4-way Traffic Signal

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BCSE - II

Hardware Design Lab.

Design a system for a traffic signal at a 4-way crossing.

The 24 hr. clock designed in the previous assignment is used here.

Basic design:

There are 4 lanes. When one lane is open, all others are closed. In this way, when a lane is open, the vehicles can go straight, turn left or turn right without any problem.

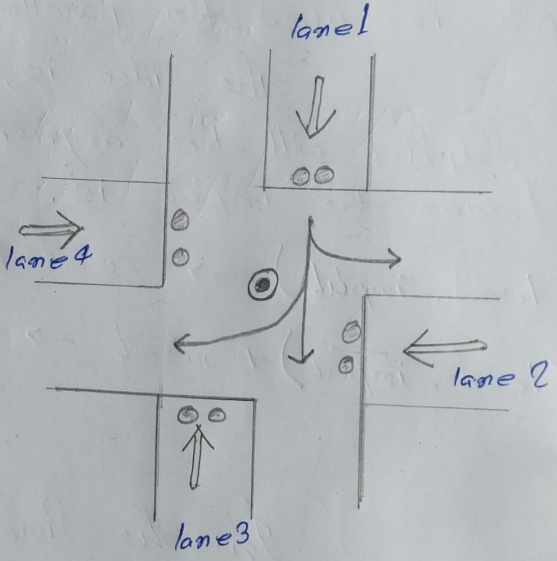


Figure - lane 1 is open

light control:

At every lane, the green light is connected to the control line for that lane, and the red light is complement of the green light line. The control line of a lane is only high, when all other control lines are low. That means, when one lane has a green signal on, all other lanes will have a red signal on.

The control lines are controled by a mod 4 counter, so that after a certain time interval, the 4 control lines change state.

The time interval between the state change is monitored by a timer. The timer

is basically a mod 60 counter with a "not busy" pin. When the pin is connected to a low line, the timer is a simple mod 60 counter (designed in the previous assignment). When the "not busy" line is high, the timer is capped at 29, so that it becomes a mod 30 counter (design similar to that of the mod 24 counter.)

In this way, the state of the signals change every minute, when the traffic is busy, and every 30 seconds when the traffic is not busy.

the busy-hour-selector:

Here comes the clock designed at the previous assignment.

Upto this point, the whole system is independant of the clock. Only the busy hours depend on the clock.

the system is designed, such that 08:00:00 - 9:59:59 and 17:00:00 - 18:59:59 are busy hours. The mod 4 counter and the timer circuit has pins for this busy-hour-selector to switch between a 60 second interval or a 30 second interval.

the output of this selector needs to be high when the hour at clock is 8, or 9 or 17 or 18. the inputs are two 4bit lines, that represent the two digits of the hour display system of the clock, Let them be H0 and H1.

$$\text{Busy} = (\bar{H0}_3 \cdot H0_2 \cdot H0_1 \cdot H0_0).(\bar{H1}_3 \cdot \bar{H1}_2 \cdot \bar{H1}_1 \cdot H1_0)$$
$$+ (\bar{H1}_3 \cdot \bar{H1}_2 \cdot \overset{(7)}{\bar{H1}_1} \cdot \bar{H1}_0).(H0_3 \cdot \overset{(1)}{\bar{H0}_2} \cdot \bar{H0}_1 \cdot \bar{H0}_0)$$
$$+ (\bar{H1}_3 \cdot \overset{(1)}{\bar{H1}_2} \cdot \overset{(0)}{\bar{H1}_1} \cdot \bar{H1}_0).(H0_3 \cdot \overset{(8)}{\bar{H0}_2} \cdot \bar{H0}_1 \cdot \bar{H0}_0)$$
$$+ (\bar{H1}_3 \cdot \overset{(0)}{\bar{H1}_2} \cdot \bar{H1}_1 \cdot \bar{H1}_0).(H0_3 \cdot \overset{(9)}{\bar{H0}_2} \cdot \bar{H0}_1 \cdot H0_0)$$

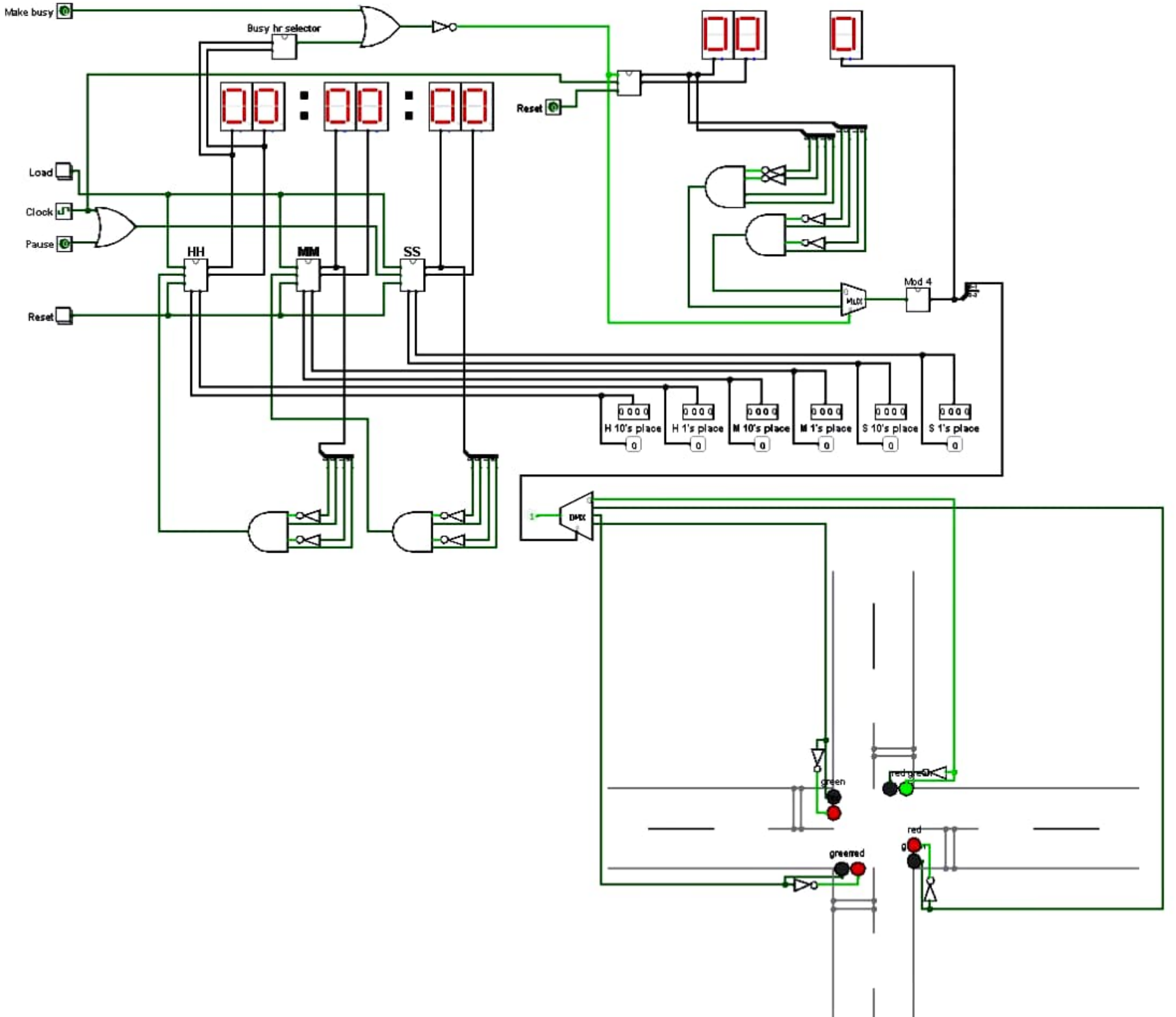
the mod4 counter is controling the 4 way signal switching system.

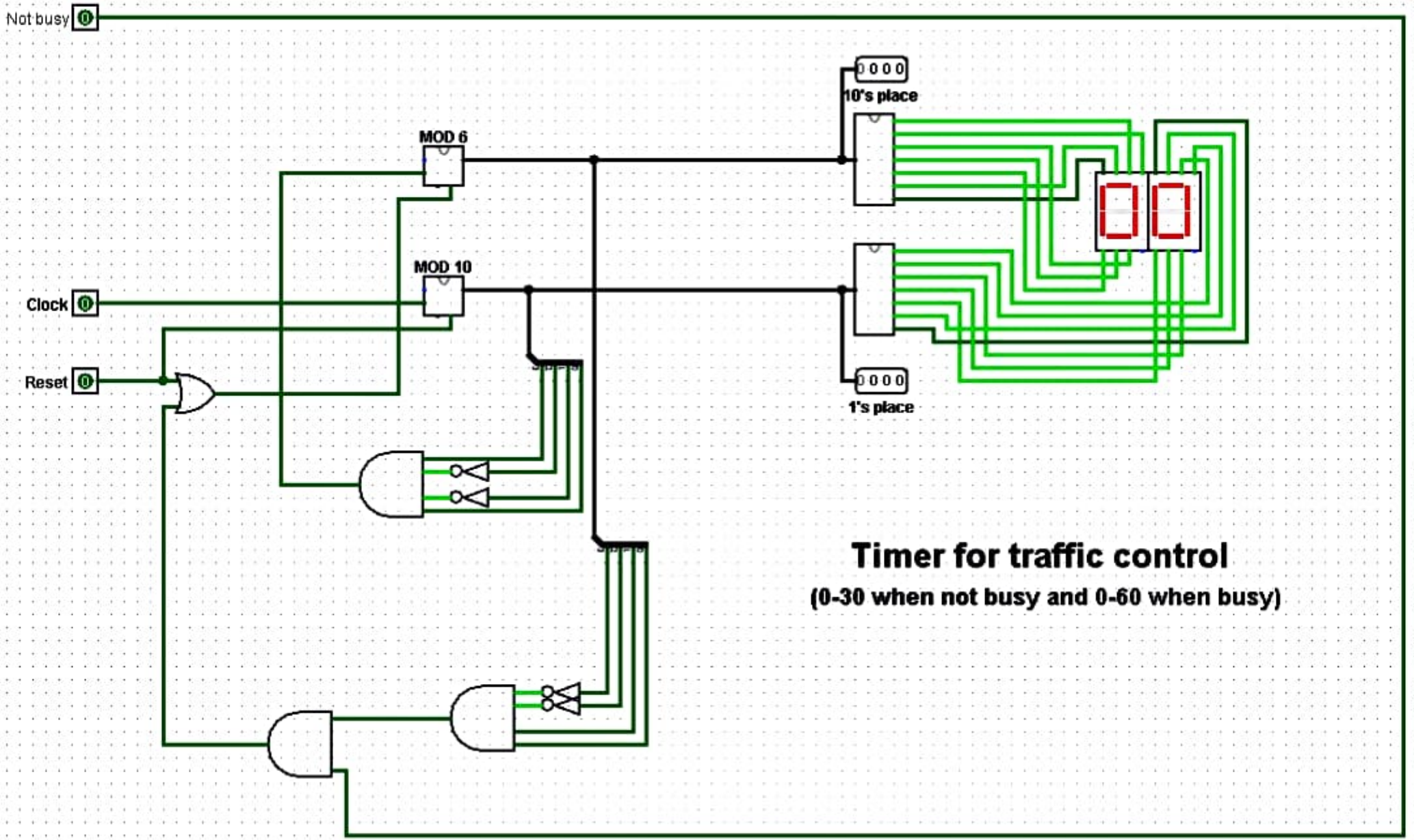
the 60/30 second timer is controling the mod4 counter

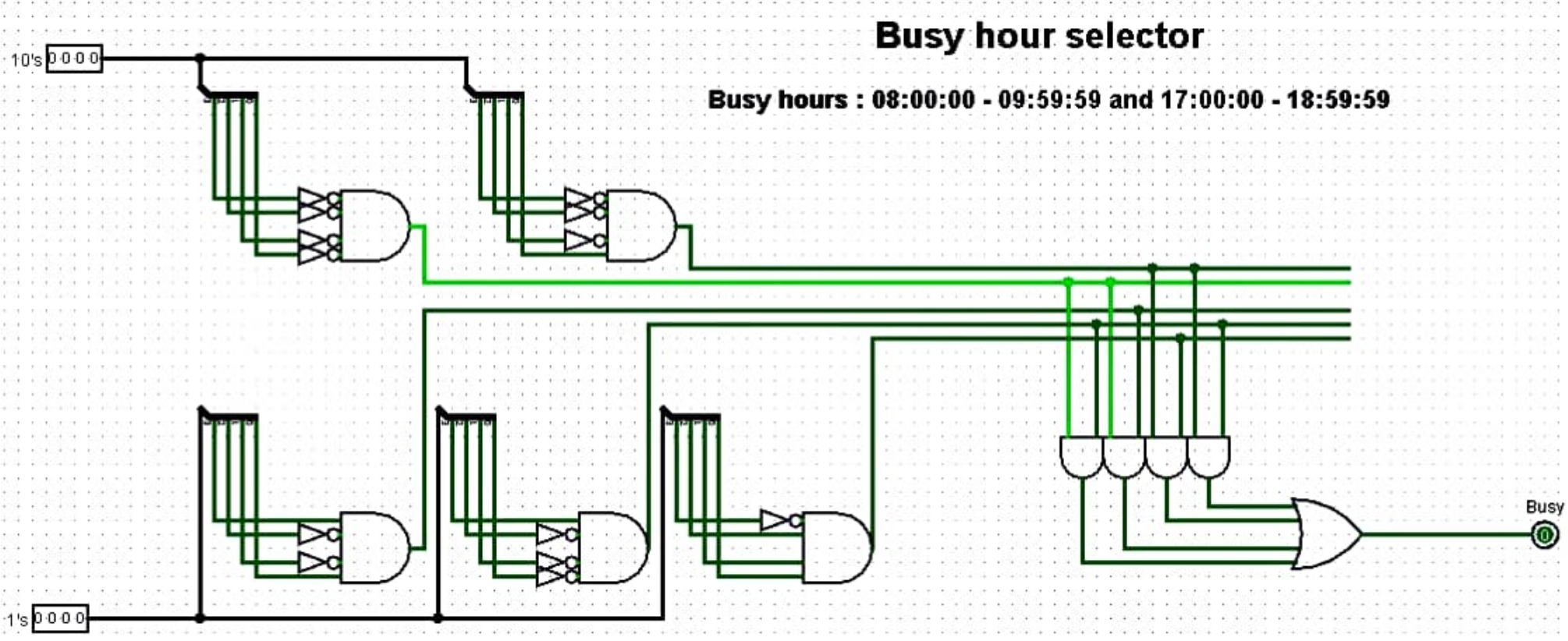
the busy hour selector circuit is controlling the timer circuit.

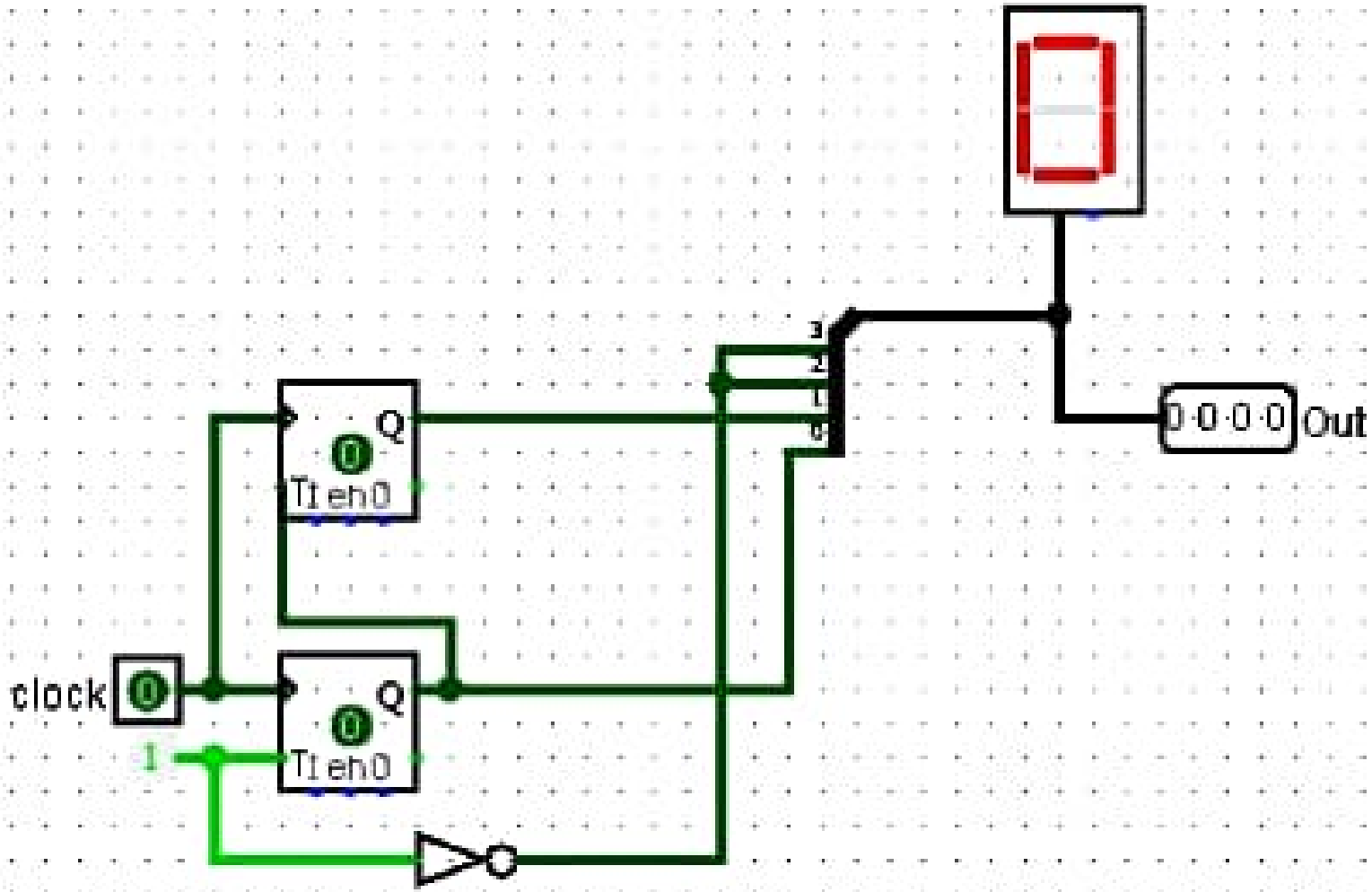
the hour outputs of the clock control the busy hour selector

- this is the basic design of the 4-way traffic signal system.


Make busy
Busy hr selector
Reset
Load
Clock
Pause
HH
MM
SS
Reset
Mod 4
H 10's place
H 1's place
M 10's place
M 1's place
S 10's place
S 1's place
green
red
greenred


Not busy
0000
10's place
MOD 6
MOD 10
Clock
Reset
0000
1's place
Timer for traffic control
(0-30 when not busy and 0-60 when busy)


Busy hour selector
Busy hours : 08:00:00 - 09:59:59 and 17:00:00 - 18:59:59
10's
0 0 0 0
1's
0 0 0 0
Busy
0



Mod 4 counter