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Department of Computer Science and Engineering

Tech e Bytes

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“WE DON'T DO DIFFERENT THINGS, WE DO THINGS DIFFERENTLY”



Our Vision: To become a globally recognized institution that develops professionals with integrity who excel in their chosen domain making a positive impact in industry, research, business and society.



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

VISION OF CSE DEPARTMENT

To acquire global excellence in the field of Computer Science and Engineering, nurturing in professionals, technical competence, innovative skills, professional ethics and social commitment.

MISSION OF CSE DEPARTMENT

- To equip students with a strong foundation in the area of Computer Science and Engineering using effective teaching -learning practices.
- To provide state-of-the-art infrastructure to suit academic, industry and research needs at the global level.
- To engage students and faculty in interdisciplinary research that promotes innovative ideas for sustainable development.
- To incorporate skill enhancement programmes for students and faculty to cope with the contemporary developments in technology.
- To inculcate effective communication skills, professional ethics and social commitment among professionals through value added programs.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Computer Science & Engineering will

1. Evolve as globally competent computer professionals, researchers and entrepreneurs possessing collaborative and leadership skills, for developing innovative solutions in multidisciplinary domains.
2. Excel as socially committed computer engineers having mutual respect, effective communication skills, high ethical values and empathy for the needs of society.
3. Involve in lifelong learning to foster the sustainable development in the emerging areas of technology.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Student of the Computer Science and Engineering program will:

- **PSO1: Professional Skills:** Attain the ability to design and develop hardware and software based systems, evaluate and recognize potential risks and provide creative solutions.
- **PSO2: Successful Career and Entrepreneurship:** Gain knowledge in diverse areas of Computer Science and experience an environment conducive in cultivating skills for successful career, entrepreneurship and higher studies.

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APACHE SPARK

....NITISH ALBIN (S8 CSE)

Industries are using **Hadoop** extensively to analyze their data sets. The reason is that Hadoop framework is based on a simple programming model (MapReduce) and it enables a computing solution that is scalable, flexible, fault-tolerant and cost effective. Here, the main concern is to maintain speed in processing large datasets in terms of waiting time between queries and waiting time to run the program. Spark was introduced by Apache Software Foundation for speeding up the Hadoop computational computing software process. Spark is not a modified version of Hadoop and is not dependent on Hadoop because it has its own cluster management. Hadoop is just one of the ways to implement Spark.

Spark uses Hadoop in two ways – one is **storage** and second is **processing**. Since Spark has its own cluster management computation, it uses Hadoop for storage purpose only.

Apache Spark

Apache Spark is a lightning-fast cluster computing technology, designed for fast computation. It is based on Hadoop MapReduce and it extends the MapReduce model to efficiently use it for more types of computations, which includes interactive queries and stream processing. The main feature of Spark is its **in-memory cluster computing** that increases the processing speed of an application. Spark is designed to cover a wide range of workloads such as

batch applications, iterative algorithms, interactive queries and streaming. Apart from supporting all these workload in a respective system, it reduces the management burden of maintaining separate tools.



Features of Apache Spark

Apache Spark has following features.

- **Speed** – Spark helps to run an application in Hadoop cluster, up to 100 times faster in memory, and 10 times faster when running on disk. This is possible by reducing number of read/write operations to disk. It stores the intermediate processing data in memory.
- **Supports multiple languages** – Spark provides built-in APIs in Java, Scala, or Python. Therefore, you can write applications in different languages. Spark comes up with 80 high-level operators for interactive querying.
- **Advanced Analytics** – Spark not only supports 'Map' and 'reduce'. It also supports SQL queries, Streaming data, Machine learning (ML), and Graph algorithms.

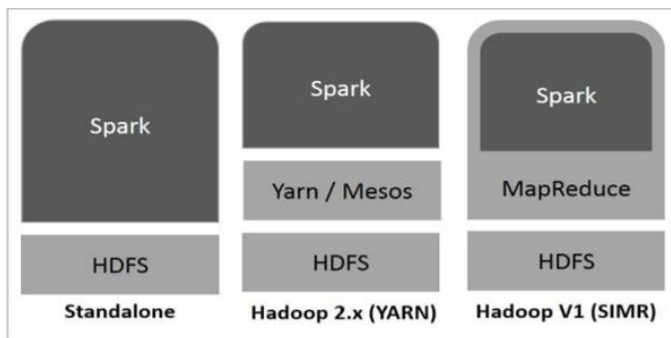
Evolution of Apache Spark

Spark is one of Hadoop's sub project developed in 2009 in UC Berkeley's AMPLab by Matei Zaharia. It was Open Sourced in 2010 under a BSD license. It was donated to Apache software foundation in 2013, and now Apache Spark has become a top level Apache project from February 2014.

Spark Built on Hadoop

There are three ways of how Spark can be built with Hadoop components.

Standalone – Spark Standalone deployment means Spark occupies the place on top of HDFS(Hadoop Distributed File System) and space is allocated for HDFS, explicitly. Here, Spark and MapReduce will run side by side to cover all spark jobs on cluster.



Hadoop Yarn – Hadoop Yarn deployment means, simply, spark runs on Yarn without any pre-installation or root access required. It helps to integrate Spark into Hadoop ecosystem or Hadoop stack. It allows other components to run on top of stack.

Spark in MapReduce (SIMR) – Spark in MapReduce is used to launch spark job in addition to standalone deployment. With SIMR, user can start Spark and uses its shell without any administrative access.

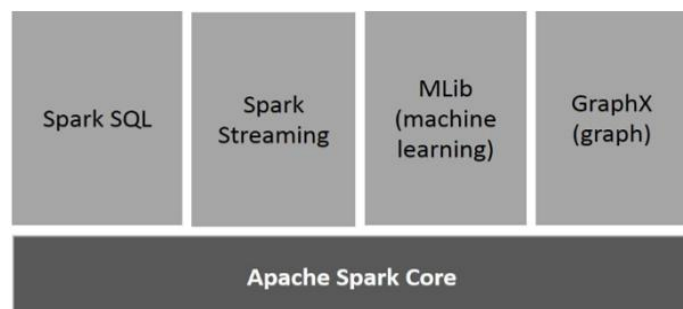
Components of Spark

Apache Spark Core: Spark Core is the underlying general execution engine for spark platform that all other functionality is built upon. It provides In-Memory computing and referencing datasets in external storage systems.

Spark SQL: Spark SQL is a component on top of Spark Core that introduces a new data abstraction called SchemaRDD, which provides support for structured and semi-structured data.

Spark Streaming: Spark Streaming leverages Spark Core's fast scheduling capability to perform streaming analytics. It ingests data in mini-batches and performs RDD (Resilient Distributed Datasets) transformations on those mini-batches of data.

MLlib (Machine Learning Library): MLlib is a distributed machine learning framework above Spark because of the distributed memory-based Spark architecture. It is, according to benchmarks, done by the MLlib developers against the Alternating Least Squares (ALS)



implementations. Spark MLlib is nine times as fast as the Hadoop disk-based version of Apache Mahout (before Mahout gained a Spark interface).

GraphX: GraphX is a distributed graph-processing framework on top of Spark. It provides an API for expressing graph computation that can model the user-defined graphs by using Pregel abstraction API. It also provides an optimized runtime for this abstraction.



EEG HEADSET

....**SARATH MOHAN E (S8 CSE)**

Electroencephalography (EEG) is an electrophysiological monitoring method to record electrical activity of the brain. It is typically noninvasive, with the electrodes placed along the scalp. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a period of time, as recorded from multiple electrodes placed on the scalp. Diagnostic applications generally focus either on event-related potentials or on the spectral content of EEG. The former investigates potential fluctuations time locked to an event like stimulus onset or button press. The latter analyses the type of neural oscillations (popularly called "brain waves") that can be observed in EEG signals in the frequency domain.

EEG signals can be captured using special headsets and it can lead to many useful applications. Emotiv Epoc is a brain computer interfacing headset that works on the principle of Electroencephalography or EEG. It is basically a headset that can read and interpret brain waves. Emotiv Epoc is based on two working principles which are Electroencephalography and Brain-Computer Interfacing. Electroencephalography (EEG) is the recording of electrical activity along the scalp produced by firing of neurons within the brain. A brain-computer interface (BCI), sometimes called a direct neural interface or a brain-machine interface, is a direct communication pathway between a human brain and an external device.



The Emotiv system measures the electrical activity associated with the brain and the muscles of the face. What the brain-computer interface essentially does is process the electrical signals linked with the brain activity and convert them into a command or a language that can be understood by the machine. Then such commands can be utilized for invoking certain operations for a

paralysed person. As the patient is paralyzed, he/she can't use the facility of remote control to control the appliances in home. It has got several other applications also. Neurogaming,

harnessing the power of mind to achieve personal well being, measuring attention etc are some of them.

Emotiv headset Features:

- Easy to fit and flexible design
- Wireless and rechargeable
- Dense array spatial resolution ensuring 'whole brain' measurement
- Saline based wet sensors (no sticky gels)
- Lithium battery providing up to 12 hours of continuous use
- Windows, OSX, Linux, Android, and iOS compatible
- Provides access to Raw EEG data with software subscription
- Access performance metrics, mental commands and facial expressions

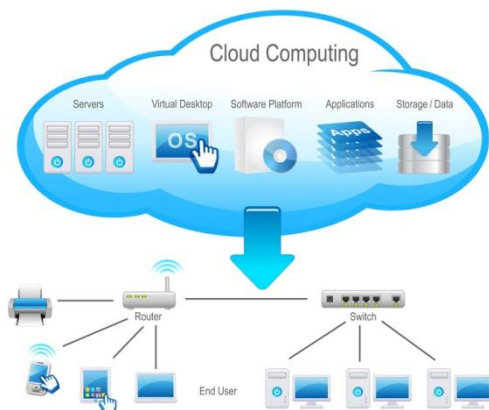
Mindwave is another competitor. The MindWave Mobile headset turns your computer into a brain activity monitor. The headset safely measures brainwave signals and monitors the attention levels of individuals as they interact with a variety of different apps. This headset is useful for OEMs and developers building apps for health and wellness, education and entertainment.



AMAZON WEB SERVICES

....KALYANI SUDEEP (S8 CSE)

Cloud computing has become a hot topic of today. cloud computing is the delivery of computing services—servers, storage, databases, networking, software, analytics and more—over the Internet (“the cloud”). Companies offering these computing services are called cloud providers and typically charge for cloud computing services based on usage, similar to how you are billed for water or electricity at home.



Benefits of cloud computing

Cloud computing is a big shift from the traditional way businesses think about IT resources.

1. **Cost:** Cloud computing eliminates the capital expense of buying hardware and software and setting up and running on-site datacenters—the racks of servers, the round-the-clock electricity for power and cooling, the IT experts for managing the

infrastructure. It adds up fast.

2. Speed: Most cloud computing services are provided self service and on demand, so even vast amounts of computing resources can be provisioned in minutes, typically with just a few mouse clicks, giving businesses a lot of flexibility and taking the pressure off capacity planning.

3. Global scale: The benefits of cloud computing services include the ability to scale elastically. In cloud speak, that means delivering the right amount of IT resources—for example, more or less computing power, storage, bandwidth—right when its needed and from the right geographic location.

4. Productivity: On-site datacenters typically require a lot of “racking and stacking”—hardware set up, software patching and other time-consuming IT management chores. Cloud computing removes the need for many of these tasks, so IT teams can spend time on achieving more important business goals.

5. Performance: The biggest cloud computing services run on a worldwide network of secure datacenters, which are regularly upgraded to the latest generation of fast and efficient computing hardware. This offers several benefits over a single corporate datacenter, including reduced network latency for applications and greater economies of scale.

6. Reliability: Cloud computing makes data backup, disaster recovery and business continuity easier and less expensive, because data can be mirrored at multiple redundant sites on the cloud provider’s network.

AMAZON WEB SERVICES:



Amazon Web Services (AWS) is a subsidiary of Amazon.com that provides on-demand cloud computing platforms to individuals, companies and governments, on a paid subscription basis with a free-tier option available for 12 months. The technology allows subscribers to have at their disposal a full-fledged virtual cluster of computers,

available all the time, through the internet. AWS's version of virtual computers have most of the attributes of a real computer including hardware (CPU(s) & GPU(s) for processing, local/RAM memory, hard-disk/SSD storage); a choice of operating systems; networking; and pre-loaded application software such as web servers, databases, CRM, etc. Each AWS system also virtualizes its console I/O (keyboard, display, and mouse), allowing AWS subscribers to connect to their AWS system using a modern browser. The browser acts as a window into the virtual computer, letting subscribers log-in, configure and use their virtual systems just as they would a

real physical computer. They can choose to deploy their AWS systems to provide internet-based services for their own and their customers' benefit.

The AWS technology is implemented at server farms throughout the world, and maintained by the Amazon subsidiary. Fees are based on a combination of usage, the hardware/OS/software/networking features chosen by the subscriber, required availability, redundancy, security, and service options. In 2016, AWS comprised more than 70 services spanning a wide range including computing, storage, networking, database, analytics, application services, deployment, management, mobile, developer tools, and tools for the Internet of Things. Amazon Web Services' offerings are accessed over HTTP, using the REST architectural style and SOAP protocol. All services are billed based on usage, but each service measures usage in varying ways. Most services are not exposed directly to end users, but instead offer functionality through APIs for developers to use in their applications.

The most central and best-known of these services are :

- Amazon Simple Storage Service (S3).
- Amazon Elastic Compute Cloud (EC2)

Amazon Simple Storage Service (S3).

- Amazon S3 is storage for the internet.
- It is designed to make web-scale computing easier for developers.
- It provides a simple web service interface to store and retrieve any amount of data from anywhere on the web.
- It gives any developer access to the same infrastructure that Amazon uses to run its own global network of websites.

Amazon Elastic Compute Cloud (EC2)

- Amazon EC2 is a web service that provides resizable compute capacity in the cloud.
- It is designed to make web-scale cloud computing easier for developers and administrators.
- EC2's simple web service interface allows users to obtain and configure capacity with minimal friction.
- Elastic Web-Scale Computing
- Completely Controlled
- Flexible Cloud Hosting Services
- Integrated, Reliable and Secure
- Inexpensive
- Easy to start and use



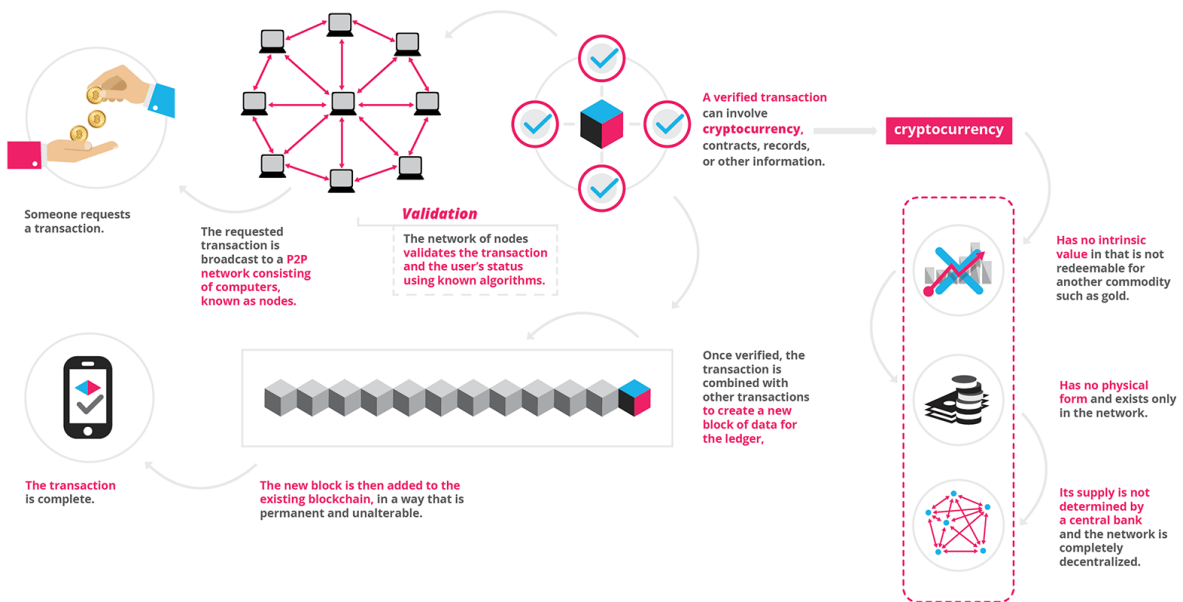
BLOCK CHAIN TECHNOLOGY

...AISWARYA WARRIER (S8 CSE)

Blockchain and Bitcoins :

It is the technology behind various crypto-currencies and new generation transactional applications. It provides a digital history of all the events in the network. It is a distributed and public database which cannot be tampered. It can provide trust, accountability & transparency. By allowing digital information to be distributed but not copied, blockchain technology created the backbone of a new type of internet. Originally devised for the digital currency, Bitcoin, the tech community is now finding other potential uses for the technology.

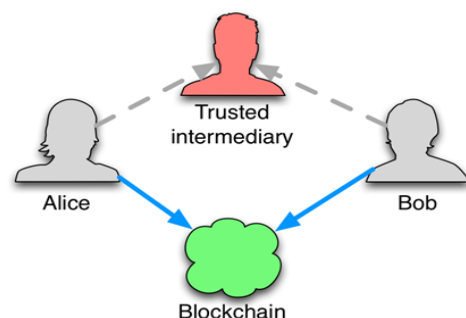
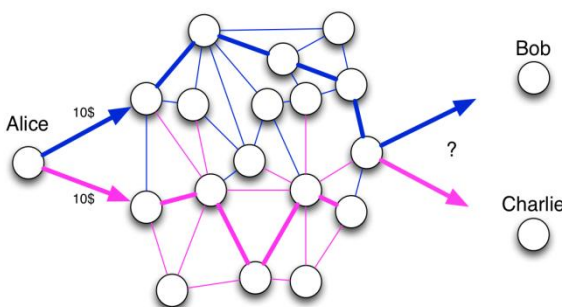
Bitcoin has been called “digital gold,” and for a good reason. To date, the total value of the currency is close to \$9 billion US. And blockchains can make other types of digital value.



Cryptocurrency

Issues:

- Double spending problem
- Need for trusted members and trusted third party.



BLOCK CHAIN IMPLEMENTATION

The two main concepts used in implementing the technology is:

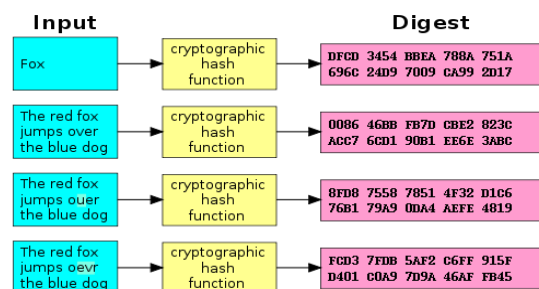
- Peer to peer network
- Blocks as database

Blocks

- A block holds time-stamped batches of valid transactions.
- Each block includes hash to the prior. Thus blocks are linked to form *chain*.
- Only one block(successor) is allowed to link to another block (predecessor).
- Each block is identified by its hash.

Hashing

- Each block is identified by a hash number.
- Hash is a one way function which takes input and gives different outputs based on the input data.
- SHA-256 is used for hashing a block.
- Each transaction inside a block is also hashed .
- Hash of each block has 'n' leading zeroes
- Every block has hash of previous block

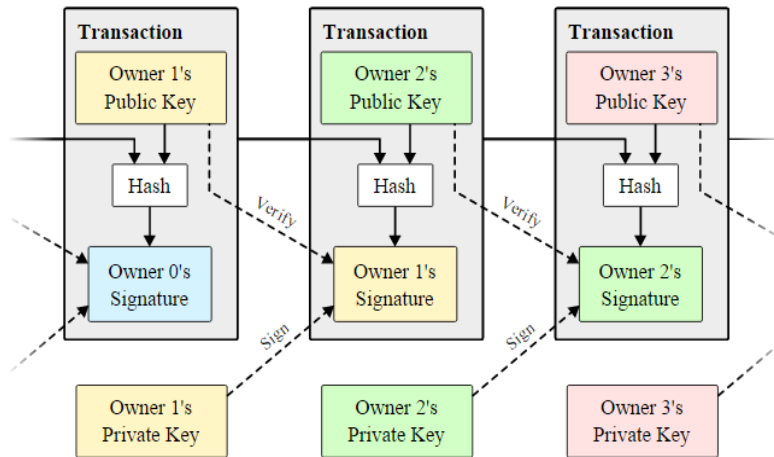


Mining

- Process of creating a new block that can be added to end of Blockchain.
- Nodes in a chain create a local block with pending facts.
- A local blocks is added to blockchain only if the block is found to be valid.
- Nodes competes with each other to mine and node creating required hash of block wins.
- Eg: // a losing hash for bitcoin
787308540121f4afd2f55179998563210f5455df85236479e44d
// a winning hash for Bitcoin if n=10
0000000009f766c17c736169f79cb065dde07244e9468bc60c4
- 'n' is called difficulty - It gives the number of zeroes to be present in the hash of a block for it to be a winning block.
- 'n' increases computational power, so there is less fraud.
- Each block is mined at a constant interval.

Transactions

- Each owner does transactions by using digital signature on the transaction block.
- Public key of the next owner is added to the end of each transaction.
- Receiver verifies signatures to verify the chain of ownership of assets.
- Each block can hold multiple sanctioned transactions .

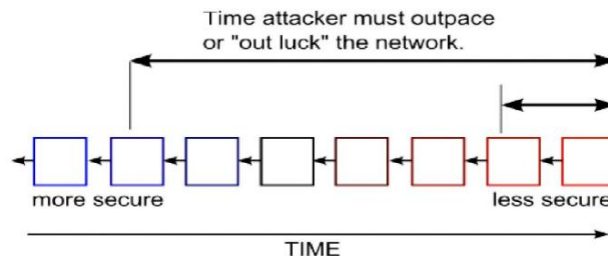


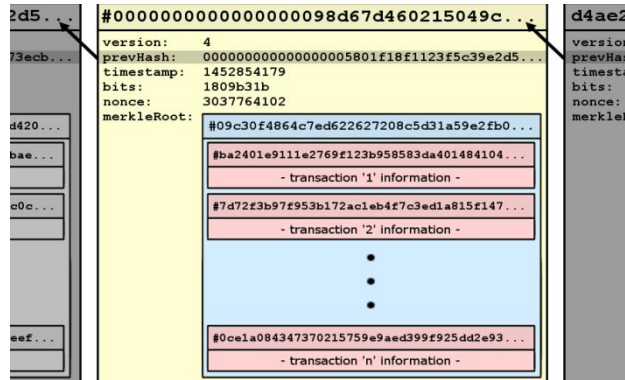
Timestamp Server

- Timestamp server resolves the double spending problem.
- Participants agree on a single history of transactions in the correct order.
- Server takes the hash of a block of items to be time-stamped and widely publishes the hash in the network.
- A timestamp proves that the data must have existed at the time in order to get into the hash
- Each timestamp includes the previous timestamp in its hash, forming a chain, with each additional timestamp reinforcing the ones before it.

Proof-of-Work

- It involves scanning for a value that begins with a number of zero bits.
- Average work required is exponential to the number of zero bits required.
- In timestamp network, proof-of-work is implemented by incrementing a nonce in the block.
- This is done until a value is found that gives the block's hash with the required zero bits.
- Block cannot be changed without redoing the work the CPU expended.
- Work done to change the block would include redoing all the blocks after it.

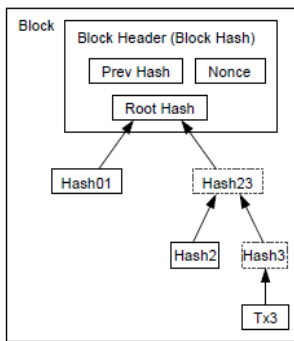




A Block in BlockChain

Merkle Tree

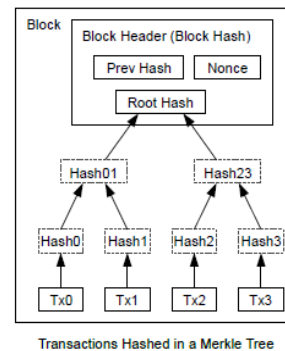
- Transactions in a block are hashed into a Merkle tree



After Pruning Tx0-2 from the Block

Reclaiming disk space

- Once the latest transaction in a coin is buried under enough blocks, the spent transactions before it can be discarded to save disk space.
 - Old blocks can then be compacted by stubbing off branches of the tree.
 - Interior hashes do not need to be stored.



Transactions Hashed in a Merkle Tree

Network

The steps to run the network are as follows:

1. New transactions are broadcast to all nodes.
2. Each node collects new transactions into a block.
3. Each node works on finding a difficult proof-of-work for its block.
4. When a node finds a proof-of-work, it broadcasts the block to all nodes.
5. Nodes accept the block only if all transactions in it are valid and not already spent.
6. Nodes express their acceptance of the block by working on creating the next block in the chain, using the hash of the accepted block as the previous hash.

Blockchains provide an effective solution to problems currently faced in online transactions but it is not yet used widely.

Advantages of using a Blockchain

- Reliability & Authentication
- Public record of all transactions
- Records are immutable
- Uses peer to peer network; so anybody can join or leave without centralized authority



IBM WATSON

....SREELAKSHMI K K (S8 CSE)

Watson is a question answering computer system capable of answering questions posed in natural language. This is developed in IBM's DeepQA project and was named after IBM's first CEO, industrialist Thomas J. Watson. The computer system was specifically developed to answer questions on the quiz show Jeopardy and, in 2011, the Watson computer system competed on Jeopardy winning the first place prize of \$1 million.



Watson had access to 200 million pages of structured and unstructured content consuming four terabytes of disk storage including the full text of Wikipedia, but was not connected to the Internet during the game. For each clue, Watson's three most probable responses were displayed on the television screen. Watson consistently outperformed its human opponents on the game's signaling device, but had trouble in

a few categories, notably those having short clues containing only a few words.

As per the IBM website, Watson can be utilized in the following ways.

Conversation: Quickly build and deploy chatbots and virtual agents across a variety of channels, including mobile devices, messaging platforms, and even robots.

Discovery: Unlock hidden value in data to find answers, monitor trends and surface patterns with the world's most advanced cloud-native insight engine.

Virtual Agent: Build a chatbot for customer service - no machine learning experience required.

Visual Recognition: Tag, classify and search visual content using machine learning.

Natural Language Understanding: Analyze text to extract meta-data from content such as concepts, entities, keywords and more.

Discovery News: Infuse dynamic news content into every app you build.

Knowledge Studio: Teach Watson to discover meaningful insights in unstructured text without writing any code.

Document Conversion: Document Conversion capabilities have been migrated to Watson Discovery. Take advantage of improvements to PDF conversion using Watson Discovery.

IMPLEMENTATION: Watson's key components :

- ✓ **Hardware components:**
 - 90 IBM Power 750 servers
 - 2,880 Power 7 processor cores: performs 80+TFLOPS
 - 20 terabytes of RAM
 - 10 Gbps network
- ✓ **Software components:**
 - SUSE Enterprise Linux Server 11, the fastest available Power7 processor operating system
 - 500 gigabytes of preprocessed information
 - IBM's DeepQA software
 - Apache UIMA - Unstructured Information Management Architecture
 - Apache's Hadoop
- ✓ Watson has access to 200 million pages of structured & unstructured content consuming 4TB of disk storage
- ✓ Sources of information for Watson include:
 - Wide range of encyclopaedias
 - Dictionaries
 - Thesauri
 - Newswire articles
 - Full text of Wikipedia
 - Literary works etc.
- ✓ Watson was not connected to the Internet during the final game of Jeopardy

WORKING:

First Watson learns a new subject: All related materials are loaded into Watson, such as Word documents, PDFs and web pages. Questions and answers pairs are added to Train Watson on the subject. Watson is automatically updated as new information is published, Then Watson answers a question: Watson searches millions of documents to find thousands of possible answers, Collects evidence and uses a scoring algorithm to rate the quality of this Evidence. Ranks all possible answers based on the score of its supporting evidence.

APPLICATIONS

- Medicine
- Business
- Finance
- Travel : Makes sure optimal travel choices are made



DIGITAL FORENSICS IN CLOUD ENVIRONMENTS: CHALLENGES AND SOLUTIONS

...MEGHNA ASHOKA (S8 CSE)

Digital Forensics is a branch of the forensic sciences that deals with the analysis of digital evidence from digital sources. Cloud Computing is regarded as on-demand computing in which users take desired and required services in terms of Software, Platform and Infrastructure from Cloud Service Providers(CSPs) and pay as per their usage.

- ✓ Cloud Forensics = Cloud Computing+ Computer Networks+ Forensics (Digital + Network)

Network Forensics is basically doing crime based investigation and forensics on computer networks for efficiently scanning out the digital fingerprints of attackers or intruders in the network and tracking the cybercrime. Cloud Computing Forensics is regarded as a specialized forensic science of applying scientific principles, technological tactics and methods to cloud computing in order to obtain evidences and prove crime in the court.

A TYPICAL SCENARIO: In traditional investigations, the suspect or victim's computers may normally be the main source of information about an incident. For example, in a child exploitation case, a suspect may have stored illicit images on their local hard drive. In the case of cloud-based storage, the images may not be stored locally. Cloud services may reduce the amount of direct evidence available on a suspect's disk and reduce the client-side impact.

MULTI-JURISDICTION: When suspect data is stored in the Cloud the data may be in one jurisdiction while the suspect machine connecting to the service may be in another jurisdiction.

MULTI-TENANCY: Shared storage nature of cloud computing - In traditional investigations, a computer or server may possibly be taken down. Taking servers down in a cloud environment may have an impact on many customers, creating more liability.

ACCUMULATION OF DATA: The amount of stored data could quickly add up resulting again in too much data for law enforcement.

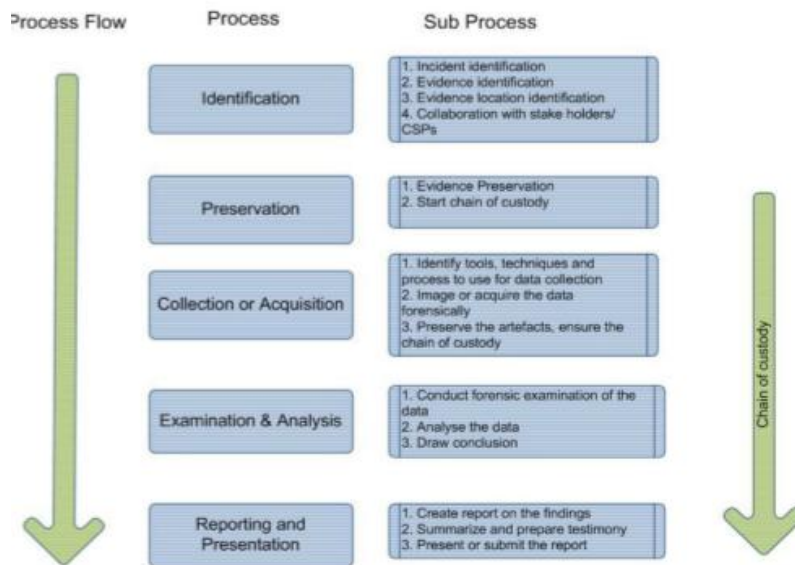
DATA ACQUISITION: Selective data acquisition can cause missing of evidence.

FAILURE OF CSP: Reputation is affected if incident occurs on the side of the CSP.

VOLATILE DATA: Rapid elasticity in cloud environments.

SOLUTIONS:

The general application of a current digital forensic investigation process model—the Integrated Digital Investigation Process—to cloud computing. The process is a five step process which includes – Identification, Preservation, Collection, Examination and Analysis , Reporting and Presentation.



IDENTIFICATION – SOLUTIONS

Identification is a two-step process: (i) identification of the incident and (ii) identification of necessary evidence to prove the incident.

UNKNOWN PHYSICAL LOCATION: The location of virtual instances and digital artifacts is unknown to the customer and therefore it can

be difficult to identify the artifacts.

RESOURCE TAGGING: The cloud resource consumers “tag” their resources to mark the location of their information assets. Resource tagging can be used to inform the CSPs “what can be” and “what cannot be” moved.

ROBUST SERVICE LEVEL AGREEMENTS(SLA) :Option to choose a geographic location to host the VM instance when first created. This partially solves the jurisdictional or data location issue for customers.

DECENTRALIZED DATA: CSPs provide the details of how the logs are created and where they are stored. Having a valid Log Framework specifying ‘what to log’ and ‘when to log’ is one way to solve log file access issue.

DATA DUPLICATION: Good feature, because it will be very hard to completely destroy all the evidence from cloud.

PRESERVATION – SOLUTIONS

Preservation encompasses all activities that protect the integrity and that proper chain of custody process is initiated.

CHAIN OF CUSTODY: A roadmap that shows how evidence was collected, analyzed and preserved in order to be presented as evidence in court. - Chain of custody

- Use of techniques such as time stamping, hashing and e-signatures.
- An investigator can perform checksum on the artifacts and digitally sign the checksum using his/her private key.

EVIDENCE SEGREGATION:

- **SANDBOXING:** Sandboxing is a mechanism by which the running programs are separated into virtual enclaves and each of them uses its own enclave such that no instance knows the existence of its neighbor.
- **DATA INTEGRITY:** Data Integrity ensures that the evidence is an accurate representation of the data found in the computer system using proven hash techniques such as MD5.

COLLECTION AND ACQUISITION – SOLUTIONS

Collection refers to the “process of gathering items that contains the potential digital evidence”. Acquisition refers to the “process of creating a copy of the data within a defined set”. Due to multi-tenancy, even if the location is known, physical acquisition is not possible.

INACCESSIBILITY

REMOTE DATA ACQUISITION: It refers to acquiring the evidence remotely over a secure channel such as Guidance EnCase forensic tool including retrieval of volatile and nonvolatile data.

MANAGEMENT PLANE: Controlling the virtual assets in the cloud using a web interface. Acquiring the disk image from cloud using tunneling protocol, e.g., virtual private network (VPN)

LIVE FORENSICS: Forensics on a running system is called Live Forensics. Provides running system info, like process list, open ports etc., which are not available in offline forensics.

DELETED DATA: Frequent snap shots - Capturing of live VM instance, Difficult to achieve and manage due to the sheer volume of snap shot images, Overwriting of unwanted image dumps can prevent storage issues.

EXAMINATION AND ANALYSIS – SOLUTIONS

Examination is defined as “Forensic tools and techniques appropriate to the types of data that were collected are executed to identify and extract the relevant information from the collected data while protecting its integrity”. Analysis is defined as “analyzing the results of the examination to derive useful information that addresses the questions”.

LACK OF LOG FRAME WORK: A good log helps to timeline the events and understand the case better.

EVIDENCE TIME LINING: End-to-end log helps to create a time line of events. Ownership and process history attributes provide information regarding ‘who’ owned the data object at a given time, and ‘who’ updated the objects respectively.

EVIDENCE DATA INTEGRATION: CSPs often trade services among themselves, creating a complex array of intra-cloud dependency chain. Data tracking can be performed using software tools.

REPORTING AND PRESENTATION – SOLUTIONS

Presentation of analytical reports to the court of law - Reporting as a process which “includes describing the actions performed, determining what other actions need to be performed, and recommending improvements to policies, guidelines, procedures, tools, and other aspects of the forensic process”.

JURISDICTION: The law of each land is different from place to place.

- Cross border law: collaboration between international law enforcement agencies and legal frameworks.

CRIME SCENE RECONSTRUCTION: The algorithms and software tools for reconstruction of cloud storage and evidence are yet to be validated and developed.

ADVANTAGES

- These methods and solutions helps investigators to obtain an even better idea of the suspect, suspect's device and incident.
- Evidence can be segregated from chunks of data.
- The introduction of a laws irrespective of physical borders simplifies the task of investigators.
- Awareness of cloud and cloud forensics.

DISADVANTAGES

- Cloud forensic methods are to be implemented without losing the features of cloud computing.
- Strict laws may or may not be accepted by all stakeholders of cloud computing.
- Certain procedures of cloud forensic investigation might hinder particular features of cloud services.
- Trust issues between client and service providers.



NEUROMORPHIC TECHNOLOGIES

...ATHIRA RADHAKRISHNAN (S8 CSE)

The term “neuromorphic” was coined by Carver Mead, of the California Institute of Technology. Neuromorphic technology aims at the modern computer system that mimics the human brain. Neuromorphic chips are used in this latest technology. Neuromorphic chip obtain and process the information in a different way, mimicking the brain’s architecture to deliver a huge increase in a computer's thinking power. Neuromorphic architectures are efficient in pattern recognition to increase weather prediction or capabilities of robotics.

NEUROMORPHIC CHIP: Chips that model the human brain.

- Process sensory data such as images and sound and to respond to changes in that data in ways not specifically programmed.

MEMRISTOR:

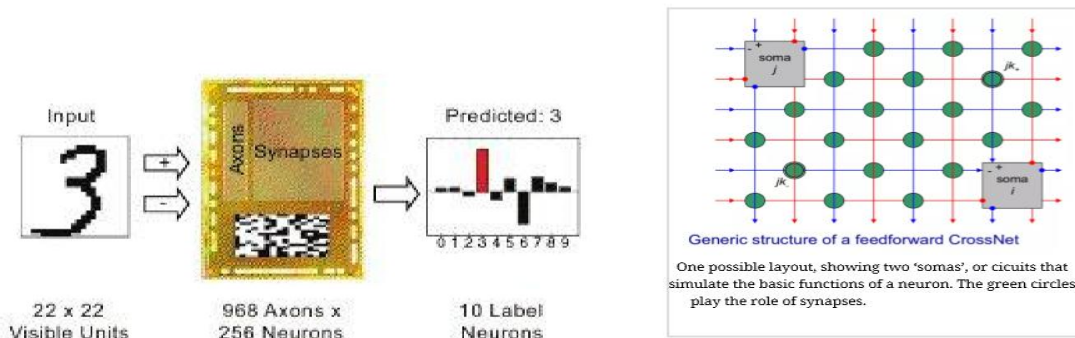
- Memristor can be used as a synapse in the neuromorphic system.
- Concatenation of memory and resistor, Memristor =memory+resistor.
- Composed of Ag and Si layers.

SPIKE:

- Refers to an action potential generated in the dendrite of a neuron.
- Receive electrical signals emitted from projecting neurons and transfer these signals to the cell body, or dendrite.

Characteristics that brains have and computers do not: low power consumption, fault tolerance and lack of need to be programmed

NEUROMORPHIC CHIPS:



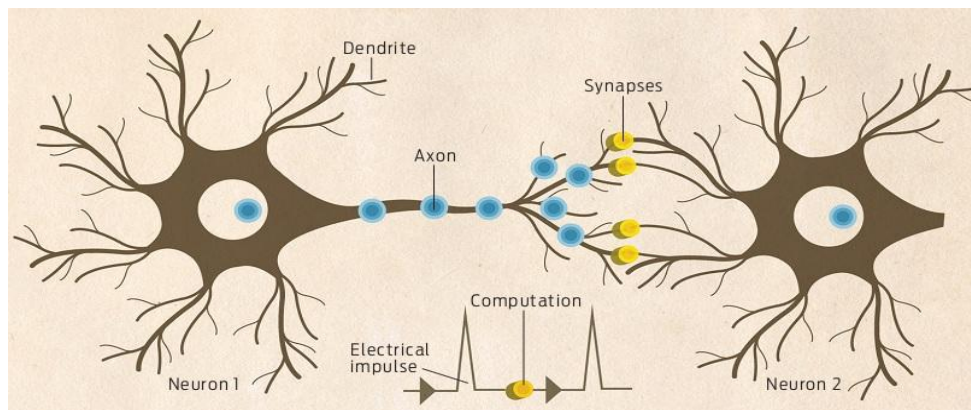
IBM CHIP

Ten networks each trained to identify one digit as its "pattern" Each receives the input in parallel and reaches output at the same time. Every neuron fires proportional to how strong it thinks the input matches the internalized pattern. The strongest output wins, so "3" is the result. The chip is named TrueNorth. It tries to mimic the way brains recognize patterns, relying on densely interconnected webs.

THE CROSSNET APPROACH

Electronic devices called 'somas' play the role of the neuron's cell body, which is to add up the inputs and fire an output. Somas can mimic neurons with several different levels of sophistication, depending on what is required for the task at hand. Somas can communicate via spikes, (short lived electrical impulses). The red and blue lines represent axons and dendrites, the two types of neural wires. The green circles connect these wires and play the role of synapses. Each of these 'latching switches' must be able to hold a 'weight', which is encoded in either a variable capacitance or variable resistance. In principle, memristers would be an ideal component here, if one could be developed that is cheap to produce and has high reliability.

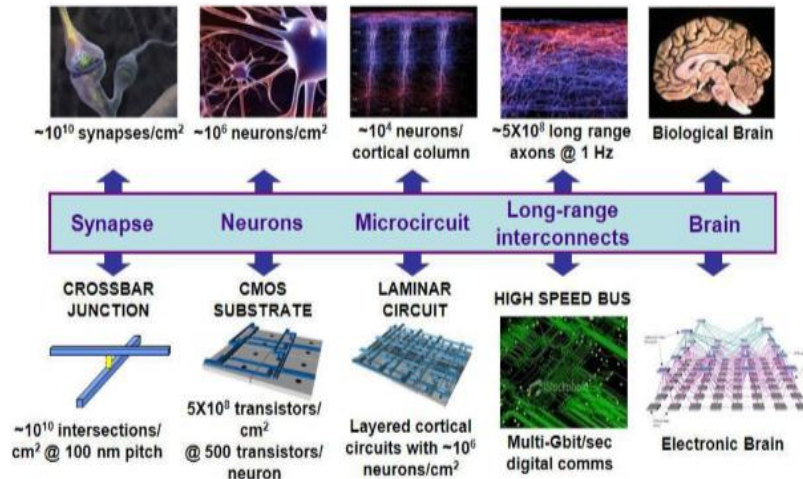
NEUROMORPHIC ARCHITECTURE



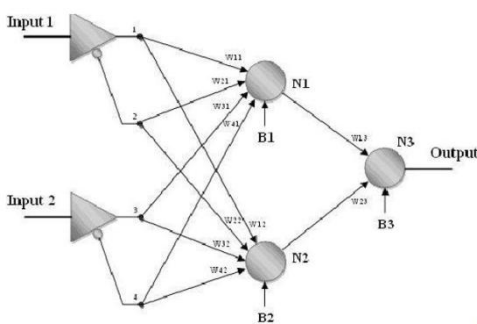
Neuromorphic architectures are the computer architectures similar to biological brains. Functional units are composed of neurons, axons, synapses, and dendrites. Synapses are connections between two neurons. Axon and dendrites connect to many neurons/synapses, like long range. Neural networks are based on spike from neuron. Neurons send a spike once a threshold voltage. The voltage is added to or subtracted from neurons. Signals are sent to a

neuron through dendrites and sent out through the axon. A neural network is a series of interconnected neurons. If the sum of the input signals into one neuron surpasses a certain threshold, the neuron sends an action potential (AP) at the axon and transmits this electrical signal along the axon. The core component of the nervous system in general, and the brain in particular, is the neuron or nerve cell, the “brain cells”. A neuron is an electrically excitable cell that processes and transmits information.

BIOLOGICAL VERSES HARDWARE



Synapses that are present in the human brain can be illustrated as a cross bar junction. Neurons can be illustrated as CMOS substrate. Cortical column present in the biological brain can be illustrated with the layered cortical circuits. Long range axons can be substituted by digital comms, thus the electronic brain can be obtained. The yellow coloured slot present in the intersections represents the synapse junction where two neurons can be connected. The electronic brain is composed of transistors, intersections, layered cortical circuits, digital comms and finally it leads to the formation of electronic brain.



IMPLEMENTATION OF LOGICAL NETWORK

Neural network can be trained as two input logic gate. It requires three neurons and ten synapses. With each input, define the correct input and thus the network develops.

Neuromorphic chips have a number of applications including big data mining, character recognition, surveillance, robotic control and in driveless car technology.



LIFI TECHNOLOGY

....NAMITHA BABU (S8 CSE)



Li-fi is a wireless optical networking technology that uses light-emitting diodes (leds) for data transmission. It is designed to use led light bulbs similar to those currently in use in many energy-conscious homes and offices. However, li-fi bulbs are outfitted with a chip that modulates the light imperceptibly for optical data transmission. Li-fi data is transmitted by the led bulbs and received

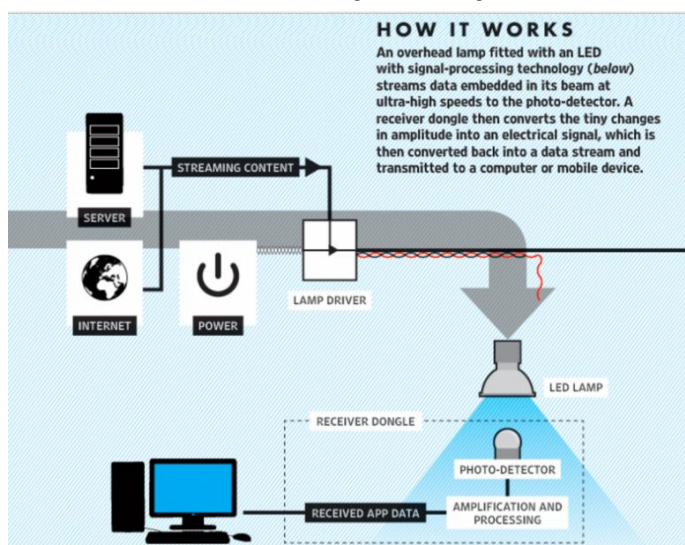
by photoreceptors. Professor Harald Haas, from the university of Edinburgh in the UK, is widely recognised as the original founder of li-fi. He coined the term li-fi and is chair of mobile communications at the university of Edinburgh and co- founder of pure li-fi. The first li-fi smartphone prototype was presented at the consumer electronics show in Las Vegas in 2014.

WiFi vs LiFi

LiFi is a high-speed wireless communication technology that uses visible light to transmit information. It has some similarities to existing WiFi technology, as well as some huge differences. WiFi and LiFi are similar because both technologies are wireless, but also very different, because unlike WiFi, which relies on radio waves, LiFi uses visible light communication (VLC) or infrared and near-UV spectrum waves. In other words, LiFi works by using visible light, like the light that is emitted by any regular lamp or bulb!

How Does it Work?

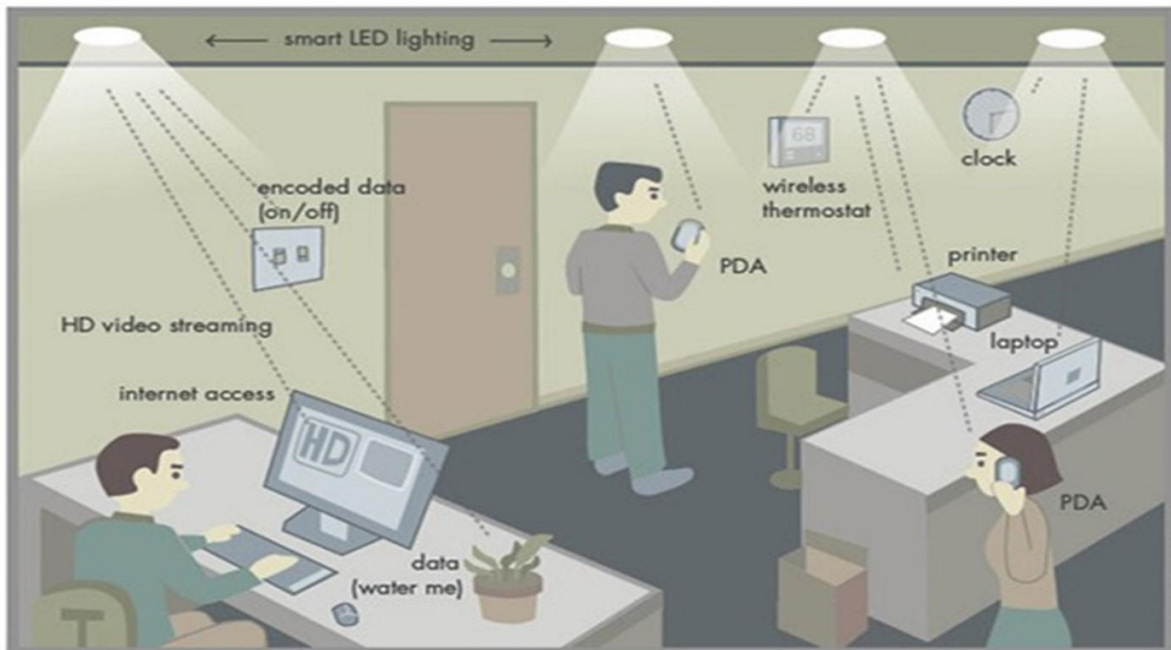
When a constant current is applied to an LED (LED lamps are commonly found in households and offices nowadays), tiny packets of energy (called photons) are released, which we perceive as visible light. If the input current to the LED is varied slightly, the intensity of the light output also varies. However, the good thing is that such small variations in the intensity of light is



imperceptible by human eyes. Since LEDs are semiconductor devices, the current and the optical output (the light produced by LEDs) can be modulated at very high speeds, which is then detected by a photodetector device that converts it back to electric current.

In this way, LiFi technology uses light from LED lights to transmit data and provide much faster Internet connectivity.

Benefits of LiFi



Since we are already largely dependent on visible light from lamps and bulbs, LiFi presents many unprecedented advantages for its uptake and use, as far as wireless Internet connectivity is concerned. Lights are almost everywhere we go – in our room, in halls and auditoriums, in cafes..... If this new trend catches on, then where there's light, there will be Internet connectivity through LiFi. As mentioned above, LiFi relies on visible light to communicate, which is a good thing in more ways than one. These waves are able to carry far more information than the traditional radio waves used in WiFi technology. The visible light spectrum is almost 10,000 times larger than the spectrum occupied by radio waves. Also, LiFi is said to increase bandwidth by 100 times what we have today with WiFi. This incredible feat is only possible because a LiFi connection can transmit data at the rate of 224 gigabytes per second!

BIG DATA AND CHALLENGES

....UNNIKUTTAN T S (S8 CSE)

'Big Data' is a term used to describe collection of data that is huge in size and yet growing exponentially with time. In short, such a data is so large and complex that none of the traditional data management tools are able to store it or process it efficiently.

Examples of 'Big Data'

Following are some the examples of 'Big Data'-

- ✓ The New York Stock Exchange generates about one terabyte of new trade data per day.
- ✓ Social Media Impact: Statistic shows that 500+terabytes of new data gets ingested into the databases of social media site Facebook, every day. This data is mainly generated in terms of photo and video uploads, message exchanges, putting comments etc.

- ✓ Single Jet engine can generate 10+terabytes of data in 30 minutes of a flight time. With many thousand flights per day, generation of data reaches up to many Petabytes.

Categories Of 'Big Data'

Big data' could be found in three forms: Structured, Unstructured, Semi-structured

Structured:

Any data that can be stored, accessed and processed in the form of fixed format is termed as a 'structured' data. Over the period of time, talent in computer science have achieved greater success in developing techniques for working with such kind of data (where the format is well known in advance) and also deriving value out of it. Data stored in a DB is an example. However, now days, we are foreseeing issues when size of such data grows to a huge extent, typical sizes are being in the range of multiple zettabyte.

0^{21} bytes equals to 1 zettabyte or one billion terabytes forms a zettabyte.

Unstructured

Any data with unknown form or the structure is classified as unstructured data. In addition to the size being huge, un-structured data poses multiple challenges in terms of its processing for deriving value out of it. Typical example of unstructured data is, a heterogeneous data source containing a combination of simple text files, images, videos etc. Now a day organizations have wealth of data available with them but unfortunately they don't know how to derive value out of it since this data is in its raw form or unstructured format.

Examples of Un-structured Data: Output returned by 'Google Search'

Semi-structured

Semi-structured data can contain both the forms of data. We can see semi-structured data as a structured in form but it is actually not defined with e.g. a table definition in relational DBMS..

Examples of Semi-structured Data: Personal data stored in a XML file-

Characteristics of 'Big Data'

(i)Volume – The name 'Big Data' itself is related to a size which is enormous. Size of data plays very crucial role in determining value out of data. Also, whether a particular data can actually be considered as a Big Data or not, is dependent upon volume of data. Hence, '**Volume**' is one characteristic which needs to be considered while dealing with 'Big Data'.

(ii)Variety – The next aspect of 'Big Data' is its **variety**.

Variety refers to heterogeneous sources and the nature of data, both structured and unstructured. During earlier days, spreadsheets and databases were the only sources of data considered by most of the applications. Now days, data in the form of emails, photos, videos,

monitoring devices, PDFs, audio, etc. is also being considered in the analysis applications. This variety of unstructured data poses certain issues for storage, mining and analysing data.

(iii) Velocity – The term '**velocity**' refers to the speed of generation of data. How fast the data is generated and processed to meet the demands, determines real potential in the data.

Big Data Velocity deals with the speed at which data flows in from sources like business processes, application logs, networks and social media sites, sensors, Mobile devices, etc. The flow of data is massive and continuous.

(iv) Variability – This refers to the inconsistency which can be shown by the data at times, thus hampering the process of being able to handle and manage the data effectively.



Benefits of Big Data Processing

Ability to process 'Big Data' brings in multiple benefits, such as-

- **Businesses can utilize outside intelligence while taking decisions**

Access to social data from search engines and sites like facebook, twitter are enabling organizations to fine tune their business strategies.

- **Improved customer service**

Traditional customer feedback systems are getting replaced by new systems designed with 'Big Data' technologies. In these new systems, Big Data and natural language processing technologies are being used to read and evaluate consumer responses.

- **Early identification of risk to the product/services, if any**

- **Better operational efficiency**

'Big Data' technologies can be used for creating staging area or landing zone for new data before identifying what data should be moved to the data warehouse. In addition, such integration of 'Big Data' technologies and data warehouse helps organization to offload infrequently accessed data.



SCREENLESS DISPLAYS

....ASHOK BALAJI (S8 CSE)

Screenless display is the advanced display technology, which replaces the touch screen technology to resolve the problems and to make lives more comfortable. Screenless display transmits or displays the information without using a projector or the screen. By using this technology, we can display the images directly on the open space, human retina and also to the human brain.



During the year 2013, this display came into progress by the implementation of products like virtual reality headsets, retinal displays and holographic videos. Lack of space is the major drawback for most of the screen displays. This problem can be overcome by the use of screenless displays.

Courtesy: <https://www.elprocus.com/introduction-to-screenless-displays-and-their-types/>

What is Screenless Display?

Screenless display is an interactive projection technology developed to solve the problems related to the device miniaturization of the modern communication technologies. It can be defined as a display used to transmit any data such as pictures or videos without the help of screens.

Types of Screenless Display

Screenless display technology is divided into three main categories:

- Visual Image Display
- Retinal Display
- Synaptic Interface

The first category, visual image is defined as the things that can be seen by the human eye such as holograms. The second category, retinal display – the name itself- indicates the display of image directly onto the retina. The third category, synaptic reference which means sending information directly to the human brain.

1. Visual Image Display

The visual image is a type of screenless display, which recognizes any type of image or thing with the help of the human eye. Holographic display, virtual reality goggles, heads up display, etc are few examples of the visual image display. The working principle of this display states that the light gets reflected by the intermediate object

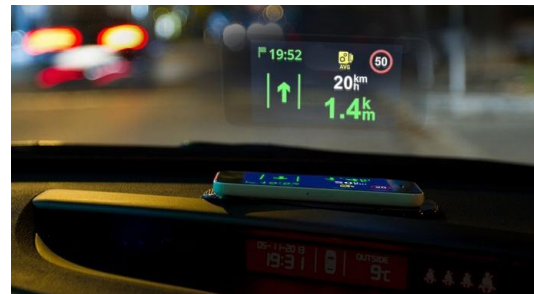


before reaching the retina or the eye. The intermediate object can be a hologram, Liquid Crystal Displays (LCD)s or even windows.

By using the components like Helium Neon Laser, an object, a Lens, a holographic film and mirror, the **Holographic Displays** display the three dimensional (3D) images. A 3D image will be projected and appears to be floating in the air whenever the laser and object beams overlaps with each other. This display can supply accurate depth cues and high-quality images and videos that can be viewed by the human eyes without any need of special observation devices. Based on the colors of the laser projector, images are formed in three distinct planes. Holographic displays are commonly used as an alternative to screens.

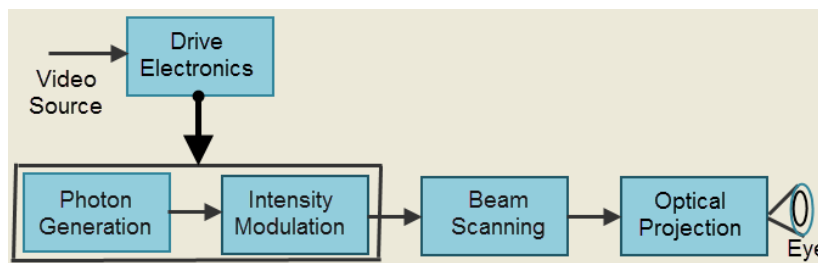


Heads up display are also named as transparent displays. These displays are applied in different applications such as aeroplanes, computer games and automobiles, etc. Many of the users do not need to look away from their field of view because the device displays the information on a windshield. An ordinary heads up display comprises of following components: a projector unit, combiner and a computer. The projector unit projects the image, and the combiner redirects the displayed image by that projected image, and the field of view are seen simultaneously. The screenless computer acts as an interface between the projector and the combiner (data to be displayed).



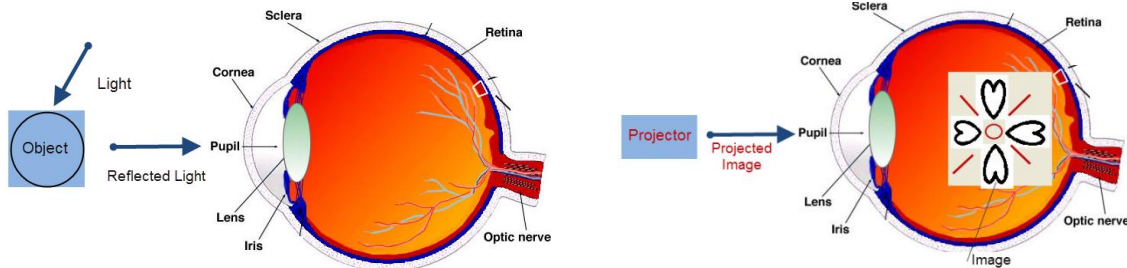
2. Retinal Display

The second category of advancement in display system, retinal display as the name itself indicates the display of image directly onto the retina. Instead of using some intermediate object for light reflection to project the images, this display directly projects the image onto the retina. The user will sense that the display is moving freely in the space. Retinal display is commonly known as retinal scan display and retinal projector. This display allows short light emission, coherent light and narrow band colour.



Block Diagram of Retinal Screenless Display

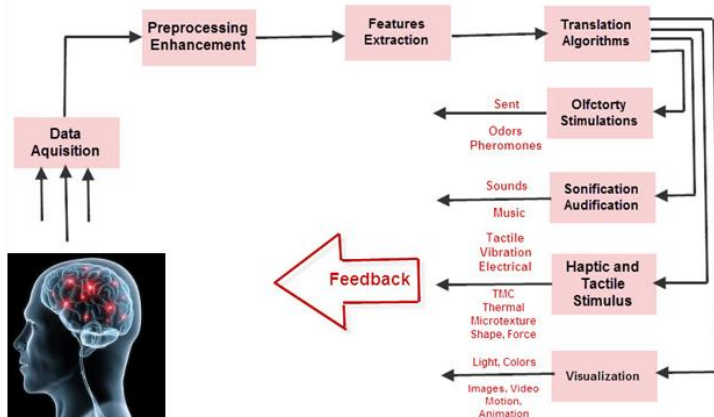
The block diagram of the virtual retinal display consists of following blocks: photon generation, intensity modulation, beam scanning, optical projection and drive electronics. Photon generation block generates the coherent beam of light; this photon source makes use of the laser diodes as coherent source with retina display to give a diffraction onto the retina of the human eye. The light generated from photon source is intensity modulated. The intensity of the light beam gets modulated to match the intensity of the image.



How Vision Works

The modulated beam gets scanned by the beam scanning. By using this scanning block, the image is placed onto the retina. In this beam scanner, two types of scanning modes takes place: raster mode and vector mode. After the scanning process, optical projection takes place for projecting a spot-like beam onto the retina of the eye. The spot focused on the eye is sketched as an image. A drive electronics placed on the photon generator and intensity modulator is used for synchronization of the scanner, modulator and coming video signal. These displays are made available in the market by using MEMS technology.

3. Synaptic Interface:



The third category, synaptic interface means sending information directly to the human brain without using any light. This technology is already tested on humans and most of the companies started using this technology for effective communication, education, business and security system. This technology was successfully

developed by sampling the video signals from horse crab eyes through their nerves, and the other video signals are sampled from the electronic cameras into the brains of creatures.

The brain computer interface allows direct interaction between the human brain and external devices such as computer. This category can also be known by different names such as human machine interface, synthetic telepathy interface, mind machine interface and direct neural interface.

