

# Securing Digital Democracy

Lecture 6 | *E-Voting Around the World*



J. Alex Halderman  
University of Michigan

# Case Studies

## 6.1 Case Studies

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## 6.1 Case Studies



Bundesverfassungsgericht Karlsruhe image by Lothar Schaack via Wikimedia Commons, [http://en.wikipedia.org/wiki/File:Bundesarchiv\\_B\\_145\\_Bild-F083310-0001,\\_Karlsruhe,\\_Bundesverfassungsgericht.jpg](http://en.wikipedia.org/wiki/File:Bundesarchiv_B_145_Bild-F083310-0001,_Karlsruhe,_Bundesverfassungsgericht.jpg)

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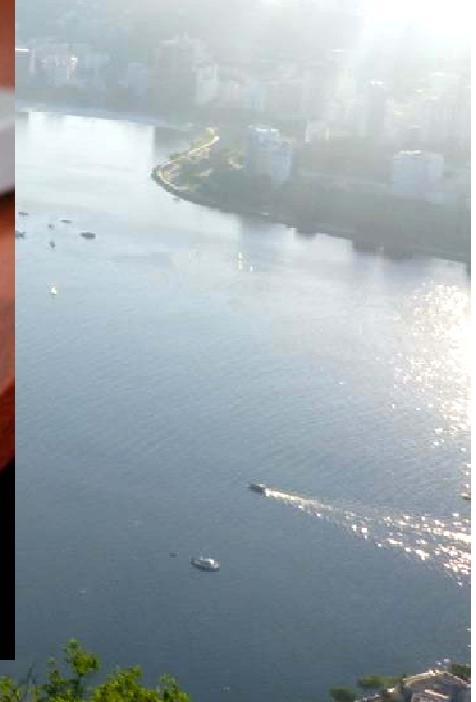
Germany

## 6.1 Case Studies



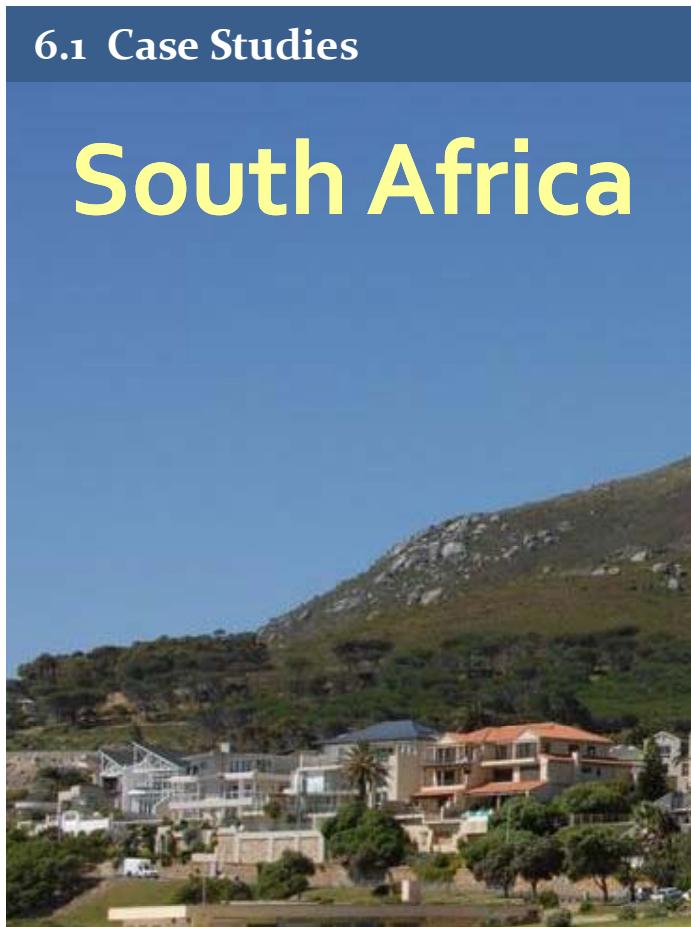
Voting machine photo by José Cruz, AgenciaBrasil via Wikimedia Commons,  
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# Brazil



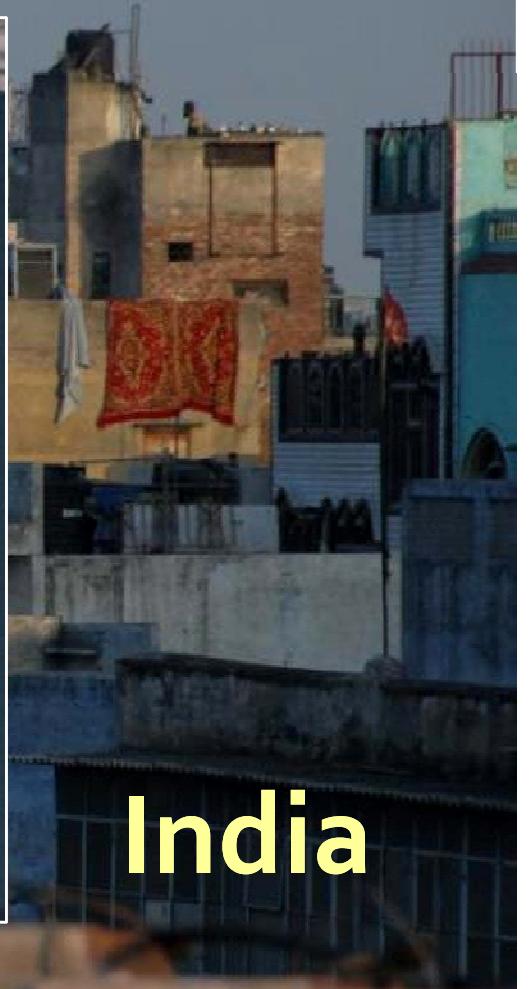
## 6.1 Case Studies

# South Africa



Mandela and de Klerk photo via Wikimedia Commons,  
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## 6.1 Case Studies



# India's EVMs

## 6.2 India's EVMs

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## 6.2 India's EVMs



## 6.2 India's EVMs

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## 6.2 India's EVMs



## 6.2 India's EVMs



## US/Europe

Complex machines

PC-like design

Research shows  
vulnerable

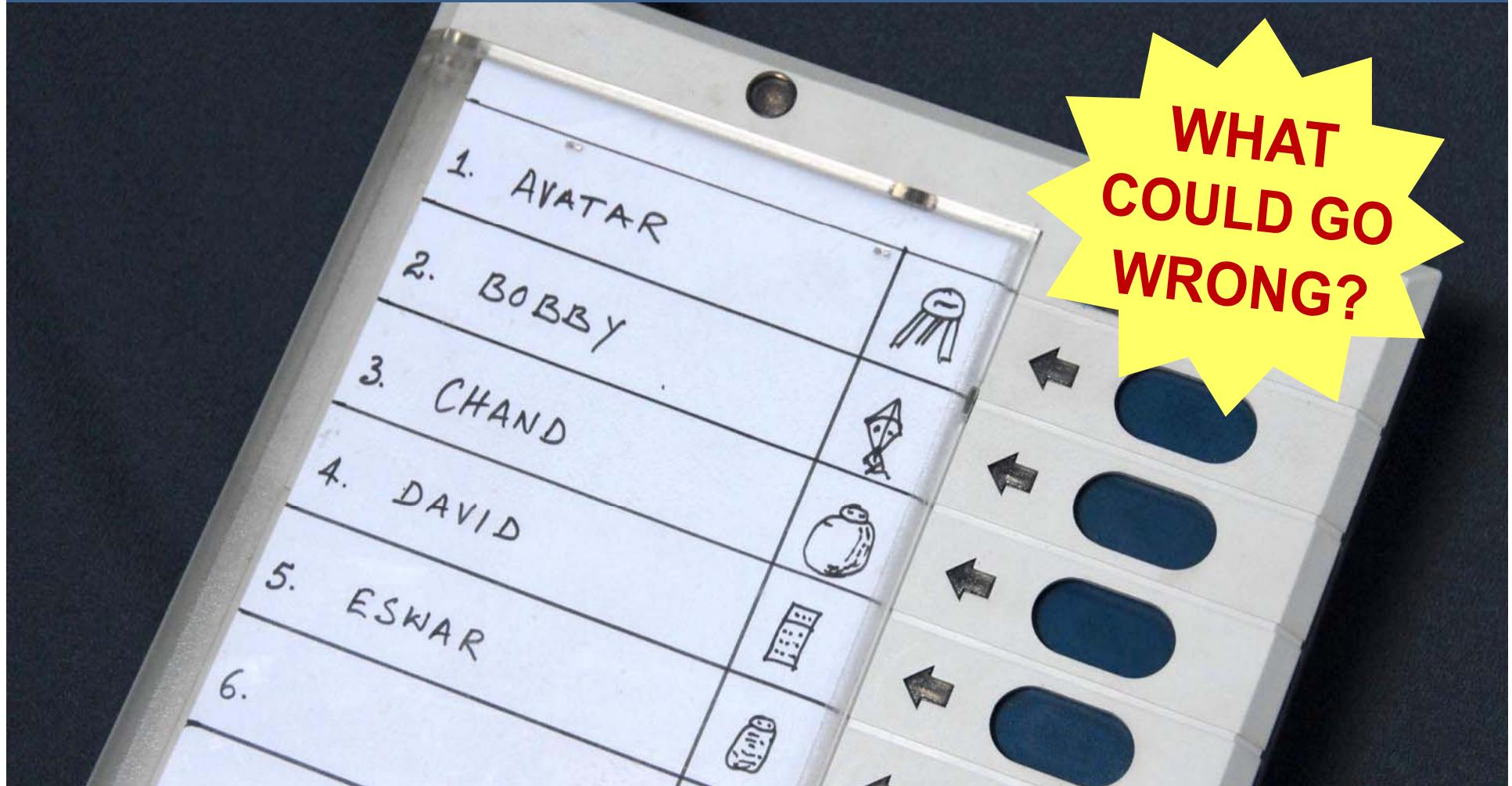
## India

Simple machines

Embedded system

*Also vulnerable,  
but in different ways*

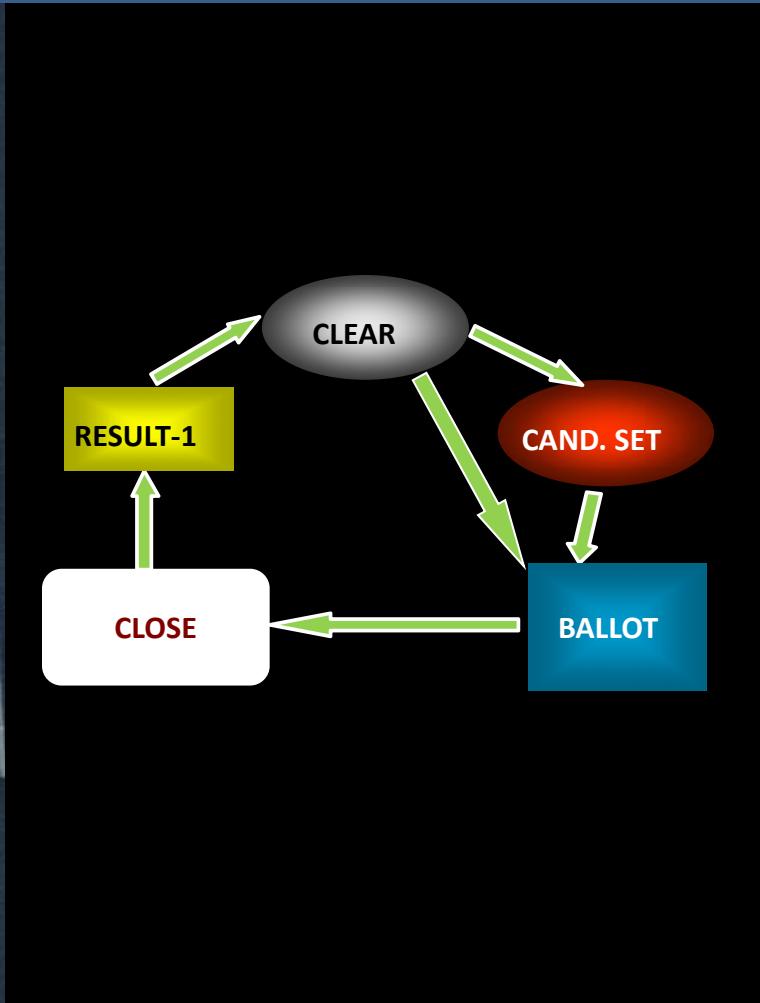
## 6.2 India's EVMs

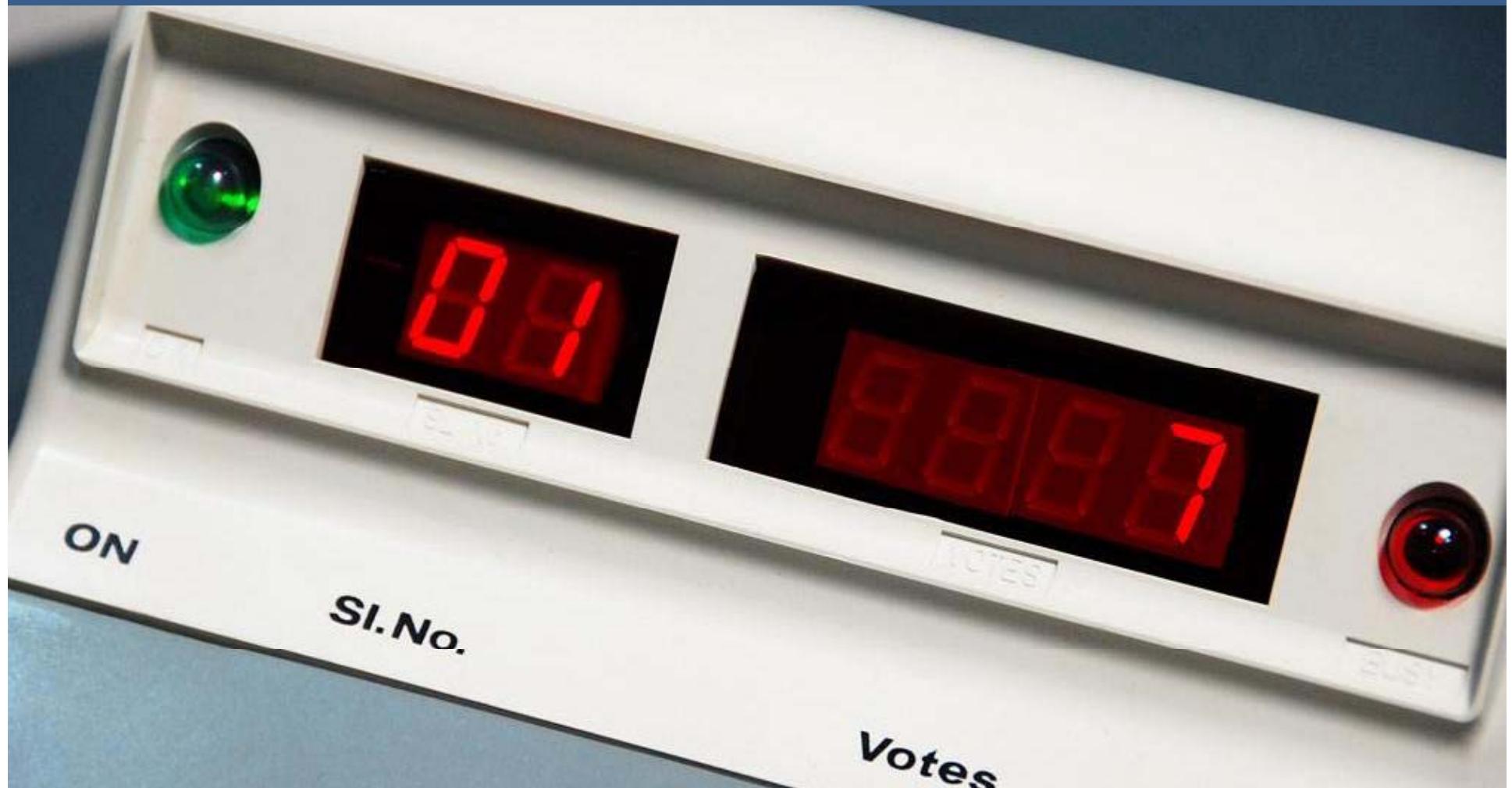


## 6.2 India's EVMs



## 6.2 India's EVMs





## 6.2 India's EVMs





## Officials' Claims...

*“perfect”*

# EVMs

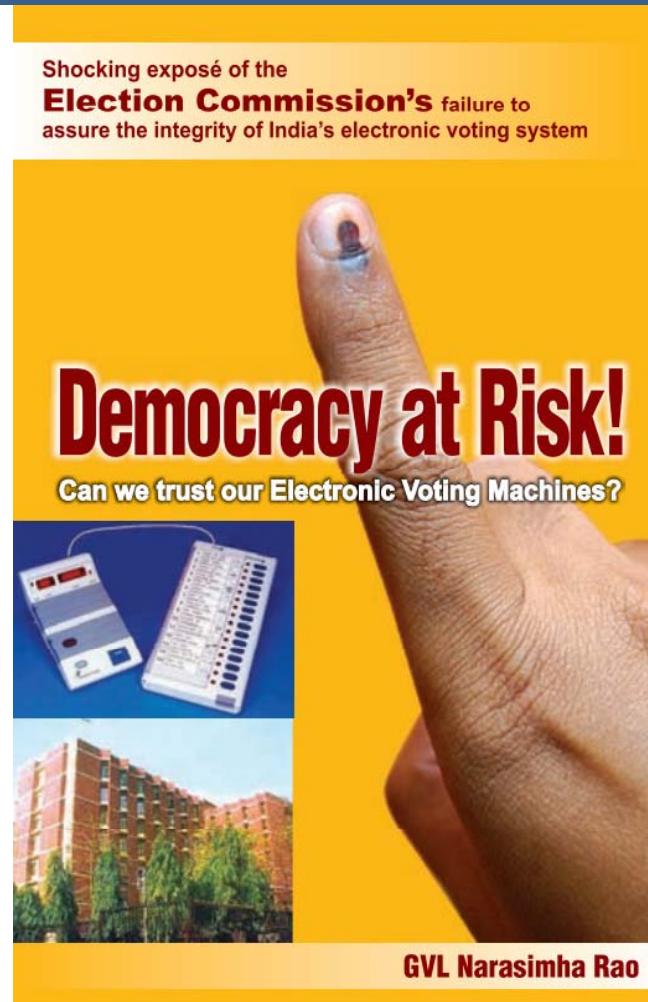
*“tamperproof”*

*“infallible”*

*“no need for  
technical improvement”*

## 6.2 India's EVMs

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E-book available at  
<http://www.indianevm.com/book.php>

## 6.2 India's EVMs



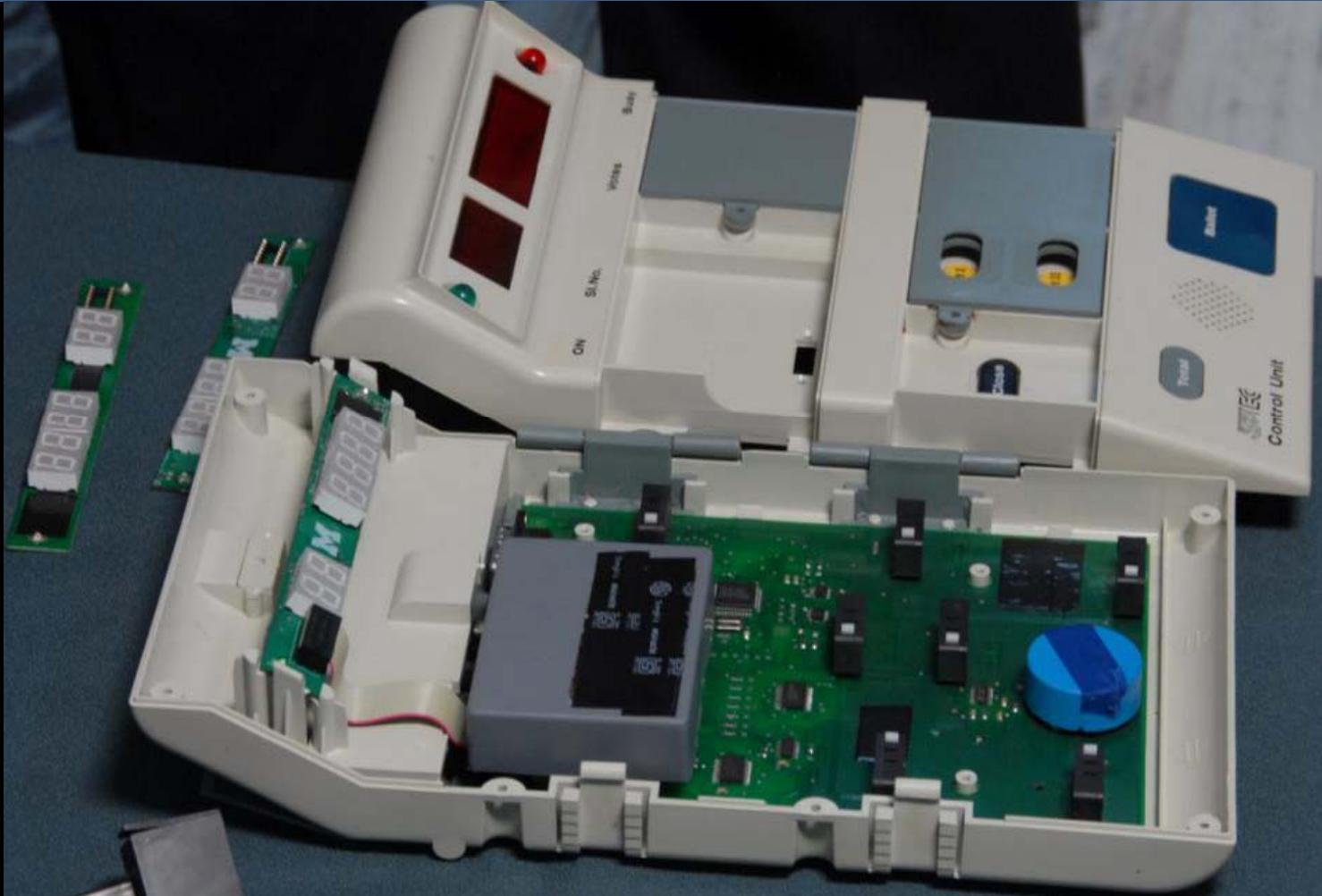
## 6.2 India's EVMs

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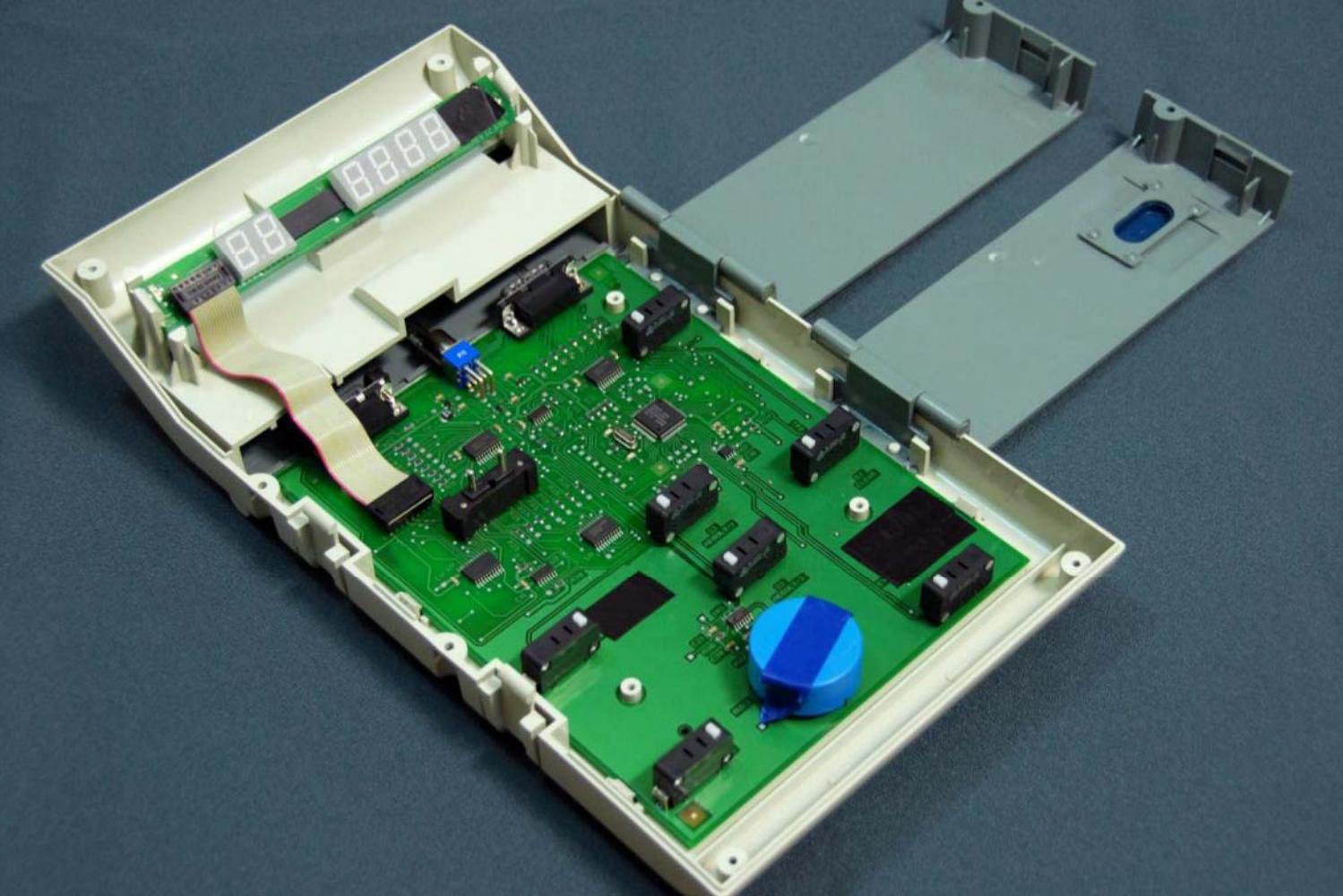
## 6.2 India's EVMs



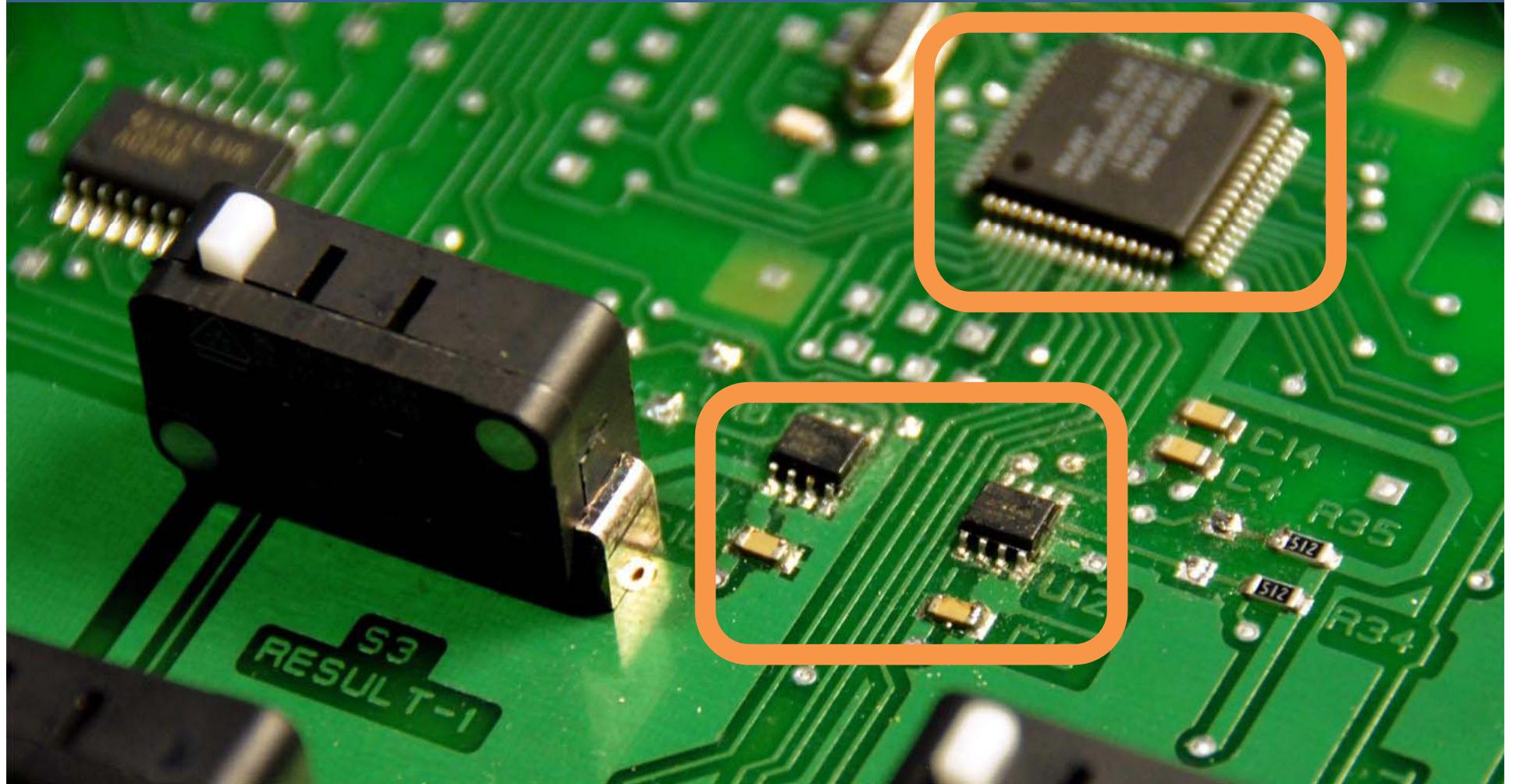
# Tamperproof ?

## 6.3 Tamperproof?

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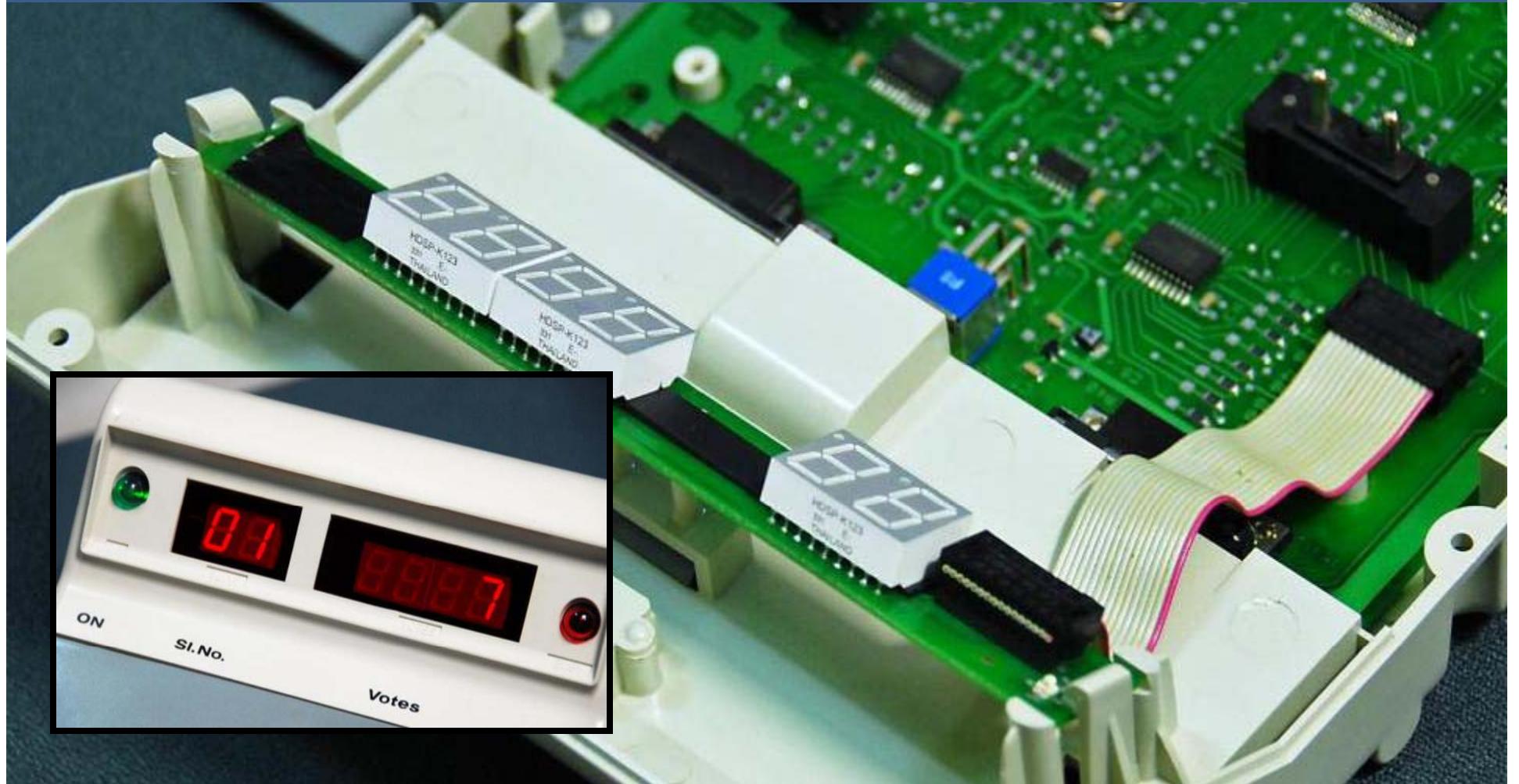


## 6.3 Tamperproof?

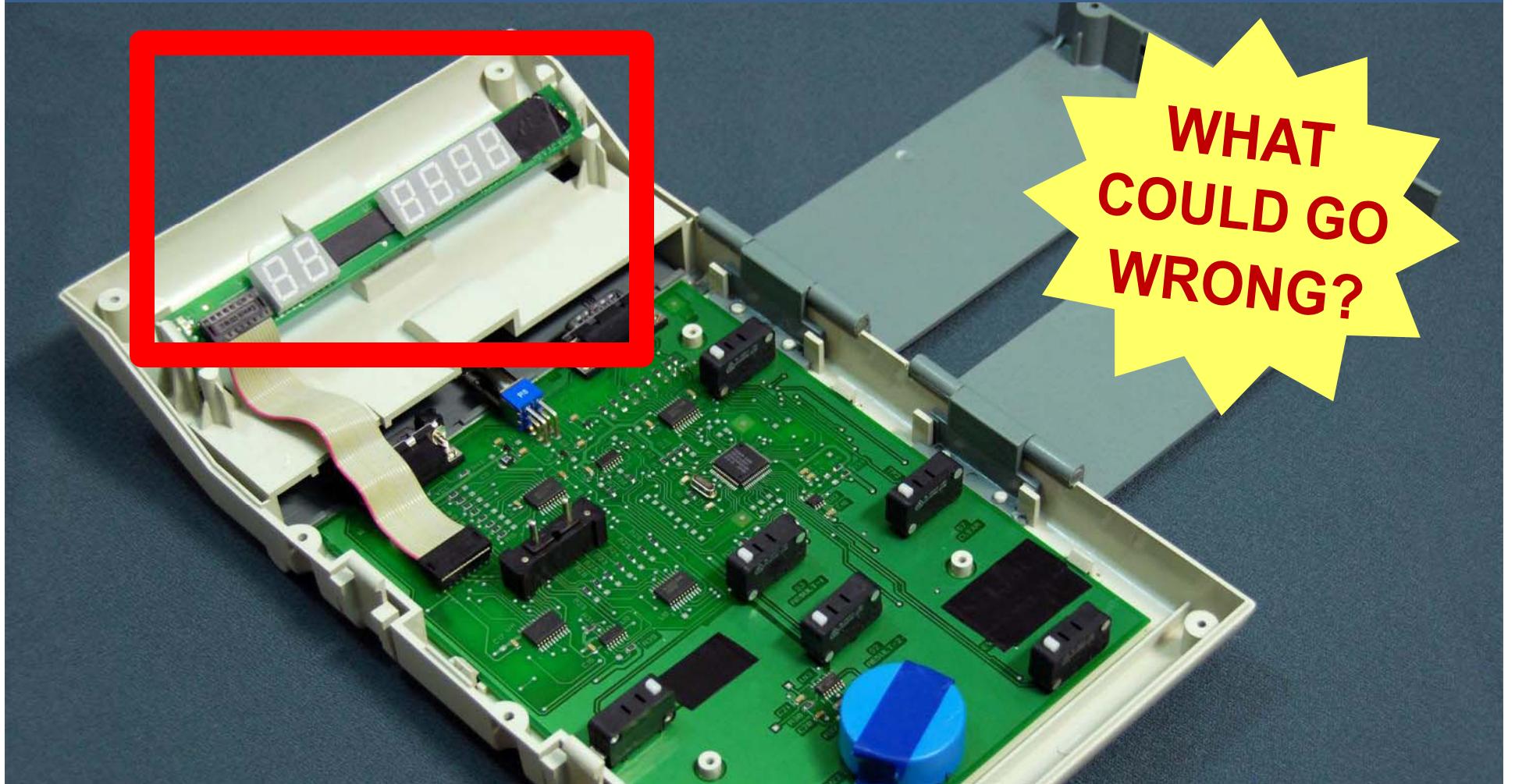


## 6.3 Tamperproof?

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### 6.3 Tamperproof?



## 6.3 Tamperproof?

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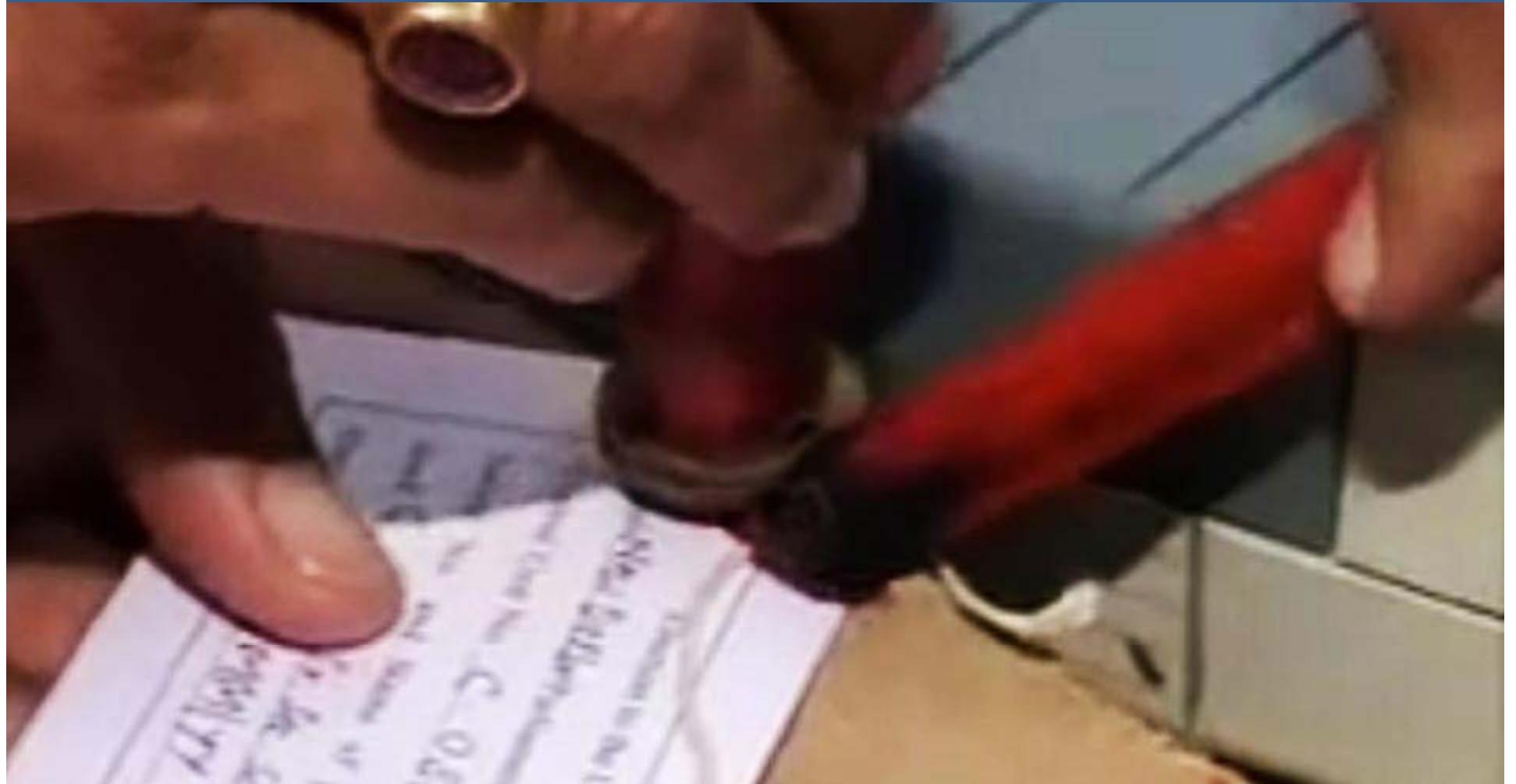
## 6.3 Tamperproof?

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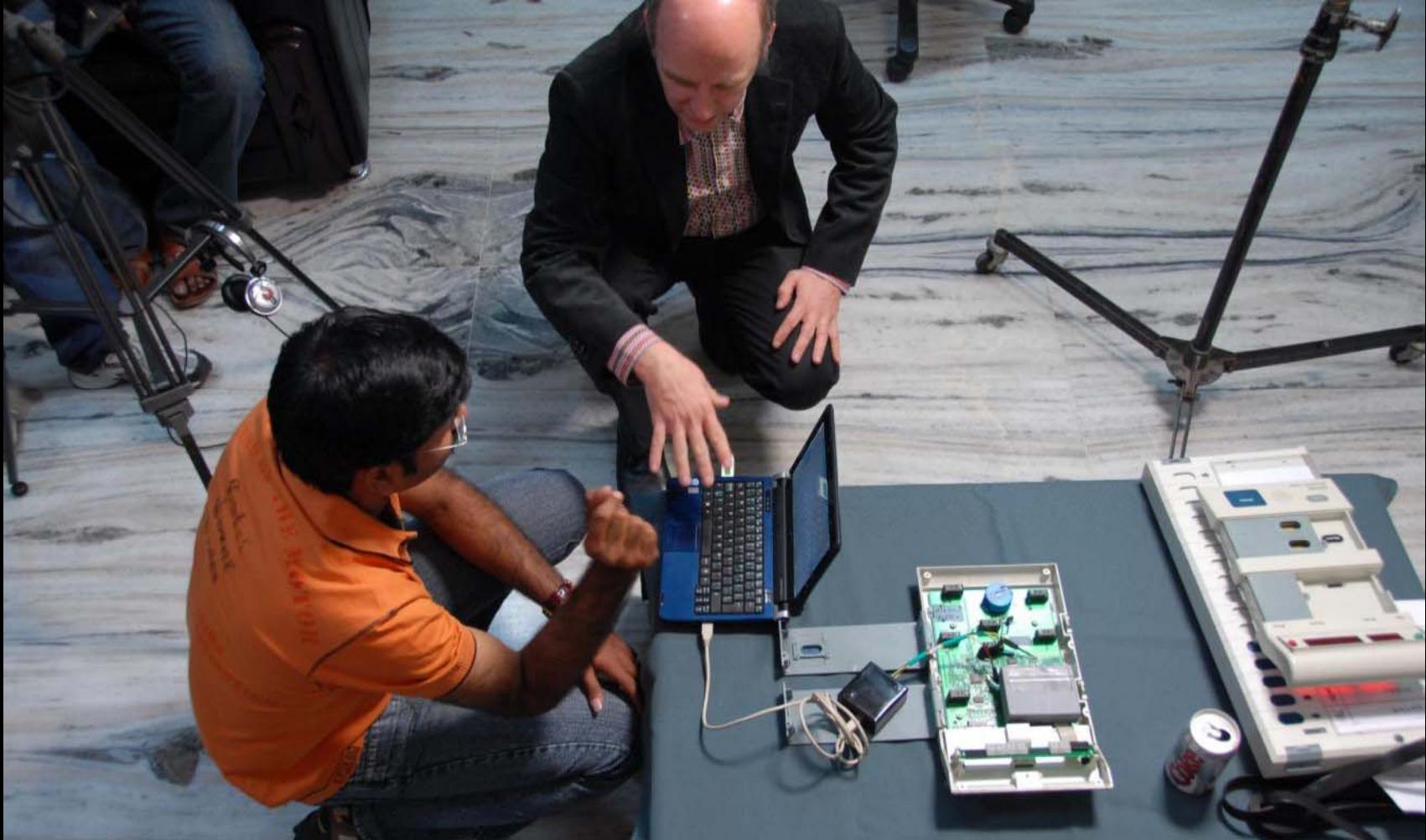
## 6.3 Tamperproof?

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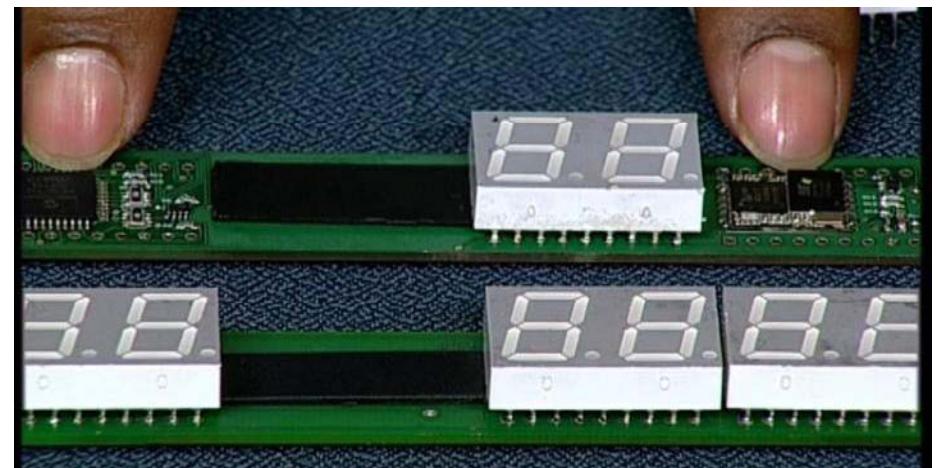
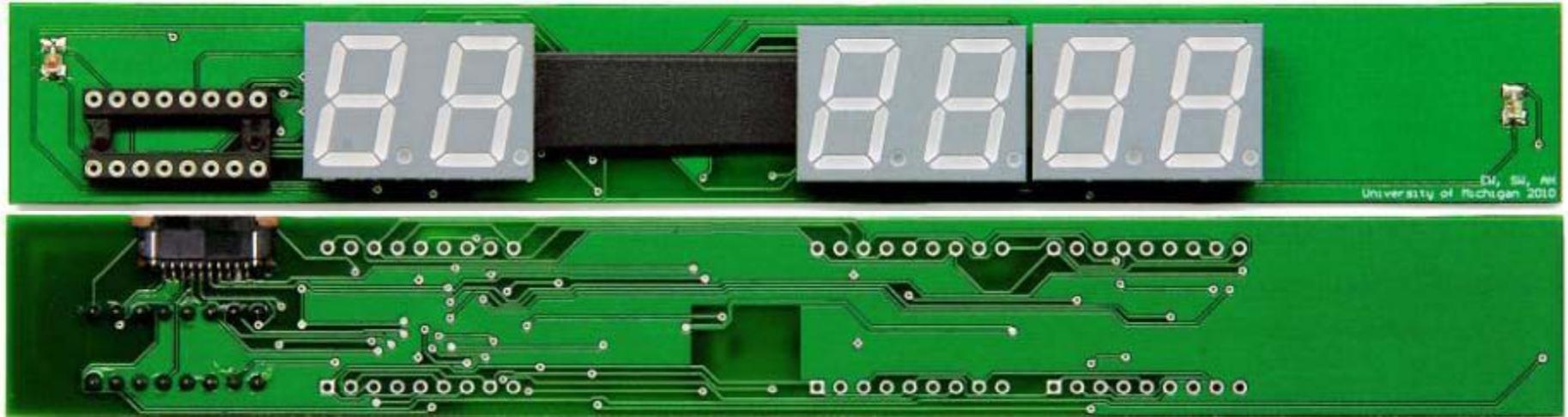
## 6.3 Tamperproof?

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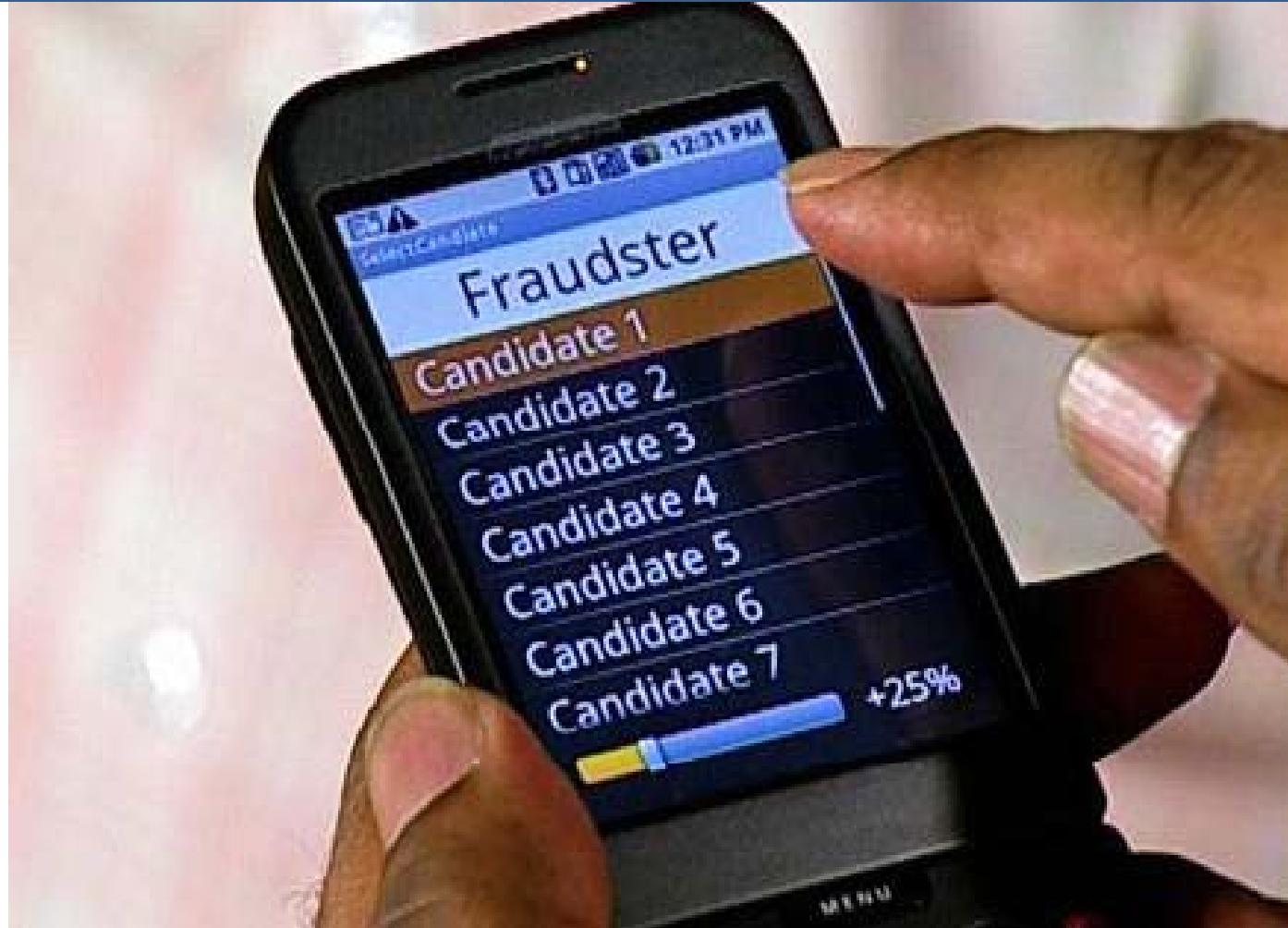


## 6.3 Tamperproof?

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## 6.3 Tamperproof?



## 6.3 Tamperproof?



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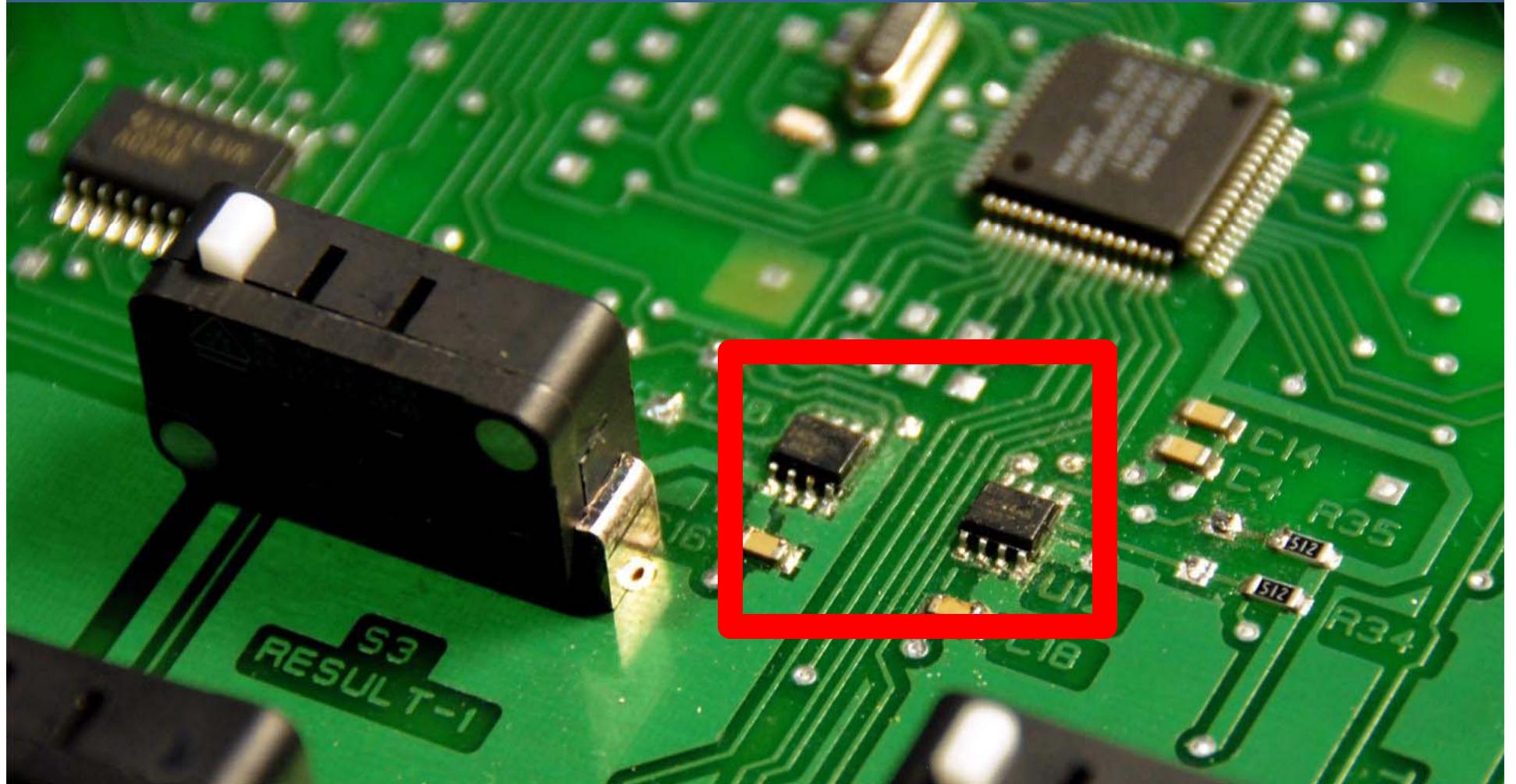


## 6.3 Tamperproof?

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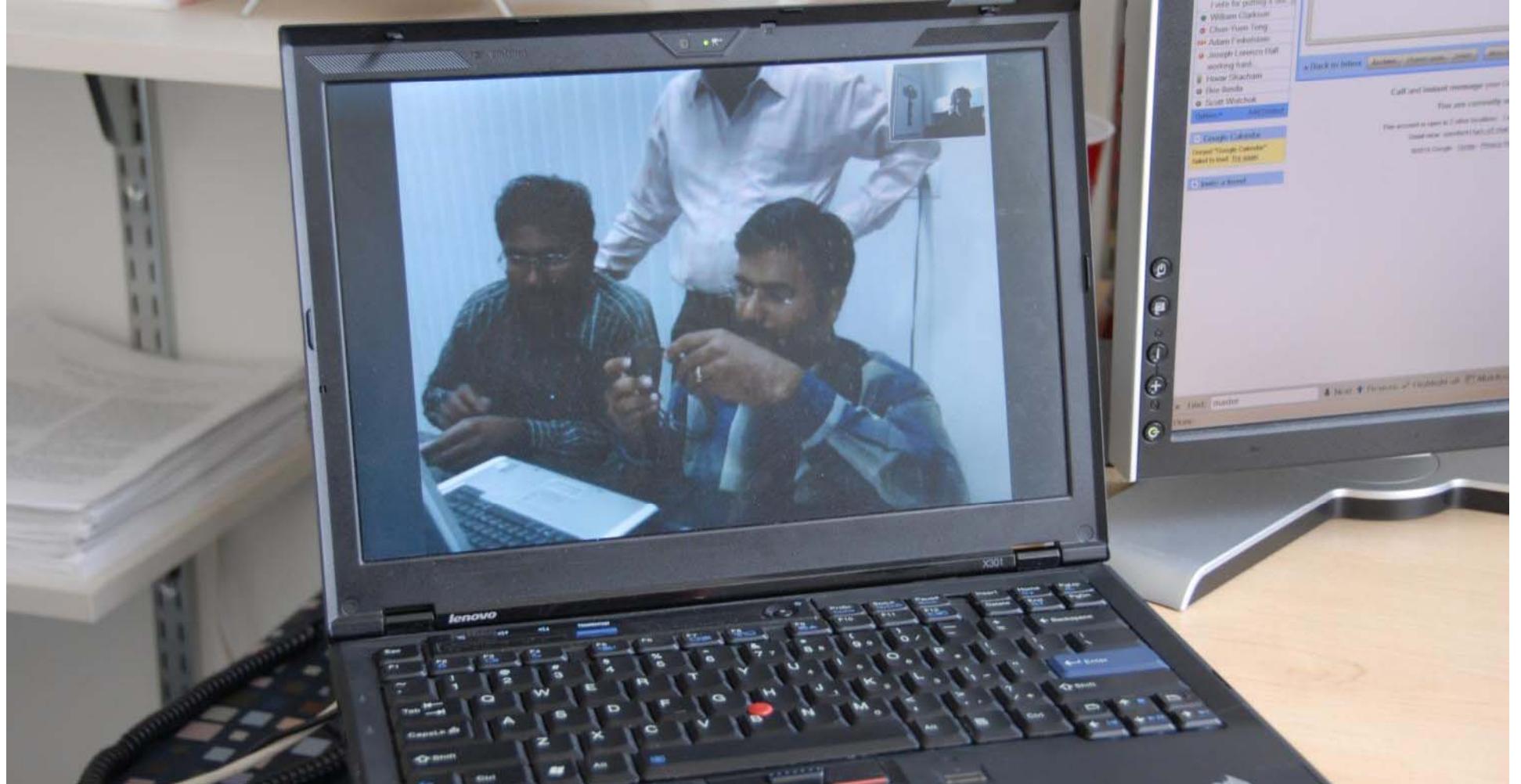


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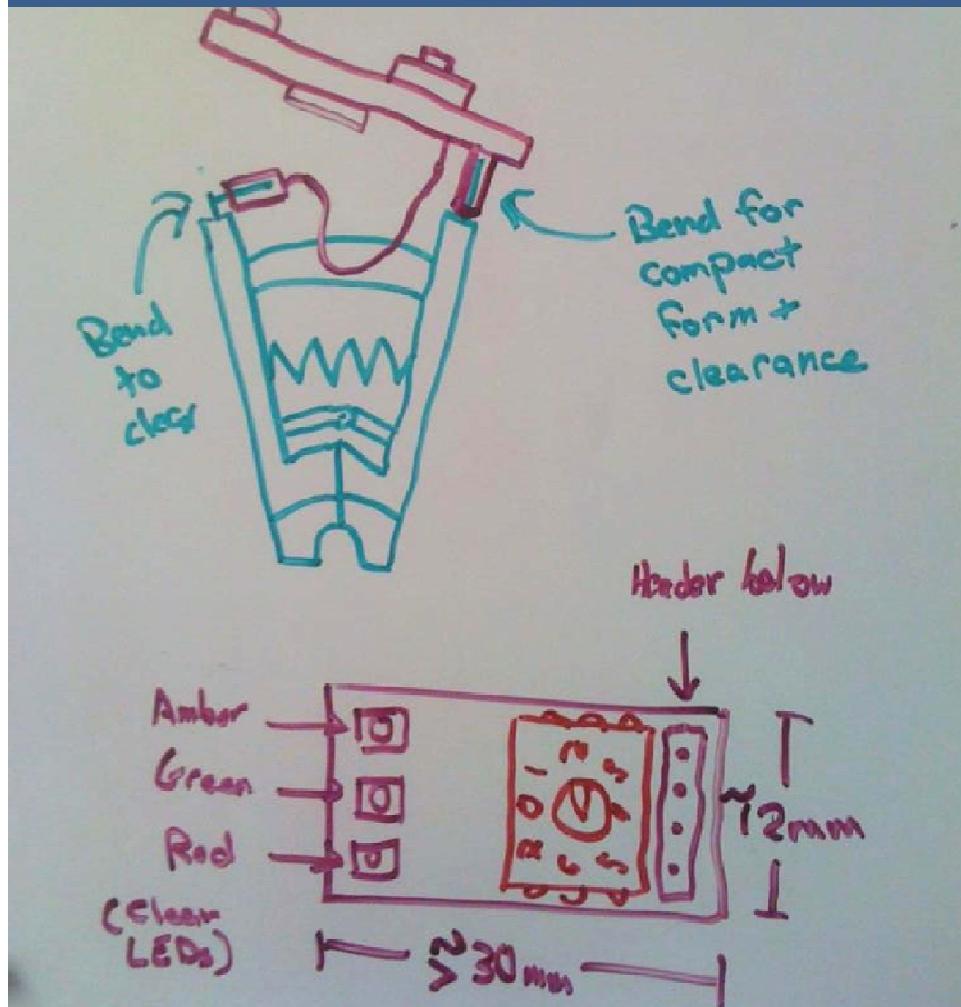
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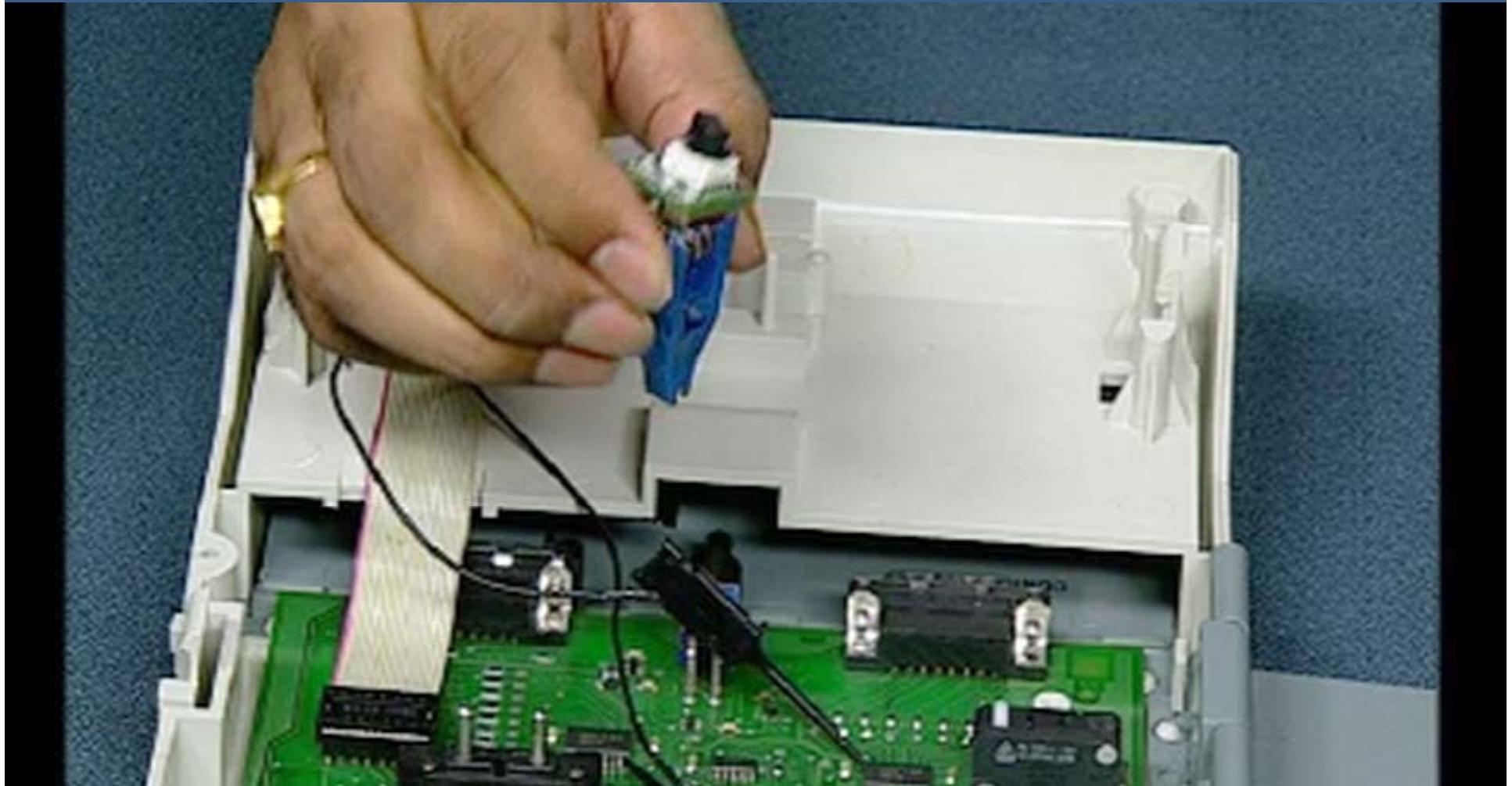
## 6.3 Tamperproof?



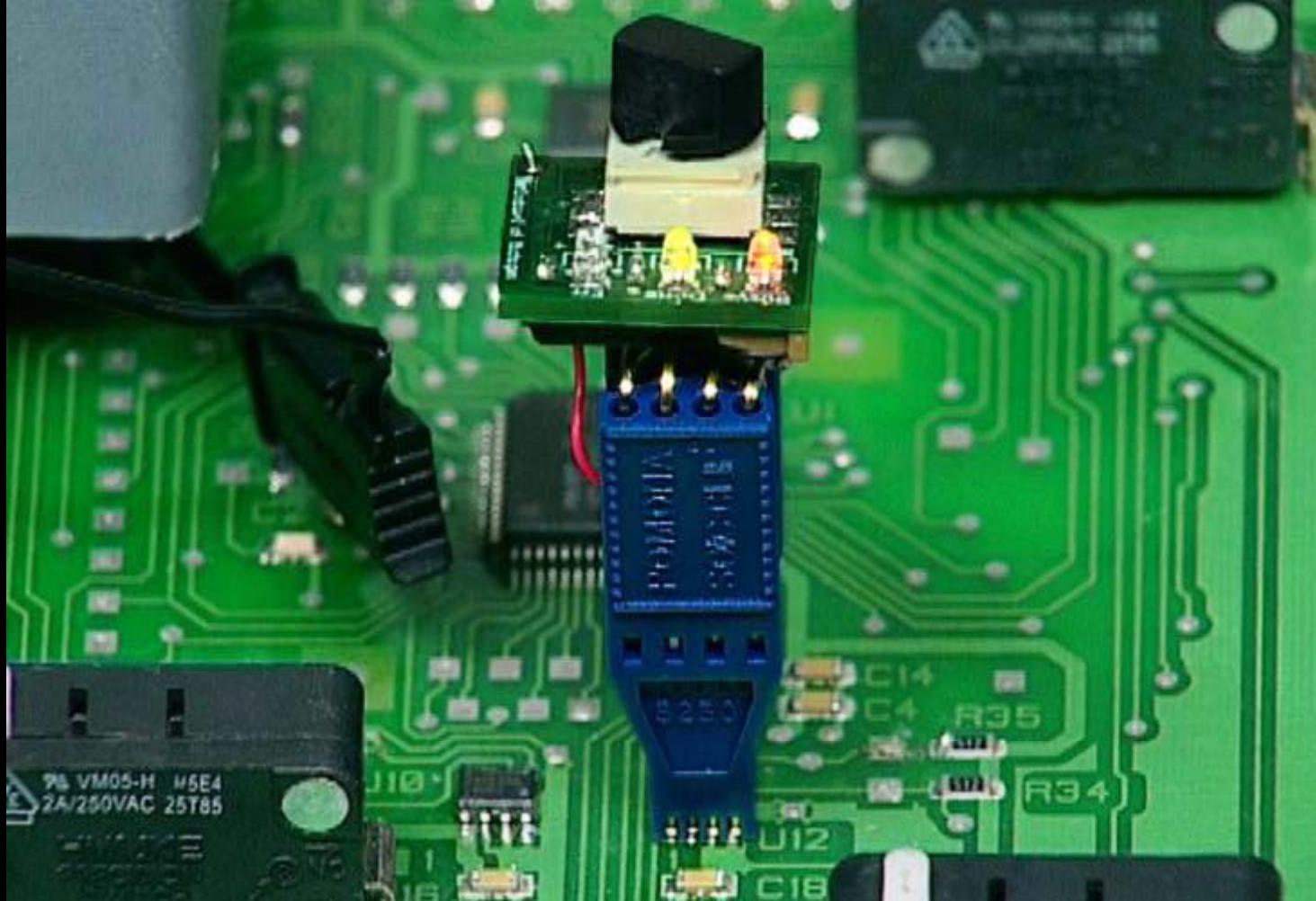
## 6.3 Tamperproof?



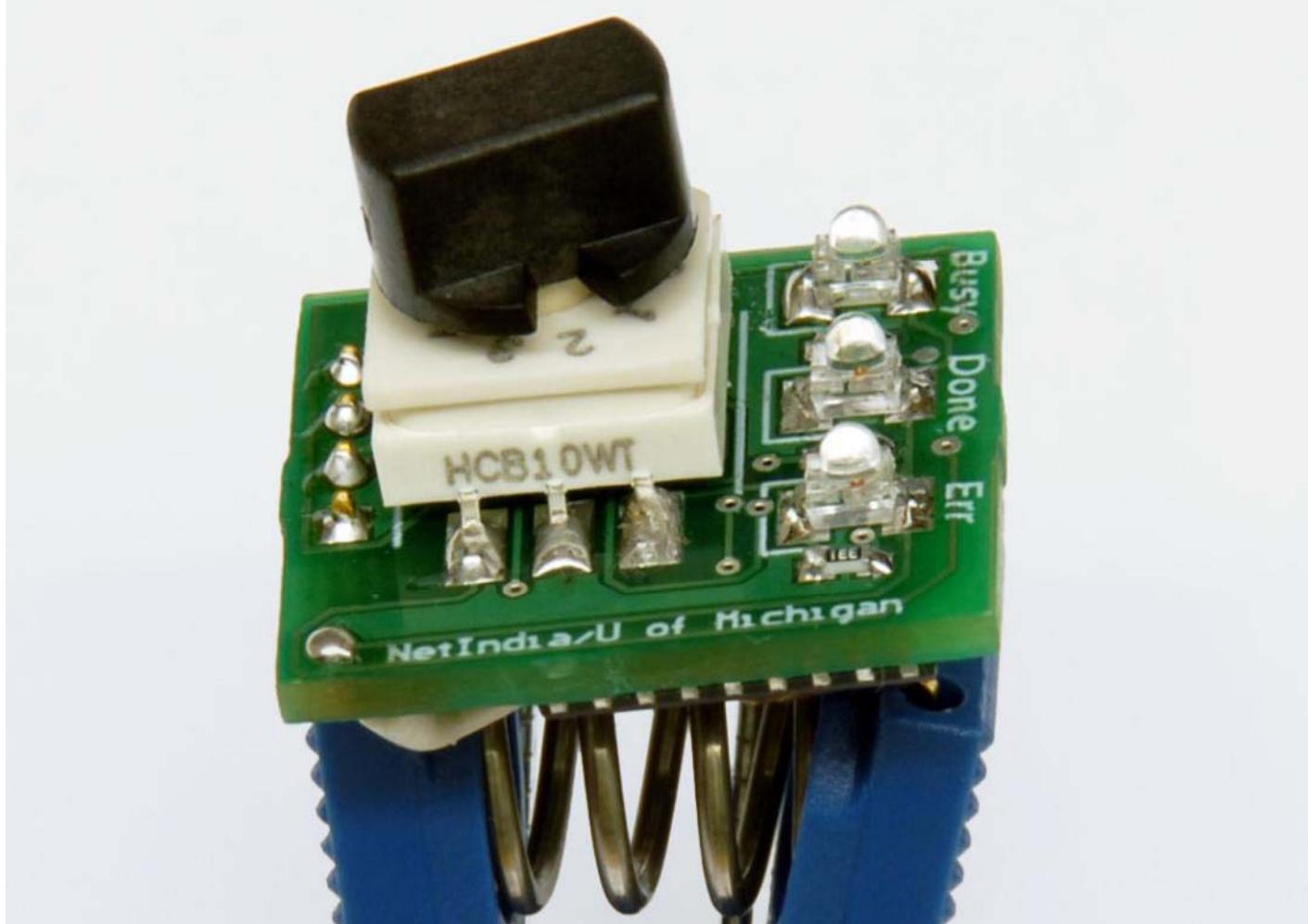
### 6.3 Tamperproof?



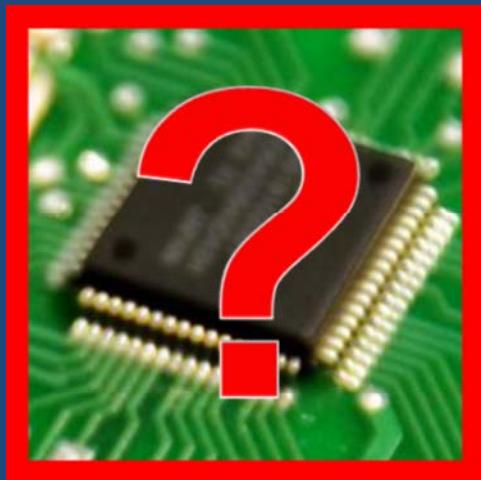
## 6.3 Tamperproof?



## 6.3 Tamperproof?



## Secret Software



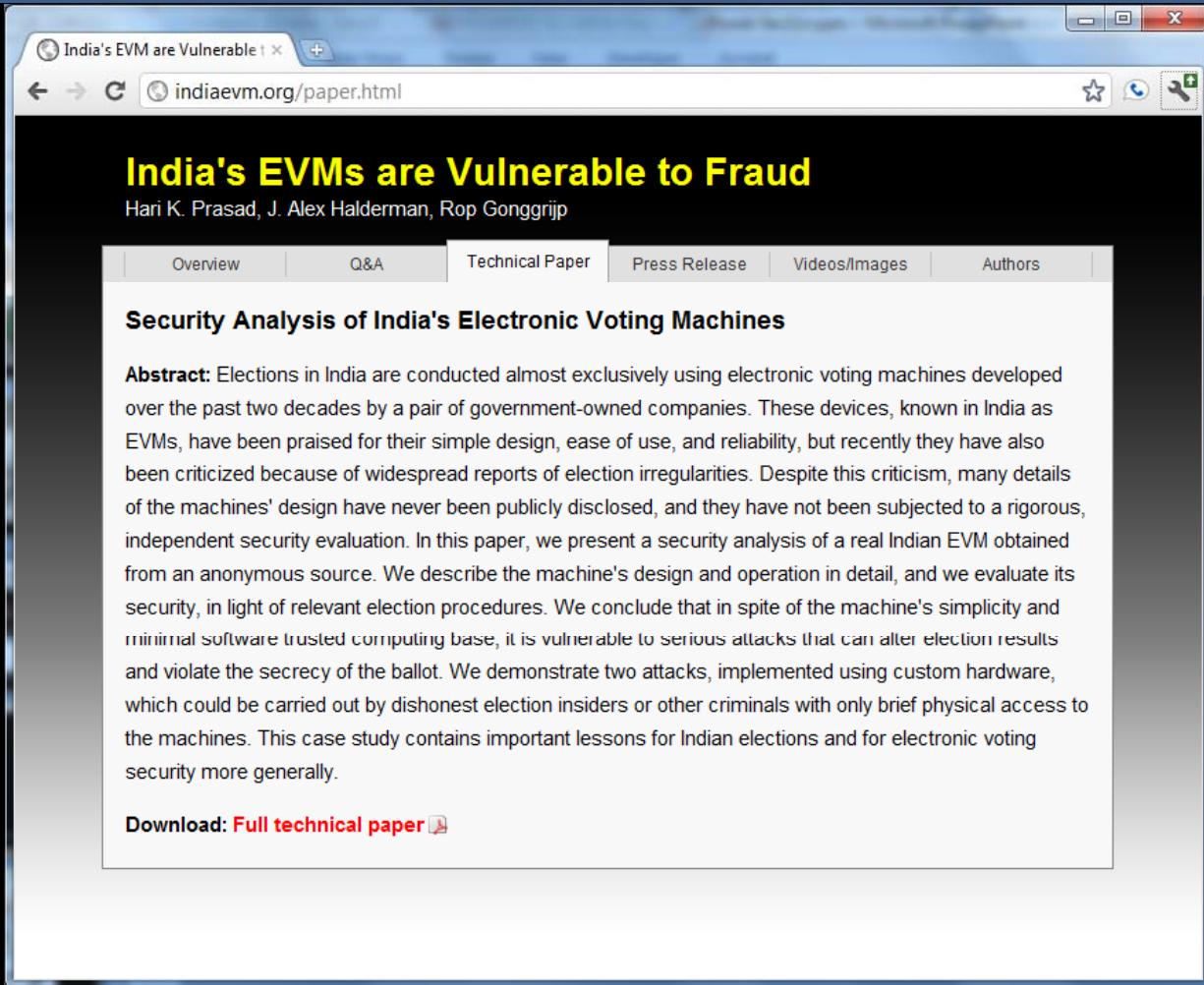
ECI doesn't own source code  
ECI has never seen the source code  
Only "3-4 guys" at the companies  
"know what's in the code"  
Even ECI cannot verify the chips  
contain original code

## Our Study Concluded:

- India's paperless EVMs are, in fact, insecure
- Indian EVM fraud takes basic electronics skills, not rocket science
- Fraud is easy for anyone with access to EVMs at any stage
- Detect fraud could be difficult or impossible

# India's Response

## 6.4 India's Response



The screenshot shows a web browser window with the title "India's EVMs are Vulnerable to Fraud" displayed prominently. The URL in the address bar is "indiaeVm.org/paper.html". The page content includes a header with authors' names (Hari K. Prasad, J. Alex Halderman, Rop Gonggrijp), a navigation menu with tabs like Overview, Q&A, Technical Paper (which is selected), Press Release, Videos/Images, and Authors, and a main section titled "Security Analysis of India's Electronic Voting Machines". The abstract discusses the vulnerability of Indian EVMs to fraud due to their design and lack of security evaluation. A red link at the bottom left of the page text area reads "Download: Full technical paper" followed by a small icon.

**India's EVMs are Vulnerable to Fraud**

Hari K. Prasad, J. Alex Halderman, Rop Gonggrijp

Overview | Q&A | **Technical Paper** | Press Release | Videos/Images | Authors

**Security Analysis of India's Electronic Voting Machines**

**Abstract:** Elections in India are conducted almost exclusively using electronic voting machines developed over the past two decades by a pair of government-owned companies. These devices, known in India as EVMs, have been praised for their simple design, ease of use, and reliability, but recently they have also been criticized because of widespread reports of election irregularities. Despite this criticism, many details of the machines' design have never been publicly disclosed, and they have not been subjected to a rigorous, independent security evaluation. In this paper, we present a security analysis of a real Indian EVM obtained from an anonymous source. We describe the machine's design and operation in detail, and we evaluate its security, in light of relevant election procedures. We conclude that in spite of the machine's simplicity and minimal software trusted computing base, it is vulnerable to serious attacks that can alter election results and violate the secrecy of the ballot. We demonstrate two attacks, implemented using custom hardware, which could be carried out by dishonest election insiders or other criminals with only brief physical access to the machines. This case study contains important lessons for Indian elections and for electronic voting security more generally.

Download: [Full technical paper](#) 

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## Intel background check on EVM 'thief'

Vishwa Mohan, TNN Aug 27, 2010, 03.06am IST

NEW DELHI: Is the arrested activist, who showed that an Electronic Voting Machine (EVM) can be tampered with, a mere tool in the hands of some corporate rivals who want to make a clone of the equipment which has a huge demand in countries across Africa and South America?

Or, is he, who got technical help from three foreigners, a part of some larger conspiracy to discredit India's election process?

With these sneaking suspicions in mind, the intelligence agencies -- both IB and R&AW -- have set into motion their network to check the backgrounds of Hari Prasad, who was arrested in Hyderabad in the EVM theft case last Saturday, and his foreign contacts.

## 6.4 India's Response



## 6.4 India's Response



Sircummons U/sec 41 cont. Office of the  
Sr. Insp. of Police  
160 Cr PC  
Mata Ramchandar Ambodkar  
Marg Police Station  
Near Haji Pheri Crawford  
Market, Mumbai 400005  
Maharashtra  
Tel No. 022-22621313  
022-22620759

To  
Shri Mukundan Prasad Venkara  
Petrolina Pet Ltd  
Plot No. 67 Karmal Hills  
Gulbarga Hyderabad 500033

Subject: Attendance for investigation in  
C.R.No. 159/10 U/sec 45/157 280 I.A.C.  
at MRA Marg P.S., Mumbai.

MRA Marg P.S. Mumbai Maharashtra  
is conducting investigation vide C.R.No. 159/10 U/sec  
45/157 280 I.A.C. in which an Electronic Voting  
Machine Control Unit No. E-131812 has been  
stolen.

During the course of investigation, it is  
revealed that said EVM control Unit has been  
shown by you during the telecast on 28th April 2010  
on TV 9 channel.

You are therefore instructed to attend  
the MRA Marg P.S. New Haji House.

Near C.S.T. Rd. Shri Mumbaras or above  
mentioned issue in the investigation of said  
offence within four days from receipt of  
this summons with all concerned/relevant  
documents.

Ravindra A. Wani  
Asst. Inspector of Police,  
M.R.A. Marg Police Station,  
Mumbai.  
In-charge Officer  
Mobile - 9821104068

## 6.4 India's Response

During the course of investigation, it is revealed that said EVM control Unit has been shown by you during the telecast on 28/9/2010 on TV9 channel.

You are therefore instructed to attend the MCA along & Shri New Haj House, Near C.S.T. Rd Shri Mumbai or above mentioned issue in the investigation of said offence within four days.

Near C.S.T. Rd Shri Mumbai or above mentioned issue in the investigation of said offence within four days.

## 6.4 India's Response



## 'Enhance confidence in EVMs'

HT Correspondent, Hindustan Times

Email Author

New Delhi, October 04, 2010

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Leaders from different political parties asked the Election Commission to enhance confidence of people on use of Electronic Voting Machines (EVMs) following allegations that the machines can be tampered. At a meeting of all political parties, Congress leader Sharad Pawar had called for use of paper ballot. Prasad said his party supported the call. He said that the vote has been tampered with in the past. EVMs were started as a pilot project in a small constituency. In a statement, Congress leader Jayant Sinha said that the VVPAT add-on should only be accessed if there is a complaint.

**October 4:** All major political parties meet with ECI and insist on a verifiable audit trail to provide voter confidence

ECI forms a commission to study ways to achieve transparency & verifiability

**Present:** ECI testing new EVMs with a VVPAT add-on

## 6.4 India's Response



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