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Software Engineering in Healthcare

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***Abstract:** As technology is advancing and affecting every phase of human life, health care facilities are also getting improved with the introduction of new advanced, customized, and patient-centric approaches in software engineering. Engineers all around the world are working to create unique and efficient ways for the prevention and early detection of diseases along with improving the patients' experience while using these technologies. With the gain in computing power and access to a wide range of software, software engineers are working on technologies such as Big Data, AI, Data Science, and Cybersecurity to improve the existing methodologies and pave the way for patient-centric approaches and knowledge translation.*

I. THESIS

Identifying the issues and challenges present in the healthcare sector and aiming to find efficient measures to tackle them with the introduction of new technologies such as AI, Big Data, and Cybersecurity while following the best software practices.

The rest of this paper is structured as follows. Section 2 shows an introduction to the topic. Key challenges and issues faced in the healthcare industry are present in Section 3. An overview of patient-centric approaches is present in Section 4. The discussion of how new technologies such as BigData, AI, Data Science, and Cybersecurity can improve the existing healthcare technologies is present in Section 5. Knowledge Translation in healthcare is discussed in Section 6. Finally, the paper is concluded in Section 7.

II. INTRODUCTION

The Healthcare industry demands unique devices and services tailored to the best project methodologies and software development models with limited chances of error. Over the last few decades, the demand for software engineering principles and methodologies has grown rapidly due to the advancement in technology. Healthcare requires the use of software engineering technologies at every step of the way starting from complex devices to monitor various aspects of the human body to the less complex patient record management systems.

The technology sector is growing at a very fast pace and thus it opens new avenues for research in software engineering for health care. The rise of digital health can bring in an opportunity for "patient centricity", thus improving the quality of healthcare experience for the patient.

III. KEY CHALLENGES IN HEALTHCARE

One of the challenges the healthcare industry is facing is with the growing use of technical appliances and medical equipment, almost everything needs to be linked together to provide information and data. Software Engineering helps to create viable and bug-free software which solves this problem and helps provide the medical personnel with correct and efficient results from the medical equipment. Cloud systems can help store massive volumes of patient information.[1]

Cybersecurity is also a problem that SE can solve as since the need for patients' information to be stored online is increasing along with connected medical devices, they attract the attention of malicious hackers to healthcare providers. Thus, to prevent data theft and loss of information, a robust system is required in healthcare.

Another major challenge that software engineering helps to solve is the creation of a Data Management System powered by data analytics for the Logistics of medical supplies and appliances. Logistics is a huge problem in the healthcare industry as the traditional supply chain is often wasteful and inefficient. Hence, the creation of such a system will help to avoid heavy losses, supply shortages, misplaced inventory, and many other such instances.[2]

IV. PATIENT-CENTRIC APPROACH IN SOFTWARE ENGINEERING

Turning into a functioning member in one's well-being is freeing; and the utilization of cell phone applications that are connected to online platforms implies that patients are more contributed, at prior stages, in their own wellbeing stories. At the point when people approach tools for diagnosis, they don't need to wait for the doctor's assessment and thus it leads to a decrease in medical services costs along with personalized health management.

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The advancing utilization of innovation incorporates arrangement and medicine updates, accessible information bases of clinical counsel, and treatment use cases concerning indications, medicines, recuperation periods, torment levels, and that's just the beginning. Whole income streams are being made by the consideration of applicable medical care offers of administrations and items – which can be bought, safely online employing Web-based business. [3]

Wearable devices such as Fitbits that can be used to measure heart rate, calories, and other medical metrics are gaining traction by the users.[3] The data collected using these wearable devices can be communicated wirelessly and can be further used for health management, reviews by medical professionals, and emergency healthcare service personnel in the time of need as these devices capture data in real-time and can facilitate quick decision-making.

V. REVOLUTIONIZING SOFTWARE ENGINEERING IN HEALTHCARE

With the advancement in technology, every industry that uses software engineering practices is moving towards utilizing them to improve their existing models. The development of newer and advanced models for Data Science, Big Data analysis, and Cybersecurity for the healthcare sector can prove to be a boon for this industry.

A. Big Data Analysis

Medical institutions have acquired a humongous amount of medical data and it still keeps on accumulating. This data is very complex and can be used for further research purposes. Handling such a huge amount of data using paper-based methods is a highly time-consuming process and is not scalable. This data can be used to improve the performance and management of healthcare as this data directly ponders on how medicine and care can be delivered efficiently to the patients.

Using the software engineering methodologies, Electronic Health Records (EHR) [4] can be maintained which would provide scalability, backups, and insights using various tools of visualizations. Since the medical data is highly intertwined in nature, maintaining EHR can help to embrace the connectedness of this data and the insights generated would prove to be of great clinical value.

Doctors and medical practitioners are highly considering the predictions based on the already available data of their patients for further diagnosis and recommendation processes. Due to the availability of this wide range of data and high computing power, practitioners are relying on the value of lifestyle choices, early detections, hereditary patterns, and the influence of environmental factors. They feed these data elements into the equation for diagnosis to get a better variety of prospective treatments [3].

Healthcare technology is moving towards creating a personalized experience for the patients by simulating a legion of humans' emotions using supercomputers to get acceptable levels of personalized healthcare facilities. Doctors are relying on software tools to apprehend various surgical procedures, recovery rates, and survival costs that would need to be paid by patients to the healthcare providers and thus would give them a better understanding and personalized healthcare experience.

B. Chatbots

Many companies and organizations are creating chatbots to help customers and patients manage their healthcare needs. Chatbots are smart robots for assisted living and personal care. They provide customized diagnoses and treatment.

Chatbots can transform the healthcare industry by replacing unprofessional, inefficient visits to doctors with a less expensive, higher-quality alternative. These bots come in various forms that provide feedback on conditions such as diabetes or asthma or automate routine tasks such as scheduling appointments. [3]

Chatbots make it easier for people who otherwise wouldn't have access to medical help because of economic constraints or geographic location. Many other mobile health applications have also become popular such as those which can help patients take their medication or track their health records and thus facilitating the beginning of a new era in digital healthcare.

C. Cybersecurity

Cyber-attacks have increased a lot in the healthcare industry as almost everything is now digital, and for the normal functioning of organizations and systems, cybersecurity in healthcare and protecting information is vital. Specialized healthcare systems which exist in many healthcare organizations such as radiology information systems, e-prescribing systems and many more must be protected.[5]

Different types of cyberattacks occur in the healthcare industry which includes: 1. Ransomware 2. Data Breaches 3. DDoS attacks 4. Insider Threats 5. Business email compromise and fraud scams. Beyond financial loss and breach of privacy, these attacks can cause patients' lives at risk due to the loss of data.[6]

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The WannaCry ransomware attack, the attack Anthem Blue Cross, Premera Blue Cross, University of California, Los Angeles Health, TRICARE, Newkirk Products, and much more cybersecurity attacks have forced the government and the organizations to implement and increase the emphasis on successful cybersecurity systems or frameworks.

VI. KNOWLEDGE TRANSLATION IN HEALTH CARE

Knowledge translation(KT) can be termed as the recursive process or events through which individuals and organizations can implement the research obtained from research journals, laboratories, and academic conferences and put them to practical use which in turn forms the next iteration of the Knowledge Translation research cycle.[7]

Knowledge Translation is not an action, but it is research and it transmutes accordingly. While being an established term in the healthcare industry, it is relatively unknown in Software Engineering.[8] The World Health Organisation (WHO) values the exchange and application of knowledge to expedite the profits of global and local innovation to improve healthcare systems and peoples' health thereby making it an important factor in the healthcare industry. [9]

International Organisations are holding programs to improve Knowledge Translation so Software Engineering in Healthcare can improve. Some of the organizations are 1. Agency for Healthcare Research and Quality(AHRQ) 2. Canadian Institute for Health Research(CIHR) 3. What Works Clearinghouse(WWC) 4. Campbell Collaboration.[10]

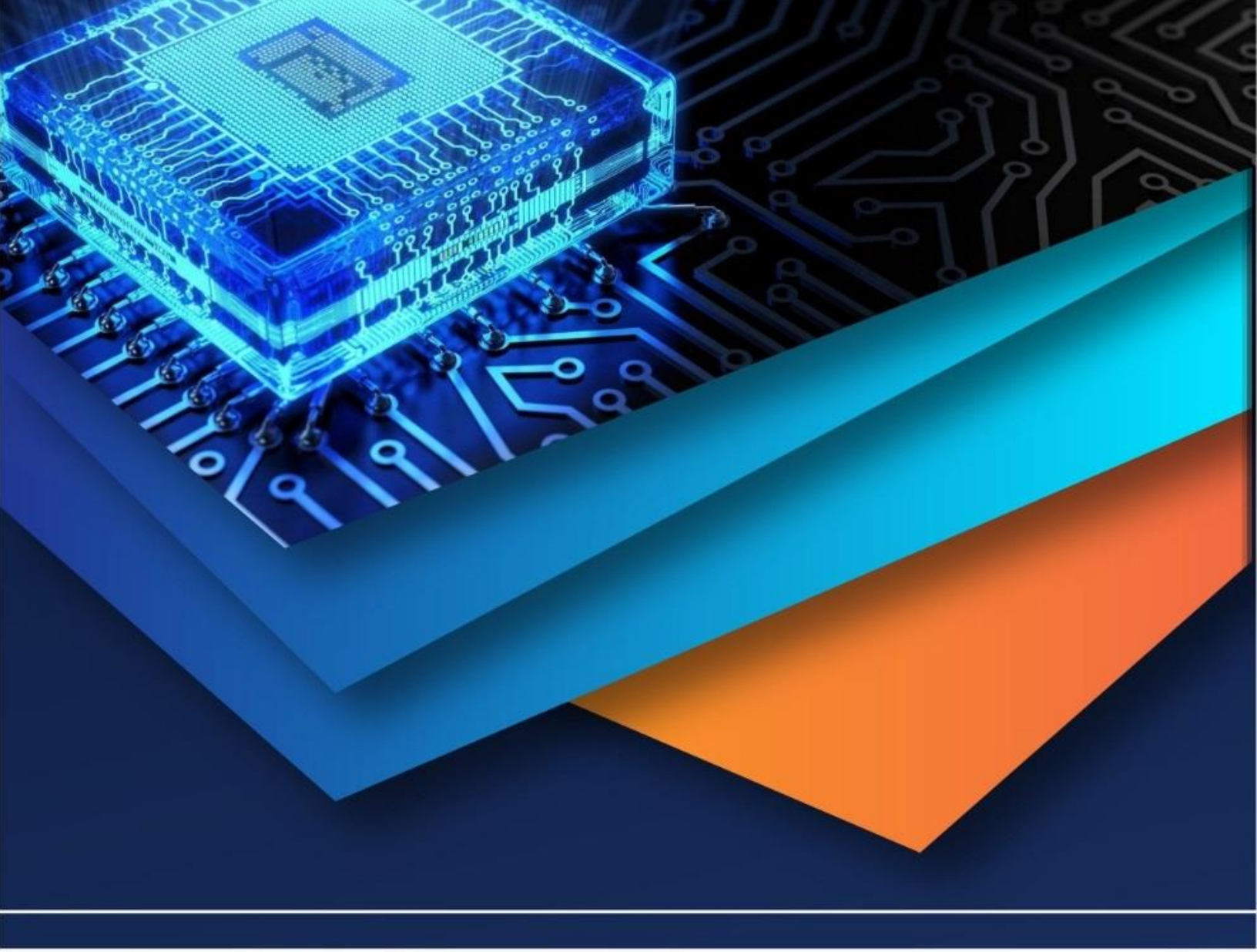
VII. CONCLUSION

With the increase of mutations and diseases, identification and early diagnosis have become an integral part of the healthcare industry. Knowledge Translation combined with software engineering can, in turn, pave the way for the introduction of new methodologies and technologies to cater to the needs of the patients and in turn, lead to the development of the healthcare sector. The current ongoing problems can be tackled using patient-centric approaches and by introducing technologies such as AI, Big Data, and Cybersecurity to reform the existing practices.

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