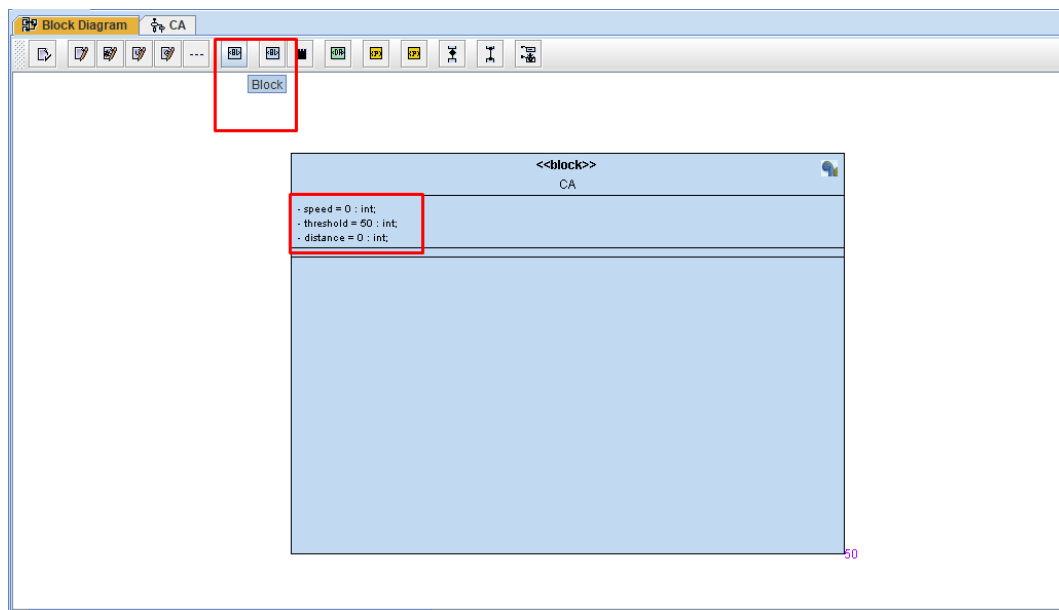


## Unit 4 Lesson 2

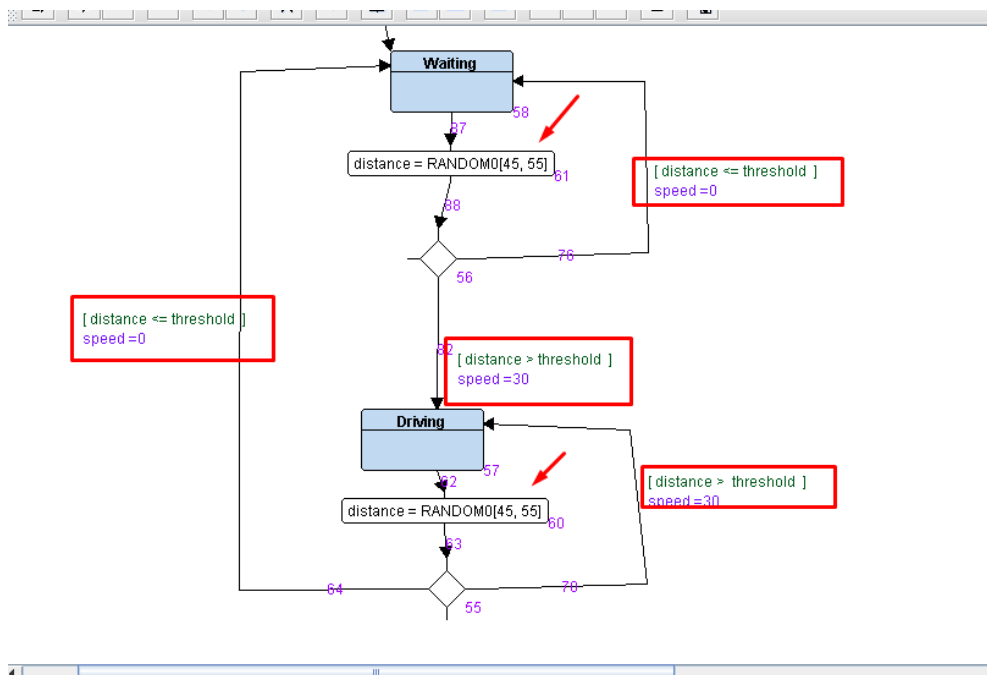
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Version 1 :

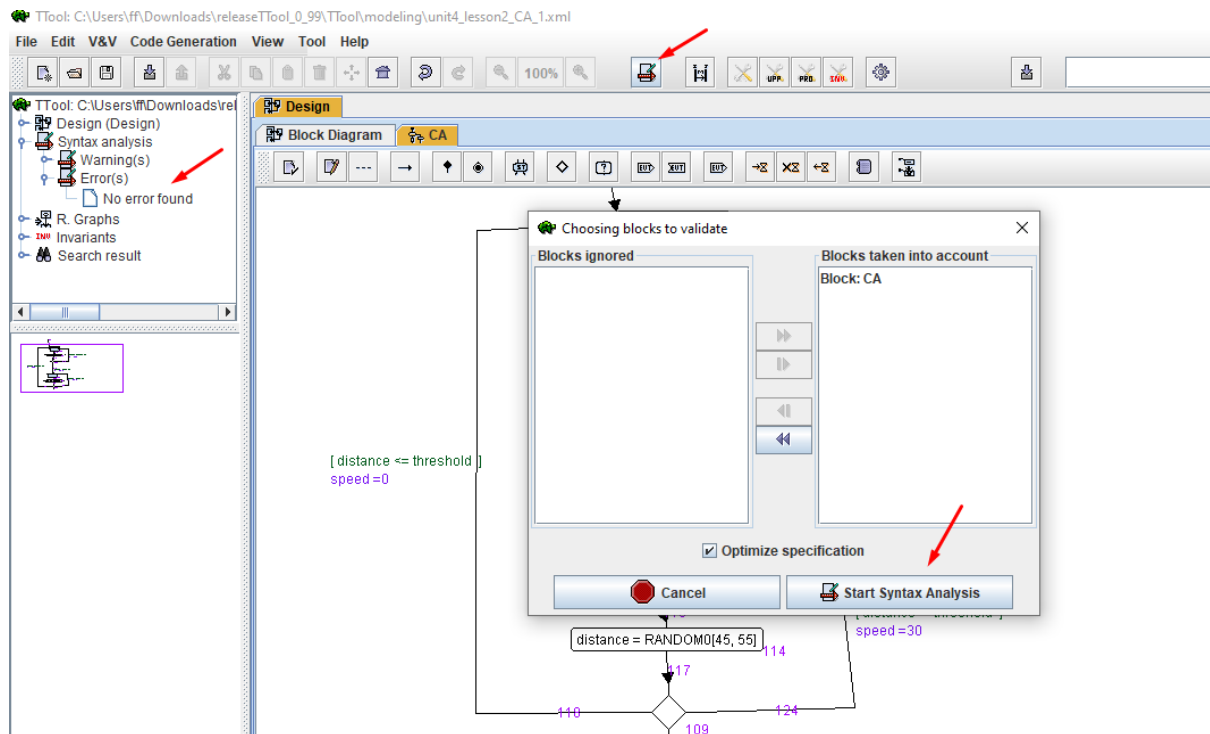
Design :



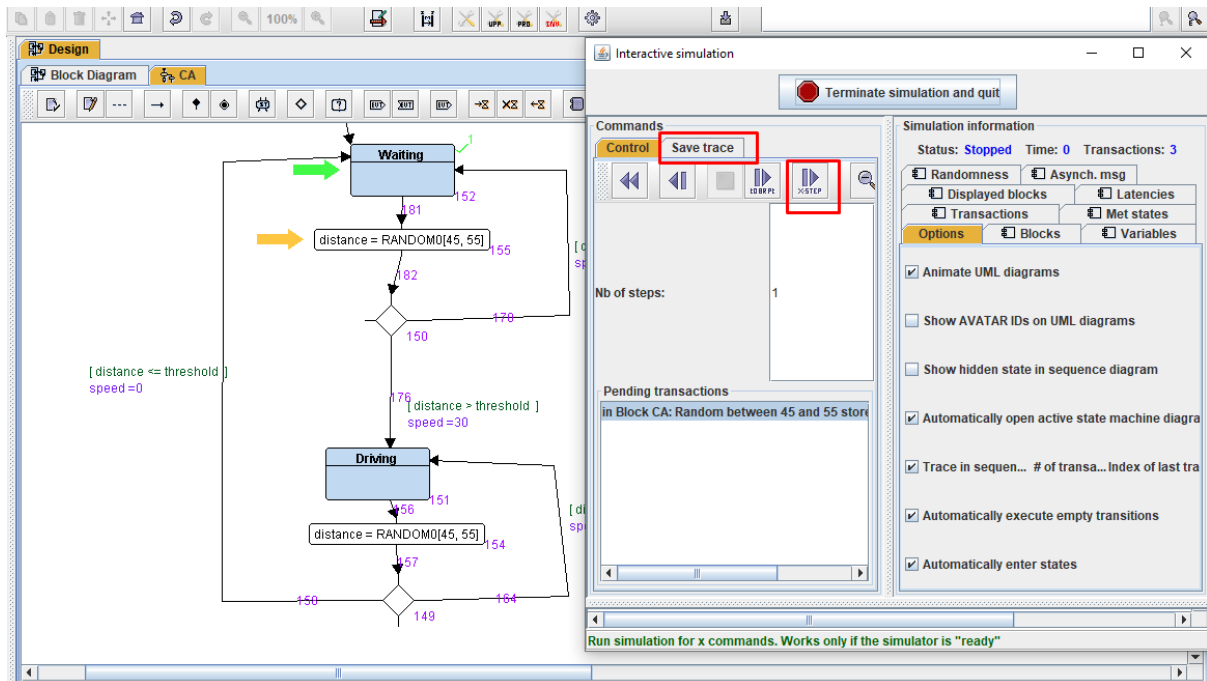
State Machine Diagram :



## Start Test Syntax :



## if you Found No Error in Syntax Start interactive Simulation:



Start Coding :

State.h File :

```
20 * state.h
7
8 #ifndef STATE_H_
9 #define STATE_H_
10 #include "stdio.h"
11 #include "stdlib.h"
12
13 //Automatic State Function Generated
14 #define STATE_define(_statFUN_) void ST_##_statFUN_()
15 #define STATE(_statFUN_) ST_##_statFUN_
16
17
18 #endif /* STATE_H_ */
19
```

CA.h File :

```
20 * CA.h
7
8 #ifndef CA_H_
9 #define CA_H_
10
11 #include "state.h"
12 //Define States
13 enum {
14     CA_waiting,
15     CA_driving
16 }CA_state_id;
17
18 //STATE Pointer to Function
19 extern void (*CA_state )();
20
21 //Declare States Functions CA
22 STATE_define(CA_waiting);
23 STATE_define(CA_driving);
24 #endif /* CA_H_ */
25
```

## CA.c file :

```
main.c CA.h state.h CA.c
2 * CA.c
7
8 #include "CA.h"
9 //Variables
10 int CA_speed =0;
11 int CA_distance =0;
12 int CA_threshold =50;
13
14
15 //STATE Pointer to Function
16 void (*CA_state )();
17 int US_GET_distance_rondom(int l,int r,int count);
18
19 STATE_define(CA_waiting)
20 {
21     //State_Name
22     CA_state_id=CA_waiting;
23
24     //State_Action
25     CA_speed=0;
26
27     //Event_Check
28     //US_GET_Distance(CA_distance)
29     CA_distance=US_GET_distance_rondom(45,55,1);
30
31     (CA_distance <=CA_threshold)?(CA_state=STATE(CA_waiting)):(CA_state=STATE(CA_driving));
32
33     printf("CA_driving State : Distance =%d \tSpeed =%d\n",CA_distance,CA_speed);
34 }
35
36
37
38
39
40 STATE_define(CA_driving)
41 {
42     //State_Name
43     CA_state_id=CA_driving;
44
45     //State_Action
46     CA_speed=30;
47
48     //Event_Check
49     //US_GET_Distance(CA_distance)
50     CA_distance=US_GET_distance_rondom(45,55,1);
51     (CA_distance <= CA_threshold)?(CA_state=STATE(CA_waiting)):(CA_state=STATE(CA_driving));
52
53     printf("CA_driving State : Distance =%d \tSpeed =%d\n",CA_distance,CA_speed);
54 }
55
56 int US_GET_distance_rondom(int l,int r,int count)
57 {
58     int i;
59
60     for(i = 0;i < count; i++) {
61         int rand_num = (rand() % (r - l + 1)) + l;
62         return rand_num;
63     }
64 }
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```

## main.c File :

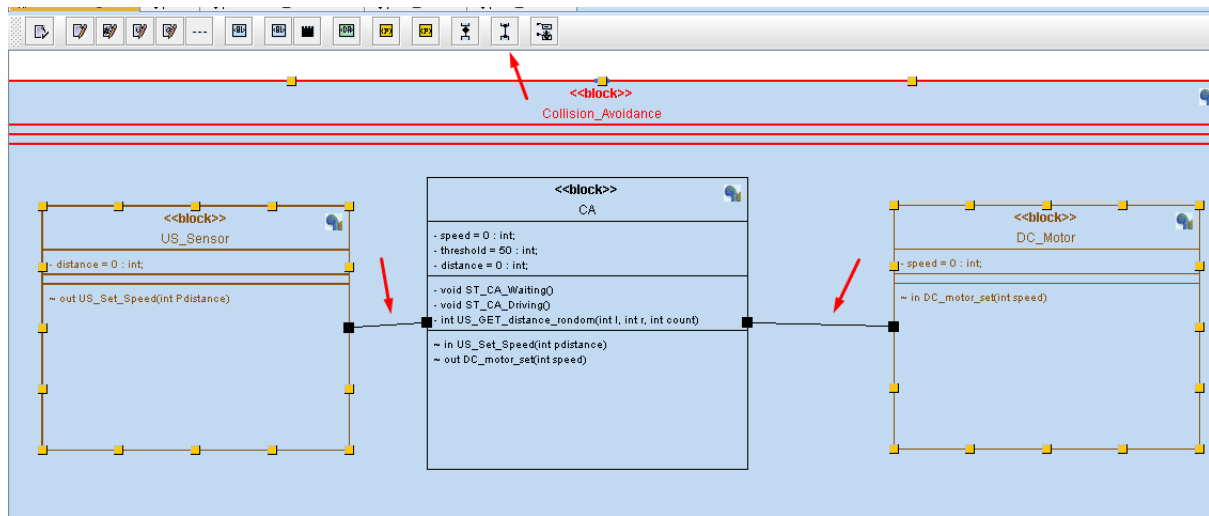
```
main.c CA.h state.h CA.c
24 * main.c
7
8 #include "CA.h"
9
10 void setup()
11 {
12     //init all The Drivers;
13     //init IRQ ....
14     //init HAL_US_Driver DC_Driver
15     //init Block
16     //Set States Pointer for each Block
17
18     CA_state=STATE(CA_waiting);
19 }
20 int main ()
21 {
22     setup();
23     while(1)
24     {
25         //Call State for each Block
26         CA_state();
27     }
28     return 0;
29 }
30
31
```

## Output Result :

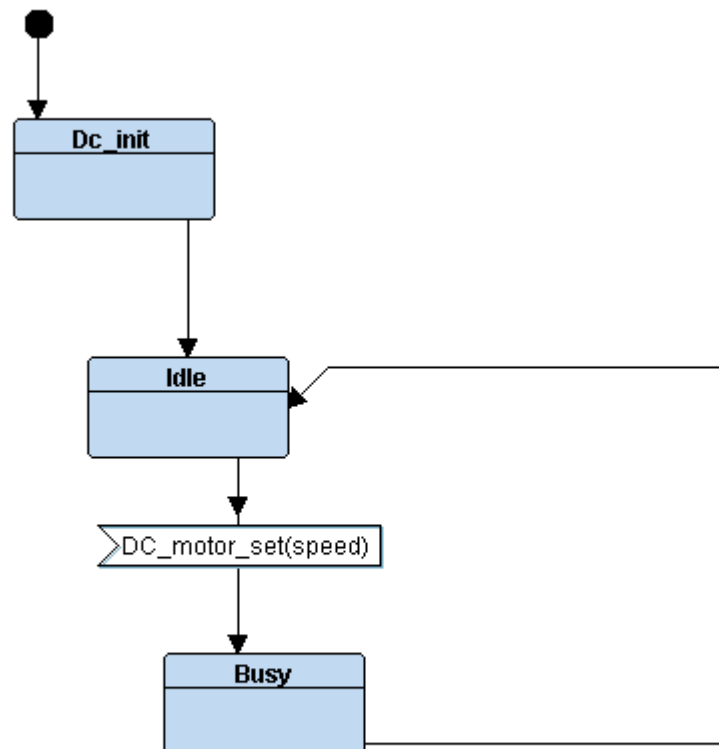
```
Problems Tasks Console Properties Debugger Console
<terminated> (exit value: -1,073,741,510) unit4_lesson2_CA_v1.exe [C/C++ Application] C:\U
CA_driving State : Distance =55      Speed =0
CA_driving State : Distance =53      Speed =30
CA_driving State : Distance =46      Speed =30
CA_driving State : Distance =47      Speed =0
CA_driving State : Distance =51      Speed =0
CA_driving State : Distance =50      Speed =30
CA_driving State : Distance =55      Speed =0
CA_driving State : Distance =52      Speed =30
CA_driving State : Distance =52      Speed =30
CA_driving State : Distance =51      Speed =30
CA_driving State : Distance =51      Speed =30
CA_driving State : Distance =54      Speed =30
CA_driving State : Distance =45      Speed =30
CA_driving State : Distance =48      Speed =0
CA_driving State : Distance =51      Speed =0
CA_driving State : Distance =46      Speed =30
CA_driving State : Distance =51      Speed =0
CA_driving State : Distance =46      Speed =30
CA_driving State : Distance =48      Speed =0
CA_driving State : Distance =51      Speed =0
CA_driving State : Distance =48      Speed =30
CA_driving State : Distance =48      Speed =0
CA_driving State : Distance =49      Speed =0
CA_driving State : Distance =54      Speed =0
CA_driving State : Distance =47      Speed =30
CA_driving State : Distance =50      Speed =0
CA_driving State : Distance =48      Speed =0
CA_driving State : Distance =47      Speed =0
CA_driving State : Distance =54      Speed =0
```

Version 2 :

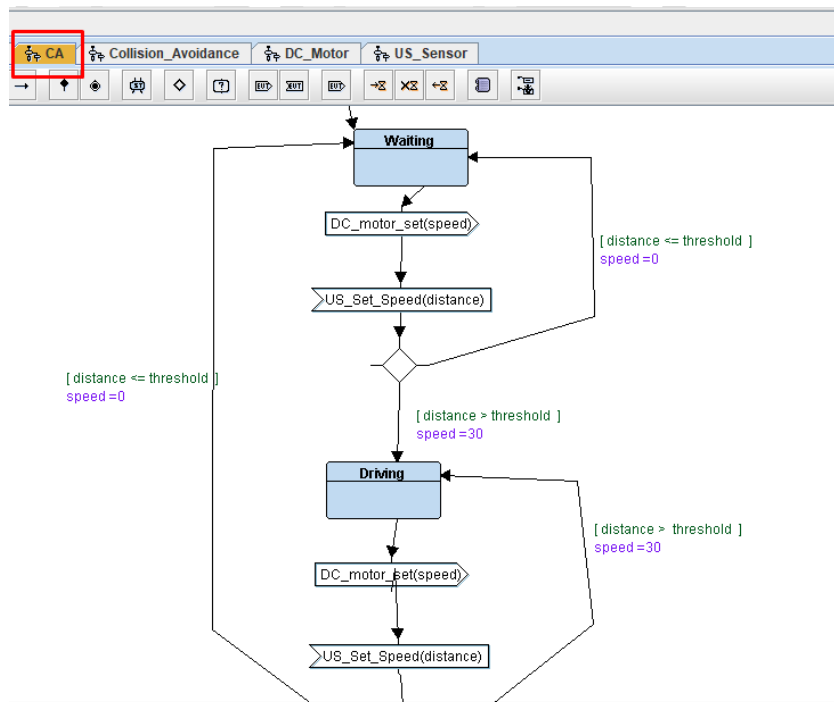
Design :



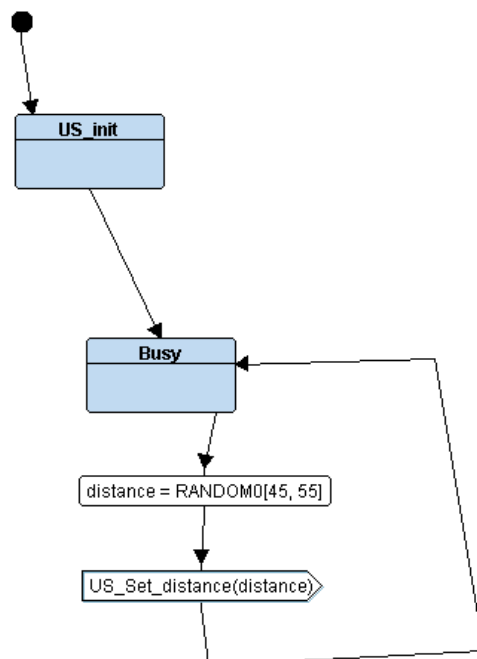
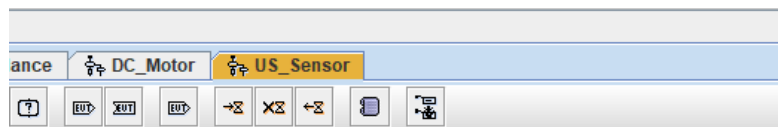
DC Motor State Diagram :



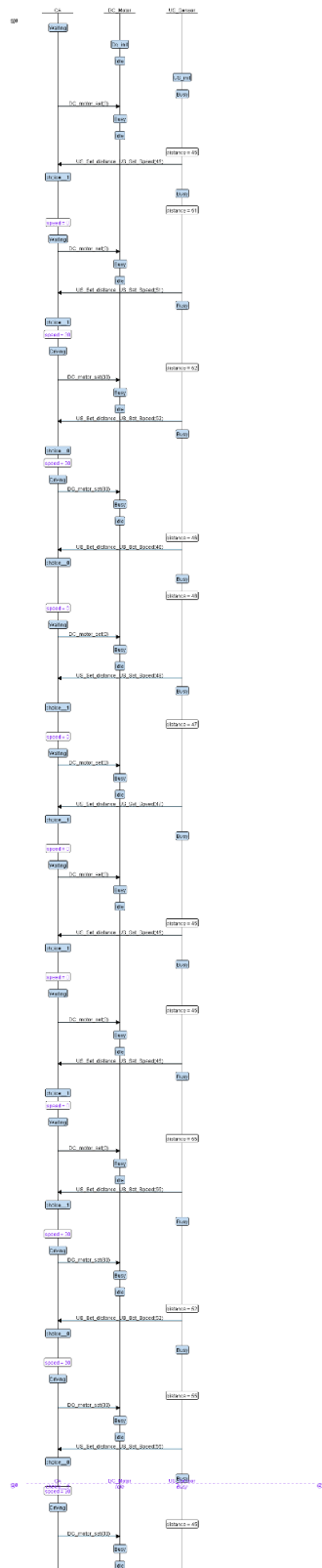
## CA State Diagram :



## US Sensor State Diagram :



Output of TTool :





Start Coding :

State.h File :

```
[.c] US.c [c] US.h [h] state.h x [c] main.c [c] DC.h [c] DC.c [c] CA.h
2+ * state.h
7
8 #ifndef STATE_H_
9 #define STATE_H_
10 #include "stdio.h"
11 #include "stdlib.h"
12
13 //Automatic State Function Generated
14 #define STATE_define(_statFUN_) void ST_##_statFUN_()
15 #define STATE(_statFUN_) ST_##_statFUN_
16
17
18
19 |
20 //States Connection
21 void US_Set_distance (int d);
22 void DC_motor (int s);
23
24 #endif /* STATE_H_ */
25
```

US.h file :

```
[c] US.c [h] US.h x [h] state.h [c] main.c [c] DC.h
2+ * US.h
7
8 #ifndef US_H_
9 #define US_H_
10
11 #include "state.h"
12 //Define States
13- enum {
14     US_busy,
15 }US_state_id;
16
17 //STATE Pointer to Function
18 extern void (*US_state )();
19
20 void US_init();
21
22 //Declare States Functions US
23 STATE_define(US_busy);
24 #endif /* US_H_ */
25
```

## US.c file :

```
US.c  US.h  state.h  main.c  DC.h  DC.c  CA.h
10 int US_distance =0;
11
12
13
14 //STATE Pointer to Function
15 void (*US_state )();
16 int US_GET_distance_rondom(int l,int r);
17
18
19
20 void US_init()
21 {
22     //Initialize US Driver
23     printf("US init \n");
24 }
25
26 STATE_define(US_busy)
27 {
28     //State_Name
29     US_state_id=US_busy;
30
31     //State_Action
32     US_distance=US_GET_distance_rondom(45,55);
33
34     printf("\nUS_busy State : Distance =%d\n",US_distance);
35     US_Set_distance(US_distance);
36     US_state=STATE(US_busy);
37 }
38
39 int US_GET_distance_rondom(int l,int r)
40 {
41
42     int rand_num = (rand() % (r - l + 1)) + l;
43     return rand_num;
```

## DC.h file :

```
US.c  US.h  state.h  main.c  DC.h  CA.h
20 * CA.h
7
8 #ifndef DC_H_
9 #define DC_H_
10
11 #include "state.h"
12 //Define States
13 enum {
14     DC_idle,
15     DC_busy
16 }DC_state_id;
17
18 //STATE Pointer to Function
19 extern void (*DC_state )();
20
21
22
23 void DC_init();
24 //Declare States Functions CA
25 STATE_define(DC_idle);
26 STATE_define(DC_busy);
27 #endif /* DC_H_ */
28
```

## DC.c file :

```
US.c  US.h  state.h  main.c  DC.h  DC.c  CA.h  CA.c
20 * DC.c
7
8 #include "DC.h"
9 //Variables
10 int DC_speed;
11
12 //STATE Pointer to Function
13 void (*DC_state )();
14
15
16 void DC_init()
17 {
18     //init PWM
19     printf("DC_init \n");
20
21 }
22
23 void DC_motor (int s)
24 {
25     DC_speed=s;
26     (DC_speed ==0)?(DC_state=STATE(DC_idle)):(DC_state=STATE(DC_busy));
27     printf("CA-----speed=%d----->DC\n",DC_speed);
28 }
29
29
30 STATE_define(DC_idle)
31 {
32     //State_Name
33     DC_state_id=DC_idle;
34
35     //State_Action
36     //CALL PWM to make speed =DC_speed
37
38     printf("DC_idle State :Speed =%d\n",DC_speed);
39 }
40
41
42
43 STATE_define(DC_busy)
44 {
45     //State_Name
46     DC_state_id=DC_busy;
47
48     //State_Action
49     //CALL PWM to make speed =DC_speed
50
51     printf("DC_busy State :Speed =%d\n",DC_speed);
52     DC_state=STATE(DC_idle);
53 }
54
55
56
57
```

## CA.h file :

```
US.c US.h state.h main.c DC.h DC.c CA.h x
2+ * CA.h
7
8 #ifndef CA_H_
9 #define CA_H_
10
11 #include "state.h"
12 //Define States
13 enum {
14     CA_waiting,
15     CA_driving
16 }CA_state_id;
17
18 //STATE Pointer to Function
19 extern void (*CA_state )();
20
21 //Declare States Functions CA
22 STATE_define(CA_waiting);
23 STATE_define(CA_driving);
24 #endif /* CA_H_ */
25
```

## CA.c file :

```
US.c US.h state.h main.c DC.h DC.c CA.h CA.c x
2+ * CA.c
7
8 #include "CA.h"
9 //Variables
10 int CA_speed =0;
11 int CA_distance =0;
12 int CA_threshold =50;
13
14
15 //STATE Pointer to Function
16 void (*CA_state )();
17
18
19
20
21 void US_Set_distance (int d)
22 {
23     CA_distance=d;
24     (CA_distance <=CA_threshold)?(CA_state=STATE(CA_waiting)):(CA_state=STATE(CA_driving));
25     printf("US-----distance=%d----->CA\n",CA_distance);
26 }
27
28 STATE_define(CA_waiting)
29 {
30     //State_Name
31     CA_state_id=CA_waiting;
32     printf("CA_waiting State : Distance =%d \tSpeed =%d\n",CA_distance,CA_speed);
33
34     //State_Action
35     CA_speed=0;
36     DC_motor(CA_speed);
37 }
38
39
```

```

39
40 STATE_define(CA_driving)
41 {
42     //State_Name
43     CA_state_id=CA_driving;
44     CA_speed=30;
45
46     printf("CA_driving State : Distance =%d \tSpeed =%d\n",CA_distance,CA_speed);
47     //State_Action
48
49     DC_motor(CA_speed);
50 }
51
52

```

Problems Tasks Console Properties Debugger Console

main.c file :

```

.c US.c .h US.h .h state.h .c main.c .h DC.h .c DC.c .h
2+ * main.c
7
8 #include "CA.h"
9 #include "US.h"
10 #include "DC.h"
11
12 void setup()
13 {
14     //init all The Drivers;
15     //inti IRQ ....
16     //init HAL US_Driver DC_Driver
17     //init Block
18     US_init();
19     DC_init();
20     //Set States Pointer for each Block
21     US_state=STATE(US_busy);
22     CA_state=STATE(CA_waiting);
23     DC_state=STATE(DC_idle);
24 }
25 int main ()
26 {
27     //volatile int i ;
28     setup();
29
30     while(1)
31     {
32         //Call State for each Block
33         US_state();
34         CA_state();
35         DC_state();
36         // for(i=0;i<50000;i++);
37     }
38     return 0;
39 }

```

## Output Of C Code :

```
US_busy State : Distance =51
US-----distance=51----->CA
CA_driving State : Distance =51      Speed =30
CA-----speed=30----->DC
DC_busy State :Speed =30

US_busy State : Distance =55
US-----distance=55----->CA
CA_driving State : Distance =55      Speed =30
CA-----speed=30----->DC
DC_busy State :Speed =30

US_busy State : Distance =51
US-----distance=51----->CA
CA_driving State : Distance =51      Speed =30
CA-----speed=30----->DC
DC_busy State :Speed =30

US_busy State : Distance =54
US-----distance=54----->CA
CA_driving State : Distance =54      Speed =30
CA-----speed=30----->DC
DC_busy State :Speed =30

US_busy State : Distance =47
US-----distance=47----->CA
CA_waiting State : Distance =47      Speed =30
CA-----speed=0----->DC
DC_idle State :Speed =0
```