LasIR Tag

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Introduction:

The current technology market is lacking a full-featured, low-cost recreational laser tag system. A basic professional laser tag system for four players can cost up to $2000 depending on where you look. In the low-end consumer segment of the laser tag market, it is virtually impossible to find reasonably priced sets including anything more than two blasters and, with some luck, a single chest-mounted hit sensor. Nerf's own popular solution sells for anywhere from $49.99 to $63.99, including two blasters with single hit zones on top. The market needs a more robust solution in the sub-$200 per blaster range. Shoulder, chest, and back hit sensor zones provide a much more realistic and engaging experience, and wireless vest-to-blaster communication creates a no-hassle hit handling system. None of these features are yet available at such a price point. This project utilized readily available parts in order to bring a low cost, DIY, wireless laser tag system to the market. Additionally, the design implements 4 hit marker zones, 9 V rechargeable batteries, and infrared lasers for eye safety.

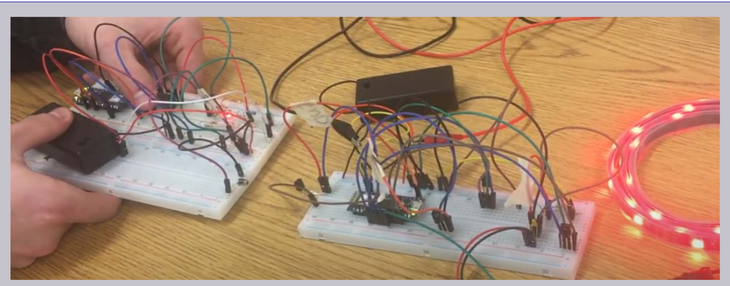

Figure 1: Image of single vest and blaster circuit currently indicating a hit. From left to right: Blaster ciccuit, vest circuit, and vest LED strip.

Materials and Methods:

Software programs used were:

- Developed using the Arduino IDE with Open Source Libraries.
- SolidWorks CAD (for blaster design).

Hardware used in the project consisted of:

- Arduino Nano 33 IoT microcontroller.
- 950 nm infrared emitter and receiver, RGB LED and 5 V LED strip.
- Rechargeable 9 V batteries with housing.
- Various resistors, capacitors, and MOSFETs.

The testing methods for this project included:

- Unit testing for a single vest and blaster system by using the associated blaster to fire at their own vest (self-tag). Verified correct outputs with a logic analyzer.
- Verified PCB functionality by replicating unit tests with breadboards and soldered wire leads.
- Integration testing for the full system using blasters of a specific team to tag members of opposite team using visual feedback for verification.

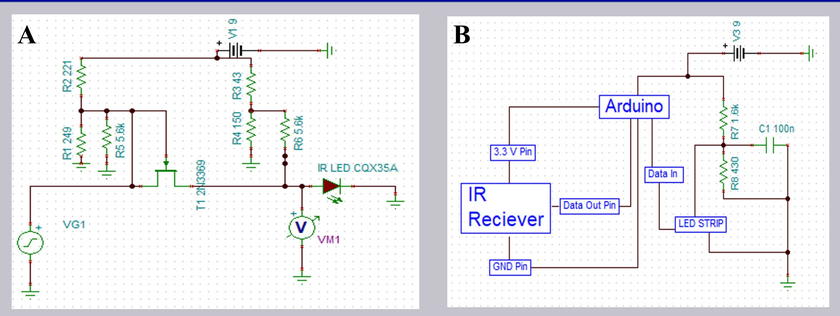

Figure 2: **(A)** Blaster Cirucit Digram. **(B)** Vest (Main) Circuit Diagram

Results and Discussion:

- Wireless capability of the system is entirely successful based on unit testing and visual feedback using an onboard LED of the blaster microcontroller.
- Simulation results of the infrared (IR) laser circuit confirmed that operational voltage (Figure 4) and current of the IR LED could be achieved for sending tagging signals.
- Tagging distances can reach up to 23 feet in lit areas and up to 30 feet in completely dark playing conditions.
- Although not implemented in the final design, the use of lenses can enhance tagging by adding an additional 15 feet to the range.
- Easily scalable programming can allow users to expand their player base with a simple copy and paste.
- Labeled PCB reduces struggles of assembling a circuit by allowing users to "plug, solder, and play" with needed hardware components. Examples can be seen in Figure 3 E and F.
- Complete vest units for both the red and blue team can be seen in Figure 3 A and B.
- Complete blaster units for each team can be seen in Figure 3 C and D.

Figure 3:
(A) Red Team Vest
(B) Blue Team Vest
(C) Red Team Blaster
(D) Blue Team Blaster
(E) Blaster PCB
(F) Vest PCB

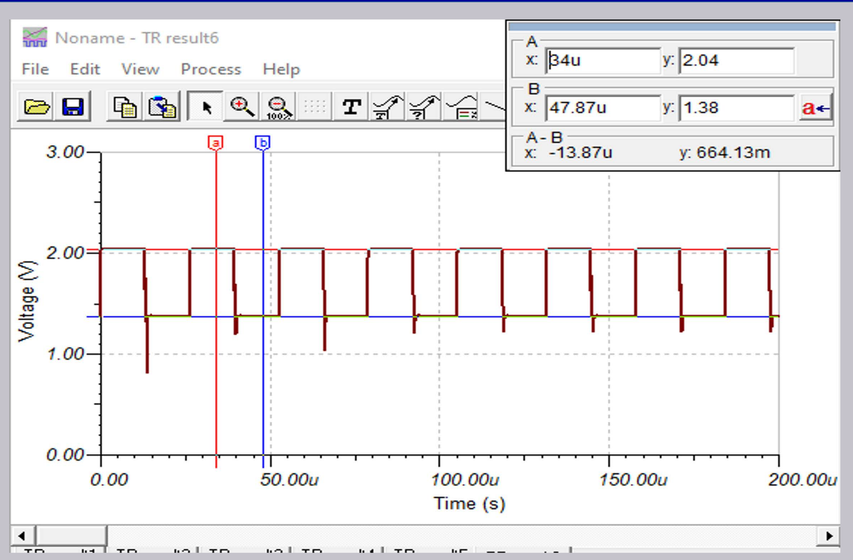

Figure 4: Voltage of the IR LED over time

Conclusion:

Our team has created an affordable, wireless, hobbyist laser tag system from readily available parts and materials. The system is all-inclusive, bringing with it laser tag blasters and laser-detecting vests for two teams of two players each. Additionally, these components communicate with each other without the need for a bulky cord. These advancements come in at a price point well below similarly featured laser tag sets, and the plans for all of the parts will be freely available to any who wish to reconstruct them at home. By releasing the system to the public, our team is contributing to the hobbyist community as a whole and providing beginners with a launching point to learn about building electronics.

Future Work:

The following are ideas to improve the LasIR Tag project:

- Implementation of lenses for further range of IR LED
- Further testing of Vest LED strip for color issues
- Additional game modes selectable in code
- Adjust IR receiver to reliably detect hits on each zone

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