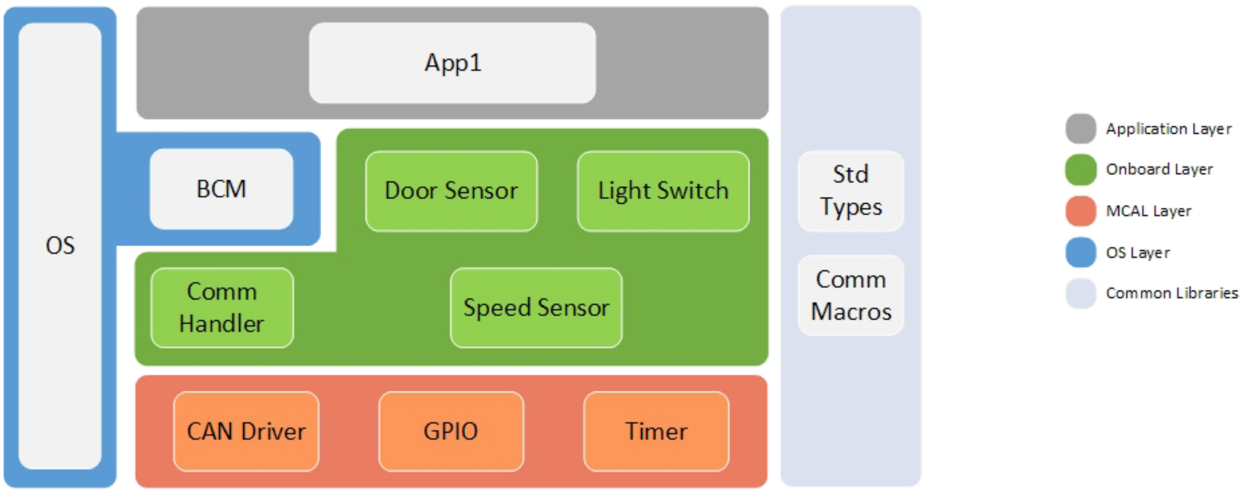
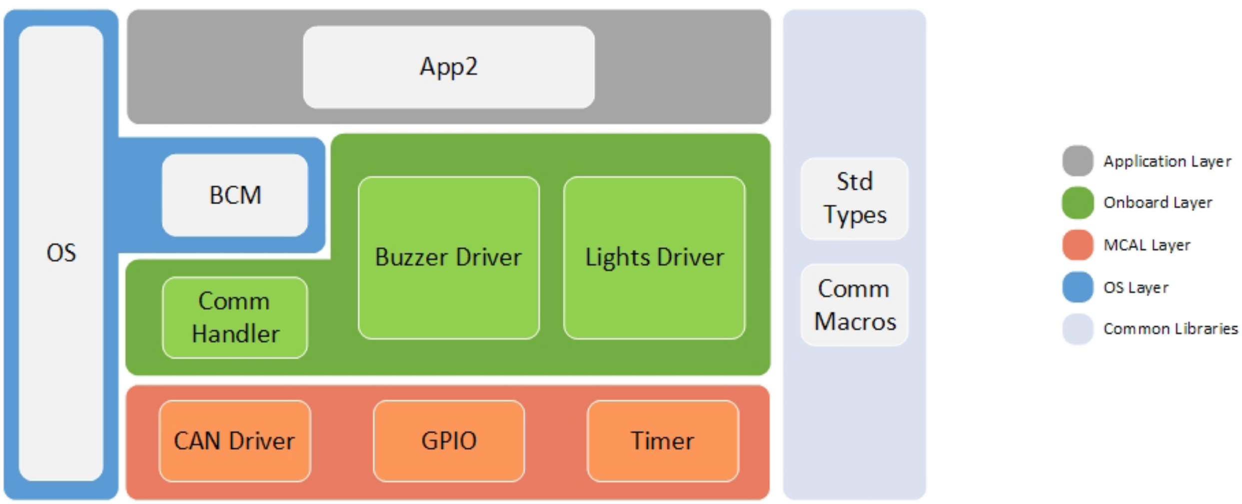
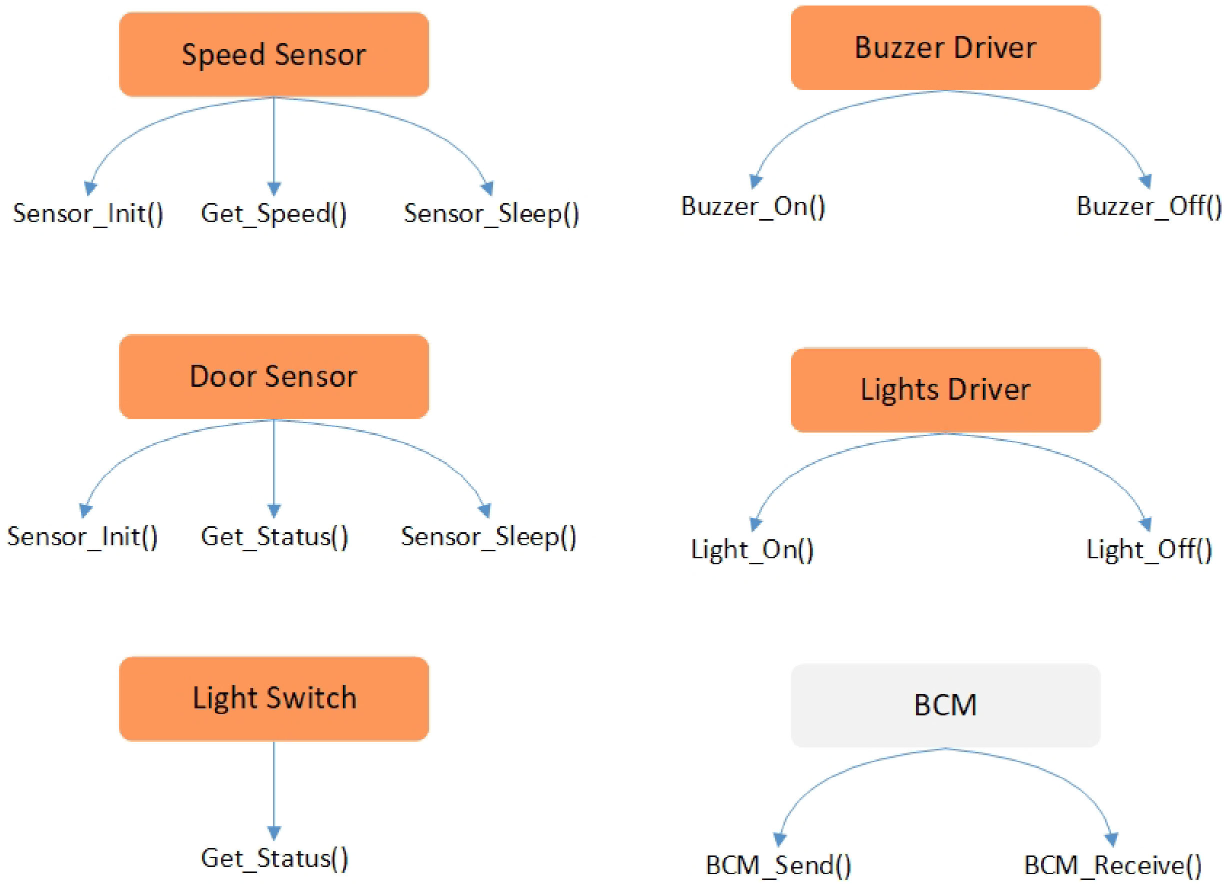
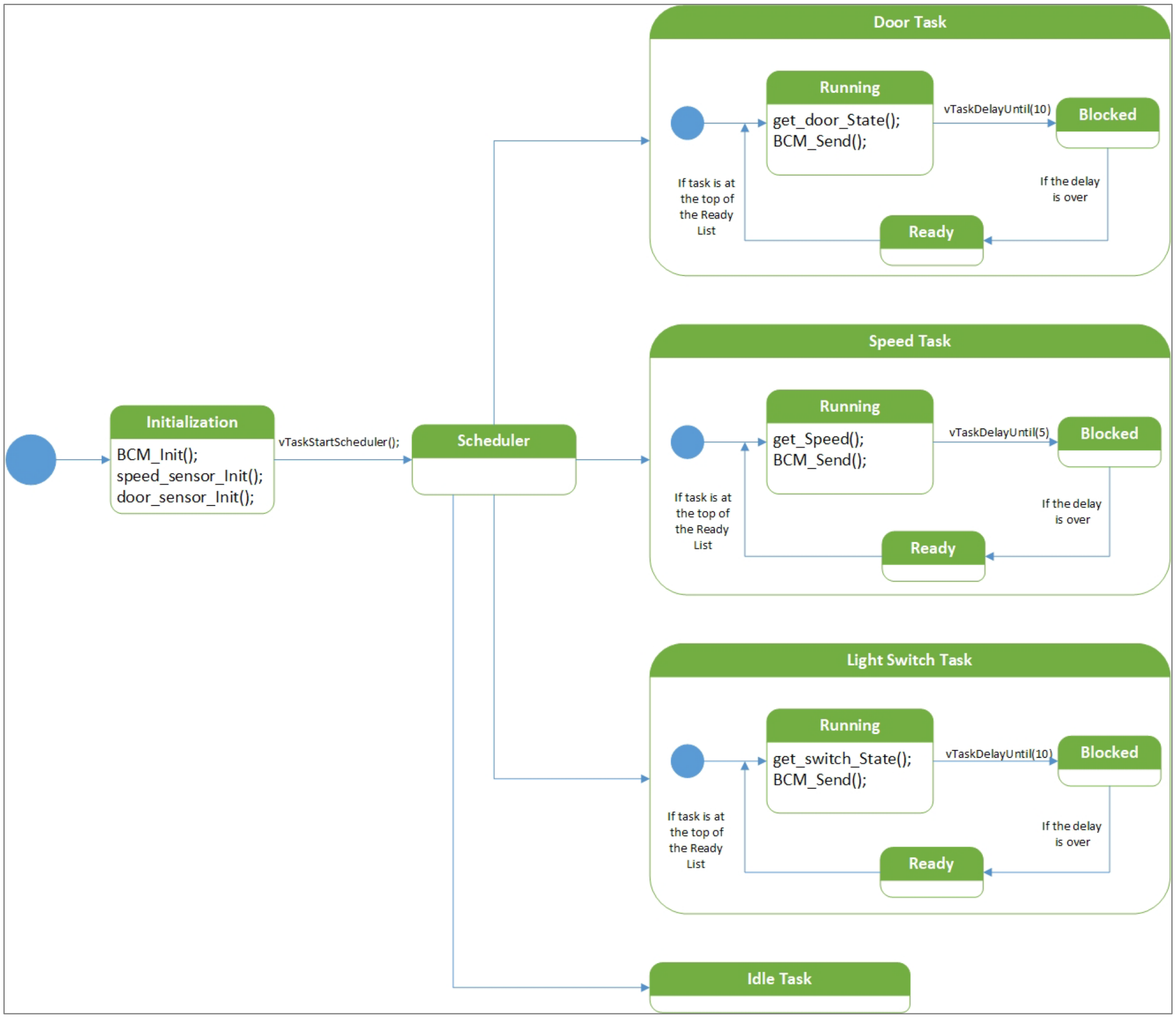
Static Design



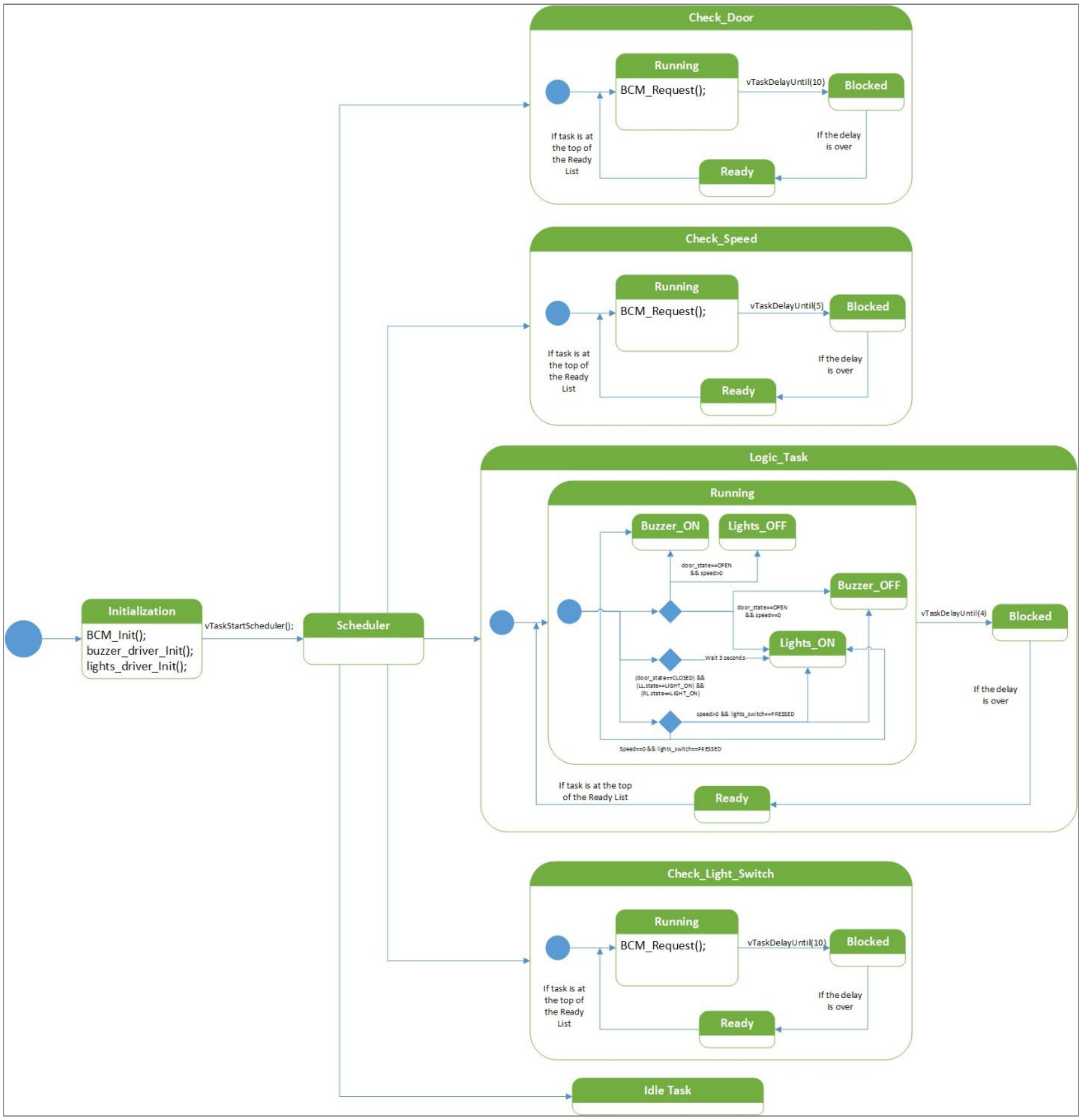



Speed Sensor
Sensor_Init()
Get_Speed()
Sensor_Sleep()
Buzzer Driver
Buzzer_On()
Buzzer_Off()
Door Sensor
Sensor_Init()
Get_Status()
Sensor_Sleep()
Lights Driver
Light_On()
Light_Off()
Light Switch
Get_Status()
BCM
BCM_Send()
BCM_Receive()

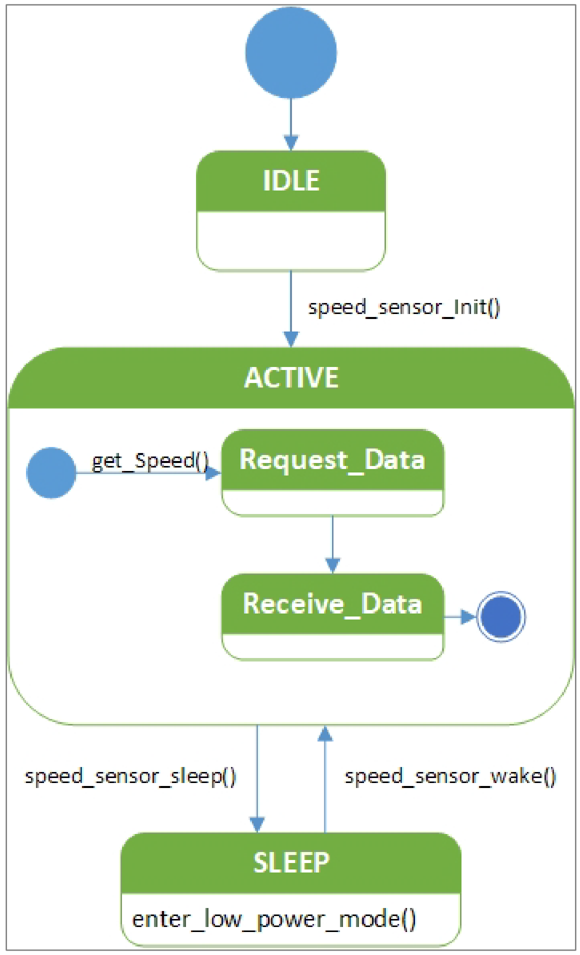
Dynamic Design



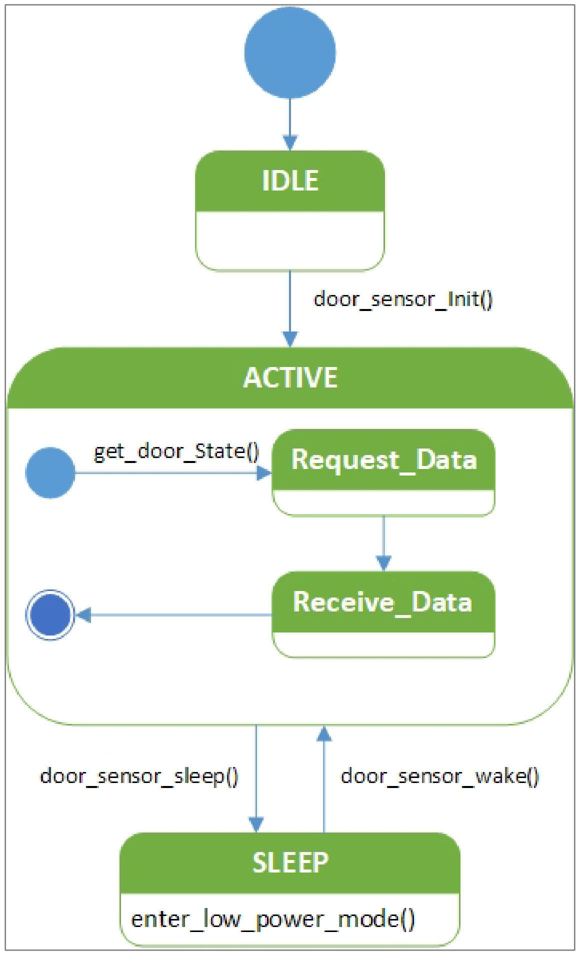
State Machine Diagram of ECU 1



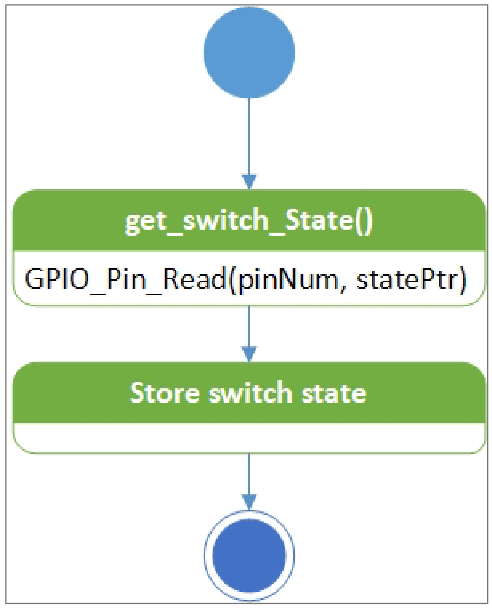
State Machine Diagram of ECU 2



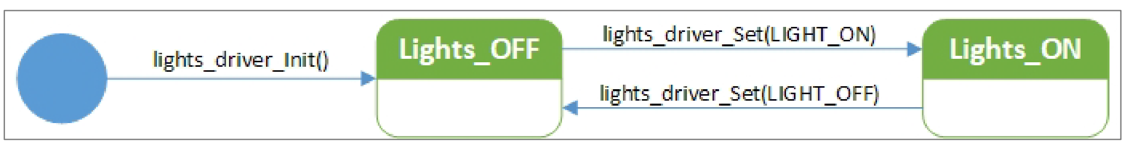
State Machine Diagram for Speed Sensor



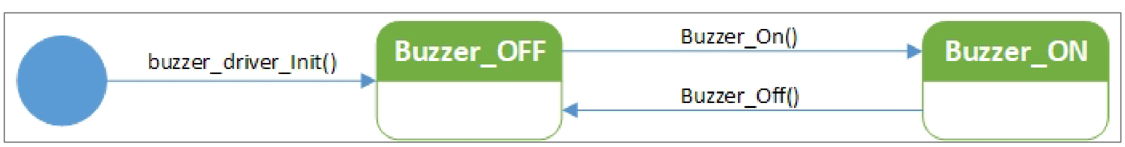
State Machine Diagram for Door Sensor



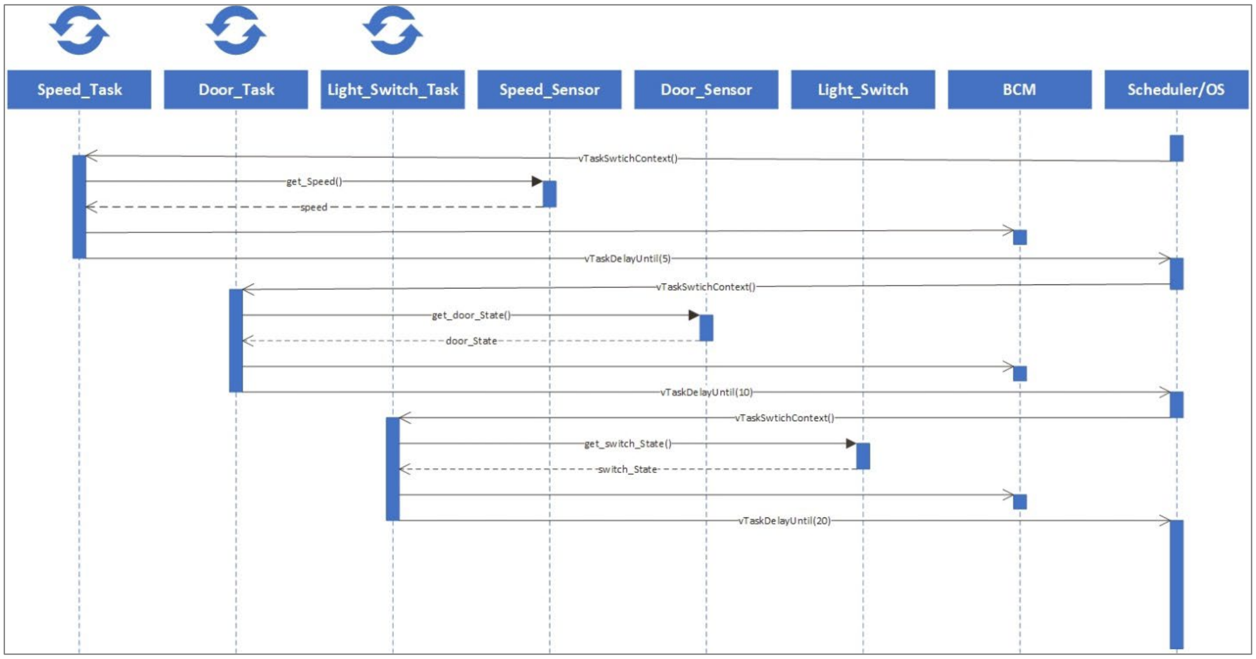
State Machine Diagram for Light Switch



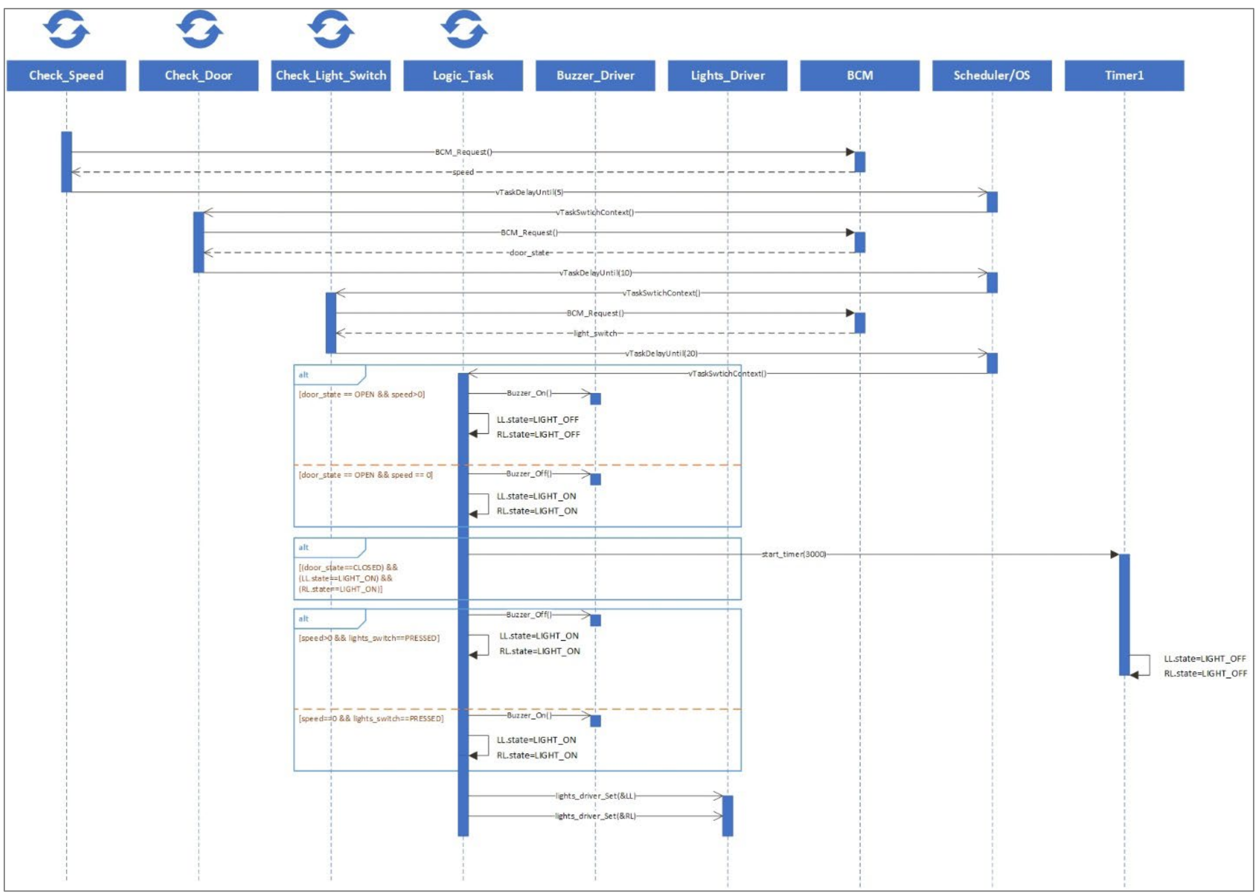
State Machine Diagram for Lights Driver



State Machine Diagram for Buzzer Driver



Sequence Diagram for ECU 1



Sequence Diagram for ECU 2

To calculate CPU Load:

$$U = \sum_{i=1}^{n} \frac{C_i}{P_i}$$

For ECU 1, assume that C1, C2 and C3 are about 0.05 ms:

$$\sum_{i=1}^{n} \frac{C_i}{P_i} = \frac{0.05}{5} + \frac{0.05}{10} + \frac{0.05}{20} = 0.0175$$

CPU Load for ECU 1 is 1.75%.

For ECU 2, assume that C1, C2 and C3 are about 0.04 ms and C4 is about 0.2 ms:

$$\sum_{i=1}^{n} \frac{C_i}{P_i} = \frac{0.04}{5} + \frac{0.04}{10} + \frac{0.04}{20} + \frac{0.2}{4} = 0.064$$

CPU Load for ECU 2 is 6.4%.

To calculate Bus Load, first we get total number of bits we can send in 1 second:

$$bits_{total} = (time\ interval)(baud\ rate) = (1000)(500) = 5 * 10^5\ bits$$

Then we get the number of bits sent on our CAN Bus:

For a frame sending speed data, we will have 82 bits per CAN frame, for the other two it is 74 bits. Since we send a speed frame every 5ms and a door sensor frame every 10ms and a light switch frame every 20ms, the number of bits sent by our network is:

$$bits = \left(\frac{1000}{5}\right)(82) + \left(\frac{1000}{10} + \frac{1000}{20}\right)(74) = 16400 + 11100 = 27500\ bits$$

$$bus\ load = \frac{bits}{bits_{toal}} = \frac{27500}{5 * 10^5} = 0.055$$

Total Bus Load for our system is 5.5%