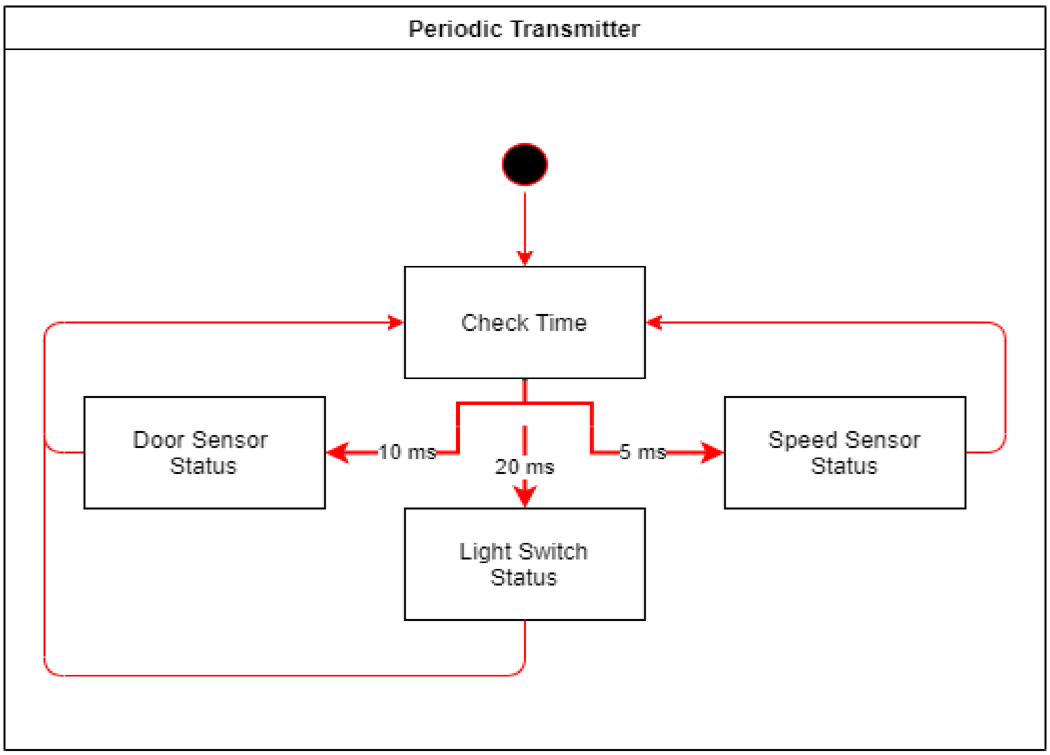
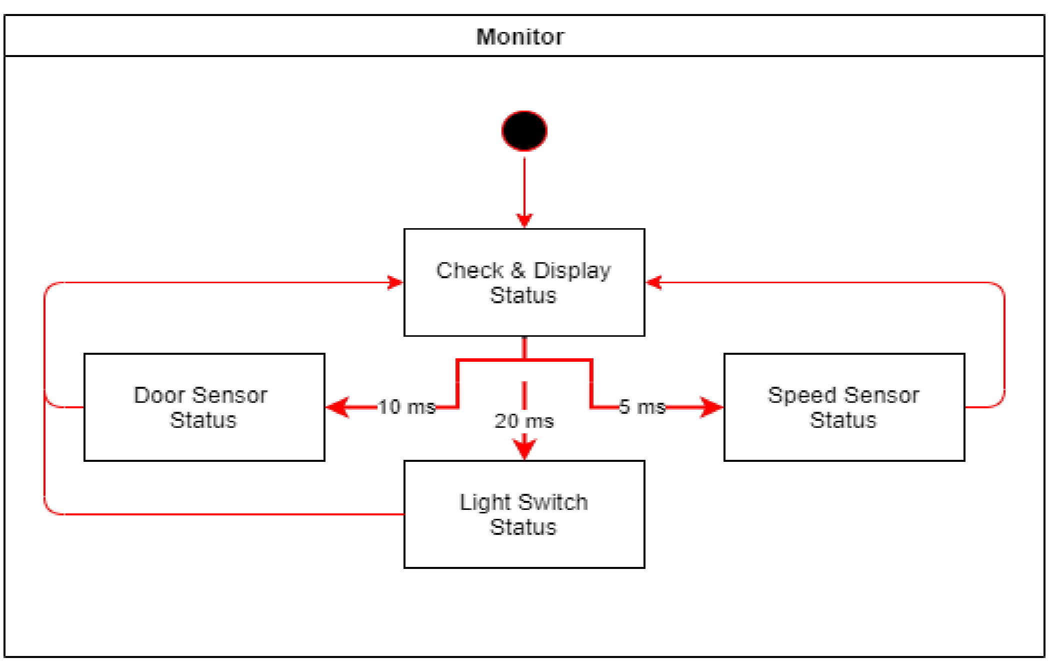
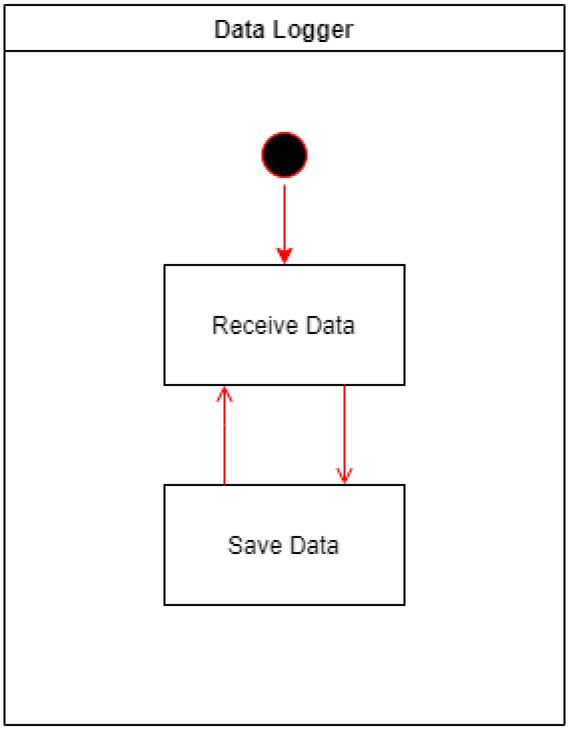
Dynamic Design Analysis

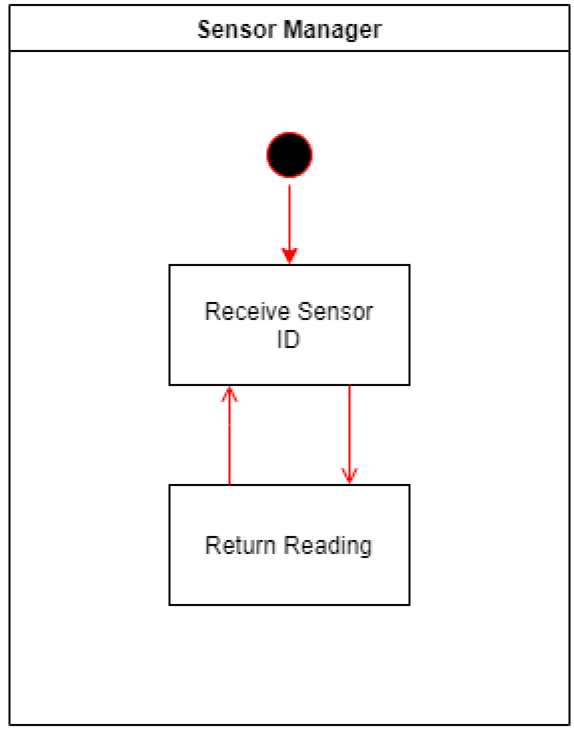
ECU 1: -

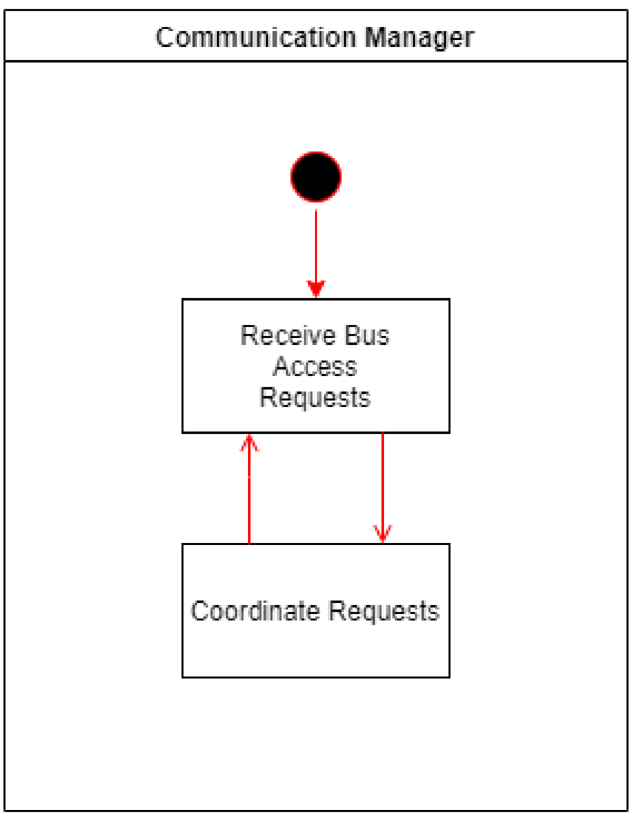
- State Machine Design for ECU 1:

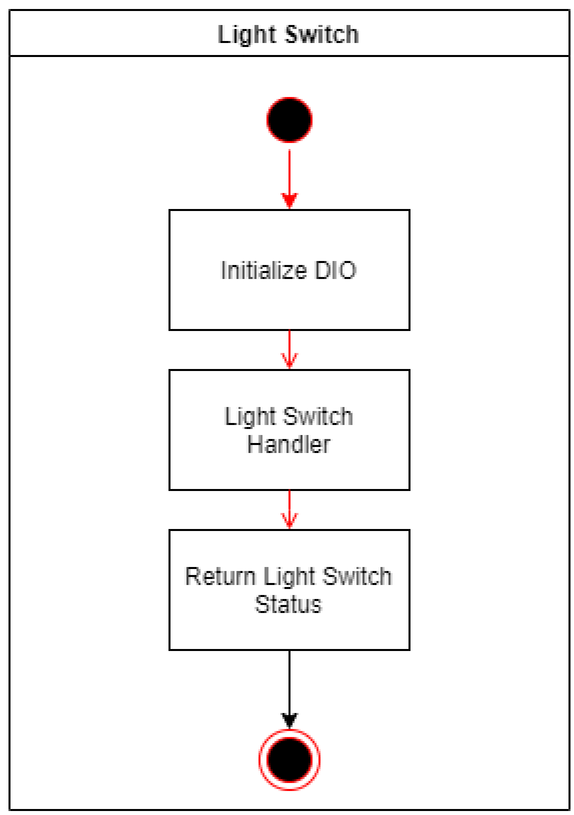


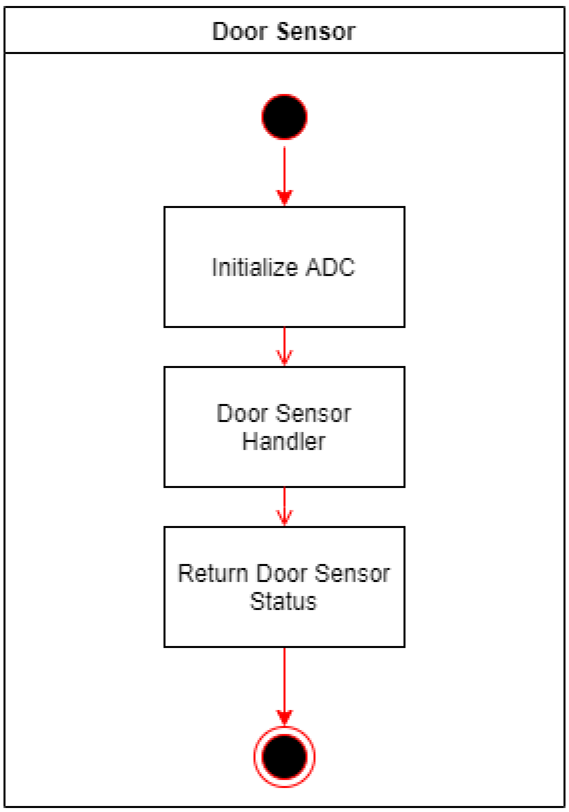


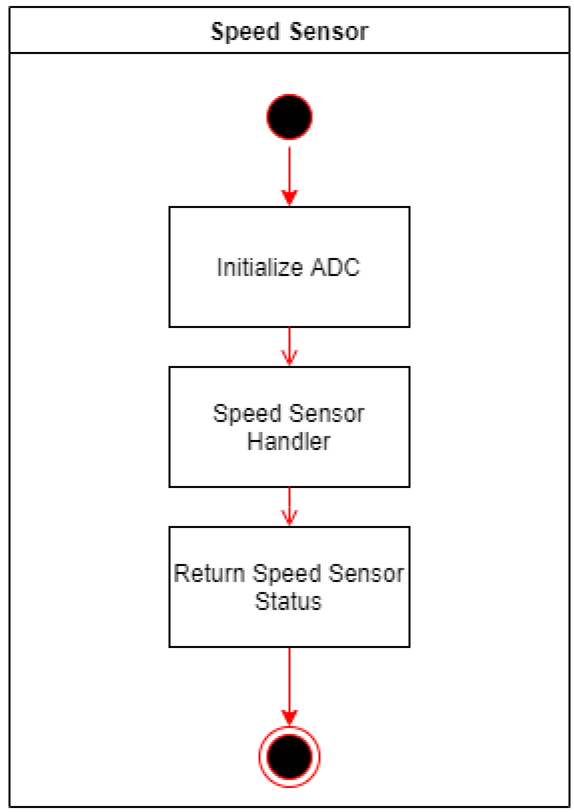

Data Logger
Receive Data
Save Data

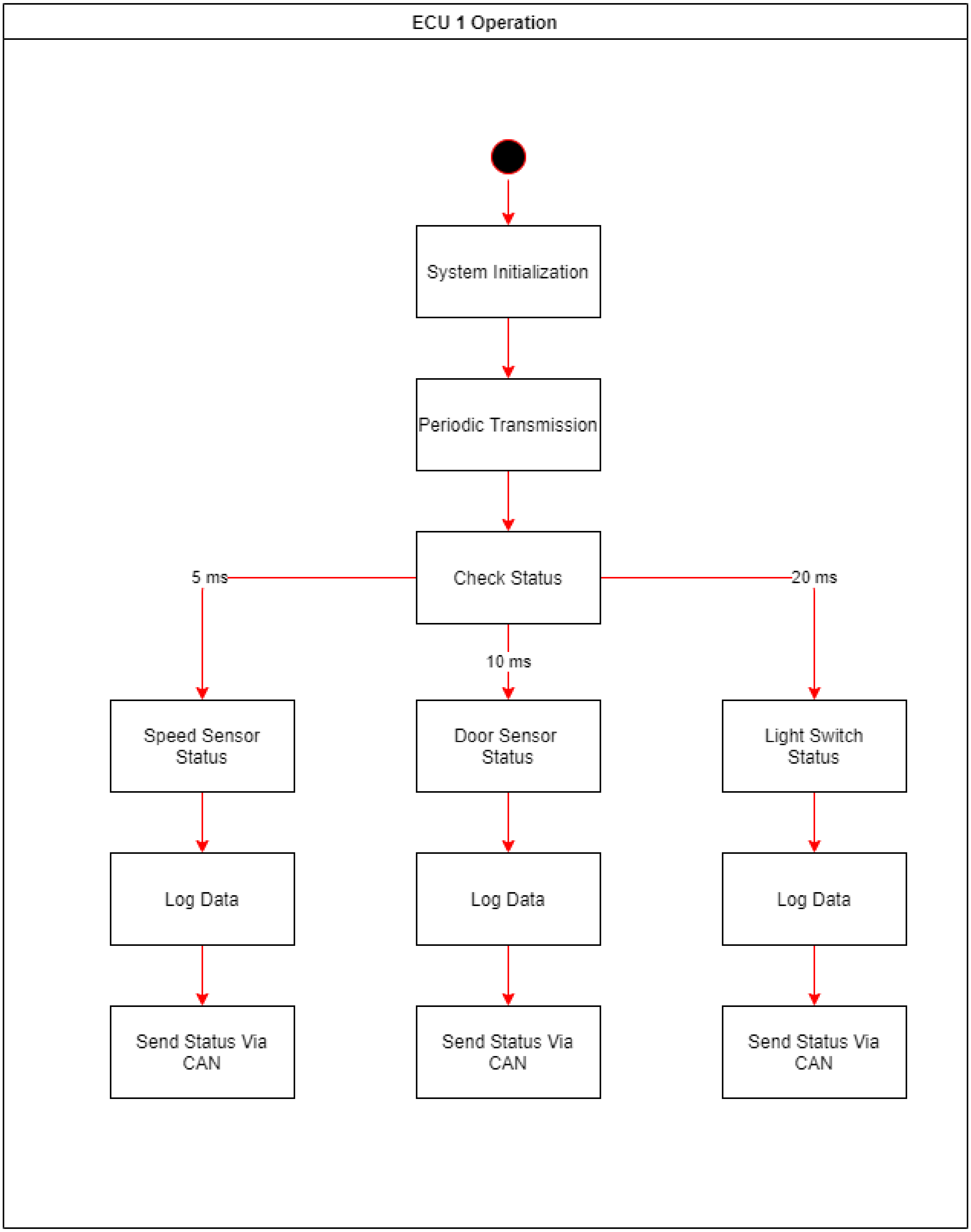

Sensor Manager
Receive Sensor ID
Return Reading


Communication Manager
Receive Bus Access Requests
Coordinate Requests

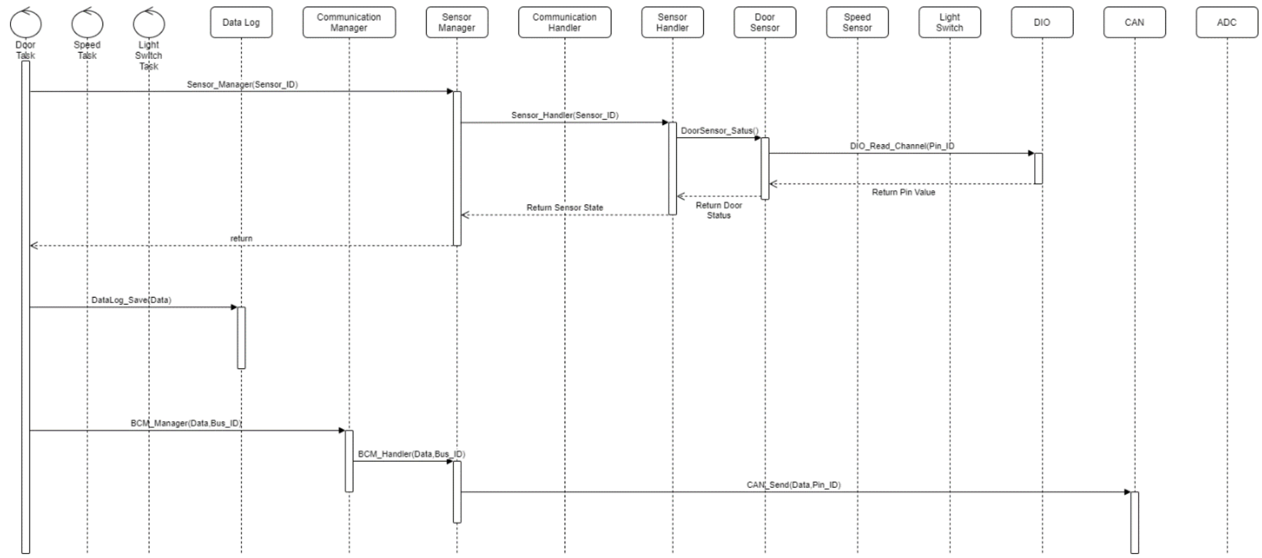

Light Switch
Initialize DIO
Light Switch Handler
Return Light Switch Status

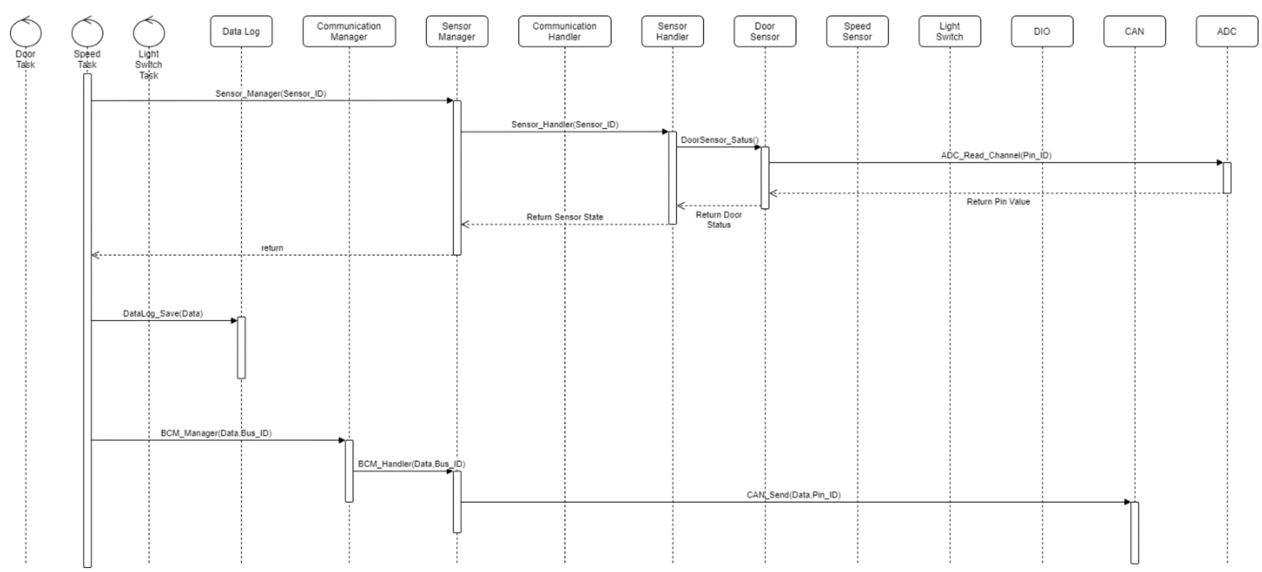

Door Sensor
Initialize ADC
Door Sensor Handler
Return Door Sensor Status

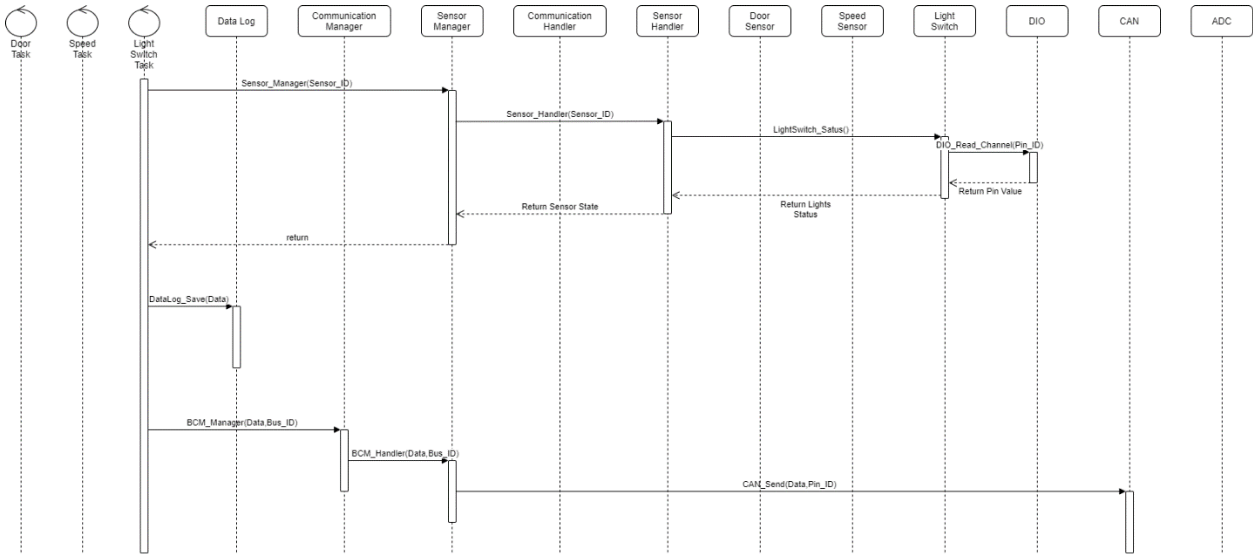

Speed Sensor
Initialize ADC
Speed Sensor Handler
Return Speed Sensor Status


ECU 1 Operation
System Initialization
Periodic Transmission
Check Status
5 ms
10 ms
20 ms
Speed Sensor Status
Door Sensor Status
Light Switch Status
Log Data
Log Data
Log Data
Send Status Via CAN
Send Status Via CAN
Send Status Via CAN

- Sequence Diagram of ECU 1: -







- CPU Load for ECU 1: -

We have three tasks: (Assume Execution Time)

T_1: {Periodicity: 10ms, Execution Timer: 1ms}

T_2: {Periodicity: 5ms, Execution Timer: 1ms}

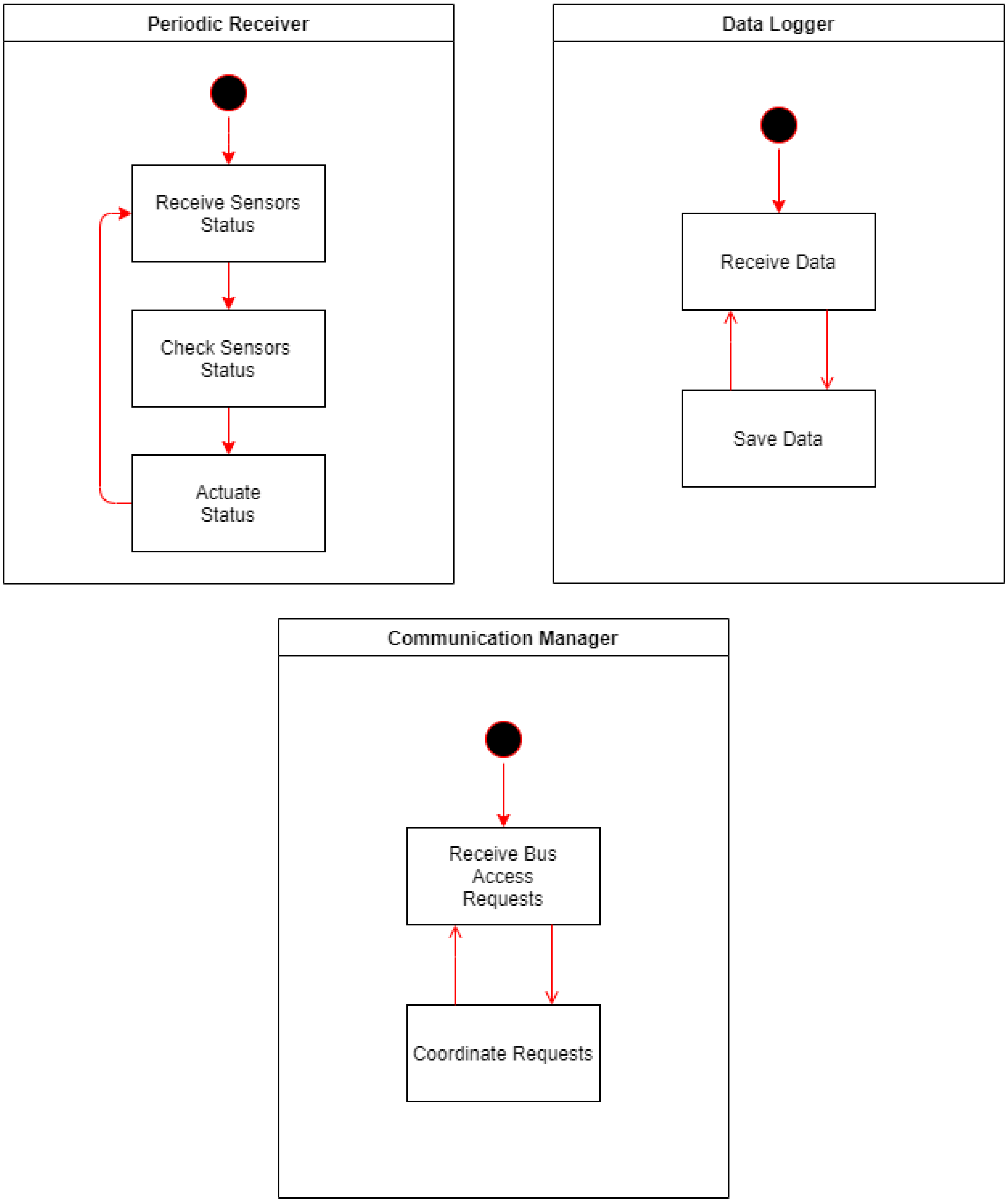
T_3: {Periodicity: 20ms, Execution Timer: 1ms}

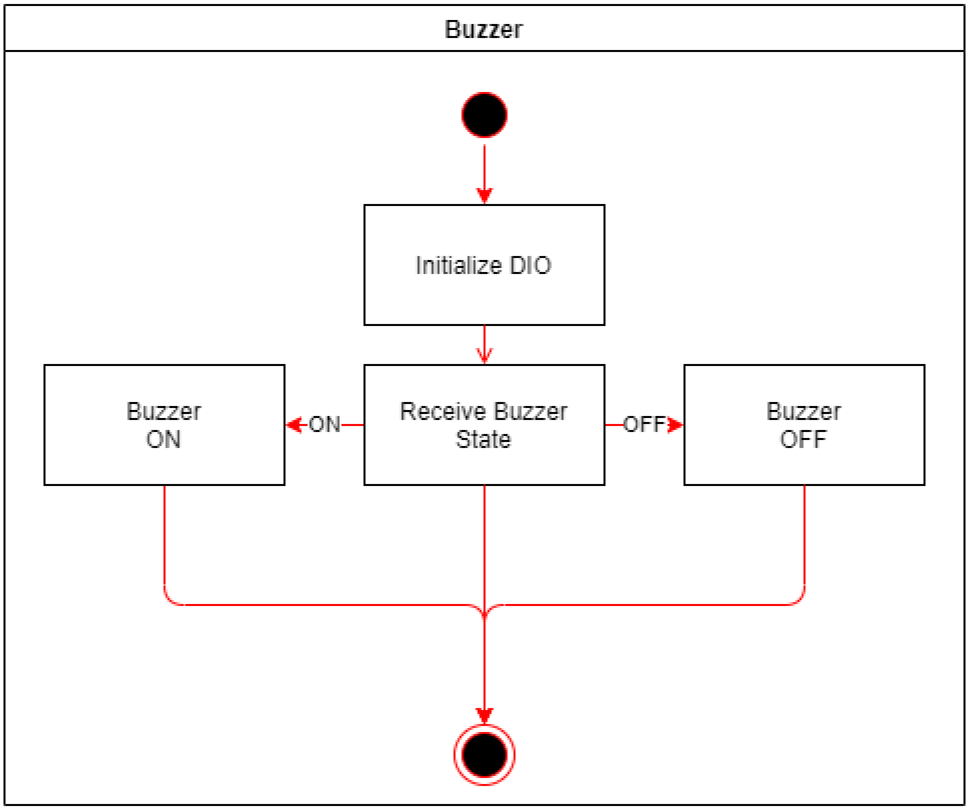
Hyperperiod = 20 ms

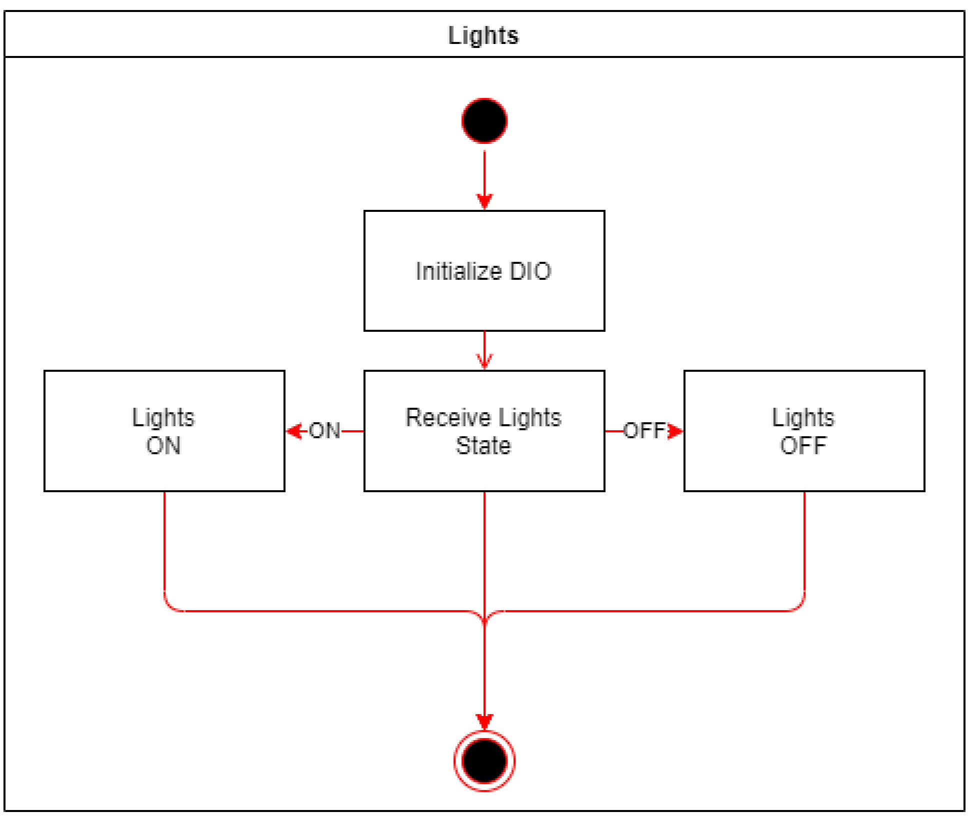
CPU Load = Σ E/H = ((1*2+1*4+1*1) /20)*100 = 35%

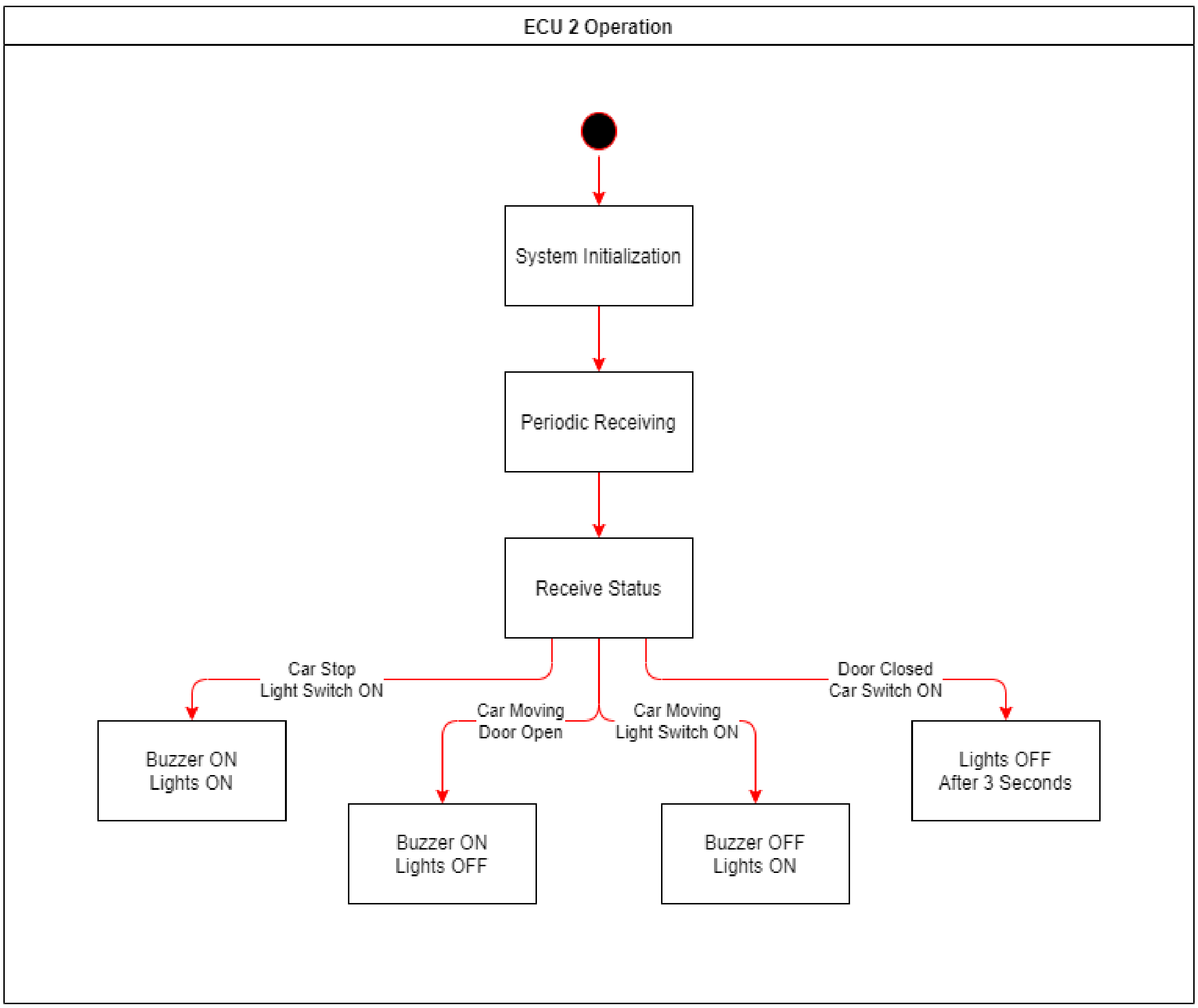
ECU 2: -

- State Machine Design for ECU 2:

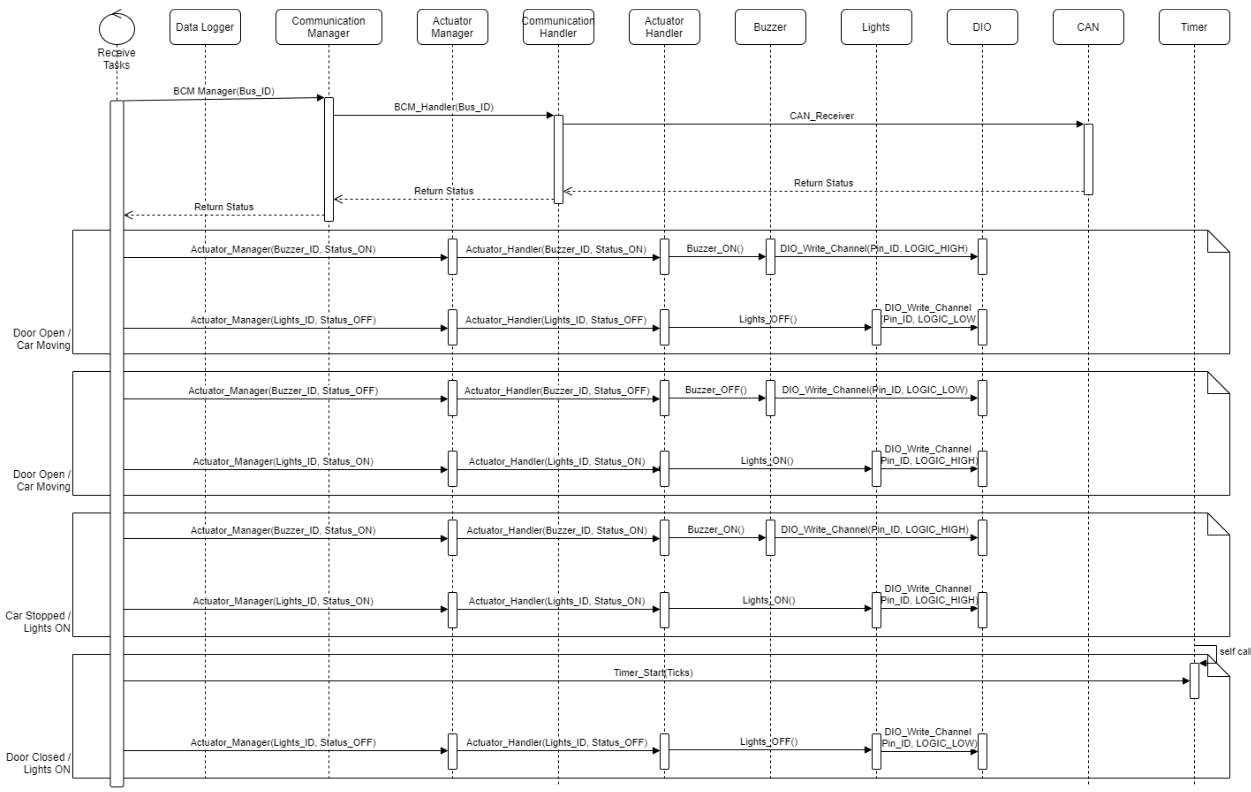



Buzzer
Initialize DIO
Buzzer ON
ON
Receive Buzzer State
OFF
Buzzer OFF


Lights
Initialize DIO
Lights ON
ON
Receive Lights State
OFF
Lights OFF


ECU 2 Operation
System Initialization
Periodic Receiving
Receive Status
Car Stop
Light Switch ON
Car Moving
Door Open
Car Moving
Light Switch ON
Door Closed
Car Switch ON
Buzzer ON
Lights ON
Buzzer ON
Lights OFF
Buzzer OFF
Lights ON
Lights OFF
After 3 Seconds

- Sequence Diagram of ECU 2:



- CPU Load for ECU 2:

We have just one task: (Assume Execution Time)

T_1: {Periodicity: 5ms, Execution Timer: 2ms}

Hyperperiod = 5 ms

CPU Load = Σ E/H = (2 /5) *100 = 40%

- CAN Bus Load

1 CAN frame contains around 125 bits.

Assume we are using a 500 kb/s bit rate:

∴ Bit time = 1 / bit rate => 1 / (500 * 1000) = 2µs.

This means 1 bit will take 2µs to transfer on the bus.

The approximate time to transfer one frame is 250µs.

The total number of frames = 350 frames every 1000ms.

Bus Load = (((350*250)/(1000*100))/100) = 8.75%