FROM MICCAI TO AFRICAI: AFRICAN NETWORK FOR ARTIFICIAL INTELLIGENCE IN BIOMEDICAL IMAGING

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ABSTRACT

Over the recent years, there has been excitement about the extraordinary opportunities that artificial intelligence may offer in tomorrow's healthcare. Given the potential of AI technology in facilitating the quantification of large and complex datasets, medical imaging has witnessed rapid and revolutionary developments. However, a limitation of current AI developments for medical imaging is that they have overwhelmingly, and almost entirely, targeted imaging applications in high-income settings. Hence, it is important to promote and accelerate the development of trustworthy and accessible AI solutions for medical imaging in low-to-middle income countries –an urgent need to advance *global* healthcare. This paper describes the authors' experience and initiatives in promoting AI for medical imaging on the African continent, by Africans for Africans. First, the paper will discuss MICCAI 2024, the first international conference on medical image computing and computer assisted intervention that will be taking place on the continent. Subsequently, we will present AFRICAI, a new African network dedicated to research, education and cooperation in the field of AI in imaging and radiology. With this paper, we hope to raise awareness about these initiatives and attract more collaborators, promote new research and innovation in the field to address Africa-specific healthcare challenges, and encourage similar initiatives for promoting practical AI solutions for developing countries in Africa and beyond.

1 INTRODUCTION

Artificial intelligence (AI) is widely regarded as one of the most promising and disruptive technologies for future healthcare. In recent years, the use of AI for disease quantification has seen an immersive leap forward thanks to the advent of convolutional neural networks (CNNs) and steadily increasing computational power. Given the potential of AI technology in facilitating the quantification of large and complex datasets, medical imaging has witnessed rapid and revolutionary developments in the last years (Alexander et al., 2020). This is well illustrated by the comprehensive list of FDA-cleared AI algorithms that is maintained online by the American College of Radiology[1]

[1]FDA Cleared AI Algorithms: `https://models.acrdsi.org`

(> 150 AI technologies as of February 2022). However, despite such advances, a major limitation of current AI developments for medical imaging is that they have overwhelmingly, and almost entirely, targeted imaging applications in high-income countries (Mollura et al., 2020), thereby limiting their usability and deployment at a *global* scale.

We analysed all papers ($n = 670$) published in the whole 2021 calendar year, with the keywords "deep learning" and "medical imaging", in three of the most important journals in the field, namely Medical Image Analysis, Radiology: Artificial Intelligence and Journal of Digital Imaging. The results show that 94.1% of the imaging datasets used in these papers originated from 20 countries only, and that 160 countries did not contribute any imaging datasets used to train and test new artificial intelligence solutions and applications. There is a concern, if this trend continues, that AI will increase the existing high inequalities in global radiology, and hence in global health. At the same time, medical imaging plays an important role in modern medicine. It allows non-invasive assessment of internal organs and tissues, and hence it is a core medical exam used in diagnosing and monitoring a range of major health problems, such as heart disease, brain disease, cancer, bone disease or pregnancy conditions. Imaging has also a great potential for the screening and detection of many infectious diseases such as tuberculosis (Skoura et al., 2015), which is a great health issue in many Sub-Saharan African countries, especially in populations with HIV (Williams et al., 2017).

Medical imaging requires highly trained and qualified clinical experts to acquire, process and interpret the imaging scans. However, the shortage of trained clinicians in low-income countries, in particular in Sub-Saharan Africa (Haseeb, 2018), is a highly critical global health issue. In addition to a lack of medical graduates and where available, their concentration in urban centres, high rates of emigration of the most skilled workforce to high-income countries adds more challenges and complexity to the current situation (Duvivier et al., 2017).

In this context, AI with a local perspective is a promising solution as it will provide increased automation for medical image quantification and will enable the development of novel computer-aided diagnosis systems that can be used in areas with a lack of trained specialists, hence increasing affordable healthcare coverage. Hence, it is important to promote and accelerate the development of new affordable and accessible AI solutions for medical imaging in developing countries such as those found in Africa. To this end, new researchers, innovators and clinicians with skills and expertise in AI and medical imaging are highly needed in low-to-middle income countries to drive future developments. Over the last years, Africa has seen a great boom in research, education and innovation in the field of AI. Communities such as Deep Learning Indaba[2], Masakhane[3], Data Science Africa, Black in AI[4] and AI Expo Africa have played an important role in advancing the field of AI in Africa. Every year, a wide range of applications are targeted by African researchers and innovators in a wide range of application domains (Cisse, 2018).

However, the application of AI to medical imaging differs greatly from applications in other fields of AI. It requires a highly inter-disciplinary collaborative approach integrating elements and skills from mathematics, computer vision, image processing, data science, biomedical engineering, radiology and clinical medicine. Challenges that are specific to AI in medical imaging include the difficulties in gathering, anonymising, curating and annotating large and high-quality datasets of medical images to train and test new AI models.

Furthermore, concerns including privacy, organizational and structural challenges, socio-cultural contexts, unjust historical pasts, and potential harm to marginalized communities make improving data access highly complex in the healthcare domain (Abebe et al., 2021). Data sharing challenges are exacerbated in the African context: various obstacles limit equitable data sharing practices; heterogeneous geographies have their data accessed and shared, yet do not receive the same benefits as the data collectors and owners of data infrastructures (Abebe et al., 2021; Denny et al., 2015; Mwaka, 2017). At the same time, African countries have their own healthcare challenges and imaging applications that need to be taken into account and it is expected that African researchers will contribute to shaping and driving future developments and innovations in the field.

This paper describes the authors' experience and initiatives in promoting increased AI for medical imaging in Africa, by Africans for Africans. First, the paper will discuss the conception and imple-

[2] https://deeplearningindaba.com/2021/

[3] https://www.masakhane.io/

[4] https://blackinai.github.io/#/

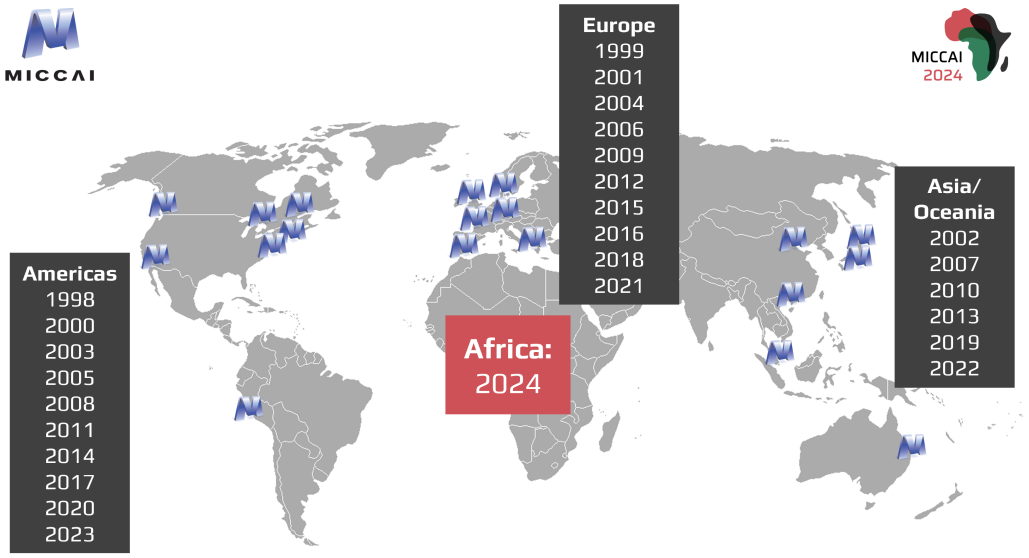

Figure 1: Geographical distribution of past MICCAI conferences. MICCAI 2024 is the first edition to take place in Africa, specifically in the city of Marrakesh, Morocco.

mentation of MICCAI 2024, the first international conference on medical image computing that will be taking place on the African continent. Subsequently, we will present AFRICAI, a new African network dedicated to research, education and cooperation in the field of AI in imaging and radiology. With this paper, we hope to boost awareness AI in imaging, attract inter-disciplinary collaborators in the field, and encourage similar initiatives to promote practical AI solutions for developing countries in the African continent and beyond.

2 MICCAI 2024: First Time in Africa

The Medical Image Computing and Computer Assisted Interventions (MICCAI) is a major annual international conference, which focuses on the dissemination of new research in the fields of medical image computing and computer assisted intervention. The conference is organised and operated by the MICCAI Society, which additionally promotes education, diversity and cooperation between engineers, clinicians, industries and educators, across the globe. MICCAI was firstly organised in 1998 in the city of Boston, United States, and it has been organised 25 times since. The MICCAI conferences now attract over 2,000 participants each year, who attend a wide range of activities including keynote lectures, oral presentations, posters, workshops, tutorials and challenges, as well as students, academia-industry and mentorship events. Furthermore, the MICCAI Society has several bodies to promote education, diversity and cooperation, including a MICCAI Student Board (MSB) and a Women in MICCAI Board (WiM), as well as a diversity and inclusion network (RISE-MICCAI) to support researchers in low-to-middle income countries, and is in the process of launching a far-reaching mentorship program.

MICCAI is a major meeting for computer engineers and data scientists working in AI for medical imaging. Many of the methodological developments in the field are often first presented at MICCAI before they are disseminated as journal papers. For example, the U-Net (Ronneberger et al., 2015), which ranks among the most important developments in the field, was first published in MICCAI and the paper itself has been cited over 38,000 times as of February 2022 (Google Scholar). Thus far, the MICCAI conference has taken place in all regions of the world except in Africa, i.e. nine times in the Americas, ten times in Europe, five times in Asia and one time in Australia (Figure 1).

In 2020, a team of researchers prepared a bid proposal to organize the MICCAI conference on the African continent for the first time, specifically for the MICCAI 2024 edition. The bidding team, which includes the authors of this paper, consisted of a highly diverse team of scientists, engineers

and innovators working in the field; a third of which were African researchers. The objectives of the bid were two-fold, i.e. to bring MICCAI to Africa, and to bring Africa to MICCAI.

Bringing MICCAI to Africa means extending the MICCAI research themes to take into account the imaging, clinical and healthcare challenges that are specific and even unique to Africa. Until now, the majority of scientific MICCAI works have focused on designing innovative AI methods for imaging applications in high-resource settings. We believe that organising MICCAI in Africa will raise awareness and open new research avenues that focus on Africa-specific imaging and clinical problems. In particular, increased research will be encouraged in at least three main areas, i.e. (1) new low-cost imaging enabled through affordable AI, (2) teleradiology solutions for isolated communities, and (3) image-based screening of infectious diseases (Naraghi et al., 2018).

The objective of bringing Africa to MICCAI seeks the promotion of the MICCAI themes (including AI for medical imaging) to an African audience, in order to attract a new generation of African researchers, engineers, data scientists, clinicians and innovators, that will contribute to the MICCAI research, meetings and community. Despite its existence for 25 years, MICCAI is not well known in Africa. Thus far, very few papers have been presented in the MICCAI conference by researchers based in Africa. In 2020, for example, only four papers (Kinyanjui et al., 2020; Fouefack et al., 2020; Bessadok et al., 2020; Mhiri et al., 2020) from Africa, were accepted at MICCAI, two of which were selected for oral presentation.

Hence, the MICCAI 2024 bid emphasised the need for new initiatives to enhance the participation of African scientists in the field of AI for medical imaging, as well as to enhance international cooperation between African and other members of the MICCAI community. The MICCAI 2024 bid was submitted with the city of Marrakesh in Morocco as the host city, as it is more easily accessible from international destinations, with only few visa requirements, which will encourage a wide participation for the first MICCAI edition in Africa. The bid received a wave of enthusiasm and support from within and outside Africa (including support from African communities such as Deep Learning Indaba, Data Science Africa and the Association of African Universities). In January 2021, our bid was announced as the winning bid by the MICCAI Society Board[5].

Since the announcement, we have been working on several concrete actions to achieve the objectives of MICCAI 2024. In particular, the conference will include keynotes speakers from the continent, invited experts in global health and low-cost imaging, grand challenges with equitable imaging data sharing practices from Africa. Furthermore, travel awards and waiver of registration fees for African researchers to attend the conference, among many other actions. Last but not least, the MICCAI 2024 Organising Committee proposed the creation of an African Network for Artificial Intelligence in Imaging (AFRICAI), operated by Africans for Africans.

3 AFRICAI: AFRICAN NETWORK FOR AI IN IMAGING

The African Network for Artificial Intelligence in Radiology and Imaging (AFRICAI) was created in January 2022[6]. Its main objectives are to:

- Create, maintain and increase an inter-disciplinary community of active contributors to AI for radiology and imaging applications in Africa.
- Promote a culture of responsible and equitable sharing of African imaging datasets.
- Increase cooperation in the field within Africa and internationally.
- Promote the development of trustworthy, transferable AI solutions to address Africa-specific real-world healthcare challenges.

The founding members of the AFRICAI network consists mostly of researchers based in Africa, or African researchers based outside Africa. Three weeks after its creation and without much advertising, the AFRICAI network attracted 275 new members from 23 African countries (Figure 2), including 36.2% self-identified female members. We expect that over the next weeks and months the network will grow significantly as we put in place dedicated campaigns and start organising

[5] http://www.miccai.org/news/2020/12/31/and-the-location-of-miccai-2024-is

[6] www.africai.org

Table 1: Subset of African companies operating in the field of imaging and/or AI.

Company	Location	Area	Link(s)
Lodox	Johannesburg, SA	Fast body X-ray	`www.lodox.com`
Intixel	Cairo, Egypt	General radiology	`www.intixel.com`
Caperay	Cape Town, SA	Breast imaging	`www.caperay.com`
Accuread	Lagos, Nigeria	Teleradiology	`www.accureadradiology.com`
NabdaCare	Cairo, Egypt	Information systems	`www.nabdacare.com`
Gudra Studio	Accra, Ghana	General radiology	`www.gudra-studio.com`
Edai	Johannesburg, SA	Imaging diagnostics	`www.edai.africa`
Rology Health	Cairo, Egypt	Teleradiology	`www.rology.health`
Algorizmih	Abuja, Nigeria	Imaging diagnostics	`www.algorizmih.com`
Accrad	Cape Town, SA	Chest image analysis	`www.accrad.com`

events. We are planning to target students of Master's degrees in computer science, biomedical engineering, data science, artificial intelligence, biomedical informatics, and related topics. We will also contact medical associations and professional societies to attract additional members from the clinical and radiology communities. Further, the African Continent has several emerging SMEs in AI and medical imaging (Table 3); we also intend to involve African and international companies to promote collaborations with industry and future economic growth in the field. In the next two years, a number of activities will be organised, including monthly seminars to offer regular tutorials on technical subjects; Annual winter/summer schools (online in 2022 and in-person in 2023) with international experts that comprise a comprehensive set of courses related to AI in medical imaging; Mixer events between AI scientists, students, clinicians, and industries.

After MICCAI 2024, our objective is to turn AFRICAI into an annual meeting with calls for papers, workshops, challenges and other activities.

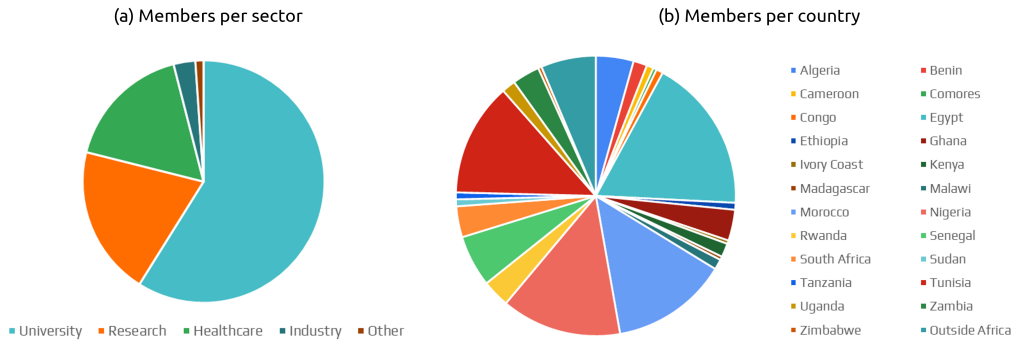

Figure 2: Current distribution of AFRICAI's members per sector (a) and country (b).

4 Discussion & Conclusions

Medical imaging is considered critical for the provision of comprehensive and quality healthcare. However, while high-income countries are equipped with an abundance of sophisticated radiological resources including AI based tools, at the other end of the spectrum there is a major lack of access to basic medical imaging and medical image analysis resources in the Global South (Maru et al., 2010).

In this paper, we have described our experience and aims in bringing the MICCAI conference to Africa. We are working towards ensuring a major impact of this upcoming event on Africa's research and innovation in the field of AI for medical imaging. In particular, MICCAI 2024 will promote new research and equitable cooperation in the field to address scientific and clinical challenges that are

specific to Africa and to develop new solutions for affordable radiology and imaging in resource-limited settings.

We also presented our recent initiative to create an African network for AI in imaging, to further develop and shape the field in Africa, by Africans for Africans. While we are aware that there are formidable challenges such as the lack of awareness about application of AI in imaging, computational infrastructure, research funding and availability of as well as access to large imaging data sharing practices, we strongly believe that such obstacles can be addressed by building on the African assets, namely a dynamic workforce, new university programs that have been created across Africa in the field of AI and data science, as well as an existing critical mass thanks to previous efforts by the African AI community.

Joining forces and building synergies with other ML conferences such as ICLR, would facilitate the implementation of such vision ensuring its extended benefits to the global community. To resolve today's healthcare challenges requires a diverse and far-reaching set of researchers, as has been made apparent by the global pandemic, and we hope that initiatives such as MICCAI'24 in Africa, and the new AFRICAI network, will be able to contribute to this endeavour.

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