

Real-Time Data Processing in Healthcare: Architectures and Applications for Immediate Clinical Insights

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Abstract - Many important applications of data processing are there in the sector of healthcare. This is needed for the different aspects of treatment. In this report, there is a description of the architecture of the process of doing the data processing in this sector. Other than this, several applications for processing data are also present in this report. It can be seen that there are different necessities for processing data in this sector. Some of these are making proper decisions, and carrying out the work efficiently. There are several applications and processes such as “stream processing”, & “edge computing” are investigated here. There are many important applications of this work in the sector of healthcare. Among these, the most important applications such as monitoring the patients, making predictions about the conditions of the patients, and the detection of the anomaly were analyzed here in this report. There are technologies like “machine learning” and “IoT systems” that can be helpful in this regard.

INTRODUCTION

In the current era, one of the most important resources is data. In every sector, data is utilized to enhance the performance of the sector. The sector of healthcare is not an exception. There is a huge amount of data always generated in this sector. Most of these data are about the conditions of patients, treatments, signs of illness, and others. Some of the most impressive sources of doing this are keeping records of the health of the patients electronically, devices used for treatment, sensor devices, and others. Other than just data processing the processing of data in real time results in more actionable responses. Moreover, the technologies that are used for doing this processing are presented in this report. The description of the point of view of the different people or authors regarding this topic was presented here. This gives us a good idea of how different people think about the processing of data in this sector. Also, there are certain processes that are applied for the processing of the data. The description of the stages of the processes is presented here. After this, the results that can be obtained from this has its description here. Also, the future possibilities of this process were analyzed here.

LITERATURE REVIEW

According to Qureshi *et al.* 2023, before discussing the different forms of applications of data processing in the sector of healthcare, it is needed that what is important is understood first. One of the most important results that “data processing” provides is the efficiency of caring the patients (Qureshi *et al.* 2023). In actual practice, it is likely to make important decisions regarding the treatments of patients considering the condition of the patients. The thing that can help in doing this is to process the data of the patients. Thus it helps in making proper & justified decisions. Other than this another important benefit that can be obtained from this process is the detection of diseases at a very early stage. This reduces the recovery time of the patients and also increases the chances of survival in case of critical diseases. One of the methods that are used these days for this is the sensors that can be worn by the patient. These sensors give critical data on the condition of the health of the patients. With the use of this data, patients are treated and decisions are made on the basis of the condition of the patients.

According to Mohapatra *et al.* 2023, processing of data of the patients has become an unavoidable work in the industry of healthcare. There are a lot of data was generated in this field resulting in difficulty in making decisions about the patients with a limited number of medical professionals (Mohapatra *et al.* 2023). This induces treating the patients with the proper identification of the symptoms and health condition of the patients. Considering these aspects it can be said that the process of data of the patients in real-time is very much necessary for treating the patients with ease and for making better decisions. The main things that are included in this are monitoring the condition of the health of the patients, making predictions on the process of treatment on the basis of the patient data, and detecting anomalies. In the traditional form of treatment, this thing is not present (Jat, 2023). So, all of the work and decisions are to be taken by the healthcare professionals only all by themselves. Data processing removes this drawback of the traditional method. In addition to this, considering the conditions of health of the patients and analyzing the similar previous cases, the future condition of health of the patients can be predicted.

According to Mao *et al.* 2023, There are different aspects of the processing of data of patients in real-time that can be observed. Several benefits can be obtained from this. However, although with the benefits there is the risk of privacy of the data of the patients. This is becoming one of the most critical issues in implementing data processing in the sector of health care. The effect of a data breach is critical in

the case of sensitive data of the patients (Mao *et al.* 2023). Some of the methods that can be used for this purpose are techniques of encryption, controlling the access to the data, anonymization of data of the patients, and others. Another issue that can be observed in this processing of data is the presence of a large amount of data. This results in managing this data to produce the results. In the current era, this data is growing rapidly. In consideration of this data it can be seen that techniques like interpolation of data become very hard. However, the benefits given by this method is setting aside the issues created because of data processing. The best results that can be obtained from this are better treatment, good care of the patients, and making critical decisions about the process of treatment.

METHOD

A set of processes is followed for processing the data of patients in real-time in the sector of healthcare. This consists of different stages that are implemented on a sequential basis. This description of this process is described below.

SELECTION OF THE ARCHITECTURE

The architecture for the processing is the most important thing and needs to be considered first. For doing this the first thing that is done is to evaluate the processing of stream framework. In this way, a good volume of data can be maintained and analyzed (Shukla, 2023). Other than this, there are aspects of “edge computing” that can be considered for the processing of data.

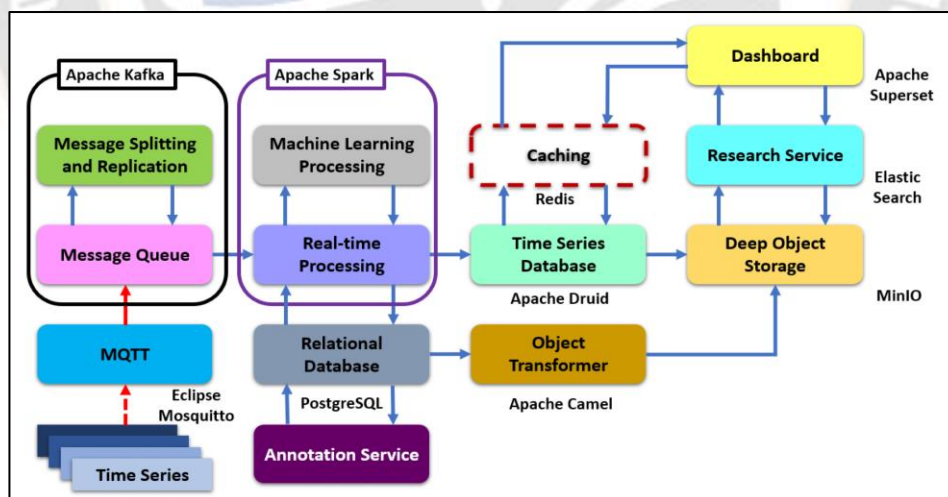


Figure 1: Elderly Health Monitoring Architecture
 (Source: <https://pub.mdpi-res.com>)

INTEGRATION OF DATA

This is another important stage in which the data from the different sources are integrated together. The main sources of data are records kept in electronic format, devices used in the treatment process and the use of sensors worn by the patients.

DEVELOPMENT OF MODEL

This is the work that is done after the integration of data. The models are prepared for the extraction of meaningful results regarding the important aspects of the patients. One of the best things that can be used in doing this is machine learning

(Sindhuja, 2023). The benefits of this are the detection of the diseases from the symptoms of the patients, prediction of the

process of treatment and the condition of the health of the patients.

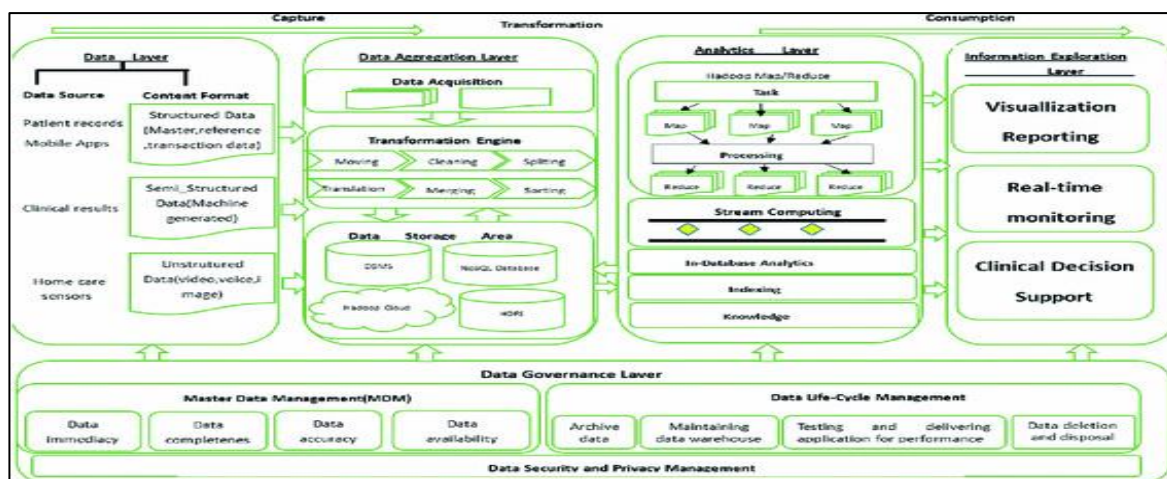


Figure 2: Architecture of data processing (Source: <https://www.researchgate.net>)

PRIVACY OF DATA

This is one of the most important requirements of the processing of data. There are different techniques that are used for this purpose. These are the encryption of data, limiting the access to the data, methods of anonymization and others.

EVALUATION

This is the last stage of “data processing”. In this, the entire process is evaluated. The main thing that is evaluated is the effectiveness of the method.

RESULTS

There are certain results that can be obtained in this matter. The results are discussed below.

PROPER DECISION MAKING

One of the best results that can be obtained from “data processing” is making decisions. It can be seen that there are many instances where decisions are to be made on the basis of the condition of the patients. This includes the condition of health of the patients, past details of the health of the patients and other details of the patient (Khan & AbaOud, 2023). All of these together help obtain results or in other words make decisions.

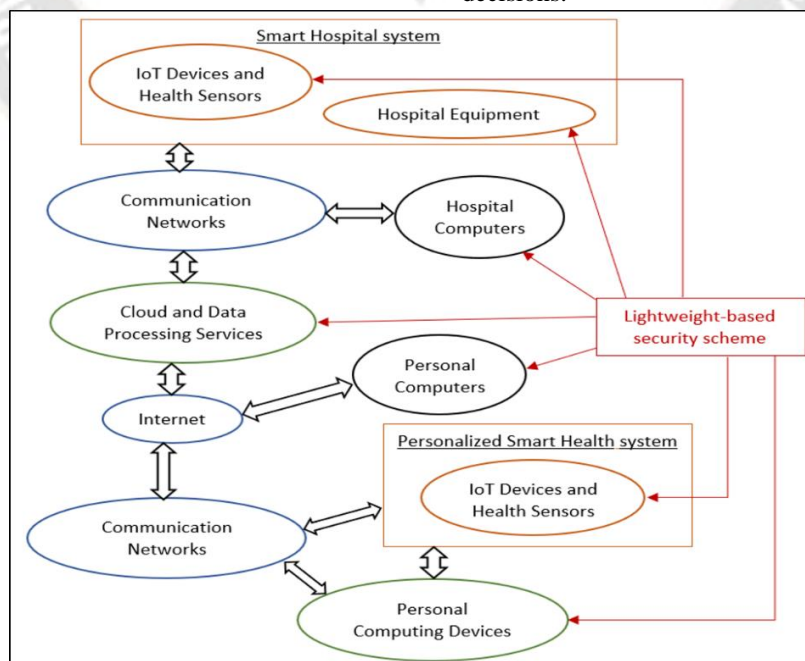


Figure 3: Smart Hospital system (Source: <https://www.mdpi.com>)

IMPROVEMENT IN PATIENT CARE

The patients can be treated more effectively with the use of “data processing” in real-time than the traditional methods of treatment. One of the best outcomes of this method is to detect the diseases at a very early stage. Other than this, the diseases can be managed well with this.

RESOURCE UTILIZATION

It is to be noted that resources should be allocated to the needs of the patients. In other words, the resources are to be allocated on the basis of the condition of the patients. “Data analysis” is helpful in allocating resources. This is done by checking the patterns of the details of the patients, and managing the flow of work and others (Chen *et al.* 2023). With the use of this, predictions are made on the allocation of resources for the treatment of the patients.

MANAGEMENT OF HEALTH

In this system of processing, the main thing that is done is to find out the patterns obtained from the data collected for the

purpose of processing. On the basis of this, the trends of treatments are identified for the population of the patients. Other than this, the details of the conditions of health of the population can also be identified from this (Junnu, 2023). Moreover, the outbreaks of severe diseases can also be predicted by analyzing the patterns.

DISCUSSION

BENEFITS

There are several benefits are obtained from the use of “data processing”. All of these help in lifting the quality of treatment and also managing the process of treatment quickly. With the use of this, the critical aspects of treatment are evaluated. Moreover, when data of the current time is analysed it helps in making decisions on the process of treatment. Also, another good result of this is that patients can have individual plans for treatment on the basis of the details of the health of the patients (Ahmed *et al.* 2023). Other than this, the management of diseases also becomes easy.

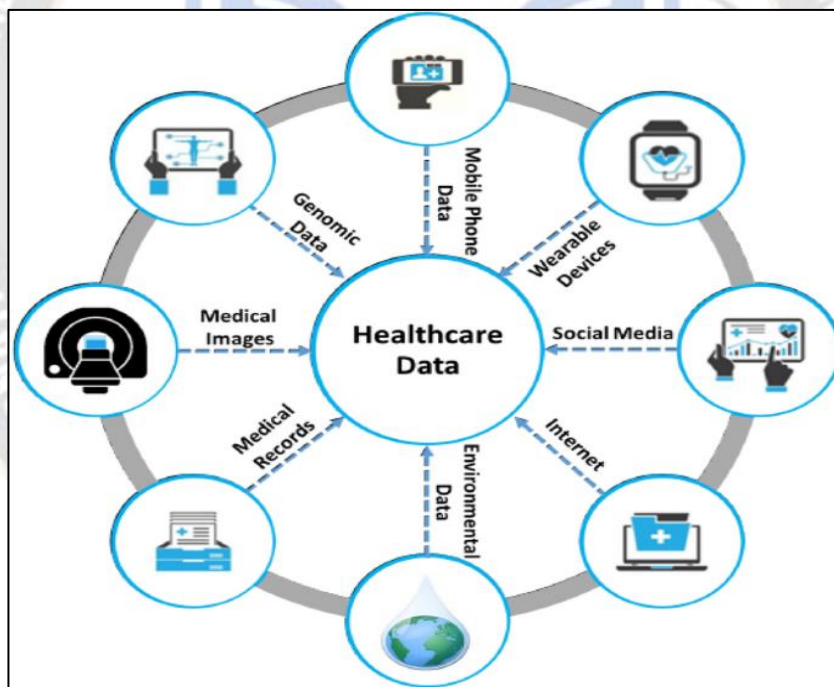


Figure 4: Use of ML in predictive analysis
(Source: <https://media.springernature.com>)

Challenges

Certain challenges are there are faced by this method during implementation. The most critical one in this regard is the concern of privacy. There are many instances of breaching of crucial data of the patients. Other than this, complexity in the integration of data from different sources also becomes difficult (Hossain *et al.* 2023). Other than this, it is not always

easy to follow the regulations for the implementation of “data processing” in healthcare.

ETHICS

There are some ethics are considered in the processing of data. In this process, it is tried to maintain a balance between the process of data and the privacy of the data of the patients.

FUTURE DIRECTIONS

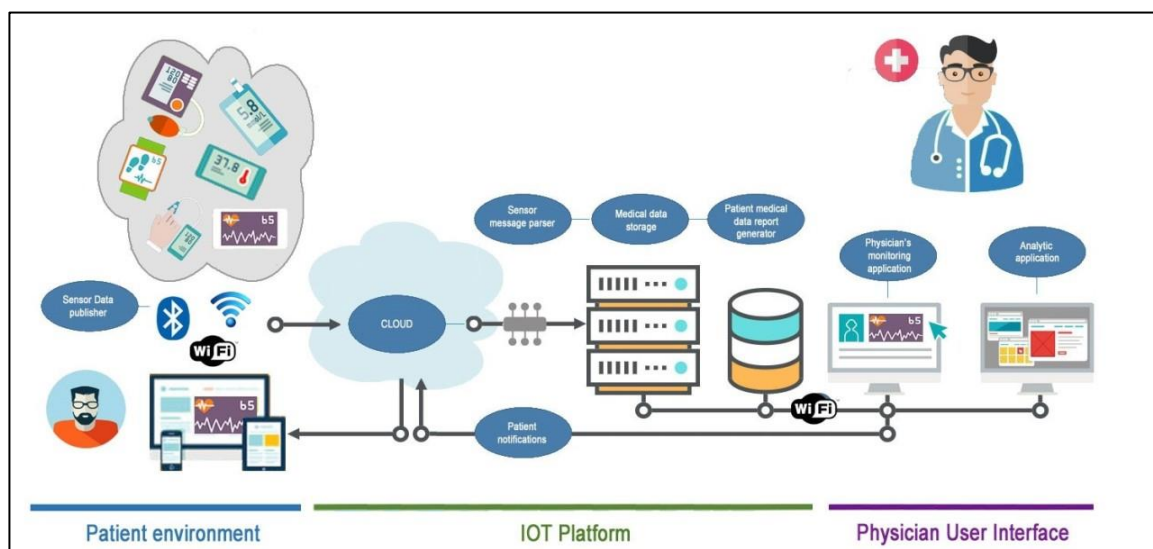


Figure 5: Future of data analysis in healthcare
 (Source: <https://media.licdn.com>)

Different things are there that can be added to the system of “data processing” in the future for the betterment of the process. In the current era, the use of “machine learning” can be observed for the processing of data. ML can be combined with AI to obtain better results (JEMAA *et al.* 2023). Other than this, the focus needs to be given to making the privacy of data better. Moreover, for the collection of patient data, advanced technologies can be used in the form of advanced sensors that can be worn by the patients.

CONCLUSIONS

This report presents the details of the critical details of the processing of data in the sector of healthcare. In doing this, the complete process of “data processing” in the sector of healthcare was analyzed here. The first thing that was done was to find out the opinions of different people on this matter. After this, the method or the possession of “data analysis” is shown here. Other than this the results of this process in terms of theoretical description are present in this report. A thorough of the findings from the results can be observed.

REFERENCE LIST

Journals

[1] Ahmed, A., Xi, R., Hou, M., Shah, S.A. and Hameed, S., 2023. Harnessing big data analytics for healthcare: A comprehensive review of frameworks, implications, applications, and impacts. *IEEE Access*.
 [2] Chen, W., Milosevic, Z., Rabhi, F.A. and Berry, A., 2023. Real-Time Analytics: Concepts, Architectures and ML/AI Considerations. *IEEE Access*.
 [3] Hossain, E., Rana, R., Higgins, N., Soar, J., Barua, P.D., Pisani, A.R. and Turner, K., 2023. Natural language

processing in electronic health records in relation to healthcare decision-making: a systematic review. *Computers in Biology and Medicine*, 155, p.106649.

[4] Jat, A.S., 2023. Towards Next-Generation Healthcare: Architectural Insights into an AI-Driven, Smartwatch-Compatible mHealth Application. Avnish Singh Jat, Tor-Morten Grønli, Abdullah Raza Lakhan, "Towards Next-Generation Healthcare: Architectural Insights into an AI-Driven, Smartwatch-Compatible mHealth Application," *International Journal of Computer Trends and Technology*, 71(10), pp.92-106.
 [5] JEMAA, M.H., JEMILI, F., Charfeddine, A.M.R.I., MSOLLI, M.A. and KORBAA, O., 2023. Digital Twin For A Human Heart Using Deep Learning and Stream Processing Platforms.
 [6] Junnu, M., 2023. ROLE OF NATURAL LANGUAGE PROCESSING IN EXTRACTING INSIGHTS FROM MEDICAL TEXT DATA. *EUROPEAN JOURNAL OF MODERN MEDICINE AND PRACTICE*, 3(9), pp.128-137.
 [7] Khan, M.F. and AbaOud, M., 2023. Blockchain-Integrated Security for real-time patient monitoring in the Internet of Medical Things using Federated Learning. *IEEE Access*.
 [8] Mao, J., Zhou, P., Wang, X., Yao, H., Liang, L., Zhao, Y., Zhang, J., Ban, D. and Zheng, H., 2023. A health monitoring system based on flexible triboelectric sensors for intelligence medical internet of things and its applications in virtual reality. *Nano Energy*, 118, p.108984.

- [9] Mohapatra, S., Sahoo, A., Mohanty, S. and Singh, D., 2023. IoT Enabled Ubiquitous Healthcare System using Predictive Analytics. *Procedia Computer Science*, 218, pp.1581-1590.
- [10] Qureshi, R., Irfan, M., Ali, H., Khan, A., Nittala, A.S., Ali, S., Shah, A., Gondal, T.M., Sadak, F., Shah, Z. and Hadi, M.U., 2023. Artificial intelligence and biosensors in healthcare and its clinical relevance: A review. *IEEE Access*.
- [11] Shukla, S., 2023. Real-time monitoring and predictive analytics in healthcare: harnessing the power of data streaming. *International Journal of Computer Applications*, 185(8), pp.32-37.
- [12] Sindhuja, R., 2023. A Survey of Internet of Medical Things (IoMT) Applications, Architectures and Challenges in Smart Healthcare Systems. In *ITM Web of Conferences* (Vol. 56, p. 05013). EDP Sciences.
- [13] Kanungo, Satyanarayan. "Cross-Border Data Governance and Privacy Laws." *International Journal of Open Publication and Exploration (IJOPE)*, vol. 11, no. 1, January-June 2023, pp. 44-46. Available online at: <https://ijope.com>
- [14] Kanungo, Satyanarayan. "Security Challenges and Solutions in Multi-Cloud Environments." *Stochastic Modelling and Computational Sciences*, vol. 3, no. 2 (I), July - December 2023, p. 139. Roman Science Publications. ISSN: 2752-3829. <https://romanpub.com/resources/smc-v3-2-i-2023-14.pdf>
- [15] Kanungo, Satyanarayan. "Blockchain-Based Approaches for Enhancing Trust and Security in Cloud Environments." *International Journal of Applied Engineering & Technology*, vol. 5, no. 4, December 2023, pp. 2104-2111.
- [16] Kanungo, Satyanarayan. "Edge Computing: Enhancing Performance and Efficiency in IoT Applications." *International Journal on Recent and Innovation Trends in Computing and Communication* 10, no. 12 (December 2022): 242. Available at: <http://www.ijritcc.org>
- [17] Kanungo, Satyanarayan. "Hybrid Cloud Integration: Best Practices and Use Cases." *International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC)*, vol. 9, no. 5, May 2021, pp. 62-70. Available at: <http://www.ijritcc.org>
- [18] Kanungo, Satyanarayan. "Decoding AI: Transparent Models for Understandable Decision-Making." *Tuijin Jishu/Journal of Propulsion Technology* 41, no. 4 (2020): 54-61.
- [19] Kanungo, Satyanarayan, and Pradeep Kumar. "Machine Learning Fraud Detection System in the Financial Section." *Webology*, vol. 16, no. 2, 2019, p. 490-497. Available at: <http://www.webology.org>
- [20] Kaur, Jagbir. "Streaming Data Analytics: Challenges and Opportunities." *International Journal of Applied Engineering & Technology*, vol. 5, no. S4, July-August 2023, pp. 10-16. <https://romanpub.com/resources/ijaetv5-s4-july-aug-2023-2.pdf>
- [21] Kaur, Jagbir, et al. "AI Applications in Smart Cities: Experiences from Deploying ML Algorithms for Urban Planning and Resource Optimization." *Tuijin Jishu/Journal of Propulsion Technology* 40, no. 4 (2019): 50. (Google scholar indexed)
- [22] Case Studies on Improving User Interaction and Satisfaction using AI-Enabled Chatbots for Customer Service . (2019). *International Journal of Transcontinental Discoveries*, ISSN: 3006-628X, 6(1), 29-34. <https://internationaljournals.org/index.php/ijtd/article/view/98>
- [23] Ashok Choppadandi, Jagbir Kaur, Pradeep Kumar Chenchala, Akshay Agarwal, Varun Nakra, Pandi Kirupa Gopalakrishna Pandian, 2021. "Anomaly Detection in Cybersecurity: Leveraging Machine Learning Algorithms" *ESP Journal of Engineering & Technology Advancements* 1(2): 34-41.
- [24] Ashok Choppadandi et al, *International Journal of Computer Science and Mobile Computing*, Vol.9 Issue.12, December- 2020, pg. 103-112. (Google scholar indexed)
- [25] AI-Driven Customer Relationship Management in PK Salon Management System. (2019). *International Journal of Open Publication and Exploration*, ISSN: 3006-2853, 7(2), 28-35. <https://ijope.com/index.php/home/article/view/128>
- [26] Predictive Maintenance and Resource Optimization in Inventory Identification Tool Using ML. (2020). *International Journal of Open Publication and Exploration*, ISSN: 3006-2853, 8(2), 43-50. <https://ijope.com/index.php/home/article/view/127>
- [27] Rahman, Md. Rezowanur, Diponkor Kumar Shill, Uttom Kumar, A.S.M. Monjur Al Hossain, Sitesh Chandra Bachar, and Abu Shara Shamsur Rouf. "Formulation and Evaluation of Ledipasvir Nano-suspension Through QbD Approach." *Journal of Pharmaceutical Technology* 19, no. 3 (2023): 127-135.
- [28] Chintala, S. (2023). Improving Healthcare Accessibility with AI-Enabled Telemedicine Solutions. *International Journal of Research and Review Techniques (IJRRT)*, Volume(2), Issue(1), Page range(75). Retrieved from <https://ijrtr.com>

- [29] Chintala, S. (2022). Data Privacy and Security Challenges in AI-Driven Healthcare Systems in India. *Journal of Data Acquisition and Processing*, 37(5), 2769-2778. <https://sjcjycl.cn/18>. DOI: 10.5281/zenodo.7766
- [30] Chintala, S. K., et al. (2022). AI in public health: Modeling disease spread and management strategies. *NeuroQuantology*, 20(8), 10830-10838. doi:10.48047/nq.2022.20.8.nq221111
- [31] Chintala, S. (2022). Data Privacy and Security Challenges in AI-Driven Healthcare Systems in India. *Journal of Data Acquisition and Processing*, 37(5), 2769-2778. <https://sjcjycl.cn/DOI:10.5281/zenodo.7766>
- [32] Chintala, S. K., et al. (2021). Explore the impact of emerging technologies such as AI, machine learning, and blockchain on transforming retail marketing strategies. *Webology*, 18(1), 2361-2375. <http://www.webology.org>
- [33] Chintala, S. K., et al. (2022). AI in public health: Modeling disease spread and management strategies. *NeuroQuantology*, 20(8), 10830-10838. doi:10.48047/nq.2022.20.8.nq221111
- [34] Sathish Kumar Chintala. (2023). Evaluating the Impact of AI on Mental Health Assessments and Therapies. *Eduzone: International Peer Reviewed/Refereed Multidisciplinary Journal*, 7(2), 120-128. Retrieved from <https://eduzonejournal.com/index.php/eiprmj/article/view/488>
- [35] Chintala, S. (2022). AI in Personalized Medicine: Tailoring Treatment Based on Genetic Information. *Community Practitioner*, 21(1), 141-149. ISSN 1462-2815. www.commprac.com
- [36] Machine Learning Algorithms and Predictive Task Allocation in Software Project Management". (2023). *International Journal of Open Publication and Exploration*, ISSN: 3006-2853, 11(1), 34-43. <https://ijope.com/index.php/home/article/view/107>
- [37] Chintala, S. (2023). AI-Driven Personalised Treatment Plans: The Future of Precision Medicine. *Machine Intelligence Research*, 17(02), 9718-9728. ISSN: 2153-182X, E-ISSN: 2153-1838.
- [38] Chintala, S. (2019). IoT and Cloud Computing: Enhancing Connectivity. *International Journal of New Media Studies (IJNMS)*, 6(1), 18-25. ISSN: 2394-4331. <https://ijnms.com/index.php/ijnms/article/view/208/172>
- [39] Chintala, S. (2018). Evaluating the Impact of AI on Mental Health Assessments and Therapies. *EDUZONE: International Peer Reviewed/Refereed Multidisciplinary Journal (EIPRMJ)*, 7(2), 120-128. ISSN: 2319-5045. Available online at: www.eduzonejournal.com
- [40] Sathishkumar Chintala. (2021). Evaluating the Impact of AI and ML on Diagnostic Accuracy in Radiology. *Eduzone: International Peer Reviewed/Refereed Multidisciplinary Journal*, 10(1), 68-75. Retrieved from <https://eduzonejournal.com/index.php/eiprmj/article/view/502>
- [41] Chintala, S. (2023). Artificial Intelligence-Based Device for Managing Patient Privacy and Data Security. Patent No. 6335758. Retrieved from <https://www.registered-design.service.gov.uk/find/6335758/>