Week three tutorial session activity

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Step 1: Understand and define the problem (analyze)

LOW level alarm signal will be whenever the car ignition is on, and either the driver or the passenger seat is occupied, and their seatbelts are not fastened. This would mean that if the driver is in the car and their seatbelt is not fastened, if the passenger seat and the driver seat is occupied and the passenger seatbelt is not fastened, and the ignition is one, and the ignition is on, then the alarm will ring, which will be a LOW signal.

Step 2: Organize and describe the data

|  |  |  |  |
| --- | --- | --- | --- |
| Symbol | Meaning | Type | Active Logic |
| DRIV | Driver is in the seat | Input | HIGH (1= present) |
| PASS | Passenger is in the seat | Input | HIGH (1= present) |
| IGN | Ignition switch is ON | Input | HIGH (1= on) |
| BELTD | Driver’s seatbelt unfastened | Input | LOW (0= unfastened) |
| BELTP | Passengers’ seatbelt unfastened | Input | LOW (0= unfastened) |
| ALARM | Alarm signal (active LOW = sounds when 0) | Output | LOW = ON |

Step 3: Design the Solution

3.1: Algorithm

Monitor ignition status: IGN must be HIGH

Check if driver is seated and driver’s belt is not fastened:

DRIV = 1 AND BELTD = 0

Check if passenger is seated and passenger’s belt is not fastened:

DRIV = 1 AND PASS = 1 AND BELTP = 0

If either condition above is TRUE and IGN = 1, the alarm activates (LOW).

Otherwise, alarm remains HIGH (OFF).

3.2: Truth Table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | DRIV | PASS | BELTD^ | BELTP^ | IGN | Alarm^ |
|  | 0 | 0 | 0 | 0 | 0 | 1 |
|  | 0 | 0 | 0 | 1 | 0 | 1 |
|  | 0 | 0 | 1 | 0 | 0 | 1 |
|  | 0 | 0 | 1 | 1 | 0 | 1 |
|  | 0 | 1 | 0 | 0 | 0 | 1 |
|  | 0 | 1 | 0 | 1 | 0 | 1 |
|  | 0 | 1 | 1 | 0 | 0 | 1 |
|  | 0 | 1 | 1 | 1 | 0 | 1 |
|  | 1 | 0 | 0 | 0 | 0 | 1 |
|  | 1 | 0 | 0 | 1 | 0 | 1 |
|  | 1 | 0 | 1 | 0 | 0 | 1 |
|  | 1 | 0 | 1 | 1 | 0 | 1 |
|  | 1 | 1 | 0 | 0 | 0 | 1 |
|  | 1 | 1 | 0 | 1 | 0 | 1 |
|  | 1 | 1 | 1 | 0 | 0 | 1 |
|  | 1 | 1 | 1 | 1 | 0 | 1 |
|  | 0 | 0 | 0 | 0 | 1 | 1 |
|  | 0 | 0 | 0 | 1 | 1 | 1 |
|  | 0 | 0 | 1 | 0 | 1 | 1 |
|  | 0 | 0 | 1 | 1 | 1 | 1 |
|  | 0 | 1 | 0 | 0 | 1 | 1 |
|  | 0 | 1 | 0 | 1 | 1 | 1 |
|  | 0 | 1 | 1 | 0 | 1 | 1 |
|  | 0 | 1 | 1 | 1 | 1 | 1 |
|  | 1 | 0 | 0 | 0 | 1 | 0 |
|  | 1 | 0 | 0 | 1 | 1 | 0 |
|  | 1 | 0 | 1 | 0 | 1 | 1 |
|  | 1 | 0 | 1 | 1 | 1 | 1 |
|  | 1 | 1 | 0 | 0 | 1 | 0 |
|  | 1 | 1 | 0 | 1 | 1 | 0 |
|  | 1 | 1 | 1 | 0 | 1 | 0 |
|  | 1 | 1 | 1 | 1 | 1 | 1 |

Look for the ignition to be on and the driver to be in the seat, to make the seat belt sign turn on.

Usually 0 is off, and 1 is on, but it’s the opposite in this scenario

Boolean equation: to simplify is better

ALARM^ = IGN x (DRIV x BELTD^ + PASS x ^)

Flowchart:

A diagram of a system

AI-generated content may be incorrect.

Pseudocode:

IF (DRIV.(PASS)^(BELTD)^.(BELTP)^.IGN) OR

(DRIV.(PASS)^.(BELTD)^.BELTP.IGN) OR

(DRIV.PASS.(BELTD)^.(BELTP)^.IGN) OR

(DRIV.PASS.(BELTD)^.BELTP.IGN) OR

(DRIV.PASS.BELTD.(BELTP)^.IGN)

Step 4: Implement the Solution

4.1: Logic Circuit

A computer screen with a diagram

AI-generated content may be incorrect.

^for not simplified Boolean equation

Step 5: Test and Refine the Solution:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| DRIV | PASS | BELTD^ | BELTP^ | IGN | ALARM^ (EXPECTED) | ALARM^ (ACTUAL) |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 | 1 | 0 | 0 |

Where 0 means that the seatbelt alarm will ring.