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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 systemscausesanexplosionoftime-gapsandthedecision-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 applicationdomainofhealth.Criticalcriteriasuchasintegration, expandability and security, accessibility and performance have been evaluated. It has been identified with significant flaws inthe current technology, such as synchronization issues between devices,unavailabilityofrelevantanalyticsandabilitytorespond efficientlytocriticalsituations.Itcanbeconcludedthatinvention 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, morethaneverwhenallinvolvedinthehospitalandin 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.Servicesthathospitalsnowprovideareappointment service, laboratory information system, payment system, humanresourcessystem,propertysystem.Evenpatientinforma-tion can be controlled by the use of computer structure. Only Webbasedhospitalsupervisionsystemhaveapotentiality to run hospital more efficiency. Also make each and every staff much faster. A hybrid combination of all most modern technologyavailableinthistimei.e.TheMERNStack(Mongo DB, Express.js, React, Node.js), which has a potentiality to developing up a high volume and rich clients application that arecapabletoholdanimmensedataanditispossibleto getandusetherealtimedataconcurrently.NoSQLdatabase Mongo DB can reduce the duplication of the database and increase the retrieve rate, hence make it more faster and secured.Ourstatementofintentis'Tobuildandtodesign 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 supervisionsystem.Drawbackswerethefactthatnoanalytical processingwasusedandittookawayallthehumanerrors 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,thissystemhadadrawbackthatitbecame verycomplexintime,thusitwasrequiredtomakesomemore improvements.

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There is a systematic review of IT approach in hospitals basedonEHRusagebyMathewKruseetal[1]anddiscussing the advantages such as shared data and less staff input.IT system use in hospitals is heavily cited, is relevant to services anddatapresentation,usage,treatment,processingandstorage andthereareamultitudeofpublicationseverydayrelated 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 senttodoctor/nurse/doctorsthroughtheinternetreal-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 ofdistributedarchitectureandcloudcomputing;itlookssecure 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 andalso allows the doctor to make a diagnosis from their housebut 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 im-plemented all his system on web using the existing hospital supervision system and aimed at the speed and efficiency to makeitrequireveryminimaleffortsbyhumansforitsworking and the system had no decision-making tool to the system. Thus Vivek Singh came up with a better idea of using newer webtechnologyfordevelopingasystem,whichautomatesthe 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 hasbeen improved in terms of database supervision and billing. Databasedesigntechniquesareutilizedinordertodevelopthis 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 confi-dentiality;butsuchadvancementscanbeutilizedinsmaller 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 ex-pectationsbecausedesiredrequirementscan'tbeimplemented 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 performanceinaveryconsistentmannerwhichhasto 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] | Kruseetal. (2016) | EHRSystems | Highcost;in-teroperability |
| [2] | Adler-Milstein etal.(2017) | HospitalInfo. Systems | Integration challenges |
| [3] | Kuo et al. | CloudComput- | 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

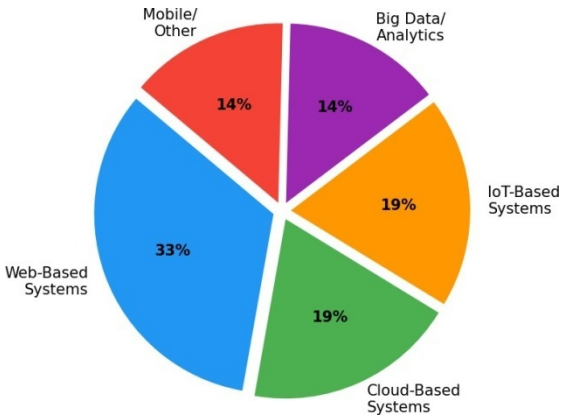



Fig.1:DistributionofTechnologiesUsedinReviewedStudies n=21)

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 problemwastheproblemsufferedbymorethanhalfofall theapparatustested(62%)andthecauseofthosedefect were the non-analytical power thus resulting not in correct decisionmadeandunificationproblemofmodulewasanother cause.Thethirdsecurityproblemwasthesecondmajor 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.ThispaperreviewisbasedonHospitalsupervision

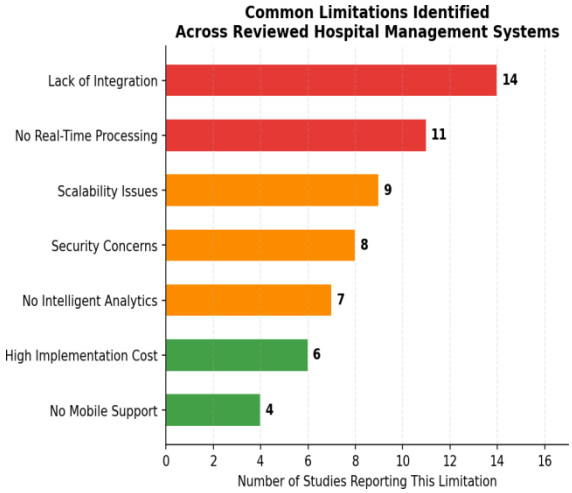



Fig.2:SystemCategorization

System, Health Care Information System, Smart Health Care, CloudComputinginhealthcare,monitoringsystembased onIoT,WebBasedApplicationforhealthcare.Reliability,operating, design, secure, real-time system, scalable, human-centered design was criteria used by researcher. On the re-search, we selected criteria by considering the quantity of technicalinformation,thecontentisn'ttoobroadanditshould be new enough. Then, on those tests, once a research was chosen, one researcher will read it, extract all features anddataonthatresearch.Comparisionisdoneontechnologyused, system function feature, advantages, disadvantages, system performance test. Lack of large-scale system updates and problemsofhospitalshavebeenreportedassignificantfactors. Howeverwiththeproposedconceptualmodelweareable 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 | ProposedMERN Framework |
|---|---|---|---|
| [1] | Integration | Fragmented | FullyIntegrated |
| [2] | Real-Time Support | Limited | Available |
| [3] | Scalability | Moderate | High |
| [4] | Security | Basic | Enhanced (JWT - based) |
| [5] | UserInterface | 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 thesestructureareseldominsync.Incontrast,itpathprovides anintegratedhospitalsupervisiontoenablecollectivecompar-ison of the fragmented operations in a hospital which concede for seamless communications and proficient operational effi-ciency.Asecondobservationhastodowithprocessingdata.

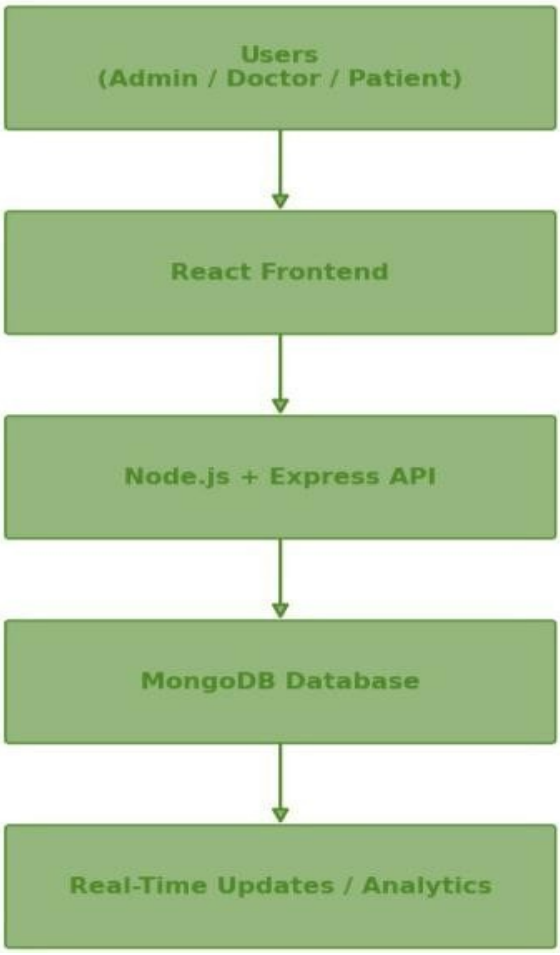



Fig.3:ConceptualMERN-BasedSystemArchitecture

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 basedon MERN by the authors for bringing real-time data synchro-nization in this domain, which ensures instant updates and responsiveness.Anotherlargeissuewithinexistingsolutionsis scalability, particularly in larger healthcare environments. Ini-tially, 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 hospitalsinanintegratedmannerforseamlesscommunication andprocessoptimization.TheresultsvalidatethattheMERN-based framework with databases integrated at different levels iscomparativelymorescalableandprovidesnearrealtime performance over some of the existing hospital supervision structure. These enhancements make it a good candidate for the backbone of next-generation healthcare applications .

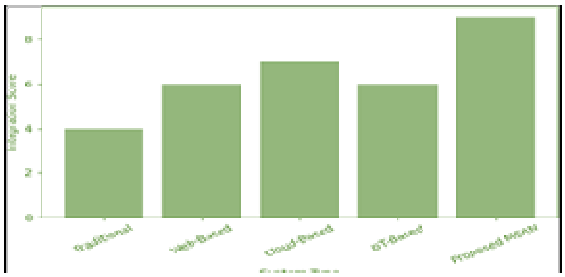


Fig.4:SystemInterfusionCapabilityComparision

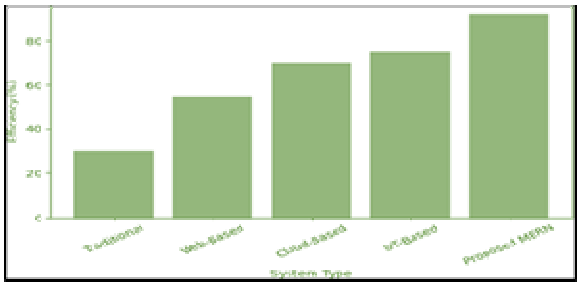


Fig.5:EventDrivenRefinement

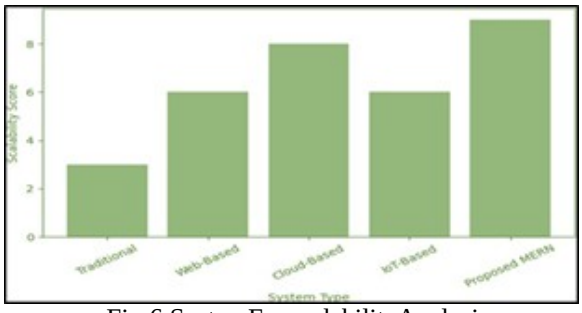



Fig.6:SystemExpandabilityAnalysis

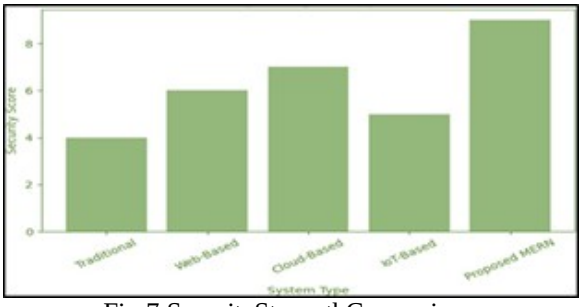



Fig.7:SecurityStrengthComparison

TABLEIII:ComparisonofExistingSystemsandProposed 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 hasbeenfastermovementtowardamoredigitaloffering than you might expect in existing hospital care supervision apparatus as compared to conventional medicine. The system underreviewinmajorityisoperationali.e.forpurposes suchasmanagingpatientrecords,appointmentscheduling 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 ofthebestmajorfindingsonyourrecentlyreviewedliterature 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 ontinuous 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 effective. 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.Mostofthereviewedstudiesprovidebasicaccess control, while stronger mechanisms are expected, including token-basedauthentication,encryption,auditloggingandrole-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 healthcareenvironments,relativelyfewstructuressuccessfully convert this information into predictive insights, workloads forecasting or resource optimizations. This indicates an un-equivocalscopeforfuellingtheutilityofArtificialIntelligence and analytics-led supervision tools. Collectively the results demonstrate that hospital supervision systems of the future willrequireamigrationawayfromisolatedautomationmodels 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 groundworkfornext-genhealthcaresupervisionenvironments 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 in-telligent(digitalandhuman)clinicalecostructures.Oneof themostattractivewaystoproceed istointegrateArti-ficial 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 con-nectedmedicaldevices,wearablesensors,andsmartdiagnostic equipmentisanotherareathatisbeingdeveloped.Thisallows forbetterpatient safety fromhealthdatacollectedinreal-time, castsasidemuchofthemanualworkloadandmostimportantly 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 pro-poses the future progression of the security frameworks that assurancetosecuretrademarkidentifiablehealthinforma-tion 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 theconstantevolutionofpreventivehealthcaremodelsthrough digital transformation. Development can additionally concen-trateoncompatibleplatformswithwhichhealthcarestructures ought to carry out communication no longer simply between hospitals, laboratories, pharmacies and insurance companies, however with telemedicine as well.

Clinicians, patients, doc-tors 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 com-parative study of the hospital supervision structures devel-oped using different web architectures like web based tech-nologies, cloud-based platform, IOT frameworks and data-driven approaches.The study states that, despite the fast-paced digitisation of almost all health careoperations, most modern healthcareinformationstructuresstillhaveill-combinedarchi-tectures. 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 alto-gether.

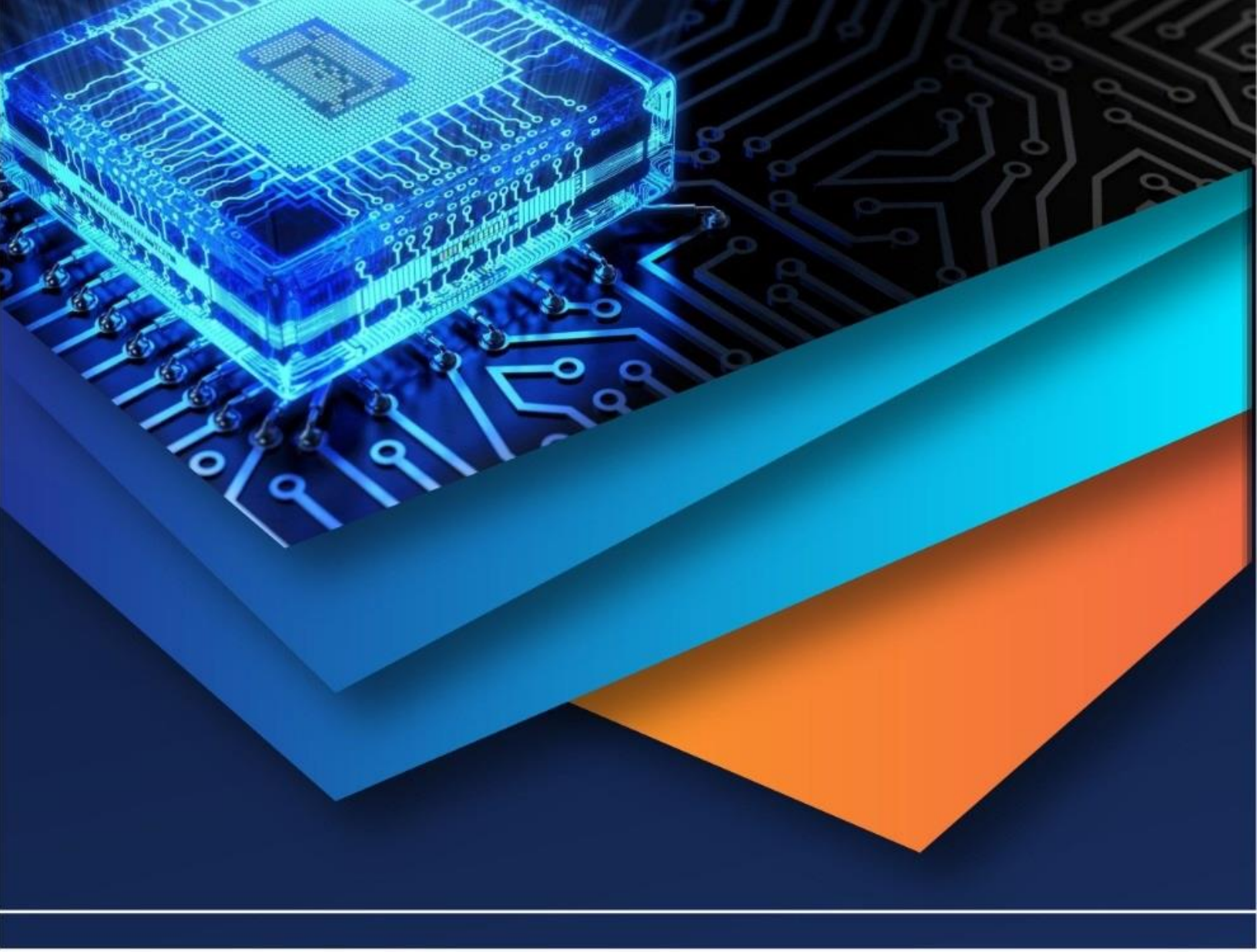
Thereishopeinthecomparativeresults-evidence of modern full-stack architectures as a solution to many of these long-term challenges and helping to improve coordina-tion among clinical, administrative, and operational functions. Such a review has the capacity to identify emerging trends, clarify perennial challenges and articulate future technology focusareasinhealthcare supervisionsystems.Futuresolutions would instead consider all automation not one at a time, butas interconnected and data driven ecosystems that could be leveragedtodrivebetterdecisionmaking,optimizetheuse 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.

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