Automotive Door Control System Design Project

Dynamic Design Analysis

Developed By :

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PROJECT SPECIFICATION

1- Hardware Requirements

1- Two microcontrollers connected via CAN bus
2- One Door sensor (D)
3- One Light switch (L)
4- One Speed sensor (S)
5- ECU 1 connected to D, S, and L, all input devices
6- Two lights, right (RL) and left (LL)
7- One buzzer (B)
8- ECU 2 connected to RL, LL, and B, all output devices

2- Software Requirements

1- ECU 1 will send status messages periodically to ECU 2 through the CAN protocol
2- Status messages will be sent using Basic Communication Module (BCM)
3- Door state message will be sent every 10ms to ECU 2
4- Light switch state message will be sent every 20ms to ECU 2
5- Speed state message will be sent every 5ms to ECU 2
6- Each ECU will have an OS and application SW components
7- If the door is opened while the car is moving → Buzzer ON, Lights OFF
8- If the door is opened while the car is stopped → Buzzer OFF, Lights ON
9- If the door is closed while the lights were ON → Lights are OFF after 3 seconds
10- If the car is moving and the light switch is pressed → Buzzer OFF, Lights ON
11- If the car is stopped and the light switch is pressed → Buzzer ON, Lights ON

3- Dynamic design analysis

For ECU 1:

1. Draw a state machine diagram for each ECU component
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

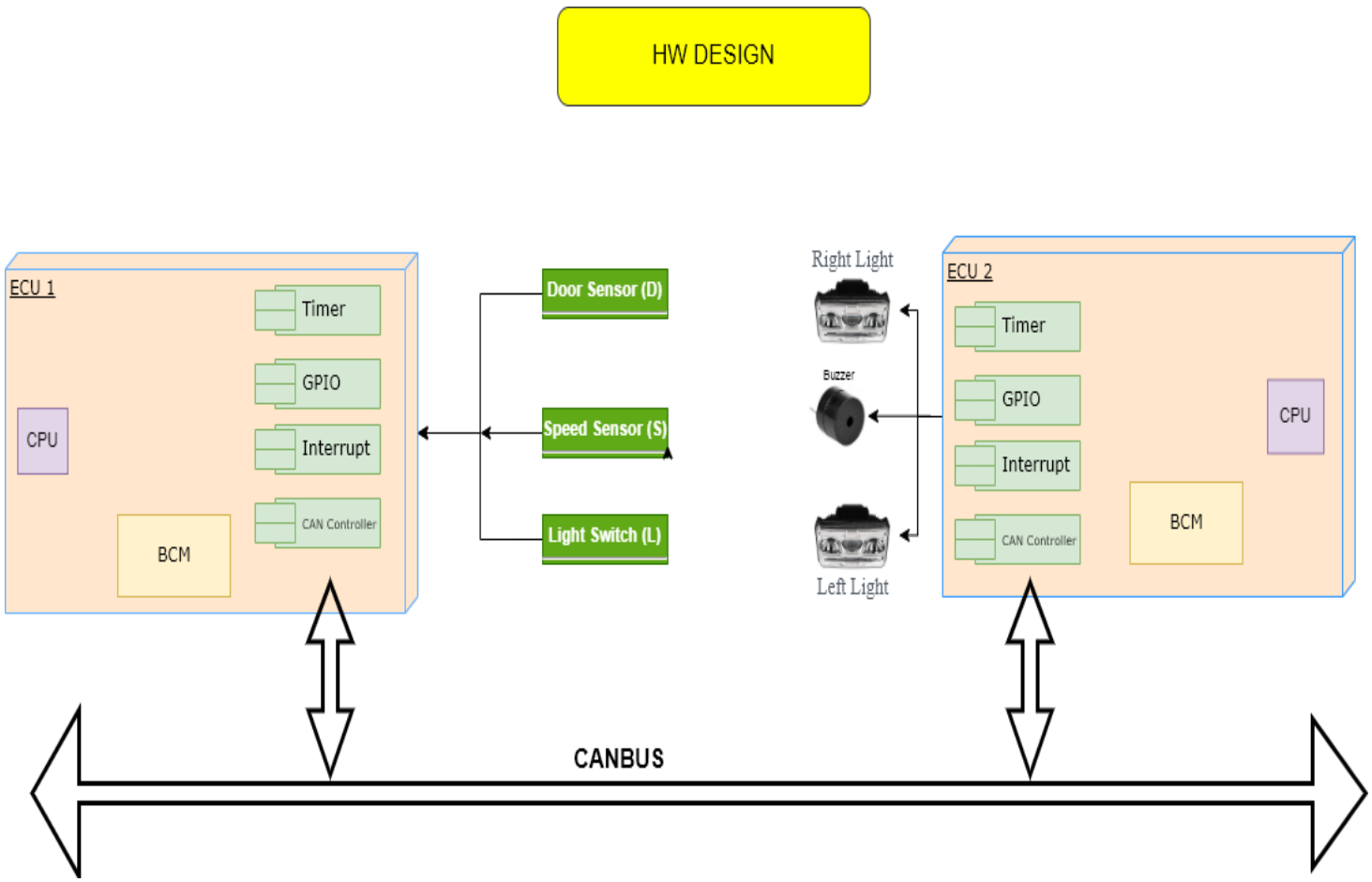
For ECU 2:

1. Draw a state machine diagram for each ECU component
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

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

PROJECT Development

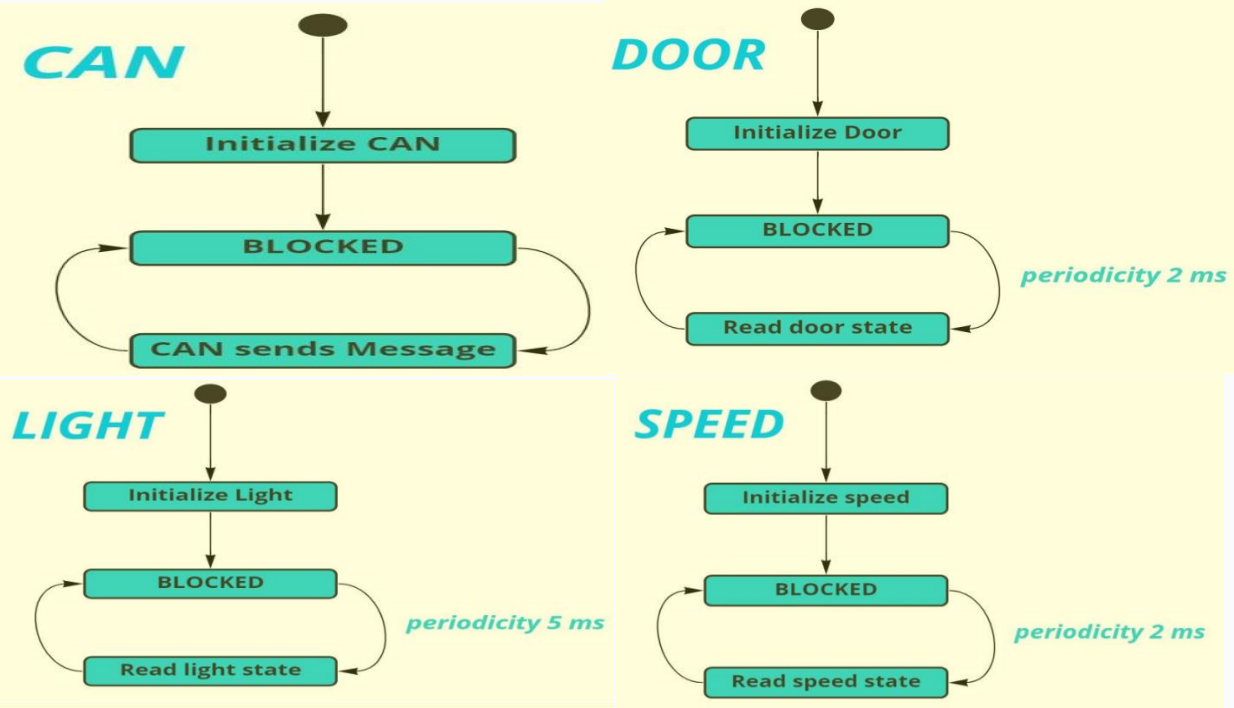
1-Hardware Design Block Diagram



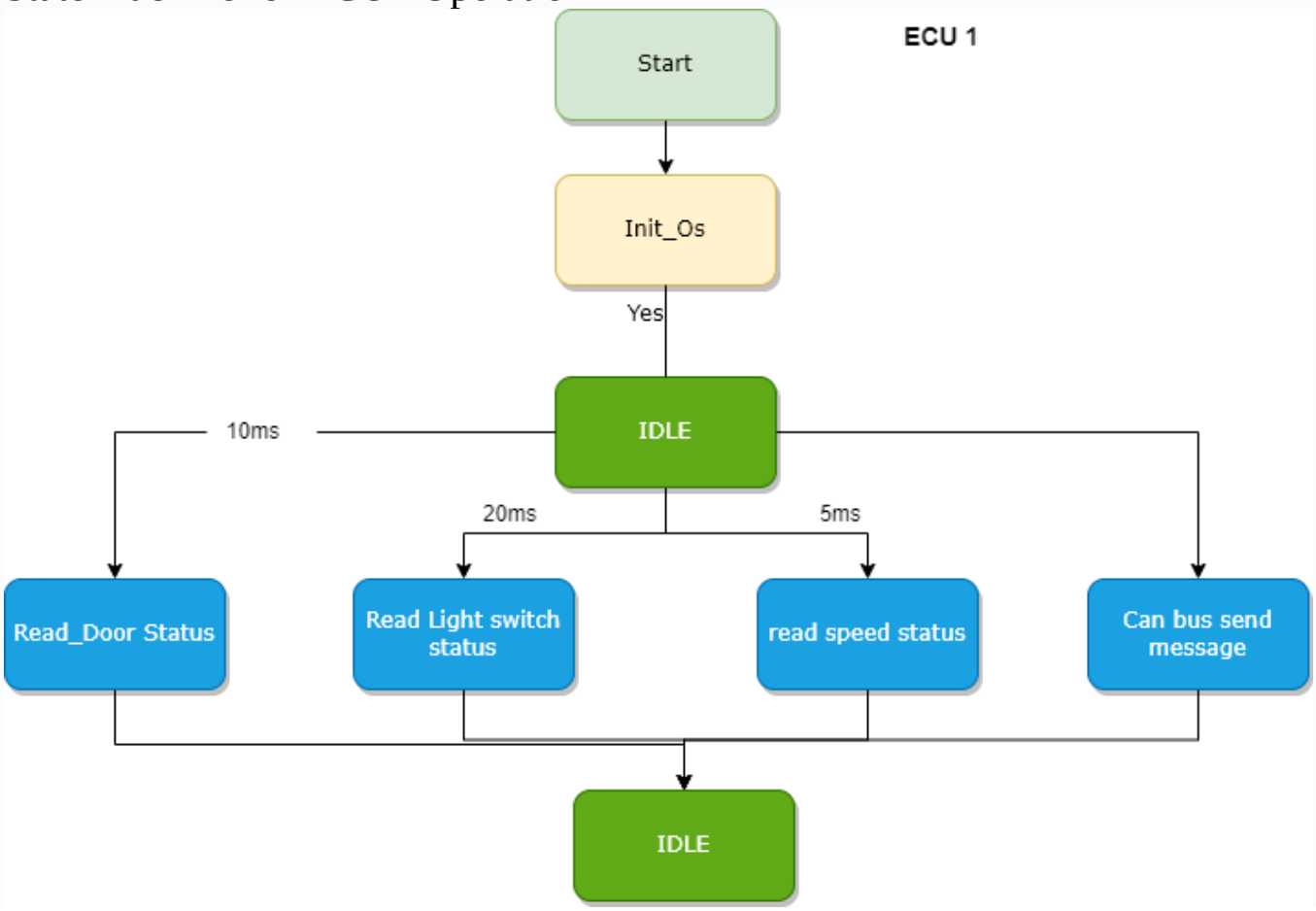
2-State Machine Diagrams

FOR ECU 1

Each Component State Machine Diagrams



State machine for ECU1 Operation

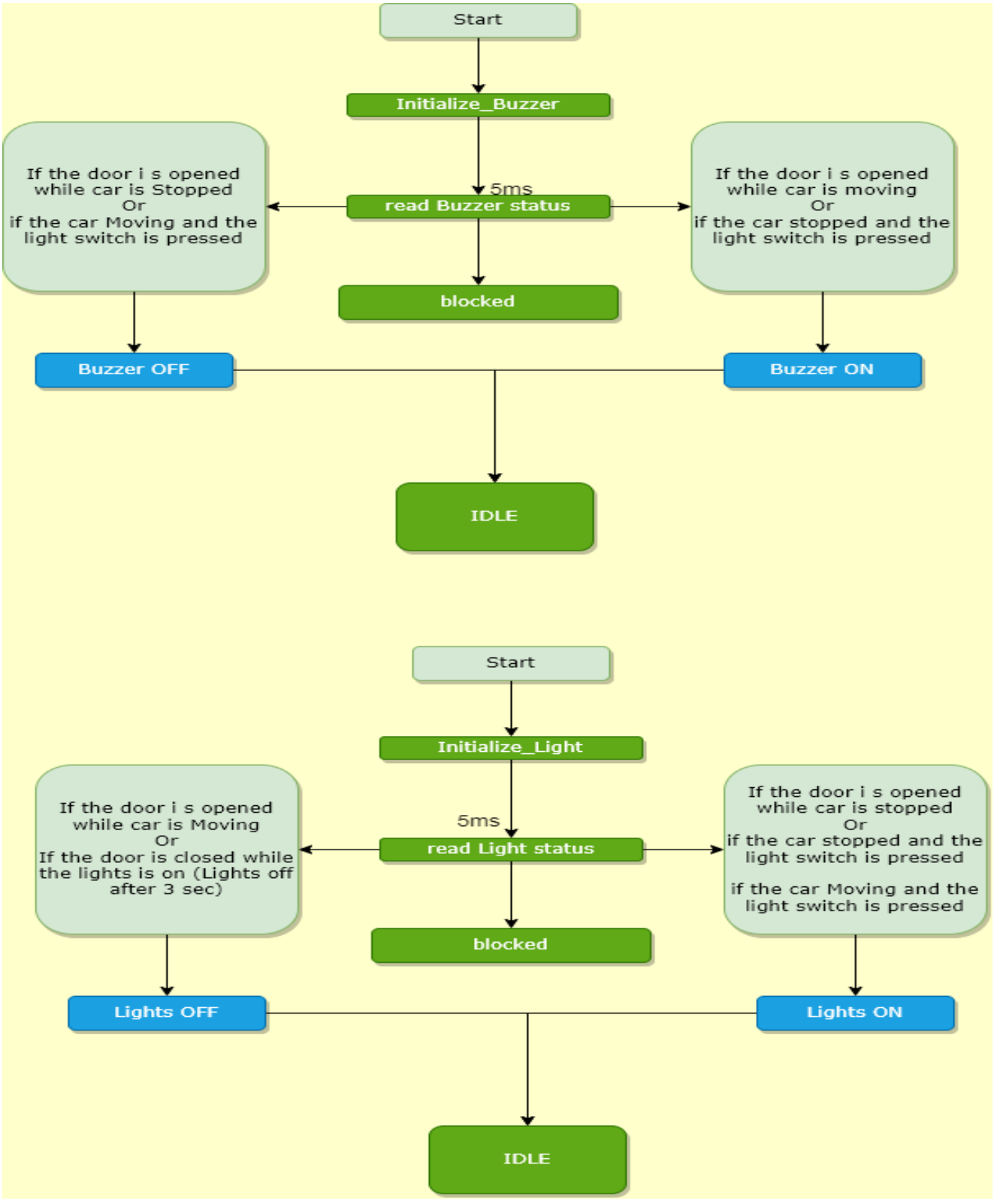


TaskName	Period	AProx Excution Time	Description
Light read status	5	5us	
Door read status	2	5us	
Speed read status	2	5us	
Can send light message	20 ms	2ms	
Can send Door message	10 ms	2ms	
Can send speed message	5 ms	2ms	
Hyper Period	20 ms		

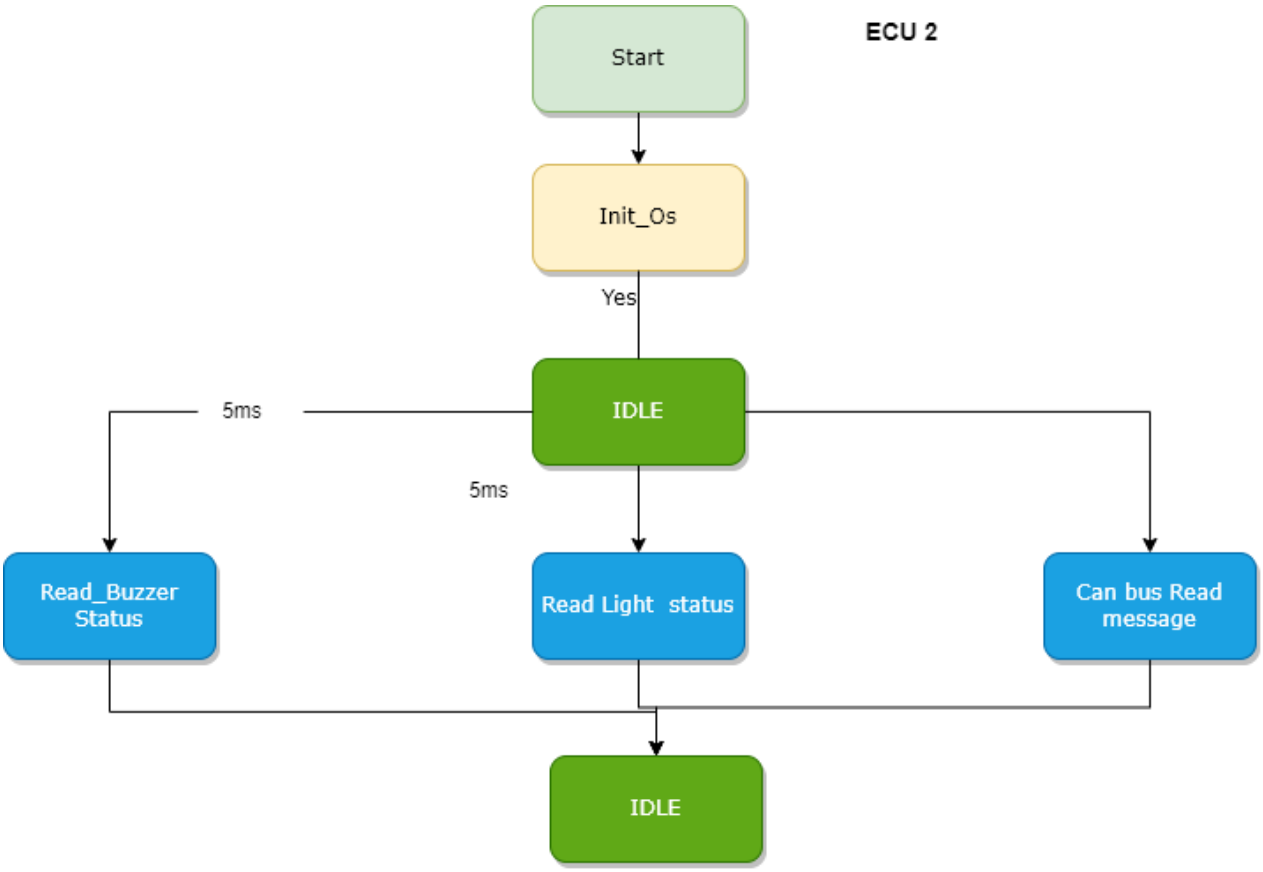
Cpu load = (0.05*4) + (0.05*10) + (0.05*10) + (2* 4) + (2* 2) + (2* 1) = 15.2 ms 15.2/20=76%

FOR ECU 2

Each Component State Machine Diagrams



State machine for ECU2 Operation



TaskName	Period	AProx Excution Time	Description
Light read status	5	5us	
Buzzer read status	2	5us	
Alarm Task	2	5us	
Can Rec light message	20 ms	2ms	
Can Rec Door message	10 ms	2ms	
Can Rec speed message	5 ms	2ms	
Hyper Period	20 ms		

Cpu load (0.05*4) +(0.05*4) + (1*4) +(1*1) + (1* 2) + (1* 4) + (0.05* 7) = 11.75 ms 11.75/20= 85.75%

Bus load:

We Assume a complete message takes one mille second to send.
Total time of messages = 4+2+1 = 7ms / hyper period (20 ms)

Bus load =7/20 =35% per second