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Title: Att.2 – CfTGP (TG-Ophthalmology)

Purpose: Engagement

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Abstract: Calling on members of the medical and artificial intelligence communities with a vested interest in AI for Ophthalmology (retinal imaging diagnostics)! Become engaged in the group dedicated to establishing a standardized benchmarking platform for AI for Ophthalmology (retinal imaging diagnostics) within the International Telecommunication Union (ITU)/World Health Organization (WHO) Focus Group on “Artificial Intelligence for Health” (FG-AI4H).

Call for Topic Group Participation: AI for Ophthalmology (retinal imaging diagnostics)

The International Telecommunication Union (ITU)/World Health Organization (WHO) Focus Group on “Artificial Intelligence for Health” (FG-AI4H; <https://www.itu.int/go/fgai4h>) seeks engagement from members of the medical and artificial intelligence (AI) communities (including clinicians, technologists, entrepreneurs, potential benchmarking data providers, machine learning experts, software developers, researchers, regulators, policy-makers, companies/institutions, and field experts) with a vested interest in shaping the benchmarking process of AI for Ophthalmology (retinal imaging diagnostics)

1 About FG-AI4H

Over the past decade, considerable resources have been allocated to exploring the use of AI for health, which has revealed an immense potential. Yet, due to the complexity of AI models, it is difficult to understand their strengths, weaknesses, and limitations. If the technology is poorly designed or the underlying training data are biased or incomplete, errors or problematic results can occur. AI technology can only be used with complete confidence if it has been quality controlled through a rigorous evaluation in a standardized way. Towards developing this standard assessment framework of AI for health, the ITU has established FG-AI4H in partnership with the WHO.

Thus far, FG-AI4H has established thirteen topic groups. These are concerned with: AI and cardiovascular disease risk prediction, child growth monitoring, dermatology, falls among the elderly, histopathology, neuro-cognitive disorders, ophthalmology (retinal imaging diagnostics), psychiatry, radiotherapy, snakebite and snake identification, symptom checkers, tuberculosis, and volumetric chest computed tomography.

Each topic group agrees upon representative benchmarking tasks in a pragmatic, best-practice approach, which can later be scaled and expanded to similar tasks. Every benchmarking task should address a health problem of relevance (e.g. impacting a large and diverse part of the global population or challenging to treat) and for which AI technology would provide a tangible improvement relative to the current practice (e.g. better care, results, and/or cost/time effectiveness).

For a rigorous and sound evaluation, undisclosed test data sets must be available (or have to be collected) for each task. All data must be of high quality and compliant with ethical and legal standards. In addition, the data must originate from a variety of sources so that it can be determined whether an AI algorithm can generalize across different conditions, locations, or settings (e.g. across different people, hospitals, and/or measurement devices). The format/properties of the data serving as input to the AI and of the output expected from the AI, as well as the benchmarking metrics are agreed upon and specified by the topic group.

Finally, the AI-to-be-evaluated will be benchmarked with the undisclosed test data on FG-AI4H computing infrastructure. Here, the AI will process single samples of the undisclosed test data set and predict output variables, which will be compared with the "ground truth." The results of the benchmarking will be provided to the AI developers and will appear on a (potentially anonymized) leaderboard.

2 Topic group: AI for Ophthalmology (retinal imaging diagnostics)

A topic group is a community of stakeholders from the medical and AI communities with a shared interest in a topic. The objectives of the topic groups are manifold:

1. to provide a forum for open communication among various stakeholders,
2. to agree upon the benchmarking tasks of this topic and scoring metrics,
3. to facilitate the collection of high quality labeled test data from different sources,
4. to clarify the input and output format of the test data,
5. to define and set-up the technical benchmarking infrastructure, and

6. to coordinate the benchmarking process in collaboration with the Focus Group management and working groups.

The primary output of a topic group is one document that describes all aspects of how to perform the benchmarking for this topic. (The document will be developed in a cooperative way by suggesting changes as input documents for the next FG-AI4H meeting that will then be discussed and integrated into an official output document of this meeting. The process will continue over several meetings until the topic description document is ready for performing the first benchmarking.)

This topic group is devoted to using artificial intelligence for the detection and diagnostics of ophthalmological diseases and conditions, including Diabetic Retinopathy (DR), Age-related Macular Degeneration (AMD), Glaucoma (GC) Pathological Myopia (PM) and Red Eye. Additional diseases and conditions related to ophthalmology that are relevant to this Topic Group may be added in the future.

DR is a serious eye-disease caused by diabetes that affects blood vessels in the light-sensitive tissue called the retina that lines the back of the eye. It is the most common cause of vision loss among people with diabetes and the leading cause of vision impairment and blindness among working-age adults worldwide. The WHO estimates that there are over 422 million people with diabetes worldwide. Of these 35% or over 148 million are estimated to have DR with potential for vision impairment and 11% or 48 million are estimated to have Vision Threatening DR that can lead to blindness. Prevention of vision loss requires early detection of DR via regular eye exams and screening by a trained ophthalmologist or eye care professional.

AMD causes damage to the macula and is a leading cause of vision loss among people age 50 and older. According to Lancet research, the number of people living with macular degeneration is expected to reach 196 million worldwide by 2020 and increase to 288 million by 2040.

GC is a group of diseases that damage the eye's optic nerve—the bundle of nerve fibers that connects the eye to the brain and leads to vision loss and blindness. In adults, diabetes nearly doubles the risk of glaucoma. Globally, 8% of all blindness is attributable to glaucoma, making it a leading cause of global irreversible blindness. There were 60 million people with glaucoma in the world in 2010 and will be nearly 80 million by 2020. Of these 7.4 million were bilaterally blind from glaucoma in 2010 and 11.2 million (14%) will be bilaterally blind in 2020.

PM represents a subgroup of myopia and affects up to 3% of the world population. Vision loss related to pathologic myopia is of great clinical significance as it can be progressive, irreversible and affects individuals during their most productive years. Among myopic patients, about 35% have high myopia. The overall global prevalence is estimated to be 0.9-3.1% with regional variability. The prevalence of pathological myopia-related visual impairment has been reported as 0.1%-0.5% in European studies and 0.2% to 1.4% in Asian studies.

All of these conditions require regular screening by an eye care professional or an ophthalmologist in order to prevent vision impairment and vision loss. However, given the large numbers of people affected worldwide, there are not enough specialists globally to screen everyone at risk. The shortfall is particularly acute in developing countries, including India, and many countries in Asia and Africa. In addition, many affected people live in remote areas with little or no access to clinics and screening facilities. This makes these conditions a global healthcare challenge that needs urgent resolution.

Recent advances in Artificial Intelligence algorithms for image recognition and medical diagnostics have been shown to be effective in detecting these conditions at accuracy levels comparable to human specialists. A standard way of benchmarking the performance of various AI applications to detect and diagnose these conditions is therefore important. It will help in the evaluation and selection of appropriate solutions to address the global healthcare challenge posed by these diseases.

Conjunctivitis is the most common cause of red eye. Other causes include blepharitis, corneal abrasion, foreign body, subconjunctival haemorrhage, keratitis, iritis, glaucoma, chemical burn, and scleritis. Although most causes are usually benign and can be managed by primary care physicians, certain uncommon conditions with red eye like keratitis, iritis and glaucoma require early recognition, initiation of treatment and quick referral to a higher centre for appropriate management. There is a high likelihood of complications including irreversible loss of vision if referral is delayed.

Benchmarking:

The benchmarking of the algorithms for detecting these conditions would need to be done on a sufficiently large, and undisclosed test data set – which is representative of the different diagnosis and categories that the algorithm seeks to classify. The ground truth in all cases will be diagnostic classifications of the condition from one or more professional eye-care provider qualified and licensed to make a diagnosis.

The following are the classifications currently being considered for each condition:

a) DR:

i) Classification: All DR severity levels:

- 0 (Non-gradable Image)
- 1 (No DR)
- 2 (Mild DR)
- 3 (Moderate non-proliferative DR)
- 4 (Severe non-proliferative DR)
- 5 (proliferative DR or PDR)

ii) Classification: Referable or Non-referable DR:

- 0 (Non-gradable Image)
- 1 (Non-referable Retinopathy – No DR or mild DR)
- 2 (Referable Retinopathy – Moderate NPDR, Severe NPDR, PDR)

b) AMD:

- 0 (Non-gradable Image)
- 1 (No/early stage AMD)
- 2 (Intermediate/advanced stage AMD)
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c) GC:

- 0 (Non-gradable Image)
- 1 (No GC)
- 2 (GC)

d) PM:

- 0 (Non-gradable Image)
- 1 (No PM/HM)
- 2 (HM: high myopia)
- 3 (PM)

In all cases, the following are some of the metrics that will be used for benchmarking on an undisclosed test dataset to evaluate the AI algorithms:

- Accuracy
- Sensitivity, Specificity, Precision, F-Score, Cohen's Kappa
- Area under the Receiver Operating Characteristics (ROC) curve or AUC,

Available Datasets:

There are several publicly available datasets including: the EyePACS dataset (around 90,000 fundus images, 5 levels of severity), MESSIDOR dataset (1,200 images, 4 levels of severity), the DIARETDB dataset (around 200 images marked with lesions) and Kaggle Diabetic Retinopathy challenge datasets (35,000 and 3664 images, 5 levels of severity) . Currently, there are no known private datasets for testing. One of the goals of the focus group is to facilitate the procurement of such undisclosed datasets for benchmarking.

Topic Group Activity:

More details about the activities of the topic group can be found in the most recent Topic Description document under the Ophthalmology topic group on the following page:

<https://www.itu.int/en/ITU-T/focusgroups/ai4h/Pages/tg.aspx>

Topic Group Members:

Current members of the topic group on Ophthalmology (retinal imaging diagnostics) include

- 1) Arun Shroff, CEO Xtend.AI (USA) - Topic Drier for TG-Ophthalmology
- 2) Xingxing Cao, Artificial Intelligence Group, Baidu, China
- 3) Yanwu XU, Artificial Intelligence Innovation Business, Chief Scientist, Baidu, China
- 4) Jingyu WANG, Artificial Intelligence Group, Baidu, China
- 5) Shan Xu, CAICT, China
- 6) Ashley Kras, M.D. M. S., Ophthalmologist & Bioinformatician (Harvard Medical School)
- 7) Dr Covadonga Bascaran, PHEC MSc Programme Director, International Centre for Eye Health (ICEH), London School of Hygiene & Tropical Medicine, U.K.
- 8) Inês Sousa, Head of Intelligent Systems, Fraunhofer Portugal AICOS
- 9) Parvathi Ram, St. John's Medical College, India
- 10) Dr. Suneetha N, St John's Medical College, India
- 11) Dr. Sheila John, Sankara Netralaya, Chennai, India.
- 12) Rajaraman Subramanian, Calligo Technologies, India
- 13) Sriganesh Rao, Calligo Technologies, India
- 14) Sushil Kumar TEC, New Delhi India
- 15) José Tomás Arenas C., Ricolta, Chile
- 16) Daniel Ting MD, PhD, Consultant, Vitreo-retinal Service, Singapore National Eye Center, Head, AI and Digital Innovation, Singapore Eye Research Institute
- 17) Dr. Karthik Srinivasan, Medical Officer, Vitreo retinal Services, Aravind Eye Hospital, Chennai.
- 18) João Victor Dias, Lead Data Scientist, NTT Data Brazil, GeekVision (São Paulo), Brazil.
- 19) Jianrong Wu, Tencent Healthcare (Shenzhen), China
- 20) Yanchun Zhu, Tencent Healthcare (Shenzhen), China
- 21) Man Tat Alexander Ng, Tencent Healthcare (Shenzhen), China
- 22) Yajun Zhang, Tencent Healthcare (Shenzhen), China

The topic group would benefit from further expertise of the medical and AI communities and from additional data.

The requirement for this topic group is – to be(come) an active member of the FGAI4H group and have a background, interest or expertise in this topic - Ophthalmology (retinal image diagnostics) either as a healthcare professional or an AI practitioner with a model or algorithm for DR or in some other capacity.

3 Get involved

To join this topic group, please send an e-mail to the focus group secretariat (tsbfgai4h@itu.int) and the topic driver (arunshroff@gmail.com). Please use a descriptive e-mail subject (e.g. "Participation topic group AI for Ophthalmology"), briefly introduce yourself and your organization, concisely describe your relevant experience and expertise, and explain your interest in the topic group.

Participation in FG-AI4H is free of charge and open to all. To attend the workshops and meetings, please visit the Focus Group website (<https://www.itu.int/go/fgai4h>), where you can also find the whitepaper, get access to the documentation, and sign up to the mailing list.
