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Comprehensive Study of the 4th Industrial Revolution

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ABSTRACT

Comprehensive Study of the 4th Industrial Revolution has been presented in this research. The 4th Industrial Revolution refers to Cyber-Physical-Biological System components are connected and communicated through the Internet of Things (IoT} concept. It affects the changes in individual and society, Politics and governments, employee and organizations as a whole how we work, think, learn, educate, entertain ourselves, commutations and behave with each other. The 4IR system components comprises of devices, edge and platform. The IoT means people, devices and services all are connected in the platform. The 4IR Industry 4.0 includes emerging technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Robotics, 3D Printing/Additive Manufacturing, Big Data, Autonomous Vehicles, Cloud Computing, Cyber Security, System Integration and Virtual Reality (VR). The evolution of mobiles, homes and embedded systems are represented by the industry 4.0 which evolution helps to create a SMART world for the people because the objects around us have better knowledge of our likes, wants and needs. As it continues to expand, there is a need of flexible, layered architecture to connect billions or trillions of heterogeneous objects via the internet. While projects like SMART system are tasked with designing a common architecture, a dominant choice has yet to be defined. Most initial models featured a three-layer or five-layer architecture consisting of the Perception, Network and Application layers or Perception Layer, Transport Layer, Processing Layer, Application Layer and Business Layer. Various applications of 4IR are not limited to smart home, smart city, smart grid, smart traffic, smart education, smart healthcare, smart agriculture, wearable technology, smart retail, smart supply chain and smart industries have been discussed. Challenges of SMART systems are risks of security, privacy problems and standardization & regulatory frameworks have been presented as well.

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KEYWORDS: *Industrial Revolution, Industry 4.0, Emerging Technologies, SMART system and SMART systems Applications*

1. INTRODUCTION

The Fourth Industrial Revolution, 4IR, or Industry 4.0, conceptualizes rapid change to technology, industries, and societal patterns and processes in the 21st century due to increasing interconnectivity and smart automation[1]. Every industrial revolution has been called disruptive in its time as machines replaced the human labor with the development of stean engine during the first industrial revolution (1765-1870). During the second revolution (1870-1969) electric energy was used to increase mass production. Electronics and information technologies were utilized in the third industrial revolution (1969-2000) to automate production; machines took over a lot of human labor. However, the fourth industrial revolution (4IR) that merges the digital, biological and physical worlds with development of emerging technologies like Internet of Things (IoT), Artificial Intelligence (AI), Robotics, 3D Printing/Additive Manufacturing, Big Data, Autonomous Vehicles [2]. The evolution of industrial creation over a period of time can be seen through its first version in 1784 until today 4th Industrial revolution, where cyber-physical system components will communicate with each other using IoT concept. The driving forces of industries are dynamic leadership and emerging technologies.

Fig.1: Transformations of Industrial Revolutions.

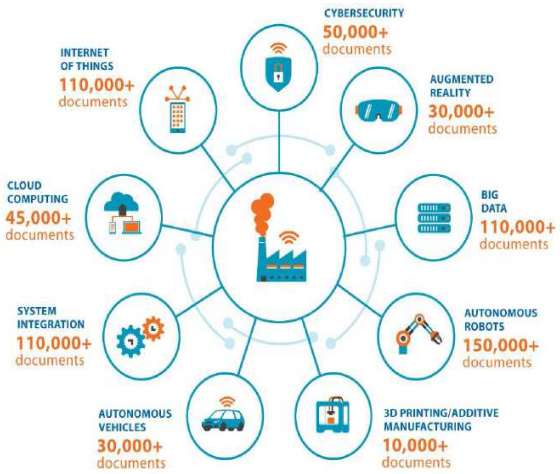

Fig.2: Emerging Technologies Fueling in 4IR.

Small and medium enterprises are constantly emerging and facing the challenges of market leaders [3]. In this research, Cyber-Physical-Biological System concept, components and Architectures have been discussed, Emerging technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Robotics, 3D Printing/Additive Manufacturing and Autonomous Vehicles are dominated in the 4IR Industry 4.0. 4IR applications are smart home, smart city, smart education, smart agriculture and smart industries have been discussed as well. Risks of security, privacy problems and standardization & regulatory frameworks for SMART systems also have been presented.

2. Industry 4.0

2.1. Emerging Technologies in industry 4.0

2.1.1. Internet of Things (IoT)

The Internet of Things (IoT) has become a reality. the demand for IoT technologies to manage the communication of devices with the rest of the world has increased. The IoT is connecting various individual devices called things and a wireless sensor network. A thing can be defined as an embedded device based on a micro controller that can transmit and receive information, IoT device operating systems (OSs). These devices are extremely low in power, memory, and resources. An adequate OS with a kernel, networking, real-time capability, and more can make these devices flexible.

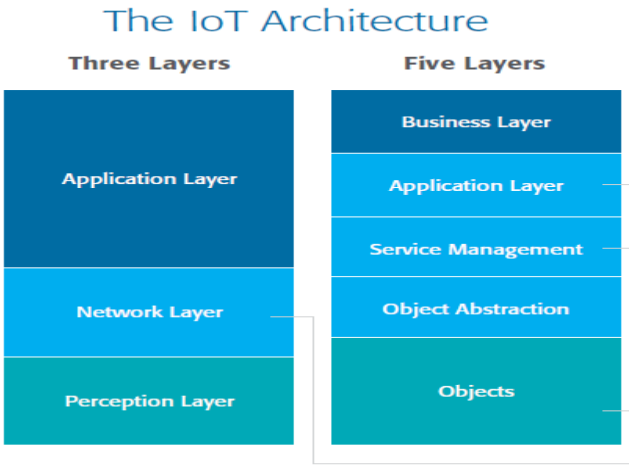

Fig.3: Layers of the IoT

2.1.2. Artificial Intelligence (AI)

Artificial Intelligence (AI) is the ability for machines to learn and adapt to different problems and situations. Also called machine intelligence, AI is very versatile and can work in conjunction with the IoT, autonomous vehicles and robotics in addition to other advanced technologies [4].

2.1.3. Robotics

With 4IR, the prevalence of robotics in society will be one of the most notable changes. Robots are already utilized in manufacturing facilities around the world, but the field of robotics is not limited to manufacturing.

2.1.4. Autonomous Vehicles

Self-driving cars have been in the news for the last few years with companies around the world looking to bring the technology to the public. These cars have the ability to sense things around them and drive with minimal human input. Companies are still working to perfect self-driving cars, but 4IR breakthroughs will lead to massive improvements in the space. Autonomous vehicles could make transportation more efficient and safer for many types of vehicles. With 4IR advancements, drones, buses and underwater vehicles will also experience autonomous operation.

2.1.5. 3D printing

The Fourth Industrial Revolution is said to have extensive dependency on 3D printing technology. Some advantages of 3D printing for industry are that 3D printing can print many geometric structures, as well as simplify the product design process.

2.2. Applications of 4IR

2.2.1. Smart Homes

There have been new inventions for products that connect and control our homes from our phones. With

just one touch, an application installed on a phone will control a smart door lock, the lights, the burglar alarms, home appliances, electronic devices, a smart air conditioning, a smart thermostat, the distance learning and the control of carbon footprint and drapes.

2.2.2. Smart City

A smart city is an area of technology that serves people, and this technology is essentially built around the user. A smart city is nothing but a network designed to optimize resources. The core is the connected street, in this way a city will be more livable and more alive. It can help manage a city through an expanded network that will monitor traffic, street lights, parking, water, gas, electricity supplies and waste management.

2.2.3. Smart Education

A smart school with the facilities operating smoothly promotes a higher level of personalized learning. A computational nervous system for colleges and schools helps to keep track of major resources, create smarter lesson plans, design secure campuses, enhance information access, and much more.

2.2.4. Smart Agricultural

The introduction of quantities techniques into agriculture production processes, cultivation of environmental, and monitoring. With smart e-commerce and smart logistic inventory control, management and traceability can enhance. Moreover, it will enrich public logistic services.

2.2.5. Smart Industries

The IoTs in industries has been indicated predominantly to increase progress for operations. Companies can grow by boosting profits in form of rapid production, novel hybrid business models, smart technologies and transform industrial workforce. However, these designed can help to explore the possible and feasible solutions for digital industry, robots, digital grid and energy. IoTs is changing its competitive landscape of industries in control process, monitoring of the industrial environment, product life cycling, energy saving, pollution control, medical, healthcare and transportation[5].

2.3. Security Risk

Today's smart automation/ IoTs capabilities with respect to security can roughly be divided into the following areas: sensor security, device security, edge security and cloud infrastructure and network security. Network security to protect them is just a first level of protection. A second level of protection within the devices and sensors themselves, as well as a third level providing security monitoring and threat analytics on the device in combination with edge as well as platform capabilities, are required. There are use cases for which more involved solutions already exist: for example, surveillance and video cameras have implemented integrity protection on the data and device levels

2.4. Privacy Problems

Privacy considerations in today's smart systems/ IoTs are largely managed on a non-technical level by concluding service-level agreements (SLAs) with the customer granting permission to use the data produced. On a technical level, only very simple mechanisms, if any, are employed to preserve privacy. Common capabilities comprize encryption to hide sensitive information and use of pseudonyms instead of personal identification items or aggregation to hide personal data within a crowd. Privacy protection within cloud infrastructures commonly uses well-established measures, such as storing and communicating data in an encrypted manner or employing access control to prevent unauthorized information leakages.

2.5. Regulations

The smart automation/ IoTs can help make society more effective, safer and greener, hence government bodies strive for regulations that provide a proper balance between supporting helpful innovation and protecting consumers. Although the goal is the same, the approach between different geopolitical entities varies greatly[6].

2.6. Standards

For the purpose of this analysis, we lump together the various deliverables from recognized SDOs without prejudice under the banner of standards. §§ Horizontal standardization – International standards should be the preferred approach for standards activities that cross domains, geopolitical boundaries, functionalities and requirements elaborated at the international level. – Horizontal standards from ISO, IEC, ITU, IEEE

Vertical and specialty standards – Standards that are domain-specific or geopolitical should come from relevant organizations. Wherever possible, they should draw on higher-level horizontal standards.

3. Conclusion

Comprehensive Study of the 4th Industrial Revolution has been presented in this research. Cyber-Physical-Biological System concept, System components and System Architecture have been discussed, emerging technologies which are dominated in the 4IR Industry 4.0 Internet of Things (IoT), Artificial Intelligence (AI), Robotics, 3D Printing/Additive Manufacturing, Big Data, Autonomous Vehicles, Cloud Computing, Cyber Security, System Integration and Virtual

Reality (VR). 4IR applications are smart home, smart city, smart grid, smart traffic, smart education, smart healthcare, smart agriculture, wearable technology, smart retail, smart supply chain and smart industries have been discussed as well. Risks of security, privacy problems and standardization & regulatory frameworks for SMART systems also have been presented.

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