Sparkling Light Publisher

Sparklinglight Transaction on Artificial Intelligence and Quantum Computing(STAIQC)

Website: **https://sparklinglightpublisher.com/ ISSN (Online):2583-0732**

A Study on Future Perspectives of Healthcare Data Analytics Using Internet of Things

Taheya Ali Salim Al Habsi[a,*], Vishal Dattana[b]

[a]*Post Graduate Student, Department of Computer Science, Middle East College, Muscat, Sultanate of Oman*
[b]*Senior Lecture , Department of Computer Science, Middle East College, Muscat, Sultanate of Oman*

Abstract

In the fields of electronics and computer science combined result, technological advances are formed with the realization of IoT (internet of things), connected healthcare, and smart concerns. The impact related to IoT in healthcare still has significant stages of development in the early days. The networked sensors are used in it that is embedded in living environments for the possible gathering of rich information with mental and physical health. This research work tries to comprehend and review the applications related to IoT with custom-made healthcare for excellent achievement at a reasonable cost. The explanation is given out in brief with IoT over which functions are used in the combination of sensing and wireless techniques with the implementation of healthcare applications. Here, the brief clarification is also given out with the challenges and opportunities for IoT. The research also highlights the opportunities and challenges for IOT in realizing the vision of the future of health care. Telemedicine is defined clearly in the research with different terms and conditions.

© 2021 STAIQC. All rights reserved.
Keywords: IoT, Smart Healthcare, Sensors, Physical health, Tele-medicine, Patient monitoring system, Network of Things.

1. Introduction

Internet is related to different protocols and applications that built the interconnected networks of computers that are refined with a large number of users. In this era, connectivity and global communication are performed with the integration of devices and people for a virtual environment. The active participation is performed in IoT with social processes and enabled with an interaction for proper communication processes. The processes are performed with trigger actions without any human intervention performed directly [1]. The internet is linked with the information and data that make the privacy and security interactions properly. The sensors, software's, embedded system, actuators, and network connectivity is performed to exchange the data properly linked with an infrastructure. The availability of data is controlled with integration over direct ways and resulted as the opportunities with an evolution.

E-mail address of authors: [a,*] h.taheya@gmail.com
[b]vishal@mec.edu.in
© 2021 STAIQC. All rights reserved.

Please cite this article as: Taheya Ali Salim Al Habsi, & Vishal Dattana. (2021). A Study on Future Perspectives of Healthcare Data Analytics Using Internet of Things. *Sparklinglight Transactions on Artificial Intelligence and Quantum Computing (STAIQC), 1*(1), 1–10. **ISSN (Online):2583-0732.** Received Date: 13/02/2021, Reviewed Date: 24/03/2021, Published Date: 31/03/2021.

1.1 IoT in Healthcare

The practice of medicine is performed that diagnoses as well as treated the reactive paradigm. The diseases are prognosis in early stages with cure; prevention and overall management process of health care cost reduction improve simultaneously. IoT devices are used principally to enable emergency and health monitoring processes. The health monitoring devices are formed with heart rate and health monitoring process over the notification systems properly. The devices of IoT are range from heart rate monitoring, blood pressure monitoring, advanced devices for specialized implants like pacemakers [3] being for citizens. The sensor people ensure the proper treatment that is well-being assisting and administered to lose the therapy via mobility in different ways as fine. More and more the platforms are formed related to end-to- end health monitoring in IoT that come up for chronic and antenatal patients. The management has performed that help out with health vitals and recurring with the requirements of medications. IoT in the sector of healthcare is known as heterogeneous computing that has wirelessly linked with the communicating system of devices and applications. The connection among patients is formed and health care providers essentially diagnose, track, monitor, vital storage, statistics and provide medical information properly. The solutions related to IoT healthcare are required to monitor remotely with the patients suffering concerns from diabetes, arrhythmia, cardiac and chronic disease. the GPS tracking related to Alzheimer's and dementia suffered put the life with data saving such as test results, CT scans, patient records, and medical staff management.

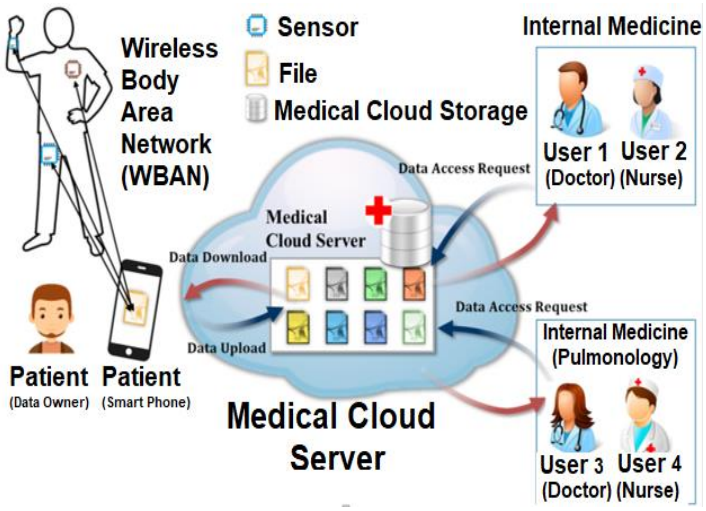

Fig.1. In-hospital patient system

The physiological parameters are measured properly through an in-hospital patient over the periodic base of healthcare professionals required over it. IoT in the healthcare sector removed the issues that come at regular intervals through monitoring systems such as gateways, sensors, and cloud for store and evaluate the data that is communicated wirelessly for analysis. The physician accesses the data of the patients from anywhere over the internet-enabled devices such as smartphones, tablets, PCs to appropriately prescribed the medical management [1]. The webpage is accessed by a physician and IoT enhances the quality of care with regular attention and the need for personal engagement in data collection and analysis processes.

In the IoT field of healthcare, the development activities are formed with WSNs (wireless sensor networks) and transforming gradually into LoWPAN (lower power wireless sensor networks) that are based on IPv6. The devices are limited with processing that has power-life and the ability to transmit the information wirelessly by using an IP. The wearable gadgets, sensors, devices in the healthcare industry make the large internet revolution and open the horizons of connectivity, usability, research facilitation as well as development in the part of IoT [6].

The healthcare diagnostic and imaging devices, sensors, wearable devices, monitoring systems work as the essential part of IoT [5]. The prominent applications are linked with cost-effective and innovative medical applications with the emergence of quality of life in IoT. The IoT-related system is capable of human-to-machine (H2M), machine-to-machine (M2M), and human-to- human (H2H) communication processes without involvement in humans.

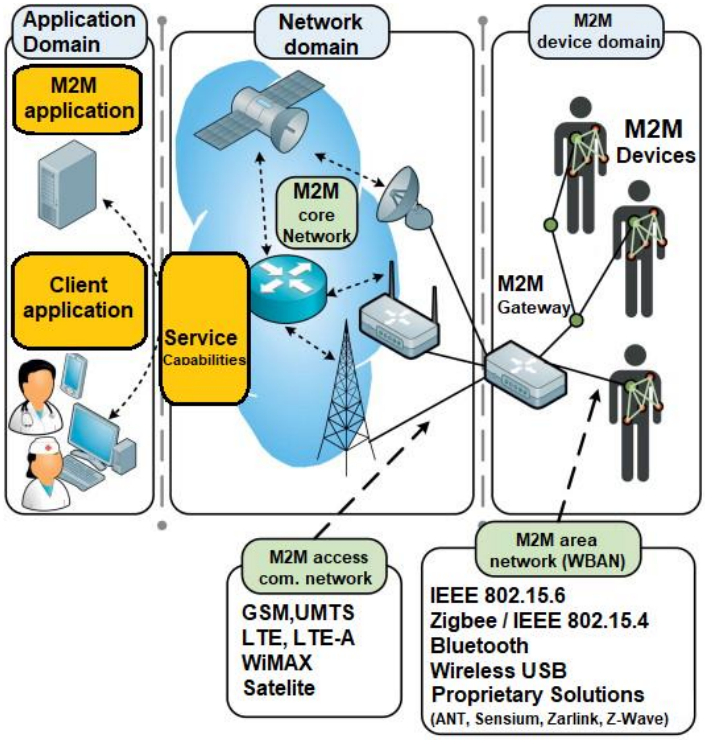

Fig. 2. Human-to-machine (H2M), machine-to-machine (M2M)

In the treatment methods, the advancements are formed in which patients are looked after it and enabled with the access of health care data linked with doctors, nurses, and relatives related to patients. Additionally, the efficiency and quality related to medical services are improved greatly [3]. For example, chronically elder people, ill patients reduced the mobility that is managed remotely. The hospital visits are minimized substantially and reduced the inconvenience and cost towards the patients. The wearable's for healthcare monitoring like such as smart blood pressure that is sent remotely with the data during different day times. The gap formed the bridges among patients and doctors that speed up with the treatment through critical needs related to the patients. IoT has the potential that reduces significantly medical complications and diminishes moralities related to no- communicable diseases such as hypertension, heart disease, hyperglycaemia, hypo, and cancer, etc.

2. Literature Review

The IoT (internet of things) is connected with the physical objects through an IP over the network that exchanges information to businesses and consumers through the software application. The IoT applications encountered by every person with predicted concerns and opportunities are formed with industries harnessing to gain a competitive advantage [2]. Initially, RFID (radio frequency identification) is used to governing technologies behind IoT development. In India, a survey was conducted that observed different medical centers functioning and improvement in healthcare delivery [3]. The survey is revealed the records of the patient in the

hospital that are not managed properly. Electronic health records (EHRs) were revealed with healthcare facilities that improved with complexity issues solutions. The paper is proposed with pragmatic and simple terms as the WebEHR. The web-based connectivity is formed through different healthcare centers, maintenance of data sharing processes. This paper proposed the cloud computing approach for integrating hospital records to maintain the data of the patients properly [2]. In the hospital, the clinical deterioration makes the important clinical concern with the patient community and ensures the government healthcare facilities. The implementation and deployment are given out in wireless monitoring with in-patients inside the premises of a hospital. The wireless systems gathered with oxygen saturation measurements and regular pulse from the patients. It provides the medical equipment with safety measures as well as the precautionary steps taken out to improve the quality of healthcare in India.

According to [4] remote healthcare-telemedicine has use of information and telecommunication technologies to provide the clinical concerns remotely provided over the healthcare. The distance barriers are removed that improve the access to medical services that are not consistently available in rural communities. Exchange of data and information provided in the healthcare medical field concerns provided over it such as image, voice, video, elements of the medical record, graphics and command to the surgical robot. The research work explained different wearable devices related to IoT and healthcare involvements are linked through it properly [5]. The wearable that monitored properly the circadian rhythm related to the heart and after that it eliminates the electrocardiogram test properly. The users just put the finger and set the pads in the mobile phone after that the reading is taken out through the device. The heartbeat is considered as it is normal or has fibrillation. Another version of this wearable device is linked with a heart-rate watch sensor to analyze the readings properly. Recently L'Oreal introduced wearable devices related to UV sense and when users are exposed to a high dose of UV radiation it starts to beep that adverse health effects. It is battery-free and the nail is worn with the sensorless than the centimeter. The NFC is enabled over it and downloaded on mobile with the data of users about the sun exposure properly. Different innovations related to IoT are enabled that supports the Bluetooth and manages the body temperature up to 48 hours [6] and has the patch sensor. The readings are managed or monitored properly on mobile devices through an application interface. The advanced functionalities are supported over it that raise an alarm when the temperature is exceeded to the set threshold values. These types of Wearables are helpful in the viral and bacterial infections when body temperature is suddenly increases and response towards the diseases of body fighting.

According to [7], IoT-based personal services have highlighted the promise to fulfilled and evaluated human societies and long-awaited requirements all around the world. The new method is deployed through an intelligent object in the environment for dependency and mobility especially to monitor and support the information continuously. The independent and secure concerns or services related to IoT are enabled with time management of the adverse drug reaction (ADR). The primary aspect of primary medical care is to make sure that patients are prolonged by the medications with minimal subjected concerns of ADRs. The compliance to the medical concerns has the severe health-related issues over which the patient abandons as well as neglected the combination of medicine without an expert of healthcare.

3. Study of the Existing System

The IoT community of IEEE defined the adaptive system and self-configuring that are considered to the network of sensors. The smart objects are interconnected with each other for daily industrial objects in a way that makes them programmable and intelligent for the human interaction process [8]. The devices are connected with the internet excluding computers, cell phones, and tablets within IoT referred to as NoT (Network of Things). The fig.3. explains the concept of NoT in healthcare. The four primitives are proposed by NoT through Voas such as:

- ***Sensor:*** the electronic utility is measured digitally with physical properties in healthcare for hospitals with cameras and microphones
- ***Aggregator:*** the software implementation is given out with the intermediate data in conjunction with cluster and weight by computation
- ***Communication channel***: it is the medium that is transmitted the data over wired and wireless concerns. The

external utility has the hardware and software services to process and executes the data feeds over the dataflow of NoT(network of things).

- **Decision trigger:** it creates the output and results finalized with data consideration processes to satisfy the requirements and data of specific NoT. The computational and physical technologies are linked with the healthcare naturesystem with the design and implementation of NoT.

3.1. Secure cloud storage and machine learning

It is enough with the technology that meets the needs of caregiving with a recent study conducted by HITLAB (health innovation technology laboratory) for a better understanding of the technology implementation. The medical-related information is obtained first through the patients and stored securely for continuous usage. Doctors learn the patient history properly and a large database of information is available in it. The data of doctors and patients are secured properly that are saved in different machines such as accessibility for the healthcare for storing data. Additionally, machine learning is identified to improve the healthcare system and explored the medical data [9]. The diagnostics are provided with the recommendation over the individual patient's concern. The cloud storage architectures are designed for big data sets and the implementation of machine learning. Fig.4. demonstrates cloud storage and machine learning.

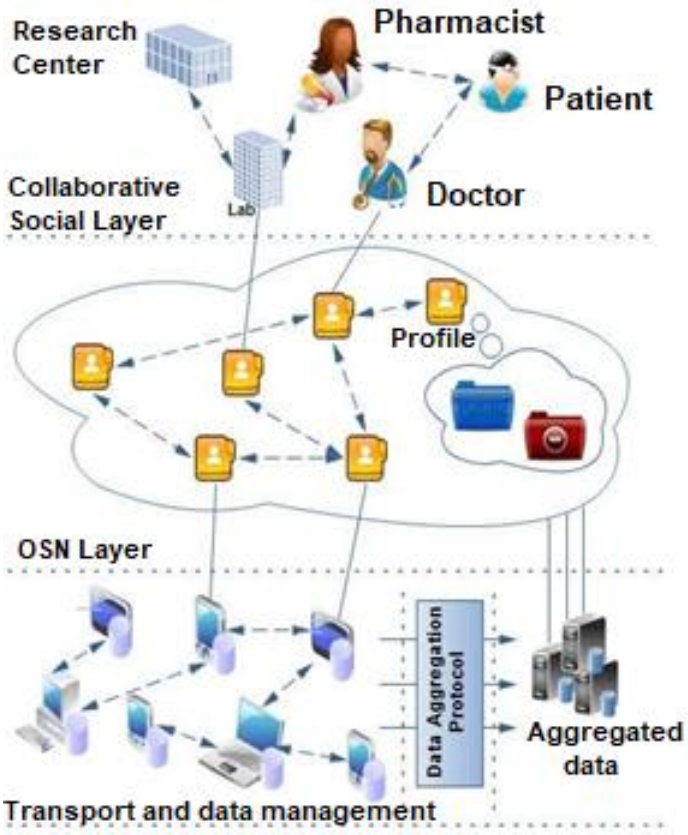

Fig.3. IoT in healthcare

The model used in it is linked with the development that is accomplished of supporting the management of chronic situations such as hypertension. The normal health care activities are monitored properly such as blood

pressure with different allocation on the body set intermissions measured all over the day and interconnected with the wrist-worn central node. The comprehensive records related to the patient are measured by machine learning processes and identify the highest reading in emergencies [10]. The complete information is determined through an optimal time of the patient-related concerns in medication that are required to manage different conditions and remind the alarm and buzzer for the patient with central node connection.

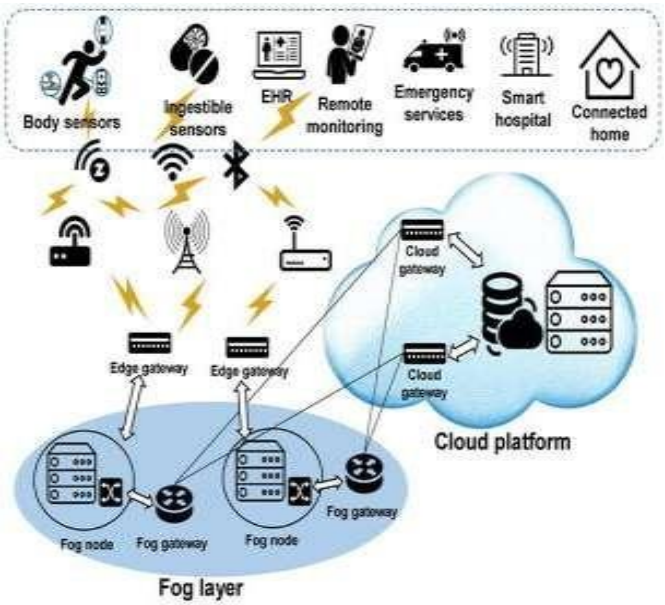

Fig. 4. Cloud storage and Machine learning

4. Proposed Research

The generic model is formed that proposed the guiding apprehensions in the growth of future IoT healthcare systems with the different number of used cases. The subsections are formed with the discussions and use cases that include assisting management related to chronic conditions, restoration, monitoring, and degenerative conditions to monitor the health care emergencies properly. The proposed model has the reintegration system for knee injuries established properly through wearable accelerometer sensors on one side of the knee that is positioned and after that calculated properly. All of the measurements are recorded with different activities such as rehabilitation exercises and normal jogging or walking. The communication is performed through short-range communication that becomes comfortable with wearable wristwatch nodes and forwards all information through the cloud storage process by long-range communication [5]. In the cloud information and data of the patients are recorded with the progress that is continued to expand with the received message. The records are secured and saved that have the patient's progress shown by the continuous expansion received with the message. The algorithms of machine learning are implemented that are identifying with the patient request predicted and dully rehabilitated to manage the working and exercises with better outputs. The system is adapted easily and with additional injuries, the modification is performed through the wearable sensors used over it properly.

In healthcare, the sensor covers the respiration rate, heart rate, and galvanic skin responses to share the measurements changes that occurred within the body. The measurements are performed with the impedance that is created with the volume of blood flowing processes through radial and ulnar. Finally, the critical healthcare is

monitored that are used by the system comprised with the wearable sensors and monitor the vital concerns by pulse, body temperature, blood pressure, and respiratory system [8]. The measurements are taken out regularly with the parameters of thresholds over the dominant node to frontward the data to the cloud by emergency services notification. The emergency time can be verified with the patient reading with the health record in the cloud with doctor information related to the diagnosis regarding concerns.

The emergency health conditions are formed among diagnosis and symptoms with the connection added to the files in machine learning. The information is responded that is provided with the paramedics ensure with the patients received over the appropriate car for different conditions in a rapid manner. In use cases of the system, it developed the model with the versatility with different conditions that are managed properly. Cloud technologies are used widely that are researched due to big data management, analytics, and processing. Different technologies related to IoT are proposed like smart grid and cloud computing smartphones [9]. In complex computations, the low resource mobile devices and high- power environment is formed in the cloud returned with the data processing and data storage memory managementprocesses.

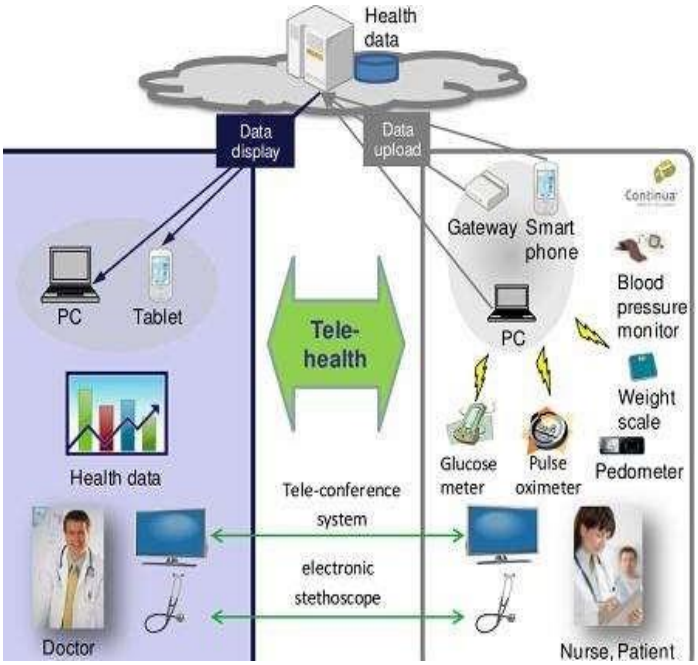

Fig.5. Tele-health system

In healthcare, the sensor covers the respiration rate, heart rate, and galvanic skin responses to share the measurements changes that occurred within the body. The measurements are performed with the impedance that is created with the volume of blood flowing processes through radial and ulnar. Finally, the critical healthcare is monitored that are used by the system comprised with the wearable sensors and monitor the vital concerns by pulse, body temperature, blood pressure, and respiratory system [8]. The measurements are taken out regularly with the parameters of thresholds over the dominant node to frontward the data to the cloud by emergency services notification. The emergency time can be verified with the patient reading with the health record in the cloud with doctor information related to the diagnosis regarding concerns.

The emergency health conditions are formed among diagnosis and symptoms with the connection added to the files in machine learning. The information is responded that is provided with the paramedics ensure with the patients received over the appropriate car for different conditions in a rapid manner. In use cases of the system, it developed

the model with the versatility with different conditions that are managed properly. Cloud technologies are used widely that are researched due to big data management, analytics, and processing. Different technologies related to IoT are proposed like smart grid and cloud computing smartphones [9]. In complex computations, the low resource mobile devices and high- power environment is formed in the cloud returned with the data processing and data storage memory managementprocesses.

4.1 Tele-medicine

Different concerns related to telemedicine in defined properly with different terms and conditions. Tele-health is the delivery related to health services as well as clinical information over remote locations. It is an FDA-approved process over the platform that is interactively connected with licensed doctors 24/7 using and internet, IoT, and electronic medical record clouds. The hour in need solutions is provided with a new paradigm over in the healthcare industry. Telemedicine makes the consultation for the patient in a remote location that assists the primary care of physician rendering for the diagnosis process [10]. According to AMA (American medical association), the emergency case is handled properly through the telemedicine processes. telemonitoring terms is related to the data collection process of the patient by using IoT technology and send the data over the healthcare monitoring process and remote the diagnosis and testing. telemonitoring services include different personalized alerts to inform the patients of the concerns of their healthcare in time of mental and physical terms. Telesurgery enabled the surgeons to perform the best operations of the patients over the distant location through the technology of telerobotics. Remote medical education provides the healthcare education service through the community that is targeted in different geographical locations of the groups. The data services related to telehealth share the specialized information to provide the health services, by research firms, the education industry, and the government with many others linked with it.

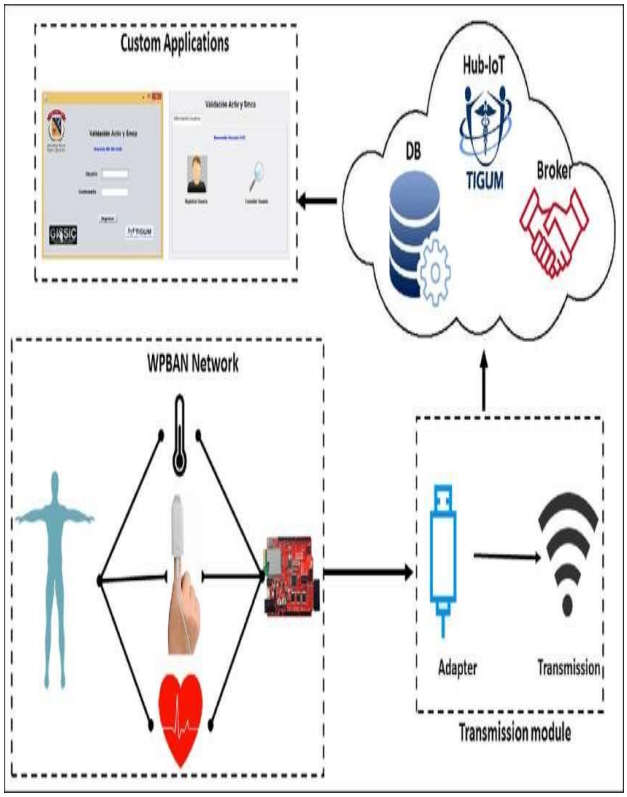

Fig.6. Tele-medicine system

5. Critical Evaluation

The lessons that are learned from this research paper are through the conduction of surveys with several research areas. In terms of sensors, the progress is applied that is made with available devices in the hospital-grade environment of wear-ability and efficiency [7]. It is especially true with complex concerns and the devices such as respiratory and blood pressure rate sensors that become valuable in the field of medicine. In further research, exertions are performed that improved the superiority of the sensors until they become reliable, precise, and comfortable for wearable concerns.

In future works, particular concerns are placed and focused on the development of work that monitors IoT technology with compromising accuracy levels. The impact is analyzed that reduce the impact of the sensor with the communication standards that develop the systems of healthcare with emerging NB-IoT concerns [5]. The new standards are implemented in the healthcare environment that makes extreme advantages in this field. In future work, the implementation is made that make the suitability with communication standard over the system in the healthcare environment. The cloud technologies related to data storage are considered over the processing in the development of cloud-based algorithms. The information is extracted through the sensors and processing is continued over the capable concerns.

Table 1. IoT Applications in Healthcare

IoT applications	Patients	Hospital Staff	For completehealthcare departments
Robotics	Medium level	High level	High level
Wearable'sdevices	Strong level	Medium level	High level
Smart cards	Medium level	Low level	Medium level
Non- wearable's devices	Low level	Medium level	Low level

Machine learning is linked with data processing that is valuable tremendously in healthcare concerns. The high-power computing environment is applied in the cloud- machine learning with patient's diagnostics for new disease detections and has an aid applied in the different improvement of treatment plans. Notwithstanding it, the clear compensations are gained with machine learning related to IoT implementation that is explored widely with healthcare applications provided the significant opportunity.

5.1 Features of Telemedicine

The various features of Telemedicine are listed below.

- Remotely diagnoses recorded and transfer healthcare parameters with remote patients.
- Historical records management and prescription- based diagnostics.
- Personalized website for patients.
- Management of patients with an appointment thatcan book the doctor schedule.
- Record management and patient profile linkedwith doctor dashboard.
- Billing features are inbuilt with bio-sensors for vital information.
- Both in offline and real-time mode with seamless video conference multiple camera optionsavailability.

5.2 Through speech-based query system used in telemedicine

The patient's records are saved with local languages, doctors that are followed up through SMS, voice treatment information. The continuous support is linked with healthcare providers and training through materials that are created over multilingual speech recognition. This process is used to engage the practitioners over the human

conversation and tests the skills and knowledge related to telemedicine architecture [4]. The planning and continue delivery can be improved with outpatient monitoring architecture in healthcare.

6. Conclusion

It is concluded at the end that, all physical objects are work seamlessly with human-to-machine interactions and machine-to-machine interfaces. The interconnection levels are formed in the health influencing factors that are linked with the internal and external body with clear concerns. The link predicated IoT revolution makes the healthcare case with emerging technologies that are accessible, affordable. The building blocks of IoT make the automation of machine-to-machine communication that are continued and established properly. The service layer is formed with the addition of IoT infrastructure and mutiny is considered by end-to-end processing and connectivity processes. The doctors are linked with IoT and collaboratively experience the technology-based input over the new concerns. Primary healthcare transforms with patients over the developing world and brings an affordable level of quality. The concerns are reviewed and predictable with future guidelines with the incorporation of remote health monitoring technologies. The medical practices are given out with the medicine and wearable sensors that are equipped particularly over the IoT intelligence and offer attractive options with enabled recording and observations for data environments. The enabling observations are given out that are recorded in an environment that is easy-to-assimilate and virtualization isradically given out to reduce cost in healthcare.

References

[1] Klímová, B,. & Kuča, K. (2019). Internet of things in the assessment, diagnostics and treatment of Parkinson's disease, *Health and Technology*, 9(2), 87-91.

[2] Tokareva, M.S., Vishnevskiy, K.O., & Chikhun, L.P. (2018). The impact of the Internet of Things technologies on economy. *Бизнес-информатика*, 3(45), 62-78.

[3] Patil, V., Thakur, S.S., & Kshirsagar, V. (2018, June) Health Monitoring System Using Internet of Things. In *2018 IEEE, Second International Conference on Intelligent Computing and Control Systems (ICICCS)* (pp. 1523-1525). IEEE.

[4] Wangkhem, K., & Joshi, K. (2018) IoT for Healthcare and Its Challenges. *International Educational Journal of Science and Engineering*, 1(2), 1-5.

[5] Vyas, J.D., Han, M., Li, L., Pouriyeh, S., & He, J.S. (2020, April). Integrating blockchain technology into healthcare, In *Proceedings of the 2020 ACM Southeast Conference (*pp. 197-203).

[6] Wang, M.M., Zhang, J., & You, X. (2020). Machine-type communication for maritime Internet of things: a design. *IEEE Communications Surveys & Tutorials*, 22(4), 2550-2585.

[7] Park, T., & Saad, W.(2019). Distributed learning for low latency machine type communication in a massive internet of things. *IEEE Internet of Things Journal*, 6(3), 5562-5576.

[8] Schlienz, J., & Raddino, D.(2016). Narrowband internet of things whitepaper, *White Paper, Rohde&Schwarz*, 1-42.

[9] Zayas, A.D., & Merino, P. (2017, May). The 3GPP NB-IoT system architecture for the Internet of Things. In *2017 IEEE International Conference onCommunications Workshops (ICC Workshops) (*pp. 277-282). IEEE.

[10] Ai, Y., Peng, M., & Zhang, K. (2018). Edge computing technologies for Internet of Things: a primer. *Digital Communications and Networks*, 4(2), 77-86.

****

ISSN (Online):2583-0732