Automotive door control system design
Dynamic design Report

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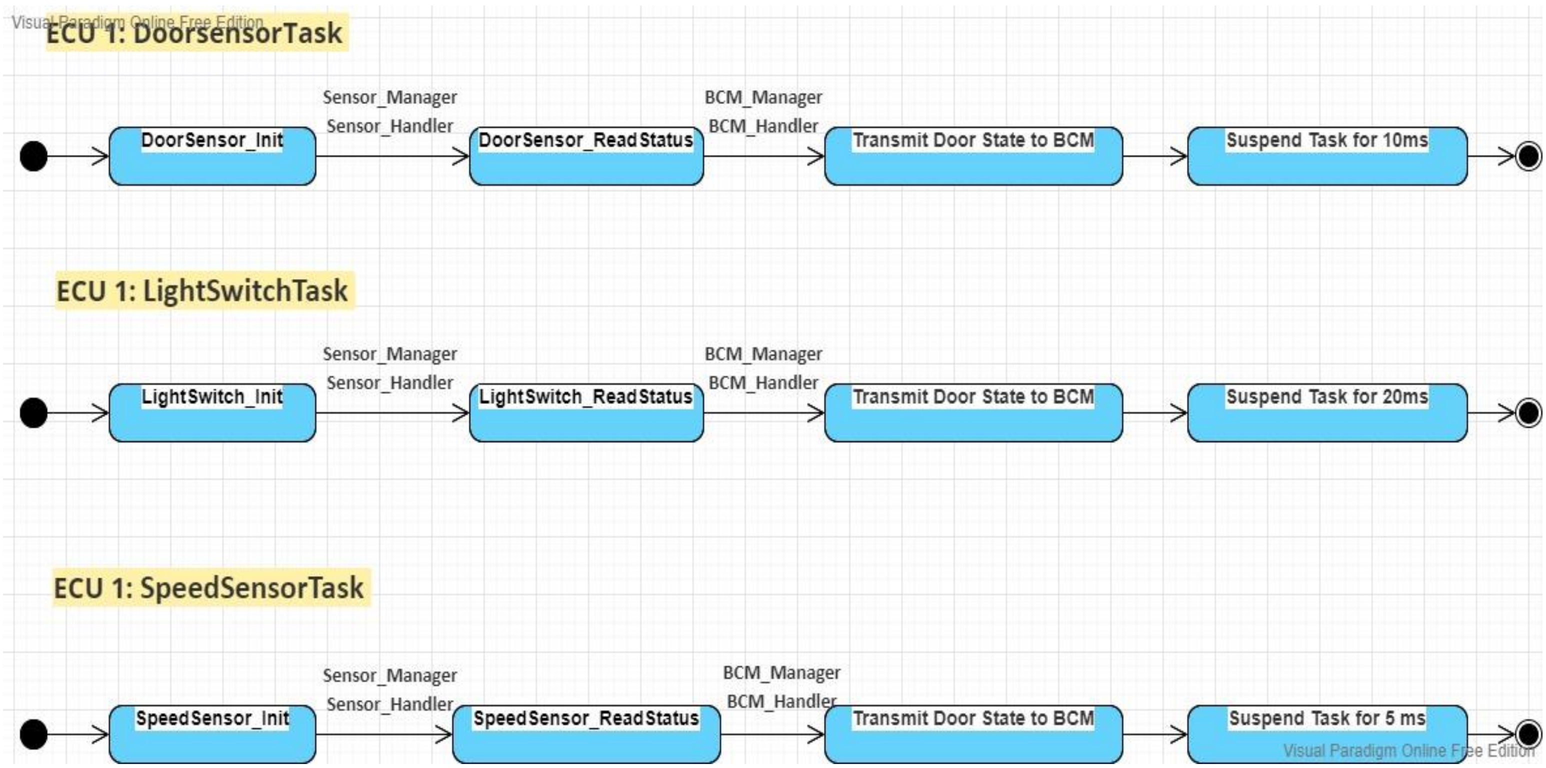
Dynamic Design:

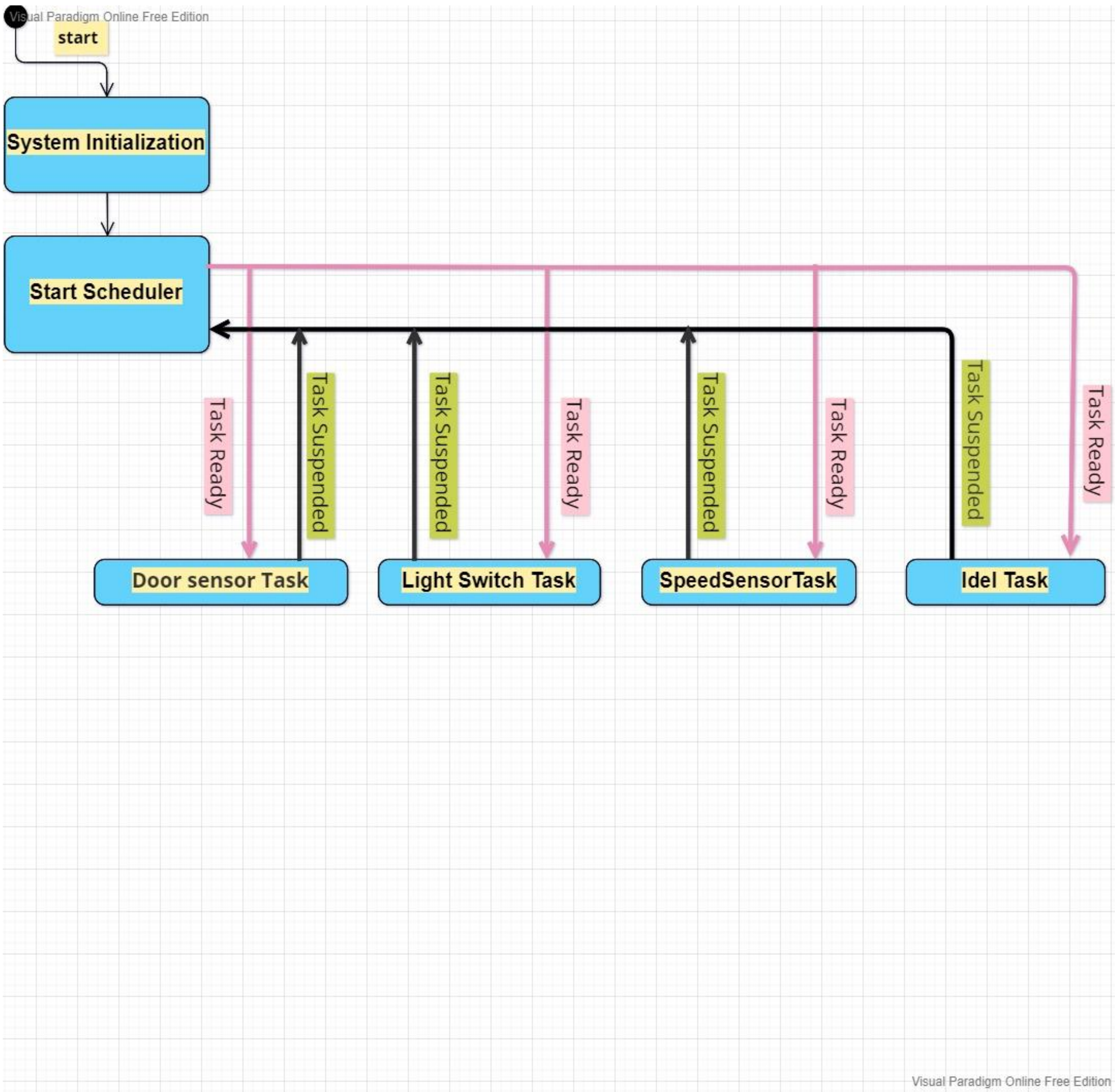
➢ **For ECU 1:**

1- state machine diagram for ECU 1 component:

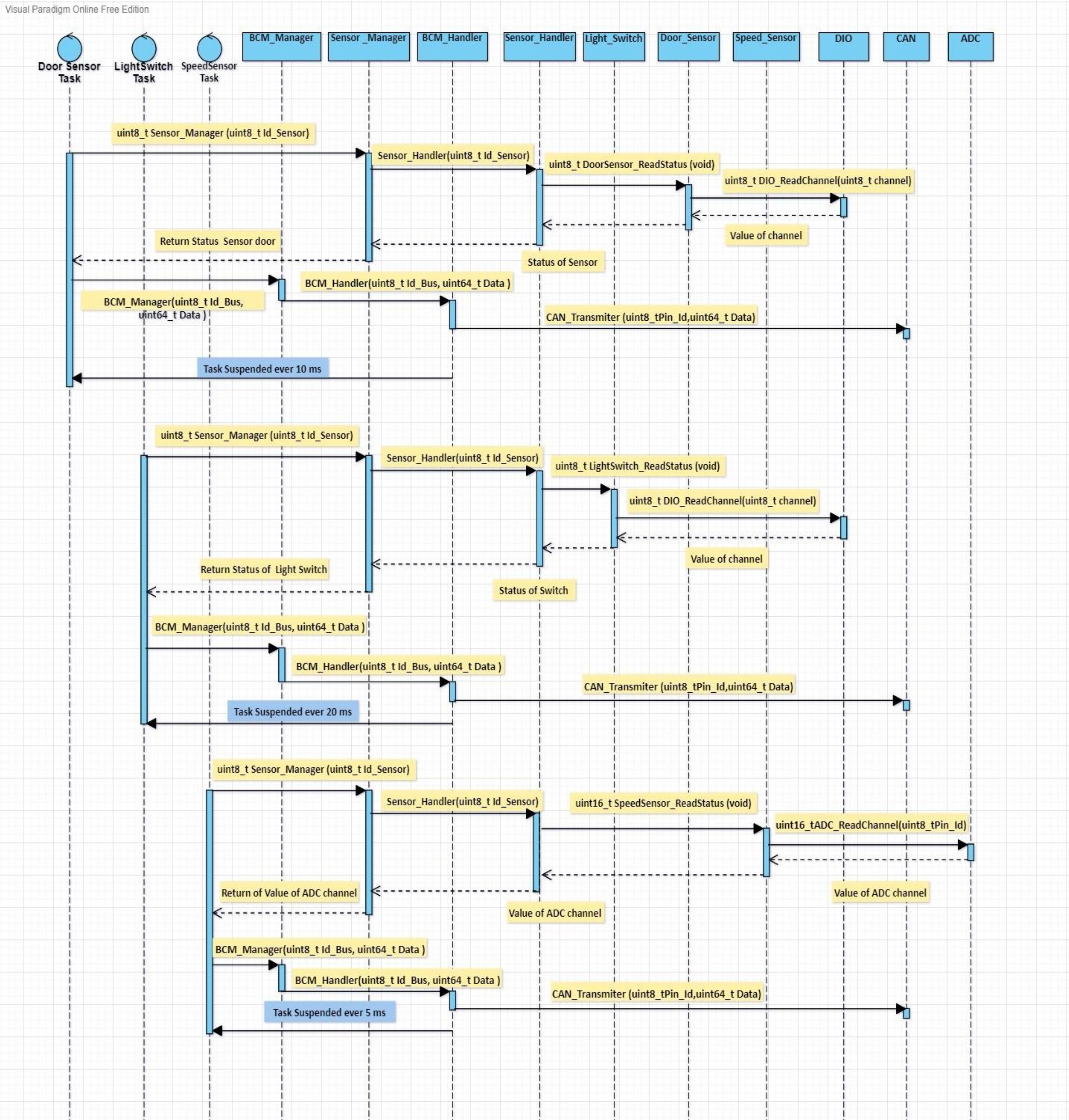


Notes: IDEL task exaction when the processor not exaction any task.

2- state machine diagram for the ECU 1 operation :



3- <u>sequence diagram for the ECU 1 :</u>



4- <u>Calculate CPU load for the ECU 1:</u>

The system contains three tasks assuming worst case scenario that the execution time of task is **500 µs.**

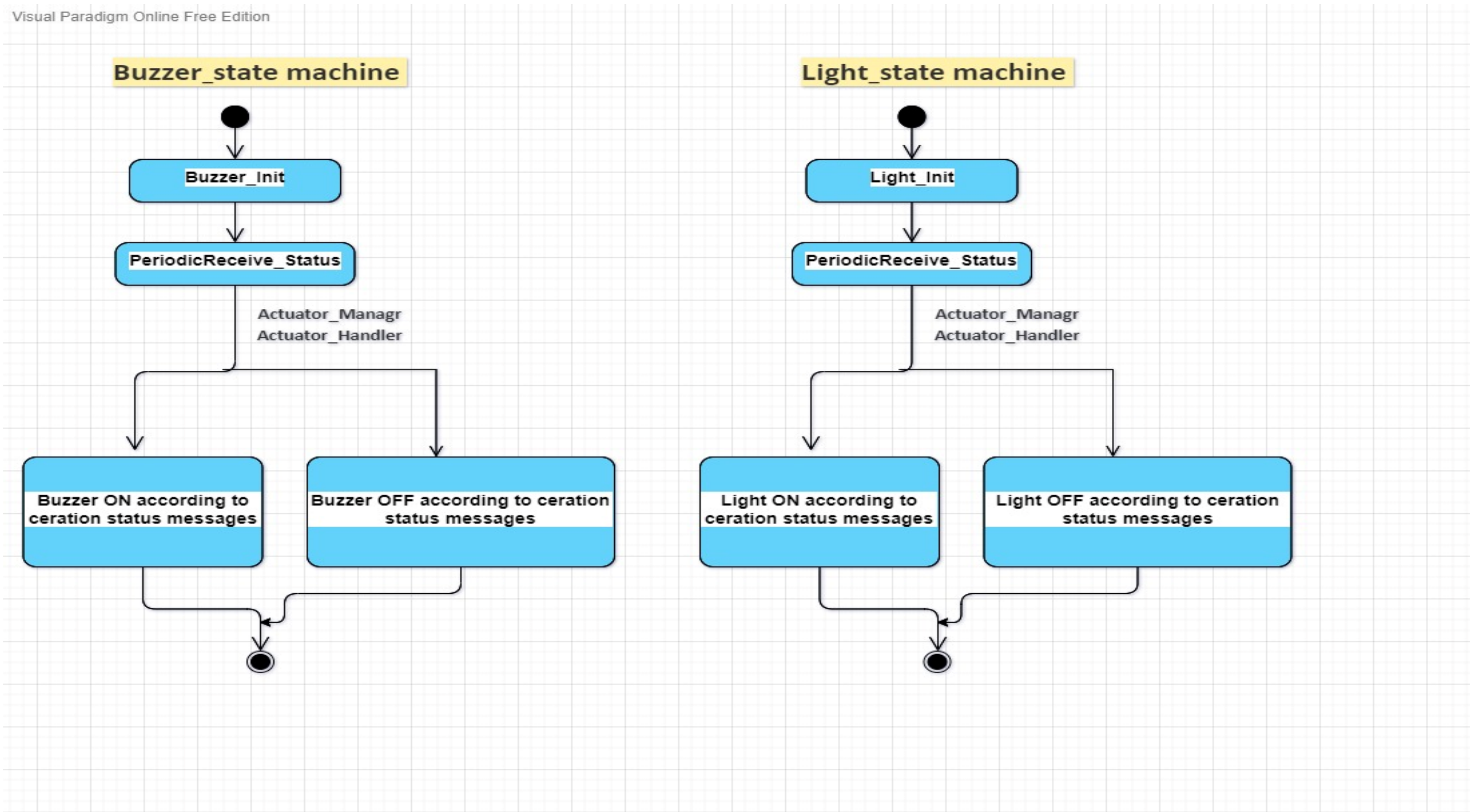
Name Task	Periodicity	Execution Time
Door Sensor Task	**10 ms**	**500 µs**
Light sensor Task	**20 ms**	**500 µs**
Speed Sensor Task	**5 ms**	**500 µs**

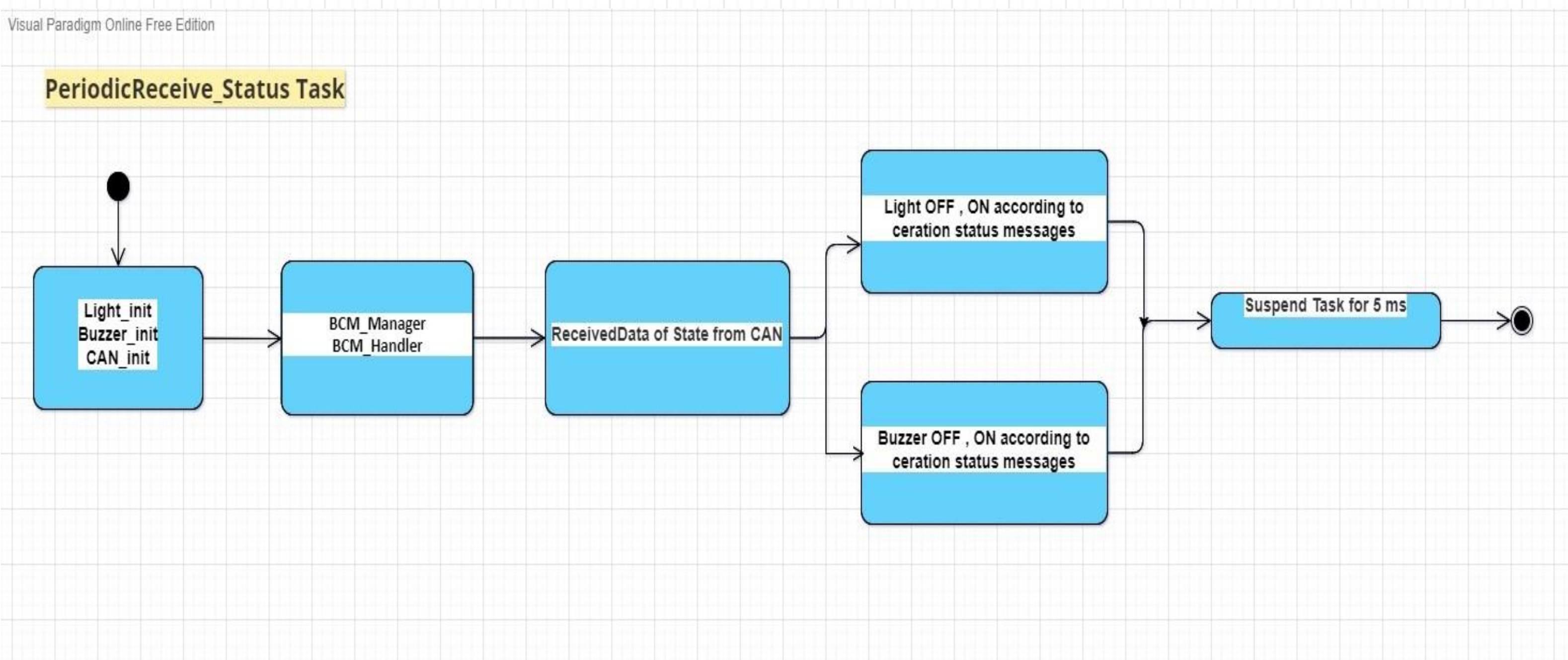
H (Hyper Period) = LCM(Pi) = 20 ms

CPU Load = ∑ E / H = (0.5*2 + 0.5*4 + 0.5*1) /20 * 100 = 17.5 %

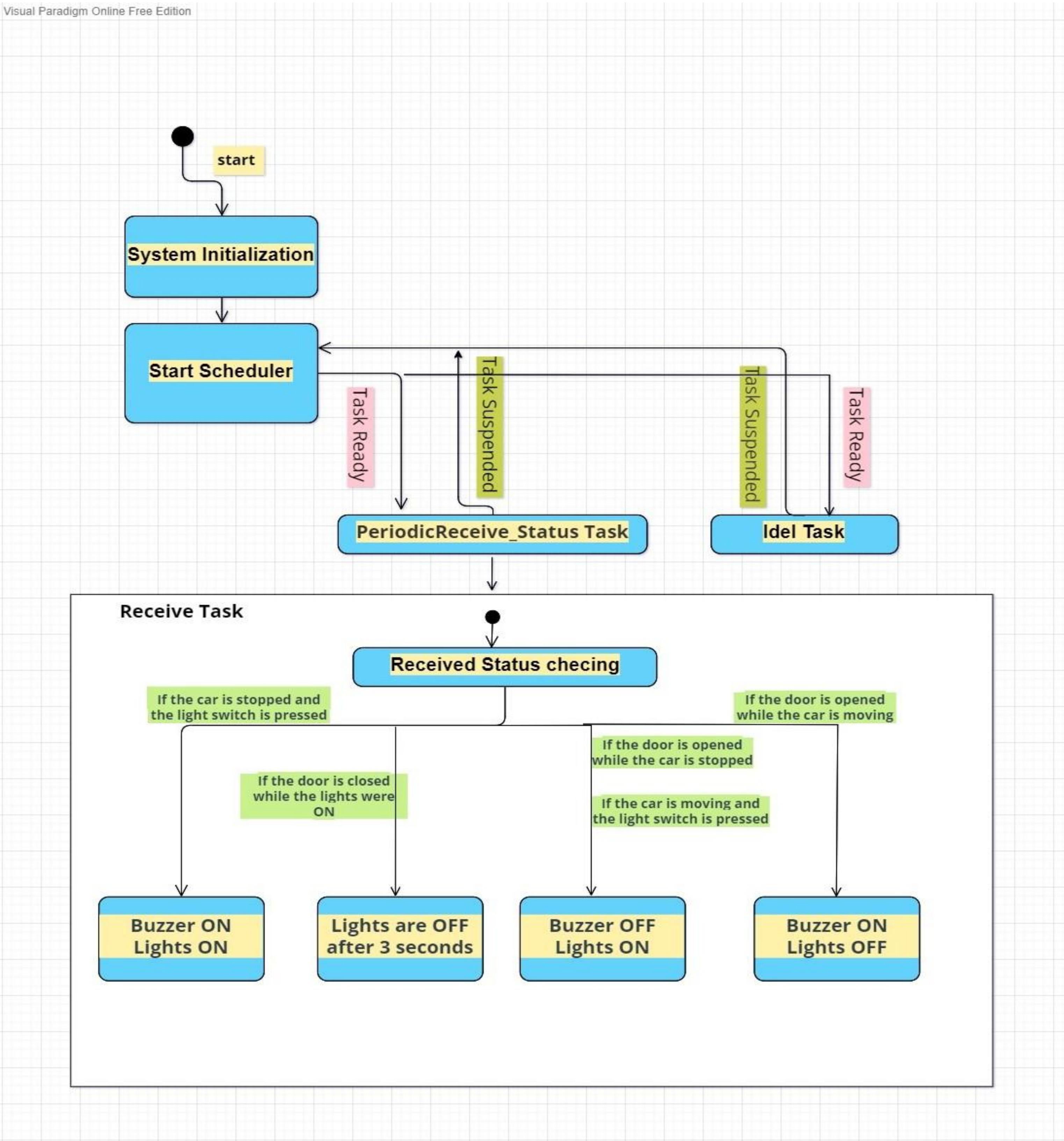
➢ **<u>For ECU 2:</u>**

1- <u>state machine diagram for ECU 2 component:</u>

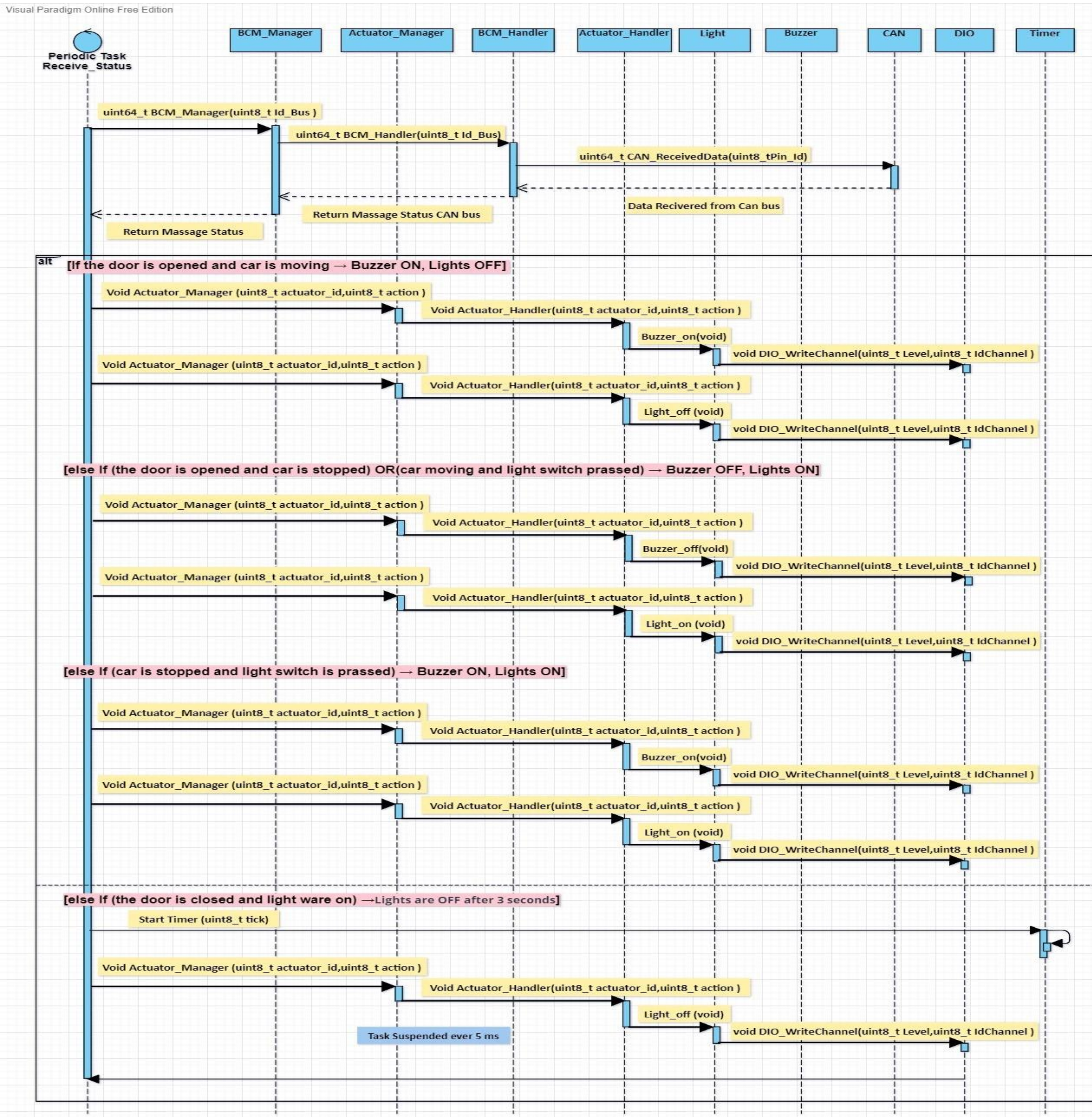




2- state machine diagram for the ECU 2 operations:



3- <u>sequence diagram for the ECU 2 :</u>



4- Calculate CPU load for the ECU 2:

The system contains one tasks assuming worst case scenario that the execution time of task is 1 ms.

Name Task	Periodicity	Execution Time
Periodic Task Receive Status	**5 ms**	**1 ms**

H (Hyper Period) = LCM(Pi) = 5 ms

CPU Load = ∑ E / H = (1*1) /5 * 100 = 20%

- ## Calculate bus load in your system:

  Notes: With what percentage of system bus was busy per 1 second

CAN Bus Load in System: time the CAN bus loaded with data

1 CAN frame contains approximately 125 bits.
assume we are using a 500 Kbit/s bit rate.
bit time = 1 / bit rate = 1 / (500 * 1000) s = 2 µs
Approximate time to transfer 1 frame = (2 µs/bit * 125 bit) = 250 µs.
We have multiple sending intervals on the bus:
1 frame every 5 ms → 200 frames every 1000 ms
1 frame every 10 ms → 100 frames every 1000 ms
1 frame every 20 ms → 50 frames every 1000 ms
This is in total = 350 frames every 1000 ms
Total time on bus = (total number of frames) * (time of 1 frame)
Total time on bus = 350 * 250 =87500 µs
Bus load = {((87500 µs *1000)\ 1000)* 100 %} = 8.75 %