CHAPTER I
INTRODUCTION

1.1 Background

Strabismus is an ocular disorder characterized by the misalignment of the visual axes, preventing both eyes from focusing on a same point simultaneously. This condition arises from an imbalance in the extraocular muscles or a deficit in the cranial nerves governing ocular coordination. Empirical evidence indicates that parental knowledge correlates directly with the efficacy of early detection; a lack of understanding regarding initial symptoms frequently leads to delayed medical intervention [1]. This issue is further compounded by the evolution of digital technology, which has fundamentally altered human interaction with electronic devices, particularly smartphones, tablets, and personal computers. Both children and adults increasingly engage with these devices for prolonged periods, often while recumbent or maintaining an inadequate viewing distance. Such habits impose substantial strain on the visual system, exacerbating the risk of asthenopia, accommodative dysfunction, and potential long-term ocular pathologies. This phenomenon is intensified by a pervasive lack of public awareness regarding optimal screen distance and duration, leaving ocular health highly vulnerable from an early age.

This condition not only compromises visual function but also induces adverse psychological and social ramifications, such as diminished self-esteem due to aesthetic ocular abnormalities [2]. Furthermore, if left unaddressed during early developmental stages, strabismus can precipitate amblyopia—commonly known as "lazy eye"—a permanent reduction in visual acuity in one eye that becomes highly refractory to correction in adulthood..

Conventionally, the diagnosis of strabismus relies on clinical examinations conducted by ophthalmologists, which necessitates specialized expertise and dedicated diagnostic instruments [3]. However, a critical challenge arises when the general public fails to recognize the early onset of this anomaly in themselves or their children. This diagnostic oversight often leads to delayed treatment, thereby elevating the risk of irreversible complications. Moreover, disparate access to specialized healthcare professionals, particularly in remote regions, underscores the urgent need for accessible, self-administered screening methodologies [4].

Advances in Artificial Intelligence (AI), particularly within the domain of computer vision, offer a promising avenue for developing digital image-based health screening systems [5]. Convolutional Neural Networks (CNN) have demonstrated robust efficacy in medical image classification, including the differentiation between orthotropic (normal) and strabismic eyes [6]. CNN are capable of extracting intricate patterns from ocular images that are imperceptible to manual inspection, thereby facilitating early screening without the immediate necessity of an in-person clinical examination.

Nevertheless, in practical applications, captured images rarely consist of pre-cropped, focused ocular regions; they typically encompass the entire facial structure. Consequently, an object detection phase is imperative to isolate the ocular region prior to classification. The You Only Look Once (YOLO) framework serves as an effective solution, offering rapid and precise object detection that allows the ocular region to be seamlessly segmented from facial images before being processed by the CNN architecture [7].

The integration of YOLO and CNN enables the architecture of a practical, cost-effective, and highly accessible self-screening system. Through this approach, the general public can conduct preliminary digital assessments to evaluate their ocular alignment, thereby mitigating diagnostic delays and fostering greater awareness of visual health [8]. Rather than replacing clinical practitioners, this system functions as a supportive tool for early detection and health education—a utility that is highly germane given the escalating intensity of digital device usage among both pediatric and adult populations [9].

The deployment of YOLO and CNN in medical imaging offers high flexibility, facilitates real-time detection, and allows for seamless integration into mobile devices to expand its clinical outreach [10]. By bypassing the need for high-end computing infrastructure, this hybrid framework democratizes specialized ophthalmic screening. Ultimately, this technology is expected to educate the public in recognizing the rising incidence of strabismus, while concurrently establishing a robust foundation for future academic research in ophthalmic informatics, particularly in optimizing light-weight deep learning models for tele-ophthalmology.

1.2 Formulation of the problem

The following is the problem formulation of this research:

a) How can people know whether their eyes are strabismus or not?
b) How does YOLO play a role in detecting/finding the eye area in a person's face?
c) What is the role of CNN with YOLO architecture in classifying squint/normal eyes?
d) How does this screening system contribute to early detection of strabismus in preventing complications such as amblyopia?

1.3 Research purposes

This study aims to provide early detection of strabismus in individuals, determining whether their eyes are normal or not. If a person has strabismus, the system will indicate a possible strabismus. This provides information for managing their eye health before seeing an eye specialist.

DiagnosisThis is the first step in providing a quick, practical, and accessible screening tool for everyone. This initial screening is a way to prevent further complications such as lazy eye (amblyopia). Lazy eye refers to a person using only one side of their vision to see an object, leaving the other eye unused due to their habit of seeing with only one eye.

ByTherefore, it is hoped that this screening system will enable the public to detect whether they have strabismus. If someone is embarrassed about their strabismus, this system also provides a solution, as the symptoms are immediately detected without fear of photos being shared publicly.

1.4 Benefits of research

The benefit of this research is that it provides a system that can be used as an early screening tool to detect whether someone is experiencing strabismus. Early detection is crucial because the sooner an abnormality is identified, the greater the chance of receiving appropriate treatment before the condition develops into a more serious problem. Therefore, this screening system can also help prevent further complications, one of which is lazy eye, or amblyopia. This condition often arises from a delay in recognizing strabismus, resulting in one eye being deprived of visual acuity.

1.5 Scope of problem

The following are the problem limitations of this research:

a) This screening system results cannot be considered an official diagnosis by medical professionals.
b) This system is still limited to existing datasets.
c) This system cannot detect more than 2 facial objects, so the image required is a facial image like a normal passport photo.
d) This system still cannot distinguish between crossed eyes and glancing eyes.