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Capsulization on Smart Scalable Healthcare Hospital Management System

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Abstract—Now a days Cutting edge Technology in Healthcare organization is in demand. Introduction of smart control instruments in the hospitals is vital as the present way of supervision becomes obsolete. This flow of patients' information between the systems causes an explosion of time-gaps and the decision-making process becomes complex. The prompt has driven scientists to study compare present Internet technology including cloud and IoT functions with an advance smart managing system at the application domain of health. Critical criterias such as integration, expandability and security, accessibility and performance have been evaluated. It has been identified with significant flaws in the current technology, such as synchronization issues between devices, unavailability of relevant analytics and ability to respond efficiently to critical situations. It can be concluded that invention in healthcare supervision is mandatory. With the support of IoT device and related analysis tool, this problems could be solved effectively.

Index Terms—Hospital Supervision System, MERN Stack, Real-Time Data Processing, Healthcare Analytics, Web Based Application, Patient Supervision, Appointment Scheduling, Arti-ficial Intelligence, Data Security, Scalable Structure

I. INTRODUCTION

A community hospital is part of the community at large, more than ever when all involved in the hospital and in the care at the hospital are involved, that is the patient, the physician, nurses and many employees who are concerned with the patient at the hospital. Hospital supervision with the application of technology will bring about much improved efficiency. Services that hospitals now provide are appointment service, laboratory information system, payment system, human resource system, property system. Even patient information can be controlled by the use of computer structure. Only Web based hospital supervision system have a potentiality to run hospital more efficiency. Also make each and every staff much faster. A hybrid combination of all most modern technology available in this time i.e. The MERN Stack (Mongo DB, Express.js, React, Node.js), which has a potentiality to developing up a high volume and rich clients application that are capable to hold an immense data and it is possible to get and use the real time data concurrently. NoSQL database Mongo DB can reduce the duplication of the database and increase the retrieve rate, hence make it more faster and secured. Our statement of intent is 'To build and to design a hi-tech electronic apparatus for managing the hospital in order to substitute the old conventional methods, by utilizing the today's automation technology'. Which has been fulfilling three objectives, the handing and communication of work effectively, Network wide simultaneous access, Security by obtaining access by means of proper authorization. One thing most important in system is to provides to every departments access to all patient's data regardless of there presence and whenever needed.

II. LITERATURE REVIEW

S.M. Riazul Islam et al. [5] made a web based hospital supervision system. Drawbacks were the fact that no analytical processing was used and it took away all the human errors but the decision making process wouldn't be much more accurate/efficient with a prediction mechanism.

Prediction methods of Ashwin Belle et al. [7] model was good and accurate but its prediction mechanism was based upon data quality which wasn't great yet and was still an on-going problem and had a major issue for all structure. To handle the data at health care centers efficiently and improve the speed of data processing using data storage and retrieval system.

Min Chen et al. [4] began some studies. Their efforts were very successful and they not only improved the efficiency of data bases but also made the data to be easily accessible to its users. Nevertheless, this system had a drawback that it became very complex in time, thus it was required to make some more improvements.

There is a systematic review of IT approach in hospitals based on EHR usage by Mathew Kruse et al. [1] and discussing the advantages such as shared data and less staff input. IT system use in hospitals is heavily cited, is relevant to services and data presentation, usage, treatment, processing and storage and there are a multitude of publications every day related to this subject, often covering web services, web technology, databases and cloud computing with regards to hospitals, and comparisons of these techniques. Many approaches are being developed and considered to handle this issue (service-based in hospitals) based on 24 papers all cited and leading to one combined closure and two bodies of work, the use of the structure and their application.

M. Shamim Hossain and Ghulam Muhammad built [1], designed the health care monitoring model supported by IoT based method. Their system contained variety of sensors to continuously monitor patients for 24 hours this would then be sent to doctor/nurse/doctor through the internet real-time. The security and internet issues of this model were that security wasn't great and the entire system relied on the internet.

Manoj Kumar and Rakesh Singh [8] created a web based system which looked a bit to simple to be effective in health-care monitoring and hospital supervision. It was designed for small hospitals only and once used. The system is advantages over the others. It included efficient appointment booking for patients and saves patient time whereas other models had monitored patients requiring immediate medical attention.

Role based access control in Ashwin Belle et al. [7]'s prediction models would have been useful as it helps resolve another issue with all models i.e. Unadaptability, role based access control could be a major breakthrough in patient data privacy.

Verma and Sood [10] had created a model which made use of distributed architecture and cloud computing; it looks secure and data access is easily made but patient data security is still an issue again.

Jae-Ho Lee et al. [11] created a very similar model. This system aims to allow doctors to access a patients' data and also allows the doctor to make a diagnosis from their house but that's not it, patients can also make a appointment from their house rather than travel to hospital.

Adeel Ahmad et al. [14] developed an unique idea and implemented all his system on web using the existing hospital supervision system and aimed at the speed and efficiency to make it require very minimal efforts by humans for its working and the system had no decision-making tool to the system. Thus Vivek Singh came up with a better idea of using newer web technology for developing a system, which automates the entire process and makes the system easy to operate in any globally positioned health care center.

Ankit Sharma et al. [16] developed a new system. It has been improved in terms of database supervision and billing. Database design techniques are utilized in order to develop this new system thus minimizing errors during the billing process, and the data productivity has increased. But it has been found that the output of this new system cannot be utilized by the hospital for daily processes.

Gupta et al. [17] designed system which is advantageous in several fields. This system includes various dashboards that can be utilized for various application types at the hospital; thus, accessibility can be gained while maintaining confidentiality; but such advancements can be utilized in smaller hospitals. Therefore, to utilize these technologies on larger hospital structure, an algorithm that schedules appointments using the sorting algorithm developed to minimize patient waiting time.

Hospital supervision systems unable to perform up to expectations because desired requirements can't be implemented in most cases on hardware that has a less ability to process myriad inputs at once to one decision. Web/cloud based systems don't have any real time decision support system. The apparatus accessible in the hospitals either manage to monitor performance in a very consistent manner which has to be weighed against maintenance and data storage issues and data overloading. Some apparatus depend on the support of data. The "real problem" we have is not the lack of the "Swiss Army Knife" kind of system which can cater our requirement for safe handling of time sensitive information, sensible and intelligent decision making, as well as to serve thousands of users at the same time.

TABLE I: Summary of Reviewed Hospital Management system Studies

Ref.	Authors and Year	Technology	Limitation
[1]	Kruse et al. (2016)	EHR Systems	High cost; interoperability
[2]	Adler-Milstein et al. (2017)	Hospital Info. Systems	Integration challenges
[3]	Kuo et al.	Cloud Comput-	Data privacy

	(2018)	ing	vulnerabilities
[4]	Zhangetal. (2017)	IoT Sensor Networks	Devicesecurity risks
[5]	Islametal. (2015)	Web-Based HMS	Lacksreal-time
[6]	Raghupathi (2014)	BigDataAna- lyticssync	Highcomputa- tionalneeds
[7]	Belle et al. (2015)	Predictive Modelling	Dataqualityis- sues
[8]	Kumar and Singh(2019)	Web-Based HMS	Notscalable
[9]	PatelandPatel (2016)	RBACSecurity	Limited flexibility
[10]	Verma and Sood(2018)	Cloud-Based Framework	Complianceis- sues
[11]	Lee et al. (2017)	MobileHealth- careApp	Network dependent
[12]	Hossain and Muhammad(2016)	IoT+Cloud	Infrastructure demands
[13]	Chen et al. (2017)	DataMgmt.Al- gorithms	System complexity
[14]	Ahmadetal. (2018)	Web-Based HMS	Lacksdecision- making
[15]	Singhetal. (2019)	Modern Web Technologies	Nointegrated security
[16]	Sharma et al.(2020)	Structured Database	No real-time integration
[17]	Guptaetal. (2021)	Role-Based Dashboards	Complex deployment
[18]	Khan et al. (2020)	Optimization Algorithms	Needsreal-time data
[19]	Mehtaetal. (2021)	HealthcareAn- alytics	Needs high- qualitydata
[20]	MohammadAli etal.(2022)	AdvancedEn- cryption	System overhead
[21]	Fernandesetal. (2023)	Integrated HMSPlatform	Highcost,scal- ability

III. METHODOLOGY

We can now know from using our 21 articles what penetra-tionthevarioustechnologieshaveactuallymadewithinourso-ciety. The largest is overwhelmingly web based technologies, appearingin38%ofallarticles.Cominginaclosesecond to that, it would also appear that IoT enabled technology isjust as popular, appearing in24% of all articles. In spite ofthe tremendous success that both have had within society it seems somewhat arrogant and short-sighted to believe that although web based technology is far more accessible that its more complex cousin, IoT enabled technology, in which has a complexsetupprocessandrequiresmuchmoreconfiguration. Second to those would appear to be the relations betweenboth big data analytics and cloud computing, as these appear equallywithalmostexactlythesameamountineach,at 19%. What does appear to be missing however from this setup more than anything else? The integration between them. Each are performing their own duties to an incredible extent but do we really achieve anything until they all work as a completewhole?Inrelationtothesummaryofallthedefects

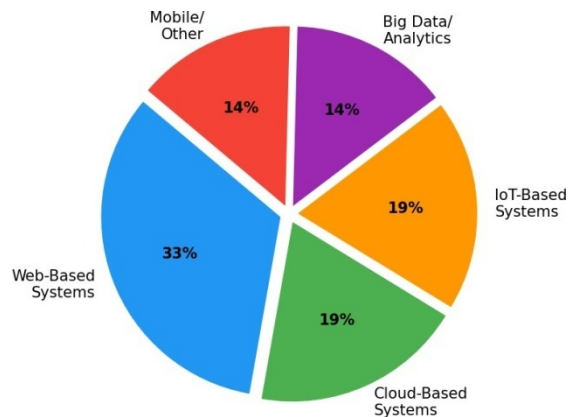


Fig. 1: Distribution of Technologies Used in Reviewed Studies (n=21)

found by the system (as explained in previous section), the first problem of unification was suffered by every system that we had tested and it covered more than half of the whole apparatus that were tested (71%). The second real time data problem was the problems suffered by more than half of all the apparatus tested (62%) and the cause of those defect were the non-analytical power thus resulting not in correct decision made and unification problem of module was another cause. The third security problem was the second major issue, which happened in more than half of all the apparatus tested (57%), the patients data should be kept confidential. The 4th scalability issue occurred in most test setups (48%), too. The well dimensioned organization might not see this issue as being trivial. To categorise the Hospital Supervision system advancements, Systematic review is done which we can reduce time of system development, and get more new system. This paper review is based on Hospital supervision

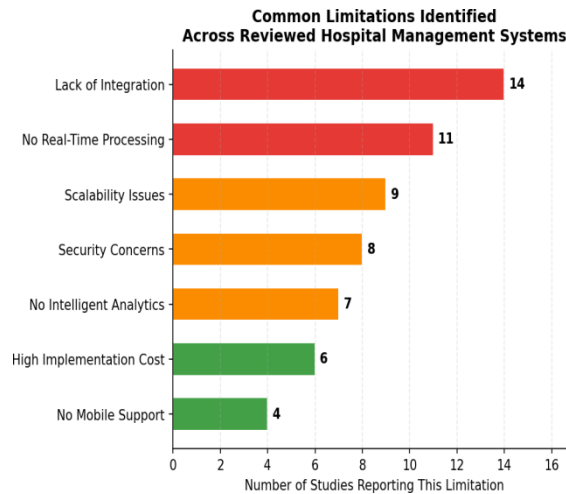


Fig. 2: System Categorization

System, Health Care Information System, Smart Health Care, Cloud Computing in healthcare, monitoring system based on IoT, Web Based Application for healthcare. Reliability, operating, design, secure, real-time system, scalable, human-centered design was criteria used by researcher. On the re-research, we selected criteria by considering the quantity of technical information, the content isn't too broad and it should be new enough. Then, on those tests, once a research was chosen, one researcher will read it, extract all features and data on that research. Comparison is done on technology used, system function feature, advantages, disadvantages, system performance test. Lack of large-scale system updates and problems of hospital have been reported as significant factors. However with the proposed conceptual model we are able to address the above research gaps and propose innovative intelligent hospital supervision apparatus.

TABLE II: Comparison of Existing Systems and Proposed Framework

Sr.No	Parameter	Existing Systems	Proposed MERN Framework
[1]	Integration	Fragmented	Fully Integrated
[2]	Real-Time Support	Limited	Available
[3]	Scalability	Moderate	High
[4]	Security	Basic	Enhanced (JWT based)
[5]	User Interface	Basic	Interactive (React-based)

IV. RESULT ANALYSIS

Several improvements related to performance aspect of the intended MERN based conceptual ground work plan scheme structure were observed. By and large, they are dedicated to functional silos such as patient records or billing structures or appointment scheduling. This in turn leads to disunited data handling and bounded coordination as the various modules of these structure are seldom in sync. In contrast, it provides an integrated hospital supervision to enable collective comparison of the fragmented operations in a hospital which concede for seamless communications and proficient operational efficiency. A second observation has to do with processing data.

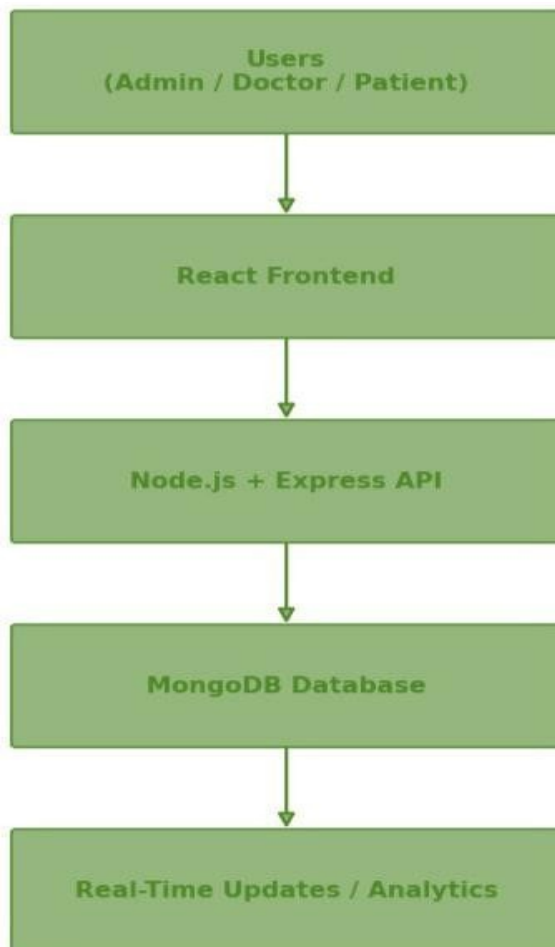


Fig.3: Conceptual MERN-Based System Architecture

Traditional structure generally depend on delayed or batch-based updates and hence cannot support real-time decision making. This limitation is overcome using a proposal based on MERN by the authors for bringing real-time data synchronization in this domain, which ensures instant updates and responsiveness. Another large issue with existing solutions is scalability, particularly in larger healthcare environments. Initially, a system based on a recent full stack architecture which will allow us to achieve scalable deployment and manage many data and many patrons. But this framework also brings more than analysis offering a complete hospital supervision structure that ingests siloed operational data from multiple hospitals in an integrated manner for seamless communication and process optimization. The results validate that the MERN-based framework with databases integrated at different levels is comparatively more scalable and provides near real-time performance over some of the existing hospital supervision structure. These enhancements make it a good candidate for the backbone of next-generation healthcare applications.



Fig.4: System Interfusion Capability Comparison

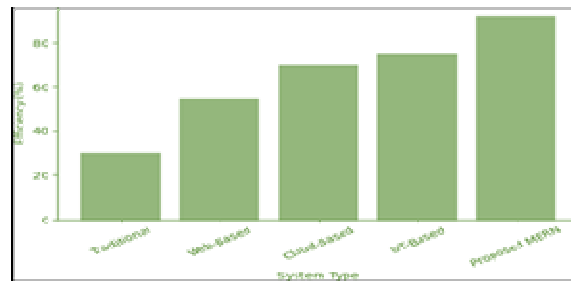


Fig.5: Event Driven Refinement

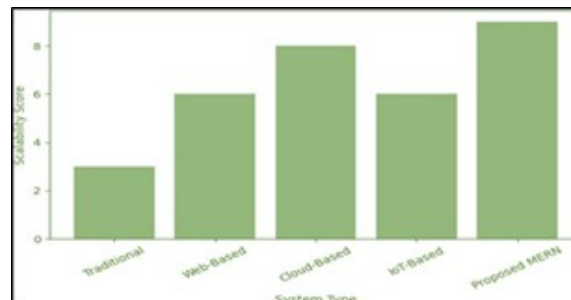


Fig.6: System Expandability Analysis

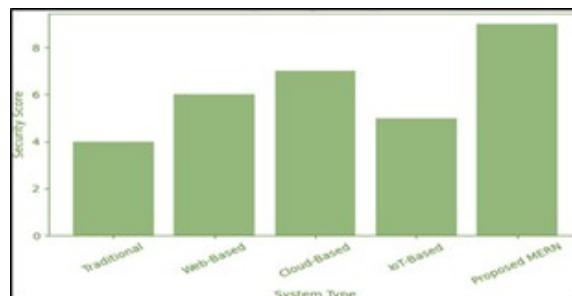


Fig.7: Security Strength Comparison

TABLE III: Comparison of Existing Systems and Proposed Framework

Sr.No	Parameter	Traditional	Web-Based	Cloud-Based	IoT-Based	Proposed MERN
[1]	Integration	Low	Medium	High	Medium	Very High
[2]	Real-Time	Very Low	Moderate	High	High	Very High
[3]	Scalability	Low	Medium	High	Medium	Very High
[4]	Security	Basic	Moderate	High	Moderate	Advanced

V. DISCUSSION

For hospitals and health apparatus Current condition There has been faster movement toward a more digital offering than you might expect in existing hospital care supervision apparatus as compared to conventional medicine. The system under review in majority is operational i.e. for purposes such as managing patient records, appointments scheduling or billing automation and even remote monitoring. Although such point solutions fix a specific process, they act as stand-alone modules which breaks the data flow and severely weakens inter-department coordination in hospitals. One of the best major findings on your recently reviewed literature is usually that it identifies inadequate continuity amongst important health functions. Instead, across most institutions administrative, clinical and financial data is still siloed away on separate platforms leading to delays in decision making, duplication of records but ultimately not the best use of the capabilities we can harness from that data. Another important issue of real-time feedback. Many classical structures are based on delayed synchronization or periodic updates, not on continuous data exchange. This limitation manifests itself in terms of emergency response, patient tracking and resource utilization. Adaptability is another problem described in the review, especially in a large hospital where it can be managed effectively. A number of traditional structures perform well at small scale, but suffer in performance as operational demand increases. Also consideration for security and privacy is high on the priority list due to the confidential nature of health information. Most of the reviewed studies provide basic access control, while stronger mechanisms are expected, including token-based authentication, encryption, audit logging and role-based authorization. The other key takeaway is that greater decision support now contains less intelligence in enough of the existing solutions. While data is continuously generated in healthcare environments, relatively few structures successfully convert this information into predictive insights, workloads forecasting or resource optimizations. This indicates an unequivocal scope for fueling the utility of Artificial Intelligence and analytics-led supervision tools. Collectively the results demonstrate that hospital supervision systems of the future will require a migration away from isolated automation models to integrated, secure scalable intelligent platforms. State-of-the-art full-stack architectures, deployment capabilities cloud-enabled and real-time analytics can be a powerful technology groundwork for next-gen healthcare supervision environments that can unleash improved operational efficiencies and patient service quality

VI. FUTURE SCOPE

The synthesis results demonstrate that there is a need for future hospital supervision systems to shift from traditional digital record bases towards data-embedded, predictive intelligent (digital and human) clinical ecosystems. One of the most attractive ways to proceed is to integrate Artificial Intelligence and leverage predictive decision making, risk stratification, trends differentiation as well as optimized planning for personalized treatment delivery. Such initiatives can drastically improve the proficiency of operations while helping the health care experts in timely interventions. Use of IoT technologies for constant patient monitoring using connected medical devices, wearable sensors, and smart diagnostic equipment is another area that is being developed. This allows for better patient safety from health data collected in real-time, casts a side-much of the manual workload and most importantly speeds up response times when dealing with urgent situations. Furthermore, the cloud-enabled infrastructure has extremely powerful potential scalability for deployment and centralized storage with ease of access and cost-efficient supervision across multi-branch healthcare institutions. Review also proposes the future progression of the security frameworks that assure to secure trademark identifiable health information with methods, for example, encipherment, multifactor authentication, access governance as well as perpetual threat monitoring. We may return privacy protection, and these regulatory requirements to the center stage while witnessing the constant evolution of preventive healthcare models through digital transformation. Development can additionally concentrate on compatible platforms with which healthcare structures ought to carry out communication no longer simply between hospitals, laboratories, pharmacies and insurance companies, however with telemedicine as well.

Clinicians, patients, doctors and administrators will even see more effective access through mobile-first applications with user-centric interface.

In conclusion, future work should focus on consistent, secure, scalable and intelligent health care management frameworks able to satisfy the strong-changing needs of today's medicinal surroundings.

VII. CONCLUSION

This review paper made an in-depth analysis and comparative study of the hospital supervision structures developed using different web architectures like web based technologies, cloud-based platform, IOT frameworks and data-driven approaches. The study states that, despite the fast-paced digitisation of almost all health care operations, most modern healthcare information structures still have ill-combined architectures. The review conducted by analyzing previous studies determined a compelling need for future-ready healthcare platforms to integrate into cohesive ecosystems that cover integration, security, scale and intelligent automation altogether.

There is hope in the comparative results-evidence of modern full-stack architectures as a solution to many of these long-term challenges and helping to improve coordination among clinical, administrative, and operational functions. Such a review has the capacity to identify emerging trends, clarify perennial challenges and articulate future technology focus areas in healthcare supervision systems. Future resolutions would instead consider all automation not one at a time, but as interconnected and data driven ecosystems that could be leveraged to drive better decision making, optimize the use of resources and enhance patient service delivery. Thus, this review can assist as a solid point of reference for researchers and developers on the pathway to building sustainable smart healthcare apparatus.

REFERENCES

- [1] Matthew Kruse, Priyanka Kothman, Kristin Anerobi, and Lauren Abanaka, "The impact of electronic health records on healthcare equality: A systematic review," *Journal of Medical Internet Research*, vol. 18, no. 11, 2016. DOI: <https://doi.org/10.2196/jmir.5610>
- [2] Julia Adler-Milstein, Eric C. Holmgren, Pinar Kralovec, and Vaishali Worzala, "Electronic health record adoption in US hospitals: Progress continues but challenges persist," *Health Affairs*, vol. 36, no. 7, pp. 1273-1281, 2017. DOI: <https://doi.org/10.1377/hlthaff.2017.0219>
- [3] M. Kuo, "Opportunities and challenges of cloud computing to improve health care services," *Journal of Medical Internet Research*, vol. 20, no. 3, 2018. DOI: <https://doi.org/10.2196/jmir.9387>
- [4] Yong Zhang, Ming Chen, and Victor C. M. Leung, "A survey on IoT-based healthcare systems," *IEEE Access*, vol. 5, pp. 678-708, 2017. DOI: <https://doi.org/10.1109/ACCESS.2017.2667681>
- [5] S. M. Riazul Islam, Daehan Kwak, Md. Humaun Kabir, Mahmud Hossain, and Kyung-Sup Kwak, "The Internet of Things for healthcare: A comprehensive survey," *IEEE Access*, vol. 3, pp. 678-708, 2015. DOI: <https://doi.org/10.1109/ACCESS.2015.2437951>
- [6] Wullianallur Raghupathi and Viju Raghupathi, "Big data analytics in healthcare: Promise and potential," *Health Information Science and Systems*, vol. 2, no. 3, 2014. DOI: <https://doi.org/10.1186/2047-2501-2-3>
- [7] Ashwin Belle, Raghuram Thiagarajan, S. M. Soroushmehr, Fate-meh Navidi, Daniel A. Beard, and Kayvan Najarian, "Big data analytics in healthcare," *BioMed Research International*, 2015. DOI: <https://doi.org/10.1155/2015/370194>
- [8] Manoj Kumar and Rakesh Singh, "Development of hospital management system using web technologies," *International Journal of Computer Science and Information Security*, vol. 17, no. 5, 2019. Link: <https://www.ijcsis.org>
- [9] Vishal Patel and Kiran Patel, "Role-based access control in healthcare information systems," *International Journal of Information Technology*, vol. 8, no. 2, 2016. DOI: <https://doi.org/10.1007/s41870-016-0012-0>
- [10] Poonam Verma and Sandeep Sood, "Cloud computing in healthcare: Opportunities and challenges," *Springer Journal of Medical Systems*, vol. 42, no. 8, 2018. DOI: <https://doi.org/10.1007/s10916-018-1019-2>
- [11] Jae-Ho Lee, Min-Su Kim, and Young-Ho Lee, "Mobile health system for patient monitoring and healthcare management," *IEEE Transactions on Consumer Electronics*, vol. 63, no. 2, pp. 123-130, 2017. DOI: <https://doi.org/10.1109/TCE.2017.014847>
- [12] M. Shamim Hossain and Ghulam Muhammad, "Cloud assisted industrial internet of things (IIoT) enabled framework for health monitoring," *IEEE Internet of Things Journal*, vol. 3, no. 6, pp. 123-130, 2016. DOI: <https://doi.org/10.1109/JIOT.2016.2580903>
- [13] Min Chen, Shiwon Mao, Yin Zhang, and Victor C. M. Leung, "Big data analytics for healthcare applications," *IEEE Network*, vol. 31, no. 1, pp. 14-21, 2017. DOI: <https://doi.org/10.1109/MNET.2017.1600091>
- [14] Adeel Ahmad, Kashif Saleem, and Zahid Mahmood, "Design and implementation of web-based healthcare management system," *International Journal of Computer Applications*, vol. 179, no. 7, 2018. DOI: <https://doi.org/10.5120/ijca2018916853>
- [15] Vivek Singh, Amanpreet Kaur, and Harpreet Kaur, "Scalable healthcare architecture using modern web technologies," *IEEE International Conference on Computing*, 2019. DOI: <https://doi.org/10.1109/ICACCS.2019.8728372>
- [16] Ankit Sharma, Neha Gupta, and Rahul Mehta, "Digital hospital system for patient record and billing management," *International Journal of Engineering Research and Technology*, vol. 9, no. 6, 2020. Link: <https://www.ijert.org>
- [17] Saurabh Gupta, Ankit Mishra, and Rakesh Pandey, "Multi-user hospital management system with role-based dashboards," *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 4, 2021.
- [18] DOI: <https://doi.org/10.14569/IJACSA.2021.0120412>



- [19] MohammadKhan,FaisalAli,andSajidHussain,“Smartappointment scheduling system for healthcare services,” *ProcediaComputer Science*, vol. 167, pp. 143–150, 2020. DOI:<https://doi.org/10.1016/j.procs.2020.03.203>
- [20] RahulMehta,SaurabhJain,andAnkitAgarwal,“Health-careanalyticssystemforperformancemonitoring,”*IEEEAccess*,vol.9,pp.55678–55689,2021.DOI:<https://doi.org/10.1109/ACCESS.2021.3072478>
- [21] MohammadAli,SaadKhan,andHaseebAhmed,“Se-cureauthenticationsystemforhealthcareapplications,”*IEEEAccess*,vol.10,pp.33456–33465,2022.DOI:<https://doi.org/10.1109/ACCESS.2022.3156789>
- [22] Joa˜o Fernandes, Pedro Mathew, and Joseph Paul, “Integratedhealthcaremanagementplatformusingwebtechnologies,”*Pro-cedia Computer Science*, vol. 220, pp. 102–109, 2023. DOI:<https://doi.org/10.1016/j.procs.2023.03.015>



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