Volume: 5, Issue: 1
Page: 115-126
2021

International Journal of
Science and Business
Journal homepage: ijsab.com/ijsb

IJSAB International

# Impact of IoT Frameworks on Healthcare and Medical Systems Performance

**Rezgar Hasan Saeed, Hivi Ismat Dino, Lailan M. Haji, Daroon Mudhafer Hamed, Hanan M. Shukur, Omid H. Jader**

**Abstract:**
Internet of Thing (IoT) is a system of interconnected calculating equipment, electronically and mechanically and digital equipment delivered with Unique Identifiers and capability of data-transmission through a system without needful of Human-to-Human or Human-to-Computer communication. However, IoMT considered as IoT-program-implementation aimed at medicinal besides healthcare requirements, information gathering also investigation to be studied and observed. This led to proposing extensive scope of fascinating prospective consequences for enterprises: vehicles mileage-sensitivity as well auto-strategy support otherwise prepare it strongly establish in addition description predicted alighting periods towards taking-up travelers. This is due to that its standards are as of now being connected to improve access to the mind, increment the quality of care also, above all decrease the cost of care. An efficient IoT healthcare system aims to give continuous remote checking of patient health conditions, to counteract the basic patient conditions, and to improve personal satisfaction through a smart IoT environment. The trend of this paper is about displaying a detailed survey that addresses the closest previous studies to IoT roles in the healthcare sector. Giving inspiration, confinements looked by specialists, and recommendations proposed to examiners for improving this basic research field, according to detailed comparison among the addressed researches.

**IJSB**
**Literature Review**
Accepted 26 December 2020
Published 07 January 2021
DOI: 10.5281/zenodo.4423394

**Keywords:** Internet of Things, Healthcare, Cloud Computing, Wireless Sensors.

.

About Author (s)

**Rezgar Hasan Saeed** (corresponding author), Computer and Technology Education Department, Near east university, Cyprus. rezgarhasan1992@gmail.com
**Hivi Ismat Dino,** Department of Computer Science, University of Zakho, Kurdistan Region – Iraq, hivi.dino@uoz.edu.krd
**Lailan M. Haji,** Department of Computer Science, University of Zakho, Kurdistan Region – Iraq, lailan.haji@uoz.edu.krd
**Daroon Mudhafer Hamed,** Lebanese French University, Erbil – Kurdistan Region – Iraq, daroon.m.h@gmail.com
**Hanan M. Shukur,** It Department, Al Kitab University, Kirkuk – Iraq, hanan89md@gmail.com
**Omid H. Jader,** Information System Engineering Dept. Erbil Polytechnic University, Kurdistan Region-Iraq, omid.jader@epu.edu.iq

## 1. Introduction

Internet of Things (IoT) consolidates plenty of headways that engage a wide extent of mechanical assemblies, gadgets, and objects (or basically "things") to relate and pass on among themselves utilizing organizing advancements (Alzakholi et al. 2020; Sadeeq et al. 2018; Yasin, Zeebaree, and Zebari 2019). Individuals gracefully most by far of the substance and information found on the Internet as of not long ago. While in IoT, little contraptions are constantly the dynamic part that gives the information (Abdulla et al. 2020; Abdulraheem et al. 2020). There are various applications for IoT; including human administration systems, which are the essential point of convergence of this paper. Restorative administration structures use plenty of interconnected contraptions to make an IoT association provided for therapeutic administration examination, including watching patients and thus recognizing conditions where helpful interventions are required (Li, Da Xu, and Zhao 2015; Zebari et al. 2019; Subhi R M Zeebaree, M. Shukur, et al. 2020). The IoT made modifications to people's daily life, work, and decision. It has just had a significant and positive effect on numerous ventures, including healthcare. The healthcare industry has started to experience a huge change with the effect of IoT (Saleem et al. 2020; Zeebaree, Shukur, and Hussan 2019). The determined estimation of the Internet of Healthcare Things (IoHT) is venture to surpass $163 billion by 2020 as indicated by an ongoing examination from Accenture1. IoT arrangements offer more productivity that is prominent and precision in the task of human services suppliers—and have appeared to include an incentive in basic healthcare activities, for example, understanding observing (Abdulazeez, Zeebaree, and Sadeeq 2018; Haji et al. 2020; Shukur, Zeebaree, Zebari, Zeebaree, et al. 2020). The H-IoT is otherwise called the health IoT, which is an achievement of data frameworks improvement. It expects a vital activity in illuminating everybody wellbeing level and constructs the estimation of life (Acharjya, Geetha, and Sanyal 2017), (Zeebaree, Zebari, et al. 2019).

It is a perplexing framework, which includes microelectronics frameworks, medical and health, software engineering, and numerous different fields. As indicated by the, generally speaking, associated medicinal services framework, the period from 2017 to 2022 is the development period of IoT healthcare applications that quicken the social insurance ventures and different partners that are venturing up their endeavors (Li et al. 2015). The IoT is an aggregate term for any one of the numerous systems of sensors, actuators, processors, what's more, computers associated with the Internet. Social insurance applications for the IoT can convey exhaustive patient consideration in different settings, including intense (in-hospital), long haul (nursing homes), and network-based (ordinarily, in-home) (Abdullah et al. n.d.; Laplante and Laplante 2016). There is a change in outlook from the once doctor focused condition to a progressively understanding driven human services framework. Shrewd homes, that incorporate wellbeing and other Ambient Assisted Living (AAL) advances, can assume a lead job in changing the manner by which human services administrations are being given to the old individuals (Abdullah et al. 2020; Shukur, Zeebaree, Zebari, Ahmed, et al. 2020; SUBHI R.M. Zeebaree, Salim, et al. 2020). Indeed, giving human services office is one of the center functionalities offered by the shrewd homes that have been talked about in detail later in the writing audit area of the paper (Pal et al. 2018).

IoT has been generally characterized over various spaces, in any case. Accordingly, the presentation of IoT from a wellbeing point of view has realized numerous advantages in the zones of clinical hardware and drug control. For example, continuous checking and clinical decline data the executives, hostile to fake of clinical hardware and medicine (Dino et al. 2020; Haji et al. 21, May; Subhi RM Zeebaree, Zebari, and Jacksi 2020). Also, clinical data the board (for example health-related crisis, tolerant data the executives, the board, blood data

the board, drug stockpiling the executives, clinical hardware and medicine detectability, blunder anticipation component of pharmaceutical arrangements, the neonatal enemy of burglary and alert frameworks, data sharing), portable clinical consideration, telemedicine, wellbeing the executives (O'Connor et al. 2017).

## 2. Internet of Things in Medical and Healthcare Fields

The difficult issue that every patient, particularly living in remote zones discovered was the detachment of specialists and treatment on essential conditions. These advancements address a considerable lot of the difficulties that people are confronting today, for example, populace development, vitality concerns and expanding requests for better methods for detecting our condition (Qadir et al. 2018). This had frightful results at the forefront of individuals' thoughts about the hospitals and doctor's administrations. These days with the executions of innovations by utilizing IoT gadgets for human services checking framework, these issues have been arranged to a gigantic degree. IoT can keep patients sheltered and solid, however, to improve how doctors convey care too (Dino et al. n.d.; Mahmood et al. n.d.; Sallow et al. 2020.). Medicinal services IoT can likewise support persistent commitment and fulfillment by enabling patients to invest more energy connecting with their specialists. The utilization of IoT in healthcare is an immense biological system. Inside the all in all related human services and eHealth picture, progressively joined (Alamr et al. 2018).

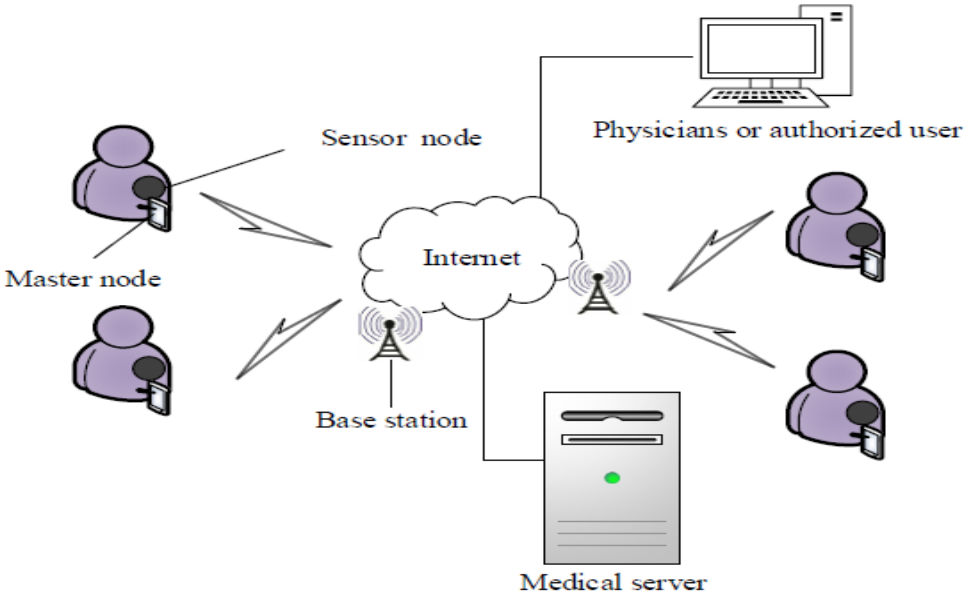


Fig. 1: IoT Healthcare System (Bin-Yahya 2015)

.

The interest for associated devices is found over various ventures today. IoT has plenty of applications in medicinal services, similar to remote checking of patient's health, following patients and types of gear inside the social insurance association (Jader, Zeebaree, and Zebari 2019; Subhi R. M. Zeebaree, Haji, et al. 2020; Subhi RM Zeebaree, Jacksi, and Zebari 2020). Adding to that, it includes smart beds to distinguish the inhabitance, smart pill containers to screen the patient's admission of prescription and to send ready messages to the guardian, and so on as shown in figure1. IoT can likewise give early discovery of certain health states of patients and give fast reactions to therapeutic crises, all things considered, when the patient is moving. IoT advances can help the healthcare associations to diminish the expense by utilization of hardware following systems (Sadeeq et al. 2020; Salih et al. 2020; Sulaiman et al. 2020). What's more, it can give customized care to patients, subsequently improving the nature of medicinal services administrations (Bin-Yahya 2015).

Right off the bat, web-calculating was addressed in certain objects. Like that announced before, another computing worldview (programming system) utilized towards appropriate dynamic assignments via distributed mist hubs just as keen passages, individual entryways arranged on longsuffering field fill in such a middle of the road hub, alluded like mist hub, that implemented for treating longsuffering wellbeing information (Mohammad et al. 2017; Rashid et al. 2018; Zeebaree and Yasin 2014). A calculation that is utilized to encourage asset sharing among mist hubs was proposed. Besides, different papers utilized keen portals and actualized for web calculating like fog hub by interfacing several mist hubs for human services submissions (Mutlag et al. 2019). As detailed before, a model was proposed which created two calculations: the first pick a mist when the client is at the covering some portion of fogs, while the subsequent calculation illuminates the circumstance when the client changes his area; the most limited way among hazes can be found by a coordinated door associated with each gadget. A system of Smart e-Health Gateways was proposed, which helps in preprocessing the information and mitigates further handling by burdening from cloud and sensors (Alansari et al. 2017). To progressively distribute assets, fog processing with the brilliant portal (Micro Datacenter) was proposed prior. As detailed in a prior examination, individual portals go about as moderate mist hubs that geologically conveyed between the IoHT gadgets and the human services cloud. To bunch little cells in order to encourage asset sharing among them, a calculation was proposed. A technique was introduced to streamline the sharing of assets to expand the relating utility (Alraja, Farooque, and Khashab 2019).

## 3. Literature Survey

In 2020, Tuli et al. (Tuli et al. 2020), proposed a novel structure called HealthFog, this structure is to incorporating Edge processing gadgets and sent it for a genuine utilization of programmed Heart Disease investigation by utilizing deep learning. HealthFog conveys social insurance as a haze administration productively deals with the information of heart patients utilizing IoT gadgets, which comes as client demands. Likewise, the Fog-empowered cloud structure, utilizing test besides sending presentation as far as system data transfer capacity, power utilization, inactivity, precision, jitter, and convenient execution. In 2017, Laplante et al. (Laplante et al. 2017), proposed an organized structure for portraying, and help in determining, planning, and executing healthcare IoTs. The structure concerned characterizing general classes of framework types, grouping the conveyance settings of medicinal services, at that point utilizing an organized way to deal with depicting the part for a specific case use. Utilizing such a methodology for depicting human services IoTs could prompt normalization, interoperability, reuse, best practices. They likewise, recognized the need to consider "mindful" as a significant quality for IoT-empowered human services frameworks.

In 2019, Ni et al. (Ni et al. 2019), structured a non-intrusive wearable gadget relying upon BLE (Bluetooth Low Energy) to distinguish crucial signals likewise another smart terminal to create social insurance IoT. Creators distinguish heart vibration flags by utilizing spiral conduit vibration flags as opposed to client attires to recognize pulse. The gadget can likewise diminish power utilization. To raise Signal to Noise Ratio (SNR), utilizing a canny terminal channel circuit planned and top discovery calculation to wipe out clamor, to have the option to accomplish high precision pulse computation. Moreover, the canny terminal will transfer the information to the cloud, at that point clinical organizations can get to the information if there should be an occurrence of a crisis and the client can screen self-crucial data whenever.
In 2018, Verma and Sood (Verma and Sood 2018), represent the piece of the arrangement for m-healthcare middleware producing client conclusion outcome (UDR) in light of happiness assessments gave through clinical besides various sensors. Moreover, the proper prototypical

includes ideas, significant concepts, malady determination approach, and ready age instrument. The system providing outcomes commencing different resolve strategies for exploiting various arrangements estimations above specified period to get well dissecting wellbeing. Likewise, suggested SSIS considered as a patient-compelled approach for agreement through representing outcomes commencing facts collected via clinical sensors aimed at the nonstop richness, testing, besides maintenance. Moreover, infer that designs, frequencies-based findings, and scale results assume gigantic task trendy recognizing an individual through probable sickness kind.
In 2018, Al-Turjman and Alturjman (Al-Turjman and Alturjman 2018), proposed a safe CSIP Continuous Service Improvement Process shared verification structure for the healthcare framework by utilizing a remote mixed media clinical sensor systems. This paper benefits from the two-factor (sensor hub and in particular clinical master) procedure for the moderation of computational expense and satisfaction of WMSN security objectives. Besides, it settles the common tradeoff between security level and the additional correspondence overhead, where the data transfer capacity use is improved and the prerequisites in both security and continuous are met. Finally, the researched use case situations show that CSIP is fruitful in confirming client personality with a high level of unwavering quality.

In 2017, Chen et al. (Chen et al. 2017), proposed a launderable shrewd apparel framework, which relies upon the number of sensors, wires, and cathodes. In this article, an exhaustively examine the disservices of wearable figuring in existing medicinal services framework. Contingent upon this thorough a Wearable 2.0 social insurance framework is proposed dependent on shrewd garments to improve Experience (QoE) and Quality of Service (QoS) of the cutting-edge human services framework. In this framework, the physiological information of clients is unknowingly gathered, and modified community indemnification managements are a huge statistics checkup scheduled hazes. Likewise, framework engineering, practical parts, and the planned subtleties of savvy apparel dependent on a Wearable 2.0 social insurance framework are available. At long last, a testbed with different convincing situations is introduced to confirm the possibility of this engineering.

In 2017, Abawajy and Hassan (Abawajy and Hassan 2017), proposed the PPHM structure. This system uses the consolidated solid participation of IoT, Cloud Computing (CC), Electrocardiography (ECG), skin sensor, and remote innovations for effective and top-notch remote patient wellbeing status. Utilizing a cheap material making cloud advancements besides IoT aimed at patient's wellbeing status remote checking. The proposed system is vitality proficient and versatile with exceptionally high order precision through test examination. Additionally, the proposed structure can address the difficulties of social insurance spending by significantly decreasing waste and wastefulness just as empowering patients to improve care by a stay in their homes. Besides, the system incorporates protection and security viewpoints.

In 2020, Akkaş et al. (Akkaş, SOKULLU, and Çetin 2020), proposed a framework for gathering clinical information dependent on ZigBee hubs, MicaZ hub, nesC language. For remote correspondence, standard creators chose ZigBee and Industrial Scientific and Medical (ISM) band in view of its low force utilization and permit free activity recurrence. Additionally, MicaZ remote modules utilized for gathering information for the patient's pulse, which is the ease and off-the-rack Wireless sensor arrange (WSN) parts and nesC language. Information for the patient's pulse, plethysmogram, and blood oxygen levels are moved remotely to the focal database utilizing the model comprises of these modules associated with heartbeat oximeter sensors and modified with nesC language to frame a remote sensor organize,

meager individual record documents for every patient are made. The limit an incentive for every patient can be resolved and visual admonition can be sent to a focal station or an ideal warning can be produced if it is important. The test outcomes show that the framework is dependable, attainable, and self-configurable.

In 2017, Raj et al. (Raj, Jain, and Arif 2017), heated up a typical interface between various remote habitats and clinical specialists for move information as picture, content, waveform, parameters, and AV data. This model managed the installed framework stage. Information and interchanges innovation minimal effort Health sensor stage for country wellbeing checking with a very much organized for clinical specialists besides Far-flung habitats aimed at distribution significant clinical factors and correspondence convention, Data obtaining (DAQ) used to adjust application for solid information and web interface to engage rustic towns with great medicinal services support. Additionally, incorporate a portion of the significant sensors to secure information for treatment and powerful finding and. The framework is tried and the outcomes are good with 8 clinical parameters alongside living gushing is made accessible instead of information investigation of certain signs are likewise made and a different interface for clinical specialists and remote Center and presented another calculation for usage.

In 2019, Aladwani (Aladwani 2019), proposed new algorithms Tasks Classification and Virtual Machines Categorization (TCVC) which improve the IoT social insurance planning execution in Fog registering conditions dependent on task significance. Creators likewise accomplish better Total Execution Time (TET), Total Finish Time (TFT) and Total Waiting Time (TWT) instead of reasonableness between assignments, load balance between Vessel checking framework (VMS) in VMs list, and execute high significant undertakings (touchy information) and high effectiveness with least inertness by applying the MAX-MIN errands planning calculations. Assignments that got by IoT ordered into three classes: high significance undertakings, medium significance errands, and low significance assignments dependent on the significance of wellbeing status. In 2019, El Zouka and Hosni (El Zouka and Hosni 2019), proposed secure medicinal services checking framework utilizing a fuzzy logic-based choice emotionally supportive system to ensures individual wellbeing data and assurance secure correspondence, the framework has been created by utilizing a fuzzy-based deduction framework (FBIS) method to baling uncover patient's conditions. Thus, a mix of secure versatile design and fuzzy rationale is made to distinguish the patient's wellbeing status, as long as the neural system is ceaselessly prepared and can adjust to the adjustments in the info when the ideal yield is relegated. Additionally, a test arrangement for handling the clinical sensors signals relegated utilizing a fuzzy deduction framework has likewise been done with an improved savvy understanding observing model that naturally dissects the patient's essential body parameters. This framework permits specialists to follow the ongoing status of the patient's profile signals and furnished with a crisis salvage system utilizing the M2M quiet checking screen and remote wellbeing application.

In 2017, Ullah et al. (Ullah et al. 2017), proposed the Semantic Interoperability Model for Big-data in IoT (SIMB-IoT) to convey semantic interoperability among heterogeneous IoT gadgets in the social insurance space. This model is utilized when various side effects gathered from heterogeneous IoT sensors to suggest medication with reactions. For the examination of large information, there are two datasets taken, one dataset contains prescriptions with symptoms and the second dataset contains infections with medicate subtleties. Data among doctors and patients is semantically clarified and moved in an important manner. To give explanations to huge information A Lightweight Model for Semantic comment of Big-data utilizing

heterogeneous gadgets in IoT was proposed. Additionally, to reused convey things, Resource Description Framework (RDF) utilized which is a semantic web system that is utilizing Triples to make it semantically huge. RDF clarified patients' information and made it semantically interoperable. Farther more, to extricate records from the RDF diagram Simple Protocol and RDF Query Language (SPARQL) inquiry is utilized.

In 2019, Onasanya and Elshakankiri (Onasanya and Elshakankiri 2019), proposed the selection and execution of IoT/Wireless sensor arrange (WSN) innovation for disease care which is to raise human services arrangements and expand the current treatment choices. Here, IoT/WSN innovation improved treatment, finding, identification, and checking of disease patients dependent on malignant growth care administrations. Because WSN assumes a significant job that permits, various spatially appropriated self-sufficient sensors to be connected to the system texture dependent on geological directing from source to goal, which encourages information transmission/trade. The business investigation/cloud administrations comprise the empowering agents for noteworthy bits of knowledge, information transmission, dynamic and announcing for upgrading disease medicines. Besides, for savvy social insurance answers for malignant growth care, administrations creators proposed an assortment of structures to represent the useful IoT-based arrangement that is being thought of or used in our proposed shrewd human services disease care administrations. At last, for security issues and operational difficulties creators delineate some portrayed the IoT empowered human services framework.

In 2020, TD and KR (TD and KR 2020), structured an IOT based Multi-parameter Patient Monitor(MPM) framework where four-parameter in heart rate, oxygen immersion, temperature, and breath rate is checked utilizing Electrocardiogram (ECG) sensor which obtained to ascertain the breath rate from the ECG signal. An email is sent to the patient's gatekeeper by means of wi-fi module ESP8266 if there should arise an occurrence of irregular condition was recognized or crisis. The venture additionally utilized the Support Vector Machine (SVM) calculation to improve the presentation of the MPM framework by arranging typical and unusual conditions. The arrangement exactness of 95% has been accomplished. In 2019, Gupta and Karadbhajne (Gupta and Karadbhajne 2019), planned a framework for checking the patient's pulse, body temperature level utilizing Raspberry Pi board innovation by utilizing temperature sensors, heartbeat sensors, that accomplish the least multifaceted nature and versatile for human services seeing of the patient. At the point when Raspberry Pi associates with the Internet, it goes about as a server, at that point the server is naturally sending information to the webserver. At that point these parameters are observed utilizing the website page anyplace on the planet utilizing PCs, cell phones, and the pro or the specialist can promptly get to the patient's data wherever with the assistance of internet providers.

## 4. Discussion

From the details explained in the literature review section of the previous works, it very well may be reasoned that scientists have worked in various fields of healthcare utilizing different apparatuses and sensors. Analysts outlined framework planned and critical focuses identified with the valuation of their proposed draws near. Table 1 represents a comparison among the researches explained in section II. The comparison includes three main features that satisfy their trends in order to verify the aims drawn through their approaches in the IoT healthcare field. From the table, it is clear that references (Laplante et al. 2017) recommended an organized structure for depicting, and help in indicating, planning, and actualizing medicinal services IoTs.

The structure concerned characterizing general classes of framework types, grouping the conveyance settings of medicinal services. AT that point utilizing an organized way to deal with portraying the part for a specific case use. Research (Al-Turjman and Alturjman 2018) proposed a protected CSIP Continuous Service Improvement Process common validation structure for the social insurance framework by utilizing a wireless multimedia medical sensor network. Authors of (Chen et al. 2017) proposed washable smart clothing system, which depends on several sensors, wires, and electrodes, which wellbeing besides nostalgic intelligence. Reference (Abawajy and Hassan 2017) proposed a remote pervasive patient health monitoring (PPHM) framework. This framework leverages the combined strong cooperation of IoT, Cloud Computing (CC), Electrocardiography (ECG), skin sensor and wireless technologies for efficient and high-quality remote patient health status. Moreover, references (Akkaş et al. 2020) proposed system for collecting medical data based on ZigBee nodes, MicaZ node, nesC language. For wireless communication, standard authors selected ZigBee and Industrial Scientific and Medical (ISM) band because of its low power consumption and license-free operation frequency. Research [30] boiled a common interface between multiple remote centers and medical practitioner for transfer data in form of image, text, waveform, parameters, and AV information. In addition, reference (Onasanya and Elshakankiri 2019) proposed the adoption and implementation of IoT/Wireless sensor network (WSN) technology for cancer care, which is raise healthcare solution, and augment the existing treatment options. References (TD and KR 2020) designed an IOT based Multi-parameter Patient Monitor (MPM) system where four parameter namely heart rate, oxygen saturation, temperature and respiration rate are monitored. References (Gupta and Karadbhajne 2019) designed system for monitoring patient's heart rate, body temperature using Raspberry Pi board technology by using temperature sensor, heart beat sensor, that achieve minimum complexity and portable for healthcare observing of the patient.

Table 1: Comparison of Healthcare and Internet of Things.

| **Author(s)/Year** | **Applied Field** | **Tools/application** | **Significant Satisfied Aims** |
|---|---|---|---|
| Tuli et al. (Tuli et al. 2020) , 2020 | Heart Diseases | Deep learning and IoT called HealthFog, FogBus frame-work | Proposed e a Fog based Smart Healthcare System for Automatic Diagnosis of Heart Diseases. |
| Laplante et al. (Laplante et al. 2017), 2017 | Cases Specifications of patient | Sensor, Communication channel, Utility Remote monitoring software, ana-lyses tools for decision | Introduce a structured framework for implementing healthcare IoTs |
| Ni et al. (Ni et al. 2019), 2019 | Heart rates | Electrocardiography, photoplethysmography (ECG and PPG) heart rates measure sensor, | Designed a non-invasive wearable device for heart rates. |
| Verma and Sood (Verma and Sood 2018), 2018 | Diagnosis of Patient | Sensors to provide health measurements, different sets of IoT measurements, SSIS data collected by medical sensors | Diagnosis of healthcare framework |
| Al-Turjman and Alturjman (Al-Turjman and Alturjman 2018), 2018 | Data Security of Patient | using wireless multimedia medical sensor network, sensor node, different security level requirements and the user is authenticated automatically based on history/learning mechanisms. | Proposed a secure-CSIP Continuous Service Improvement Process mutual authentication framework for the health care system. |
| Chen et al. (Chen et al. 2017), 2017 | Smart Clothing | Sensors, wires and electrodes, which collect users' physiological data, comprehensive a Wearable 2.0 | Proposed washable smart clothing system |

| | | | |
|---|---|---|---|
| | | healthcare smart clothing to improve Experience (QoE) and Quality of Service (QoS). | |
| Abawajy and Hassan (Abawajy and Hassan 2017), 2017 | patient health monitoring | ICloud, Cloud Computing (CC), Electrocardiography (ECG), skin sensor and wireless technologies for remote patient health status. | Proposed e a remote pervasive patient health monitoring (PPHM) framework |
| Akkaş et al. (Akkaş et al. 2020), 2020 | biomedical application | oZigBee nodes, MicaZ node, nesC language. | Proposed e system for collecting medical data of patents. |
| Raj et al. (Raj et al. 2017), 2017 | medical experts | Embedded system platform, communication protocol, Data acquisition (DAQ) | Build a common interface between multiple remote center and medical practitioner |
| Aladwani, (Aladwani 2019), 2018 | remote health monitoring | Fog computing environment, the MAX-MIN tasks scheduling algorithms, Vessel monitoring system (VMS) | New algorithms Tasks Classification and Virtual Machines Categorization (TCVC) |
| El Zouka and Hosni, (El Zouka and Hosni 2019), 2019 | remote health monitoring | Fuzzy-based inference system (FBIS) technique, neural network, sensors for processing the medical signals | Secure healthcare monitoring system using fuzzy logic-based decision support system |
| Ullah et al. (Ullah et al. 2017), 2017 | Medicine effects | (SIMB-IoT), IoT sensors, big-data, RDF, SPARQL | Proposed e Semantic Interoperability Model for Big-data in IoT (SIMB-IoT) |
| Onasanya and Elshakankiri (Onasanya and Elshakankiri 2019), 2019 | Cancer care | IoT/ WSN, medical sensors | Proposed e the adoption and implementation of IoT/ Wireless sensor network (WSN) technology for cancer care |
| TD and KR (TD and KR 2020), 2020 | Heartrate and oxygen saturation | (ECG) sensor, (SVM) algorithm, wi-fi module ESP8266 | Designed an IOT based Multi-parameter Patient Monitor (MPM) system |
| Gupta and Karadbhajne (Gupta and Karadbhajne 2019), 2019 | Heart rate, body temperature | Temperature sensor, heart beat sensor, web server | Designed system for monitoring patient's heart rate, body temperature using Raspberry Pi board technology |

## 5. Conclusion

Depending on the details explained in (literature review and discussion) sections addressed in this research, it can be concluded that researching dynamic methodologies were delivered besides huge of them mined at issue control. Several frameworks and systems are designed in the healthcare field depending on IoT fields such as HealthFog using deep learning with a remote pervasive patient health monitoring (PPHM), IoT/Wireless sensor network (WSN) technology, and Raspberry Pi board technology. Great means besides sensors are dependent like; deep learning with IoT, communication channel, utility remote monitoring software, sensors to provide health measurements. However, other means depended such as SSIS data collected by medical sensors, electrocardiography, photoplethysmography (ECG and PPG) heart rates measure sensor, wireless multimedia medical sensor network, IoT cloud, Cloud Computing (CC), oZigBee nodes, MicaZ node, nesc language, Vessel monitoring system (VMS), fuzzy-based inference system (FBIS) technique, (SVM) algorithm, wi-fi module ESP8266. The great role of the IoT implementation in the healthcare sector can be browsed during these hard days due to the Corona epidemic COVID19.

## References


Abawajy, J. H., and Mohammad, M. H. (2017). Federated Internet of Things and Cloud Computing Pervasive Patient Health Monitoring System. *IEEE Communications Magazine* 55(1):48–53.

Abdulazeez, A. M., Zeebaree, S. RM., and Sadeeq, M. AM. (2018). Design and Implementation of Electronic Student Affairs System. *Academic Journal of Nawroz University* 7(3):66–73.

Abdulla, A. I., Abdulraheem, A. S., Salih, A. A., Sadeeq, M. AM., Ahmed, A. J., Ferzor, B. M., Omar, S. S., and Mohammed, S. I. (2020). Internet of Things and Smart Home Security. *Technol. Rep. Kansai Univ* 62(5):2465–2476.

Abdullah, P. Y., Zeebaree, S. RM., Jacksi, K., and Zeabri, R. R. (2020). AN HRM SYSTEM FOR SMALL AND MEDIUM ENTERPRISES (SME) S BASED ON CLOUD COMPUTING TECHNOLOGY. *International Journal of Research-GRANTHAALAYAH* 8(8):56–64.

Abdullah, P. Y., Zeebaree, S. RM., Shukur, H. M., and Jacksi, K. (2020). HRM System Using Cloud Computing for Small and Medium Enterprises (SMEs). T*echnology Reports of Kansai University*, 62(4), 1977–1987.

Abdulraheem, A. S., Salih, A. A., Abdulrahman, I. A., Sadeeq, M. AM., Salim, N. OM., Abdullah, H., Khalifa, F. M., and Saeed, R. A. (2020). Home Automation System Based on IoT. *Technol. Rep. Kansai Univ*, 62(5), 2465–2476.

Acharjya, D. P., Geetha, M. K., & Sanyal, S. (Eds.). (2017). *Internet of Things: novel advances and envisioned applications* (Vol. 25). Heidelberg: Springer.

Akkaş, M. A., Radosveta, S., and Hüseyin, E. Ç. (2020). Healthcare and Patient Monitoring Using IoT. *Internet of Things* 100173.

Aladwani, T. (2019). Scheduling IoT Healthcare Tasks in Fog Computing Based on Their Importance. *Procedia Computer Science* 163:560–569.

Alamr, A. A., Firdous, K., Jongsung, K., and Changho, S. (2018). A Secure ECC-Based RFID Mutual Authentication Protocol for Internet of Things. *The Journal of Supercomputing* 74(9):4281–4294.

Alansari, Z., Anuar, N. B., Kamsin, A., Soomro, S., & Belgaum, M. R. (2017). The Internet of Things adoption in healthcare applications. 2017 IEEE *3rd International Conference on Engineering Technologies and Social Sciences (ICETSS)*. doi:10.1109/icetss.2017.8324138

Alraja, M. N., Farooque, M. M., & Khashab, B. (2019). The Effect of Security, Privacy, Familiarity, and Trust on Users' Attitudes Toward the Use of the IoT-Based Healthcare: The Mediation Role of Risk Perception. *IEEE Access*, 7, 111341-111354. doi:10.1109/access.2019.2904006

Al-Turjman, F., & Alturjman, S. (2018). Context-Sensitive Access in Industrial Internet of Things (IIoT) Healthcare Applications. *IEEE Transactions on Industrial Informatics*, 14(6), 2736-2744. doi:10.1109/tii.2018.2808190

Alzakholi, O., Haji, L., Shukur, H., Zebari, R., Abas, S., & Sadeeq, M. (2020). Comparison Among Cloud Technologies and Cloud Performance. *Journal of Applied Science and Technology Trends*, 1(2), 40-47. doi:10.38094/jastt121

Almadani, B., Bin-Yahya, M., & Shakshuki, E. M. (2015). E-AMBULANCE: Real-Time Integration Platform for Heterogeneous Medical Telemetry System. *Procedia Computer Science*, 63, 400-407. doi:10.1016/j.procs.2015.08.359

Chen, M., Ma, Y., Li, Y., Wu, D., Zhang, Y., & Youn, C. (2017). Wearable 2.0: Enabling Human-Cloud Integration in Next Generation Healthcare Systems. IEEE *Communications Magazine*, 55(1), 54-61. doi:10.1109/mcom.2017.1600410cm

Dino, H. I., Zeebaree, S. RM., Salih, A. A., Zebari, R. R., Ageed, Z. S., Shukur, H. M., Haji, L. M., and Hasan, S. S. (2020). Impact of Process Execution and Physical Memory-Spaces on OS Performance. *Technology Reports of Kansai University*, 62(5), 2391–2401.

Dino, H. I., Abdulrazzaq, M. B., Zeebaree, S. RM., Sallow, A. B., Zebari, R. R., Shukur, H. M., and Haji, L. M. (2020). Facial Expression Recognition Based on Hybrid Feature Extraction Techniques with Different Classifiers. *TEST Engineering & Management* 83(May-June 2020), 22319 – 22329.

Zouka, H. A., & Hosni, M. M. (2019). Secure IoT communications for smart healthcare monitoring system. Internet of Things, 100036. doi:10.1016/j.iot.2019.01.003

Gupta, S. R., & Karadbhajne, R. T. (2019). Design and Implementation of IOT Based Health Monitoring System Using Raspberry PI.

Haji, L. M., Zeebaree, S. R., Ahmed, O. M., Sallow, A. B., Jacksi, K., & Zeabri, R. R. (2020). Dynamic resource allocation for distributed systems and cloud computing. *TEST Eng. Manag*, *83*, 22417-22426.

Haji, L., Zebari, R. R., Zeebaree, S. R. M., Abduallah, W. M., Shukur, H. M., & Ahmed, O. GPUs Impact on Parallel Shared Memory Systems Performance. *Int. J. Psychosoc. Rehabil*, *24*(08), 8030-8038.

Jader, O. H., Zeebaree, S. R., & Zebari, R. R. (2019). A State of Art Survey for Web Server Performance Measurement and Load Balancing Mechanisms. *International Journal of Scientific & Technology Research (IJSTR)*, *8*(12), 535-543.

Laplante, P. A., Kassab, M., Laplante, N. L., & Voas, J. M. (2017). Building caring healthcare systems in the Internet of Things. *IEEE Systems Journal*, *12*(3), 3030-3037.

Li, S., Da Xu, L., & Zhao, S. (2015). The internet of things: a survey. *Information Systems Frontiers*, *17*(2), 243-259.

Mahmood, M. R., Abdulrazzaq, M. B., Zeebaree, S. R., Ibrahim, A. K., Zebari, R. R., & Dino, H. I. Classification techniques' performance evaluation for facial expression recognition. *Indonesian Journal of Electrical Engineering and Computer Science*, 21(2), 176~1184

Mohammad, O. F., Rahim, M. S. M., Zeebaree, S. R. M., & Ahmed, F. Y. (2017). A survey and analysis of the image encryption methods. *International Journal of Applied Engineering Research*, *12*(23), 13265-13280.

Mutlag, A. A., Abd Ghani, M. K., Arunkumar, N. A., Mohammed, M. A., & Mohd, O. (2019). Enabling technologies for fog computing in healthcare IoT systems. *Future Generation Computer Systems*, *90*, 62-78.

Ni, J. C., Yang, C. S., Huang, J. K., & Shiu, L. C. (2019). Combining non-invasive wearable device and intelligent terminal in HealthCare IoT. *Procedia Computer Science*, *154*, 161-166.

O'Connor, Y., Rowan, W., Lynch, L., & Heavin, C. (2017). Privacy by design: informed consent and internet of things for smart health. *Procedia computer science*, *113*, 653-658.

Onasanya, A., & Elshakankiri, M. (2019). Smart integrated IoT healthcare system for cancer care. *Wireless Networks*, 1-16.

Pal, D., Funilkul, S., Charoenkitkarn, N., & Kanthamanon, P. (2018). Internet-of-things and smart homes for elderly healthcare: An end user perspective. *IEEE Access*, *6*, 10483-10496.

Qadir, Q. M., Rashid, T. A., Al-Salihi, N. K., Ismael, B., Kist, A. A., & Zhang, Z. (2018). Low power wide area networks: a survey of enabling technologies, applications and interoperability needs. *IEEE Access*, *6*, 77454-77473.

Raj, C., Jain, C., & Arif, W. (2017, March). HEMAN: Health monitoring and nous: An IoT based e-health care system for remote telemedicine. In *2017 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET)* (pp. 2115-2119). IEEE.

Rashid, Z. N., Zebari, S. R., Sharif, K. H., & Jacksi, K. (2018, October). Distributed Cloud Computing and Distributed Parallel Computing: A Review. In *2018 International Conference on Advanced Science and Engineering (ICOASE)* (pp. 167-172). IEEE.

Sadeeq, M. A., Abdulla, A. I., Abdulraheem, A. S., & Ageed, Z. S. (2020). Impact of Electronic Commerce on Enterprise Business. *Technol. Rep. Kansai Univ*, *62*(5), 2365-2378.

Sadeeq, M. A., Zeebaree, S. R., Qashi, R., Ahmed, S. H., & Jacksi, K. (2018, October). Internet of Things security: a survey. In *2018 International Conference on Advanced Science and Engineering (ICOASE)* (pp. 162-166). IEEE.

Saleem, S. I., Zeebaree, S. R., Zeebaree, D. Q., & Abdulazeez, A. M. Building Smart Cities Applications based on IoT Technologies: A Review. *Technology Reports of Kansai University* 62(3):1083–92.

Salih, A. A., Zeebaree, S. R., Abdulraheem, A. S., Zebari, R. R., Sadeeq, M. A., & Ahmed, O. M. (2020). Evolution of Mobile Wireless Communication to 5G Revolution. *Technology Reports of Kansai University*, 62(5), 2139-2151.

Sallow, A. B., Sadeeq, M. A., Zebari, R. R., Abdulrazzaq, M. B., Mahmood, M. R., Shukur, H. M., & Haji, L. M. An Investigation for Mobile Malware Behavioral and Detection Techniques Based on Android Platform. *IOSR Journal of Computer Engineering (IOSR-JCE)*, 22(4),14-20.

Shukur, H., Zeebaree, S., Zebari, R., Ahmed, O., Haji, L., & Abdulqader, D. (2020). Cache coherence protocols in distributed systems. *Journal of Applied Science and Technology Trends*, *1*(3), 92-97.

Shukur, H., Zeebaree, S., Zebari, R., Zeebaree, D., Ahmed, O., & Salih, A. (2020). Cloud computing virtualization of resources allocation for distributed systems. *Journal of Applied Science and Technology Trends*, *1*(3), 98-105.

Sulaiman, M. A., Sadeeq, M. A., Abdulraheem, A. S., & Abdulla, A. I. (2020). Analyzation Study for Gamification Examination Fields. *Technol. Rep. Kansai Univ*, *62*(5), 2319-2328.

TD, D., & KR, V. (2020, March). Design and Development of IOT Based Multi-Parameter Patient Monitoring System. In *2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS)* (pp. 862-866). IEEE.

Tuli, S., Basumatary, N., Gill, S. S., Kahani, M., Arya, R. C., Wander, G. S., & Buyya, R. (2020). Healthfog: An ensemble deep learning based smart healthcare system for automatic diagnosis of heart diseases in integrated iot and fog computing environments. *Future Generation Computer Systems*, *104*, 187-200.

Ullah, F., Habib, M. A., Farhan, M., Khalid, S., Durrani, M. Y., & Jabbar, S. (2017). Semantic interoperability for big-data in heterogeneous IoT infrastructure for healthcare. *Sustainable cities and society*, *34*, 90-96.

Verma, P., & Sood, S. K. (2018). Cloud-centric IoT based disease diagnosis healthcare framework. *Journal of Parallel and Distributed Computing*, *116*, 27-38.

Yasin, H. M., Zeebaree, S. R., & Zebari, I. M. (2019, April). Arduino Based Automatic Irrigation System: Monitoring and SMS Controlling. In *2019 4th Scientific International Conference Najaf (SICN)* (pp. 109-114). IEEE.

Zebari, R. R., Zeebaree, S. R., Jacksi, K., & Shukur, H. M. (2019). E-business requirements for flexibility and implementation enterprise system: A review. *International Journal of Scientific and Technology Research*, *8*(11), 655-660.

Zeebaree, S. R., & Yasin, H. M. (2014). Arduino based remote controlling for home: power saving, security and protection. *International Journal of Scientific & Engineering Research*, *5*(8), 266-272.

Zeebaree, S. R., Haji, L. M., Rashid, I., Zebari, R. R., Ahmed, O. M., Jacksi, K., & Shukur, H. M. (2020). Multicomputer Multicore System Influence on Maximum Multi-Processes Execution Time. *TEST Engineering & Management* 83(May/June):14921–31.

Zeebaree, S. R., Shukur, H. M., Haji, L. M., Zebari, R. R., Jacksi, K., & Abas, S. M. Characteristics and Analysis of Hadoop Distributed Systems. (2020). Characteristics and Analysis of Hadoop Distributed Systems. *Technology Reports of Kansai University* 62(4):1555–64.

Zeebaree, S. R. M., Salim, B. W., Zebari, R. R., Shukur, H. M., Abdulraheem, A. S., Abdulla, A. I., & Mohammed, S. M. (2020). Enterprise Resource Planning Systems and Challenges. *Technol. Rep. Kansai Univ*, *62*(4), 1885-1894.

Zeebaree, S. R., Jacksi, K., & Zebari, R. R. (2020). Impact analysis of SYN flood DDoS attack on HAProxy and NLB cluster-based web servers. *Indones. J. Electr. Eng. Comput. Sci*, *19*(1), 510-517.

Zeebaree, S. R., Shukur, H. M., & Hussan, B. K. (2019). Human resource management systems for enterprise organizations: A review. *Periodicals of Engineering and Natural Sciences*, *7*(2), 660-669.

Zeebaree, S. R., Zebari, R. R., & Jacksi, K. (2020). Performance analysis of IIS10. 0 and Apache2 Cluster-based Web Servers under SYN DDoS Attack. *TEST Engineering & Management* 83(March-April 2020):5854–63.

Zeebaree, S. R., Zebari, R. R., Jacksi, K., & Hasan, D. A. (2019). Security Approaches For Integrated Enterprise Systems Performance: A Review. International Journal of Scientific & Technology Research (IJSTR), 8(12), 2485-2489.

## Cite this article:

**Rezgar Hasan Saeed, Hivi Ismat Dino, Lailan M. Haji, Daroon Mudhafer Hamed, Hanan M. Shukur, Omid H. Jader** (2021). Impact of IoT Frameworks on Healthcare and Medical Systems Performance. *International Journal of Science and Business, 5*(1), 115-126. doi: https://doi.org/10.5281/zenodo.4423394

Retrieved from http://ijsab.com/wp-content/uploads/661.pdf

# Published by