

Conducting Laboratory Experiments over the Internet

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1999 IEEE

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Outline

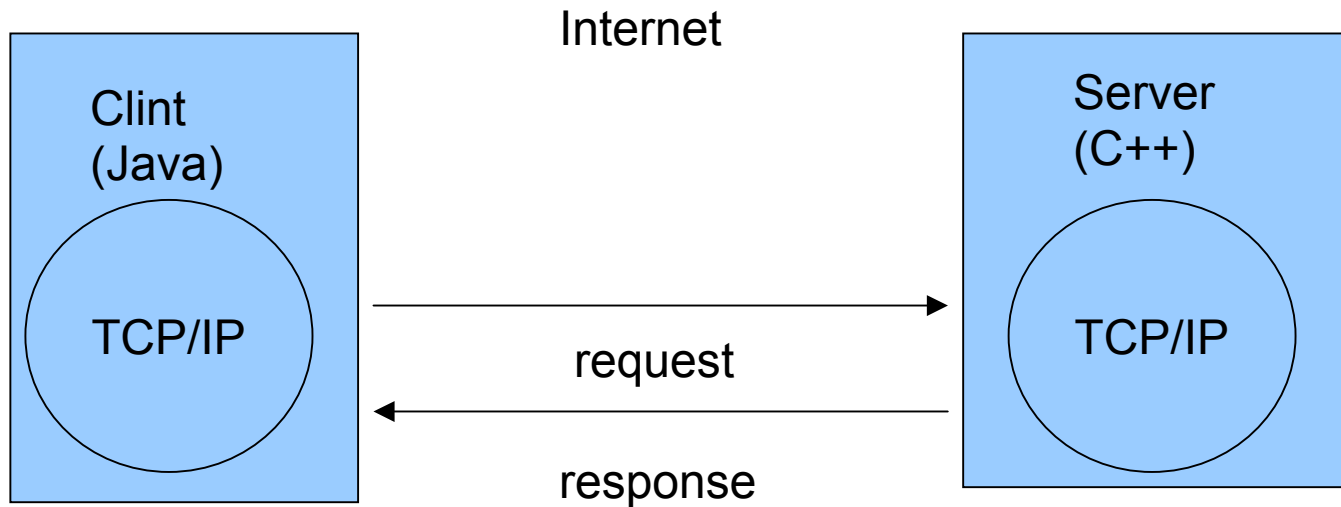
- Introduction
- System Architecture
 - Server Architecture
 - Client Architecture
 - System characteristic
- Applications
 - Server GUI
 - User GUI
- Conclusions

Introduction

- Internet is an ideal medium for remote instruction.
- What is **AIM-Lab** (Automated Internet Measurement Laboratory)
 - Establish a boundless education curriculum.
 - Base on client/server architecture.

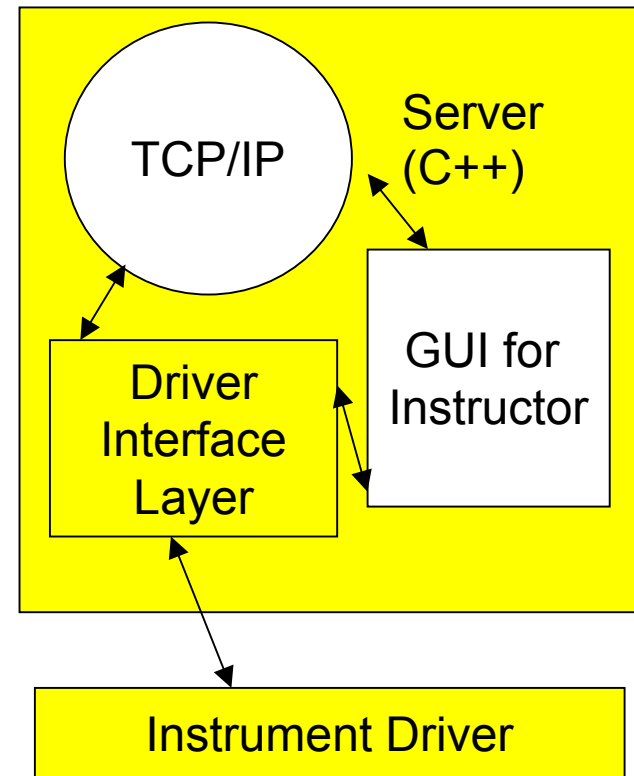
System Architecture

- Base on Client/Server paradigm



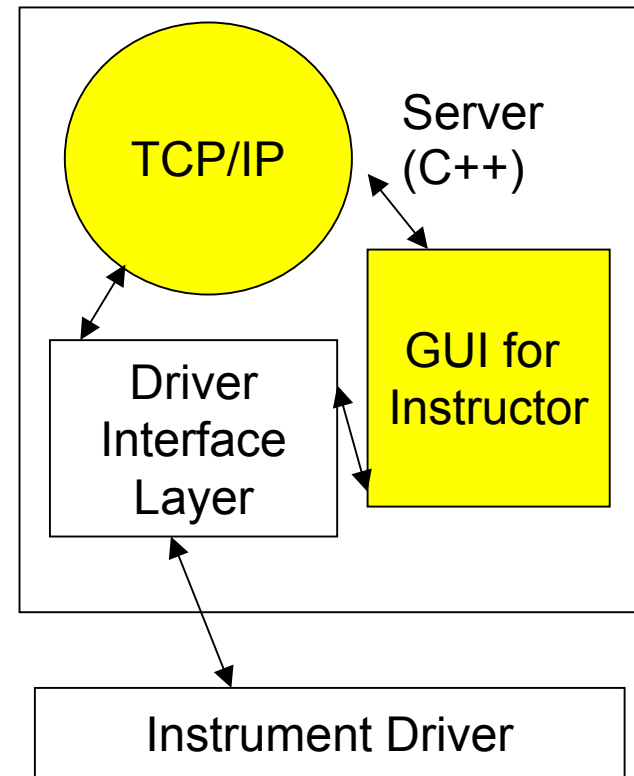
Server Architecture

- Written in MS VC++
- DIL: manages the tasks and communicates with the instrument driver
- ID: Uses HP-IB IEEE488.2 standard to drive the instrument



Server Architecture

- GUI for instructor: allows the instructor to monitor and control the server process
- TCP/IP: communicates with the client side over the internet



Client Architecture

- Java applet
- GUI for student
- CG: issues commands according to the parameter set by user and handle experimental result

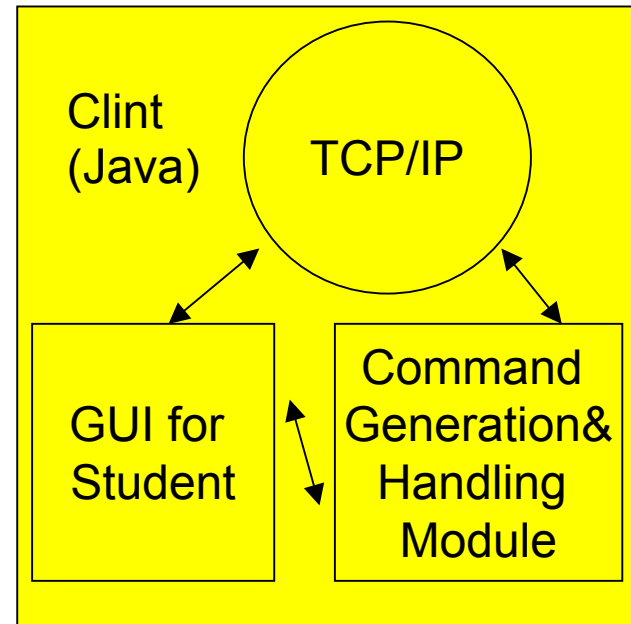
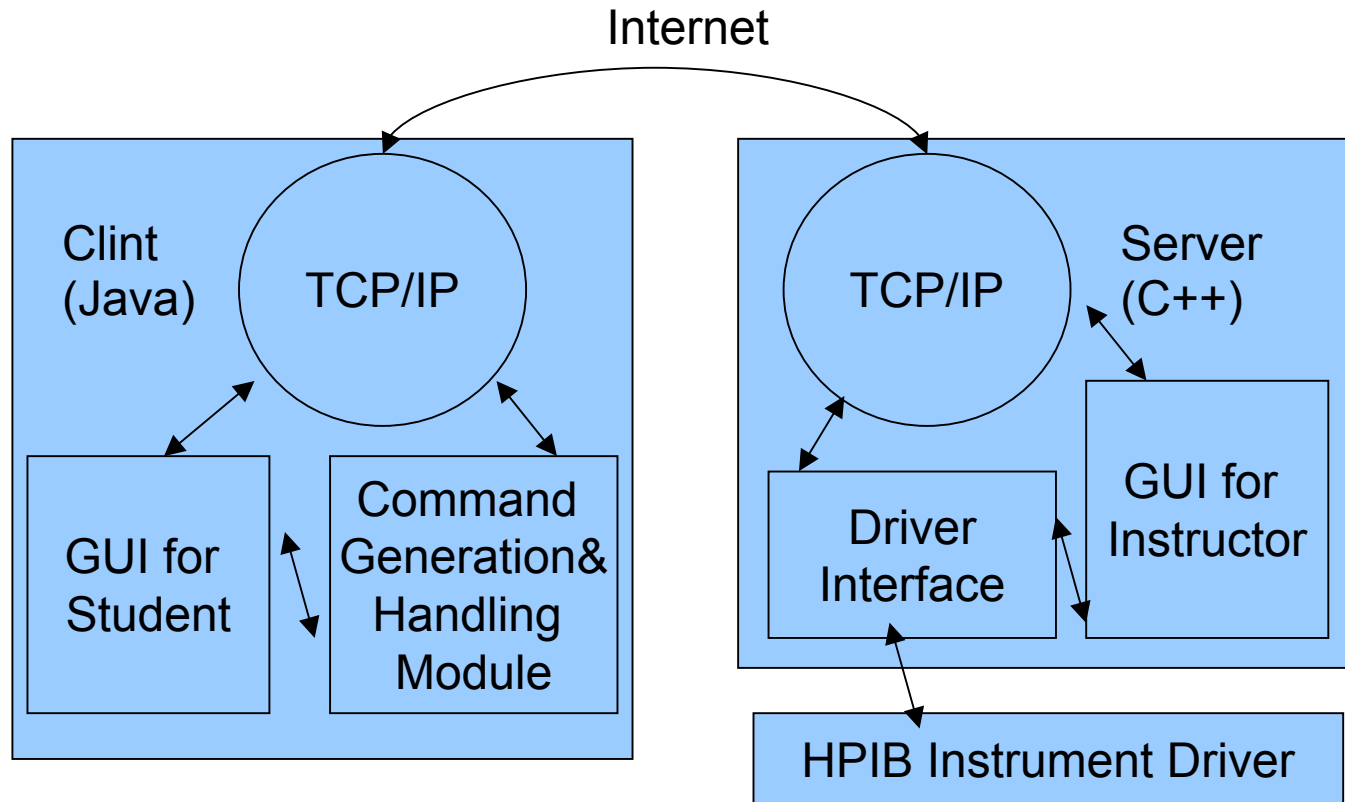
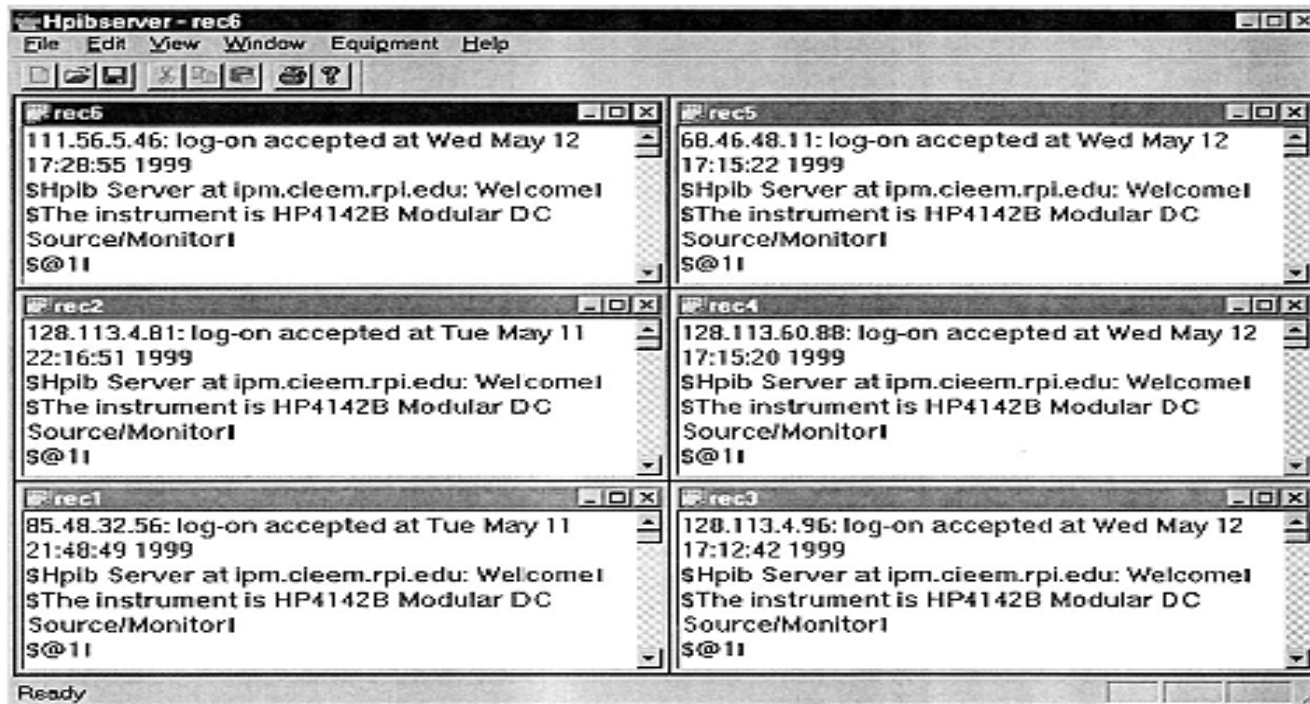


Fig1 AIM-Lab system Configuration



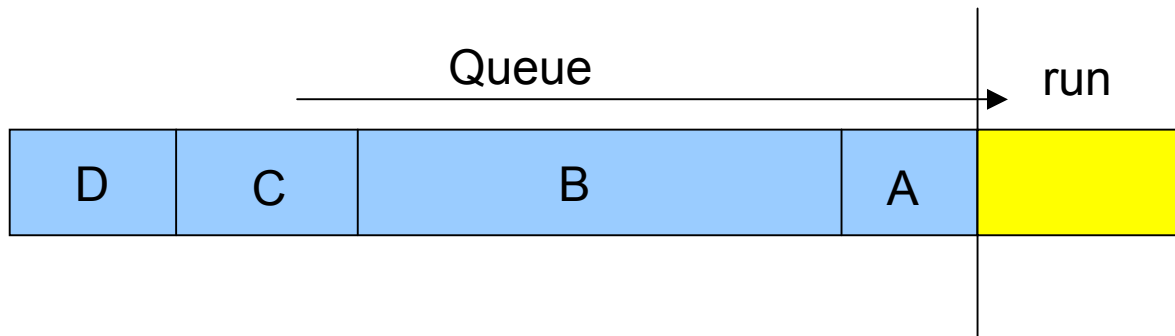
System characteristic

- The AIM-Lab is designed to Maximize the server performance and efficiency.



System characteristic

- System stability.
 - No experiment failure or errors cause by the clients lead to a malfunction of the server.
 - The server will discard the error commands.



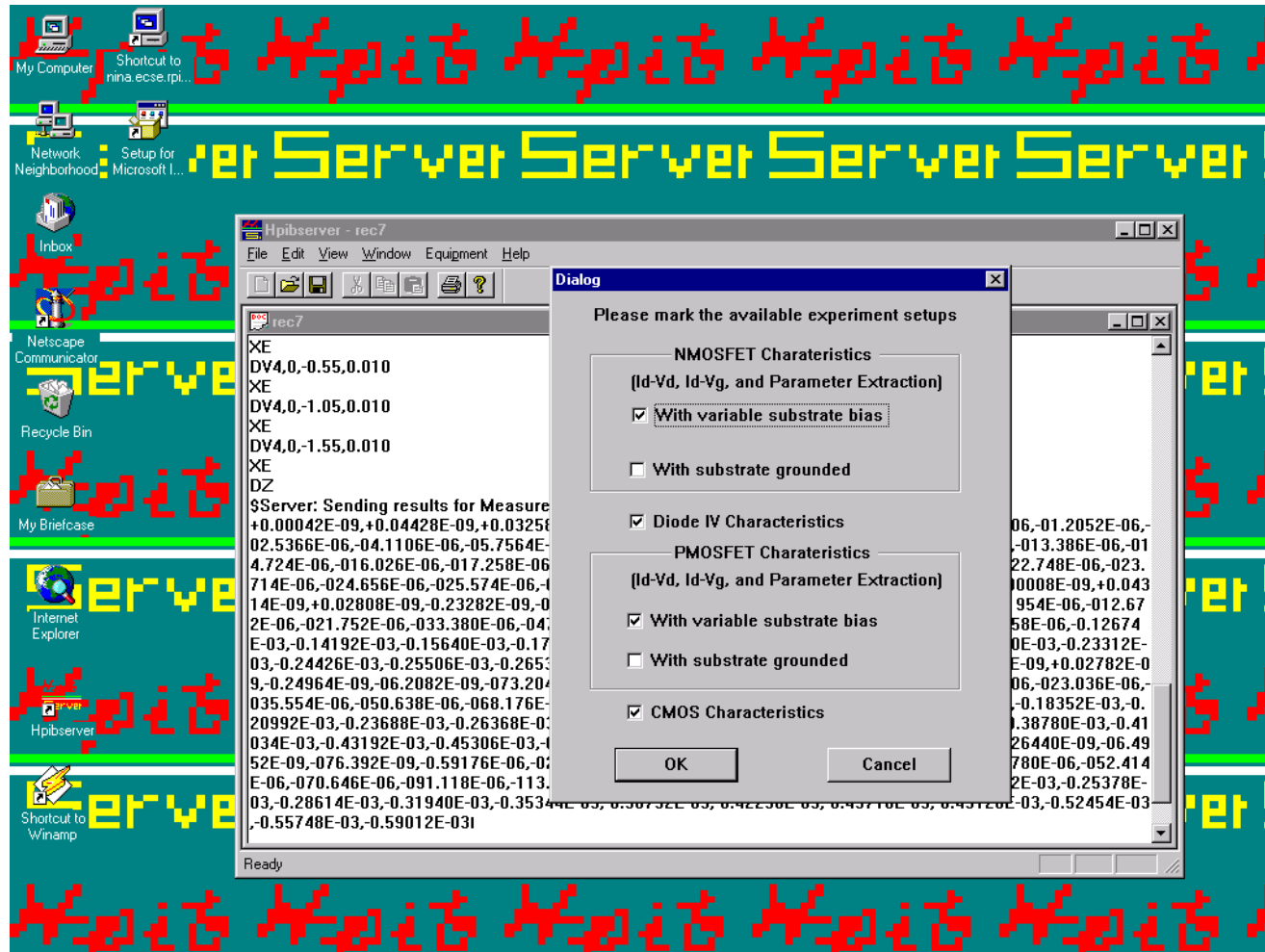
System characteristic

- We can also develop a different applet for each group of experiments with the server remaining unchanged.
- The system provides easy access to the user and maximizes the speed of the on-line measurement.

Applications

- We have applied AIM-Lab for the characterization of complementary metal oxide semiconductor (CMOS) devices and a SiC light emitting diode (LED).
- nina.ecse.rpi.edu/shur/Remote/

Server GUI



Server GUI

The screenshot shows a Windows-style graphical interface titled "Hpibserver - rec2". The interface contains five terminal windows, each displaying a different type of data or log output:

- rec2:** Displays a long list of scientific data points in scientific notation, such as $084.046E-06$, $+093.886E-06$, $+100.864E-06$, etc.
- rec4:** Displays a long list of scientific data points in scientific notation, such as $09,-0.02866E-09$, $-0.03544E-09$, $-0.03160E-09$, etc.
- rec1:** Shows a log entry: "128.113.4.81: log-on accepted at Tue Nov 24 15:25:33 1998". It includes a welcome message, instrument identification ("HP4142B Modular DC Source/Monitor"), user ID ("S@11"), and protocol details like "\$Server: doing Experiment #1", "*RST", "CN:FMT 2,0", "MM 2,6;WV 6,1,0,-3,3.00,61,0.050;", "XE", "DZ", and "\$Server: Sending results for Measurement #1...".
- rec3:** Shows a log entry: "128.113.4.121: log-on accepted at Tue Nov 24 20:10:21 1998". It includes a welcome message, instrument identification, user ID, and protocol details like "\$Server: doing Experiment #1", "*RST", "CN:FMT 2,0", "MM 2,1;WV 1,1,0,0.00,3.00,31,0.010;DV8,0,1,0,0.010", "XE", "DV8,0,1,5,0.010", "XE".
- rec5:** Shows a log entry: "85.48.32.56: log-on accepted at Tue Nov 24 22:02:39 1998". It includes a welcome message, instrument identification, user ID, and protocol details like "\$Server: doing Experiment #1", "*RST", "CN:FMT 2,0", "MM 2,6;WV 6,1,0,-3,3.00,121,0.005;", "XE", "DZ", and "\$Server: Sending results for Measurement #1...".

The status bar at the bottom left of the window indicates "Ready".

User GUI

The screenshot displays a web browser window titled "Insert Heading Here - Netscape" with a menu bar (File, Edit, View, Go, Communicator, Help) and a toolbar. The main content area features the heading "Diode I-V Characteristics" and a circuit diagram of a diode connected to a DC voltage source. Three windows are overlaid on the page:

- Client Window:** A window titled "Client Window" with a menu bar (Operation, View, About, Help). The text inside reads: "-- Trying to connect --", "-- Connection established --", "Hpib Server at ipm.cieem.rpi.edu: Welcome", and "The instrument is HP4142B Modular DC Source/Monitor".
- Instructions:** A window titled "Instructions" containing the following text:
INSTRUCTIONS
Connect to the Server by choosing Connect in the Operation menu
Configure the experiment by choosing Start Experiment
Set the parameters in the source setup panel and send the experiment to server
New experiments can be set and sent while the instrument is doing a previous one
Terminate the connection by choosing Quit
To open another session: click on the button 'open client window' at the bottom of any experiment page
A "Hide instruction" button is located at the bottom of this window.
- Channel Setup Dialog:** A dialog box titled "Channel Setup Dialog" with the prompt "Please select the type of experiment you want to do". It contains two columns of radio button options:
 - NMOSFET:** Id-Vd Characteristics, Id-Vg Characteristics, Parameter extraction
 - PMOSFET:** Id-Vd Characteristics, Id-Vg Characteristics, Parameter extraction
 - CMOS Inverter:** Transfer Characteristic, Is-Vi Characteristics
 - Diode:** I-V CharacteristicsButtons for "Go to Source Setup Panel" and "Cancel" are at the bottom.

At the bottom of the browser window, there is a "Open the client window" button and a navigation bar with links: [Home](#) | [Remote Lab Homepage](#) | [Background and Instructions](#). The status bar at the very bottom shows "Reading file... Done" and a system tray with various icons.

User GUI

NMOS Parameter Extraction

Client Window
Operation View About Help
-- Trying to connect --
-- Connection established --
Hpiib Server at ipm.cieem.rpi.edu: Welcome
The instrument is HP4142B Modular DC Source/Monitor

Source Setup Panel

| Vd--Drain Voltage | | Vg--Gate Voltage | | Vb | |
|-------------------|---------|------------------|---------|------------------------|--|
| Start V | 0.00 V | Start V | -1.00 V | Substrate Voltage Bias | |
| Stop V | -3.00 V | Steps | 4 | 0.00 V | |
| Step V | -0.10 V | Step V | -0.50 V | Compliance | |
| Sweep Mode | inear | Sweep Mode | inear | 0.10 A | |
| Compliance | 0.010 A | Compliance | 0.010 A | Source Voltage Vs=0 | |

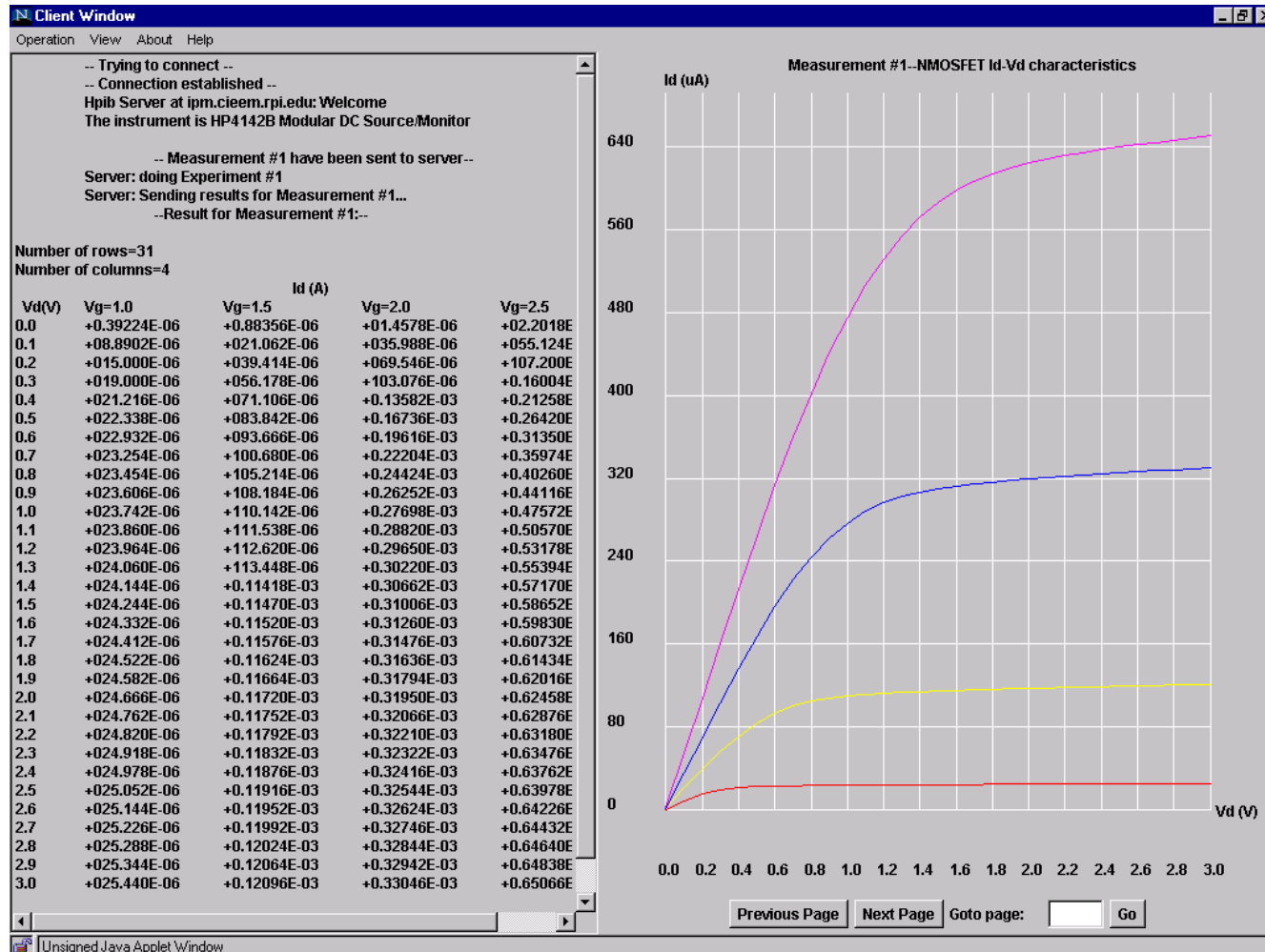
Send experiment to server Cancel

Message

Unsigned Java Applet Window

Reading file...

Output



Conclusions

- The AIM-Lab provides real laborator experiment via the Internet.
- AIM-Lab courses may be offered to remote students any place in the world.