Objective: Since it first emerged into the mainstream media, there has been persistent growth in the demand for steampunk electronics. Creating entertainment electronics for this market can be profitable as well as help serve the needs of a niche artist market. This prototype examines the implementation of steampunk design principles on a simplified tabletop game of Sudoku using the MC68HC11. It can be used for preliminary market research and cost analysis to assess manufacturability.

Key Points for Selecting Your Design: Keeping labor and cost down were our main goals of design. Creating a marketable prototype was an additional goal and for this, steampunk theory was applied. Visually, steampunk design is rooted in “Victorian and the idea that the computer age evolved alongside the industrial.” Utilizing wood, metals, leather, rivets, switches, pulleys and gears, steampunk artists strip technology of “convenience and portability [while] imbuing them with antiquity” and devices; 1910.305(f), conductors for general wiring; and 1926.405(b)(3), wiring must be completely enclosed.

Theory of Operations: Sudoku is a numerical logic puzzle that has already proven to be popular in the entertainment industry. It utilizes a 9x9 matrix, partially filled with numbers, which the user must complete. This tabletop version is comprised of the MC68HC11 microcontroller and the accompanying Axon in CME11E9-EVB1U (per the project specifications), sixteen seven segment displays (SSDs), 4-to-16 decoder with PNP current amplified outputs, an 8-bit shift register with latched current sinks and other various miscellaneous circuitry. The software, an essential driving force behind the design, continually pushes the values from a set matrix in memory to the SSDs, a process that is only interrupted when a button is selected. All buttons are connected to the IRQ* pin and when one is pressed, the HC11 executes a routine based on the state of the program and the particular button pressed and then returns to the display output. The begins a game by pressing enter (the large central button) to initialize a puzzle. The arrow key buttons are used to select a location and the enter button is used again to choose a cell for editing. The arrow buttons are then pressed to change the value in the cell. If the value the user selected is invalid, the user is notified with a message. The user is also notified when a puzzle is successfully finished. The solved puzzle will remain displayed until the user presses enter to begin a new puzzle.

Design Alternatives: The original concept was to do a 9x9 SSD matrix but it would have required a minimum of 1500 soldering joints. This was far more labor intensive than resources allowed. In addition, it would have been much more costly as each SSD needed an accompanying octal D-Flip Flop to hold its values (we used an LED driver) instead. The final decision was that 4x4 SSDs would significantly reduce the amount of soldering joints to a manageable

Constraints from Regulating Bodies on the Project: This device does not wirelessly communicate and thus simply complies with the FCC regulation of a class B digital device per part 15 subpart A of the Federal Code of Regulation. The OSHA regulations included those in sections 1910 and 1926. Specifically, 1910.303(c), splicing; 1910.303(e), marking electrical equipment; 1910.303(g), working space about electric equipment; 1910.304(a)(1), identification of conductors and devices; 1910.305(f), conductors for general wiring; and 1926.405(b)(3), wiring must be completely enclosed.

Discussion of the Results: There was a great deal of debugging involved in creating the steampunk sudoku machine. For example, a bouncing problem was discovered with some of the input buttons as occasionally pressing an arrow key was read as an enter button selection. It took a long time to determine a reliable rate to send the values to the SSDs to ensure proper brightness. Additionally, we had to add a 5-input NOR gate to the IRQ* as we didn’t realize we couldn’t directly attach 5 pins to it. A grounding issue with two different breadboards was found which caused the displays to flicker, which took a while to correct. These are only a few of the issues we ran into, which ranged from software to hardware related.

Conclusions: The final cost was $237.75, but it was discovered that with dedicated hardware, PCBs and bulk rates, this price could be brought down significantly. The machine performed as expected after thorough debugging, and thus it is deemed an adequate prototype for exploration of viable markets and manufacturability.

Related Patent Applications (currently not approved):
1. Application number: 11/320,925
2. Application number: 11/340,143
3. Application number: 11/340,129
4. Application number: 11/340,127
5. Application number: 11/344,169

References