

Embedded web server for remote laboratory access for undergraduate students studying electronic engineering

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Overview



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- Motivation
 - remote versus virtual
- Technical developments
 - system architecture
- User screenshots
- Recorded operation
- Live demonstration
- Conclusions

Why remote?



- Removes time and place access restrictions (e.g., the University of Nottingham has campuses in China and Malaysia)
- Totally safe to the learner
- Can be fully automated and run unattended allowing better utilisation of the equipment and lab space use
- Enables sharing equipment among institutions

Notable example



- “**Labshare**: National Support for Laboratory Resource Sharing” (Australia)
- Secured funding of 111.5 MAUD (c.\$50M)
- Participation: 5 universities
- Present status:
 - 11 operational
 - 5 under development
 - 13 proposed
- *sourceforge.net/projects/labshare-sahara/* - open source (queuing, reservation, lab management)
- <http://www.labshare.edu.au>

Virtual vs real



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Enigma Applet



Input: VICTO RY Clear

Output: GQLFD ZT

Machine Settings Advanced Settings About

Wheel Order: 312 Set

Ring Settings: 1 1 1 Set

Stecker Pairs: AB CD Set

Indicator Settings: CEE Set

Number of Rotors : 3 4 Set

Reflector : B C Set

Thin (Leftmost) Rotor : beta gamma Set

Use 4/5 letter groups in text display Set

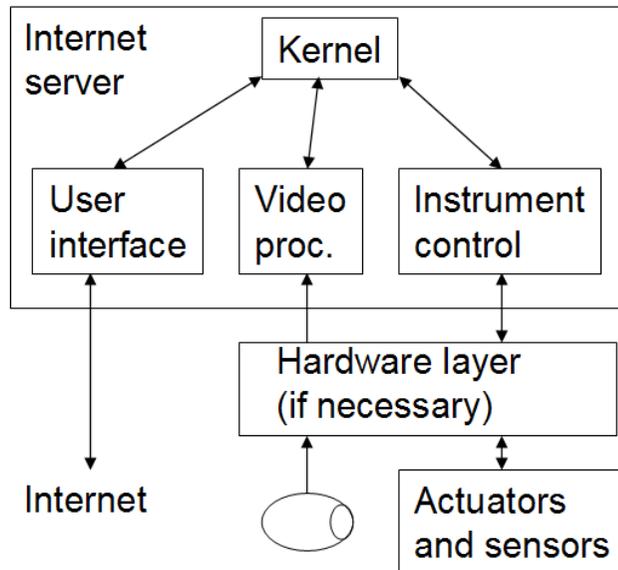


System Architecture

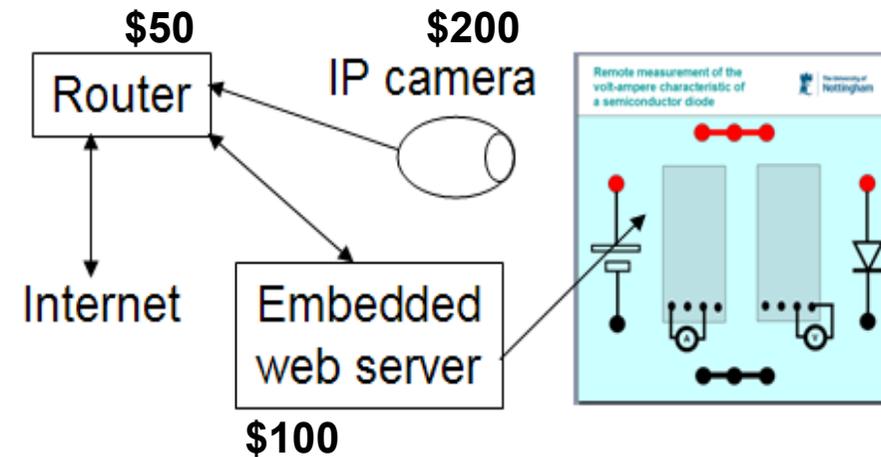


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Conventional



Developed for the project

Custom developments - II

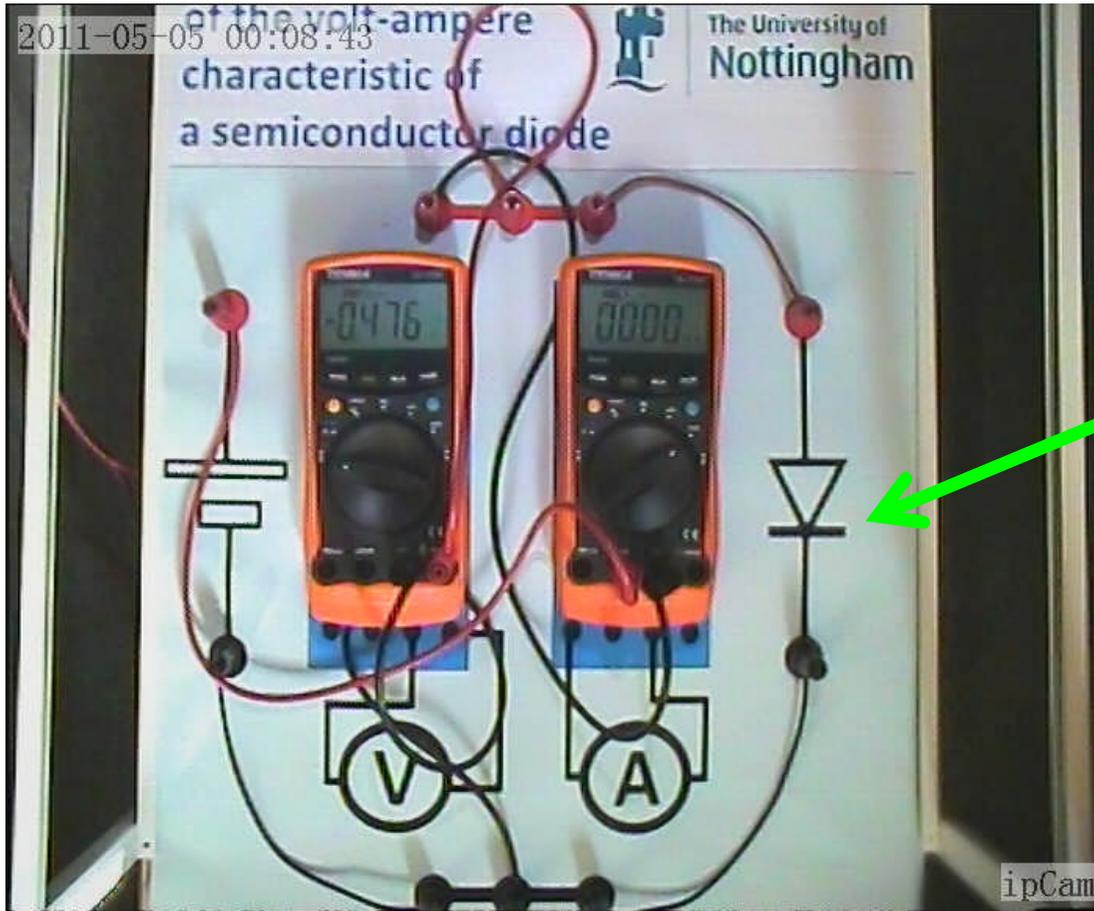


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Firmware

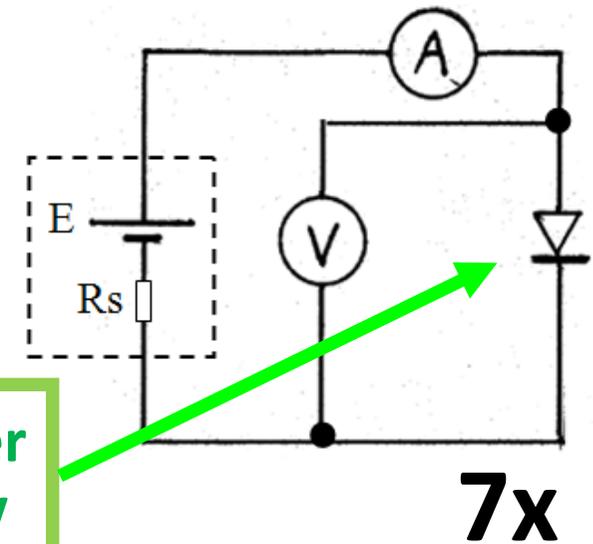
- Controls the programmable power supply
- Operates PIC32 Ethernet Starter Kit
- Utilises Microchip's TCP/IP stack
- Utilises TCPMaker Pro message server

The workspace

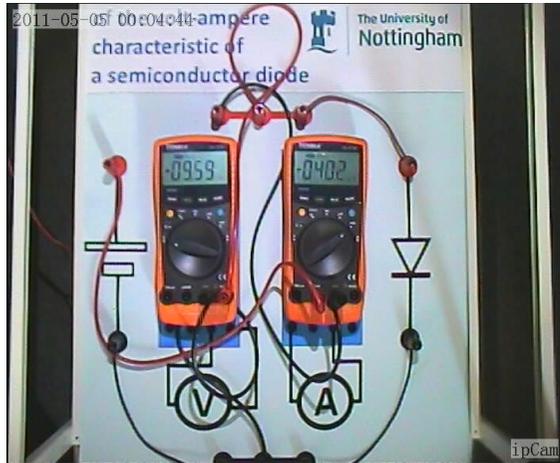


1x

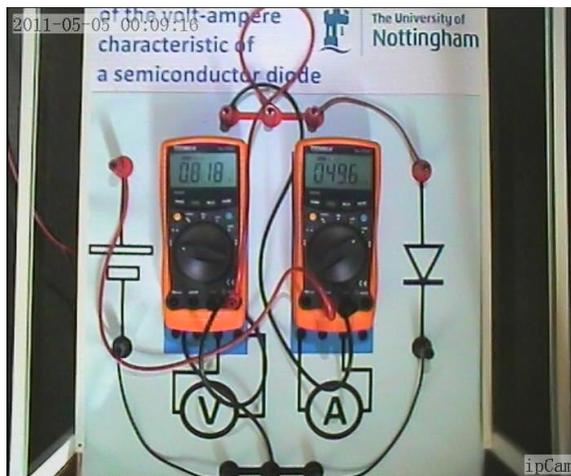
Zener
9.1 V



Extreme readings



Negative voltage (Zener breakdown)



Positive voltage (voltage drop)

On screen controls



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The image shows two side-by-side browser windows. The left window, titled 'DVS/IP-CAM - Windows Internet Explorer', displays a live video feed of two orange Tenma RS222C digital multimeters. The left multimeter's display shows '-0.476 V' and the right one shows '00.00'. The video feed includes a timestamp '2011-05-05 00:17:18' and an 'ipCam' watermark. The browser's address bar shows 'http://192.168.1.233/login'. The right window, titled 'TCPmaker Test - Windows Internet Explorer', displays a control interface for the multimeter. It features the text 'Power supply voltage' in green, followed by two sliders: 'Coarse' set to '0.0 Volts' and 'Fine'. The browser's address bar shows 'http://192.168.1.101'. Both windows have standard browser menus and toolbars.

Limit exceeded



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The image displays two side-by-side screenshots from a Windows Internet Explorer browser window.

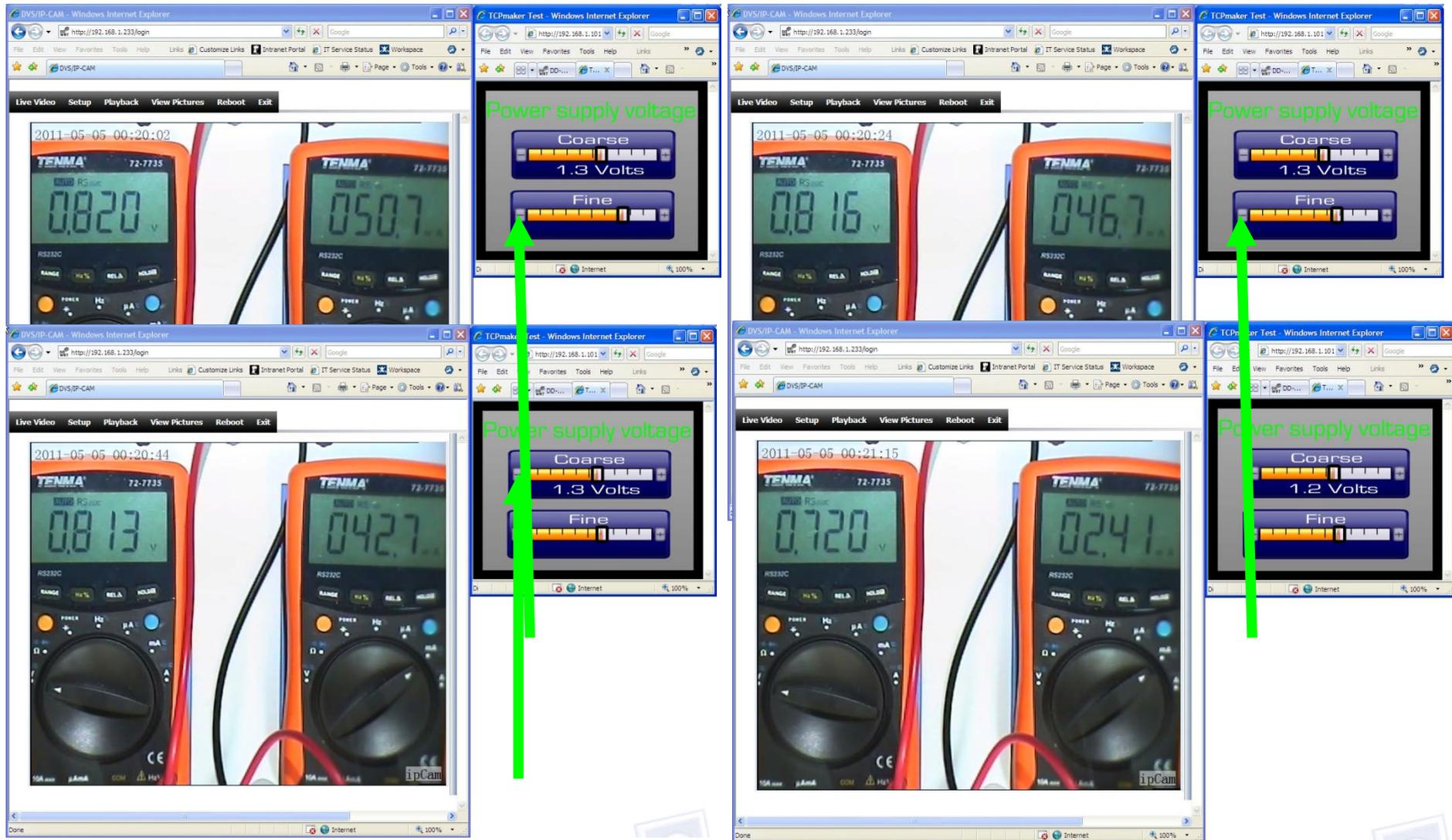
The left screenshot, titled "DVS/IP-CAM", shows a live video feed of two digital multimeters (TENMA RS222C) connected to a power source. The left multimeter displays a reading of -09.58 V , and the right multimeter displays -04.45 V . The video feed includes a timestamp of "2011-05-05 00:18:23" and a "Live Video" control bar with options for Setup, Playback, View Pictures, Reboot, and Exit.

The right screenshot, titled "TCPmaker Test", shows a software interface with a "Power supply voltage" section. A "Coarse" control is set to -9.3 Volts . Below this, a large red box with the word "FIRE" in yellow text is displayed, indicating a critical warning or error state.

Successive screenshots



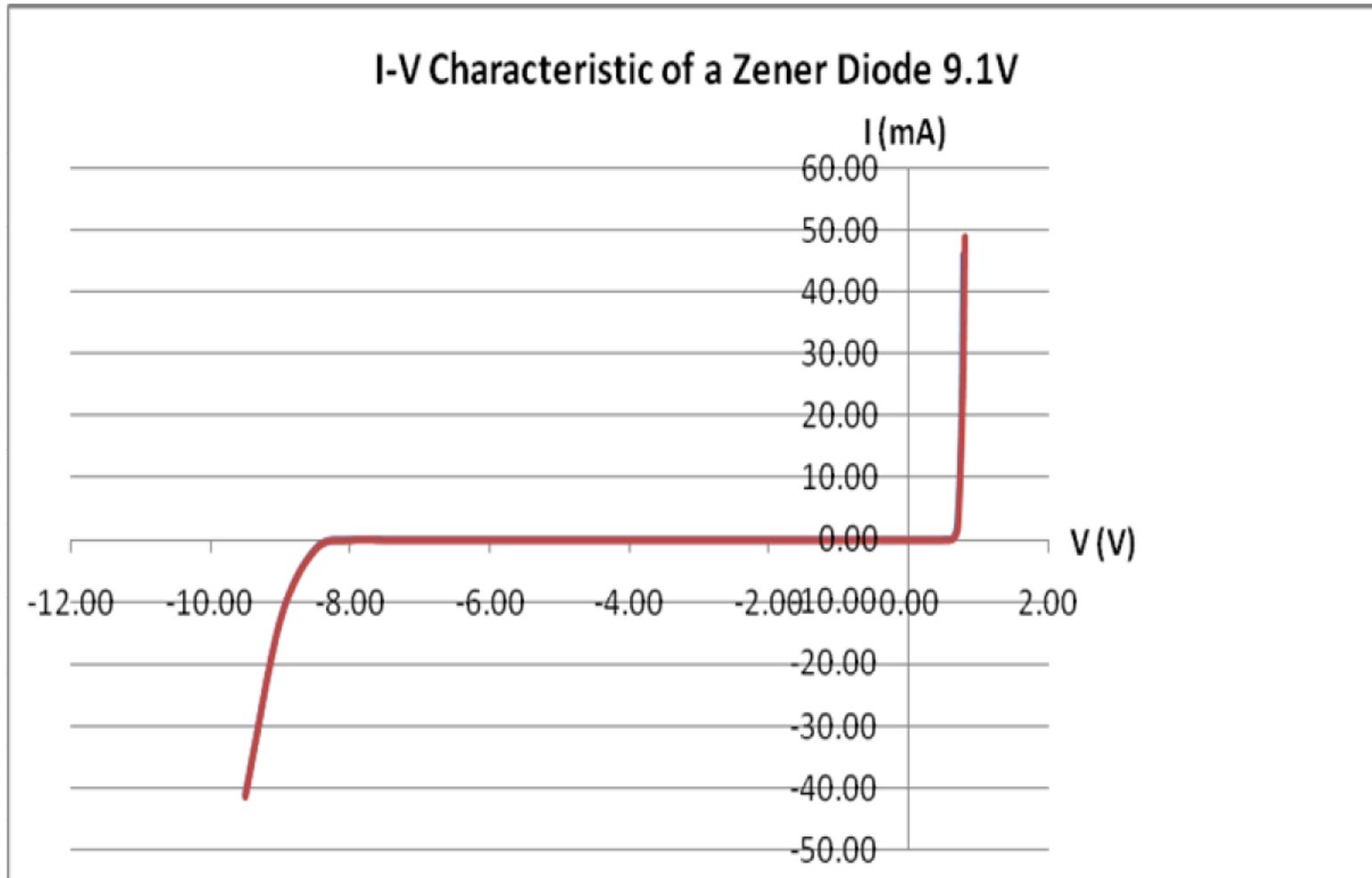
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Measurement results



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Playback



Conclusions



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- Advantages of the remote laboratory
 - 100% safe
 - 100% real
 - 100% automated
- Developed remote laboratory
 - measures volt ampere characteristic of a semiconductor diode
 - is accessible over the Internet