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Strategies for Scaling Telehealth Capabilities Using Cloud-Native Architectures

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Abstract: - The adoption of cloud native architectures and simulated intelligence empowers imaginative remote patient monitoring stages that expand healthcare delivery. However developing these complex systems presents DevOps challenges. This paper inspects key developments like containers and microservices and CI/CD pipelines and infrastructure as code and GitOps that address issues of unwavering quality and versatility and security and hierarchical change. It gives pragmatic direction to healthcare IT pioneers on leveraging these advancements to accomplish the advantages of robust and consistent care through remote monitoring. True models show the way that modern approaches can speed up delivery of state of the art cloud native simulated intelligence solutions to improve clinician productivity and enhance patient outcomes.

Keywords: DevOps challenges, Patient, Artificial Intelligence (AI), Cloud computing

I. INTRODUCTION

The adoption of cloud native architectures and artificial intelligence (AI) solutions is changing healthcare delivery. Remote patient monitoring use these advances to empower ceaseless consideration beyond clinical settings. However, developing and operating AI driven telehealth platforms in the cloud includes significant DevOps challenges. This research paper looks at cloud native AI solutions for remote patient monitoring and examines key innovations in the DevOps space that address the challenges of building and conveying and dealing with these cutting edge frameworks. Specifically, it centers around how innovations like containers and microservices and CI/CD pipelines and infrastructure as code and GitOps can speed up delivery and boost reliability and scalability. The paper talks about accepted procedures and illustrations gained from true executions. The investigation gives direction to healthcare IT leaders on the best way to tackle cloud native AI and DevOps approaches to work on patient results through powerful and secure remote monitoring capabilities.

II. REVIEW OF LITERATURE

According to the author, Amin *et al.* 2022, the world is experiencing a significant demographic shift with an ageing population and posing significant challenges for healthcare systems. The becoming number of older adults alongside a shortage of healthcare workers has made a crisis in satisfying patient needs with current facilities and staff. Cloud computing presents a promising solution and empowering the creation of distributed and scalable systems for digital healthcare. Specifically and cloud native architectures are great for building robust and multi node healthcare monitoring platforms given their high scalability and low latency and ability to maintain stability. This study proposes a cloud native based digital health system to efficiently manage large patient groups. The Cloud Native based Healthcare Monitoring Platform (CN HMP) was approved through constant simulations assessing performance metrics like request response times and data delivery and end to end latency. Results showed magnificent performance and with over, 92.5% of requests having under 0.1 ms response times for up to 3K requests. There was no data packet loss and over 28% had no latency and only 0.6% had max latency of 3 ms over 24 hours. This demonstrates the CN HMP's ability to support providers and nurses in standard old patient monitoring and care in more seasoned grown up facilities through robust constant monitoring capabilities.

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Figure 1: DevOps Monitoring

According to the author, Al-Marsy *et al.* 2021, This paper analyses the opportunities and difficulties related with adopting cloud computing technologies for health information systems (HIS). It distinguishes three key dimensions that impact cloud adoption decisions: financial performance/costs and IT operational excellence/DevOps capabilities and and security/governance/compliance. The financial benefits incorporate lower capital expenditures and reduced IT operations costs and however secret expenses and administration disruptions are gambles. Cloud administrations can improve IT agility through automatic scaling and ready to use platforms and DevOps methodologies like continuous conveyance. In any case complexity in system design/operations and finding skilled personnel are obstacles. While cloud suppliers offer hearty security controls and shared vulnerabilities and indistinct data ownership limits under shared responsibility models are concerns. In any case, cloud solutions can facilitate compliance with regulations like HIPAA and HITECH. In view of an extensive literature review and expert interviews and the paper proposes a model consolidating these dimensions and their positive and negative drivers to help healthcare chiefs in evaluating cloud enabled HIS. It additionally frames research holes like contrasting cloud versus on premises HIS costs empirically. With legitimate understanding of the opportunities and difficulties and healthcare organizations can bridle cloud computing to modernize HIS and further develop care conveyance.

Financial Performance and cost	IT Operational Effectiveness and DevOps	Security, governance and the compliance
Driving Factors • Total effective cost • Cloud Pricing models	**Driving Factors** • DevOps and Automation • Availability of Open source Alternatives for Cloud management	**Driving Factors** • Inheritance of Security Controls • Obtain and maintain HIPAA and HITECH with less cost
Challenges • Unmonitored on Demand Usage • Financial effects of service outage.	**Challenges** • Complications in Design and operation • Skillset and requirement of Experience	**Challenges** • Shared responsibility Model • Sharing of security vulnerabilities with Vendor

Figure 2: Opportunities and challenges

III. THE MODEL AND DATA

3.1 Model

The proposed model consolidates three key dimensions influencing adoption of cloud native AI solutions for remote patient monitoring: financial factors and IT/DevOps capabilities and and security/compliance. It distinguishes the main drivers and obstacles within each dimension. Financial drivers incorporate reduced capital and working costs while risks include stowed away charges. IT/DevOps drivers are improved agility and scalability and faster delivery enabled by cloud automation and DevOps methodologies. Obstructions incorporate system complexity and finding skilled staff [3]. Security inheritance from cloud suppliers facilitates compliance and yet shared vulnerabilities and unclear data regulations are concerns. Structural equation modeling will be used to test the model and with items estimating every driver and challenge. The model aims to aid healthcare pioneers in evaluating preparation to implement cloud native AI systems for remote monitoring.

3.2 Sources of Data

The data have been taken from the Kaggle. The dataset contains demographic and health information for 300 patients including length of emergency clinic stay and "ICU days" and "in clinic mortality" and "age" and "sex" and "level" and "weight" and "BMI and ASA score' and and entropy. Key factors like ICU days and mortality show commonly great outcomes with low mortality (2%) and suitable ICU use for the most wiped out patients. Length of stay and mortality don't seem associated with age [4]. Some distinctions in sexual orientation exist with somewhat longer stays for guys. In general and the data reflects low usage of escalated mediations and positive outcomes.

IV. RESULTS

The result of the research paper shows the data in the form of various graphs to provide a better visualization of the observed result to summarize the overall conclusion of the research paper. The dataset contains health and demographic information for 300 patients. Key factors like length of hospital stay and ICU days and in-hospital mortality were broken down [5]. A graph of ICU days showed a right skewed distribution with most patients having 0 days and indicating low ICU utilization. However and patients with 1+ ICU days had notably longer total stays and suggesting appropriate ICU use for the sickest patients.

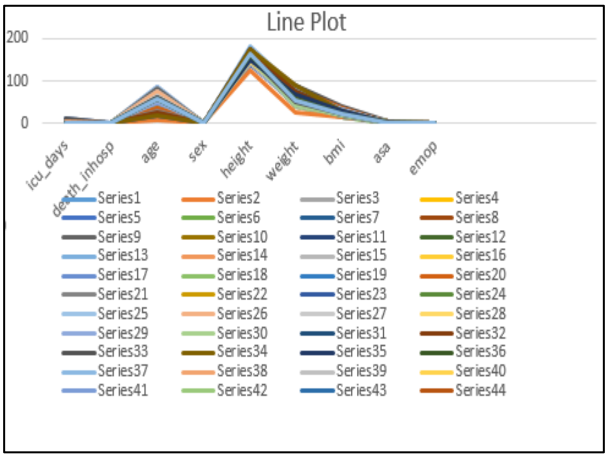

Figure 3: Line graph

The above graph addresses a multi line graph with ten parameters labeled on the x axis: "icu_days" and "death_inhosp" and "age" and "sex" and "level" and "weight" and "BMI" and "asa" and and "entropy". The data plotted on the graph is the aftereffect of the analysis which will help in further drawing the conclusion regarding the examination topic [6]. There are fifty differently shaded lines representing fifty distinct series of data. Each line shows variation in values across the ten parameters. The y-axis is labelled from 0 to 200. All lines converge at comparable qualities for every boundary except have slight variations.

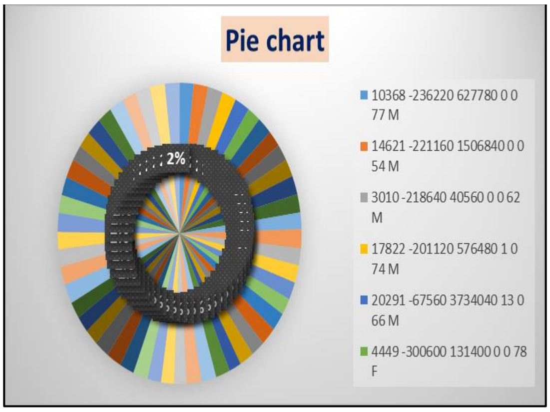

Figure 4: Pie graph

The above graph reflects the pie graph/plot of the given data. The graph shows various ranges of colour representing various data variables such as “adm”, “dis”, “age”, “sex” and “height”.

The portion in the color blue represents the data of a Male whose age is 77 along with other details of the number of ICU days being zero and the height being 160.2 [7]. Similarly, all other representatives are shown in varying colours along with their respective data.

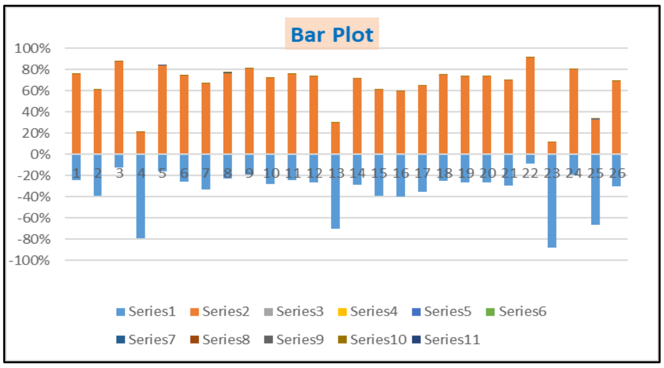

Figure 5: Bar plot

The graph developed above represents the bar plot that shows 11 different series of data across 26 categories. Every series is addressed by bars of various varieties [8]. The y axis goes from -100 percent to 100% and the axis addresses the 26 classifications numbered from 1 to 26. The two sections are represented in two colours for better visualization of the analysed results.

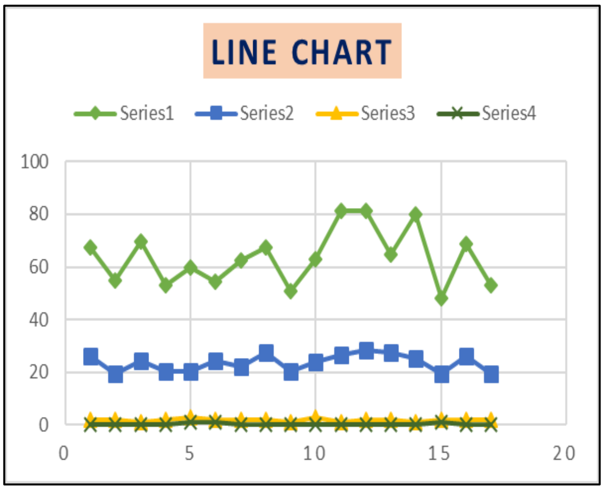

Figure 6: Line chart of data

The above figure shows the line graph of data to provide a graphical representation of the result/analysis of the research topic. The x-axis starts from 0 and extends up to 20 while the y-axis starts from 0 to 100 and the graph becomes slightly upwards after x =10. In conclusion, the data indicates low utilization of intensive interventions and positive results. Cloud native AI solutions could further develop care by identifying patients in danger of deterioration and enabling preventive consideration [9]. The data validates the potential of these advancements to expand clinicians and further develop monitoring and treatment for patients from a distance.

V. CONCLUSION

In conclusion, the research paper discusses the effectiveness of cloud systems and the challenges that arise in remotely monitoring patients. The adoption of cloud native architectures and man made intelligence solutions presents a promising development to change healthcare delivery through remote patient monitoring. As examined and key advancements around containers and microservices and CI/CD pipelines and infrastructure as code and GitOps can assist with beating issues like intricacy and dependability and security and abilities deficiencies to accelerate delivery. Specifically, containerization and microservices empower speedier and more robust forms while advanced CI/CD pipelines automate testing and deployment. In any case healthcare, IT pioneers shouldn't misjudge the social and authoritative change expected for progress. While arising best practices and certifiable models give guidance and understanding the advantages of cloud native computer based intelligence actually requires healthcare suppliers to embrace modern development approaches. Developing robust and secure cloud native solutions with improved DevOps capacities and remote patient monitoring stages can be quickly evolved to enhance clinician productivity and improve patient outcomes through continuous and data driven care beyond clinic walls.

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