AI AND ML APPLICATIONS TO BRACE HUMAN INTERVENTIONS

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ABSTRACT

AI/ML—short for artificial intelligence (AI) and machine learning (ML)—represents an important evolution in computer science and data processing that is quickly transforming a vast array of industries. Artificial Intelligence is a booming technological domain capable of altering every aspect of our social interactions. The complexity and rise of data in healthcare means that artificial intelligence (AI) will increasingly be applied within the field. Several types of AI are already being employed by payers and providers of care, and life sciences companies. The key categories of applications involve diagnosis and treatment recommendations, patient engagement and adherence, and administrative activities. Although there are many instances in which AI can perform healthcare tasks as well or better than humans, implementation factors will prevent large-scale automation of healthcare professional jobs for a considerable period. AI, and specifically ML, are techniques used to design and train software algorithms to learn from and act on data. These AI/ML-based software, when intended to treat, diagnose, cure, mitigate, or prevent disease or other conditions, are medical devices under the FD&C Act, and called "Software as a Medical Device" (SaMD) by FDA and IMDRF. Finally, this paper reflects on future directions for AI in education, ending with an open invitation to create new discussions around the uses, possibilities and risks of AI in education for sustainable development.

Keywords: Artificial intelligence, machine learning, clinical decision support, electronic health record systems, SaMD, HILML.

INTRODUCTION

Artificial intelligence (AI) and machine learning (ML) based technologies have the potential to transform healthcare by deriving new and important insights from the vast amount of data generated during the delivery of healthcare every day. The term artificial intelligence (AI), however, was first introduced by John McCarthy in 1956. AI mainly relies on analyzing large databases, recognizing interactions, cross-matching complex symptoms and signs, and developing algorithms to resolve problems. [1,2]

Current applications include disease diagnostics, drug development, the personalization of treatment, supportive health services, and gene editing. The use of AI in medicine can be classified into visual and physical domains. Visual AI covers areas such as electronic medical records, outpatient appointment reminders, and health tracking applications, whereas physical AI encompasses tasks such as robotic surgeries and robotic drug dispensaries.

Recent studies identified that Machine Learning and Artificial Intelligence are promising technology employed by various healthcare providers as they result in better scale-up, speed-up processing power, reliable and even outperform human in specific healthcare tasks. Therefore, healthcare industries and clinicians worldwide employed various ML and AI technology to tackle the Covid-19 pandemic to address the challenges during the outbreak. With the current pace of technological advances in the field of AI, the debate on the possibility of whether AI will replace humans has shifted from a fictional landscape to a realistic one. The need is to carefully weigh the possible socio-legal and ethical impacts of such advances and prepare society to embrace such changes when they happen. In this paper we discuss some of the successes, opportunities, and challenges associated with the integration of AI in health care. [3]

LITERATURE REVIEWS [4,5,6,7]

1. Samuel Lalmuanwma et al., Chaos, Soliton, and Fractals, Elsevier Publication, 139, 2020:1-6.

The ongoing development in AI and ML has significantly improved treatment, medication, screening, prediction, forecasting, contact tracing, and drug/vaccine development process for the Covid- 19 pandemic and reduce the human intervention in medical practice. However, most of the models are not deployed enough to show their real-world operation, but they are still up to the mark to tackle the SARS-CoV-2 epidemic.

2. Abdulla Shoaib et al., International Journal of General Medicine, Dovepress Journal, 2020:13, 891-896. Artificial intelligence (AI) pertains to the ability of computers or computer-controlled machines to perform activities that demand the cognitive function and performance level of the human brain. The use of AI in medicine and health care is growing rapidly, significantly impacting areas such as medical diagnostics, drug development, treatment personalization, supportive health services, genomics, and public health management. AI offers several advantages; however, its rampant rise in health care also raises concerns regarding legal liability, ethics, and data privacy.

3. Mansoureh Maadi et al., International Journal of Environmental Research and Public Health, MDPI, 2021,18,1-27. To provide a human–Artificial Intelligence (AI) interaction review for Machine Learning (ML) applications to inform how to best combine both human domain expertise and computational power of ML methods. The review focuses on the medical field, as the medical ML application literature highlights a special necessity of medical experts collaborating with ML approaches. Methods: A scoping literature review is performed on Scopus and Google Scholar using the terms "human in the loop", "human in the loop machine learning", and "interactive machine learning"

4. 4th WHO GLOBAL FORUM ON MEDICAL DEVICES, Ministry of Health and Family Welfare Government of India, 1-20. AI/ML one of the greatest benefits of in software resides in its ability to learn from real-world use and experience, and its capability to improve its performance. The ability for AI/ML software to learn from real-world feedback (training) and improve its performance (adaptation) makes these technologies uniquely situated among software as a medical device (SaMD) and a rapidly expanding area of research and development.

METHODOLOGY

A selective assessment of information on the research article was executed on the databases related to the application of ML and AI technology on Covid-19. Rapid and critical analysis of the three crucial parameters, i.e., abstract, methodology, and the conclusion was done to relate to the model's possibilities for tackling the SARS-CoV-2 epidemic. [4]

1. Survey Methodology

To collect relevant papers for this survey, "human-in-the-loop machine learning", "human in the loop" and "interactive machine learning" were three major keywords that we used to search papers indexed with Scopus and Google Scholar. We also screened the most important and related conferences in the field of ML applications which was cited in IEEE and ACM websites to find high-quality work. We reviewed all the recent (2015–2020) highly cited papers to describe human–AI interaction in current ML applications, and highlighted recent work in medical HILML applications. However, we considered and reviewed selected highly cited and important papers published as early as 2001 to not lose any vital information about human–AI interaction in ML applications. [6]

DATA ANALYSIS [8-11]

Early detection of any disease, be it infectious and non- infectious, is critically an important task for early treatment to save more lives. Fast diagnosis and screening process helps prevent the spread of pandemic diseases

like SARS-CoV-2, cost- effective, and speed up the related diagnosis. The development of an expert system for health care assists in the new order of identification screening and management of SARS-CoV-2 carrier by more cost-effective compared to the traditional method. ML and AI are used to augment the diagnosis and screening process of identified patient with radio imaging technology akin to Computed Tomography (CT), X-Ray, and Clinical blood sample data. In this regard, Table 1 shows selective information on diagnosis and screening proposed for the Coronavirus disease.

Table 1: ML and AL technology in SARS-CoV-2 Screening

Publication	ML/AI method	Types of data	No of patients	Validation method	Sample size	Accuracy
Wu, J. *et al* .,	Random forest Algorithm	Clinical, Demographics	253, 169, 49,24	Cross-validation	Total of 253 samples from 169 patients suspected with Covid-19 collected from multiple sources. Clinical blood test of 49 patients derived from commercial clinic center. 24 samples infected patient with Covid-19	Accuracy: 95.95% Specificity: 96.95%
Ozturk, T. *et al* .,	Convolutional Neural Network DarkCovidNet Architecture	Clinical, Mamographic	127, 43 f, 82 m 500, 500	Cross-validation	127 X-ray images with 43 female and 82 male positive cases 500 no-findings and pneumonia cases of 500	Accuracy: 98.08% on Binary classes Accuracy: 87.02% on Multi-classes
Ardakani, A. A *et al* .,	Deep Convolutional Neural Network ResNet-	Clinical, Mamographic	1020, 86	Holdout	1020 CT images of 108 volume of patients with laboratory confirmed Covid-19, 86 CT images of viral and atypical pneumonia patients,	Accuracy: 99.51% Specificity: 99.02%
Sun, L *et al* .,	Support Vector Machine	Clinical, laboratory features, Demographics	336, 220	Holdout	336 infected patients with PCR kit, 26 severe/critical cases and 310 non-serious cases and with another related disease 79 hypertension, 29 diabetes, 17 coronary disease and 7 having history of tuberculosis	Accuracy: 77.5% Specificity: 78.4% AUROC reaches 0.99 training and 0.98 testing dataset

The first aim of this paper is presenting a generalized and comprehensive overview of human–AI interaction. We focus on HILML as a more general key term for human–AI interaction to review ML applications and present a framework for human–AI collaboration. This framework is organized according to the three main stages of ML models: data producing and pre-processing, ML modelling and ML evaluation and refinement (see Figures 1–3). In this framework, corresponding human interactions are adopted in each stage to improve the performance of ML methods. It provides a perspective that researchers can use to quickly understand different aspects of human–AI interaction. As well as presenting a comprehensive framework, we try to review recently published papers to survey human–AI interaction for current real-world ML applications. We also investigate the importance of the human role in HILML, as well as the characteristics of humans who collaborate with ML methods and categorise human issues in HILML by discussing the research questions. Moreover, we highlight the role of humans in medical ML applications and review important human–AI collaboration approaches in this area to investigate research challenges, research gaps and future research. To summarize, the key contributions of this paper are threefold in that we conduct a comprehensive review on human roles in human–AI interaction in ML applications, we provide an overview for the current research in human–AI interaction area, and we discuss the role of humans in collaboration with ML methods in medical applications and identify challenges and future directions.

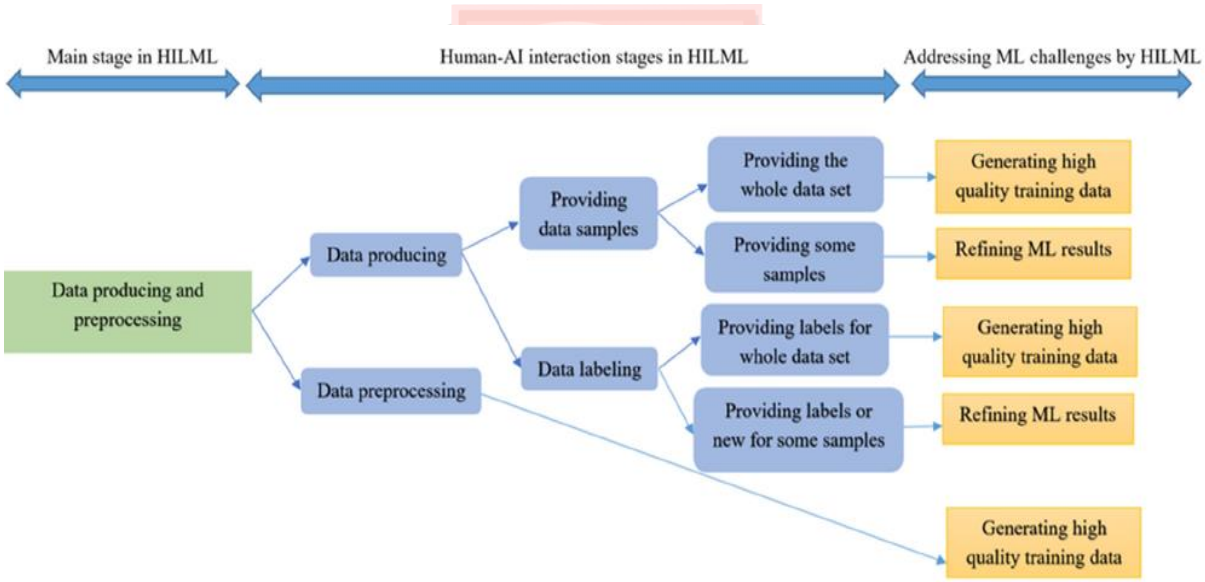

Figure 1: A framework overview of human AI interaction in data producing and preprocessing[12]

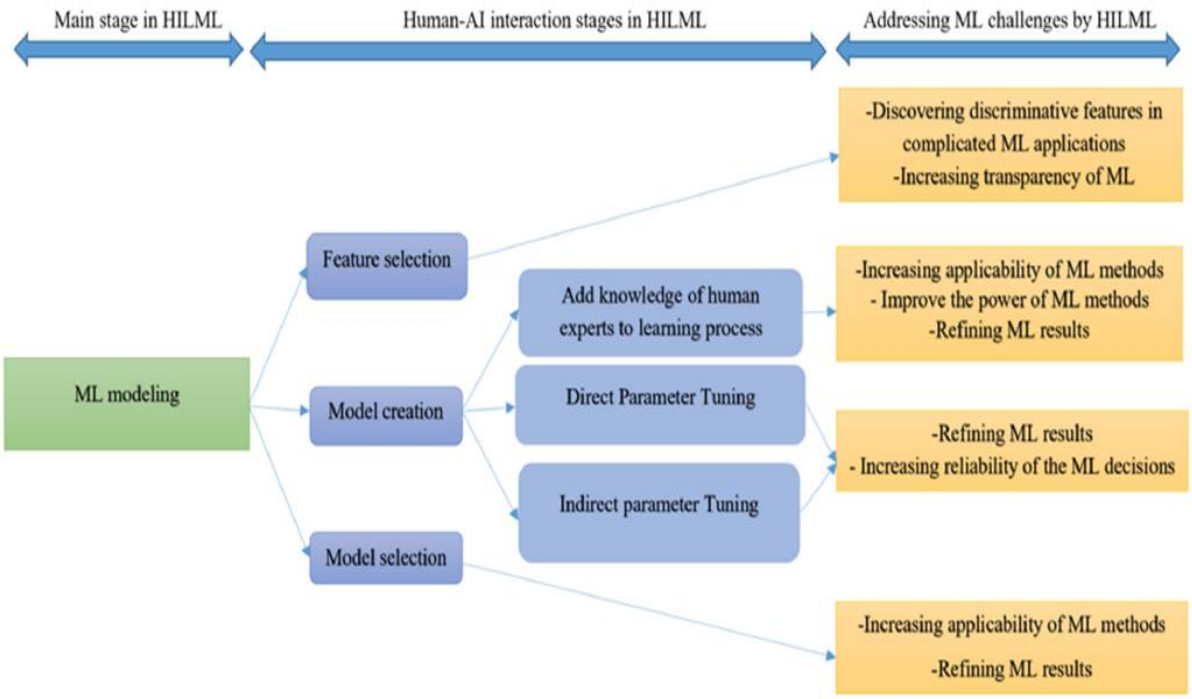

Figure 2: A framework overview of human AI interaction in ML modelling

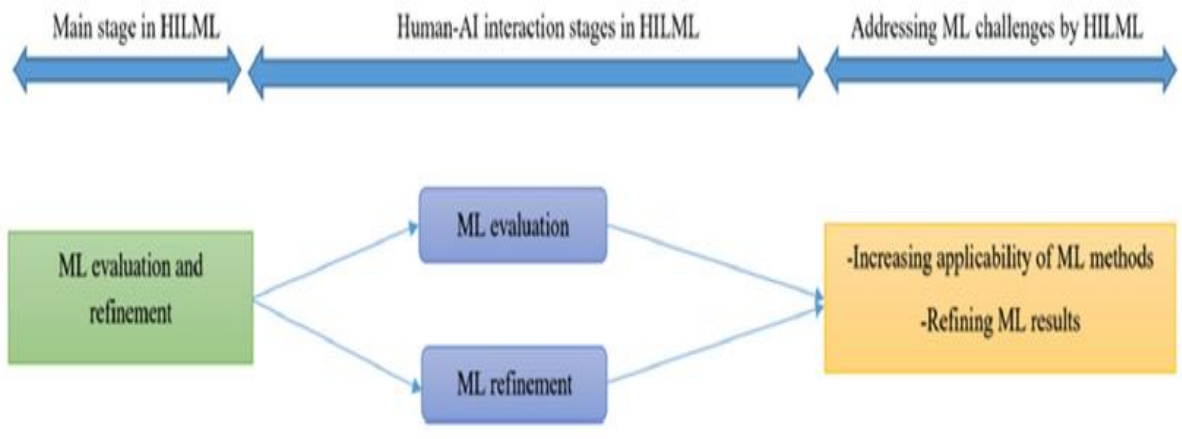

Figure 3:A framework overview of human–AI interaction in ML evaluation and refinement

CONCLUSION

Machine Learning and Artificial Intelligence are such promising methods employed by various healthcare providers. This paper addresses on recent studies that apply such advance technology in augmenting the researchers in multiple angles, addressing the troubles and challenges while using such algorithm in assisting medical expert in real-world problems. Humans as the users of the ML methods can interact with ML methods and improve ML performance with their knowledge, experience and expertise. This interaction between domain human experts and ML methods in ML applications has generated a new term in ML applications named HILML. HILML enables domain human experts to collaborate with the ML methods so that they can engage their knowledge, experience and skills in ML process to get better ML results. Our review has provided a human–AI interaction pipeline to investigate different aspects of the human involvement in ML applications. According to this review, we concluded that HILML approach can increase the transparency of the ML methods in medicine so that both powers of ML methods and medical experts result in accurate and trustable decision making.

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