Conducting Laboratory Experiments over the Internet

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Outline

Introduction

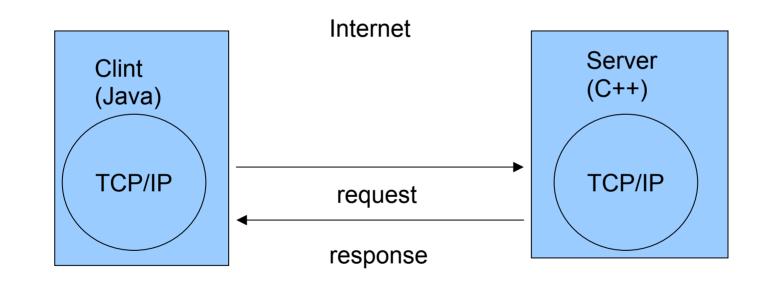
- System Architecture
 - Server Architecture
 - Client Architecture
 - System characteristic
- Applications
 - Server GUI
 - User GUI
- Conclusions

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.

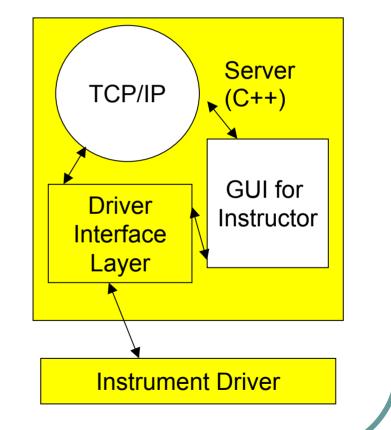
System Architecture





Server Architecture

- Written in MS VC++
- DIL: manages the task s and communicates with the instrument driver
- ID: Uses HPIB
 IEEE488.2 standard to drive the instrument

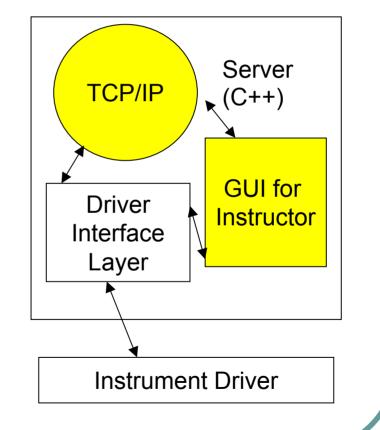


Server Architecture

 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

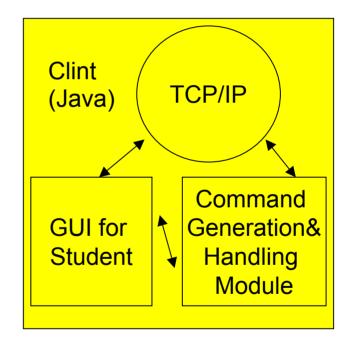
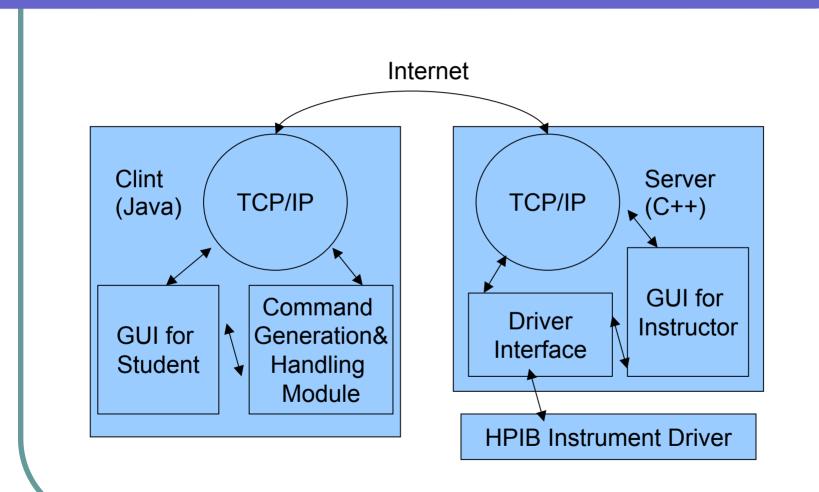


Fig1 AIM-Lab system Configuration



System characteristic

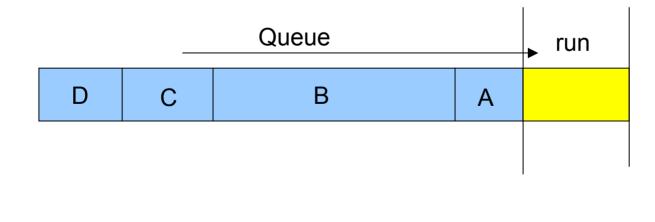
• The AIM-Lab is designed to Maximize the server performance and efficiency.

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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

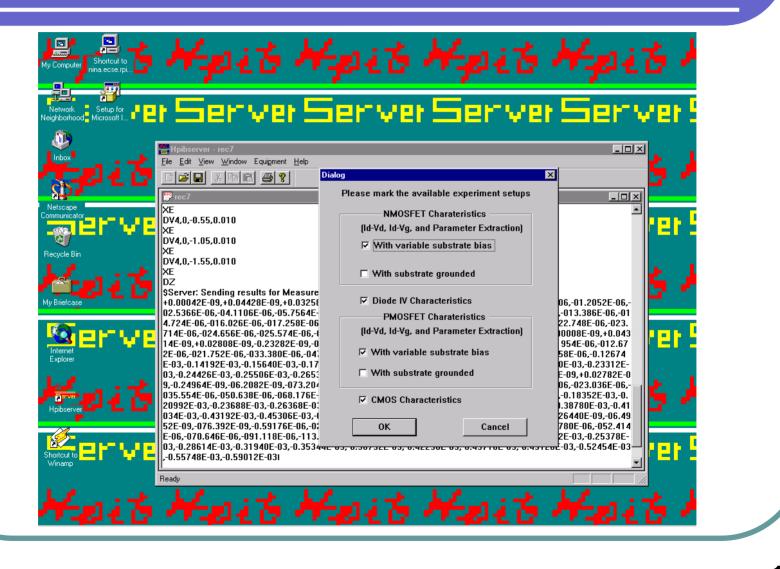
- We can also develop a different applet for each group of experiments with the server remaining unchanged.
- The system provides easy access to the user and maximizes the speed of the online measurement.

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

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User GUI

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Home <u>Remote Lab Home</u>	Open the client window	Go to Source Setup Panel	Cancel	

User GUI

🔆 Insert Heading Here - Netscape _ 8 × <u>File Edit View Go Communicator Help</u> NMOS Parameter Extraction - 🗆 🗵 Operation View About Help -- Trying to connect ---- Connection established --Hpib Server at ipm.cieem.rpi.edu: Welcome 4 11 Pin # Pad # The instrument is HP4142B Modular DC Source/Monitor N Source Setup Panel × Vd--Drain Voltage Vg--Gate Voltage Vb Substrate Voltage 18 0.00 -1.00 17 16 15 14 13 Start V ъ. 1 v Start V Bias -3.00 CG 25/1.2 25/1.5 25/2 3/25 2/25 1.1 Stop V Steps 0.00 v 19 5 9 СВ б 7 8 10 4 -0.10 -0.50 Step V Compliance Step V 20 URSC OUT 3 0.10 Sweep Mode inear Sweep Mode inear 0.010 A 0.010 Α Compliance Source Voltage Compliance 21 LRSC OUT 2 Unloaded ring Oscillator Vs=0 Loaded ring Oscillator Send experiment to server Cancel 22 CJSWPW 1 Message Aim Spice Chip 23 28 100/100 💣 Unsigned Java Applet Window 24 27 17 6 СВ (±) ™ 26 23 25 22 21 20 19 18 24 CG 2/25 3/25 25/2 25/1.5 25/1.2 CS 1.5/25 25 27 28 2 26 3 1 4 5 Ŧ (\pm) Vd ar -0-Reading file. - 🔆 🎿 🗗 🖬 🎸

Output

N Client Window _ 8 × Operation View About Help -- Trving to connect -Measurement #1--NMOSFET Id-Vd characteristics ld (uA) -- Connection established --Hpib Server at ipm.cieem.rpi.edu: Welcome The instrument is HP4142B Modular DC Source/Monitor 640 -- Measurement #1 have been sent to server--Server: doing Experiment #1 Server: Sending results for Measurement #1... --Result for Measurement #1:--560 Number of rows=31 Number of columns=4 Id (A) Vd(V) Vg=1.0 Vg=1.5 Vg=2.0 Vg=2.5 480 +0.39224E-06 0.0 +0.88356E-06 +01.4578E-06 +02.2018E 0.1 +08.8902E-06 +021.062E-06 +035.988E-06 +055.124E 0.2 +015.000E-06 +039.414E-06 +069.546E-06 +107.200E 0.3 +019.000E-06 +0.16004E +056.178E-06 +103.076E-06 400 0.4 +021.216E-06 +071.106E-06 +0.13582E-03 +0.21258E 0.5 +022.338E-06 +083.842E-06 +0.16736E-03 +0.26420E 0.6 +022.932E-06 +093.666E-06 +0.19616E-03 +0.31350E 0.7 +023.254E-06 +100.680E-06 +0.22204E-03 +0.35974E 0.8 +023.454E-06 +105.214E-06 +0.24424E-03 +0.40260E 320 0.9 +023.606E-06 +108.184E-06 +0.26252E-03 +0.44116E 1.0 +023.742E-06 +110.142E-06 +0.27698E-03 +0.47572E 1.1 +023.860E-06 +111.538E-06 +0.28820E-03 +0.50570E 1.2 +023.964E-06 +112.620E-06 +0.29650E-03 +0.53178E 240 1.3 +024.060E-06 +113.448E-06 +0.30220E-03 +0.55394E 1.4 +024.144E-06 +0.11418E-03 +0.30662E-03 +0.57170E 1.5 +024.244E-06 +0.11470E-03 +0.31006E-03 +0.58652E 1.6 +0.59830E +024.332E-06 +0.11520E-03 +0.31260E-03 1.7 160 +024.412E-06 +0.11576E-03 +0.31476E-03 +0.60732E 1.8 +024.522E-06 +0.11624E-03 +0.31636E-03 +0.61434E 1.9 +024.582E-06 +0.11664E-03 +0.31794E-03 +0.62016E 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9 +024.666E-06 +0.11720E-03 +0.31950E-03 +0.62458E +024.762E-06 +0.11752E-03 +0.32066E-03 +0.62876E 80 +024.820E-06 +0.11792E-03 +0.32210E-03 +0.63180E +024.918E-06 +0.11832E-03 +0.32322E-03 +0.63476E +024.978E-06 +0.63762E +0.11876E-03 +0.32416E-03 +025.052E-06 +0.32544E-03 +0.63978E +0.11916E-03 0 +025.144E-06 +0.11952E-03 +0.32624E-03 +0.64226E Vd (V) +025.226E-06 +0.11992E-03 +0.32746E-03 +0.64432E +025.288E-06 +0.12024E-03 +0.32844E-03 +0.64640E +025.344E-06 +0.12064E-03 +0.32942E-03 +0.64838E 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.0 +025.440E-06 +0.12096E-03 +0.33046E-03 +0.65066E Next Page | Goto page: Previous Page Go 💣 Unsigned Java Applet Window

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.