**Block Diagram**

**Clock**

**Attention**

**Data**

Control System

**1**

**x1**

**x2**

**x3**

**x4**

M1

M2

H-Bridge

**EA**

**EA**

**IN1**

**IN2**

**EB**

**EB**

**IN3**

**IN4**

Car System

8-Bit Register

Comparison

PlayStation 2 Controller

FPGA

**Circuit Description**

The circuit is composed of 3 main subcircuits. The first subcircuit is the input subcircuit, which gathers input from the PlayStation controller. This circuit has a single input -- the 8 bit data stream from the controller -- and 6 outputs -- four of which (x1, x2, x3, x4) represent the input on the controller, an “Attention” signal, and a clock signal.

When the Attention signal is pulled low, the clock goes through eight cycles. On each cycle, the Data signal takes on a new value. Across the eight cycles, this means that the Data signal is conveying an eight bit number, least significant bit first. In order to translate this signal, the value of each bit will be successively stored in an eight bit register, allowing us to wait until after the 8 clock cycles to see the full value of the input.

The value of the input will then be compared to four predetermined values and the button being pressed will be determined. The outputs will be set by: x1 and x2 represent forwards and backwards, respectively, and x3 and x4 represent left and right, respectively. Thus x1 and x2 can not both be set high, and the same applies to x3 and x4.

The second subcircuit controls the motors. There are two motors, M1 and M2. M1 drives the car forwards and backwards, M2 controls the steering column, allowing for turning motion in the car. This subcircuit has four inputs, each of which will control a specific direction on the car. As above, x1 and x2 represent forwards and backwards, and x3 and x4 represent left and right.

This circuit has 8 outputs, four for each motor. At each motor, two of the four output signals are set to a constant high value -- these are enable signals. Given that we do not anticipate needing to disable the motor function while leaving the circuit active, these four signals (two for each motor) are constant high.

The other four outputs are IN1 and IN2 are associated with M1, whereas IN3 and IN4 are inputs associated with M2. When IN1 is high, M1 drives the car forwards, and when IN2 is high, M1 drives it backwards. When IN3 is high, M2 rotates the steering column so that when M1 is driven forwards, the car will turn to the left. When IN4 is high, M2 rotates the steering column in the opposite direction. These outputs are sent to the H-Bridge, which then translates the signals into the appropriate signals to drive the motors. It then outputs those signals through the GPIO pins.

**Test Plan**

There are only two things that need to be tested for our project: the car and PlayStation 2 controller. In order to test the functionality of the car, it will be operated by push buttons. The pushbuttons will be programmed to the motors which will send a signal and drive the wheels of the electric car. If the cars wheels move in the correct direction when the correct pushbutton is pressed, the car system would be functioning correctly.

We would test the PlayStation 2 controller by assigning buttons on the PS2 controller to LEDs on the Altera DE2 board. The outputs will be tested. When a button is pressed, the corresponding LED should turn on. This indicates that the Data Register and the Comparison subcircuit are functioning correctly.

**Milestones**

Our first milestone, due the week of November 18th, is to demonstrate the second subcircuit described above. That is, to use the Altera board to drive the motors on the car system.

The second milestone, due the week of November 25th, is to demonstrate the Altera board receiving input from the controller system.

The final deliverable is to demonstrate the controller system can be used to control the car system .i.e. the PlayStation controller driving the motors on the car correctly.

**Bonus Feature**

As this feature employs purely third party code, we do not consider this as a part of our project to be marked.

Connecting a Camera to the DE2 Board via Video-in or USB and outputting the result onto a VGA monitor. This system does not interact with the Control System or Car System.

**Reference Manuals**

We will be using the following resources for reference.

*Interfacing a PlayStation 2 (PS2) Controller*

<http://store.curiousinventor.com/guides/PS2>

*PlayStation 2 (Dual Shock) Controller Protocol Notes*

<https://gist.github.com/scanlime/5042071>

*How PlayStation Works*

<http://electronics.howstuffworks.com/playstation3.htm>

*PlayStation.txt*

<http://www.raphnet.net/electronique/psx_adaptor/Playstation.txt>