Hypothesis

Google Lens: A potential cost-effective screening tool for diabetic retinopathy

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ABSTRACT

Background: Diabetic retinopathy (DR) is a major, sight-threatening complication of diabetes mellitus. Blindness from DR can be prevented by successful and proactive screening. However, DR is screened in less than half of the patients because of barriers in availability, affordability, accessibility, and awareness. Although artificial intelligence (AI)-based algorithms are being evaluated for DR screening, they have limitations of infrastructure, accessibility, training, and manpower cost. Therefore, simpler and more practical DR screening tools should be explored.

Hypothesis: Google Lens, an easily available, vision- and AI-based application in most smartphones, is a potential tool for cost-effective DR screening. It recognises images through a visual analysis based on neural networking. Thus, it can recognize retinal disorders, such as DR, in images. The development and adoption of Google Lens-based DR screening would have several advantages over the conventional hospital/specialist/healthcare facility-based approach, including widespread accessibility, acceptable accuracy, reduction in the direct cost of healthcare for patients with diabetes mellitus, and active patient participation in self-care.

Conclusions: DR screening, detection, and grading using Google Lens is a feasible and effective option. Despite current limitations, it could transform DR screening from a costly, hospital- and expert-based method to a cost-effective, self-applicable, and home-based one. However, diagnostic accuracy studies comparing the index test with Google Lens-based screening are required to determine the usability and validity of this proposed screening tool for DR.

KEYWORDS

diabetes mellitus, retinopathy, diabetic, deep learning, AI, artificial intelligence, machine learning, google glass, google lens

INTRODUCTION

Google Lens is an image recognition software that was released in 2017 by Google and is now available in most smartphones [1]. It recognizes images through a visual analysis based on neural networking [2]. Currently, Google proposes that Google Lens can identify certain objects, translate text, find look-likes, see what is popular on menus, explore nearby places, and identify plants and animals [3]. The aim of the present hypothesis was to explore the ability of Google Lens to recognize diabetic retinopathy (DR) in sample retinal fundus photographs.

Diabetes mellitus, a global epidemic, is projected to reach over 640 million cases by 2040 [4]. DR is a major complication of diabetes mellitus with a strong potential to result in visual disability from diabetic macular

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edema (DME) and proliferative DR (PDR) [5]. After the onset of DME or PDR, restoring the normalcy of vision is difficult despite laser therapy, pharmacotherapy, or surgery [6]. Visual disability combined with the treatment cost poses an economic healthcare burden on the country. Successful DR screening can help reduce the healthcare budget by allowing early detection of DR, early treatment initiation, and prevention of severe visual disability [7]. However, even in developed countries, 30% – 50% of patients with diabetes mellitus do not undergo regular DR screening [8].

Conventionally, for DR screening, patients visit a healthcare or telemedicine facility. However, such facilities provide limited access, and the dependency on technicians and healthcare professionals to run screening programs, increases expenditure, and reduces affordability [9]. In recent decades, machine learning and artificial intelligence (AI) algorithms have been explored to overcome the limitations of conventional diabetic screening methods [10].

Several AI algorithms/models have been evaluated for DR screening and shown high sensitivity and specificity [11, 12]. However, no country has fully adopted AI for DR screening because of costs involved in the setting-up, training, and maintenance of the infrastructure and manpower, medicolegal considerations, and questionable patient accessibility and affordability [13].

An ideal technology that can be used as a universal tool for DR screening is currently lacking. The aim of the present study was to conceptualize how the readily available Google Lens could be used for DR screening.

HYPOTHESIS

Evaluation of AI for application in the medical field has been steadily increasing over the past decade, and a major area of study has been its utility as a DR screening tool. Systems using AI can correctly and automatically screen patients in real time for a referral. Therefore, AI algorithm-based screening could render DR screening more economical compared to screening by ophthalmologists [14]. Although several AI grading systems for DR screening have been investigated, only one has obtained approval from the United States Food and Drug Administration, i.e., the IDx-DR AI diagnostic system (Topcon TRC-NW400) [15-21]. Automated Retinal Disease Assessment (ARDA) software is another AI-based diagnostic system that has been extensively investigated [22]. Under controlled research conditions, the diagnostic accuracy of AI-based screening is comparable to that of screening by ophthalmologists. However, despite the extensive research of AI-based DR screening, only a few studies have evaluated its efficacy in real-world situations [23, 24], partly because utilization of AI depends on the availability of sophisticated telecommunication networks, systems with increased computational power and running time, and trained manpower to install and maintain these systems [25-27]. We hypothesize that the readily available application Google Lens [1, 2] would perform DR screening without requiring sophisticated equipment or trained manpower.

DR is a common microvascular complication occurring in most patients with diabetes mellitus [5, 6]. Blindness from DR results from the development of DME and/or PDR. The overall prevalence of diabetes mellitus, DR, DME, and PDR are 6% – 15%, 30% – 35%, 1% – 5%, and 1% – 2%, respectively [17]. If patients with diabetes mellitus are successfully screened for DR, according to recommended national and international guidelines, blindness resulting from DR can be largely prevented. However, even in developed countries, approximately 50% – 60% of patients with diabetes fail to undergo successful DR screening [8]. This failure is attributed to lack of accessibility, affordability, availability, and awareness. The use of Google Lens for DR screening may help overcome some of these barriers.

Google Lens [1, 2] is integrated into most smartphones and allows instant image recognition by comparing a captured image with numerous similar images available on the internet. Google Lens achieves image recognition through a visual analysis based on neural networking [28, 29]. Therefore, it would also have the inbuilt capability of recognizing retinal disorders, such as DR, in images.

EVALUATION OF THE HYPOTHESIS

The Messidor DR dataset [30] was downloaded after obtaining permission for its use for academic purposes. The images were first uploaded to Google Photos. Subsequently, the feature of searching the image with Google Lens was utilized, and the responses were obtained. Different categories of images were used for this purpose, including normal fundus (no DR), mild DR, severe DR, PDR, mild DME, and severe DME. Google Lens could correctly identify the image as being that of the retina or fundus. However, concerning the disease pathology, i.e., correct identification of DR or DME, the response lacked specificity. The results provided for these conditions ranged from a reference to a certain type of microorganism and age-related macular degeneration.

The ability of Google Lens to find a match for a recently captured photograph of the retina for DR seems to depend on two major factors: overall resolution of images (color value, saturation, sharpness, centration, etc.) and availability of abundant similar/identical images on the internet as on screening device. Therefore, future requirements for Google Lens to become integral to DR screening programs would be the universal availability of free access to standardized, well annotated, and high-resolution images of retinal conditions ranging from normal to various grades of DR and severity of DME [30] and the ability of the user to compare images captured using Google Lens with previous retinal images of the user (archived images). This would allow a more personalized search and enable Google Lens to detect the progression and severity of DR.

Future and implications of Google Lens-based DR screening

Development and adoption of Google Lens-based DR screening would have several advantages over the conventional hospital/specialist/healthcare facility-based approach, including widespread accessibility, acceptable accuracy [31], reduction in the direct healthcare cost of diabetes mellitus, active patient participation in self-care [32], and improved efforts by patients to achieve better control of systemic factors, such as blood glucose levels and the urgent need of consulting an ophthalmologist. Thus, the Google Lens is likely to significantly influence early detection of vision-threatening DR, thereby preventing diabetes mellitus-related blindness from moderate and severe visual loss. This, in turn, would help improve economic productivity of patients with diabetes and reduce the country's healthcare budget currently incurred for managing established vision-threatening complications of DR [33].

Furthermore, we described our initial pilot results of an innovative approach to DR screening called "Selfie fundus imaging" [34, 35]. User-friendly and affordable devices for self-screening for DR would likely become a reality in the next few years and have inbuilt DR screening applications. This screening application would capture retinal images using Google Lens or automatically become linked to Google Lens. Google Lens [28, 36], being a vision-assisted AI tool, would then search the web or dedicate DR image libraries to find an appropriate match. This match would then inform the patient about the grade of DR, including no DR, mild DR, moderate DR, severe DR, and presence/absence of DME [30]. It would highlight a predictive risk of disease progression and requirement of deferred, early, or urgent referral. As algorithms are developed, these results may even link the patient to a network of ophthalmologists that may be approached for further treatment. Nevertheless, diagnostic accuracy studies [37-39] comparing the index test with Google Lens-based screening are required to determine the usability and validity of this proposed screening tool for DR.

CONCLUSIONS

Google Lens is a readily available AI-based tool possessing inbuilt characteristics that would allow it to be easily adopted for population-based, hospital-based, or individualized DR screening. It can become a free and readily available vision-based AI tool for the screening, grading, and management of DR. By integrating Google Lens-based image recognition to affordable smartphone-based selfie fundus imaging devices, DR screening is likely to see a shift from dependency on healthcare facilities to home- and individual-based ones.

ETHICAL DECLARATIONS

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Conflict of interests: None

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