BDH 2024 WORKSHOP

in Conjunction with IEEE MIPR 2024
San Jose, CA, USA

August 7 - August 9

ABSTRACT BOOKLET

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Improving Machine Learning-based Activity Type Prediction from Time-Series EEG Data

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Machine learning is essential to the development of personalized medicine, brain-computer interfaces (BCIs), classification and prediction, and the detection and elimination of artifacts in EEG signal data, among other applications. This work, in order to differentiate between target and non-target rapid serial visual presentation (RSVP) experimental conditions predicts the spatiotemporal patterns of entire trial types. We developed an optimized pipeline to preprocess EEG time-series data in a way that maximizes the relevance of event-related potentials (ERPs). We then utilized the machine learning techniques with the open-source EEG software, namely the MNE-Python tools (library), using the performance criteria, area under the receiver operating characteristic curve (ROC-AUC) with 5-fold cross-validation to predict the trial types.

Keywords: EEG time-series, machine learning, ERPs, RSVP, MNE-Python, Clinical applications

Patient 3D Data Visualisation with AR-based Interactive Technology for Brain MRI

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Effective 3D patient data visualization for brain MRI is required in surgical planning and in-situ guidance during brain tumor resection. Traditional 2D displays do not possess depth perception and are poor in understanding complex anatomical structures being displayed in 3D. In this work, an interactive visualization system based on augmented reality is presented, which provides an intuitive and truly immersive way to visualize and interact with 3D brain MRI data as preoperative planning and in-situ guidance by a surgeon during tumor resection procedures of the brain. In this work, we propose a system where AR Devices can render patient-specific 3D brain models, reconstructed from MRI data, in a spatially registered way to the surgical field. These 3D virtual models can then be interacted by the surgeon, through the natural use of controls, to study the spatial relationship of critical structures such as tumors, ventricles, and functional brain regions. Advanced volume rendering and multi-modal data fusions are used in creating photorealistic 3D visualizations with high anatomical detail.

Keywords: Augmented Reality (AR), Magnetic Resonance Imaging (MRI), Brain Tumour, 3D Data Visualization

Big Data and Bigger Moral Dilemmas: Ethical Concerns of Data in Healthcare

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The healthcare system collaborates with a wide range of stakeholders working towards shared objectives and generating an immensely large volume of data. This offers researchers an extensive reservoir of data which contributes to the advancement of medical science and treatment practices. However, this data deluge has also brought about a variety of ethical quandaries that are intertwined with big data in healthcare. This research paper examines the complex relationship between the ever-increasing use of big data and major ethical issues that are corollaries of the use and explores the potentials of principlism as a promising tool to evaluate ethical ramifications of utilising big data in healthcare. In addition to recognizing the moral dilemmas, the paper also proposes a comprehensive protocol for effective utilization of big data in healthcare and recommends a synergetic approach which incorporates both the data driven innovation strategies in healthcare and adequate attention to moral maps and normative frameworks.

Keywords: Healthcare, Bigdata, Principlism, Moral dilemmas, Protocol

A Clustering-based Sequence Variants Analysis Method for Electronic Medical Records of Multimedical Institutions

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A sequence variant (SV) containing branches is considered an extension of a sequence widely used to represent an ordered list of items. Although comparing such SVs is vital in practical applications, an efficient method to compare more than three SVs efficiently has yet to be studied. When the number of SVs increases, there is a high possibility that common parts do not exist. Hence, we cannot thoughtfully understand the similarities and differences among the SVs that were compared. In this paper, we first develop a method to exclude general items that have high frequency because they appear in almost every sequence and then cluster the SVs into several groups using a defined SV distance. Finally, we calculate the longest common SV in each group and generate a merged SV to visualize the commonality and differences of the target SVs efficiently. The proposed method is shown to be effective when applied to a real medical dataset from 23 medical institutions.

Keywords: Sequential Pattern Mining, Electronic Medical Records, Sequence Variant, Medical Support.

Privacy-Preserving Disease Prediction with Secure Data Deduplication on Untrusted Cloud Servers

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In the era of digital healthcare, ensuring the privacy of sensitive health data while optimizing storage on cloud servers is paramount. This paper introduces a novel privacy-preserving framework that not only predicts diseases based on encrypted symptom data but also employs secure data deduplication techniques to significantly reduce storage requirements. Our approach utilizes homomorphic encryption to safeguard patient identities and a unique dual-level deduplication process that efficiently handles disease prescriptions. We demonstrate this through rigorous testing of the effectiveness of our system in maintaining privacy and optimizing cloud storage, setting a new standard for secure digital healthcare solutions.

Keywords:
Privacy-preserving, Digital healthcare systems, Secure data deduplication, Homomorphic encryption.

Understanding eGFR Trajectories and Kidney Function Decline via Large Multimodal Models

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The estimated Glomerular Filtration Rate (eGFR) is an essential indicator of kidney function in clinical practice. Although traditional equations and Machine Learning (ML) models using clinical and laboratory data can estimate eGFR, accurately predicting future eGFR levels remains a significant challenge for nephrologists and ML researchers. Recent advances demonstrate that Large Language Models (LLMs) and Large Multimodal Models (LMMs) can serve as robust foundation models for diverse applications. This study investigates the potential of LMMs to predict future eGFR levels with a dataset consisting of laboratory and clinical values from 50 patients. By integrating various prompting techniques and ensembles of LMMs, our findings suggest that these models, when combined with precise prompts and visual representations of eGFR trajectories, offer predictive performance comparable to existing ML models. This research extends the application of foundation models and suggests avenues for future studies to harness these models in addressing complex medical forecasting challenges.

Keywords: Large multimodal model, Estimated glomerular filtration rate, Healthcare, Chronic kidney disease.

Self-Monitoring the Mental-Health State of a Focused Population with Multiple Self-Questionnaires and Sentiment Descriptions

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The growing trend of increased mental health disorders in the general population necessitates an expanded mental health service to the general public, prompting a paradigm shift from a traditional face-to-face psychiatric clinic to a non-face-to-face treatment with a self-monitoring platform. A self-monitoring platform enables to self-collect a wide variety of non-biased data from everyday lives for a prolonged period while playing a role as an intermediary to psychiatric treatment based on self-diagnosis and self-therapy tools. In this paper, we presented multiple self-questionnaire- and sentiment description-based self-diagnosis tools developed under the framework of a self-monitoring platform, in particular, for analyzing the depression and anxiety levels associated with the Korean university student group chosen as a focused population. To obtain high accuracy and reliability in self-diagnosis, a large amount of multiple questionnaire and sentiment description data were collected weekly online and accumulated for a prolonged period for the same individuals. Furthermore, we achieved optimal cut-off regions and generalized factor analysis by fusing multiple self-questionnaire scores in the fusion space. We validated the developed self-diagnosis tools by experiment.

Keywords:
Self-Monitoring Platform, Mental Health, Self Questionnaire, Sentiment Description, Self-Diagnosis Tool.

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