# Integrating Blockchain Technology and Artificial Intelligence: Synergies, Perspectives, Challenges and Research Directions

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*Abstract:* Have you seen a future when Blockchain technology is integrated with Machine Learning (ML) or Artificial Intelligence (AI)? In general, Artificial Intelligence (AI) contains everything inside it, i.e., machine learning and deep learning (as a part of computer vision). The world is looking with a huge hope to AI to make human life better and better. In the past decade, several organizations are moving towards the implementation of AI in their working-structure. But, implementing AI with new technologies raises several concerns like scalability, security and privacy, etc. Moreover, a new distributed (and decentralized) technology has been used since the last decade in several applications like finance, crypto currency, and smart contracts, etc. It is interesting to think about using the block chain Technology concept/smart contract/ consensus function with Artificial Intelligence in the near future. To deliver a message from the sender to the receive side or contain data security or providing trust to consumers, we need to use the Blockchain concept with AI or ML in several applications. For example, prediction of data is a tedious task and usually involves big data, which also requires trust and need to keep securely. This task (providing privacy, trust and security), could be better handled using 'Blockchain technology'. This article discusses all possible angles/ views or current projects initiated by several organizations of using Blockchain technology with AI/ML. We also illustrate how the integration of Blockchain technology with AI will change the experience of human beings.

Keywords: Block chain Technology, Big data, Crypto currency, Machine learning, data security and privacy

## I. INTRODUCTION

The Blockchain is an incorruptible digital ledger of transaction data. Blockchain functions as a distributed ledger that contains similar network information blocks (there is no single point of system failure since no single node / user / organisation can manage it because it is distributed). A Blockchain network is often based on agreement, i.e. it dynamically verifies (checks) for itself at regular intervals / to verify any transaction that has taken place This collection of transactions, thus the name Blockchain,' is referred to as 'chains.' For example, Modex is the first application store for the Blockchain platform[1]. Now that many words such as AI, ML and DL are added, each can be represented as (in brief): Artificial intelligence is a technique that allows computers to imitate human behaviour, such as IBM Deep Blue chess and Computer Game Characters, for example. Machine learning is an area of computer science (first developed by Arthur Samuel in 1959) that requires computer systems to be able to progressively get better at solving problems (by using computational power and a lot of data, without being explicitly programmed).Machine Learning (ML) has typically evolved from the study of pattern detection in artificial intelligence and computational learning theory. It focuses on the analysis and development of algorithms

(called Big Data [2]) that can learn from and make predictions based on a vast volume of data. In simple terms, ML is a methodology that uses mathematical methods to allow computers, for example, IBM Watson, Google search algorithm, Email Spam philtre, to benefit from their past results. Machine learning is now used in numerous fields, such as software engineering, education, healthcare, travel, industry, financial markets, search engines, localization tools, credit card identification and internet fraud. Deep learning is also a subset of the ML composing algorithm that helps a model, such as AlphaGo[3], Natural Speech Recognition, to train itself and perform tasks. After studying the capabilities of each technology (ML, AI, DL, and Blockchain), it becomes apparent how these technologies operate together independently. Blockchain and deep learning techniques are actually only recommended for use in many applications, such as mining, banking, etc. Notice that both technologies complement each other because they are capable of solving existing challenges though in their respective areas. Machine learning requires vast volumes of data in order to become applicable to current age technologies/ uses.

This is the exact point where Blockchain technology shines and has a capability to merge with machine learning/ AI. Hence, Blockchain technology can be a valuable technology (component/tool) for machine learning scientists to collect data (including keeping secure this data at every location/ client/server/ in a network). For example, a neural network can be deployed on top of a Blockchain network, i.e., widely distributed in order to collect large quantities of data. The neural network can analyse the Blockchain system, monitoring the network load and adjust the Blockchain code in order to regulate changes in the load.

Blockchain technology can also be used to / in create personal trust and in the management / security of industrial IoT and Operational Technology (OT) devices in addition to the above uses. It cannot be touched once a sensor/ system or controller has been deployed somewhere and it works.. It may be due to security vulnerability or any device issue in that enabled devices, for example, sensors inbuilt with spacecraft cannot be touched or repaired several times, they may get affected by solar energy or due to any secure vulnerability. But, as cloud computing has shown, devices and systems are increasingly struggling when running (operations) are performed on a very large scale. Large-scale systems that are weak and not resilient to failure cannot be controlled, as is the case for many existing industrial IoT and OT systems. Therefore, Blockchain has been used in many other applications in the past decade since the launch of Bitcoin [4], i.e., it is known as a great asset management mechanism (due to its zero-knowledge storage, encryption, anonymity, protection and trust, all combined with the decentralised immutable ledger). By using a combination of specialised SSL (Secure Sockets Layer)/TLS (Transport Layer Security) certificates and Blockchain public keys, Blockchain can use or resolve password limitations to authenticate the user before any information is transmitted.. Notice that TLS and SSL (the obsolete predecessor of TLS) are cryptographic protocols designed to provide two end users with a protected channel/ communication. Thus, if the intruder does not use the correct files on the right device (secured by Blockchain technology), it is impossible for him to get to the exact position or point of a file or he would also be unable to crack a password.

Apart above (discussed) points, Blockchain can also be used as a secure and transparent database for sensible information, like transactions and healthcare that constantly collects information (in real-time). At the same time, machine learning algorithms can analyse this large data (in real time) with providing some useful information. It is also possible that a machine learning algorithm will be able to automatically enact changes in the Blockchain network, as a response to real time collected data. For example, a real world example which combines machine learning and Blockchain technology together is 'the Lending Robot'. This Lending Robot[5] platform acts as an automated advisor for peer to peer lending, using machine learning to automate loan selection and trading. The whole process is built on top of a Blockchain network which provides increased transparency and security (using this, it eliminates the need of blind trust of other users/ customers). Further, Blockchain Technology strengthens this platform, because it consolidates data integrity. Here integrity is a part of the CIA (Confidentiality, Integrity and Availability) triad. In general terms, a block chain is a shared public ledger or a public record keeping system (on which, today the entire Bitcoin network relies [6]), whereas records are stored in blocks (and making a chain). The distributed public ledger can be examined and analysed both by external and internal systems and with the added layer of automation makes the data essentially tamper-proof. The Blockchain benefits within its architecture are given below:

- It follows a decentralised transaction ledger, in which there is either no controlling authority or a single point of network failure,
- Since no central authority exists, all respondents have equal rights,
- Since all participants hold the same copies of the ledger, there is no opportunity for foul play,
- Fraud and counterfeiting can be avoided with the aid of high-level block chain system security and high confidence,

Hence, the transformation from the traditional scheme of sending signed documents via email to a transparent, fraudfree and decentralized technology can be achieved with the help of Blockchain. This not only helps to increase the processing speed of business-related documents and provide security but also reduce the cost. Note that Ripple is an opensource Blockchain network. Blockchain is still an evolving technology, i.e. it has the potential to do very positive things for this planet, but it still addresses some key issues such as protection, privacy, legislative, legal , and ethical (i.e., five key issues facing Blockchain and crypto currencies[7]).

Hence, this remaining section of this paper is organized as follows: Section 2 discusses related work done with respect to integration of Blockchain Technology with Artificial Intelligence. Later, the process of combining Blockchain concepts on large data (to keep this data secure) will be discussed in section 3. Next, the blend of IoT and Blockchain is discussed in section 4. Further, a database enabling Blockchain and Machine Learning Techniques concept will be shown in section 5. Then, section 5 will explain several advantages of Blockchain with Artificial Intelligence for this world. Then, this work will show an example (real-time), where smart-world is connecting with Blockchain and AI, ML, etc., in section 6. Further, section 7 discusses combining the process of Blockchain and Robotic Process Automation in the near future. Then, several challenges during/ in integration of these technologies will be discussed in section 7. Then, data analysis and several advantages of Blockchain with machine learning are discussed in section 8. Section 9 discusses a smart world with Blockchain and Artificial Intelligence (or Machine Learning) in detail. Further, Current Challenges in Integration of Artificial Intelligence and Machine Learning have been discussed in section 10. Section 11 discusses security and privacy issues of Blockchain in detail. In last, section 12 gives the conclusion of this work with some future enhancements.

### II. RELATED WORKS

Blockchain eliminates the need of centralised operation, as stated in Section 1. As a first aspect, by allowing system networks to defend themselves in other ways, such as enabling devices to form a group consensus on what is common within a given network (in a distributed and decentralised way), and to quarantine any nodes that act unusually, it avoids a single point of decision-making (that leads to failure). The second aspect of this technology is to create trust in IoT [8] information by allowing five primitives of digital security, i.e. accessibility, integrity, accountability, confidentiality, and audibility. In this (Blockchain) technology, Auditability and Accountability are two new terms irrespective of CIA triad/ securing a network/ system. Today's Blockchain is already being used by several applications like retail, finance, etc., whereas, Blockchain start-up Bit SE'sVechain The platform is used to explain the provenance of high-value items to Chinese customers who have a clear need to understand the authenticity of goods, including luxury wines and Louis Vuitton handbags. Data is automatically stored in various locations in Blockchain. (In the form of blocks and create a chain of all records with previous and next records reference / address) and is still available to users. Private, permissionbased Blockchain can be used to achieve auditability and accountability. In this system all the authorised users can access the network. Since, each computer is responsible for its behaviour because of all signed data stored on the Blockchain. Blockchain acts as a public records / data entry ledger for honesty achievement. i.e., any deletion or alteration of data is entered whenever entries are validated by the network in order to create a full chain of events. For example, Blockchain technology has used Francisco-based Chronicled to distribute the correct medications to the right person. The consistency standards of the drugs can be tagged with the aid of the IoT platform to ensure that these drugs do not malfunction during the supply phase when consumed by the consumer, impacting performance. Hence, all five necessary (mandatory) components achieved successfully with Blockchain technology. Due to containing these features only, a Blockchain became popular and being used in many industries/ applications. Now the next section will discuss the process of combining Blockchain technology for large quantities of data (generated by billions of Internet of Things (IoTs) devices) to secure this data and provide availability of this data to all users (all the time). Note that several serious concerns in IoTs have been discussed in [33]. Also, the possibilities with Internet of Things as Internet of Nano Things and Internet of Everything (IoE) have been discussed in [32]. Hence, this section discusses related work with respect to integration of Artificial Intelligence and Blockchain technology together. Now next sections will discuss the concept that "How these both technologies can be connected in near future" and "How much it will be beneficial to society/ human beings/ nature"?

### III. COMBINING BLOCKCHAIN AND BIG DATA

Before integration of all these technologies/ techniques, we need to discuss AI and ML in detail. Generally, Artificial Intelligence (AI) is also called Machine Intelligence (MI). It is related to Natural Intelligence (NI) which is seen in humans and animals. The term artificial intelligence is applied when a machine copies "cognitive" functions that humans relate with other humans' minds, such as "learning" and "solving problems". From the functions of speechpattern recognition to self-driving cars, AIs' goal is to learn and apply knowledge that is extracted from large amounts of data to make them more intelligent. Whereas, according to Don and Alex Tapscott [9](authors of Blockchain Revolution) "The Blockchain is an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value" .As discussed above, Blockchain's main features are transparency, security and authentication. Wherein the records are transparent and visible publicly (as a public ledger), it is secure as the data is immutable or incorruptible and authenticity refers to the verification process of the user's identity. The implementation of the Blockchain definition with data analytics adds another data layer, i.e. the security layer (providing unbreakable security), to the Big Data analytics process. Most notably, this data layer satisfies the two key criteria of the study of big data:

- The Big Data generated by Blockchain is stable and secure, i.e. it cannot be forged due to its network architecture (unique features),
- Big Data based on Blockchain is useful, i.e. it is standardised, abundant and complete, making it a great source for further study.

In general, with regard to big data analytics, applications for Blockchain (in the future) are:

- Creation of a transparent market for peer-to peer energy
- Trading of real estate and land using Blockchain ledgers

Note that the data stored in the ledger (in the chain) can relate to several applications like energy trading, real estate, automation, and so on. There are multiple Big Data Analytics (BDA) [10] improvements stemming from this fact. For example, in case of fraud prevention, Blockchain technology verifies every transaction of the organisation in real-time. The records are analysed before the fraud has happened, and so the organisations can detect risky or fraudulent transactions before it occurs and can prevent the fraud entirely. Using Blockchain, fraud proof/ a malicious user/ consumer or node can be easily identified (in near future).

#### A. Machine Learning analyzing collected Data:

There is no point in collecting information for storage purposes only. Machine Learning processing is a logical continuity to use a Blockchain database. We can collect data, store it on a decentralized system (manner), and machine learning algorithms will process/ analyze it with several efficient techniques. In result, the updated system (after analyzing) will be constantly learning, and fueled by obtained information. Note that Machine Learning algorithms can assist data scientists/ users in collecting data (apart from analyzing). Trigg mine is a decentralized AIpowered marketing automation platform that automated digital marketing campaigns, saving business owners' time from making manual settings.

• Machine Learning plays a key part in a business model. ML algorithms collect customer insights based on their behaviour on the website, analysing preferences and behavioural patterns.

- After this data is collected, it goes straight up to the Blockchain database where it will be again useful for system learning. The platform processes collected insights and uses them for its continuous improvement.
- As a result, business owners get automated campaigns that precisely target their target audience, based on its interest and behaviour.

#### B. Artificial Intelligence cover Blockchain

Blockchain is concerned with keeping correct data, authentication and execution. Even though Blockchain is powerful (but remember it also has some limitations, i.e., fails with 51% attack or majority attack). AI can cover up Blockchain in following ways:

- Energy consumption: Mining is one of the concepts used in Blockchain. Mining is a difficult work and to complete the mission requires a large amount of resources. AI has shown itself to be very effective in optimising energy usage. If we see the efficiency, it can also help maximise the energy for the Blockchain. AI will assist with lower investment in hardware for mining.
- Security: The blockchain is almost impossible to hack, but the layers and implementations are not that secure when we go deeper. In the last two years, AI has been progressing at a reasonable pace. AI will enable Blockchain to guarantee a safe implementation of applications, primarily provided the system's fixed structure.
- Efficiency: In 2016, Deloitte estimated a total cost of \$600 million for validating and sharing transactions on the Blockchain. An intelligent system might be of assistance here. It can compute on the fly the likelihood for particular nodes to be the first performing a certain task and informing the other miners to shut down efforts for the certain transaction and eventually cut down on total cost.

#### C. Blockchain Cover Artificial Intelligence

A Blockchain can be useful to artificial intelligence in several ways like increasing efficiency of machines due to less faults/reduce attacks, reduce cost, faster mining, etc. Blockchain can cover up AI in following ways:

- Can Help AI to Explain Itself: AI black-box suffers from explain-ability problem. It cannot explain itself. Having a clear trail will increase the trustworthiness of the data and the models. It will also help to trace the machine's decision making process. So, if we are not convinced about any decision (taken by the machine) then we can have a look at the process ourselves and evaluate it (again).
- Increase the efficiency of AI: As it has more data to evaluate, AI performs better. Safe data exchange thus means more data, meaning that more models, more models lead to better behaviour, i.e. better results and more new data. At the end of the day, network influence is all that matters.

• Reduce disaster risk scenario: An AI coded with specific smart contracts in a DAO (Data Access Object) would only be able to perform specific actions such as digital contract execution, etc.

One possible application of a Blockchain with machine learning could be the use of consensus systems (as discussed in section 4), and the verification of data used in learning algorithms. Consensus is essentially the members of a Blockchain reaching an agreement on the validity of the Blockchain. It allows for the database to remain consistent from user to user. In this case, consensus could be used in verifying the outcomes of a machine learning algorithm and training it to give more accurate results. Under supervision of many individuals across a large network, a machine could grow consistently with verifiable checks and balances along the way.

Hence, this section discusses the concepts AI over Blockchain and Blockchain over AI in detail. Now the next section will discuss a database which is leaning by itself/ using machine learning including Blockchain technology.

# IV. BLEND OF INTERNET OF THINGS AND BLOCKCHAIN TECHNOLOGY

IoT's main aim is to connect the physical world to the digital era. It also links devices to humans, as it is linked with each other. Blockchain allows IoT devices to boost security and to provide IoT environments with transparency. Twenty per cent of all IoT implementations will allow blockchain-based services by 2019, according to IDC.Blockchain provides IoT devices, networks, and applications with a scalable and decentralised framework. Blockchain and IoT fit together perfectly and have blended well throughout time. IoT operates on a single platform, i.e. a business model for customers. This blend offers a platform for interacting with interconnected physical objects through the internet. You can run those devices from any place. These devices run on cloud servers with limitless storage space, and IoT can help authenticate & recognize such systems.

IoT and blockchain together makes the devices' networking and security enhanced in a stronger and more effective manner. In addition, blockchain is well-known and is used in almost every industry to fulfil the needs and create better systems. Even Walmart incorporates blockchain technology in order to improve workflow performance and accuracy.

#### A. How Blockchain and IoT Function Together?

If a transaction occurs in a specific sector, such as in the supply chain, it may require multiple parties and intermediaries to settle disputes and apply eventual penalties, which can be a complicated and lengthy procedure. With the costless validation process on a blockchain it will be a lot easier. With data within the blockchain, this kind of validation occurs. In many sectors, however, the need to resolve validation outside of the blockchain is often referred to as the "last mile problem."

The information systems are just as successful as their data quality. Blockchains are distributed ledgers that are subject to this concept, although in the sense of blockchain, this argument is more impactful here than traditional systems because once the information is entered into a blockchain, it will remain there permanently, even if the data is wrongly entered.

If logistics can be managed, blockchain implementation in IoT devices promises a solution to the difficult problem of running secure, efficient and independent IoT systems. Privacy and security in IoT is a fundamental concern, especially given the vast amounts of personal data IoT collects and transfers on a daily basis. Ensuring a secure process between validated, legitimate stakeholders is of primary importance, and blockchain ensures this through user verification and provenance checks. Blockchain also allows for consensus and agreement models to detect hackers and unverified users, thereby mitigating cyber threats. And the probability of hacking the network is remote at best on a device with tens of thousands of IoT nodes. Blockchain allows for automated interactions to occur between different nodes in the system, predicated on pre-set embedded criteria, without the need for communicating with the central network. This means that business logic can be executed automatically, without human intervention, significantly streamlining processes and increasing efficiency of IoT devices while still maintaining high levels of security.

# B. Blockchain solving IoT security and scalability challenges

In a blockchain system the distributed ledger is tamper-proof and this eliminates its need for trust among the parties involved. The overwhelming amount of data produced by IoT devices is not managed by any particular organisation. In order to get network access, the use of blockchain to store IoT data would add another layer of authentication that hackers would need to bypass. Blockchain offers a much stronger encryption degree that makes it nearly impossible to overwrite current records and documents. By enabling anyone allowed to access the network to monitor transactions that have occurred in the past, Blockchain offers transparency. This will provide a clear means of determining a particular source of any data leakage and taking swift corrective measures. Blockchain will allow billions of connected devices to process transactions quickly and communicate with each other. The distributed ledger technology offers a feasible solution to facilitate the handling of a vast number of transactions as the number of interconnected devices increases. By offering a way to allow stakeholder trust, blockchain will allow IoT enterprises to reduce their costs by reducing IoT gateway processing overheads.

#### C. Benefits of Combining Blockchain and Internet of Things

Before being connected to a blockchain, IoT will expand trust to a blockchain network as it creates trust between system information and blockchain network users, minimising the likelihood of data-tampering because human interference is not involved in data flow. It also lowers or removes extra costs including intermediaries and can significantly decrease the amount of time it takes to settle a complaint, since all the case information is easily audited. It is much less expensive to connect each of your partners as a "node" to a network than to create a full-on integration. Here are 5 unique advantages that will drive business growth for blockchain and IoT.

1) Accelerated Data Change: One of the main benefits that Aftrek Market Research cites is the accelerated shift in data. It is assumed that this feature of the new blockchain implementation has its drawbacks because it restricts the amount of transactions in each second.

2) Lower Costs: One of the most valued benefits for businesses is the opportunity to slash operating costs. The technology enables data to be distributed without centralising power on a peer-to - peer basis, thus reducing business expenses.

*3) Improved Security:* Because of its ability to legitimise knowledge and ensure that it comes from a trustworthy source, one of the intrinsic qualities of blockchain is protection. Due to the high number of devices inside the IoT, this advantage is particularly helpful. The technology combination could boost secure communications and enhance agreements on privacy. Security mechanisms, such as system authentication, are also relied on by businesses that are currently implementing a blend of blockchain and IoT. That's just the tip of the iceberg when it comes to the blockchain and IoT security aspects.

*4) Streamlines Accounting:* Accounting will be one of the first divisions within an organisation that could instantly benefit from the enhanced transparency offered by IoT and blockchain

5) A More Efficient Supply Chain: Making the supply chains more effective is considered a big goal for many companies. Yet this phase is made more complex by various economic and global challenges. By removing the middleman, increasing the speed of transactions, and lowering costs, Blockchain and IoT will increase supply chain performance.

# V. BLOCKCHAIN MACHINE LEARNING DATABASE

With rising tensions between security and privacy, it became a conflict/ tendency to Blockchain technology that it primarily used to store information securely on a distributed system. Applying Machine Learning techniques on this large data (or Big data)[11], make this data useful (after analysis/ prediction using machine learning) in various applications. Machine learning models can be applied to systems (anything) which contain a large/ vast amount of data. In summary, Blockchain and ML can be combined for betterment for the future.

ML + Blockchain = Better Machine Learning Models

Now, imagine a place where a Blockchain (think about a Blockchain as a decentralised database) stores all of the data that these giant companies have, but without any person controlling them and making better use given that there are

no information silos meaning that no data is lost. For example, Spam detection. In this example, а communication/ exchange gets hacked, there are certain activities/ mails that are always the same. In this case, the use of a Blockchain where all exchanges share information about these events will increase the probabilities of a ML model anticipating any undesirable event. Remember, that ML is about learning from past data, so more data will mean higher probabilities of anticipation. For example, a project where machine learning is used with Google AdWords. There are also Red Lanterns. They are implementing it on their platform machine learning, and combine it with Blockchain. Decentralized deep learning on a Blockchain. AI owned by everyone (Bitcoin meets TensorFlow[12]). Additionally, the main problem is communication speed between layers in a neural network [13]. The bandwidth of a modern GPU is about 300 GB/s. if we compare this with the existing internet speed it almost makes no sense. So naively distributing current approaches like deep convolutional neural networks without a good approach to parallelize the algorithms makes no sense. One of those approximations can be LSH (Locality-Sensitive Hashing), but also could be making the data need lower, e.g. using hessian free optimization. Now the next hard part: Distributing it on the Blockchain. Ethereum[14] has its own language called solidity, which is semi-Turing complete and allows a full analysis of the computational need. Current implementations like TensorFlow build on Cuda [15]. Cuda code is not semi Turing complete and not completely static analyzable. Hence, we require a team of several scientists/ experts to develop a deep learning framework for solidity. On Ethereum, we can also easily implement a democracy system with votes. Two algorithms here: Paxos and Raft. Paxos is old, not easy to understand/ implement. Raft is a much easier consensus algorithm, already used in practice, even if it's young. For example, Kaggle challenges, i.e., calculating the performance of each system/ technique.

The Blockchain concept is very strong. Artificial Intelligence (AI) and Machine Learning (ML) are two primary innovations that will offer an ability to dramatically improve computing device capabilities. Like other technology, the above technologies are not limited by their programming parameters, but can understand, recognise patterns, adjust, predict, and evolve dynamically. Most AI and ML techniques make use of Artificial Neural Networks (ANNs) for learning processes that mimic the basic functions of the human brain. Large sets of training data and high processing power are needed to integrate complex tasks into ANNs. For example, if an ANN is learning how to recognise humans or monkeys, to quickly process the information, a large data collection of human or monkey images and a powerful set of servers are needed.

The advancement of AI and ML has effectively been strongly balanced by the rapid increase in cloud computing and Big Data computing resources (which have been available over the past decade). It is possible to classify organisations such as Google, Facebook and Amazon as data centres that not only generate huge, centralised cloud storage data, but also retain huge user data volumes. In order to enter the AI field, China is also creating technology giants like Tencent (games, communication), JD.com+, Alibaba (e-commerce), and Baidu (search). Many of China's tech majors are interested in autonomous vehicles as well. Which means that a lot of data, including the idea of big data and big data analytics here, has been generated? Since large volumes of data are required by the Artificial Neural Network (ANNs) for training purposes, researchers have invested vast resources in many institutions to create powerful data centres and obtain massive data sets.

- Marketing Personalization/Advertising (i.e., Facebook, Google, Tencent, JD.com, Alibaba)
- Financial Trading (i.e., Wall Street)
- Healthcare (i.e., Google, Apple, Amazon)
- Autonomous Vehicles (i.e., Tesla, Waymo/Google, GM/Cruz, Uber, Baidu, Tencent, Didi)
- Cybersecurity/Defense/Surveillance (i.e. world governments)

As AI and ML have become more efficient, new ANNs have been designed for specific tasks. These new styles include: a) Convolutional Neural Networks (CNNs) to classify and categorise images, b) Natural Language Processing (NLP) recurrent neural networks[16], and c) Generative Adversarial Networks (GANs) to imitate human artistic capabilities (i.e. art, music, and writing).

Hence, this section discusses the Blockchain Machine Learning database in detail. Now the next section will discuss several advantages of Blockchain with Artificial Intelligence., i.e., How Blockchain technology can be beneficial to the society using Artificial Intelligence in near future?

## VI. NEED OF BLOCKCHAIN IN MACHINE LEARNING

The combination of both machine learning and blockchain technology has a lot of benefits in terms like enhancing security, managing the data market and optimizing energy consumption. As revolutionary as they are already, Blockchain and AI have the potential to be much more revolutionary when combined together. Both can augment each other's capabilities as well as improve levels of transparency, trust, and communication

A. How Machine Learning and Blockchain will Combine? Machine learning is a powerful tool that relies on large amounts of data for model creation and precise prediction. Much time is spent gathering, arranging, and auditing this information for accuracy. This is where the blockchain comes into play as blockchain technology can drastically reduce the time taken. Data can be exchanged directly and safely through the use of smart contracts in this situation. For example, hundreds of terabytes of actual car driving data will require a machine learning model for self-driving cars. Traditionally, all the data including fuel consumption, driving speeds and breaks will be gathered using various trackers. Then, it would be sent for processing where auditors would analyse the data to make it authentic and free of any discrepancies before sending it for processing to data scientists.

Smart contracts, however, could considerably enhance the whole process by using digital signatures. Smart contracts can be designed to directly transfer the data from the car driver to data scientists who will use the data for developing machine learning models in order to ensure the confidentiality of the data obtained, using blockchain technologies. This means that like many other technologies, this integration of machine learning and blockchain technology could be a game-changer, as it will continue to create a platform for data science.

Similarly, this amalgamation supports sectors such as finance and insurance, as they can be used in developing instruments for fraud detection and prevention. Supply chain systems can be enhanced using artificial learning and billions of dollars can be saved every year by that corruption and wastage.

#### B. Benefits of ML and Blockchain when Combined

"When put together, the two complement and enhance each other, and it is up to entrepreneurs to explore ways to implement the two, to gain the benefits of deeper insights greater efficiency and accountability"

1) Improving security: Data is well-secured in a blockchain. For the storing of extremely sensitive personal data such as personalised reviews or medical records, Blockchain is ideal. There's another angle to boost safety. If the blockchain is protected at its foundation, implementations and additional layers may, however, be vulnerable. ML can aid in detecting future device violations and blockchain application implementation.

2) Data market management: Major corporations such as Google, Facebook and Amazon have access to huge quantities of data that may be useful for AI operations, but much of this knowledge is unavailable to everyone. Through accessing the same data pool and even the same AI, startups and small companies will challenge these giants with the help of a blockchain.

3) Optimizing energy consumption: Data mining, being a very energy-consuming process, is one of the major struggles of the modern world. However, Google has shown that MI can fix the issue. By training the DeepMind AI, they have succeeded in reducing the energy usage needed to cool their data centres by 40 percent. For mining, a similar principle may be used, which will lead to lower prices for mining hardware

#### C. Applications of ML and Blockchain

1) Automation in Manufacturing: Companies are now relying on smart contracts and bitcoin blockchain-based processes as part of the manufacturing process to enable transparency, development, security, and enforcement checks. Instead of designing conventional fixed computer maintenance schedules, the predictive algorithms used in machine learning are used to design flexible plans. Product testing and quality control also have progressively become automated.

2) Food and Logistics: ML and Blockchain are increasingly reducing the food industry's supply chain problems by

allowing transparency and accuracy. With the arrival of blockchain, it became possible to track food sources and control the associated financial transactions. IBM recently partnered with Twiga Foods and unveiled a micro financing strategy for food vendors focused on blockchain. But without the implementation of ML techniques the task would not have achieved it. To assess credit scores & predict creditworthiness, IBM scientists purchase data from mobile devices, evaluate and then implement ML algorithms.

*3) Energy and Utilities:* Blockchain aims to promote energy transactions in the energy and utility sectors. For example, IOTA, an energy-based business, has recently introduced peer-to - peer development and consumption of blockchain energy. Micro grids for smart energy are also rapidly becoming a common way to create renewable resources for energy. LO3 Energy, a NY-based company, also uses blockchain-based innovation to allow local communities to generate, conserve and trade energy.

## VII. COMBINING BLOCKCHAIN AND ROBOTIC PROCESS AUTOMATION

Robotic Process Automation (RPA) and Blockchain are new innovations and have the ability to modify the way businesses operate. About any industry out there can be affected by both technologies. In sectors like retail, insurance, banking, infrastructure, healthcare, and so on, we may see use-cases of RPA and Blockchain.

The automation mechanism that automates routine and manual activities using robotics is Robotic Process Automation (RPA). The success of RPA is due to the utility of it in existing manufacturing activities. Much as a human would do, it will communicate with any modern machine. This makes it easy for sectors to automate a broad range of tasks. RPA is still deep in the high growth stage, with Gartner projecting a 57% increase in RPA work in 2019 alone. By the end of the year 2022, 80% of the large and very large organizations are projected to have deployed RPA in some form.

# A. What happens when RPA and Blockchain work together?

To achieve the best possible results, it is very often for companies to integrate different innovations. The business is very dynamic, and now than ever before, clients demand more from brands. That is why corporations need to grow beyond their approach. It is now easier for organisations to implement them and build a solution that fits well for them as well as the end-user, with technology operating together more smoothly than ever. The data generated by firms is often broad enough for them to test different variations. With the mixture of RPA and blockchain, both of these are feasible.

So, where do any of these blockchains come in? A global, decentralised ledger can be created by Blockchain to manage all the data and information. It provides all the interested parties with a knowledgeable, trustworthy, and seamless sharing forum. In short, when it comes to information sharing among different IT infrastructures, RPA will allow blockchain. When it comes to monitoring and

performing transfers through the scheme, RPA and blockchain will both function well. With the trust of blockchain, without any concerns, RPA will function smoothly and provide knowledge inside the setting. With the assistance of the blockchain, the transactions can be validated and then transmitted. In addition, all the information can be stored in the decentralised ledger, providing the stored data with immutability. For enterprises, this implies that the treatment of audit trails would be basic. To satisfy consumer needs, they will simplify the processes and achieve full efficiency.

#### B. Power of Combining RPA with Blockchain

Robotic Process Automation (RPA) with cognitive capabilities (e.g., connected-RPA) can play the central role as an intelligent gateway to interact with end users, capture data inputs, and interact with IT systems to disseminate information in real-time. From a "people" perspective, the human role will be that of spotting processes for automation, training digital workforce, and interacting with digital coworkers. Blockchain can provide shared ledger and distributed infrastructure for the transaction processing capabilities among organizations. From a "process" perspective, Blockchains role will be that of enabler for smart, trusted, and frictionless value exchange between transacting parties.

RPA can enable Blockchain to exchange information with existing IT systems as well as help establish monitoring around transaction processing activities. Blockchain can ensure trust to RPA orchestrated process flows by providing a secured environment to validate all transactions and maintain an audit trail in an immutable shared ledger. If integration is designed amicably, RPA and Blockchain can fully automate end-to-end digital process flows to achieve enterprise-wide goals. We are already seeing emerging themes in leveraging the combined power of RPA and Blockchain:

1) Fully Automated & Trusted Data Processing: RPA driven processes interact with end-users and systems to capture data (e.g., customers, orders, documents) using bots and orchestrating the workflow for processing. Blockchain can provide a ledger to record business transactions and processes for automated decisions (e.g., identity management, information verification, payments processing). Example Use-Cases: Rewards Point Management in Hospitality Industry, Peer-to-Peer Lending, Insurance Claim Payments Processing, KYC Processes in Financial Services, HR Recruitment Processing

2) *Regulatory & Compliance Management*: RPA can automate repetitive compliance tasks for regulatory flows as well as automating process controls. Blockchain can be used to create an immutable record of the regulatory events which can be accessed in case of internal or external audits. Example Use-Cases: Recording Customer Data Preferences (e.g., GDPR, CCPA), Compliance Audit Management (e.g., SOX).

#### C. Benefits of using RPA with Blockchain

Regulatory and Regulatory Management: For corporations

out there, enforcement is a major problem. They ought to ensure that their method is consistent with the governanceassigned regulatory requirements that they are currently running. When they work worldwide, things get more complicated. To reduce routine regulatory processes, RPA and blockchain will interact together. Blockchain plays a key role in the development of regulatory and enforcement control by providing immutability to the events registered. It is also possible to track all activities across the network, allowing for external investigations as well. This can be extended to statutory regulations currently applicable, such as GDPR.

Automated Trusted Data Processing: The development of automated trusted data processing is another clear use-case of Blockchain and RPA. This has wide-ranging usage cases in which blockchain serves as a central network to handle another method's distributed data. The public ledger is a marvel here, since it provides a means to monitor data processes and business transactions for RPA 's automatic decisions. The KYC method, insurance premium settlements, HR recruitments, and so on is the best use-case for automated trustworthy data processing!

Customer satisfaction: With quick, automatic transactions that are safe and secure, RPA and blockchain can both work together to build improved customer loyalty.

RPA and blockchain co-worker: RPA and blockchain will also build a more sustainable human partner co-worker.

### D. . Challenges and Opportunities

Both RPA and Blockchain are new technologies and are evolving at a different pace. That means, the implementation of RPA and Blockchain does not come without its challenges. For example, in these early days, Blockchain had constraints such as scalability, interoperability, and standardization which are pre-requisite for the enterprise adoption. Numbers of organizations are working to overcome these constraints. However, this coupled with regulatory uncertainty and governance issues have slowed down Blockchain adoption.

Many companies are not fully utilizing RPA as an enterprise transformation capability that scales across multiple business functions. These organizations are recognizing benefits from the use of digital labour, but their overall value proposition is diminished by not thinking strategically and not thinking big enough. Top management consulting firms like Alvarez and Marsal are spending more and more time helping clients build an RPA strategy and roadmap that is sustainable and drives ever-increasing benefits over time.

While RPA does not have that many problems, adoption rates are still struggling. Companies don't use RPA correctly to simplify their business processes. Most of them use RPA purely to automate human labour. They should, however, think creatively about how to get the best out of the RPA. In plain terms, as they incorporate RPA into their business operation, they can strengthen their value proposition. When it comes to implementing RPA for blockchain technologies, companies should still be vigilant. Before thinking about using RPA and blockchain, they should look into their specifications and methodologies. Before they proceed to alter their business procedure, they should ensure that they fulfil the usage case properly. They will want to look at common use-cases and see the obstacles for effective adoption that other enterprises or organisations have to go through. Organizations should also often take a pilot position to assess the effect of introducing RPA and blockchain implementation.

When picking a use-case for RPA and Blockchain strategy, it is important to carefully review an organization's methodologies and understanding of technology. Many pilots have failed because the organization does not establish rigor around use-case selection. Pick a use-case that has a logical, repeatable processing and benefits from immutable records as a potential candidate for RPA + Blockchain pilot. Consider avoiding processes with huge volumes of data due to scalability constraints of Blockchain in its current state.

Finally, the success of digital transformation relies upon thinking through holistic requirements, clearly aligning to business goals, identifying key success metrics, and establishing strong governance. Spending time on analyzing the current operation model, designing a target state, and articulating process integration points before starting implementation is critical.

#### VIII. DATA ANALYSIS AND ADVANTAGES OF BLOCKCHAIN WITH ARTIFICIAL INTELLIGENCE

Blockchain contains actual transactions. All decisions have been made by people/ users, so very little irrelevant data created with Blockchain transactions. Note that we always require data quality with integration of AI and Blockchain together. Also the high level of data quality is bound to make any algorithm based on it to be progressively, infinitely more powerful than any other data source in existence today. There are several advantages and disadvantages of using AI with Blockchain, which are summarized as:

#### A. Data Analysis

Data analysis is vital for training AI / ML algorithms, as discussed above. We have been given siloed, unshared data stores that are subject to attack by the new paradigm. The consistency and credibility of the records, however, is also not necessarily optimum. The data should be precise, immutable, and complete in order to be useful. However, data processing methods may be flawed, data analysis may be error-prone, and due to incompleteness, datasets can involve sample-bias. Try gathering and capturing manually some kind of data-customs records at ports, critical hospital patient information, and food information in the supply chain. Under all these instances, a small number of unsupervised persons depend on manual data collection and documentation. A much better solution can be offered by recording data on a Blockchain, especially when combined with IoT. First, before it goes through a consensus process, data in a Blockchain is not documented.

To ensure that the data being documented is checked and reliable, the consent process pulls in a collection of incentivized participants (public nodes) or stakeholders (permitted nodes). Next, the registered data is time-stamped, signed cryptographically, and permanent. By architecture, it is auditable, open, and secure. Adding IoT devices that write directly to the Blockchain will improve both the reliability and precision of the reported data in some situations (i.e., supply chain, healthcare, logistics, etc.).Centralized data is also incomplete and, with such a limited number of use cases (Facebook, Google, etc.), it collects data collected by a single entity. In the dataset, this technique will lead to both design bias and sample bias. Data exchange with a wider range of organizations will produce broader and more complex databases covering a broader variety of use cases.

For instance, the most commonly used medical datasets collect data predominantly from middle-income white males. There is also sample and design bias in many common AI innovations, ranging from facial recognition (i.e. Microsoft and IBM) to word matching and translation (i.e. Google). There is also no sharing of centralised datasets because dataset owners are concerned with privacy and competitive advantage. Because partial databases are more likely to suffer from extreme bias, competitive advantage is more likely to be a misnomer, but this is an understanding concern that Blockchain can not specifically answer. Blockchain does, however, have the potential to make data even more shared with regard to privacy, as Blockchain data is practically unbackable in accepted chains and the most commonly used public chains (i.e. Bitcoin, Ethereum, etc.). Note that in an environment where users own the data, it would be possible for private and public entities to create widely distributed and more robust datasets that would eliminate biases and form a basis for genuinely usable AI / ML. In this case, it is possible to schedule datasets and then purchase data from data owners whose profile supports the dataset strategy. For example, if a dataset is intended to include information ,i.e. demographically segregated depending on a nation's population (i.e. 50 percent females, 50 percent males, 20 percent 18-34, 40 percent minorities, etc.), it can be prepared, purchased, and created.

#### B. Interaction with the Artificial Intelligence Program

Today, bots generate more than 52 percent of web traffic, i.e., bots are computer programmes that cross the Internet and carry out some kind of purpose. A growing number of such bots, including voice order bots, chatbots, virtual assistants, and other types of learning and evolving digital helper systems, are beginning to use AI. Human interaction with the Internet and the Web is projected to decrease over time and humans will delegate many tasks to bots. This is also in place of services such as Alexa, Siri, Cortana, etc., thus increasing the amount of web traffic. There are also many bots in the social media environment, like Facebook, Telegram, WeChat, Whatsapp, etc. Similarly, we can use Blockchain to build a layer of human-Internet identity and trust, and the bot-based Internet will do the same. This is especially helpful because some of the (online) bots are very helpful and malicious. If bots can be explicitly defined on the Blockchain with an immutable identity, this will greatly reduce the potential of malicious bots to wreak havoc, particularly if it is possible to create metadata and records based on the actions of the bot. Note that as bot traffic grows, human-bot interaction converts to bot-bot interaction. In the future, bots will begin to communicate more with each other than with humans . For example, a scenario in which each individual has a virtual assistant (such as the recent Google demo) and all virtual assistants begin to communicate with each other to collect information, arrange appointments, buy products, etc. In the future, bots will have to be able to ask each other for identities, and then look up history and ratings before interacting. Therefore, to be safe and gain confidence, this expertise has to be placed on the Blockchain. In addition, advanced bots might also need to be able to access each other's programming algorithms and training data. It will encourage bots to properly 'understand' each other by communicating/ querying this information, then 'decide' whether they want to establish a working relationship.AI programs are black box systems because all the data and programming are hidden from view. In a future dominated by bot-bot interactions, a higher level of transparency is required. Here, Blockchain is the right choice/ technology for storing data that will enable bots to more easily audit each other. The Blockchain can also be used to incentivize auditing interactions, for example, by rewarding greater transparency with tokens.

Since all the details and code are shielded from view, AI programmes are black box systems. A higher degree of transparency is expected in a future characterised by bot-bot interactions. Here, Blockchain is the right data storage option / technology that will help bots to audit each other more easily. For example, by rewarding greater accountability with tokens, the blockchain may even be used to promote auditing experiences. Better Human-Bot and Bot-Bot Interaction Management: In *an* environment controlled by human-bot and bot-bot interactions, because of the black box design of most AI systems, it could be very possible for interactions to spiral out of control. Microsoft's chatbotTay being sexist (human game bots), Facebook botbot encounters producing sub-languages (bots going wild), etc. are several instances of alarming AI conduct.

To instil order and more control over bot-bot interactions, or even human-bot interactions, it may be prudent to use another main Blockchain technology: smart contracts. Smart contracts describe contact rules, place limitations on future performance, and do not function until these conditions have been met. In addition, intelligent contracts can be tested for errors by means of mathematical formal testing to ensure that they are error-free and bug-free. Parameterization and structure will be included in this logic layer to reduce the potential for unpredictable or troublesome effects on otherwise free-form machine learning algorithms. Note that smart contracts may not be used in both situations, because innovation could lead to fresh ideas and breakthroughs that are serendipitous. However, they could be used in various situations where parties would like to restrict the outcome in a well-defined way, such as in commercial transactions, legal agreements, stock contracts, etc.

#### C. Use Cases

Some key use cases where the power of AI/ML plus Blockchain becomes obvious, can be seen in the following domains/ areas:

1). *Healthcare:* Personalized Medicine[17]: Blockchain paired with self-sovereign identity and medical data may be released, silos opened and new capabilities developed by AI / ML. For example, each doctor may use an automated medical assistant (AI / ML medical bot) to query the Personal Health Record (PHR) of a patient, current vital / symptoms, and related community health data to easily diagnose a patient To build a custom recovery plan tailored for the case, the doctor will use the bot's recommendations. Today, such a method is impossible: due to security concerns, few people have a PHR, public health information is siloed and full of application bias and due to a lack of quality data, and medical bots are primitive and untrained.

2). Transportation: Autonomous Vehicles on Demand[18]: There is so much (by many authors) about the self-driving future that has been written / discussed. Self-driving vehicles will roam the streets in many instances, picking up passengers on demand. However, there are some big hurdles that need to be tackled before this is possible, including: safe identities, secure identification, protection of car interference, genuine autonomous vehicles (level 5), and large bias-free datasets. These problems will be solved by the merger of Blockchain technologies (immutability, ultrasecurity, decentralisation, and intelligent contracts), selfsovereign identities, unbiased Big Data, and AI / ML. Blockchain technology can ensure that buses are not hacked remotely, that rides are picked up and paid for by the right customers, that identities are not compromised, that individual interests are prioritised, and that networks become more powerful over time. Each car and each person would likely have a bot assistant to communicate for planning, payment, routing, and car preferences. These systems will interact via smart contracts and learn from each other to help configure future drives based on machine input (i.e. efficiency, cost / time, vehicle use) and person input (i.e. likes, dislikes, preferences). Biometrics (facial recognition, fingerprints) can minimise the success of hacking in combination with a decentralised car and human identification (private key encryption) by minimising single points of failure. Mutual, unbiased big data sets will be required for obstacle categorisation and avoidance plus culturally and gender-appropriate human interaction.

3) Logistics and Supply Chains[19]: Fully Automated Systems: There are many different actors in supply chains and logistics systems today, including suppliers, transporters (i.e., truck, trains and aircraft), warehouses, customs, insurers, consolidators, buyers, etc. Any of these plays (i.e. first step / last step, and/or prior step / next step, and/or arrival / departure time, or product status, etc.) has a tiny piece of information about a shipment. As a consequence, whether mistakes are made or poor people are involved in a process, critical issues will ensue. The main issues confronting logistics and supply chains arise from a lack of accountability in procedures, inadequate coordination amongst parties, and the addition of parties who might not be trustworthy. Problems include delayed hand-offs, malicious people stealing items or money, missing documents or data, items that are fake or counterfeit, weather delays, etc.

4) A combination of Blockchain, IoT, plus AI / ML: It can ensure that all players maintain a real-time database of an entire transaction, can communicate easily, and can accurately record and manage the actions of each player over time. Key blockchain platforms have developed RFIDbased IoT devices for the supply chain and logistics industries that can scan for products and report activities directly to the blockchain. Such a technology provides an efficient and irreversible track and trace capacity that, as well as the players who agree, determines the root cause of any faults or concerns. Theoretically, a supply chain or logistics process could be fully automated with the inclusion of AI / ML bots, robotics and self-driving cars, with smart contracts steering all transactions. In order to correct previous errors and improve efficiency, the AI / ML bots will analyse transactions both in real time and historically. When transporting perishable items such as food or 'sensitive' items such as pricey artwork, environmental conditions, such as temperature and humidity, may also be tracked using IoT devices. The end outcome would be much lower inventory and distribution prices, less failures, less bad actors, and innovative market strategies that would be more sustainable. This segment also addresses many benefits (including Artificial Intelligence) of Blockchain technology / concept in real-life implementations. Now, the next segment will cover one case of use as a case study, i.e. a Blockchain and Artificial Intelligence (or Machine Learning) smart world.

# IX. A SMART WORLD WITH BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE

In general, Blockchain Technology was used to develop trust among users or remove the necessity of third parties to make a secure transaction. Moreover, one affordable (and reliable) scheme using Blockchain technology for Healthcare applications has been developed by Tyagi et al [30].

# A. Blockchain, Machine Learning, and a Future Accounting

In our current reality where interruption is a trendy expression, it's as yet uncommon for an innovation to drastically modify the essence of an industry. For accountants and auditors, in any case, Blockchain has the potential to do only that, particularly when joined with different developments such as machine learning. Since accounting records contain organized arrangements of information, this innovation is well suited for this profession.

#### B. Blockchain - Way more than bitcoin

Though Blockchain was developed to promote bitcoin, the invention is currently spreading out beyond the

cryptocurrency world. Blockchain technology's key advantage is that it is decentralised. Blockchain technology shares data with a massive peer-to - peer network instead of holding data in one place. In Blockchain technology, records are structured in such a way that it is almost impossible for records to be falsified or manipulated. We are currently using trustworthy third parties to establish authenticity during transactions. The reason is that, as transactions are permanently added to the ledger (like blocks in a chain), all parties involved are transparently presented with information and then one block in the chain is linked to the next. We may also use the time-stamp method to ensure that files marked with a virtual fingerprint known as a "hash string" are unchanged. Since programmers are unable to

access data through a key defencelessness problem,

#### C. Blockchain Altering Accounting

Blockchain systems are impervious.

Blockchain reception is still in its infancy, but that has not stopped experts from theorising about the tremendous changes that innovation will bring. For instance, Deloitte has set up a consulting business for Blockchain and EY accepts bitcoin to settle invoices. How do accounting systems based on Blockchain look? Theoretically, it will allow stable. validated data to be stored and used in various locations by different parties. Because a blockchain is encrypted and verified by consensus, it basically notarizes itself. The entirety of this demonstrates the possibility of a substitution for the accounting technique of double entry that has been typical since the Renaissance. Therefore, "Imagine a world where accounting was not double entry, but kept on multiple computers in ledgers concurrently recording the same object in multiple locations, all self-balancing and checking every few minutes," Also, "No middlemen, no reconciliation, no corrupt date, no need for month-end cycles, no need to bring together all the different books and records of departments and counter-parties." In short, this is the promise of Blockchain accounting.

#### D. Combining Blockchain with Artificial Intelligence

The field of accountancy mentioned above may change with Blockchain, but other innovative advances are causing ripple effects as of now. A subfield of AI that should be of special interest to accounting professionals is machine learning. "Arthur Samuel, author of the word machine learning, describes machine learning as giving" computers the ability to learn without needing to be programmed directly. Machine learning helps to automate the task which traditionally needed human intervention. This technology builds proficiency within the accounting profession to a phenomenal degree, which in turn influences our future work process procedure and how we interface with the users/ customers. We can achieve technological revolution by combining machine learning and Blockchain together. It is conceivable to imagine a world where accounting and auditing are continuously occurring, with each progression being informed by all relevant parties about the way, i.e., a true continuous audit. In order to take advantage of the technology, accounting companies and corporate accounting divisions have to study and also validate the latest working method internally with their teams and externally with customers. An approach to gaining confidence in the benefits of using innovation (similar to conventional ledger systems) may be to start little with cost revealing / reporting collection applications.

#### E. Visions of the Future with Blockchain

Due to using Blockchain in future in accounting firms, accountants and auditors can face some problems. But it will create more choices for them. We cannot imagine the account sector without human intervention, but the development of new technologies is going to change the roles and workflows of this area in the next few years. In the coming era auditors will spend very short time for audit, and more time for designing, reviewing, and verifying the flow of information among systems. Instead of conducting auditing periodically. Blockchain and machine learning present the chance of a true continuous audit Not only do all these technologies help to focus more time on your internal teams, but also on your external customers. Soft skills, analytical ability, and advisory services are essential in providing value to an organisation. Trends and missing data, with the aid of continuous audit, could be identified much earlier. As a proactive method, this can be considered. Continuous auditing often tends to minimise many of the activities that accounting companies often have written off or not paid for. Both accounting professionals need to change this approach so that accountants could also have a similar move. It helps to decrease the time required for dataentry activities, so that account professionals can concentrate on design and analysis. Currently, accountants and organizations building up these skills will have the options to differentiate as the technology becomes large.. The times of offering value just through exact data sections and calculations are numbered, so setting aside the effort to retool now and work on your advisory skills is an interest later on for our work.

Blockchain and Machine Learning are made for each other and are two pillars of future technology. Note that with any cryptocurrency, we can use machine learning on the usual algo trading, i.e., predicting price movements, volatility, risk or other things which help in trading strategy (to earn more money). We also could use it to improve storage (If you teach a machine to find the most optimal way of storing items in a network, it would likely improve the efficiency of all Blockchain databases) and Security (If you teach a machine to find encryption algorithms, then we could find many). In future, we can use it to encrypt separate parts of the Blockchain, so that no one can ever decrypt the whole database without the algorithms. Combine this with the above and you just greatly improved Blockchain with machine learning. In summary, by using ML and AI to govern the chain, there is also an opportunity to significantly enhance security. Further, as ML likes to work with a lot of data, it creates an opportunity to build better models by taking advantage of the decentralized nature of Blockchain (that encourages data sharing).

Hence, this section discusses a smart world which consists of Blockchain technology and artificial intelligence together. In this section, the role of these technologies is discussed with one example. Now the next section will discuss current challenges raised/ investigated in integration of AI and ML.

# X. CURRENT CHALLENGES: INTEGRATION OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Because of systemic concerns, some organisations currently collaborating with AI and ML in company and government are facing a huge number of challenges. The concerns recognised by the AI / ML community include:

- Widespread consumer privacy violation
- Siloed and unshareable knowledge
- Biased or tampered with AI systems
- Hackable datasets
- Lack of accountability of data collection

Above issues are because of AI/ML training. AI/ ML data usage is centrally stored plus owned and controlled by the group that collects it. This centralized structure for both data storage and data ownership is directly responsible for each of the challenges discussed above. Specifically:

- Owners of large central data stores have a clear incentive for profit to breach consumer privacy and use AI / ML to identify trends and connexions (i.e. Facebook) that can be specifically monetized.
- Owners with large central data stores are encouraged to optimise the size of their data stores (silos) and are not likely to exchange information as they see it as a strategic (not shared) advantage.
- Data sets are not complete and a lack of sharing and collaboration means that methods and training sets involve some sort of bias (i.e. design bias, selection bias).
- Central data stores are a major draw for hackers because they have a single point of failure and a high pay-out for bad actors because they have millions of user records per break in.

Within large companies, datasets and AI/ ML algorithms are hidden, so their structure and logic cannot be understood, i.e. they are like black boxes. So when these groups are active in AI/ ML, they prefer a centralized structure where they own the data. It is clear that a more decentralized, secure and transparent structure where users own their own data is actually advantageous to society. Since decentralization, transparency, security, and self-sovereign ownership are the hallmarks of Blockchain, i.e, There is huge potential for generating significant benefits from combining the two technology sets together.

# Impacts of Artificial Intelligence using Blockchain (Socially)

The activity of Intelligence and Autonomy generates grounded, subjective research to educate AI-driven frameworks in design, evaluation, and guidance. The Mapping Human Infrastructures of AI project began this year; a chain of intelligent systems ethnographically informed studies in which human work has a vital effect. This project explores how and why artificial intelligence's constitutive human elements are often obscured or rendered unseen. Data & Society also facilitated the Workshop on Artificial Intelligence and Human Rights, which welcomed a group of experts from civil society, industry, academia, international organisations, and government to take part in unique exchanges around a central topic: Can AI research, growth, and deployment be effectively educated, shaped, and regulated by the international human rights system? In the fall of 2018, a report from this conference was published. In 2017-2018, researchers from Data & Society further investigated the impacts of innovative change on the framework of administration. Recent studies have been carried out to describe the effect of big data on police and the different approaches by which machine learning intersects with existing legal and regulatory evaluations and requirements. This research also focuses on alternative methods to design models against a values-based context. Looking ahead to 2019, this operation will increase its degree of incorporation into interconnected work regions, such as the request for the previously stated human rights zone and Justice, Accountability, and Transparency in Machine Learning.

Hence, this section discusses several critical challenges raised in integration of Artificial Intelligence and Machine Learning together to solve real world's problems. Now the next section will discuss several issues raised in Blockchain, which may affect any technology in integration.

## XI. SECURITY AND PRIVACY ISSUES IN BLOCKCHAIN

Nowadays Big Data sources (the web, social media, etc.) contain more of the irrelevant collection of data (useless). For example, corporate data sources have several quality issues like junk, duplication, missing data values or even plain errors. They contain a huge quantity of unstructured data also. This is a serious issue.

#### A. Security issue

The decentralised existence of nodes (i.e. the computers involved in Blockchain transactions) is the primary security function of a Blockchain. Since the ledger (transaction record) is public, nobody can change the ledger secretly. And when changing is completed, before it reaches the record, it must be accepted by other nodes involved in the method. But all public blockchains are vulnerable to 51% of attacks due to the architecture of Blockchain technology[34].

• 51 percent attack: This type of attack occurs when more than half a percent of a Blockchain's computing power is created by a hacker (or group of hackers). As a result, the hacker community functions as the majority of the network and can take ownership of the complete Blockchain, enabling the hacker(s) to double-spend coins, preventing the formation of blocks by other nodes, and fully preventing transactions. In addition, 34 percent of attacks are potentially vulnerable to certain Blockchain architectures like IOTA's Tangle. This is because of the decentralisation of different data, i.e., anyone with only 34 percent of the hashing power of the network could gain control of the Blockchain.

• Another security problem is the broader population of cryptos. Security exchanges are another big concern. Many cryptocurrency hacks have already been recorded that cause the great loss of money by users. With the aid of cold storage for your coins, we can decrease these kinds of attacks.

#### B. Blockchain Privacy issues

Every transaction recorded on the public Blockchain is visible to everyone involved in the system. It does not mean that an outsider will find out your identity. But the fact is that the amount of information available in the public domain especially in the financial, legal, and healthcare sectors, must satisfy the privacy requirements. Even though we use blockchain technology and if the patient's private health record is available in public may cause some sort of threats. As Arran Stewart, co-founder of Job.com [31] says, "Someone somewhere will list information publicly that is sensitive, and someone else will spend a lot of time figuring out how to get it".

#### C. Others

There are some other issues available with Blockchain Technology, can be included as:

1) Scalability: Since the number of transactions performed per day is increasing daily the Blockchain is becoming bulky. Whenever a transaction is done, every node involved in the system must update their transaction entry, for validation purposes. The reason is to check the validity of the user who performed this transaction.

The Bitcoin Blockchain can handle only seven transactions per second because of block size constraints and time interval limitations for creating new blocks. This is not necessary to satisfy the demand that millions of transactions be performed in real-time. Meanwhile, as the capacity of blocks is very small, many small transactions might be delayed since miners prefer those transactions with a high transaction fee. Two methods have been proposed to address the scalability problem of the Blockchain, which are:

- Blockchain storage optimization: Bruce implemented a new blockchain system, under which the old transaction documents are deleted by the network, to escape the challenge of a node to run a fresh copy of ledger. To keep the balance of all non-empty addresses, they use a database called account treeEven lightweight clients can also fix this issue. VerSum [19] is a novel scheme implemented to offer a different way for lightweight consumers to exist. This helps lightweight customers to outsource costly calculations over a large input range. It compares the findings from different servers to verify the accuracy of computation.
- Redesigning Blockchain: In [20], Bitcoin-NG (Next Generation) was introduced. Conventional blocks are decoupled into two sections in Bitcoin-NG: main blocks used for the election of

representatives and microblocks used for transaction storage. Time splits the protocol into epochs. Each time, miners have to hash to produce a key block. The node serves as the leader until the main block is generated and creates the microblocks. The heaviest/longest chain technique in which microblocks bear no weight was also expanded by Bitcoin-NG. In this way, Blockchain overhaul is achieved to resolve the trade-offs between block size and protection of the network.

Selfish Mining: Blockchain infrastructure is vulnerable to attacks by colluding malicious miners. In specific, Eyal and Sirer [21] find that even though only a limited portion of the hashing power is used for hacking, the network is susceptible. In this process, the greedy miners are kept with the mined blocks instead of broadcasting them, and the private division will only be exposed to the public if any conditions were fulfilled. As the length of the private branch is longer than the existing public chain, both miners will be permitted to do so. Honest miners are spending their money on a futile branch prior to the private Blockchain release, while greedy miners are mining their private chain without competitors. So greedy miners are going to get more gains.

Based on greedy mining, several other attacks have also suggested that Blockchain is dangerous. In stubborn mining, by non-trivially combining mining attacks with networklevel eclipse attacks, miners could optimise the advantage. One of the persistent methods that miners still mine the blocks is trail-stubbornness.

But in some situations, in contrast with a non-trailstubborn relative, it may result in 13 percent gains. [22] Shows that, as opposed to plain selfish mining, there are selfish mining techniques that get more revenue and are productive for smaller miners. Yet the benefits are far smaller than that. Again, it illustrates that attackers with fewer than 25% of computing power will also earn more from selfish mining.

Heilman[23] suggested an innovative solution in order to solve the greedy mining dilemma, in which honest miners would choose which branch they choose to obey. Honest miners use random beacons and timestamps to pick fresh blocks. Timestamps[24] are, however, vulnerable to forgery. In addition, in ZeroBlock [25], a maximum time interval is set to be produced for each block and agreed by the network. Inside ZeroBlock, it is difficult for greedy miners to receive more than their desired reward. In last, Artificial Intelligence is the future for intelligent automations and blockchain is the technology to secure its communicated (or data at rest) data. We recommend readers to read more about issues with AI or its subset like machine learning and deep learning in [26, 28, and 29].

This section discussed several issues (i.e., security and privacy) raised in implementing Blockchain technology with real world applications. Also, to know more security and privacy concerns in various computing platforms, readers can read the work [34].

#### **XII.** CONCLUSIONS

In order to bring significant benefits to human society, AI and ML innovations have enormous promise. However, the new AI / ML model is fundamentally flawed and incidents of violence are rampant, centred on centrally managed structures, skewed databases, and enfranchised users.

technologies including ultra-secure Blockchain and immutable ledgers, solid, consensus processes. decentralisation, and self-sovereign identities have enormous potential to rebalance and enhance AI / ML algorithms. In addition, as the Internet shifts away from human-human encounters and towards being more bot-bot encounters, by using Blockchain-base, we will be able to see a better future. In short, Blockchain + AI / ML + Big Data is a much better mix than either of these innovations alone, and for certain areas such as computers, energy, etc. the impact of the mix is likely to be innovative. The near future belongs to an interoperable Blockchain network that will be based on numerous distributed-ledger technology and holding numerous digital currencies also can be federated to handle different aspects of distributed applications. Therefore, Machine Learning and Blockchain obviously make a perfect mix, because with effective and stable systems, if we can incorporate them, it will transform the world. Therefore, instead of using a blockchain (which is constrained by the speed of the internet), it is clear that it is easier to create and process neural networks on top of GPUs. Blockchain and Big Data are the successful mix. But here, the real question is "who will be the first person to have the most relevant and best qualified AI / machine learning model that works on top of distributed, open and immutable data layers generated by Blockchain"?

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