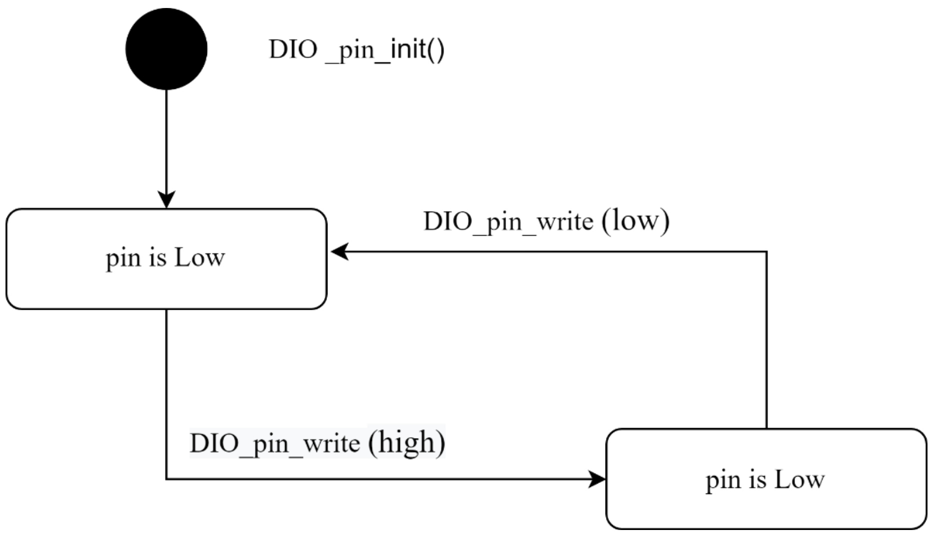
Dynamic design:

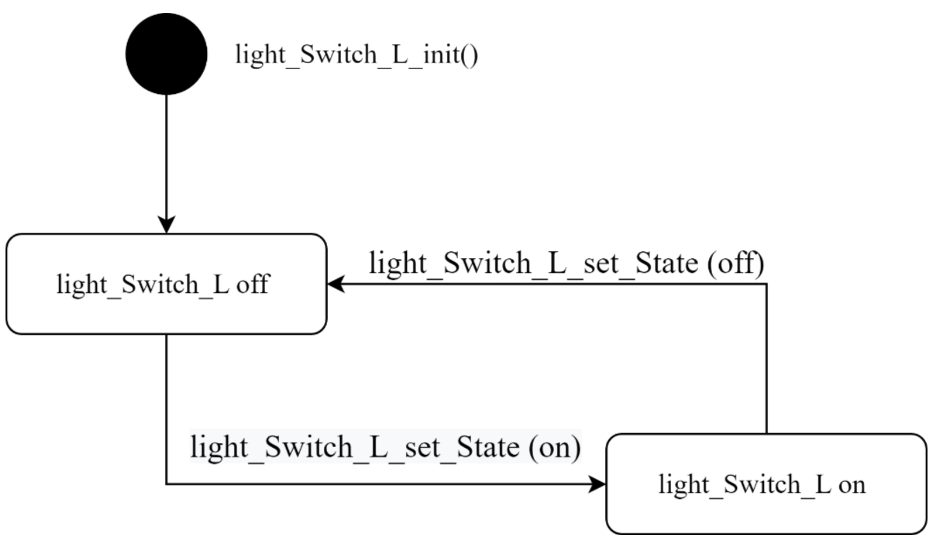
1. state machine diagram

MCU 1:

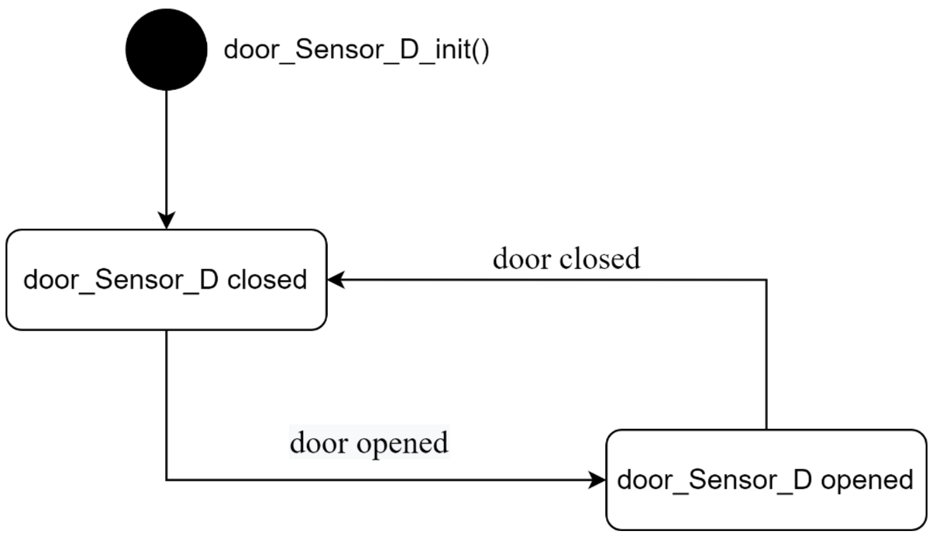
a. DIO:



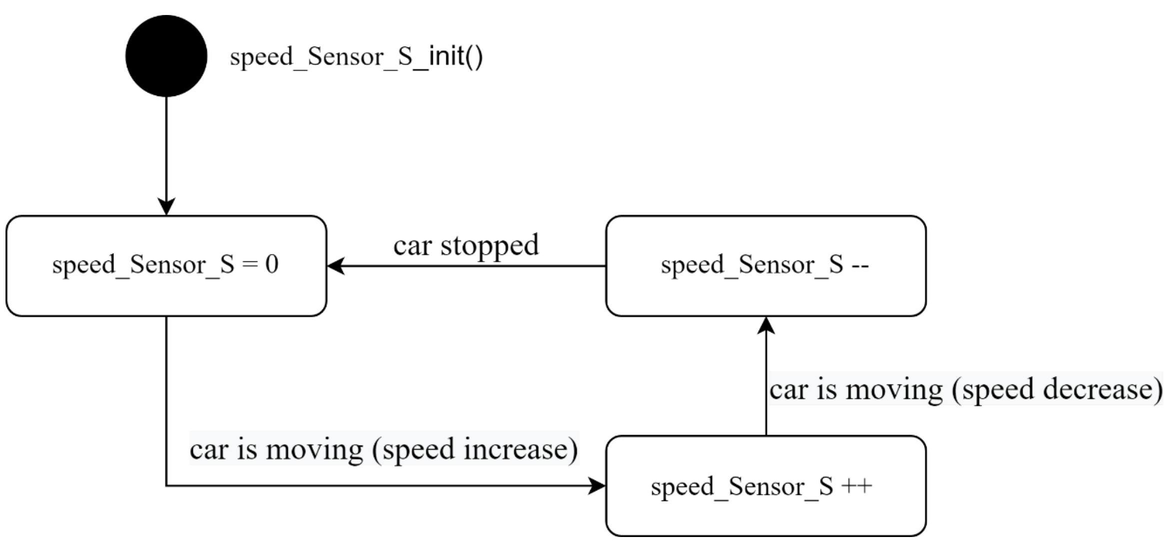
b. light_Switch_L:



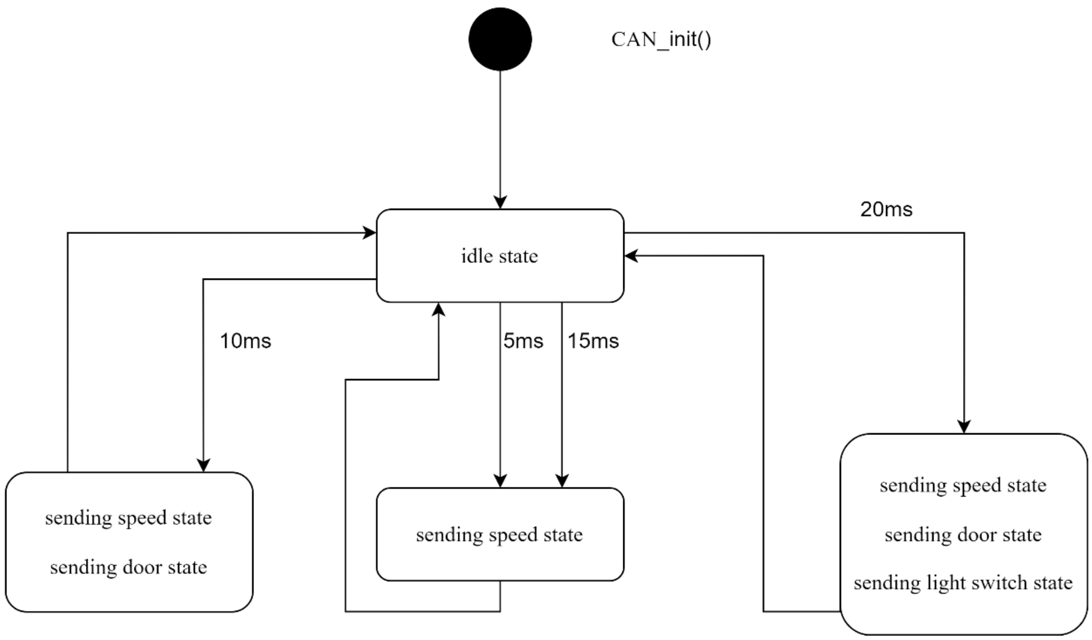
c. door_Sensor_D:



d. speed_Sensor_S:

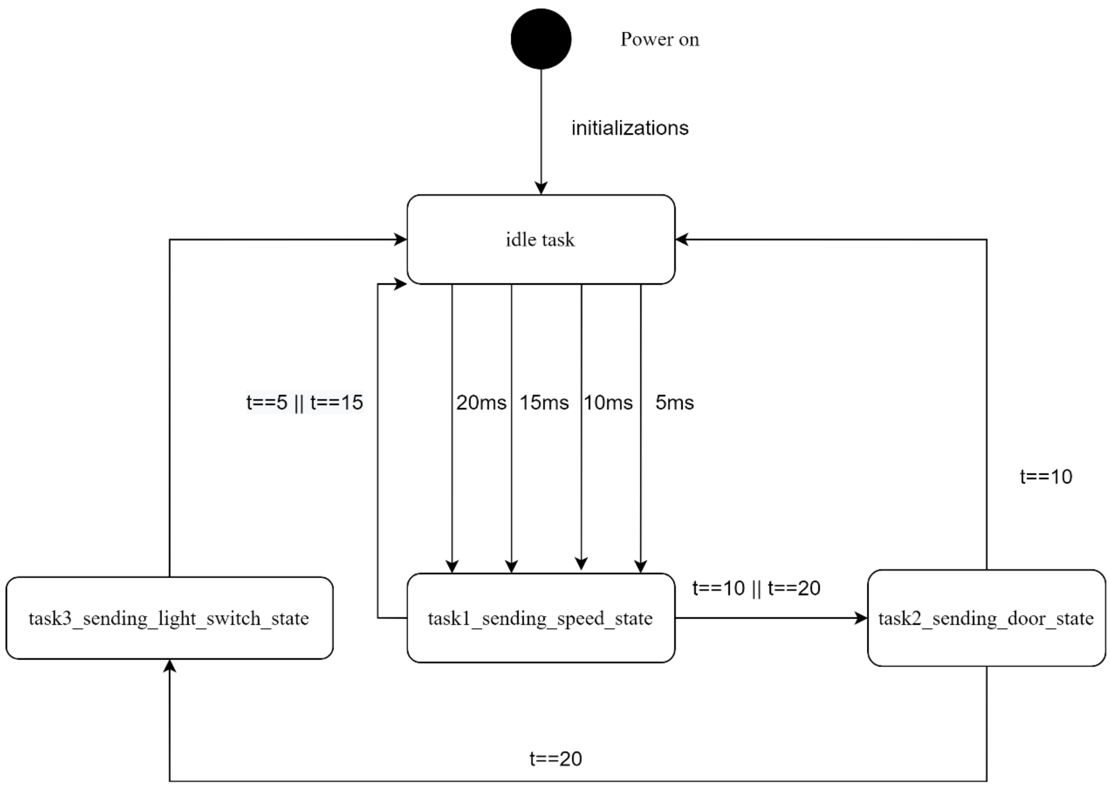


e. COM :

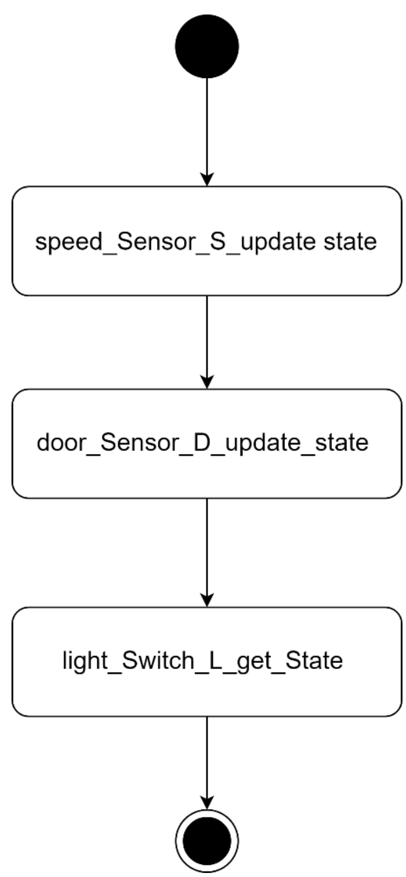


CAN_init()
idle state
20ms
10ms
5ms
15ms
sending speed state
sending door state
sending speed state
sending speed state
sending door state
sending light switch state

RTOS (ECU1):

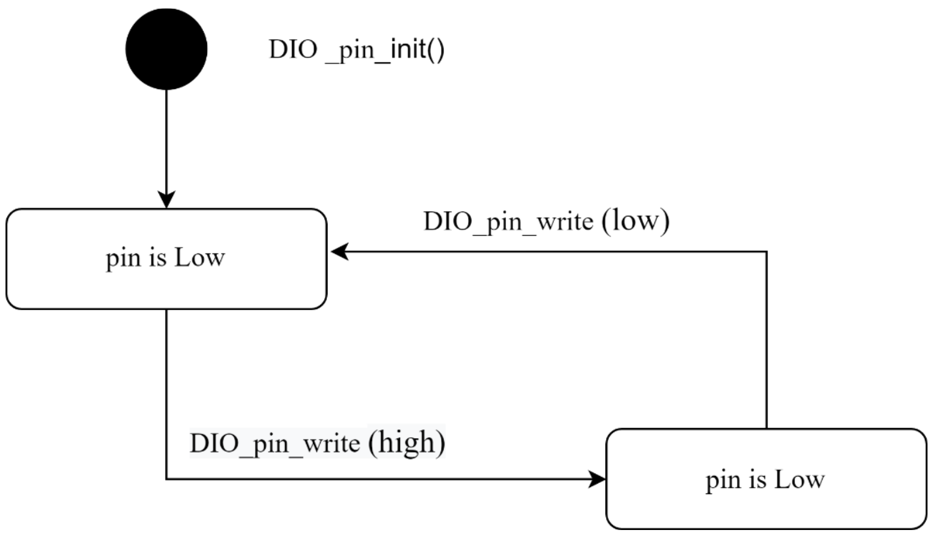


Idle task :

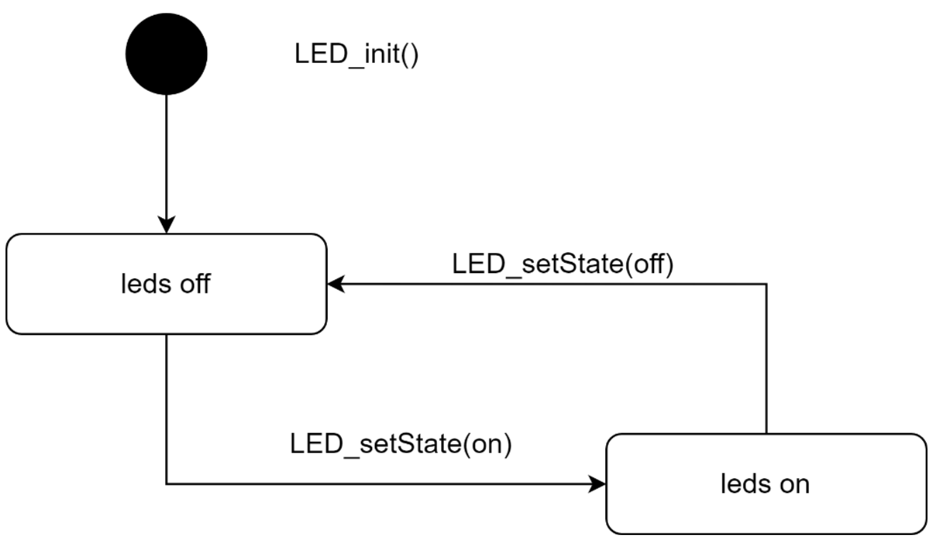


MCU 2:

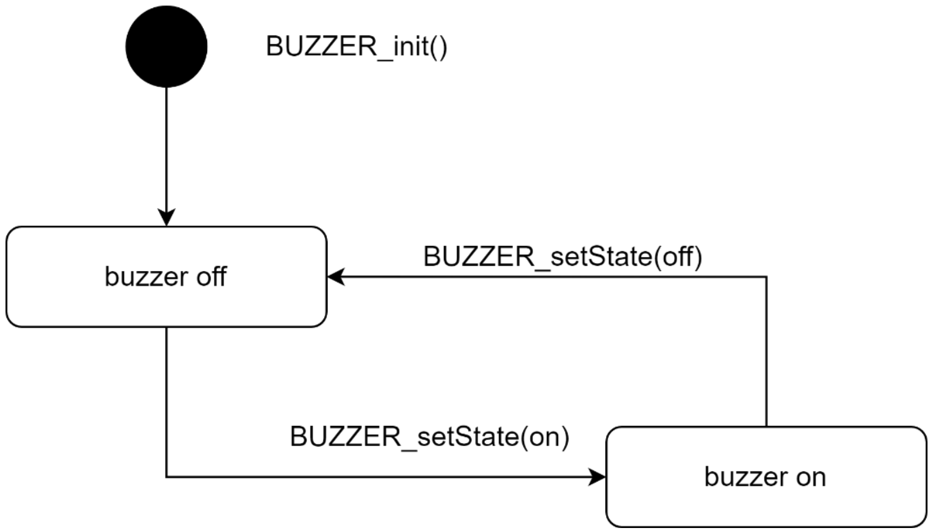
a. DIO:



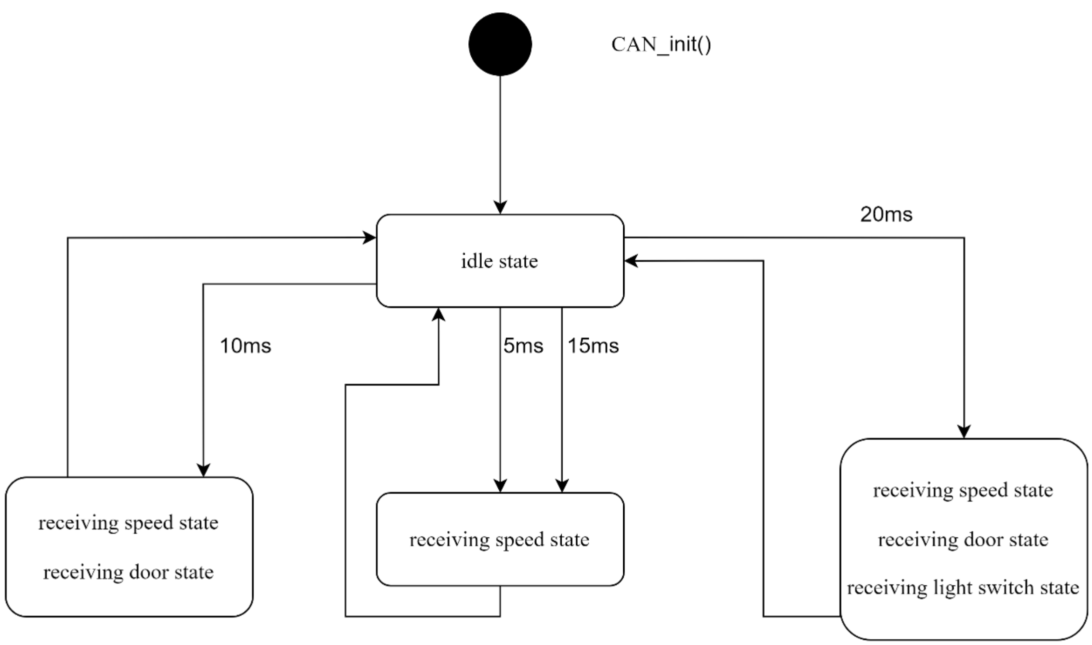
b. LED:



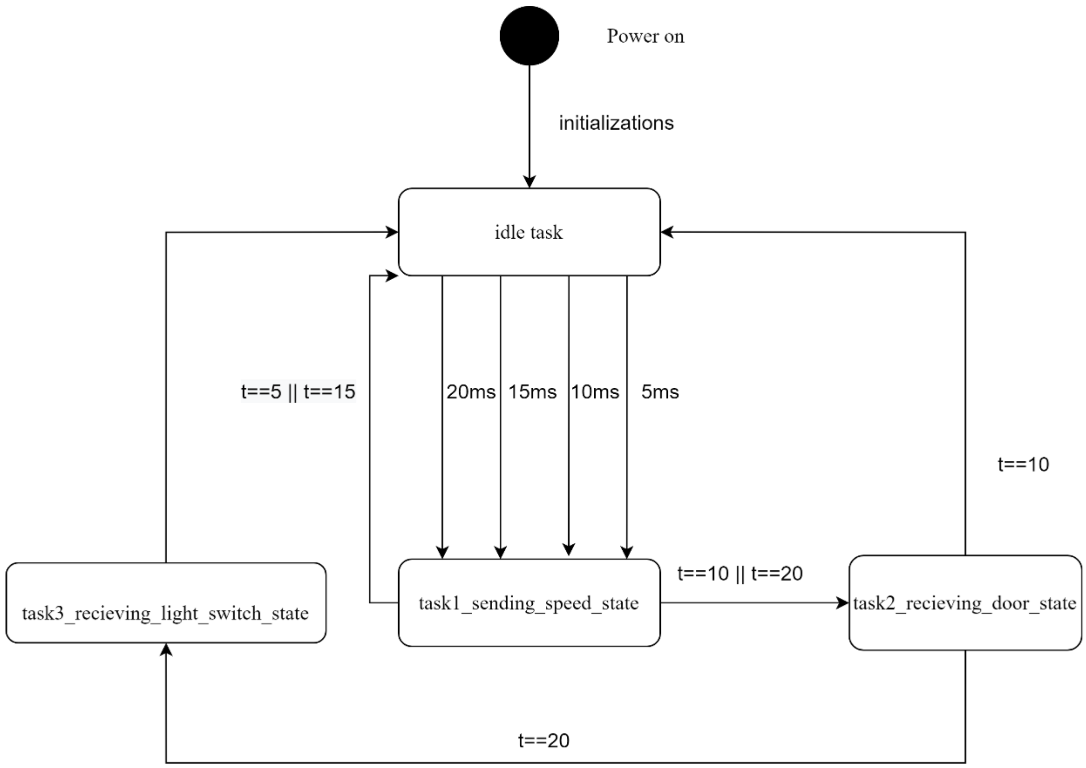
c. BUZZER:



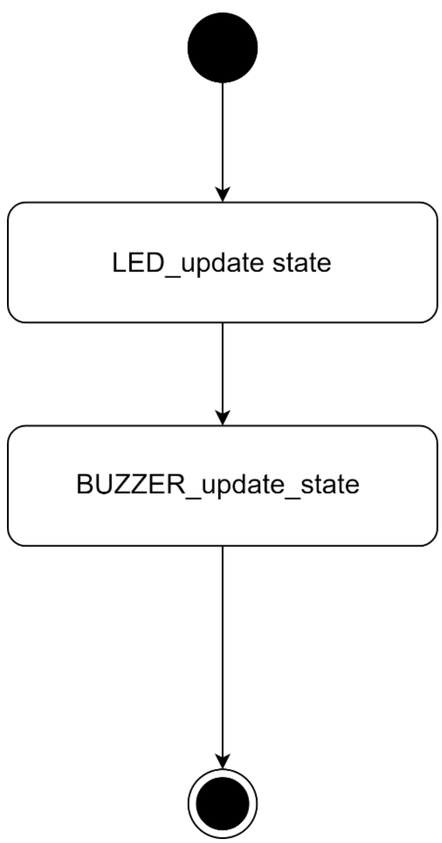
d. CAN:



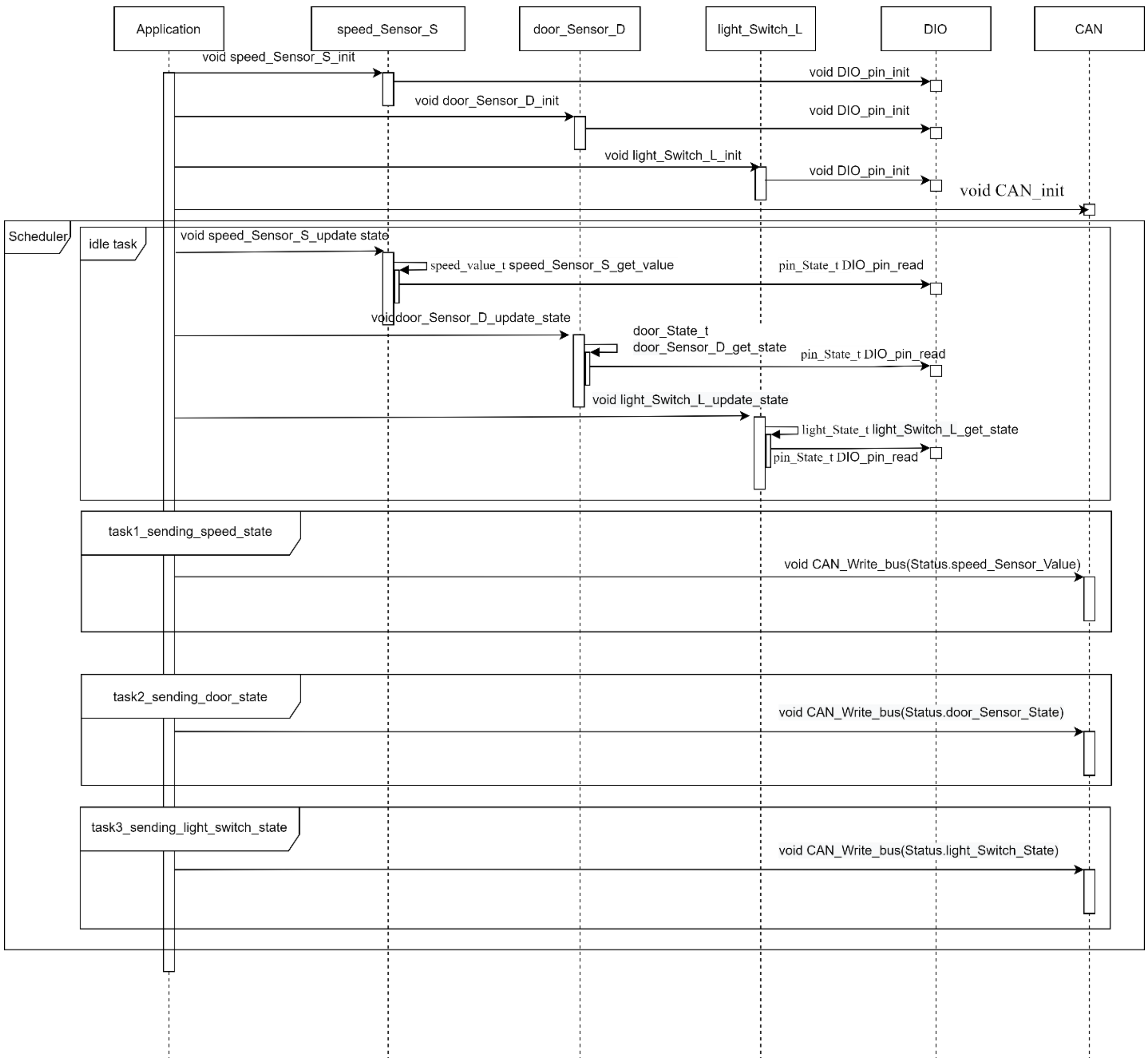
RTOS (ECU 2)



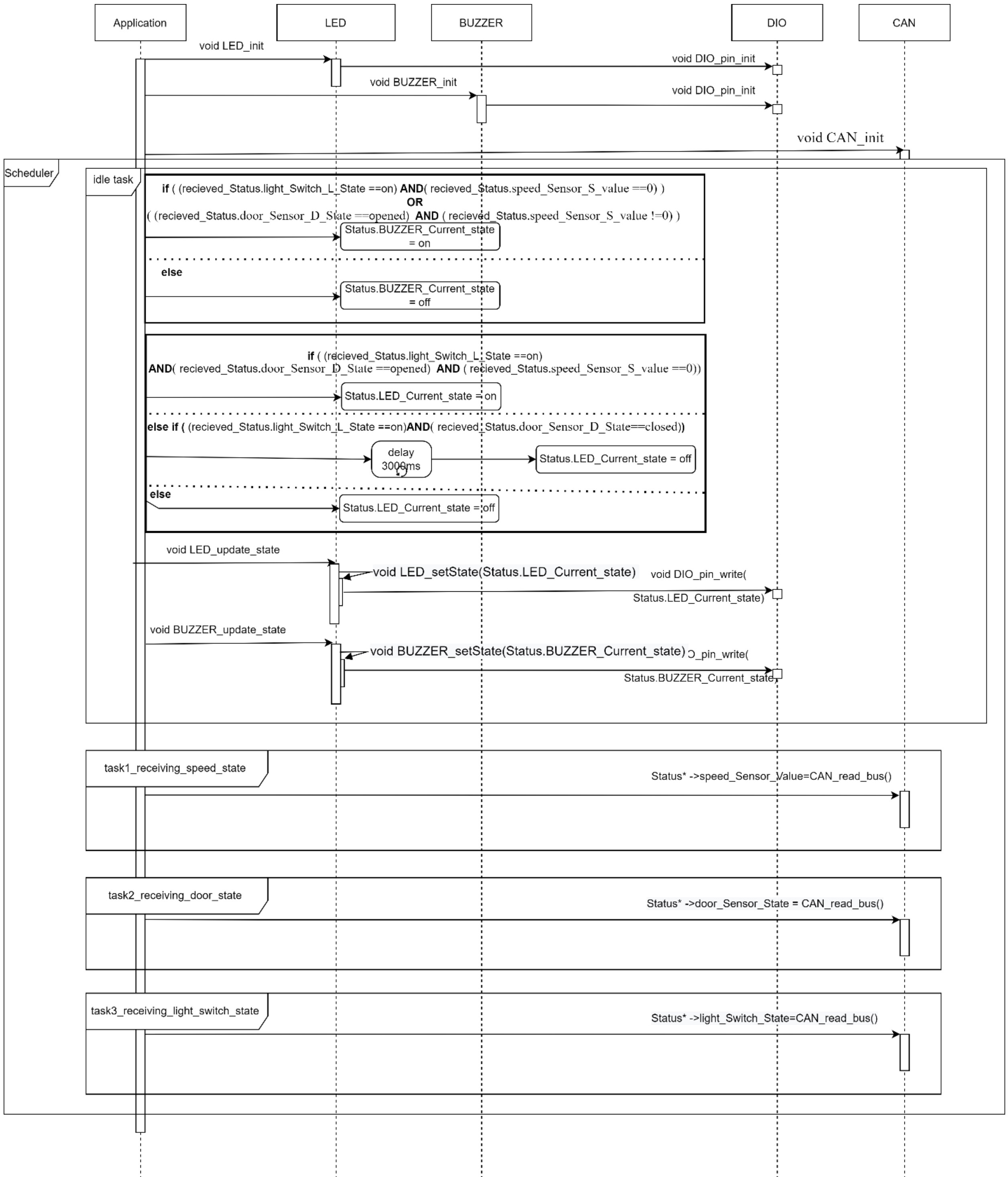
Idle task :



ECU1 Sequence diagram:



ECU2 Sequence diagram:



ECU1 CPU Load :

$$U = {\sum_{i=1}^{n}(E_i)}/_{H}$$

That:

- U is CPU utilization
- H is the hyper period.
- E_i is the ith task total execution time.
- n is the number of tasks.

Assume :

- $E_1 = 10\mu s$
- $E_2 = 50\mu s$
- $E_3 = 500\mu s$

So,

U= $\frac{((4*0.01)+(2*0.05)+(1*0.5))}{20} = 0.03$ $\therefore U\% = 3.2\ \%$

ECU2 CPU Load :

$$U = {\sum_{i=1}^{n}(E_i)}/_{H}$$

That:

- U is CPU utilization
- H is the hyper period.
- E_i is the ith task total execution time.
- n is the number of tasks.

Assume :

- $E_1 = 20\mu s$
- $E_2 = 60\mu s$
- $E_3 = 300\mu s$

So,U= $\frac{((4*0.02)+(2*0.06)+(1*0.3))}{20} = 0.025$ $\therefore U\% = 2.5\%$

CAN Bus Load calculations:

$$L = {}^{used\ capacity}/_{Maximum\ capacity}$$

Over 20 ms (Hyper period)

Assume we use Baud Rate of 200kbps, and we have frame size with 7 byte data with worst-case stuffing is something like 32+47+19=98.

Data	Description
1 byte * 4	speed_Sensor_S_Value
1 byte * 2	door_Sensor_D_State
1byte * 1	light_Switch_L_State
So data size over 20 ms = 7 bytes	

- Maximum capacity in 1 sec = 200000 bit.
- Number of frames sent in 1 sec = $\frac{1000}{20} = 50\ frame$

  So bus load

$$L = {}^{50 * 98}/_{200000} = 0.0245$$

L% =2.45%