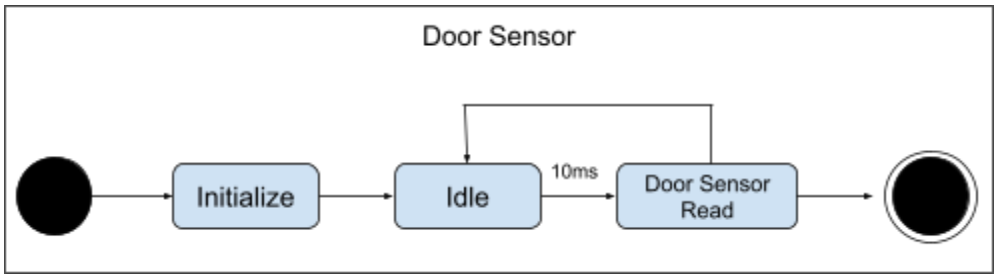
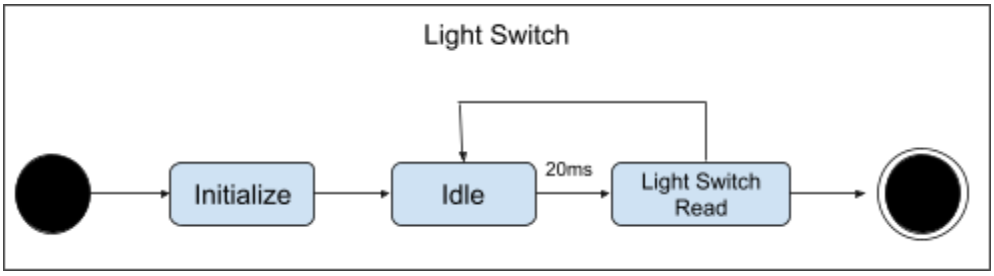
Name: Yasser Waleed Date: 12 Oct 2022

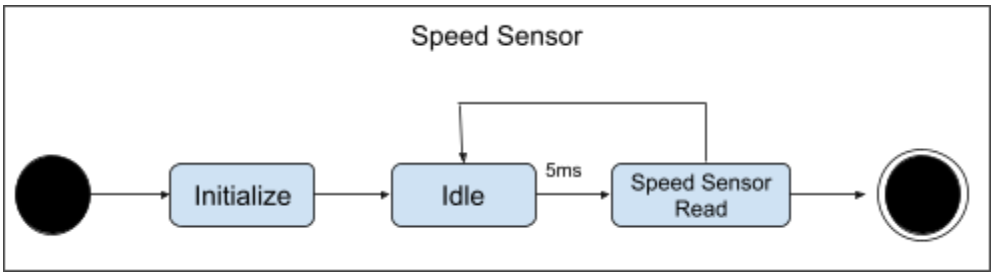
PROJECT 3
Automotive Door Control System Design
Dynamic Design

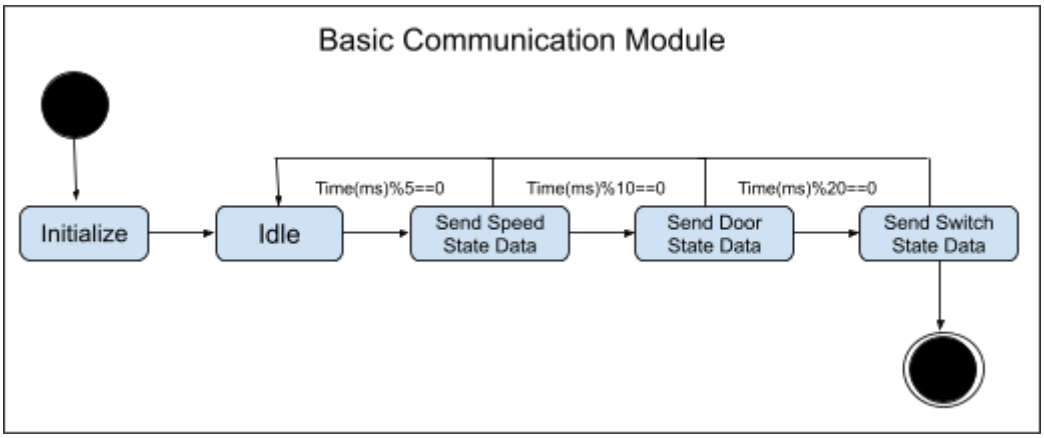
- For ECU 1:

1. Draw a state machine diagram for each ECU component









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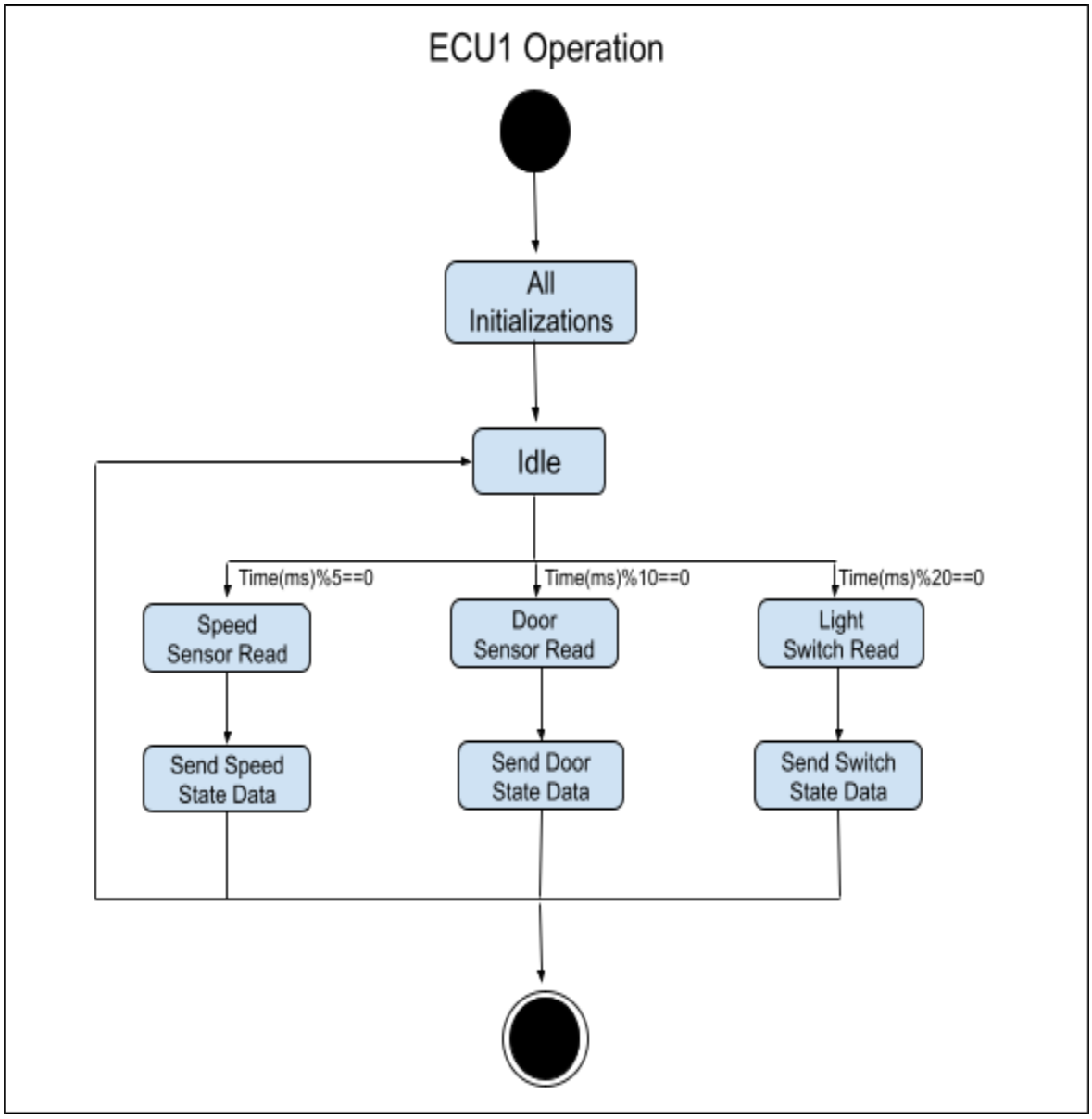
2. Draw a state machine diagram for the ECU operation



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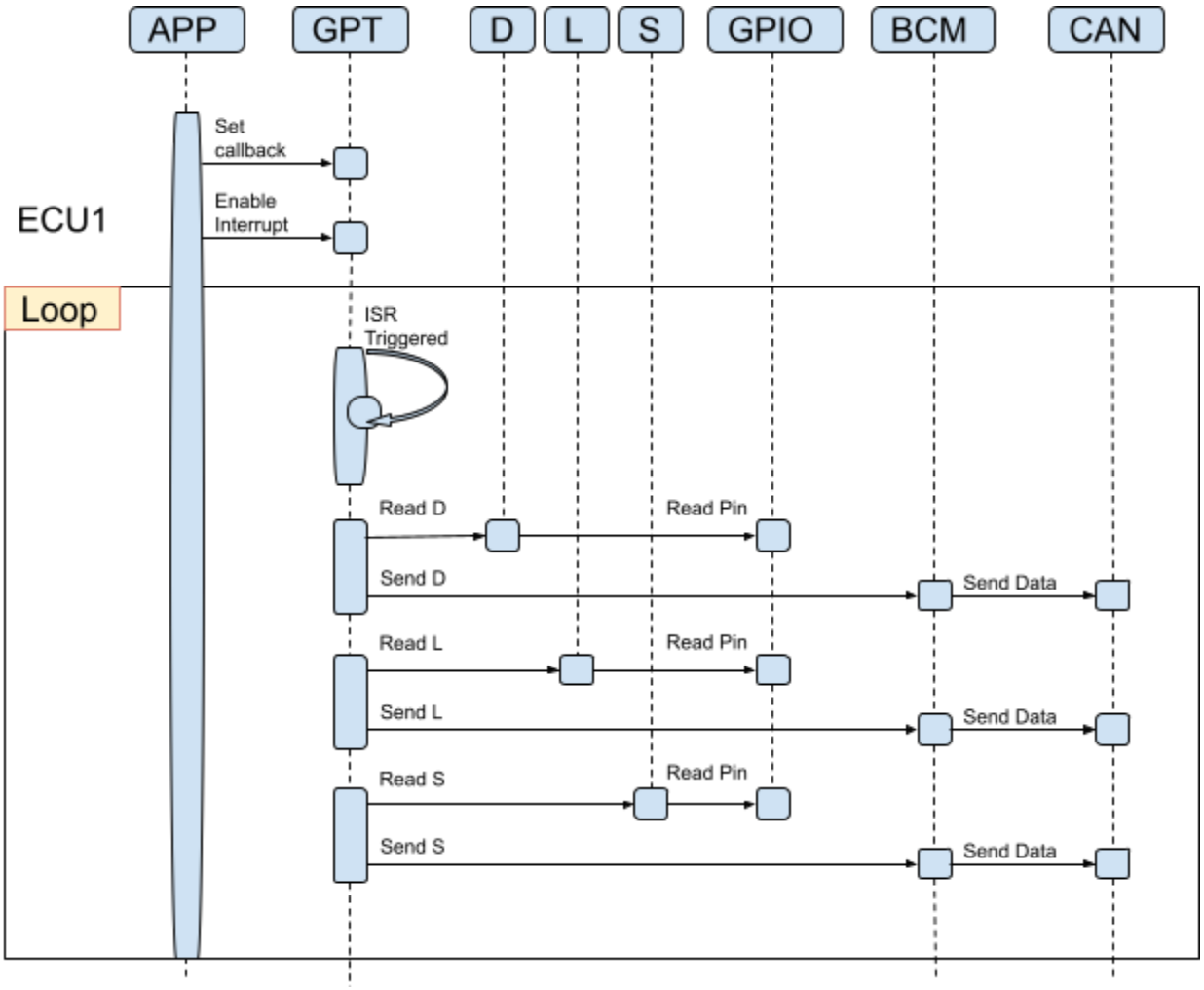
3. Draw the sequence diagram for the ECU



4. Calculate CPU load for the ECU

The CPU load is the busy time over the total time. The total time of a single hyperperiod is LCM(5,10,20) = 20ms. There are three tasks, each reading and sending data. S is to be read and sent 4 times per hyperperiod, D twice, and L once. All tasks should share the same execution time, which can be estimated to be around 400µs for example. The CPU load could then be calculated as follows. (Note: This is just an estimation)

$$CPU\ Load = \frac{0.4 * (4 + 2 + 1)}{20} = 0.14 = 14\%$$

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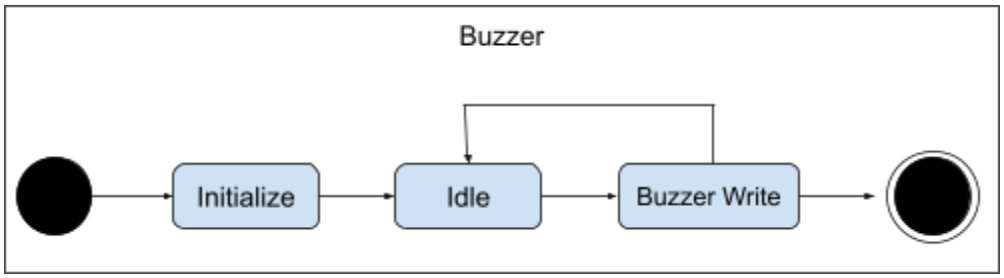
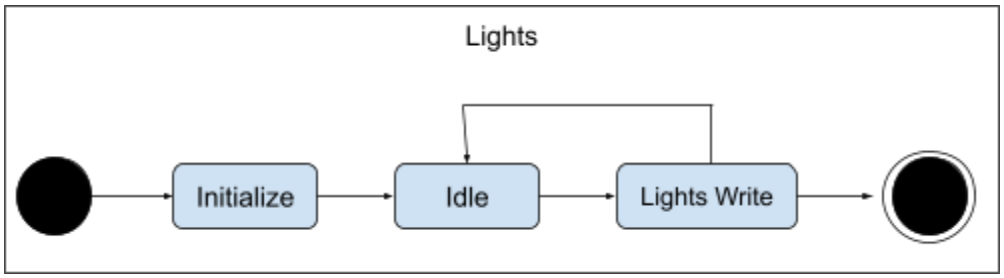
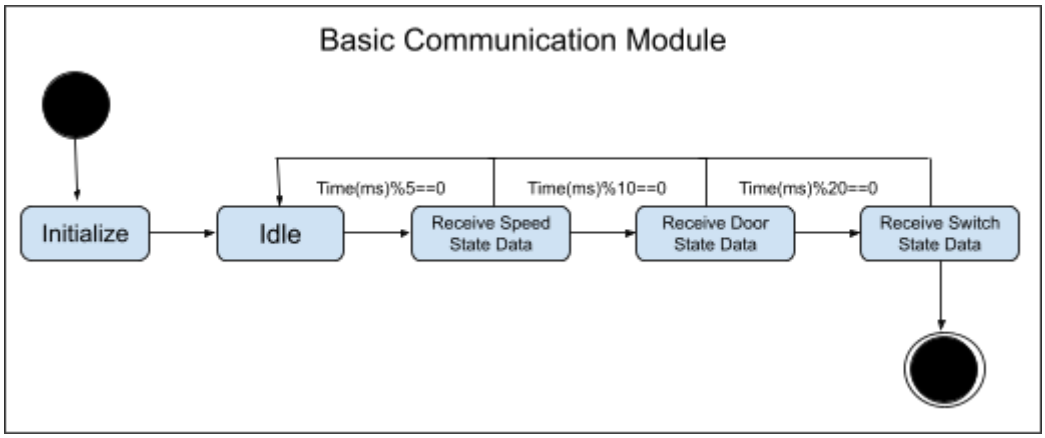
- For ECU 2:

1. Draw a state machine diagram for each ECU component







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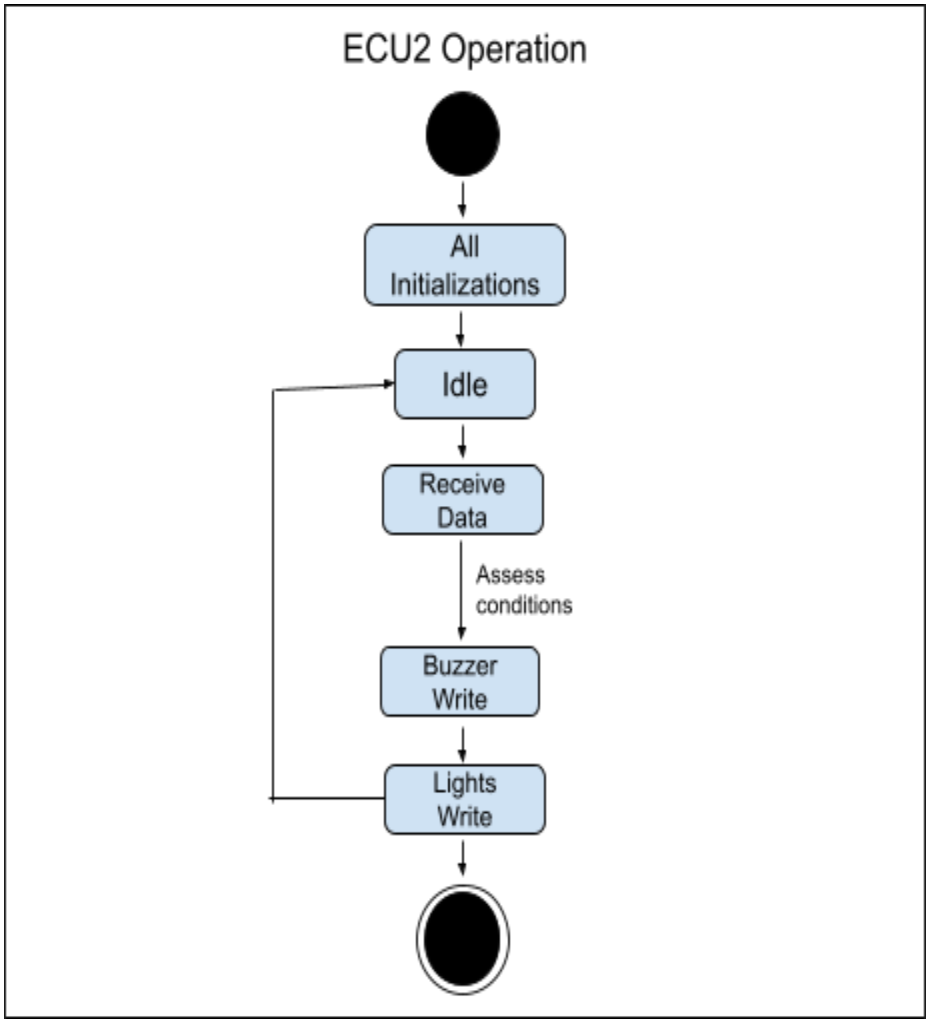
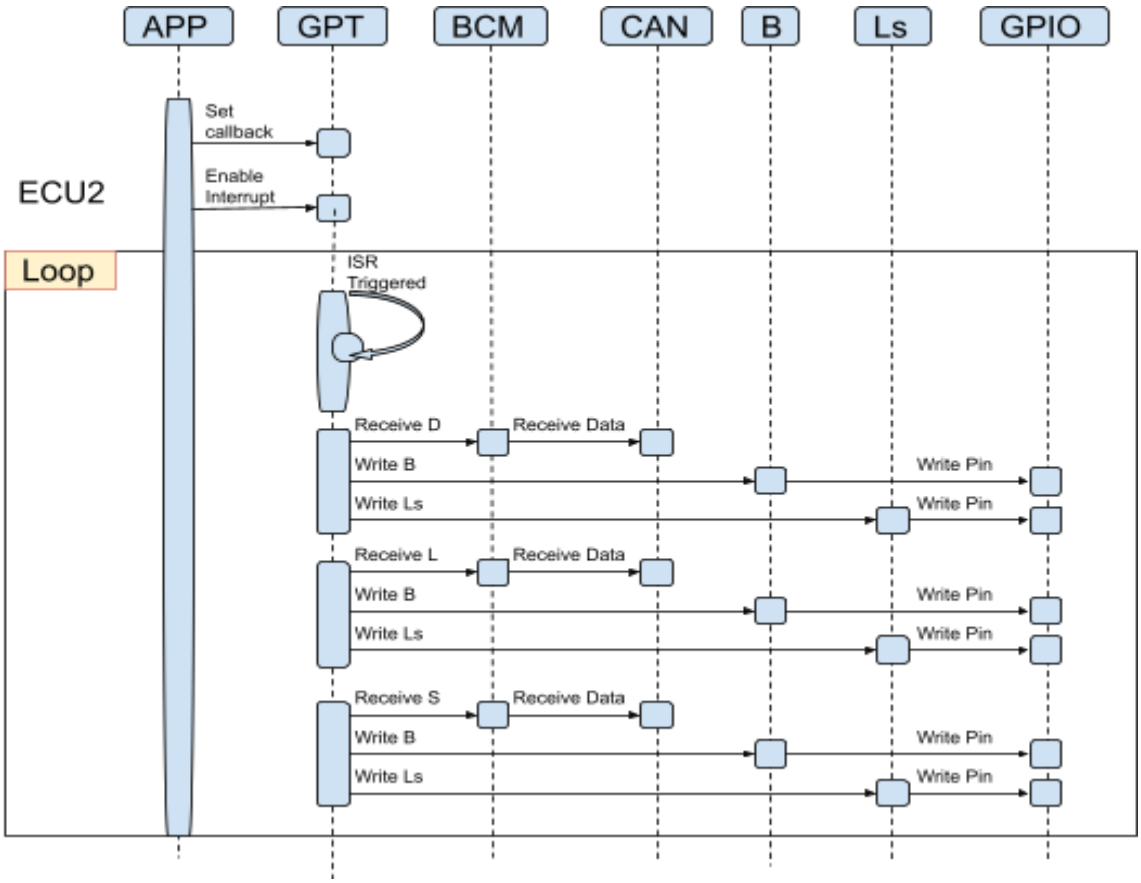
2. Draw a state machine diagram for the ECU operation



3. Draw the sequence diagram for the ECU



4. Calculate CPU load for the ECU

The CPU load is the busy time over the total time. The total time of a single hyperperiod is LCM(5,10,20) = 20ms. There are three tasks, each receiving data and update output pins accordingly. S is to be received 4 times per hyperperiod, D twice, and L once. All tasks should share the same execution time, which can be estimated to be around 400µs for example. The CPU load could then be calculated as shown below. (Note: This is just an estimation)

$$CPU\ Load = \frac{0.4 * (4 + 2 + 1)}{20} = 0.14 = 14\%$$

- Calculate bus load in your system: With what percentage of system bus was busy per 1 second

A single CAN frame has about 125 bits. If a bit rate of 500 kBits/s is used, then the bit time would be 2µ, and so a frame would take 250µs. S message is sent every 5ms, D every 10ms, and L every 20ms. So every 20ms there are 7 frames. The busy time is 7*0.25 = 1.75ms, and the total time is 20ms. Bus load is 1.75/20 = 0.0875 = 8.75%. (Note: This is just an estimation)