MCU 1

1- State Machine

Start

Initialize GPIO,CAN, SysTick,ADC → System Tick

Periodic every 20ms

send light switch status

Read switch status → send via can

periodic every 10ms

Read door sensor status → send via can
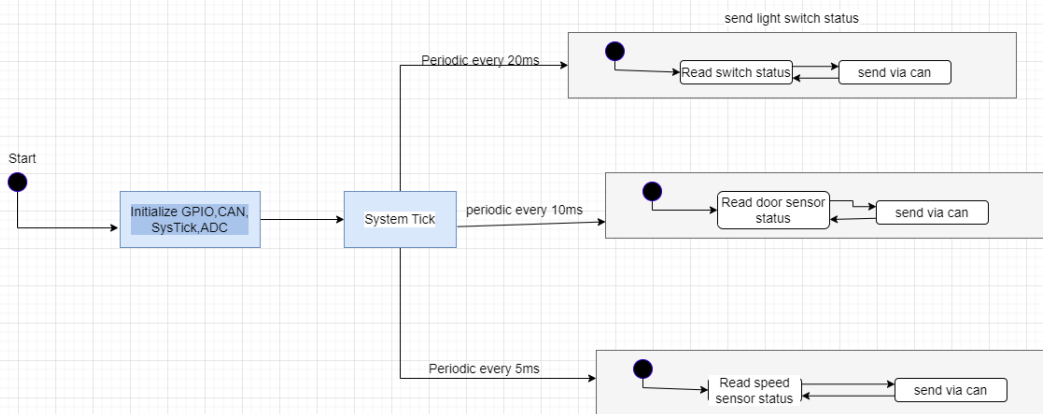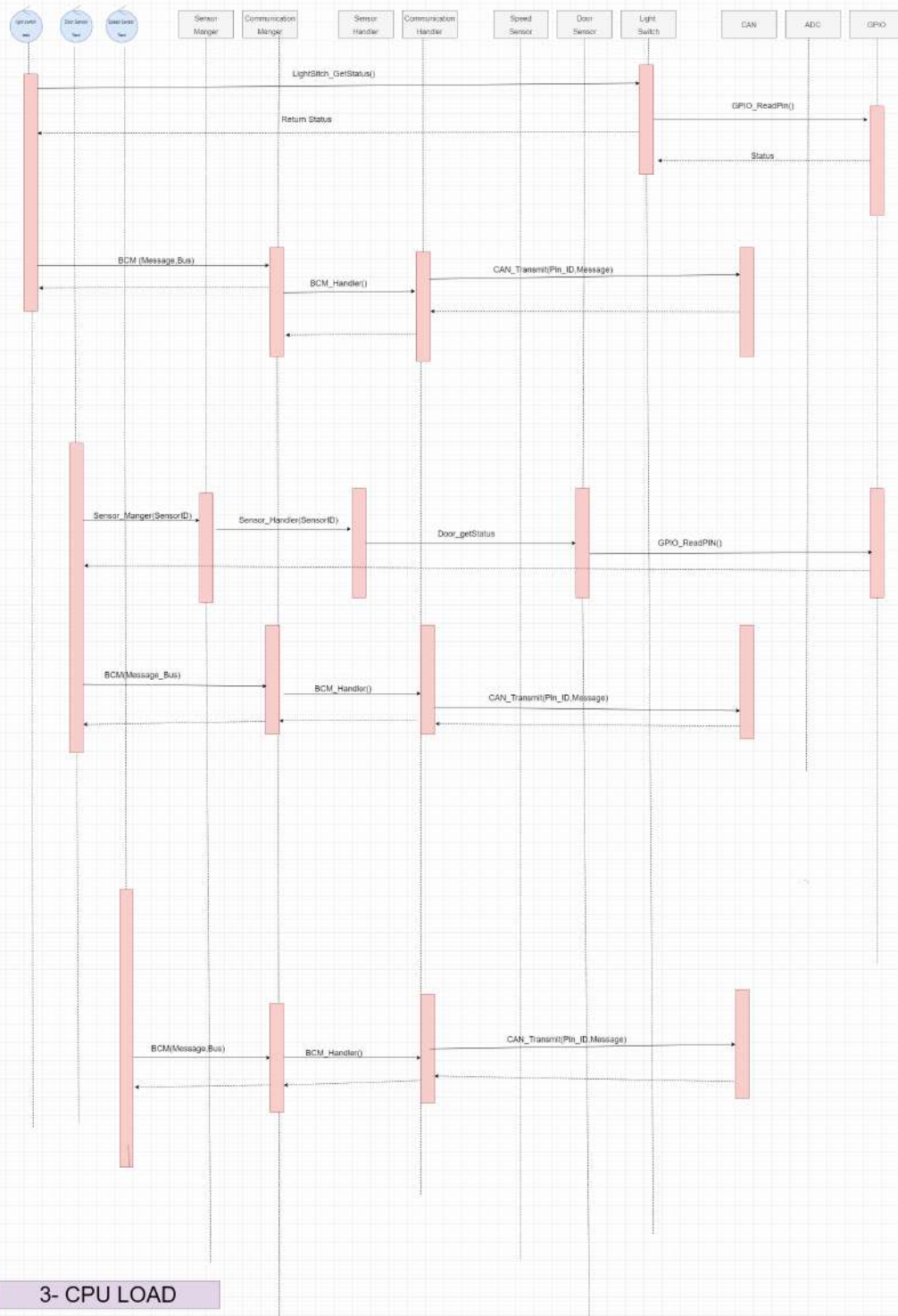
Periodic every 5ms

Read speed sensor status → send via can

2- Sequence Diagram

3- CPU LOAD

The system contains three tasks assuming worst case scenario that the execution time of task is 1ms.
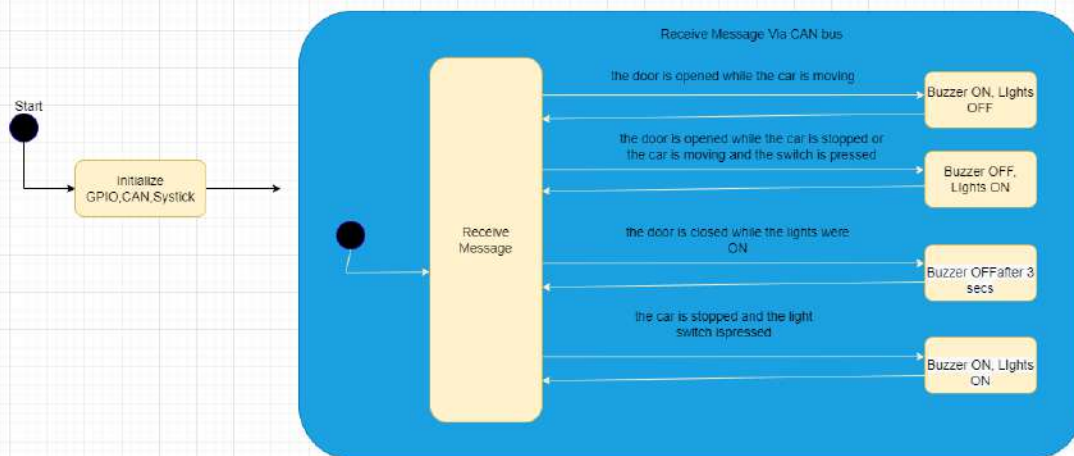
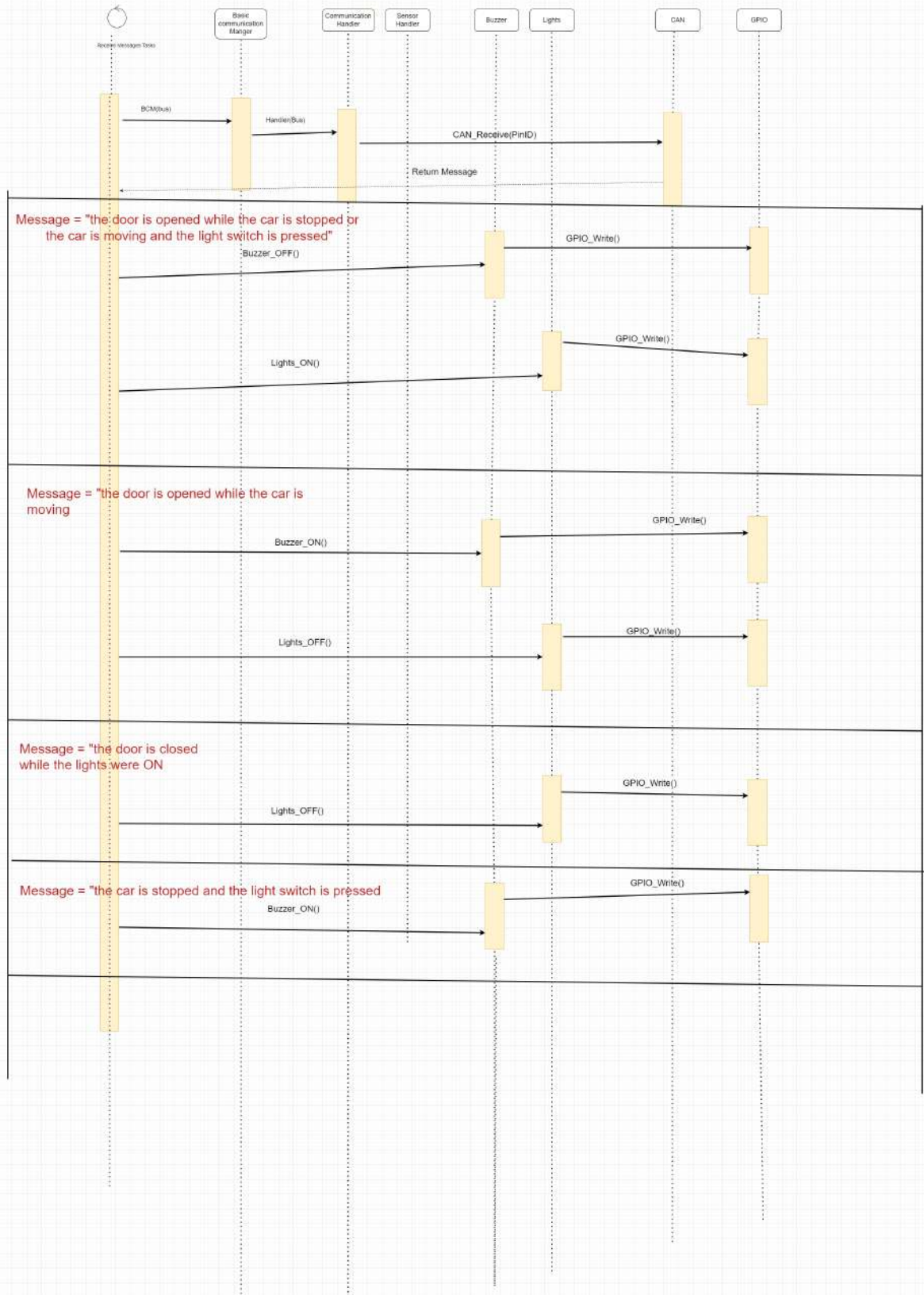T1 {P:20, E:1} T1 {P:10, E:1} T1 {P:5, E:1}

Hyper period = 20

U = (E1 + E2 + E3) / H = ((1*1) + (1*2) + (1*4) / 20) * 100 % = 35%

MCU 2

1- State Machine Diagram

Start

initialize GPIO,CAN,Systick

Receive Message Via CAN bus

Receive Message

the door is opened while the car is moving

Buzzer ON, Lights OFF

the door is opened while the car is stopped or the car is moving and the switch is pressed

Buzzer OFF, Lights ON

the door is closed while the lights were ON

Buzzer OFFafter 3 secs

the car is stopped and the light switch ispressed

Buzzer ON, Lights ON

Receive Messages Tasks

Basic communication Manger

Communication Handler

Sensor Handler

Buzzer

Lights

CAN

GPIO

BCM(bus)

Handler(Bus)

CAN_Receive(PinID)

Return Message

Message = "the door is opened while the car is stopped or the car is moving and the light switch is pressed"

GPIO_Write()

Buzzer_OFF()

GPIO_Write()

Lights_ON()

Message = "the door is opened while the car is moving

GPIO_Write()

Buzzer_ON()

GPIO_Write()

Lights_OFF()

Message = "the door is closed while the lights were ON

GPIO_Write()

Lights_OFF()

Message = "the car is stopped and the light switch is pressed

GPIO_Write()

Buzzer_ON()

3- CPU Load

The system contains only one task assuming execution time 2.5ms And periodicity is 5ms.
T1 {P:5, E:2.5}
Hyper period = 5
U = E1 / H = ((1*2.5) / 5) * 100 % = 50%

BUS LOAD

Assuming CAN frame consists of **125 bit** and using **500 kBit/s**

Bit time = 1 / bit rate = 1 / (500 * 1000) s **= 2 us**

Frame time = number of bits * bit time = 125 bit * 2 us = **250 us**

the bus load for 3 messages every 5, 10 and 20 ms can be calculated by
- 1 frame every 5 ms = 200 frame every 1000 ms
- 1 frame every 10 ms = 100 frame every 1000 ms
- 1 frame every 20 ms = 50 frame every 1000 ms

Total frames in 1 s = **350**
Total time on bus = 350 * 250 us = 87500 us
Bus load in 1 s = (87500 * 1000 ms / (1000)) * 100 % = **8.75 %**