Dynamic Design

FEBRUARY 9

Automotive Door Control System Design

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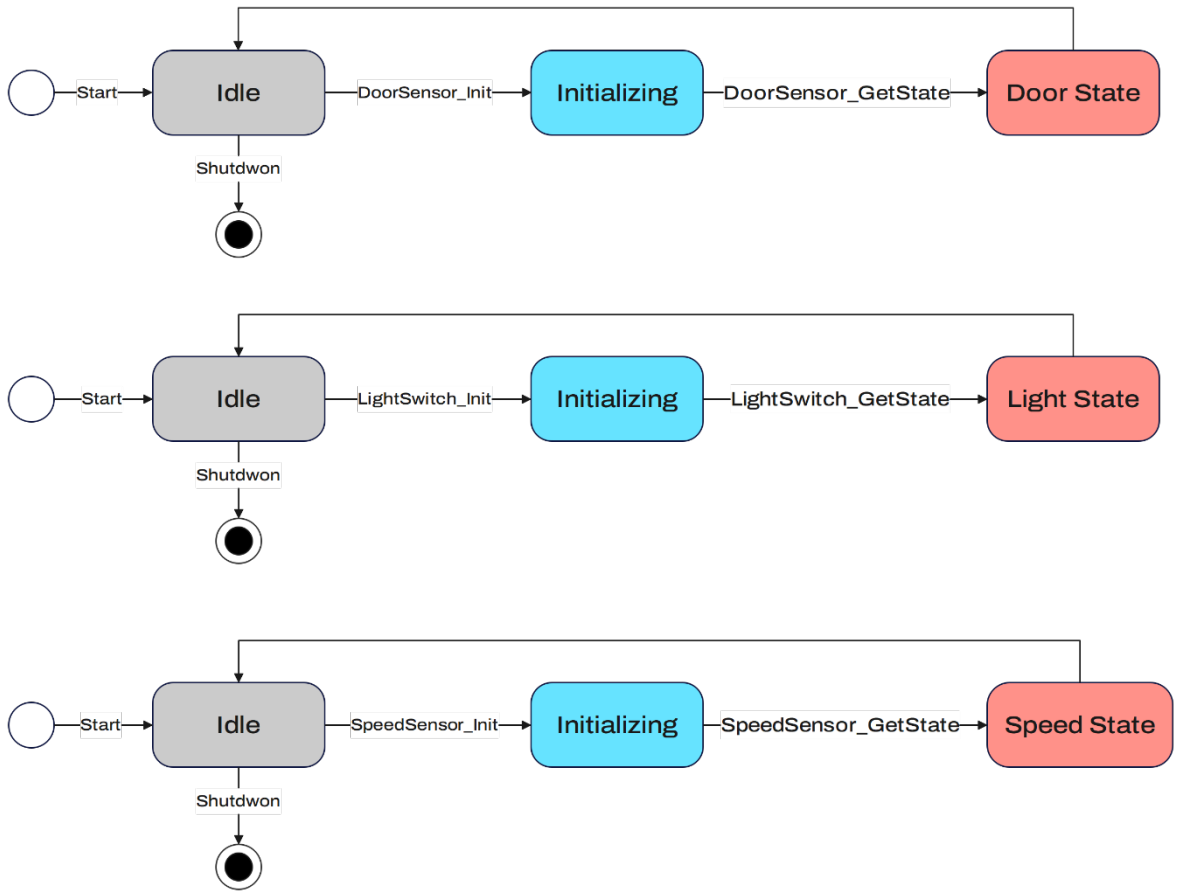
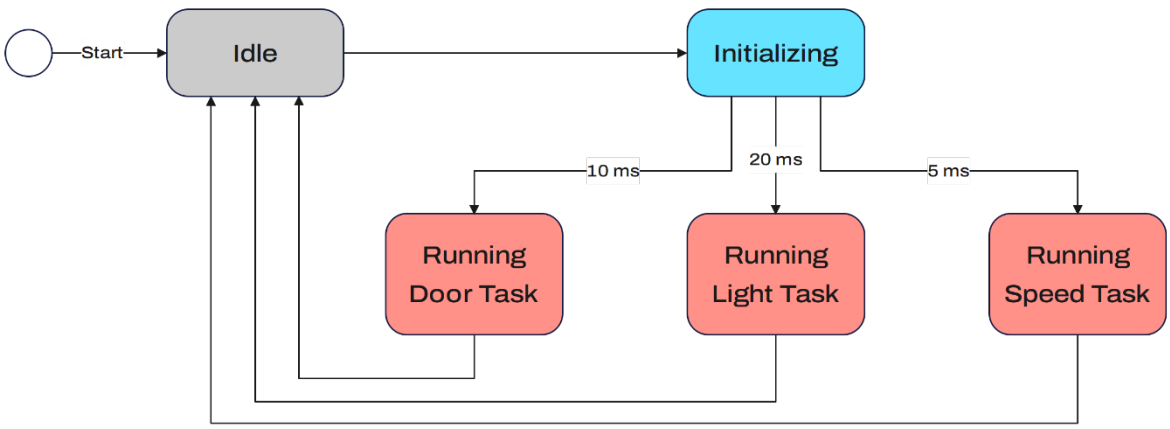
1.ECU1

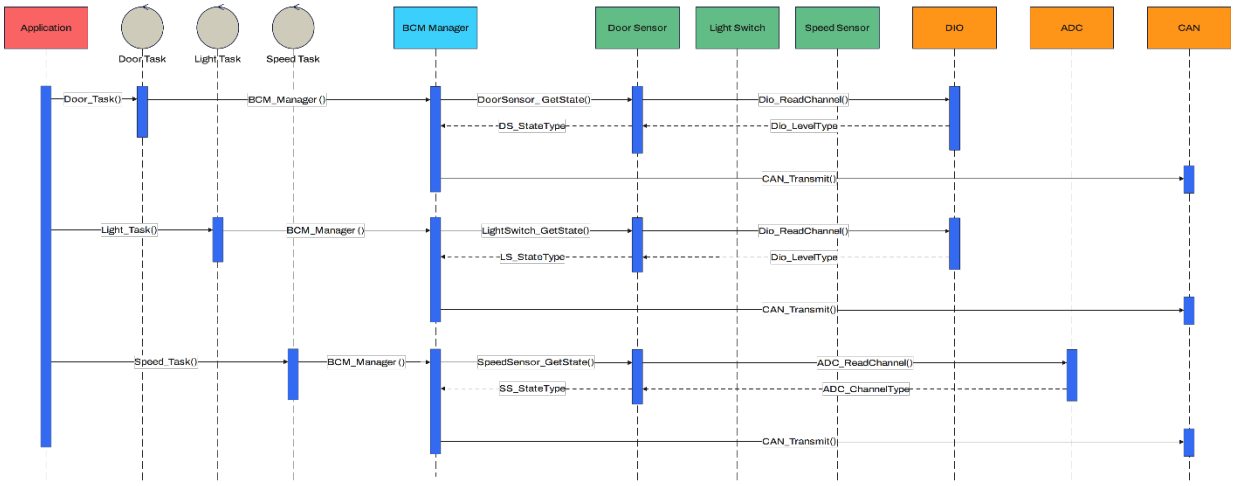
1.1 State Machine for Components



1.2 State Machine for Operation



1.3 Sequence Diagram



1.4 CPU Load

Assume that execution time of each time = 1 ms

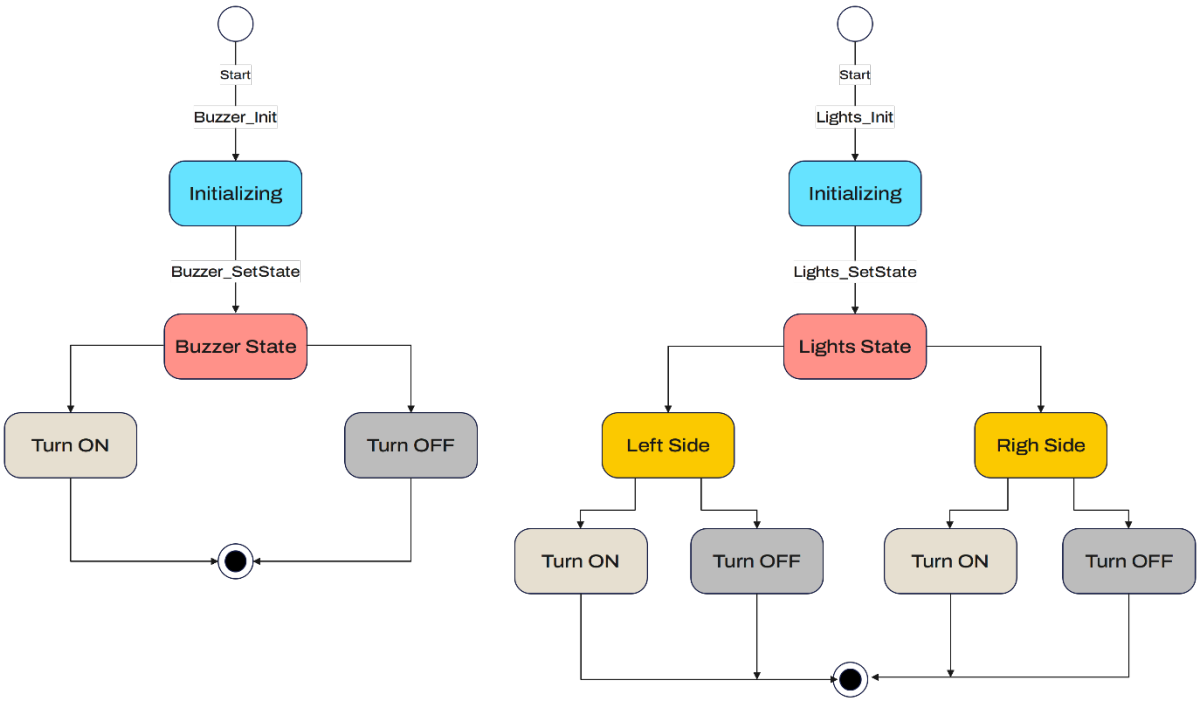
Task Name	Periodicity (ms)	Execution Time (ms)	Occurrence
Door Task	10	1	2
Light Task	20	1	1
Speed Task	5	1	4

Hyper period (H) = LCM = 20 ms

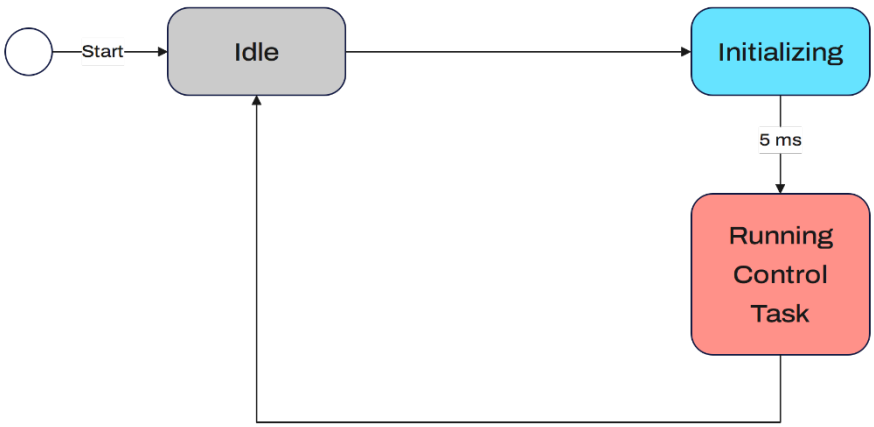
CPU Load = Sum(E) / H = (1 x 2 + 1 x 1 + 1 x 4) / 20 = 0.35

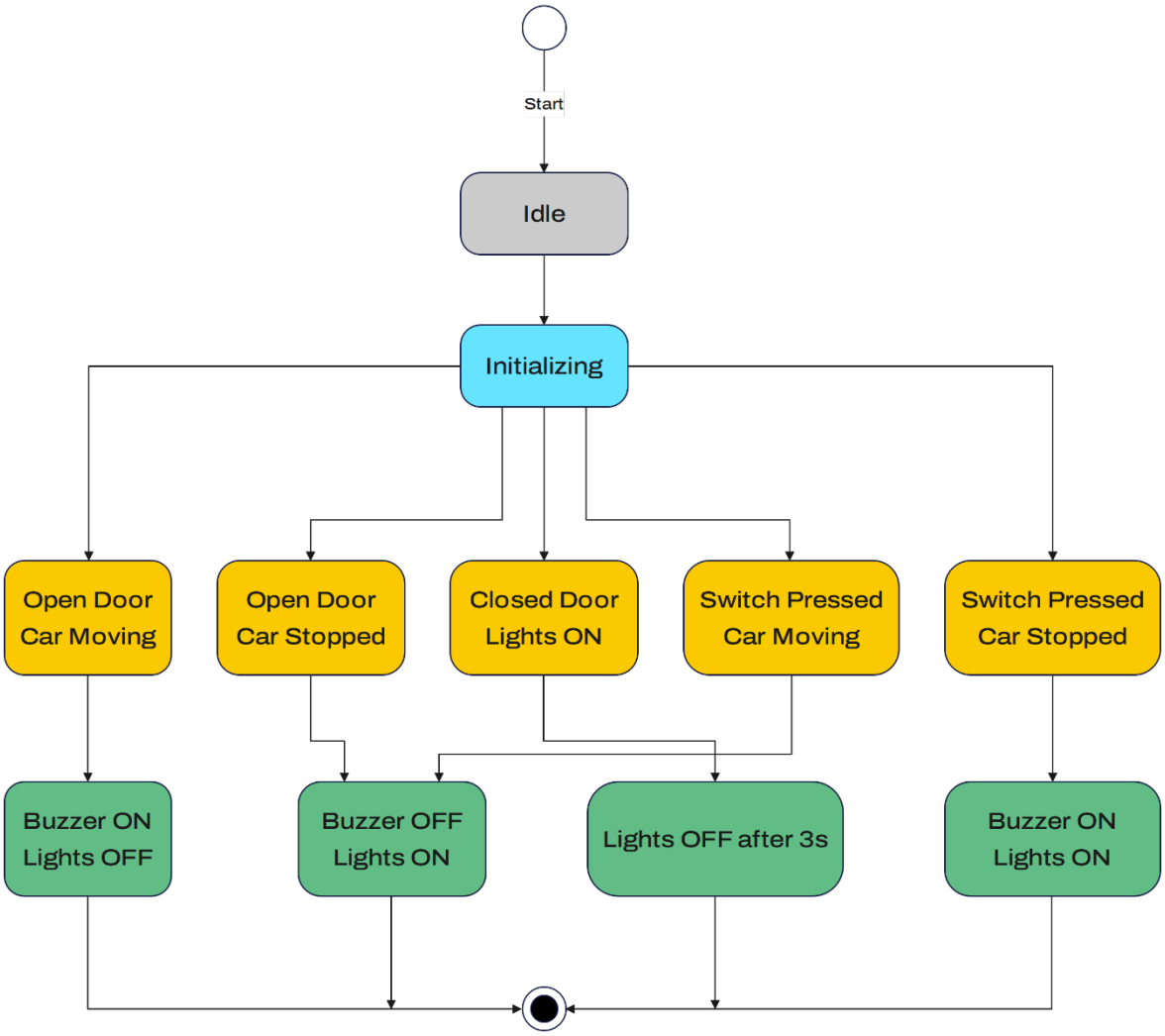
2.ECU2

2.1 State Machine for Components

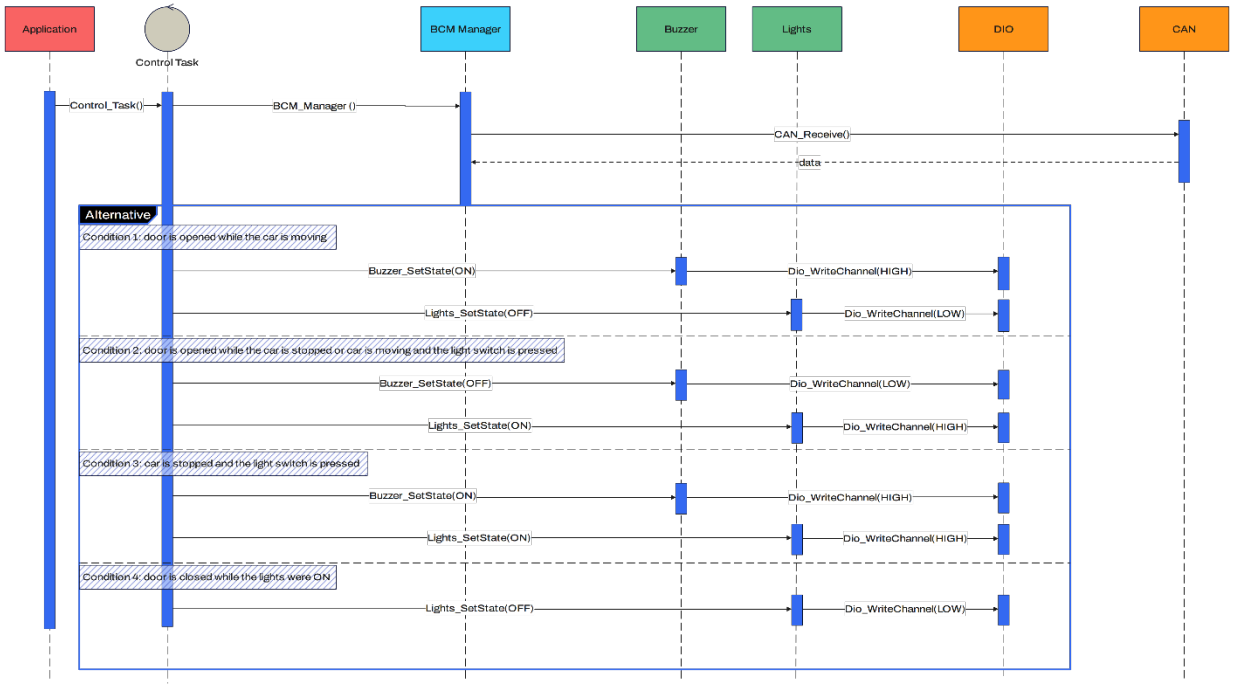


2.2 State Machine for Operation




Start
Idle
Initializing
Open Door
Car Moving
Open Door
Car Stopped
Closed Door
Lights ON
Switch Pressed
Car Moving
Switch Pressed
Car Stopped
Buzzer ON
Lights OFF
Buzzer OFF
Lights ON
Lights OFF after 3s
Buzzer ON
Lights ON

2.3 Sequence Diagram



2.4 CPU Load

Assume that execution time of each time = 1 ms

Task Name	Periodicity (ms)	Execution Time (ms)	Occurrence
Control Task	5	1	1

Hyper period (H) = LCM = 5 ms
CPU Load = Sum(E) / H = (1 x 1) / 5 = 0.2

3. BUS Load

CAN frame has about 125 bits, assuming we're using 500 kbit/s.
Time to transfer 1 bit Time = 1/bitrate = (1/500*1000) = 2 µs
Time to transfer 1 frame = 2 * 125 = 250 µs
1 frame / 20 ms -> 50 frames every 1000 ms, 1 frame / 10 ms -> 100 frames every 1000 ms, 1 frame / 5 ms -> 200 frames every 1000 ms
Total of frames per 1 second = 350 frames
Total time on Bus = total frames * time for frame = 350 * 0.25 = 87.5 ms
Bus Load = (87.5 / 1000) * 100= 8.75%