

# Lucent Tag

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## Project Proposal

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ETEC 471 Class 2013-2014

## Introduction

Laser tag was first designed by the US military, but became commercially popular in the 1980s. That being said, laser tag systems are not a new idea, but it has a chance now more than ever to expand its market.

Commercially, laser tag has always been marketed as a toy, or the setting of a kid's birthday party. Most American young adults will have memories of playing laser tag this way. Currently, laser tag is gaining niche popularity in the open source, DIY community through the Miles Tag system (produced by Combat Tag, LLC). Hardcore enthusiasts use this system to create their own very high quality laser tag guns and peripherals. Unfortunately, the barrier to entry is very high, thereby not attracting much attention, but still proving that the market currently exists. Similar action sports like airsofting and paintballing are very popular, but have high fiscal barriers of entry. A fully electronic system potentially can be much cheaper, thereby drawing crowds from that market. Additionally, shooter video games are extremely popular now, so adapting semblances from video games could open the market of gamers. Not only are several markets open to laser tag, but several technological advances can make the Lucent Tag system innovative to a 2 decade old sport.

Laser tag has normally been played as an episodic, recreational game, even though almost every game or sport that exists can also be played competitively. With the help of the internet, a global laser tag league can easily be set up and administrated. Additionally, since Lucent Tag is entirely electronic, recording of statistics and refereeing can be simple. This creates a social hub for all players to gather and organize events.

## Summary

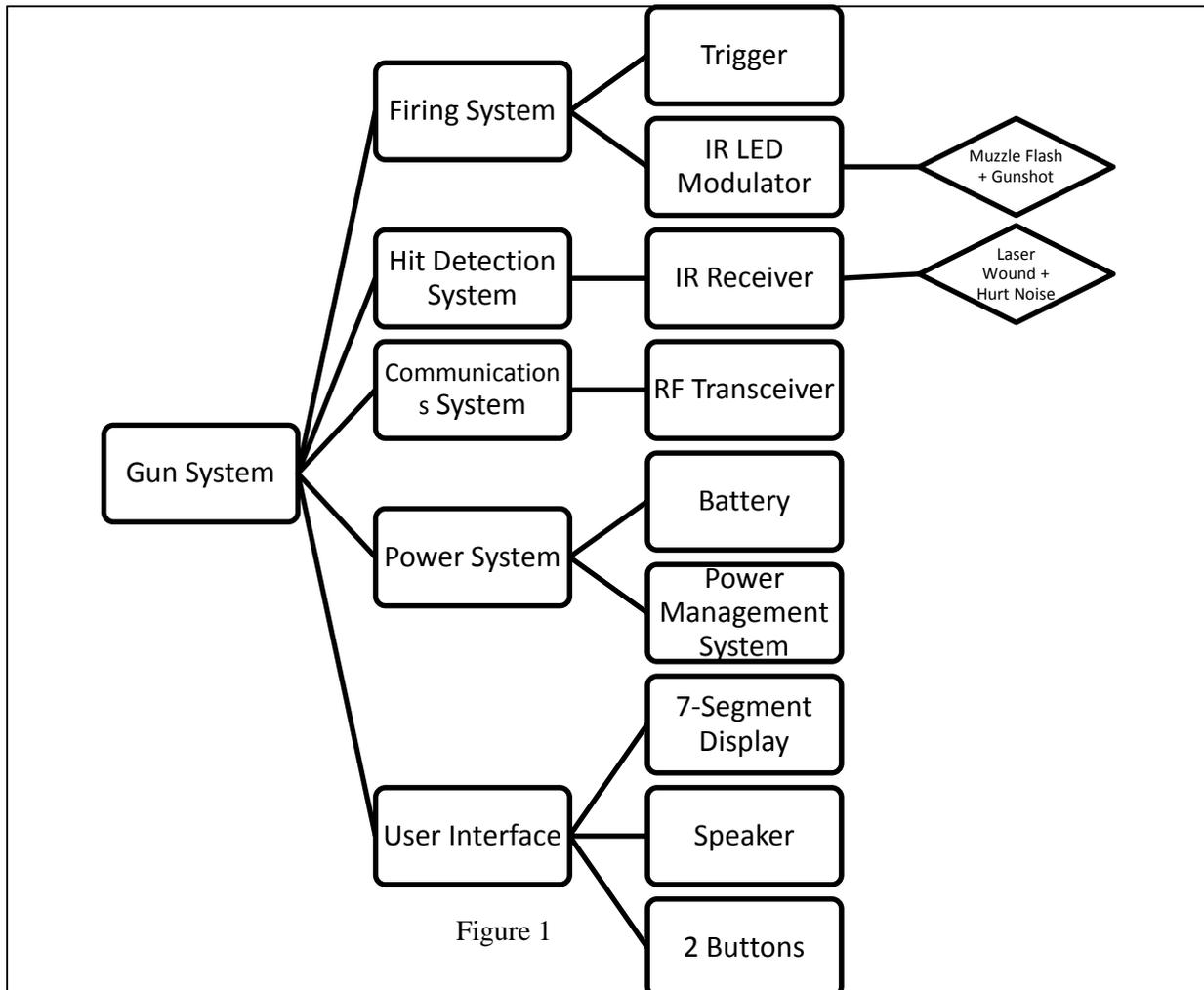
Lucent Tag is an entire laser tag system, containing 3 parts to it, the gun and its peripherals, the ref module, and a computer. The gun is an all in one system that is supplemented by the other two systems. The gun fires an infrared (IR) beam that is detected by IR detection nodes on other players. The gun has several user feedback elements, such as a 7 segment display, speakers, and light emitting diodes (LEDs) on the gun and in the IR detection nodes. Each gun also has an optional radio frequency transceiver (RFT) that communicates with ref module.

The ref module functions as a virtual referee and scorekeeper. When the ref module is used, it controls who the players are, the game mode, the game timing, as well as collects data from the each player (i.e. accuracy or who shoots who). The ref module can be standalone, but also connects to a computer via universal serial bus (USB). This connection makes controlling the game much easier through a graphical user interface (GUI) and also allows for uploading the statistics of the game to the Lucent Tag website.

## Detailed Description

### The Gun

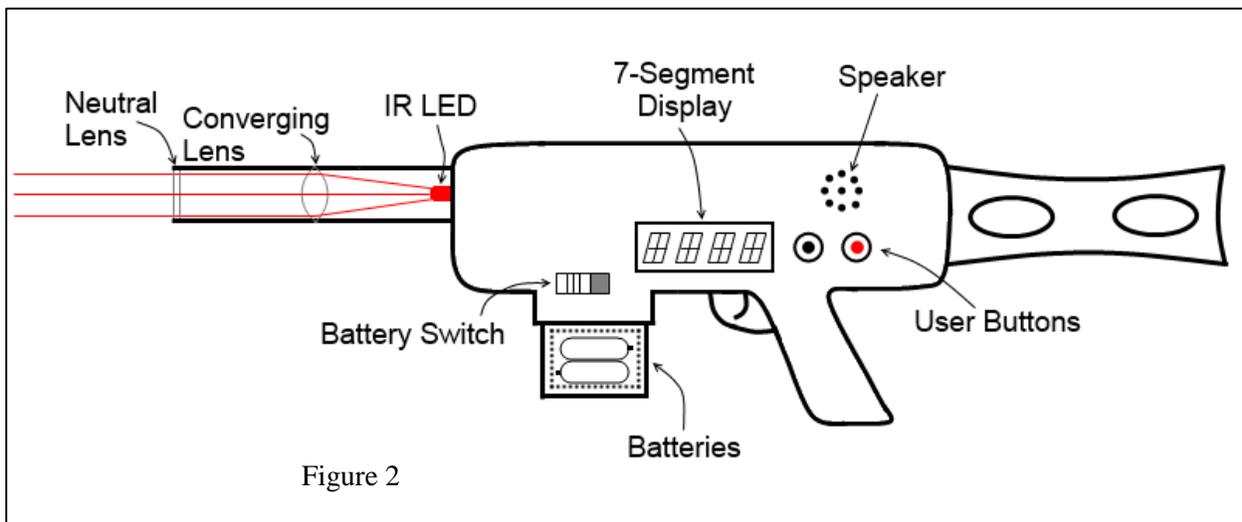
The gun contains 5 systems in it, which are the firing system, hit detection system, communications system, power system, and a user interface (UI). Each system in the gun is controlled by a central microcontroller unit (MCU).



- **Firing system:** To shoot, the user must press the trigger. Once he/she fires, the MCU creates a serial signal to be sent. This signal is “fired” by modulating an IR LED encoded with the signal from the MCU. The barrel of the gun will have a converging lens to converge the light beam to become parallel. User feedback of each shot is given by a “muzzle flare” and a “gunshot”. The “muzzle flare” is an LED that can be multiple colors, depending on the player’s team, that flashes down the barrel of the gun. The “gunshot” is a sound-bite played through the speaker on the gun.
- **Hit detection system:** Each player has multiple “weak spots”, or designated nodes where a shot can be detected. There will be several nodes placed on every player’s body, as well as 1 attached to the gun. Each node is comprised of at least 1 IR receiver and “laser wound”

LED. The IR receiver is tuned to the frequency of the IR LED to minimize noise and other interference. User feedback when a hit is detected is given by a “hurt noise” and a “laser wound”. The “hurt noise” is a sound-bite played by the user’s speaker who got shot and the “laser wound” is a flash of a colored LED on the wounded user’s peripheral nodes.

- **Communications system:** This system is optionally used when the ref module is used to control the game. The communications system communicates with the ref module via radio frequency using a point-to-multipoint protocol with a half-duplex design.
- **Power System:** This system controls the power for the gun. The gun will be battery powered with removable batteries to allow for recharging. The power system also controls when to turn on and off certain systems to conserve power.
- **User interface:** The UI gives the user control over pregame elements and in-game elements. Before the game starts the user can make some choices, like team choice or weapon choice etc. During the game, the 7-segment display offers information to the user, such as health or ammo. 2 buttons are available for navigating the menus in the pregame and performing actions in-game. The speaker helps the user navigate the menus pregame and provides feedback in-game.



## The Ref Module

The ref module is the virtual referee and scorekeeper of the game. In the pregame it will register which users are playing and set the game mode. During the in-game, the ref module will be communicating with each user to receive updates of each one. The ref module connects to each user via a point-to-multipoint protocol.

When the ref module is plugged into the computer it can be controlled by a graphical UI (GUI). This GUI will also stream statistics from the game as it receives it. When the match finishes, information from the whole match displays and is saved on the computer. This data is saved in a format able to be uploaded to a database for storage.

## Prioritized List of Features

### High Priority

1. All the gun's hardware and basic software required for a standalone game.
2. Basic ref module connecting to the computer via serial cable.

### Medium Priority

3. Develop the ref module controlled game.
4. Realize USB for the ref module.
5. Create a GUI on the computer for the ref module.

### Low Priority

6. Create a database to store stats of the game.
7. Use an LCD on the gun instead of a 7-segment display.
8. Allow for a standalone ref module with an LCD display and buttons.
9. Battery monitor.
10. Create a website to host the stats of the games.

## User Benefits and Impacts

This product is designed to be sold to both individuals and businesses, and will affect customers differently whether they buy their own system or using a business'. Either way, customers will use this product based over a gradient of fun and competition. Businesses and individuals can set up competitive leagues, keeping up to date statistics on the Lucent Tag website. If popular enough, national or even global competitions could be created.

Similarly to airsoft and paintball, a major draw to laser tag is the physicality of the sport, and the health benefits that go along with that. Conversely to airsoft and paintball, Lucent Tag is a very safe sport and can be played anywhere. This may be a large draw to individuals or individuals' parents/guardians.

## Project Development and Demonstration

For development, at least 2 gun systems must be made for full testing. This means even as prototypes, they must be fully functional and fit inside the chassis. Getting the gun system working with minimal complication (no custom messages) is the first priority. The second priority will be getting the RFTs working, and developing the communication protocols for the RF and IR data transmission. Building the ref module is the final high priority feature to develop. The ref module prototype's encasing, however, will probably be very light since it's not crucial to its operation. After both the gun system and ref module have been built, most of what remains to design is software, which makes any new additions to the project simple.

The demonstration will feature the two+ gun systems able to shoot at each other with the ref module streaming stats. Exhibitors will be encouraged to test the system when they discover the booth.