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Rodrigo Ferraz Souza

Computer Vision and Eyetracking Approach for Assessing Visual Disorders in Premature Infants

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Trabalho de Conclusão de Curso do Curso de Graduação em Engenharia de Computação submetido ao Centro de Ciências, Tecnologias e Saúde do Campus Araranguá da Universidade Federal de Santa Catarina para a obtenção do título de Bacharel em Engenharia de Computação.
Orientador: Prof. Antonio Carlos Sobieranski, Dr.
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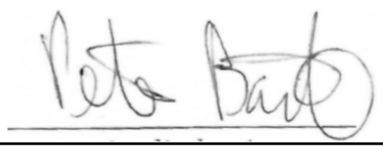

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Computer Vision and Eyetracking Approach for Assessing Visual Disorders in Premature Infants

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***Abstract*—Premature infants are subjected to an elevated risk of abnormal visual development, leading to potential visual impairments such as field defects, optic nerve dysfunctions, eye movement abnormalities, and nystagmus. To mitigate these dangers, early and exact assessment is important. This paper presents a computer vision approach that uses face mapping and eye-tracking technologies to objectively and accurately assess further visual disorders in infants. Our methodology integrates eye-tracking with facial recognition techniques to quantify eye movements and gaze stability accurately. Detailed video recordings of infants responses to visual stimuli are analyzed using a custom-developed algorithm, which processes eye and head movements to generate precise metrics of visual function. The results demonstrate that our computational tool significantly enhances the diagnostic capabilities by providing quantifiable and objective metrics that supports the clinical observations, thus assisting healthcare professionals in identifying and addressing potential visual abnormalities at early stages effectively.**

***Index Terms*—Eye tracking, Visual Assessment, Premature Infants, Computational Diagnosis, Facial Recognition, Computer Vision.**

I. Introduction

The human visual system, vital to interact with the environment in our daily activities, has one of the most important development steps during gestational stages [1]. Premature births can disrupt this evolution process, subjecting to formation problems and leading the individual to visual impairments [2]. The early intervention is essential to address potential limitations and mitigate potential risks, improving the prognosis.

The clinical analysis, such as fixation tests and visual tracking of stimulus patterns, are the main artifacts used to perform tests. Basically, it corresponds to the analysis of the infant in response to some stimulus movements, which can be vertical or horizontal, slowly or sudden. However, the infants head must be stationary, imposing some difficulty to the analysis and requiring patient cooperation, demonstrating a challenging task when considering newborns and children [3].

Over the recent years, due to the computational processing capacity and the development of newly deep learning approaches, many tasks involving images or videos have achieved considerable improvements. The use of machine learning methods have been employed for several applications, providing efficient ways for distinct areas, including surveillance, industry, production, and for the medical and clinical context it is not different.

Eye-tracking approaches have been developed in order to assess the analysis, aiming to provide a computer-based method to reduce the subjectivity and provide some objective metric [3]. Eye-tracking approaches are well-established methods and are well-explored over the literature for many applications. However, for the accurate analysis in infants population, where specific tests, stimuli and movements are employed, the existing approaches are only marginally suitable to express into objective metrics to asses the analysis for infants and premature newborns [3] [4] [5] [6], still requiring efficient solutions.

To address this gap, we propose an effective approach for assessing visual disorders in premature infants. In this paper, we present a computational tool that integrates 3D facial mapping and eye-tracking to enhance the accuracy of visual diagnosis in newborns and young children. Our approach utilizes precise eye tracking and gaze data to analyze fixation time, ocular motion, and amplitude. The study involved 37 clinical assessments, meticulously capturing pupil and iris circles, gaze directions, and head orientation. The experimental results demonstrate the effectiveness of our method in assessing visual disorders in the infant population and supporting clinical decision-making.

Our main contribution is the development of a novel computational tool that combines 3D facial mapping and eye-

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