The TT Screener: A Novel Smartphone App for Community-level Screening of the World's Most Common Infectious Cause of Blindness

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WCE

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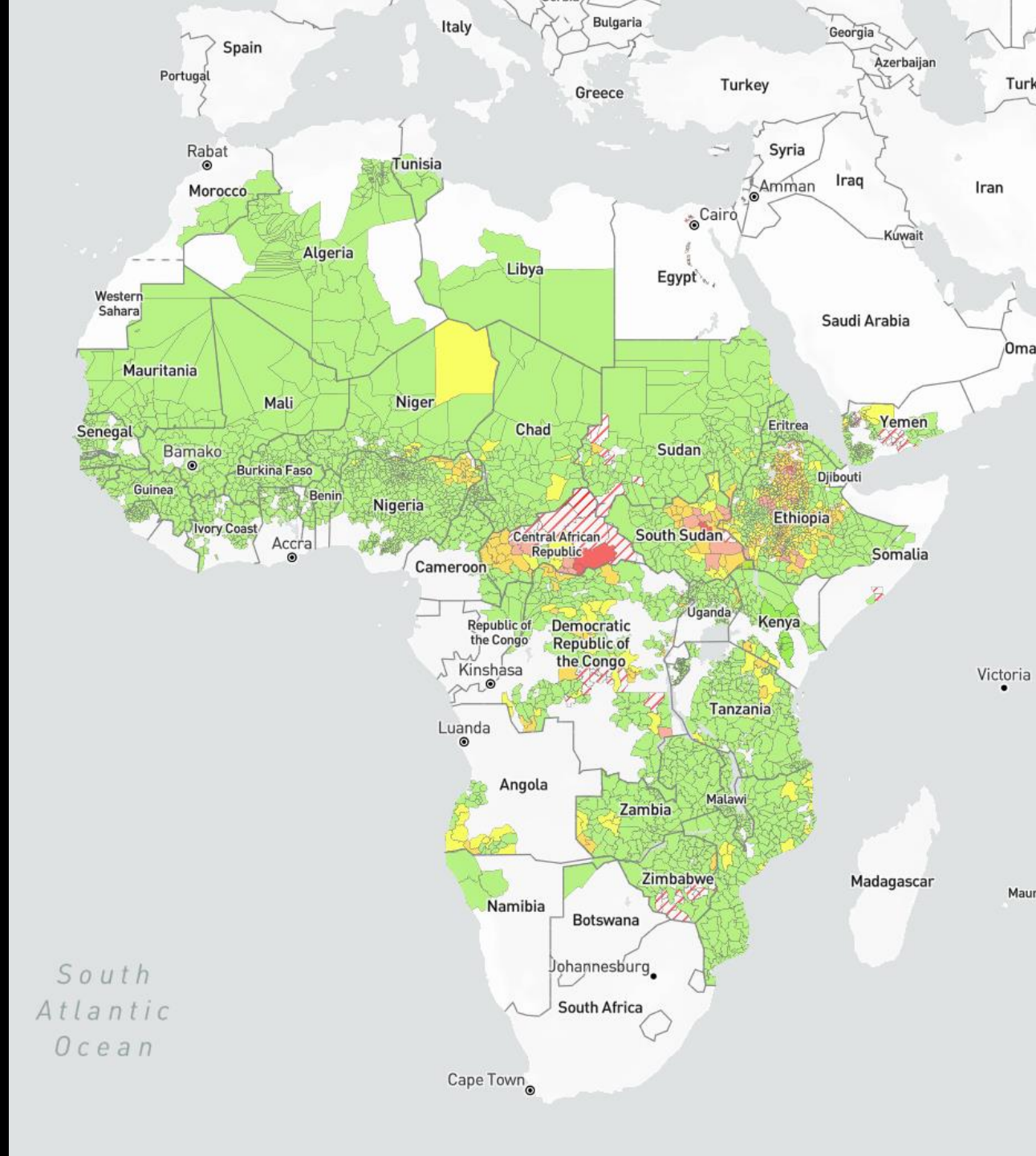
Trachoma Epidemiology

- Leading infectious cause of blindness globally
- Endemic in 40 countries, mostly Sub-Saharan Africa
- 116 million people
- Presents as conjunctivitis in kids; >50% infected at a time



Trachomatous Trichiasis (TT)

- Chronic sequelae from repeated infection
- Women 2-4 higher risk
- Surgery is the main treatment
- 1.5 million people

Program Rationale

- WHO targets elimination as a public health problem by 2030
- Countries need TT prevalence <1/1000 population to be certified free of trachoma
- Most TT cases live in rural areas
- House-to-house case finding is a primary strategy for case finding

Problems with TT Case Finding

Requires significant training on how to identify TT (w/live patients)

TT case finders often send large numbers of people without TT to surgical camps (PPV ~0.25 in many settings)

>30% of households not visited

Mobile Phones for TT Image Capture

- Great resolution
- Allow immediate assessment of photo quality

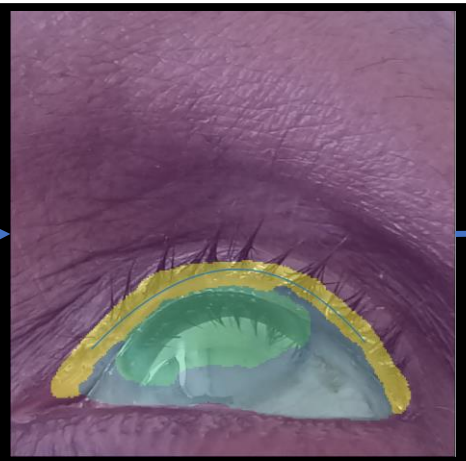
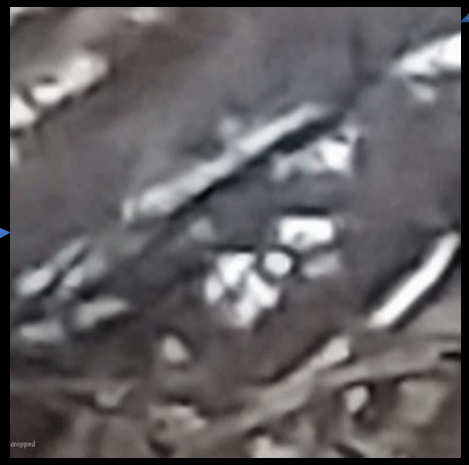
TT Screener

Image Recognition Algorithm

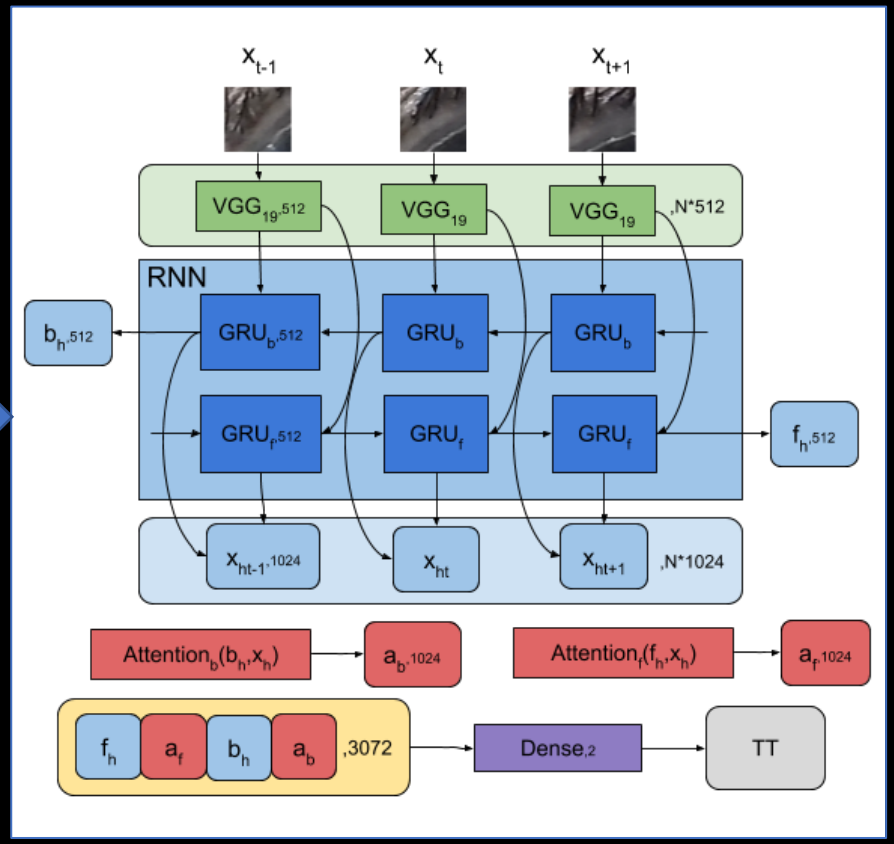
(neural network)

Smartphone App

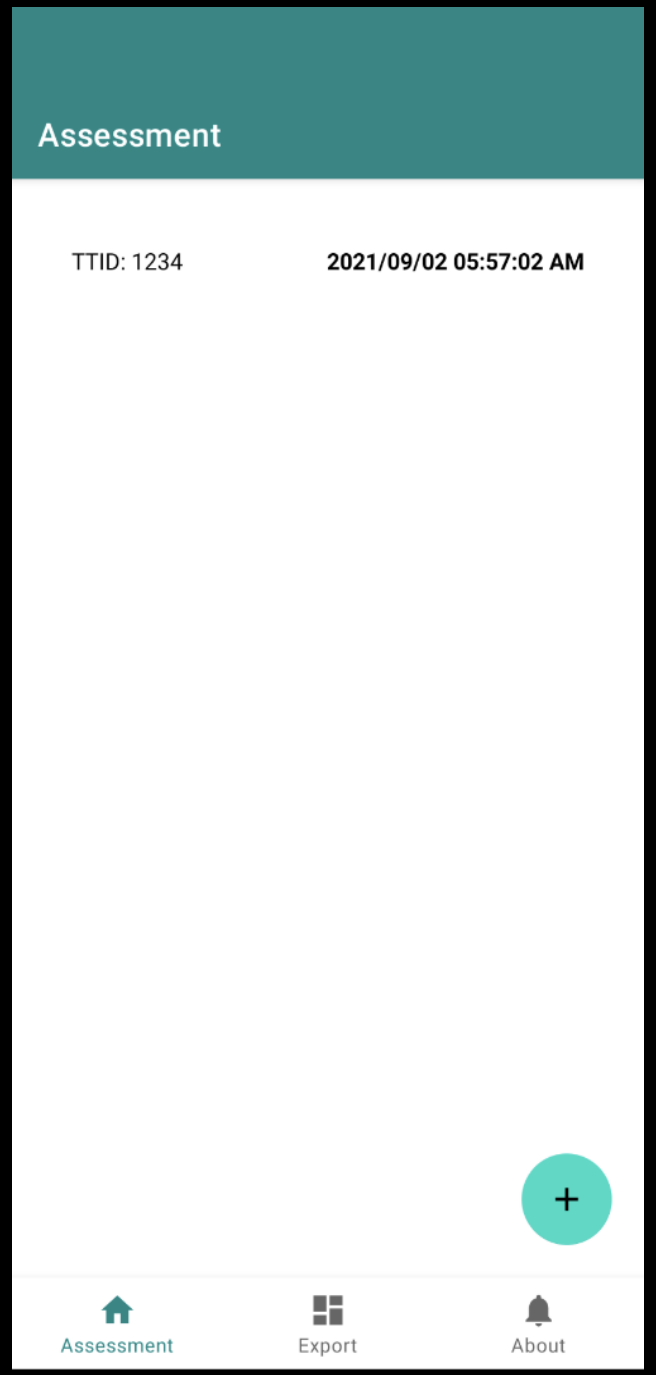
Algorithm Training Process

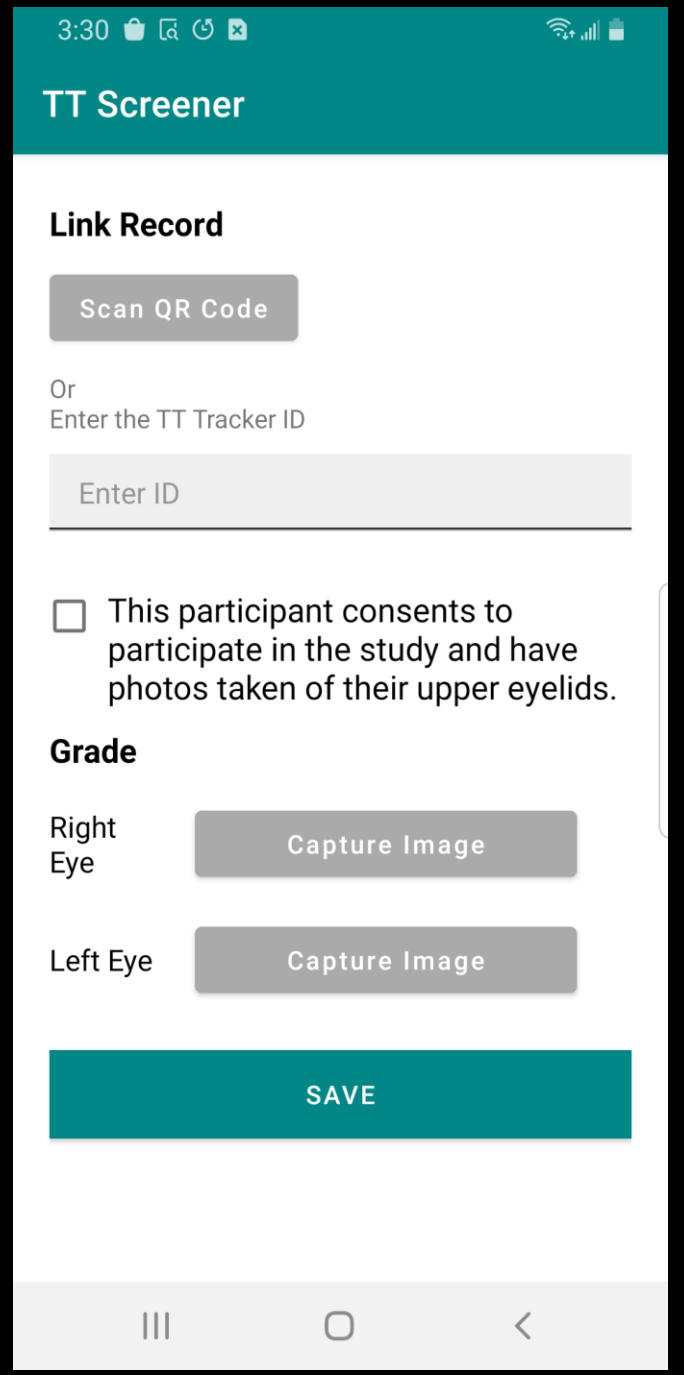
	Original	AI based Segmentation + Fitting	Sequence Extraction
Healthy			
TT			

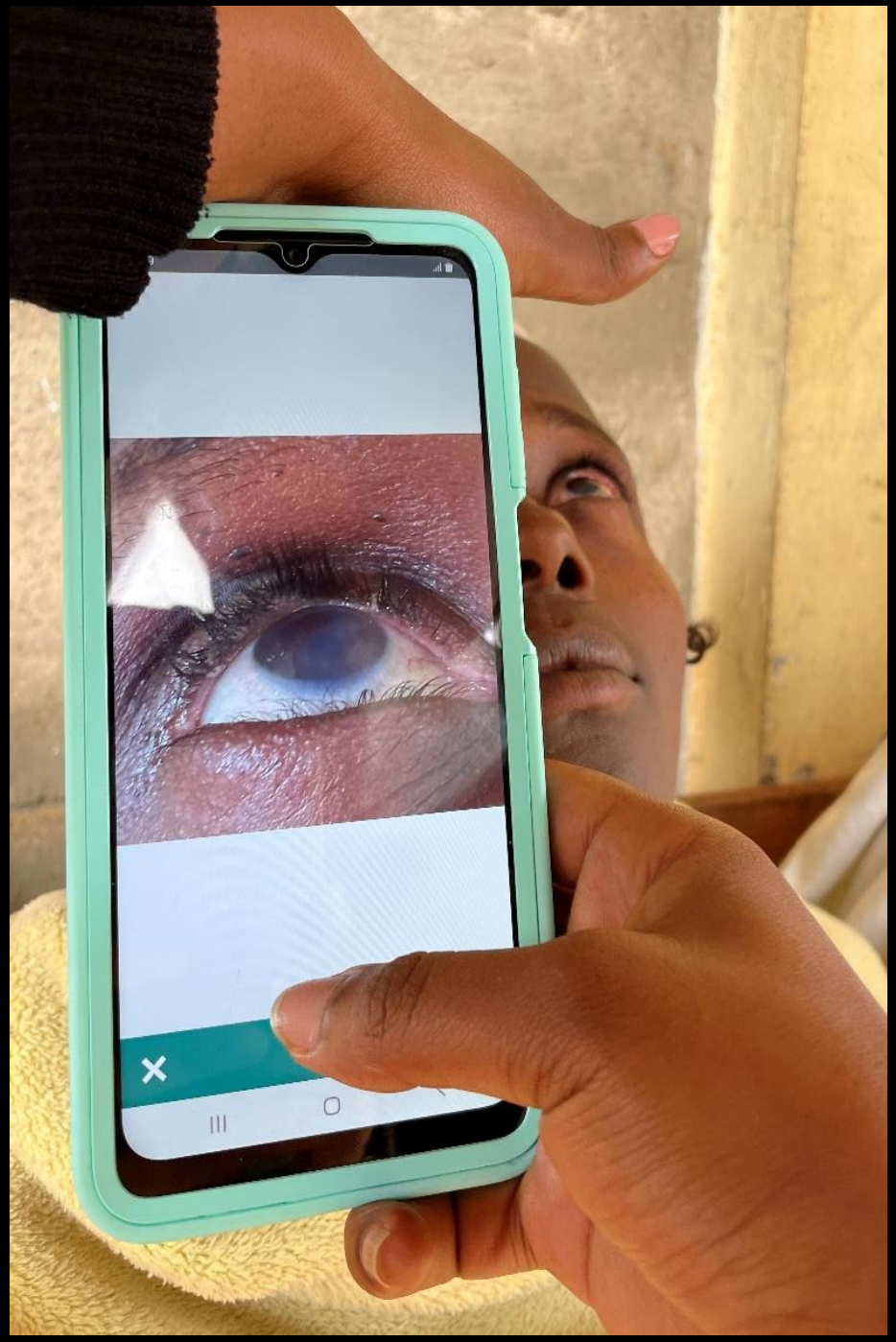
AI Model for TT Identification

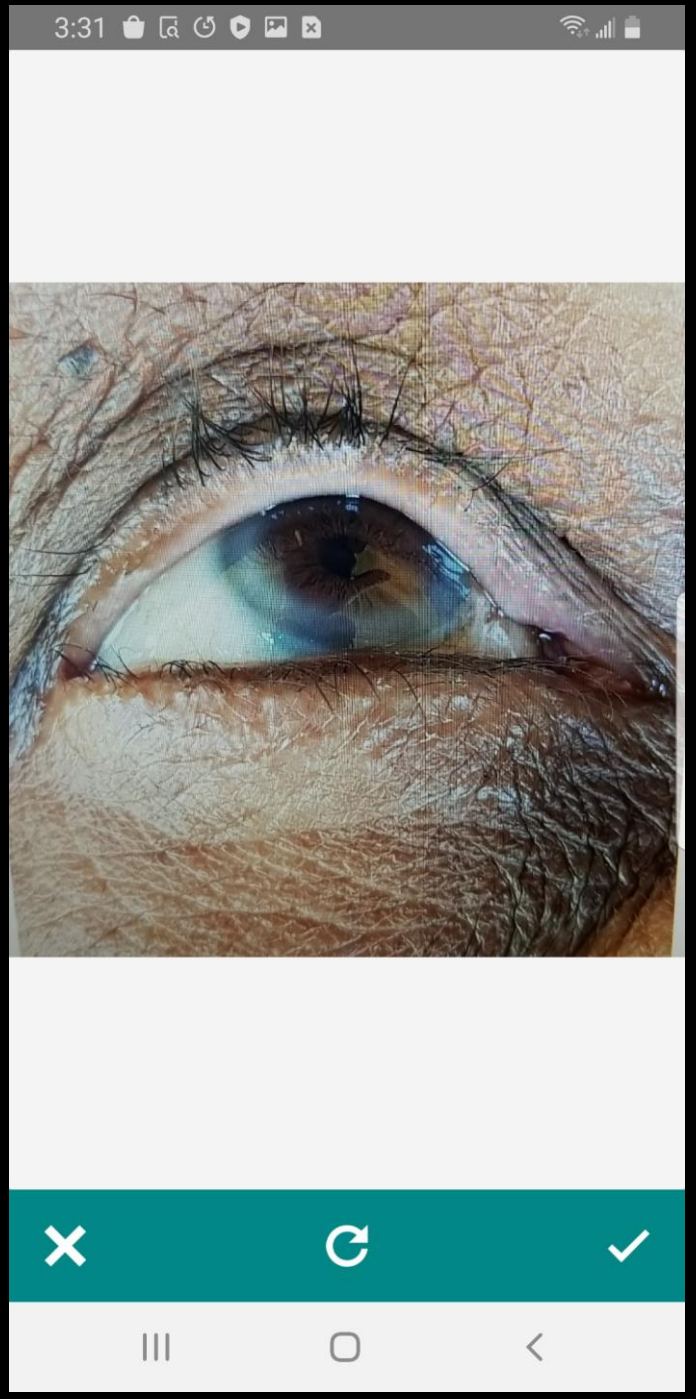


The TT Screener Smartphone App





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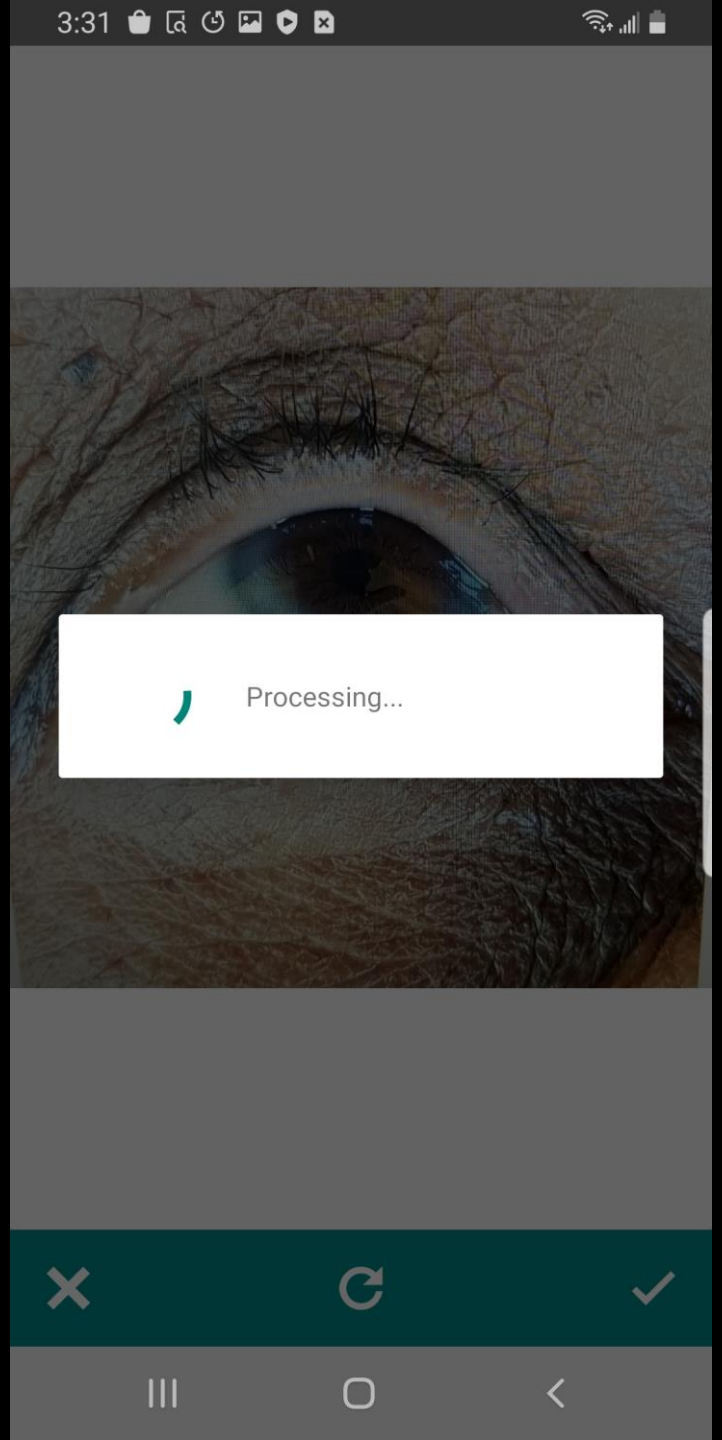
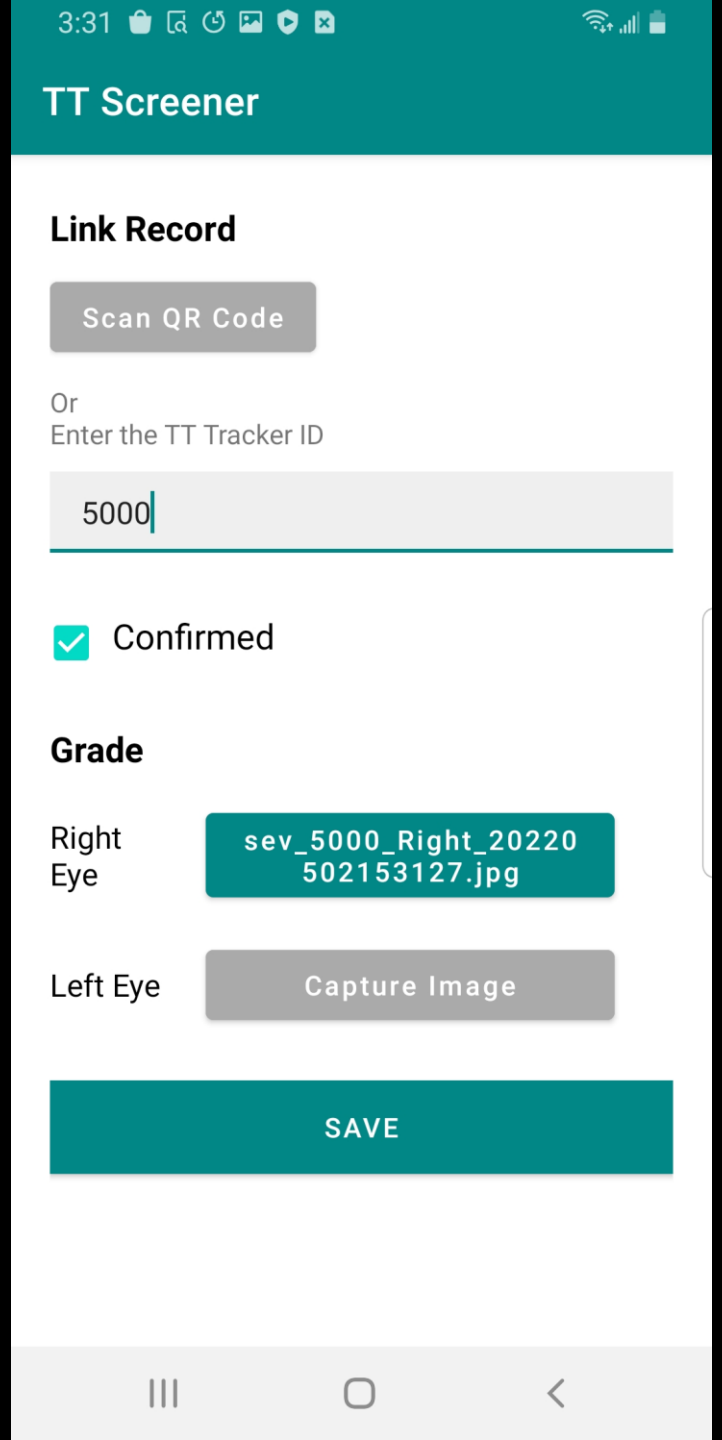
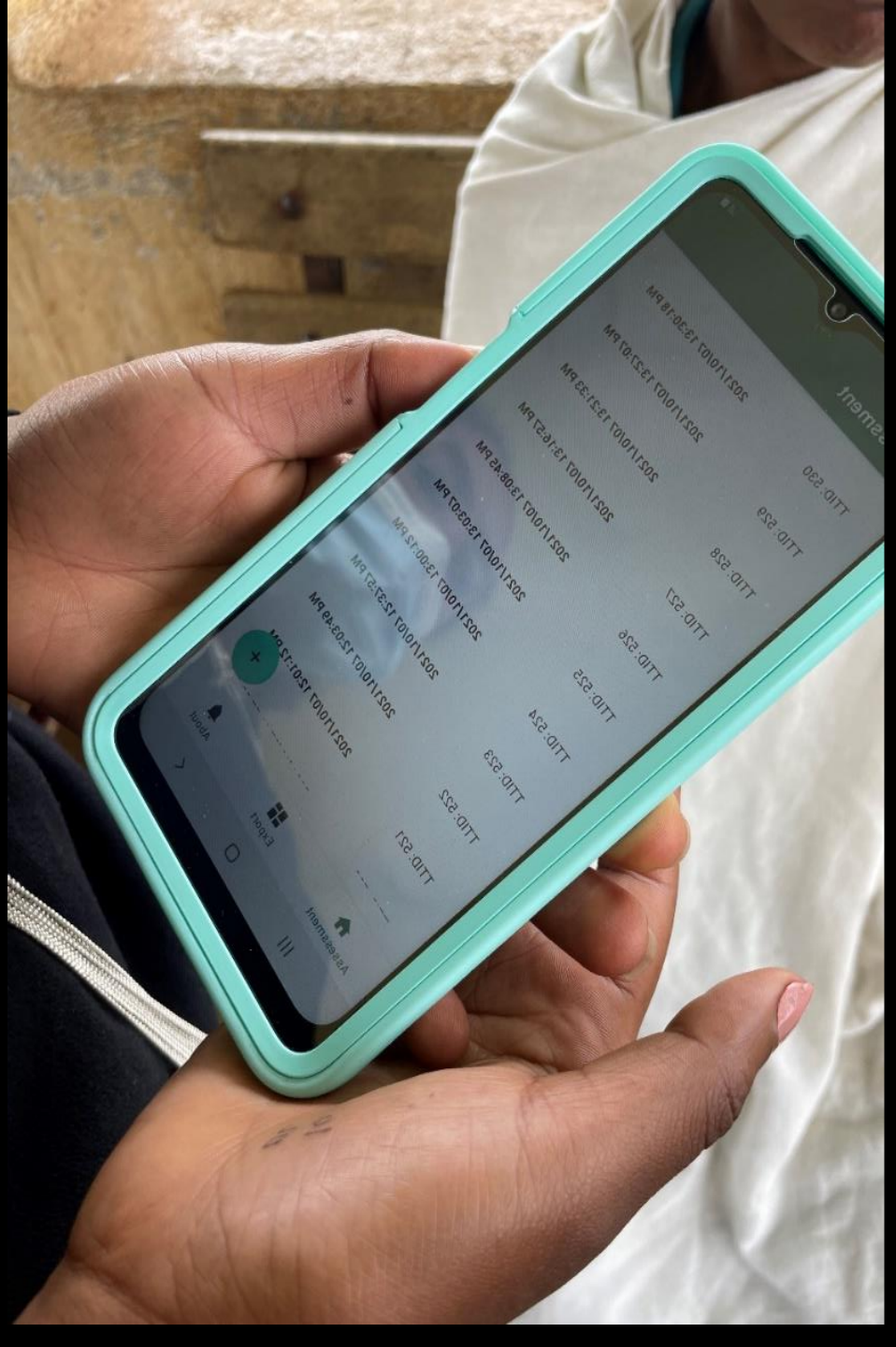

3:31
Processing...


3:31
TT Screener
Link Record
Scan QR Code
Or
Enter the TT Tracker ID
5000
Confirmed
Grade
Right Eye
sev_5000_Right_20220502153127.jpg
Left Eye
Capture Image
SAVE



Testing

- TT case finder grade
- Algorithm grade
- Compared grades
- Adjudicated discordant grades

- Countries involved:
  - Ethiopia
  - Mozambique
  - Senegal

Screening Results

District	Screening Dates	# Screened People (Eyes)	TT Case Finder Said TT Present (eyes)	Supervisor Confirmed Cases	App Identified but TTCF Missed (eyes)	Total Supervisor Confirmed TT Cases (eyes)
Kebemer	Nov 17-22, 2023	3,039 (6,078)	144	44 (31%)	8 (15%)	52
Louga	Nov 28-Dec 4, 2023	3,372 (6,744)	245	35 (14%)	5 (20%)	40
Total		6,411 (12,822)	389	79 (20%)	13 (14%)	92

Learnings

- Community very receptive to image capture
- TT Screener identified ~15% more true cases
- Reduced number of community members unnecessarily attending surgery outreach

- Variable image quality across TTCFs
- Better to train smaller groups of people
- Phone quality matters (Samsung Galaxy S better than Galaxy A)

Our Team and Funding Sources

UNC-CH

Hashiya Kana
Juan Carlos Prieto
Hina Shah
Jerusha Weaver

RTI International

Robert Chew
Rebecca Flueckiger
Mawo Fall
Biruck Kebede
Scott McPherson
Adam Preston
Rachel Stelmach

Sightsavers

Ibrahima Aw
Paul Courtright
Phil Downs
Fiona James
Michaela Kelly

Senegal Ministry of Health

Mouctar Badiane
Aliou Wade
Elimane Faye
Babacar Top
Henriette Bassene
Khady Seye

Funding

- RTI International Strategic Investment Fund
- National Eye Institute
- COR-NTD

- **Programmatic abstract:** describes an epidemiological programme, service platform or training initiative. Information presented in programmatic abstracts may not be findings of an epidemiological study; instead these abstracts present the unique features and/or learning from a programme in the field of epidemiology.
- Key components of the abstract include:
-
- Background: An overview of the public health issue or problem being addressed and the rationale for the program.
- Description: Details about the design, implementation, and evaluation of the programme, including any innovative approaches or strategies used.
- Outcomes: Presentation of the program's results, including information on its effectiveness, impact on health outcomes, and any relevant findings.
- Impact & Lessons: Interpretation of the results and their implications for the field of epidemiology and public health more generally.

- **The TT Screener: A Novel Smartphone App for Community-level Screening of the World's most Common Infectious Cause of Blindness.**
- **Background:** Trachomatous trichiasis (TT) is the leading infectious cause of blindness globally, impacting nearly 2 million people living in 40 LMIC countries. The WHO has set targets to eliminate TT as a public health problem by 2030. Countries where TT is endemic are conducting house-to-house searches to identify individuals with TT and to offer them corrective surgery. Screening programs engage local volunteers to conduct screenings, but these screening programs often have low rates of accuracy in case identification.
- **Description:** We designed an image recognition algorithm and associated smartphone app to facilitate case identification in remote settings. App users enter tracking information and then the app then prompts them to take an image of the participant's upper eyelid (Image 1). Next, the imbedded algorithm assesses the image and reports whether the eye has TT. We tested the app in Mozambique, Tanzania and Senegal, with a variety of app users.
- **Outcomes:** Assessments conducted in Ethiopia and Mozambique using trained TT graders and recorders and Samsung Galaxy S series phones showed that the app was easy to use and readily accepted by the communities. The algorithm had > 93% accuracy and identified 15% more true TT cases than the trained graders. Over 90% of images were of adequate quality for algorithm assessment.
- We further tested the app in Senegal with 74 TT case finders we trained to use smartphones and to take upper eyelid images. They screened >7,400 community members. We initially used lower quality phones but faced problems processing images quickly. So, mid-project we switched to S series phones for improved computing power. The app again identified 13-15% more true TT cases than the local community members. Image quality varied across TT case finders.
- **Impact and Lessons:** Community members can collect data on smartphones, and communities are receptive to the use of photography as part of TT screening. Given the variability in skills across community members, an initial screening process to identify good quality photographers is essential for maximizing screening success. Additionally, phone computing quality is an important consideration when selecting devices not only for image capture but also for computing capacity.

Supervisors Roles

4-5 TTCF/Supervisor

Supervisors assisted in training TTCF on image capture

Revisit households with algorithm-suspected TT cases

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