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Smart Wearable Device for Health monitoring using IoT and Cloud Technology

Dr.Jaishankar B[a], Aiswarys R S[b,*], Dr.Ramesh S M[c]

[a]*Associate Professor,Department of Electronics and Communication Engineering, KPR Institute of Engineering and Technology, Coimbatore. India*
[b]*PG Scholar, Department of Electronics and Communication Engineering, KPR Institute of Engineering and Technology, Coimbatore. India.*
[c]*Professor, Department of Electronics and Communication Engineering, KPR Institute of Engineering and Technology, Coimbatore. India*

A B S T R A C T

Internet of Things (IoT) is incredibly an ample space with a variety of hardware and software technology evolve around it. In the world of IoT, interconnection between the devices and things is considered to be an essential factor in healthcare systems. The goal of achieving interoperability depends on how data is shared among the devices. In IoT protocols like CoAP, MQTT and Http are widely used in connecting devices. This paper proposes a solution to enhance interoperability under various interactive environments in healthcare Systems. Further, the data centers of the system are provided with horizontal platform to share data between them. The sharing involves the use of middleware to increase interoperability between the data centers and also between the various IoT devices in interactive healthcare systems. Comparison result of the increase in the overall performance of the system. The experimental part includes the analysis of optimization of the data between data centers, time taken to deliver, efficiency in transferring off data and the rate of packet delivery.

1. Introduction

The word interoperability refers to the ability of various hardware and software components to communicate with one another in order to exchange data. The purpose of interoperability would be to ensure that linked devices are compatible. Interoperability is required in IoT[3] contexts to enable smooth device or sensor programming and to enable a world of linked equipment in interactive healthcare systems[20]. This implies that the Internet of Things will need standards to allow transversal frameworks[1] that are communicative, operable, and configurable among equipment of any manufacture, type, producer, or industry. The concept is that communication between people, processes, and objects works regardless of the kind of screen, browser, or technology utilized. Indeed, the Internet of Things (IoT) would be a continually developing network of physical objects equipped by sensors, detectors, and wireless transmission that communicate and share data with one another. The Internet of Things is still being utilized in a range of sectors, like agriculture, livestock and agribusiness, smart[2] cities, and healthcare, where a sensor network must manage a variety of sensor devices and wireless connection techniques.

Interoperability is a term that refers to the competence of two or multiple equipment, platforms, systems, or infrastructures to communicate with one another. Interoperability permits the exchange of data across disparate devices or systems in order to accomplish a shared purpose in interactive healthcare systems. Current devices and systems, on the other hand, are fragmented in addition to the abovementioned methods, standards, and file systems. This variety complicates the communication and data sharing between equipment and software in an IoT network. The lack of compatibility limits the value of IoT networks. Researchers seek to achieve and maintain interoperability in the Internet of Things (IoT) technologies and ecosystem in interactive healthcare[8] systems. Designers present ways for integrating peripherals with IoT devices seamlessly, with the goal of establishing a worldwide Network infrastructure of diverse sensors and devices. Researchers investigate and assess the adaptive interoperability between different devices in an Internet of Things (IoT)[6] framework in interactive healthcare systems.

Interoperability on a technical level is often connected with software and hardware components, platforms, and frameworks which allow machine-to-machine[7] interaction. Furthermore, sort of interoperability verifies the protocol stack used and the infrastructure required for interactive healthcare systems to perform. Additionally, syntactic compatibility is often linked to data formats[9]. Without a doubt, the messages sent through communication protocols must have a well-defined grammar and encoding, even if merely inside the shape of bit fields. Additionally, semantic interoperability allows computers to integrate incoming data with other data sources and analyse it meaningfully[10] in interactive healthcare systems as mentioned in fig 1.

* Corresponding author. E-mail address: *Aishurs08@gmail.com*

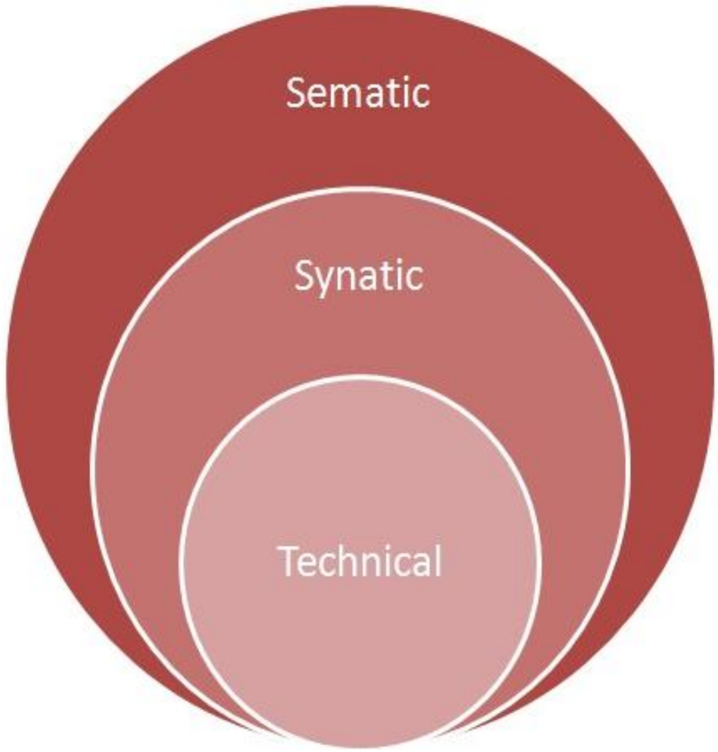

Fig.1 - Layers of Interoperability

To facilitate interoperability amongst interactive healthcare systems, the CoAP protocol is employed at the application layer, which is built with either a RESTful-integrated frontend and operates over constrained networks. It is mostly utilised in limited networks, including those with low-end device connectivity. To take use of current web-based techniques, the CoAP was built to really be HTTP-compatible and capable of utilising the same HTTP methods as HTTP, namely GET, POST, and PUT as conferred in fig 2. However, one distinguishing aspect of CoAP[10] is its usage of User Datagram Protocol as both the transport layer protocol in interactive healthcare systems, but instead of TCP. According to the connectionless characteristic of UDP, the CoAP protocol may offer a portable dependability mechanism in interactive healthcare systems by dividing it into two layers.

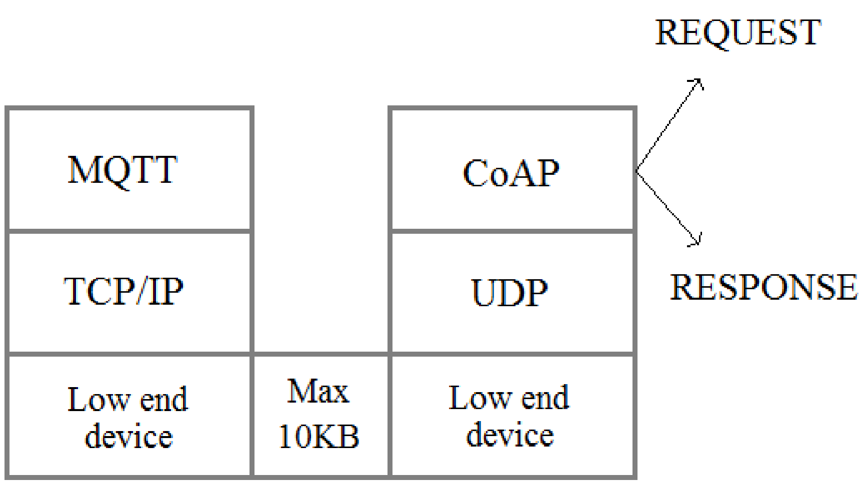

Fig. 2 - CoAP vs MQTT Layers

The Request/Response layer would be used to manipulate resources by specifying procedures, whereas the Transaction layer is being used to identify the dependability mechanism was using to process messages and to detect message duplicate []. Each message may be one of four sorts in the Transaction layer; confirmable, non-confirmable, acknowledgement, or reset. Apart from the capabilities listed above, CoAP seems to have the additional critical aspects that are critical in IoTs contexts, such as multiplex compatibility, asynchronous data transfers, reduced preamble latency, a simple parsing procedure, and URI and content-type assistance []. CoAP's message type might be CON, Non-CON, ACK, or RST.

Each answer is associated with a token that corresponds to the accompanying request. Asynchronous communications would be exchanged to convey the requests, answers, and semantics. Due to the fact that CoAP is tied to UDP, dependability has been built into the protocol and may be utilized easily []. For reliability, the system is lightweight and includes features such as simple stop-and-wait retransmissions with exponential backoff for CON messages []. Additionally, duplication detection is performed both CON and Non-CON signals. As a result, individual communications would be transmitted both reliably or unreliably, depending on the GET response headers option given. If indeed the service is accessible at the moment the CON-Request is processed, the server may piggyback the answer on the Ack packet [].

MQTT is a simple message-oriented protocol that operates on a publish/subscribe architecture. It enables high scalability and dynamic support for a diverse variety of applications, particularly inside the M2M and IoT sectors. Each MQTT device is depicted as either a consumer and is capable of communicating through TCP with a MQTT broker []. MQTT offers a number of unique qualities that make it an attractive solution for IoT contexts requiring low-bandwidth, low-latency, and power-efficiency needs, including a minimal header overhead, topic-oriented administration, and automated message forwarding when clients rejoin [].

Additionally, it provides dependability by dynamically selecting one of three QoS levels for message delivery if indeed the message is QoS 0. This option is utilized whenever the communication is not acknowledged or saved. The message may have been misplaced or duplicated. It is the quickest method of communication transmission.

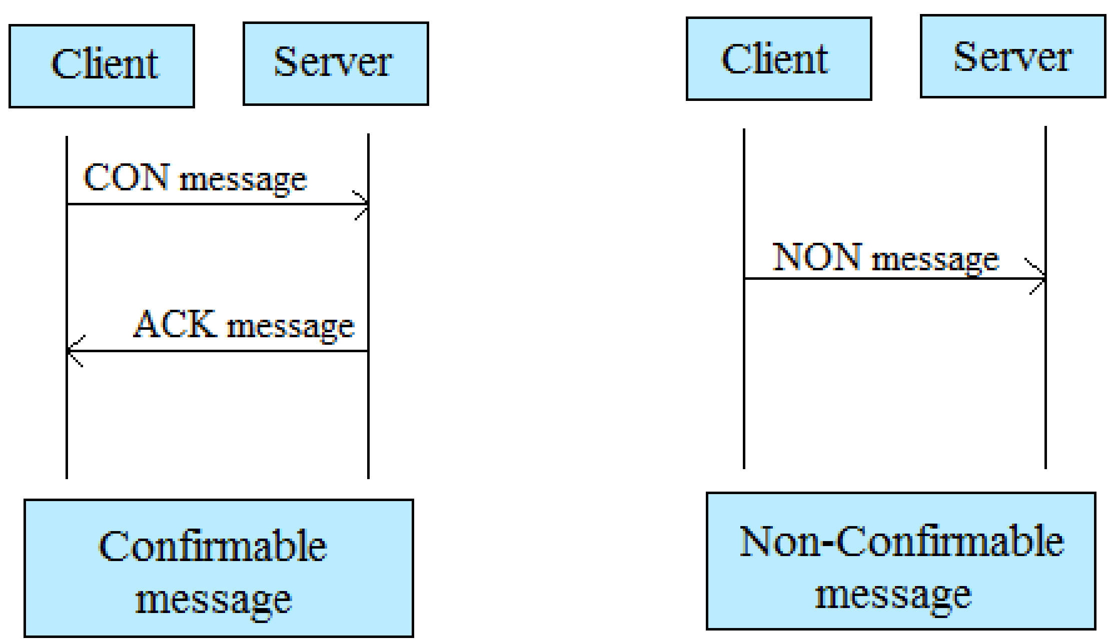

Fig.3- CoAP CON, ACK, NON messages

Alternatively, if the message has a QoS of l, it is an at least once. Each message may be transmitted numerous times, with probable duplications, if errors occur before to the sender receiving an acknowledgement. While using option, signals must be held temporarily at the sender until they are sent to their intended recipient, allowing for potential retransmissions as mentioned in fig 4. Additionally, if indeed the signal QoS2 – It is sent precisely once, ensuring that no messages are duplicated. It enhances QoS l by storing messages at both senders and recipients to minimize duplication.

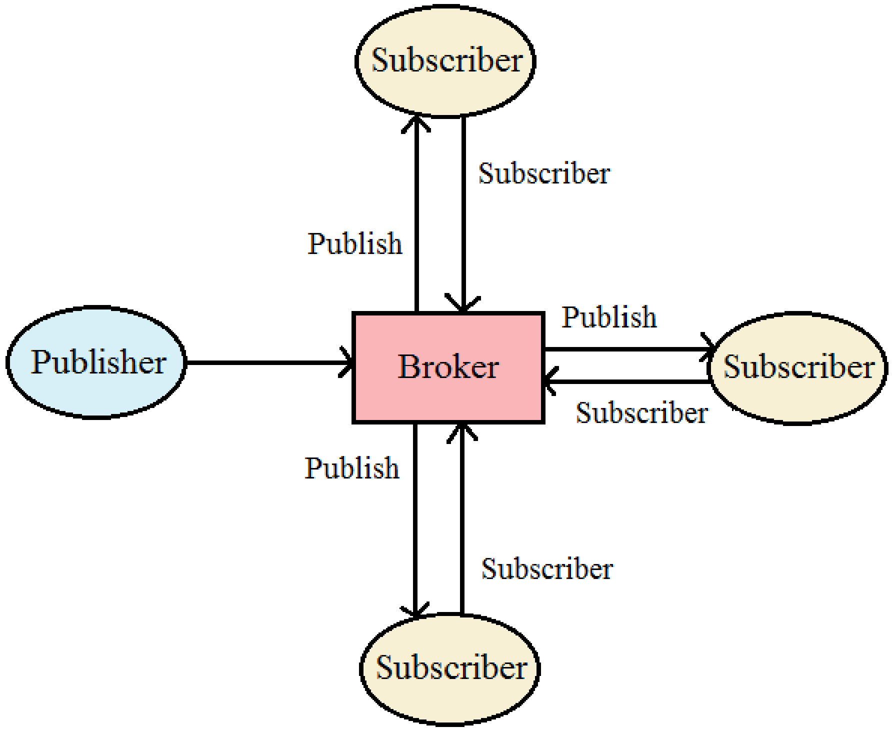

Fig.4- MQTT Publish/Subscribe

In the end, MQTT allows every node to register a broker-side message (Last Will and Testament) that the broker will send to all subscribed clients on the topic, when the node is disconnects unexpectedly []. This provides a basic automated mechanism for the monitoring and management of disconnections in highly dynamic IoT environments [].

2. Proposed DDS framework

Internet of things is a combined network of physical and virtual objects and resources that are equipped with sensing, computing, actuating, and communication capabilities. The Data-Distribution Service (DDS)[3] is a middleware protocol and API standard for data-centric connectivity, it integrates the components of a system together, providing low- latency data connectivity. In this work, let us consider the features of a smart home[19] automation system. A cluster of IoT devices[5] will be connected in the automation process of the smart home. The devices are separated depending upon the features and use, the possible sets of separations may include devices for monitoring environment activates, devices used for home security, devices monitoring health issues, etc. Each environment consists of its own data centers for processing of the accumulated information. Data from these systems are stored for their respective data centers. The demanding and sharing of information within the data centers is achieved by the automation system. These automation systems differ for different environment. It is based on the platform where it is used, the sharing of data between the data centers seems to be difficult as mentioned as fig 5.

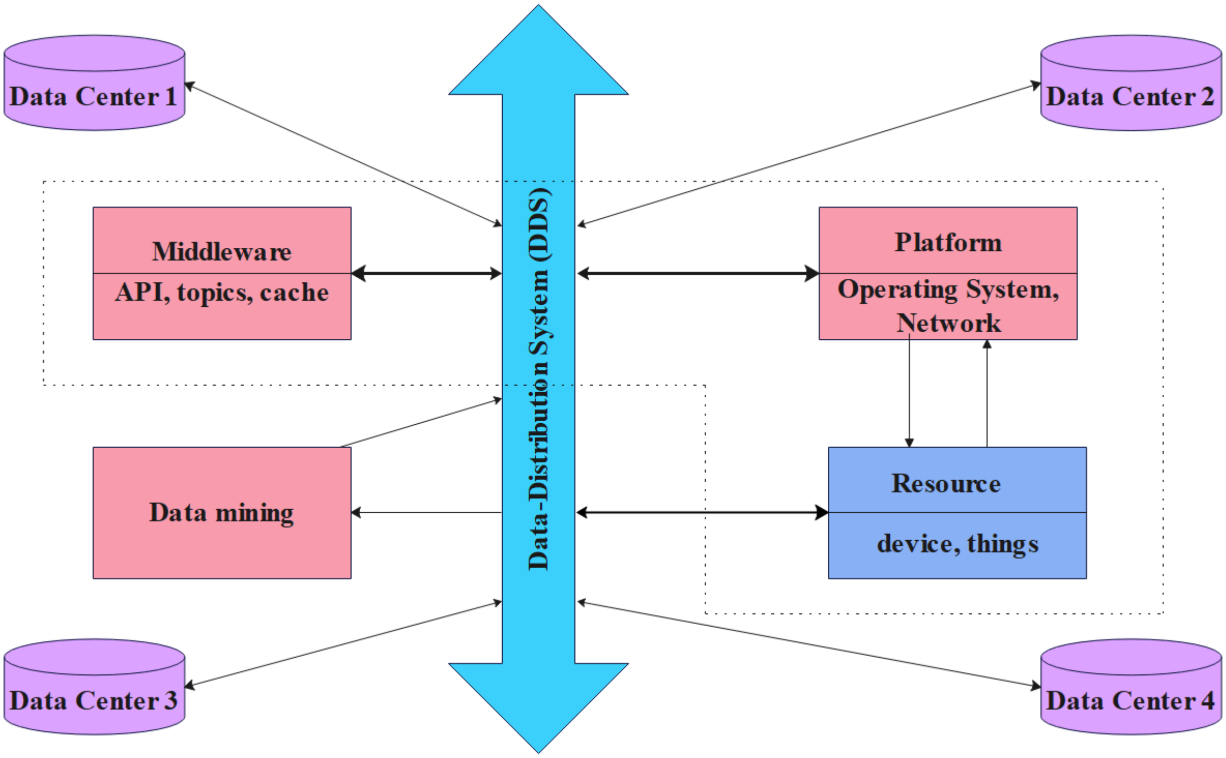

Fig. 5- Block diagram of Interoperable System (DDS system)

The devices in the health monitoring system may need information from the security automation system. The sharing of data is difficult between different automation environments. DDS is a common middleware protocolthat lies between the operating system and applications. It enables the various components of a system to more easily communicate and share data. The using of the DDS system as a middleware in connecting the data centers increases the rate of data sharing in the system. This middleware is a software layer that gets the details of the operating system,network transport and low-level data formats. The same data and APIs are provided in different programming languages allowing applications to exchange information across operating systems, languages and processor architectures. Low-level details like data wire format, discover, connection, reliability, protocol, QoS management, etc. are managed by the middleware.The use of middleware data centric system is to eliminate the clash of data sharing between the open system and proprietary system. This provides ease of data sharing capability in the sharing and increases interoperable of data among the data centers.

2.1 Layers in IoT for Enhancing Interoperability

Data integration

The data integration layer's primary function is to perceive the physical qualities of objects in our environment that are connected to the Internet of Things. This layer is created using a variety of sensor methods [6]. Additionally, this module is responsible for transforming the data to serial communication that are more easily sent via a network. However, certain items may not be immediately perceived [6]. These things will be implanted with microchips to provide sensing and processing capabilities. Indeed, embedded intelligence and nanotechnologies will play a significant role inside the perception layer. The first will produce chips tiny enough to be inserted into commonplace things [6]. The second one will provide them with the processing capability that future applications may demand.

Device management

The device management layer manages and processes the information from different integration layer. The device management layer is in charge of data transmission to the application layer via a variety of network protocols, including wired networks, wireless network and LAN. Moreover, Bluetooth, 3G/4G, Wi-Fi, UMB, Zigbee, and infrared technologies are the primary modes of transmission [6].The network transports massive amounts of data. As a result, providing a robust gateway to gather and process this massive volume of data is implausible. Cloud computing is the key technology employed at this tier to accomplish this aim [6]. This technology enables the storage and processing of data through a dependable and interactive connection. Furthermore, computational research & development are critical for the future growth of IoT [6].

Data management

The data management layer makes use of the device management layer's processed data. This layer serves as the front interface of the entire IoT architecture, allowing for the exploitation of IoT data [6]. Additionally, this layer offers the necessary infrastructure for developers to implement the Internet of Things concept. The spectrum of conceivable linked applications is astounding in this vision (for example, intelligent transportation systems warehouse management, identity identification, location-based services, and security) [6].

Data Centers:

The data centre was where an enterprise's processing capacity, memory, and software are housed as illustrated in fig 6. The data centre design is comparable to the information technology architecture, which is the source of or conduit for all content [12]. Proper implementation of the virtualization architecture is crucial, as is careful consideration of efficiency, reliability, and adaptability. Another critical aspect of data centre architecture is the ability to rapidly install and maintain new services. Creating a nimble infrastructure capable of supporting new applications quickly may result in a major competitive advantage [12]. To construct such a system, it is necessary to do thorough initial planning and to think carefully about port frequency, network infrastructure uplink throughput, actual server capacity, and over subscription [12].

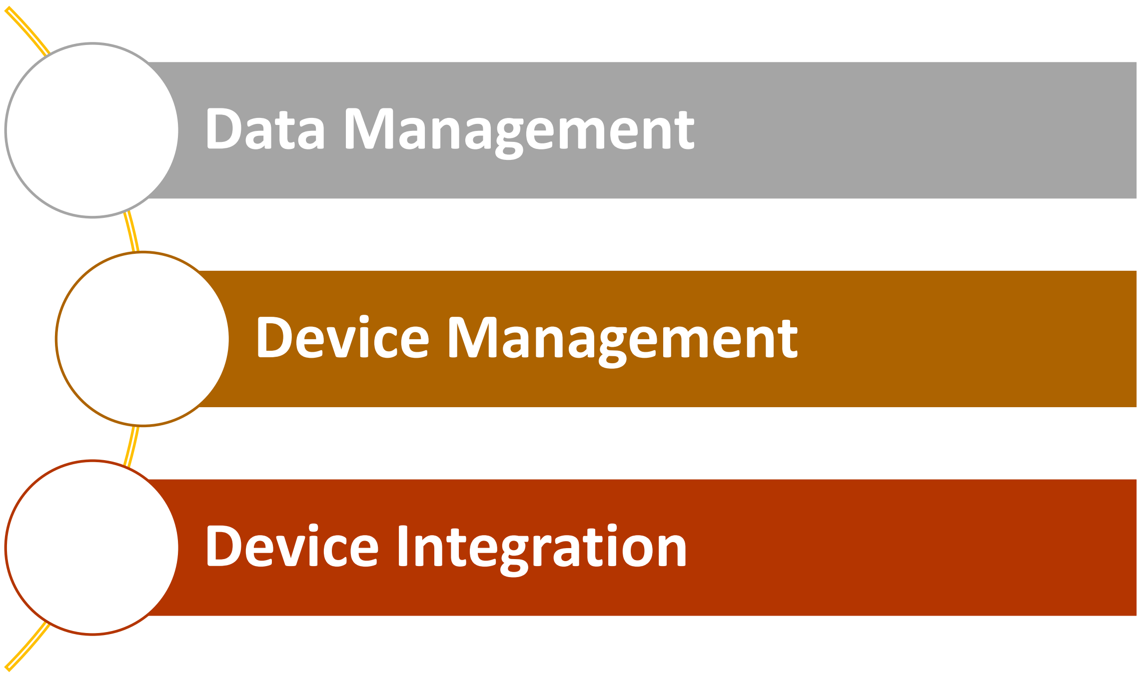

Fig. 6 - Layers in IoT

3. Results and Implementation

In the experimental process, theenhancing interoperability among interactive healthcare systems proposed system is analysed for some of the basic parameters with the existing system. The metric which are used the analysis the performance of the proposed model are optimization, time, efficiency and packet delivery.

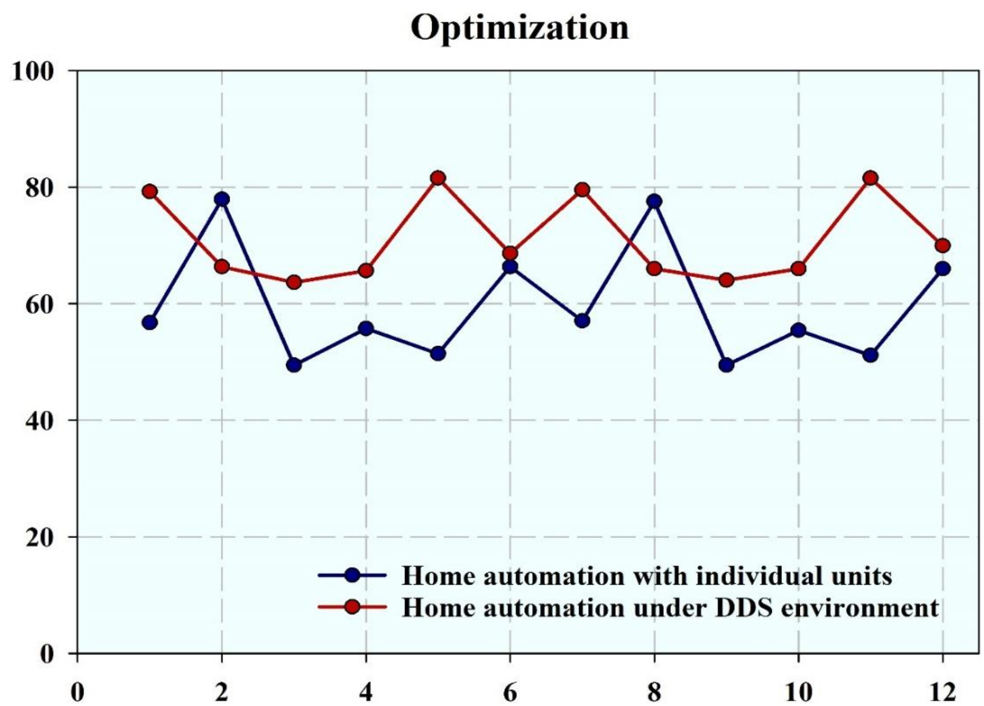

Fig. 7 - Comparisonon optimization

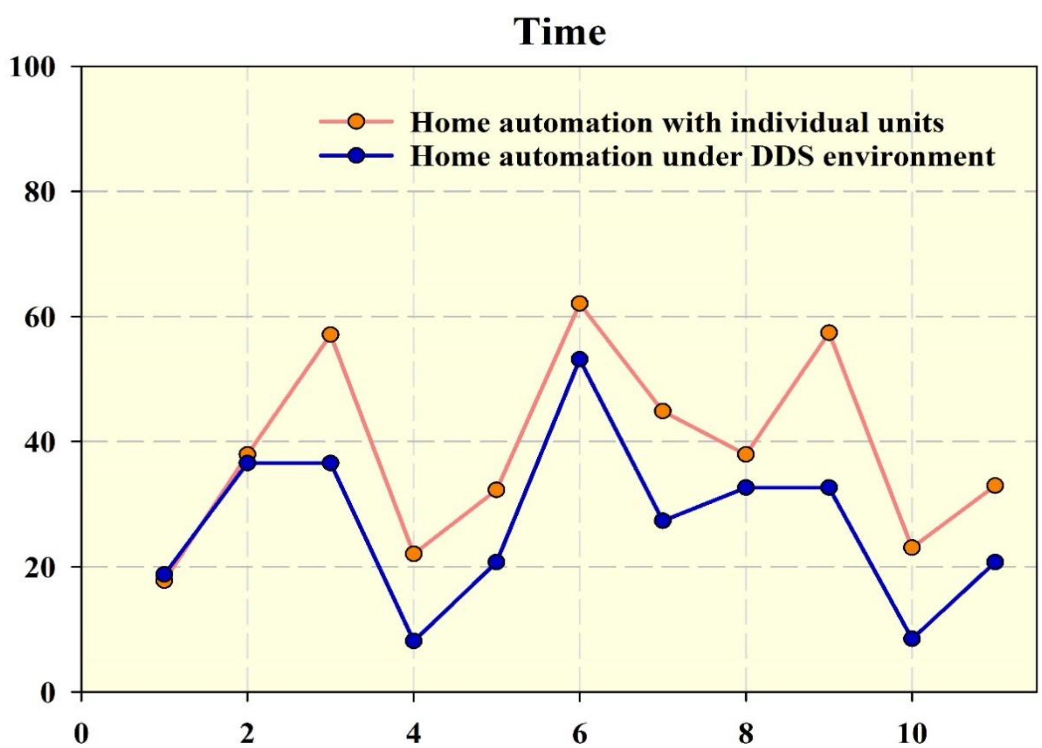

Fig. 8 - Comparison on Time

Moreover, with the respects time optimization comparison is made on automation with existing individual unit and proposed DDS framework as mentioned in fig 8, the results shows that the proposed model in time optimization is comparatively high with the existing individual unit.

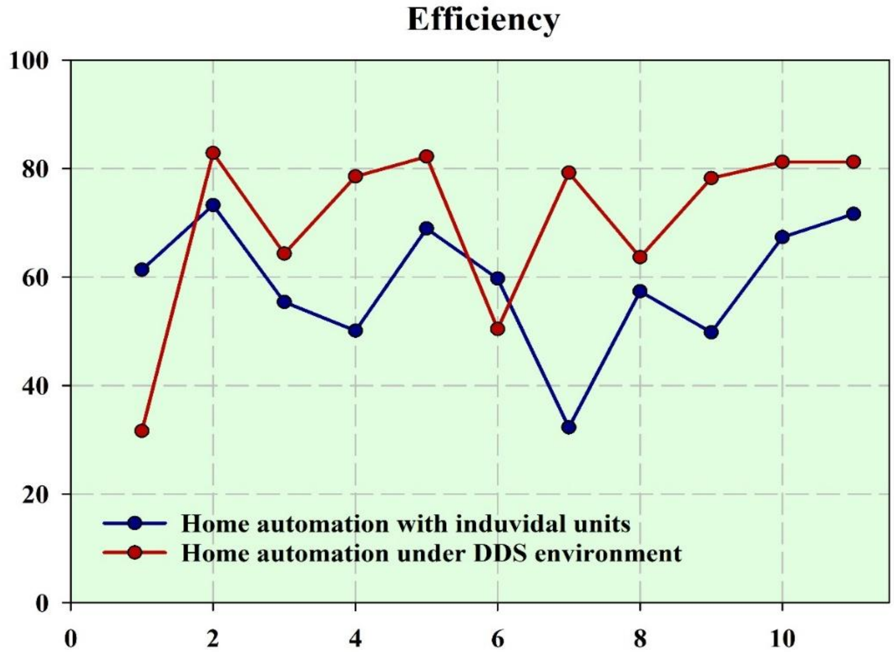

Fig.9 - Comparison on efficiency

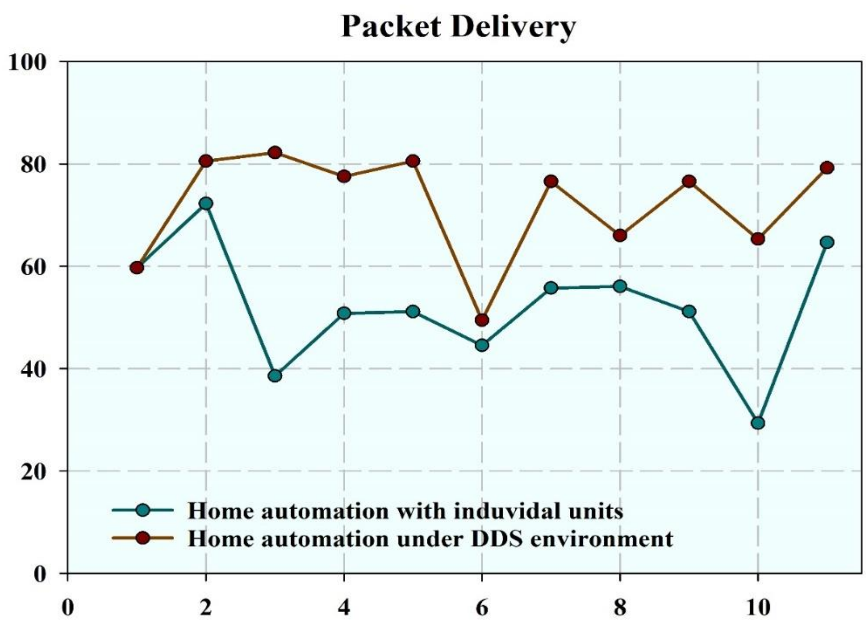

Fig. 10 - Comparison on Packet Delivery

Furthermore, with the respects efficiency comparison is made on automation with existing individual unit and proposed DDS framework as mentioned in fig 8, the results shows that the proposed model in efficiency is comparatively high with the existing individual unit. Finally, with the respects packet delivery comparison is made on automation with existing individual unit and proposed DDS framework as mentioned in fig 8, the results shows that the proposed model in packet delivery is comparatively efficient with the existing individual unit.

4. Conclusion

The objective of attaining interoperability is contingent upon the manner in which data is transferred across devices. In the Internet of Things, protocols like as CoAP, MQTT, and HTTP are often used to link devices. This article suggests a method for enhancing interoperability in healthcare systems that operate in a variety of interactive contexts. Additionally, the system's data centers are equipped with a horizontal platform for data sharing. The sharing entails the use of middleware to facilitate communication between data centers and also between the numerous IoT devices used in interactive healthcare systems. Comparison result of the increase in the overall performance of the system. The experimental part includes the analysis of optimization of the data between data centers, time taken to deliver, efficiency in transferring off data and the rate of packet delivery.

REFERENCES

Dianes, J. A., Manuel Díaz, & Rubio, B. (2010). ServiceDDS: A Framework for Real-Time P2P Systems Integration. *ISORC*.

Vega-Barbas, M., Casado-Mansilla, D., Valero, M. A., Lopez de-Ipina, D., Bravo, J., & Florez, F. (2012). Smart Spaces and Smart Objects interoperability Architecture (S3OiA). In: Sixth International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing.

Ennio Gambi, Laura Montanini &Laura Raffaeli. (2016). Interoperability in IoT Infrastructures for Enhanced Living Environments, in black sea Conference on Communication and Networking.

Alaa Alaerjan, Dae-Kyoo Kim. (2016). Tailoring DDS to smart grids for improved communication and control", in ICSCGIS.

Andrew Foster. (2013). Messaging Technologies for the Industrial Internet and the Internet of Things, Version 1.

Layers of Interoperability: http://www.springer.com/978-3-642-22501-7.

Bernheim Brush, A. J., Bongshin Lee, Ratul Mahajan, Sharad Agrawal, Stefan Saroiu and Collin Dixon. (2011). Home Automation in the Wild: Challenges and Opportunities, Proceedings of ACM CHI Conference on Human Factors o Computing System, May 7-12, Vancouver, BC, Canada

Shelby Z. (2014). The constrained application protocol (CoAP)[S]. IETF RFC7252.

Emerson, S., Choi, Y. K.,&Hwang, D. Y., et al. (2015) AnOAuth based Authentication Mechanism for IoT Networks[C]. ICTC.

Datta, S.K.,& Bonnet, C. (2014). Smart M2M Gateway Based Architecture for M2M Device and Endpoint Management, IEEE Int. Conf. Internet of Things.

MQTT - Message Queue Telemetry Transport. Available online at: http://mqtt.org.

Al-Fuqaha, A., et al. (2015). Towards Better Horizonal Integration among IoT Services", IEEE Communications Magazine, vol. 53, no. 9, pp. 72-79.

Tom Rodden & Steve Benford. (2003). The evolution of buildings and implications for the design of ubiquitous domestic environments, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, April 5-10, Fort Lauderdale, Florida, pp. 9-16.

Hartke, K., & Bormann, C. (2014). The constrained application protocols. *Internet Engineering Task Force (IETF)* Universities Bremen TZI, ISSN: 2070-1721.

Lee, S., Kim, H., Hong, D. K., & Ju., H., (2013). Correlation analysis of MQTT loss and delay according to QoS level. International Conference on Information Networking. pp. 714-717.

Subramani, S., Vignesh, C. C., Daniel, J. A., Sivaparthipan, C. B., Muthu, B., & Suganthi, N. (2022). Fuzzy-Based Intelligent Crop Prediction over Climate Fluctuation Using IoT. In Cloud IoT Systems for Smart Agricultural Engineering (pp. 147-162). Chapman and Hall/CRC.

Vignesh, C.C., Sivaparthipan, C. B., Daniel, J.A. et al. (2021). Adjacent Node based Energetic Association Factor Routing Protocol in Wireless Sensor Networks. Wireless Pers Communication 119, 3255–3270. https://doi.org/10.1007/s11277-021-08397-0

Che, Y., Sivaparthipan, C. B., & Alfred Daniel, J. (2021). Human–Computer Interaction on IoT-Based College Physical Education. Arab J Sci Eng. https://doi.org/10.1007/s13369-021-05895-y

Huiyi, Z., Chandru Vignesh, C., & Alfred Daniel, J. (2021). Influence of Social and Environmental Responsibility in Energy Efficiency Management for Smart City. Journal of Interconnection Networks, 2141002.

Tang, X., Li, F., Seetharam, T. G., & Vignesh, C. C. (2021). Internet of things-assisted intelligent monitoring model to analyze the physical health condition. Technology and Health Care, (Preprint), 1-15.