HEAD
Helminth Egg Automatic Detector

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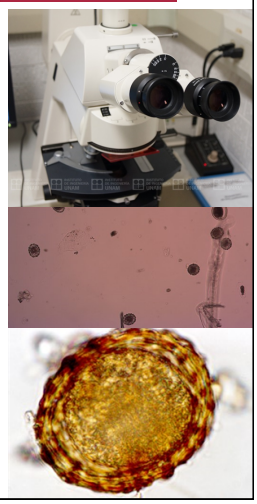
BILL & MELINDA GATES foundation



Software to identify and quantify helminth eggs

Catalina Maya & Antonio Barrios
Instituto de Ingeniería UNAM

PI Meeting
Validation of both automated quality assured egg counting system and molecular markers for monitoring the spread of anthelminthic resistance
Ghent University, Belgium
February 24-26, 2016.

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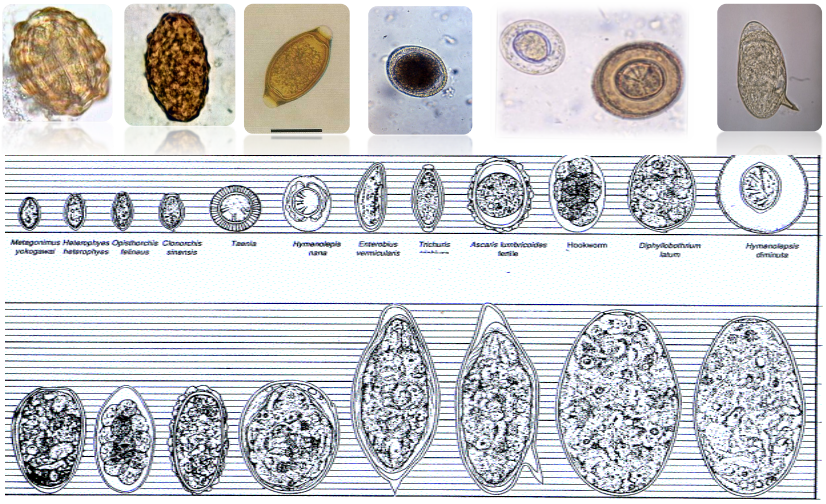
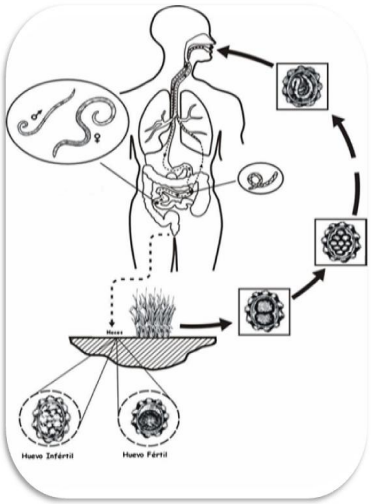
Wastewater in Agriculture

- Saves first-use water
- Reduces production costs and the use of artificial fertilizers
- Increases crop yield
- Reduces pollution…
- It May contain helminth eggs

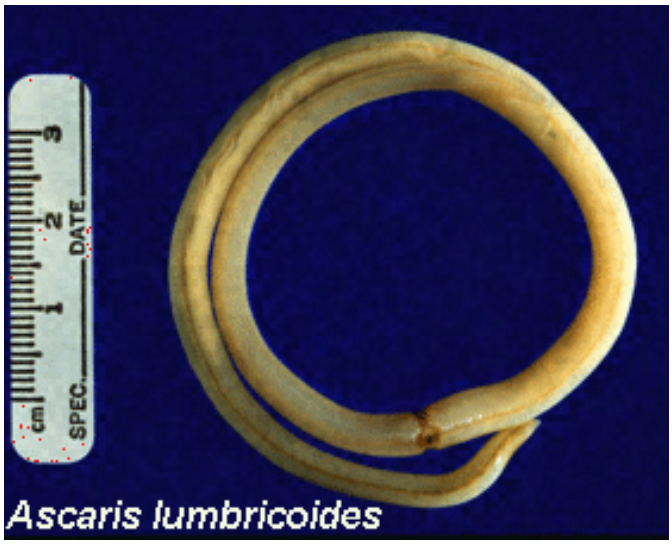
Parasites associated to human life





Health risks

- 3,500 million infected
- 80,000 annual deaths
- Malnutrition
- Anaemia
- Digestive infections
- Diverse malformations

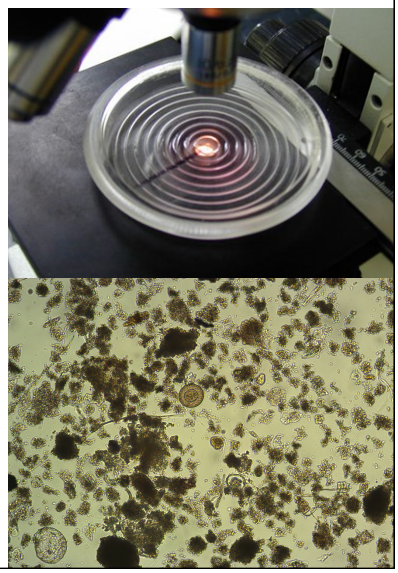


Techniques evaluated

- US EPA (Yanko, 1992)
- Membrane filter (Galván *et al*., 1996)
- Leeds I (Ayres, 1989)
- Faust (Faust *et al*., 1939)
- qPCR (Pecson *et al*., 2006 & 2007)

Traditional methods for helminth determination

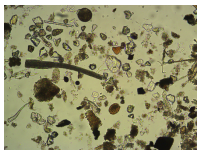
- Performed by visual identification
- Require highly trained personnel
- Time consuming
- Differences in results between technicians, even in the same sample (subjectivity)
- Under/over counting



An Alternative

Software:

- Algorithms
- Digital image processing
- Pattern recognition systems
- Based on morphological and texture characteristics



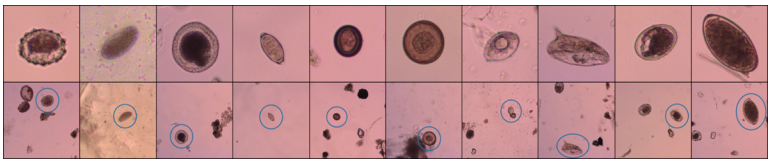
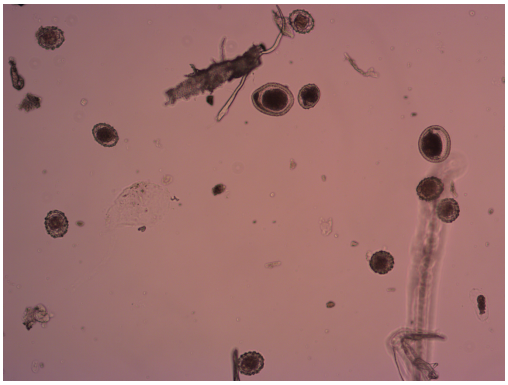


Image acquisition

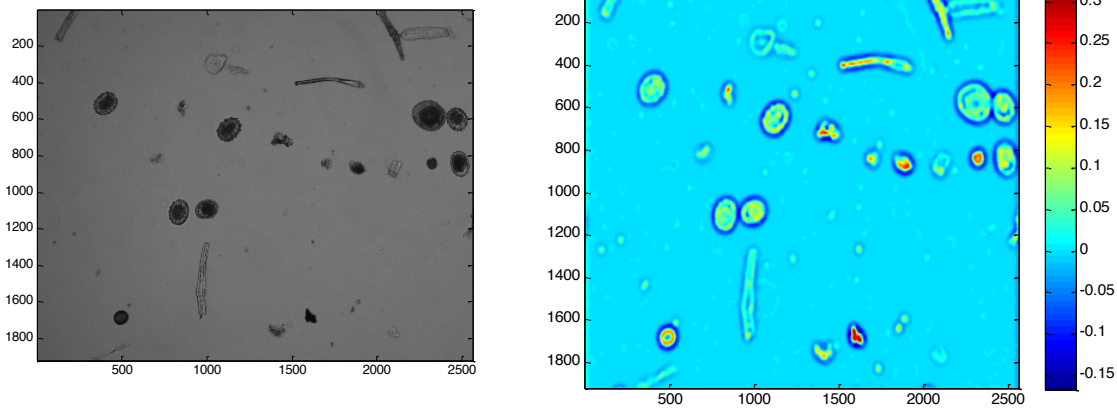
To train and validate the software:

~1,000 images were used



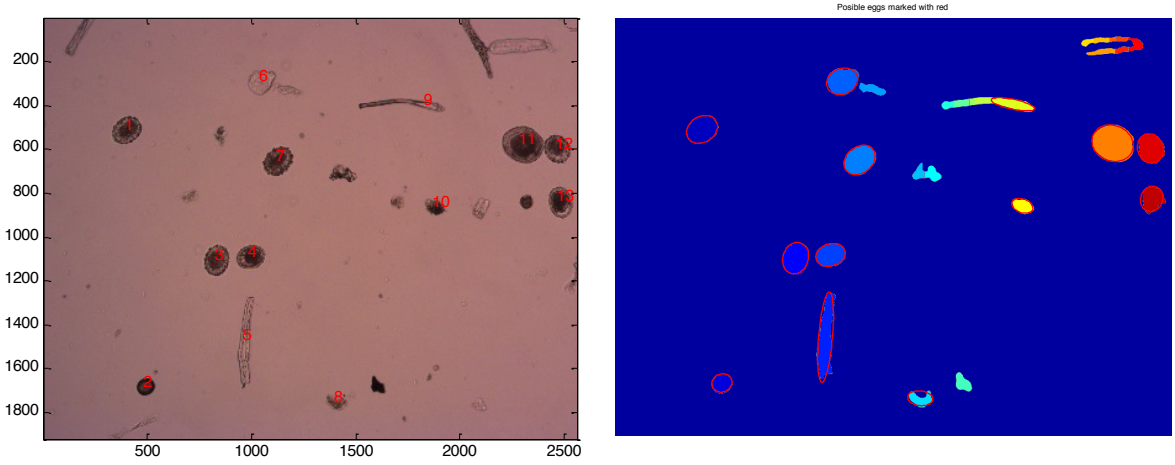
Object segmentation

To locate potential eggs on an image, border detection algorithms were used on greyscale images



Morphological filtering

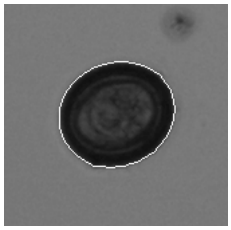
Detected objects whose size and form meet a predetermined threshold are marked as possible helminth eggs.

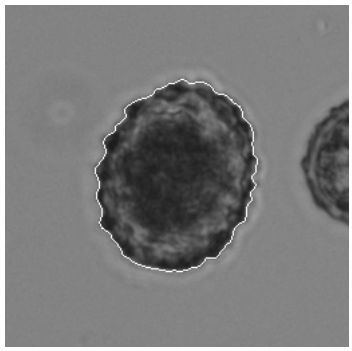


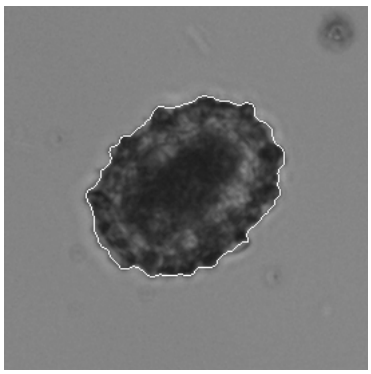
Obtaining characteristics

Main characteristics:

Form (e.g. perimeter and area), texture, etc.

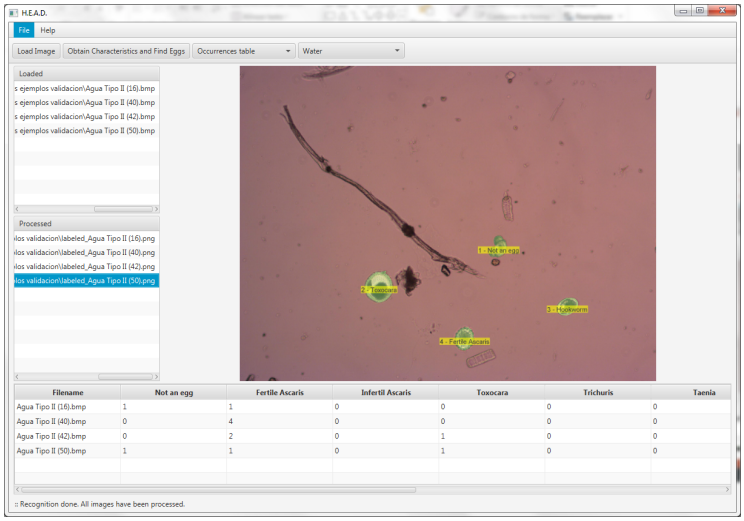






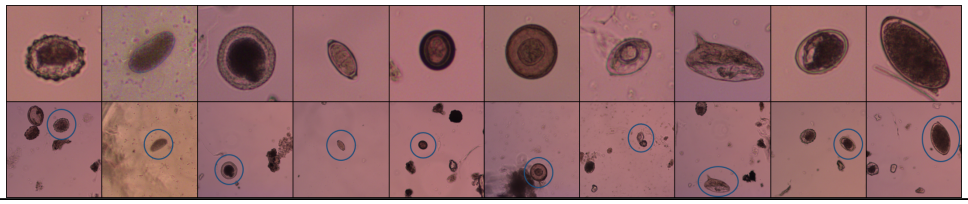
Classification

- Classification is performed, based on the distance between the characteristics of a possible egg and the ones in the database.
- Finally the object is statistically validated to ensure it is actually an egg.
- The image is labelled and the eggs are quantified.

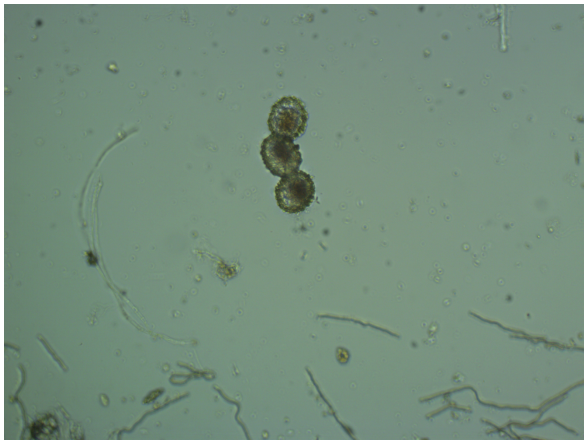


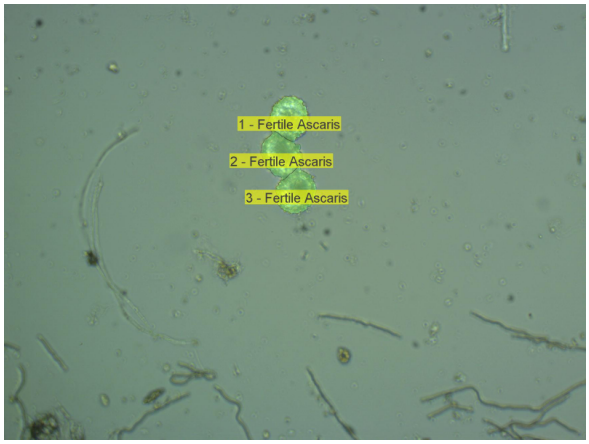
Advantages

- Sensitivity and specificity over 90% in wastewater, soil, sludge and excreta samples.
- Identifies 11 different helminth eggs species (possibility to increase this number).
- Easy to use.
- Useful and accessible alternative.
- Cloud computing.
- A valuable tool to improve sanitation and quality of life.



Actual examples





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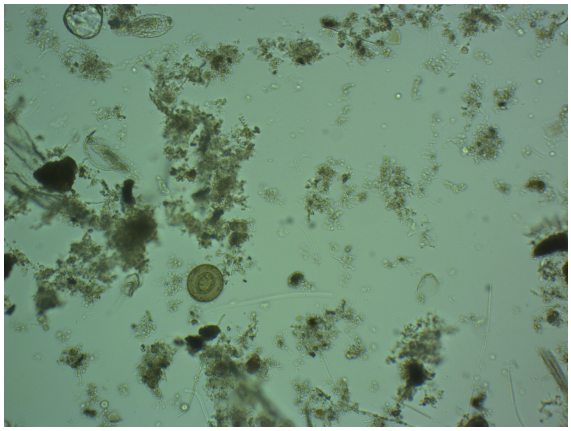

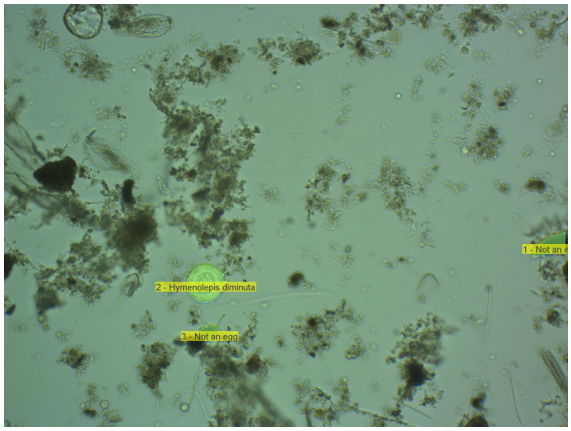

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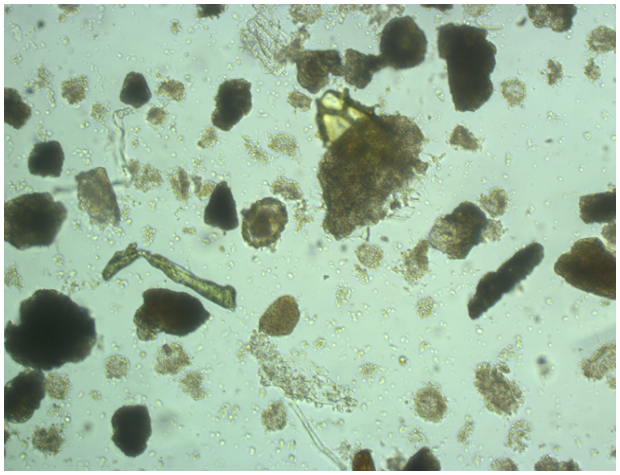

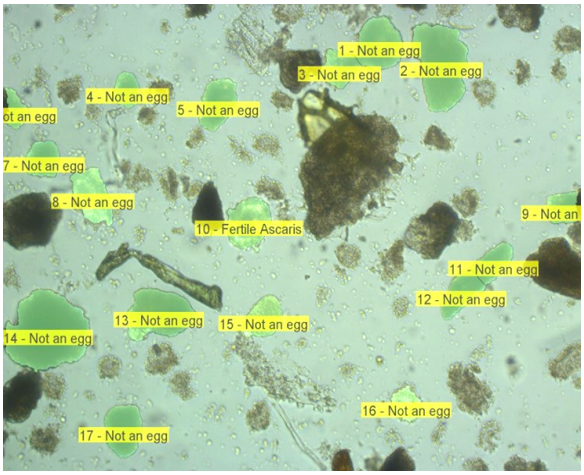

Current state of development

- Validation in France, Colombia, and Brazil.
- Need for a scaling module to account for different conditions.
- Integration of scaling module in existing software versión.
- Software ready in a couple of months.

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Thank you for your attention.

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Helminth eggs identified

- *Ascaris:*
  - Fertile
  - Unfertile
- *Toxocara*
- *Trichuris*
- *Taenia*
- *Hymenolepis diminuta*
- *Hymenolepis nana*
- *Schystosoma mansoni*
- *Hookworms*
  - *Necator*
  - *Ancylostoma*
- *Fasciola hepatica*