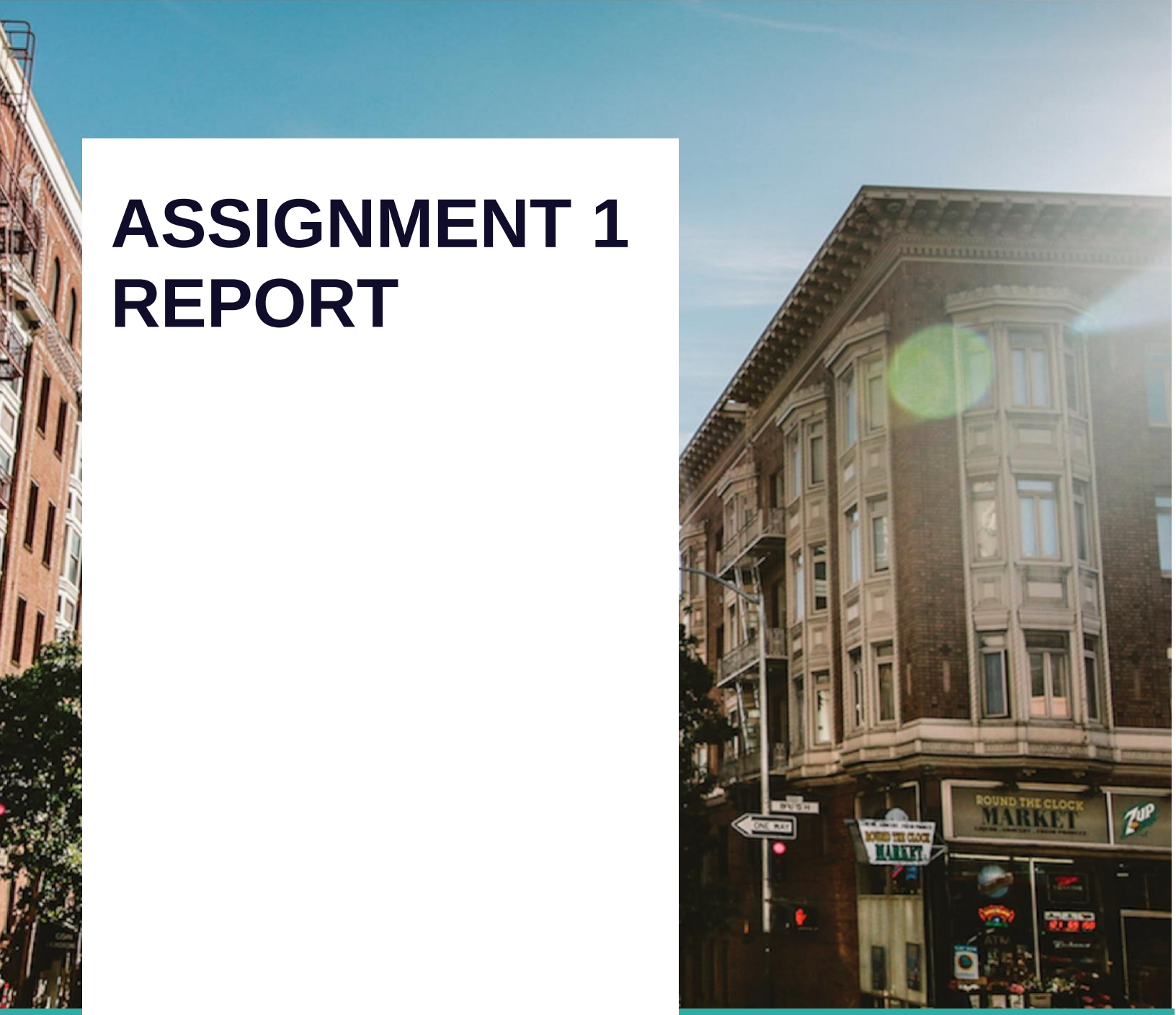
ASSIGNMENT 1 REPORT



SUN 25 JUNE 2023

COS10004 – Computer System
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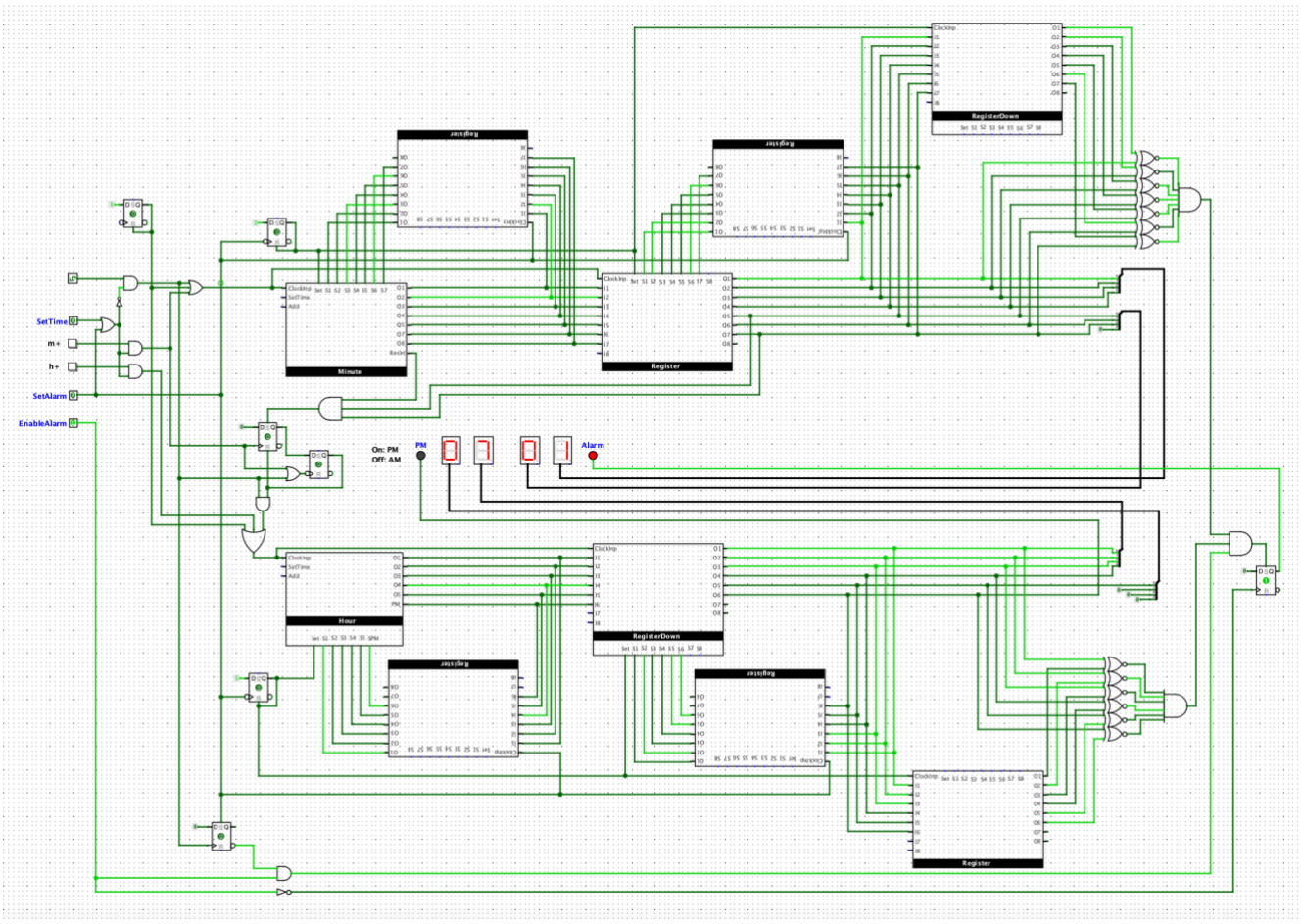
I. Description.

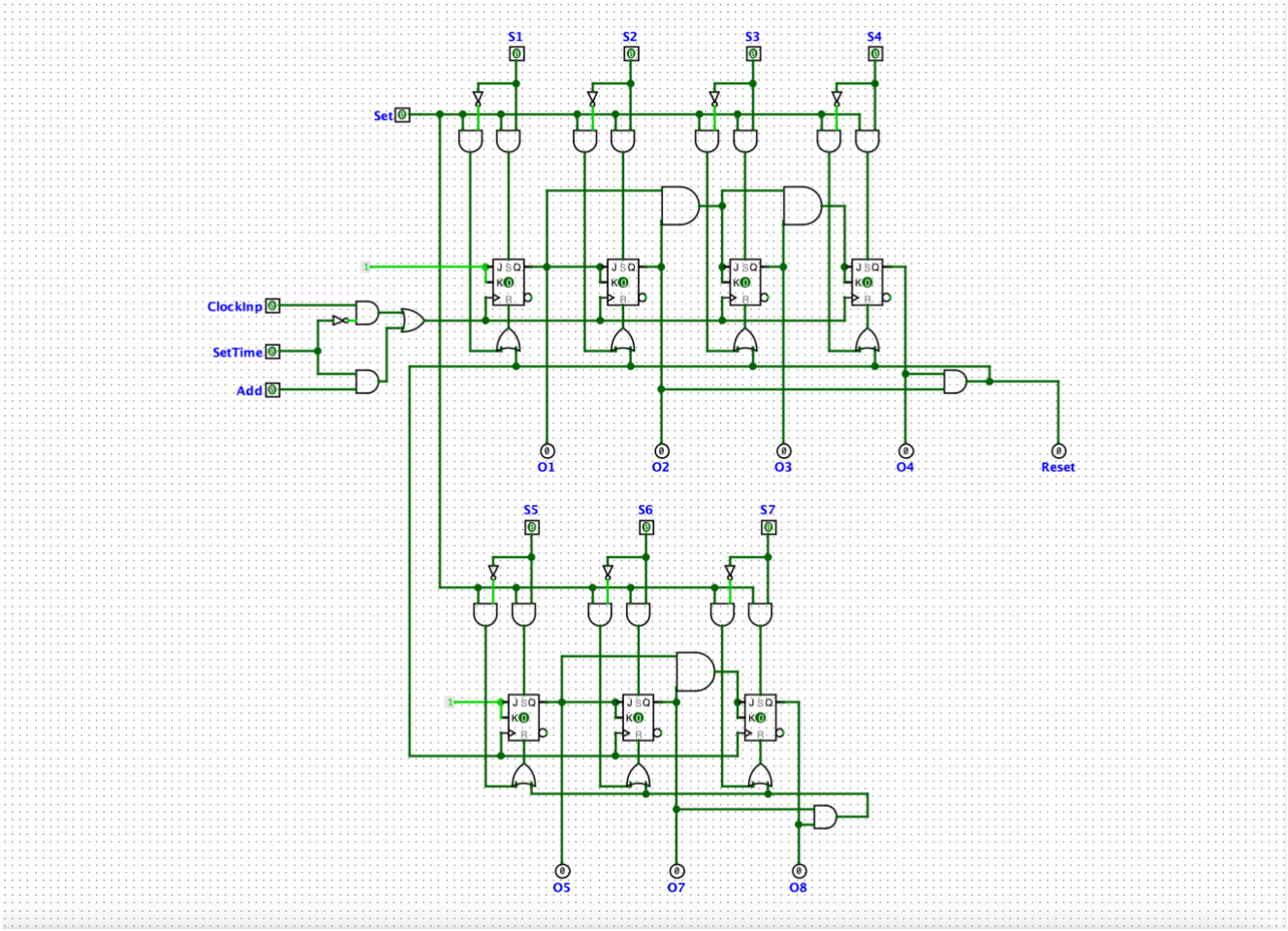
The circuit resembles a 12-hour digital clock with a time-setting function. Additionally, an alarm can be set for a specific time and will activate when the clock reaches that time.

II. Screenshot.

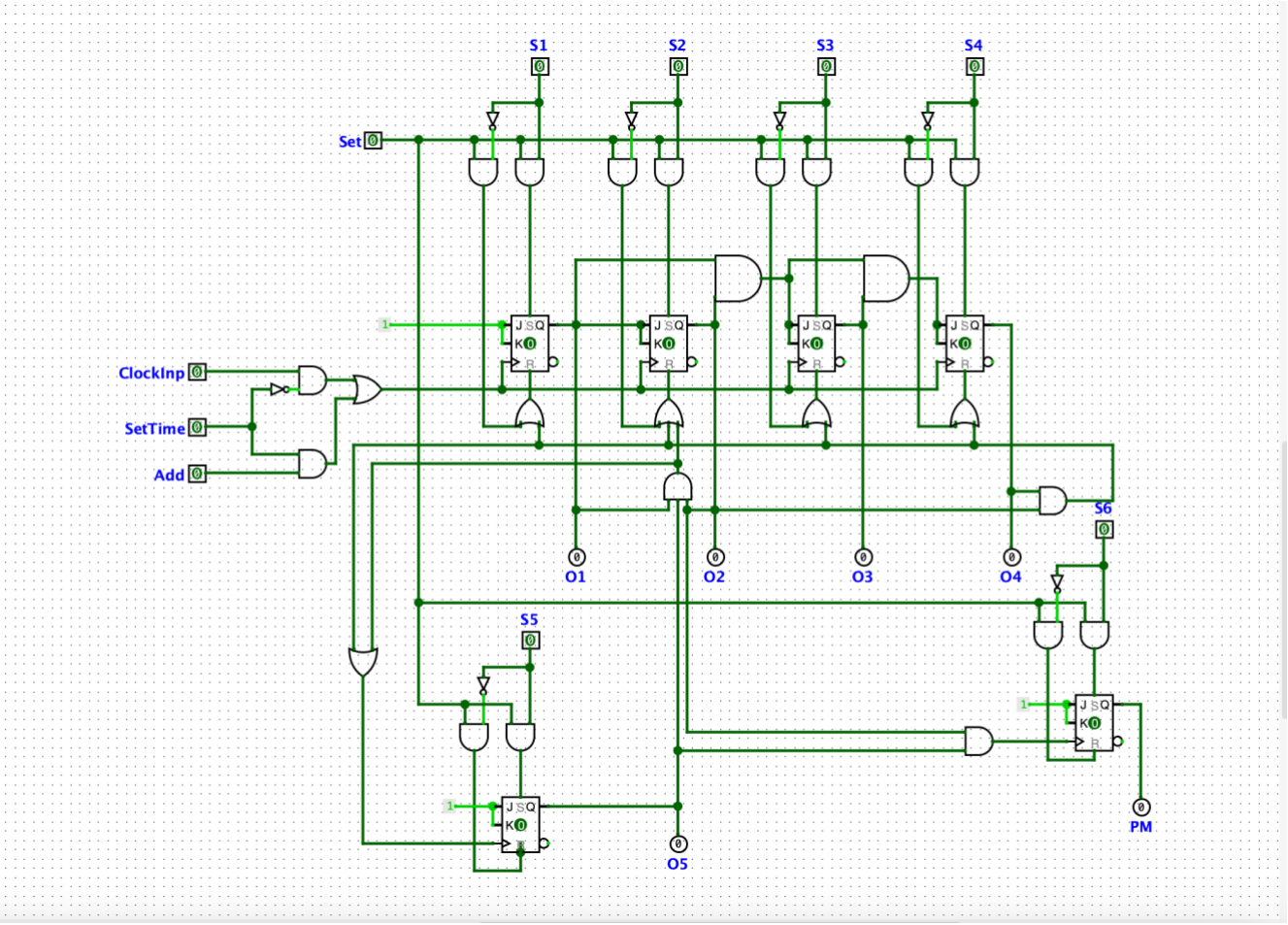
Main circuit:



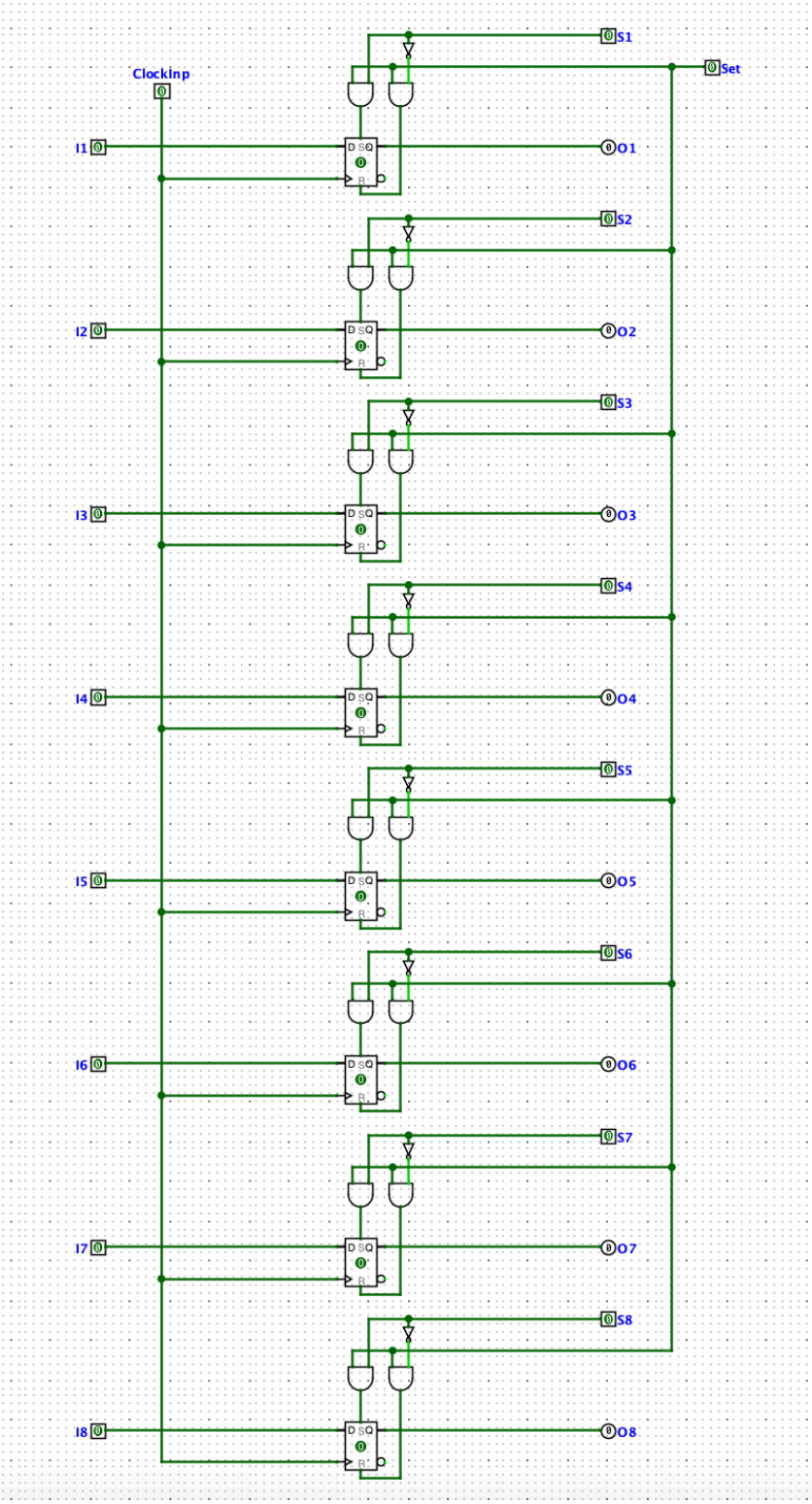
Minute circuit:



Hour circuit:



8-Bit Register circuit:



III. Outline.

The circuit consists of 5 main components:

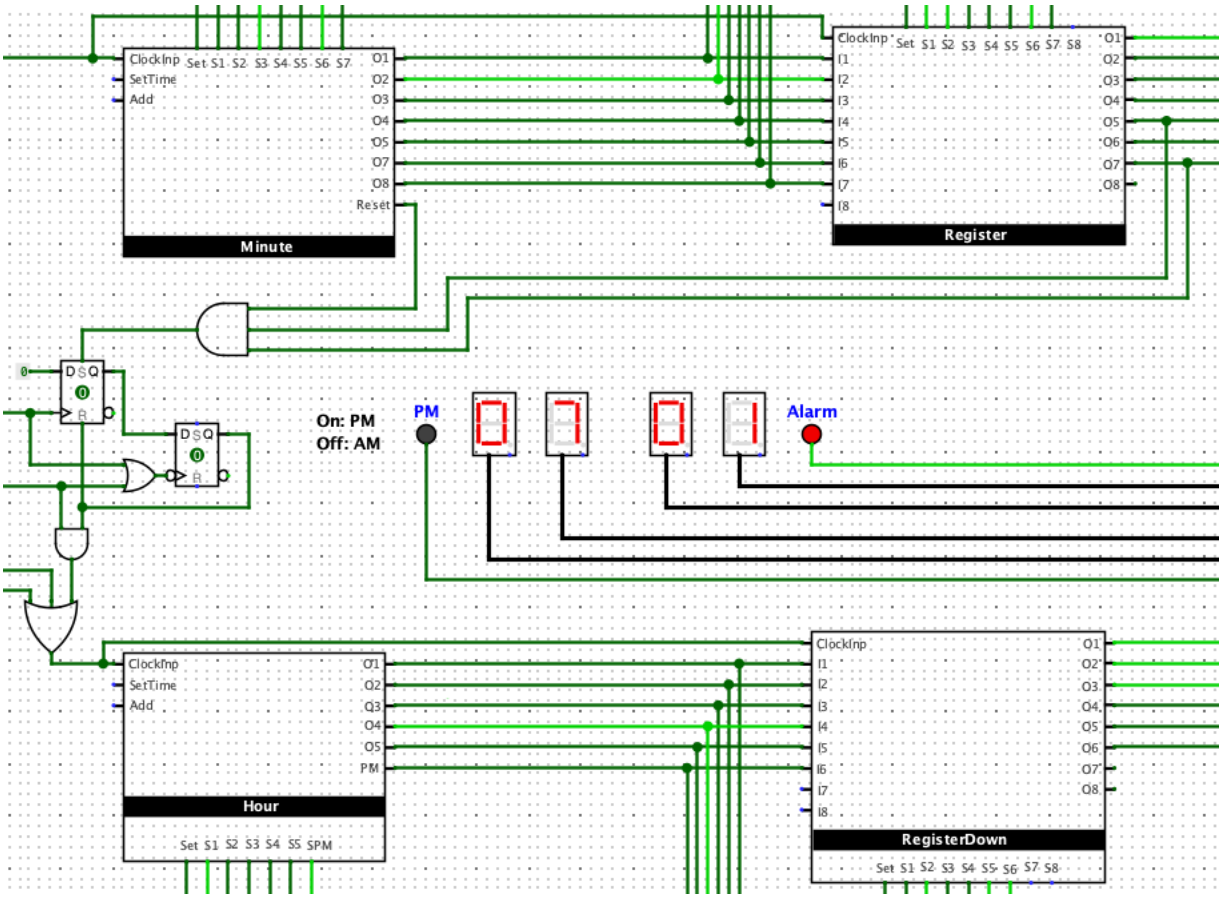
- A minute counter
- An hour counter
- Register for setting and storing alarm
- An input controls
- Output components

The "units" and "tens" columns of the minute counter are constructed with modulo 9 and modulo 5 synchronous counters, respectively. By connecting the modulo 9 counter's reset signal to the modulo 5 counter's clock input, the modulo 5 counter is incremented whenever the modulo 9 counter wraps back to 0.

Likewise, the hour counter consists of two counters. Nevertheless, there are two reset signals: one when the "units" counter returns to 0 from 9 and another when the hour wraps back to 1 from 12. This is achieved by combining the inputs of both counters to generate a reset signal. In addition, since this is a 12-hour clock, the AM/PM circuit is toggled when the hour reaches 12.

A register buffers each of those two counters to prevent illegal states. JK flip-flops' set/reset inputs allow parallel loading of both counters.

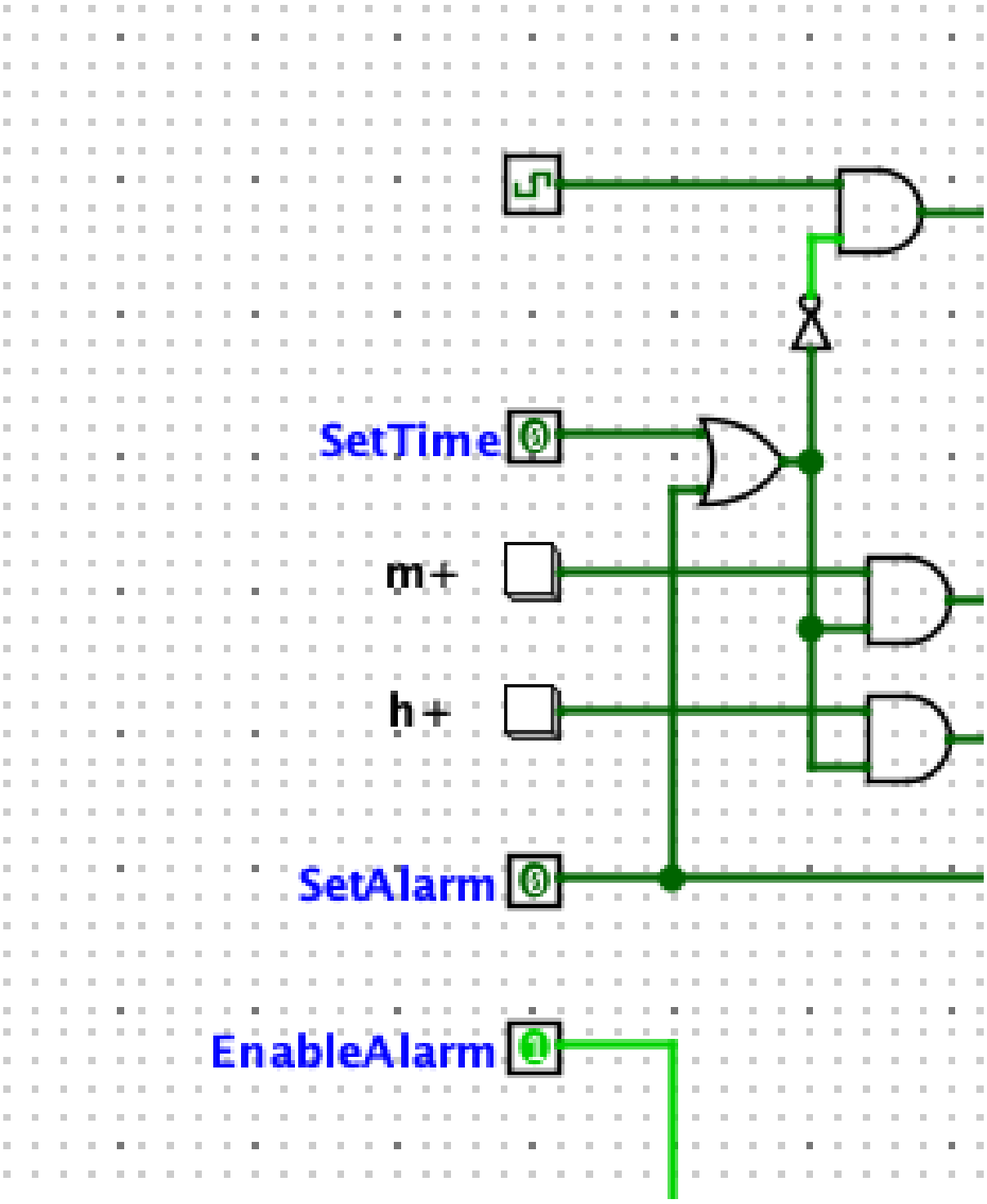
Control gates handle hour increments when the minute counter wraps back to 0. A half-clock buffer receives the minute counter reset signal and triggers the hour counter and its buffer with the next clock pulse.



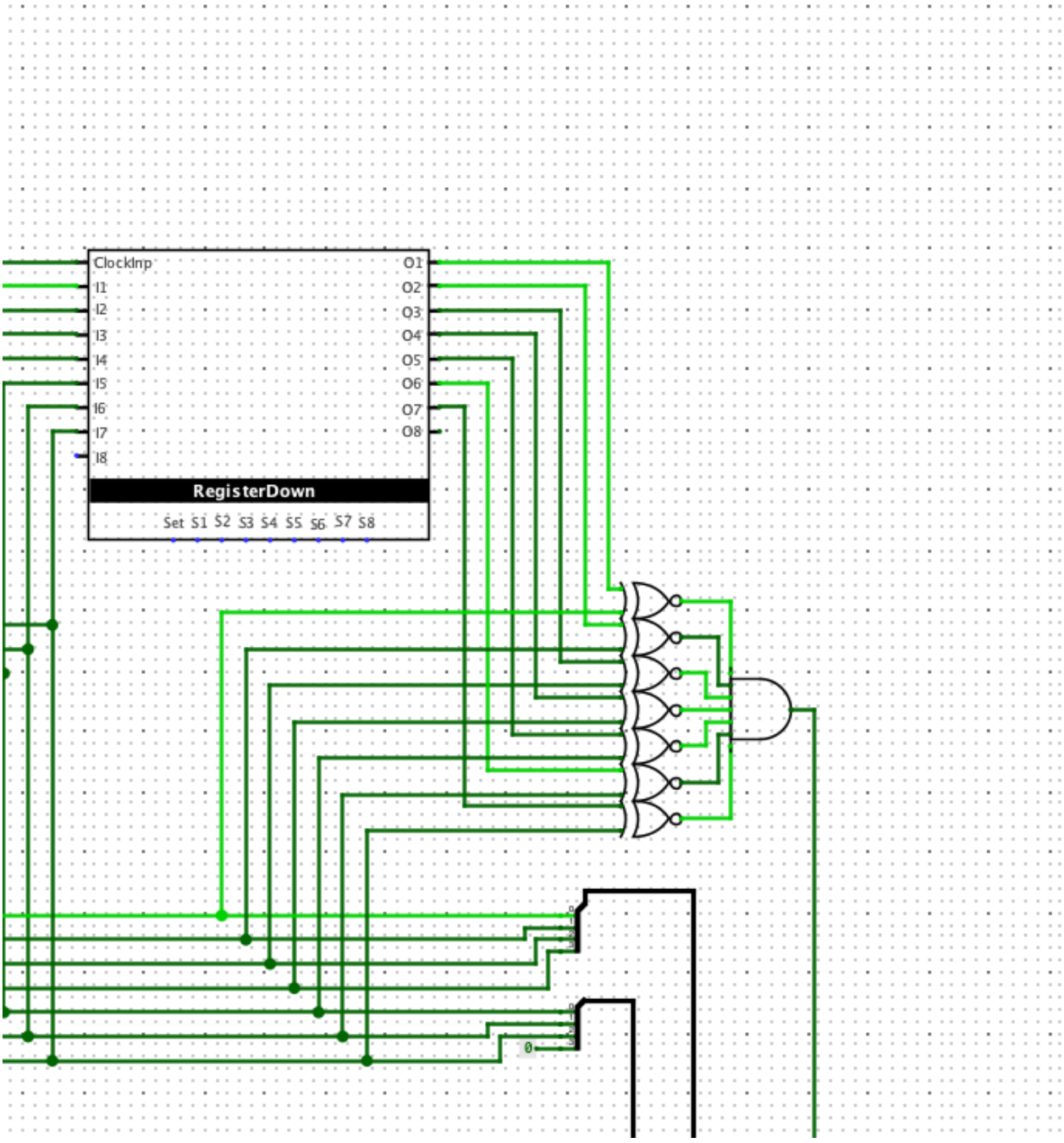
The control circuit includes the following:

- A "Set time" pin: When high, the clock is disconnected and the "m+" and "h+" button outputs enter the circuit. The "m+" and "h+" buttons are blocked when the clock output is low.
- An "m+" button sends a pulse to the minute counter and buffer's clock input, incrementing the minute by 1. The circuit prevents the hour counter from incrementing when incrementing the minute from 59 to 00.
- An "h+" button sends a pulse to the hour counter and buffer's clock input, incrementing the hour by 1.
- A "Set alarm" pin: When high, the two counters and their buffers dump their states into registers. After leaving alarm mode, the "Enable alarm" output is blocked until the next clock pulse. This pin allows output from the "m+" and "h+" buttons to change the time and dump into registers to save the alarm time. When this pin is low, a falling edge pulse triggers the loading of clock states from registers into counters parallelly.

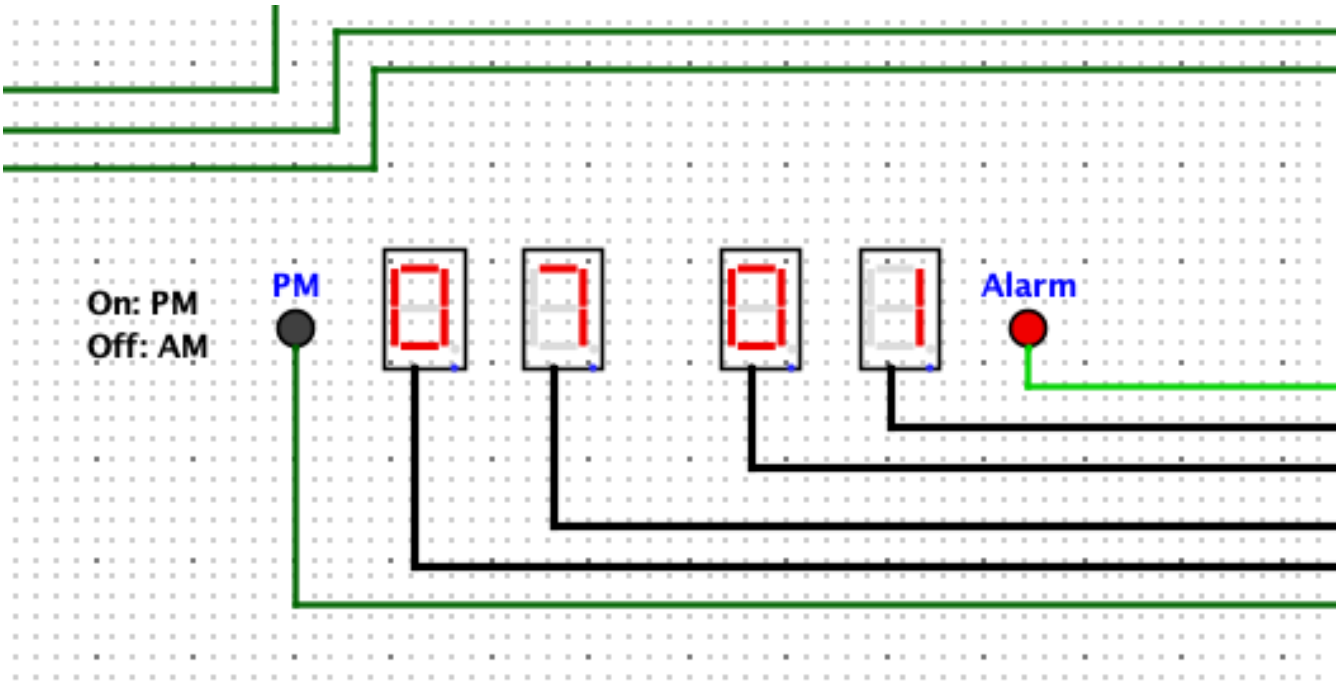
- An "Enable alarm" pin: When high, the alarm LED turns on at the alarm time. When set to low, the alarm LED will turn off and not turn on at alarm time.



The alarm time is determined by XNOR gates. If inputs match, XNOR gate value is 1. This compares current time to register alarm time.



Two LEDs and a 4-digit hex display comprise the output. The PM LED lights up between 12 and 11:59 pm. Alarms activate the alarm LED. The splitter converts buffer input to hexadecimal, which the hex displays display.



IV. Assumption.

When the time is set to the current time, it is presumed that the alarm function will not activate immediately after exiting the alarm mode that was previously set. Instead, it is activated whenever the clock reaches that time again in the future. If you set your alarm for ten in the morning, it will only go off the following morning at ten in the morning. This function is found on a good number of genuine alarm clocks.

V. Problem.

The circuit fails if the assumption is irrelevant. After exiting alarm mode, the alarm only activates on the next clock pulse. Setting the "Set alarm" pin to low takes a moment to reset the clock. The alarm will be activated when the display time matches the register time.