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Survey on Comparison of Brain Age with Human Age

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ABSTRACT

Machine learning (ML) models play a significant role in the brain age prediction structure however the analysis of how regression models affect precision is still in its early stages of investigation. By comparing the predicted brain age with the chronological age we determine the significance of specific algorithms in precisely calculating brain age in our proposed system.

The models outcomes demonstrate the capabilities of antiquated machine learning algorithms particularly those found in neural networks and regression algorithms. The accuracy of brain age assessments in clinical stages should increase with the use of these methods. By improving brain age estimation accuracy our method will help with more neurological disease evaluations. Regression algorithms and neural network capabilities are employed to achieve this. This study provides information to aid in the development of clinical applications and identifies the major gaps in the assessment of machine learning algorithms for estimating brain age. By providing more precise and effective diagnoses the use of sophisticated algorithms not only improves accuracy but also transforms neurology.

1. INTRODUCTION

The intersection of machine learning and neuroscience presents a captivating avenue for exploration in understanding the aging process of the human brain. This study endeavours to compare brain age with human age, aiming to elucidate the intricate dynamics that underlie the structural and functional changes occurring over time. With a focus on unravelling the complexities of brain aging, this survey seeks to assess the interactions between various life elements influencing the mind's maturation. By delving into this realm, we anticipate significant impacts on artificial intelligence and neuroscience, potentially revolutionizing our approach to healthcare by offering insights into neurological illnesses. Through the amalgamation of machine learning techniques and neuroscientific inquiry, this research aims to pave the way for more accurate and personalized medical interventions.

2. LITERATURE SURVEY

One of the suggested ways of estimating brain age from MRI images is through Convolutional Neural Networks (CNNs) for the detection of domain specific cognitive impairment [1]. After testing on 1170 independent test subjects and training on 4681 cognitively normal individuals, this CNN showed statistically superior results to previous studies. The model provides holistic anatomical maps that detail the aging process of the brain, neurocognitive trajectories and sex dimorphisms in MCI and AD cohorts. There are better measures of identifying dementia -related symptoms when BA outperforms CA and is used in the determination of functional impairment , executive function in MCI patients. This implies that it could be possible to use aging -related neuroanatomy as a way of establishing AD risk during early stages of life.

The impact of machine learning on the processing of structural neuroimaging data particularly in brain age prediction is investigated in Machine Learning for Brain Predictions Age: a Review of Technologies and Clinical Applications [2]. This review discusses how to detect age-related changes in neuroanatomical characteristics in healthy individuals using machine learning regression models. When these models are applied to new participants, the discrepancy between brain age and chronological age results into what is referred to as the brain age gap that can be used to know more about such things as neuroanatomical problems and general brain health. The consequences can help the therapeutic significance and extend to early detection of brain-based illnesses, facilitating different diagnosis and therapies in brain related disorders.

By looking at the ML algorithms for many illnesses The classification of neurodegenerative syndromes from [3] dive into the effects of machine learning on structural neuroimaging data analysis, particularly in the field of brain age prediction. The technique of using regression models to age related changes in a healthy person is highlighted in the review. There creates a brain-age gap when these models are applied to fresh participants, it may results in neuroanatomical problems and general brain health. The implications emphasize the therapeutic relevance of this developing discipline by extending to the early detection of brainbased illnesses, hence improving differential diagnosis, prognosis, and targeted therapies in age related disorders .

From [4] recognize the growing burden of neurodegenerative diseases in the aging population and emphasize the complex interplay of genetic, environmental, and epigenetic factors influencing individual aging rates. The Brain Age Gap Estimation (BrainAGE) method, leveraging structural predicting individual brain age. This approach has the MRI, emerges as a promising tool for potential to assess personalized risks for neurodegenerative diseases, enabling the development of tailored neuroprotective interventions. Through advanced imaging techniques, BrainAGE provides a nuanced understanding of individualized aging trajectories, contributing to more precise diagnostics and interventions in the challenging field of neurodegenerative diseases.

Classification-biased Apparent Brain Age for the Prediction of Alzheimer's Disease from [5] research endeavours to validate brain age as a biomarker for evaluating neuroanatomical aging and diagnosing neurodegenerative diseases. The disparity between predicted and chronological age serves as an indicator of pathological brain aging. The study introduces an innovative approach that fuses data science techniques and linear models, culminating in heightened accuracy and descriptive power. By integrating advanced methodologies, this research contributes to the establishment of a robust biomarker system, enhancing our capacity to identify and understand agerelated neurodegenerative processes through precise and insightful assessments of brain age.

Increased MRI-based Brain Age in Chronic Migraine Patients from [6] employs the Brain Age framework and machine learning to investigate the influence of migraine on brain aging by predicting age from neuroimaging data. Chronic migraine patients exhibit an elevated Brain Age Gap in comparison to healthy controls, revealing distinct aging patterns associated with chronic migraine. These findings imply that the predicted brain age can function as a sensitive biomarker for chronic migraine patients. The utilization of the Brain Age framework and machine learning not only sheds light on the impact of migraine on neuroanatomical aging but also highlights the potential for personalized and precise assessments in the context of chronic migraine

Using MRI data from 48,040 UK Bio bank people, Brain Asymmetries from Midlife to Old Adulthood and Hemispheric Brain Age from [7] examined anatomical and functional brain asymmetries in aging and neurological disorders. It revealed reductions in regional asymmetries of grey and white matter with age. The hemispheric brain age predictions (HBA) provided a unique indicator of brain asymmetry, mirroring traditional forecasts. Age-related decreases in this asymmetry difference highlight the need of looking into falling brain asymmetry in the aging process and the emergence of neurological disorders. The results provide important new information about the subtle elements of brain asymmetry and its significance for understanding the course of disease and age-related changes.

3. CONCLUSION

In conclusion, there is a serious societal issue raised by the increasing count of neurological illnesses in the older people. Using structural MRI, the Brain Age Estimation (BrainAGE) method shows guaranteed results in displaying an persons brain age and offering insights on the risks of neuropsychiatric and neurodegenerative diseases.

4. FUTURE SCOPE

In addition to this improving our knowledge of unique aging ways, this approach makes it possible to develop new techniques in neuroprotective therapies. By this study, we can estimate the difference between a person's brain age and Human age. The usage of such modern techniques offers us better results and quality of life for people who are dealing with these difficult health concerns and it is a critical step toward addressing the difficulties of neurodegeneration.

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