

# **Mastering Embedded Systems**

## **Unit 4**

### **Data Structure**

### **Collision Avoidance**

## **Case Study:**

We need to implement a Collision Avoidance system. Where, we have 3 main modules.

Ultrasonic sensor driver used to detect the distance between our moving object and any facing obstacles.

DC Motor driver used to move our object with a given speed.

CA driver used to set speed according to distance read from the ultrasonic sensor based on a predefined threshold.

## **Requirements:**

UltraSonic Sensor Driver:

- Detect distance between object and obstacle.
- Send distance data to CollisionAvoidance Driver.

CollisionAvoidance Driver:

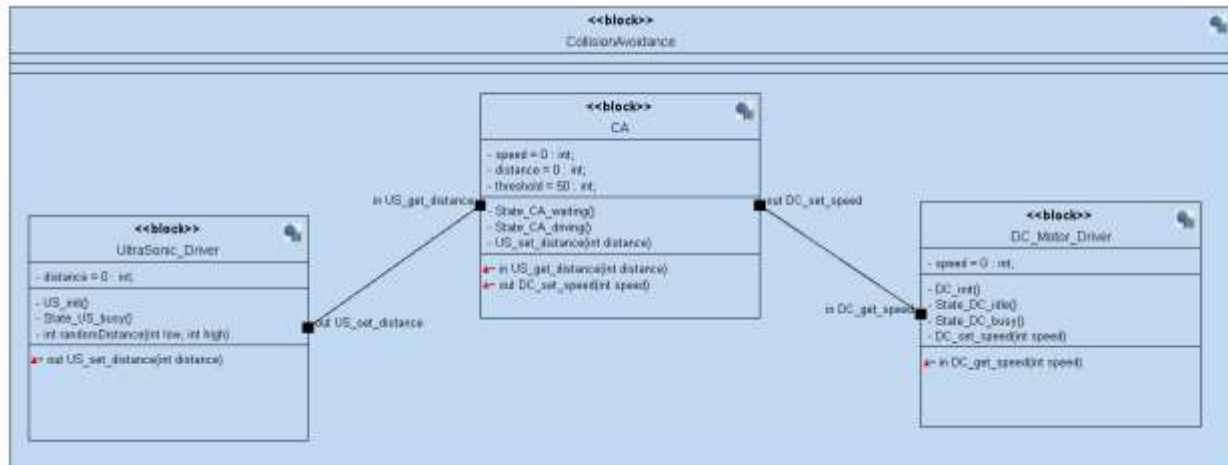
- Receive distance data from UltraSonic Sensor Driver.
- Compare distance with defined threshold.
- Send speed data to DC Motor Driver.

DC Motor Driver:

- Receive speed data from CollisionAvoidance Driver.
- Set new speed.

## Main Block Diagram:

This diagram elaborates each of the nested blocks with their variables, methods and input/output signals and their connection with each others.

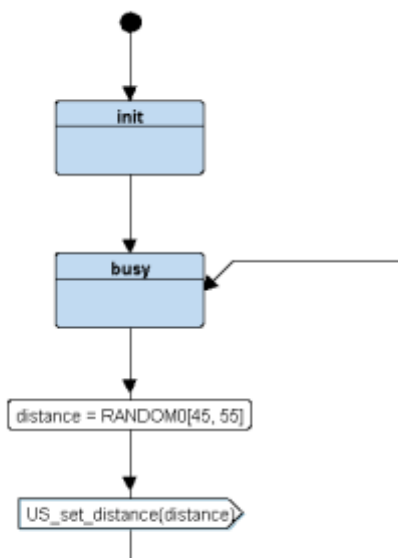


## UltraSonic\_Driver State Diagram:

This diagrams shows the following:

2 states: Init state and busy state.

1 trigger signal: US\_set\_distance(distance)

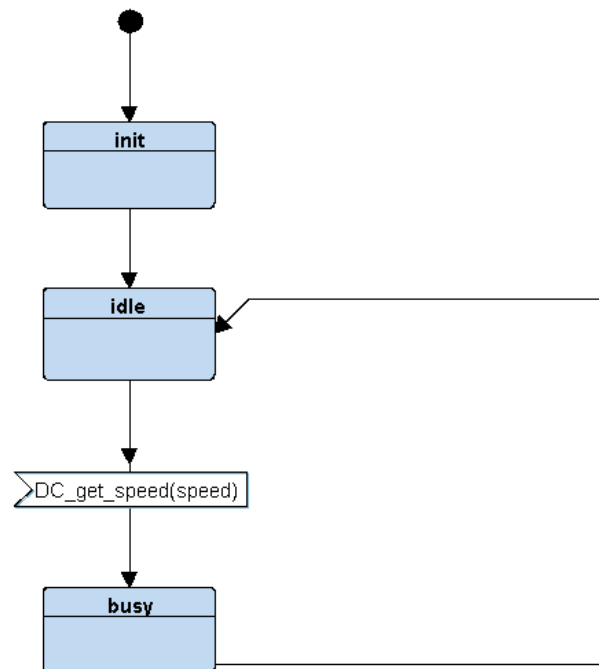


## DC\_Motor\_Driver State Diagram:

This diagrams shows the following:

3 states: Init state, idle state and busy state.

1 trigger signal: DC\_get\_speed(speed)

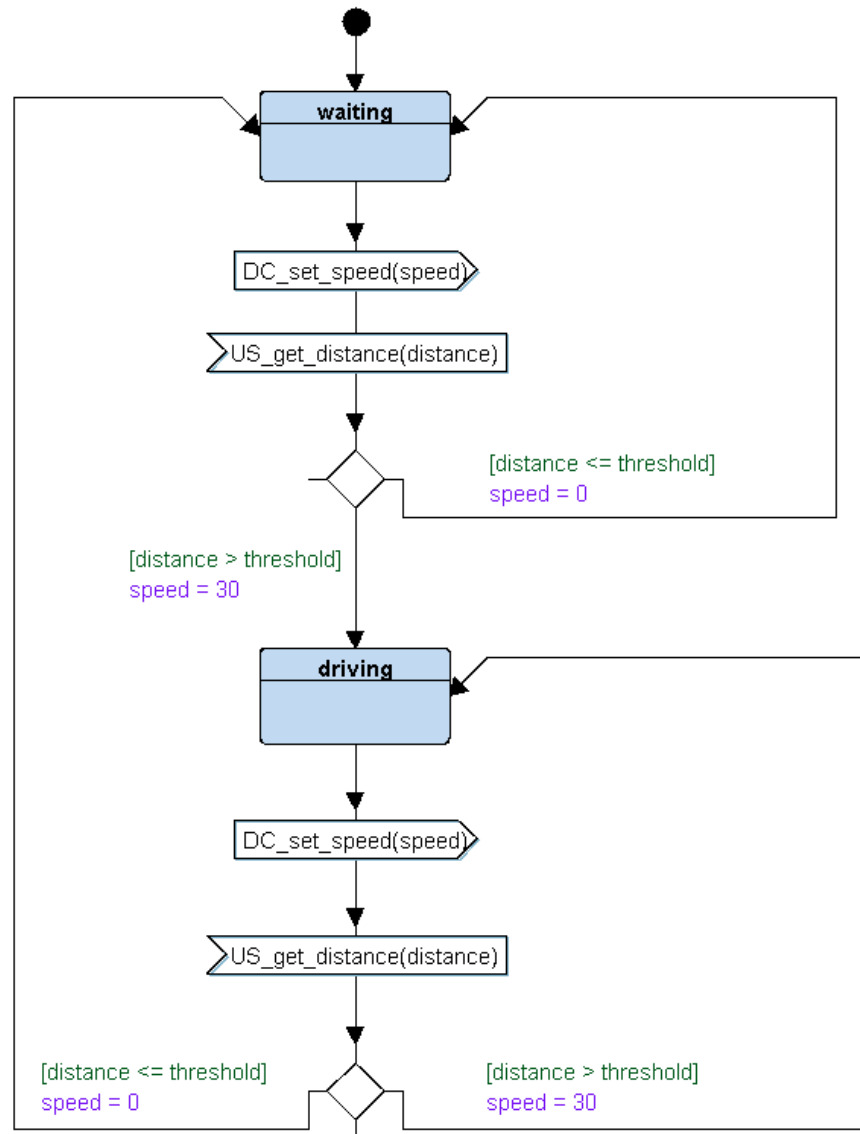


## CollisionAvoidance State Diagram:

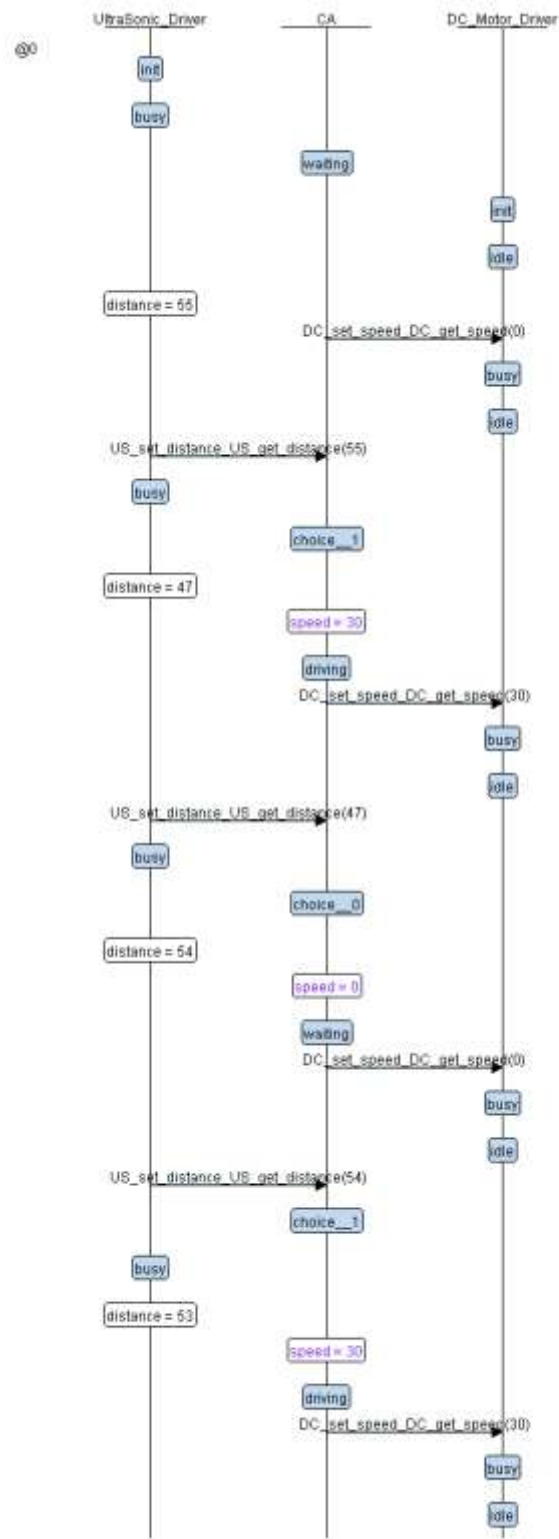
This diagrams shows the following:

2 states: waiting state and driving state.

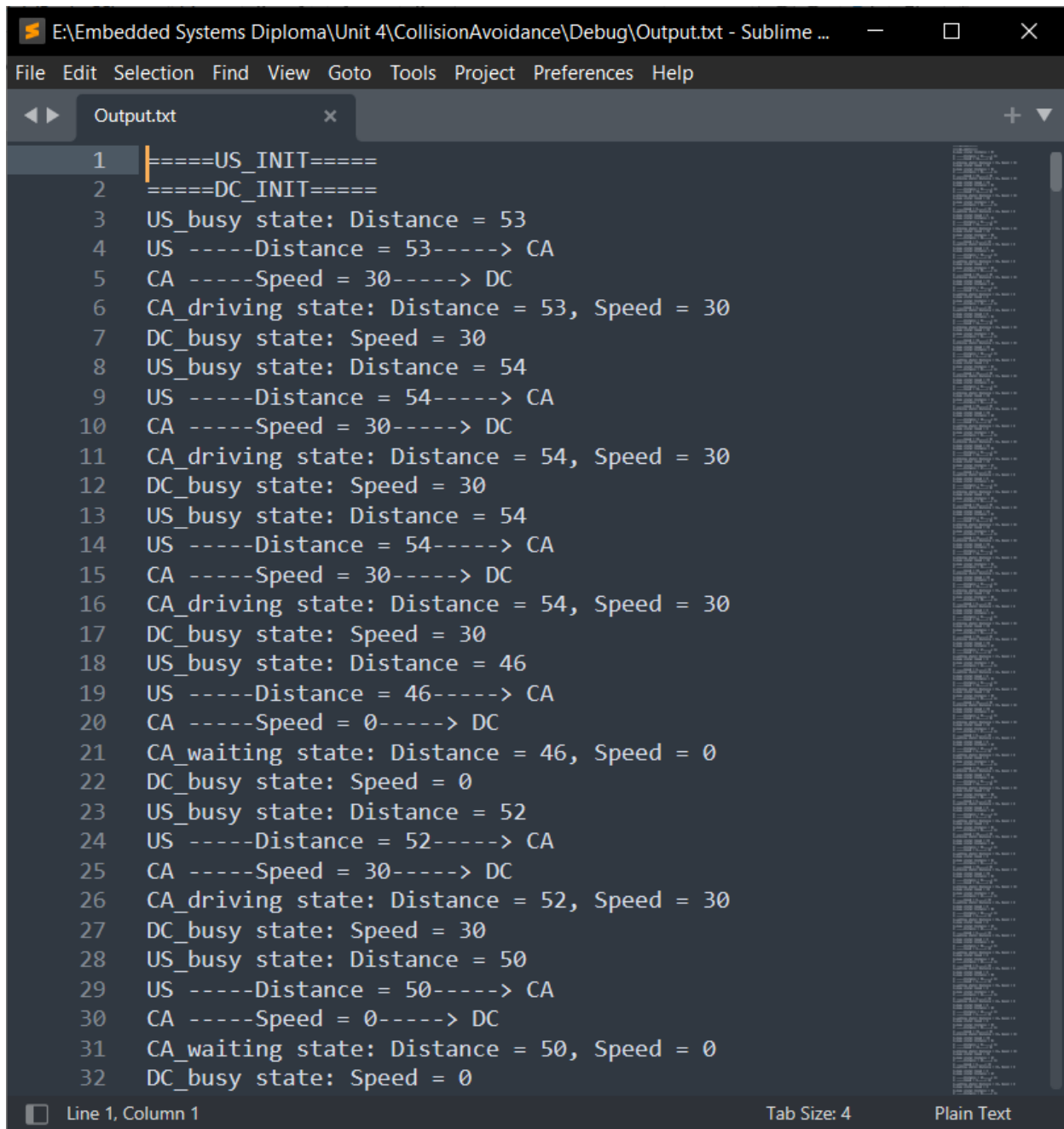
2 trigger signals: DC\_set\_speed(speed), US\_get\_distance(distance)



## Sequence Diagram:



## Implementation Output:



```
1 |=====US_INIT=====
2 |=====DC_INIT=====
3 US_busy state: Distance = 53
4 US -----Distance = 53-----> CA
5 CA -----Speed = 30-----> DC
6 CA_driving state: Distance = 53, Speed = 30
7 DC_busy state: Speed = 30
8 US_busy state: Distance = 54
9 US -----Distance = 54-----> CA
10 CA -----Speed = 30-----> DC
11 CA_driving state: Distance = 54, Speed = 30
12 DC_busy state: Speed = 30
13 US_busy state: Distance = 54
14 US -----Distance = 54-----> CA
15 CA -----Speed = 30-----> DC
16 CA_driving state: Distance = 54, Speed = 30
17 DC_busy state: Speed = 30
18 US_busy state: Distance = 46
19 US -----Distance = 46-----> CA
20 CA -----Speed = 0-----> DC
21 CA_waiting state: Distance = 46, Speed = 0
22 DC_busy state: Speed = 0
23 US_busy state: Distance = 52
24 US -----Distance = 52-----> CA
25 CA -----Speed = 30-----> DC
26 CA_driving state: Distance = 52, Speed = 30
27 DC_busy state: Speed = 30
28 US_busy state: Distance = 50
29 US -----Distance = 50-----> CA
30 CA -----Speed = 0-----> DC
31 CA_waiting state: Distance = 50, Speed = 0
32 DC_busy state: Speed = 0
```

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