Using Autorefraction Data to Predict Strabismus with Deep Learning Technology

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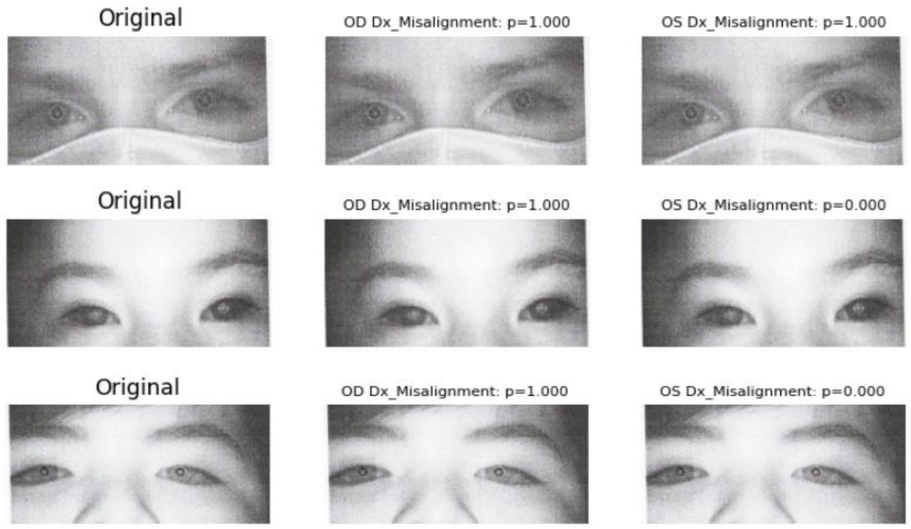
INTRODUCTION

- Strabismus is one of the most common eye conditions in children, characterized by the misalignment of eyes, and may pose permanent and irreversible damage if untreated.
- While many AI applications have been implemented in general ophthalmology, the field of pediatric ophthalmology has seen less integration of AI in patient care [1].
- Using a dataset from the Welch Allyn Spot Vision screener, our study aims to train an AI model that will employ advanced image processing and machine learning algorithms to detect conditions such as strabismus and misalignment in patients' eyes.

METHODS

- A dataset of over 433 medical charts of patients with autorefraction data from February 2022 - May 2023 was retroactively reviewed.
- After the review was performed, the dataset was enhanced by undergoing image normalization, label balancing, and the removal of noise and ambiguity. Multiple clinical attributes, including sex, age, and refractive diagnosis data, were associated with each image.
- A Deep Learning Model was developed based on the processed data, and testing and validation were conducted using a subset of the data to determine model accuracy.

OPD DATA



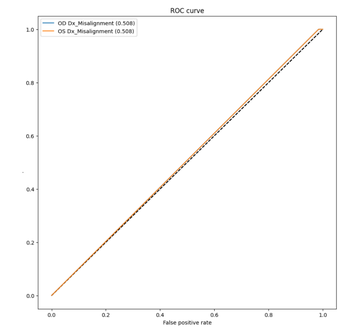
- Python was used to code the model and Jupyter Notebook was used to visualize the data and results.

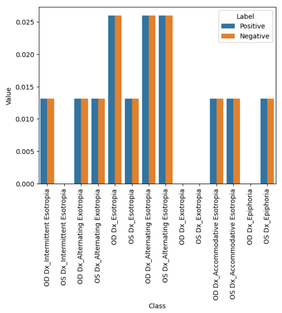
RESULTS

- The research yielded promising results, with the preliminary model demonstrating competency in classifying strabismus and related diagnoses. The class imbalance challenge was addressed by introducing class-specific weight factors, ensuring equitable contributions from positive and negative cases.
- Confidence intervals for performance metrics were estimated using bootstrapping.
- The model's sensitivity, determined using the ROC method, was 0.508 (95% confidence interval 0.326 - 0.690).

Accuracy

- Accuracy is given in this chart on the right. The chart shows an ROC(Receiver Operating Characteristic) curve
- The number of epochs or trials affects the accuracy. The more the epochs, the better the model.





Class Imbalance

- Class imbalance is when the negative samples outweigh the positive samples, so we fixed that by weighing the positive samples more and penalizing the negative samples. The graph on the left shows how the positive and negative samples were balanced.

DISCUSSION

This study advances our understanding of the potential to use deep learning in diagnosing strabismus and misalignment, offering medical professionals a powerful tool for early detection and treatment planning. Nonetheless, further model training is required to improve the model's accuracy. The study also highlights the importance of addressing class imbalance in medical image classification. In conclusion, the ongoing collaboration between artificial intelligence and medical expertise has the potential to improve patient care and outcomes.

FUTURE DIRECTIONS

Future research may focus on refining the AI model by exploring new pre-trained models, expanding the dataset, and exploring other applications of deep learning technology in pediatric ophthalmology.

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