CYDNEY SCOTT

■ Stephanie Simms found that the clay balls she discovered in Maya ruins had been heated to temperatures comparable to those in an open fire pit.

and today the Maya still line pits with stones, build a fire on top, and cook root vegetables or corn. Even before the balls' history of exposure to high heat had been confirmed, Simms extracted residues from cracks in the balls and found traces of starch from maize, beans, and squash, a strong indicator that the balls had been in contact with food.

In the lab, Simms used samples of Yucatán clay to re-create the work of the Maya. "I cooked the balls in different places at different temperatures and saw these interesting iron depletion patterns," says Simms, who ran the experiment in a closed environment—a furnace—as well as in an open outdoor fire pit.

The next step was to enlist the help of Francesco Berna, a CAS adjunct assistant professor of archaeology and an expert in ancient pyrotechnology, as well as of a state-of-the-art analytic tool called Fourier transform infrared spectroscopy (FTIR). When rocks and clay are exposed to extreme temperatures, their mineral composition changes; FTIR, guided by a microscope, can meticulously graph those changes.

With the test balls as reference, Berna calibrated the thermal behavior of soil from the site, which served as a point of comparison when he analyzed the excavated samples. The most common mineral in the Yucatán soil, kaolinite, survives up to 500 degrees Celsius (932 degrees Fahrenheit), while smectite and mica survive up to 700 degrees Celsius (1,292 degrees Fahrenheit). Knowing the concentrations of these minerals in the starting materials, Berna was able to "map" the balls' histories of heat exposure. He and Simms found that the balls from the site burned at temperatures comparable to the test balls they burned in an open fire pit.

Based on the evidence, which they outline in the 2013 issue of the *Journal of Archaeological Science*, Berna and Simms are fairly certain the Maya formed the balls with clay left over from crafting pottery. "Kaolin is really good for this purpose," says Berna. "It's nonswelling and won't crack, so it's perfect for pottery and ceramics." The researchers also believe that because the grain residue is small and random, the balls probably had little direct contact with food and were used mainly to control the distribution, and extend the life, of the oven's heat. The balls could also have been used for "hot-rock" boiling, either placed in water or in bean pots, a technique Native Americans still use, but with stones rather than clay.

Simms next will turn her attention to identifying and analyzing the elusive cooking hearths, if any survived. And more analysis is needed to determine whether use of the fired clay balls was restricted to the Puuc region, where they were found, or was a common practice among all the Maya. It seems clear that for at least these hilltop settlements, the clay balls formed an important part of what the researchers call "the culinary toolkit."

Opening Movements

YOUR NEXT SECURITY ID MAY BE A DEFINING GESTURE

BY RICH BARLOW

TO THE CASUAL passerby, Janusz Konrad may seem a bit fanatical about tai chi: standing in his office, waving one arm, then spreading both arms and bringing them together. Duck inside, however, and you'll notice he's not stretching for his health; he's stretching for a camera, and images on a computer monitor are responding to each gesture—zooming in and out of photos or leapfrogging through a photo series.

Konrad, a College of Engineering professor of electrical and computer engineering, and Prakash Ishwar, an associate professor, designed the computer's algorithms to recognize specific body motions. They're not making video games. This, they hope, is the future security portal to your smartphone, tablet, laptop, or the locked door: software programmed to recognize a gesture, from your torso, your hand, or perhaps just your fingers.

Armed with an $800,000 grant from the National Science Foundation

THE NEW CYBERLOCK? Janusz Konrad demonstrates the kind of body motion his computer algorithms recognize. He and his colleague Prakash Ishwar hope that this is the future security portal to your smartphone, tablet, laptop, or the locked door: software programmed to recognize a gesture, from your torso, your hand, or perhaps just your fingers.

PHOTOGRAPHS BY MELODY KOMYEROV

Researchers believe that certain body parts, like hands, lend themselves to identity authentication better than others.

and collaborating with colleagues at the Polytechnic Institute of New York University, the BU duo is developing algorithms for ever-smarter motion sensors. In doing so, they have to thread a tricky technological needle. “On the one hand,” says Ishwar, “you want security and privacy; nobody else should be able to authenticate on your behalf” by aping your gesture. On the other hand, if the system demands a perfectly precise gesture, you may have to flail your arms or other parts 10 times to get into your own account. “That’s annoying,” he says.

WEB EXTRA
Watch a video of ENG professors demonstrating the computer algorithms they are developing to recognize specific body motions at bu.edu/bostonia.

A workable system must be able to screen out distractions, like the motion of someone moving behind you or of the backpack you’re wearing, or changes in ambient lighting.

Yet using gestures as keys to cyberlocks would have some great advantages. A gesture, like a lateral swipe of your hand, has “subtle differences in the way people do it,” Ishwar says—and people vary in arm length, musculature, and other traits that might help a detector distinguish between you and Arnold Schwarzenegger or Elle Macpherson. True, gestures aren’t as unique as fingerprints or as irises, for which there are authentication scanners. But unlike those traits, which theoretically are vulnerable if someone hacks the database storing them, an authenticating gesture that’s been compromised by an impostor can be replaced immediately. Getting a new fingerprint? Well, “you wouldn’t like it,” says Ishwar.

Security passwords pose another problem: the most effective ones tend to be inconveniently complex. Konrad surveyed one of his classes and found that no one used a smartphone passcode longer than four digits. An effective motion sensor could “simplify, make more secure and more pleasant the process of logging in,” he says. He and Ishwar are developing gesture-based authentication algorithms to be test-run on Microsoft’s motion-sensing Kinect camera, used with the Xbox video game console and the Windows computer operating system. “It can track your body,” Ishwar says, “get some skeleton approximation for your body, and then that information is provided to you in some real-time format.”

They also hope to use start-up company Leap Motion’s smaller motion-sensing device for notepads and laptops. The company claims that its device, the size of an iPod, will be able to read “micro-motions of your fingers,” says Konrad. In the next three to four years, “we want to develop something that’s extremely simple, inexpensive, and can be embedded into other products and could be used daily by millions of people.”

One thing that’s clear is that certain body parts, like hands, lend themselves to identity authentication better than others. “The degree of freedom that you have with your hands is significantly higher,” Ishwar says. “Maybe if I’m a yoga master, I can move my right leg and put it across my left shoulder, but most people can’t do that.” They’d like to experiment also with the torso, says Konrad, since people’s posture can vary. Then there’s Leap Motion and its potential finger recognition.

“We plan to involve more and more body parts” as the research progresses, Konrad says. If that sounds vaguely Frankenstein-ish, consider that today’s security technology already involves fingerprints, iris scans, and face recognition. “Wouldn’t it be nice,” muses Ishwar, “if we could do that using our everyday body language or gestures?” ■