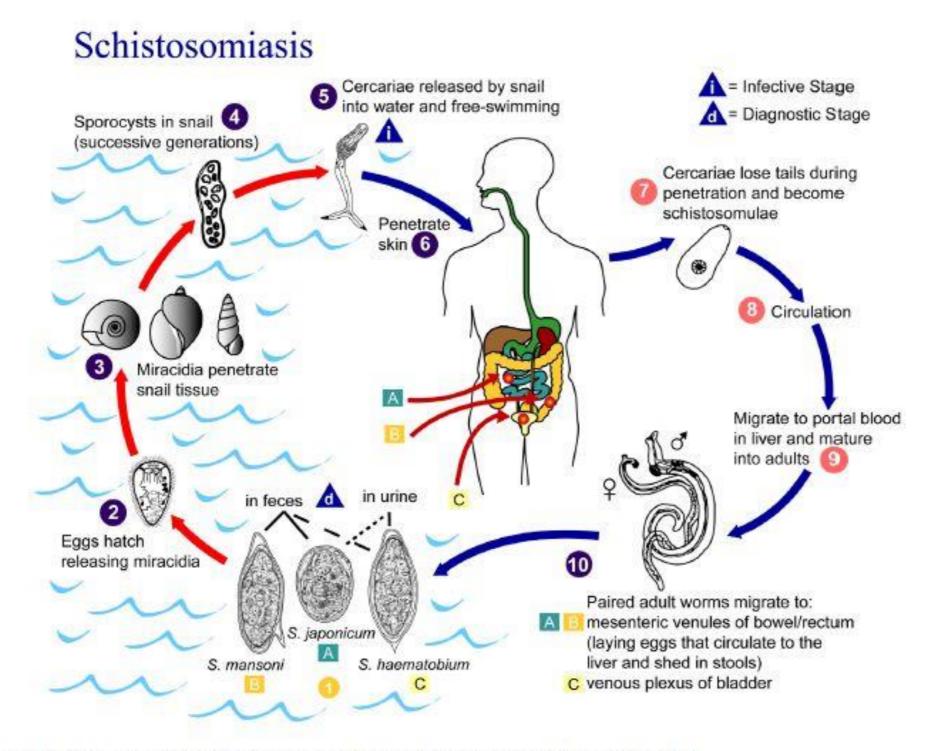
Development of an App. for the identification of schistosomiasis intermediate host snails

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Figure 6. Life cycle of schistosomes infecting humans (CDC Image library).

Schistosome species and their intermediate snail hosts

Schistosome species infecting humans	Snail genus responsible for transmission
S. mansoni	Biomphalaria
S. haematobium, S. intercalatum, S. guineensis	Bulinus
S. japonicum	Oncomelania
S. Mekongi	Neotricula



Rationale for the App. development

- WHA 65.21 called for interruption of transmission of schistosomiasis where possible
- Operational components (the provision of potable water, adequate and reliable sanitation, hygiene interventions, and <u>snail control</u>) are required to have a greater impact towards the interruption of transmission.
- Implementation of snail control activities require competences in malacology.
- Limited capacity in snail control exist in endemic countries, considering the priority given to preventive chemotherapy and the abandon of snail control
- Existing WHO guidance on snail identification is outdated (1984)
- New technologies /AI allows the development of a phone application that is based on a photograph of individual field-collected snails to assist in building capacity for the surveillance and evaluation of the snail control activities



Main characteristics of the App.

Must, Should, Could	Торіс	Description
Must	AI Model performance	AI Model recognition ratio must be 90%
Should	AI Model performance	AI Model recognition ratio should be 90%
Must	Taking pictures	 The mobile application must allow the user to: •make one or several photos of a snail •visualize the photos taken •submit one or several photos together for recognition (depending on the AI model).
Must	Metadata	The mobile application must collect photo's metadata and background information like GPS coordinates, date, time and other data relevant to the AI model.
Must	Offline recognition	The mobile application must answer, in offline mode, to the user whether the snails is a vector or not.
Must	Sub-species recognition	The mobile application must tell which sub-species it recognized (if positive)
Must	Send data when online	Application must offer the user the possibility to submit pictures taken to the platform along with data related to the pictures and recognition (Answer provided by the recognition algorithm).
Should	Detect phone language	Application should detect the language of the phone and remember what the user selected on the same phone.
Must	Platform Vector validation. Entry form	To control the quality, a form will be created showing randomly the pictures received on the platform. This form will be accessible to WHO experts only. Experts will be able to enter following fields: official species and official sub-species (selected from a list), and a comment. The system will register the date of entry (or update). User will be able to save the entry, discard changes, skip current picture and either exit review process or see next picture.



Methods

- Constitution of image datasets for the App. database and for the software evaluation
- Collection of snails images from various regions (Africa, Asia, Americas) from experts and research centre collection and from google searches
- Identification and classification of the snail images (1st quality control)
- Color information in photos not used as predictor of species, because field snails often have encrustment on the shell.
- Identification based on the snail morphology (shell)



Methods

- Creation of a machine learning model based on a dataset of snail shell photographs, organized by a malacologist
- Creation of a specific data set for the model challenge



- Experiments using raw dataset with cropped images of size
- Model biased towards background color and texture.

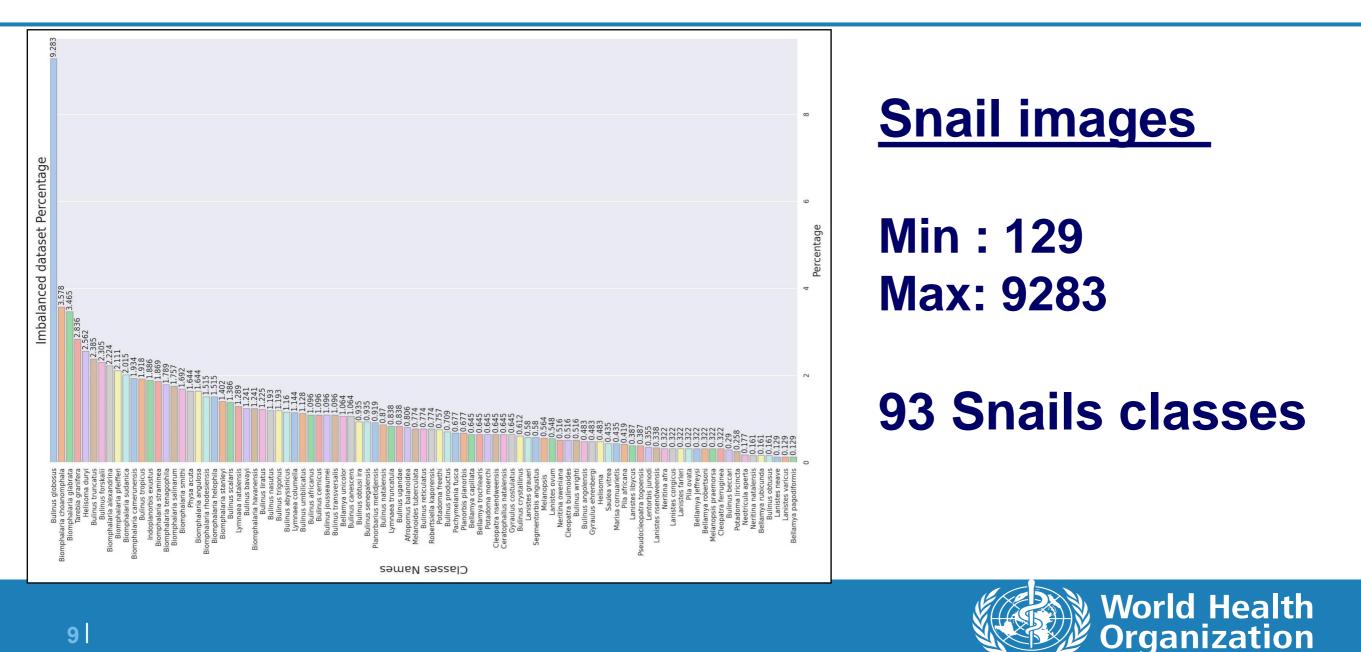


Preliminary results

- Best accuracy on Training set 92 %
- Best accuracy on Validation set 80 %
- Some more experiments showed that model still had biais towards a few classes whose images vary a lot in sizes and colour.
- The scores are good, and the model is expected to perform well if certain conditions are met



Imbalance class distribution of the dataset





Accuracy scores for each species in the validation dataset

Class Accuracy	0.83	0.75		1	0.67	0.88		1 10.83	0.79				4			C/'0		0.75		0.83	1	0.88				0.81				0 03	0.83	0.75	000	0.56	0.92	0.92	10.75	1	0.75	0.00	0.82		0.61		0.92		1	0.87		0.88			1 U 64		0.52	67.0	0.64		0.76	0.83	0.89				1	28 U T / 'N	0.81		0.94	4.64	1	0.6 0.8 1.0	0	y JCOIC3	
Class A	0.5		0.2	0.33																					0				2 U				0				0.42					0		0.29		0.14												0.39														0 0.2 0.4			
Neritina natalensis	Neritina oweniana Neritina afra	Afropomus balanoidea Lanistes congicus	Lanistes nsendweensis Lanistes neave	Lanistes varicus	Lanistes ovum	Lanistes farleri Lanistes graueri	Pila ovata	Pila africana	Bellamva unicolor	Bellamya capillata	Bellamya trochlearis	Bellamva parodiformis	Bellamva leffrevsi	Bellamya robertsoni	Pachymelania fusca	Melanopsis praemorsa	Dotadoma freethi	Potadoma moerchi	Potadoma liricincta	Cleopatra bulimoides	Cleopatra ferruginea	Cleopatra nsendweensis	Pseudocleopatra togoensis	Melanoides tuberculata Tarahian aranifara	Lymnaea natalensis	Lymnaea columella	Lymnaea truncatula	Bulinus abyssinicus	Bulinus angolensis Bulinus reticulatus	Bullius reticulatus Bullinus havavi	Bulinus africanus	Bulinus wrighti					G Bulinus canescens G Bulinus nasutus		Bulinus productus	Bulinus crystallinus Bulinus obtusi ira	Bulinus forskali	Bulinus obtusus	Bulinus scalaris	Bulinus transversalis	Bulinus senegalensis	Bulinus umbilicatus	Bulinus trigonus Bulinus tropicus	Bulinus truncatus	Physa acuta	Ceratophallus natalensis	Gyraulus ehrenbergi	Gyraulus costulatus	Planorbarius metidjensis Halisoma Aurui	Biomphalaria alexandrina	Biomphalaria angulosa	Biomphalaria camerunensis	Biomphalaria choanomphala Biomeria differi	Biomphalaria rhodesiensis	Biomphalaria salinarum	Biomphalaria smithi	Biomphalaria stanleyi	biompnalaria suganica Lantorhis iunodi	Segmentorbis angustus	Marisa cornuarietis	Helisoma	Biomphalaria glabrata Biomphalaria tenagophila	Biomphalaria straminea	Biomphalaria havanensis	Biomphalaria helophila Neotricula aperta	Robertsiella kaporensis	Indoplanorbis exustus	0.0	2		

Example:

Bulinus africanus - 83% Bulinus globosus - 82% Bulinus senegalensis - 92% Bulinus umbilicatus - 14% Bulinus truncatus - 87% Biomphalaria pfeiferi - 64% Biomphalaria sudanica - 88%

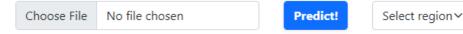


Snail App. Web interface

The webapp is live at: https://who-snail-api.aicrowd.com/



Please submit an image of a snail, and our AI model will make a prediction about the risk of <u>Schistostomasis</u>, and the species the snail belongs to.





Genus	Species	Confidence	
<u>Gyraulus</u>	Unknown		27.50 %
<u>Gyraulus</u>	<u>convexiusculus</u>		27.04 %
Brotia	Unknown		16.60 %
<u>Segmentina</u>	<u>hemisphaerula</u>		15.05 %
Melanoides	j <u>ugicosta</u>		13.81 %

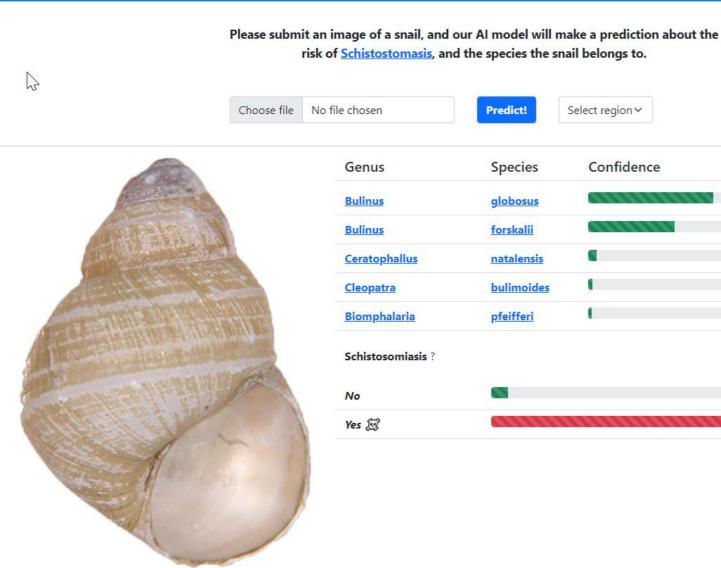
Schistosomiasis ?

No

Yes 😥



External evaluation of the App.



This shell is a Bellamya and it shows no 55.20 % 38.02 % resemblance to 3.57 % 1.70 % neither Bulinus 1.50 % globosus or 5.28 % 94.72 % Bulinus forskalii.



Next steps

- Additional rounds of training using new data sets
- Review of the recognition algorithm
- Launching of a global challenge for improvement of the App.
- Launching of the 1st version of the App.
- Field testing of the App. in Tanzania
- Monitoring and control the quality of the tool, Sensitivity, Specificity, Predictive Values etc., review of the pictures of sub-species received (without being biased by the response from the algorithm) and re-evaluation of the accuracy of the classification.
- Development of the version 2



Thank you



World Health Organization

The gastropod shell ax ax SU sp wh wh wh wh wh dap CIap um 15 ap: aperture; ax: apex; cl: columella; sp: spire; su World Health Organization suture; um: umbilicus; wh: whorl 15