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WEB 3.0 – A DIGITAL REVOLUTION

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Abstract: *Over many years, the internet has grown rapidly. In its early stages, no one could fully grasp its potential or how it would affect us. Computer networking in the 1960s and 1970s was only allowed for academic and interpersonal communication. Commercial use was not allowed. The number of applications increased significantly as advancements were made, which is what got us to where we are today. Many businesses view technology as a valuable asset for increasing revenue and reducing expenses. The Web is acknowledged as the publishing medium with the quickest rate of growth ever. For organizations, this abundance of unstructured data opens them a wide range of new possibilities. The Web has developed in its own particular style and serves as a catalyst for technical growth. Web 3.0, the third iteration of the internet, combines a variety of disruptive technologies, including blockchain, augmented reality, virtual reality, cloud computing, IoT, geolocation technology, 5G, and digital twins, and it is powered by an AI-based analytics layer that enables data-driven insights. Through mathematical evidence and smart contracts, the underlying blockchain technology facilitates trust. As a result, networks may be created with little administrative expertise, assisting in the development of the new internet economy as a whole or as individuals rather than succumbing to the centralized management of powerful tech companies. The impressive capabilities of Web 3.0, such as its ability to understand information like a human through hyper-intelligent networks, combined with an underpinning secure digital ledger layer to track financial interactions, and the convergence of AI and 5G telecommunications, will open new doors for the digital ecosystem's development and exploration. The Semantic Web as it was first imagined by Berners-Lee in 2001 has significantly evolved with the advent of Web 3.0. This is due in part to the fact that translating human language, with all of its nuanced variations, into a format that computers can easily understand is incredibly expensive and extremely complex, as well as the fact that Web 2.0 has advanced significantly over the previous 20 years. The whole research paper is divided into six parts. The first section focuses on the expansion and the dynamic features of Web 3.0 Technology. The purpose of the second part is to comprehend and envision the development of the web from its inception to the anticipated advancements in web technology. The third part highlights the Top 5 Web 3.0 Technology in the real world. The fourth part focuses on the development and the architecture of Web 3.0 Technology. The fifth part highlights the importance of Data Storage and how is data stored in Web 3.0 technology. The sixth part deals enlist the advantages and disadvantages of the Web 3.0 technology. The seventh part deals with various use cases and application of this Digital Revolution.*

Key Word: *Technology, Internet, Networks, Cloud, Semantic Web, Blockchain, Paradigm, Digital Ecosystem, Telecommunications, Data Storage, Metaverse, 5G.*

I. INTRODUCTION

Many organizations view technology as a crucial asset required to increase revenue and reduce expenses. With well over 1 trillion URLs, the World Wide Web (hereafter referred to as the Web) is acknowledged as the publishing medium with the highest rate of growth ever. The use of the Internet has increased at an estimated pace of 566 percent during the past 12 years, making it the primary global medium for communication. The technology behind the Internet's organizational structure is developing at an ever-increasing rate. Organizations face problems and new possibilities as a result of keeping up with technology advancements.

The third stage of the development of web technology is known as Web 3.0 (Web3). The World Wide Web, sometimes referred to as the web, is the basic layer upon which all other layers of the internet are built, offering website and application services. There isn't a definitive, widely acknowledged definition of Web 3.0 since it is continuously developing and being defined. But one thing is certain: Web 3.0 will heavily emphasize decentralized apps and employ blockchain-based technology. AI and machine learning will both be used in Web 3.0 to support the development of smarter, more adaptable apps. An all-encompassing term used to describe the next stage of the internet's development, known as Web 3.0, involves decentralization and user sovereignty, together with a remarkable depth of the experiences and benefits that people get from the internet.

Tim Berners-1999 Lee's idea for a semantic web is different from Web3. The semantic web was referred to by Berners-Lee as a part of Web 3.0 in 2006, which differs from the definition of Web3 in blockchain settings. Gavin Wood, the inventor of Polkadot and a co-founder of Ethereum, first used the phrase "Web3" in 2014 to describe a "decentralized online ecosystem built on blockchain." The notion of Web3 became more well-known in 2021. A surge in interest occurred around the end of 2021, partly as a result of investments made by well-known firms and technologists and curiosity from cryptocurrency aficionados. In October 2021, executives from the venture capital company Andreessen Horowitz visited Washington, D.C. to advocate for the concept as a potential response to the issues with online regulation that legislators have been wrestling with. Giving users more control and functionality throughout the internet is one of Web 3.0's main objectives. Despite the fact that Web 2.0 is referred to as the social web, the top visited websites are run by significant technological companies. In order to make the World Wide Web more democratic, a movement called "Web 3.0" is attempting to decentralize it.

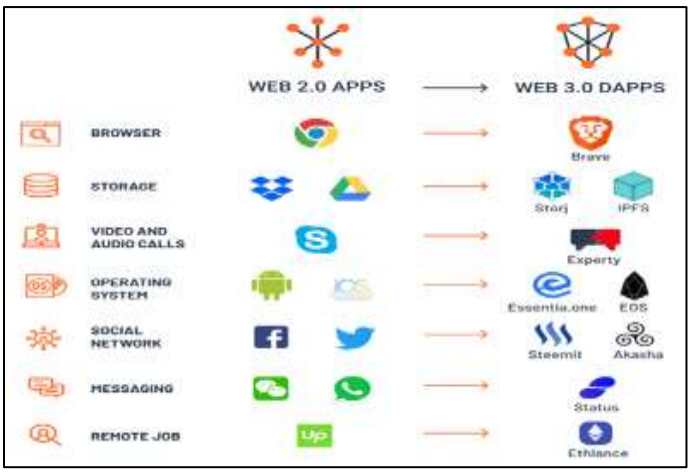

Fig. 1: Examples of Web 3.0 Technology

Key Features of Web 3.0 Technology

1. Decentralization

The underlying block chain technology prevents gatekeepers of the internet from storing data in silos. Information will be kept in numerous places at once in Web 3.0. Massive datasets now kept by tech goliaths like Google and Face book won't be used anymore because to this. All locations and devices will be able to access Web 3.0, and a wide range of potent computing devices, such as computers, mobile phones, appliances, and sensors, will be used to create the data. Users will have ownership control over the data since they will sell it over decentralized data networks.

The risk of data leak is nonexistent in a decentralized network. Your personal information is not in the hands of anyone. No centralized server will exist. The whole network will receive all of the info. If a toaster or refrigerator has internet connectivity, your data can be kept there as well. The decentralized, secure, private network that prioritizes being kind is the fundamental beauty of the Web 3.0 block chain technology stack.

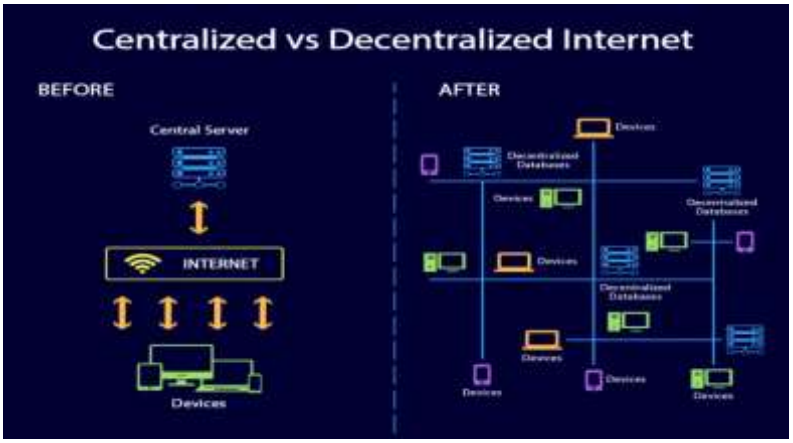

Fig. 2: Architecture of Centralized and Decentralized Internet

2. Connectivity

Many of the shortcomings of Web 2.0 will ultimately be fixed in Web 3.0. Semantic metadata allows for improved information linking in Web 3.0. The user experience advances to a new degree of connectivity as a consequence, making use of all available data. With no requirement for a computer or smart phone, Web 3.0 makes the Internet accessible to everyone, everywhere, at any time. It is heavily reliant on IoT sensors. Being or having the capacity to be everywhere, especially at once,

is referred to as ubiquitousness. Pervasive is the best way to describe it.

By enabling universal internet connectivity at all times and locations, Web 3.0 just advances the current technology. As was the case with Web 2.0, only PCs and cell phones could be internet-connected devices; but, the Internet of Things (IoT) will usher in a variety of new smart device categories. Your identity, the majority of the things you own, all of your data, and every software capability you are legally entitled to use will eventually be connected and able to work together.

Fig. 3: The Door to the Web 3.0

3. Semantic Web

The study of the connection between words is known as semantics. The capacity of computers to interpret vast amounts of Web data, including content, grammar, transactions, and linkages between people, is known as the semantic web. Web 3.0, also known as semantic online, aims to interpret web material like human behavior, in contrast to earlier versions of web 2.0, which rely on keywords, page authority, and domain authority to rank the information.

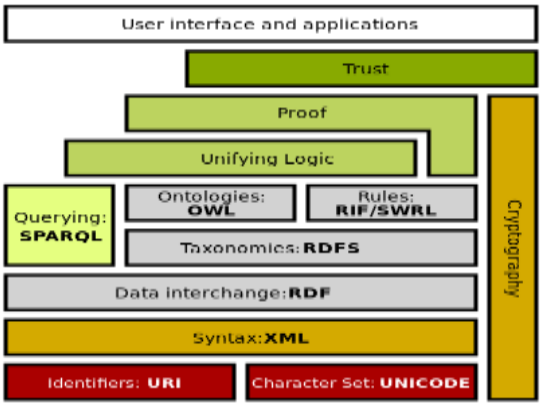

Fig. 4: Semantic Web Stack

The Semantic Web Stack serves as an example of its structure. The following succinct summary of the components' connections and functions:

- Although XML offers a fundamental syntax for document content organization, it does not provide any semantics to the content's content. Since other syntaxes like Turtle exist, XML is currently not an essential component of Semantic Web technology in most circumstances. Despite not having through a formal standardization procedure, Turtle is a de-facto standard. A language called XML Schema is used to specify and limit the structure and content of components included in XML documents.
- Data models, which describe objects (or "web resources") and their connections, may be expressed using the straightforward language of RDF. Different syntaxes, such as RDF/XML, N3, Turtle, and RDFa, can be used to express an RDF-based model. A foundational Semantic Web standard is RDF. The W3C has created a syntax called RDF/XML that allows you to express (or serialize) an RDF graph as an XML document. Due to its history as the first W3C standard RDF serialization format and the fact that it was issued with other W3C specifications defining RDF, RDF/XML is sometimes incorrectly referred to as just RDF.

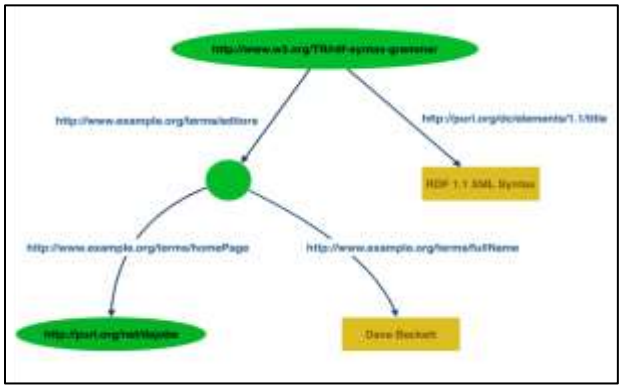

Fig. 5: RDF/XML Example

- The language for defining the properties and classes of RDF-based resources, along with the semantics for extended hierarchies of such attributes and classes, is called RDF Schema.
- Ontologies may be created using the Web Ontology Language (OWL), a family of knowledge representation languages. The structure of knowledge for different domains is primarily defined by ontologies, which are formal ways to describe taxonomies and classification networks. Ontologies have nouns that represent classes of things and verbs that show relationships between the items. In object-oriented programming, ontologies are similar to class hierarchies, but there are several important distinctions. Class hierarchies are designed to represent structures found in source code, which change relatively slowly (perhaps with monthly modifications), whereas ontologies are designed to represent information found on the Internet and are anticipated to change virtually continuously. A set of annotations, axioms, and facts are presented as an ontology in the OWL abstract syntax. Both human and machine-oriented meta-data are carried by annotations. Axioms and facts are the only elements of the ontology that provide information on the classes, characteristics, and individuals that make it up. Both anonymous and URI references are used to identify each class, property, and person.

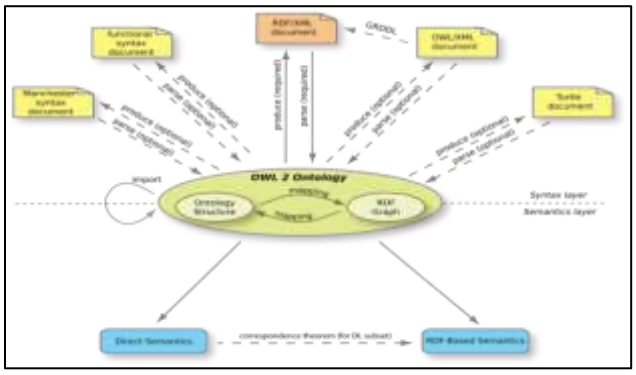

Fig. 6: The Structure of OWL 2

- A query can use triple patterns, conjunctions, disjunctions, and optional patterns according to SPARQL. Users of SPARQL can create queries against data that vaguely fits the category of "key-value" data or, more specifically, against data that adheres to the W3C's RDF standard. A collection of "subject-predicate-object" triples may be used to describe the complete database. This is comparable to the phrase "document-key-value," which is used by some NoSQL databases like MongoDB. For data whose schema is an inherent component of the data rather to needing a separate schema definition, SPARQL offers a full range of analytical query operations including JOIN, SORT, and AGGREGATE. To enable the clear linking of several datasets, schema information (the ontology) is frequently given outside. Additionally, SPARQL offers a special syntax for graph traversal for data that may be seen as a graph.

RDF data or URI:

```
@prefix ab:
<https://web3.0researchpaper/sanika#shifa#anant> .
ab:01 ab:firstName "Shifa" ;
ab:fatherName "Siraj" ;
ab:lastName "Khan" ;
ab:postalCode "400097" ;
ab:city "Mumbai" ;
ab:homeTel "9876865469" ;
ab:street "Rani Sati Rd" ;
ab:societyname "Mohammadi Apartment" ;
ab:state "Maharashtra" ;
ab:country "India" ;
ab:email "shifaskhan123@gmail.com" .
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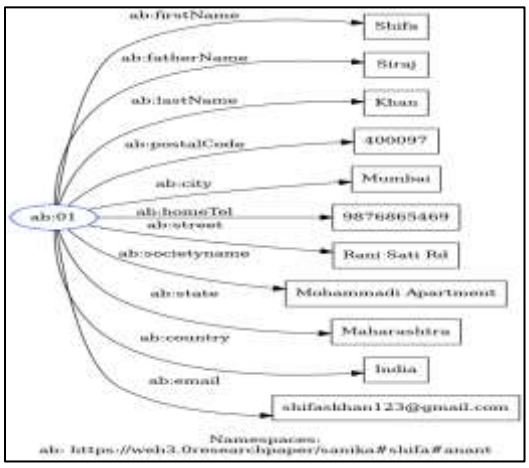

Fig. 7: Example of SPARQL

- RIF's main objective is to establish a standard for exchanging rules between rule systems, particularly Web rule engines. Because, unlike other Semantic Web standards like RDF, OWL, and SPARQL, it was immediately apparent that a single language would not cover all common paradigms of using rules for knowledge representation and business modelling, RIF focuses on exchange rather than defining a single one-fits-all rule language. It didn't take long to realize how difficult it would be to just exchange rules. First-order, logic-programming, and action rules are the three major subcategories of known rule systems. Little is shared between these paradigms in terms of syntax and semantics. Furthermore, even within the same paradigm, there are significant differences between systems. The RIF Working Group's strategy is to create a family of dialects, or languages, with rigidly defined syntax and semantics. The RIF dialect family is designed to be consistent and expandable. RIF homogeneity suggests that as much of the current syntactic and semantic infrastructure as feasible should be shared between dialects. A new RIF dialect should be definable by motivated specialists as a syntactic extension to an already-existing RIF dialect, with new components matching to desired extra capabilities. When first defined, these new RIF dialects would be non-standard, but they may later become into standards.

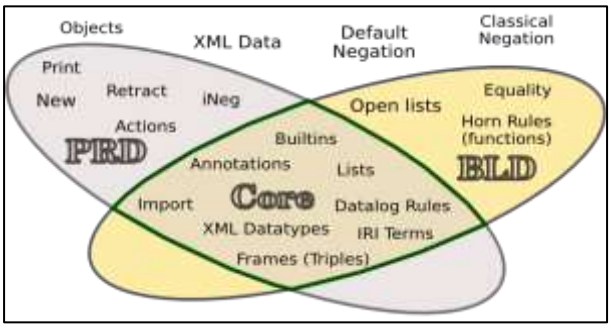

Fig. 8: RIF Dialects

4. Artificial Intelligence and Machine Learning

In Web 3.0, computers will employ AI and ML algorithms to select and present the best information to consumers depending on their search. These algorithms will enable computers to mimic human learning processes and steadily improve their accuracy. As a consequence, they will generate outcomes that are more pertinent than Web 2.0's simple targeted advertising. With the use of AI algorithms, Web 3.0 websites will be able to personalize content to each user's tastes and likes, do rid of problems like rating manipulation (for instance, on websites that rate movies like IMDb), and provide them the best most objective information possible.

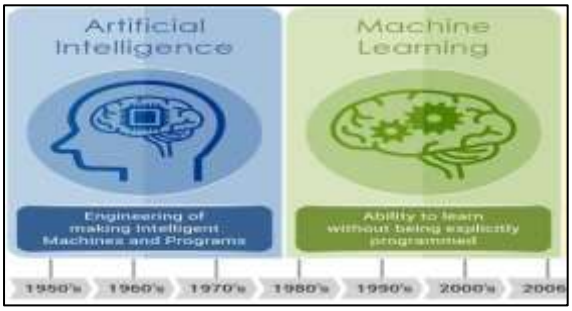

Fig. 9: Difference between AI and ML

5. 3D Graphics

Web 3.0, which rethinks graphics technology and brings three-dimensional (3D) virtual worlds or the metaverse into sharp contrast, is sometimes referred to as the Spatial Web by visionaries because it aspires to obfuscate the distinction between the actual and virtual worlds. Web 3.0 websites and services typically use three-dimensional design. Unlike their 2D forebears, 3D visuals foster a new degree of immersion not just in futuristic gaming applications like Decentraland but also in other fields like health, real estate, and e-commerce. Applications for 3D graphics include computer games, virtual reality, e-commerce, and geographic settings.

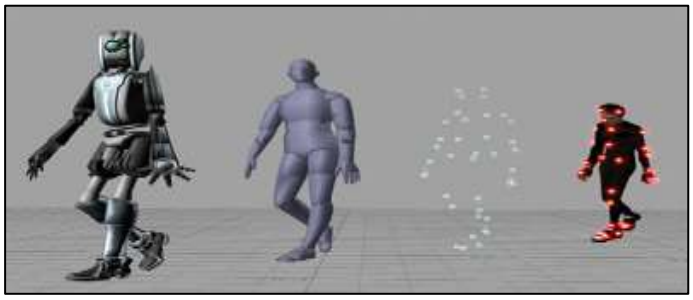

Fig. 10: 3D Computer Graphics

6. Open, Trustless and Permission less

Redesigning online services and goods to serve people rather than corporate interests is the goal of Web3. By making the web decentralized, distributed, open, trustless, and permission less, Web3 improves the web as we know it. It is being designed as a "read-write and own web," meaning that no central authority will be able to govern the system because everything will happen in a decentralized, distributed manner.

"Open" in the sense that it would be created using open-source software by a community of developers who are available to the public and who work on it in public view. "Trustless" in the sense that it enables direct communication between users, either in public or privately, without the need for a third party. "Permissionless" in the sense that anybody may participate—both users and suppliers—without getting approval from a regulatory organization.

The ultimate benefit of these new open, trustless, and permissionless networks will be their capacity to coordinate and reward the long tail of work, service, data, and content providers that serve as the disenfranchised background to many of the world's most pressing problems, including sustainability, finance, health, and food.

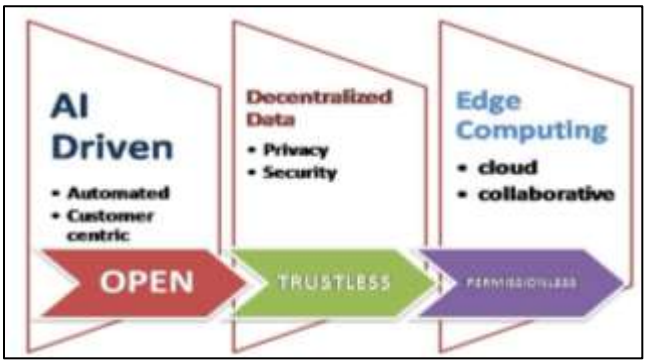

Fig. 11: Web 3.0 Key Feature

II.EVOLUTION OF WEB 1.0 TO WEB 3.0

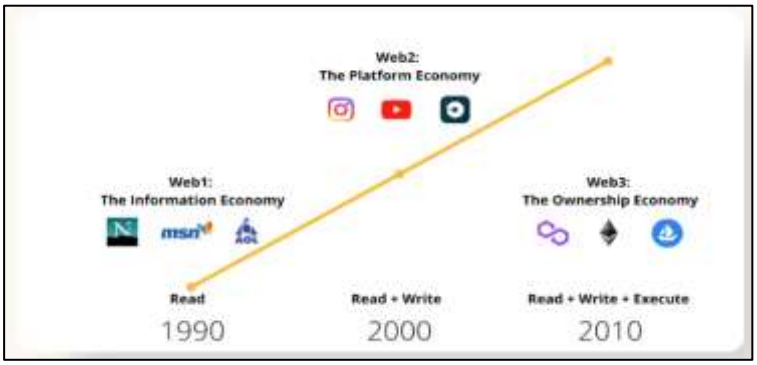

Fig. 12: Evolution of Web 1.0 to Web 3.0

Web 1.0 :

The initial version of the web, known as Web 1.0, ran from 1989 until 2005. It was described as an informational

network of connections. Tim Berners-Lee, the creator of the World Wide Web, claims that the internet is a "read-only" medium. There is very little opportunity for customer sharing of information, and there was no way to communicate with the website. The web had a largely passive role in society. The first iteration of the World Wide Web, known as Web 1.0, was generally described as "it is an information space in which the things of interest referred to as resources are recognized by global identifiers called Uniform Resources Identifiers(URLs)." The first generation of the web was a time of static sites and solely content delivery. In another universe, the early web enabled information searching and reading. User participation and content creation were quite minimal.

Characteristics:

HTML, HTTP, and URI are among the basic web protocols that are part of Web 1.0 technologies. Following are some of the key features of web 1.0:

1. They have merely read material.
2. Create an internet presence and make their information available whenever and wherever possible.
3. It uses basic Hypertext Mark-Up Language and provides static web pages.

Challenges:

1. Web 1.0 pages lack content that is machine compatible and can only be interpreted by humans (web readers).
2. The Webmaster is alone in charge of administering the website's content and keeping users up to date.
3. Lack of a web console, which made it possible to only gather static information and execute dynamic events.

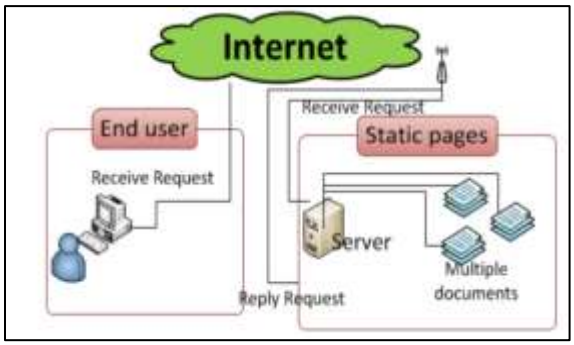

Fig. 13: Web 1.0 Architecture

Web 2.0:

The second web generation is known as Web 2.0. It was described as a read-write web by Dale Dougherty in 2004. A brainstorming session at a conference between O'Reilly and Media Live International served as the inspiration for the idea. Web 2.0 technology make it possible to organize and control sizable international audiences with shared interests in social interactions. Ajax and JavaScript frameworks are client-side (web browser) technologies used in Web 2.0 development. Instead of requiring a complete page reload, Ajax programming updates certain page areas using JavaScript and the Document Object Model (DOM). Communications, such data requests going to the server, are segregated from data coming back to the page to allow users to continue interacting with it (asynchronously).

Major features of Web 2.0, such as interactive, collaborative, and dispersed behaviors, make it possible for both official and informal arenas of daily activities to take place online. According to another definition, it is similar to Web 2.0's key distinguishing features, which include "relationship" technologies, participatory media, and a social digital technology that is also known as the wisdom web. Web that is participatory and focused on people is considered, and that allows for reading and writing online makes web transactions bidirectional. Web 2.0 is a platform that uses the web, allowing users to abandon many of the restrictions they previously utilized. In other words, web 2.0 users have more control over less engagement. In addition to being an updated version of web 1.0, web 2.0 also refers to flexible web design, creative reuse, updates, collaborative content creation, and content modification. Compared to web 1.0, one of the most notable features of web 2.0 is its support for collaboration and ability to gather collective intelligence.

Characteristics:

1. A platform with software beyond the level of a single device has emerged on the web. Wikis, podcasts, RSS feeds, and other related technologies.
2. It is a method of designing both software and organizations. Moving to the internet as a platform and attempting to comprehend the guidelines for success on that new platform are what have sparked a commercial revolution in the computer sector.
3. The term "social web" is frequently used to describe websites with communities. The focus is on content management as well as cutting-edge user engagement and communication channels. Web applications promote social networking, boost user-to-user information exchanges, and assist the generation of collective knowledge.

Challenges:

1. In certain cases, even if a new technology matches the expectations of the general public, there is still a possibility that the external environment may have a significant negative impact on the technology, perhaps stifling or even limiting its overall progress.
2. Continuous Improvement Services undergo a cycle of modification and updates.
3. There are relatively few venues that connect and share information beyond community borders.

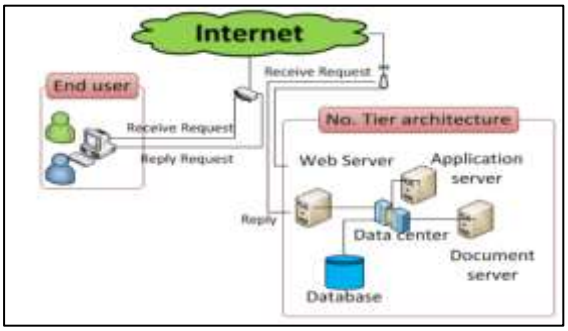

Fig. 14: Web 2.0 Architecture

Web 3.0:

A contemporary and evolving issue, web 3.0 is related to the web 2.0 efforts listed below. John Mark of the New York Times invented the phrase "web 3.0" and recommended it as the third generation of the internet in 2006. Executable Web is another name for Web 3.0. In order to improve discovery, automation, integration, and reuse across many applications, the fundamental notion of 3.0 is to create data structures and link them. It has the power to boost data management, assist mobile internet accessibility, mimic creativity and invention promote the phenomenon of globalization, increase consumer happiness, and facilitate social network cooperation.

Semantic web is a term that describes Web 3.0. Tim Berners-Lee, the creator of the World Wide Web, proposed the concept of the semantic web. The World Wide Web consortium has a committed team striving to enhance, expand, and standardize the system. Languages, publications, and tools have already been created. In the web of version 3.0, the idea of a website or webpage is gone, data is shared rather than owned, services that display many web or data views for the same site. All those services programmes, devices, or anything else, but they must be context- and context-sensitive. Vertical search will enable personalization and both of these. Web 3.0 enables web-oriented architecture, which was formerly referred to as a web of documents, as well as global databases. Static HTML documents are the main topic. However, whenever feasible, linkages between papers or between portions of them should be made, as should dynamically produced pages and alternate formats. Papers and linkages between documents make up the fundamental objects of the web of documents, which was created for human use. The level of structure between items is rather minimal, with implicit semantics for content and connections.

A large portion of the data in the world, according to the web of data proponent, should be connected and freely available to everyone. This vision is similar to the web of documents of common knowledge in many ways, but instead of focusing on making documents and media openly accessible, the focus is on making data accessible. The web of data hosts a variety of data sets that include encyclopedic facts, drug and protein data metadata on music, books, and scholarly articles, social network representations, geospatial information, and many other types of information, in some ways similar to a global database that stores all kinds of information. Based on the RDF model, the content and linkages have precise semantics, and there is a high level of structure between the objects.Blockchains are open-source digital ledgers on which Web3 is built. In theory, before transactions can take place without the need for an intermediary, the network will check everything before accepting it. The blockchain will then have a trustworthy and confirmed record of all exchanges, making it more difficult to alter and abuse data. In order to counter the dominance of larger technological businesses, several analysts predict that Web3 will give consumers improved data protection and privacy.

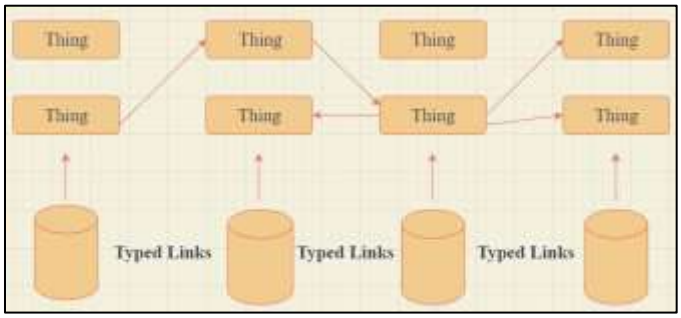

Fig. 15: Structure of web of data

COMPARISON OF WEB 1.0, WEB 2.0 & WEB 3.0:

Based On	Web 1.0	Web 2.0	Web 3.0
Content-Type	Read-Only	Read-Write	Read-Write-Execute
Content	Owned by the creator only	Shared by the creators and users	Consolidated by creators and users
Type of Web	Simply Web	Social Web	Semantic Web
Priority Order	First Stage	Second Stage	Third Stage
No. of Users	Millions	Billions	Trillions
Basic Concepts	Connect Information	Connect People	Connect Knowledge
Years	1990-2000	2000-2010	2010-2020
Associated Websites	CNN, MySpace, LiveJournal	Flikr, YouTube, Blogger, Wix, Wordpress, Medium	GoogleMaps, Wolfram, Audius, IDEX, Steemit
Focus	Organization	Community	Individual
Personal	Home Pages	Blogs/Wikis	Lifestreams
Interaction	Web Forms	Web Applications	Smart Applications
Search	Directories	Keywords/Tags	Context/Relevance
Metrics	Page Views	Cost Per Click	User Engagement
Advertising	Banner	Interactive	Behavioral
Technologies	HTML, HTTP, URL and Portals	XML, RSS	RDF, RDFS, OWL

Table 1: Comparison between Web 1.0, Web 2.0 and Web 3.0

III.TOP 5 WEB 3.0 TECHNOLOGY

1. Block chain Technology

All peer-to-peer transactions are recorded on a block chain, which is a decentralized ledger. This technology enables participants to confirm transactions without the need for a central clearing authority. Transferring money, concluding deals, casting ballots, and a host of other challenges are all possible uses. It's critical to think of block chain technology from a business perspective as a type of next-generation business process optimization software. Block chain and other collaborative technologies have the potential to significantly reduce the "cost of trust" while improving commercial processes between organizations. As a consequence, compared to the majority of common internal investments, it may offer much higher returns on investment. Financial institutions are researching the potential applications of block chain technology to transform everything from insurance to clearing and settlement. Understanding these trends and deciding what to do about them will be made easier for you by the essays in this collection. With validated copies of the database dispersed over the internet, any attempt to tamper with a record breaks the chain, and no central authority can control it. Although most people associate it with crypto currencies, which we'll explore next, block chain technology may be used to store a record of transactions in any application.

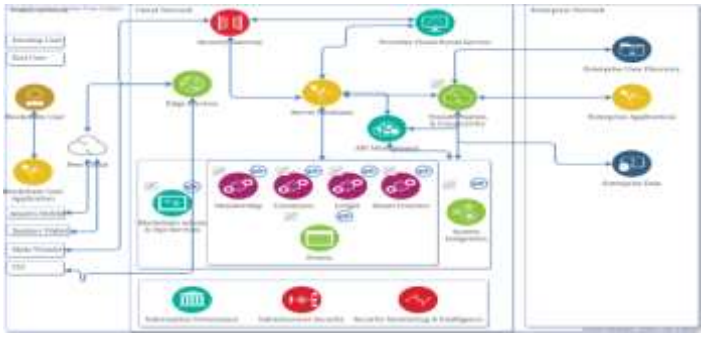

Fig. 16: Block chain Architecture

2. Crypto currency

Any form of digital or virtual currency that uses encryption to secure transactions is known as cryptocurrency, also referred to as crypto-currency or crypto. Cryptocurrencies work without a central issuing or regulating body, instead using a decentralized network to keep track of transactions and create new units. To keep track of how much money is in circulation and who is the owner of how much of it, cryptocurrencies use blockchain technology. Due to the peer-to-peer nature of the system, anyone can send and receive payments from anywhere. Unlike traditional forms of payment, such as carrying cash and exchanging it in person, cryptocurrency payments only exist as digital records in an online database that describe specific exchanges. You can see a public ledger of all the transactions you've made using cryptocurrency money.Since encryption is used to authenticate transactions, cryptocurrency is known by that name. This suggests that complicated code is needed for data storage, transmission, and receipt between wallets and to public ledgers. Safety and security are what encryption aims to provide. Since its inception in 2009, Bitcoin has maintained its position as the most well-known cryptocurrency. The urge to trade for profit accounts for a large portion of people's enthusiasm with cryptocurrencies, and at times, speculators drive up prices.

Fig. 17: Crypto currency Workflow

3. Smart Contracts

A self-executing contract known as a "smart contract" is one in which the terms of the buyer-seller contract are written directly into lines of code. The code is distributed over a decentralized blockchain network, along with the agreements it includes. The programming controls the tracking and irreversibility of transactions. For reliable transactions and agreements to be carried out between dispersed, anonymous players, smart contracts do away with the requirement for a central authority, a legal framework, or an external enforcement mechanism. Smart contracts enable the establishment of legal agreements between parties or the supply of financial services at a price that is significantly lower than that of conventional contracts. Additionally, they are much fairer and unchangeable once activated. According to Nick Szabo, an American computer scientist who created a virtual currency called "Bit Gold" in 1998, smart contracts are computerized transaction protocols that carry out contract terms. With smart contracts implemented on block chains, transactions are verifiable, transparent, and irreversible. When it comes to insurance claims, smart contracts are especially helpful since they handle error checks, routing, and the transfer of funds to users automatically if the necessary requirements are satisfied. Additionally, smart contracts are beneficial because they incorporate practical bookkeeping tools and prevent the intrusion of accounting records.

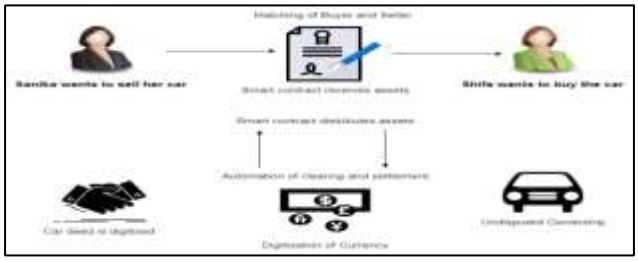

Fig. 18: Real-life Example of Smart Contract

Simple "if/when...then" words encoded into code on a block chain are the basis for how smart contracts operate. When certain criteria have been satisfied and validated, the activities are carried out via a network of computers. These procedures could involve paying out money to the proper people, registering a car, sending out notices, or writing a ticket. Following the

transaction's completion, the blockchain is updated. That implies that the transaction is irreversible and that the only persons who are permitted to see the results are those who have been given authorization. There might be as many conditions as are required in a smart contract to reassure the parties that the work will be finished successfully. Participants must decide how transactions and their data are recorded on the blockchain, come to an agreement on the "if/when...then..." rules that govern those transactions, consider any potential exceptions, and design a framework for resolving disputes in order to set the terms. The smart contract can then be written by a developer, while increasingly businesses using blockchain for business offer templates, web interfaces, and other online tools to make smart contract construction simpler.

4. Edge Computing

Bringing compute and data storage closer to the sources of data is the idea behind the distributed computing paradigm known as "edge computing." It's anticipated that this would reduce bandwidth use and speed up response times. As opposed to a particular technology, it is an architecture. This type of distributed computing is location- and topology-sensitive. In the late 1990s, content-distributed networks were developed to provide web and video content from edge servers that were placed nearby consumers. These networks are where edge computing got its start. The first commercial edge computing services, which hosted applications like dealer locators, shopping carts, real-time data aggregators, and ad insertion engines, appeared in the early 2000s as a result of these networks evolving to host applications and application components at the edge servers. One use of edge computing is the internet of things (IoT). The idea that IoT and the edge are interchangeable is a prevalent one. The phrase is frequently used interchangeably with "fog computing." This is particularly important for modest deployments. Fog computing, on the other hand, can act as a separate layer between the Edge and the Cloud when the deployment size is enormous, as in the case of Smart Cities. Therefore, in such deployments, the Edge layer is a separate layer with unique duties. The basic idea behind edge computing approaches is to gather, filter, process, and analyse data "in-place" at or close to the network edge. It's an effective way to use data that can't be moved to a centralized place right once, frequently due to the sheer volume of data making such movements prohibitively expensive, technologically impracticable, or perhaps violating other compliance duties like data sovereignty.

The architecture that best suits one form of computing activity may not always be the best design for other sorts of computing activities, and computing tasks necessitate appropriate architectures. Edge application services cut down on the amount of data that needs to be transported, the traffic that results, and the distance that data needs to travel. As a result, latency is decreased and transmission costs are decreased. Early research has shown that offloading computations for real-time applications, such facial recognition algorithms, significantly improves reaction times. The usage of resource-rich devices dubbed cloudlets or tiny data centres close to mobile users, which offer services generally found in the cloud, has been shown to enhance execution time when some of the jobs are offloaded to the edge node, according to further research. The best arrangement can be determined depending on the workload because offloading every task might cause a slowdown owing to transfer times between devices and nodes.

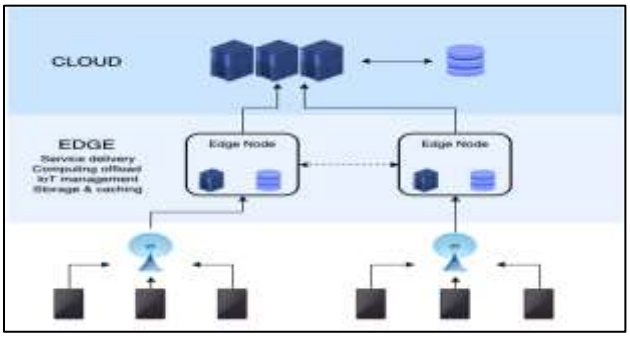

Fig. 19: Edge Computing Architecture

5. Decentralised Autonomous Organisations

The principal-agent dilemma, which political scientists and economics refer to as an old issue in governance, is addressed by DAOs. This happens when an organization's agent has the authority to make choices that affect or act on behalf of the principle, a different person or thing inside the organization. Here, managers who operate in the interests of the shareholders or politicians who work in the interests of the electorate might serve as examples. In such situations, moral hazard happens when one individual takes greater risks than they ordinarily would since those risks are paid for by others. More typically, it happens when the agent works against the principal's interests since the principle cannot fully control the agent's conduct. When there is underlying information asymmetry at work, this quandary typically gets worse.

A group of individuals engage with one another via a self-enforcing open-source protocol in a DAO. The native network tokens are awarded for maintaining network security and carrying out various network-related duties. Since all stakeholders' interests are aligned by the consensus rules linked to the native token, blockchains and smart contracts lower the transaction costs of administration at higher degrees of transparency. An incentive is used to encourage individual behaviour so that it may be used to advance a group objective. No formal legal contracts or other agreements have been made between members of a DAO to bind them together. Instead, they are guided by rewards associated with the network tokens and completely open regulations that are included into the software and are upheld by machine consensus. Bilateral agreements do not exist. All network participants' behaviour is governed by a single set of rules, known as the protocol or smart contract.

DAOs offer an operating system for people and institutions that do not know or trust each other, who might live in different geographic areas, speak different languages, and therefore be subject to different jurisdictions. This is in contrast to traditional businesses that are structured in a top-down manner, with many layers of management and bureaucratic coordination. In the Bitcoin Network, all agreements take the form of open-source code that is self-enforcing by majority consensus of all network players. This replaces the traditional method of using legal contracts to govern interpersonal relationships. With the exception of the code, DAOs don't have a hierarchy. Once activated, this entity is separate from its originator and cannot be censored by a single entity, but rather by a predetermined majority of the organization's members. Open-source DAOs are transparent and, in theory, uncorruptible since they are transparent. The company keeps track of and maintains a blockchain for all of its transactions. The incentive rules associated with the native token should be structured in a way that aligns the interests of the organization's members. Within a DAO, voting on proposals that receive the support of the majority of the network actors engaged determines the major course of action. As a result, DAOs can be thought of as distributed organisms or distributed Internet tribes that exist on the Internet and are autonomous but also largely rely on specialized people or smaller organizations to carry out specific functions that cannot be automated.

Fig. 20: DAO and Traditional Top Down Organizations

IV.ARCHITECTURE

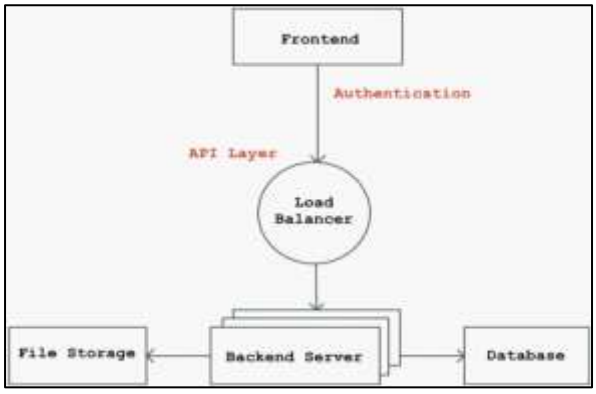

Fig. 21: Basic Web 2.0 Architecture

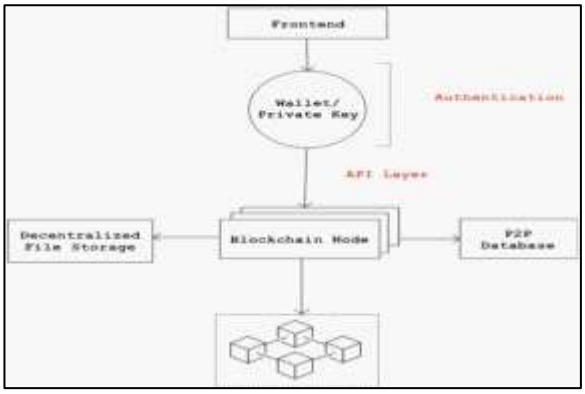

Fig. 22: Basic Web 3.0 Architecture

In a Web3 app, the frontend will remain the same, but some changes start to happen on the backend side of things.

In comparison of Web2 and Web3, the heavy lifting and managing our data is done by the block chain node, which is decentralized into a network of block chains.

It is quite expensive to store data directly on the chain therefore we have some off-chain File Storage and a P2P Database facilitating data storage. As a last step in creating a secure layer, we may use a wallet or private key-based authentication to confirm a person's identity.

The Web3 Stack:

Let’s take a deep dive into each of the components of Web3 to better understand the tech stack. Starting from the bottom:

Block chain

One of the most difficult decisions to make is which block chain to choose. As a beginner we recommend starting with Ethereum Virtual Machine(EVM) with Solidity.

Block chain Node

The "block chain software" is executed by network stakeholders or devices known as "block chain nodes."They are therefore permitted to manage the distributed ledger and act as the primary points of contact for network operations.
A P2P (Peer to Peer) protocol enables nodes to exchange data about transactions and new blocks among themselves.

P2P Database

Storing data on a block chain is slow and expensive. We need an additional database to access data ensuring that we're not accessing the chain again and again. To have that decentralization part of it, we use peer-to-peer or P2P databases that store and host all of the data in streams to eliminate centralized database servers, block chains, or local storage.

Decentralized File Storage

We require a specific file storage system, just like any other programme (similar to Amazon S3 for Web2 applications). File storage is the folder-based data you need to store your massive media assets, whereas databases are primarily tabular data. The most popular P2P file system protocol, IPFS, has strong community support.
Another choice with an emphasis on long-term data storage is Arweave. To host these file storage systems, utilize services like Filecoin, Skynet, Storj, and 0Chain.

Better web architecture is possible because to decentralized storage platform Filecoin. They construct a network that resembles a supercomputer by combining the computational power and storage capabilities of several devices. This network can store multiple copies of data. A decentralized internet may be built using Filecoin's programmable money mechanism. Filecoin operates through a rewards system. Every time a user stores data on the network, they get compensated. The Inter Planetary File System, or IPFS, on which Filecoin is based does not recover material from its original location. Similar to this, the storage node-based Storj network saves data for other people. Storage and bandwidth allocation are paid for by contributors. Client-side encryption and erasure coding are used to protect all data saved on storage nodes. Developers may store data on Storj's decentralized cloud storage by using uplink clients. The files are subsequently split into 80 parts and dispersed over the storage node network. The 80 pieces are kept on several storage nodes with various power sources and functions. They benefit greatly in terms of security, functionality, and endurance as a result.Web3 storage requires these solutions, and some examples of decentralized web3 storage that offers capabilities very different from those supplied by a centralized system are Filecoin and Storj.

Authentication in Web3

Authentication is one of the most essential aspects of Web3. Users can connect to a particular network with Web3 authentication. This authentication is therefore necessary for every web3 dApp.Without logging in users into the smart contract, one cannot access their wallets and make the most straightforward transactions. You should note that signing a transaction enables every interaction with a block chain.

Implementing the Front end

The frontend technologies for Web3 and Web2 are the same. The only difference is where you need to reimagine the UX of the application because the authentication, processing in the block chain, and general flow of the application are slightly different from Web2 applications. We would recommend going on with React & Next.js since most developers are currently using this in the Web3 world.

V.DATA STORAGE IN WEB 3.0

Peer-to-peer solutions are replicated across n nodes on a decentralized network in a web3 tech stack, making them more trustworthy than databases that are used in traditional tech stacks, according to Nader. I love the sound of this! To make decentralized data storage possible, organizations like Harper DB are doing precisely that.

Is a database being completely decentralized even theoretically viable at this point? Block chain technology differs from a database since it primarily holds transaction information rather than other types of data. Therefore, a database will undoubtedly be required if you need to convey or store any kind of data, which you probably do. Despite the possibility of complete trustless decentralization made possible by block chain, certain applications still require off-chain data storage. If you require database-style storage, you won't be completely decentralized, but this compromise could be worthwhile in the long run.

VI.ADVANTAGES AND DISADVANTAGES

6.1advantages of Web 3.0

1. **Improves Data Management and provides Continuity of services**

- The process of managing data on websites is complicated because it often necessitates knowledge of several apps and involves merging data from different formats that the computer may or may not be able to grasp. Linking data to gain the necessary information in these situations becomes quite challenging. With the introduction of semantic web, this issue may be partially overcome since it first explains the relationship between various sets of data, which makes it simpler for computers to comprehend the relationship and integrate the data easily to provide the intended result. There is a significant

decrease in account suspensions and distribution service denials. There won't be much service disruption because there isn't a single point of failure. To provide redundancy, the data will be kept on distributed nodes, and several backups will fend off server failure or seizure.

2. Favors mobile Internet Accessibility

- By the end of 2008, there would likely be four billion mobile device subscribers worldwide. During the same time period, it was anticipated that the global mobile penetration rate would reach 50%. However, this number is anticipated to reach 60% with the introduction of 3G technologies, which make it simple to access the Internet on mobile devices. Consequently, due of its higher quality, Web 3.0 is projected to see an increase in demand. It is anticipated to have a significant impact on improving Internet accessibility on mobile devices. The Cascading Style Sheet (CSS) Standard, which is the foundation of Web 3.0, assists in bringing the page size down to less than 20kb.

3. Promotes the phenomenon of Globalization and Digitization

- Through the use of a common programming language called Resource Description Framework, Web 3.0 attempts to create and standardize numerous data structures (RDF). The model used to exchange data on the Internet is this one. RDF is written in XML, which makes information transmission between various systems simple. This overcomes obstacles like limited bandwidth and poor web display on mobile devices.

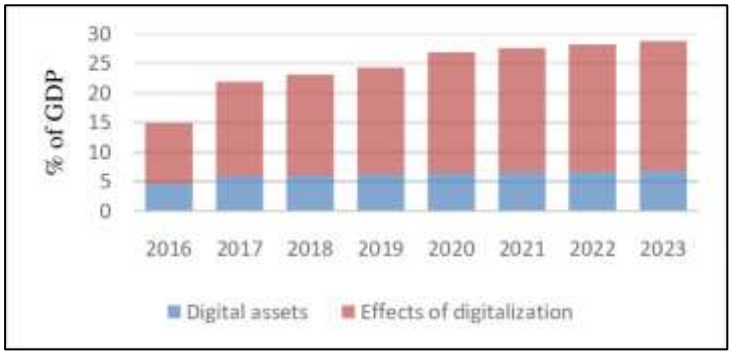

Fig. 23: Predicted Growth of Digital Economic

4. Increases customer satisfaction and facilitates collaboration through social networks

- Web 3.0 assists the firm in raising the degree of customer satisfaction in terms of customer relationship management with the use of "Artificial Intelligence" (CRM). Customers may access all of the product information that the firm has available on its website through this. This enhances the company's reputation in the marketplace, which might draw in new clients. Nowadays, the majority of individuals have accounts on many social networking sites. As a result of these websites, several Weblogs have appeared. The information that is available may be connected using RDF thanks to Web 3.0. This procedure aids in compiling a list of discussions that have taken place on blogs and mailing lists. Because Web 3.0 may be accessed on a variety of devices, consumers can enjoy a completely new type of internet. A rich application tier with greater logic is also provided.

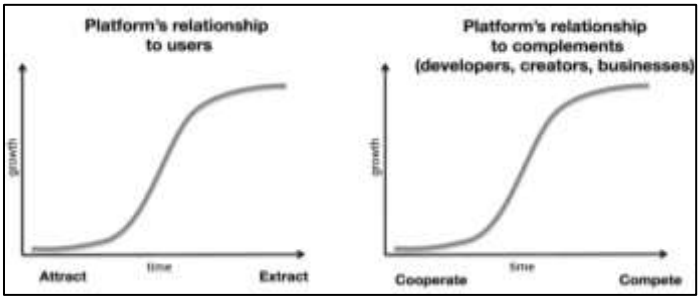

Fig. 24: S-curve showing a platform's relationships with users

5. Data Ownership and Transparency

- In Web 2.0, digital behemoths manage and profit from user-generated data. End users will assume complete ownership of the data on web3 enabled by block chain. You will have the option to decide which information you wish to sell to businesses and advertising agencies in order to profit from it. Furthermore, no one organisation will have authority over Web3. Decentralized apps (dApps) wouldn't be banned or subject to censorship as a result. Users will be able to trace their data on the decentralised web and see the platform's source code if they so want. Every stakeholder will constantly be aware of the worth and business they are connected to. For access to this information, you won't need to rely on a middleman.

Fig. 25: Ownership Economy

6.2disadvantages of Web 3.0

1. **Increase in Cyber Crime**

- Some analysts claim that Web 3 regulation would be challenging. They further assert that decentralisation may result in the emergence of novel forms of cybercrime. Among other things, it may cause a rise in online abuse and cybercrime. Given that the value of unauthorised transactions is rising as a result of increased total transaction volumes, cryptocurrency-based crime is still a serious problem that has to be addressed. Particularly DeFi seems to be experiencing comparable growth issues. Sales of all cryptocurrency assets, including land in Decentraland, Cryptovoxels, The Sandbox, and Somnium Space, have surpassed $500 million as of 2021, and this figure is predicted to double in 2022. According to the Elliptic research, criminals trying to launder money will find the Metaverse to be an increasingly alluring liquidity venue. The official domain has been substituted with phishing URLs in an effort to mislead Decentraland users. Since most users would connect via their MetaMask to have an enhanced experience with a permanent avatar, there is a risk that employing a dubious link might enable an unauthorised party to steal money through this connection.

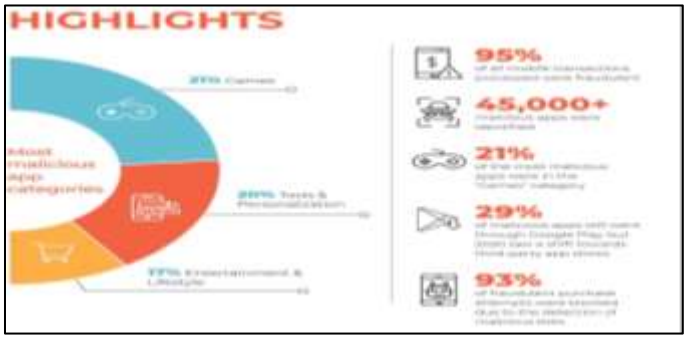

Fig. 26: Terrifying Cyber Crimes Statistics as of 2022

2. **Regulatory Ambiguities and One Man Control**

- The regulatory landscape, which is still being worked out, is still being navigated by the Web3 and crypto currency companies. With the adoption of tax changes, the government of India has acknowledged the business as a mainstream sector, which is a positive move for the sector, but a clear regulatory framework is still pending, according to the Officials. Additionally, on a global basis, many nations have not yet developed clear policies and norms for space. In the block chain, the individual with the most tokens is granted authority. A person's stock in the firm is represented by the token. Any person who purchases more company tokens gains more influence over the firm and hence more decision-making authority. The one with more tokens makes more money from the business. Few individuals can therefore wield central authority in web 3.0.

3. **Computational power & Losing Web 1.0**

- The majority of devices and PCs cannot support web 3.0 because it employs more sophisticated technologies that need more computing capacity. For instance, processing block chains, AI, and 3D visuals all require powerful processors. Therefore, customers must upgrade their equipment, which will cost them a lot of money. Many websites that are utilising web 1.0 get disconnected since there are so many new advances in web 3.0. The majority of Web 1.0 websites are text-based, therefore comments were not supported. They don't additionally make advantage of large-capacity storage. Old websites that adhere to web 1.0 standards may eventually become outdated as more and more users transition to web 3.0.

4. **In relation to Mass Adoption**

- It's understandable that not everyone is familiar with block chain technology or the decentralised web given the present situation. A quick change is unlikely to be welcomed by most internet users. People need to be adaptable in order for the decentralised web to truly revolutionise society. The general population has become incredibly used to using centralised social media platforms like Face book and Twitter. A key concern is that people could be against the idea of using a block

chain-based application to replace the current platform. Technical viability will not be a strong enough reason for everyone to adopt the decentralised web. People may opt to keep things as they are unless they have an urgent need for the decentralised web. By 2030, analysts estimate that the Web3 business will be worth $81.5 billion, but there will be challenges along the way.

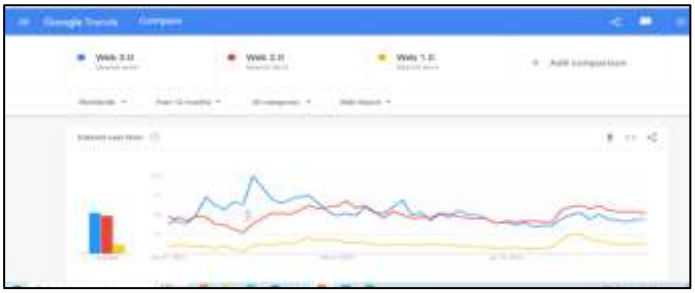

Fig. 27: Results of a Past 12 months global Google Trends search for the keyword "Web 3.0", "Web 2.0" and "Web 1.0"

5. Problems due to Latency and Expenses

- Modern centralised systems come with cutting-edge hardware and software that accelerate networks. With networks or Dapps, this isn't true, though. Decentralized networks and applications struggle with latency. A decentralised app processes far fewer requests per second on average than a centralised app does. We want to share a shocking information with you: PayPal executes 193 transactions every second, but Bitcoin averages 3–4 transactions per second. Sites on a decentralised network might now load rather slowly. In order to function properly, outdated websites must be upgraded. This is a significant issue, and website owners must implement new, in-vogue technology in order to stay in contact with new users. A fast server, the hiring of web engineers, the ability to switch to new payment channels, and the adoption of the blockchain are all necessary for updating a website. Expenses will increase as a result of all these changes.

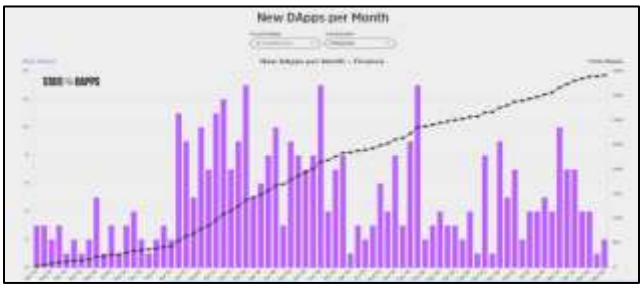

Fig. 28: State of Dapps per Month w.r.t Finance

Fig. 29: State of Dapps per Month w.r.t Governance

VII.APPLICATIONS OF WEB 3.0

1. Virtual Reality and Augmented Reality

- A user's physical presence in the environment is simulated through the use of virtual reality, a computer technology that mimics an environment, whether it be actual or imagined. Sight, touch, hearing, and smell are just a few of the artificially produced senses in virtual reality. In augmented reality (AR), real-world items are "augmented" with computer-generated perceptual data, sometimes spanning many sensory modalities as visual, aural, haptic, somatosensory (tactile), and olfactory. This allows users to interact with the environment in real-world settings. Healthcare, education, industry, gaming, and other sectors all use AR.

2. DeFi and Gaming

- Although playing games has always been a common method for individuals to pass their leisure time, they are increasingly being utilised for more than simply amusement. When programmers recognised how helpful block chain technology might be for developing virtual economies within their worlds, video games were among the first to utilise it. These virtual

marketplaces enable participants to exchange bit coin for goods. Decentralized finance (DeFi) is the term used to describe financial applications constructed using block chain technology or other distributed ledger technologies, such as hyperledger. Without the need for banks or other middlemen, it enables consumers to hold their money securely.Web3 gaming is a decentralised gaming process in which any central authority is removed from the operations of a gaming ecosystem or gaming platform, especially the ownership of gaming assets and decision-making in all game-related areas. Players may access and completely own in-game digital assets on fair virtual markets that Web3 gaming offers for the gaming business. These resources are unique in that they are kept as gaming NFTs.By tying together players and in-game materials across platforms, web3 gaming also offers extensive interoperability among multiple gaming ecosystems. The block chain technology that is chosen to create a gaming ecosystem will have an impact on interoperability.

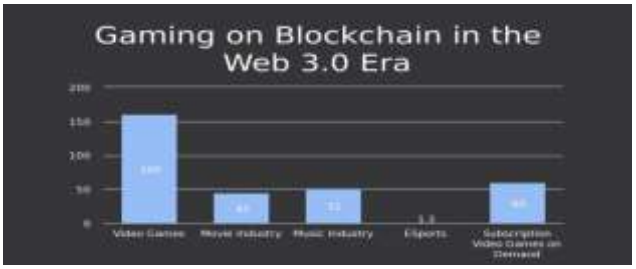

Fig. 30: Gaming on Blockchain in the Web 3.0 Era

3. FinTech Industry

- One of the most regulated and tightly monitored businesses in the world is the financial services sector. In addition to being one of the most lucrative, it also requires ongoing innovation to keep up with consumer needs. Innovation may be challenging to put into practise since there are so many stakeholders. Blockchain technology developed for the Web 3.0 enables users to transfer peer-to-peer payments without going through financial institutions or banks; cryptocurrencies like bitcoin allow users to exchange money directly between two people without the need of middlemen. Web3 essentially decentralises financial services.

Fig. 31: India's Fintech Startup Landscape

4. Real Estate And Education

- The real estate market is changing, and so is how we conduct business. The real estate sector is not an exception to how important the Internet has become for communication and business. Web 3.0 has left its imprint on the real estate sector by facilitating quicker, simpler, and more transparent transactions. Users no longer need to wait for information to be updated on a website or application because to web 3.0 technology, which enables instantaneous access to it. While they are out showing properties, this enables agents to keep in front of the curve whether it comes to home pricing, home sales, or locating new customers.The digital age is where education is headed. With the use of the Internet, educators may now come up with creative ways to effectively teach, learn, and share knowledge. Teachers employ a variety of methods to give students from all over the world a great education because there are millions of students online. The use of Web 3.0 technologies like blockchain, which can help permanently resolve these problems, could be used to address some of the remaining difficulties faced by educators who want to incorporate technology into their classrooms. These difficulties include financial constraints and a lack of technical support, among others.

Fig. 32: Purchase of Virtual Land in Web 3.0 Era

5. Healthcare Industry

- An essential economic sector, the healthcare sector will expand during the next few years. Healthcare professionals are always seeking for ways to improve their practises and identify strategies to enhance patient outcomes. What web3 implies presents a number of options for healthcare organisations and hospitals to broaden their clientele and provide patients and consumers better services. With remote monitoring, data analytics, individualised treatment, and patient participation, Web 3.0 has enormous potential to improve health and wellbeing. In important healthcare facilities, proper data management is mostly accomplished using Web 3.0 technology. Each patient that comes to the hospital has particular signs, flaws, illnesses, and treatments. Therefore, each patient needs a unique and comprehensive medical record, which can be challenging for hospital management administration given that the facility may receive hundreds to thousands of patients each day. As a result, there may be an information overload and disorganised data management. If every medication has a token ID (NFT) that can simplify the tracking procedure, the pharmaceutical supply chain security can be improved even further. Additionally, each NFT metadata will be used to record information on each drug's individuality.

Fig. 33: Use Cases of Web 3.0 in Healthcare Sector

VIII.CONCLUSION

Web 3.0 is the third generation of the World Wide Web, and it is characterized by increased functionality, connectivity, and user-friendliness. While earlier versions of the web were focused on simply providing information, Web 3.0 is designed to provide a more immersive and interactive experience. It does this by using semantic web technologies to connect different types of data and by making use of social media and other web-based applications. One of the most important aspects of Web 3.0 is the way it allows different devices to connect and interact with each other. This is known as the Internet of Things, and it is a key part of the Web 3.0 vision. By connecting devices, Web 3.0 will allow for a more seamless and integrated experience. For example, you might be able to use your smartphone to control the lights in your home or to start your car. In addition to increased connectivity, Web 3.0 will also be more user-friendly and easier to use. Semantic web technologies will make it easier for computers to understand the meaning of data, and this will allow for more natural language search. Social media will also play a big role in Web 3.0, as it will allow users to connect with. Web 3.0 may still be in its very early stages, but the foundation has been laid, and much work and effort is being poured into this area. To fully utilize and profit from the spatial web, much more work will still be needed to be put out by the government and other stakeholders. To encourage adoption, people must be provided a cause to change combined with the appropriate incentives. The value advantages that web3 has provided make the importance of the top characteristics of web3 evident.

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