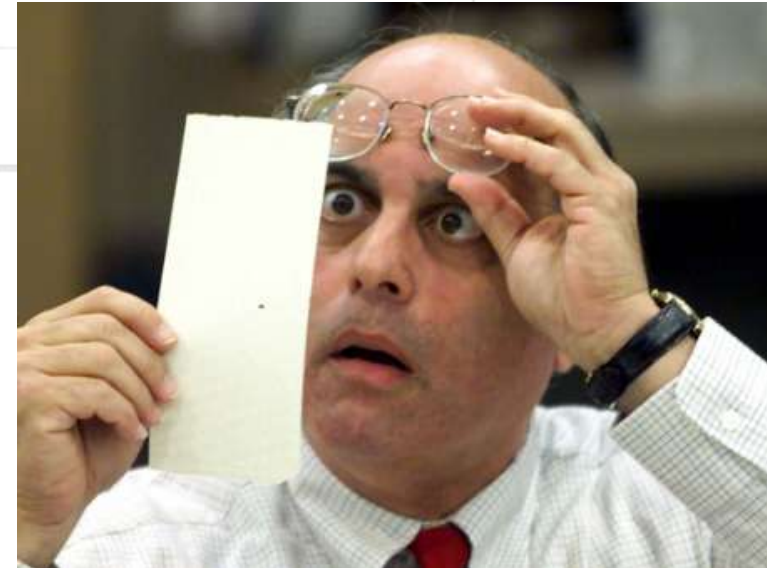


Do paper trails help?

CalTech/MIT Voting Project

Ted Selker selker@media.mit.edu

- Familiarity / (Complexity + import)
- Perceptual & Motor Accessibility
- Feedback
- Consider Review and Change



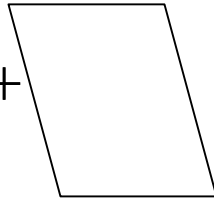
Caltech/MIT voting project

Votes that could counted...

The process has to want the votes

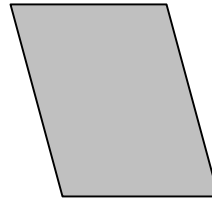
Registration 1- 3 million +

Registration is obsolete?



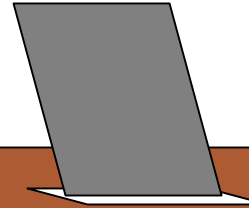
Confusing ballot 1 - 2 million

Incumbent top on ballot?



Polling place operations 1 million

Intermediaries improve confidence?

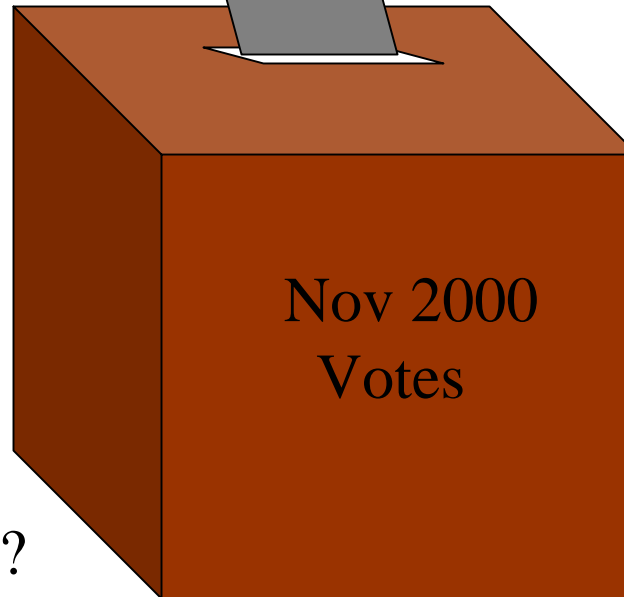


Absentee ballots ??

Rampant coercion?

Stolen or changed?

People make mistakes



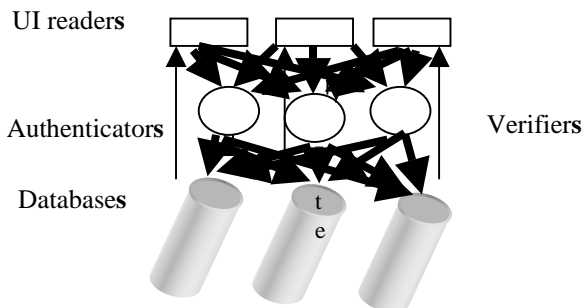
Nov 2000
Votes

Technology isn't only problem

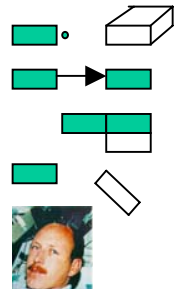
- ❑ Cook county card undercount variation .75 % to 39% no random!
- ❑ Paper 1.8%
- ❑ Punch Card 2.5
- ❑ Optical Scan 1.5
- ❑ Lever Machine 1.5
- ❑ DRE 2.3

Technology we have been making

- ❑ XML registration database verifier
- ❑ SAVE Secure Architecture for Voting Electronically
- ❑ Game machine Voting machines
- ❑ Smart Ballot design system



- ❑ Token
- ❑ Pointers
- ❑ Slider
- ❑ Check
- ❑ Lever
- ❑ Ecology



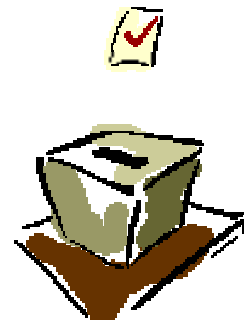
A+ checklist & Performance Standards

Knowledge and Action will help



- Usability standards history :Test with appropriate methods
 - ✓ New designs compared to performance bar
 - ✓ Many problems found in tests with few people
- Perceptual & Motor Accessibility
 - ✓ Perception, Cognition, Action, Social factors
- Feedback
 - ✓ Physical,Memory, Emotion
- Consider, Mark, Review, Change and Deposit - Coercion

Perception & Motor Problems in 2000 Elections



❑ Distinguish ability

- ✓ Ambiguity: mislabel, association
- ✓ Alignment
- ✓ Viewable height/position in list
- ✓ Poor audio: 1 ... to select gore 2...to select Bush

Democrats under “Republican” NY
Wrong odometer Boston
Everywhere
Accessibility?

❑ Feedback and Side effects

- ✓ Action
- ✓ Undo ... action symmetry?
- ✓ Visual (x not counted)
- ✓ Completion

Several levers below referendum
Punch cards, marked ballots...
Optical Scan
All but lever

❑ Validation

- ✓ Counted

Ballots, Registration - In trunks

❑ Mechanical

- ✓ Difficult to pull, push, turn grab or reach
- ✓ Dexterity, accuracy,
- ✓ Button pressure

Philadelphia ...
Punch cards!
DRE

Interaction design

Many Voting Problems Not Unique

❑ Perceptual

✓ Graphical

✓ View ability, Color, contrast, size,

✓ Readability, Distinctions, Distinguishably

✓ Precognitive, cognitive,

✓ Feedback; Proprioceptive,

❑ Cognitive Interface

✓ Precognitive recognition issues, Recognition VS Recall (except when conflicting)

✓ Short term memory 7 ± 2 (in 2 d), depth of info 2 or three

✓ Cognitive load, syntactic, semantic. bored ... overloaded

❑ Social issues

✓ You are doing Great...

✓ Your Vote Matters

✓ Androgynous Voice...

❑ Cognitive Styles

✓ Verbal/ Visual

✓ Procedural/Conceptual

✓ Myers Briggs

✓ Physical, perceptual, psychological, neurological

“Bad ballot design gave highest error rates”

Keeting et al

- Two line names
- Size
- Crossing two columns
- Two-page designs
- Running partner in same font
- Position
- Language (YES NO)

TOWN CLERK
SPECIAL ELECTION
M.S.A.D. NO. 51
N

INST
A. TO VOTE, completely fill
B. Follow directions as to the
C. To vote for a person whose name
the line provided
D. If you wrongly mark, tear

TOWN OFFICER
COUNCILOR
Cumberland Forside
To Fill Unexpired Term ending June 10, 2003
Vote for ONE (1)
 SAVASUK, MICHAEL X., SR.
 (Write-In, If any)

YES
 NO

(a) The entire additional operational costs borne by revenues raised by the District shall be paid by the State Board of Education.

(b) The estimated amount of the interest-only interim local financing on the portion of the middle school construction project approved for inclusion in the State Board of Education's 18 month period, on the portion of the of 5.00%, is estimated to be \$217,388. This amount shall be allocated to the District's debt service allocation during the period of the State Board of Education's approval of the District.

(c) The District shall be responsible for the portion of the middle school construction project approved for inclusion in the State Board of Education's 18 month period, on the portion of the of 5.00%, is estimated to be \$217,388. This amount shall be allocated to the District's debt service allocation during the period of the State Board of Education's approval of the District.

(d) The State Board of Education shall be responsible for the portion of the middle school construction project approved for inclusion in the State Board of Education's 18 month period, on the portion of the of 5.00%, is estimated to be \$217,388. This amount shall be allocated to the District's debt service allocation during the period of the State Board of Education's approval of the District.

(e) The SAD No. 51 School Board shall be responsible for the portion of the middle school construction project approved for inclusion in the State Board of Education's 18 month period, on the portion of the of 5.00%, is estimated to be \$217,388. This amount shall be allocated to the District's debt service allocation during the period of the State Board of Education's approval of the District.

ARTICLE III: "Shall the school issue bonds or notes in anticipation of the first year and \$217,388?"

1 OFFICIAL BALLOT, GENERAL ELECTION
PALM BEACH COUNTY, FLORIDA
NOVEMBER 7, 2000

ELECTORS FOR PRESIDENT AND VICE PRESIDENT (A vote for the candidates will actually be a vote for their electors.)	(REPUBLICAN)	3 ➤
	GEORGE W. BUSH - PRESIDENT DICK CHENEY - VICE PRESIDENT	
	(DEMOCRATIC)	5 ➤
	AL GORE - PRESIDENT JOE LIEBERMAN - VICE PRESIDENT	
	(LIBERTARIAN)	7 ➤
HARRY BROWNE - PRESIDENT ART OLIVIER - VICE PRESIDENT		
(GREEN)	0 ➤	
RALPH NADER - PRESIDENT		

OFFICIAL BALLOT, GENERAL ELECTION
PALM BEACH COUNTY,
NOVEMBER 7, 2000

4 ➤	(REFORM)
	PAT BUCHANAN - PRESIDENT EZOLA FOSTER - VICE PRESIDENT
6 ➤	(SOCIALIST)
	DAVID McREYNOLDS - PRESIDENT MARY CAL HOLLIS - VICE PRESIDENT
8 ➤	(CONSTITUTION)
	HOWARD PHILLIPS - PRESIDENT J. CURTIS FRAZIER - VICE PRESIDENT

Voters oriented and able to focus

FULTON County, MA

President
US Senator
Fashion God

Please make your selection for President
Click on a candidate's name to select them,
or click on a selected candidate to de-select them.
Your selection will be indented and darkened.

AL GORE
GEORGE W BUSH
RALPH NADER
No Choice
Write In

I'm Finished

Voters oriented and able to focus

FULTON County, MA


President: AL GORE

US Senator

Fashion God

Please make your selection for President

Click on a candidate's name to select them,
or click on a selected candidate to de-select them.
Your selection will be indented and darkened.

 AL GORE[SELECTED]

GEORGE W BUSH

RALPH NADER

No Choice

Write In

I'm Finished

Voters oriented and able to focus

FULTON County, MA

President: AL GORE

US Senator: No Choice

Fashion God

Please make your selection for US Senator

Click on a candidate's name to select them,
or click on a selected candidate to de-select them.
Your selection will be indented and darkened.

Edward Kennedy

Jackie Robinson

Loony Independent

No Choice[SELECTED]

Write In

I'm Finished

Best of Breed Experience

registration, authentication, inform, intention, counting

❑ Best practices ameliorate problems

- ✓ Getting filling out reviewing, changing and verifying deposit of ballot

❑ All Interfaces can be improved

- ✓ Voter scan cards/paper,
- ✓ take pictures of odometers...
- ✓ Current DRE's can change software
- ✓ Hot voting machines in a trailer

❑ Best of breed interaction designers

- ✓ Shadows, short term memory

❑ Best of breed testing

- ✓ Test on 1 to 5 people first
- ✓ Different tests/people for different stages/purposes

Problems have not been voter verifiable

- Brevard 4000 Back end software
- Volusia 16022 Back end software
- Boone County 10000 Back end software
- Washington State Altered paper ballots
- Dallas Destroyed paper ballots
- Many places replaced paper ballots
- Georgia Not close enough to recount
- Indiana ? User interface (Straight vote)
- Recent Republican shown on UI
- Mail in Absentee No secrecy

Problems with a separate paper trail.

People can't verify their receipts: Chicago (2002, 2003)

- Connection broken
- Paper out
- Paper Jam
- Ink out
- Printer broken
- Paper looks different
- Different format than DRE
- Separate thing to look at
- Extra time & step for voting
- No way for ballot worker to help
- Lighting, readability
- Special needs (Dyslexia, ADHD, blind)
- Several extra steps for ballot worker
- Collecting the ballots
- Ballots could be exchanged
- Revoting a machine at end of day
- Rereading ballots

Problems are normal

*Experience is not enough;
metrics and interaction design expertise needed*

- ❑ Admin & registration 20+% incorrect?
 - ✓ 2 of 3 motor can be registered
- ❑ Setup Complex but uncommon
- ❑ Voting difficulty matters:
 - ✓ Perceptual, Cognitive and Physical Special Needs
 - ✓ 11PM voting (1 minute or only vote for...)
 - ✓ Separate decision from information?
- ❑ Advocacy
 - ✓ palm cards
 - ✓ Absentee
 - ✓ ...
- ❑ Backend
 - ✓ Bear kept them from submitting ballots, behind a door
 - ✓ Reporting tallies, Volusia...
 - ✓ Un controlled computer rooms ...

Ways to foil paper trails

- Disenfranchise in all the normal ways
 - Registration, ballot design,
- Change, lose, or add paper
- Question paper result in any way
- Print what they want to see (but don't check)

Coersion?

- We* disagree so lets neither vote
 - ✓ 15 years later one spouse had been voting all along
 - Ballot marking parties at churches
 - We* like this guy
 - ✓ Said a 45 year old child to their parent in a voting booth
 - Nursing homes
 - ✓ *They* have a right to vote
 - Palm cards
 - Precinct Captain
 - Ballot layout
 - Order on Ballot
 - Stand in voters
- Humiliation,
 - intimidation,
 - hand over hand voting
 - Misinformation
 - Parallax and other physical access
 - (arm extension)

Defense in Depth?

- Registration?
- Access to polling machine
- Orienting and focusing to know
- No coercion (other hands, palm cards, money...)
- Actions and undo obvious and available
- Feedback that is interpretable
- Obvious chance to consider and change
- Demonstration that the vote was recorded

TURN PAGE TO CONTINUE VOTING

Reference Platform: Brazil

Renewed belief in government!!

Electronic voting; 96, 98, 2000

- ✓ 96 Unisys 7% failure
- ✓ 98 Procomp
- ✓ 2000 Procomp .02% failure 106,000,000 votes

Trusted Scientific organization

- ✓ Create requirements

Trusted Technical organization

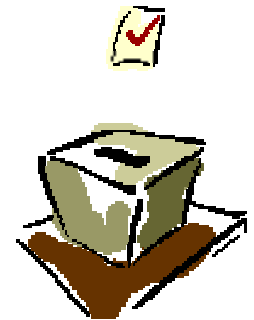
- ✓ Create reference platform

Companies (5)

- ✓ Create demonstratable products for bid

Government election officials

- ✓ Create open viewing and decision of vendor



What will improve Voting

- ❑ Follow Brasil's example (associate with best scientists)
- ❑ Separate Election commission, Equipment manufactures and design activities
 - ✓ Funded requirements gathering team outside election commission
 - ✓ Funded reference platform coding team outside election
 - ✓ Equipment inexpensive and replaceable through open competitions
- ❑ Performance based standards:
- ❑ All standards are relative to best of breed

Bringing in the HCI community

Ted Selker, technologist
Selker@media.mit.edu

Workshop on Elections Standards Technology Conference 1/31/2002

- | | |
|--------------------------------------------------------------------------------------|---------------------------------------|
| <input type="checkbox"/> Doug Jones
✓ Systems and ballot design | Iowa Election Board |
| <input type="checkbox"/> Connie McCormack
✓ What happens and what registrars want | LA Registrar |
| <input type="checkbox"/> Clyde Terry
✓ Universal Design | NH Disabilities Council |
| <input type="checkbox"/> Ben Bederson
✓ How It could look | UMD HCI Lab |
| <input type="checkbox"/> Cliff Nass
✓ Work with me please... | Stanford Communication Dept |
| <input type="checkbox"/> John Cugini
✓ Focusing on Voting and usability | NIST Visualization Lab |
| <input type="checkbox"/> Paul Herrnson
✓ Focusing on Voting and usability | UMD Political Science |
| <input type="checkbox"/> Ted Selker
✓ Demonstrating usability improvements | CalTech/MIT Voting Technology Project |

ACM CHI Panel on User interface in Voting 1/31/2003

- | | |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Eric A. Fischer, | Congressional Research Service, Library of Congress s, efischerR@crs.loc.gov |
| <input type="checkbox"/> Benjamin B. Bederson, | Human-Computer Interaction Lab, University of MD, bederson@cs.umd.edu |
| <input type="checkbox"/> Conny McCormack, | Registrar-Recorder /County Clerk, LA County CA , cmccorma@rcc.co.la.ca.us |
| <input type="checkbox"/> Clifford Nass, | Department of Communications, Stanford University, |
| <input type="checkbox"/> Ted Selker | CalTech/MIT Voting Technology Project |

NIST 12/11/2003

TURN PAGE TO CONTINUE VOTING

New Technology and Testing

Sorry partisans;

Defense in Depth



- ❑ Registration and Registration Checking
 - ❑ Polling place worker training materials
 - ✓ LA simple procedures, Chicago vague concepts
 - ❑ Ballot design (guidelines, experts and testing)
 - ❑ Simple voting technology that makes it easy
 - ✓ Secure Architecture for Voting Electronically?
 - ✓ Specially handled Standard game machines or PCs ?
 - ✓ Never before used
 - ✓ Each one has its own CD
 - ❑ Funded innovation everywhere (contracts & prizes)
- ...Information and long voting times could reduce coercion