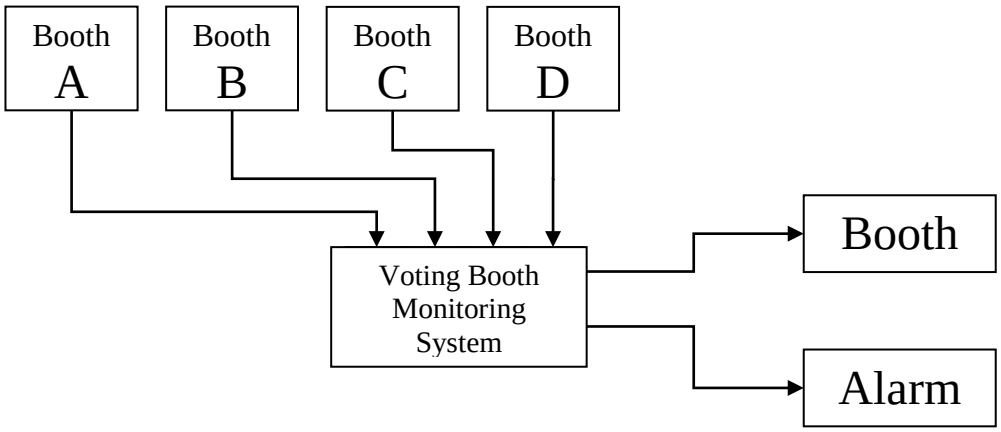
# Universal Gates: NAND Only Logic Design

## Introduction

The block diagram shown below represents a voting booth monitoring system. For privacy reasons, a voting booth can only be used if the booth on either side is unoccupied. The monitoring system has four inputs and two outputs. Whenever a voting booth is occupied, the corresponding input (***A, B, C, & D***) is a (1). The first output, ***Booth***, is a (1) whenever a voting booth is available (safety rule is not violated). The second output, ***Alarm***, is a (1) whenever the privacy rule is violated.




In this activity you will implement NAND only combinational logic circuits for the two outputs ***Booth*** and ***Alarm***. These NAND only designs will be compared with the original AOI implementations in terms of efficiency and gate/IC utilization.

## Procedure

Construct truth table for Booth and Alarm.

1. In the space provided, draw the AOI circuits that implement the logic expressions (not simplified) for ***Alarm and Booth***.

Booth – AOI

Alarm – AOI

2. The simplified equation for Booth = A′ B′ + C ′ D′
3. The simplified equation for alarm = A B + B C + C D

4. Re-implement the simplified circuits with NAND gate only. Draw the circuit in the space provided.

Alarm – NAND

Booth - NAND

5. Build and test the two logic circuits that you designed. Verify that the circuits are working as expected. Even though the two circuits work independently, they are part of one design and should be tested, and prototyped together.

## Conclusion

1. For your AOI implementations, how many ICs (i.e., 74LS04, 74LS08, and 74LS32 chips) were required to implement your circuits? Note: You're not just counting the number of gates used, but rather, the number of IC, in whole or part, that were required.

2. For your NAND implementations, how many ICs (i.e., 74LS00 chips) were required to implement your circuits? Again, we are counting ICs, not gates.

3. In terms of hardware efficiency, how does the NAND implementation compare to the AOI implementation?

Lab performed on (date): _____ Signature: _____

Checked by: _____ Date: _____

Marks Awarded: _____