Microcontrollers-based system design

S/W Design Document

Laser Tag Project
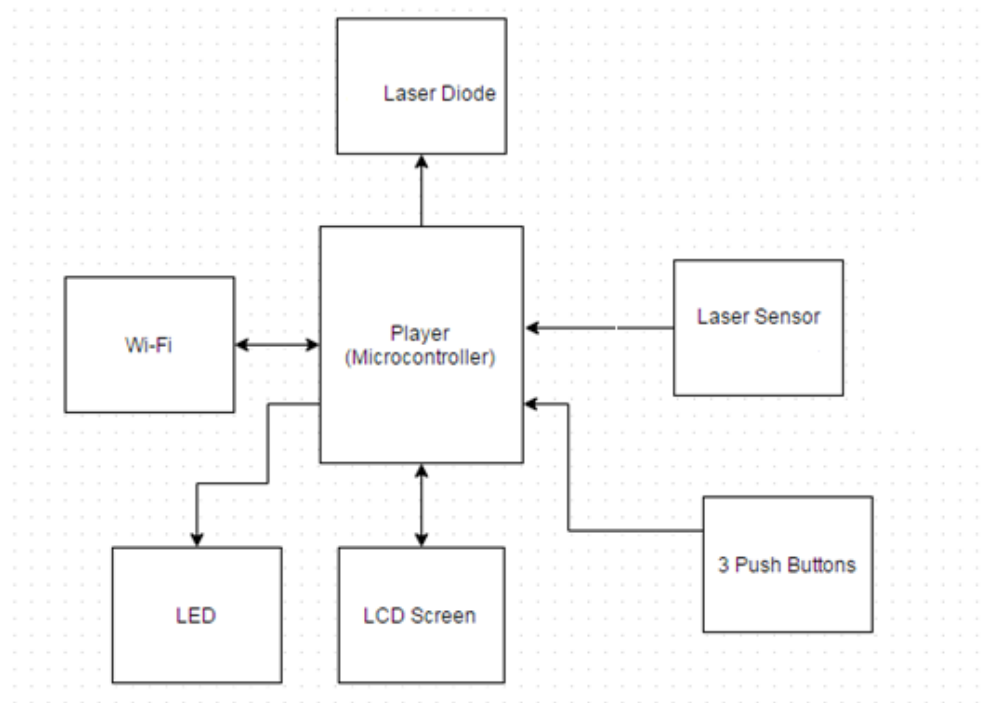
Dr. Mohamed Shalan
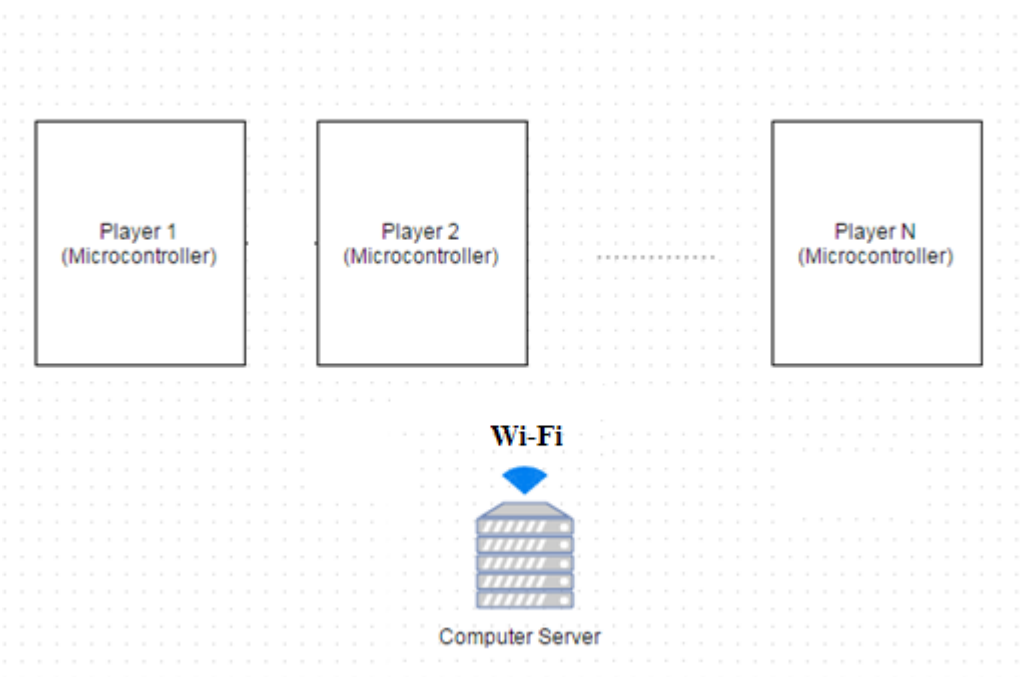
4/12/2015

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System components:

1- Player unit:

```
                    ┌──────────────┐
                    │  Laser Diode │
                    └──────────────┘
                           ▲
                           │
┌──────────────┐    ┌──────────────┐    ┌──────────────┐
│              │◄──►│   Player     │◄───│ Laser Sensor │
│    Wi-Fi     │    │(Microcontroller)│  │              │
└──────────────┘    └──────────────┘    └──────────────┘
                    │       ▲       │
          ┌─────────┘       │       └─────────┐
          ▼                 ▼                 ▲
   ┌──────────┐      ┌──────────────┐   ┌──────────────┐
   │   LED    │      │  LCD Screen  │   │ 3 Push Buttons│
   └──────────┘      └──────────────┘   └──────────────┘
```

2- Online Server

```
┌──────────────┐   ┌──────────────┐              ┌──────────────┐
│   Player 1   │   │   Player 2   │              │   Player N   │
│(Microcontroller)│ │(Microcontroller)│  ........  │(Microcontroller)│
│              │   │              │              │              │
└──────────────┘   └──────────────┘              └──────────────┘

                        Wi-Fi
                         ▲

                    Computer Server
```
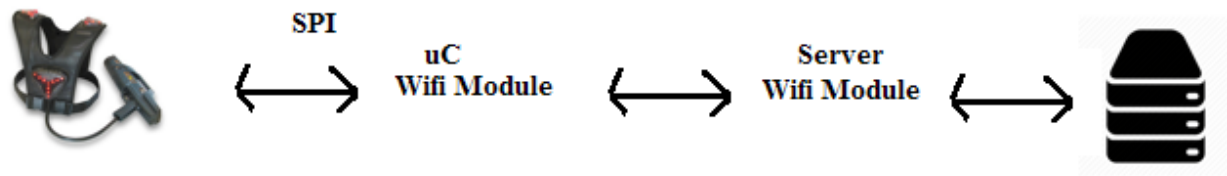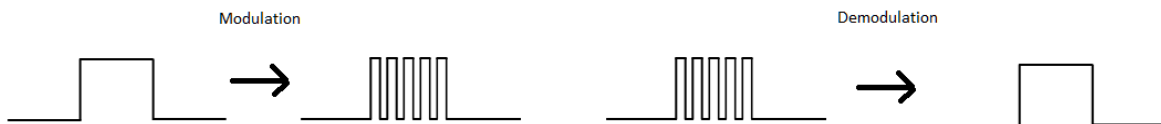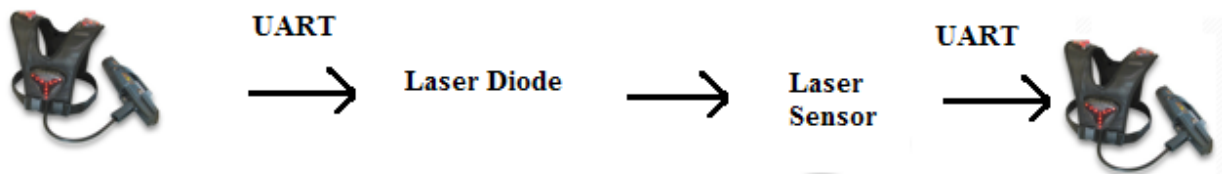
Two types of communication exist in the system:

Player – Server:

Player – Player:

Overview of system tasks:

1. Gun:

N	Task	Periodic/Aperiodic	Notes
1	**Trigger:** • The fire button is pressed **Action:** • Check if player has enough ammo. • If yes: • Sends data (player ID + bullet damage) to UART to be sent as laser pulses to hit the target • Decrease the ammo by one. • Communicate ammo change to server. (task below) • Update LCD with ammo change (task below) • If no: • Do nothing.	Aperiodic	
2	**Trigger:** • The reload button is pressed **Action:** • Check if player has enough ammo. • If yes: • Reload the ammo. • Communicate ammo change to server. (task below) • Update LCD with ammo change (task below) • If no: • Do nothing.	Aperiodic	
3	**Trigger:** • The switch weapon button is pressed **Action:** • Switch to another weapon • Communicate ammo change to server (task below) • Update LCD with weapon change (task below)	Aperiodic	
4	**Trigger:** • Data has been placed in UART transfer register, to be sent as laser pulses. **Action:** • Interrupt the TX port of the UART	Aperiodic	PWM to be initialized to have a duty cycle of 50%. It is enabled or disabled according to data signal

	• When data signal is 0, disable the PWM. • When data signal is 1, enable the PWM		

2. Vest

	Task	Periodic/Aperiodic	Notes
1	**Description:** • Laser sensor continuously receives data (light) • Demodulation of data is needed before passing the data to RX port of microcontroller	Periodic, 10KHz	Task of highest priority

2	**Trigger:** Bullet information resulting from data demodulation
	Action:
	• Decrement the health, according to bullet damage info.
	• Communicate health change to server (task below)
	• Update LCD with health change (task below)
	• If player is dead:
	    • Turn off their LED on their vest
	    • Communicate who killed player to server (task below)
		Aperiodic	

3. LCD

1	**Trigger:** • Information to display on LCD is changed **Action:** • Display is changed	Aperiodic	

4. Server Communication

	Task	Periodic/Aperiodic	Notes
1	**Trigger:** • Server receives request from player to send data to server. **Action:** • After establishing connection, server receives data from one player and identify the player through player ID • Server has array of players, each player is a class which has private data members	Aperiodic, happens when server receives request	

	corresponding to the state of the player (health, weapon, ammo, score, …etc) • Server updates scoreboard / other information.		
2	**Trigger:** • Server requests connection to send data to player for example weapon upgrade **Action:** • After establishing connection, server send data to one player and identify the player through player ID • Player unit updates itself using this data.	Aperiodic, happens when server send request	