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ITU-T Focus Group on AI for Health

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Source:	TG-Snake Topic Driver
Title:	Att.2 – CfTGP update (TG-Snake) [same as Meeting G]
Purpose:	Engagement
Contact:	Rafael Ruiz de Castaneda UniGe, Switzerland	Email: rafael.ruizdecastaneda@unige.ch

Abstract:	Calling on members of the medical and artificial intelligence communities with a vested interest in "Snakebite and Snake Identification". Become engaged in the group dedicated to establishing a standardized benchmarking platform for "AI for Snakebite and Snake Identification" within the International Telecommunication Union (ITU)/World Health Organization (WHO) Focus Group on "Artificial Intelligence for Health" (FG-AI4H).
	This version of the CfTGP is the same as seen in Meeting G (FGAI4H-G-005-A10), reproduced for easier reference as a Meeting N document.

Call for Topic Group Participation: "AI for Snakebite and Snake Identification"

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 Snakebite and Snake Identification".

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 diseases, 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 Snakebite and Snake Identification"

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 dedicated to "Snakebite and Snake Identification". Here some key points on this topic:

- **The problem:** Snakebite envenoming is a major global health issue and neglected humanitarian crisis (https://www.who.int/snakebites/en/). Today, 5 million snake bites occur globally every year causing 125,000 deaths and 400,000 victims of disability/disfigurement. In India, snakebite is responsible for five deaths/hour and 70% bitten are men and "bread winners" of the family (Menon et al, 2017). Snakebite exacerbates poverty in rural, and increasingly urban, communities in developing countries, which host high snake diversity and limited medical expertise (Gutierrez et al., 2017; Longbottom et al., 2018). Snakebite deaths are preventable using correct antivenoms, which are often expensive, scarce and can have side effects. Antivenom choice is critical and depends first on identifying the biting snake (Bawaskar and Bawaskar 2019). However, healthcare providers are not herpetologists (i.e. snake experts) and often struggle to identify the snake carcass brought by victims/bystanders/relatives or to interpret their description of the biting snake.
- **The proposed solution and the role of AI:** Although certain laboratory techniques (i.e. immunoassays and genetic techniques based on snake venom and cells) have been

developed to identify certain snakes, they are not adapted to poor countries (i.e. expensive and require several hours and experienced professionals for often insensitive diagnosis). We propose the first mobile app to urgently and reliably (I) identify snakes from photos using AI and crowdsourcing (i.e. global network of herpetologists), and (II) support victims and healthcare providers in the management of snakebite in endemic countries (scenarios: https://unige.ch/medecine/isg/files/2315/2377/5239/Snapp_diagram.pdf). Our solution is direct, rapid and adapted, empowering communities and healthcare providers. It builds on:

(1) Rapid growth in smartphone/Internet use/access in developing countries (ITU 2018).

(2) Emerging smartphone-based practices in communities confronted with snakebite (e.g. snakes and/or their carcass are often photographed/filmed by snakebite victims/bystanders or healthcare professionals).

Snakebite is a health emergency requiring immediate action in the field and at the health centre (e.g. neurotoxic envenomation can produce generalized paralysis, respiratory arrest and death in 30 min to few hours). AI offers an unprecedented opportunity for high-speed snake identification to support snakebite victims and healthcare providers. Interestingly, AI-based animal identification exists for other groups (e.g. birds, Hernández-Serna et al., 2014) but not for snakes, offering an innovative application for a life-threatening situation.

Benchmarking task: Our AI model would consume taxonomically-identified wild snake images from across the globe and associated geolocation and timestamp metadata to reply to the zoological question: "What snake is that?". More specifically, we plan to test:

1. How the accuracy of the AI model is affected by the absolute number of training images of a species

2. How the accuracy of the AI model is affected by the ratio of training to testing images of a species

3. How well images that are difficult for humans to identify can be accurately identified by the AI model

4. Whether AI accuracy at identifying images to genus or family is better than identifying them to species, given the same amount of training data

5. How much AI accuracy improves when geographic location information are incorporated (e.g. in India there are about 300 snake species out of 3,700 globally)

Ultimately, the AI model would provide species- and context-specific recommendations on snakebite management for both victims (i.e. first aid/pre-hospital care, most accessible snakebite treatment centre) and healthcare providers (i.e. expected clinical signs, antivenom choice). For the latter, the mobile app would be developed integrating existing snakebite management guidelines and collaborating closely with snakebite experts from Doctors Without Borders, WHO, and the Global Snakebite Initiative. Data on patients' evolution and outcomes would be integrated to reinforce and improve clinical recommendations given by the app (i.e. integrated learning system).

Data available: We are building the largest global set of snake images. We currently have >395,000 labeled images from museums, personal collections, and open online citizen science/crowdsourcing platforms (e.g. iNaturalist, VertNet, GBIF, HerpMapper). The average number of new snake images posted on iNaturalist daily in 2018 was 141, a 50% increase over the 2017 average, facilitating continuous growth of our dataset. We plan to expand the database with additional sources, using crowds to tag images from Facebook groups on herpetology. Importantly, the lead herpetologist of our project is also co-manager of the Snake Identification Facebook group, with >100,000 members. Most images are geolocalised, with date and time when available. We collaborate with indiansnakes.org and snakebiteinitiative.in to access 5,000 photos of snakes through the

project [Mapping the Big Four of India](http://snakebiteinitiative.in/snake/) (http://snakebiteinitiative.in/snake/). Of ~3,800 snake species globally ~2,400 are currently represented in our data set. Concerning the undisclosed data set, we continue to collect images from natural history museum collections and from private researcher and personal image collections, but anticipate potential differences in the species coverage of training and undisclosed testing data.

A detailed description of the project can be found in this document: click [here](). This document can be accessed with a free ITU account (cf. "Get involved").

This topic group on "AI for Snakebite and Snake Identification" currently involves an interdisciplinary global health team (see below). The current topic driver is Dr. Ruiz-de-Castañeda (zoologist, Global Health expert) in collaboration with Dr. Bolon (veterinarian), who created the One Health Unit at Institute of Global Health, and who are part of an unprecedented epidemiological survey on snakebite in Nepal/Cameroon (Snake-Byte project). Dr. Durso (herpetologist) joined the Unit in 2018. They share an interest in digital innovation and citizen science for tackling the snakebite humanitarian crisis. We published [Genevieve et al. (2018)]() and [Longbottom et al. (2018)]() and we have been invited to international conferences (e.g. Venom 2017, IMED 2018) and by the media (e.g. Le Temps, SciDev.Net, Swissinfo.ch, RTS). Dr. Durso co-leads the largest Facebook group on snake identification and is part of the HerpMapper scientific advisory board.

Project team:

Dr. Rafael Ruiz de Castañeda, Institute of Global Health, UNIGE

Dr. Isabelle Bolon, Institute of Global Health, UNIGE

Dr. Andrew Durso, Institute of Global Health, UNIGE

Prof. François Chappuis, Division of humanitarian and tropical medicine, HUG/UNIGE

Dr. Gabriel Alcoba, MSF and Division of humanitarian and tropical medicine, HUG/UNIGE

Dr. Nicolas Ray, Institute of environmental sciences & Institute of Global Health, UNIGE

Prof. Marcel Salathe, Digital Epidemiology Lab, EPFL

Sharada Prasanna Mohanty, Digital Epidemiology Lab, EPFL

Prof. François Grey, Citizen Cyberlab, UNIGE

Dr. Jose Luis Fernandez, Citizen Cyberlab, UNIGE

Rosy Mondardini, Citizen Science Center Zurich, ETH / UNIZH

Prof. David Williams, Global Snakebite Initiative, University of Melbourne

Dr. Abiy Tamrat, Médecins Sans Frontières, Geneva

Hanne Epstein, Médecins Sans Frontières, Copenhagen

Donald Becker, Christopher Smith, Michael Pingleton, HerpMapper

M. Jose Louies, IUCN Viper Specialist Group, indiansnakes.org & snakebiteinitiative.in

Dr. Brian Lohse, AntiVenom Venture & University of Copenhagen

Dr. Ulrich Kuch, University of Frankfurt, Germany

The topic group would benefit from further expertise of the medical and AI communities and from additional data. Particularly valuable would be the creation of a permanent and regularly-updated archive of images and data from social media (Facebook, Twitter), where hundreds of thousands of users post photos of snakes, coupled to a system for verifying the identification of snakes in these photos. Collaboration with Facebook would be a major asset, and we are currently discussing this possibility with them. Very valuable undisclosed data exist in the form of heretofore undigitized

photographs or slides, most of which reside in the collections of natural history museums or in private collections. Networking with the owners of these images is underway, although the process of digitizing them will be time-consuming and expensive.

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 (rafael.ruizdecastaneda@unige.ch). Please use a descriptive e-mail subject (e.g. "Participation topic group AI for Snakebite and Snake Identification"), 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.

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