

## **Laser Shoot-Out Game System Block Diagram**

Our project is to design and build a laser shoot-out game, in the manner of mythical old west “quick-draw” contests. The game will consist of two players standing across from each other and using harmless laser weapons to shoot at each other. Each player will wear a reflective vest to reflect laser signals so they may be detected by the transmitting weapon. The following narrative discusses the hardware and software components and subsystems of the project.

### **Hardware**

The system consists of one central controller, and a weapon and display board for each player. Figure 1 gives an overall block diagram of the main hardware components and its subsystems.

#### **Central Controller**

The central controller starts the games and decides which player wins the game. The central controller consists of a microcontroller, a serial communication unit, and a user interface. The user interfaces are a power and a reset button. The serial communication unit allows the microcontroller to talk to the display units.

#### **Display Boards**

The displays are small scoreboards located near each player. They communicate with the weapons and the central controller, and display game information (See table 1). The display consists of a serial communication unit, a user interface, a speaker, a microcontroller, and an RF receiver. The serial communication unit allows communication between the microcontroller in the display and the microcontroller in the central controller. The RF receiver allows the weapon to talk to the display board. The user interface is several LED's and LCD's that display game information. It displays a light if the system is ready. The LCD displays the ammo count and a countdown to begin the game. The LCD also displays the result of the game when it is over. The speaker makes a noise when the gun is fired. There are also several buttons in the user interface for power and reset. When the system is set up, the Display ID may also be set to match the Weapon ID of a weapon, so the wireless communication may be synchronized.

#### **Weapons**

The weapon is a portable, wireless unit. It consists of a RF transmitter, user interface, microcontroller, laser transmitter, and laser receiver. The RF transmitter sends information to the display. The user interface has several LED's that represent battery power, low power, and out of ammo. The user interface on the weapon also has buttons for the hammer, trigger, and weapon reset. The laser transmitter sends out the laser when the microcontroller tells it to. An opponent is hit if the laser reflects off of their vest and returns to the firing weapon. The laser receiver detects the reflected laser and informs the microprocessor to indicate a hit. Each weapon's ID should be set to match a display's ID, so that when it sends data, the correct display will receive it.

## Software

Figures 2 through 4 show the proposed software flowcharts for this project. There are three separate algorithms, one for each microcontroller-driven component: the central controller, the display boards, and the players' weapons.

### Central Controller

Figure 2 shows the software flowchart for the central controller. This is a simple algorithm: When the system is turned on or the master reset button is pushed, the processor will first initialize itself. It will then transmit a signal to the display boards, telling them to reset, in preparation for a game. The processor will then wait for the displays to respond with ready signals. After both display boards are ready, it will broadcast a "game start" signal, and let the other microcontrollers run the game. The central controller then waits for one "hit" signal (a game victory) or two "out of ammo" signals (a tie) from the display boards. When one of these situations happen, the central controller broadcasts the game results, and waits for the next game.

### Display Boards

The algorithm for the display board is shown in figure 3. When a display board is turned on, or when it receives a "reset" signal from the central controller, it will power-up and initialize, clearing the LCD display. It will then wait for a "game start" signal, which is generated by a player pushing a button on the display board. It will also wait for a "gun ready" signal from the player's weapon, to ensure that the wireless communication link works. After that is received, the display board transmits a ready signal to the central controller, and when the central controller responds with its "game start" signal, the game begins, and the display will show a countdown for each player to draw their weapon.

At this point, the display board's microcontroller waits for further communications from the weapon or central controller. As the interrupt-handler flowcharts show, if a signal is received from the gun (shot, hit, or out of ammo), the processor will take the appropriate action. Also, when a signal is received from the central controller (Game reset, win, loss, or tie), the processor will perform the necessary end-of-game actions and return to waiting for a new game.

### Weapons

Figure 4 shows the flowchart for each weapon's microcontroller. Because the gun has a wireless transmitter but not a receiver, it operates in isolation and transmits signals that the display board will analyze for the game. Each signal is prefaced by the weapon's Weapon ID (set to match a display's ID) so that the matching display will know it's being addressed. When the weapon is turned on, it initializes and waits for the "gun reset" button to be pushed. When this occurs the weapon transmits a "gun ready" signal so the display board can verify the wireless transmission. Then the gun is ready to fire. When the hammer is "pulled" and the trigger pressed, a "shot" signal is sent. The microcontroller then uses the laser to transmit a pulse. If the pulse is reflected and received properly, a hit is scored, and a "hit" signal is sent. Then the microcontroller returns to waiting for another trigger-pull or reset. There is also an interrupt handler in each weapon to light a "low power" LED and warn the display if the battery voltage falls below a certain minimum level.

Table 1 – Description of Inputs and Outputs

Signal Name	Input/Output	Description
<b>Central Controller</b>		
Power	Input	Power provided by a wall outlet
Reset Central Controller	Input	Button pushed to reset the entire game
<b>Displays</b>		
Power	Input	Power provided by a wall outlet
Display ID	Input	ID Number to match Display and Weapon
Begin Game	Output	Row of LED's counts down to game start
Speaker	Output	Makes sound effects for gun noises
Ammo Count	Output	Displays remaining ammo count on LCD
Win/Lose	Output	Displays outcome of game on LCD
Weapon Ready	Output	LED lights up from when the weapon is reset until the game is over
<b>Weapons</b>		
Battery Power	Input	Power provided by a battery
Reset	Input	Button pushed to reset gun in order to start game
Hammer	Input	Button pushed to cock the gun
Trigger	Input	Button pushed to fire the gun
Laser Receiver	Input	Sensor used to detect reflected laser beam
Weapon ID	Input	ID Number to match Display and Weapon
Laser Transmitter	Output	Emits laser beam when the gun is fired
Low Power	Output	LED lights up when battery voltage is low
Power	Output	LED lights up when gun is on

Table 2 – Coaxial Cable Signal Description

Signal Name	Direction	Description
Game Reset	From Central Controller to Displays	Resets entire system
Game Start	From C.C. to Displays	Starts countdown to beginning of game
Game Winner	From C.C. to Displays	Reports game outcome
Display/Gun Ready	From Display to C.C.	Tells C.C. that display and weapon are ready
Target Hit	From Display to C.C.	Tells C.C. that player hit opponent
Weapon Out of Ammo	From Display to C.C.	Tells C.C. that player has shot all six rounds

Table 3 – RF Link Signal Description

Signal Name	Direction	Description
Weapon Reset	From Weapon to Display	Tells display that weapon and player are ready to start a game
Weapon Fire	From Weapon to Display	Tells display to decrease ammo count and make gunfire sound effect
Target Hit	From Weapon to Display	Tells display that player hit opponent
Low Power	From Weapon to Display	Tells display that weapon battery voltage low

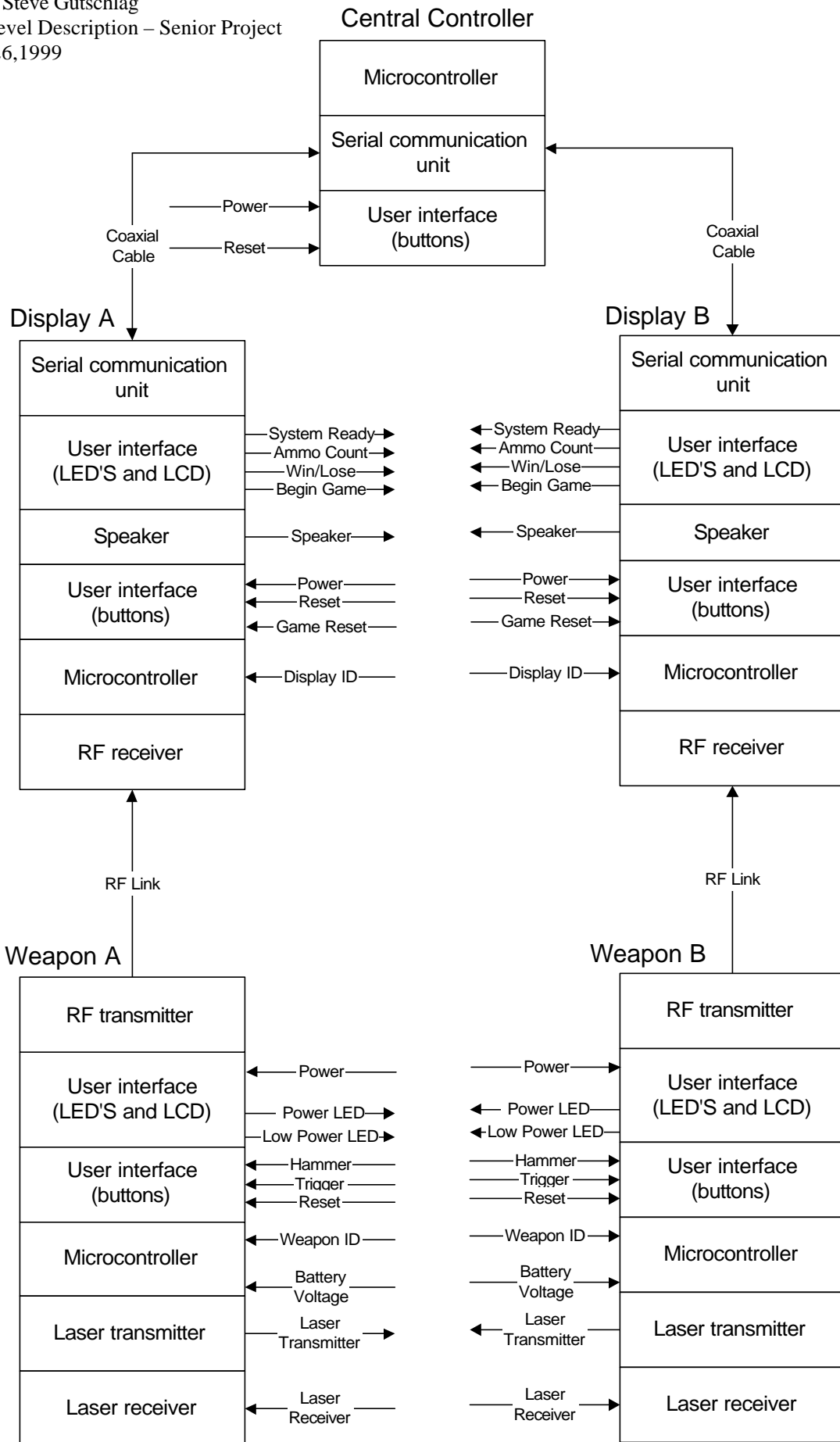


Figure 1 - Hardware block diagram

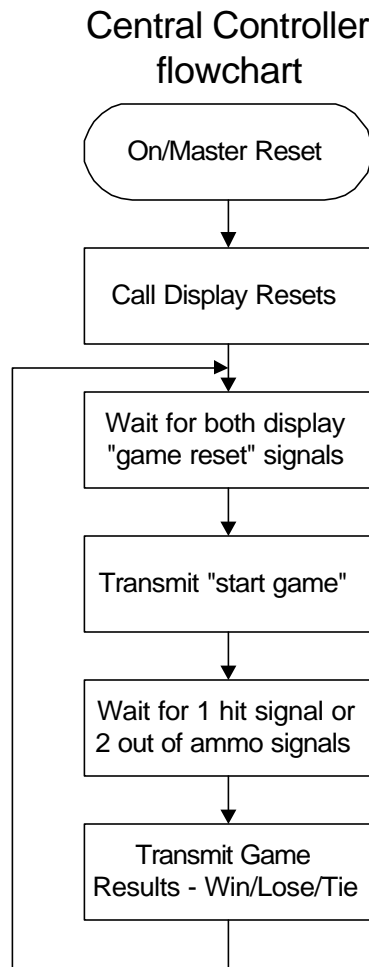
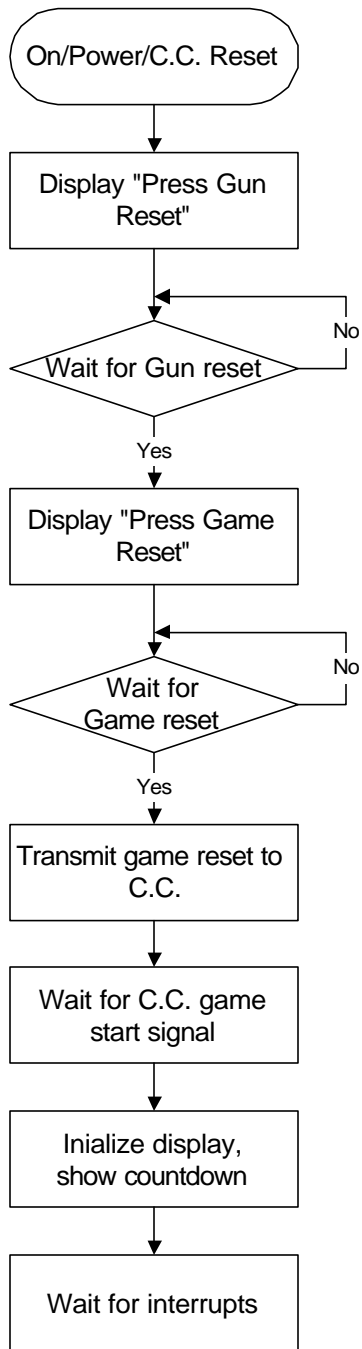
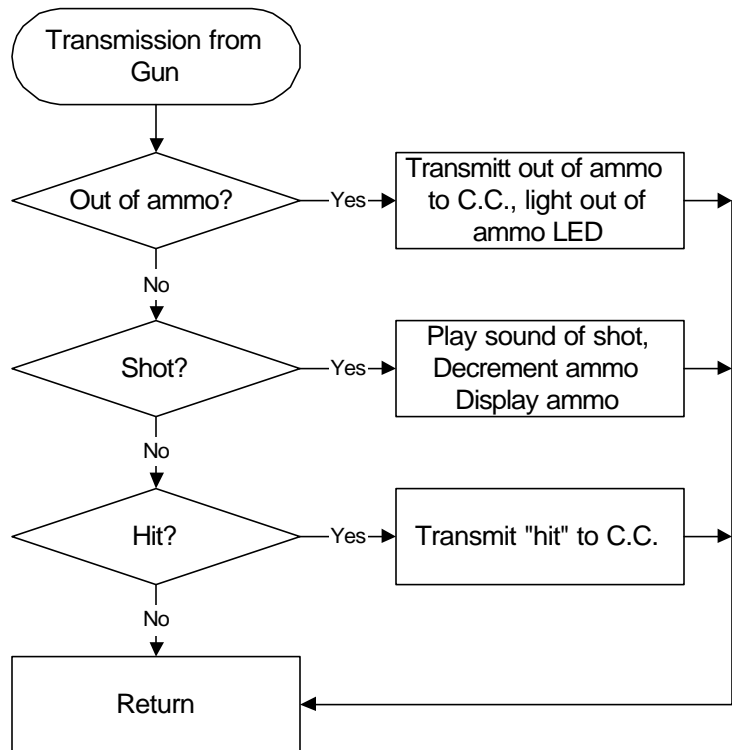


Figure 2 - Central  
Controller flowchart

### Display Flowchart



### Interrupts from gun



### Interrupts from Central Controller

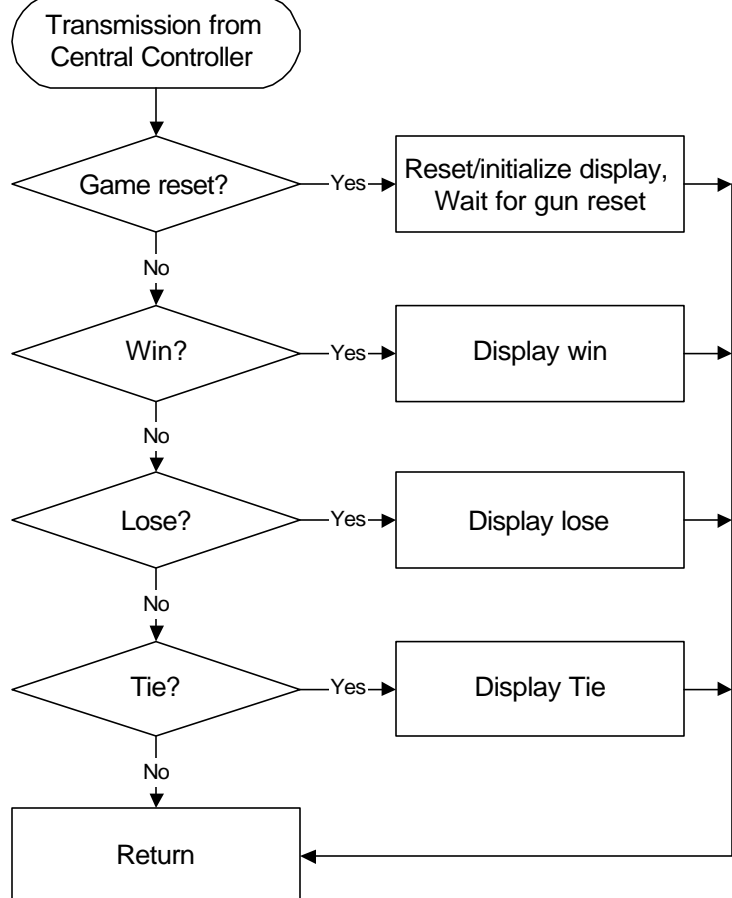


Figure 3 - Display Software flowchart

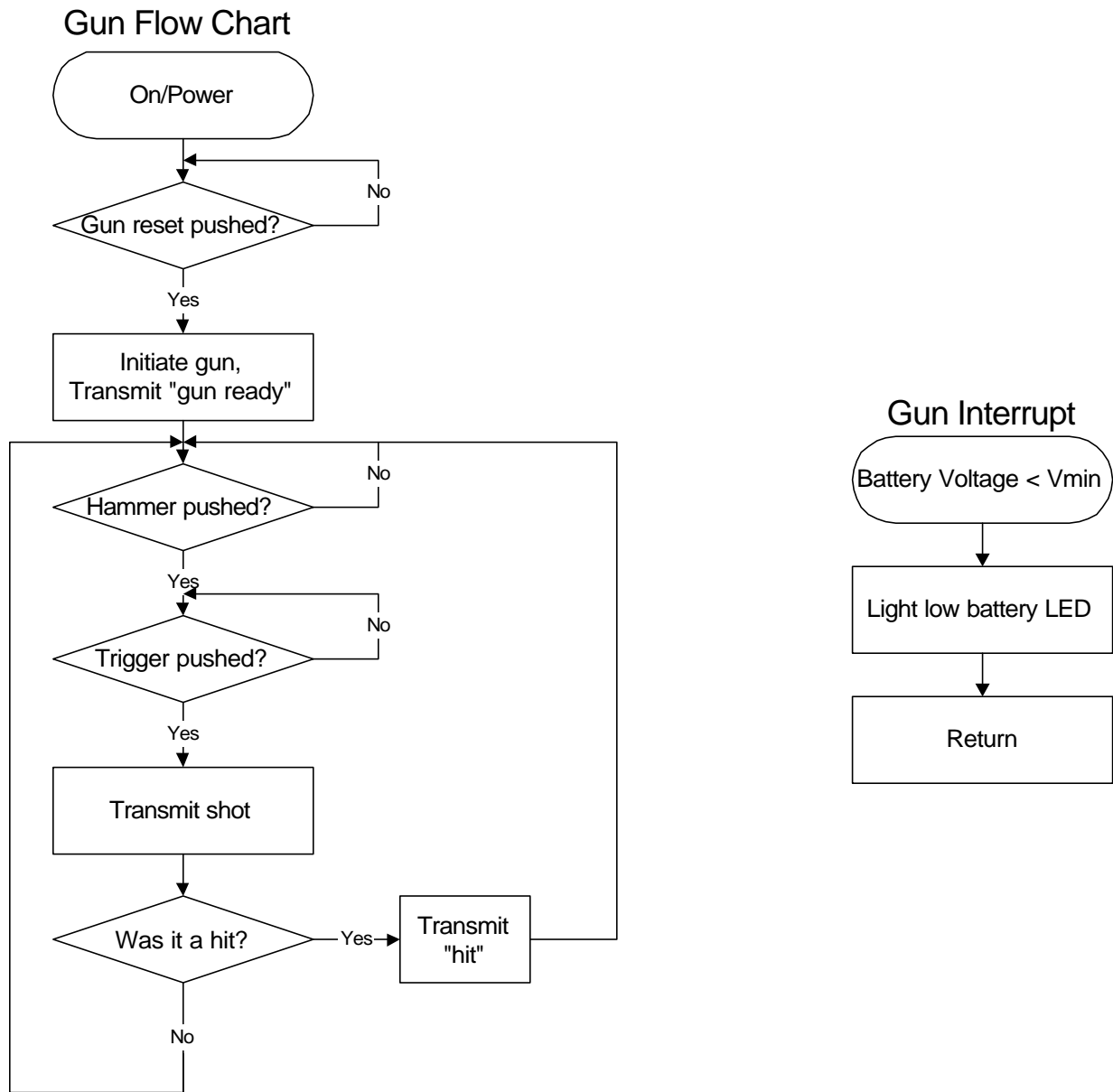


Figure 4 - Weapon software flowchart