Vending Machine

– The Idea

The buyer checks the led light representing the availability of beverage in the vending machine. If the led light is on then there is beverage in the machine and the buyer can get it by putting a 1 Pound coin through the coin opening in the machine. After that the buyer pushes the button and the first barrier inside the vending machine will open so the beverage can pass to the buyer then the first barrier will close. Next, the second barrier will open for a beverage in the stock to pass to the first barrier and then the second barrier will close again.

– Sensors and Parts used

- ❖ Infrared sensor that detects coins put in the machine
- ❖ Ultrasonic sensor that determines whether the machine is empty or not
- ❖ Button the buyer presses for the process to begin
- ❖ 360-degree Servo to control the first barrier
- ❖ 180-degree Servo to control the second barrier

- **Implementation**

I. The pushbutton is in the fpga board in pin B8 (active low)

II. Infrared sensor has 3 pins. They are for vcc, ground and digital output (active low). The digital output is going to the fpga through pin W7

III. Ultrasonic sensor has 4 pins for vcc, ground, trigger and echo. The trig is generated and goes out of the fpga through pin W8. Echo is transmitted to the board through pin W9.

```
PROCESS (clk)
VARIABLE c1, c2 : INTEGER := 0;
VARIABLE y : std_logic := '1';
BEGIN
   IF rising_edge (clk) THEN

      IF (c1 = 0) THEN
         ultra_clk <= '1';
      ELSIF (c1 = 500) THEN--100us
         ultra_clk <= '0';
         y := '1';
      ELSIF (c1 = 5000000) THEN-- 100 ms
         c1 := 0;
         ultra_clk <= '1';
      END IF;
      c1 := c1 + 1;

      IF (echo = '1') THEN
         c2 := c2 + 1;
      ELSIF (echo = '0' AND y = '1') THEN-- I change the y to not get echo_time =0;
         echo_time <= c2;
         c2 := 0;
         y := '0';
      END IF;
      IF (echo_time < 10000) THEN
         ultdist <= '1';
         ultdist_led <= '1';
      ELSE
         ultdist <= '0';
         ultdist_led <= '0';
      END IF;
   END IF;
END PROCESS;
```

IV. Each of the 2 servos has 3 pins vcc, ground and signal input. The signals are generated and transmits to the 180-degree servo and 360-degree servo through pins W6 and Y3 respectively.

```
PROCESS (clk)
VARIABLE cservo,xserv : INTEGER := 0;
VARIABLE cserv, c1serv : INTEGER := 0;
BEGIN
   IF rising_edge (clk) THEN
      IF (inProcess = '0') THEN
         inProcess <= (NOT btn) AND cinfsig AND ultdist;
      END IF;
      IF (inProcess = '1') THEN
         IF (cservo < 10000000) THEN
            IF (yserv = '0') THEN
               IF (c1serv = 8000000) THEN-- 0.8s
                  yserv <= '1';
                  xserv := 0;
                  c1serv := 0;
               ELSE
                  c1serv := c1serv + 1;
               END IF;
            END IF;
            IF (cserv = 200000) THEN -- 20 ms
               cserv := 0;
            ELSE
               cserv := cserv + 1;
            END IF;
            IF (yserv = '1') THEN
               IF (cserv < 13000) THEN --1ms
                  servo_clk <= '1';
                  xserv := xserv+1;
               ELSE
                  servo_clk <= '0';
               END IF;
            END IF;
            IF (xserv = 1 AND cserv = 200000) THEN --20ms
               yserv <= '0';
            END IF;

         ELSIF (cservo > 18000000 AND cservo < 28000000) THEN

            IF (yserv = '0') THEN
               IF (c1serv = 8000000) THEN-- 0.8s
                  yserv <= '1';
                  xserv := 0;
                  c1serv := 0;
               ELSE
                  c1serv := c1serv + 1;
               END IF;
            END IF;
            IF (cserv = 200000) THEN -- 20 ms
               cserv := 0;
```

```
        IF (cserv = 200000) THEN -- 20 ms
           cserv := 0;
        ELSE
           cserv := cserv + 1;
        END IF;
        IF (yserv = '1') THEN
           IF (cserv < 21000) THEN -- 2ms
              servo_clk <= '1';
              xserv := xserv+1;
           ELSE
              servo_clk <= '0';
           END IF;
           IF (xserv = 1 AND cserv = 200000) THEN --20ms
              yserv <= '0';
           END IF;
        END IF;
        ELSIF (cservo > 38000000 AND cservo < 48000000) THEN
        IF (yserv = '0') THEN
           IF (c1serv = 8000000) THEN-- 0.8s
              yserv <= '1';
              xserv := 0;
              c1serv := 0;
           ELSE
              c1serv := c1serv + 1;
           END IF;
        END IF;
        IF (cserv = 200000) THEN -- 20 ms
           cserv := 0;
        ELSE
           cserv := cserv + 1;
        END IF;
        IF (yserv = '1') THEN
           IF (cserv < 20000) THEN --2ms
              servo_clk2 <= '1';
              xserv := xserv+1;
           ELSE
              servo_clk2 <= '0';
           END IF;
        END IF;
        IF (xserv = 1 AND cserv = 200000) THEN --20ms
           yserv <= '0';
        END IF;

    ELSIF (cservo > 56000000 AND cservo < 66000000) THEN

        IF (yserv = '0') THEN
           IF (c1serv = 8000000) THEN-- 0.8s
              yserv <= '1';
              xserv := 0;
```

```
        ELSIF (cservo > 56000000 AND cservo < 66000000) THEN

            IF (yserv = '0') THEN
               IF (c1serv = 8000000) THEN-- 0.8s
                  yserv <= '1';
                  xserv := 0;
                  c1serv := 0;
               ELSE
                  c1serv := c1serv + 1;
               END IF;
            END IF;
            IF (cserv = 200000) THEN -- 20 ms
               cserv := 0;
            ELSE
               cserv := cserv + 1;
            END IF;
            IF (yserv = '1') THEN
               IF (cserv < 10000) THEN -- 2ms
                  servo_clk2 <= '1';
                  xserv := xserv+1;
               ELSE
                  servo_clk2 <= '0';
               END IF;
               IF (xserv = 1 AND cserv = 200000) THEN --20ms
                  yserv <= '0';
               END IF;
            END IF;

         END IF;
         IF (cservo = 70000000) THEN
            cservo := 0;
            inProcess <= '0';
         ELSE
            cservo := cservo + 1;
         END IF;
      END IF;
   END IF;
END PROCESS;
```

– Results

As a result of the buyer inserting a coin and triggering the circuit to run, he/she will receive their beverage from the vending machine