

Chapter 17

Unlocking and Maximising the Multifaceted Potential of Machine Learning Techniques in Enhancing Healthcare Delivery

B. G. Geetha

K.S. Rangasamy College of Technology, India

R. Senthilkumar

Shree Venkateshwara hi-tech Engineering College, India

S. Yasotha

Sri Eshwar College of Engineering, India

S. Ayisha

Shree Venkateshwara Hi-Tech Engineering College, India

K. Asique

The Zubair Corporation LLC, Oman

ABSTRACT

Machine learning (ML) has become an integral tool in numerous fields, demonstrating unparalleled capabilities in deriving actionable insights from data. ML is propelling a paradigm shift in healthcare, enhancing diagnostic precision, predictive analytics, and patient-centred care. This research explores and maximises ML's potential in healthcare delivery by evaluating various techniques and their applications in predictive diagnostics, personalised medicine, and operational efficiency. By analysing multiple case studies and real-time applications, the authors conclude the efficacy and challenges of implementing ML in healthcare settings. Furthermore, they propose a robust architecture for ML deployment in healthcare, considering data security, ethical concerns, and seamless integration with existing systems. Through quantitative and qualitative analyses, the research highlights the significant improvements ML brings to patient outcomes and operational efficiencies while also pointing out areas that require further exploration and mitigation strategies to overcome prevailing challenges.

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INTRODUCTION

In the epoch of technological advancements, Machine Learning (ML), a subset of artificial intelligence, has anchored its roots deeply across diverse domains, showcasing its robust capability to parse through voluminous data, learn patterns, and predict outcomes with remarkable accuracy (Zou et al., 2018; Hasan et al., 2020). The healthcare sector, being a critical domain that interfaces with human lives directly, has witnessed a transformative impact ushered in by ML, wherein the technology has not only enhanced diagnostic and predictive capabilities but has also paved the way for personalised medicine and improved operational efficiency (Kapoor & Priya, 2018; Santhanam & Padmavathi, 2015; Nai-aruna & Mounmaia, 2015).

Machine Learning algorithms utilise statistical techniques to enable computers to ‘learn’ and improve their performance at a task as they are exposed to more data (Agrawal et al., 2019). Within the healthcare context, this translates to improved diagnostic precision, predictive analytics, and the enablement of a more patient-centric approach to care. ML has applications ranging from predictive diagnostics, where algorithms predict diseases and outcomes, to operational efficiencies, where ML optimises workflows and resource allocations within healthcare settings.

Despite ML’s significant strides in healthcare, its journey is not devoid of challenges. Data privacy, ethical concerns, algorithmic biases, and integrating ML technologies into existing healthcare systems present substantial hurdles that need meticulous addressing (Kanne et al., 2020). Furthermore, the rapidly evolving nature of ML technologies necessitates continual research to keep abreast of developments and ensure healthcare applications of ML are maximised and optimised effectively (Xie et al., 2020; Zu et al., 2020; Chung et al., 2020; Rathore et al., 2021; Ahirwar et al., 2021).

This research paper endeavours to explore the multifaceted potential of ML in enhancing healthcare delivery, delving into its varied applications, exploring challenges, and offering solutions and recommendations to navigate through the existing hurdles (Zou et al., 2018; Hasan et al., 2020). The paper will traverse through the landscape of ML applications in healthcare, evaluate various techniques, assess their implications, and weave through the complexities and challenges encountered in real-world applications (Kapoor & Priya, 2018; Santhanam & Padmavathi, 2015; Mujumdara & Vaidehi, 2019; Nai-aruna & Mounmaia, 2015). Moreover, through a systematic review of case studies and applications, the paper aims to draw coherent results about the efficacy, challenges, and future trajectory of ML applications in healthcare delivery (Zou et al., 2018; Hasan et al., 2020).

The subsequent sections will unfold a comprehensive review of existing literature (Khambra & Shukla, 2021), articulate the methodology employed in this research (Agrawal et al., 2019), showcase results through quantitative and qualitative analyses (Zou et al., 2018; Hasan et al., 2020), and engage in detailed discussions to analyse and interpret the findings (Kapoor & Priya, 2018; Santhanam & Padmavathi, 2015; Mujumdara & Vaidehi, 2019; Nai-aruna & Mounmaia, 2015). The paper will summarise key findings, their implications in the healthcare domain (Zou et al., 2018), and potential avenues for future research (Kapoor & Priya, 2018), thereby contributing to the expanding reservoir of knowledge in this domain.

REVIEW OF LITERATURE

The application of Machine Learning (ML) in healthcare has witnessed exponential growth, spawning a wide array of research and real-world applications that leverage ML algorithms’ predictive and ana-

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