LASER TAG

Summer Project Completed Under

Electronics Club

Team Members:

Satyam Dwivedi

Akhil Garg

Sanchit Mall

Introduction

Laser Tag is a popular recreational sport in which players attempt to score points by tagging targets, traditionally with hand held infrared - targeting devices. Infrared sensitive targets are commonly worn by each player. The whole system is often integrated with an arena in which the game is played. In this project we have made our own laser tag system with equipment for two players.

Motivation behind the Project

Sitting in our hostel rooms, we often saw our wing mates animatedly playing the popular computer game Counter Strike. Although the game is admittedly fun to play, we wondered how much cooler it would be it we had a real life simulation of that. A little search on the matter brought the game Laser Tag to our notice, which is a popular game worldwide but still little known in India. Hence the team concluded to build a comprehensive laser tag gaming system, with equipment minimum for two players. We also decided it would be better to use actual lasers instead of commonly used infrared light in our laser guns, to make it more appealing.

Background Theory

The crux point in the working of the project is to have robust communication between the laser emitter and sensors. Information needs to be sent from the laser emitter to sensor regarding the attack made, and back from sensor to emitter for updation of various gaming parameters. For the former, we have implemented UART (Universal Asynchronous Receiver/Transmitter protocol). A 7-bit laser pulse, apart from the start and stop bit is sent every time the emitter is triggered.

The sensor receives the data via a voltage divider circuit and appropriately processes it. For data transmission from sensor back to laser emitter, radio frequency at 434 MHz is used.

Gaming Equipments:

- Laser Gun – The gun is made of aluminium and acrylic. The choice of the material was guided by weight factor and manufacturing techniques available.

- Sensor Jacket and Helmet– We have used two plain T-shirts and caps and put sensors on them for detecting laser signals.

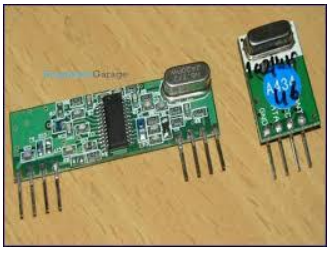
Hardware Selection:

- Arduino Mega

- 650 nm 5mW red laser

- 20 mm diameter LDR (Light Dependent Resistor)

- 434 MHz RF(Radio Frequency) Trans Receiver



- ks0108 128 x 64 Graphics Display

Game Play:

The game play comprises of two teams with multiple players each equipped with a laser gun, vest and helmet. The main purpose of the laser gun is to emit laser pulse when triggered. It also has a GLCD mounted on it which displays various game parameters. There are several weapons available, differing in the modes available, reload time, total initial ammo and magazine size. Each weapon in turn has multiple modes available, further differing in recoil time, damage caused and Xammo.

Similarly multiple types of vests and helmets are available, differing in health defense factor and decay rates.

Moreover, each player is provided a certain amount of money in the beginning which can be used to buy ammo, weapons, vest, helmet and medics. Medics perform the function of healing the player.

When a player makes an attack, his ammo decreases as per the gun and mode selected. If it hits another player, he earns a particular amount of money. The attacked player suffers decrease in health, as well as his vest/helmet decays. The game ends when the health of a person reaches 0 and he dies.

Implementation:

For all our coding purposes, Arduino platform is used. In built libraries such as Virtual Wire and GLCD (Version 3) are used for RF Trans Receiver and GLCD respectively.

Laser Pulse :

Every time the gun is triggered, information of which player emitted the laser and how much health to reduce when other player is hit is transmitted via UART protocol. Two 7 bit laser pulses (apart from start and stop bit) are sent, first containing player name and second health factor (in binary form) is sent. The time duration between two signals in a laser pulse is kept quite low at 2ms, for faster data transmission.

The sample code for UART Sender and Receiver:

Sender Code:

```
int fac = 128;
 if((triggerPin == HIGH)    {
   digitalWrite(laserPin, HIGH);
   delay(PERIOD);
   while(fac > 0)
   {
     if(val/fac == 1)
     {
       digitalWrite(laserPin, HIGH);
```

```
      delay(PERIOD);
    }
    else
    {
      digitalWrite(laserPin, LOW);
      delay(PERIOD);
    }
    val = val % fac;
    fac = fac / 2;
  }
  digitalWrite(laserPin, LOW);
  delay(PERIOD);
}
```

Receiver Code:

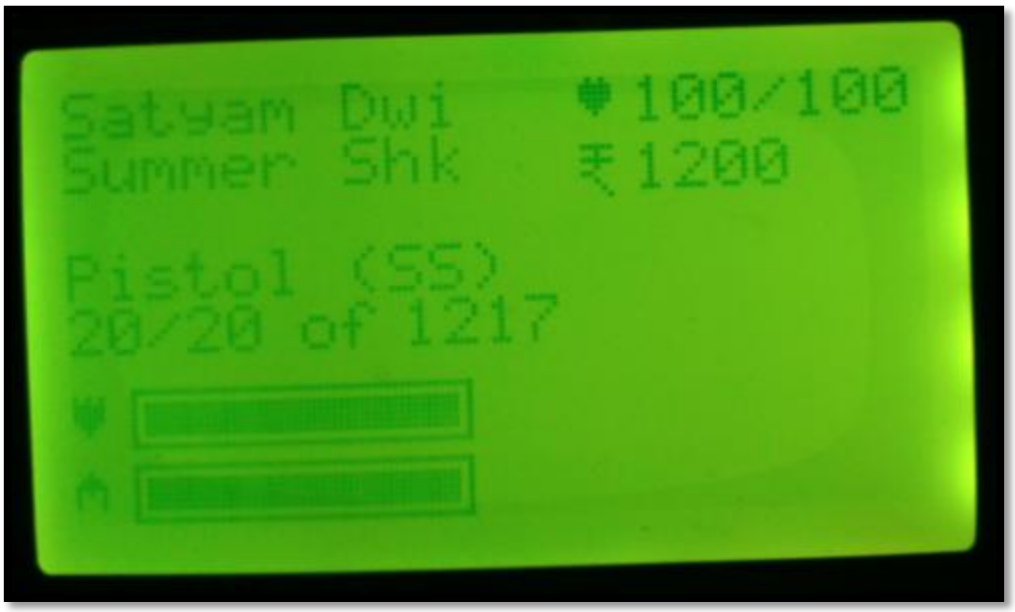
```
int val = 0;
 int count = 8;
 if(analogRead(inputPin) > THRESHOLD)
 {
  delay(PERIOD*3/2);
  while(count > 0)
  {
    if(analogRead(inputPin) > THRESHOLD)
    {
      val = 2*val + 1;
```

```
    }
   else
   {
     val = 2*val;
   }
   count--;
   delay(PERIOD);
  }
  Serial.print((char)val);
}
```

GLCD Interfacing :

The ks0108 Graphics LCD is connected to Arduino using standard Panel B. Simple functions, described in GLCD documentation such as

GLCD.GotoXY() , GLCD.SetDot() , GLCD.DrawRect(), GLCD.FillRect(), GLCD.CursorTo(), GLCD.print() are used to print simple graphics such as heart, armour, helmet and rupee symbol. For showing armour health and reloading, progress bar is made. The home screen looks like:



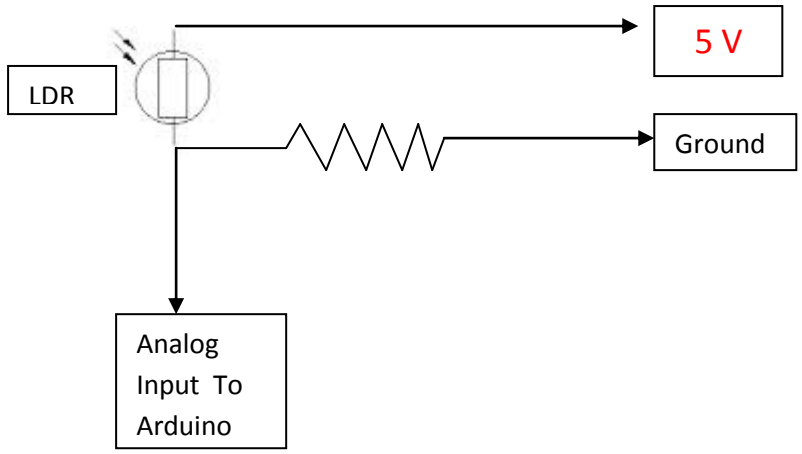
Five buttons are there for interacting with LCD, scroll left, scroll right, shop, home and reload. The latter three buttons perform multiple functions:

- Reload button is also select button
- Home button opens the player's inventory when the player is already on home screen.

LDR Sensor :

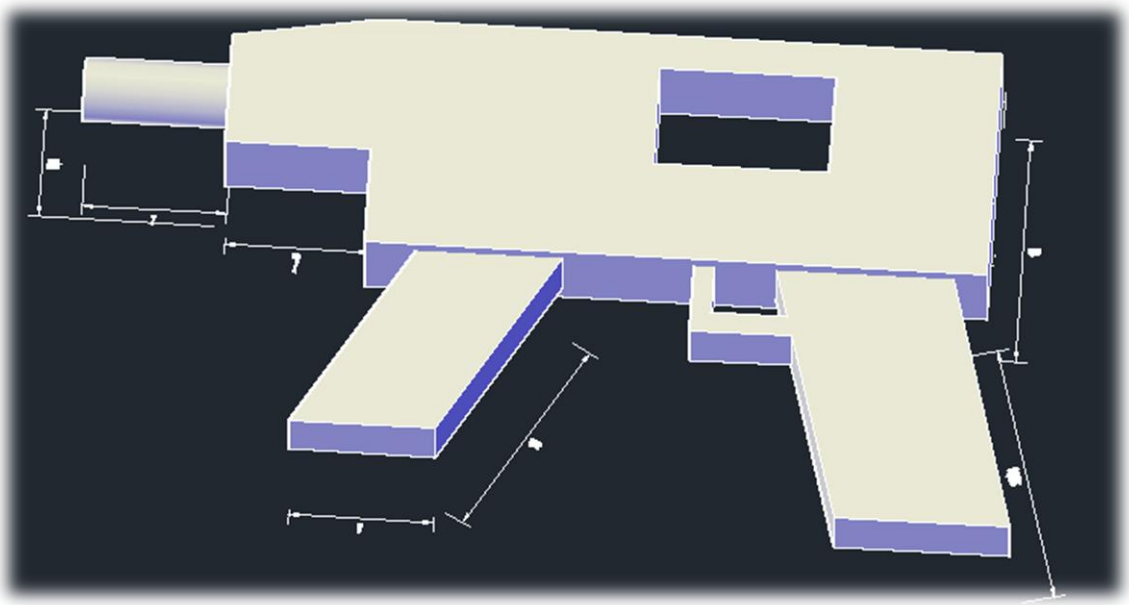
The laser pulse is detected by using a voltage divider circuit. The LDR has extremely high resistance when no light falls on it.

Hence the output voltage is quite low. Using an appropriate resistor of 220 ohm, the output voltage shows a stark difference from its previous value. Hence we have kept a threshold voltage check at 700, to detect incoming signal. The laser pulse is appropriately converted back to original information and then processed by Arduino. The LDR sensors are connected in parallel on the sensor jacket so that even when a single LDR is hit by a laser, the output voltage crosses threshold value. This was done because of we limited pins present on Arduino Mega.



Laser Gun:

Here is the CAD design of the gun manufactured in tinkering lab.



The material used is aluminium and acrylic. Different parts are made by simple tinkering processes of cutting, bending and drilling. The different parts are glued together strongly. A rectangular slot on the top is made for mounting GLCD and some buttons for interacting with GLCD.

Limitations:

The biggest limitation of the project is that there are only a few sensors on the jacket, and so a hit will be considered an attack only when the laser is incident on one of the LDR's. Also since the laser beam is quite narrow, it can be difficult to aim at an LDR from a distance.

The RF trans receiver can detect signals only upto a distance of 6 meters, so any hit made from a greater distance will not earn the attacker any money, as the signal would not detect the signal emitted.

Future Scope:

The game can easily be expanded for more than two players by building similar equipment. Also, with multiple players on on team, many new features can be added such as ammo sharing between players of same team, weapon exchange etc.

Actual Laser Tag game is played in a proper arena and many specialty games depend on protecting one's base, capturing other team's flag etc. At a higher budget and technological level, these can be implemented.

References:

- http://www.arduino.cc
- http://people.ece.cornell.edu/land/courses/ece4760/FinalProjects/
- https://www.youtube.com/watch?v=MfAMKPoym_w
- http://arduino-ua.com/docs/VirtualWire.pdf
- http://www.engineersgarage.com/electronic-components/rf-module-transmitter-receiver