Scientists use a gaming algorithm to enhance a DNA sequencing Android app

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The accuracy of a smartphone app called GelApp, designed by A*STAR scientists to help analyze biomedical samples, has been greatly enhanced by the addition of a cutting-edge image processing algorithm.

GelApp was developed in 2015 by intern Jia-Zhi Sim under the supervision of Samuel Ken-En Gan and Hwee Kuan Lee at the A*STAR Bioinformatics Institute. The app analyzes and labels outputs from 'gel electrophoresis'—a common laboratory technique that separates and identifies molecules, such as DNA and proteins, by passing a sample through a gel under electric charge. Individual molecules move through at different speeds, so they separate out and create a pattern of bands across the surface. Gel band images are traditionally analyzed by eye and labeled by hand; the size of each band indicates which precise molecules are present, and highlights where genes are truncated or proteins are altered.

"Eyeballing band size means that subtler details might be missed, not to mention the time demanded by the task," explains Gan. "While our first GelApp went a long way to enable automated analysis, there are still improvements to be made."

The A*STAR team and their collaborators in France wanted to improve GelApp's functional accuracy when faced with variations in experimental set-ups, cameras, lighting, reflections and blurring.

"We looked to machine learning and advances in computer gaming to

find a solution," says Lee. "We settled on a Monte Carlo Tree Search algorithm, used to great effect in Google's Alpha-Go, which we trained using expertly-labeled gel band images. The algorithm then continues to learn from individual GelApp users according to their own laboratory set-up and inputs."

GelApp uses image filters linked in a chain. Each filter heightens the sharpness and accuracy of band detection by reducing noise and pinpointing the horizontal edges of each band. The algorithm automatically selects the best five filters from a filter bank to provide the best match to manually-analyzed images, before GelApp is used on new images.

The team found GelApp 2.0 enhanced band detection accuracy by around 56 per cent for proteins and around 36 per cent for DNA compared with the original app.

"With better automation, there is less room for error, greater standardization and accuracy; this in turn enhances experimental reproducibility," says Gan. The team hope to expand the use of Monte Carlo algorithms in image processing, for example in analyzing tissue images for disease diagnostics.

More information: Phi-Vu Nguyen et al. Optimal processing for gel electrophoresis images: Applying Monte Carlo Tree Search in GelApp, *ELECTROPHORESIS* (2016). DOI: 10.1002/elps.201600197

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