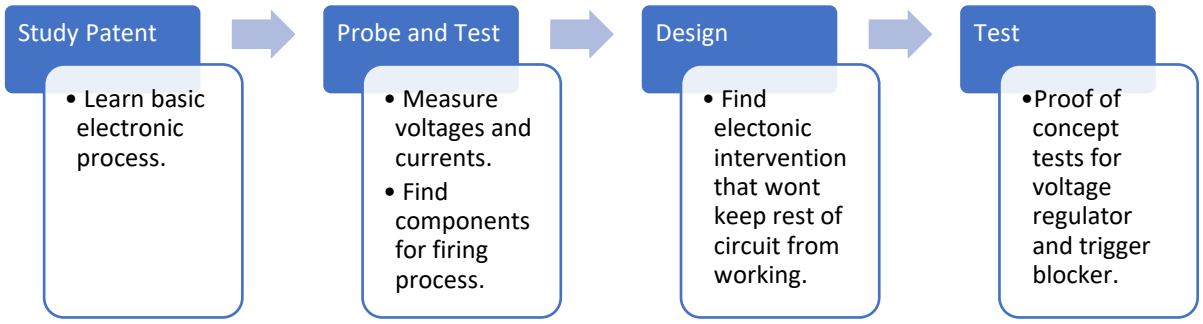
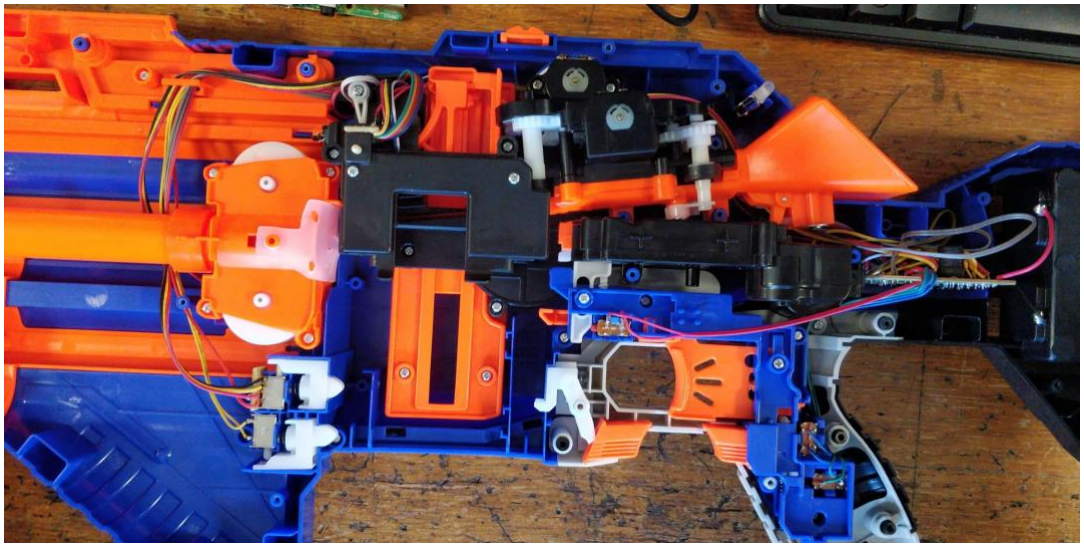
Electronic Design





Overview of Infinus Nerf N-Strike Elite internals.

The electronic design of the Infinus Nerf N-Strike Elite was more complex than anticipated. Extensive reverse engineering was required to understand the circuit well enough to design a solution for our safety system. The following excerpt from the patent filing were used along with the images:

> Also shown is a LED Status key is shown where: (1) Red=jam detected or jam door open; (2) Yellow=empty magazine; (3) Blinking Yellow=magazine full, and will turn Green below when accelerator activated launch motors 51 and 53 drive rotation of accelerator launch wheels 54 and 56 discussed below; finally indicating (4) Green=ready to shoot. A micro switch and/or a sensor limit stuffer home switch may be provided as an infrared sensor IR (infra-red) beam sensing with a check cycle to monitor the time it takes to fill the dart into the magazine and launch apparatus 10 conditions. Using the IR the launch apparatus 10 determines when the drum is empty and via a light color can give feed back to the user that the drum is empty (Solid Yellow). Using the IR the launch apparatus 10 determines when a dart is in position to be fired. Determining this can govern the driving of the pusher to only push when a dart is ready reducing the likelihood of jams. Via the light colors the launch apparatus 10 can let the user know when the system is ready (Green). Using the home switch for the pusher the launch apparatus 10 can determine when the pusher does not return home and assumes it has jammed and alert the user to the presence of a jam

via the red color (Solid Red). If the jam door is open the firing is disabled until it is closed (Solid Red). As described earlier using the home switch for the suffer the launch apparatus 10 can monitor the time it takes to fill the clip and if not completed in a designated amount of time let the user know the drum/clip is in a full state via the lights (blinking yellow).

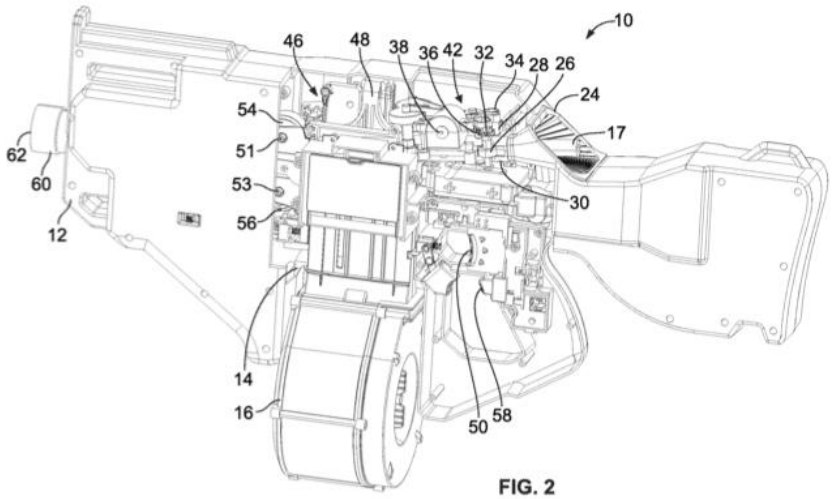


FIG. 2

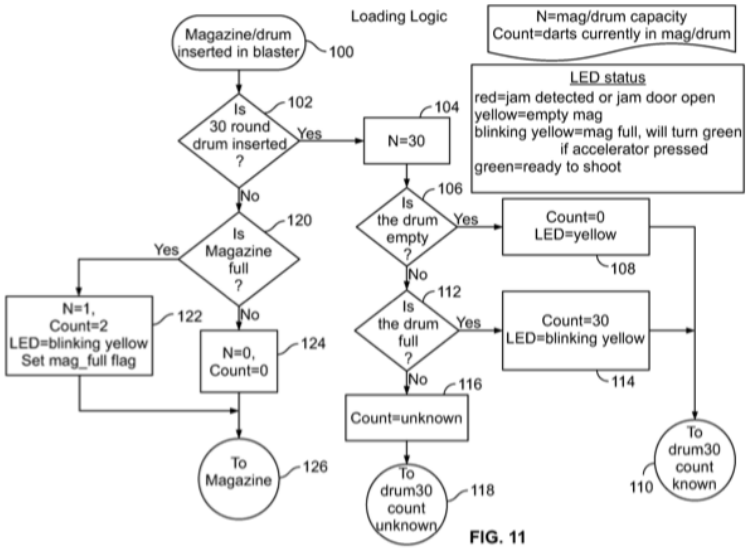


FIG. 11

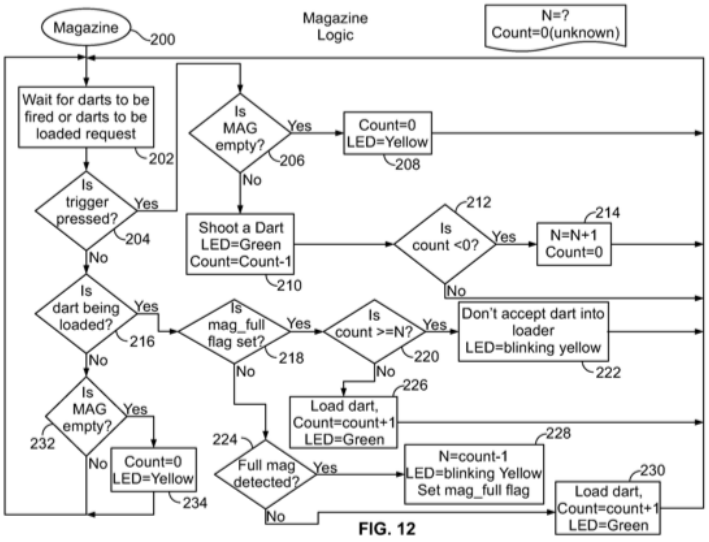
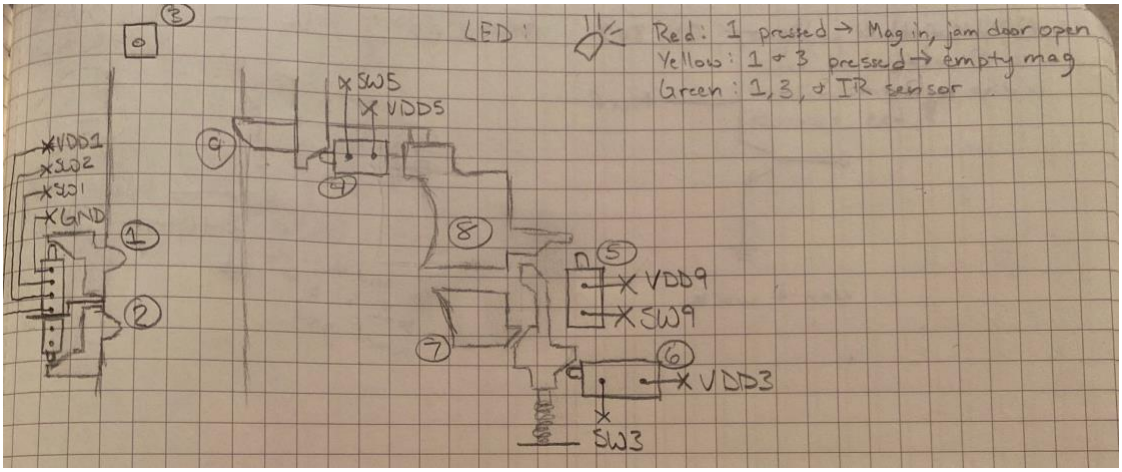


FIG. 12

Voltages were then probed in different modes of operation to determine how system sent instructions for firing. The following is an illustration of the components important for the firing process, as seen in the Infinius overview image above:



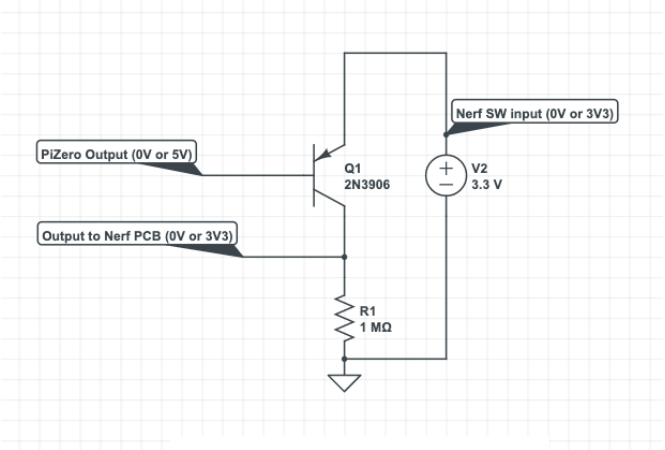
1. Magazine sensor – This component is responsible for sensing whether a magazine is inserted into the system and initiates power to the board.
3. Frame sensor – Button that is pressed when the halves of the nerf frame are put together.
7. Flywheel trigger – Pressed to start flywheel spin.
8. Trigger – Pressed to fire dart.

Firing Process:

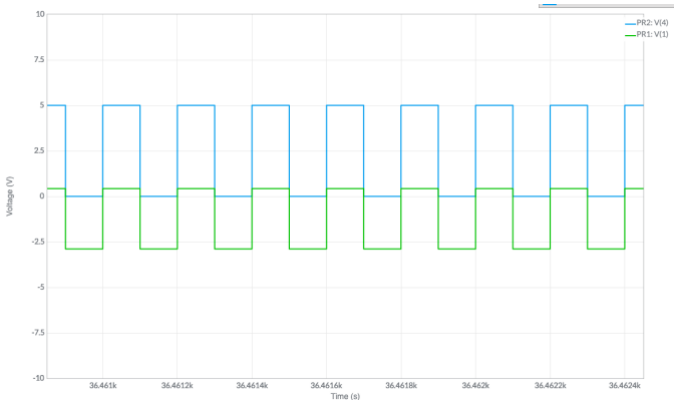
- 1 and 3 are pressed to deliver power to circuit
    - Mechanical:
        - 9 is pressed in by magazine, unlocking 8.
        - 7 is pressed in to start flywheel and unlock 8.
        - 8 is pressed to activate plunger.
    - Electrical:
        - If VDD9 and SW9 are shorted, flywheel and plunger are initiated, and a dart is fired.

Goal: Design circuitry to ensure the gun can only fire when a face is detected by the onboard camera connected to the Raspberry Pi.

Receives a 5V signal from the Raspberry Pi pinout and the signal from the Nerf trigger would be variable: typically 0V and 3V3 when trigger pressed. Because of limited power supply and space restrictions, PNP BJT was best solution. Trigger would only activate when trigger is pulled (sending 3.3V to emitter) and face detected (gate voltage switched from 5V to 0V).



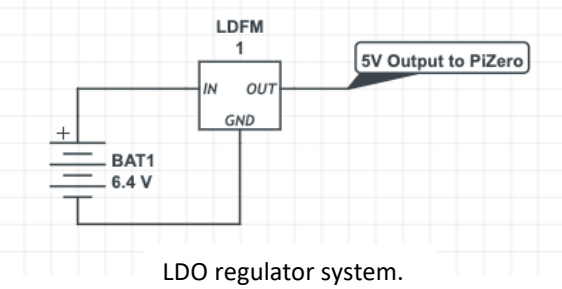
PNP BJT trigger block system.



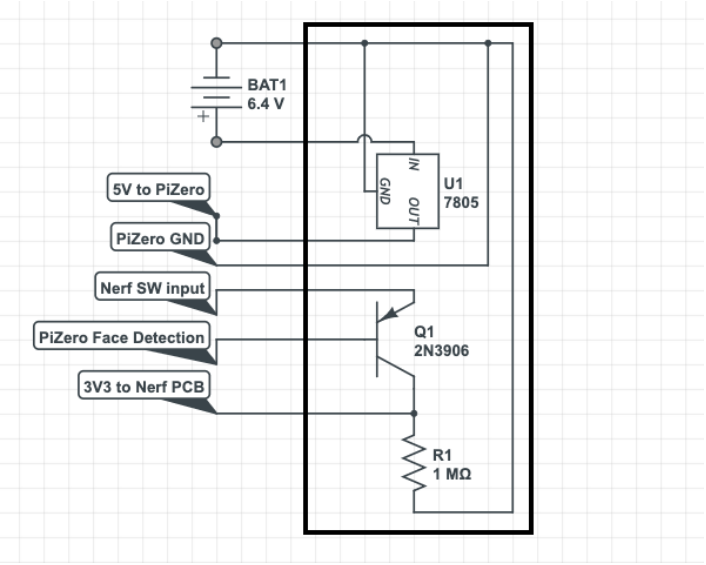
Simulation showing how output changes as PiZero pin changes.

Second goal: Design a circuit capable of providing power to the onboard Raspberry Pi Zero using the Nerf's batteries.

Nerfs batteries provide voltage of 6.4V when at full charge. Voltage will decline with use, but the Raspberry Pi Zero requires a constant voltage of 5V. This is a very small difference in voltage, with voltage nearing 5.5V when discharged, so voltage regulator with small dropout voltage required. Regulator needs to be able to consistently provide 200mA. LDFM50DT-TR fixed LDO voltage regulator ideal.



LDO regulator system.



Example layout of board.

Conclusion: Before the University lab spaces were closed, these designs were successfully implemented and tested with perfboard. Future tasks included designing a circuit capable of reacharging the onboard batteries through an external Micro-USB connection, further studying the Nerf PCB to ensure its protection, and designing a compact PCB to fit in the gun.