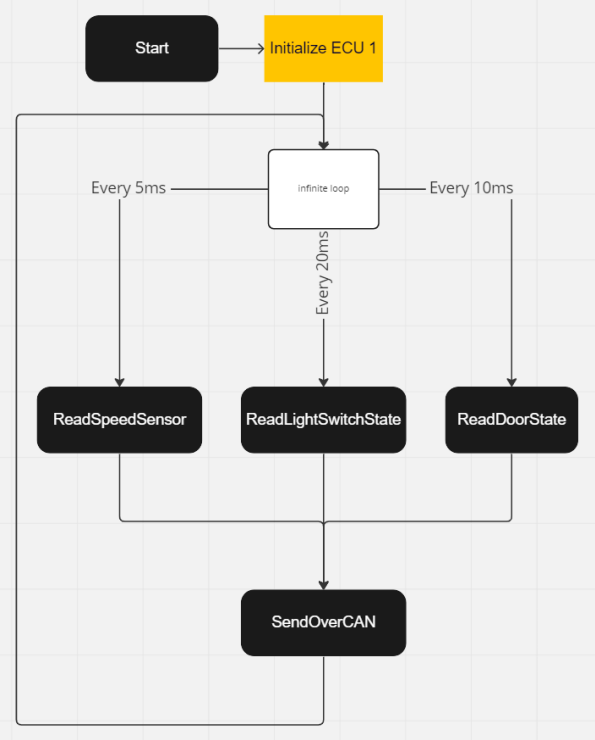
# System Dynamic Design

## Contents

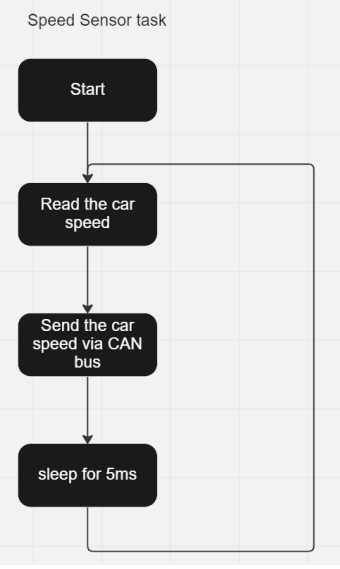
# 1 Flowcharts

## 1.1 ECU 1

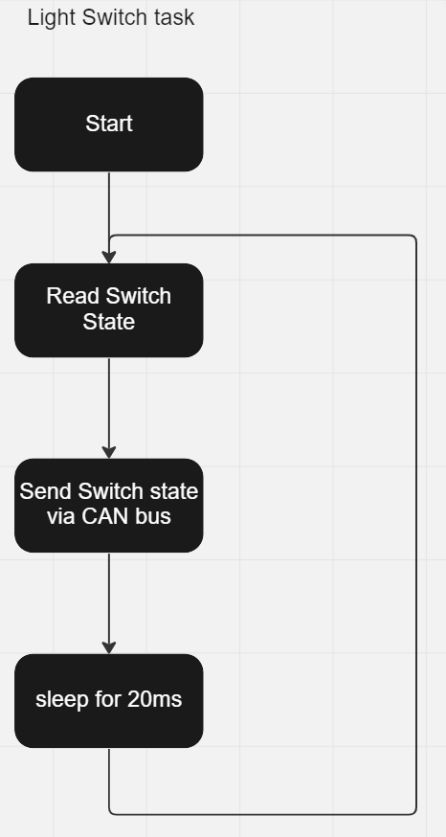
### 1.1.1 ECU 1 System flowcharts



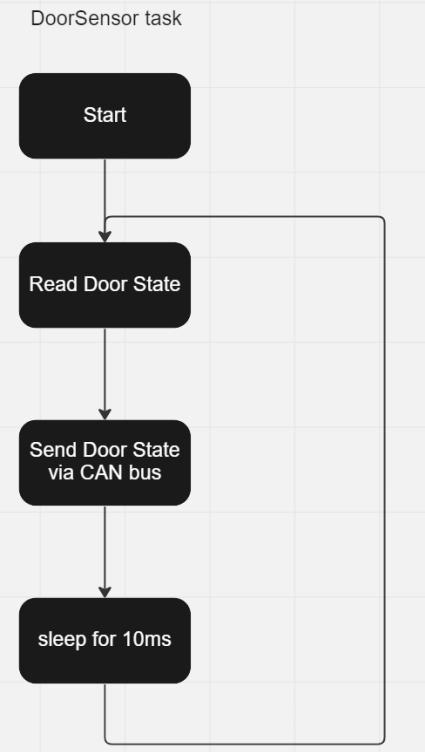

### 1.1.2 Speed sensor flow chart



### 1.1.3 Switch light flow chart

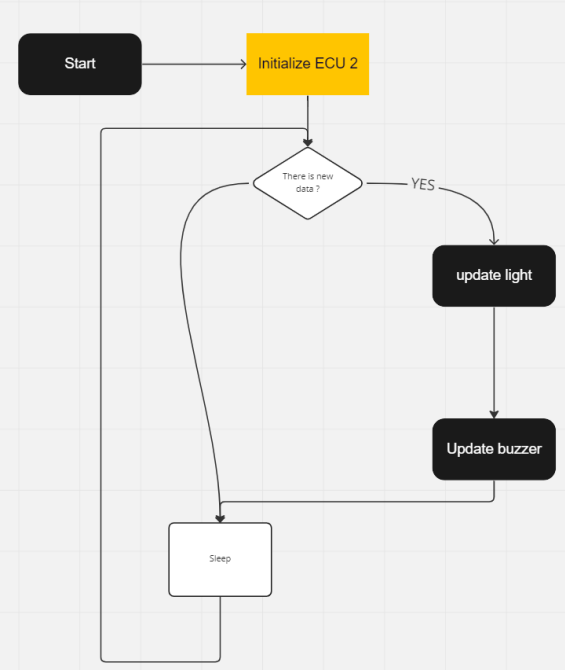



### 1.1.4 Door state flow chart

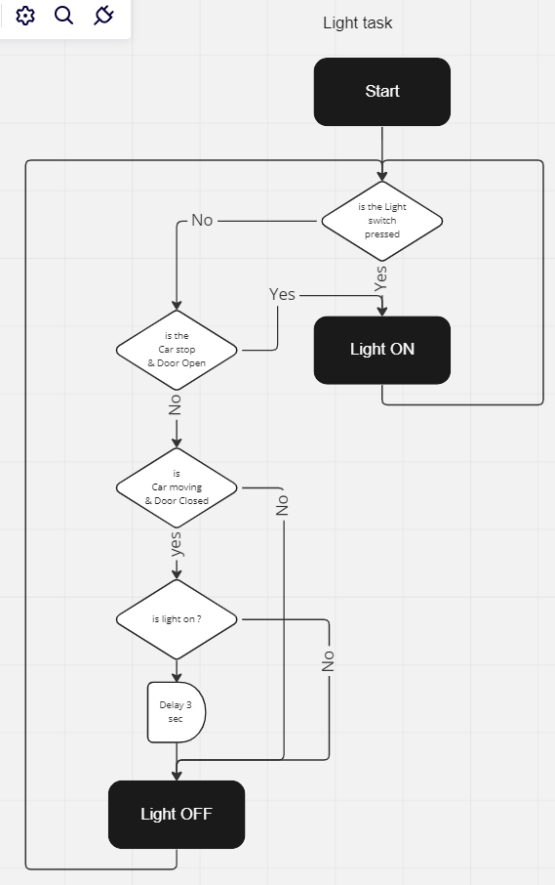


## 1.2 ECU 2

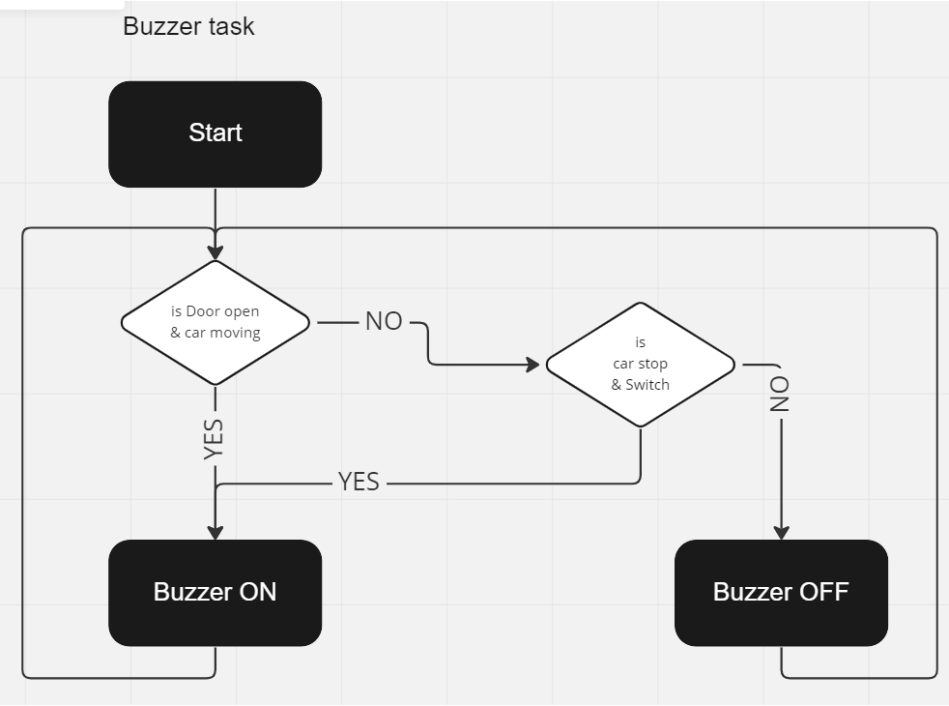
### 1.2.1 ECU 2 System Flow chart




### 1.2.2 Light Flow chart



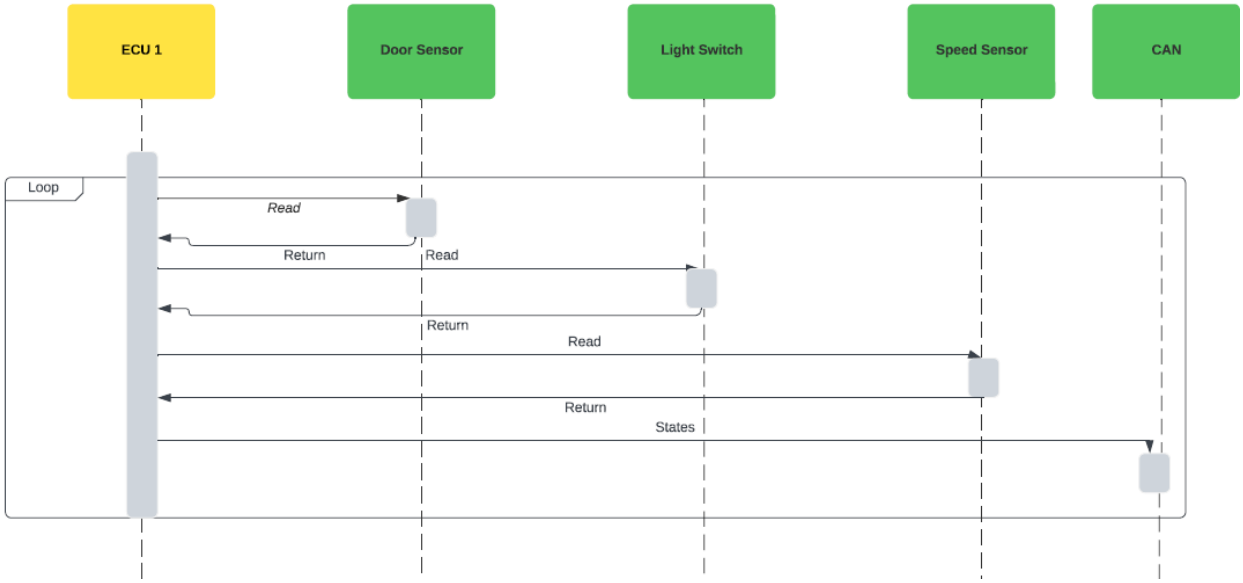
### 1.2.3 Buzzer Flow chart



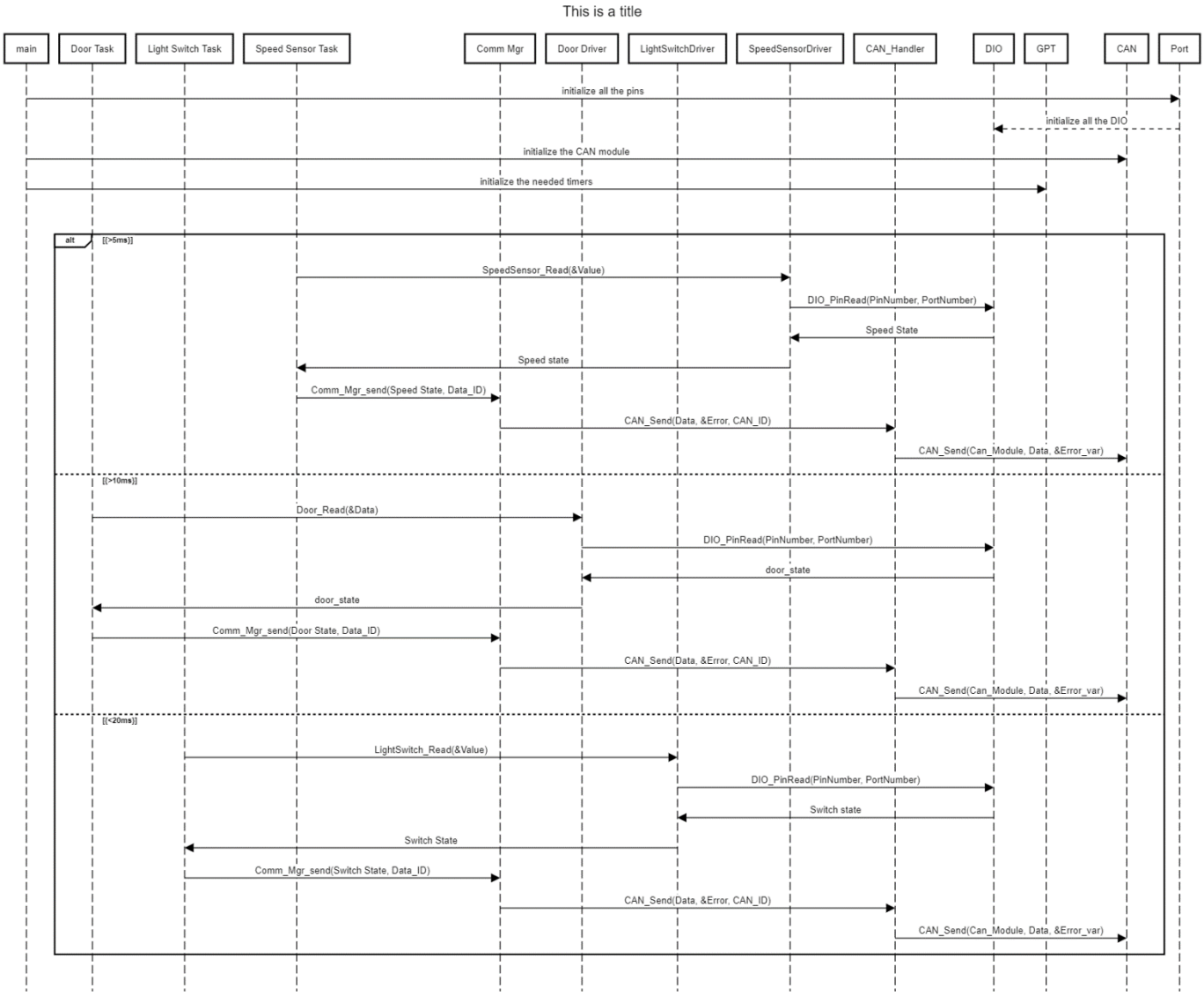
# 2 Sequence diagram

## 2.1 ECU 1

### 2.1.1 Simple sequence diagram for ECU 1

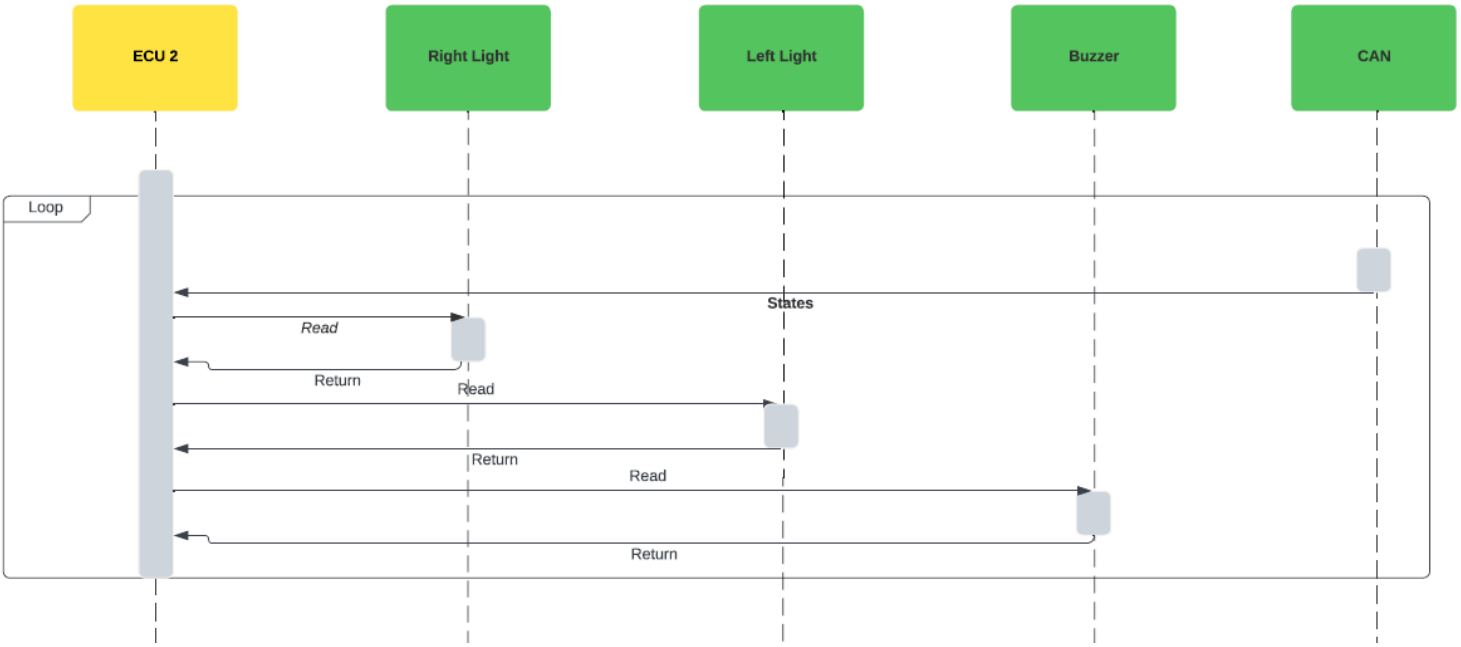


### 2.1.2 Complex sequence diagram for ECU 1

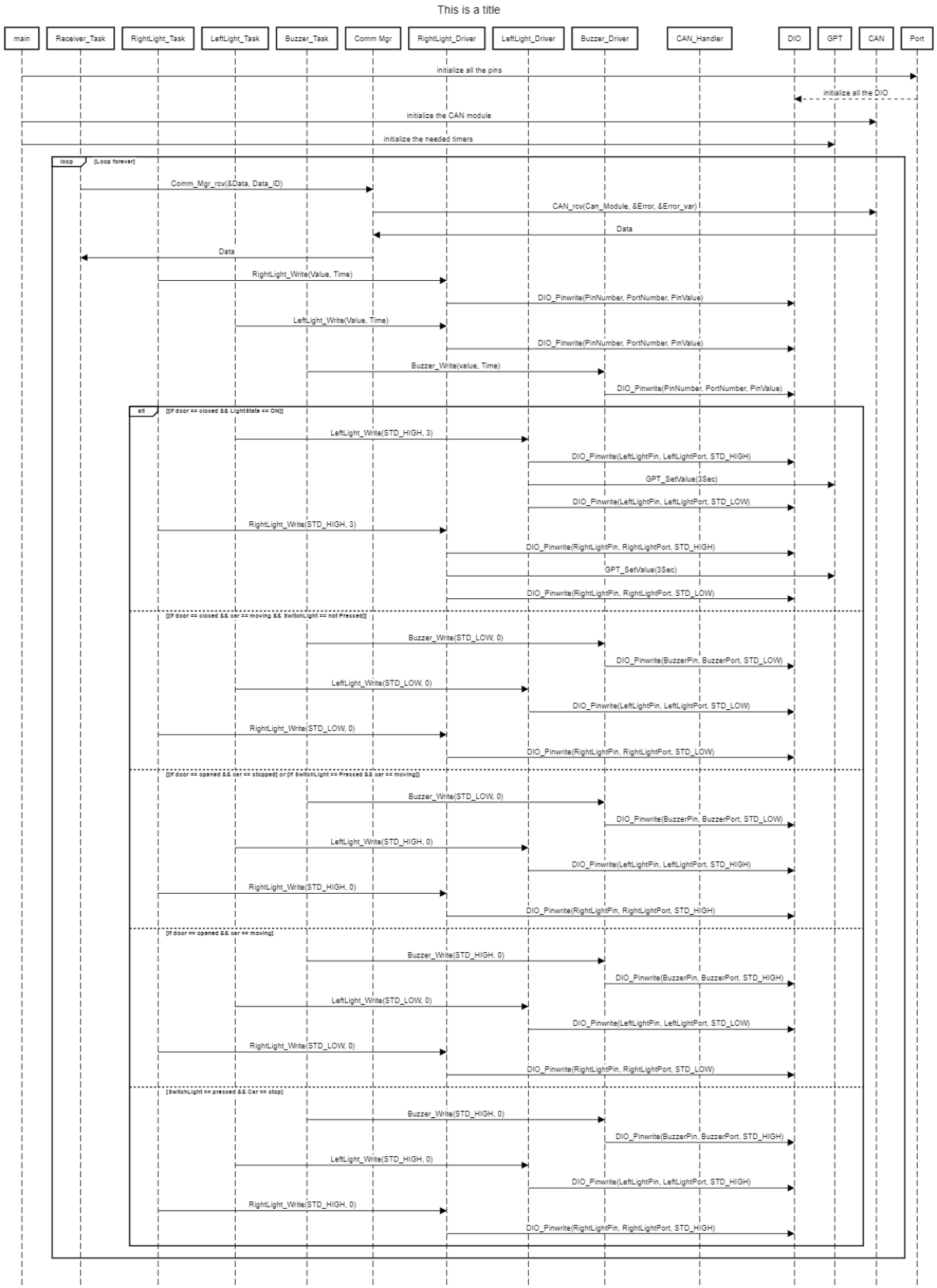


## 2.2 ECU 2

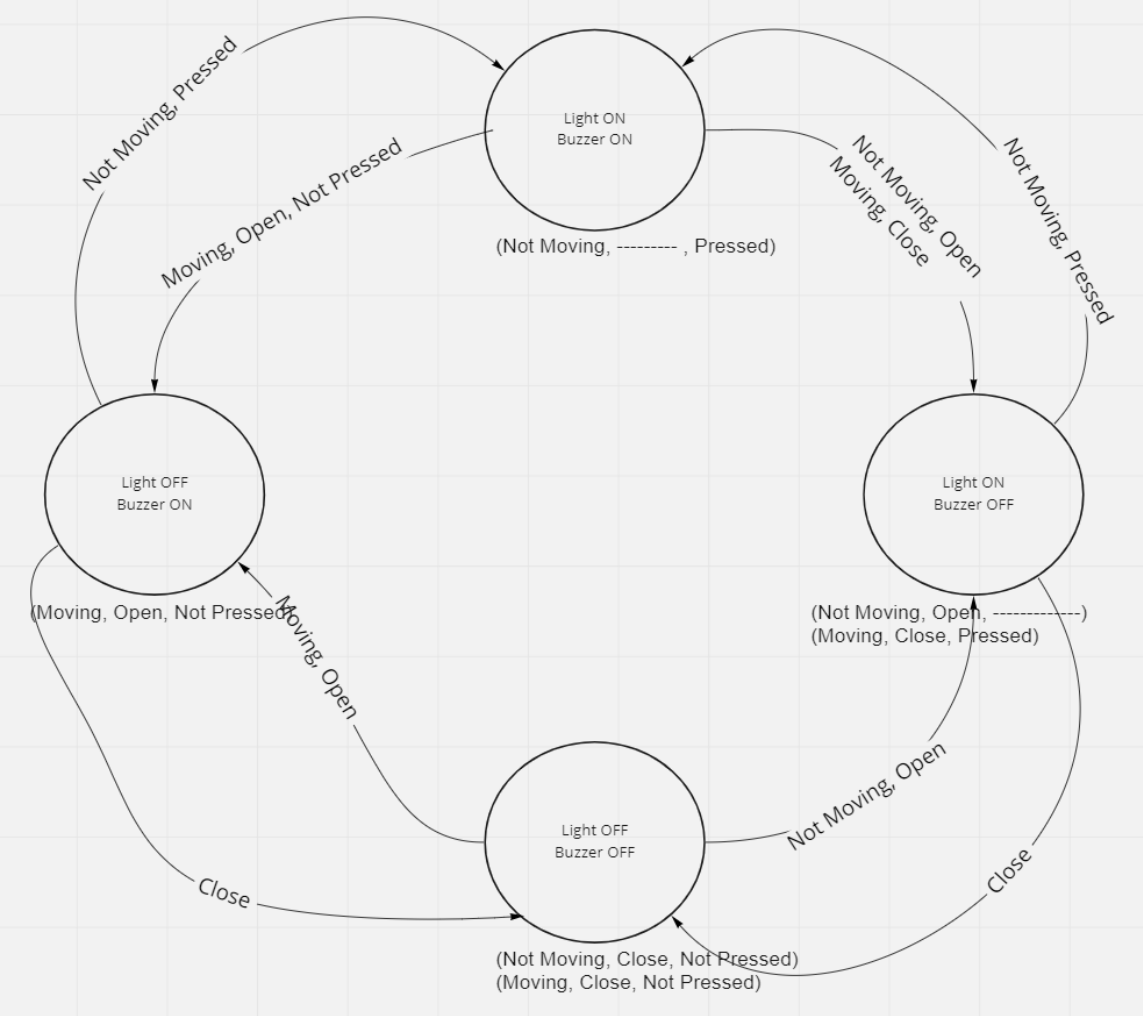
### 2.2.1 Simple sequence diagram for ECU 2



## 2.2.2 complex sequence diagram for ECU 2



# 3 System State machine diagram



# 4 Calculations

## 4.1 ECU 1 CPU load

Tasks number = 3

Tasks periods = 5, 10, 20 so, Hyperperiod = 20ms

Let's say that SpeedSensorTask will consume 800µs

DoorSensorTask will consume 600µs

SwitchLightTask will consume 500µs

In the hyperperiod the SpeedSensorTask will be executed 4 times, DoorSensorTask for 2 times and SwitchLightTask for 1 time.

So, the total execution in the hyperperiod will equal to

$$800 * 4 + 600 * 2 + 500 * 1 = 4.9\text{ms}$$
$$CPU\ Load = \frac{4900}{20000} = 24.5\%$$

## 4.2 ECU 2 CPU load

Tasks number = 3

LightTask period = 5ms, consume 300µs

BuzzerTask period = 10, consume 150µs

ReceiveTask period = 10, consume 500µs

So, Hyperperiod = 10ms

In the hyperperiod the LightTask will be executed 1 times, BuzzerTask for 1 times and ReceiveTask for 2 time.

So, the total execution in the hyperperiod will equal to

$$300 * 2 + 150 * 1 + 500 * 1 = 1.25\text{ms}$$
$$CPU\ Load = \frac{1250}{10000} = 12.5\%$$

## 4.3 Calculate Bus load in the system

### 4.3.1 CAN bus in general

CAN bus can use multiple baud rates up to 1 Mbit/s, and the low speed can go up to 125 kbit/s

Single-wire CAN interfaces can communicate with devices at rates up to 33.3 kbit/s.

So, our speed is 33. 3 kbit/s, which means 34099 per second

Which means that it sends 34 bits per 1ms

Which means that it sends 1 byte every 250µs

### 4.3.2 CAN calculations in our system

so, in 20ms it can send up to 80 bytes if all what the system doing is sending data.

But we are using 4900µs of the 20ms, so we have 15ms for sending the data we need

Which mean that in our system we can send 60 bytes

SpeedSensorTask = $\frac{800}{5000} = 16\%$

Which leave us to 4200µs to send the data, which allow us to send up-to 16 bytes

DoorSensorTask = $2 * \frac{800}{10000} + \frac{600}{10000} = 22\%$

Which leave us to 7800µs to send the data, which allow us to send up-to 31 bytes

SwitchLightTask = $4 * \frac{800}{20000} + 2 * \frac{600}{200000} + \frac{500}{20000} = 24.5\%$

Which leave us to 4900µs to send the data, which allow us to send up-to 60 bytes

so, the first task can send up to 16 byte and the second task can send up to 15 bytes and the third task can send up to 30 bytes.

But if each task only sends 1 byte

The CPU load = 7 * 250 = 1.75ms of CPU load in CAN transmitting