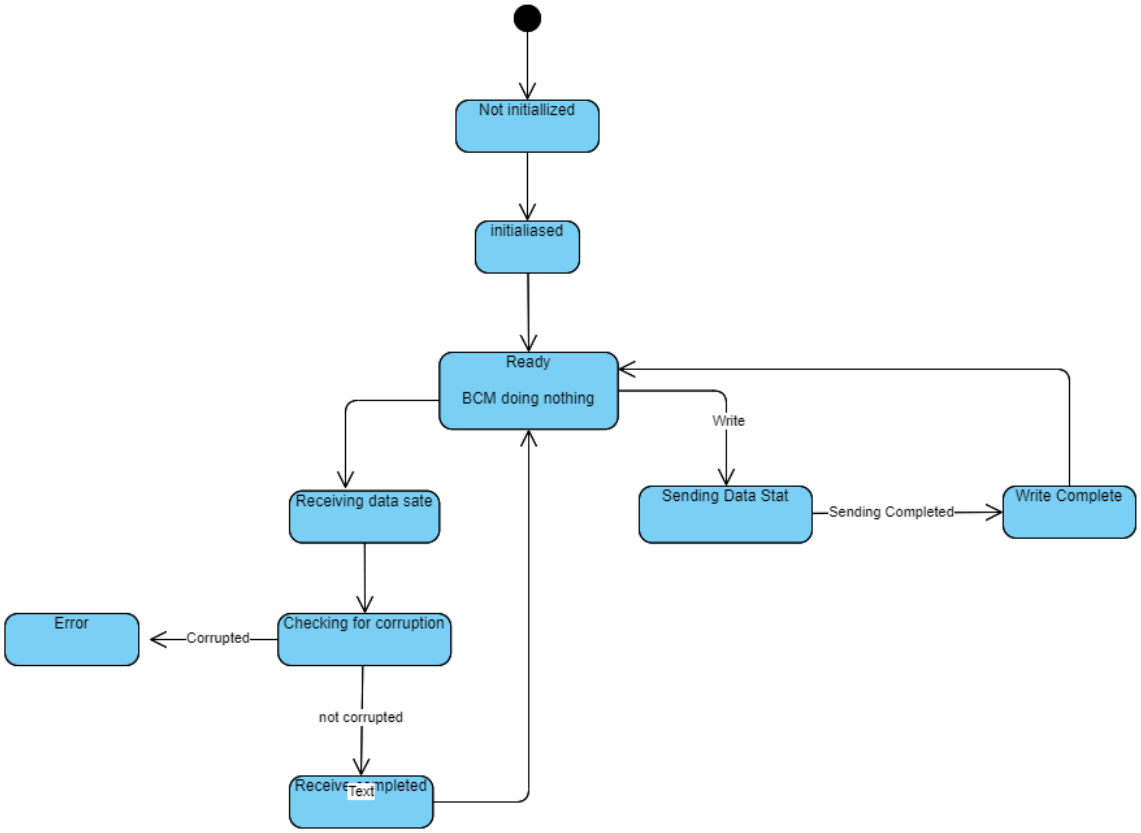
Dynamic Design

I. For ECU 1

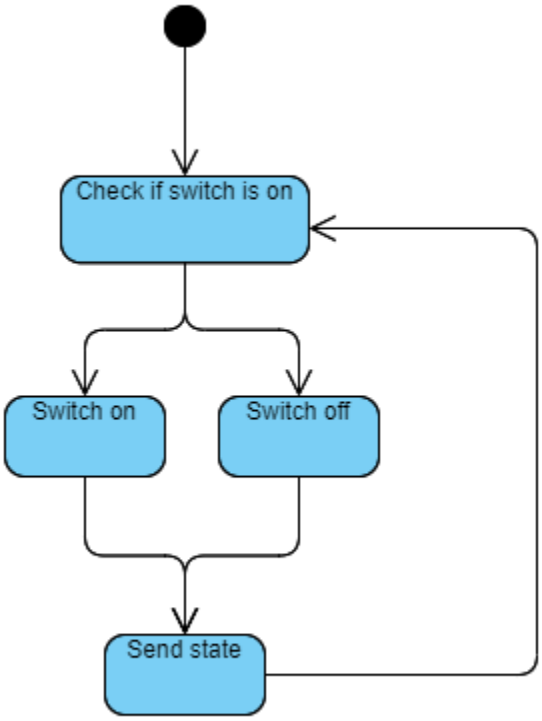
1. Draw a state machine diagram for each ECU component

A. OS Component

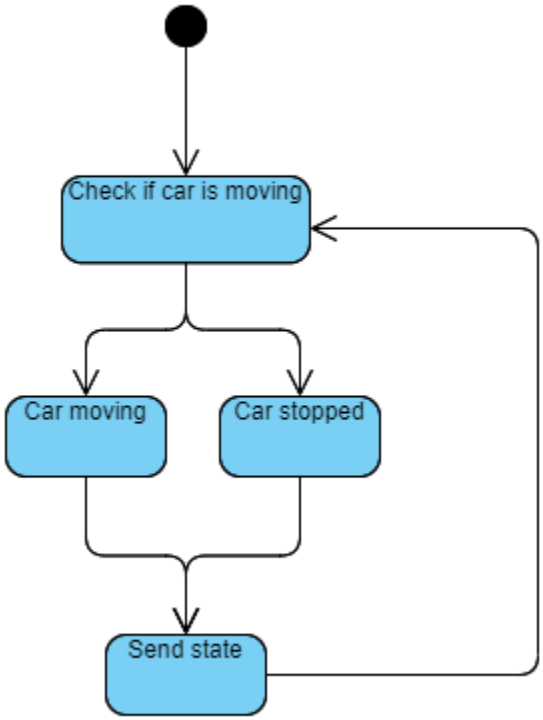
a. BCM



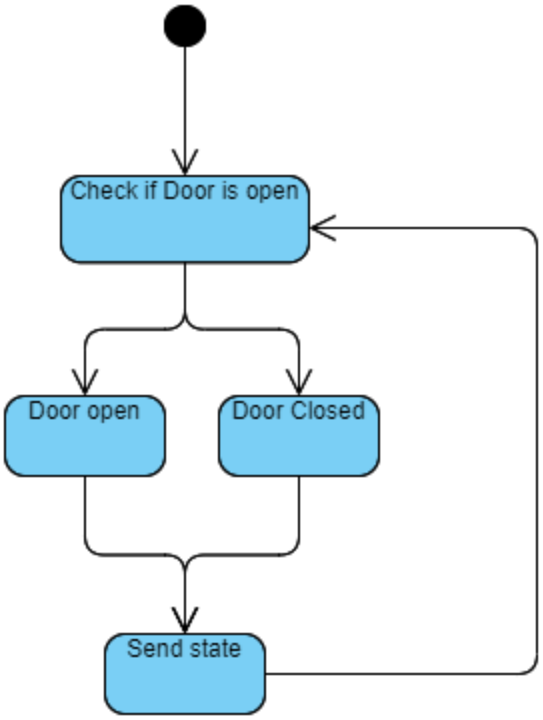
B. Software component
   a. Switch button state



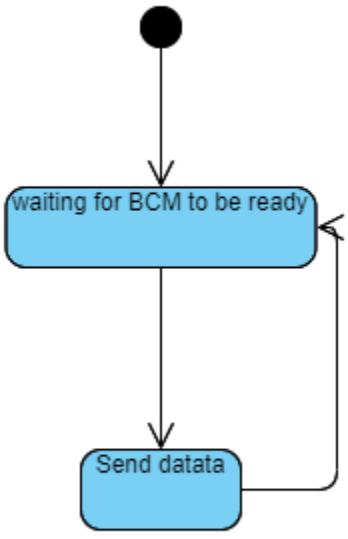
   b. Car state



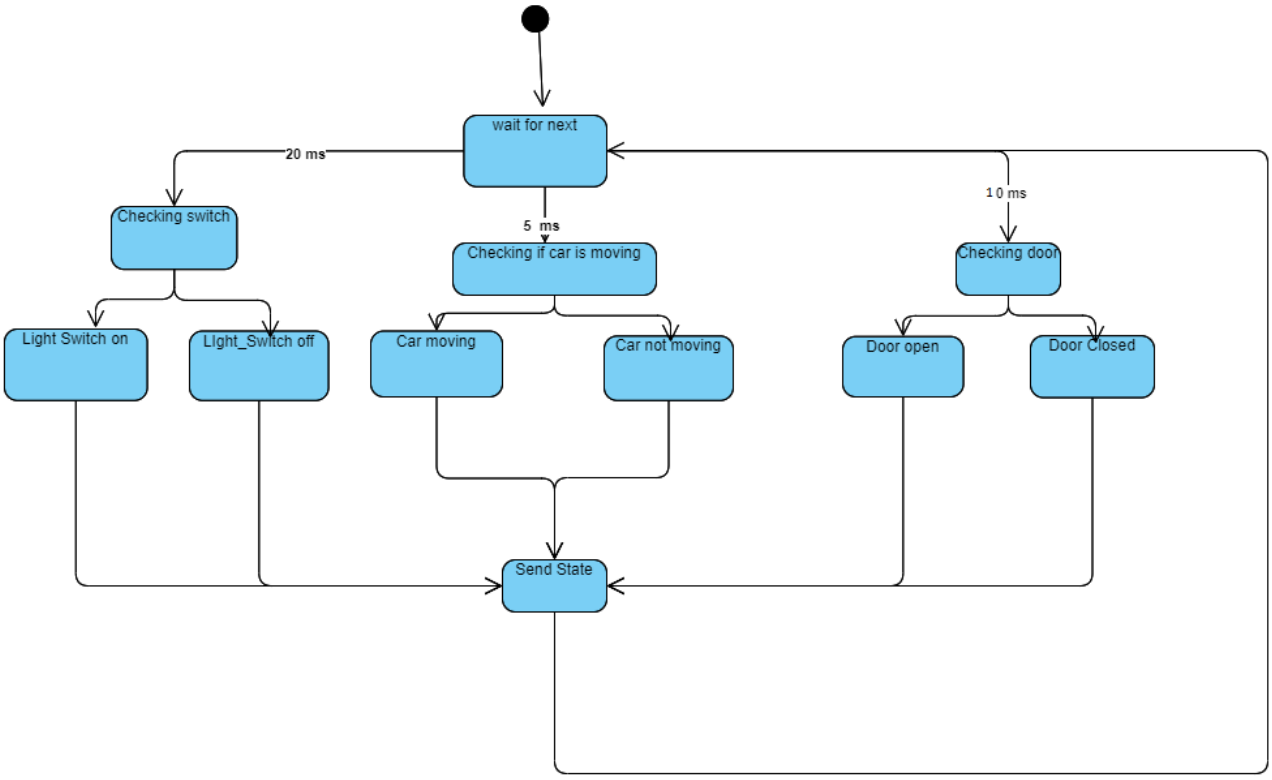
c. Door state



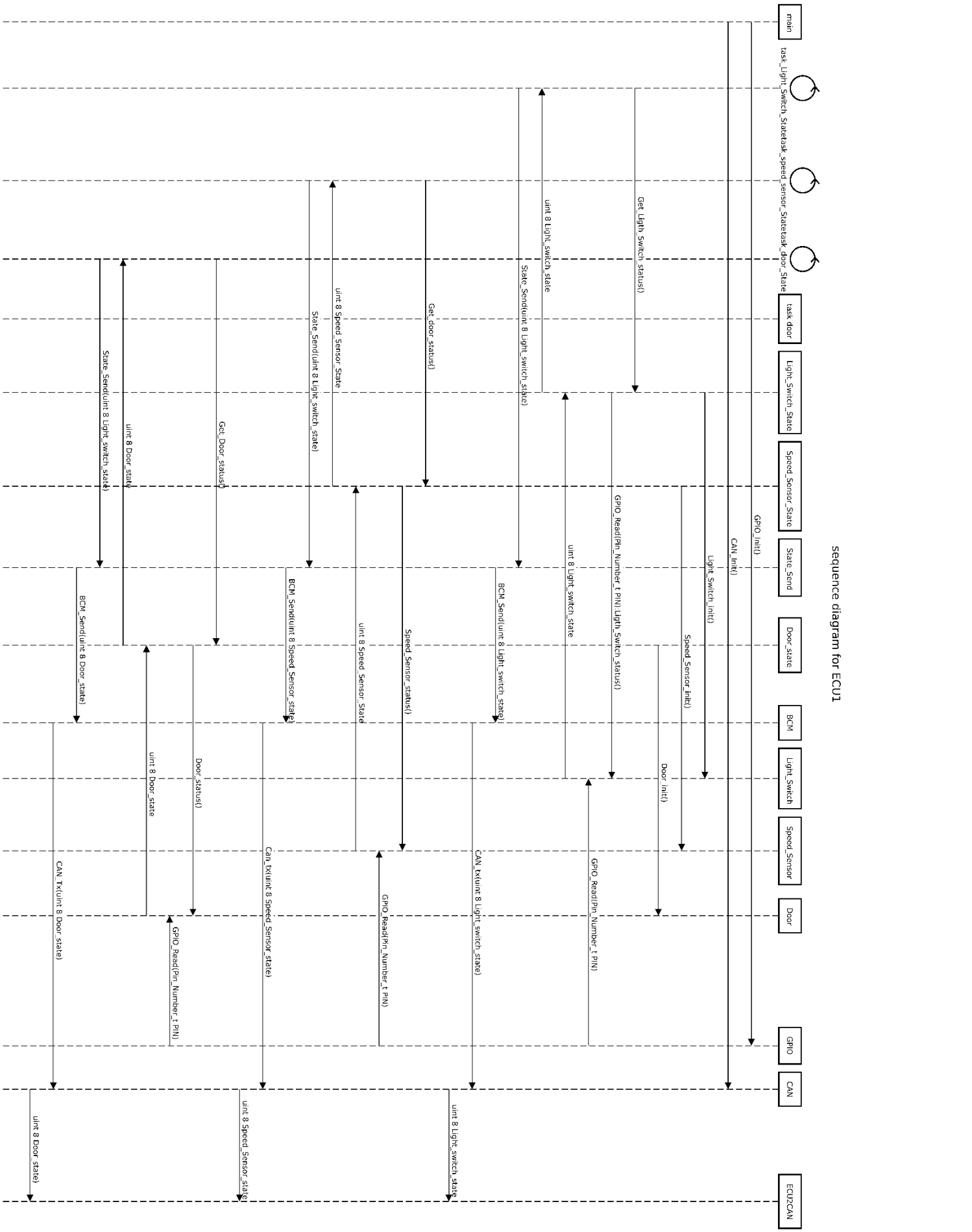
d. State send



2. Draw a state machine diagram for the ECU operation



3. Draw the sequence diagram for the ECU



4. Calculate CPU load for the ECU 1
   Note: no code was written and it is all just theoretical calculations

Hyper period will be 20 ms in my design

It will consist of 3 tasks of periods 5,10,20

Assuming each task is similar as they do basically the same thing and saying the entire process takes around 350 μs to execute and another 150 μs for debounce and any other safety related features.

So Execution time will be 500 μs for each task

So at 20 ms

The 5 ms periodicity task would have run four times for a total time of 2 ms

The 10 ms periodicity task would have run two times for a total time of 1 ms

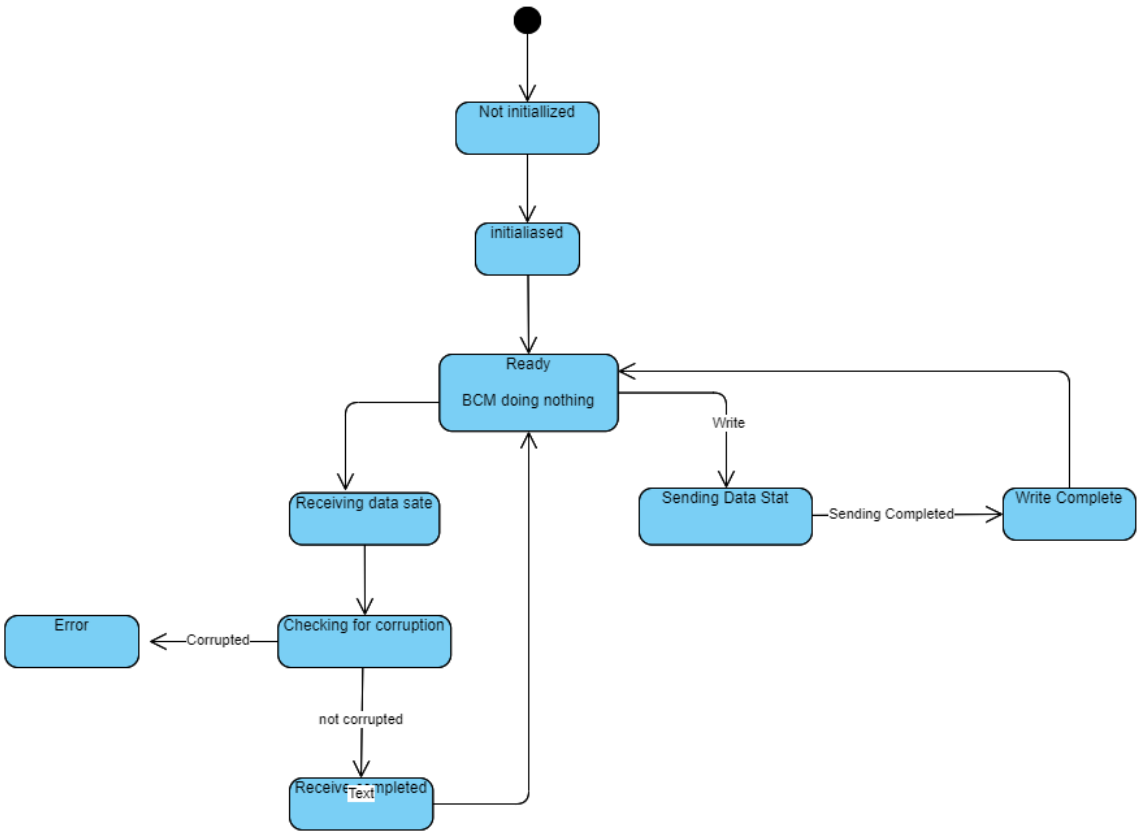
The 20 ms periodicity task would have run once for a total time of 0.5 ms

Then the total execution time is 1.75 ms

$$ECU\ 1\ load = \frac{Excecution\ time\ per\ hyper\ period}{hyper\ period} = \frac{3.5}{20} = 17.5\%$$

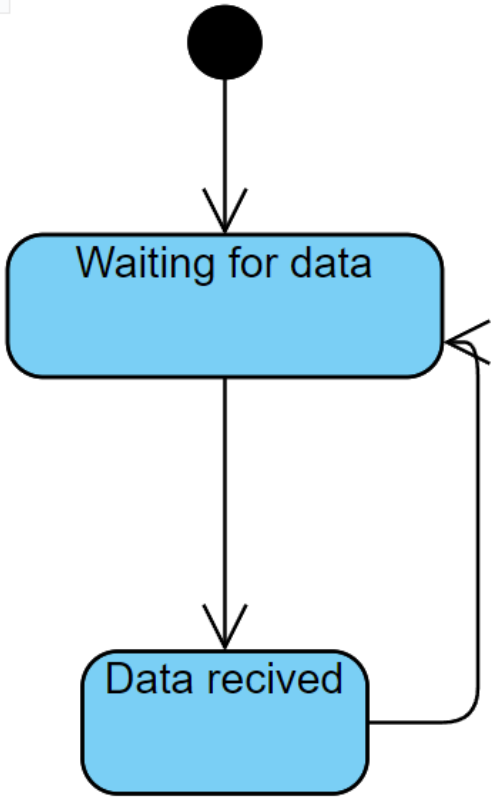
II. For ECU 2

1. Draw a state machine diagram for each ECU component
   A. OS Component
      a. BCM

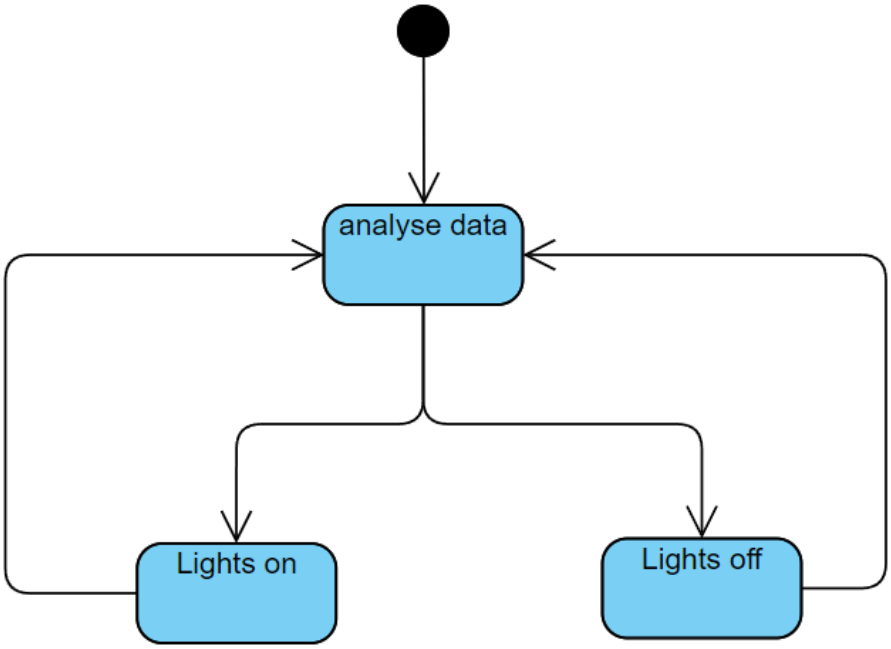


B. Software Components

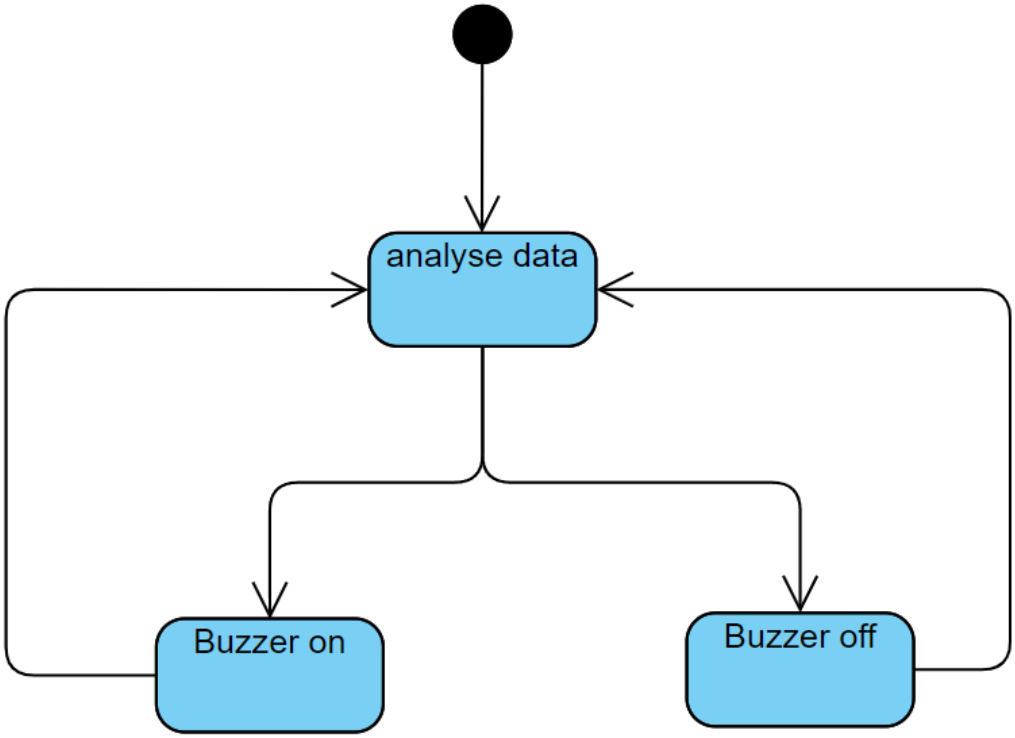
a. State send



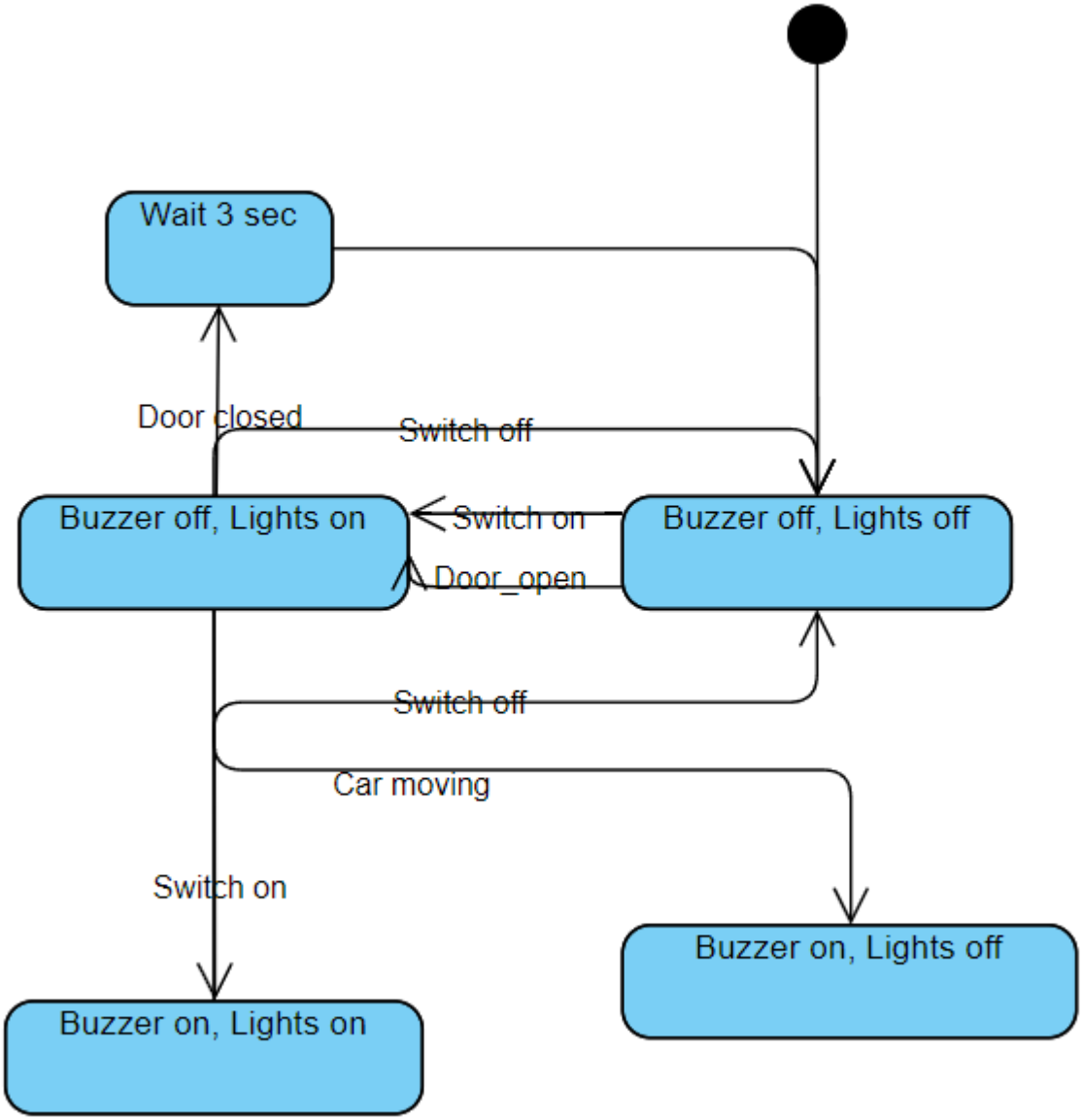
b. Lights Ctrl



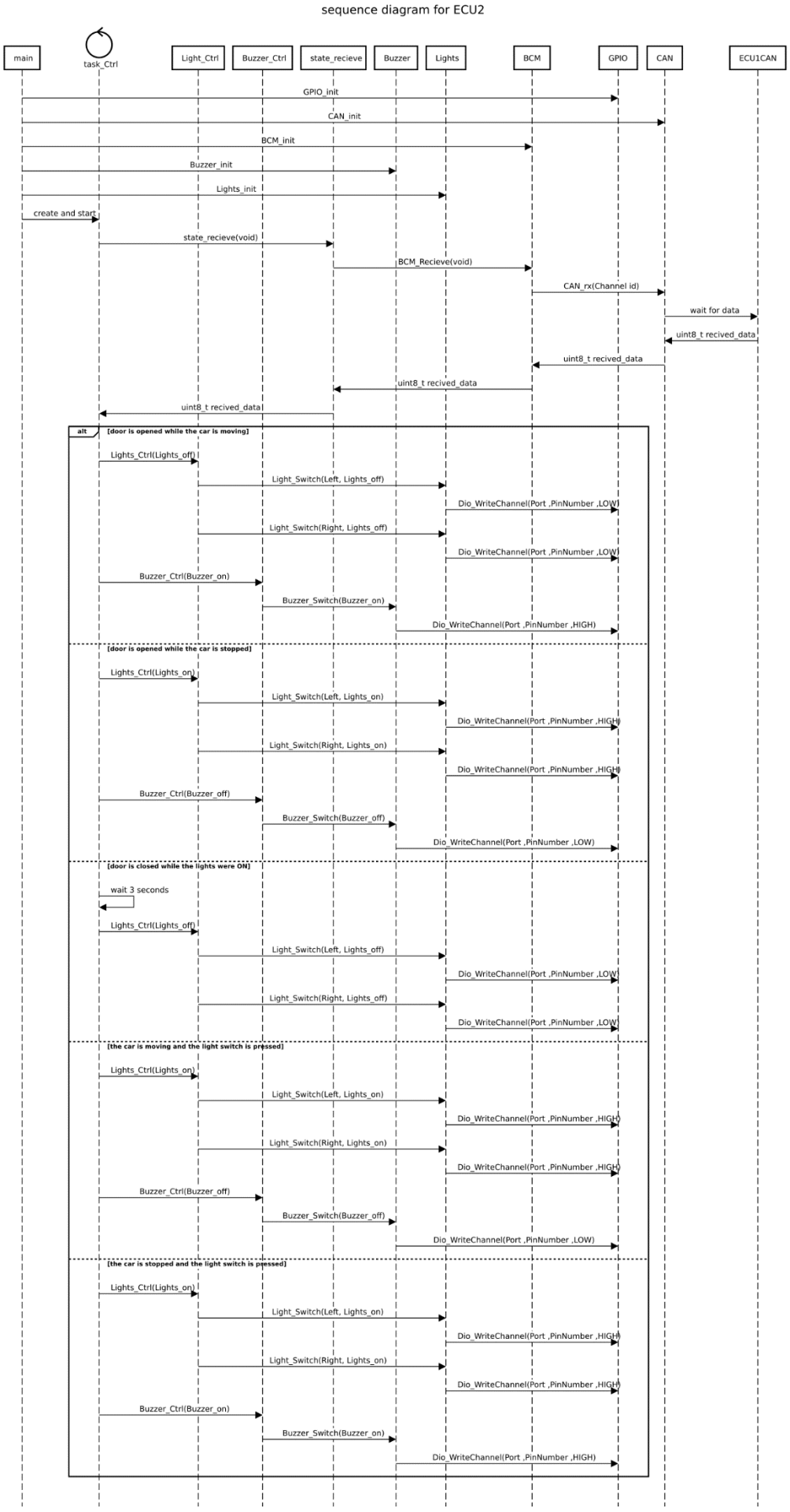
c. Buzzer Ctrl



2. Draw a state machine diagram for the ECU operation



3. Draw the sequence diagram for the ECU



4. Calculate CPU load for the ECU 2

Note: no code was written and it is all just theoretical calculations

Here it is only one task with 5 ms periodicity this task checks everything then controls

Assuming this task takes 400 μs to receive and Ctrl using the data from ECU 2

Then execution time will be 400 μs

$$ECU\ 1\ load = \frac{Excecution\ time\ per\ hyper\ period}{hyper\ period} = \frac{.4}{5} = 8\%$$

III. Calculate bus load in your system

Assuming single wire CAN interface

As single wire CAN wire has a rate of 33.3 kbit/s and we are sending a single byte at once

So, it takes around 300 μs for each operation we do exactly 7 CAN transmissions in 20ms

So, the average CAN bus load= $\frac{300\times7}{20000} = 10.5\%$