A Digital Queue System

Team 6

Harsith R

Kaustav Prasad

Khagesh Vaidya

Namita Agrawal

Uppala Mukesh

Varad Mahashabde

Abstract

When students try to do laundry in their hostels, they often do not find free machines. The problem becomes worse when they do not know when to return to find one. We designed digital circuits that notify students when washing machines are, provide them with tickets arranged in a queue and authenticate their tokens before allowing the washing machine to function.

An **ID generator** assigns a unique value to every student waiting in the queue for washing machine. This is done using a random number generator ranging from 0 to 15. This is a register where the outputs are passed through XOR, OR gates and are fed into the input of this register. The gates effectively perform a linear operation on the data fed into it. The final output from this is the ticket value. This generator is triggered every time a student presses the button to request for a washing machine.

The next part of the circuit is the **queue**. The ticket number is passed onto a multiplexer. The multiplexer determines if the value that needs to be passed into the first register is the ticket value or the value from the last register that is looped to the first one. The registers are connected in such that the number in the previous register will be passed to the next register until it get's to the last register. The display shows the value stored in the last register.

If the user does not reach the washing machine on time, a waiting timer starts counting down. When the counter eventually ends, a kickback signal is triggered. This enables the registers and the value of the first register is transferred to the multiplier. This pushes the first person to the last position. If the user reaches the washing machine before the timer ends, they pass their ID through the verification circuit. If the ID matches with the displayed ticket number, the registers are enabled again. This time, the value from the penultimate register is passed to the last register and the value initially stored in the last register is pushed out of the queue (i.e. it is erased and the penultimate value is stored in its place).

The **timer unit** displays the time that the n^{th} user needs to wait for before being able to use a washing machine. When a user presses the switch, it increments the DISPLAY2 timer by a fixed time, t, which is the time taken for a washing machine to complete the load. When a washing completes its cycle, the unoccupancy activates DISPLAY1 to begin countdown for wait time and DISPLAY3 will continue displaying the ID of the previous user until the ID of the next user in the queue is verified. This window is set by default to be 5

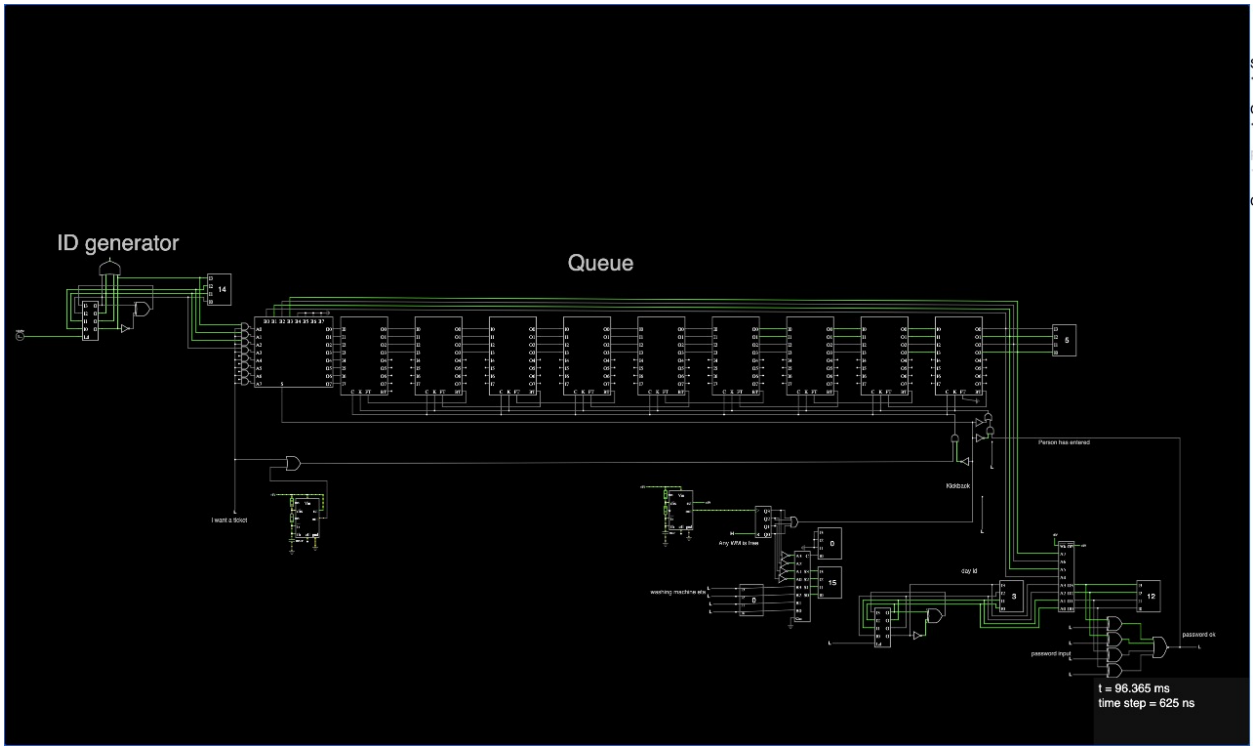
min. When the DISPLAY3 changes to its next value this will decrement the DISPLAY2 by t min.

Finally, the **authenticator circuit** verifies if the value displayed is the same as the ID input by the user. Every bit is passed through an XOR gate, and the output of the XOR gates are passed to a NOR gate.

There are few improvements that enhance the utility of this circuit. The current circuit implements queues, IDs and timers for one washing machine. While this would be perfect for the setup in hostels where there is one washing machine on each floor, scaling this for n washing machines would enable implementation in laundry rooms. We should also be able to display which washing machines are empty and assign users to those in a systematic manner.

Despite these few limitations, we have successfully demonstrated how queues can be implemented in digital circuits. This circuit is versatile and can be used is several contexts like assigning tables in a restaurant, calling patients for their appoitments, ticket counters, etc.

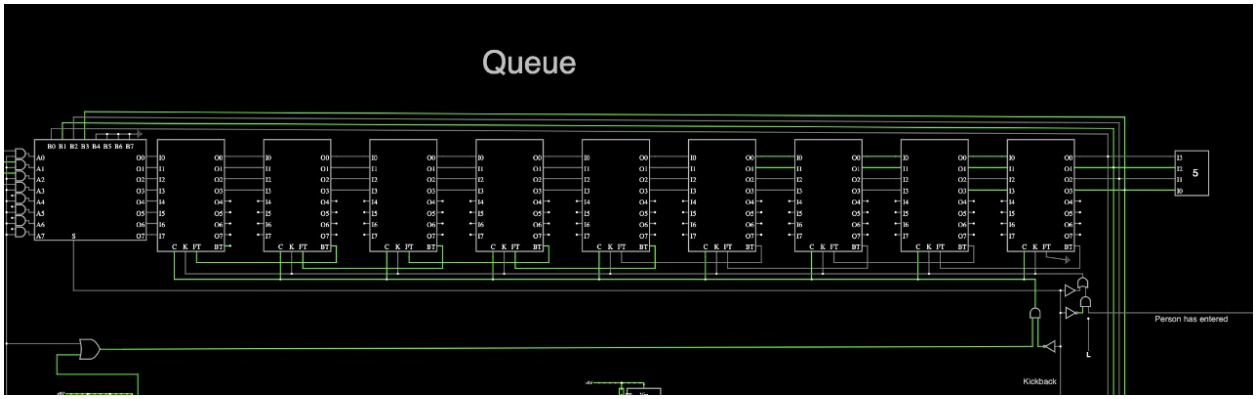
Circuit Design



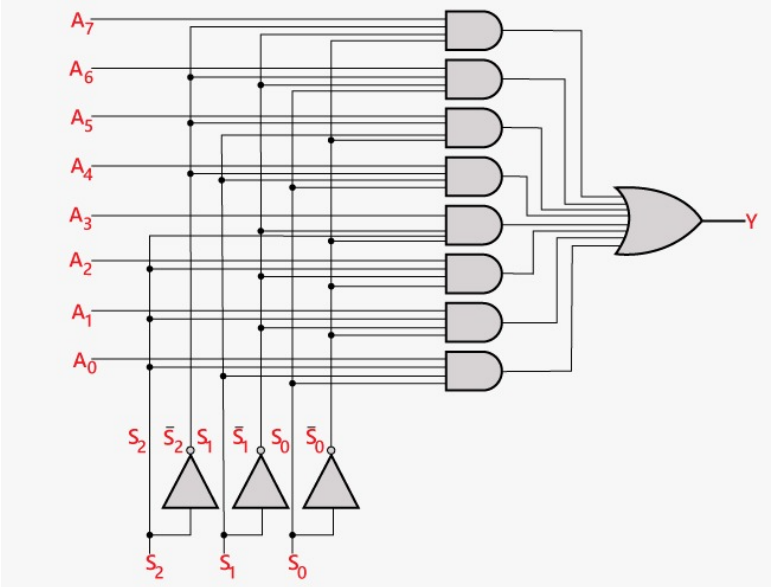
Note: We have isolated the four independent circuits that constitute our main circuit. All the circuits have been designed on falstad or cburch.com/logisim

This is the circuit link- https://tinyurl.com/y9sf9sun

Queue

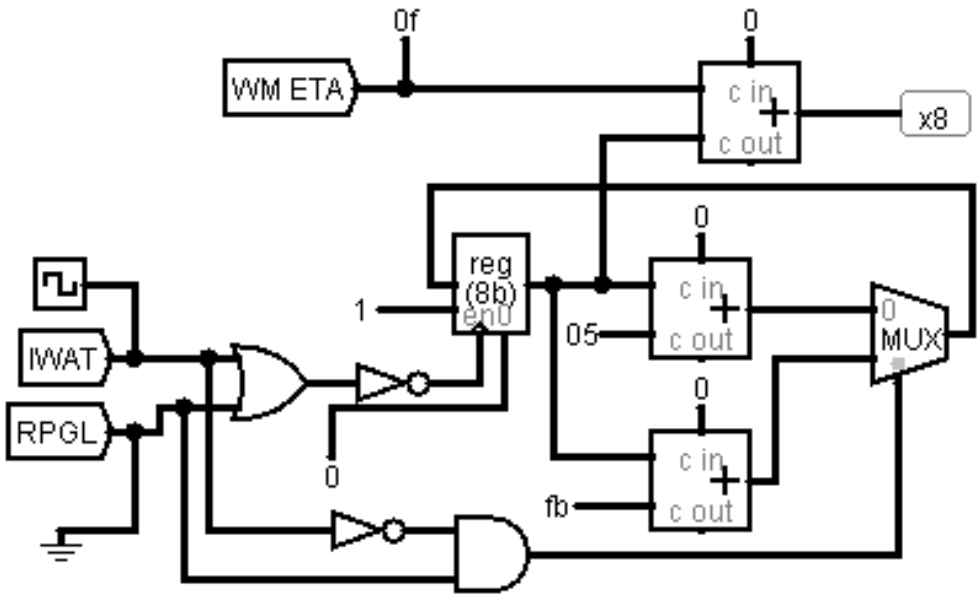


Internal circuit of the multiplexer

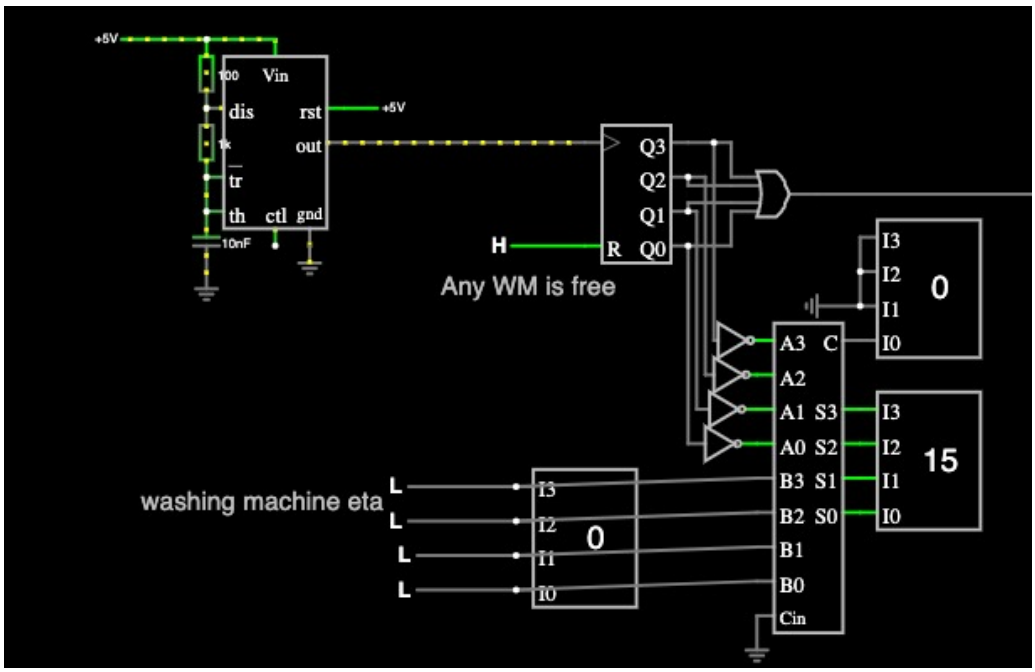


Timer

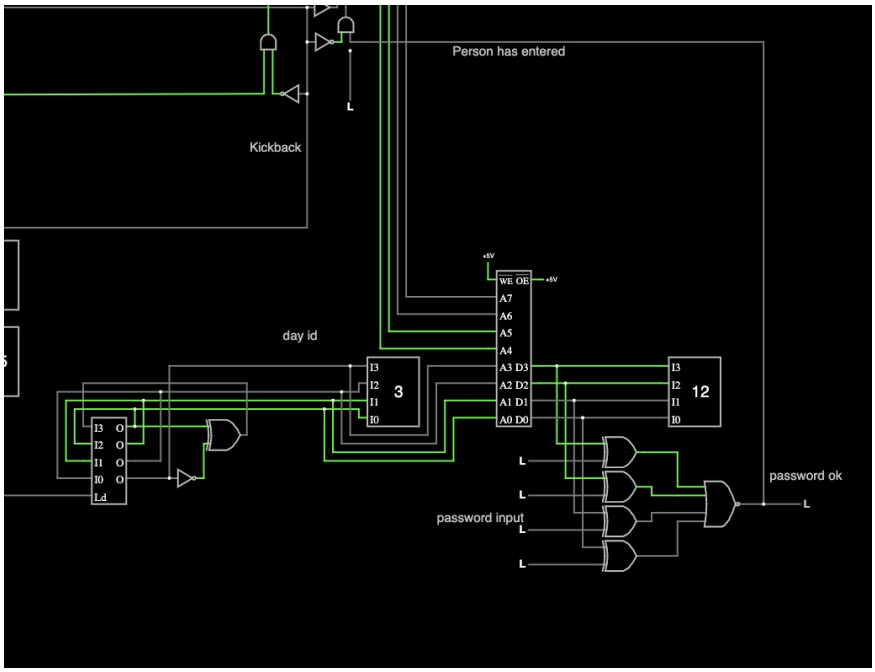
Circuit that adds and subtracts washing time *t*



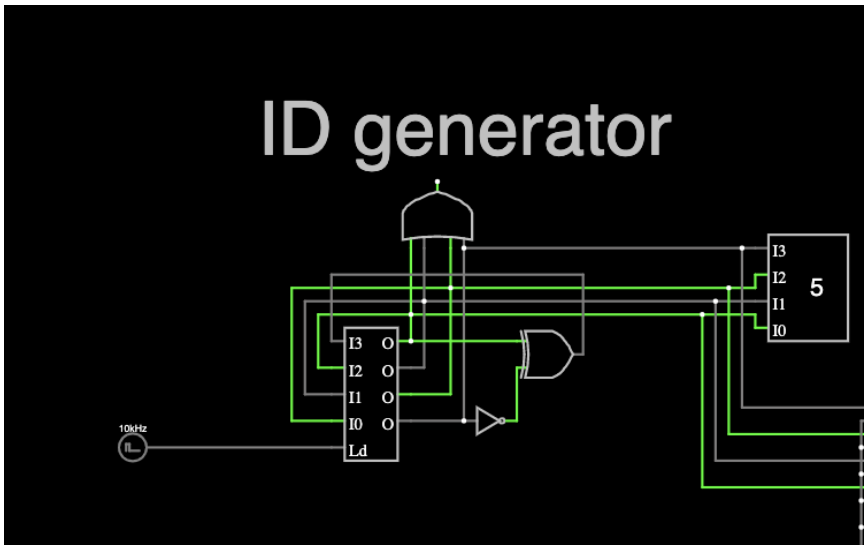
Countdown timer connected to the display



Authenticator



ID Generator



References

1. Albert Paul Malvino, Ph.D., Jerald A Brown, “Digital Computer Electronics”, Third Edition, ISBN-0-02-800594-5,1999
2. Donald P Leach, Albert Paul Malvino, Goutam Saha, “Digital Principles And Applications”, Seventh Edition, ISBN 0-07-01
3. Ben Eater, https://www.youtube.com/c/BenEater
4. Falstad.com
5. Dr. Carl Burch, http://cburch.com/logisim .