Texas Instruments Electronics Online Challenge

ERAUW – Embry-Riddle Aeronautical University White Team
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Introduction:

The ERAUW Team chose to document the deconstruction of a 3D printer, focusing primarily on researching the control boards and integrated circuits used. The team chose to analyze the da Vinci 1.0 from XYZ Printing for several main reasons. First, 3D printers are becoming increasingly common and useful for manufacturing. Second, VEX U teams may use 3D printed parts on our robots. Lastly, this printer is non-functional currently, and the team intends on repairing it to be used in the future.

Internal Components List:

1. External Plastic Frame
2. Internal Steel Frame
3. Stepper Motors x3
4. Pulley Belts
5. Extruder Assembly
    a. Stepper Motor
    b. Cooling Fan
    c. Nozzle
    d. Heating Element
    e. Compression Wheels
6. Heated Print Bed
7. Front Panel Interface
    a. Printed Circuit Board
    b. LCD
    c. Surface Mount Buttons x6
    d. Resistors
    e. Texas Instruments Model: TXB0108, Marking: YE08, Bidirectional Voltage-Level Translator with Auto-Direction Sensing
8. Control Motherboard
    a. ATMEL ATSAM3X8E Controller Chip
    b. Allegro A4988 Stepper Motor Driver Chip x4
    c. Resistors
    d. Capacitors
    e. SD Card Reader
9. Power Supply

Research and Findings:

Upon final disassembly of the 3D printer, the team could access and remove the Control Motherboard and Front Panel Interface from the internal frame. Once removed, the motherboard was inspected and studied. The team noted that the board layout was repetitive in nature when it came to the orientation and placement of components around the Allegro A4988 chip. This result was logical to the team since this chip was used four times on the board to control each of the four identical stepper motors. Since each stepper motor used the same chip, the board design could be simplified, resulting in an improved development time.

After the team members studied the Control Motherboard, they focused their work on the Front Panel Interface board and components. Here, the team noted that this board had a repetitive layout similar to that of the Control Motherboard. In the case of the Front Panel Interface, this repetition came from the six surface mount buttons. Although no visible identification number for the part could be found, the team inferred the buttons were all the same for this device; this inference was based on the similarity in physical and visual appearance. Along with the buttons on this board, the team discovered two Texas Instruments TXB0108 bidirectional voltage-level translators. Based on its research, the team determined that these two chips worked together in order to control the LCD screen.

Conclusion:

In conclusion, the team learned more about the inner workings of its 3D printer. Due to the team focusing mainly on the circuit boards, most of the knowledge that team members gained was from the circuit boards. The team learned most about layout design and parts identification. In the future, members of the team can apply this knowledge to design projects they will have in their academic classes. Along with learning more about circuit board design, the team was able to track down the source of the problem with the 3D printer; upon inspection of the motherboard using a multi-meter, the team determined that one of the resistors in the heating circuit had blown, restricting the signal from reaching the extruder assembly and preventing the system from heating and printing.

Pictures:

Figure 1: The XYZ Printer before disassembly

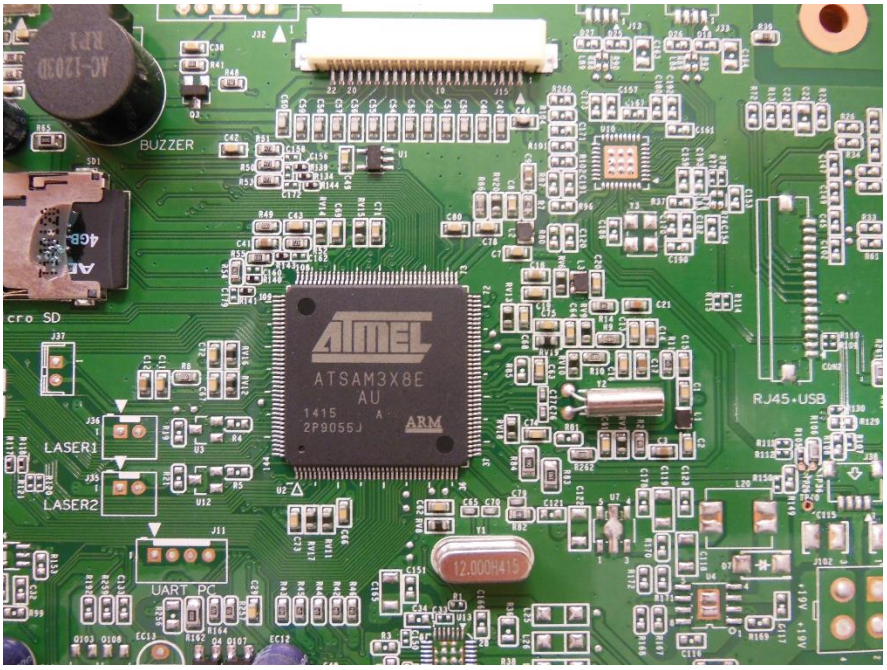

Figure 2: The ATMEL ATSAM3X8E Controller

Figure 3: The Two Texas Instruments TXB0108 chips

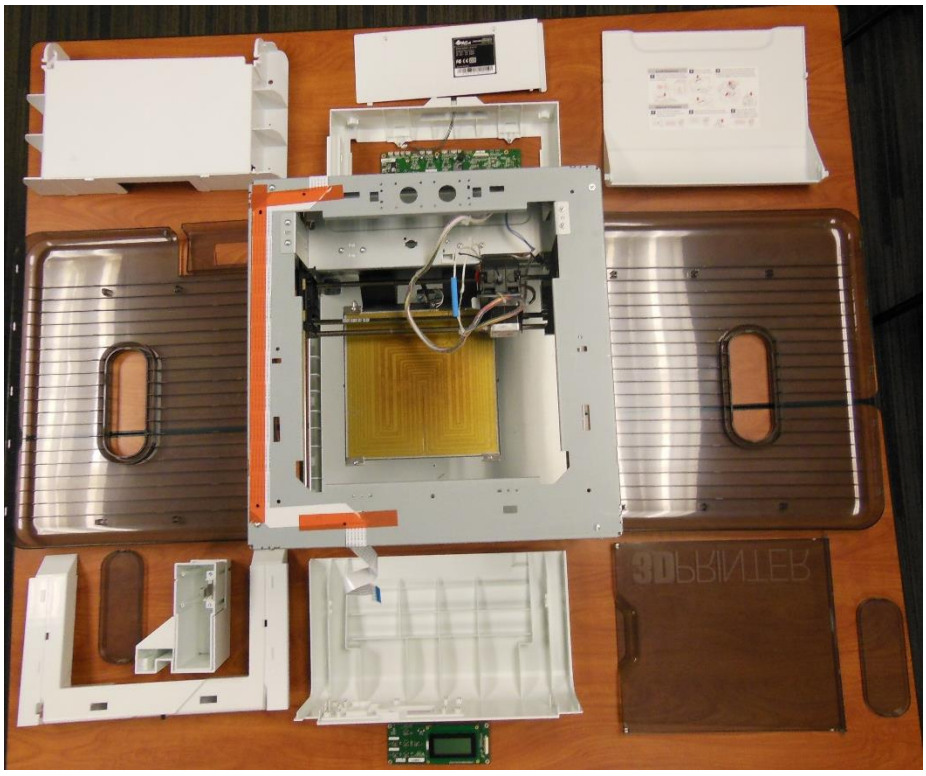

Figure 4: Exploded view of the disassembled 3D printer