Red Light Camera Final Report

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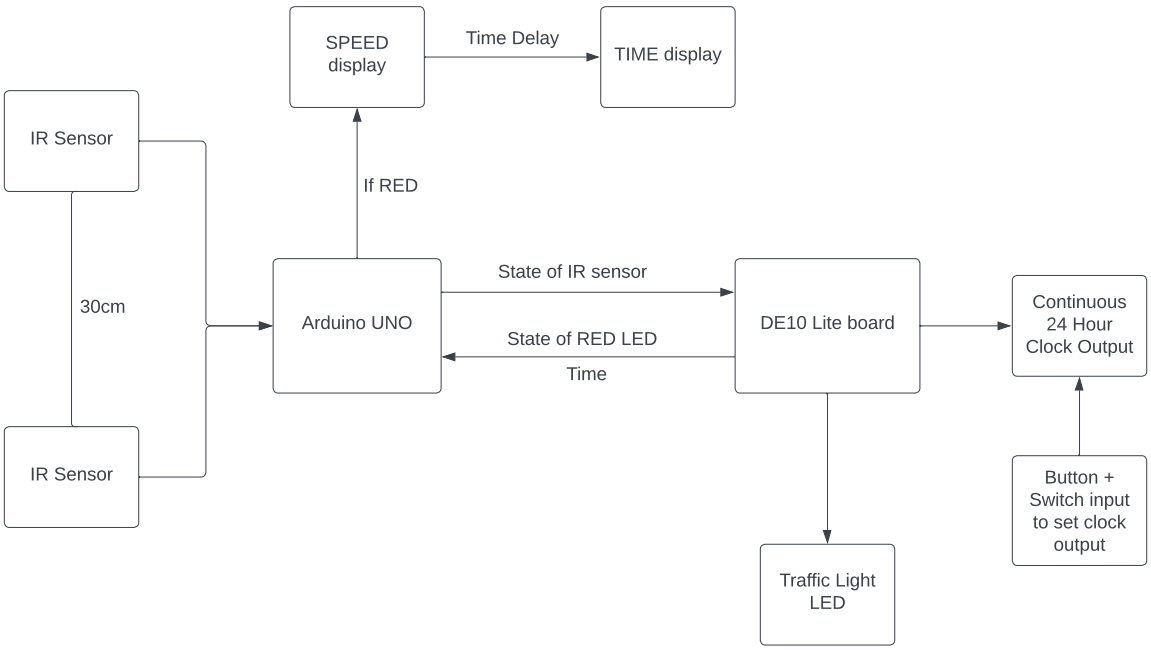
Introduction

Each year in India alone over 4 lakh traffic accidents take place and 1.5 lakh people lose their lives. With the help of a red light sensor, police can be more successful in catching rule breakers and people would be less likely to break the traffic laws, resulting in fewer accidents. Our project is a red light camera system which uses 2 infrared sensors 30cm apart to detect movement of a vehicle in front and uses the data to calculate speed. Then, it displays both speed and time on a LCD screen with time delay between the two at which they crossed the sensors if the vehicle crosses at a red light.

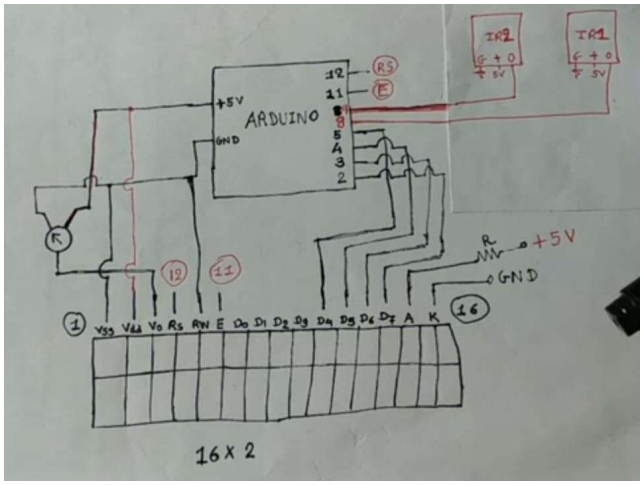
Block Diagram



System Overview

Starting from the DE10Lite board, on the 7 segment display it shows the hours, minutes and seconds from left to right on all 6 of the SSD displays in a 24 hour clock fashion, that is hours varying from 00 to 23, minutes from 00 to 59 and seconds from 00 to 59. Moreover, we have additional functionality to change the time on the clock. The DE10Lite board also serves the additional function of making a traffic light LED system on the breadboard. Finally, it sends a signal to the Arduino if the red LED is on at every point, and the current time if it gets a signal from the arduino that an object has passed the sensors.

Now, moving to the arduino, it takes input from two IR sensors placed 30cm apart, and calculates the speed of any object which passes across both of them. It also sends a signal to the DE10Lite board if it detects the object in both sensors. Then, if the red LED is on, it displays the speed on the LCD display then the time at which the object crossed the sensors after a short time delay.



Implementation Details

0.1 DE10Lite Board

The DE10Lite board is the core of the project and uses a Moore type finite state machine to create a traffic light which turns on the LEDs of Green, Yellow and Red in cycles of 9 seconds (4 for Green, 1 for Yellow, 4 for Red). There is also an enable switch on the board which when turned off, pauses the traffic light at the next Red.

The board is also responsible for a 24 hour clock displayed on the 7 segment display. It functions using D Flipflops which function as a synchronous UP Counter. It shows the hours, minutes and seconds from left to right on all 6 of the SSD displays. 3 of the input switches to the board also function as enable, reset and pause switches to the clock. We have also implemented an additional functionality to change the time on the clock. First, we have to turn off the enable switch and then turning off an additional "time change" switch. Now, by giving in a BCD input through the last four switches on the left of the board, we can change any of the 4 hour or minute outputs. The two buttons on the DE10Lite board can be used to select the position on the clock to be changed and then change it to the BCD input respectively.

Finally, the DE10Lite board takes in a digital input from the Arduino that is 1 only when the arduino detects that an object passes across the two IR sensors. It then send the current time in hours and minutes to the arduino through 4 digital outputs in BCD format with a time delay of 1 second between each output. Additionally, it sends a digital output continuously which reflects the state of the red LED to the arduino.

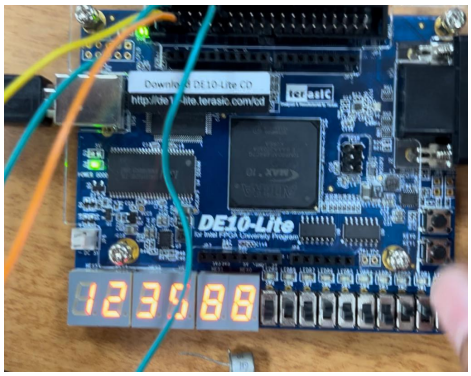
0.2 Arduino UNO

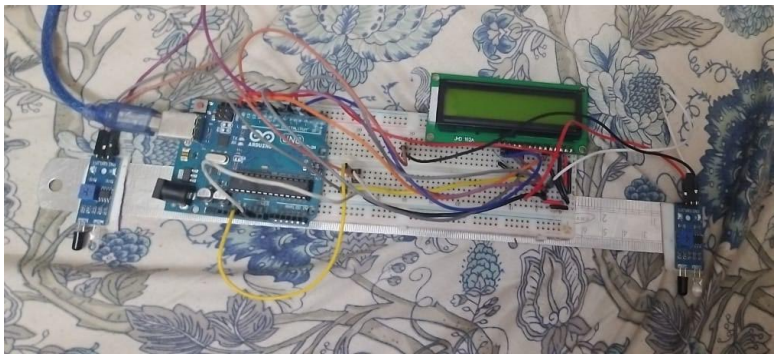
The Arduino takes in input from 2 analog IR sensors placed at a distance of 30cm away from each other. It then calculates the speed of the vehicle based on the time delay between the two sensors. Then, it sends a digital output of '1' as mentioned above to the DE10lite board if it gets a signal from the IR sensors. Finally, if the object passees the sensors and the red LED signal from the de10lite is '1' then it displays the speed, followed by the time on the LCD screen. It gets the time through the BCD inputs from the board as mentioned above then converting the BCD to regular numbers.

0.3 In-Class concepts used in the implementation

The concept of Finite State Machines was used to create the VHDL code for the traffic lights, by creating a state for each second of the 9 second cycle and assigning an output of either red, yellow or green depending on the current state. It also uses an if statement in the last state which prevents it from going back to green output if the enable switch is low.

The clock VHDL code uses synchronous counters and a clock divider of 1 second to make counters for 6 different BCD variables continuously, 2 for seconds, 2 for minutes and 2 for hours, going from 0 to 60, 0 to 60 and 0 to 24 respectively. Each counter only increases when the counter to the right reaches its maximum value and overflows back to zero. For example if we consider S(1) and S(0) to be the two seconds variables, S(1) only counts up when S(0) reaches its maximum value of 9 and goes back down to 0.





Timeline

17-27 October: Complete VHDL code for traffic light as well as basic clock functionality. Start independent arduino circuit.
27 October to 3 November: Complete remaining clock functionality. Complete arduino citcuit.
4 November to 9 November: Combine DE10Lite board and Arduino UNO

Contributions

Shivam Salgaocar: CLOCK VHDL code
Shubham: Arduino
Shivam: Arduino
Sparsh: Traffic Light VHDL Code

Conclusion

Project works as intended and the functionality is complete. We learnt a lot about application of the VHDL concepts to real life problems and how to build electronic systems. The combination of hardware and software presented some challenges but while solving them we learnt more about both aspects of electronics.