E-Governance Based on Evolution of Information, Data and Communication Technologies

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Abstract

The Information Technology and Data Science (ITDS) development has led to a deep change in our lifestyle. This change is enabled by the power of cheap computing and access to large datasets, and smart devices are already doing better than humans in many areas. This "intelligence" moves from central servers to devices and things that will soon become part of our daily lives. These evolving will revolutionize e-governed and create a new generation of e-government emerging that give the ability to impact in this sector by transforming the way public administrations provide advanced and innovative services and but the way citizens interact with them. The combination of ITDS technologies will prompt major disruption to established industries and modes of commerce. The aim of this paper is to provide researchers and practitioners with a detailed overview of the areas and technologies of ITDS (Internet of Things (IoT), Artificial Intelligence (AI), Big Data (BD), Behavioral/Predictive Analytics and Blockchain) and the extent to which it is possible to strengthen the means available to government for robust, secure and scalable solutions developable and reliable when integrating and merging IDTS domains and technologies

Key Words: e-government, Internet of Things, Artificial Intelligence, Big Data, Behavioral/Predictive Analytics and Blockchain;

1. INTRODUCTION

Governance has been defined to refer to structures and processes that are designed to ensure accountability, transparency, responsiveness, rule of law, stability, equity and inclusiveness, empowerment, and broad-based participation. Governance therefore can be subtle and may not be easily observable. Furthermore, International agencies such as UNDP, the World Bank, the OECD Development Assistance Committee (DAC) and others define governance as the exercise of authority or power in order to manage a country's economic, political and administrative affairs. The 2009 Global Monitoring Report sees governance as 'power relationships,' 'formal and informal processes of formulating policies and allocating resources,' 'processes of decision-making' and 'mechanisms for holding governments accountable [1].

Based on the definition of governance, governments in developed countries have accelerated the adoption of Blockchain, AI, IoT and other IT tools and technologies at a rapid pace. All these countries are busy becoming fully digital societies, hoping before the end of the decade [2]. Although all of these technologies offer stand-alone functionality, each has the ability to interact with either or both. Logically, this integration arises from fundamentally different characteristics of each of these techniques.

IoT was first used in 1999 by British technology pioneer Kevin Ashton to describe a system in which objects in the physical world could be connected to the internet by sensors [3] and the first example of IoT was an internet connected Coke machine in 1982. The first work on a cryptographically secured chain of blocks was described in 1991 by Stuart Haber and W. Scott Stornetta [4,5].

Blockchains have been shown to improve the levels of economic efficiency, security and decentralization in administration related research is Blockchain electronic voting system studies, studies exploring how transparency can be secured using distributed storage techniques, and studies on how to use it to create an electronic governance or communication system [6-9].

AI, based on the primitive computing of the day, emerged as a defined academic discipline in 1956[10]. According to the e-government architecture project approved by the People's Committee of Ho Chi Minh City, from 2020-2025, Ho Chi Minh City will build an intelligent electronic government based on big data technology, Blockchain, AI, cloud computing, and exploiting social networking to deliver smart public services to people and businesses [11]. A full technology framework has been reviewed on how the emerging technologies could be utilized in the public sector based on a number of studies and projects across the globe [12]. In this article we will introduce the concept of each technology separately and how these common techniques when combined can add some value while solving critical problems of economy and society applications.

2. THE INDUSTRIAL FOURTH REVOLUTION TOWARDS E-GOVERNANCE

Until now we have seen 3 industrial revolutions. The first revolution used steam power to further production while the 2nd used electricity. The third revolution automated production with electronics and IT. Now the world is witnessing the fourth revolution which is in essence a digital revolution.

Because e-governance is the ability of sectors to exchange information and provide services to citizens and business sectors quickly and accurately and at the lowest possible cost while ensuring the confidentiality and security of information. The catalyst came to take advantage of the opportunities created by the fourth revolution in the development of the digital economy that leads to sustainable development and increase personal income by taking care to harness current and emerging digital technologies such as the IoT, AI, BD analytics and Blockchain for e-government.

The IoT provides circulating data while AI provides minds that think, train, learn analyze, make decisions and Blockchain rules of engagement. However, at the intersection of IoT, AI and Blockchain, there are not only opportunities to add exciting new possibilities and capabilities, but also challenges, constraints and concerns that must be carefully studied and resolved. In order to understand the importance, the interlacing of AI, IoT and Blockchain and their effects, it is important to understand what AI and Blockchain are in the first place.

2.1 IoT

According to Gartner's definition of the IoT is a network of physical objects "things" embedded with digital system and sensors to communicate and sense or interact with their internal states or the external environment through internet without human intervention taking advantage of advancements in computing power, electronics miniaturization, and network interconnections to offer new capabilities not previously possible. This technology promises to be beneficial for people with disabilities and the elderly, enabling improved levels of independence and quality of life at a reasonable cost [13].

A number of companies and research organizations have offered a wide range of projections about the potential impact of IoT on the internet and the economy during the next five to ten years. Cisco, for example, projects more than 24 billion internet–connected objects by 2019[14]. Morgan Stanley, however, projects 75 billion networked devices by 2020[15]. Looking out further and raising the stakes higher, Huawei forecasts 100 billion IoT connections by 2025[16]. McKinsey Global Institute suggests that the financial impact of IoT on the global economy may be as much as $3.9 to $11.1 trillion by 2025[17].

Two important developments related to IoT and managing the public infrastructure are Building Information Modeling (BIM) [18] and blockchain smart contracts, is a computer program that directly controls a transaction or an IoT device. Elements of Blockchain technology originally conceived for Bitcoin and other crypto currencies are now recognized to have far-reaching potential in other areas, including IoT [19].

2.2 AI

AI makes it possible for machines to learn from experience, adjust to new inputs and perform human-like tasks. In other way AI refers to the potential of computer-controlled machines/robots towards performing tasks that almost or similar to human beings. In this case, AI is used to develop various robots that have human intellectual characteristics, behaviors, learning from past experience, have abilities to sense, and abilities to making predications and determine meaning of certain situation [20, 21]. AI techniques are case-based reasoning, rule-based systems, artificial neural networks, genetic algorithms, cellular automata, fuzzy models, multi-agent systems, reinforcement learning and hybrid systems [22].

Case-based reasoning (CBR) solves a problem by recalling similar past problems [23] assumed to have similar solutions. Rule-based systems (RBS) solve problems by rules derived from expert knowledge [24]. Artificial neural networks (ANNs) employ a caricature of the way the human brain processes information. An ANN has many processing units (neurons or nodes) working in unison. They are highly interconnected by links (synapses) with weights [25, 7, 27]. A genetic algorithm (GA) is a search technique mimicking natural selection [28]. Cellular automata are dynamic models, discrete in space, time and state. They consist of a regular lattice of cells which interact with their neighbors. The cell states are synchronously updated in time according to local rules, which calculate the new state of a cell at time t+ 1 using its state and those of neighboring cells at time [29]. Fuzzy systems (FS) use fuzzy sets to deal with imprecise and incomplete data. In conventional set theory an object is a member of a set or not, but fuzzy set membership takes any value between 0 and 1. Thus fuzzy models can describe vague statements as in natural language [30]. A multi-agent system (MAS) comprises a network of agents interacting to achieve goals [31]. An agent is a software component containing code and data [32]. It is incapable of solving the problem assigned to the MAS on its own [33]. The agents communicate by a high-level Agent Communication Language (ACL) through which they share information, request services and negotiate with each other [32]. Reinforcement learning (RL) is learning through interaction between a learning agent and its environment [34].

2.3 BD Technology

In 2011, a report of the international data corporation has defined BD as "a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling high-velocity capture, discovery, and/or analysis"[35]. Big data in general refers to sets of data that are so large in volume and so complex that traditional data processing software products are not capable of capturing, managing, and processing the data within a reasonable amount of time. BD has one or more of the following characteristics: high volume, high velocity or high variety. AI, mobile, social and IoT are driving data complexity through new forms and sources of data. For example, big data comes from sensors, devices, video/audio, networks, log files, transactional applications, web, and social media, much of it generated in real time and at a very large scale. These big data sets can include structured, unstructured, and semi structured data, each of which can be mined for insights. BD technology is mainly classified into two types: operational big data technologies and analytical big data technologies. The operational big data is all about the normal day to day data that we generate. It's a kind of raw data which is used to feed the analytical big data technologies (EX. Online ticket bookings, online shopping, data from social media sites, the employee details of any multinational company). Analytical big data is like the advanced version of big data technologies. It is a little complex than the Operational Big Data. In short, Analytical big data is where the actual performance part comes into the picture and the crucial real-time business decisions are made by analyzing the operational big data (EX. Stock marketing, carrying out the Space missions where every single bit of information is crucial, weather forecast information, medical fields where a particular patient's health status can be monitored).

Analysis of big data allows analysts, researchers and business users to make better and faster decisions using data that was previously inaccessible or unusable. Businesses can use advanced analytics techniques such as text analytics, machine learning, predictive analytics, data mining, statistics and natural language processing to gain new insights from previously untapped data sources independently or together with existing enterprise data.

2.4 Blockchain Technology

Instead of having a network, a central server, and a database in the traditional centralized model of business, the Blockchain is a network and a database all in one. A Blockchain is a peer-to-peer network of computers, called nodes that share all the data and the code in the network. So, if you're a device connected to the Blockchain, you are a node in the network, and you talk to all the other computer nodes in the network. You now have a copy of all the data and the code on the Blockchain. There are no more central servers but just a group of computers that talk to another on the same network. All the transaction data that is shared across the nodes in the Blockchain is contained in bundles of records called blocks, which are chained together to create the public ledger. This public ledger represents all the data in the Blockchain. All the data in the public ledger is secured by cryptographic hashing, and validated by a consensus algorithm. Nodes on the network participate to ensure that all copies of the data distributed across the network are the same.

In the traditional centralized model of business relationships, there's always a third party that stands between the two parties that are making a transaction and affirming the terms and conditions in a contract. This third party may be a banking institution, a law enforcement company, a government establishment, or some other intermediary. When building relationships within a centralized model, businesses are dependent on an intermediate, which puts customers at risk. Besides, central systems can't guarantee payments and implementation of contracts. Block chain, which allows businesses to build decentralized models and proposing an alternative to the traditional model, is the smart contract.

2.5 Smart Contracts

Smart contracts are simply the rules, possibly computer programs are in charge of reading and writing data to the Blockchain, as well as executing business logic. The idea of smart contacts is the translation of traditional contracts into code written in a programming language called Solidity, which looks a lot like JavaScript and distributed to multiple nodes for verification in a Blockchain. Smart Contracts may be one of the biggest drives behind the eagerness for blockchain. However, the current smart contract protocol is far from perfect, suffering from both limited computing capacity and defective judgment. Without enhancing the capability of the smart contract, it is hard to implement real-world decentralized applications on the Blockchain. Whilst there are various approaches to solving the problem, enabling AI on the Blockchain and integrating AI to be nested within the smart contract offers us a powerful solution.

AI technology that can be applied to smart contracts ranges from rule-based systems such as expert systems designed to make decisions based on rules and input, to more adaptive systems, such as neural networks, knowledge graphs, and logic. One area important for smart contract is natural language processing (NLP). AI and NLP could be used with smart contracts in at least two aspects: to negotiate and agree to terms on behalf of people, and/or to generate the smart contracts. These contracts may be programmed to negotiate terms for price and quality of certain goods using well-known AI game playing algorithms. Parameters can be established for certain gap filler terms such as ranges of price and range of quality that can be adjusted dynamically, and fixed inputs by users for the type of goods. Care should however be taken to record that an offer and acceptance to the terms of the agreement has been provided by the smart contract, AI-powered negotiation agents on behalf of real people, as offer and acceptance is one of the cornerstones of a contract.

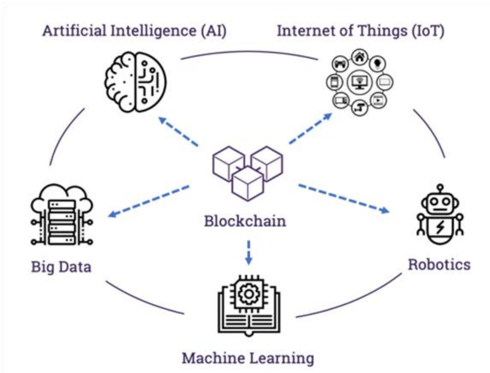
activation layer, and the fully connected layer. The building blocks will be described along with some basic concepts such as SoftMax unit, Rectified linear Unit, and Dropout. According to the architecture of the CNN as shown in figure 1, the convolution layer (CONV) which processes the received input data. The pooling layer (POOL) provides compressing of the information (often from pooling) by reducing the size of the intermediate image. The activation layer (Rectified linear Unit) often called as 'ReLU' which refer to the activation function that is used in this layer. The “Fully Connected” (FC) layer which is considered as a Multiple-perceptron layer (MLP) of neural network algorithms. The classification layer (SoftMax) that predicts the class of the input image.

3. TOWARDS BLOCKCHAIN, IoT AND AI CONVERGENCE MODEL

Since the current IoT architecture is based on a centralized model known as the server / client model, all devices are identified, authenticated, and connected via cloud servers that support massive processing and storage capabilities. Because server / server models are expensive, IoT networks are vulnerable to attack and anticipate potential failures.

20-25 billion IoT devices estimated coming online this year. All these devices will produce raw data which we aren’t able to process into intelligence. Not only that but they’re being communicated on the internet which is insecure and open to cyber-criminal activity.

With the emergence of mission-critical applications and critical infrastructure, this can affect the evolving IoT systems themselves. This brings us to a vital point of analysis: should decentralization be part of the IoT equation? The IoT or devices that speak to each other are inherently distributed. As a result, it makes sense that decentralized distributed ledger technology such as Blockchain is the solution to how devices communicate directly with each other, or with human decision makers. Now, since all IoT devices will need to be tagged, you'll also need to document the path of the IoT devices and what you interact with because they will undoubtedly play a specific role outside the Internet. It is understood that the security model will have a completely different shape style.



Blockchain now allows you to create secure networks where IoT devices will be able to communicate reliably while avoiding cyber threats. With each original node registered and registered on the Blockchain, IoT devices on the network will be able to identify and authenticate each other without the need for human permission or authority. As a result, the authentication network will be scalable to support billions of devices without requiring additional human resources. The Blockchain of IoT data provides new ways to automate processes at all levels without creating complex and expensive centralized storage architecture.

As the volume and complexity of data generated by digital integration or the integration of our physical world increases, it will be greater than human processing capacity; hence the importance and role of AI and machine learning in analyzing public data using basic algorithms, data tuning and learning from the feedback loop. Smart contracts on blocks will play a crucial role in formalizing and automating the relationship between individuals, machines or organizations. As the IoT is an ideal and unique way for the government to communicate and manage public infrastructure dynamically, especially when integrated with smart contracts (Blockchain nodes imbedded with AI techniques), it can make significant shifts across industries, processing and making room for new distributed applications. Also at a higher level, in national decision making and data centers, AI supports the government's decision-making, analyzes, and evaluates the services, public programs or civil servants.

4. GOVERNMENT EMERGING TECHNOLOGIES CASE STUDIES

China recently unveiled a social credit system to evaluate individuals and government agencies in areas ranging from paying taxes to judicial credibility. The system uses massive data and analysis to build a risk assessment model.

Philippines department of Science and Technology - Intelligent Operations Center offers integrated data visualizations in near real-time collaboration and deep analytics to help city agencies to achieve the greatest efficiency of city operations. It is composed by integrated maps, online dashboards, customizable reports, multiple analytic algorithms, interactive standard operating procedures and other tools for improved city operations and incident or emergency response.

Singapore Government – Conversational Systems building a prototype chat bot for selected public services, which is an evolution of the previously implemented virtual assistant. This initiative is an attempt to control the next shift in computing which gives people the ability to talk more and more with computers, which could lead to the biggest shift in computer interaction since the graphical user interface.

Smart Transportation use of autonomous vehicles to reduce pollution.NuTonomy is a MIT-spinoff that is testing self-driving cars. In early 2016 this company was the first one to obtain permission from the Singapore government to test self-driving cars in a small area of the city

(One-North district). It has now started trials with passengers. In this case, Deep Learning is applied in the car technology for object recognition (perception).
Dutch Government by using text mining and machine learning implemented a Decision Support System for child abuse identification, based on knowledge mined mainly from unstructured medical and semi-medical records, using a machine learning approach.
Dutch Government Smart City Amsterdam
Amsterdam Smart City (ASC) is the innovation platform of the Amsterdam Metropolitan Area. It challenges businesses, residents, the municipality and knowledge institutions to suggest and apply innovative ideas and solutions for urban issues. Since 2009 Amsterdam Smart City has grown into a platform comprising more than 100 partners, who are actively involved in over 140 innovative projects.
Estonia's Government use the blockchain for a wide variety of record management systems. The most mature initiative currently in place is the Estonian e-Health Foundation›s deployment of a blockchain-based system to secure over one million patient healthcare records.
The **Danish government** has been modernizing its healthcare system for many years. Many initiatives have been carried out from a number of large-scale telehealth projects, which have been running until 2015, to the construction of new specialized and highly-computerized hospitals. The main aim is to set up a more efficient and sustainable Healthcare system that can be accessed by everyone and respond to citizen's needs, improving disease prevention, diagnosis and treatment.
Seoul Arisu Clean Water Leakage Detection
The Seoul Metropolitan Government (SMG) implemented a new system based on data analytics for studying the correlation between leakeage points and weather conditions. 25 years of data were analyzed in order to correctly modulate pressure and reduce their leakage rate. Moreover, the leak detection system has been highly improved with the introduction of a multi-point leak noise correlation system, which offers real-time data about leaks.
UK Government Digital Catapult Things Connected in depth
Things Connected will initially provide 50 LoRaWAN base stations located across London to establish the UK's largest IoT LoRaWAN network. Free to use, the program will provide a testbed to support evolving IoT technologies in its roll out. LoRaWAN is the first phase of the testbed and additional low-power wide area network (LPWAN) technologies will be included as the network develops.

5. CONCLUSION

Transforming the world and realizing the sustainable development goals by 2030 will require a paradigm shift in the way societies govern themselves. It will require rethinking the role of government and the way it interacts with civil society and the private sector in managing the public affairs of a country and responding to the needs of its people.
Since we now live in a fast-moving space between two existing realities: the central "old world" and the emerging "decentralized reality". Certainly, the central reality with hierarchical organizations, rules, regulations and institutions still takes over. But with confidence declining in the central "old world" due to the concentration of power, wealth and information.
Therefore, the aim of this paper was to provide a comprehensive discussion of integrating the IoT system with blockchain technology. After introducing the foundation of IoT and blockchain, the paper provides a comprehensive discussion on integrating IoT with blockchain by highlighting how blockchain can solve IoT issues. Alongside this, recent studies showing the convergence of IoT with blockchain are also presented. Next, Blockchain as a Service for IoT is discussed to show how the various features of Blockchain technology as a Service can be implemented for different IoT applications. This was followed by a discussion of the impact of AI integration on both the Internet of Things and the blockchain
At the end AI and distributed ledger technologies, including Blockchain, are increasingly seen as offering a better and more extreme alternative in the long run. These technologies have the ability to create a real and transparent playground and operate applications as they are programmed without any possibility of interrupt, control, fraud, or third-party interference. By encouraging more in building this decentralized "new world", we can

guarantee this decentralized world to reach its full potential and provide greater comfort, accountability and confidence by integrating multiple perspectives and diverse disciplines such as business, mathematics and law to ensure that the right decisions.

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