

DD Design Assignment

Group Number: 34

Topic: 15

Design an adaptive lighting system for your automobile, whose headlights turn on automatically as the ambient light reduces. Similarly the reverse should happen at day break. Feel free to pick on how many intensity settings you want for the headlight. Assume that the light sensor measures light to dark in 8 levels.

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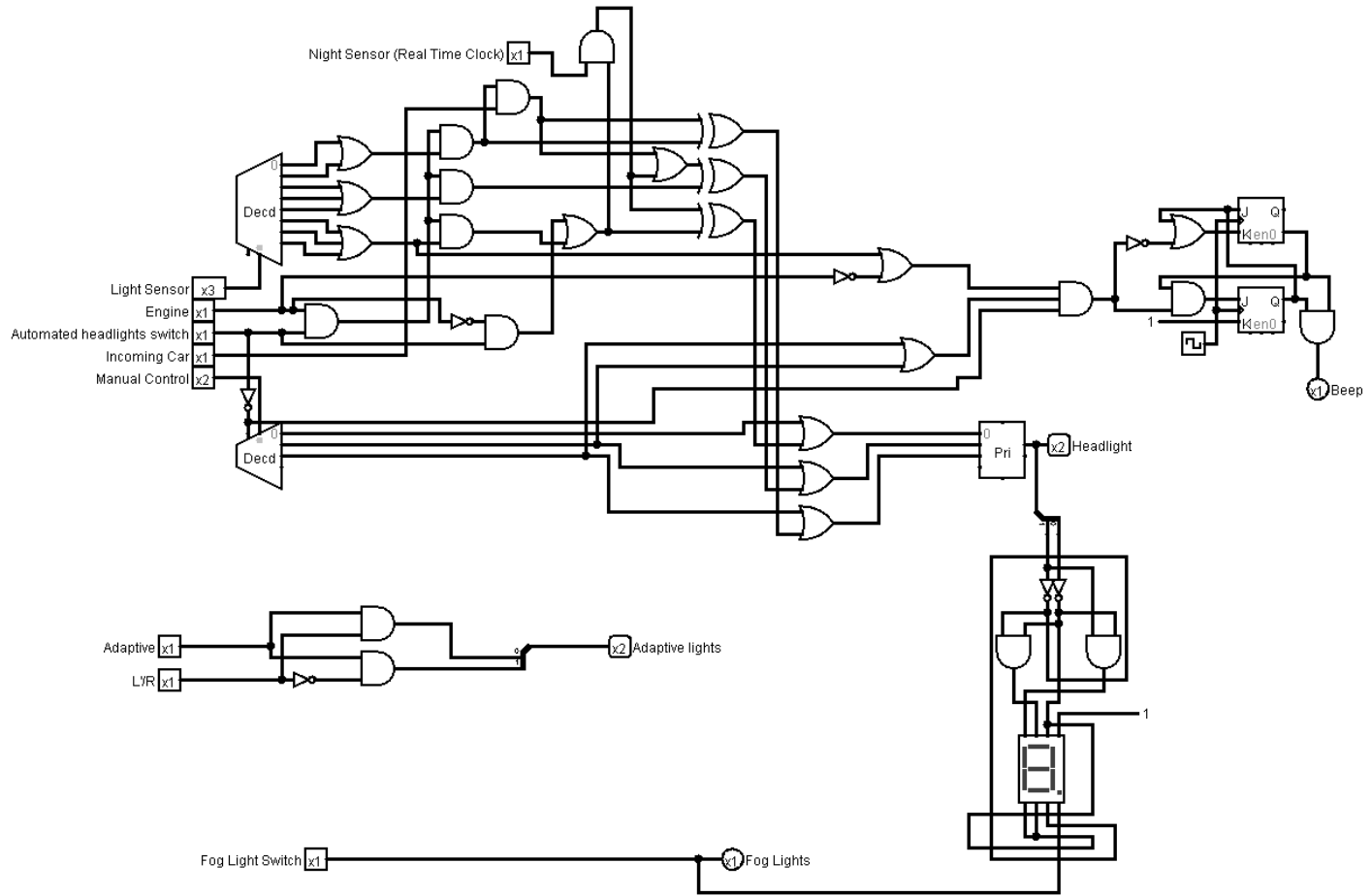
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Top Level Block Diagram:



Inputs:

1. Light Sensor (3-bit input) - Input from the light sensor where 000 represents no light and 111 represents maximum light
2. Engine (single bit):
0 - Engine off
1 - Engine on
3. Automated headlights switch (single bit):
0 - Manually controlling headlights
1 - Automated headlight system switch on
4. Incoming car (single bit - input comes from the camera sensor):
0 - No incoming car within 200m
1 - Incoming car within 200m
5. Manual control (2-bit input):
00 - headlight off
01 - low beam
10 - high beam

6. Night Sensor (single bit):
 - 0 - Day time
 - 1 - Night time
7. Adaptive (single bit):
 - 0 - Adaptive headlights off
 - 1 - Adaptive headlights on
8. L'/R (single bit):
 - 0 - Steering wheel turned anti-clockwise
 - 1 - Steering wheel turned clockwise
9. Fog Light Switch (single bit):
 - 0 - Fog lights off
 - 1 - Fog lights on

Outputs:

1. Headlight (2-bit output):
 - 00 - Headlights off
 - 01 - Low beam
 - 10 - High beam
2. Beep (single bit):
 - 0 - No beep
 - 1 - Beep
3. Adaptive lights (2-bit output):
 - 00 - Straight
 - 01 - Right
 - 10 - Left
4. Fog Light (single bit):
 - 0 - Fog lights off
 - 1 - Fog lights on
- 10.

Design Assumptions:

1. The light sensor has been placed on the windshield of the car.
2. In manual control, there are ONLY 3 settings the user can toggle between (Off, Low and High)
3. Camera Sensor:
 - a. Placement of the camera: The camera is placed centrally on top of the dashboard.
 - b. The camera will sense any car approaching from the opposite direction, within the range of 200 metres, and will give a signal 1. (This is done to avoid accidents due to high brightness of the headlight)
4. Beep: The beep output is connected to a device which beeps when the output goes to 1.
5. Clock:
 - a. The in-built clock of the car shows the correct time.
 - b. During night hours, we get the clock input as 1
6. Adaptive light: When the driver turns the steering wheel beyond a threshold angle, the adaptive lights will switch on.
7. Outputs of the light sensor:

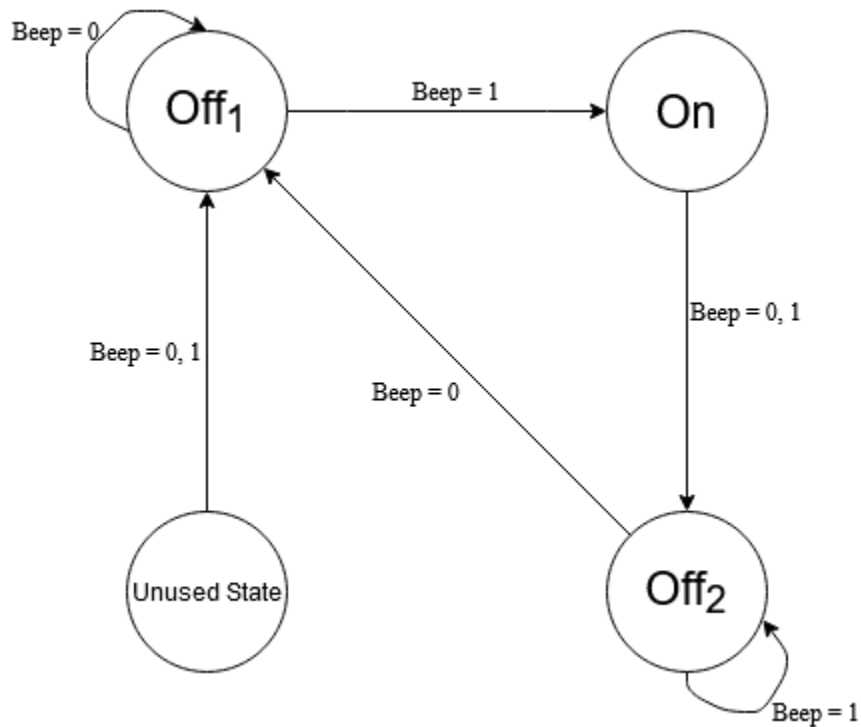
We have taken a 3-bit word as the output:

 - a. 000 to 001 – Represents the typical light conditions where we use high beam.
 - b. 010 to 100 - Represents the typical light conditions where we use low beam.
 - c. 101 to 111 - Represents the typical light conditions where the headlights are not used.

State Diagram:

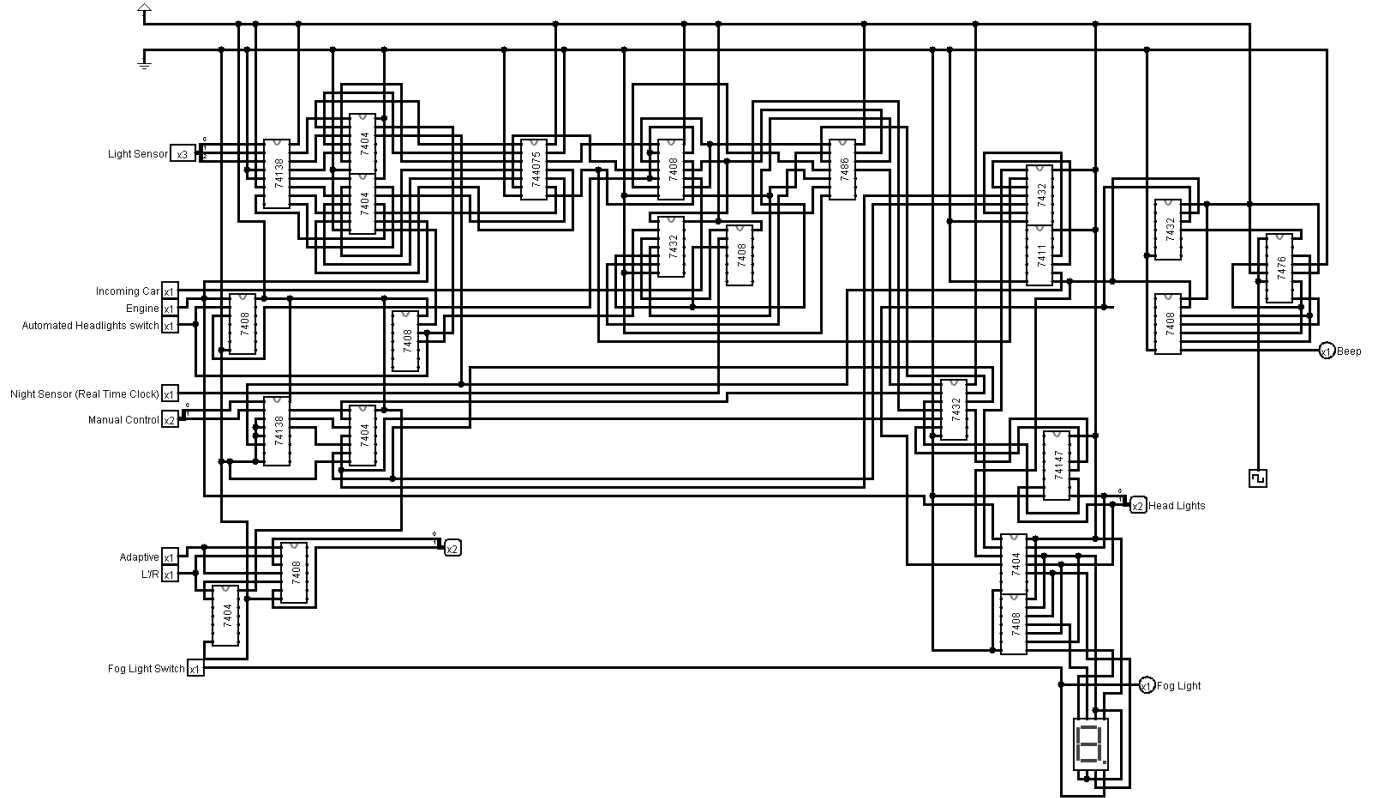
This state diagram is only used for warning the user when they have switched to manual control under these two conditions:

- They have left the headlights on during day time while driving.
- They have switched off the engine and the headlights are still on.



- Inputs:
 - Beep
- States:
 - Off₁ - Coded as 00
 - On - Coded as 01
 - Off₂ - Coded as 10
 - 11 is an unused state
-

Pin-out Diagram:



Sample Input/Output:

1. User toggling between different modes in manual

Light Sensor	Automated headlights switch	Engine	Manual Control	Night Sensor (Real Time Clock)	Headlight
000	0	0	00	0	00
000	0	0	01	0	01
000	0	0	00	0	00
000	0	0	10	0	10

2. Automated headlights:

- Different light conditions when engine is off
- Different light conditions when engine is on
- When high beam is used and there is an incoming car
- During night time(Real Time Clock input is 1), when the light sensor senses light conditions which are normally for no headlights

Light Sensor	Automated headlights switch	Engine	Incoming Car	Night Sensor (Real Time Clock)	Headlight
000	0	0	0	0	00
000	1	0	0	0	00
001	1	0	0	0	00
011	1	0	0	0	00
001	1	0	0	0	00
000	1	0	0	0	00
000	1	1	0	0	10
001	1	1	0	0	10
011	1	1	0	0	01
010	1	1	0	0	01
110	1	1	0	0	00
111	1	1	0	0	00
101	1	1	0	0	00
100	1	1	0	0	01
000	1	1	0	0	10
000	1	1	1	0	01
001	1	1	1	0	01
001	1	1	0	0	10
001	1	1	0	1	10
101	1	1	0	1	01
111	1	1	0	1	01
110	1	1	0	1	01
110	1	1	0	0	00

3. Adaptive lights

- Output 01 indicates that lights move towards the right
- Output 10 indicates that light moves towards the left

<u>Adaptive</u>	<u>L'/R</u>	<u>Adaptive lights</u>
0	0	00
0	1	00
0	0	00
1	0	10
1	1	01
0	1	00

4. Fog Lights:

<u>Fog Light Switch</u>	<u>Fog Lights</u>
0	0
1	1
0	0

5. Beep (Only happens when user is manually controlling headlights)
- When ambient light is bright enough, but user had headlights on
 - When engine is switched off and headlights are left on

<u>Light Sensor</u>	<u>Automated headlights switch</u>	<u>Engine</u>	<u>Manual Control</u>	<u>Headlight</u>	<u>Beep</u>
000	0	0	00	00	0
000	0	1	00	00	0
000	0	1	01	01	0
100	0	1	01	01	0
101	0	1	01	01	0
101	0	1	01	01	1
101	0	1	01	01	0
001	0	1	01	01	0
000	0	1	01	01	0
000	0	0	01	01	0
000	0	0	01	01	1
000	0	0	01	01	0

Functionalities:

MAIN FUNCTIONALITY:

In this circuit we were supposed to design an adaptive lighting system for an arbitrary automobile, whose headlights are turned on automatically as the ambient light is reduced and at daybreak, when sufficient ambient light is present, the headlights turn off.

We decided on implementing a combinational logic circuit that took in 8 inputs from the light intensity sensor and gave out 3 outputs (as seen in standard vehicles on the road), which were off, low and high.

The implementation of this is dependent on the intensity of ambient light falling on the sensor:

- If it is daytime, then the headlights will be off
- If the ambient light reduces then the headlights will be set to low
- If the ambient light is very low then the headlights are set to high beam.

ADDITIONAL FUNCTIONALITIES:

1. There is a manual override option for the driver. If they wish to change the light settings themselves, they can switch off the automated headlight system anytime they choose to with a switch. After toggling the switch, they can choose between the three options (i.e off, low or high beam).
2. A 7-segment LED display is present to indicate to the driver, the current state of the headlights:
 - a. 0 if the lights are off
 - b. 1 if the lights are low
 - c. 2 if the lights are high
 - d. Single LED lights up when fog lights are enabled
3. In addition to this, we made the circuit automatically dim the headlights when an approaching car is detected by the [camera sensor](#) in absence or scarcity of ambient light while the lighting system is on. If the headlights are on the “high” setting, they get switched to “low” so that the driver of the other car is not blinded. This feature allows other drivers to see better while maintaining their own visibility, thus increasing road safety.
4. An indicator has been added to alert the user in case the headlights are left on while the engine is off or the ambient light offers suitable visibility to help in reducing power wastage. In both these cases, the beeper emits a sound to notify the driver to turn off the headlights. This occurs only when the driver has toggled the manual override.
5. The adaptive lighting system makes the lights turn with the help of a motor when the car is making a turn in absence of ambient light, in order to provide visibility in the direction they are turning. It can also help alert cars coming from the opposite direction and on the

other side of the turn who are not making direct visual contact with the user's car. After shifting the steering wheel either left or right past a threshold angle, the adaptive lighting system turns the lights by a fixed angle in the same direction.

6. Fog lights are an additional feature that can be toggled on or off by the driver, in poor weather conditions where there is low visibility.
7. After a certain time in the evening, the headlights of the car are always on (low or high) in automated mode irrespective of the ambient light that falls on the sensor for better visibility of the driver in the evening/ night time. The time is read from the dashboard clock of the car and a signal is sent once it crosses the fixed time.

Bill of Materials:

S.No.	MATERIAL	QUANTITY
1.	7404 IC	5
2.	7408 IC	6
3.	7411 IC	1
4.	7432 IC	4
5.	7476 IC	1
6.	7486 IC	1
7.	74128 IC	2
8.	74147 IC	1
9.	744075 IC	1
10.	7 Segment Single Display (LED)	1
11.	Real-Time Clock	1
12.	Camera Sensor	1
13.	Light Sensor	1

Appendix:

S.No.	IC	DATASHEET
1	7404	https://www.ti.com/lit/ds/symlink/sn74ls04.pdf
2	7408	https://www.ti.com/lit/ds/sdls033/sdls033.pdf?ts=1605904231709&ref_url=https%253A%252F%252Fwww.google.com%252F
3	7411	https://www.ti.com/lit/ds/sdls131/sdls131.pdf?ts=1605937628077&ref_url=https%253A%252F%252Fwww.google.com%252F
4	7432	https://www.ti.com/lit/ds/symlink/sn54ls32-sp.pdf?ts=1605895450063
5	7476	https://www.ti.com/lit/ds/symlink/sn54ls76a.pdf?ts=1605856215270&ref_url=https%253A%252F%252Fwww.google.com%252F
6	7486	https://www.ti.com/lit/ds/sdls124/sdls124.pdf?ts=1605937702166&ref_url=https%253A%252F%252Fwww.google.com%252F
7	74138	https://www.ti.com/lit/ds/sdls014/sdls014.pdf?ts=1605854768375&ref_url=https%253A%252F%252Fwww.google.com%252F
8	74147	https://www.ti.com/lit/ds/symlink/sn74ls148.pdf?ts=1605937801012&ref_url=https%253A%252F%252Fwww.google.com%252F
9	744075	https://assets.nexperia.com/documents/data-sheet/74HC_HCT4075.pdf
10	7 Segment Single Display	https://www.vishay.com/docs/83126/tdsg51.pdf