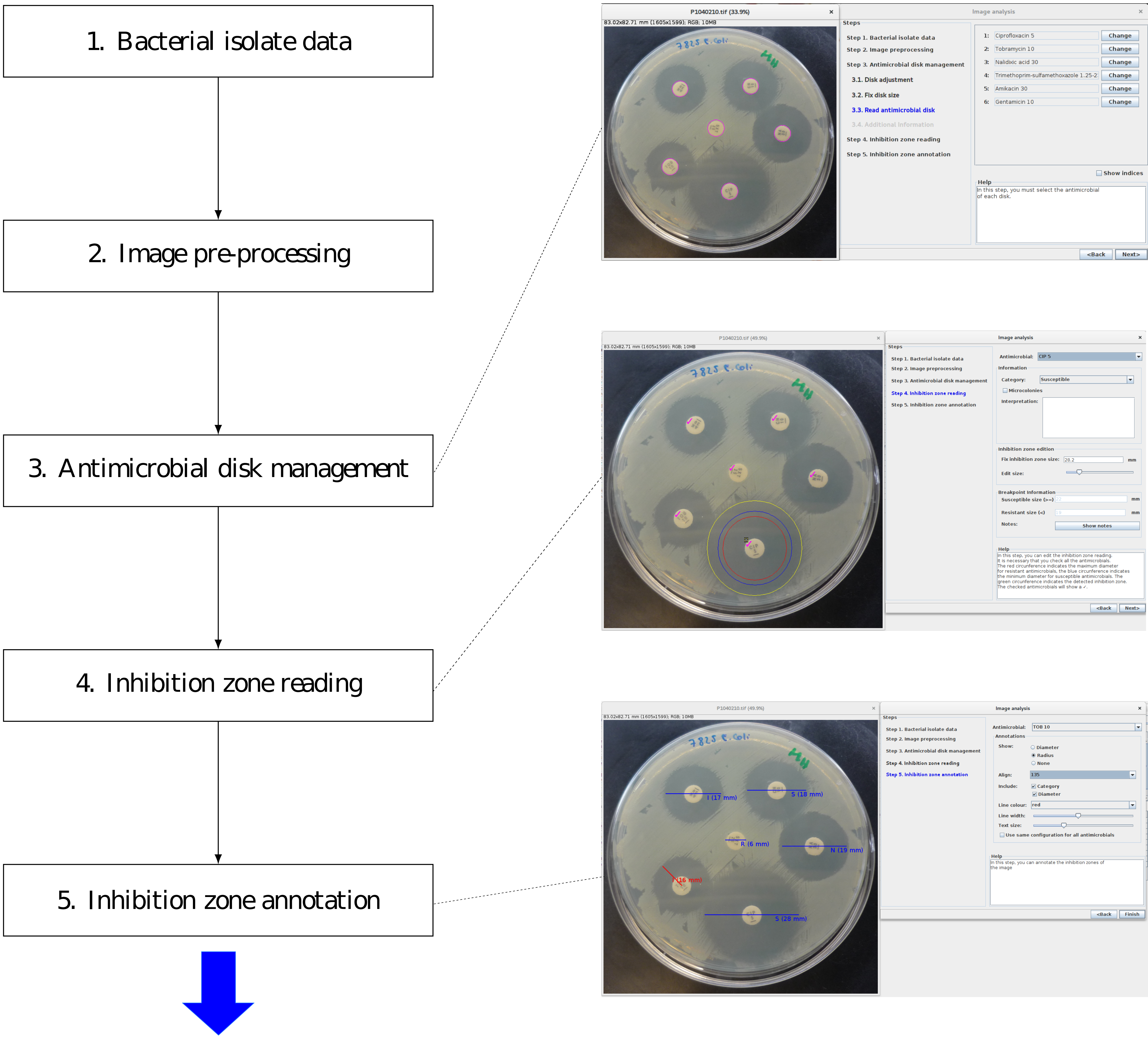




Abstract

Disk diffusion testing [1], known as antibiogram, is widely applied in microbiology to determine the antimicrobial susceptibility of microorganisms. The measurement of the diameter of the zone of growth inhibition is frequently performed manually by specialists using a ruler since automated or semi-automated readers are expensive instruments with embedded software that require significant changes in laboratory design and workflow [2]. AntibiogramJ is a user-friendly and open-source software tool to semi-automatically determine, measure and categorise inhibition zones of images from disk diffusion tests. AntibiogramJ is implemented in Java and deals with images captured with any device that incorporates a camera, including digital cameras and mobile phones.

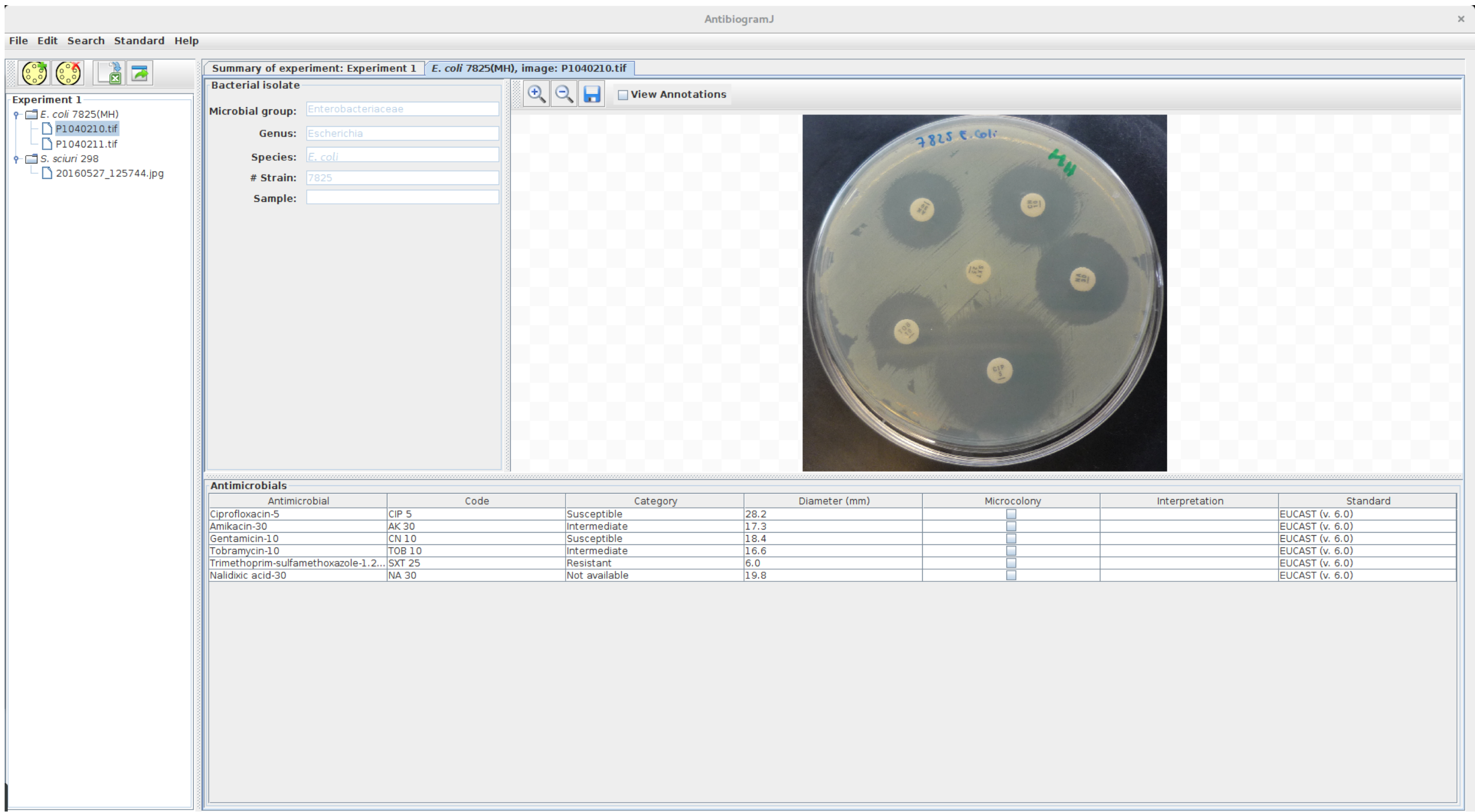
Workflow to analyse images from disk diffusion tests



Left. In the plate image, the purple circles indicate the automatically detected antimicrobial disks (the user can add or remove disks if needed). **Right.** Plate analyser wizard showing the codes of the antimicrobial disks. These codes are automatically read using a learning system based on a matching procedure.

Left. In the plate image, the red circle indicates the limit of the resistant value, the blue circle indicates the limit of the susceptibility value, and the yellow circle the detected inhibition zone. **Right.** Plate analyser wizard showing (1) information about the selected antimicrobial (category, whether it has microcolonies (in the inhibition zone), and interpretation given by the user), (2) options to edit the inhibition zone (by changing the size in mm of the inhibition zone or by moving a slider), (3) breakpoint information provided by the standard.

Left. In the plate image, each inhibition zone has been annotated with its category and the diameter in mm. **Right.** Plate analyser wizard showing the different options to annotate the image.



Conclusions

AntibiogramJ is, up to the best of our knowledge, the most complete software tool for antibiogram analysis without requiring any particular hardware system. The agreement percentage obtained automatically by AntibiogramJ when compared to manual measurements is similar to those reported in the literature for special purpose systems; in addition, the users of AntibiogramJ can easily detect when the automatic reading has failed and fix it.

Availability

- Project home page: <https://sourceforge.net/projects/antibiogramj/>
- Operating system(s): platform independent
- Other requirements: Java 8

Implementation

AntibiogramJ relies on several third-party libraries: ImageJ (functionality for image processing), OpenCV (computer vision and machine-learning algorithms), IJ-OpenCV (interoperability between ImageJ and OpenCV), and JavaDB (database to store results).

Bibliography

- [1] A. Bauer et al. *Antibiotic susceptibility testing by a standardized single disk method*. Am. J. Clin. Pathol. 45, 493-496, 1966.
- [2] D. D. Rhoads et al. *A review of the current state of digital plate reading of cultures in clinical microbiology*. J. Pathol. Infor. 6 (23), 2015.