Researchers develop a pioneering mobile application for portable analysis of DNA sequences

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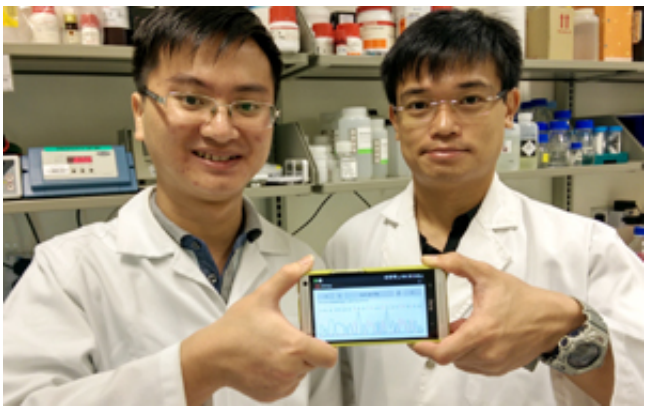

Samuel Gan (right) and Phi Vu Nguyen (left) from the A*STAR Bioinformatics Institute have developed DNAApp — a convenient app for analyzing DNA sequencing files on mobile devices. Credit: A*STAR Bioinformatics Institute

A*STAR molecular cell biologist Samuel Gan was in the midst of an exasperating work trip in Shanghai, China. Away from his office, his email inbox was filling up with DNA sequencing files that needed his urgent attention.

Gan's research group in Singapore is engaged in therapeutic antibody production and had engineered DNA molecules known as plasmids to transmit protein-encoding information into cells. Before the plasmids could be introduced into cells, however, their DNA sequences had to be

determined and verified. But with no way to interpret these sequences on his smartphone, Gan was unable to instruct his team back home to begin the next stage of producing antibodies.

"I asked myself: 'Why can't I use my phone to do something so simple?'" explains Gan, team leader of the Antibody and Product Development Laboratory at the A*STAR Bioinformatics Institute (BII). "I was frustrated."

Knowing there had to be a way to unlock the processing power contained in his smartphone to decode the sequencing files, Gan posed this challenge to a research officer in his team, Phi Vu Nguyen. Within three months, Nguyen had developed 'DNAApp'—the first mobile application, or app, for viewing and analyzing DNA sequencing files on an Android mobile device. And since its April 2014 launch, close to 700 scientists in over 11 countries have already downloaded Android and iOS versions of the app.

Decoding DNA

DNA sequencing methods allow scientists to determine the precise order of the four basic units, or 'bases', of DNA—adenine (A), guanine (G), cytosine (C) and thymine (T)—in a sample. These methods have been used to sequence DNA strands of varying lengths from individual genes to the 3 billion base pairs of the human genome. By analyzing this genetic information, researchers can identify sequence mutations to improve our understanding of the genetic causes of a range of diseases, with the added possibility of finding treatments.

Conventional sequencing technology employs automated machines to record the information contained in genetic material as raw data in the 'Ab1' file format. "Anyone who works on gene sequences will be familiar with these files," explains Gan. Until now, researchers have

relied on conversion programs designed for personal computers to translate this data into more intelligible sequences of As, Gs, Cs and Ts, which has prevented them from completing sequence analysis while away from their desk. With DNAApp on the scene, scientists can now undertake this task wherever they may be.

Mobile revolution

In Gan's eyes, mobile applications are the next frontier in helping scientists keep up with the increasing demands of speedier science, especially in the field of gene sequencing. "Fifty to sixty years ago, a researcher may have been able to publish a paper in the journal *Nature* after cloning a particular restriction enzyme," notes Gan. "Today, even sequencing a whole genome may not generate sufficient data for publication in a high-impact journal."

The formerly labor-intensive and time-consuming work of sequencing a gene can now be completed in a day at an industrial scale and without human intervention. Next-generation sequencing technologies promise complete sequences of five human genomes within a week, compared to the decade it took to decipher the first human genome. "Whole-genome sequencing is now part of the norm," adds Gan. "Our standards have gone up and we need to move along with those standards."

Until recently, however, mobile apps had not taken advantage of the processing power and tools built into smartphones in a way that really contributed to research. "Many existing apps are simply textbooks pasted into an application," says Gan. "DNAApp could transform the way that scientists view their phones as a tool for increasing productivity."

Screening sequences

DNAApp lets users work through DNA sequencing tasks with a few simple gestures—allowing them to easily visualize sequences and assess the quality of their samples. Researchers can copy, cut and paste sections of genetic code, and even search, locate and jump to sections of interest in the sequence.

Another useful function of DNAApp is the ability to convert a DNA sequence into its 'reverse complement', replacing each base in a sequence with its natural partner—A with T, and G with C. This feature is especially useful when initial sequencing is performed on the DNA strand that pairs with the strand of interest.

In addition, DNAApp's 'translation' feature can interpret the sequence of bases as a chain of corresponding amino acids, enabling a deeper investigation of the effects of mutations, for example to determine the association between small changes in the DNA sequences that encode viral proteins and drug resistance.

Users are already finding DNAApp to be an essential tool. "It has released me from being stuck in front of a computer or a laptop," explains Gan. "I can do sequencing analysis on the go: on the bus, on the train—basically anywhere."

Feedback from those who have downloaded the app has been extremely positive. "It has been rewarding to create something that makes the life of a researcher easier and helps to move their research forward," says Gan.

Advanced automation

Gan and Nguyen plan to develop further apps that they hope will make the life of the experimental scientist easier as well as establish the smartphone as a convenient tool for the lab. Frank Eisenhaber, executive

director of the BII, has pledged his continued support for these endeavors, stating that: "We will continue to develop creative ideas for useful and efficient tools and techniques in computational biology for applications in the life science field."

Smartphones, of course, take up only a slice of the innovation potential in the broader field of computational biology, points out Gan. His dream is to have robots perform experiments for him, so that he can concentrate his efforts on the theoretical—rather than the operational—aspects of his research. "And with advanced automation already built into a lot of laboratory equipment, that reality may not be too far off," he says.

More information: Download DNAApp from Google play (Android): play.google.com/store/apps/det … i.seqdatreader&hl=en

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