standard (5G). In this new landscape, organizations use advanced analytics, AI, ML and 5G technology to drive digital industrial transformations, one of which is Edge Computing. Edge Computing is a distributed, open IT architecture and it features a decentralized processing power that enables IoT technologies and mobile computing. Edge Processing reduces the distance between the source and destination during the to and from transmission of data. Actually, Edge Computing infrastructure off loads some of the high volume of data providing faster response to IoT devices. Resultantly, the latency time is decreased. So that, the data stored on cloud becomes accessible very quickly by reducing the delay of even milliseconds. High volumes of data is stored and accessed without high network delay. Massive data of IoT is processed locally through Edge Computing and significantly enhances the response to the user. Modern edge computing brings data storage, data analytics and processing as close as possible to the end-user location.

Nvidia announced EGX edge computing platform to be launched in the coming years that will help telecommunication operators to adopt 5G network standard and also help them maintain edge workloads. Gartner estimates that 80% of enterprises will shut down their traditional data centers by 2025. The edge computing market is projected to grow by a compound annual growth rate of 19.9% between now and 2025.

CONCLUSION

Edge Computing is a next level computing infrastructure to be adopted by technology giants in upcoming years. It will provide local storage and processing of data rather than sending all the data to far off data processing and storage centers thus producing faster response and less latency time.

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SURAH *"Noah"*
VERSE *"15-16"*

"

أَلَم تَرَوا كَيفَ خَلَقَ اللَّهُ سَبعَ سَماواتٍ طِباقًا٥ وَجَعَلَ القَمَرَ فيهِنَّ نورًا وَجَعَلَ الشَّمسَ سِراجًا٥

"Did you see how Allah created seven heavens, one above the other, and made in them the moon a light and the sun a lamp?"

"

Article 6

Digital Twins Technology

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ABSTRACT

A digital twin is a digital replica of a living or non-living physical entity. Digital twin refers to a digital replica of potential and actual physical assets (physical twin), processes, people, places, systems and devices that can be used for various purposes. This article revolves around an advancement in the field of computer science that monitors the systems to the root of problems. Key points to be discussed in this article include digital twin technology and its influences on the world.

INTRODUCTION

The world is moving towards digitalization. Physically handled systems are now studied to be handled automatically. With all these innovations, technology brings yet advancement in the form of digital twin technology. A digital twin is a virtual model of a process, product or service. This pairing of the virtual and physical worlds allows analysis of data and monitoring of systems to head off problems before they even occur, prevent downtime, develop new opportunities and even plan for the future by using simulations.
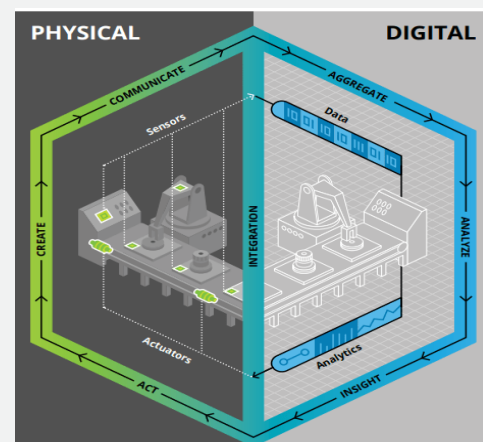
Figure 1. Physical World vs. Digital World.
*Source: "Industry 4.0 and the digital twin",
https://www2.deloitte.com/us/en/insights/focus/industry-4-0/digital-twin-technology-smart-factory.html*

DIGITALIZATION OF THE WORLD

Digitalization refers to the conversion of any kind of data in its digital form of i.e. 0s and 1s. The digital data then gets shape to be processed by the machine. A discrete set of bits is generated from analogous data to make it readable by machines. This paradigm is of crucial importance because

data of any form when converted into digital form can be

processed and carried with same efficiency and can be intermingled.

Digitalization is affecting issues like security, efficiency, wages and health. Digitalization has leaded to automation thus reducing the need of human services. It has brought industrial revolution, economic growth and also a shift in mindset. Physical services are reduced quite a much. Digitalization improves accessibility to information, creates one source of truth for each, item of data, helps in eliminating transcript error, integrates business systems, implements security protocols and helps in creating audit trails. In short digitalization has influenced the world in hundreds of ways.

DIGITAL TWINS AUTOMATION AND HOW IT INFLUENCES THE WORLD

Digital twin technology can be termed as a digital replica of any process, service or process. It is basically a virtual model of any living or non-living physical entity. In this world of digitalization and automation, Computer Science is working to give digital revolution to already been automatized industries.

Digital twins are virtual replicas of physical devices that data scientists and IT pros can use to run simulations before actual devices are built and deployed. They are also changing how technologies such as IoT, AI and analytics are optimized. Digital twins can be used in many industries such as in manufacturing, automotive, construction, utilities and healthcare industries. Digital twins are the next big thing in the 4th industrial revolution for development of new products and processes. Digital data can use variable data to predict different results using Artificial Intelligence (AI) technology. In this way, any loss can be avoided, and production be made efficient and optimizing.

DIGITAL TWIN WORKS AND BACKGROUND TECHNOLOGIES

Real-time data is collected that may be stored in a cloud centrally or may be stored on a locally decentralized sever from where it is accessed to connect virtual and real (analogous) worlds. The data is then simulated and evaluated in virtual copy of assets. After receiving the information from the simulation, the parameters are applied to real assets. This integration of data in real and virtual representations helps in optimizing the performance of real assets. It basically is meant to get a digital model of the real entity as a replica from the unit where it is being stored. The fact should be kept under consideration that the data is already been digitalized to get the information in discrete

form as bits. The digitalized data from either cloud storage and processing units or from decentralized local servers is collected to be evaluated as digital copies. After getting the processed data, the real model is optimized to enhance it using the copy that was simulated earlier. In this way digital twins are used to enhance a model that is either a product or a process, a living or a non-living physical entity.Physics behind the entity that is to be replicated is deeply studied so as to define the attributes of the entity. Data science experts analyze the collected data after studying the properties of the object. In digital space, the data is being evaluated and simulated to make a mathematical model by mathematics experts and the object is mimicked to reflect the characteristics of the real entity that might be a system or an object. The twin is then produced to give a real-time counterpart that can collect information through sensors installed in it.

Technologies used behind the formation of digital twins is mainly Artificial Intelligence (AI). Internet of Things (IoT) has a role in the formation of digital twins. In fact, IoT sensors explosion is something that makes digital twins come into formation. IoT devices are also known as the backbone of digital sensors. These technologies make it a masterpiece of technological reforms.

CONCLUSION

Digital twin is basically a software representation of an object or process that can be replicated as the real model. In this way, the problem can be figured out and can be corrected before making the real physical entity thus to optimize the resources and also a better version of the product is obtained as an outcome.

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Article 7

Eye Tracking – A new chapter of Human-Computer Interaction

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ABSTRACT

The eye tracking technology is another innovative wonder used to overcome various problems faced by electrical devices users. With its distinctive features it is revolutionizing the lives of many people out there. This article discusses why the need of eye tracking has arisen and what is its methodology.

INTRODUCTION

Eye tracking is a process by which a device measures where our point of gaze is i.e. where we are looking. The device which keeps track of eyes' movement is called eye tracker. The eye tracker is designed in a way that it can make record of attention, focus and presence of user by keeping the track of user's eyes. Eye tracking technology is used in numerous areas like in visual systems, psychology, marketing, human-computer interaction, product design and automobiles safety system etc. There are a number of methods by which eye movement can be measured, the most

popular and common one being video-based tracking, in which a camera records the eye movement. Others include contact lenses having magnetic sensors and optical tracking through infra-red rays.

Figure 1. A simple preview how an eye tracker records the movement of an eye, *Source: https://www.sociograph.info/blog/eye-tracking-in-advertising/*

WHY DO WE NEED EYE TRACKING?

There are tasks which we, normal people can perform easily, but become much difficult for disabled people. These

people cannot afford to use computers, cars and other machines with ease like we do. For example, they want a piece of information from internet, a person with disabled hands cannot do so by simple type and search. Similarly, there are many security systems and electrical devices which use voice commands. A person unable to speak finds it problematic instead of an aiding invention. Therefore, some steps must be taken to overcome these undesirable circumstances, to aid such people. Accidents occurring due to drowsy condition of the driver can also be termed as reason enough to use this technology.

METHODOLOGY

These problems can be resolved with the help of eye tracking technology. By keeping track of eye movement, such things are avoided. The way we use mouse to scroll, activate, select and zoom, the eye tracking technology can be used for similar purposes. People unable to use their hands and people with problems like paralysis, spinal cord injury, autism and cerebral palsy etc. can do similar things with their eye movement through this technology. Tobi Assistive Technology Inc. has developed eye tracking based Augmented and Alternative Communication (ACC) device, which aides such people.

Figure 2. An ACC developed by tobi inc. aiding a disabled in PC control, *Source: https://www.abilities.com/community/assistive-eye-control.html*

This device uses IR light to illuminate eyes and then uses camera sensors to measure the reflection off retina and cornea of eyes. Then the device builds a 3D model of the eye to find where the user is looking, and where his eyes are in space, relative to the location of computer. This device enables them to open and control third party software, control their physical environment, play PC games and keep in touch with family and friends via various social media platforms.

Similarly, eye tracking technology can be used in automobiles to measure the eye movement of the driver. When in drowsy or sleepy condition eyes keep on closing and movement is much haphazard. Hence, when the driver's eyes are not focused, the eye tracker can trigger an alarm to make him attentive.

CONCLUSION

With the increase in population day by day, the need for newer and better technical devices also increases. Eye tracking seemed impossible in the past. However today, it has become a reality. Nonetheless, more research is being done in this area and we will be able to see even better tools in the near future. It can be rightly said that electrical technology has always played an integral role in making our lives easier and more comfortable.

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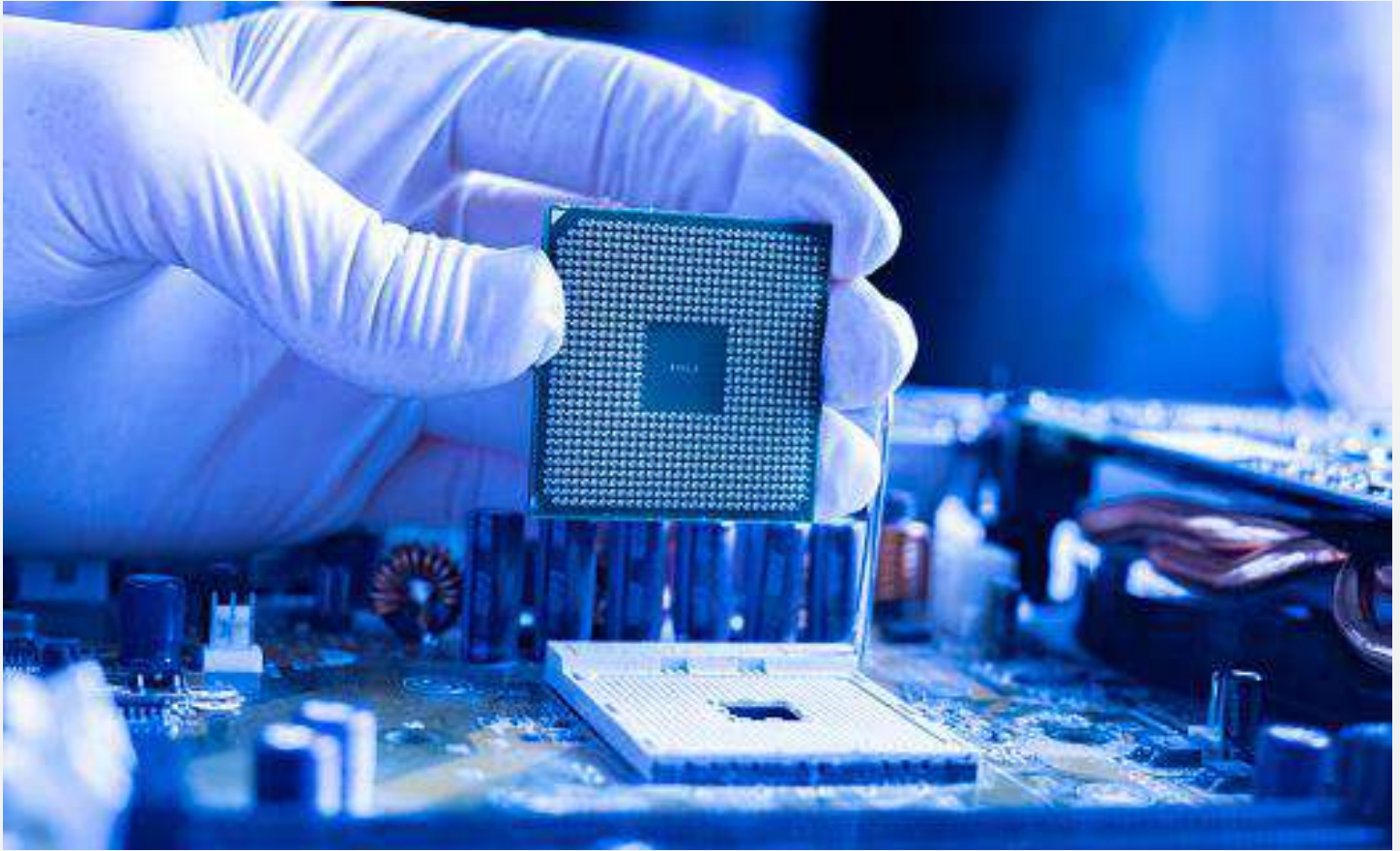
Article 8

Lab-on-a-Chip Technology

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ABSTRACT

Lab-on-a-chip technology (LOC) is an amalgamation of various examinations and investigations such as biochemical/biomedical operations, chemical synthesis, DNA sequencing onto a single chip - which otherwise would have been performed in laboratory taking sufficient amount of time. Owing to the miniaturization of these biochemical processes- Better diagnostic speed, cost efficiency, sensitivity and so on can be achieved.

INTRODUCTION

Lab-on-a-chip devices are a well-known microfluidic methodology that moves tiny amounts of fluid through IC-type devices. Once inside, the presence of indicators, such as any sort of a virus, can be ascertained.

METHODOLOGY

LOC is basically the integration of microfluidics, electronics, optics and biosensors. Microfluidics is the

technology of manipulating and controlling fluids and particles at micron and submicron dimensions and the technology associated with the development of methods and devices to undertake such operations.

Lab-on-a-chip devices are miniaturized chemical laboratories built on a small glass or plastic chip. Electrodes are placed at strategic locations on the chip. Applying electrical fields along micro-channels controls the liquid flow and other operations in the chip. These LOCs can duplicate the specialized functions of their room-sized counterparts, such as clinical diagnostics, DNA scanning, and electrophoretic separation. The key microfluidic functions required in various lab-on-a-chip devices are

electro kinetic processes including- pumping, mixing, thermal cycling, dispensing and separating.
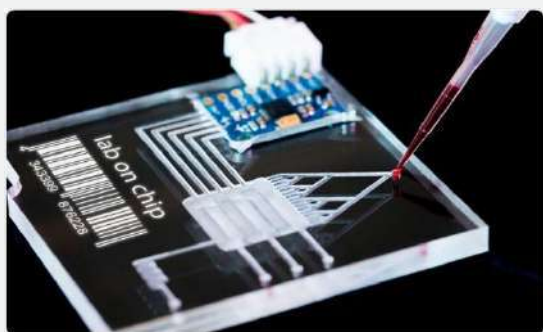

Figure 1. A Lab-on-chip device, *Source: "Benefits of using a Microfluidics Device", https://www.news-medical.net/life sciences/Benefits-of-a-Microfluidic-System.aspx*

Modeling and controlling of these key microfluidic functions are essential to systematic design and operational control of lab-on-a-chip systems. As all solid–liquid (aqueous solutions) interfaces carry electrostatic charge hence there is an electrical double layer in the region close to the solid–liquid interface on the liquid side. Such an EDL field is responsible for two basic electro-kinetic phenomena: *electro-osmosis* and *electrophoresis.*
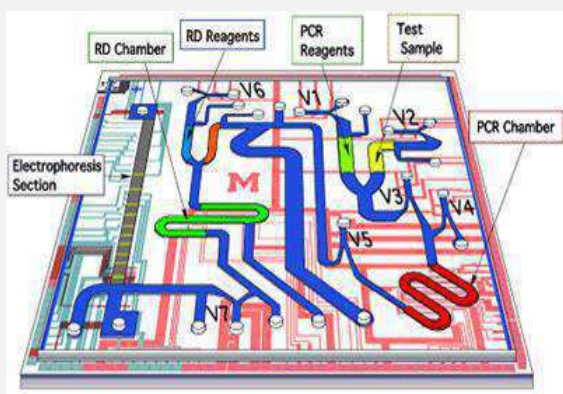

Figure 2. Schematic of the "Genotyper" device, developed by researchers at the University of Michigan, which could identify different strains of flu, *Source: Dr Ronald Larson, https://www.azonano.com/article.aspx?ArticleID=3081*

ADVANTAGES

The advantages of these labs on a chip include dramatically reduced sample size, much shorter reaction and analysis time, high automation and portability.

Furthermore, it is foreseen that the use of LOC will have several advantages compared to the current test methods. Most important ones concern fast diagnostics at the location where diagnosis is needed, and small amounts of samples and materials required to perform tests. However, calibration and maintenance of the device requires quality management along with proper training and education of the user. This way, the benefits of LOC

applications will not compromise quality of health care and patient safety. The use of LOC applications will contribute

to the current trend of more self-reliance in health care, because general practitioners can perform tests immediately or even the patients themselves can do the test.

CLINICAL APPLICATIONS

Applications include measurements of blood gases, blood glucose, cholesterol, counting the number of HIV cell and rapid and early diagnosis of infectious diseases. Such handheld diagnostic gadgets employing LOC can quickly analyze blood samples of patients and precisely detect various strains of viruses, thus allowing tailored treatment plans which are very useful and also help to reduce drug wastage and drug resistance.
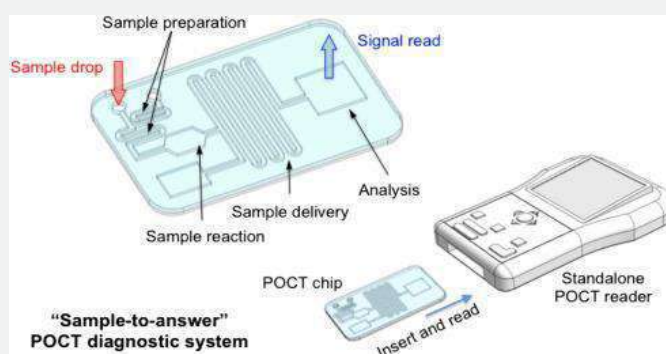
Figure 3. A diagnostic LOC, *Source: https://www.sciencedirect.com/science/article/abs/pii/S016793171 4004316*

LOCs FOR COVID-19

COVID-19 is still an elusive target for healthcare workers. Although doctors and scientists have them in their sight, engineers are supplying the necessary equipment by which medical professionals are able to target the virus and treat affected patients.

This portable device can test bodily fluids to quickly identify COVID-19 using a DNA amplifier. Coronavirus can be confirmed within 60 minutes, which is faster than traditional tests that can take three hours using bulky instruments in the lab.

CONCLUSION

The aim of this technology is to provide engineering solutions for biological and healthcare applications. LOC devices are closely linked to and often overlap with microfluidics. Microfluidics and Lab on a chip (LOC)

technology offers versatile and automatable means to enable the exploitation of bio analytical systems to control and manipulate biological and chemical samples.

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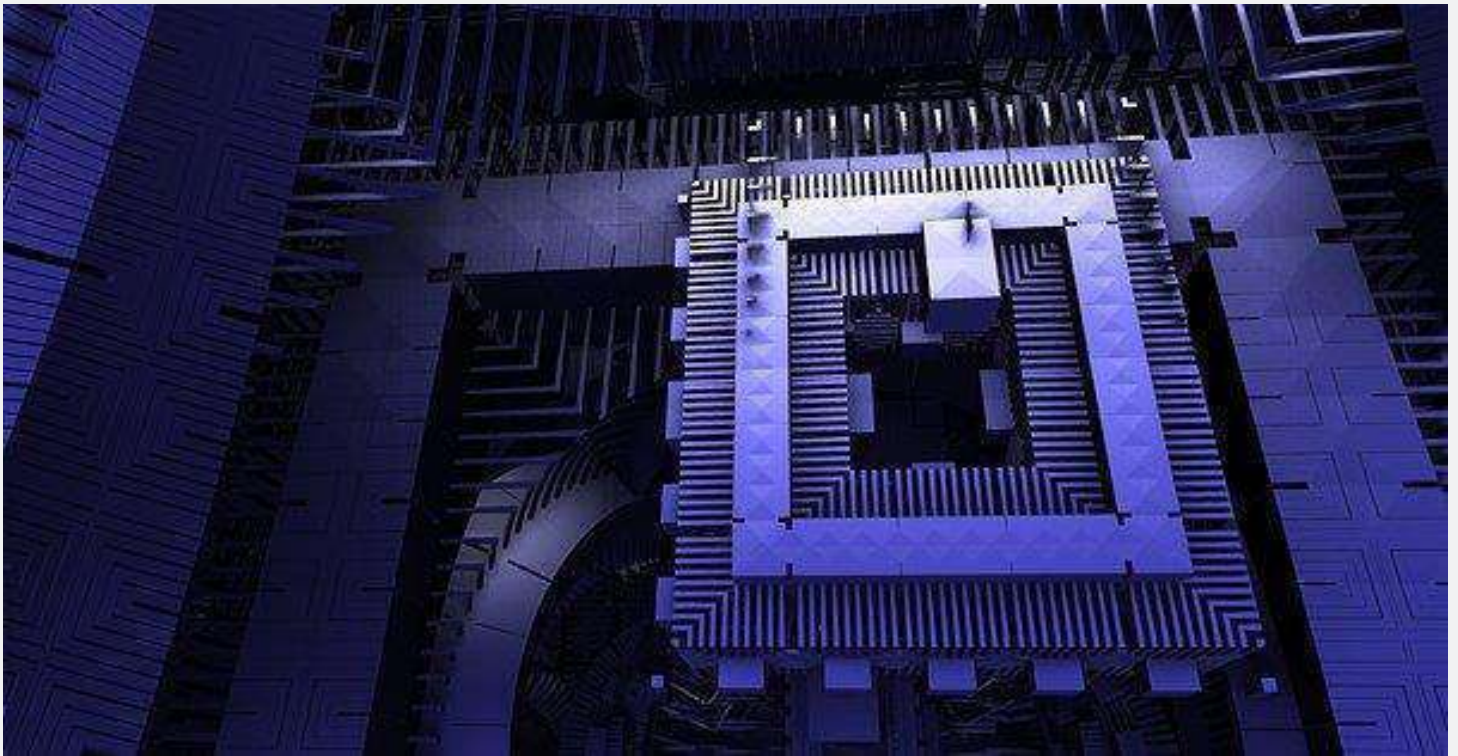
Article 9

Are You Ready for the Quantum Computing Revolution?

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ABSTRACT

Quantum Computers could impel the revolutions in science and technology, medical to save lives and treat maladies, machine learning methods to diagnose ailments in no time, supplies and materials to make more efficient user-friendly devices and infrastructure, financial strategies to live in peace and algorithms to make life easier than it ever was. Classical and traditional computing benefits us every day, every month even every second however with increasing challenges it has also become difficult to almost impossible that these systems will never be able to solve what we are facing.

INTRODUCTION

With not enough computational power on planet to confront problems over a certain size and complexity, we are in a dire need for a new kind of computing-Quantum Computing which gets influenced from quantum mechanical phenomena of superposition and entanglement in creation of states which scale quite rapidly with number of qubits, or quantum bits. With becoming a focal point of interest among researchers across the globe, this alluring technology promises an advanced and improved version of traditional and standard computers we use every day. Powered by superposition and quantum entanglement, quantum computing differs in almost all working phenomena from the encoding and decoding system of a conventional computer. Developments in the said field and research can lead to phenomenal break-throughs in drug discovery, cybersecurity, cryptography and many more and is set to revolutionize the world as we know it. Quantum Computing began in the 80s when physicist Paul Benioff proposed quantum mechanical model of the Turing Machine. Theoretically, it would be efficient enough to store many more states per unit of information and would be able to

operate many folds faster and more proficient algorithms at numerical levels such as Shor's Algorithm or quantum annealing.

This new generation of computers uses the knowledge and phenomena of quantum mechanics- the area of physics which deals in the studies of atomic and subatomic particles- and is a new breakthrough to overcome the limitation of classic and traditional computing. Although the main problems which incur in quantum computing in scalability and incoherence, yet it makes it possible to perform several simultaneous operations and programs to

eliminate the tunnel effect that is a major hurdle and limits current nanometric scale programming. The ordinary bits work just fine and in fact great things, but it does not reflect the actual way the universe works. For the things being most uncertain and even the supercomputers are not any good at dealing with uncertainties of the world problems and that is a major problem. Quantum mechanics being the foundation of physics and underlies the principles of chemistry and associated sciences and for scientists to actually and accurately simulate any of those principles and problems, a better and more efficient way of making calculations that can handle uncertainties. There enter, quantum computers.
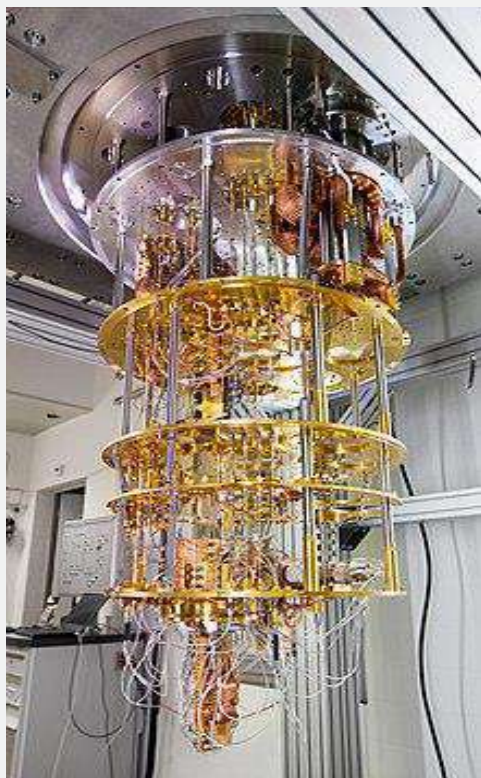

Figure 1. Quantum Computer based on superconducting qubits developed by IBM Research in Zurich, Switzerland, *Source: https://www.codemotion.com/magazine/dev-hub/big-data-analyst/ibm-think-digital-2020-quantum-computing-is-a-game-changer-for-enterprise/*

QUANTUM ENTANGLEMENT

Called as **'spooky action at a distance'** by Albert Einstein, entanglement is still being observed at every possible microscopic level. Entanglement can be thought of as particle present **'here'** playing their role to influence particles **'far away'**. Bell State perfectly demonstrates of how qubits have a perfect correlation, and which does not fit in with the laws of quantum mechanics. The following equation aptly illustrates quantum entanglement with two qubits entangled in the Bell State:

"In this state of equal superposition, multiple states can happen simultaneously, and quantum computation elements such as super-dense coding and quantum teleportation utilize entanglement".

WORKING OF QUANTUM COMPUTERS

A previously explained the main usage of quantum computing is through quantum bits or simply qubits. And rather than just being on and off, the principle of binary bits of one or zero on which traditional computers work, qubits can also be in what is mainly called **'superposition'**- where both states of being on and off exhibit at the same time, or somewhere on a spectrum between the two. If a complex problem is assigned to a traditional computer or say a normal computer, it will try every single possibility and ruling out the every odd one, it will then return the right one. Whereas a quantum computer can go down every path of the maze it is released in, at once and can hold uncertainty in its head just in case. In the mighty realm of quantum computing it's easy for you to move information around, even it contains uncertainty.

They are extremely sensitive and require specific condition to work such as temperature and pressure to name a few and insulation to operate correctly. Interaction of these machines with the external particles can cause faulty measurements and state overlap occurs that is why they are properly sealed and have to be operated using traditional and conventional computers to ensure the proper working without erroneous results and conclusions. Almost no atmospheric pressure, ambient temperature almost close to absolute zero(-273.15°C) and proper insulation from the Earth's magnetic field that keeps atoms from colliding with each other, moving or even interacting with the external environment. Also, these systems operate for very short span of time and the damaged information cannot be stored which hinders the smooth working of these systems.

WHAT ARE QUANTUM COMPUTERS CAPABLE OF?

Letting us do things that we couldn't even have imagined of is the perk of possessing a quantum computer. Yet still a dream, being under process is a milestone for the humanity. Let's dive into what these machines can actually do. They have potential to rapidly accelerate the development of artificial intelligence which is now becoming an integral and almost inevitable part of the planet. Google is already working on this and is utilizing this thing to improve the technology of self-driving cars and is investing most of its resources in this emerging yet the most wondrous technology that we are ever going to witness. Supercomputers can only analyze basic molecules and their structural phenomena, but quantum computers offer a lot more than that. Using the same properties as the molecules, quantum computers simulate and provide the results and have little to no complications or problems in handling even the most complicated reactions.

More efficient products, better and cheaper drugs, increased diagnostics and treatments of ailments and a promising future is what quantum computers are to offer. Even the physicians and doctors around the world hope that quantum simulations will help find a reliable cure for Alzheimer's. Cryptography will be another key application and a lot of encryption systems rely on the basic difficulty of **'factoring'** and is slow and expensive for the classic and traditional computers. Quantum encryption keys will not be vulnerable as the data of a classical computer and it could not be copied or hacked and would be completely unbreakable that we can term as **'Virtually Unbreakable Encryption'** and this will change the landscape of data security. These machines will be able to process data up to 100 million times faster than any classical computers and will be capable of processing exabytes of data without any problem. Reduction of power consumption will be a main advantage of quantum computers as they will be processing mainly by using quantum tunneling.

WHY DO WE WANT QUANTUM COMPUTERS?

As discussed earlier, the promise of developing a quantum computer sophisticated enough to execute Shor's algorithm has been a primary motivator for the researchers and engineers for advancing the field of quantum computing. They will likely deliver huge speed ups for particular types of complex problems.

Multiple additional applications for qubit systems that are not related to computing or simulation also exist and are active areas of research. Two of the most prominent areas are (1) quantum sensing and metrology, which leverage the extreme sensitivity of qubits to the environment to realize sensing beyond the classical shot noise limit, and (2) quantum networks and communications, which may lead to revolutionary ways to share information.

CONCLUSION

Quantum computers may offer a great deal and have enough potential to revolutionize computation by making certain types of classically intractable problems solvable which our classical and traditional computers are not capable of. While no quantum computer is yet sophisticated enough to carry out calculations that a classical computer can't, great progress is under way as Google and IBM have already announced their progress about the quantum computers and when they are expected to be launched.

As small systems come online a field focused on near-term applications of quantum computers is starting to burgeon. This progress may make it possible to actualize some of the benefits and insights of quantum computation long before the quest for a large-scale, error-corrected quantum computer is complete.

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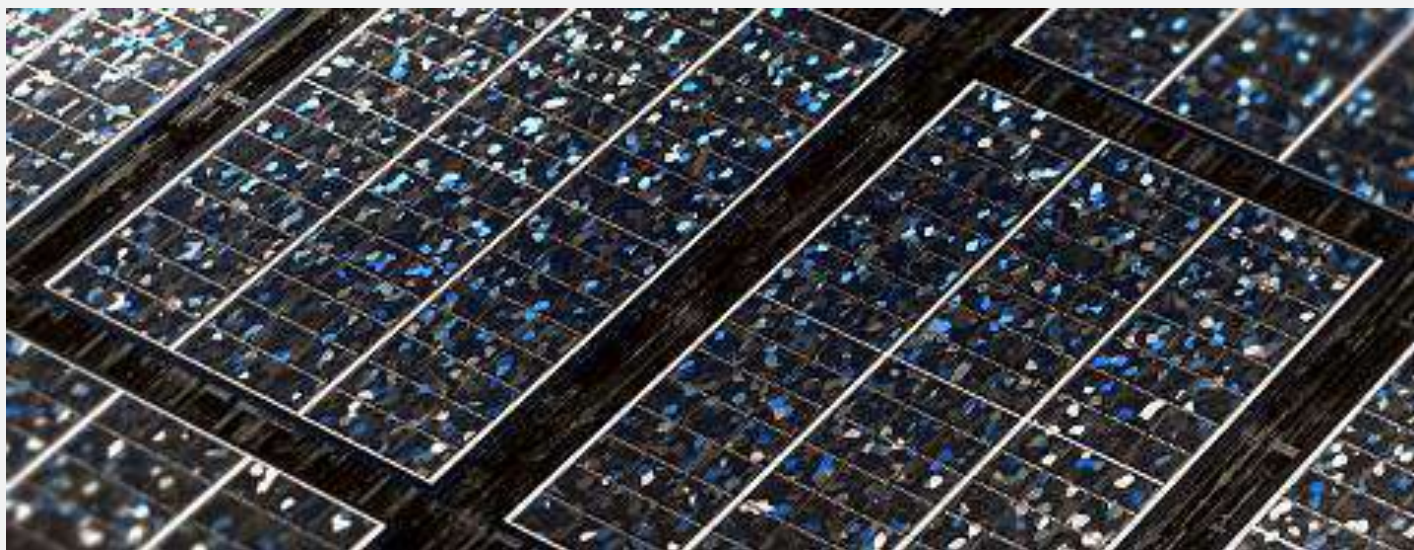
Article 10

Graphene Battery-Future of Li-ion Battery

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ABSTRACT

Graphene, an atomically thin two-dimensional carbonaceous nanomaterial, has attracted tremendous research interest in both scientific studies and technological development due to its exceptional electric, mechanical, and chemical properties. Since the discovery of graphene, many efforts have been done to modify the graphene structure for integrating this promising material to vast applications. This article discusses one of the most important application of graphene, in batteries.

INTRODUCTION

Batteries are integral to our modern world, serving as essential components in innumerable devices. However, with the advancements in technology, limitations in battery systems primarily resulting from the composition of the battery electrodes, have caused them to hinder rather than enable innovation. The material used in common lithium ion battery presents several issues of sustainability, including resource depletion and the introduction of environmental and human health hazards.

Intensive research has been done to find the materials with more desirable qualities to be used in batteries. One such material is graphene, a sheet of carbon atoms bonded together in honeycomb-lattice pattern, exactly one atom thick. With the several desirable qualities like larger surface area, higher conductivity resulting from high electron mobility and incredible intrinsic strength, graphene holds great potential for applications in energy industry. Furthermore, it is very lightweight, flexible and most importantly, eco-friendly.
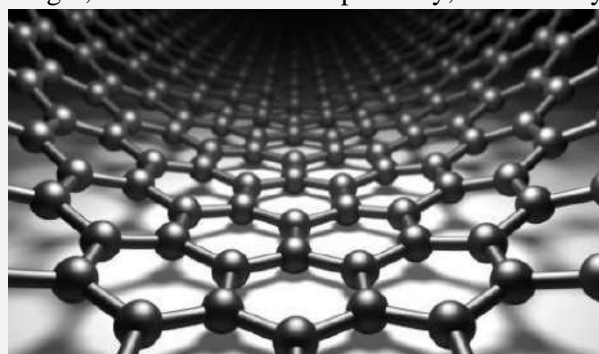
Figure 1. Computer generated image of Graphene structure, *Source: https://www.azonano.com/article.aspx?ArticleID=4841*

PROBLEM

Rapid innovation over the past several decades has led to increased proliferation of electrically powered technology. These technologies have profoundly impacted our lives and as such, have become integral parts of our society. While many devices are powered by direct connections to an electric grid, many more can only fulfill their purpose if they can operate

without a direct and permanent tether. As such, many devices rely on portable sources of power in which energy is stored for future use; the most common of which is the battery. The smartphone for example, can only function as a portable device because it is built with an internal power supply.

Many other devices rely on batteries as well, including cars (especially hybrid and all electric cars), laptops, and tablets. Countless devices are reliant upon batteries and therefore, the capability of our technology depends upon the quality and capability of the batteries used. Significant advances have been made in battery performance and they still have not reached a level that makes a certain innovation viable.

DRAWBACKS OF LI-ION BATTERY

The current and most widely used batteries are Lithium Ion Batteries. These batteries, with high specific energy, single-cell voltage, high energy efficiency, and long life-spans, are excellent sources of power. They are the most efficient, rechargeable batteries available commercially and they operate at low costs of $150 per kilowatt-hour (kWh), affordability set by the US Department of Energy. Even with a specific energy and energy density, the lithium-ion battery still cannot provide enough power for some things. For example, due to environmental factors like climate change and the limitation of fossil fuels, people are moving towards hybrid and electric vehicles to reduce emission and fossil fuel dependence. While Li-ion batteries are the main source of these vehicles, but these are unable to match the performance of combustion engines. According to the research paper on the energy storing devices by Dr. K.M. Abraham "Energy densities of Li ion batteries, limited by the capacities of cathode materials, must increase by a factor of 2 or more to give all-electric automobiles a 300-mile driving range on a single charge".

Similarly, another sector in which a more powerful battery is required, is the personal electronics industry. As the personal electronics devices are becoming faster, they can reach the point in which lithium ion battery is unable to enhance performance. This is prominently demonstrated in smartphones. Additionally, the depletion of these resources could lead to shortcomings in other areas as well. Some of these same variations, due to procedures used during the processing and production of their constituent materials, also impact the environment and human health negatively. The current use of rare materials in lithium ion batteries alone, is in direct violation of the most basic definition of sustainability and the preservation of resources for future generations.

However, lithium ion batteries also violate other aspects of sustainability. Among the United Nations' 17 goals for the development of a sustainable world, are good health and well-being, economic growth, industry and innovation, responsible consumption and production, and climate action. Currently, it seems they violate these goals as the toxicity of the processes used to produce the raw material that makes them up is harmful for the environment as well as for the human health.

POSSIBLE SOLUTION

As it has become clear that current batteries are not suitable, so new researches have been started to solve the shortcomings that lie in the chemistry of batteries. New material is used in the composite to increase the efficiency of specific components or a completely new battery design. One material is graphene, which was theorized many years ago but discovered recently. It has shown remarkable properties, and many have begun to test it in electronic and energy systems. It was also able to address the issue with sustainability currently in lithium ion batteries. This is produced by a different method, but the important achievement was gained in 2004 when Andre Geim and Konstantin Novoselov created graphene for the first time using a method called the "Scotch Tape method". Despite the apparent superiority of graphene enhanced batteries, they are still in a phase of development. Researchers are still finding a way to produce this on the commercial scale. Some newer, and more theoretical methods like Sorenson's chemical vapor deposition methods are far efficient, require less resources and are environmentally friendly. This means that graphene batteries could be produced at low price. Applications for these batteries have been mostly theoretically discussed. For instance, Samsung's "graphene ball" battery shows that it could be produced commercially.

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SURAH *"AL-ANBIYĀ"* VERSE *"33"*

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وَهُوَ الَّذي خَلَقَ اللَّيلَ وَالنَّهارَ وَالشَّمسَ وَالقَمَرَ ۚ كُلٌّ في فَلَكٍ يَسبَحونَ

“(Allah is) the one who created the night, the day, the sun and the moon. Each one is traveling in an orbit with its own motion.”

”

Article 11

Do You Really Understand Wireless Power Transfer?

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ABSTRACT

Wireless power transfer (WPT) is one of the hottest topics being actively studied, and it is being widely commercialized. In particular, there has been a rapid expansion of WPT in mobile phone chargers, stationary charging electric vehicles (EVs), and dynamic charging EVs. It is expected that WPT industry will grow persistently in the coming decades. This article discusses WPT technology along with its types.

INTRODUCTION

Since the invention of electricity in nineteenth century, the power sector has improved drastically over the years. Electricity started being generated in huge mounts which was then delivered to the consumers through a complex network of power systems. At first the power generation was simple and unmonitored but then Power Electronics introduced the concept of controlled power which yielded maximum power with minimum losses. With the passing days, researchers and scientists have been working to improve the controlled power in different fields starting from load side. Now the smart grids and smart meters have been introduced which monitor the transmission, distribution and load side, respectively.

Now to utilize this power being delivered through electric sockets, the power plug wires are a means of transferring power from the socket (source) to the electric appliance (consumer). Now a days, electronic devices are being used extensively and their battery life is decreasing too. For the sake of charging, it is a common to use wired chargers which follow the process explained previously. But the progress in technology has also introduced Wireless Power Transfer (WPT) in which power gets transferred from electrical source to the consumer load without any physical

wire or connection. This WPT technology has introduced a whole different line of research.

WHAT IS WPT TECHNOLOGY?

This question has been circulating around the research area blogging websites and articles for quite some time and it has surely made its impact on the readers. As per the personal experience and literature survey, the common readers who are intrigued to read about WPT are not really aware of the basic definition and mechanism of wireless power transfer. This article aims to cover approximately all the misconceptions about WPT technology.

As the name suggests, Wireless Power Transfer is the transfer of power without the help of any physical wire between the transmitter and the receiver in the form of waves. Now it may look like the literal meaning has been explained in the name of definition but most of the readers misinterpret the real meaning of the two most important words used in the definition above: transmitter and receiver. Consequently, the whole concept of wireless power transfer is misunderstood.

Let us divide the definition of WPT into four major parts and explain them one by one.

Lack of Physical Wire

The fact has already been established that power is to be transferred. But the lack of physical wire makes it even more interesting. It compels the readers to think of the process which would aid this transferring of power without any wire or simply a cable. For instance, in wireless mobile charging the mobile is required to e placed on a charging pad. Here it is to be observed that no charging cable is being used to help the power transfer. Here a question is always raised that why the word physical wire has been used instead of medium? The answer is quite obvious because in WPT technology, air is being utilized as a physical medium directly or indirectly for the power transfer. Hence the term medium is unfit for the definition WPT technology.

Transmitter

The word transmitter in WPT is often confused with the actual power source (usually an electric supply or socket). While the convenient thinking points towards this conclusion but this is not correct. Transmitter is a device which manipulates the input power into waves carried out towards the receiver through a medium without the use of wire or cable. A source or supply acts as stimulator of power for the actual transmitter to transmit power towards the receiver with the absence of wire.

Receiver

The receiver same as the transmitter, is mixed up with the port connected to the battery of load. A receiver is a device which captures the waves from the medium transferred from the transmitter. Usually, it is a common misunderstanding that there should be no plug port inserted in the charging socket of the mobile or laptop or electronics in order to be acclaimed as wireless power transfer charging. It is considered that the charging socket is the receiver and it should capture the transmitted waves and charge the battery. But this is just a misconception which hinders the readers to fully grasp the concept of WPT.

The charging port of any electronics is not the receiver we used in the WPT definition but simply a passage towards the load (battery). The receiver is an additional device specifically designed for the target transmitted waves to receive power and charge the battery with the help of a micro-USB port (in case of mobiles).

Waves

The power from the source or supply is reformed by the transmitter into moving waves picked up by the receiver which then converts these waves back into their original form of power. It should be noted that moving waves have the same power intensity and they should convert back to same amount of transmitted power but due to unideal conditions, the receiver cannot secure every wave and hence an efficiency decrease is observed at the load.

Wireless Power Transfer

In detail, WPT is defined as the transfer of power through a transmitting device, driven by an electric power source, which generates the waves in the medium (e.g. air, wood, aluminum, fiber, etc.) towards the receiver which extracts the power from the transmitted waves and supplies it to the load (most commonly the battery) with the help of a plug port (e.g. micro-USB port) under the strict condition that the medium present is not connecting the transmitter and receiver terminals directly with each other like a wire does. It is explained with the help of block diagram shown in
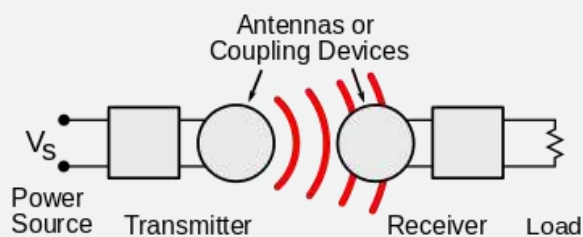

Figure 1.

Figure 1. Visual Description of WPT Technology, *Source: sshttps://en.wikipedia.org/wiki/Wireless_power_transfer*

As shown in Figure 1, the transmitter and receiver devices are collectively called as antennas or coupling devices.

TYPES OF WPT TECHNOLOGY

Depending upon the distance between the source and destination, WPT is divided in far-field and near-field transfer. The far-field WPT can be done either by Microwaves or Laser Technology while the near-field WPT is further categorized into inductive coupling, capacitive coupling, inductive resonant coupling and capacitive resonant coupling.

These WPT technologies also differ in the terms of types of transmitters, receivers and waves used. All of these WPT technologies are efficient and reliable based on their own specific applications.

CONCLUSION

Wireless Power Transfer Technology is an emerging research area and expensive study is being done for the increase of efficiency achieved through WPT. As discussed in the article, the wireless transfer if power is basically done between the coupling devices (transmitter and receiver) with the help of different types of waves depending upon the type of WPT technology being employed. The article focused on the proper explanation of the concept of WPT technology and to diminish the misconceptions of the common readers when they imagine a system of WPT.

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Article 12

Python Sudoku Game Solver

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ABSTRACT

Python is an interpreted programming language that is now used for daily tasks. It is used to solve different daily life problems and automating different processes. The advancements in python have been quite fast in the past few decades due to its simplicity. Today, python is also considered one of the most suitable languages for the fields of Machine Learning and AI.

INTRODUCTION

Sudoku is quite a logical game. This game has different modes depending upon the size of the game. The standard size is 9x9. Moreover, there are 25 different types of Sudoku available having different rules according to them.

Figure 1. A simple sudoku puzzle, *Source: https://en.wikipedia.org/wiki/Sudoku*

RULES OF GAME

The general rule of the game is simple. The 9x9 Sudoku contains 81 square boxes. These 81 boxes are divided into 9 equal squares, each square containing 9 boxes. Some boxes are prefilled with random numbers.

The primary rule is that in each square of the nine boxes, there must be numbers between 1 to 9 and no number can repeat itself. Moreover, we should also consider that each line of 9 boxes horizontally and vertically should also contain 1 to 9 numbers, without any number repeating itself.

IMPLEMENTATION THROUGH CODE

Several studies have shown that lazy people always find a creative way to complete their routine tasks. However, if you are lazy and a programmer both, then you can automate a lot of your daily tasks. Many routine tasks can be programmed using different ways. You can solve Sudoku game through python language. Therefore, the next time when you play the game, you will not have to spend hours solving the game.

Coding Aspect

```
giv = [[7, 8, 0, 4, 0, 0, 1, 2, 0],
       [6, 0, 0, 0, 7, 5, 0, 0, 9],
       [0, 0, 0, 6, 0, 1, 0, 7, 8],
       [0, 0, 7, 0, 4, 0, 2, 6, 0],
       [0, 0, 1, 0, 5, 0, 9, 3, 0],
       [9, 0, 4, 0, 6, 0, 0, 0, 5],
       [0, 7, 0, 3, 0, 0, 0, 1, 2],
       [1, 2, 0, 0, 0, 7, 4, 0, 0],
       [0, 4, 9, 2, 0, 6, 0, 0, 7]]
```

Figure 2. Inputting sample data into sudoku program, *Source: https://github.com/talha-svg/Soduko-Game-Solver.git*

From Figure 2, it can be seen that the data is simply put in a 3-Dimensional array. Sudoku is based on trial and error method therefore; we will apply the same technique in coding. First, we will go to the empty box of the puzzle or in code you can see that we have shown it as zero. To find the empty box, the following code was made to return the coordinates and positions of the box.

```
def empty_coord(giv):
    for q in range(0, 9, 1):
        for lo in range(0, 9, 1):
            if giv[q][lo] == 0:
                return q,lo
```

Figure 3. Code snippet to find empty box, *Source: https://github.com/talha-svg/Soduko-Game-Solver.git*

Backtracking algorithm is a recursive algorithm and if it fails at a point, it goes back to its previous position, changes its value and goes to the next position. In context of the Sudoku game, we will place a value in the empty box and go to the next empty box and if value does not satisfy, then it will go back to the previous box and change the value there , finally checking the value in the next box. This process continues until all the values are satisfied.

```
def back_tracking(giv):
    fifi=empty_coord(giv)
    if not fifi:
        return True
    else:
        rr, yy = fifi
    for i in range(1,10,1):
        x=rule(giv,rr,yy,i)
        if x==0:
            giv[rr][yy]=i
            if back_tracking(giv)==True:
                return True
            else:
                giv[rr][yy]=0
    return False
```

Figure 4. Code snippet for backtracking, *Source: https://github.com/talha-svg/Soduko-Game-Solver.git*

From Figure 4, it can be deciphered that the code inputs every value, from 1 to 9, into the box and recursively solves all the empty boxes. The function **'rule'** used in backtracking algorithm is used to check if the value can be inserted there. If it cannot be placed there, then it returns 0; otherwise, it returns 1 as shown in the code below.

```
def rule(giv, row, coloumn, inputt):
    wx, wy, wz = 0, 0, 0
    for compare in range(0, 9, 1):
        if (inputt == giv[row][compare]) or (inputt == giv[compare][coloumn]):
            wx = 1
    rott = row // 3
    cott = coloumn // 3
    for rq in range(rott * 3, rott * 3 + 3):
        for re in range(cott * 3, cott * 3 + 3):
            if inputt == giv[rq][re]:
                wy = 1
    if wx == 1 or wy == 1:
        wz = 1
    return wz
```

Figure 5. Code snippet for 'rule', *Source: https://github.com/talha-svg/Soduko-Game-Solver.git*

Finally, after running the code, it can be seen that the Sudoku game is solved completely.

```
the solved is

-------------------------
| 7 8 5 | 4 3 9 | 1 2 6 |
| 6 1 2 | 8 7 5 | 3 4 9 |
| 4 9 3 | 6 2 1 | 5 7 8 |
-------------------------
| 8 5 7 | 9 4 3 | 2 6 1 |
| 2 6 1 | 7 5 8 | 9 3 4 |
| 9 3 4 | 1 6 2 | 7 8 5 |
-------------------------
| 5 7 8 | 3 9 4 | 6 1 2 |
| 1 2 6 | 5 8 7 | 4 9 3 |
| 3 4 9 | 2 1 6 | 8 5 7 |
-------------------------
```

Figure 6. Solved Sudoku game, , *Source: https://github.com/talha-svg/Soduko-Game-Solver.git*

CONCLUSION

The screenshots inserted in this article explain the basic working of the algorithm for sudoku game. The layout of the final solved sudoku game has not been discussed here. However, it is fairly simple to program and the source code can be found in the references. Finally, just like the Sudoku game here, programmers can implement their own logic or use some other algorithms to code games such as hangman and chess as well.

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Floating Solar Photovoltaic (FSPV): An Idiosyncratic Pillar to Solar Sector

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ABSTRACT

The high energy demand and constant depletion of fossils fuels lead us to shift our focus on Renewable Energy Resources (RES) which are not only future unlimited source of energy. Hydro and Wind though are renewable sources but are area specific. Solar systems can be installed in any place. The major issue with the solar energy is the requirement of land which is scarcely available in the world and even costly to get. But floating solar plants can be installed in any water bodies which will not only reduce the cost of the land but will increase the amount of generation with the cooling effect of water.

INTRODUCTION

The evident increase in energy demand and the utilization of rapidly depleting fossil fuels are causing serious environmental impacts. To mitigate these effects Renewable energy production is the only way out and solar energy is promising to be the more and more reliable energy source than ever before. In solar technology, Floating solar PV (FSPV) is being proposed as a suitable alternative with several advantages other than the preservation of land and water resources. FSPV also known as floatovoltaics is a solar PV application in which PV panels are designed and installed to float on water bodies such as reservoirs, hydroelectric dams, industrial ponds, water treatment ponds, mining ponds, lakes, and lagoons. In this, solar panels are usually mounted upon a pontoon-based floating structure and to keep its location fixed, floating structure is anchored and moored.

In 2007, the National Institute of Advanced Industrial Science and Technology (AIST) built the world's first FSPV plant of 20-kWp capacity in Aichi, Japan. Later in 2008, the first commercial-scale installation of capacity 175 kWp came up at Far Nienty Winery, California, USA. Most of these early projects are small-scale systems with a purpose of research and demonstration. From early 2013, megawatt scale

FSPV plants started to appear in Japan and South Korea. Since then installations have increased many folds from few megawatt-peak (MWp) to more than 1300 MWp by the end of 2018.

The technology is currently deployed in more than 24 countries across the entire world with the majority of installations are coming up in Asia, particularly in Japan,

China, and South Korea. The FSPV technology has been able to gather a lot of traction in the past 3 years (2016, 2017 and 2018) globally. Pakistan is one of those countries which have rich amount of renewable energy resources that can be utilized for carbon emission-free power production. Pakistan has the potential to produce up to 1600GW of energy as it is 15.5*104 of annual solar irradiance [1]. Pakistan has already utilized a fragment of its solar potential by commissioning a 1000MW solar power project in Bahawalpur, Pakistan. This potential of solar energy available in Pakistan can be further enhanced by utilizing the latest but reliable technologies like FSPV.

WHY FSPV

Continuously increasing energy demands because of population growth and industrialization of the world and by the consumption of fossil fuels to accomplish that demands, our world is facing significant environmental issues. These issues include global warming, air pollution, sea-level rise, irregular rains, glacier retreat, and other extreme weather events. Unfortunately, most of our power sector is still mostly dependent on fossil fuels to generate electricity. Moreover, Fossil fuels are limited in nature and that is the reason that there is an exponential increase in the power generating prices over time. Due to these issues, emission of greenhouse gases and the exponential rise in the power generating prices, it has become necessary to look for various suitable alternatives to generate cheap and carbon emission-free electrical energy

Solar energy as the most easily available and global source of energy is being favored in many parts of the world where there is a shortage of energy or with the intention of environment preservation. Globally the application of solar technology to accomplish our energy demands is increasing exponentially and it is estimated that the global solar PV capacity will increase to 1582 GW by the year 2030 [2].

Another motivation to utilize solar energy for our energy demands is the exponentially decreasing cost/KW as the technology is becoming cheaper every day because of the utilization of advanced materials and because of the decrease in complexity in the manufacturing process.

FSPV - TECHNOLOGY OVERVIEW

FSPV design is similar to a conventional solar PV system except it requires a special arrangement to float on the water surface. The typical floating structure supports the PV arrays, inverters, combiner boxes, lighting arresters, etc. on a floating bed, which is made of fiber-reinforced plastic (FRP) or high-density polyethylene (HDPE) or metal structures.

Figure 1. Major Components of FSPVs, *Source: "Floating Solar Photovoltaic (FSPV): A Third Pillar to Solar PV Sector?", authored by Mohit Acharya and Sarvesh Devraj*

The whole floating bed is buoyed with the help of anchoring and mooring systems. The detailed description of floating solar components is given below:

PV Module:

The basic integral part of the FSPV plant is solar PV modules and like conventional solar projects generally, poly or monocrystalline or thin film solar panels are used for the installation of the project. Selection of PV modules technology also defers because of space, cost, relative humidity, type of water-bodies, etc. The criteria for selection of PV modules are as follows:

- ✓ Solar panel performance – power tolerance, efficiency, temperature coefficient especially in high moisture, and high humidity conditions

Inverters:

Like a conventional solar plant, DC power generated from solar PV modules is taken to the inverter through a series of combiner boxes and finally converted into AC power. A developer may select multiple string inverters or central inverters. Depending upon scale and distance from shore, inverters can be placed either on a separate floating platform or on land. Generally, for smaller capacity FSPV inverter may be located on land near to PV arrays, otherwise for large capacity plants it is advisable to place inverter on a floating platform to avoid excessive resistive losses. Both the types have some inherited advantages and disadvantage and choosing one over another must be done wisely.

Floating Platform:

This is the most crucial component of FSPV; it supports all necessary components like solar PV during the project time. Hence selection of appropriate materials for the floating platform becomes imperative. HDPE is the most popular material being used in a majority of the FSPV power plants across the globe. Other materials like FRP, medium density polyethylene (MDPE), and ferro-cement are also been utilized as materials for the floating platform.

Anchoring and Mooring System:

Since FSPV plants are installed on water bodies, any variations in water levels induced by monsoon, wind velocity or increase/decrease in water quantity could be problematic for the plants. To avoid this situation, FSPV plants are anchored through mooring systems. The placement of a mooring system must consider the location, bathymetry, soil conditions, and water-level variations. Mooring systems include quays, wharfs, jetties, piers, anchor buoys, and mooring buoys. Mooring system for a floating platform is generally attached with nylon polyester or nylon nautical ropes that are further tied to bollards on the bank and lashed at each corner. Mooring can be done in the following three ways – bank anchoring, bottom anchoring, and piles.

Cabling:

In case of FSPV plants, cable routing and its management requires cautious planning. Unlike ground-based solar PV installations, movement of floating platform on a water surface causes cable length to vary in FSPV plants. The movement of floating platform is due to wind load and variations in water level. This requires extra length in form of slack to be provided for accommodating the movement of the floating platform. Neglecting this, insufficient cable length may result in cables to snap and rupture due to the tension. Apart from the cable length the other parameters upon which cable size depends are voltage and current of the cable and losses from the cable

CONCLUSION

Renewable energy is built as the future of energy value chain. In particular, solar energy is being utilized at a faster pace than ever. The problem sometimes occurs that large scale Floating Solar Photovoltaic (FSPV) plants have to be developed, away from the population which adds to the cost of transmission and distribution. Floating solar photovoltaic (FSPV) plants have recently gained traction as a suitable alternative of ground based large scale PV installation. FSPV not only utilizes the water as real estate, but it has number of other advantages. For example, FSPV combination on a small dam in Pakistan.

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Article 14

HVDC Transmission System

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ABSTRACT

This article demonstrates the pros, cons and applications of HVDC. The preference of AC over DC in the transmission systems and reasons to shift the momentum from AC transmission to DC has been briefly reviewed. How bulk-power can be transferred with low or no line losses and connection between unsynchronized networks has been discussed.

INTRODUCTION

HVDC is abbreviated as "High Voltage Direct Current". As the name suggests, it involves the phenomenon of direct current in transferring power with high voltage.

Almost all of the electrical power transmitted around the world, starting from the generation to the distribution is done by the AC (Alternating Current). Only a few systems are operated on Direct Current which include "Rio Madeira" in Brazil, a link between Moscow and Kashia and recently China has made the longest HVDC link in 2019. These are only a few examples of DC usage. Therefore, what is the reason for using DC rarely, and why do we prefer AC over DC?

Mainly all of our electrical devices run on AC, from the transformers to the common household electrical appliances, all of them are designed to work on AC. Thus, a power transfer in DC still has to be converted to AC for usage.

ADVANTAGES OF DC OVER AC

First of all, High Voltage is preferred for transmission in order to reduce the line losses. The more the voltage, the lesser the current and consequently, lesser the losses. This is because losses are directly proportional to the square of current. The debate between AC and DC starts from the losses. A transfer via DC always has fewer line losses, this is because DC involves only active power, whereas AC acquires both active and reactive power which increases the losses, up to 30 to 40%.

HVDC requires less conductor size as it carries a single phase with current flowing in a single direction rather than three phases with current changing its direction continuously.

One of the greatest advantages of HVDC is the connection between unsynchronized systems. In AC systems, if we need to connect a generator with a power network, we need to make sure that the frequency, voltage level, phase

sequence, waveforms and phase difference is same for both systems. Whereas in DC, we need to match the

open-circuit voltage level of the generator with the voltage level of the network. Different power stations can be connected operating at different frequencies via DC transmission.

One doesn't have to worry about the three-phase short circuit fault currents. In underground transmission, the charging of capacitance can be done once with the help of DC, as the current flows in one direction. Whereas in AC, as the current keeps on changing direction so, capacitor needs to be charged again and again which requires extra current and hence power losses increase.

In Overhead Transmission lines, when AC flows, the skin effect doesn't let the major part to reach the load and the power losses to emerge. Whereas, in DC, no such phenomena are observed and as the power delivered in AC is the RMS of the Peak Voltage but in DC the power delivered is equal to the peak value of the voltage which is pro.

Figure 1. HVDC converter station, *Source: "Benefits of High-Voltage Direct Current Transmission Systems", https://www.powermag.com/benefits-of-high-voltage-direct-current-transmission-systems/*

HOW CAN HVDC BE IMPLEMENTED?

Firstly, power generated at hydropower plants is AC. It is converted to DC with the help of circuitry designs. Few examples of such circuits are given below:

Thuy Systems

These involve the connections of few motors and generators which are moved with prime movers to increase the voltage. The line is operated at a constant current mode. The disadvantage of this method is that the maintenance of the motors and generators can be costly.

Mercury Valves

Mercury valves are used to rectify the voltage. They then transmit it over to the distribution network.

LCC (Line-Commutated Converters)

These use a set of thyristors (6 or 12 configurations) to rectify the voltage which was stepped up with the help of reactor halls made of isolated transformers. These have the disadvantage that the off time of thyristors is uncontrollable.

VSC (Voltage-Source Converters)

These involve the modern techniques of using Insulated Gate Bipolar Transistor (IGBT) and Gate Turn-off Thyristor (GTO). With these, one gets full control over the on and off time. Furthermore, the rectification is done smoothly with the advantage of having the extinction angle control.

The DC Voltage out of the converters has a harmonic (in the case of LCC, there are a lot of harmonics which can be removed by filters or shifting the components to higher frequencies).

After all the conversions, the power is transferred in the form of DC. Once it reaches the Grid, it is converted back to AC with the help of inverters and is stepped down to be sent to the distribution transformers.

CONFIGURATIONS

Different configurations to implement an HVDC system are:

- Mono-pole
- Bipolar
- Back to Back

The main drawback of HVDC system is the arcing. During a fault, AC gets self-extinguishing as it has many zero-crossing points. On the contrary, DC has one direction. Consequently, extinguishing does not occur whilst arcing. ABB, a leading global technology company, did introduce a circuit breaker that could prevent arcing during the faults or jerks. Other drawbacks include the expensive maintenance of parts. Nevertheless, the advantages of HVDC outweigh its disadvantages.

Some of the HVDC projects around the world include the following:

- Belo Monte-Rio de Janeiro line, Brazil – 2539 km
- Rio Madeira line, Brazil – 2375 km
- Belo Monte-Streeton line, Brazil – 2,092 km
  The technology today, is accelerating towards efficient

converting (rectifying and inverting) techniques that include better DC transmission systems. Such systems can transfer bulk power with the least losses. Most of the overhead lines can be shifted underground and major grids, with different frequencies, can be connected. The Onshore and Offshore wind plants can be connected directly, without proper synchronization as in the case of AC transmission.

CONCLUSION

Considering all the advantages of DC, it seems that HVDC lines are more proficient than AC lines. But, the initial cost of HVDC substation is very high and their substation equipment is quite complicated. Thus, for long distance transmission it is preferable that power is generated in AC, and for transmission, it is converted into DC and then again converted back into AC for final use. This system is economical and also improves the efficiency of the system.

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Article 15

Power Quality Issues with Grid Connected Wind Energy Systems

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ABSTRACT

Wind energy sources which have been anticipated to be a promising elective vitality source can bring about new difficulties when it is associated with the power grid. Nonetheless, the produced power from the sustainable power source is continually fluctuating because of ecological conditions. A static compensator (STATCOM) is linked to lessening power quality problems. The expected aftereffect of the proposed conspire soothes the main supply from the reactive power demand of the induction generator and the load. The article demonstrates how maximum power output may be achieved by exploiting wind energy systems.

INTRODUCTION

With an ever-increasing world power demand, it has become mandatory to exploit renewable energy sources such as wind, bio-mass, hydro, geothermal, etc.

In order to have sustainable growth, it is compulsory to utilize renewable power source assets. Limiting the environmental effect on conventional plants is the key paradigm.

The integration of wind energy into existing power frameworks imposes technical challenges, and that requires consideration of voltage management, stability, power quality problems. The issue of power quality is of incredible hugeness to the wind turbine.

About 60.4 GW of wind vitality limit was introduced around the world in 2019, which shows 19% expansion from establishments in 2018. total capacity for wind energy globally became 651 GW; an increase of 10% contrasted with 2018. (Worldwide Wind Report, 2019).

The issue initiates from the input. During wind turbine operation, all the fluctuation in the wind speed is transmitted as mechanical torque variations, electrical power change on the grid, and results in large voltage fluctuations.

Electrical power quality issues can be reviewed with respect to wind generation, transmission, and distribution networks. By connecting an induction generator directly to the grid system, absorbed reactive power and terminal voltage can be significantly affected. Furthermore, a STATCOM based control technology has been proposed for enhancing the power quality, which can manage the power level associated with commercial wind turbines.

ISSUES INTERPOSING IN WIND POWER GENERATION

Similar conventional plants, wind power plants are required to yield good power quality to the electric system (constant voltage and frequency, minimum disturbance and power dissipation, low harmonic emission) in order to ensure reliability and satisfy consumers. The Power quality can be enhanced, taking into consideration the International Electrotechnical Commission Guidelines (IEC 61400), which power the quality of wind turbines.

Harmonic distortion

As Wind Power Plants have been integrated into the main grid, harmonic distortion has been one of the issues related to power quality. Success is achieved by limiting Harmonic voltage and current and adding filters. A non-Linear element in power systems such as power electronic devices, static power converters, arc discharge devices, etc., creates harmonics in the system. Harmonics cause communication interference, heating, degradation of power quality at the consumer's terminal, and malfunction of equipment.

Voltage Sag and Swell

The initiation of wind turbine causes a sudden reduction in the voltage to a value between 1% & 90 % of the nominal value after a short period of time. This problem is considered in the power quality and wind turbine generating system operation and computed according to the rule given in IEC 61400-3-7 standard, "Assessment of emission limit for fluctuating load." The startup of wind turbine causes a sudden reduction of voltage. Voltage sag consequences are tripping of motor etc.

A swell can occur due to a single line-to-ground fault on the system, which can result in temporary voltage rise on the other functioning phases. Swells can also be caused by switching off a large load or switching on a large capacitor bank.

Voltage Flicker

Flicker is induced by voltage fluctuations or regularly switching of large loads connected to the grid. It results in rapid variation in voltage and changing brightness of incandescent and fluorescent lamps at the consumer end.

Reactive power and induction generators

Traditional wind turbines are installed with induction generators. Induction generators are favored since they are inexpensive, rugged, and require little maintenance. Induction generators require reactive power from the grid to operate.

When a wind turbine is equipped with an induction generator, and a fixed capacitor is used for reactive compensation, then the risk of self- excitation may occur during off-grid operation. That can, in turn, damage sensitive equipment.

OVERCOMING POWER QUALITY ISSUES BY EMPLOYING STATCOM

A STATCOM is a shunt connected compensation device that injects current into the grid.

The injected current cancels out the harmonic part of the induction generator current and load current. It makes sure that the current is in phase angle with respect to source voltage. It is connected with a wind turbine induction generator at the point of common coupling (PCC) in the grid system. The total harmonic distortion of source current is reduced by STATCOM.

The STATCOM output is varied according to the control strategy, so as to maintain the power quality norms in the grid system. The current control strategy for STATCOM is the Bang-Bang controller.

Power Quality Improvement in Grid Connected Wind Energy System is proposed to have reactive power support to the induction generator and to the non-linear load in the grid system.

CONCLUSION

The power quality issues and its consequences on the consumer and electric utility are presented. STATCOM compensator has the capability to cancel out the harmonic parts of the load current. It maintains the source voltage and current in-phase and supports the reactive power demand for the wind generator and load at PCC in the grid system; thus, it enhances the utilization factor of the transmission line. Thus, the proposed scheme in the grid-connected system fulfills the power quality norms as per IEC standard 61400-21

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SURAH *"AL-NABA"*
VERSE *"6-7"*

"

أَلَم نَجعَلِ الأَرضَ مِهادًا ٥ وَالجِبالَ أَوتادًا٥

"Have We not made the earth an expanse and the mountains stakes?"

"

Article 16

Improving Power Sector Resilience to Natural Hazards

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ABSTRACT

While action to mitigate power supply failure through additional power generation is absolutely imperative, so is ensuring the security of the power system functioning. The grid remains vulnerable to a number of factors thus the system needs to be modified to adapt to ever changing conditions to minimalize damage.

INTRODUCTION

Electrical Transmission Infrastructure is deemed as 'critical' infrastructure in today's age where uninterrupted power supply serves as the backbone of many sectors like transportation, communication and industry etc. With a surge in the demand of electricity with each second and its direct relation with the stability of the economy, creating a resilient electricity transmission system has become the need of the hour. The grid remains vulnerable to diverse threats that can potentially cause extensive damage. To safeguard power transmission and conveyance distribution grids from various hazards, the usefulness, progression, and integrity of power transmission networks must be guaranteed. However, blackout management has become increasingly difficult in the last decade owing to the surge in natural disasters due to drastic climatic changes like rising temperatures and sea levels, the possibility of more strong winds, heat waves, heavy rain and drought. Considering all of these factors natural disasters account for roughly 30.71% of the power outages.

POWER SYSTEM RELIABILITY

Power system reliability if directly linked with increasing resilience of the power sector can be narrowed down to a few points. To combat sudden disturbances in real time operation the beginner level of preparation includes risk identification and risk reduction approaches. Risk identification primarily involves a review of historical records and identifying key climatic risks. Additionally, online monitoring of meteorological and geological databases also helps in the probabilistic modeling of hazards. Internal risk identification is equally important. After potential risks have been identified, organizations need to devote complete focus to risk reduction approaches like information transparency, expert consultation and risk proofing infrastructure and improved maintenance practices.

PLANNING FOR SUPPLY INTERRUPTIONS

Despite extreme measures and preparedness, natural disasters are ultimately the act of God, thus unavoidable. In these circumstances, emergency preparedness is what saves us. Dedicated crisis response teams need to be engaged on several levels with a clear command structure and material supplies. First priority should be given to establishing a

balance between restoring a minimum level of power and the full recovery of the power supply. Another imperative part of the response plan includes identifying local needs and supplying power to priority users like hospitals, etc. Selective power cuts also come in handy in such times. Flexibility is essential to adjust priorities and action as the situation changes.

TECHNICAL APPROACHES USED IN RECOVERY

In case a natural calamity strikes what, we witness is a plethora of sequential failures, thus standard approaches should be complemented by an equally holistic approach to help overcome losses. Emergency response should be initiated by identifying system states and highly critical areas. Once completed, teams should move on taking complete lead of the control and distribution rooms initiate under frequency lead shedding. Power generation should be shifted to portable and any other forms of temporary supply and immediate replacement of majorly damaged spare parts should be done. Automatic shutoff of power supply to unimportant high loading areas is also encouraged.
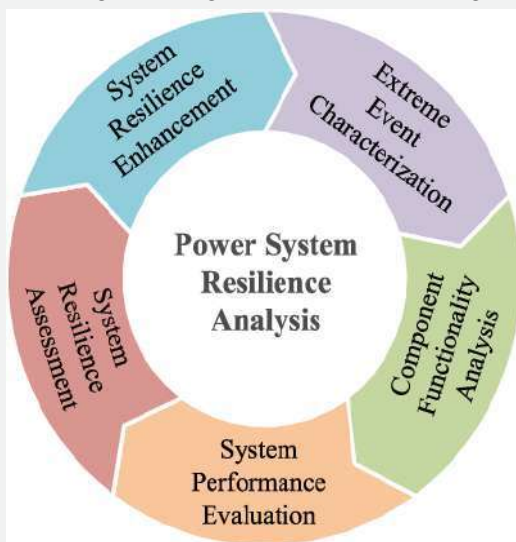

Figure 1. Adopting resilience in the power system, *Source:"Enhancing the Power System Resilience", https://www.semanticscholar.org/paper/Networked-Microgrids-for-Enhancing-the-Power-System-Li-Shahidehpour/ef7d9936635a05da97334ede1a0c489fe113aaaa*

INCLUSION OF CORRECTIVE MEASURES

The resilience and strength of the power supply system can be directly attributed to following a few basic guiding principles. Corrective measures implemented at lower level all the way to the top are the only way to associate the concept of prevention. Keeping that fact in mind Smart meters should be installed at consumer level to enable better load visibility. Adequate backup facilities like EV's are vital to the first line of defense along with complete functionality of key coupled components like nodes and links. Decoupling strategies are also to be utilized to decrease system connectivity. What radically needs change, however, is the grid topology where Independent Power Producers and decentralized clusters need to be introduced to balance interconnectedness. This will also optimize the grid structure against random failures and reduces dependability on a single source. Smart Grids which are a topic of debate throughout the world should be installed to utilize their self-healing capabilities and two-way flow. Grid and transmission lines should be relocated to reduce vulnerability and provided lighting protection. Key equipment like masts, antennae, switch boxes, aerials, overhead wires, and cables should be provided protection from precipitation and a system of underground cables should be established for critical areas. Ultimately, efficient management measures are required to revolutionize the power sector.

CONCLUSION

Climate change will continue to impact power generation and transmission in the worst ways possible, thus utilities need to change the way they design and manage power infrastructure through action specific technology and adaptive measures. Long term planning of utilities also requires call to action, to combat any future disaster.

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Article 17

Smart Grid-The future of the Electric Energy System

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ABSTRACT

The smart grid is being supported in developing nations and engineered up these days to adapt to the bottleneck of sustaining substantial provides in energy consumption like business and substitute development. Smart grid technologies are often outlined as self-sustaining systems that may realize solutions to issues quickly in available system and that reduces the work force and targets reliable, safe and quality electricity to all customers. In this respect, totally different technological applications are often seen from the perspective of researchers and investors. Even though these technological application studies represent initial step for the structure of the smart grid, they have not been completed in several countries.

INTRODUCTION

The **"smart grid"** is a term accustomed to describing the rapid infrastructure replacement of the electrical wiring system. When the advanced system is totally enforced, it'll provide communication options across the grids that aren't presently available--hence the term "smart" is used. A "smart grid" is solely an advanced electrical distribution system that has the potential to balance electrical loads from various diverse, intermittent and alternative energy generation sources. One key element of the "smart grid" is the capability to store electrical energy; this permits the demand from customers to be met. Today's power systems area unit designed to support massive generation plants that serve faraway customers via a transmission and distribution system that's basically unidirectional. However, the grid of the long run can essentially be a two-way system where power

generated by a large number of tiny, distributed sources— in addition to massive plants—flows across a grid based on a network instead of a hierarchical structure.
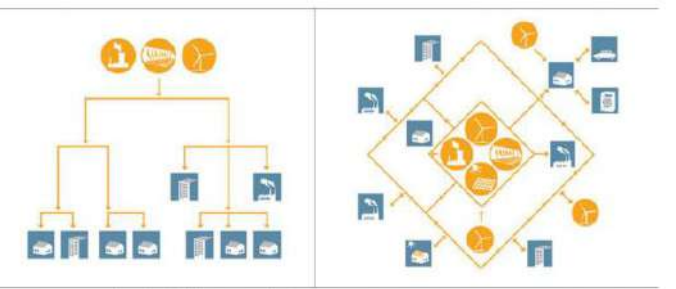

Figure 1. The Shift between today's Power system (left) and Realized Smart Grid (right), *Source: "Smart Grids to step into urban living", http://www.energy-enviro.com/demo47/index.php?PAGE=2&PRINT=yes&ID=3331*

SMART GRID TECHNOLOGY AND APPLICATION

Smart grid has a wide range of applications, we describe few that are currently in practice:

• Advanced metering infrastructure (AMI) is an integrated system of smart meters, communications networks, and data management systems that enables two-way communication between utilities and customers.

• Distribution management system (DMS) code mathematically models the electrical distribution network and predicts the impact of outages, transmission, generation, voltage/frequency variation, and more. It helps scale back capital investment by showing a way to higher utilize existing assets, by sanctioning peak shaving via demand response (DR), and by rising network reliability.

• Geographic data system (GIS) technology is specifically designed for the utility trade to model, design and manage their crucial infrastructure. By integration utility knowledge and geographical maps, GIS provides a graphical view of the infrastructure that supports value reduction through less complex designing.

PROBLEMS IN SMART GRID

Smart grid power systems use digital technology to deliver electricity. they're being extended throughout the world. Though they are promoted as a way to make energy savings, some issues exist with this technology. A number of the problems inherent in sensible grid power systems embody client privacy issues, security issues, grid volatility and inflexibility. Implementing a smart grid has tidy implications for private privacy as a result of the grid has the flexibility to regulate power access. Security consultants believe that this technology may enable somebody apart

from the client to regulate the ability provide. Some issues explained as:

Privacy Problems

Security consultants believe that smart grid technology could change some people to urge to control facility of power supply. Communication increases the possibility of somebody gaining control over the power supply of one building or a whole neighborhood.

Grid Volatility:

Smart Grid network has a lot of intelligence at its edges; that's, at the entry purpose and at the end user's meter. However, the grid has poor network within the middle, governing the switching functions. This lack of integrated development makes the grid a volatile network.

CONCLUSION

This article fundamentally assesses the smart grid definitions, features and technologies of the system. Moreover, this article also studies the smart grid technologies and their advantages in various regards. At last, it was also studied that there were some limitations in the system. The features and characteristics of smart grid systems have also been recognized. "Smart grid" enabled distribution could reduce electrical energy consumption by 5-10%, carbon dioxide emissions by 13-25%, and the cost of power-related disturbances to business by 87%. (Source: The Electric Power Research Institute). Smart grid enabled energy management systems to be able to reduce electricity usage by 10–15%, and up to 43% of critical peak loads. (Source: The Brattle Group, SMUD and PNNL.) The Smart Grid vision generally describes a power system that is more intelligent, more decentralized and resilient, more controllable, and better protected than today's grid.

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Article 18

Theft Detection in Smart Grid

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ABSTRACT

Among electricity transmission's non-technical losses, electricity theft has the most severe and dangerous effects. Especially electricity consumption decreases the supply quality, increases generation load and causes authorized consumers to pay immoderate electricity bills and affects economy. The adaptation of smart grids can significantly reduce this loss through data analysis techniques. The smart grid generate a huge amount of data including the power consumption of individual users. Utilizing this data, machine learning and deep learning techniques can correctly point out electricity theft users. Electricity theft detection system is based on combination of a CNN and LSTM architecture.

INTRODUCTION

Because of the high cost of obtain energy, as well as the limited amount of energy resources, efficient and operative use of energy resources is a very important aspect of social and economic development for any country. The smart grid has become an essential solution for making the greatest use of future energy monitoring. The smart grid

system can be thought of as an entire electricity network consisting of the power system infrastructure and computers to manage and monitor the energy usage, along with an quick monitoring system that tracks the usage pattern and mode of action of all consumers connected with the system. The smart grid provides the utilities' and customers facility to monitor, control, and predict energy use by integrating modern digital tool with the existing electrical system. In this system, the collector device delivers usage readings to the working or operative center using the internet and the power transmission company act the billing operation depending on these readings. At the same time, the working center collects user readings from neighborhood customers' periodic updates through a wireless network. The main focus is to decrease losses due to energy wastage and provide usable, cost-effective, and certain electricity supplies. The device that performs usage reporting is known as a smart meter; it is a computerized version of an former meter. The processor, nonvolatile storage, and communication facilities, along with the ability to maintain global customer energy generation, make smart meters an important part of smart grid systems.

Today, electric power loss has become one of the most visible issues affecting both conventional power grids and smart grids. From the statistics, it has been shown that transmission and distribution losses increased from 11-16

percent between the years 1980 to 2000. The electricity losses increased from country to country. The losses in the USA, Russia, Brazil, and India were 6%, 10%, 16%, and 18%, respectively, of their total energy producing. The difference between the energy manufacture in one system and the metered energy delivered to the users is known as the power loss. To establish the amount of electricity loss, smart meters in smart grids play an important role. Advanced energy meters get information from the consumers load devices and measure the consumption of energy in intervals of an hour. The energy meter furnish supplemental information to the utility company and the system operator for better monitoring and billing and provides two-way communications between the utility companies and consumers. However, it is also possible to limit the maximum amount of electricity consumption, which can conclude as well as re-connect the supply of electricity from any far place.

Electricity loss is mainly classified into two classification, namely technical loss (TL) and non-technical loss (NTL). TL appear because of the joules effect on power lines and transformer loss during the transportation of electricity. The calculation of TL is entirely complex, making it difficult to locate the point of loss and estimate the amount of energy destroyed. The TL cannot be finish completely, but it can be decrease by applying some modification methods throughout the system. The NTL can be defined directly as the difference between a total loss and TL. The main causes of NTL are billing delay and projection, energy theft, faulty energy meters, cheating, and unpaid bills.

CNN-LSTM ARCHITECTURE FOR SMART GRID DATA CLASSIFICATION

In this work, the integration of a convolutional neural network (CNN) and long short-term memory (LSTM) was utilized to solve a classification task. The CNN has an automatic feature extraction ability from the given dataset and LSTM performs better in the case of sequential data. The combination of both has been investigated in different applications, such as text from image or video, sentiment analysis, and natural language processing. In this paper, a CNN-LSTM model was used to solve a binary classification problem.

CNN Model

A CNN is a subclass of neural network which is inspired by the working principle of using the human visual cortex for object recognition. CNNs were designed for identifying objects, as well as their classes, in an image. CNN differs from conventional machine learning algorithms in the context of feature extraction, where CNN extracts attribute globally through a number of stacked layers.

Normally, CNN architecture consists of several convolution layers and pooling layers. These layers are followed by one or more fully connected (FC) layers. The convolutional layer is the principal building block of a CNN. Convolution is a mathematical operation that acts upon two sets of information. The operation can be addition, multiplication, or a derivative such as

$$Y = x \times F \rightarrow y[i] = \sum j = -\propto + \propto x\,[i{-}j]F[j]$$

LSTM

Long short-term memory (LSTM) networks are a special class of recurrent neural networks (RNN) designed to avoid the short-term memory problem of RNNs. LSTMs are efficient of remembering and grow remarkable information from the starting stages of the network regarding the final stage. In this work, we used the basic structure of an LSTM. An LSTM has a alike repetitive structure to that of an RNN, but the modules have different internal components. The important part of an LSTM is the cell state, which bring information along the chain. The information in the cell state is dropped or change by some units called gates. An LSTM module consists of three gates, the forget gate, the input gate, and the output gate.

CONCLUSION

A powerful CNN-LSTM model was investigated for electricity theft detection using historical power consumption data for 10,000 users. The dataset initially had countless missing data points. A new data preprocessing algorithm was introduced to fill in the missing data rather than just eliminate the case related with the missing data. Also, the dataset had a small number of cases for theft users, Alike to other power consumption datasets. Due to this class imbalance characteristic, the models showing of classifying the theft users was not found sufficient. The models showing improved after the inclusion of the augmented dataset in the training process. An overall 89% classification perfection was attained.

POSSIBLE SOLUTION

As it has become clear that current batteries are not suitable, so new researches have been started to solve the shortcomings that lie in the chemistry of batteries. New material is used in the composite to increase the efficiency of specific components or a completely new battery design. One

material is graphene, which was theorized many years ago but discovered recently. It has shown remarkable properties, and many have begun to test it in electronic and energy systems. It was also able to address the issue with sustainability currently in lithium ion batteries. This is produced by a different method, but the important achievement was gained in 2004 when Andre Geim and Konstantin Novoselov created graphene for the first time using a method called the "Scotch Tape method". Despite the apparent superiority of graphene enhanced batteries, they are still in a phase of development. Researchers are still finding a way to produce this on the commercial scale. Some newer, and more theoretical methods like Sorenson's chemical vapor deposition methods are far efficient, require less resources and are environmentally friendly. This means that graphene batteries could be produced at low price. Applications for these batteries have been mostly theoretically discussed. For instance, Samsung's "graphene ball" battery shows that it could be produced commercially.

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Article 19

Humanitarian work requires women

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ABSTRACT

Humanitarian crises have increased. Understanding of the impact of crises, such as conflicts and natural disasters, on both women and men, has deepened. However, there is still a long way to go before women are acknowledged as active actors – not just victims – in the context of coping with disasters. Even so, women are often among the first to feel the consequences of crises. In order for their special needs to be taken into consideration, women's voices must be better heard and their role as active actors in humanitarian work must be acknowledged. Women are particularly vulnerable when it comes to humanitarian or natural disasters, yet issues relating to their specific needs tend to be overlooked or excluded as a disaster unfolds.

INTRODUCTION

Disasters interrupt the most fundamental of community processes and resources. Communities are often physically displaced, seeking shelter in temporary accommodation or refugee camps, where conditions can be overcrowded and lack food and basic sanitation. Nowadays, women have the responsibility of both family and social work, but they are playing a significant role in this regard that not only encourages their future progress but also plays a significant role in enhancing the economy of their country.

Figure 1. Responsibilities of working women, *Source:https://www.istockphoto.com/illustrations/business-woman-working-at-her-clean-office-desk?phrase=business%20woman%20working%20at%20her%20clean%20office%20desk&sort=mostpopular*

Women often keep society standing in the midst of or after the war. During migration, women are at

considerable risk of becoming victims of human trafficking or sex slavery. Disasters have the most pronounced negative impact on the survival chances of those who are already the most vulnerable.

Crises often affect the availability of childbirth, maternity, and child health services, which can be life-threatening for women. In fact, three out of five maternal deaths occur in countries that are classified as fragile due to a natural disaster or conflict.

Thus, this cultural behavior creates a barrier for women to seek education and opt for employment. The cultural disparity makes women invisible in the workforce and the job market. As a result, compared with other developing countries, gender expressed weak indicators of Pakistan nation-building.

The funding allocated to disaster response efforts has already proven inadequate as the numbers of people requiring aid have increased to record-breaking levels. The humanitarian needs of women will also increase in volume in the future.

WHY DOES HUMANITARIAN WORK NEED WOMEN?

Disasters kill more women than men and hit women's livelihoods hardest. According to UN reports, 60 per cent of all maternal deaths take place in humanitarian settings and all forms of gender-based violence against women and girls spike during disasters and conflict. Experience and research show that when women are included in humanitarian action, the entire community benefits. Despite this, women and girls are often excluded from decision-making processes that shape the response strategies that affect their ability and that of their community to recover from crisis. Women must be included in decision-making about the forms of assistance, means of delivery, and the provision of the protection and economic and social empowerment opportunities they need so they can be agents of change. Therefore, it is vital for aid workers to always involve women in both, the planning of efforts targeting them within communities as well as humanitarian workers. This is the only way to reveal problems that would otherwise remain invisible.

POSSIBLE SOLUTION

Women deliver champions of gender equality, health, and encourage all the steps taken for the improvement of society and the environment everywhere. The humanitarian sector requires women that ensure their availability at the decision-making table and deliver the strongest response for girls and women.

Figure 2. Women approaching different sectors, *Source: https://thenationonlineng.net/education-as-a-tool-for-social-relevance/*

Empowering women through Technology

Women around the world make 80% of family healthcare decisions, but they are still disadvantaged in many ways. Technology can empower women to make informed choices about their health, and the health of their families using latest technology like Johnson & Johnson is helping to develop tech programs that can equalize their access to crucial health information programs like Mitra [2], which delivers mobile voice messages to pregnant women and new moms in India.

Inspiring a Passion for Science in Students at Initial Level

STEM education (Science, Technology, Engineering, and Mathematics) is future-oriented. Many people perceive science to be something tough and negative. So, growing interest in science from a young age is necessary to encourage them to take up science as their career path. This can be done by encouraging the students through offering different opportunities to them that motivates them to do interesting experiments. Female motivational speakers visit different institutes and try to associate the students with emerging and innovative ideas about science by exploring their interesting projects in front of them.

Supporting Women Re-entering the Workforce

Women who are not allowed to work outside the house could be made a part of the cottage industry where she could work from home, provided her wages, and earned income is raised. Initiatives should be made on Governmental level where entrepreneurial opportunities are provided to women, working directly from their homes. This can be done by opening free skill training centers in every major location so that women are empowered and could materialize their skills into a business, thus contributing to the wellbeing of their

family and country.

CONCLUSION

This research explores the significance of humanitarian work by women in different disciplines of life. Hard-working and dedicated women are valiantly contributing to the growing economy of their country. If the aim is to discuss menstrual health, maternity care, sexual and reproductive health, or aid the victims of sexual violence, it is nearly impossible to reach those in need of aid without female workers. Strengthening and promoting the participation of women's groups makes their voices heard in the promotion of women's rights.

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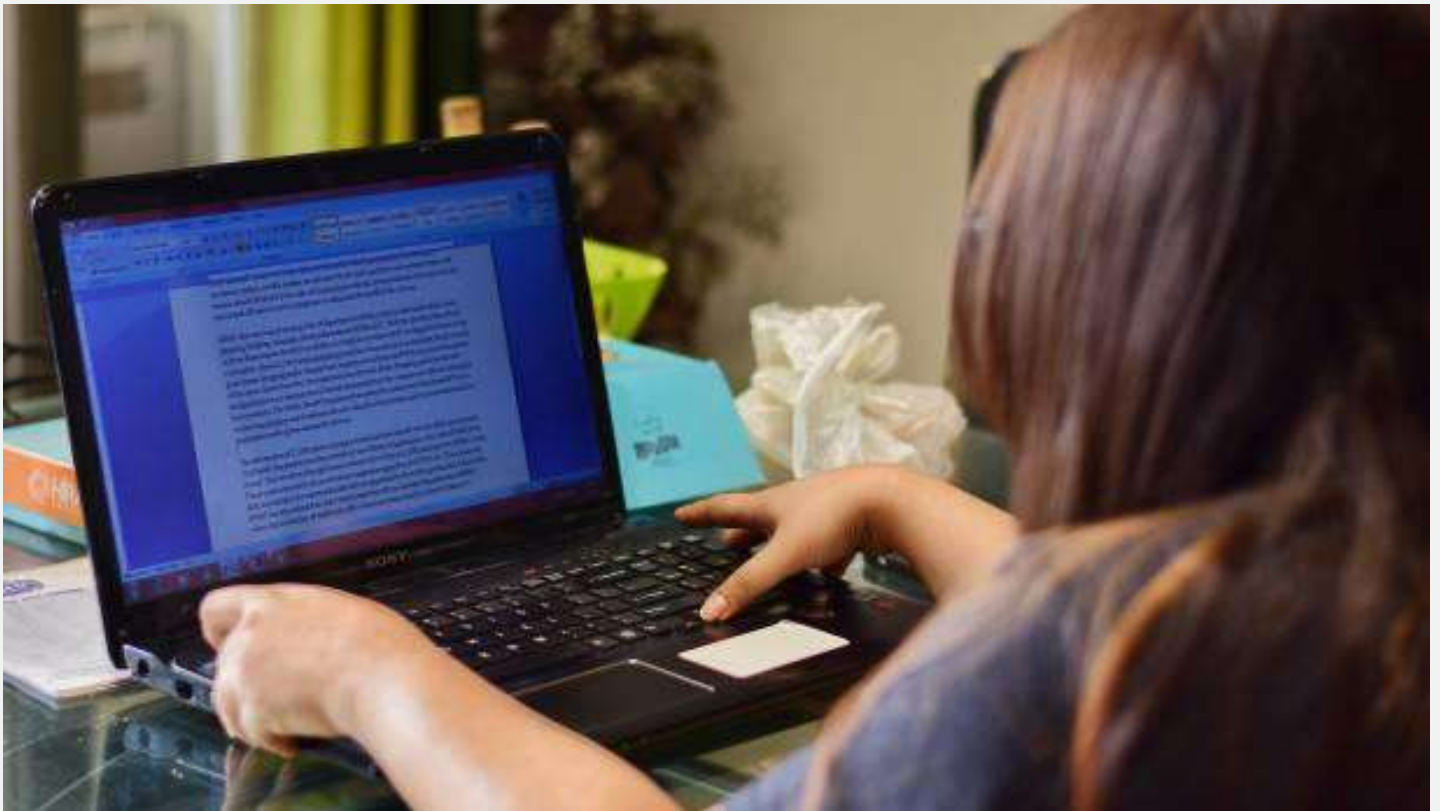
Article 20

Work from Home Opportunities

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ABSTRACT

Work-From-Home has become an emerging trend of the year 2020. Due to the outbreak of the coronavirus, more and more people have instructed to stay at home. Through immersing technology, working from home has become more convenient and this practice is observed to be more productive and efficient. In this article, we explore different work from home opportunities that have a vivid scope in the future.

INTRODUCTION

After the outbreak of the pandemic called the coronavirus or 'COVID-19', which resulted in countless deaths worldwide Government in many countries has announced Stay-at-Home policy. Thanks to ever-evolving technologies like Zoom, Loom, Microsoft Teams, Google Hangouts and Google Meet and other social apps, now everyone can still work efficiently from home without any problem or disturbance in their work routine. Simultaneously, there has been a huge change in the market.

ONLINE JOBS

Whether you are working remotely for a company or starting your own business startup, there are no shortage of **work-from-home** opportunities. Here are some recommendations for stay at home workers:

Translator

High Quality Translators are in high demand since 2015. According to the Bureau of Labor Statistics, translators and interpreter's jobs will grow by 29% through 2024. Majority of the Translators implement work-from-home practice. They are required to be fluent in at least two languages. Sites such as Upwork and Fiverr allow translators to earn up to $30/hr.

Content Writer

Content writing is emerging as a bright career because

digitization is reaching new heights day-by-day. There are huge opportunities for content writers in the market. They are required to be punctual, creative and great at expressing their writing skills.

Graphics designer

Graphic designing can be a very optimistic career for artistic and naturally creative individuals. From branding to social media marketing to designing websites and blogs and logos, graphic designers have tons of opportunities. According to the Bureau of Labor Statistics (BLS), the median annual graphic designer salary in 2018 was $50,370- meaning they earn a respectable living. You can easily begin creating graphics using websites such as Canva. This will allow you to offer clients lite graphic design and upscale your skills.

Virtual Assistant

With so many businesses moving to online, it's no wonder that virtual assistant jobs are blooming. VAs helps you organize your tasks and provides you with the best administrative services. Having VAs makes your life easier and quicker. You can hire them for different task such as customer support, HR Management, organizing/ writing email, data entry, creating presentations, organizing reports etc.

Web Developer

Web developing is very much alive as long as the industry functions online and the prospect of online system dying can't be seen in the endless future. Web developers are responsible for the outlook of the website. They create the site's layout and graphics, and other content. They are required to be skilled at programming languages such as WordPress, HTML/CSS or JavaScript.

Data Entry

Data Entry is exactly what it sounds like – entering data from any documents into a certain system. They are instructed with various tasks such as tracking and monitoring data or measure the performance or the output of a system. Data entry requires very little skill, but, nevertheless, a wide range of business need workers for doing this tedious task.

Blog Writer

Blogging is another way of expressing your writing skills and bring passion to your work. Businessman and entrepreneurs require bloggers to advertise their product or service.

Figure 1. Blogging is one of the easiest ways to work from home, *Source: https://blog.hubspot.com/marketing/how-to-start-a-blog*

CONCLUSION

Besides, those listed above, you can find tons of jobs and opportunities online. You can stay at home and get your dream job with just a click away at websites such as Upwork, Fiverr, Freelancer, Fastwork, that offer various tasks and jobs of one's liking. So, start working from home and make a lifestyle for yourself.

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