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The Application of Cognitive IoT for Smart Manufacturing

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Abstract: In recent times, novel paradigms based on cognitive manufacturing services are evolving. This paradigm shift is conveyed by integrating manufacturing assets with the latest and enhanced methods and technologies. However, today's manufacturing systems are facing various challenges, that is the researcher believed that existing technologies and tools specifically, IoT, existing learning techniques and learning systems, lack enough cognitive based intelligence and cannot achieve the expected enhancements and smart manufacturing developments.

In Light of this assessing the advances in manufacturing sectors was the major goal of this work and to identify the cuuent issues and challenches in manufacturing systems being Cognitive and or smart

Afterward, we assessed the research challenges and open issues and facilitate knowledge accumulation in efficiently in the applications of Cognitive Internet of Things (CIoT) for smart manufacturing systems.

Keywords : CIoT, Cognitive methods and model, Internet of Things, smart manufacturing,.

I. INTRODUCTION

As it has been known, computer similar to our brain modeling systems start developing that have the capability of processing the natural language learnt from past, naturally cooperate with us, and assist to make decisions, which is known as Cognitive computing [1–3]. Just after the realization cognitive technology cognitive computing several researcher scholars started developing computing infrastructures that could operate at a better rate than what we did in terms speed. Besides, researchers began to use the modern term cognitive computing which merges biology and technology together in order endeavor with reengineer our brain, which is among the most operative and competent computer technologies in world [4].

Thanks to the emerging cognitive computing technology, most of manufacturing systems are becoming learning systems and with the rapid popularity of IoT, and development of latest and enhanced tools, several scholar determinations had been conducted for empowering and integrating IoT thru smart surroundings for producing the cognitive capability. Considering this reflection, among principal inspirations of the work was to acquaint with recent paradigm called "CIoT", more or less,

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it deals without human intermediation, how broad manufacturing objects and stuffs act as proxies, as well how interrelate with surroundings and/or community internetworks.

A connected small world established as a result of sensor aided, smart object operate cooperatively and made the lives relaxed, is defined as IoT-enabled surroundings (smart environments), and such environments could be categorized as : smart-cities, smart-homes, smart-grid, smart-buildings, smart-transportation, smart-health, and smart-industry [5].

In reflection to this, most of recent works on IoT essentially emphases on empowering the overall things on seeing, hearing, and smelling themselves the bodily surroundings, and making these objects linked for sharing their interpretations. However, the works towards "CIoT" is inadequate, only connecting things is insufficient, further than that, over all objects need have to have the proficiency of learning, thinking, and understanding about their surroundings independently [6].

To this end, the word "smart" states for the capability of independently obtaining and applying wisdom and awareness, and the word "environment" states for surroundings. Therefore, the combined word "smart-environment" refers to the capability of gaining wisdom and awareness (knowledge) and applying it to familiarize to its residents' accordingly which needs to enhance environment via their knowledge [5].

Alternately, with analogous the word "smart" is could also be used as an adjective to refer devices, , when the adjective is used in the term "Smart Manufacturing" which refers manufacturing systems and the related operations are prominent to a innovative stage of intelligence connectivity, openness [7].

Moreover, from engineering standpoints and technology, SM is an evolutionary step in computer-enabled production system control that pushes beyond "smart" technologies, retaining the intelligence and reasoning [8].

Furthermore , although the bulk of works are rapidly growing, tenders and practice of the word cognitive (smart) manufacturing's onto industries and academics still there is also deficiency of universally recognized empathetic regarding the way manufacturing systems could be defined as ‘‘ cognitive or smart". To have a concise standard definitions with the usage of Cognitive/smart manufacturing, a number of literature on smart and—more recently—cognitive, tried to define Smart manufacturing with respect to integration of technologies, methods and related things.

All the way through the entire document, to have focus on the possibilities as well as a communal empathetic, as matter-of-fact the terms Cognitive, smart and digitalized are used interchangeably.

In addition, Cognitive Internet of Things (CIoT) refers to integration of cognition into IoT, all the characteristics for IoT are also considered same for Cognitive Internet of Things too. Therefore, an assumption for the use of the terms CIoT and IoT may be following same fashion as of the terms should also be considered.

II. RELATED WORKS

Although, the attribution on the preliminary use of IoT goes to, an expert on digital innovation, Kevin Ashton, later on, having a common impression of the Internet was about data generated by people as well as things respectively, the term IoT also used as defined by other groups [9].

Further, previously, bearing in mind the extensive upbringing and the technologies required, from sensor devices, communicating subsystems, aggregation of data and pre-processing to the things or objects instantiations and to end provisioning of services, an clear-cut definition of the "Internet of Things" has bed made , which was non-trivialities. But, as universal conception, it needs a communal definition [10].

Moreover, enthused by the impression of interconnecting smart devices, IoT was proposed as a upcoming technology such as RFID, which allows the automatic identifications of the physical objects, which offers a chance to detect, recognize, and realize the glob by catching data regarding the RFID tagged things as well support industries accomplish better competence and responsibility [11-13].

Despite, the growing in inter-connectivity among all-purpose objects, as one of the most distinguished characteristics of IoT, lots of exciting facilities or use cases are evolving. Thus, alternately, impressed by the use of ICTs, , and other precarious substructure mechanisms and facilities of our surroundings such as administration, educational organizations, health-care, safety, real estates, and other services could be made more conscious, collaborating and effective and such environments can be defined as smart environments [14, 15]. However, many of the existing smart environments exhausting applications of IoT still are extremely reliant on humans for smart or cognition processing.

According the authors [16], a special consideration for cognition, the working procedure our brain could be taken as framework reference [17]. Moreover, it is vital to discourse the implication of the related term "cognition" and that is supplementary apt to state "cognition" rather than a "discipline" it is an "field of integrative" due to the field of works in "cognition" incorporates several works fields which are embedded in science such as computations and mathematics, physics, neuro-science, computer science and engineering etc. [18]–[22], Similarly, CIoT is defined in [16]. Having said this, it is a novel paradigm, where interconnection of physical/virtual things or objects are required and act as proxies with minimum human intervention [18].

Eventually, cognitive systems could influence every industries and enterprises. Thus, that is compulsory to augment IoT assortments with the cognitive technologies Such as, NLP, ML, Big data(text ,image and video) analytics [24].

Due to the foremost developments in science fields, cognitive, there will meaningfully growth in our productivity over counseling, spreading and supporting the capabilities of people. For instance, few of the developing cognitive technologies and subsystems include Cognitive Materials, Cognitive (smart) Cameras, Cognitive Production Systems and other cognitive infrastructures are found with detail description in [4].

III. PROPOSED METHODOLOGY

A. DESIGN METHODS

In contrast to conventional machinery monitoring, smart manufacturing processes monitoring should covers a part with operational processes such as cognitive and manual monitoring. Thus, a cognitive design model plays crucial role as well as produces compatibility among products qualities and quantities on operational environments to be certain on workers' devotions and to grant them support for evading faults [25].

Furthermore, the adhesive relation among various platforms such as data measurement, modeling adaptation, and controlling can be realized via cognitive models, representation of the real world things. In the globe, it could be found several models with various levels of abstractions. Here after, some of the proposed models in the CIoT for smart environments domain have been presented.

From the pool of proposed models, a, a game based model for smart environment using RFID that turns and monitors data storage and permits automatic collaboration of work piece and machinery tools. To support for smart industry decision makers to assess the employee's efficiency to the degree of their enactment fairly [25].

Moreover , several models for decision making have been proposed [16], [26]-[28], such as spatial game models for large- scale CIoT, agent based, Bayesian, NN and more others in [29, 30].

However, in large-scale CIoT overall exchange of information among all players is impossible, the spatially dissemination of performers, exchange of information remotely in the collaborative manner is not feasible and generally is hard to analyze it.

An encouraging method leading to cooperation local exchange of information in the interactive was presented attractively but still it is impossible at larger-scale CIoT. Therefore, game based and the related models have less importance for Cognitive Manufacturing systems [31].

In general, the design model of a system that incorporates various levels such as, the conceptual, functional, structural levels and these levels support to improve outcomes meanwhile keeping adaptable uncertainty and difficulty, is crucial. Furthermore, the superglue relation among various platforms can be realized via cognitive models, representation of the real world things.

Therefore, in harmony to our understanding, CIoT could be noticed that the existing IoT combined through cooperative and cognitive techniques to endorse enactment and accomplish smartness,

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to improve the production practice and enhance the monitoring system, manufacturing factories should have to have a tolerable automations and interconnections in supporting the realization of smart manufacturing. Due to this fact, the cognitive ring processing model consists of a three-layers cognitive were proposed [18].

Therefore, in harmony with manufacturing standpoint, we would like to remark that, to achieve smartness/ cognition, suitable methodss need to be developed based on a learning subsystem to characterize existing states of manufacturing and industrial system, ML could be taking as an promising and suitable tools to tackle with existing and upcoming issues[44].

B. PROPOSED MODEL

Being recognized as evolving industry, many manufacturing are systems relay on technologies that leads towards cognitive or smart manufacturing systems (MS).

The proposed model collects information from the various manufacturing infrastructures and gives to data conversion block (DCB) as input. Then after, the DCB is responsible to converting the data gathered from IoT objects into valuable and suitable information and is the central element of our model. The overall manufacturing data will be to store Database system. The assessment block and decision block are responsible for tracking the daily activities of workers and/or the quality of the products and making the decisions respectively. The detailed design of the proposed model and the block diagram of system illustrated below.

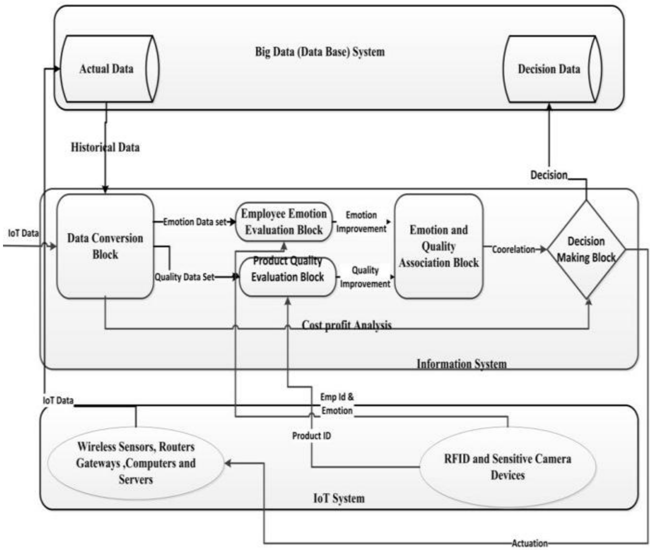

Figure 1: Bolck Diagram of CIoT system model

The above figure, presents the modeling of smart manufacturing and complete data flow of system. The proposed model comprises of three main manufacturing systems: IoT, data Processing and database. Data collection from manufacturing infrastructure, Data processing and storage are responsibility subsystem respectively.

IV. RESEARCH CHALLENGES AND OPEN ISSUES

Many existing technologies, methods and techniques are available for customer usage, however are not appropriate for cognitive manufacturing applications that have severe safety and security requirements. International cooperation efforts and a system-level perspective are required for empowering the capabilities to tackle the IoT, object detection and face detection related challenges [32]–[41].

Recent MS are facing with the challenges that are far apart from the previous ones. Therefore, to provide a basis for the argumentation of cognitive capability, which is the appropriate tools and methods for manufacturers to face those challenges (eg. machine learning and cognitive.

Technologies being the appropriate tools for manufacturers to face those challenges head on), under this section the recent challenges of CIoT and smart manufacturing aspects are discussed.

According [43], through the evolution of technology Internet of Things network arises to integrated manufacturing things, and produces a vast ground for manipulation, but in contrary it also raises complication like different issues and necessities that challenges for recent techniques over problems. Therefore, with the growth and propagation of IoT minimum cost and maximum proficiency, leads to bring the globe near to CIoT. With the cooperation of industries and organizations together, we anticipate challenges of internet of things could be dominated [49].

Moreover, with aspect of CIoT, some of the challenges and issues like: synchronization between different cloud vendors, big data data analytics, object and face detection, intelligent surveillance, Standardizing cloud computing for IoT cloud-based services, balancing the differences in the infrastructure, unreliability in the security mechanisms, handling within different resources and components, are as the result the complexity of employing cloud computing with CIoT [45-52].

V. RESULTS AND DISCUSSIONS

From the finding of our work, some research issues have been identified and with the growing amounts of data, the growing difficulty of manufacturing systems, the possibilities developed technologies in analyzing big amount, and with vast possible importance of data indicates to the anticipation of Big Data analytics. Thus, it will get into more and more focus of many areas. In fact, the adaptation of smart Manufacturing is one of them.

The national and international manufacturing initiatives, the Internet of Things initiative, standards development organization manufacturing programs, and the emergence of sustainable manufacturing requirements are among the sources of new requirements to support smart manufacturing.

However, the existing manufacturing standards are insufficient to fully enable smart manufacturing, especially in the areas of cyber security, cloud-enabled manufacturing facilities, integration of supply chain, and analytics of big data.

For this fact, derived from the application of Cognitive IoT scenarios and enhanced by literature and our experience, and the main research challenges for realization of smart manufacturing have been identified and structured in three main categories as presented in table 1.

Table1: Existing issues regarding the adoption smart manufacturing

Issues	Classifications	SM Application Scenarios
Technological Issues	• Standards/interfaces • Data analytics • Data security • Sensors/actuators	• Cyber-Physical Logistics System • Safe Human-Robot Interaction • Video Surveillance as a Service
Methodological Issues	• Reference models: • Visualization: • Service/app	
Business Issues	• Privacy issues • Investment issues	

These structures make Cognitive and/ or smart manufacturing or industrial uses altered from consolidated monitoring and simple IoT services. In the era of big data, it needs better enactment in connectivity, detection, and communication of devices and modules.

The implementation of cognitive(smart) Manufacturing frequently overtakes the facility of several industries to hold, spread over, and power computing accessibly (wireless security, cloud computing, , mobile and cellular, and remote accessing,) and technological analytics. Approximately one third of manufacturer's environment face shortage of ability major issues correlated to IoT competences which refer to Talent shortage.

Furthermore, big Data analytics is also perhaps a foremost effort for the coming basement of transformation into smart manufacturing, and could computing becomes a crucial foundation of effectiveness, increasing in efficiency, and invention. Moreover, it would be noted that, one among the sever issue of such systems, that produce vast amounts and uninterruptedly generated information, possibly comprising relevant information, is the analytics.

Therefore, in extension of our work, scholars expect to implement SM applications upon uneven addition of CIoT architectures and/ or models to uncover the opportunities for implementation of smart manufacturing environments.

VI. CONCLUSION

Due to the recent paradigm shift, most of the manufacturers have strong interest in deploying CIoT devices to develop manufacturing applications and services such as automated cognitive monitoring, cognitive control, cognitive administration, cognitive maintenance and so on.

Moreover, researchers across the world have started to explore various technological and or methodological explanations to enrich manufacturing facility in a way that supplements and present facilities by assembling and empowering the potentialities of IoT.

With reckless stepped expansions in IoT and growing accessibility of information, which is at lowest cost devices and huge number of infrastructures and the modification in the direction of smart or cognitive manufacturing and power of computation, requests for Cognitive IoT especially in related environments will rise additional at a quick speed.

In nutshell, the outcomes of our work could be anticipated to be beneficial to scholars, manufacturing experts, and officials employed in the wide range of CIoT as well as smart manufacturing.

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