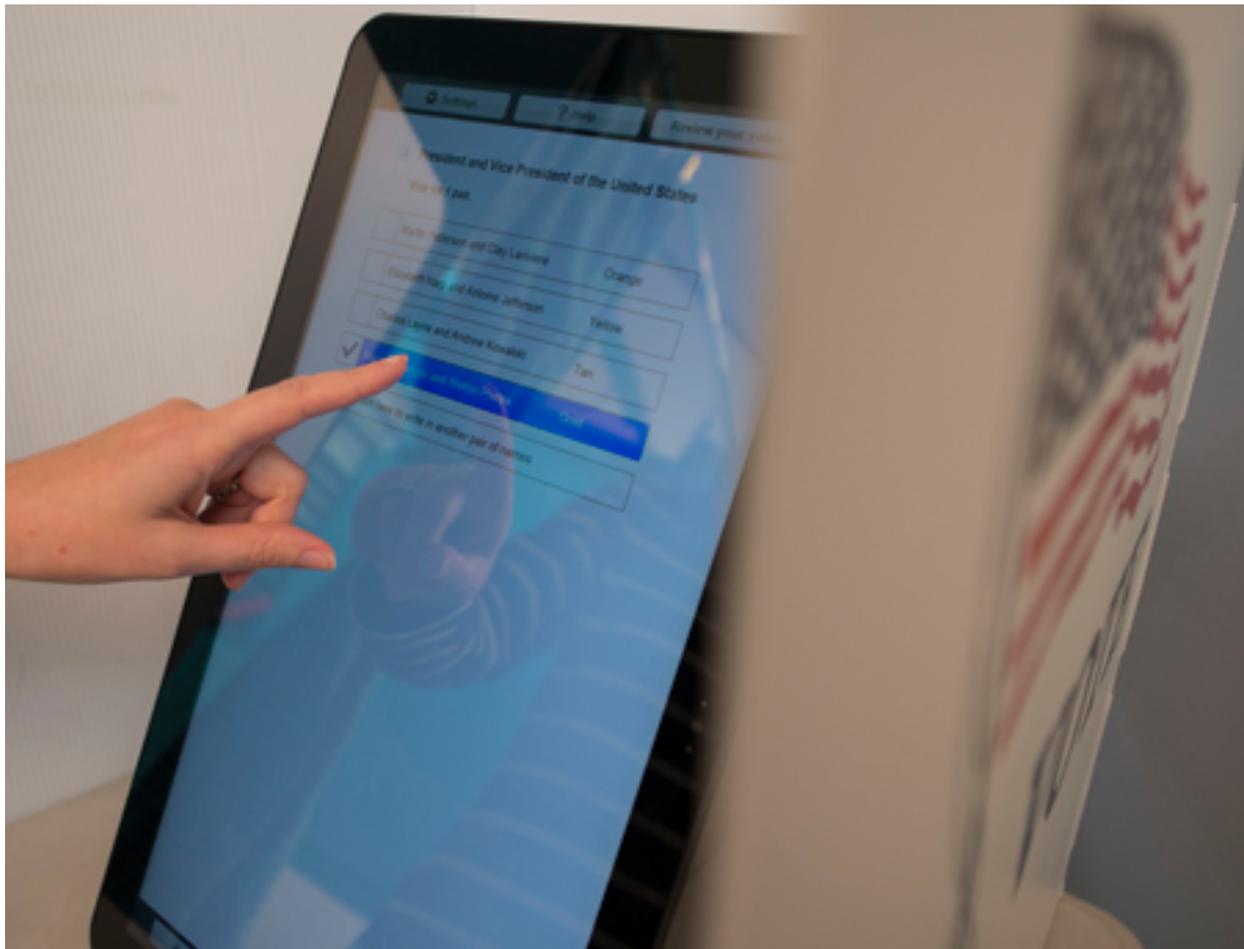# New Model of Digital Election Equipment Produces Instantly Verifiable Results

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(TNS) — The drumbeat of election rigging and foreign hacking of voting machines have energized ongoing efforts to develop a new model of digital election equipment designed to produce instantly verifiable results and dual records for security.

Election experts say this emerging system, one of three publicly funded voting machine projects across the country, shows potential to help restore confidence in the country's election infrastructure, most of which hasn't been updated in more than a decade.

"It's the hardest thing I've ever done in my life. It's taken years and years to get it done," said Dana DeBeauvoir, the Travis County clerk and leader of the voting machine project. "Now that we've had this election, there's renewed interest."

A prototype of the system, dubbed STAR Vote, sits in an engineering lab at Rice University, and bidding is open for manufacturers who want to produce it wholesale.

Similar efforts to innovate voting systems are in the works in Los Angeles and San Francisco.

"County clerks in these jurisdictions are the rock stars of running elections," said Joe Kiniry, CEO of Free & Fair, an election systems supplier currently bidding on contracts to manufacture the designs of both Travis and Los Angeles counties. "If they have success in what they do, it will have, in my opinion, a massive impact on the whole U.S."

Like any aging digital device, the voting machines are eventually bound to stumble, said Lawrence Norden, deputy director of the Democracy Program at the Brennan Center for Justice. He pointed to Detroit, where the number of votes counted didn't match the number of voters who signed in. And he noted that reports of machines flipping votes more likely result from aged touch screens than a conspiracy to rig the election.

Yet there is seldom space in county budgets to replace the machines, which cost usually between $3,000 and $5,000 each. The vast majority of electronic voting equipment was purchased with federal funds from the Help America Vote Act of 2002. Most money reached the states by 2004, and there's no foreseeable second wave of federal aid.

"This is really an oncoming crisis," said Norden, who interviewed more than 100 election officials for a 2015 report about aging voting equipment published by the Brennan center. "A lot of election officials have been unhappy with the choices that the major vendors are providing."

That's how DeBeauvoir felt 15 years ago. She's run Travis County elections since 1987, and upgraded to digital equipment in 2001. Almost immediately the criticism came flying.

With no paper trail, voters suspected that the machine hadn't accurately tallied their vote. And DeBeauvoir said wary voters were egged on by critics who talked about fatal software flaws or malicious code planted as a "Trojan horse."

'A powerful new paradigm'

Chief among her critics was Dan Wallach, a voting systems specialist at Rice University. He would demand a litany of complicated software tests then remain skeptical when the results showed nothing fishy afoot, she said.

DeBeauvoir told Wallach, "OK, enough. You think that what I'm doing isn't good enough. You tell me what is good enough."

If the best systems available didn't satisfy the critics, then she'd gather the critics to make something better, and she tapped Wallach to take the lead.

"That is not the kind of call I get every day," Wallach said. "I said, 'Can I invite my friends?'"

One long weekend in 2012, the team gathered in Austin, with software engineers, statisticians, cryptographers, security gurus, elections staff and specialists on human-computer interactions.

"It was a meeting unlike anything I expected," said Josh Benaloh, a senior cryptographer at Microsoft Research, who helped design the system.

He expected a brief talk with officials. Instead, the team hunkered down in a conference room with DeBeauvoir and her staff until they had a working design, three days later.

"We had something we were proud of," Benaloh said. "It's a powerful new paradigm, very different from the voting systems that people use."

The team conceived STAR Vote, short for Security, Transparency, Auditability and Reliability, designed to address some prolific problems.

Primarily, the team aimed for a digital system with easily verifiable results. So they devised a machine that records an electronic vote, then prints a copy of the paper ballot, which the voter examines then puts in a ballot box. If there are concerns about the accuracy of electronically tabulated results, they can be compared with a sampling of the paper ballots.

"It has a belt and suspender approach to verifiability and security," said Philip Stark, associate dean of the Division of Mathematical and Physical Sciences at the University of California, Berkeley, who collaborated on the design.

Machine leaves dual record

STAR Vote runs automatic audits, comparing a statistical sample of the paper ballots with the digital records to verify results.

"The savings are just enormous over doing a recount," Stark said.

While other systems allow for comparison of precinct-level data, STAR Vote can compare paper ballots with individual voters' digital ballots, which are encrypted and posted online.

Officials could take a small sample of printed ballots and compare them with digital results to conclude with high confidence that election results were correct.

The system itself is also inexpensive, built with off-the-shelf tablet computers and printers, which Wallach said will cut the price down to half of the current norm. Advanced software makes up for the cheap hardware, designers said, and they plan to make the software open-source, meaning it is free to use and, unlike current systems, can be serviced by any provider without exclusive long-term contracts.

The team's final main concern was security.

"Let's say the computer is evil. Vladimir Putin programmed this computer," Wallach said, standing beside a prototype of the STAR Vote machine in the basement of an engineering laboratory at Rice. "If he's in there, we're going to catch him."

Again, it comes down to the dual record of paper and digital ballots. Any fears of an altered digital record can be swiftly checked against the paper ballots, each of which was visually verified by the voter.

Surrounded by whiteboards scrawled with faded equations and fluorescent-lit tables strewn with electrical trimmings and discards from a 3D printer, Wallach cast a sample ballot.

The races appeared one-by-one on the screen of a Dell tablet computer, fitted into a custom module. Wallach logged each vote until a confirmation screen appeared, showing his selections. To make changes, he clicks that race, alters his choice, and returns to the confirmation screen. When content, he casts his ballot.

The module prints two papers. One is a copy of his ballot, which he reviews than feeds into an electronic ballot box beside him. The other is a receipt with an access code that lets him verify online that his vote was tallied.

Planning to test in 2020

This year, the STAR Vote team published design specifications for manufacturers who want to bid on a contract to design and build the machine.

A similar project in San Francisco remains in the planning phase with completion years away. The other project in Los Angeles is fully designed and taking bids for a manufacturer.

Michael Byrne, a Rice University psychologist who participated in both the Travis County and Los Angeles County projects, said the Los Angeles system will likely be ready for a test run in 2018, while STAR Vote aims for 2020.

California requires elections run with only paper ballots, so the Los Angeles system produces no digital record. It was designed mostly for optimal usability.

By contrast, STAR Vote sports sophisticated algorithms for encryption and security that makes results instantly verifiable.

"It represents a real change in the philosophy of how voting is handled," Byrne said.

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http://www.govtech.com/products/New-Model-Digital-Election-Equipment-Produces-Verifiable-Results.html