



University of Idaho

College of Engineering



ELECTRIC BLOCKS II TECHNICAL PRESENTATION

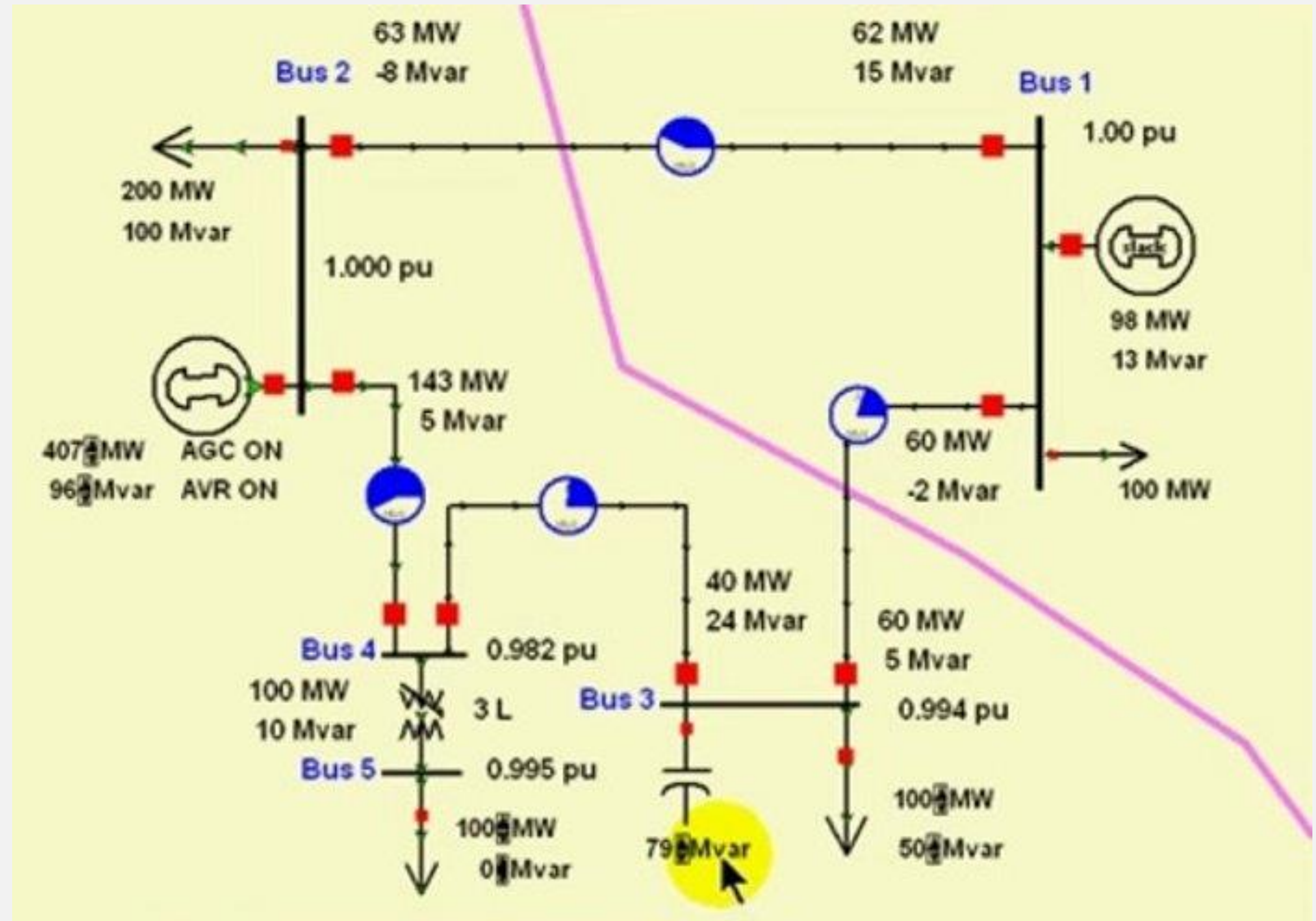
GREYSON BIGGS

RYAN BUCKEL

SAMUEL FREDERICKSON

BACKGROUND

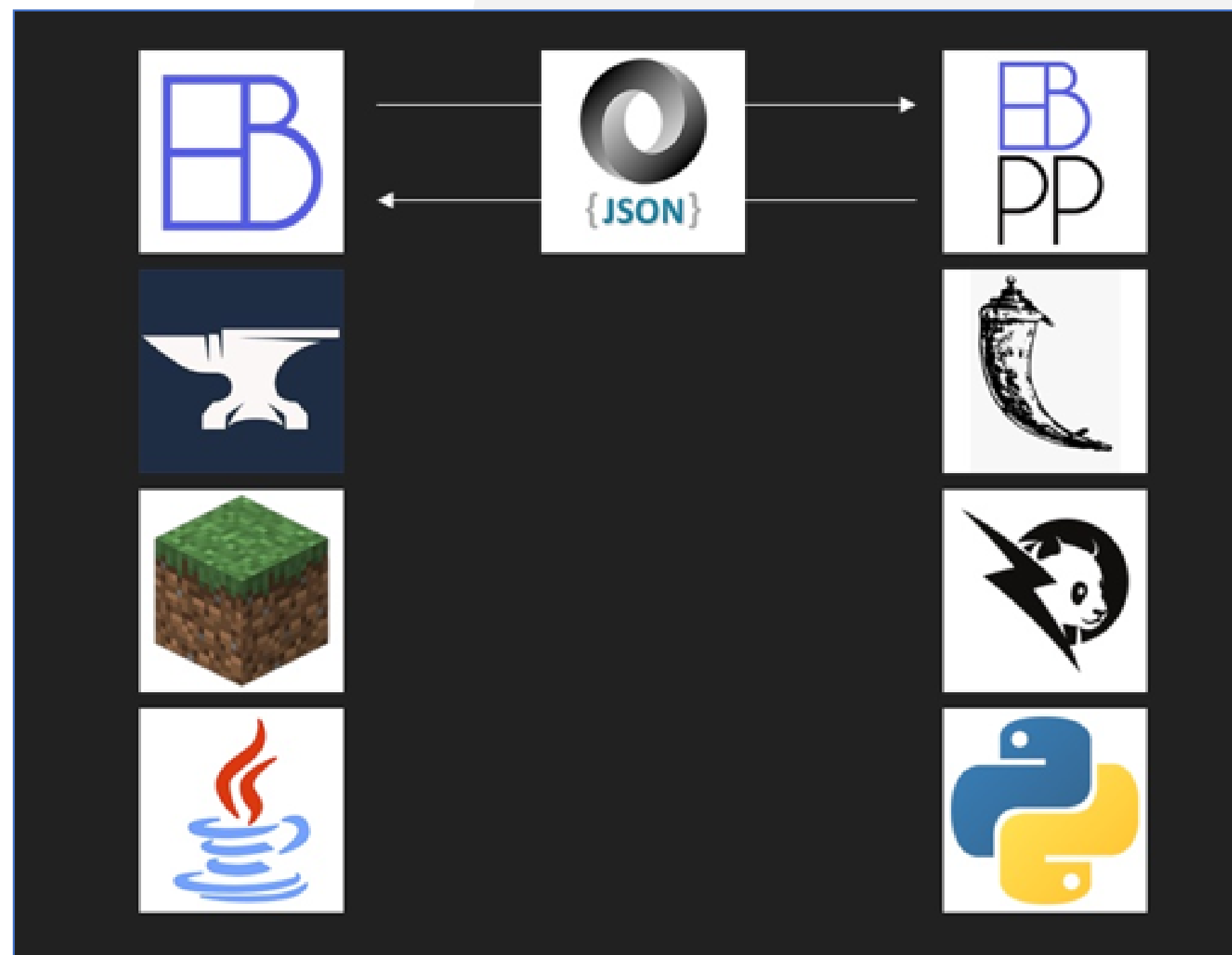
- Electric Blocks I created a tool useful for conducting power-flow study: a numerical analysis of electric flow of power in a system.



(Above: Circuit Diagram)

BACKGROUND

- Electric Blocks I uses *Minecraft Forge* to mod *Minecraft*, *Panda Power* to simulate power flow, and *JSON* for communication between the two.



(Tech stacks of Electric Blocks I)



(Simple circuit in Electric Blocks I, which lights a lamp)

VALUE PROPOSITION

- Electric Blocks I brought accurate power flow simulation to Minecraft but needed polish and quality of life improvements to be viable for its stated “educational and engineering purposes.”
- Electric Blocks II enhances UI, visual presentation, and documentation to aid in usability.



(Above: *Electric Blocks II*)

PRODUCT REQUIREMENTS

- Provide the means to create and test power systems in real time, for users of a wide range of skill levels.
 - Larger emphasis on learning about power systems
- With this high-level goal, we were given freedom to investigate, design and implement the functionality that would best move the mod forward.

DEVELOPMENT PROCESS

- This is a purely software Capstone project, so we had more flexible goals and were able to add or delay them where needed.
- Open-source software means development was free!
- Work was done over 2-week sprints, communicating with our client at the end of every sprint cycle.



NEW IMPLEMENTATION ROADMAP

- New Electrical Modeling Elements:
 - Added Support for Storage and Electric Furnace Elements.
- Graphical User Interface (GUI) Enhancements:
 - Immediate Feedback on Object Properties.
 - Support for Different Levels of User Expertise.
- Multiplayer Server Enhancements (Security Enhancements).
- Documentation Additions.



NEW ELECTRICAL MODELING ELEMENTS

STORAGE ELEMENT

- Simulates a storage system in PandaPower (battery)
- Can represent an active charging or discharging system.



(Intro Level GUI)



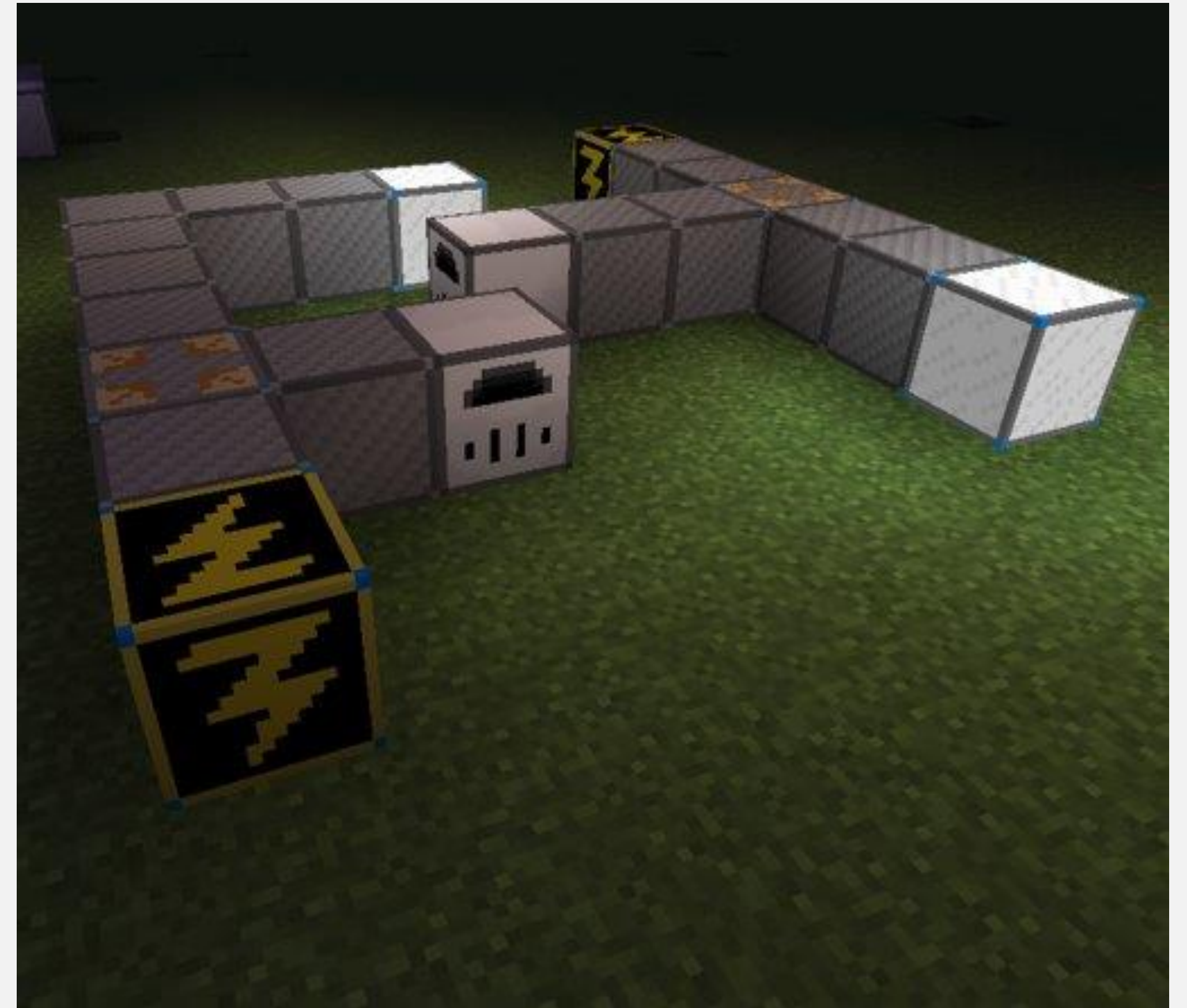
(Intermediate Level GUI)



(Advanced Level GUI)

ELECTRIC FURNACE

- Electric Furnace is a subclass of the generic load block.
- Implements processing of cookable items.
 - Ores, food, stone
- Another use of energy other than light.

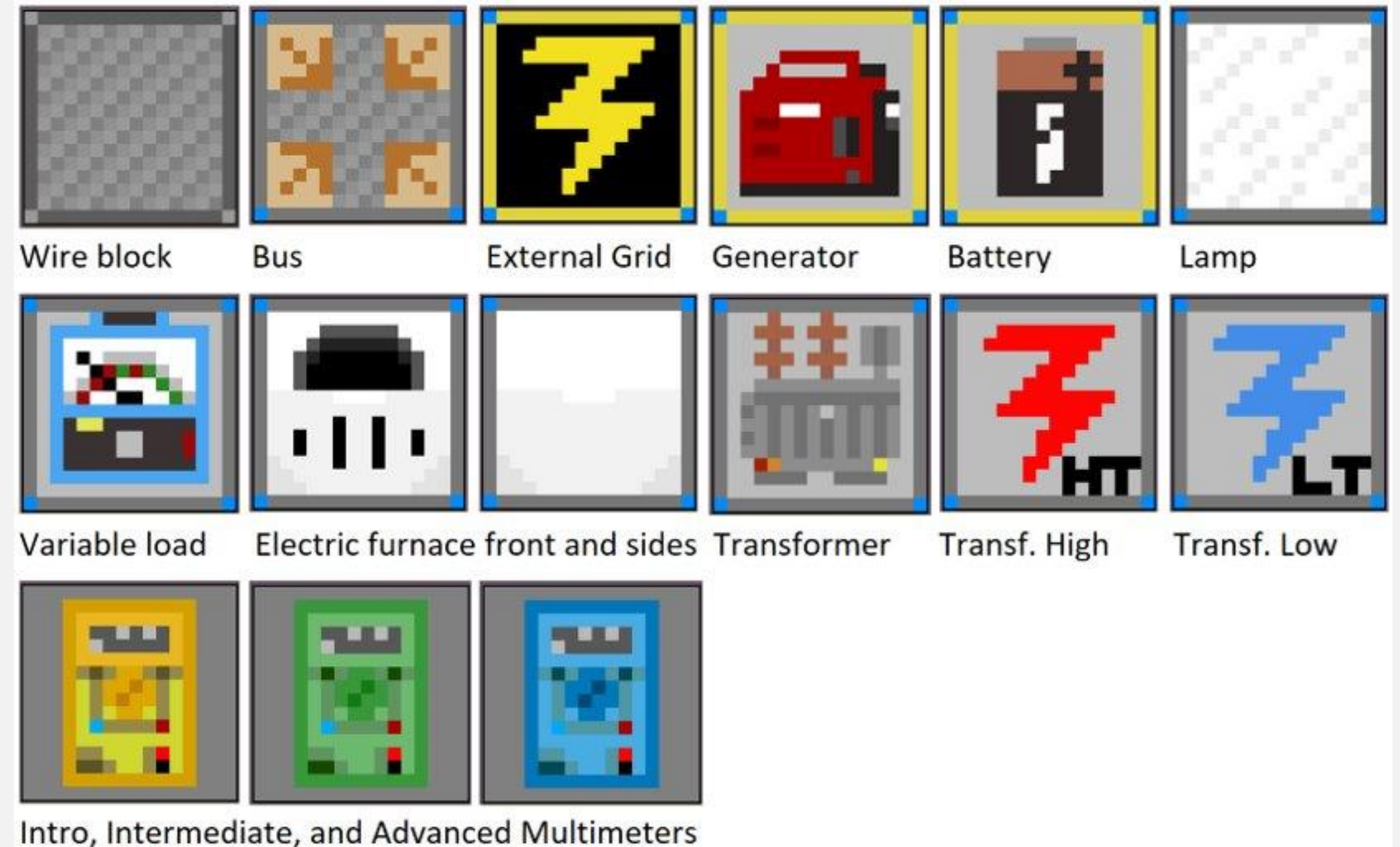




NEW GRAPHICAL USER INTERFACE ENHANCEMENTS

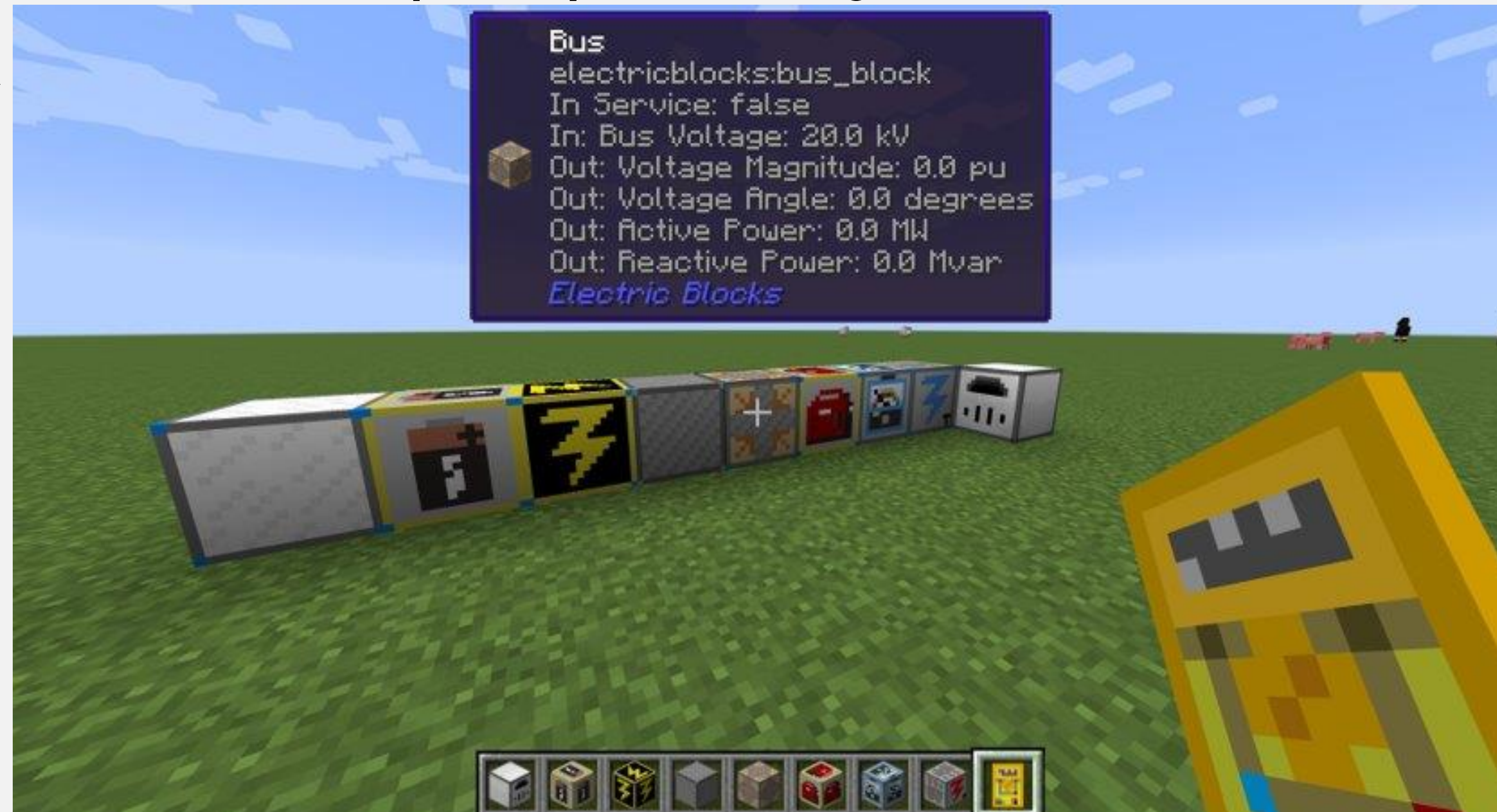
RETEXTURING

- All development textures replaced to facilitate at-a-glance identification of each block's uses and capabilities.
- Yellow borders indicate power supplies, blue corners indicate multimeter interactivity.



HWYLA PLUG-IN

- Here's What You're Looking At is a Minecraft mod that lets users see information about blocks and entities just by hovering over them.
- The Electric Blocks HWYLA plug-in allows users see all EB block input and output in a simple, toggleable tooltip, improving click efficiency and workflow.



GUI RECONSTRUCTION BEFORE

- The GUI before would display all values directly to the user's screen.
- Overwhelming amount of information for certain blocks.
- Those not versed in power flow do not understand what most of these variables mean.

Bus		
Bus Voltage	20.000000	kV

Voltage Magnitude	0.000000	pu
Voltage Angle	0.000000	degrees
Active Power	0.000000	MW
Reactive Power	0.000000	Mvar

GUI RECONSTRUCTION AFTER

Intro Level GUI



Displays basic information only

- Reduces displayed information to the user depending on level of understanding requested.
- Unique values depending on block type.

Intermediate Level GUI



Displays basic information and reactive power amounts

- Applies to all blocks currently being used in power flow calculations.

Advanced Level GUI



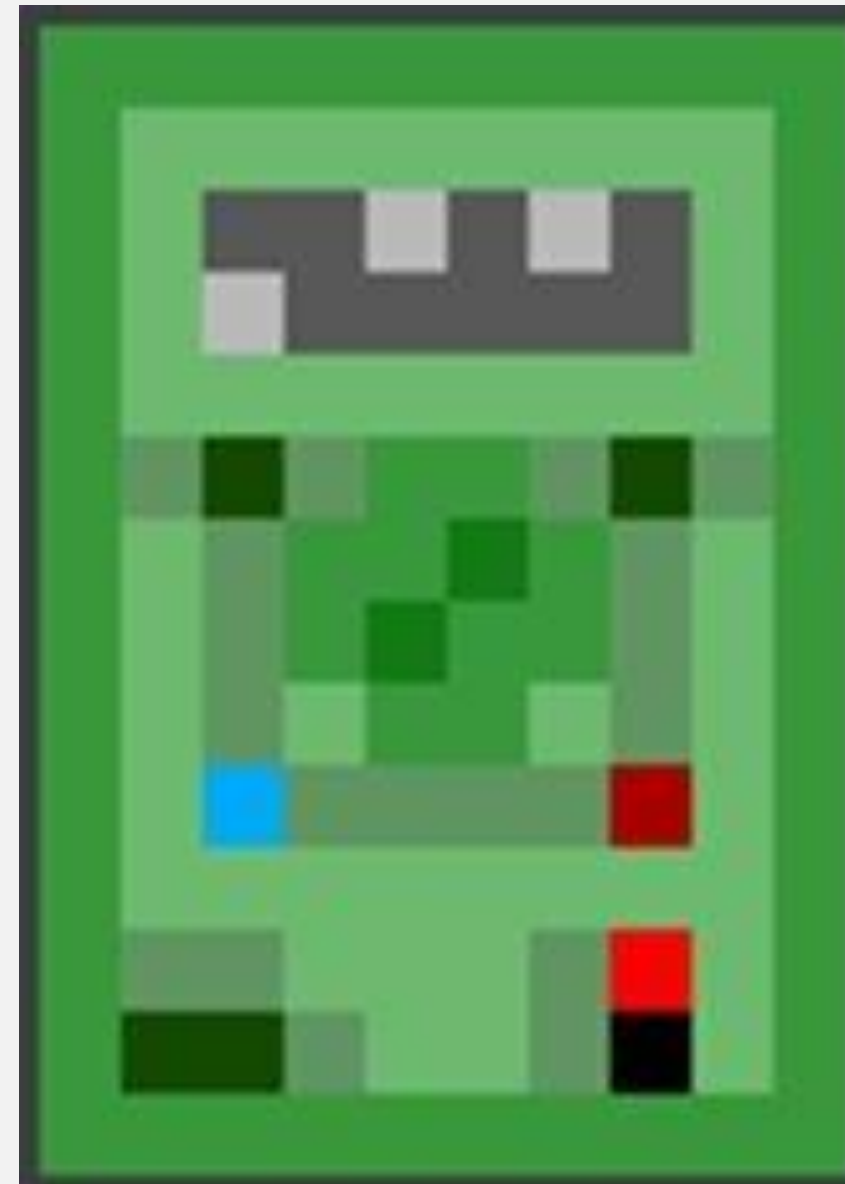
Displays all associated information

INTERACTIVE MULTIMETERS

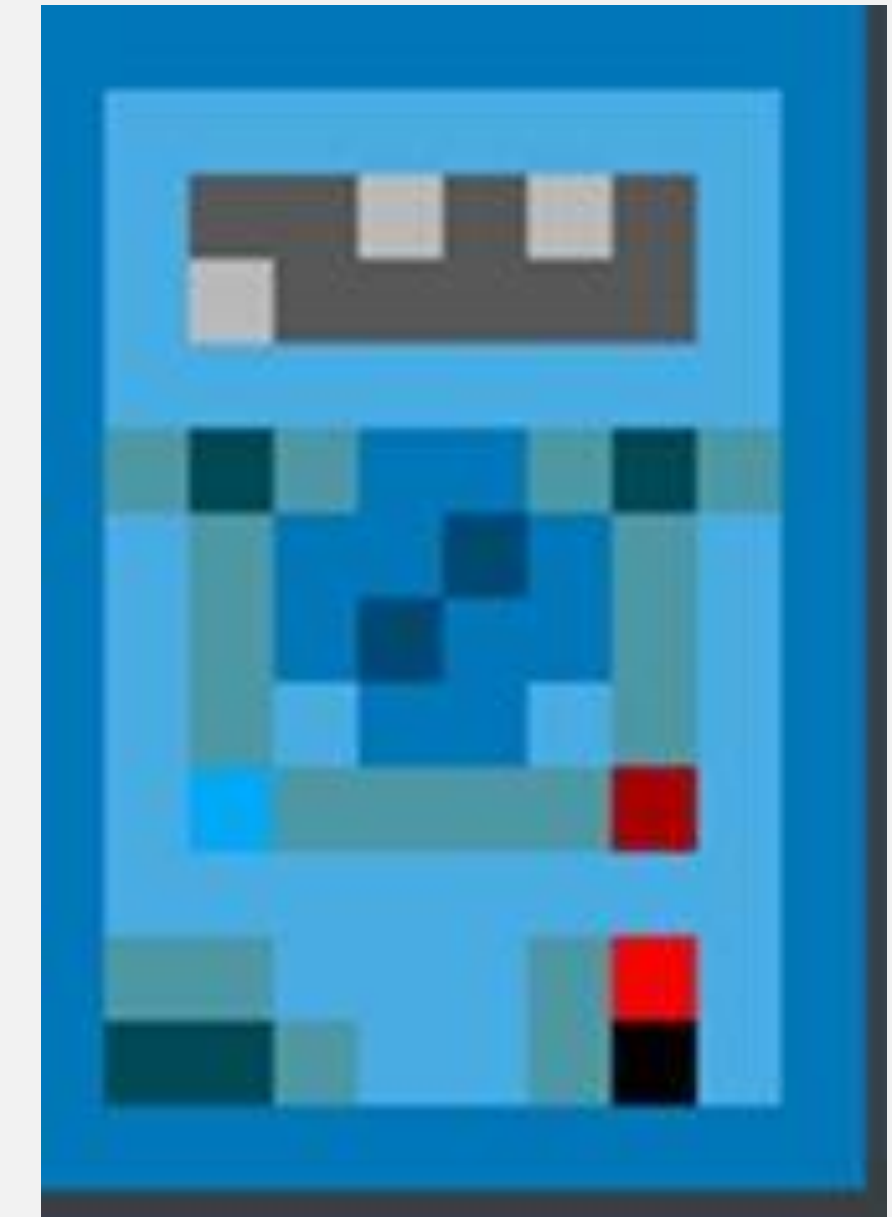
Intro Level



Intermediate Level



Advanced Level



- Determine GUI level based on which multimeter you are holding.

- Applies to all blocks that have power flow variables.



MULTIPLAYER ENHANCEMENTS

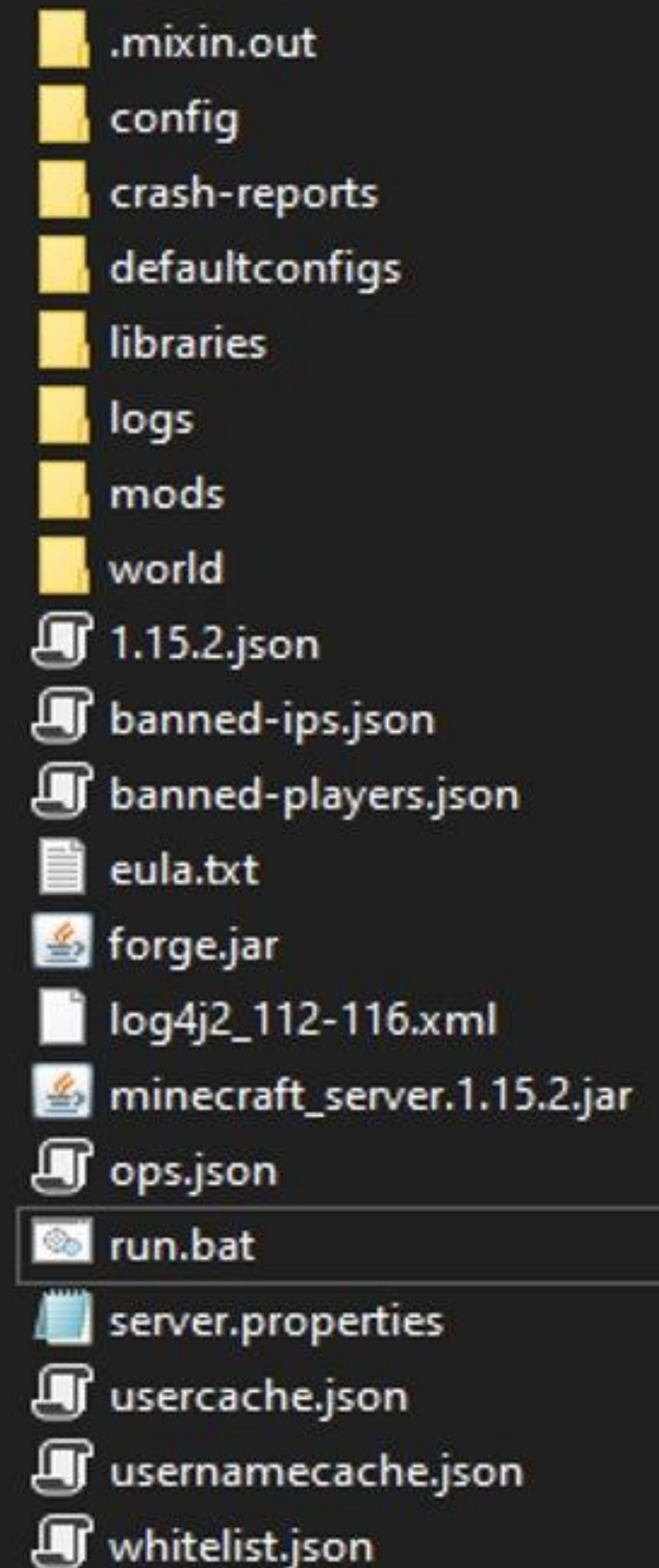
MULTIPLAYER

- Personal server creation using LogMeIn Hamachi.
- Risks:
 - EBPP has no built-in security features.
 - Log4J vulnerability issues.
- Solutions
 - Configure EBPP to be accessible only by the server's IP set to the host's IPV4 address.
 - Start server using specific configuration settings and XML file for Minecraft 1.15.2

Folder to place all required mods for Electric Blocks.

Log4J config file to prevent remote code execution.

Starts server with specified configuration.





DOCUMENTATION ADDITIONS

WRITTEN DOCUMENTATION

- Updates to the project website's documentation (electricblocks.github.io).
- Handoff document for future teams.



The screenshot shows the documentation page for Electric Blocks. The header includes the site name 'Electric Blocks', navigation links for 'Docs' and 'Blog', a search bar, and icons for settings and a GitHub repository. The main content area features the title 'Electric Blocks' and the subtitle 'The Ultimate Power Flow Mod'. A prominent blue 'Get started' button is centered below the subtitle. Underneath, it states 'Open-source AGPL v3 Licensed. GitHub v1.0.0'. The page is organized into three columns, each with a heading and a descriptive paragraph:

- Accurate**: This mod is backed by [PandaPower!](#) This means that models are usable for real world instruction and research purposes.
- Easy to Use**: Build and simulate simple electrical grids in seconds. Everything is visual. No coding required.
- Interactive**: Get immediate feedback whenever changes are made. Modifying any component automatically updates the entire network.

ORIENTATION MAP

- A Minecraft map with short descriptions of items and blocks, and simple circuits.



VIDEO DEMONSTRATION



RECOMMENDATIONS

- Recommendations for future teams include:
 - More interactive load options.
 - Three-phase power.
 - Full scale introduction map with more complex circuits.
 - Time based electrical elements.
 - Real life limitations on electrical equipment
 - Menu to describe how each element interacts with others.

QUESTIONS?



THANK YOU FOR COMING!

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- Advised by Professor Bruce Bolden