Robot Laser Tag

Revised 2/20/2017

Team: RoboLazer

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Changes from the First Proposal

The basic problem with our first proposal was that our project goal or specifically the description of our game was too broad. Consequently, it was difficult to be specific about our component needs. The following changes were made.

1. Changed the game from an automated game to a manual game between two players. We now know how the game will work what functions we need to play it. We also verified we potentially have enough difficulty for our group size.
2. Did research on a robot chassis that will work for our game.
3. Did research on laser tag hardware that will work for our game.
4. Determined what kind of wireless communications we needed and found a module.
5. Reviewed several game controllers and found one for our application.
6. Determined a display idea that would work on our cars showing game status.

1 Customer

Game enthusiasts who are seeking an RC style interactive game with the action of Laser Tag. After interviewing video gamers, Laser Tag players and even members of an RC group we think there is an interest for this product.

2 Value

Entertainment for those who enjoy RC style play with the competition of an interactive action game.

3 Approach

We will modify two, RC cars to be controlled with an on board SmartFusion with PWM control to the drive wheels. It is a 4 wheel drive car so it can be turned by spinning cross wheels in the opposite direction. The wheels can be driven and reversed with H Bridges. The wireless control will be accomplished with paired XBEE modules.

Each player will have a standard N64 game controller and SmartFusion kit interfaced to a XBEE that they can carry around and control their car. It will be necessary to power everything with batteries so the players can follow the cars as need be.

Each car will also have a directional infrared emitter and detector. The emitter will be mounted on a servo so that it can be aimed with the game controller.

Each car will have a row of LEDS that are turned off as the player takes hits until all the LEDS are turned off. The car will stop and flash the LEDs when this happens. There will also be some kind of beep or buzzer every time there is a hit.

For the demonstration we will set up a roped off area with boxes for obstacles.

Major Functions of the Project

1. Robot Chassis (the car)

The car or robot chassis must be maneuverable and relatively quick. It should turn in place, go forward and backward and have variable speed control. It also needs to accommodate a SmartFusion kit with expansion board, additional electronics roughly the square area of the SmartFusion and 2, 5 AA cell battery packs. There is a car in the lab that looks like it will accommodate these needs. The car motors can be controlled by stock H-bridges and powered by 5 rechargeable AA cell batteries.

2. Car Controller

A SmartFusion kit will be used to generate PWM control for the motors, control the servo and display based on wireless message sent from the player.

3. Display

The display will be an array of LEDS that will be mounted on both sides of a proto-board and mounted vertically so they are visible from both sides. To address the IO needs of the array we will use an I2C IO expander.

4. Laser Tag Emitter Turret

The laser tag emitter needs to turn independent of the chassis by the player. We will use a continuous rotation version so that it can turn 360 degrees Laser.

5. Laser Tag

We need a laser tag system that will work at a range of ~50 feet with a spatial resolution of a few square feet. Using standard laser tag components should allow us to accomplish this based on laser tag specs. These components are commonly available and other accessories like lenses are available from laser tag hobbyist's suppliers.

Laser Tag transmission and detection uses infrared TV remote control technology. A TV remote receiver demodulates an infrared signal of a given frequency producing a 1 when the frequency is present and a zero when it is not. In this way serial communications can be implemented for the TV controler. The demodulators are available in a 3 pin package and the transmitters are just infrared diodes of a frequency that matches the demodulator. The can infrared emitter can be switched at the appropriate frequency by the SmartFusion kit to produce a 'hit' signal.

6. Player Manual Control

The player will need a game style controller with a joystick and several buttons to maneuver the car and fire the laser tag emitter. The vintage N64 Game controllers will work nicely for this and are commonly available. They use a custom asynchronous serial communications that can be implemented in the SmartFusion FPGA.

7. Player Controller

The player controller must be able to interface to the player manual interface and translate these signals into commands that can be sent to the care controller and interface to the wireless module. We will use a SmarfFusion kit for this purpose. The interface to the N64 controller can be accomplished in the FGPA with a custom MMIO interface. The wireless module uses a UART interface that can be interfaced with one of the SmartFusion UARTS. We will likely put this in a fanny pack or small enclosure that can be clipped to the belt. All these components can be powered with a 5, AA cell battery pack and voltage regulator. Based on average power draw (100ma) of a SmartFusion we expect a battery life of at least 3 hours.

8. Wireless Communications

The wireless system must have a range of at least 50 feet, work in building and be able to work for 3 hours with a reasonably sized battery. Ideally it will act as a wireless UART so that a simple command set can be developed to convey actions from the player to the car. We also need a system that two pairs of modules can operate without interfering with one another. XBEE modules configured for serial communication will meet this spec. They have a range of about 100’ in a building, have an average draw of 10ma, and can be configured for different channel frequencies to avoid interference.

4 Essential System Components

The following components are necessary to implement a minimal two pair game with two cars and two player controllers.

1. Processor/ FPGA

   4 SmartFusion and Expansion Headers

2. Car

   2, RC Chassis (lab stock)

3. Various Electronic Components

   4, Lab H Bridges (lab stock)

   32, Red LEDs (lab stock)

   4, I2C expanders PCF8574N I2C IO expander

   Various Resistors (lab stock)

   Protoboard (lab stock)

   4, 5 volt regulators (lab stock)

4. Game Controllers

   2, N64 controllers (lab stock)

5. Communications

   4 XBEES (lab stock)

6. Infrared Emitters and Detectors/Demodulator

   6 Everlight IR333-A infrared diodes 940nm (need to order)

   6 IR (Infrared) Receiver Sensor – Vishay TSOP38238 (need to order)

   2, MilesTag Sensor PCB Conveniently mounts 3 IR receivers. (need to order)

2, MilesTag Sensor Domes Lenses that fit PCB. (need to order)

7. Continuous Servo

   Parallax Continuous Servo 900-00005

8. Batteries

   6, 5 AA battery holders

   AA battery holder charger (need to order or buy locally)

   30 AA NiMH batteries (need to order or buy locally)

9. Enclosures

   Fanny pack (Amazon or local)

   Hammond 1591ESBK ABS Project Box Black 7.5 x 4.3 x 2.2 Inch (Amazon)

   Springfield Leather Company Black Wideback Belt Clip (Amazon)

5 Optional System Components

As time permits, we will consider implementing any of the following.

Rumble Pack for the N64

Amazon, various vendors

Player Wrist Mount or Case Mount Display Providing Game Status

Adafruit, 128x32 I2C OLED, https://www.adafruit.com/products/931

Fitbit band from various Amazon sources

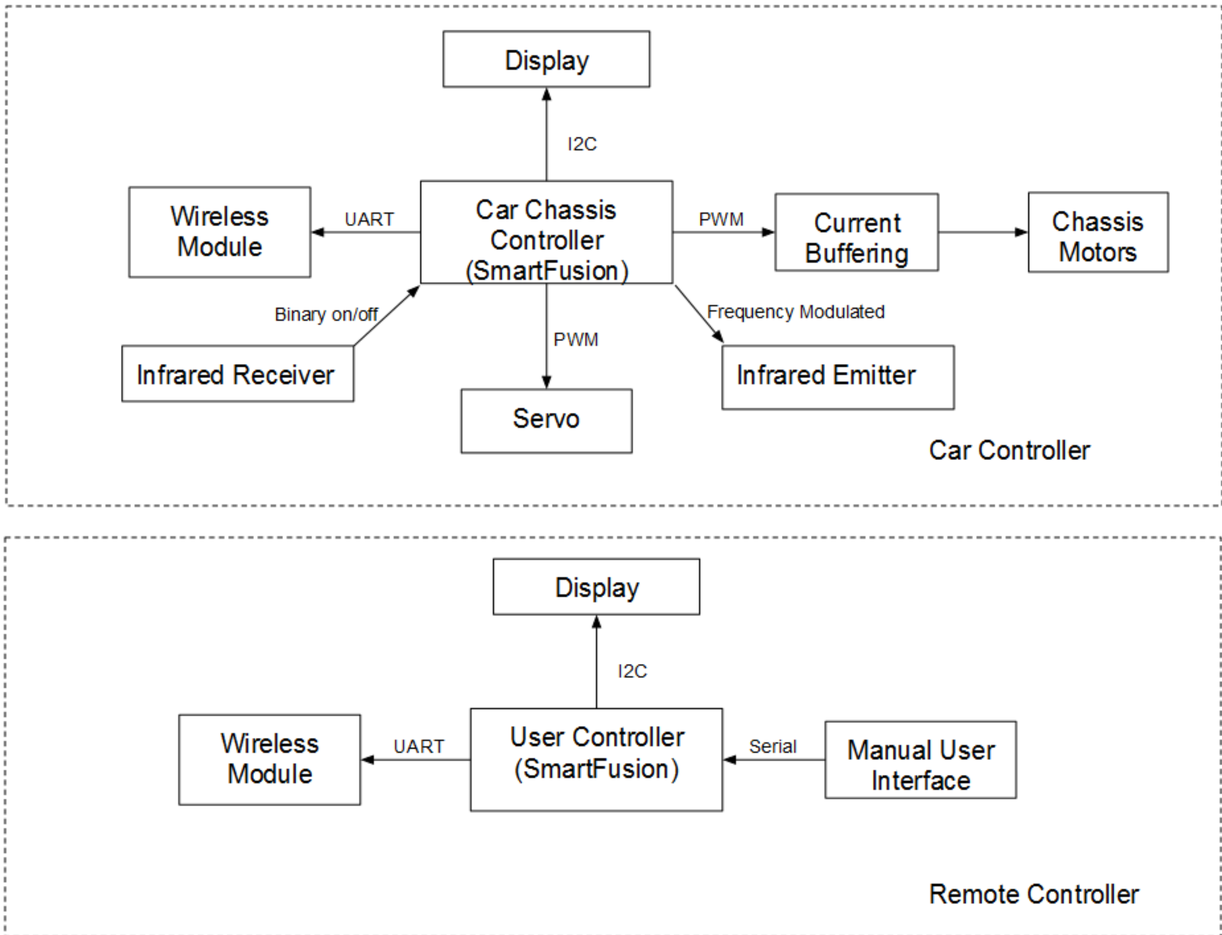

Figure 1: Functional diagram.

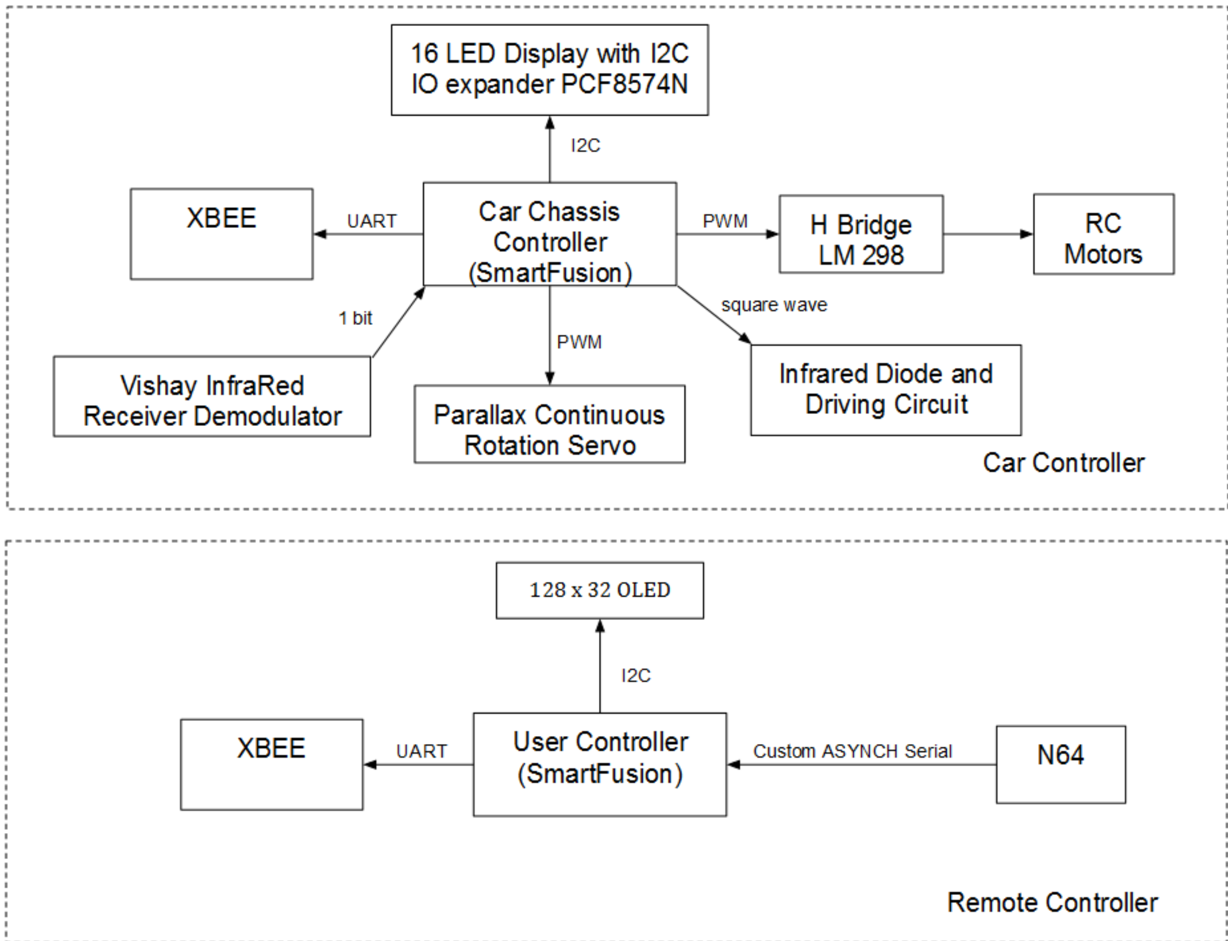

Figure 2: Component diagram.