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ITU-T Focus Group on AI for Health

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Purpose:	Engagement

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Abstract: Calling on members of the artificial intelligence, medical and public health communities with an interest in Sanitation. We invite you to join the group dedicated to exploring the potential application of AI on community-level and earth observation data streams to predict outbreaks of diarrhoeal disease in underserved communities, as a part of the Focus Group on "Artificial Intelligence for Health" (FG AI4H) under the joint collaboration of the International Telecommunication Union (ITU) and the World Health Organization (WHO).

This version of the CfTGP is the same as seen in Meeting M (FGAI4H-M-028-A02), reproduced for easier reference as a Meeting N document.

Call for Topic Group Participation: "AI in sanitation for public health"

The International Telecommunication Union (ITU)/World Health Organization (WHO) Focus Group on "Artificial Intelligence for Health" (FG-AI4H; https://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 algorithms for the prediction of diarrhoeal disease outbreaks in at-risk communities.

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 23 topic groups. The topic groups are: AI and anti-microbial resistance, cardiovascular disease risk prediction, dental health, dermatology, diabetes, volumetric chest computed tomography, endoscopy, fake medicine, falls among the elderly, fertility, histopathology, malaria, child growth monitoring, musculoskeletal medicine, neuro-cognitive diseases, ophthalmology (retinal imaging diagnostics), outbreak detection, poc, psychiatry, radiotherapy, sanitation, snakebite and snake identification, symptom assessment, tuberculosis.

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: Smart Sanitation

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. Provide a forum for open communication among various stakeholders,
2. Agree upon the benchmarking tasks of this topic and scoring metrics,
3. Facilitate the collection of high-quality labelled test data from different sources,

4. Clarify the input and output format of the test data,
5. Define and set-up the technical benchmarking infrastructure
6. 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 cooperatively over several FGAI4H meetings. Iterative versions of the document will be submitted as input documents for each meeting and relevant changes will be discussed and integrated into an official output document. 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 outbreak detection algorithms.

Topic relevance

Safe sanitation remains inaccessible to over 50% of the world population, contributing to nearly 1 million deaths in low- and middle-income countries (World Health Organization, 2019a). Inadequate sanitation and unsafe water supply contribute to diarrhoeal disease, which is a leading cause of global childhood mortality and morbidity. Poor sanitation is estimated to have cost $260 billion in disruption to economic productivity and healthcare costs per year from 2012 to 2015 (Hutton, 2012).

Role of AI

The AI's ultimate goal is to enable stewardship of diarrhoeal and sanitation related health problems in communities with limited sanitation infrastructure. The system currently in development by our field partners will enable the generation of several data streams covering several factors understood to be associated with diarrhoeal disease outbreaks: Community Ablution Block (CAB) usage, sludge supply chain monitoring data, process KPIs from sludge treatment plants, in combination with satellite observation of the watershed and earth based observation of weather patterns and watershed pollution.

The data thus collected will be — on top of being consolidated for basic analysis — fed into an algorithm to predict outbreaks of diarrhoeal disease in the community. This multi-factor aggregate of data streams should enable the AI to capture known causal chains with more accuracy than existing methodologies, and enable authorities to react to potential outbreaks.

Available Data

The project is currently in field roll-out phase, expecting many of the data streams to be available progressively during the course of the coming months. The University of KwaZulu-Natal as gathered extensive pathogen level measurements on the watershed of interest, that can be leveraged in combination with historical weather data to iterate the AI in an experimental phase. The full wealth of data streams expected to be rolled out during the first year of the project encompass CAB monitoring sensors (built in accordance with GDPR and high ethical standards established in collaboration with UKZN), earth observation data from ESA Sentinel missions, sludge processing data, weather measurements and pathogen sensing in the watershed.

Sensors to detect presence of pathogens in fecal sludge, as well as acoustic-based diarrhoea detectors in Community Ablution Blocks (CAB's) are planned to be deployed on a pilot community in KwaZulu-Natal, South Africa. Signals from the sensors are edge-processed (using standard Raspberry Pi devices) and propagated to central processing. These features are expected to provide small scale information about potential outbreaks. In the early stages of the project, the pathogen sensing technology will be replaced by frequent laboratory testing and manual input into the system.

Earth observation data from ESA missions Sentinel-5p (atmospheric composition) and Sentinel-3 (vegetation, water and moisture indices) provided by the European Space Agency allows the system to assess environmental and ecological changes including water chemistry, conditions at dumping sites, temperature changes. In combination with terrestrial sources for water level and turbidity at select sampling points of the basin, and weather observation data, we expect the system to capture weather patterns, water level, atmospheric conditions and land use (proxying for factors such as illegal dumping), and model their combined impact on disease propagation in the pilot communities.

Additionally to the aforementioned streams, data from a sludge pyrolysis plant (including inflow / outflow measures as well as process KPIs), sanitation supply chain management data (CAB usage levels, consumables, sludge transport data) will provide a fuller picture of the state of the system, and may also be incorporated into the predictive model provided they add significant performance.

Benchmarking task

Given the wealth of data we expect to gather at the pilot site with high time resolution, we expect this project to test rapid detection and processing of known causal chains in the spread of diarrhoeal disease. As a pilot phase project, TG-Sanitation aims to produce a proof of concept of rapid outbreak detection and health monitoring, and build the benchmarking and multi-factor evaluation framework (encompassing policy, organisational and ethical aspects on top of the technical learnings) to deploy similar technologies in at-risk communities.

Topic-specific questions to be addressed may include:

– Definition of the target variable, geographical and temporal resolution, and parameters of the AI model (FP/FN trade-off, acceptable performance)

– Development and labelling of a training and testing dataset for each stage of the project (where we expect progressive increases in temporal resolution of multiple variables)

– Detection and handling of sub-clinical cases in the context of labelling and detection (especially in underserved communities, many cases of diarrhoeal disease are treated at home and are thus undetected)

All aspects will be discussed during regular focus group meetings and incorporated in the corresponding *topic description document* for this topic group.

Documents

More details about the activities of the topic group can be found in the following documents:

– Proposal: FGAI4H-L-035 & FGAI4H-L-035-A01

– Most recent TDD: FGAI4H-M-028-A01

– Most recent presentation: FGAI4H-M-028-A03

Topic group members

The topic group on *Smart Sanitation* currently includes:

– Institute for Technology and Global Health, a nascent think tank out of Cambridge, USA focusing on applications of technology to public health issues

– Woodco Energy, an Irish renewable energy developer deploying a pilot Pyrolysis infrastructure in KwaZulu-Natal…

– Mindseed.ie, an Irish space and information technology consultancy driving the development of the data collection, collation with space-based data streams, and initial development of the AI

– University of KwaZulu-Natal…

3 Get involved

Tackling such a multi-dimensional topic as Sanitation in at-risk communities, involving and directly impacting a wide array of areas of social life and direct stakeholders, requires a vast diversity of talents and areas of expertise. The topic group would greatly benefit from further expertise in:

– Definition and implementation of large-scale data products for health monitoring and prediction, with particular emphasis on requirement gathering with government stakeholders

– Machine learning or AI development in the context of ecological systems, watershed monitoring, epidemiology or complex social systems

– Epidemiology of diarrhoeal diseases

The contribution can take multiple forms and the definitions will evolve with the project. We expect new joiners to help drive early stages of the AI system development, influence the development of benchmarking and decision frameworks combining the diverse factors affecting this problem space, and contribute to the development of initial training datasets and the subsequent training and evaluation of AI models.

To join this topic group, please send an e-mail to the focus group secretariat (tsbfgai4h@itu.int) and the topic driver (khahlil.louisy@pathcheck.org, alex.radunsky@mail.harvard.edu). Please use a descriptive e-mail subject (e.g. "Participation topic group AI for smart sanitation"), 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://itu.int/go/fgai4h), where you can also find the whitepaper, get access to the documentation, and sign up to the mailing list.