Smart Bicycle

Team Members:

1. 221CS106, Aditya G, adityag.221cs106@nitk.edu.in ,7892158991

2. 221CS108, Amruth S D, amruthsd.221cs108@nitk.edu.in ,8867978202

3. 221CS160, Thrishank Reddy, thrishankreddymure.221cs160@nitk.edu.in ,9353287118

Abstract:

In an era marked by rapid technological growth and an increasing emphasis on sustainability, the integration of electronics and smart systems into everyday activities is becoming increasingly prevalent. One such area of innovation is the realm of cycling, where traditional bicycles are evolving into 'smart' transportation solutions that offer enhanced functionality and safety. Our project focuses on the development of a 'Smart Bicycle'. Central to this innovation is the incorporation of a digital speedometer, a vital component for cyclists seeking accurate real-time data on their speed, distance travelled, and performance metrics. The digital speedometer project hinges on three key components. Firstly, the Hall Effect Sensor plays a pivotal role by detecting wheel rotation on the vehicle, serving as the primary data source for measuring speed. Secondly, the Seven Segment Display takes this speed data and presents it in a visually understandable numerical format, making it easily readable to the user. Together, these components form a cohesive system for accurately measuring and displaying vehicle speed. The addition of direction indicators is more than just a feature; it's a step toward making cycling in urban environments safer and more accessible.

BRIEF DESCRIPTION

The miniproject is called smart bicycle, its main functions are displaying the bicycle's speed(km/hr),distance travelled by the bicycle(m), also a button for indicators if the user wants to take a turn etc, so the the implementation of all the features can be divided into 4 major parts.

1.Clock handling(for displaying accurate speed and reseting it)

2.Calculating current speed and distance travelled(Using flipflops and adders)

3.Implementing the indicator

Let us start with indicator part:

Indicator Buttons:

You have three buttons- left indicator, right indicator, and parking lights. Each button serves a specific purpose:

Left Indicator: When pressed, this button activates the left turn indicator, signaling to other road users that the cyclist intends to make a left turn.

Right Indicator: When pressed, this button activates the right turn indicator, indicating the cyclist's intention to make a right turn

Parking Lights: This button activates the parking lights. When the parking lights are on, both the left and right indicators blink simultaneously, and this is commonly used when the cyclist wants to make their presence more noticeable, especially in low-light conditions or while stationary.

OR Gates: To begin, the state of the right indicator button and the parking lights button are connected to one OR gate, while the state of the left indicator button and the parking lights button are connected to another OR gate. These OR gates act as logic elements that combine the state of the buttons.

Clock Input: The output of each OR gate is then linked to an AND gate. Additionally, the state of a clock signal is provided as the second input to these AND gates.

Parking Lights: When the parking lights button is pressed, it activates both OR gates, causing both left and right indicators to blink. The clock signal plays a crucial role here.

Indicator Activation:

If only the left indicator button is pressed, the left indicator OR gate will have a high (1) output, and the clock signal will be used to control the blinking effect.

Similarly, if only the right indicator button is pressed, the right indicator OR gate will have a high output, and the clock signal will control the blinking of the right indicator.

When the parking lights button is pressed, both OR gates will have high outputs, and the clock signal will cause both the left and right indicators to blink together.

This setup offers a versatile indicator system that responds to the cyclist's intentions. Whether they want to signal a left turn, a right turn, or activate both indicators for enhanced visibility, the system can accommodate these actions effectively. The clock signal synchronizes the blinking effect, making the turn indicators noticeable and informative to other road users, ultimately enhancing safety while cycling

Now let us talk about the speed and distance travelled part:

Distance does not need to be reset, it just needs to be initialized at 0 and we keep adding 0.5 meters every time the hall effect sensor

sends a pulse whenever the magnet is detected and the same pulse also adds 1.8 to the speed counter and we also need to make sure to reset it every second(because speed continously changes so we need it to be as accurate as possible) so we need to keep a counter and update its value every time a magnet is detected and then we need to copy it(the output stays constant for the second and keeps getting updated every second) and then reset it. The speed counter is of 9 bits and the distance counter is of 13 bits, we can store the values in D flipflops and use full adder/half adder to increase the value.

Clock handling part:

Now we could just use a simple 1hz clock to reset and copy it but there are 2 main problems. 1)Inaccurate, after some research we found out that 1hz clocks can be very inaccurate and unreliable) 2)Delay between copy and reset, One more potential problem was if the speed got resetted before it was copied to the output then the output would always show 0 and that would be a huge problem, hence we decided to use 15Hz clock, so how we mimic a 1Hz clock is we store a 4 bit counter and increase it every time the 15Hz clock gives a pulse, and if all the bits are 1(AND of all the bits, this happens every 1 second) a pulse is given out to reset it, so to copy before this we also send another pulse if the bit configuration is 1110(which is just before 1111) so the speed value is copied just before it is reset.

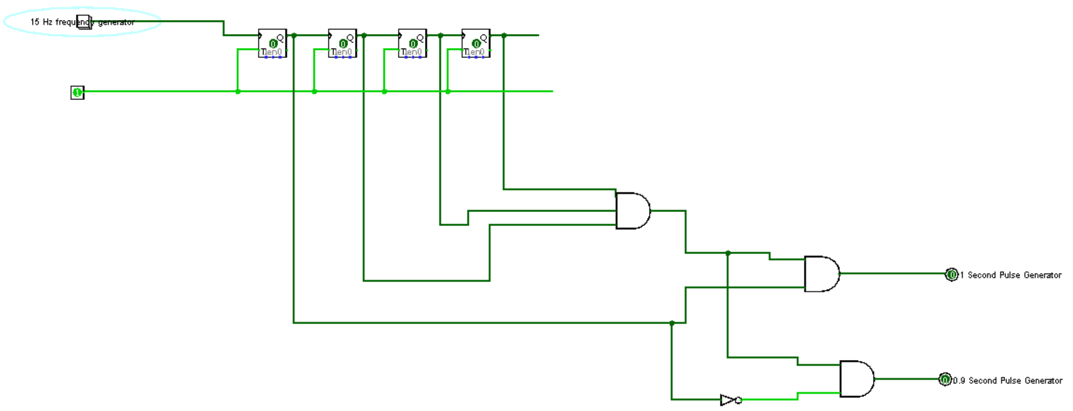
Working:

Functional Table:

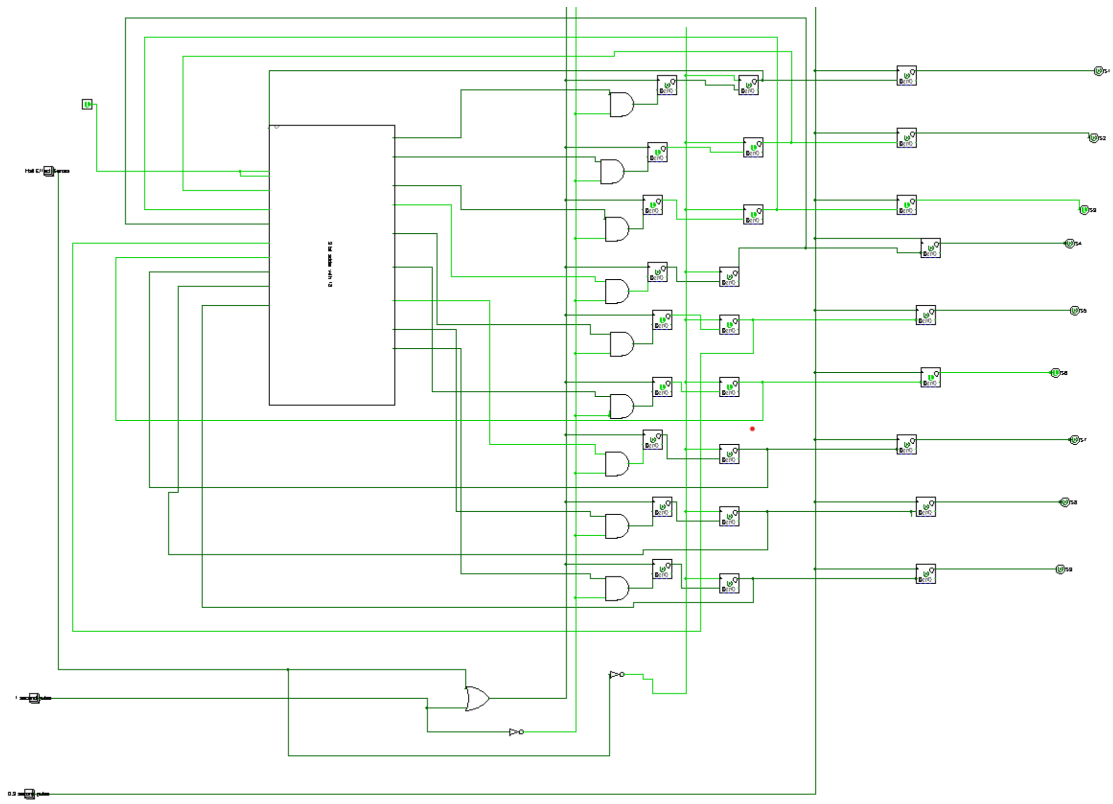
Inputs			Result	
HES	1sec Pulse	0.9sec Pulse	Speed	Distance
0	0	0	NA	NA
0	0	1	Updates Display	NA
0	1	0	Resets Speed	NA
0	1	1	----------------------------------	
1	0	0	+1.8 to Hidden speed	+0.5 to distance and Updates
1	0	1	Updates speed	+0.5 to Distance and Updates
1	1	0	Resets Speed	+0.5 to Distance and Updates
1	1	1	--------------------------------------	

Logisim Circuit Diagrams:

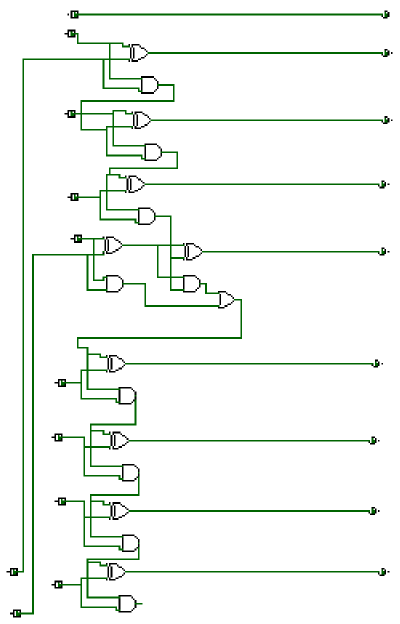
1.Converting 15Hz frequency generator to 2 pulses of 1second and 0.9seconds



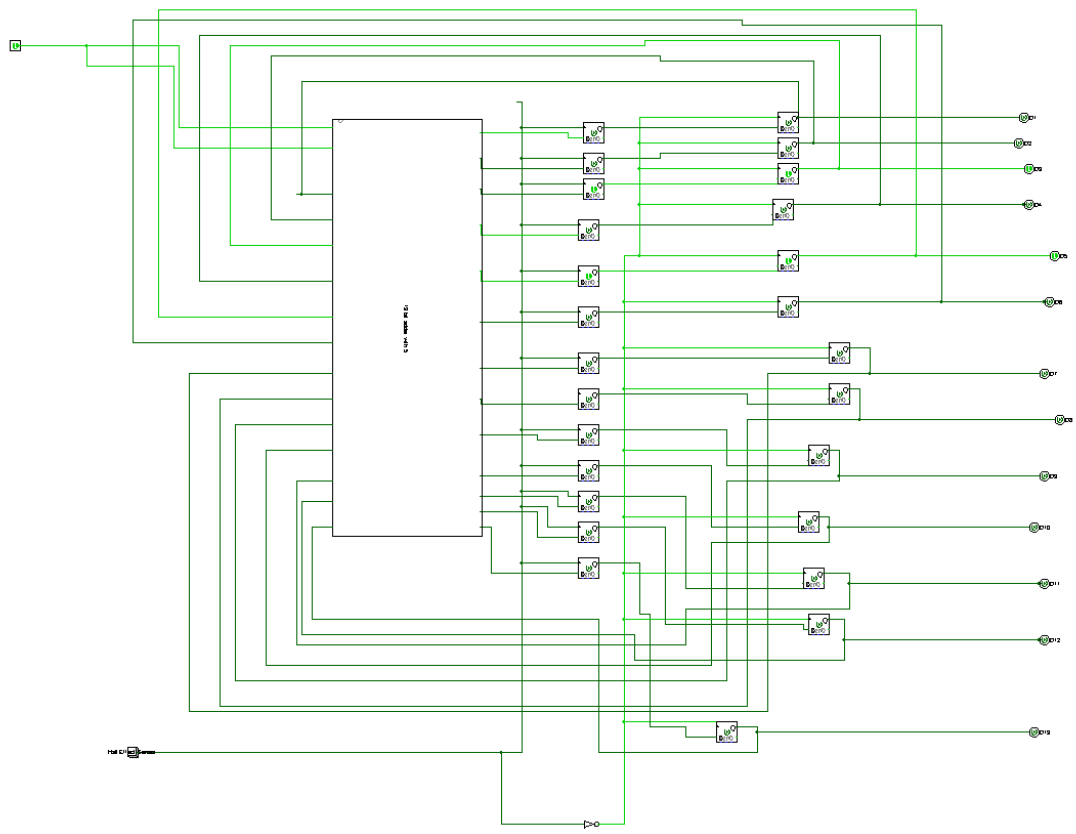
2.Speedometer circuit diagram



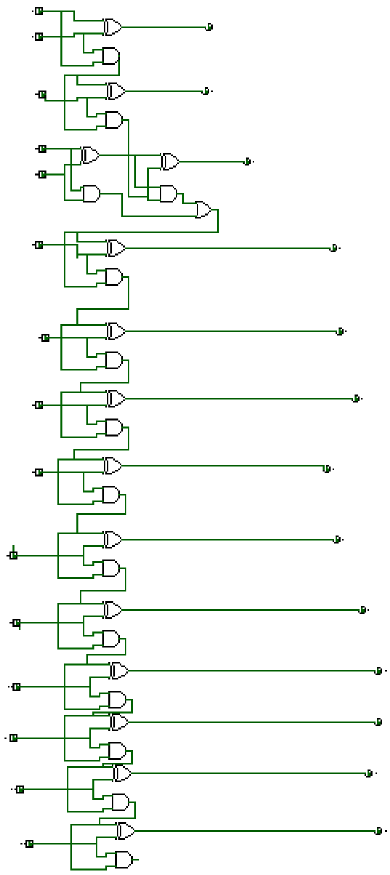
Circuit for adding 9bits and 1.8km/hr for calculating speed



3.Distance Calculator Diagram



Circuit for adding 13bits and 0.5m for calculating distance travelled



Verilog Code:

1.Verilog code for calculating the speed and distance

.v File:

```
module speed (clk,reset,result);
 input clk,reset;
 output [8:0]result;
 reg [8:0] spe;
 always @(posedge clk or posedge reset) begin
  if (reset) begin
   spe <= 9'b0;
  end else begin
   spe <= spe + 18;
  end

 end
 assign result = spe;

endmodule

module distance(clk,reset2,result);
 input clk,reset2;
 output [12:0]result;
 reg [12:0]dist;
 always @(posedge clk or posedge reset2) begin
  if (reset2) begin
   dist <= 13'b0;
  end else begin
   dist <= dist + 5;
  end
 end
```

```
  assign result = dist;
endmodule
```

Test Bench File:

```
module miniproject_tb;
  reg clk;
  reg reset,reset2;
  wire [8:0] result1;
  wire [12:0] result2;

  speed M1(clk,reset,result1);
  distance M2(clk,reset2,result2);
  // Assuming hall effect sensor as a clock with 100Hz frequency
  always begin
    #5 clk = ~clk;
  end
  initial begin
    #5 reset2=~reset2;
    #5 reset2=~reset2;
  end
  // Reset value (1 Hz)
  always begin
    #500 reset = ~reset;
  end

  initial begin
    $display("Time,Speed,Distance");
    $monitor("%d, %b %b", $time,result1,result2);
    #10000 $finish;
  end
```

```
  initial begin
    clk = 0;
    reset = 0;
    reset2=0;
  end

endmodule
```

2.Verilog Code for Indicator System

Test Bench File:

```
module indicator_tb;
    reg [0:3]A;
    wire E,F;
    indicator m1(A[0],A[1],A[2],A[3],E,F);
    initial begin
        $dumpfile("indicator.vcd");
        $dumpvars(0,indicator_tb);
    end
    initial begin
        $display("|           INDICATOR SYSTEM           |");
                $display("------------------------------------");
                $display("|   Input   | Left  | Right  |");
                $display("------------------------------------");
                $display("| A | B | C | E | F |");
                $display("------------------------------------");
                $monitor("| %b | %b | %b |  %b  |  %b |", A[0],A[1],A[2],E ,F );
        A=4'b0001;
        repeat(7)
        #10 A=A+4'b0010;
    end
```

```
initial #300 $finish;
endmodule
```

.v File:

```
module indicator(A,B,C,D,E,F);
   input A,B,C,D;
   output E,F;
   wire w1,w2;

   or(w1,A,C);
   or(w2,B,C);
   and(E,w1,D);
   and(F,w2,D);

endmodule
```

References:

1. Building a Digital Speedometer by zagGrad

   https://www.sparkfun.com/tutorials/123

2. EMBEDDED LINUX, FEATURED, SPEEDOMETER PROJECT

   by Braden Sunwold

   https://barenakedembedded.com/diy-speedometer//

3. Bike Turning Signal Circuit by Iftar Rafiq

   https://www.electronicshub.org/bike-turning-signalcircuit/#:~:text=Breadboard

4. Basic working of D flip

   flophttps://www.geeksforgeeks.org/d-flip-flop/#:~:text=The%20basic%20working%20of%20D,the%20flip%20flop's%20Q%20output

5. Asynchronous Counter

   https://electronicscoach.com/asynchronous-counter.html