Trend Speak

Camellia Institute of Technology

Madhyamgram, Kolkata, WB

Department of Electronics and Communication Engineering

Departmental Magazine, April 2022

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Principal's Message – Trend Speak

It is my immense pleasure to convey my best wishes to the Department of Electronics and Communication Engineering for releasing the departmental magazine '**TREND SPEAK'** in the academic year 2021-2022. The students and teachers of the department have shared their voices on this knowledge-sharing platform. They have penned down their thoughts on trending technology befitting the name 'Trend Speak'.

I express my sincere gratitude to the HOD of the ECE department, Prof. Uttam Kumar Dey, and his dedicated team members for taking this great initiative and making it a successful project.

I extend my heartfelt greetings to all the participants, authors, faculty, and students who are associated with this great endeavour.

Prof(Dr.)Sanghamitra Chatterjee
Principal
Camellia Institute of Technology

Registrar's Message– Trend Speak

It gives me great pleasure to know that students and faculties of Department of Electronics and Communication Engineering of Camellia Institute of Technology are going to publish the Departmental Magazine "**TREND SPEAK**" in the academic year 2021-2022. This magazine provides an insight of bright minds and their views on modern world.

I want to congratulate Faculty members of ECE department for their dedication to help students, achieve greater heights in academic excellence. Camellia Group has always encouraged young minds to explore unchartered territories and such initiatives are always welcomed.

My heartiest congratulations to the Organizing Committee for publishing this magazine. I wish all students, faculty members and staff success in all their future endeavours.

Dibyendu Chakrabortty
Registrar
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HOD's Message – Trend Speak

The Department of Electronics & Communication Engineering has consistently maintained an exemplary academic record. The greatest asset of the department is its highly motivated and learned faculty. The available diversity of expertise of the faculty with the support of the other staff prepares the students to work in the global multicultural environment. The Department not only aims to make our students technically sound and knowledgeable but also to nurture their wisdom and make them a better and responsible human being.

It is my pleasure to convey my best wishes to students and all faculties for releasing the departmental magazine '**TREND SPEAK'** in the academic year 2021-2022. The students and teachers of the department have shared their voices on this knowledge-sharing platform.

I extend my heartfelt greetings to all the participants, authors, faculty, and students who are associated with this great effort.

Prof.Uttam Kumar Dey
HOD,ECE Department
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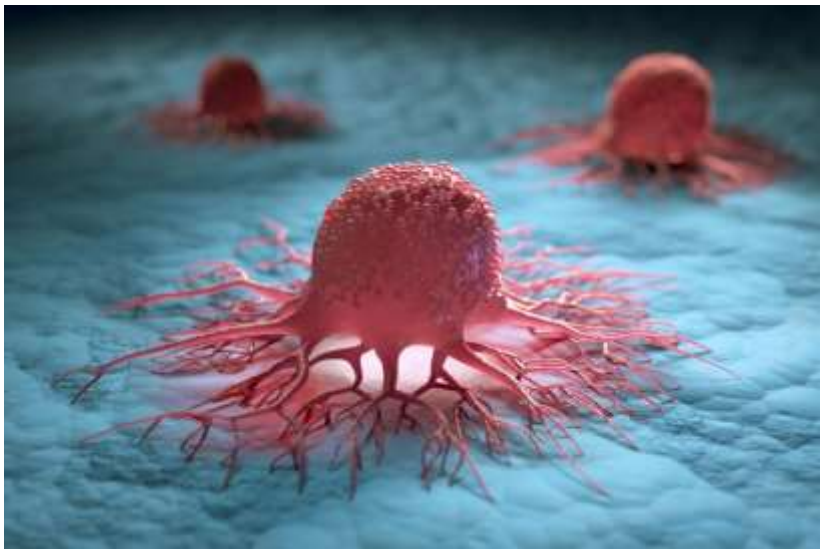
Dr.Sanghamitra Chatterjee
Principal,Camellia Institute of Technology

Cancer – a dreadful disease



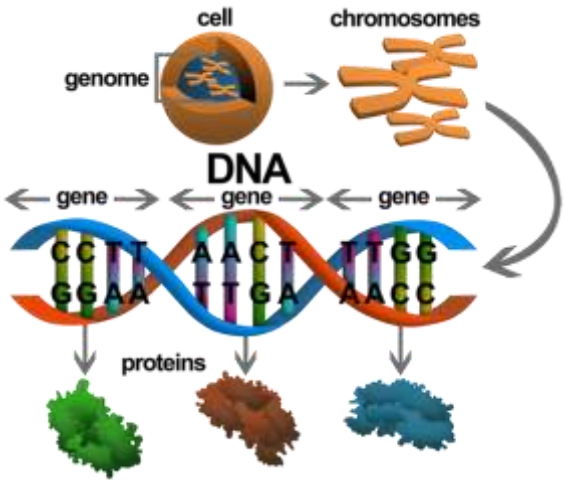
Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths in 2020, or nearly one in six deaths. The most common cancers are breast, lung, colon and rectum and prostate cancers.

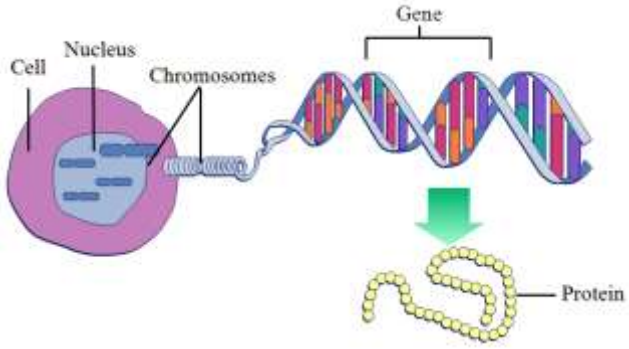
Cancer refers to a group of more than a hundred diseases that can originate in many different parts of the body. Cancer begins when genes in a normal cell in a particular site become abnormal and the cell starts to grow and divide out of control. They continue to grow and form new, abnormal cells.

For more than decades, cancer research has been focused on understanding the root cause of the disease. Technologists are also trying to beat the challenges by using cutting edge technology. It is now well known fact that most cancers are caused by gene faults (mutation) that develop during our lifetime.

Role of GENE in Cancer

Cancer cells originate from normal cells in which the DNA (deoxyribonucleic acid) within the cell nucleus has become damaged or mutated. DNA is the “blueprint” contained in every cell that carries instructions for the cell’s function, growth, death and protein synthesis. When this DNA becomes damaged, the cell usually either repairs the damage or dies. However, when the cells are cancerous, the damaged DNA is not repaired and neither does the cell die. Instead, it gives rise to many more abnormal cells that all contain the same defective DNA as the original cancer cell. DNA damage may be inherited or it may occur spontaneously at any point in a person’s life due to some external or internal stress factors.





Genes are basic units of heredity. It is made of the chemical DNA (deoxyribonucleic acid) that code for specific proteins of the living organisms. When normal cell function is disturbed by some external or internal stress then it turns into malignancy. The p53 gene, located inside human chromosome 17 is known as tumor suppressor as it repairs damaged DNA. Also it is called ‘guardian of genome’ for playing crucial role in controlling genetic disorders. The most frequent genetic changes observed in cancer cells when there is a mutation in p53 gene which

leads to uncontrolled cell proliferation and malignancy. Although it is well known that tumor suppressor p53, is mainly responsible protein for malignancy of cells, but still many unresolved questions yet to be explored. Nowadays gene therapy is a popular technique used in cancer treatment where drugs target a specific protein inside a signaling pathway. This method is less toxic compare to chemotherapy because it destroys only the specific target region.

Normally Tumor suppressor genes are protective genes and limit cell growth by monitoring cell divisions, repairing damaged DNA or controlling cell death.

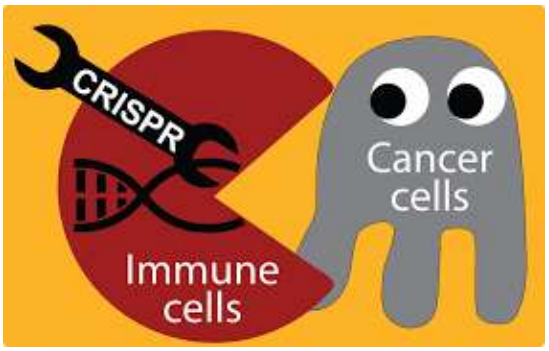
But when a tumor suppressor gene mutates, cells grow uncontrollably and they may eventually form a tumor. Examples of tumor suppressor genes are BRCA1, BRCA2, and p53. Mutations in BRCA1 or BRCA2 genes increase the risk of developing breast or ovarian cancers in female and the risk of developing prostate or breast cancers in male. They also increase the risk of pancreatic cancer and melanoma in both male and female.

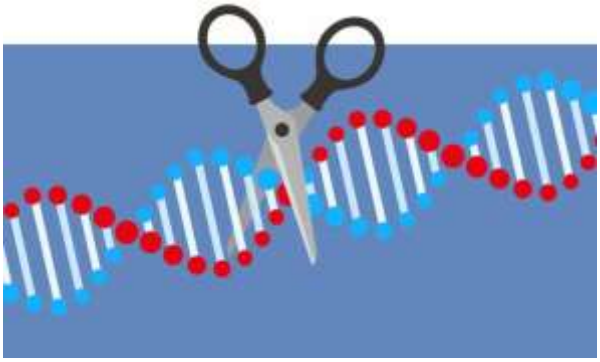
The most commonly mutated gene in people with cancer is p53 or TP53. More than 50% of cancers involve a damaged or mutated p53 gene. Most p53 gene mutations are acquired due to some external or internal stress factors such as: tobacco smoke, high energy (ionising) radiation, such as x-rays, ultraviolet radiation from the sun, some substances in food, bad chemicals in the environment. Researchers know that the p53 gene is damaged or missing in most of the cancers.

Technology in Cancer Research

A number of technological innovations that have led to breakthroughs in the ways we find, visualize, understand, and treat cancer. Continuing to explore and use these technologies can open the door to accelerate progress against this deadly disease.

CRISPR (a gene editing tool)





CRISPR, a gene editing technique which works like a pair of scissors that can precisely delete, insert, or edit specific bits of DNA inside cells changing the genetic code of living cells. CRISPR still has its limitations and debate continues around the ethics of gene editing. But one thing is clear—CRISPR is a powerful tool that could help make significant progress, in cancer research and beyond.

Artificial Intelligence (computer programming)

Artificial Intelligence (AI) is used to improve cancer diagnosis and drug development. If technologists would be able to create 'Digital Twin' of a cancer patient then physicians could use this model to explore treatments and possible outcomes before presenting it to the actual patient. NCI, the Department of Energy, the Frederick National Laboratory for Cancer Research, and a trans-disciplinary group of investigators are using AI to advance development of digital twins for people with cancer. Others use it to analyze imaging data and electronic health records to tailor patients' radiation doses. AI is even being harnessed to quickly analyze population-based cancer data and estimate the probability of certain cancers.

Telemedicine (Cancer Care)

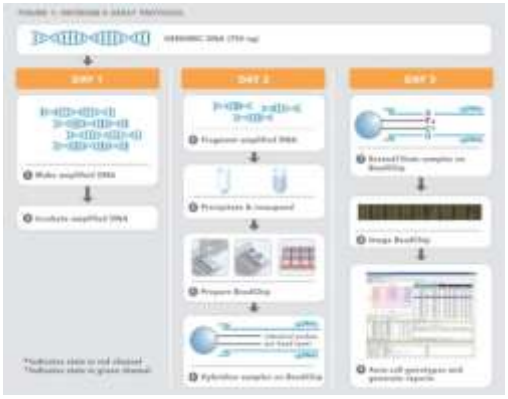
Cancer patients need regular care and treatment. Telemedicine is an useful tool for patients from remote area. It is widely used during Covid pandemic. It is used by some hospitals and clinics for remote health monitoring, video visits, and even in-home chemotherapy. It also makes access to clinical trials and cancer care easier for more diverse groups of patients across wider geographical areas.

Cryo-EM (high resolution images)

Cryo Electron Microscope (Cryo-EM) captures images of molecules that are ten-thousandths the width of a human hair, at resolutions so high they were unheard of just a decade ago. Researchers analyze hundreds of thousands of cryo-EM images for quality, reconstructing

3-D images of molecules that allow scientists to study how they behave. For cancer, this means better understanding how cancer cells survive, grow, and interact with therapies and other cells.

Infinium Assay (tools for mapping genes)



The Infinium Assay, developed by Illumina, is a process and set of tools that analyzes millions of single nucleotide polymorphisms, the most common type of genetic variation. This can help mapping of genes that cause cancer and provide insight into cancer risk, progression, and development. The assay is now used in a wide range of applications which gives a significant insight into cancer research.

Robotic Surgery (minimally invasive surgeries to remove cancer cells)

A speedier recovery and quicker return to normal life—that's what robotic surgery can make possible. For instance, someone with prostate cancer may need their prostate gland removed

(a prostatectomy), and what once required making a large incision from navel to pubic bone can now be performed with the assistance of robotic arms that enter the body through small incisions. A surgeon controls the arms using a special console that also provides a real-time, magnified view of the surgical site. Robotic surgery involves less blood loss and pain, and a patient could leave the hospital as soon as the day after surgery.

THE IMPACT OF 5G ON TE INTERNET OF THINGS

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The Internet of Things (IoT) is rapidly developing and expanding. Many things that were on the drawing board only a few years or even months ago are now becoming reality. One limiting factor, however, has always been bandwidth. Cellular networks have a good range but limited bandwidth. Wi-fi has good bandwidth but limited range, and can be a challenge to secure. One thing which might change that is the growth of 5G. 5G will increase cellular bandwidth by huge amounts, making it much easier for the Internet of Things to network large numbers of devices together.

1. What is 5G?

5G is the next-generation cellular network. 4G, the current standard, offers speeds ranging from 7 mbps to 17 mbps for upload and 12mbps to 36mbps for download. In contrast, 5G transmission speeds may be as high as 15 or 20 Gbps. Not megabytes, gigabytes. Latency will also be ten times less, and the number of devices that can be connected scales up greatly. To put this practically: A 5G phone will be able to load a full-length feature film, in HD, in a matter of seconds.

5G will thus remove all of the current limitations on bandwidth, at least until usage scales up to keep up with it. There are a number of ways in which 5G will be a game changer for the Internet of Things going forward.

Fig.1 Application of 5G.

2. Increase in Number of Connected Devices Allows for Smart City and Building Solutions

The increase in the number of connected devices will allow for many more sensors to be deployed in smart cities and buildings. Right now, smart city sensors are generally relatively limited; they're put on lamp posts and cover the area very coarsely. For better or worse, 5G allows for saturation of an area with small sensors. This allows for uses that range from detecting pedestrian movement to turn on lighting – with current systems, it's possible to have issues with the lights failing to detect a stationary person and going back off.

Inside buildings, Bluetooth technology is already creating the ability to track people, vehicles, and equipment. 5G, however, will allow for the transmission of a lot more data with the Internet of Things. Imagine hospital beds that constantly update doctors on the vital signs of the patient within.

3. AI Integration Improves Traffic Control

Imagine how a smart city with thousands of cameras could direct people around traffic accidents, or tell people where there are places to park. On top of that, autonomous vehicles will begin to take off. 5G networking with IoT allows cars to talk to each other and their environment, reducing the risk of accidents and allowing for far more efficient traffic patterns. Combining all these things will reduce traffic jams, shorten commute times, and save energy by reducing the amount of time vehicles need to idle at red lights or wait in line.

Cars could also record the condition of their oil or brakes, notifying the owner and connecting them directly to their chosen repair facility. Not only that, but self-driving cars could record and transmit data back to their manufacturers that could then be used to improve both the software and future designs.

4. Tele health

Telehealth, right now, is subject to the potential of blackouts, and to poor connectivity for those most in need of it; those in rural areas where a doctor may be an hours-long drive away.

5G will increase internet speeds in remote areas and may allow for such things as specialist surgeons working, via robot, in small rural clinics. Combined with the personal medical kits being worked on, it will also allow for people with contagious diseases to be diagnosed remotely, without having to come into an office or hospital and spread it around.

Wearable health monitors increase patient engagement and improve outcomes, and are expected to reduce hospital costs; thus freeing up money that can be better spent elsewhere.

5. Retail

Imagine walking into a store and having your phone… or better yet, your AR glasses, tell you where the item you are looking for is. Imagine that you can look at a dress and your gear will pull up a picture of how it will look on you using virtual reality. Smart tags and digital signage will allow for a much smoother and more fun shopping experience. Ultimately, there may even be clothing printers that take your measurements and instantly make the clothes in your size.

If going to a restaurant, 5G and Internet of Things would allow your phone to connect to the network and transmit to the hostess the number of people in your party, any food allergies, etc, before you even walk in the door.

6. Integrated Supply Chains

Factories and warehouses are already using real-time tracking for inventory control and to track parts, products, and equipment throughout the entire cycle thanks to IoT in manufacturing. 5G promises the ability to use a single system to, for example, track a product from manufacturing to the end-user, seamlessly, without any need to check it in or out and with the vendor being alerted when a product is delivered… and when one is “lost in the mail.” Integrating supply chains will reduce costs, allow for better customer service, and reduce the loss of product in transit. Such 5G

tags, if cheap enough, could also reduce porch banditry by allowing law enforcement to track missing parcels.

For the industry, it would allow for tracking of production bottlenecks, and improvement of processes.

7. Network Slicing

One of the best things about 5G is the ability to implement virtual networks. These will create subnets that can have different traffic priorities. For example, in a hospital, the network could be designed to ensure that a connection between a surgeon and a robot was prioritized over, for example, communications being used by patients. Emergency transmissions can thus be protected even if the network is reaching capacity.

8. Conclusion

The internet of things is going to transform our lives over the next few years; and 5G is, as it slowly rolls out, going to enable much more far-reaching connectivity. Our cities will get smarter, our cars will get smarter, and our packages will tell us when they arrive on our doorstep. The 5G revolution is coming, and it's going to look quite interesting indeed.

STUDY AND ANALYSIS OF LOW POWER TRANSISTOR LEVEL 1-BIT FULL ADDER CELLS AND COMPARISON OF THEIR POWER EFFICIENCIES

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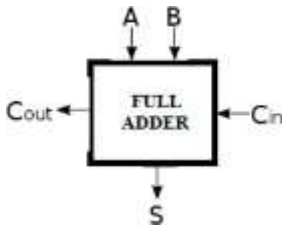
1. Introduction

In this article, different designed adders are studied and analyzed. Analysis is based on some simulation parameters like power, delay and power- delay-product (PDP), different technologies, number of transistor. Simulation is done by HSPICE in 0.18μm CMOS Technology at 1.8 V supply voltage. The different circuit designs are studied and evaluated extensively. Simulations of several designs give new information which are applicable for different requirements. Each of these circuits cell exhibits different power consumption, delay and power-delay- product in different VLSI technology. This article can be said as a library of different full adder circuits that will be beneficial for the circuit designers to pick the full adder cell that satisfied their specific application.

The extensive development in the field of portable systems and cellular networks has intensified the research efforts in low-power microelectronics. The low-power microelectronics. The low-power design has become a major design consideration. Designing low-power VLSI system is significant because of the fast growing technology in mobile computation and communication. Today, we find the number of portable applications requiring low power and high throughput circuits. The design criterion of a full adder cell is usually multi-fold. Full adders are fundamental cell in various circuits which is used for performing arithmetic operations such as addition, subtraction, multiplication, address calculation and MAC unit etc. Addition is one of the fundamental arithmetic operations. It is used extensively in many VLSI systems such as application specific DSP architectures and microprocessors. Transistor count is, of course, a primary concern which largely affects the design complexity of many function

units such as multiplier and algorithmic logic unit.

There is no ideal full adder that can be used in all types of applications [1]. In this paper, we have given a brief description of evolution of full adder circuits in terms of lesser power consumption, higher speed, lesser chip size and higher efficiency. Hence, novel architectures such as Pass-Transistor Logic (PTL), Complimentary Pass-Transistor Logic (CPL)[2] and Gate Diffusion Input (GDI) [3] are proposed to meet the requirements. Each design style has its own share of advantages and disadvantages. We have started with the most conventional 28 transistor full adder and then gradually studied 14 transistors (14T), 16 transistors (16T), complimentary Pass-Transistor Logic (CPL) [2], Gate Diffusion Input [4] and Static Energy Recovery Full Adder (SERF) are proposed to meet the requirements.



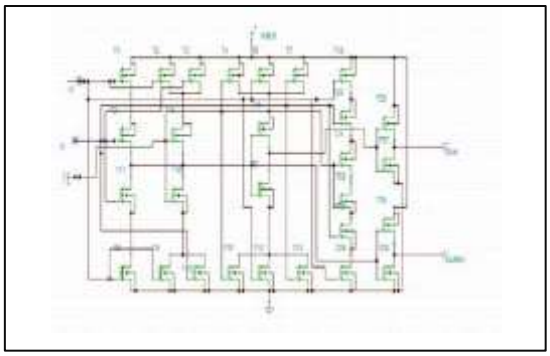
The logic for the Complimentary MOS Logic was realized using the below equations:

$C_{out} = AB + BC_{in} + AC_{in}$

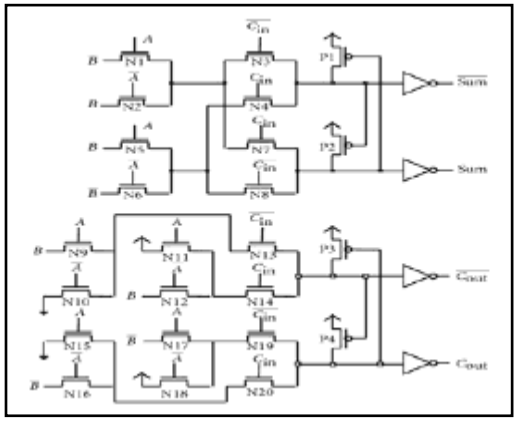
$Sum = ABC_{in} + (A+B+C_{in})C'_{out}$

1. Comparison of different Full Adders

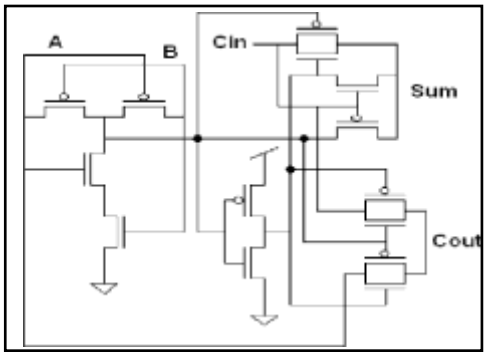
(a) **Conventional 28T Full Adder:**



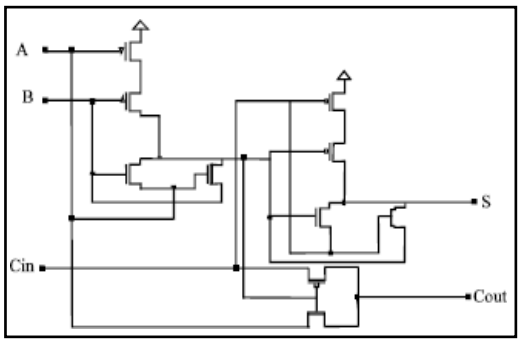
(b) **Complementary Pass Transistor Logic(CPL):**



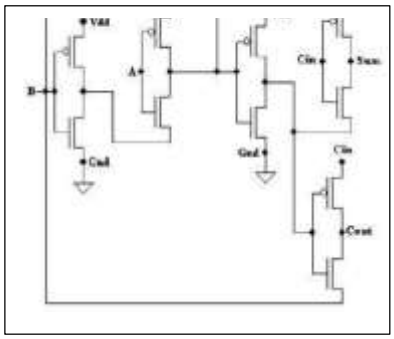
(c) **14 T Full Adder:**



(d) **Static Energy Recovery Full Adder (SERF)**



(e) **Gate Diffusion Input(GUI) based Full Adder:**



2. Comparison ofPDP of different Adders

Parameters	Conventional CMOS Adder	CPL Adder	14T Adder	SERF Adder	GDI Adder
Number of Transistors	28	18	14	10	10
Average Power (W)	3.81*E-07	4.57*E-07	2.93*E-02	1.50*E-10	1.01*E-06
Delay (s)	1.88*E-10	1.72*E-10	7.47*E-10	8.73*E-09	9.71*E-11
PDP (J)	7.16*E-17	7.86*E-17	2.18*E-11	1.31*E-18	9.81*E-17

2. Conclusion

From the above data collected by comparing the Power Delay Product of different adders, we can see that the lowest or the least PDP is of the Static Energy Recovery Full Adder (SERF), which has PDP of 1.31*E-18. So, from this we can conclude that the efficiency of the SERF adder is highest compared to the other different adders.

References:

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THE COVID-19 LOCKDOWN: BLESSING FOR ENVIRONMENT

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Since the last 2nd World war, the COVID-19 pandemic is the most critical global health disaster of the century that has challenges to world public health security. An infectious disease causing by corona virus family was identified on December 2019 at Wuhan city, China and named as COVID-19.

WHO announced COVID-19 outbreak as a pandemic on 11 March 2020. In India, the first corona virus infection and death cases were reported on 30th January and 13th March, 2020 respectively. The Govt. of India has taken some preventive measure like maintain social distance, frequently washing hands, use masks and hand sanitizers, avoid contact with sick people, always cover mouth when cough and sneeze etc. Some general recommendations circulated through social media to control the spread of the virus. But situation become worst day by day. So the Indian Government takes decision to strict nationwide lockdown of 1.3 billion citizens to reduce the spread of the COVID-19 corona virus over the whole country. The number of confirmed cases and death rates are climbed daily. No specific vaccine discovered for the treatment of COVID-19 and constant 68 days lockdown affects the people mentally and economically. But this lockdown is not only curse for human population but also blessing for environment in few cases. It decreases the industrial activity as well as transportation that results the significant reduction of energy consumption and lowering of fuel demand. This change creates a positive impact on environment. 96% air travels were dropped in this pandemic lockdown situation which is lowest by last 75 years. The respiratory diseases such as bronchitis, asthma, other lung disease found to be reduced by the improvement of air quality significantly. Noise free environment and free movement of wild animals in the street also observed during this situation.

Different research agency and scientist reported the decreasing global pollution level in the environment during the COVID-19 lockdown period. European Space Agency releases different satellite images of the change of air pollutant concentration over the globe. Nitrogen dioxide that is emitted from power plants, industrial facilities and vehicles etc. may causes the

respiratory problems. The satellite image of ESA (Fig. 1) indicates the significant reduction of averaged nitrogen dioxide concentrations over the major cities of India from January 1 to March 24, 2020 and March 25 (First day of the lockdown) to April 20, 2020 (2^{nd} phase of lockdown). Some researcher also reported that NO_2 concentration decreased at least 40-50% in the some major cities of India such as Mumbai, Pune and Ahmedabad by March 2020 than March 2019.

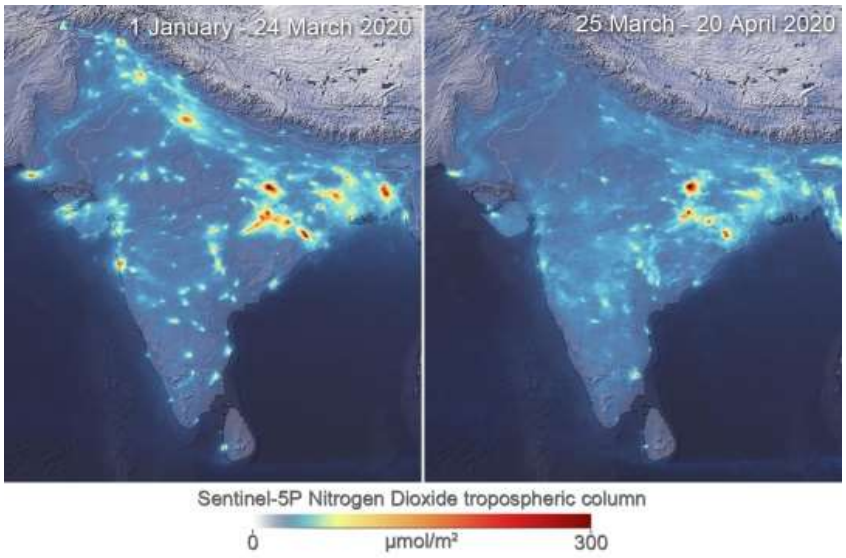


Fig.1 NO_2 emissions in India before and during lockdown due to COVID-19 outbreak .

National Aeronautics and Space Administration (NASA) satellite sensors observed the change in aerosol levels by the measurement of aerosol optical depth (AOD) from last few years to 2020 in the COVID-19 pandemic situation. As aerosols generated from anthropogenic activities, dust storms, volcanic eruptions, forest fires etc. can damage the human lungs and heart. Some aerosols have natural sources, such as dust storms, volcanic eruptions, and forest fires. Fig. 2 shows the decrease of aerosol in India during this pandemic situation. The first five maps of Fig. 2 indicates the aerosol optical depth over India same during March 31 to April 5 period for each year from 2016 through 2020 and sixth map (anomaly) shows how AOD in 2020 compared to the average for 2016-2019. The aerosol optical depth data were recovered by Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite. Several researchers also reported the beneficial effects of Covid‑19 outbreak on the environment.

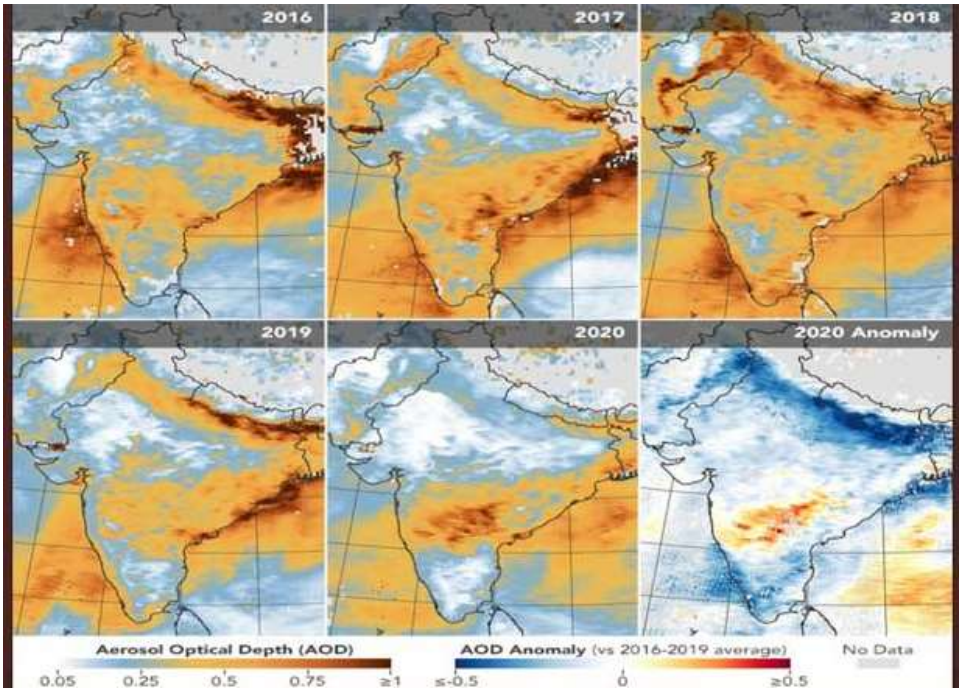


Fig. 2 Aerosol levels in India before and beginning of lockdown due to COVID-19 outbreak.

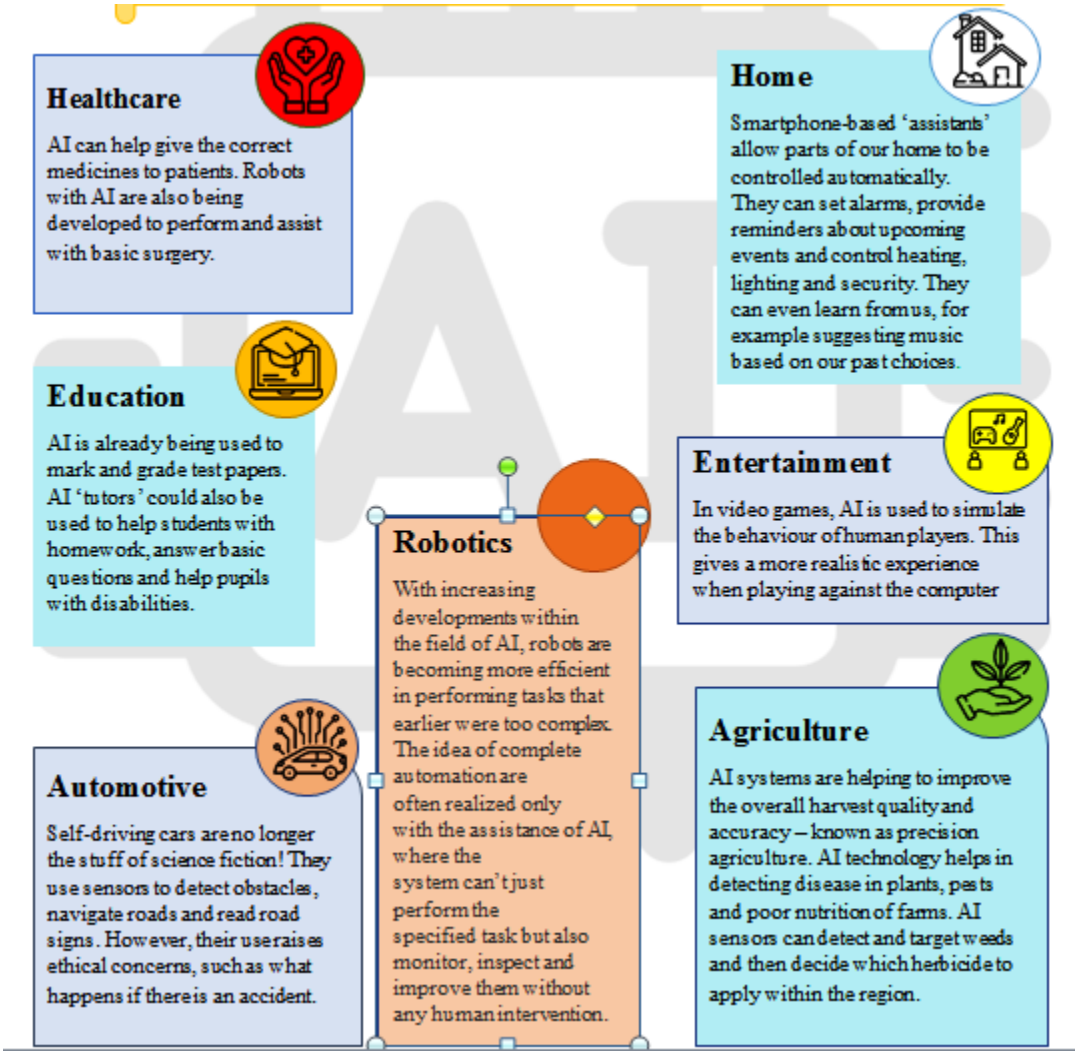
It is not only a serious threat to global human health but it is also considered some blessing of environment by reducing the pollution level. The blessing may be continued for long term basis by learning from this lockdown on how to reduce the pollution level in the environment. If we conscious about our environment then it will be the great outcome from the "curse" COVID-19 pandemic.

ARTIFICIAL INTELLIGENCE

Abhishek Yadav,ECE,6th sem, 2022

Roll No: 23000319006

Artificial intelligence (AI) is where machines simulate aspects of human or animal intelligence. This is done using programmed algorithms. It can be used for problem solving, planning, learning through experience, processing language, perception and even social intelligence.



In our daily life, we study and see that new **technology** is emerging day by day. The level of thinking had changed. Our scientists have made several unique things.

Few of them are related to our intelligence. Now we see that automatic machines, robots, satellites and our smartphones all are examples of artificial intelligence. In the least complex

terms, Artificial Intelligence implies building up the capacity to think and comprehend and settle on choices in a machine. Man-made reasoning is viewed as the most progressive type of software engineering, and it makes a brain where the PC cerebrum can think like people.

1. What is Artificial Intelligence?

Man-made brainpower (AI) or "man-made reasoning" is a part of software engineering, which is creating machines that can think and work like people.

Few examples for this are: recognition of sound or voice, problem handling and solving, teaching, learning and planning. It is the knowledge shown by machines rather than the normal insight shown by people and creatures. It intends to make a PC controlled robot or programming that can think similarly as the human psyche thinks. **Computerized** reasoning is continually being set up to make it great.

In its preparation, it is shown understanding from machines, is set up to stay up with fresh data sources and perform human-like errands.

Along these lines, by the utilization of Artificial Intelligence, such a machine is being made. This can collaborate with its condition and work carefully on the information got.

If the AI concept, later on, is more grounded, at that point, it will resemble our companion. If you get an issue at that point, you will instruct yourself for it.

2. History of Artificial Intelligence

1950 was likewise the year when artificial insight research began. Examination in AI started with the improvement of electronic PCs and put away program PCs.

Much after this, for a long time, a connection couldn't interface a PC to think or act like a human psyche. Afterwards, a disclosure that incredibly quickened the early advancement of AI was made by Norbert Wiener. He has showed that all creative conduct of individuals is the consequence of the response component. Another progression toward present-day AI was when Logic Theorist was made.

Structured by Newell and Simon in 1955, it is viewed as the principal AI program.

3. Advantages of Artificial Intelligence

Computerized reasoning advantages scientists in financial aspects and law, yet additionally in specialized teaching, for example, authenticity, security, check, and control.

A few instances of innovation, for example, administration help decrease ailment and deprivation, making AI the most significant and most prominent creation in humanity's history. Some significant advantages of AI are as per the following –

Computerized Assistance–Organizations with a propelled group use machines in the interest of people to associate with their clients as a help group or deals group.

Clinical Applications of AI –One of the most significant focal points of AI is that it is utilized in medication, use of man-made consciousness called "radio surgery". It is right now utilized by enormous clinical associations in the healing activity of "tumors".

Decrease of Errors–Another incredible bit of leeway of Artificial Intelligence is that it can diminish mistakes and increment the likelihood of arriving at higher exactness.

4. Facts About Artificial Intelligence

- Artificial insight alludes to the knowledge of machines.
- Artificial insight endeavors to make savvy PCs or machines like people.
- The idea of Artificial Intelligence initially appeared in 1956.
- Artificial insight diminishes blunders.
- Artificial Intelligence Research Center is available in many spots far and wide.
- Diseases from Artificial Intelligence can be distinguished,
- With Artificial Intelligence, it turns out to be anything but difficult to determine request, flexibly and evaluating.
- Artificial knowledge is a program for making keen machines and programming.

5. Conclusion

It is concluded that artificial intelligence is an essential invention of human development. It depends upon the correct usage.If we use it rightfully for the sake of humanity and development, then it will be a boon for us. We should not use it for losing any other. Our motto should be clear in using artificial intelligence.

Wi-Fi 7, DATA RATES, AND LATENCY: UNDERSTANDING THE IEEE 802.11 STANDARD

Sayan Saha, ECE,6th sem, 2022

Roll No: 23000319004

A Google search for "famous members of Generation Z" brings up various names that I've never heard of (I did recognize Greta Thunberg, though). One name is conspicuously absent: IEEE 802.11, more commonly known by the sobriquet Wi-Fi.

Born in 1997, Wi-Fi has influenced human life far more than any other Gen Z celebrity. Its steady growth and maturation have gradually liberated network connectivity from the ancien régime of cables and connectors to the extent that wireless broadband Internet access—something unthinkable in the days of dial-up—is often taken for granted.

I'm old enough to remember the satisfying *click* by which an RJ45 plug signified a successful connection to the rapidly expanding online multiverse. Nowadays I have little need for RJ45s, and tech-saturated teenagers of my acquaintance might be unaware of their existence.

1. A Brief Introduction to Wi-Fi Standards: Wi-Fi 6 and Wi-Fi 7

Wi-Fi 6 is the publicized name for IEEE 802.11ax. Fully approved in early 2021, and benefiting from over twenty years of accumulated improvements in the 802.11 protocol, Wi-Fi 6 is a formidable standard that does not appear to be a candidate for rapid replacement.

A blog post from Qualcomm summarizes Wi-Fi 6 as "a collection of features and protocols aimed at driving as much data as possible to as many devices as possible simultaneously." Wi-Fi 6 introduced various advanced capabilities that improve efficiency and increase throughput, including frequency-domain multiplexing, uplink multi-user MIMO, and dynamic fragmentation of data packets.

Why, then, is the 802.11 working group already well on its way to developing a new standard? Why are we already seeing headlines about the first Wi-Fi 7 demo? Despite its collection of state-of-the-art radio technologies, Wi-Fi 6 is perceived, at least in some quarters, as underwhelming in two important respects: data rate and latency.

By improving upon the data rate and latency performance of Wi-Fi 6, the architects of Wi-Fi 7 hope to deliver the fast, smooth, reliable user experience that is still more easily achieved with Ethernet cables.

2. Data Rates vs. Latencies Concerning Wi-Fi Protocols

Wi-Fi 6 supports data transmission rates approaching 10 Gbps. Whether this is "good enough" in an absolute sense is a highly subjective question. However, in a relative sense, Wi-Fi 6 data rates are objectively lackluster: Wi-Fi 5 achieved a one-thousand-percent increase in data rate compared to its predecessor, whereas Wi-Fi 6 increased data rate by less than fifty percent compared to Wi-Fi 5.

The theoretical stream data rate is definitely not a comprehensive means of quantifying the "speed" of a network connection, but it's important enough to merit the close attention of those responsible for Wi-Fi's ongoing commercial success.

Comparison of the past three generations of Wi-Fi network protocols:

Generation/IEEE Standard	Frequency	Maximum Linkrate	Year
Wi-Fi 6 (802.11ax)	2.4/5 GHz	600–9608 Mbit/s	2019
Wi-Fi 5 (802.11ac)	5 GHz	433–6933 Mbit/s	2014
Wi-Fi 4 (802.11n)	2.4/5 GHz	72–600 Mbit/s	2009

Latency as a general concept refers to delays between input and response.

In the context of network connections, excessive latency can degrade user experience as much as (or even more than) limited data rate—blazing-fast bit-level transmission doesn't help you much if you have to wait five seconds before a web page starts to load. Latency is particularly important for real-time applications such as video conferencing, virtual reality, gaming, and remote equipment control. Users only have so much patience for glitchy videos, laggy games, and dilatory machine interfaces.

3. Wi-Fi 7's Data Rate and Latency

The Project Authorization Report for IEEE 802.11be includes both increased data rate and reduced latency as explicit objectives. Let's take a closer look at these two upgrade pathways.

Data Rate and Quadrature Amplitude Modulation

The architects of Wi-Fi 7 want to see maximum throughput of at least 30 Gbps. We don't know which features and techniques will be incorporated into the finalized 802.11be standard, but some of the most promising candidates for increasing data rate are 320 MHz channel width, multi-link operation, and 4096-QAM modulation.With access to additional spectrum resources from the 6 GHz band, Wi-Fi can feasibly increase the maximum channel width to 320 MHz. A channel width of 320 MHz increases maximum bandwidth and theoretical peak data rate by a factor of two relative to Wi-Fi 6.

In multi-link operation, multiple client stations with their own links function collectively as "multi-link devices" that have one interface to the network's logical link control layer. Wi-Fi 7 will have access to three bands (2.4 GHz, 5 GHz, and 6 GHz); a Wi-Fi 7 multi-link device could send and receive data simultaneously in multiple bands. The multi-link operation has the potential for major throughput increases, but it entails some significant implementation challenges.

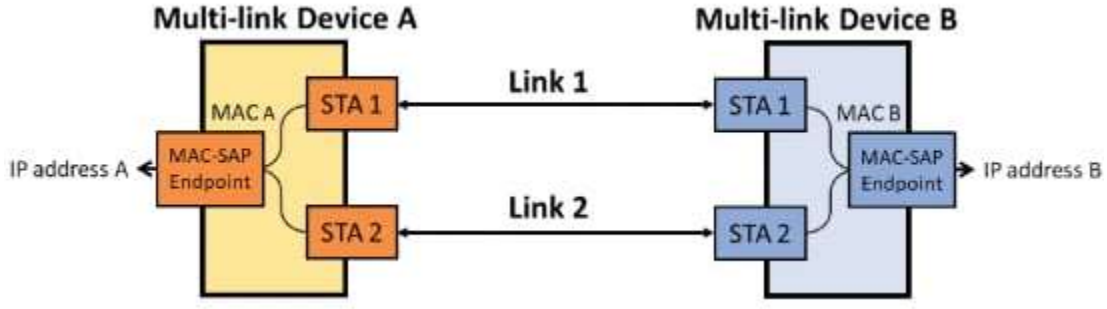


Fig.1 Multilink operation.

In multi-link operation, a multi-link device has one MAC address even though it includes more than one STA (which stands for station, meaning a communicating device such as a laptop or smartphone).

QAM stands for quadrature amplitude modulation. This is an I/Q modulation scheme in which specific combinations of phase and amplitude correspond to different binary sequences. We can (in theory) increase the number of bits transmitted per symbol by increasing the number of phase/amplitude points in the system's "constellation" (see the diagram below).

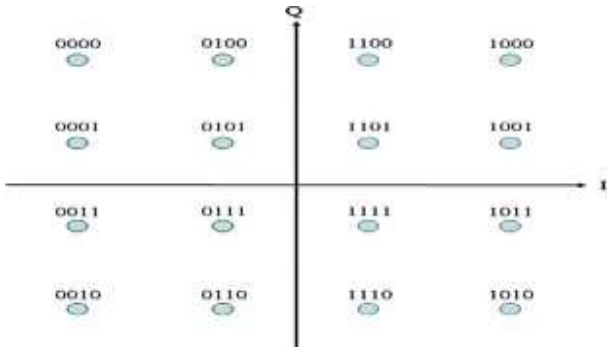


Fig.2 This is a constellation diagram for 16-QAM. Each circle on the complex plane represents a phase/amplitude combination that corresponds to a predefined binary number.

Wi-Fi 6 uses 1024-QAM, which supports 10 bits per symbol (because $2^{10} = 1024$). With 4096-QAM modulation, a system can transmit 12 bits per symbol—if it can achieve sufficient SNR at the receiver to enable successful demodulation.

Latency Features: MAC Layer and PHY Layer

The threshold for reliable functionality of real-time applications is worst-case latency of 5–10 ms; latencies as low as 1 ms are beneficial in some usage scenarios. Achieving latencies this low in a Wi-Fi environment is not an easy task.

Features operating at both the MAC (medium access control) layer and the physical layer (PHY) will help to bring Wi-Fi 7 latency performance into the sub–10 ms realm. These include multi-access point coordinated beamforming, time-sensitive networking, and multi-link operation.

Fig.3 Key features of Wi-Fi 7.

Recent research indicates that multi-link aggregation, which is included within the general heading of multi-link operation, may be instrumental in enabling Wi-Fi 7 to satisfy the latency requirements of real-time applications.

UNDERSTANDING THE SAFETY STANDARDS FOR SMART APPLIANCES

Soumo Saha, ECE,6th sem, 2022

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The market of smart devices is, without a doubt, continuing to grow rapidly, and so is the smart appliance sector. According to Statista, the revenue in the smart appliances market segment is expected to reach $38.4 billion this year, with 262 million households predicted to be using smart appliances by 2025. And the types of smart appliances available have expanded to include microwaves, refrigerators, thermostats, ovens, air fryers, ice makers, and pressure cookers.

The use of smart devices and IoT (Internet of Things) are growing throughout the house as well, extending from smart doorbells for the front door to even more advanced smart thermostats that can optimize energy usage and smart refrigerators that can alert you when certain items are running low.

Smart household appliances must comply with a different set of standards than other smart devices, and compliance with those standards must start during the design phase. In particular, compliance with the right power-related standards is critical for success in the growing smart household appliance market.

Identifying and following the appropriate standard as early as possible in the design phase can simplify decision-making and shorten time-to-market.

1. Smart Household Appliances

Household appliances are not as simple as they were in the past, and they are rapidly taking advantage of IoT (Internet of Things) capabilities and intelligent systems. Appliances can have graphical displays and wireless connectivity that makes them very similar to ITE (Information Technology Equipment) applications, but they do differ from smart devices classified as ITE, ICT (Information and Communications Technology), and AV (Audio Video).

The primary differences lie in how they are used, who the users are, where they are used, and how users can interact with them. For example, smart televisions classified as smart appliances, found in the living rooms and bedrooms of people worldwide, have made it much easier to take advantage of live and streaming entertainment. However, unlike televisions of the past, smart televisions depend heavily on data connections.

On the other hand, smart refrigerators are found in the kitchen where they can make decisions based on artificial intelligence and communicate with other devices and apps to accomplish tasks that include sending alerts to users that certain products are running low or making orders on behalf of users.

Smart household appliances can be programmed by the user and provide automation at some level (e.g., turn the coffee maker on at 6 a.m. or set the thermostat to a higher temperature when everyone is gone from the house), but also make decisions on their own via artificial intelligence (e.g., adjust the thermostat settings to minimize energy consumption). This type of usage may involve more interconnectivity than traditional smart devices and involves multiple interfaces (i.e., interacting with users, interacting with other devices, communicating with applications). And the key to determining the correct approach to design and powering such devices lies in the IEC 60335-1 standard.

2. Safety Standards for Household Appliances

The safety standard for home appliances (including smart home appliances) is IEC 60335-1, which is similar in some ways to IEC 60950 and IEC 62368-1. However, to account for smart household appliances, the IEC 60335-1 standard recognizes that modern household appliances may be internet-connected and are likely to have electronic, as opposed to manual, controls.

Newer standards, including IEC 62368-1, focus on Hazard-Based Safety Engineering (HBSE). This means that potentially hazardous energy sources and the mechanisms that could allow energy transfers from occurring are identified, and measures are taken to prevent them. And not only are safeguards put into place but their effectiveness must be evaluated.

3. Comparing IEC Power Standards: IEC 60950, IEC 62368, and IEC 60335

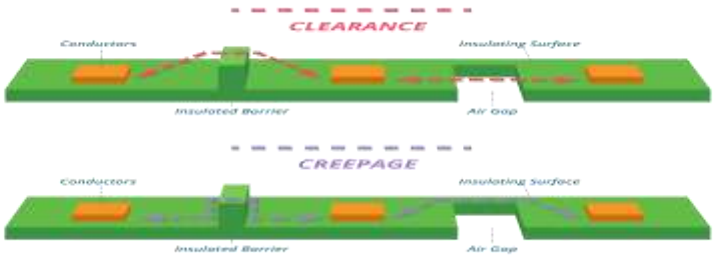
There are some differences between IEC 60950, IEC 60335, and IEC 62368 in the context of power supplies, and it is often true that the best way to become familiar with a new standard is to compare it to an existing standard. In most cases, IEC 60335 is more stringent than IEC 63268 and its ubiquitous predecessor, IEC 60950. The following compares IEC 60335 with the well-known benchmark 60950 standard for information technology equipment, all in the context of power supplies and external adapters.

4. Current Leakage Requirements

Consider current leakage: The IEC 60335 standard limits leakage current to 0.75 mA for portable appliances and 3.5 mA for stationary appliances. IEC 60950, however, has three different categories (hand-held, movable, and stationary), and the leakage current for all three of these (including portable) is the same as what IEC 60335 requires for stationary appliances: 3.5 mA.

5. Creep age Requirements

Creep age requirements for working voltages between 250 VAC and 300 VAC with reinforced insulation are as follows: IEC 60950 requires 6.4 mm while IEC 60335 requires 8.0 mm. Keeping in mind that creep age, as shown in Figure 2, refers to the shortest path along the insulation surface between two conductive parts, IEC 60335 is more stringent.



However, for clearance (which is the distance between two conductive parts through air) under the same working conditions, IEC 60950 requires 4.0 mm, and IEC 60335 requires only 3.5 mm.

6. Isolation Voltage Requirements

Another example of differences lies in the isolation voltage, which refers to the maximum voltage applied for a short period between a power supply's input and output or chassis.

IEC 60950 defines a fixed value for input-to-output isolation of 3 kV, and a maximum output-to-ground working voltage of 500 V. IEC 60335, on the other hand, only defines an input-to-output isolation voltage requirement of 2.4 kV + (Working Voltage x 2.4) with no maximum output-to-ground working voltage.

7. Meeting IEC 60335-1 Standards with CUI Power Supplies

Finding the right power supply that meets the correct set of standards is vital to success in the growing (and highly competitive) smart appliance market. However, navigating through the IEC 60335-1 standard to make sure the power supply or adapter is fully compliant can be challenging.

CUI's power supplies are designed to meet the stringent standards of IEC 60335-1. The first is the PBO-3C/5C/10C Series (3-10W), shown in Figure 3, which are open frame board mount AC-DC power supplies in an ultra-compact SIP package. Not only are they suitable for applications with limited space, but they are also economical solutions for applications with low power demands.

Figure 3. (Left) PBO-3C, (Middle) PBO-5C, (Right) PBO-10C.

The next product line is the PSK-3D/5D/10D/15D/20D/25D Series (3-25W) of encapsulated board mount AC-DC power supplies with a compact design, an input voltage range between 85 and 305 VAC, and a wide operating temperature range.

Finally, the VOF-100C/120C/180C/200C/225C/350C Series (100-350W) of power supplies are also open mount AC-DC power supplies. They are designed to reduce the standby power consumption and overall power consumption and are certified to IEC 62368, 60335, and 61558.

A BASIC INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Anwesha Ghosal, ECE,6th sem, 2022

Roll No. : 23000320029

1. Introduction

AI sometimes called as machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals, such as "learning" and "problem solving.In computer science AI research is defined as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. But if we say in simple words then , AI means The study of computer systems that attempt to model and apply the intelligence of the human mind. For example, writing a program to pick out objects in a picture.

2. Birth of AI

The start of AI is believed to be made by Alan Turing with his question "CAN MACHINE THINK?". The Turing test, developed by Turing in 1950, is a test of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human. The test set some requirements to build a truly intelligent machine that requires knowledge representation, natural language, machine learning, automated reasoning, vision, and robotics for the full test. Since then, the term AI was first introduced by John McCarthy and it was closely associated with the field of "symbolic AI", which was popular until the end of the 1980s. In the 1990s, the new concept of "intelligentagent" emerged. An agent is a system that perceives its environment and undertakes actions that maximize its chances of being successful chips too.

3. AI applications and future technology

AI is ubiquitous and is not only limited to computer science but has evolved to include other areas like health , security , education, music , art , and business application. Many AI applications are deeply embedded in the infrastructure of every industry. AI is expected, in a few years, to touch nearly all the industries and there are plenty of ways AI is and can transform certain industries. AI is currently being utilized for a wide range of activities including medical

diagnosis, electronic trading platforms, robot control, and remote sensing. It has been used to develop and advance numerous fields and industries, including finance, healthcare, education, transportation, and robotics.

AI researchers have created many tools to solve the most difficult problems in computer science and other fields. The current AI performance ranges between sub-human, optimal, and super-human performance. A wide range of tasks can be solved by AI applications including facial recognition, speech recognition, object recognition, images classification and surpassing human-level intelligence in The Game of Go, Chess, Dota 2, and StarCraft II.

4. Some key research areas of AI are:

- Problem solving, planning, and search --- generic problem solving architecture based on ideas from cognitive science (game playing, robotics).
- Knowledge Representation – to store and manipulate information (logical and probabilistic representations)
- Automated reasoning / Inference – to use the stored information to answer questions and draw new conclusions
- Machine Learning – intelligence from data; to adapt to new circumstances and to detect and extrapolate patterns
- Natural Language Processing – to communicate with the machine
- Computer Vision --- processing visual information
- Robotics --- Autonomy, manipulation, full integration of AI capabilities.

5. Opportunities, Limitations and Ethics of AI

Given the exponential rise of interest in AI, major studies have started on the impact of AI on society, not only in technological but also in legal, and ethical areas. This also includes the speculation that autonomous super AI may at some point supersede the cognitive capabilities of humans.

Current AI researchers are more focused on developing systems that are excellent at tasks in a narrow range of applications. This focus is at odds with the idea of the pursuit of artificial general intelligence (AGI)that could mimic all different cognitive abilities related to human intelligence such as self-awareness and emotional knowledge.

Current AI development and the status of our hegemony as the most intelligent species on earth, further societal concerns are raised. However, AI technologies still limited to very specific

applications. One limitation of AI is the lack of "common sense" the power to judge information beyond its acquired knowledge. AI is also limited in terms of emotional intelligence. AI can only detect basic human emotional states such as anger, joy, sadness, stress, pain, fear, and neutrality. Emotional intelligence is one of the next frontiers of higher levels of personalization. The computer science principles driving AI forward, are rapidly advancing and it is important to assess its impact, not only from a technological standpoint but also from a social, ethical and legal perspective.

6. Conclusion and Recommendations

The potential benefits from self-learning computer chips are limitless as these types of devices can learn to perform the most complex thinking tasks, such as interpreting critical cardiac rhythms, detecting anomalies to prevent cyber-hacking and composing music. This is a new one made by the Intel company and many other companies are making special AI chips too.

But there is a slight issue with this all sweet sugary AI stuff:

Many lessons are often learned from the past successes and failures of AI. Rational and harmonic interactions are required between application-specific projects and visionary research ideas to sustain the progress of AI. A clear strategy is required to consider the associated ethical and legal challenges to ensure that the society as a whole will benefit from the evolution of AI and its potential adverse effects are mitigated from early on. Along with the unprecedented enthusiasm of AI, there are also fears about the impact of technology on our society. Such fears should not hinder the progress of AI but motivate the development of a systematic framework on which future AI will florish. Most crucial of all, it is important to apart science fiction from practical reality. With sustained funding and responsible investment, AI is about to transform the future of our society, our economy, and our life, so we must use and implement it wisely.

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5G and Its IMPACT ON IOT

Utkarsh Saha, ECE,6TH Sem,2022

Roll No. 23000320016

1. Introduction

Research on the fifth generation (5G) network is becoming more and more intense and it said to improve the range of IOT applications. From a recent statistics released by International Data Corporation, 5G will drive 70% of companies across the world to spend $1.2billion on connectivity solutions. New business would require IOT with better and much improved performance criteria such as security, trustworthiness, wireless coverage, ultra-low latency, mass connectivity but to mention a few for IOT devices. To match up with these requirements, the Long Term Evolution (LTE) and 5G technologies would provide/ introduce new connectivity interfaces for future IOT applications. The next generation of networks, 5G which is still at its early stage, would introduce new Radio Access technologies, well improved antenna and also make use of higher frequencies while also altering or re-architecting networks. According to Gartner, by 2017, a total of 8.4 billion devices would be connected through machine to machine connection and this number would increase to about 20.4billion in 2020. The 5G enabled IOT would help the connection of an enormous number of these IOT devices and would help meet market demands for wireless services which would in turn lead to rapid economic and social development.

2. INTRERNET OF THINGS (IOT)

The internet of things, otherwise known as IOT can best be described as a network of gadgets, appliances and other things made up of electronics or installed software interconnecting to exchange data. Each device or appliance is identifiable by its installed computer system but has the ability of functioning within the provided internet premises. IOT enables interaction between humans and appliances by sensing or remotely controlling these devices resulting in improved efficiency, accuracy, reduced human efforts and maximum comfort. However, security concerns of IOT has been an area of research in recent times, aiming at making IoT even more accurate and efficient than it currently is.

3. 5G RADIO ENHANCEMENTS FOR THE INTERNET OF THINGS

Research has demonstrated that the 5G mobile systems need to provide for the massive organization of IOT with billions of connected smart articles and sensors that will be a worldwide representation of this present reality and to help the arrangement of mission basic IOT utilize cases, which will require constant responses and automation of dynamic procedures across over various field of tasks including vehicle-to-infrastructure , high speed motion, vehicle-to-vehicle, and process control system. In light of this, further upgrades are presently being presented in M2M and NB-IOT system as indicated in the current 3GPP Release-14 for cellular IOT, being the primary regulating stage for 5G standards. Right now, 3GPP standardization is working towards guaranteeing that further upgrades of KPIs are introduced into existing 4G systems with guarantee that the 5G mobile system limiting the cost of growing new networks. The requirement of 5G mobile network will be massive to empower mission– basic services, and will be programming driven including SDWSN, NFV, and CR to help dynamic information control, give a centralized system and to empower the adaptation of new services necessities for enabling Massive to Critical IOT use cases with productive scope and high limit focuses for lifetime MTC devices. For future advancement of IOT, it is in this manner recommended to build up a context-aware congestion control scheme for lightweight COAP/UDP-based IOT network as a multi-target function that would bolster the exponential activity development of 5G mobile networks.

4. FUTURE OF INTERNET OF THINGS (IOT) IN 5G WIRELESS NETWORKS

The internet of things is a network of connected devices; electronics, mechanical, sensors etc. both hardware and software that are interconnected that allow them to speak to each other and exchange data without requiring human-to human or human-to-computer interaction. IOT cuts across different fields in life, like; Medical, Transportation, education, environmental monitoring, energy management etc.

The emerging technology, 5G, would facilitate the expansion of the internet of things in lots of ways;

• Higher bandwidth: 5G would support 1000 times the traffic that being handled by the existing networks. This also gives speed of range of 10 Gaps.

• Millisecond latency: Latency is the amount of time needed to transmit one packet of data. 5G networks will provide latency less than 1 millisecond which is required for critical applications such as self-driving vehicles as well as surgeries by robot.

• High capacity networks: Networks with high effectiveness well as efficacy, connecting billions of physical objects at lightning speed will be the key feature of 5G technology.

• Forward compatibility: 5G technology would work with all the various types of devices to be connected in the future. Since newer devices would be added in the IOT network, this is one of the key requirements to support the growth of IOT.

5. METHODOLOGY AND TECHNICAL REVIEW

IOT is used for producing Big Data with four V's i.e. volume, velocity, variety and veracity. At that point, Cloud is acquired for Big Data storage and processing. At the final stage which is the SDN. SDN is utilized to give more proficient and adaptable systems between Cloud data transport. Out of Big Data, Cloud, and SDN, propelled advancements like machine learning investigation, Cloud RAN and software 5G are developed.5G serves as a better gateway and transport network for IOT applications in a way data gotten from IOT is transmitted more efficiently and economically, IOT will then end up as one of the major source of Big Data by delivering expansive volume, quick speed, and numerous assortments of information.

6. CONCLUSION

The Internet of Things is growing at a rapid rate and the applications are vast. There need to be a wireless network that can match the growth and application of IOT. The advantages and features of 5G are aptly suitable to support IOT in a big way. As IOT will help make our life easy by automating the physical objects, the emergence of 5G will help IOT take a big leap.

AN INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Pragya Sharma, ECE,6TH Sem,2022

Roll No. 23000319002

Artificial intelligence or AI for short is a way of Providing a computer or a robot or simply some machine to Think, process information and act on their own or in simple Words providing the machines with an ability to think like a Human. No doubt that recreating a human brain seems like a Dream and still we haven't achieved it yet but that one thing is impossible to recreate is human consciousness. The AI Includes several other fields like neural networks, deep Learning, statistics, machine learning which is proving to be Successful in various domains like security, research, Robotics, voice recognition, transportation, and many More. AI is proving to not only reducing the workload of Humans but also opening new fields that once only dreamed by us.

1. INTRODUCTION

AI is a branch of computer science by which we can create Intelligent machines which can behave like a human, think like Humans, and able to make decisions on their own. Artificial Intelligence is composed of two words artificial which define Something that's made by humans and intelligence which Refers to the ability to think on its own, and hence this makes Artificial intelligence "thinking power made by human".

This field was formed with an idea that one day machines will Be able to think or in other words, we can replicate the feature. That makes us human, our intelligence along with our Consciousness. This may sound like a sci-fi or a new age Concept but the fact is, there has been reference to such things In mythologies and several other texts, scriptures, and artifacts As well. AI has been a turning point not only in the field of Research but has also been playing a keen role in Revolutionizing industries and work as we know it today.

With an ultimate goal to create consciousness, AI goes through several stages of planning, reasoning, analyzing data, Prediction of outcomes and acting accordingly.

AI also involves the use of statistics and probability and Various other mathematical tools (neural networks and Machine learning is mostly based on these).

2. ELEMENTS OF AI

1. The Human Element

This refers to a link between humans with the machine. The Machine or simply an algorithm understands a language of 0's And 1's which is hard to understand and process by humans. Thus comes in the role of an interactive interface that can take Direction from the user, process, and then provide accurate Results.

2. Knowledge Base

The AI works on analyzing data present in it. The more data is Fed with, the more efficient result it will provide. The Knowledge base also includes previous results to review and Look for some sort of patterns. The AI analyses the data, process and compares large chunks of information to provide optimum results. It uses data algorithms and various other logic stored to find a solution to the problem present.

3. Algorithm set

The AI interface even though fed with a large chunk of data, it requires a certain set of instruction or algorithm to process and Perform operation on that data. Such algorithms are provided by programmers and data scientists working together using various mathematical tools such as statistics, probability, Calculus, and algebra.

5G and IoT NETWORKS

Soumyadeep Barui,ECE,4TH SEM, 2022

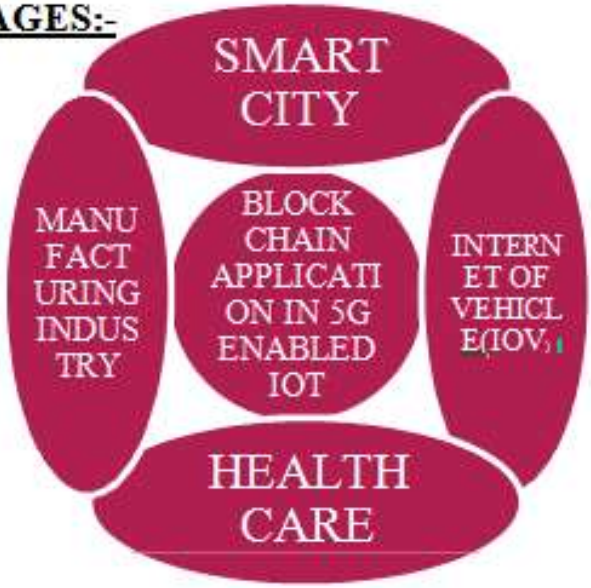
Roll No. 23000321030

- 5G and IoT technology is more than just a new generation of wireless technology.
- It represents a fundamental change in the mobile ecosystem, unleashing a powerful combination of extraordinary speed, expanded bandwidth, low latency, and increased power efficiency that is driving billions of more connections in the next five years and changing our world.
- According to the GSMA, 5G connections are expected to grow from 10 million at the end of 2019 to 1.8 billion by 2025 - and we're well on the way!
- In June 2020, the Global Mobile Suppliers Association (GSA) identified 81 Mobile Network Operators (MNOs) in 42 countries who had launched 5G commercial services, and more than 385 MNOs in 125 countries were investing in 5G development.

1. What does 5G mean for IoT?

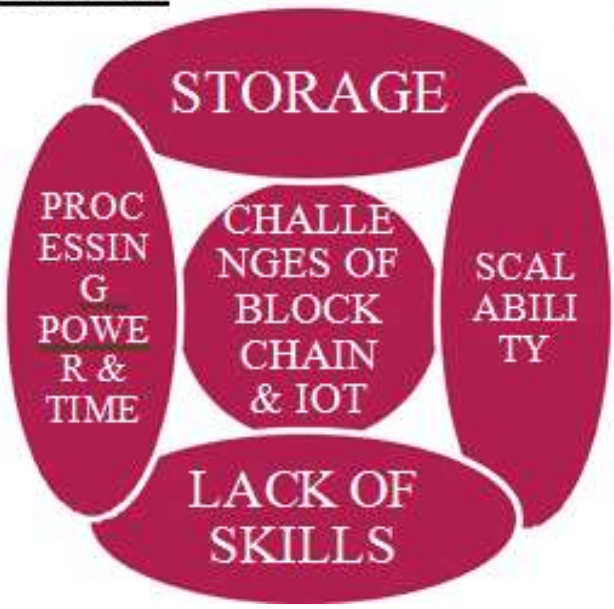
- It's a game-changer!
- 5G enables faster, more stable, and more secure connectivity that's advancing everything from self-driving vehicles, to smart grids for renewable energy, to AI- enabled robots on factory floors.
- It's unleashing a massive IoT ecosystem where networks can serve billions of connected devices, with the right trade-offs between speed, latency, and cost.
- 5G got its start when the International Telecommunications Union (ITU) identified minimum recommendations for a new technology that was further defined and standardized by the 3rd Generation Partnership Project (3GPP).
- From 5G SIMs to Centurion IoT Moduless, IoT gateways, and modem cards, Thales delivers a broad portfolio of 5G solutions that connect and secure next-generation devices and IoT projects offering seamless migration to emerging networks and features.

ADVANTAGES:-



ALTHOUGH 5G AND IOT NETWORK WILL ENHANCE AND BOOST THE EVALUATION.

DISADVANTAGES:-



BUT WE HAVE TO ALSO REMEMBER THE OTHER HAND OF THESE TECHNOLOGIES.

INDUSTRIAL AUTOMATION

Kuntal Acharya, ECE,4TH Sem,2022

Roll No. 23000321020

The word **'automation'** is derived from ancient Greek words of **Auto** (means 'self') and **Matos** (means 'moving'). Automation is the creation and application of technologies to produce and deliver goods and services with minimal human intervention. The purpose of automation is to improve the efficiency, reliability, and/or speed of many tasks that were previously performed by humans.

From the simplest to the most complex application, automation is present in many forms in our everyday life like Home Automation, Office Automation, Network Automation, Automated website Testing, Data Centre Automation, Quality Test Automation etc.

1. What is Industrial Automation?

Industrial automation is a set of technologies that uses control systems and devices, such as computer software and robotics, to enable automatic operation of industrial processes and machinery without the need for human operators.

Traditional manufacturing processes and new technologies have evolved with time to give rise to modern industrial automation processes.

For example, in the automobile industry, pistons can be installed in engines manually as well as by automated processes. While doing it manually, the error rates fluctuate between 1% to 1.5%. But the rates are reduced to 0.00001% when done through automated processes.

2. Types of Industrial Automation

Now a days, Industrial Automation is employed across a myriad of industries with automated systems doing everything from performing manufacturing tasks to operating an ATM. The applications of industrial automation solutions falls under three different automation categories, namely **Fixed**, **Programmable** and **Flexible**.

- **Fixed Automation:**

This type automation also called hard or rigid automation. Once the process set up, it is almost impossible to reconfigure or alter. In assembly lines of automotive industry uses fixed or rigid automation.

- **Programmable Automation :**

This type automation is best suited for the application where instructions have to be changed for the specified operations comprising different batches of work. Industrial Robots are the example of the Programmable Automation.

- **Flexible Automation:**

This automation are also referred to as soft automation. It is similar to programmable automation in addition to that it provides flexibility for product changeovers which are simply conveyed via control system and occur quickly and automatically.CNC machines are the example of Flexible Automation.

3. Industrial Automation Elements

It consists of various equipment and elements which perform a wide variety of functions like sensing, control, supervision and monitoring related to industrial processes.

- **Sensing and Actuating Elements**

The sensors or sensing elements convert the physical process variables such as flow, pressure, temperature, etc. into electrical or pneumatic form. Various sensors include thermocouples, Resistor Temperature Detectors (RTDs), strain gauges, etc.

Actuators convert the electrical or pneumatic signals to the physical process variables. Some of the actuators include control valves, relays, motors, etc.

- **Control System Elements**
  - **Programmable Logic Controller (PLC)**

PLC are similar to industrial computers. PLCs can work as standalone units that can continuously monitor and automate a process, specific machine function. PLCs can be adapted to monitor and control many sensors and actuators; they process electrical signals and use them to carry out pre-programmed commands for almost any application. PLCs are used in industrial automation to increase reliability, system stability and performance, minimizing the need for human operators and the chances of human error.

- **Supervisory Control and Data Acquisition (SCADA)**

SCADA systems control and monitor industrial processes. The system acquires and processes real-time data through direct interaction with devices, such as sensors and PLCs, and records events into a log file. SCADA is important for data analysis, and enables effective decision-making for optimization in industrial processes.

- **Human Machine Interface (HMI)**

An **HMI** is a software application that enables interaction and communication between a human operator and the machine, or production system. It translates complex data into accessible information, enabling better control of the production process and its various applications.

- **Artificial Neural Network (ANN)**

An **ANN** is a computing system that is built like the human brain, a network of interconnected nodes. ANNs simulate the way a human brain analyzes and processes information.

- **Distributed Control System (DCS)**

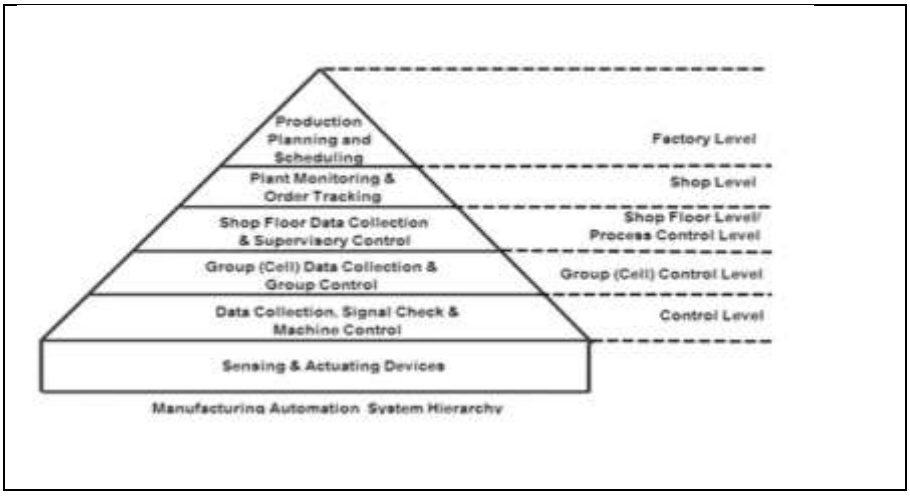
A **DCS** is a central monitoring network that interconnects devices to control different elements within an automated system.

- **Robotics**

Robots can efficiently perform tasks in complicated or dangerous situations, improve production flow and quality, and increase safety for employees. Additionally, robots can make daily life much more comfortable or convenient.

4. Automation System Hierarchy

New trends in manufacturing systems have been using automation systems at every stage such as material handling, machining, assembling, inspection, and packaging. With the computer-aided control and industrial robotic systems, manufacturing automation becomes very flexible and efficient.



Here automation system hierarchy in which all functional levels are automated by using different automation tools.

Sensors or Actuators are basically collects data from process/machine that will be used further to make decisions. This level is also called LEVEL 0.

- In **LEVEL 1** i.e. control Level Data is collected from the previous level to control the machine.
- In **LEVEL 2** data collection is done collectively or in a group. Here operations of various machines are co-ordinated with the help of PLCs.
- At **Shop Floor Level** i.e. supervisory automated level where supervision and coordination of several processes are carried out.]
- At **Plant Level** HMIs are employed to control all the manufacturing process comprising all the activities of production monitoring, control, and scheduling, etc. remotely.
- At **Enterprise Level** all the management related activities such as production planning and scheduling, etc. are done.

Basically the pyramid dictates the increasing human intervention and time from bottom to top of the pyramid.

5. Advantages of Industrial Automation

There are various **advantages** of Industrial Automation like automation increases **productivity**, **quality** of manufactured entity is increased, work can be done more **precisely** with **zero risk** factor, and by automation a manufacturing unit can **produce entity by 24/7**, eliminates **routine manual tasks**, and helps to reduce the man power in a plant.

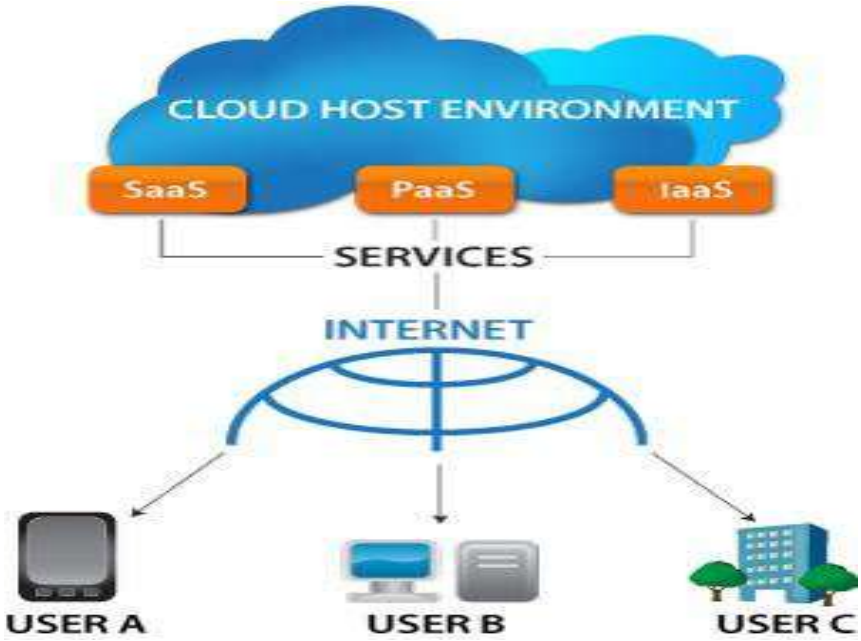
6. Disadvantages of Industrial automation

There are not so many disadvantages except initial implementation is very much expensive and automation may enhance the unemployment of a class of workers

CLOUD COMPUTING

Poulomi Chowdhury ECE, 6TH Sem,2022

Roll No. 23000319003



Cloud computing is the on-demand availability of computer system resources, especially data storage (cloud storage) and computing power, without direct active management by the user. Large clouds often have functions distributed over multiple locations, each location being a data centre. Cloud computing relies on sharing of resources to achieve coherence and typically using a "pay-as-you-go" model which can help in reducing capital expenses but may also lead to unexpected operating expenses for unaware users.

Every cloud abstracts, pools, and shares scalable computing resources across a network. Every cloud type also enables cloud computing, which is the act of running workloads within that system. And every cloud is created using a unique mix of technologies, which almost always includes an operating system, some kind of management platform, and application programming interfaces (APIs). Virtualization and automation software can also be added to every kind of cloud for additional capabilities or increased efficiencies.

Advocates of public and hybrid clouds note that cloud computing allow companies to avoid or minimize up-front IT infrastructure costs. Proponents also claim that cloud computing allows enterprises to get their applications up and running faster.

1. What is Cloud Computing?

Cloud computing is a general term for anything that involves delivering hosted services over the internet. These services are divided into three main categories or types of cloud computing: infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS).

2. Architecture of Cloud Computing

Architecture of cloud computing is the combination of both SOA (Service Oriented Architecture) and EDA (Event Driven Architecture). Client infrastructure, application, service, runtime, storage, infrastructure, management and security all these are the components of cloud computing architecture.

Frontend

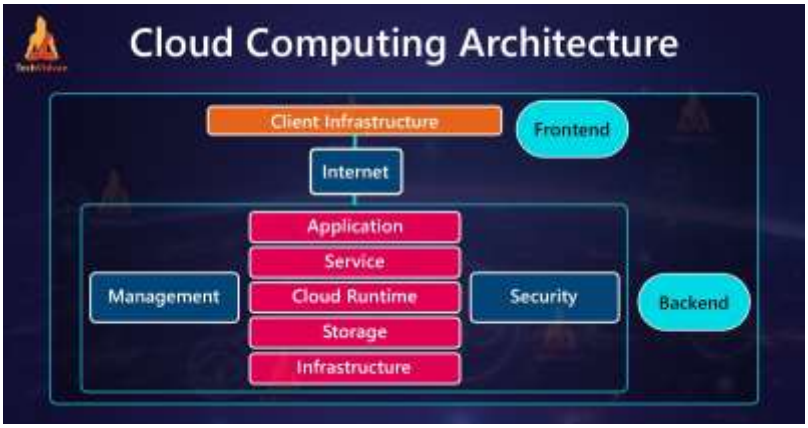
Frontend of the cloud architecture refers to the client side of cloud computing system. Means it contains all the user interfaces and applications which are used by the client to access the cloud computing services/resources. For example use of a web browser to access the cloud plat form.

Client Infrastructure

Client Infrastructure refers to the frontend components. It contains the applications and user interfaces which are required to access the cloud platform.

Backend

Backend refers to the cloud itself which is used by the service provider. It contains the resources as well as manages the resources and provides security mechanisms. Along with this it includes huge storage, virtual applications, virtual machines, traffic control mechanisms, deployment models etc.



Benefits of Cloud Computing Architecture

- Makes overall cloud computing system simpler.
- Improves data processing requirements.
- Helps in providing high security.
- Makes it more modularized.
- Results better disaster recovery.
- Gives good user accessibility.
- Reduces IT operating costs.

3.Characteristics of Cloud Computing

- Resources Pooling
- On-Demand Self-Service
- Easy Maintenance
- Scalability And Rapid Elasticity
- Economical
- Measured And Reporting Service
- Security
- Automation
- Resiliency And Availability
- Large Network Access
- Work From Any Location
- Multi-Tenancy
- Flexibility
- Service Excellence
- Comfortable Payment Structure

4. Security and Privacy

Cloud computing poses privacy concerns because the service provider can access the data that is in the cloud at any time. It could accidentally or deliberately alter or delete information. Users can encrypt data that is

processed or stored within the cloud to prevent unauthorized access. Identity management systems can also provide practical solutions to privacy concerns in cloud computing.

According to the Cloud Security Alliance, the top three threats in the cloud are *Insecure Interfaces and APIs*, *Data Loss & Leakage*, and *Hardware Failure*—which accounted for 29%, 25% and 10% of all cloud security outages respectively. In a cloud provider platform being shared by different users, there may be a possibility that information belonging to different customers resides on the same data server.

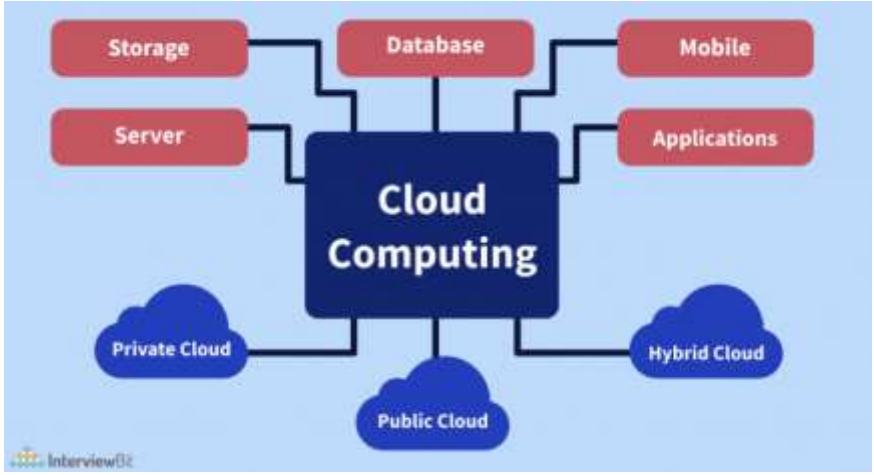
5. Benefits of Cloud Computing

- Cost Savings
- Security
- Flexibility
- Mobility
- Insight
- Increased Collaboration
- Quality Control
- Disaster Recovery
- Loss Prevention
- Automatic Software Updates
- Competitive Edge
- Sustainability

6. Disadvantages of Cloud Computing

- data loss or theft
- data leakage
- account or service hijacking
- insecure interfaces and APIs
- denial of service attacks
- technology vulnerabilities, especially on shared environments

7.Application of Cloud Computing



- Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS)
- Hybrid cloud and multicloud.
- Test and development.
- Big data analytics.
- Cloud storage.
- Disaster recovery.
- Data backup.

8. Conclusion

In conclusion, cloud computing is recently new technological development that has the potential to have a great impact on the world. It has many benefits that it provides to it users and businesses. For example, some of the benefits that it provides to businesses, is that it reduces operating cost by spending less on maintenance and software upgrades and focus more on the businesses it self. But there are other challenges the cloud computing must overcome. People are very skeptical about whether their data is secure and private. There are no standards or regulations worldwide provided data through cloud computing. Europe has data protection laws but the US, being one of the most technological advance nation, does not have any data protection laws.

DESIGN OF FRACTAL BASED DIELECTRIC RESONATOR ANTENNAS FOR UWB APPLICATIONS

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The antenna design for high-speed multimedia connectivity represents a challenging activity for designers of fixed and mobile wireless communication systems. In fact, the rapid growth of mobile systems toward the 5^{th}generation (5G systems) requires multiband, wideband, as UWB antennas suitable to cover mobile and wireless services and to reduce the system complexity, the overall device dimensions and costs. Many efforts are underway to identify new antenna geometries suitable to satisfy the challenging requirements of the modern wireless communication systems [1–5]. This is particularly relevant in UWB applications operating in the extended frequency bands, where the communication standards adopted by major countries of the world are reported [6].

Since the Federal Communication Commission (FCC) introduced the unlicensed Ultra-wideband (UWB) frequency band from 3.1 to 10.6 GHz (i.e., a 109.5% fractional bandwidth) for commercial communication applications, many types of UWB antennas have been reported [7-9]. Since then, the design and implementation of UWB systems have attracted much attention in both academic and industrial communities of telecommunications. Challenges of the feasible UWB antenna design include the UWB performance issues of the sufficient impedance matching bandwidth, the compact antenna size, high radiation efficiency, avoiding the interference problem of the nearby communication band, constant gain, constant group delay or linear phase, and getting a consistent uniform radiation pattern to avoid undesirable distortions of the radiated and received pulse. Furthermore, UWB system [2] is quite simple and low cost due to the carrier-free nature of the signal transmission. However, the very wideband nature of the UWB signal means it spans frequencies commonly used as carrier frequency. Thus, the UWB signal will propagate well in the transmitters and will be received well in the receivers without any RF mixing stage for the up/down-conversion. It makes the UWB system allow to be integrated with single-chip CMOS implementation. Also very low power density obtained through the FCC's radio regulation emission mask of -41.3 dBm/MHz (75 nanowatts/MHz) for UWB system is the other advantage. It causes the UWB system to enable the signal to consume lower power and to coexist with existing narrow-band systems with minimal or no interference which gained strong foothold in WPAN applications. Consequently, UWB communication system is a good candidate for the short distance wireless

communication due to the above-mentioned advantages. Also, high data rate cable less transmissions between personal computers and consumer electronics like digital cameras, video

Fig.1 Applications of UWB in various domains [2].

Cameras, MP3 players, televisions, personal video recorders, automobiles and DVD players will provide new experience in home and personal entertainment. Secondly, sensors of all types also offer an opportunity for UWB to flourish.

In USA, the FCC approved a UWB spectral mask [2] specified 7.5 GHz of usable spectrum bandwidth between 3.1 GHz and 10.6 GHz for communication devices and protected existing users operating within this spectrum by limiting the UWB signals EIRP level of -41.3 dBm/MHz (known as Part15Limit). However, there are some narrowband communication systems that coexist with the UWB communication system, which severely interferes with the functioning of the UWB systems. The most notable among them is 5. 15-5.825 GHz band assigned for IEEE802.11a and HIPERLAN/2 as shown in the Fig.2.

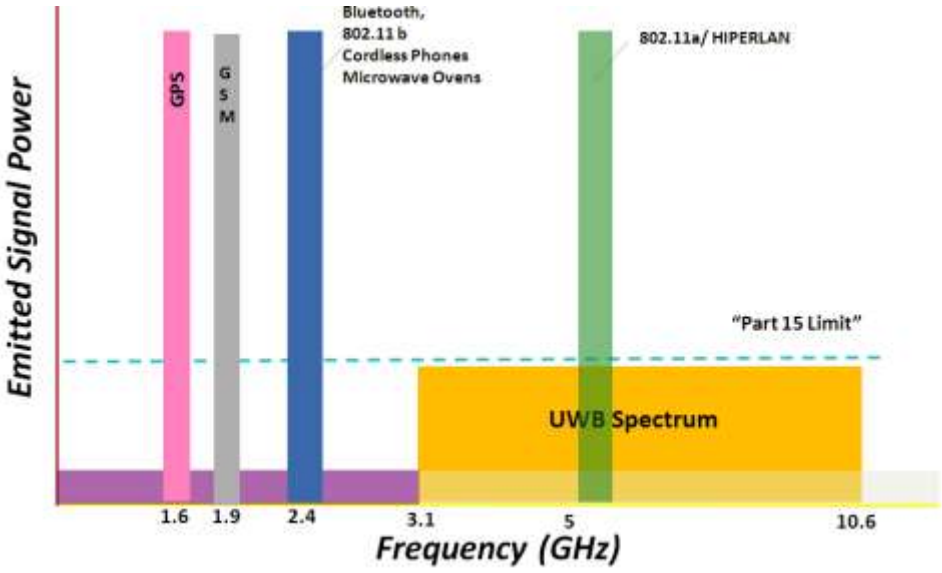

Fig.2 Existence of other systems along with UWB[2].

In the late 70's and 80's micro strip antennas were under extensive research scrutiny[8,9]. Researchers found these useful in applications where small size and light weight antennas were required. Conformable

nature of micro strip antennas to both planar and non-planar surfaces gave impetus to their research. But micro strip antennas have disadvantages like very small impedance bandwidth and low power handling capability. Also thick substrates tend to induce surface waves which reduce the power available for radiation. At the beginning of the new millennium, there was an upward shift in the operational frequencies to accommodate the surge in bandwidth requirement. Patch antennas made of metallic elements suffer from increased conductor loss at higher frequencies. Researchers found a new alternative operating at high frequencies in the form of dielectric resonator antennas when Long published his paper on cylindrical DRA[11]. They are good contenders for modern day wireless applications with their advantages of light weight, smaller size, reasonably wide impedance bandwidth, ease of coupling to most transmission lines. DRAs also have high radiation efficiencies due to the absence of conductor losses and surface waves. Dielectric resonators (DRs) [10]are slabs of dielectrics that come in different sizes and shapes and they have very high permittivity. As permittivity of the material and surrounding medium are different, the electro-magnetic waves introduced within the dielectric material reflect from the surface boundaries and form standing waves. However, the fields outside the resonator are not equal to zero as a result of which the dielectric material is shielded by metal to allow complete confinement of fields. When a dielectric resonator is unshielded, it has the capability to radiate in free space and behaves like an antenna. However, not all modes of an antenna have the ability to radiate. Certain modes have field configurations which results in cancellation of fields in the far field region. Such modes are termed as non-radiating modes [10]. Care should be taken to excite radiating modes when using the resonator as an antenna. In 1983 Long *et al*. published their paper on cylindrical dielectric resonator antenna that the idea of employing dielectric resonators as antennas was accepted [11].The investigations were carried out on various other shapes like the rectangular, hemispherical, triangular, cylindrical ring, etc[12]. Recently, A novel compact dual band-notched dielectric resonator antenna (DRA) for ultra wideband (UWB) applications is presented in [13]. Here, a and compact hybrid printed monopole loaded with a DR for UWB applications is proposed. The proposed antenna consists of a microstrip fed monopole printed on RT5880 substrate with a finite truncated ground plane on the upper side of the substrate. The monopole is then loaded with a DR with a quarter elliptical cylinder of Rogers RO3010. It is seen that the proposed antenna exhibits a wideband performance from 3.6 to 11.2 GHz (simulated) for return loss less than 210 dB, covering almost the entire UWB frequency band.

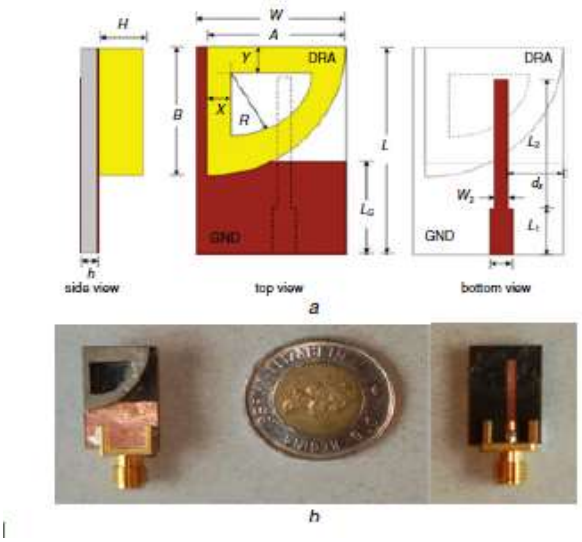

Fig. 3 Geometry of the proposed DRA: (a) side, top and bottom view (b) prototype DRA [13].

The new wireless systems provide multimedia applications so wideband and multiband antennas are in demand. Amongst the myriad of techniques available at the antenna designer's disposal, fractal shaped antennas [14-16] have been a topic of interest lately. However, most of the research on fractal shaped antennas has focused on metallic antennas. It is well known that metallic antennas have a high *Q* factor which limits its operational bandwidth. Basically, fractals are geometrical objects featured by a high irregularity that makes difficult their description with the classic Euclidean geometry. The inspiration for the development of fractal geometry came largely from an in depth study of patterns from nature [17]. Fractals have been successfully used to model such complex natural objects like cloud, galaxies, mountain ranges, coastlines, trees,leaves,ferns and much more. Mandelbort coined the term 'fractal' about 20 years ago in his book named "The fractal geometry of nature" [17]. The fractal geometry in nature and some common fractal structures are shown in Fig.4.

Fig. 4 Fractal geometry in nature.

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ERP and SAP

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Enterprise Resource Planning (ERP)

Enterprise Resource Planning (ERP) is a software that is built to organizations belonging to different industrial sectors, regardless of their size and strength.

The ERP package is designed to support and integrate almost every functional area of a business process such as procurement of goods and services, sale and distribution, finance, accountings, human resource, manufacturing, production planning, logistics & warehouse management.

Advantages of ERP

By integrating the business processes, the ERP offers the following advantages −

- Saves time and expenses.
- Allows faster decision-making by the management, utilizing the data and reporting tools designed in the systems.
- Single data source and sharing of data among all the units of an organization.
- Helps in tracking every transaction that takes place in an organization, from starting till end.
- Supplies real-time information whenever required.
- Provides synchronized information transfer in between different functional areas such as sales, marketing, finance, manufacturing, human resource, logistics, etc.

SAP is a market leader in providing **ERP** (Enterprise Resource and Planning) solutions and services. **SAP** stands for Systems, Applications, and Products in data processing.

- SAP is the fourth largest software company in the world.
- SAP Founded in and around 1972 by five IBM engineers Hopp, Wellenreuther, Hector, Tschira and Plattner.
- The SAP R/3 system is a business software package designed to integrate all areas of a business.
- It provides end-to-end solutions for financials, manufacturing, logistics, distribution, etc.
- All business processes are executed in one *SAP system* and sharing common information with everyone.

SAP R/1:– The first version of SAP software was launched in and around 1972 known as the "R/1 system. "R" stands for real-time data processing. It is one tier architecture in which three layers Presentation, Application, and Database are installed in one system/server
(one – Presentation + Application + Database)

SAP R/2:– In 1979 second version of SAP R/2 was released. with IBM's database and a dialogue-oriented business application. SAP R/2 to handle different languages and currencies. R/2 is 2 tier architecture in which three layers of Presentation, Application, and Database are installed in two separate servers.
(Server one – Presentation, Server two – Application + Database

SAP R/3:– SAP upgraded R/2 to R/3. SAP R/3 is the client/server version of the software and it is 3 tier architecture in which three layers of Presentation, Application, and database are installed in three servers/systems.
Server one – Presentation, Server Two – Application, server Three – Database

SAP S/4 Hana – In the year 2010, a new version of SAP Hana has been released. SAP Hana (High-Performance Analytic Application) is a memory computing database. The latest version of Hana is SAP S4 Hana 2021.

SAP R/3 – Modules & Integration

SAP Functional Modules

- FICO – Finance & Control
- PP – Production Planning
- MM – Material Management
- SD – Sales & Distribution
- WM – Warehouse Management
- QM – Quality Management
- HR – Human Resources
- CRM – Customer Relationship Management

SAP Technical Modules

- ABAP – Advanced business applications programming
- XI – Exchange Infrastructure
- Net viewer
- Basis
- BIW – Business Information Warehousing

SAP FICO

SAP FICO Stands for FI (Financial Accounting) and CO (Controlling). SAP FICO is the imp module of ERP and both Finance and Controlling modules stores the financial transactions data. The 'FI (Financial Accounting)' records, collects, and processes financial transactions or information on a real-time basis to provide the necessary inputs for external (statutory) reporting purposes. SAP CO plays an important role for the management decision-making purpose and for the internal reporting purpose.

SAP MM

SAP MM (Material Management) is one of the imp modules in SAP ERP software and it supports the procurement and inventory functions occurring in day-to-day business operations. This MM module contains many aspects such as purchasing, goods receiving, material storage, consumption-based planning, and inventory. SAP MM module is fully integrated with other modules in the SAP R/3 System such as FICO, SD, QM, PM, PP, and WM.

SAP PP

The Production Planning application module is used to plan and control the manufacturing activities of a company. consists of all system configuration, master data, and complete solutions to the Produce process.

SAP SD

SAP SD (Sales and Distribution) is an important module of *SAP* and it is a part of logistics. The main activities of SD are sales order handling, distribution of shipments to customers, the billing process, customer invoice, delivery. SD module is fully integrated with other modules in the SAP R/3 System such as Finance, Purchasing(MM), Production Planning(PP).

SAP HR

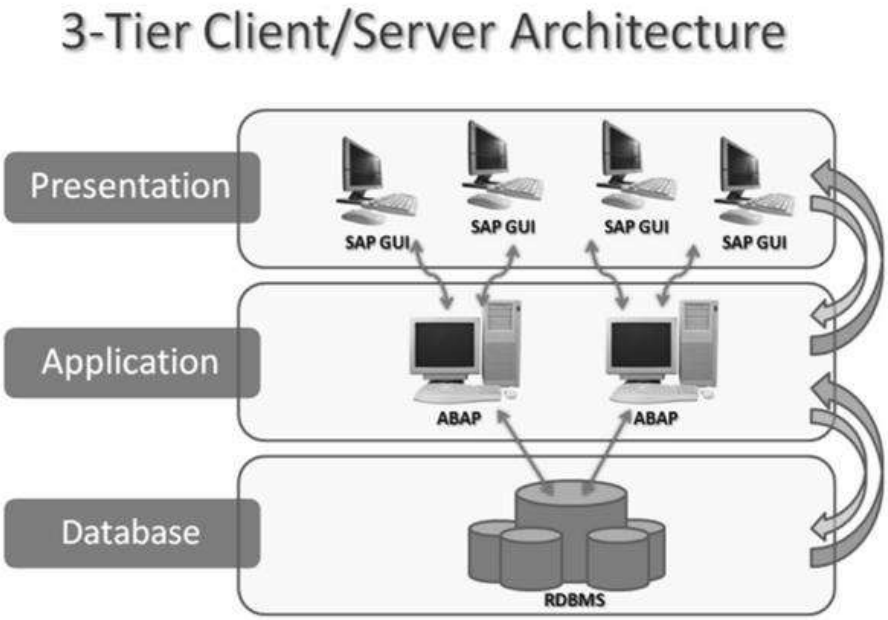
SAP Human Resources manages the complete employee life cycle and payroll. All aspects are covered from training to appraisal.

Advantages of SAP:-

- **SAP software** manages these business management tasks in modules that all work together in one system by sharing information.
- Promoting consistent practice across an entire division
- No duplicate data
- Automate Project Monitoring and Multidimensional and flexible reporting
- Standardization of business processes
- Make Planning, Scheduling, Tracking, and Management easier leaving more time for you to perform value-added work
- Ability to provide clear cut job roles with authorizations
- Enabling integration with e-commerce
- Cost Savings on overheads such as Stationery, File Storage, etc.

Architecture of SAP system

The 3-tier Client/Server architecture of a typical SAP system is depicted as follows.



The **Presentation layer** consists of any input device that can be used to control SAP system. This could be a web browser, a mobile device and so on. All the central processing takes place in **Application server**. The Application server is not just one system in itself, but it can be multiple instances of the processing system. The server communicates with the **Database layer** that is usually kept on a separate server, mainly for performance reasons and also for security. Communication happens between each layer of the system, from the Presentation layer to the Database and then back up the chain.

ABAP – Overview

ABAP stands for Advanced Business Application Programming, a 4GL (4th generation) language. Currently it is positioned, along with Java, as the main language for SAP application server programming.

SAP ABAP is one of the important programming modules in SAP. It is a 4th generation programming language (ABAP/4) developed in the 1980s. SAP ABAP (Advanced Business Application Programming) is used to develop the SAP R/3 system where the application programs are written in the ABAP language.

SAP R/3 system is divided into two types of modules, i.e., functional modules and technical modules; all functional modules are written in the form of ABAP language. SAP system provides various predefined reports and interfaces, but we can create customized reports and interfaces per business requirements.

ERP SAP is written everything in the form of ABAP. SAP ABAP is a high-level programming language used in the SAP system for development and customizing according to the company's needs.

To

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for your kind support.

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