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An Edge-Based Multi-Technology Architecture Healthcare Industry 4.0

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ABSTRACT

Healthcare Industry 4.0 refers to intelligent operation processes in the medical sector. With the development of information technology, large-scale group decision making (GDM), which enables a greater number of decision makers (DMs) from various location or sectors to participate in decision making, has been quickly developed and been applied in Healthcare Industry 4.0 to aid in make decisions effectively and strategically. This study examined numerous actual examples of AI applications in healthcare in addition to doing a thorough analysis of the literature. The findings show that large hospitals are currently utilizing AI-enabled systems to support medical staff in patient diagnostic and treatment activities for a variety of disorders. Additionally, AI technologies are enhancing the effectiveness of administrative and healthcare tasks. Healthcare professionals are welcoming AI, but its uses can be seen from both utopian and dystopian perspectives. In order to generate a thorough understanding of GDM in Healthcare Industry 4.0 and to identify potential future development directions, this study conducts an overview. According to the paradigm of the general GDM process, which involves information representation, dimension reduction, establishing consensus, and result elicitation, the implementations of GDM methods in Healthcare Industry 4.0 are evaluated. We also discuss present research obstacles and potential future developments in relation to medicinal GDM. Our work is believed to be useful for researchers looking into GDM in Healthcare Industry 4.0. Also, discuss the details of those opportunities and challenges to provide a balanced view of the value of AI applications in healthcare. It is clear that rapid advances of AI and related technologies will help care providers create new value for their patients and improve the efficiency of their operational processes.

Keywords: Healthcare Industry 4.0, Group decision making, Large-scale group decision making , Medical industry.

I. INTRODUCTION

Intelligent manufacturing production procedures are referred to as "industry 4.0," a concept first presented in 2011 [1]. Every part of people's life is now connected to smart technology with the advancement of technologies in the areas of the Internet of Things, cloud computing, big data, and artificial intelligence. As a result, Industry 4.0 has expanded to other sectors. People start to focus more and more on their health once the necessities of material life and survival are secured. The medical sector has been impacted by Industry 4.0. Healthcare Industry 4.0 [2] refers to the medical sector that uses intelligent technology like big data and machine learning. One of these disciplines is decision science, which was described as a science to identify uncertainty and techniques to derive the best decisions [3]. Making decisions is a crucial activity in people's lives and is crucial to the medical sector. Many areas of the healthcare sector have used decision science approaches and procedures [4, 5].

One of the most important aspects of decision science is group decision making (GDM) [6]. A final solution is generated by GDM using consensus measurement and result elicitation and based on the assessment data of several decision makers. GDM techniques can aid in making the best or worse decisions in a complex setting with lots of information. Modern decision makers also call for the democratization of decision-making, which can be accomplished by utilizing GDM techniques. Due to the aforementioned benefits, GDM approaches have gained the interest of numerous academics and have been used in a range of sectors [7].

Separate reviews of the literature on GDM and healthcare have been conducted in a number of studies. [8] examined the Delphi technique in relation to the examination of GDM methodologies, whereas [9] carried out surveys on multi-criteria decision making (MCDM) methodologies. The decision-making tools and applications for neutrosophic information and intuitionistic fuzzy information, respectively, were the emphasis of [10] examined the literature on familial GDM. Although each of the aforementioned papers provided a detailed introduction to a particular research subject or method, such as information representation or multi-criteria group decision making (MCGDM), they did not perform in-depth analyses of the field of medical GDM.

AI-supported technologies learn and diagnose from a large volume of medical research and patients' treatment records, they play a significant role in augmenting doctors' decision-making process for diagnoses and treatment [11]. AI-based diagnostic algorithms [12] are applied in the detection of breast cancer, serving as a 'second opinion' in assisting radiologists' image interpretations." It was also reported that AI technology can diagnose skin cancer more accurately than a professional dermatologist [13]. The diagnosis can be processed more quickly and efficiently because it is analyzed based on knowledge gained from a large body of knowledge and data [14]. Moreover, advanced virtual human avatars are being used to conduct conversations required to diagnose and treat patients with the mental disease [15].

This study's objective is to review previous research on GDM in Healthcare Industry 4.0. We do bibliometric studies on the obtained papers after gathering and merely processing the data, which enables us to clearly understand the development trends of GDM in Healthcare Industry 4.0 as well as the present research hot areas. It can also assist us in investigating innovation and potential futures. In contrast to previous survey publications, we also offer a thorough introduction to medical GDM. This study provides an in-depth explanation of various forms of information representations, expert and decision information clustering methods, consensus measurement and reaching methodologies, and result elicitation strategies[16]. In the examined publications, LSGDM approaches and numerous medical applications are also specifically introduced.

The rest of this paper is organised as follows: Section 2 conducts related works on the reviewed papers. Section 3 provides the implementation of GDM methods in healthcare Industry 4.0. Section 4 presents specific healthcare applications. Section 5 discusses conclusions in the final section.

II. METHODS AND MATERIAL

In [17], a thorough analysis of the e-Health ecosystem's state and the effects that IoT, Big Data, and cloud computing have had on it are presented. The writers talked about Industry 4.0 technology and how it applies to the healthcare industry. They discussed the fundamental technologies, as well as their advantages, cross-disciplinary difficulties, and lessons learned. The state-of-the-art in the fourth industrial revolution is currently lacking, according to the authors of [18], systematic reviews. By examining academic development in the Industry 4.0 paradigm, summarizing existing research activities, highlighting gaps, and suggesting future research areas, the authors hoped to close this gap.

Industry 4.0 that were divided into the following five study categories: IoT, BDA, Cloud Computing, blockchain, and AI. The authors noted that despite the attention Industry 4.0 has received, there are currently few systematic and thorough reviews demonstrating the dynamic nature of this paradigm. They examined the current state of research in the major Industry 4.0 sectors and highlighted the various research pathways employed in the field. An additional study [19] concentrated mostly on Healthcare 4.0 and how it evolved from Industry 4.0. They carried out a thorough analysis of the most cutting-edge digital medical technology now on the market. The writers of [20] investigated the gaps, difficulties, and trends in putting Healthcare 4.0 into practice. They identified Healthcare 4.0 deployments in hospital information management and learned that research on the topic has been undertaken in an interdisciplinary approach with a variety of applications and functions. Remote monitoring systems are made possible by IoT, which has a significant positive impact on healthcare. New advancements in health-sensing technology have been made to, among other things, measure patients' heart rates and blood pressure.

The procedure can be seen on the IoT healthcare network. The IoT network is used for both data transmission and reception. The topology, architecture, and platform together make up IoT healthcare [21]. Numerous use cases, application situations, and activities are supported by the topology. The hierarchical concept is reflected in the healthcare architecture, which displays how the system's software is organized overall [22]. Platform is made up of environment, framework, and libraries.

Systems for wearable remote heath monitoring are already in use in the healthcare industry. IoT devices have sensors built in that can deliver precise data. These wearable gadgets, such as smartwatches and smart bands, can be used to monitor chronic illnesses. Data from ECG sensors can be detected using AI-based data processing methods.Steps, heart rate, blood pressure, calories, and a number of other metrics can be tracked using smart bands, such as wristbands. As a result, IoT devices can be used to detect health issues. The Apple and Google Play application stores offer mobile smartphone applications, such as mHealth apps, that provide details about the user's health. The sensors built inside the phone are used by these applications to function. Medication adherence is another application area, although it can be expensive and is sometimes out of reach for patients, doctors, and healthcare professionals. IoT healthcare systems have been proposed in some instances.

The sensors (or IoT engines) in a cloud-based IoT system create data linked to several neuroscientific divisions. These sensors work together to define these patterns, much like how people interact. The trustworthy metrics of each node are combined during various interactions using a neuro-fuzzy technique [23]. Cyber-physical systems are a combination of physical and computational processes. Robots and sensors are examples of cyber-physical systems [24]. IoT and data services adhere to frameworks that are connected to cyber-physical systems [25]. The ideas of bio-sensors, artificial organs, and intelligent drugs are well-known from earlier science fiction [26]. Such fiction has now become reality because to the creation and development of the Internet of Things. Projections made with electronics have been a subject of several agendas.

The idea of smart manufacturing management is the next one. The nucleus of Industry 4.0 might be referred to as smart factories. Industry 4.0 guarantees the capability to automate tasks and assist individuals in achieving their engaged task objectives. Context awareness has also been introduced by Industry 4.0 [27]. Data for patients have been amassing quickly due to the Internet of Things' rapid development. The predictive potential of cognitive systems aids in improvements to secure databases. Deep learning can assist cognitive system algorithms employ self-learned data. Cognitive system methods are used in ML and pattern recognition [28]. The algorithm is often content-based, but occasionally it takes the form of collaborative filtering.

These algorithms may use memory or be model-based. Two CPS tenets are e-Health and m-Health, where e-Health refers to a combination of information and communication technologies and includes activities like gathering insurance coverage information. However, m-Health can be used as an illustration of Industry 4.0. Any sophisticated or intelligent environment can use ML concepts. Right now, automation is prioritized in the "smart factory" concept that the majority of sectors are pursuing. Industry 4.0 has a significant impact and is now widely used in engineering to create smarter, more intelligent robots that can perform tasks more quickly and effectively, among other things. Big Data is a broad term for a lot of data, both structured and unstructured.

Figure 1 Architecture Healthcare 4.0

III. PROPOSED METHODOLOGY

According to the World Health Organization 60% of factors related to individual health and quality of life correlate to lifestyle factors, such as exercise, diet, sleep, stress reduction, substance and medication abuse, and/or recreation. AI-aided technologies and their applications can now provide lifestyle interventions and reminders during the day based on an individual's vital signs through digital devices. Within healthcare organizations, AI-based technologies are set to significantly transform how healthcare systems operate, optimize, and interact with patients, and provide care services to increase the overall efficiency of patient outcomes.

3.1. Diagnostic Assistance

AI is expected to facilitate the diagnosis of patients with specific diseases. Therefore, the use of AI-based technologies in various healthcare fields can help reduce errors made by human judgment. The Mayo Clinic, a premier healthcare organization in the US noted for its innovation for patient care and health technology, employed AI for cervical cancer screening to identify pre-cancerous changes in a woman's cervix. The AI-based solution uses an algorithm employing over 60,000 cervical images from the National Cancer Institute to identify precancerous signs.

AI-based technologies with deep learning techniques utilize 101 million data points from electronic records of 1.3 million outpatient visits to the medical center. To compare performance between the AI system and physicians, the study divided the physicians into five groups based on practice experience as follows: Group 1 senior resident physicians with more than three years of experience; Group 2 junior physicians with eight years of experience; Group 3 midlevel physicians with 15 years of experience; Group 4 attending physicians with 20 years of experience; and Group 5 senior attending physicians with more than 25 years' experience. The AI-based model achieved an average accuracy score of 88.5%. This score was higher than that of the two junior physician groups (G1, 54.1% and G2, 83.9%) but lower than the three senior physician groups (G3, 90.7%; G4, 91.5%; G5, 92.3%). AI model may potentially assist junior physicians in diagnoses but may not necessarily outperform experienced physicians." In addition, the study concluded that the AI system was able to diagnose conditions with 90 to 95% accuracy rates.

The Manifal Hospital, one of the top cancer care centers in Bangalore, India, introduced Watson for Oncology in 2015 and found a significant difference in diagnoses by the medical staff (multidisciplinary team) and Watson's judgment using datasets of 1000 cancer patients, including those with breast cancer, colorectal cancer, rectal cancer, and lung cancer collected by two doctors over three-years. In the case of rectal cancer, the consensus rate between Watson's treatment recommendation and doctors' decisions was 85%, but the consensus rate for lung cancer was just 17.8%, demonstrating a large discrepancy between the two depending on the type of cancer.

3.2. Nursing and Managerial Assistance

As is widely known, healthcare staff is often inundated with much paper work in the care process. This workload has prompted the industry to transition to electronic systems that integrate and digitize medical records, which is aided by AI-based technology. In addition, the use of chatbots has been identified as a potentially effective tool for engaging in conversation with patients and family members in hospitals.

The Cleveland Clinic, a non-profit multispecialty academic medical center in Cleveland, Ohio, began using Microsoft's AI digital assistant Cortana in 2016 to "identify potential at risk patients under ICU care" through predictive and advanced analytics. Cortana is integrated into Cleveland Clinic's e-Hospital system and monitors "100 beds in 6 ICUs" from 7 p.m. to 7 a.m. An AI-assisted system of the University of Pittsburgh Medical Center can also listen and learn from conversations between doctors and patients in hospital rooms.

The Johns Hopkins University Hospital, a non-profit academic medical center in Baltimore, Maryland, announced collaboration with GE healthcare partners to use predictive analytics based on AI technologies to support a more efficient operational flow. The Johns Hopkins Hospital Command Center receives "500 messages per minute and integrates data from 14 different Johns Hopkins IT systems across 22 high-resolution, touch-screen enabled computer monitors." James Scheulen, chief administrative officer for emergency services and capacity management at Johns Hopkins, reported that as a result of AI technology, “emergency room patients are assigned a bed 30% faster; transfer delays from operating rooms have been reduced by 70%; ambulances are dispatched 63 min sooner to pick up patients from other hospitals; and the ability to accept patients with complex medical conditions from other regional and national hospitals has improved by 60%”.

Other real-world examples that apply AI-based technologies in the healthcare system comprise Robotic-assisted Surgery and Virtual Nursing Assistants. Robotic-assisted surgery is preferred by surgeons due to its high precision, controllability, and flexibility. Robotic-assisted surgery can allow surgeons to perform surgeries that are very complicated or that were previously impossible. Advanced technological enhancements allow physicians to view additional patient-critical information in real-time even during surgery that combines real-time data with medical records, thus benefiting from AI technologies that leverage previously successful data regarding the same type of surgeries.

The AI robot Paul assists medical staff on their rounds of patient visits and provides a list of inpatients to be treated by medical staff when a staff member scans a doctor’s ID card. The robot also accompanies medical staff to the ward, recognizes the voices of medical staff, and converts speech into text to transcribe electronic medical records in real-time. It also provides patient information, such as medical records, medical images, and test results, in real-time through the hospital system to assist the medical staff on their rounds. This robot can reduce the recording work of medical staff, accurately and quickly check patients’ medical examinations, and inspect information in real-time, as well as providing answers based on a real-time information-linked function through machine learning to enhance the efficiency of care services [33]. In the lobby of the hospital, the guide robot Maria provides customers directions to areas throughout the hospital. When a patient touches the robot using their own medical ID card, Maria guides them to the appointment schedule and the location of the doctor’s office. Maria can also guide patients to a particular medical department in the hospital.

The examples of AI-based diagnostics and administrative workflow assistance presented above highlight the expanding scope of AI to various areas in the healthcare system. To continuously expand and improve the quality of AI-supported systems, we examine some of the issues in the healthcare industry that need to be addressed.

The designed and implemented Edge-based architecture mainly consists of two complementary components: i) a tiny mobile client module to be installed on mobile devices (i.e., smartphones, smartwatch) to integrate BSN and ii) a performing gateway, placed at the edge of the network, deployable on different resource constrained or resource-rich hardware platforms supporting multi-radio and multi-technology communication to collect and locally process data coming from several application scenarios. Two different cardiac monitoring case studies have been implemented to detect high-stress conditions of automotive factory workers and athletes connected to both BodyEdge and a reference Cloud platform in order to measure the overall system performance in terms of processing time, delay and scalability.

The obtained results highlighted the system conditions and the application scenarios in which the proposed Edge-based approach is very useful and convenient while standard Cloud support should still be adopted for long-term storage and statistical analysis. BodyEdge, a general IoT system architecture well designed to support specific applications for emerging healthcare industry. The need to develop such novel architecture comes from the accurate analysis of the nowadays healthcare contexts in which application requirements related to communication delay, scalability, responsiveness, transmission capacity and data privacy are becoming more and more important; thus, the wise integration and use of an Edge communication device can play a key role to face few limitations of the public/private Cloud platforms as pointed out in the previous section.

The multi-radio and multi-technology Edge gateway can collect and locally process data coming from different scenarios or it can exploit the facilities made available from both private and public Cloud platforms according to the specific requirements of each scenario in order to guarantee a high flexibility, robustness and adaptability level of service. In particular, the proposed framework is organized in a three-tier (i.e., cloud/edge/IoT devices) architecture in which the Edge Layer represents the connecting layer between the far cloud and the physical IoT devices whose data can be directly collected from the BE-GTW or through the BE-MBC in specific application contexts.

The BE-MBC component, developed as a software application, can be installed on a smartphone and it communicates with the body sensors worn by the people using multi-radio interfaces. It basically acts as a multi-radio communication relay node in order to reach the Edge gateway when the body sensors at the Edge gateway are too far or they cannot be directly connected to it. In these cases, such tiny mobile client is a mandatory component of the proposed communication architecture since it also acts as a simplified edge gateway with reduced capabilities toward the more powerful BE-GTW. However, the communication with the BE-GTW can also take place without any mobile client component when IoT devices can directly send their data to the BE-GTW.

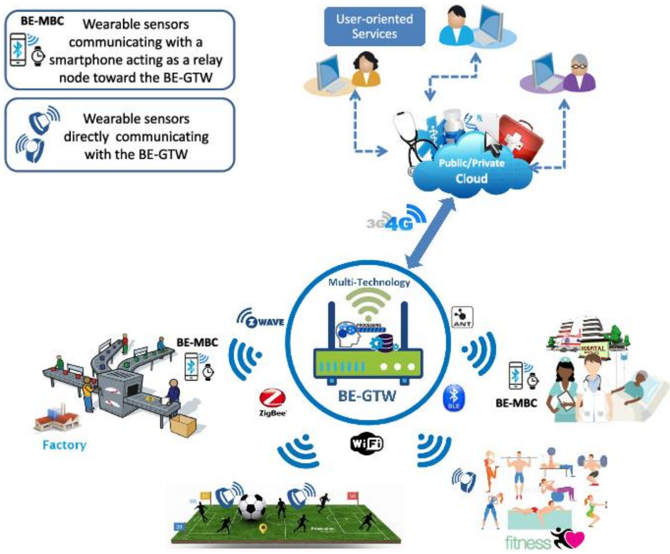

Figure 2 Architecture of Edge based Multi-Technology of Healthcare Industry 4.0

IV. RESULTS AND DISCUSSION

Improved Disease Treatments

As discussed in the real-world cases of AI applications in healthcare, advanced technologies are playing an increasingly important role in augmenting medical staff in almost every area of patient treatment. For example, how patients with high blood pressure and lung disease can be treated with more accurate data based on an AI-supported magnetic resonance imaging (MRI)-based algorithm of cardiac motion. In the same vein, 3Billion developed an algorithm to diagnose rare DNA based diseases in 2019. AI-based technologies can greatly improve patient care services in rural farm communities of developing economies.

AI has been proven to be especially effective with a large volume of radiology data to improve the quality of care services with medical imaging. If AI-based software can improve the accuracy of patient diagnoses, then it will greatly help not only patients, but also the work of medical staff. For example, the frequency analysis of mitosis in cancer cells through images or microscope is a straightforward process, but takes a great deal of time. AI software can perform this task with greater accuracy and speed, thus, helping medical staff with their professional work while eliminating some of the drudgeries of tasks. AI-supported medical software can get smarter with learning from the increased volume of accumulated data and new medical research. This fact is proven as the increased accuracy of AI-supported medical software is approaching or exceeding the accuracy of medical experts in diagnosing diseases. The continuous research in the use of AI systems will greatly augment the work of medical staff as they can alert some areas that humans often miss or help minimize medical errors during the patient treatment.

Improved Patient Engagement and Participation

The most popular smartphone-based health coaching apps, is a diet app that fully functions as a mobile diabetes prevention program. The company states, "we work with customers across the globe to help them create healthier habits, reduce their risk of chronic health problems, reverse disease, and foster healthier relationships with themselves in the process". The key to achieving the goals a person sets in using this coaching app; he/she must be fully committed to the program.

Patient participation in the medical treatment process is imperative for accurate disease diagnosis and patient safety. In addition, patients themselves perceive their personal participation in sessions with medical staff as a valuable and positive experience for their own sake. When patients are encouraged to participate in their medical treatment, they tend to be fully engaged in carrying out their part in the process, which has a positive influence on their satisfaction with the care quality. Patients' positive experience of their engagement in the treatment process has positive impacts on the treatment result and patients' safety. Therefore, to enrich the patient experience as a means to improve care quality, patient engagement and participation should be a strategic goal of healthcare providers.

While, patients may not be familiar with AI or AI-supported medical systems, they are more likely to participate in the system supported treatment process if they learned from the popular media or the attending physician about the possibility of faster and more accurate diagnosis, reduced medical errors, and decrease of the medical cost. With the rapid advances of AI and AI-imbedded medical systems, healthcare systems should develop strategies to inform and educate customers about the merits and risks of the new systems. Well-informed customers will more willingly participate in the use of AI medical systems, and thus, increase the flexibility of their treatment options.

Improved Operational Efficiency and Reduction of Medical Cost

AI-supported medical systems, as discussed above, can handle many diagnostic activities without human intervention. AI-imbedded pill-cam can replace laborious traditional upper endoscopy to check stomach cancer exam. These AI systems all help make the diagnosis and treatment processes much more efficient and cost effective.

AI systems are not exclusively for medical purposes. Some AI systems are designed to support operational innovations to create additional or new value in the value chain of a healthcare organization. AI systems can perform routine operational activities much better and faster than human workers, such as managing maintenance systems, accounting, and information inquiry. AI-enabled chatbots and nursing robots can greatly improve the efficiency of operational processes.

Increased Productivity and New Job Creation

Will robots and AI take over everything that humans are doing currently? The history and evolution of industrial development, from the 1st Industrial

Revolution to the fourth Industrial Revolution, have shown that while many routine manual jobs were replaced by technologies, many new jobs have also been created to support productivity increase. For example, although the hard-copy printing business has diminished greatly, many new jobs have been created in digital editing and typography. Many map publishers have closed their doors, on the other hand, numerous new jobs were created to develop navigation and geographic information systems.

AI solutions are already producing the kind of internal gains that suggest much more is possible in healthcare players' back offices. While, the AI-enabled app Noom helps people live with healthy lifestyles, from managing their dieting routines to preventing long-term diseases, the AI system was able to detect the reasons why some customers quit the system use and not able to fulfill their original goals. Therefore, the company introduced Noom Coach to teach people that health management requires not only regular and disciplinary diet and exercises but also psychological motivation. Thus, Noom Coach began to provide customized one-to-one support services to maintain sustained relationships with the customers to help them attain their health goals. In other words, Noom recognized through the AI system that technology alone cannot change people's behavior, but psychological analysis of emotions and desires should be incorporated to make the system work. In the process, Noom has been able to create many new jobs.

AI-enabled eye disease diagnosis system for macular degeneration and diabetic macular edema through transfer learning developed in collaboration between San Diego State University and China's Guangzhou University Medical School. This AI system can complete the diagnosis process of identifying the disease and its stage of development in just 30 s. Furthermore, the accuracy rate of diagnosis, in comparison with the collective diagnosis of five expert ophthalmologists, was over 95%. These examples clearly indicate that AI-based systems can improve productivity by decreasing the error ratio, saving the diagnosis and treatment time, and exploring opportunities to expand care services that were not possible in the past.

Reduced Healthcare Cost

The ideal healthcare service would include the following: data and evidence-based disease prevention, diagnosis and treatment with the best available technologies, patient-centric customized care, and quality care with empathy from medical staff. If AI can be applied broadly to support such ideal care service, then it can help secure both quality care service and significant savings in medical costs. According to a report by ABI Research, a consulting firm for marketing research, smart applications of AI in the healthcare industry. The number of AI-supported devices for patient training to prevent chronic diseases (e.g., diabetes, high blood pressure) in these two countries is expected to increase from 53,000 in 2017 to over 3.9 million by 2022, an annual increase of 176%. Thus, AI applications in healthcare can be a major force for reducing medical costs, not only for individual patients but also for society at large. At the national level, such savings can be diverted to prevention of diseases for better quality of life of all citizens.

V. CONCLUSION

Advances in digital technologies have greatly broadened their application areas. Furthermore, another important aspect of such advances is the increased ease of use and usefulness of digital technologies. Healthcare service is no longer an isolated silo with the monopolistic power of the medical staff. Patients' health is the result of many contributing factors: healthy diet, regular exercise routines, management of emotional and psychological stress, preventive medicine, and of course cure of diseases. Today, many patients do their own research about their health or ailment conditions through online services. AI-based systems, it is important to collect and analyze data of various types because machine learning algorithms of the systems require a sufficient volume of data for an accurate diagnosis. While there are positive and negative issues involved with the application of AI and its various aspects, it is a reality that AI has made a significant inroad into the healthcare sector and this trend is expected to accelerate in the future. Thus, it is necessary to increase the research, accessibility, and actual use of AI in the healthcare industry. A real-time data acquisition of information and sharing is required to enhance AI performance in healthcare. The qualitative accumulation of accurate and realistic data is vital because patterns of disease vary depending on individual characteristics such as ethnic and cultural background, lifestyle, socio-economic conditions of the patient's living area, etc. Therefore, to improve the accessibility of high-quality data at the governmental level, reasonable data access criteria and systems, with the consideration of risks and benefits of data sharing, should be established. Social consensus must be reached for the critical aspects of AI, including data sharing confidentiality, and liability. To acquire data, which is the essential resource of medical AI, the participation of general public should be encouraged. In addition, social consensus is required on the quality management of AI-based systems and liability for possible misdiagnosis or medical accidents during the care service. AI-based systems require the collaboration of specialists in several related areas for care service.

VI. REFERENCES

1. Aceto, G.; Persico, V.; Pescapé, A. Industry 4.0 and health: Internet of things, big data, and cloud computing for healthcare 4.0. J. Ind. Inf. Integr. 2020, 18, 100129.
2. Liao, Y.; Deschamps, F.; Loures, E.d.F.R.; Ramos, L.F.P. Past, present and future of Industry 4.0—A systematic literature review and research agenda proposal. Int. J. Prod. Res. 2017, 55, 3609–3629.
3. Kamble, S.S.; Gunasekaran, A.; Gawankar, S.A. Sustainable Industry 4.0 framework: A systematic literature review identifying the current trends and future perspectives. Process. Saf. Environ. Prot. 2018, 117, 408–425.
4. Jayaraman, P.P.; Forkan, A.R.M.; Morshed, A.; Haghighi, P.D.; Kang, Y.B. Healthcare 4.0: A review of frontiers in digital health. Wiley Interdiscip. Rev. Data Min. Knowl. Discov. 2020, 10, e1350.
5. Tortorella, G.L.; Fogliatto, F.S.; Mac Cawley Vergara, A.; Vassolo, R.; Sawhney, R. Healthcare 4.0: Trends, challenges and research directions. Prod. Plan. Control. 2019, 31, 1245–1260.
6. Kumari, A.; Tanwar, S.; Tyagi, S.; Kumar, N. Fog computing for Healthcare 4.0 environment: Opportunities and challenges. Comput. Electr. Eng. 2018, 72, 1–13.
7. Islam, S.R.; Kwak, D.; Kabir, M.H.; Hossain, M.; Kwak, K.S. The internet of things for health care: A comprehensive survey. IEEE Access 2015, 3, 678–708.
8. Mahmud, M.; Kaiser, M.S.; Rahman, M.M.; Rahman, M.A.; Shabut, A.; Al-Mamun, S.; Hussain, A. A brain-inspired trust management model to assure security in a cloud based IoT framework for neuroscience applications. Cogn. Comput. 2018, 10, 864–873.
9. Alloghani, M.; Al-Jumeily, D.; Hussain, A.; Aljaaf, A.J.; Mustafina, J.; Petrov, E. Healthcare services innovations based on the state of the art technology trend industry 4.0. In Proceedings of the 2018 11th International Conference on Developments in eSystems Engineering (DeSE), Cambridge, UK, 2–5 September 2018; pp. 64–70.
10. Lee, E.A. Cyber physical systems: Design Challenges. In Proceedings of the 11th IEEE International Symposium on Object and

Component-Oriented Real-Time Distributed Computing (ISORC), Orlando, FL, USA, 5–7 May 2008.
11. Dimitrov, D.V. Medical internet of things and big data in healthcare. Healthc. Inform. Res. 2016, 22, 156–163.
12. Liang, H.; Tsui, B.; Ni, H.; Valentim, C.; Baxter, S.; Liu, G. Evaluation and Accurate Diagnoses of Pediatric Diseases Using Artificial Intelligence. *Nat. Med.* **2019**, *25*, 433–438.
13. Accenture. AI: An Engine for Growth. 2018. Available online: https://www.accenture.com/fi-en/insight-artificial-intelligence-healthcare (accessed on 25 July 2020).
14. Amato, F.; López, A.; Peña-Méndez, E.; Vaňhara, P.; Hampl, A.; Havel, J. Artificial Neural Networks in Medical Diagnosis. *J. Appl. Biomed.* **2013**, *11*, 47–58.
15. Bennett, C.; Hauser, K. Artificial Intelligence Framework for Simulating Clinical Decision-Making: AMarkov Decision Process Approach. *Artif. Intell. Med.* **2013**, *57*, 9–19.
16. Dilsizian, S.; Siegel, E. Artificial Intelligence in Medicine and Cardiac Imaging: Harnessing Big Data and Advanced Computing to Provide Personalized Medical Diagnosis and Treatment. *Curr. Cardiol. Rep.* **2014**, *16*, 441.
17. Shiraishi, J.; Li, Q.; Appelbaum, D.; Doi, K. Computer-aided Diagnosis and Artificial Intelligence in Clinical Imaging. *Semin. Nucl. Med.* **2011**, *41*, 449–462.
18. Arsene, C. Artificial Intelligence in healthcare: The Future is Amazing. *Healthcare Weekly*. 2019. Available online: https://healthcareweekly.com/artificial-intelligence-in-healthcare/ (accessed on 15 November 2020).
19. Guo, J.; Li, B. The Application of Medical Artificial Intelligence Technology in Rural Areas of Developing Countries. *Health Equity* **2018**, *2*, 174–181.
20. Pesapane, F.; Codari, M.; Sardanelli, F. Artificial Intelligence in Medical Imaging: Threat or Opportunity? Radiologists again at the Forefront of Innovation in Medicine. *Eur. Radiol. Exp.* **2018**, *2*, 1–10.
21. marketsandmarkets.com,“IoT Health care Market by Component, Application, End User, and Region-Global Forecast to 2022”,Technical Report, April 2017.[Online].Available: https://www.marketsandmarkets.com/Market-Reports/iot-healthcaremarket-160082804.html
22. W.Shi, J.Cao, Q.Zhang, Y.Li, L.Xu “Edge Computing: Vision and Challenges”, IEEE Internet of Things Journal,vol.3,no.5,pp.637-646, Oct.2016.
23. G.Aloi, G.Caliciuri, G.Fortino, R.Gravina, P.Pace, W.Russo, C. Savaglio “A Mobile Multi-Technology Gateway to Enable IoT Interoperability”, IEEE International Conference on Internet-of-Things Design and Implementation (I4T),Berlin,April4,2016.
24. G.Aloi, G.Caliciuri, G.Fortino, R.Gravina, P.Pace, W.Russo, C.Savaglio, “Enabling IoT interoperability through opportunistic smartphone-based mobile gateways”, Journal of Network and Computer Applications,vol.81,pp74-84,2017.
25. YuCao, SongqingChen, PengHou, D.Brown “FAST: A fog computing assisted distributed analytics system to monitor fall for stroke mitigation”, IEEE International Conference on Networking, Architecture and Storage (NAS), Boston, MA,pp.2-11,2015.
26. G.Fortino, R.Gravina, W.Li,C.Ma “Using Cloud-assisted Body Area Networks to Track People Physical Activity in Mobility”, International Conference on Body Area Networks (BodyNets2015),pp.85-91,2015.
27. R.Gravina, C.Ma, P.Pace, G.Aloi, W.Russo, W.Li, G.Fortino “Cloud based Activity-Service cyber-physical framework for human activity

monitoring in mobility," Future Generation Computer Systems, vol.75, pp.158-171,2017.

28. A.Jovic, N.Bogunovic, M.Cupic "Extension and detailed overview of the HRV Frame framework for heart rate variability analysis, "Eurocon 2013,Zagreb,2013,pp.1757-1763.
29. M.H.Elgazzar "Perspectives on M2M protocols," IEEE Seventh International Conference on Intelligent Computing and Information Systems (ICICIS),Cairo,pp.501-505,2015.
30. G.Sannino,G.DePietro "A deep learning approach for ECG-based heartbeat classification for arrhythmia detection," Future Generation Computer Systems, Available online April,2018.
31. Pace, Pasquale, et al. "An edge-based architecture to support efficient applications for healthcare industry 4.0." *IEEE Transactions on Industrial Informatics* 15.1 (2018): 481-489.

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