Automotive door control system design

Dynamic design analysis

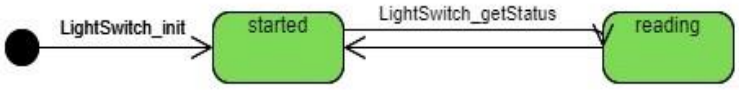
Prepared by

Esmael Ehab Esmael

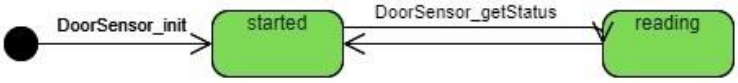
ECU 1:

1- state machine diagram for ECU 1 components

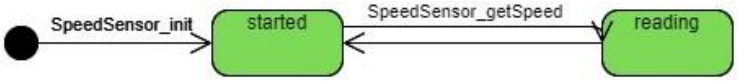
Light switch:



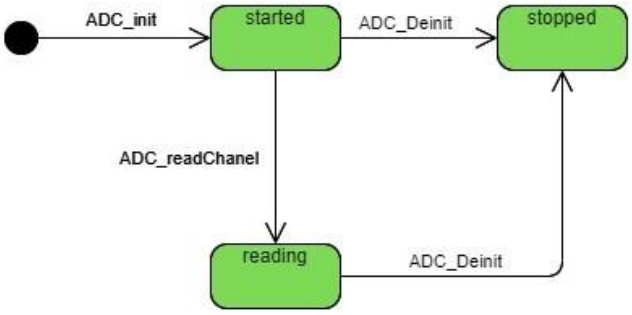
Door Sensor:



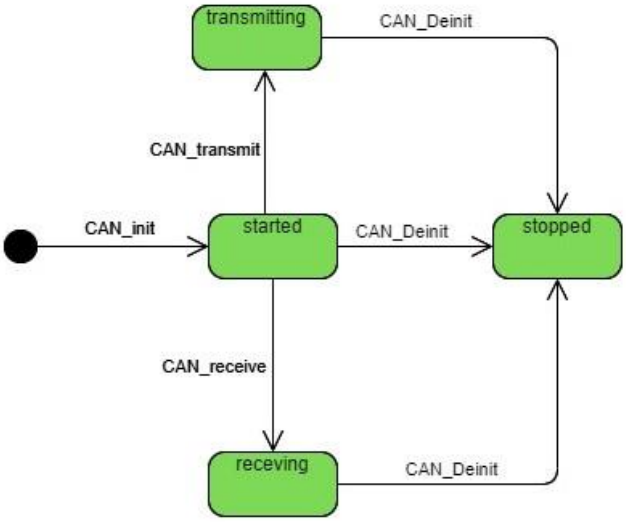
Speed Sensor:



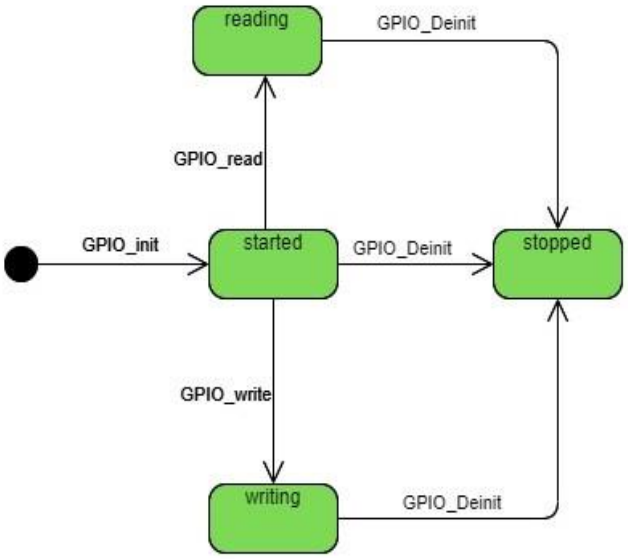
ADC:



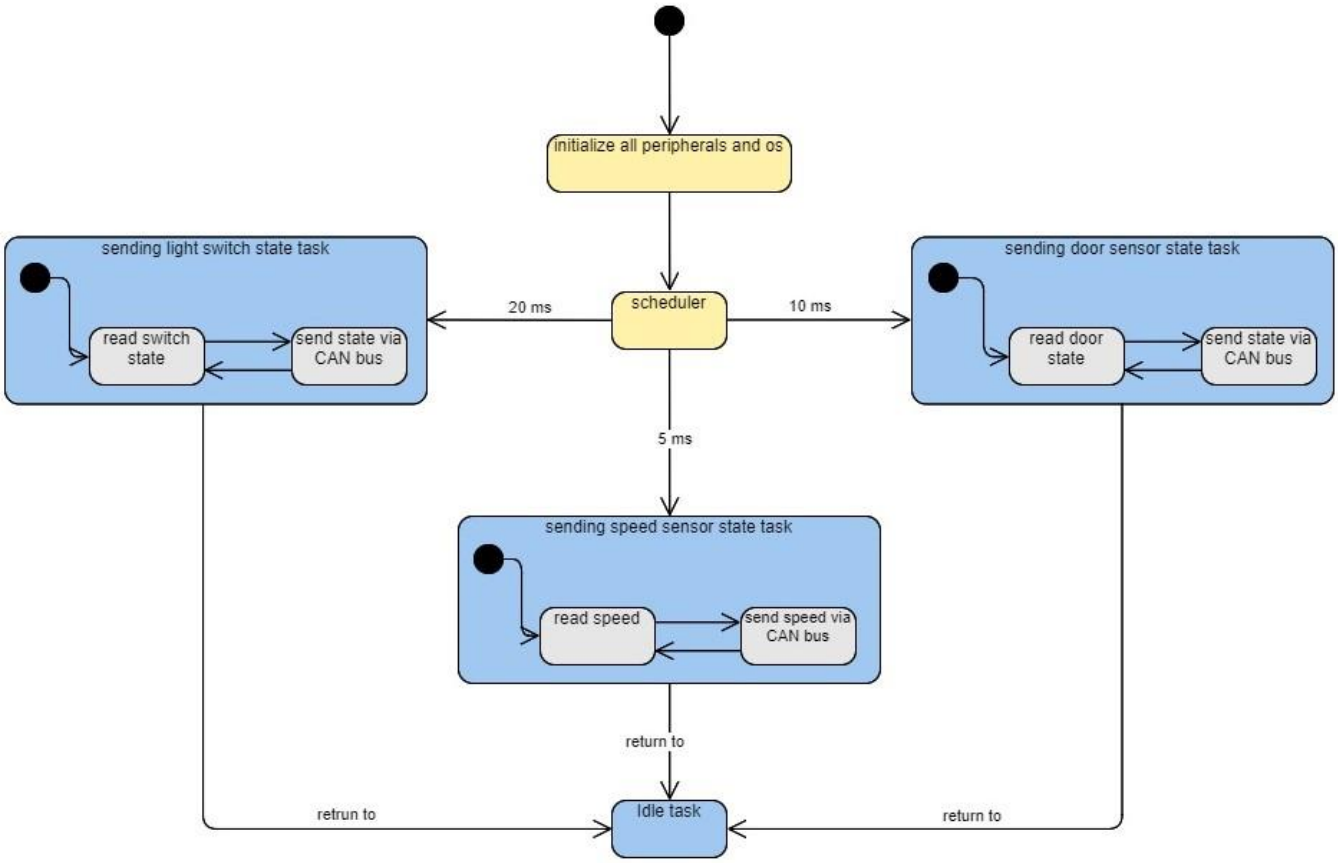
CAN:



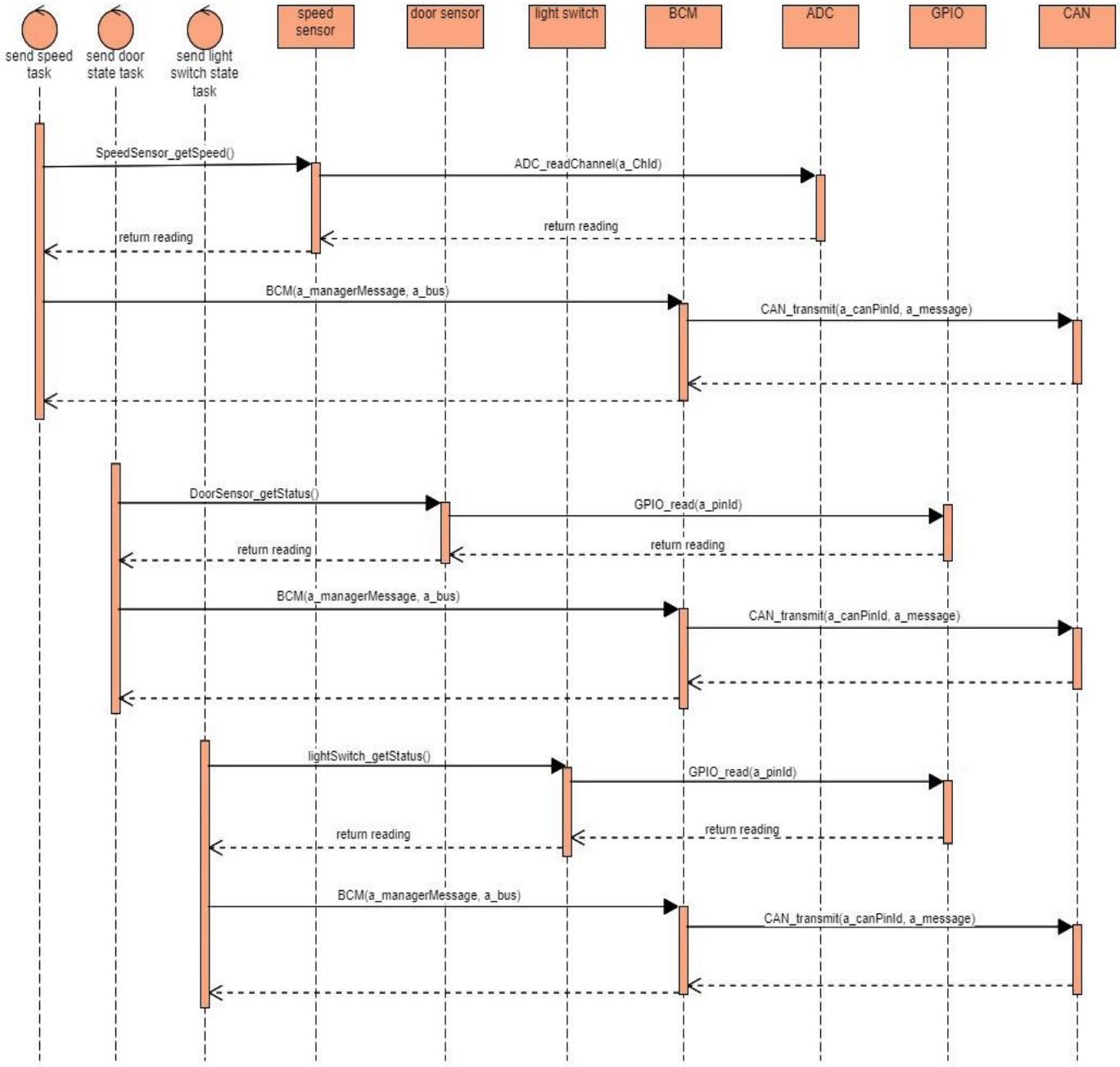
GPIO:



2- state machine diagram for ECU 1 operation



3- sequence diagram for ECU 1



4- CPU load for ECU 1

- three tasks

- we assumed all tasks execution time is 1 ms.

	PERIOD	***EXECUTION***
T1	20	1
T2	10	1
T3	5	1

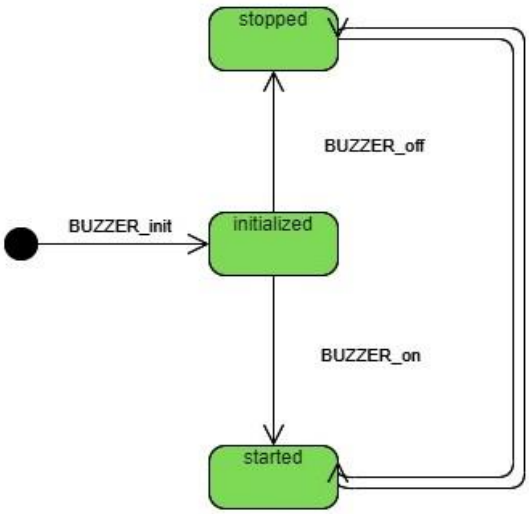
- (20/5) = 4, (20/10) = 2, (20/20) = 1.

- Then hyper period = 20.

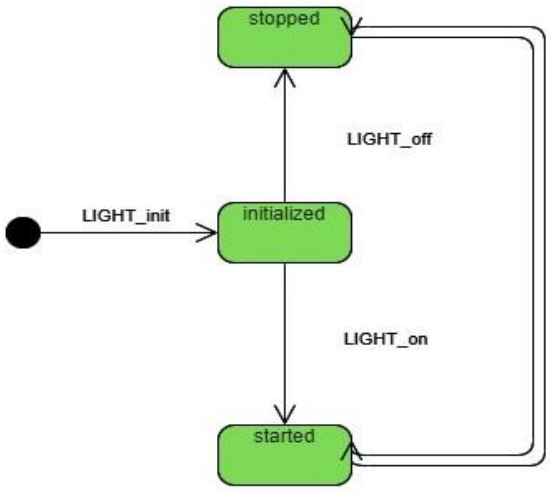
- U = (E1 + E2 + E3) / H = ((1*1) + (1*2) + (1*4) / 20) * 100 % = 35%

ECU 2:

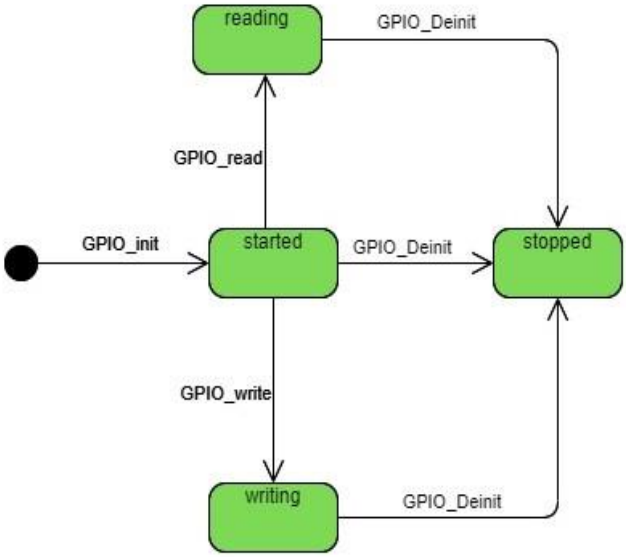
1- state machine diagram for ECU 2 components



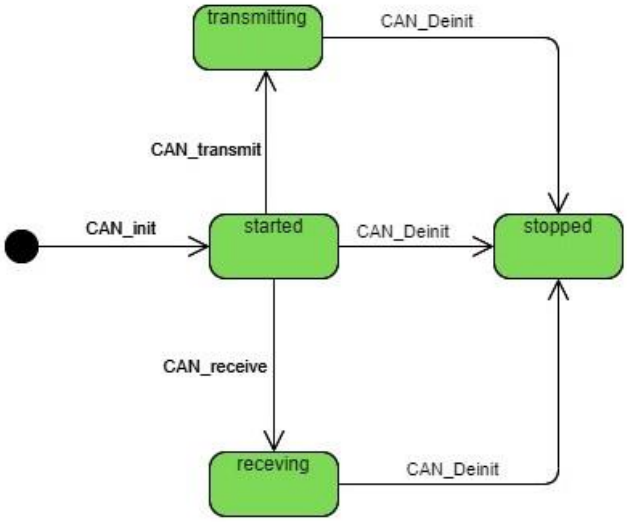
BUZZER



LIGHT

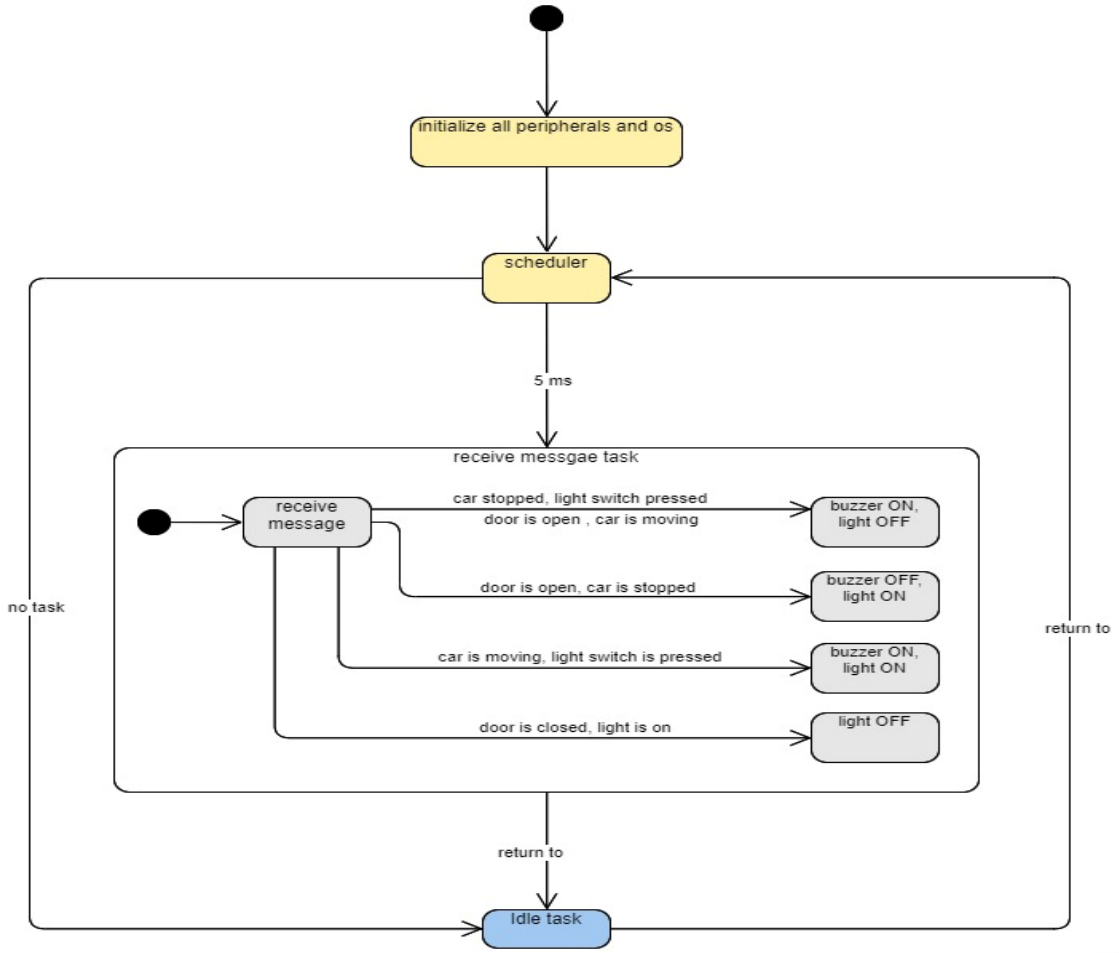


GPIO

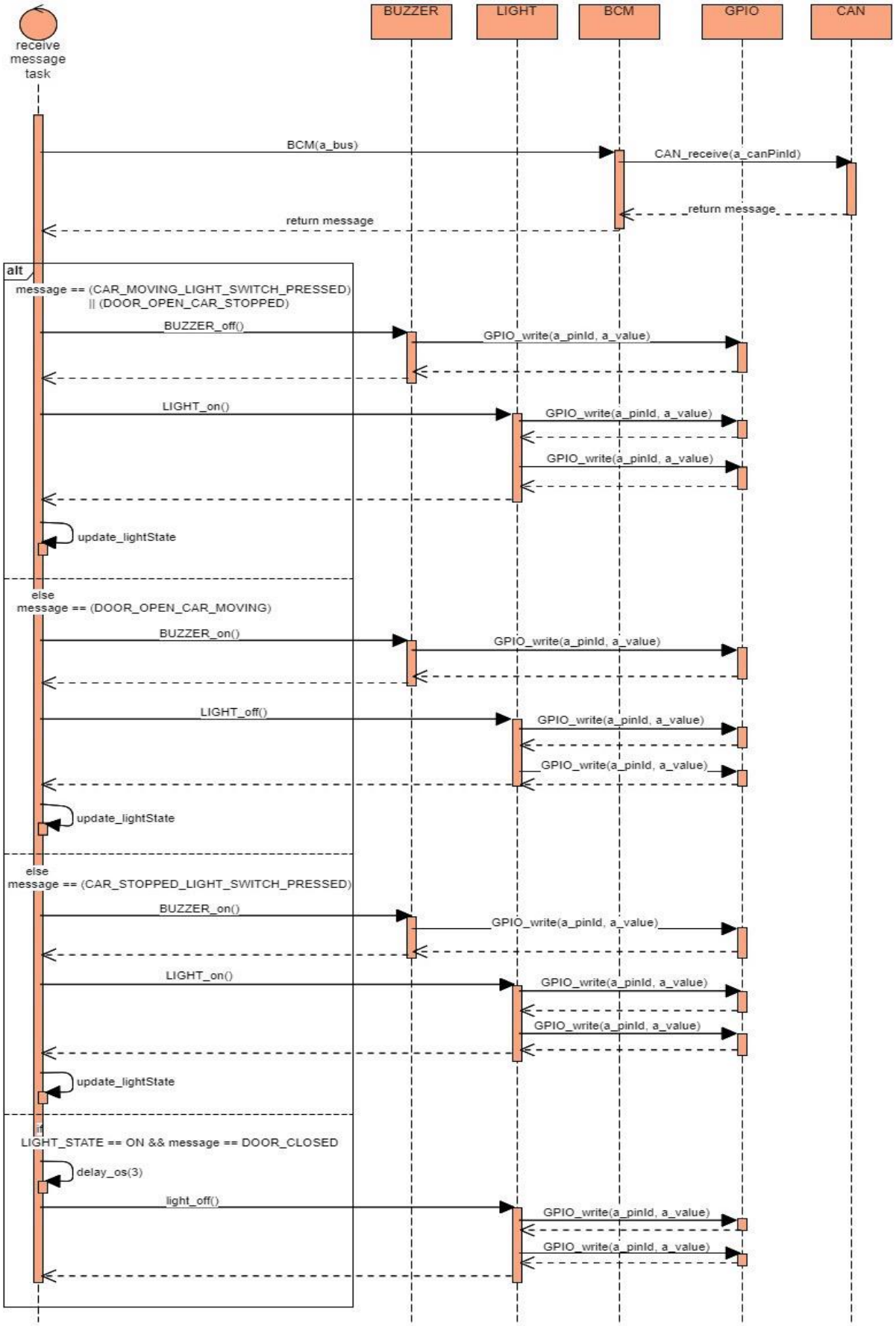


CAN

2- State machine diagram for ECU 2 operation



3- sequence diagram for ECU 2



4- CPU load for ECU 2

- One task
- we assumed the task execution time to be 3 ms.
- we assumed the task period to be 5 ms.

	PERIOD	***EXECUTION***
T1	5	3

- Hyper period = 5
- U = E1 / H = ((1*3) / 5) * 100 % = 60%

-Bus load

- Assumed a standard identifier so CAN frame consists of *125 bit* and number of bits sent per second equal to *500 kBit/s.*
- **Bit time** = *1 / bit rate*

  *= 1 / (500 * 100) s = 2 us*
- **Frame time** = *number of bits * bit time*

  *= 125 bit * 2 us = 250 us*
- The total frames for 3 messages sent from ECU 1 every *5, 10 and 20 ms* in *1 second* can be calculated by:
- **Total frames in** *1 s = 200 + 100 + 50 = 350 frame*
- **Total frames time** = *total frames * frame time*

  *= 350 * 250 us = 87500 us*
- **Bus load in *1 s*** = *(Total frames time / One second) * 100 %*

  *= (87500 us / (1000 ms * 1000)) * 100 % = 8.75 %*