Traffic Lights

1.0.0

Generated by Doxygen 1.9.1

1 Data Structure Index

1.1 Data Structures

Here are the data structures with brief descriptions:

2 File Index

2.1 File List

Here is a list of all files with brief descriptions:

3 Data Structure Documentation

3.1 cuteOS_TASK_t Struct Reference

Data Fields

- ERROR_t(∗ callback)(void)
- u16 ticks
- u8 id

3.1.1 Detailed Description

Definition at line 59 of file cuteOS.c.

3.1.2 Field Documentation

3.1.2.1 callback `ERROR_t(* callback) (void)`

Pointer to the task function

Definition at line 60 of file cuteOS.c.

3.1.2.2 id `u8 id`

Task ID

Definition at line 62 of file cuteOS.c.

3.1.2.3 ticks `u16 ticks`

Number of ticks after which the task will run

Definition at line 61 of file cuteOS.c.

The documentation for this struct was generated from the following file:

- code/src/cuteOS.c

3.2 TRAFFIC_CONFIGS_t Struct Reference

`#include <traffic_cfg.h>`

Data Fields

- TRAFFIC_SEQUENCE_DURATION_t red_duration
- TRAFFIC_SEQUENCE_DURATION_t red_amber_duration
- TRAFFIC_SEQUENCE_DURATION_t green_duration
- TRAFFIC_SEQUENCE_DURATION_t amber_duration

3.2.1 Detailed Description

Definition at line 29 of file traffic_cfg.h.

3.2.2 Field Documentation

3.2.2.1 amber_duration `TRAFFIC_SEQUENCE_DURATION_t amber_duration`

Definition at line 33 of file traffic_cfg.h.

3.2.2.2 green_duration `TRAFFIC_SEQUENCE_DURATION_t green_duration`

Definition at line 32 of file traffic_cfg.h.

3.2.2.3 red_amber_duration TRAFFIC_SEQUENCE_DURATION_t red_amber_duration

Definition at line 31 of file traffic_cfg.h.

3.2.2.4 red_duration TRAFFIC_SEQUENCE_DURATION_t red_duration

Definition at line 30 of file traffic_cfg.h.

The documentation for this struct was generated from the following file:

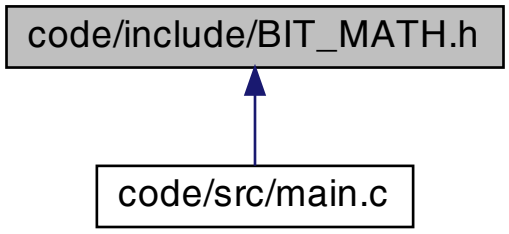
- code/include/traffic_cfg.h

4 File Documentation

4.1 code/include/BIT_MATH.h File Reference

Common bit manipulation operations.

This graph shows which files directly or indirectly include this file:



Macros

- #define GET_BIT(REGISTER, BIT) (1 & ((REGISTER) >> (BIT)))
  Read state of a specific bit.
- #define SET_BIT(REGISTER, BIT) ((REGISTER) |= (1 << (BIT)))
  Set state of a specific bit (set to 1)
- #define CLR_BIT(REGISTER, BIT) ((REGISTER) &= ~(1 << (BIT)))
  Clear state of a specific bit (set to 0)
- #define TOG_BIT(REGISTER, BIT) ((REGISTER) ^= (1 << (BIT)))
  Toggle state of a specific bit (set to 0)
- #define BIT_IS_SET(REGISTER, Bit) ((REGISTER) & (1 << (Bit)))
  Check if state of a specific bit is set (state = 1)
- #define BIT_IS_CLEAR(REGISTER, Bit) (!((REGISTER) & (1 << (Bit))))
  Check if state of a specific bit is Cleared (state = 0)
- #define CONCAT_8BITS(b7, b6, b5, b4, b3, b2, b1, b0) (0b##b7##b6##b5##b4##b3##b2##b1##b0)
- #define CONCAT_7BITS(b6, b5, b4, b3, b2, b1, b0) (0b##b6##b5##b4##b3##b2##b1##b0)
- #define CONCAT_6BITS(b5, b4, b3, b2, b1, b0) (0b##b5##b4##b3##b2##b1##b0)
- #define CONCAT_5BITS(b4, b3, b2, b1, b0) (0b##b4##b3##b2##b1##b0)
- #define CONCAT_4BITS(b3, b2, b1, b0) (0b##b3##b2##b1##b0)
- #define CONCAT_3BITS(b2, b1, b0) (0b##b2##b1##b0)
- #define CONCAT_2BITS(b1, b0) (0b##b1##b0)

4.1.1 Detailed Description

Common bit manipulation operations.

Author

Mahmoud Karam (ma.karam272@gmail.com)

Version

1.0.0

Date

2021-07-31

Definition in file BIT_MATH.h.

4.1.2 Macro Definition Documentation

4.1.2.1 BIT_IS_CLEAR

```
#define BIT_IS_CLEAR(
        REGISTER,
        Bit ) ( !( (REGISTER) & (1 << (Bit)) ) )
```

Check if state of a specific bit is Cleared (state = 0)

Parameters

in	*REGISTER*	the register includes the bit
in	*BIT*	the required bit number to be set

Returns

1 or 0: 1 if the bit is cleared, 0 if the bit is set

For example:

BIT_IS_CLEAR(PORT_A, PIN0) will return 1 if bit 0 of PORT_A is LOW or 0 if it is HIGH

Definition at line 67 of file BIT_MATH.h.

4.1.2.2 BIT_IS_SET

```
#define BIT_IS_SET(
        REGISTER,
        Bit ) ( (REGISTER) & (1 << (Bit)) )
```

Check if state of a specific bit is set (state = 1)

Parameters

in	*REGISTER*	the register includes the bit
in	*BIT*	the required bit number to be set

Returns

1 or 0: 1 if the bit is set, 0 if the bit is cleared

For example:

BIT_IS_SET(PORT_A, PIN0) will return 1 if bit 0 of PORT_A is HIGH or 0 if it is LOW

Definition at line 56 of file BIT_MATH.h.

4.1.2.3 CLR_BIT

```
#define CLR_BIT(
    REGISTER,
    BIT ) ( (REGISTER) &= ~(1 << (BIT)) )
```

Clear state of a specific bit (set to 0)

Parameters

in	*REGISTER*	the register includes the bit
in	*BIT*	the required bit number to be cleared

For example:

CLEAR_BIT(PORT_A, PIN0) will set bit 0 of PORT_A to LOW (0)

Definition at line 37 of file BIT_MATH.h.

4.1.2.4 CONCAT_2BITS

```
#define CONCAT_2BITS(
    b1,
    b0 ) (0b##b1##b0)
```

Definition at line 75 of file BIT_MATH.h.

4.1.2.5 CONCAT_3BITS

```
#define CONCAT_3BITS(
    b2,
    b1,
    b0 ) (0b##b2##b1##b0)
```

Definition at line 74 of file BIT_MATH.h.

4.1.2.6 CONCAT_4BITS

```
#define CONCAT_4BITS(
        b3,
        b2,
        b1,
        b0 ) (0b##b3##b2##b1##b0)
```

Definition at line 73 of file BIT_MATH.h.

4.1.2.7 CONCAT_5BITS

```
#define CONCAT_5BITS(
        b4,
        b3,
        b2,
        b1,
        b0 ) (0b##b4##b3##b2##b1##b0)
```

Definition at line 72 of file BIT_MATH.h.

4.1.2.8 CONCAT_6BITS

```
#define CONCAT_6BITS(
        b5,
        b4,
        b3,
        b2,
        b1,
        b0 ) (0b##b5##b4##b3##b2##b1##b0)
```

Definition at line 71 of file BIT_MATH.h.

4.1.2.9 CONCAT_7BITS

```
#define CONCAT_7BITS(
        b6,
        b5,
        b4,
        b3,
        b2,
        b1,
        b0 ) (0b##b6##b5##b4##b3##b2##b1##b0)
```

Definition at line 70 of file BIT_MATH.h.

4.1.2.10 CONCAT_8BITS

```
#define CONCAT_8BITS(
        b7,
        b6,
        b5,
        b4,
        b3,
        b2,
        b1,
        b0 ) (0b##b7##b6##b5##b4##b3##b2##b1##b0)
```

Definition at line 69 of file BIT_MATH.h.

4.1.2.11 GET_BIT `#define GET_BIT( REGISTER, BIT ) ( 1 & ( (REGISTER) >> (BIT) ) )`

Read state of a specific bit.

Parameters

in	*REGISTER*	the register includes the bit
in	*BIT*	the required bit number to be read

Returns

state of the bit: 1 or 0

For example:

GET_BIT(PORT_A, PIN0) will return 1 if bit 0 of PORT_A is HIGH or 0 if it is LOW

Definition at line 19 of file BIT_MATH.h.

4.1.2.12 SET_BIT `#define SET_BIT( REGISTER, BIT ) ( (REGISTER) |= (1 << (BIT)) )`

Set state of a specific bit (set to 1)

Parameters

in	*REGISTER*	the register includes the bit
in	*BIT*	the required bit number to be set

For example:

SET_BIT(PORT_A, PIN0) will set bit 0 of PORT_A to HIGH (1)

Definition at line 28 of file BIT_MATH.h.

4.1.2.13 TOG_BIT `#define TOG_BIT( REGISTER, BIT ) ( (REGISTER) ^= (1 << (BIT)) )`

Toggle state of a specific bit (set to 0)

Parameters

in	*REGISTER*	is the register includes the bit
in	*BIT*	the required bit number to be toggled

For example:

TOG_BIT(PORT_A, PIN0) will toggle bit 0 of PORT_A. So if it was HIGH, it will be LOW, and if it was LOW, it will be HIGH.

Definition at line 46 of file BIT_MATH.h.

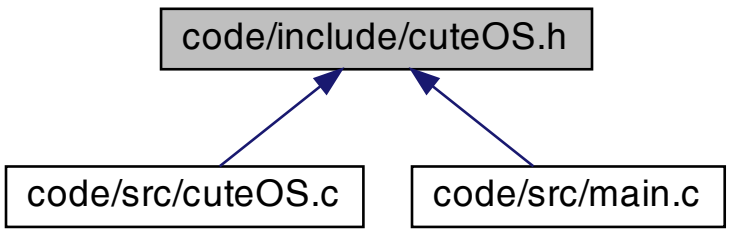
4.2 BIT_MATH.h

```
00001
00008 #ifndef BIT_MATH_H
00009 #define BIT_MATH_H
00010
00011
00019 #define GET_BIT(REGISTER, BIT)      ( 1 & ( (REGISTER) » (BIT) ) )
00020
00021
00028 #define SET_BIT(REGISTER, BIT)      ( (REGISTER) |= (1 « (BIT)) )
00029
00030
00037 #define CLR_BIT(REGISTER, BIT)      ( (REGISTER) &= ~(1 « (BIT)) )
00038
00039
00046 #define TOG_BIT(REGISTER, BIT)      ( (REGISTER) ^= (1 « (BIT)) )
00047
00048
00056 #define BIT_IS_SET(REGISTER,Bit)    ( (REGISTER) & (1 « (Bit)) )
00057
00058
00059
00067 #define BIT_IS_CLEAR(REGISTER,Bit)  ( !( (REGISTER) & (1 « (Bit)) ) )
00068
00069 #define CONCAT_8BITS(b7, b6, b5, b4, b3, b2, b1, b0)  (0b##b7##b6##b5##b4##b3##b2##b1##b0)
00070 #define CONCAT_7BITS(b6, b5, b4, b3, b2, b1, b0)      (0b##b6##b5##b4##b3##b2##b1##b0)
00071 #define CONCAT_6BITS(b5, b4, b3, b2, b1, b0)          (0b##b5##b4##b3##b2##b1##b0)
00072 #define CONCAT_5BITS(b4, b3, b2, b1, b0)              (0b##b4##b3##b2##b1##b0)
00073 #define CONCAT_4BITS(b3, b2, b1, b0)                  (0b##b3##b2##b1##b0)
00074 #define CONCAT_3BITS(b2, b1, b0)                      (0b##b2##b1##b0)
00075 #define CONCAT_2BITS(b1, b0)                          (0b##b1##b0)
00076
00077 #endif          /* BIT_MATH_H   */
```

4.3 code/include/cuteOS.h File Reference

Simple EOS interfaces header file. See cuteOS.c for more details.

This graph shows which files directly or indirectly include this file:



Functions

- ERROR_t cuteOS_SetCallback (ERROR_t(∗const taskPtr)(void))

  Set callback function for Simple EOS.
- ERROR_t cuteOS_Init (void)

  Sets up Timer 2 to drive the simple EOS.
- ERROR_t cuteOS_TaskCreate (ERROR_t(∗const taskPtr)(void), const u16 TICK_MS)

  Create a task with the given task function and the given tick time.
- ERROR_t cuteOS_TaskRemove (ERROR_t(∗const taskPtr)(void))

  Remove a task from the tasks array.
- void cuteOS_Start (void)

  The OS enters 'idle mode' between clock ticks to save power.
- ERROR_t cuteOS_SetTickTime (const u8 TICK_MS)

  Set the tick time in milliseconds.
- ERROR_t cuteOS_GetTickTime (u8 ∗const TICK_MS)

  Get the tick time in milliseconds.

4.3.1 Detailed Description

Simple EOS interfaces header file. See cuteOS.c for more details.

Author

Mahmoud Karam (ma.karam272@gmail.com)

Version

1.0.0

Date

2022-03-22

Copyright

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Definition in file cuteOS.h.

4.3.2 Function Documentation

4.3.2.1 cuteOS_GetTickTime() `ERROR_t cuteOS_GetTickTime ( u8 *const tickTimeInMsPtr )`

Get the tick time in milliseconds.

Parameters

TICK_MS	pointer to the tick time in milliseconds

Returns

ERROR Status: Check the options in the global enum ERROR_t.

Example

```
u8 tickTimeInMs;
// Get the tick time in milliseconds and store it in tickTimeInMs
cuteOS_GetTickTime(&tickTimeInMs);
```

Get the tick time in milliseconds.

Definition at line 209 of file cuteOS.c.

4.3.2.2 cuteOS_Init() `ERROR_t cuteOS_Init ( void )`

Sets up Timer 2 to drive the simple EOS.

Initialize the Cute OS using Timer 2 overflow:

- Timer mode
- Tick time
- Interrupt enable
- Auto-reload mode

< Disable Timer 2

Enable Timer 2 (16-bit timer) and configure it as a timer and automatically reloaded its value at overflow and

< Load Timer 2 control register

< Number of timer increments required (max 65536)

< Inc = (Number of mSec) * (Number of Instructions per mSec)

< Number of mSec = cuteOS_TickTimeMs

< Number of Instructions per mSec = (Number of Oscillations per mSec) * (Number of Instructions per Oscillation)

< Number of Oscillations per mSec = OSC_FREQ(MHz) / 1000

< Number of Instructions per Oscillation = 1 / OSC_PER_INST

< 16-bit reload value

< 8-bit reload values (High & Low)

< High byte

< Low byte

< Load T2 and reload capt. reg. high bytes

< Load T2 and reload capt. reg. low bytes

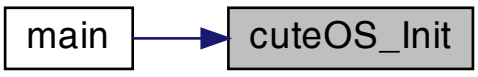
< Enable Timer 2 interrupt

< Start Timer 2

< Globally enable interrupts

Definition at line 228 of file cuteOS.c.

Here is the caller graph for this function:



4.3.2.3 cuteOS_SetCallback() `ERROR_t cuteOS_SetCallback ( ERROR_t(*)(void) taskPtr )`

Set callback function for Simple EOS.

Parameters

taskPtr	pointer to the task function

Returns

ERROR Status: Check the options in the global enum ERROR_t.

Note

This function is called by the user to set the callback function for the Simple EOS

Example

```
// Set the callback function for the Simple EOS to the function LED_Toggle()
cuteOS_setCallback(LED_Toggle);  // LED_Toggle() is a function that toggles the LED
```

4.3.2.4 cuteOS_SetTickTime() ERROR_t cuteOS_SetTickTime (const u8 *TICK_MS*)

Set the tick time in milliseconds.

Parameters

TICK_MS	tick time in milliseconds

Returns

ERROR Status: Check the options in the global enum ERROR_t.

Example

```
cuteOS_SetTickTime(1000);     // Set the tick time to 1 second
```

Set the value of the tick time in milliseconds. So, the timing of the tasks is determined by the frequency of Timer 2 overflow. Overflow occurs every tickTimeInMs milliseconds. < Set the value of the tick time in ms

Definition at line 191 of file cuteOS.c.

4.3.2.5 cuteOS_Start() void cuteOS_Start (void)

The OS enters 'idle mode' between clock ticks to save power.

Note

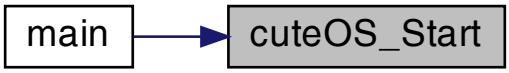
The next clock tick will return the processor to the normal operating state.

The OS enters 'idle mode' between clock ticks to save power. < Super loop

< Enter idle mode to save power

Definition at line 179 of file cuteOS.c.

Here is the caller graph for this function:



4.3.2.6 cuteOS_TaskCreate() ERROR_t cuteOS_TaskCreate (ERROR_t(*)(void) *callback*, const u16 *TICK_MS*)

Create a task with the given task function and the given tick time.

Parameters

in	*taskPtr*	Pointer to the task function.
in	*TICK_MS*	the frequency of task execution in milliseconds.

Returns

ERROR Status: Check the options in the global enum ERROR_t.

Example

```
cuteOS_TaskCreate(task1, 1000); // task1 will run every 1 second
cuteOS_TaskCreate(task2, 2000); // task2 will run every 2 seconds
```

This function does the following:

- Increment the task counter.
- Set the task ID.
- Set the pointer to the task function.
- Set the number of schedular ticks after which the task will run.

Definition at line 126 of file cuteOS.c.

Here is the caller graph for this function:

4.3.2.7 cuteOS_TaskRemove() ERROR_t cuteOS_TaskRemove (ERROR_t(*)(void) *callback*)

Remove a task from the tasks array.

Parameters

in	*taskPtr*	Pointer to the task function.

Returns

ERROR Status: Check the options in the global enum ERROR_t.

Example

```
cuteOS_TaskRemove(task1);       // remove task1
cuteOS_TaskRemove(task2);       // remove task2
```

This function does the following:

- Search for the task in the tasks array.
- If found, remove the task from the tasks array.
- Rearrange the tasks array.
- Decrement the task counter.
- If the task is not available, an error is returned.

Parameters

in	*callback*	Pointer to the task function.

Returns

ERROR Status: Check the options in the global enum ERROR_t.

< Find the task in the task array

< Task found

< Decrement the number of tasks

Definition at line 152 of file cuteOS.c.

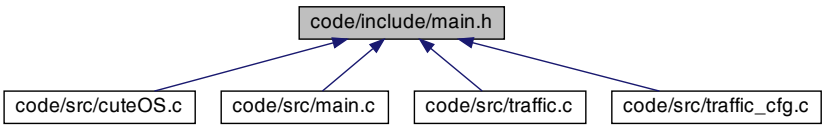
4.4 cuteOS.h

```
00001
00009 #ifndef CUTE_OS_H
00010 #define CUTE_OS_H
00011
00012
00025 ERROR_t cuteOS_SetCallback( ERROR_t (* const taskPtr)(void) );
00026
00027
00030 ERROR_t cuteOS_Init(void);
00031
00032
00041 ERROR_t cuteOS_TaskCreate(ERROR_t (* const taskPtr)(void), const u16 TICK_MS);
00042
00043
00051 ERROR_t cuteOS_TaskRemove(ERROR_t (* const taskPtr)(void));
00052
00053
00054
00058 void cuteOS_Start(void);
00059
00060
00070 ERROR_t cuteOS_SetTickTime(const u8 TICK_MS);
00071
00072
00084 ERROR_t cuteOS_GetTickTime(u8 * const TICK_MS);
00085
00086 #endif /* SIMPLE_EOS_H */
```

4.5 code/include/main.h File Reference

Project Header for main.c.

This graph shows which files directly or indirectly include this file:



Macros

- #define OSC_FREQ (12000000UL)
- #define OSC_PER_INST (12)

  Number of oscillations per instruction (12, etc)
- #define INTERRUPT_Timer_0_Overflow 1
- #define INTERRUPT_Timer_1_Overflow 3
- #define INTERRUPT_Timer_2_Overflow 5

4.5.1 Detailed Description

Project Header for main.c.

Author

Mahmoud Karam (ma.karam272@gmail.com)

Version

1.0.0

Date

2022-03-22

Copyright

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Definition in file main.h.

4.5.2 Macro Definition Documentation

4.5.2.1 INTERRUPT_Timer_0_Overflow `#define INTERRUPT_Timer_0_Overflow 1`

Definition at line 36 of file main.h.

4.5.2.2 INTERRUPT_Timer_1_Overflow `#define INTERRUPT_Timer_1_Overflow 3`

Definition at line 37 of file main.h.

4.5.2.3 INTERRUPT_Timer_2_Overflow `#define INTERRUPT_Timer_2_Overflow 5`

Definition at line 38 of file main.h.

4.5.2.4 OSC_FREQ `#define OSC_FREQ (12000000UL)`

Definition at line 16 of file main.h.

4.5.2.5 OSC_PER_INST `#define OSC_PER_INST (12)`

Number of oscillations per instruction (12, etc)

Options:

- 12: Original 8051 / 8052 and numerous modern versions
- 6 : Various Infineon and Philips devices, etc.
- 4 : Dallas 320, 520 etc.
- 1 : Dallas 420, etc.

Definition at line 26 of file main.h.

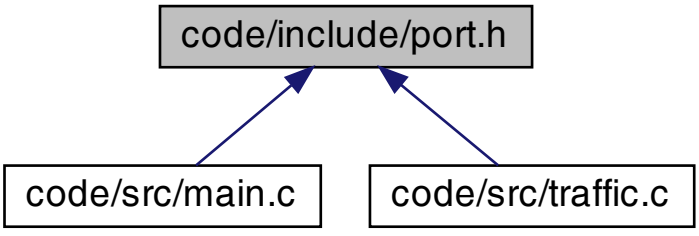
4.6 main.h

```
00001
00009 #ifndef MAIN_H
00010 #define MAIN_H
00011
00012 /*-------------------------------------------------------------------*/
00013 /* WILL NEED TO EDIT THIS SECTION FOR EVERY PROJECT                   */
00014 /*-------------------------------------------------------------------*/
00015 /* Oscillator / resonator frequency (in Hz) e.g. (11059200UL)   */
00016 #define OSC_FREQ        (12000000UL)
00017
00018
00026 #define OSC_PER_INST        (12)
00027
00028
00029
00030
00031
00032 /*-------------------------------------------------------------------*/
00033 /* SHOULD NOT NEED TO EDIT THE SECTIONS BELOW                        */
00034 /*-------------------------------------------------------------------*/
00035 /* Interrupts number of Timers overflow from the vector table of the 8051 */
00036 #define INTERRUPT_Timer_0_Overflow          1
00037 #define INTERRUPT_Timer_1_Overflow          3
00038 #define INTERRUPT_Timer_2_Overflow          5
00039
00040
00041 #endif  /* MAIN_H */
```

4.7 code/include/port.h File Reference

Porting Header file.

This graph shows which files directly or indirectly include this file:



Variables

- sbit redPin = P1^0
- sbit amberPin = P1^1
- sbit greenPin = P1^2
- sbit led1Pin = P1^3
- sbit led2Pin = P1^4
- sbit led3Pin = P1^5
- sbit motorPin = P1^6
- sbit buzzerPin = P1^7

4.7.1 Detailed Description

Porting Header file.

Author

Mahmoud Karam (ma.karam272@gmail.com)

Version

1.0.0

Date

2022-03-22

Copyright

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Definition in file port.h.

4.7.2 Variable Documentation

4.7.2.1 amberPin `sbit amberPin = P1^1`

Definition at line 16 of file port.h.

4.7.2.2 buzzerPin `sbit buzzerPin = P1^7`

Definition at line 26 of file port.h.

4.7.2.3 greenPin `sbit greenPin = P1^2`

Definition at line 17 of file port.h.

4.7.2.4 led1Pin `sbit led1Pin = P1^3`

In file main.C

Definition at line 22 of file port.h.

4.7.2.5 led2Pin `sbit led2Pin = P1^4`

Definition at line 23 of file port.h.

4.7.2.6 led3Pin `sbit led3Pin = P1^5`

Definition at line 24 of file port.h.

4.7.2.7 motorPin `sbit motorPin = P1^6`

Definition at line 25 of file port.h.

4.7.2.8 redPin `sbit redPin = P1^0`

In file traffic.C

Definition at line 15 of file port.h.

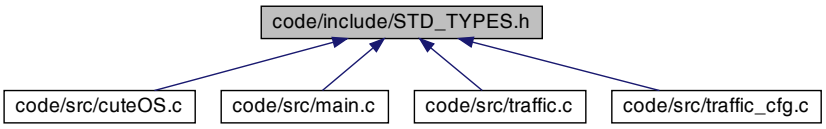
4.8 port.h

```
00001
00009 #ifndef PORT_H
00010 #define PORT_H
00011
00012
00015 sbit redPin     = P1^0;   /* Port 1 pin 0 */
00016 sbit amberPin   = P1^1;   /* Port 1 pin 1 */
00017 sbit greenPin   = P1^2;   /* Port 1 pin 2 */
00018
00019
00022 sbit led1Pin = P1^3;
00023 sbit led2Pin = P1^4;
00024 sbit led3Pin = P1^5;
00025 sbit motorPin = P1^6;
00026 sbit buzzerPin = P1^7;
00027
00028 #endif  /* PORT_H */
```

4.9 code/include/STD_TYPES.h File Reference

Standard data types For 8051 Microcontrollers.

This graph shows which files directly or indirectly include this file:



Macros

- #define NULL ((void ∗)0)
- #define NULL_BYTE ('\0')

Typedefs

- typedef signed long int s32
- typedef signed short int s16
- typedef signed char s8
- typedef unsigned long int u32
- typedef unsigned short int u16
- typedef unsigned char u8
- typedef float f32
- typedef double f64
- typedef u16 size_t

Enumerations

- enum STATE_t { LOW , HIGH , NORMAL }
- enum ACTIVATION_STATUS_t { ACTIVE_LOW , ACTIVE_HIGH }
- enum BOOL_t { FALSE , TRUE }
- enum ERROR_t {
  ERROR_NO = 0 , ERROR_YES = 0x1 , ERROR_TIMEOUT = 0x2 , ERROR_NULL_POINTER = 0x4 ,
  ERROR_BUSY = 0x8 , ERROR_NOT_INITIALIZED = 0x10 , ERROR_ILLEGAL_PARAM = 0x20 ,
  ERROR_OUT_OF_RANGE = 0x40 }

4.9.1 Detailed Description

Standard data types For 8051 Microcontrollers.

Author

Mahmoud Karam (ma.karam272@gmail.com)

Date

2022-03-20

Version

1.0.0

Definition in file STD_TYPES.h.

4.9.2 Macro Definition Documentation

4.9.2.1 NULL `#define NULL ((void *)0)`

NULL pointer

Definition at line 61 of file STD_TYPES.h.

4.9.2.2 NULL_BYTE `#define NULL_BYTE ('\0')`

Definition at line 64 of file STD_TYPES.h.

4.9.3 Typedef Documentation

4.9.3.1 f32 `typedef float f32`

Definition at line 22 of file STD_TYPES.h.

4.9.3.2 f64 `typedef double f64`

Definition at line 23 of file STD_TYPES.h.

4.9.3.3 s16 `typedef signed short int s16`

Definition at line 13 of file STD_TYPES.h.

4.9.3.4 s32 `typedef signed long int s32`

Definition at line 12 of file STD_TYPES.h.

4.9.3.5 s8 `typedef signed char s8`

Definition at line 14 of file STD_TYPES.h.

4.9.3.6 size_t typedef u16 size_t

< This is a macro defined in the C standard library <stddef.h> for the size_t type size_t is an unsigned integer type of the result of the sizeof operator

Definition at line 27 of file STD_TYPES.h.

4.9.3.7 u16 typedef unsigned short int u16

Definition at line 18 of file STD_TYPES.h.

4.9.3.8 u32 typedef unsigned long int u32

Definition at line 17 of file STD_TYPES.h.

4.9.3.9 u8 typedef unsigned char u8

Definition at line 19 of file STD_TYPES.h.

4.9.4 Enumeration Type Documentation

4.9.4.1 ACTIVATION_STATUS_t enum ACTIVATION_STATUS_t

Enumerator

ACTIVE_LOW	Active low means that the pin is pulled low when the pin is set to high
ACTIVE_HIGH	Active high means that the pin is pulled high when the pin is set to low

Definition at line 37 of file STD_TYPES.h.

4.9.4.2 BOOL_t enum BOOL_t

Enumerator

FALSE	
TRUE	

Definition at line 43 of file STD_TYPES.h.

4.9.4.3 ERROR_t enum ERROR_t

Enumerator

ERROR_NO	No error occured
ERROR_YES	Error occured
ERROR_TIMEOUT	Timeout occured
ERROR_NULL_POINTER	Null pointer occured
ERROR_BUSY	Busy state occured
ERROR_NOT_INITIALIZED	Not initialized state occured
ERROR_ILLEGAL_PARAM	Invalid input state occured
ERROR_OUT_OF_RANGE	Out of range state occured

Definition at line 48 of file STD_TYPES.h.

4.9.4.4 STATE_t enum STATE_t

Enumerator

LOW	
HIGH	
NORMAL	

Definition at line 31 of file STD_TYPES.h.

4.10 STD_TYPES.h

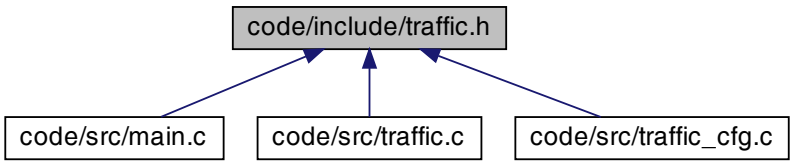
```
00001
00008 #ifndef STD_TYPES_H
00009 #define STD_TYPES_H
00010
00011 /* Signed integers  */
00012 typedef     signed long int             s32;
00013 typedef     signed short int            s16;
00014 typedef     signed char                 s8;
00015
00016 /* Unsigned integers    */
00017 typedef     unsigned long int           u32;
00018 typedef     unsigned short int          u16;
00019 typedef     unsigned char               u8;
00020
00021 /* Float numbers    */
00022 typedef     float                       f32;
00023 typedef     double                      f64;
00024
00025 /* Special types    */
00026  #undef __SIZE_TYPE__
00027 typedef     u16   size_t;
00029 #undef HIGH
00030 #undef LOW
00031 typedef enum{
00032   LOW,
00033   HIGH,
```

```
00034   NORMAL,             /* Used for any normal state */
00035 }STATE_t;
00036
00037 typedef enum{
00038     ACTIVE_LOW,
00039     ACTIVE_HIGH,
00040 }ACTIVATION_STATUS_t;
00041
00042 /* Boolean type */
00043 typedef enum{
00044     FALSE,
00045     TRUE
00046 }BOOL_t;
00047
00048 typedef enum{
00049     ERROR_NO                = 0,
00050     ERROR_YES               = 0x1,
00051     ERROR_TIMEOUT           = 0x2,
00052     ERROR_NULL_POINTER      = 0x4,
00053     ERROR_BUSY              = 0x8,
00054     ERROR_NOT_INITIALIZED   = 0x10,
00055     ERROR_ILLEGAL_PARAM     = 0x20,
00056     ERROR_OUT_OF_RANGE      = 0x40,
00057 }ERROR_t;
00058
00059 /* Pointers */
00060 #undef NULL
00061 #define NULL ((void *)0)
00063 #undef NULL_BYTE
00064 #define NULL_BYTE  ('\0')
00065
00066  #endif   /* STD_TYPES_H */
```

4.11 code/include/traffic.h File Reference

Traffic Light System interfaces header file. See traffic.c for more details.

This graph shows which files directly or indirectly include this file:



Enumerations

- enum TRAFFIC_SEQUENCE_t { RED , RED_AMBER , GREEN , AMBER }

Functions

- ERROR_t TRAFFIC_Init (void)

  Initialize the traffic light system to RED state.
- ERROR_t TRAFFIC_DeInit (void)

  De Initialize the traffic light system by turning off all the lights.
- ERROR_t TRAFFIC_Update (void)

  Update the traffic light system to the next state.
- ERROR_t TRAFFIC_SetColor (const TRAFFIC_SEQUENCE_t Copy_color)

  Set the traffic light color sequence to the given color sequence.
- ERROR_t TRAFFIC_GetColor (TRAFFIC_SEQUENCE_t *const Copy_color)

  Get the traffic light color sequence.

4.11.1 Detailed Description

Traffic Light System interfaces header file. See traffic.c for more details.

Author

Mahmoud Karam (ma.karam272@gmail.com)

Version

1.0.0

Date

2022-03-22

Copyright

Definition in file traffic.h.

4.11.2 Enumeration Type Documentation

4.11.2.1 TRAFFIC_SEQUENCE_t `enum TRAFFIC_SEQUENCE_t`

< Enumeration of the traffic light sequence states

Enumerator

RED	
RED_AMBER	
GREEN	
AMBER	

Definition at line 17 of file traffic.h.

4.11.3 Function Documentation

4.11.3.1 TRAFFIC_DeInit() `ERROR_t TRAFFIC_DeInit ( void )`

De Initialize the traffic light system by turning off all the lights.

Returns

ERROR_t: Error status. Check the options in the global enum ERROR_t.

This function does the following:

- Turning off all the traffic lights.
- Assign the callback function of the OS delay to NULL.

< Setting traffic light to red

< Setting callback function to NULL

Definition at line 67 of file traffic.c.

4.11.3.2 TRAFFIC_GetColor() `ERROR_t TRAFFIC_GetColor ( TRAFFIC_SEQUENCE_t *const Copy_color )`

Get the traffic light color sequence.

Parameters

out	*Copy_color*	pointer to the variable to store the color sequence. See TRAFFIC_SEQUENCE_t for more details about the color sequences.

Returns

ERROR_t: Error status. Check the options in the global enum ERROR_t.

Definition at line 124 of file traffic.c.

4.11.3.3 TRAFFIC_Init() `ERROR_t TRAFFIC_Init ( void )`

Initialize the traffic light system to RED state.

Returns

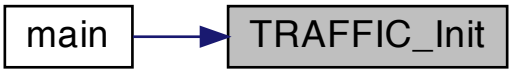
ERROR_t: Error status. Check the options in the global enum ERROR_t.

< Reset the time counter

< Initialize the colorSequence

Definition at line 47 of file traffic.c.

Here is the caller graph for this function:



4.11.3.4 TRAFFIC_SetColor() `ERROR_t TRAFFIC_SetColor ( const TRAFFIC_SEQUENCE_t Copy_color )`

Set the traffic light color sequence to the given color sequence.

Parameters

in	*color*	sequence: The color sequence to set. See TRAFFIC_SEQUENCE_t for more details about the color sequences.

Returns

ERROR_t: Error status. Check the options in the global enum ERROR_t.

Definition at line 115 of file traffic.c.

4.11.3.5 TRAFFIC_Update() `ERROR_t TRAFFIC_Update ( void )`

Update the traffic light system to the next state.

Returns

ERROR_t: Error status. Check the options in the global enum ERROR_t.

This function does the following:

- Setting the traffic light color sequence according to the current color sequence.
- Update the OS delay for the current color sequence.
- Update the color sequence value to the next color sequence. So, when calling this function again, the color sequence will be changed.

< Switch on the current color sequence

< Illegal color sequence

Definition at line 89 of file traffic.c.

Here is the caller graph for this function:

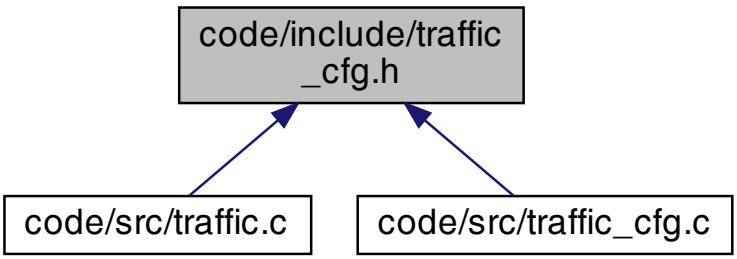
4.12 traffic.h

```
00001
00010 #ifndef TRAFFIC_H
00011 #define TRAFFIC_H
00012
00013 /*---------------------------------------------------------------------*/
00014 /* TYPE DEFINITIONS                                                    */
00015 /*---------------------------------------------------------------------*/
00017 typedef enum {
00018     RED,
00019     RED_AMBER,
00020     GREEN,
00021     AMBER
00022 }TRAFFIC_SEQUENCE_t;
00023
00024
00025
00026
00027 /*---------------------------------------------------------------------*/
00028 /* PUBLIC FUNCTIONS                                                    */
00029 /*---------------------------------------------------------------------*/
00030
00034 ERROR_t TRAFFIC_Init(void);
00035
00036
00040 ERROR_t TRAFFIC_DeInit(void);
00041
00042
00046 ERROR_t TRAFFIC_Update(void);
00047
00048
00054 ERROR_t TRAFFIC_SetColor(const TRAFFIC_SEQUENCE_t Copy_color);
00055
00056
00062 ERROR_t TRAFFIC_GetColor(TRAFFIC_SEQUENCE_t * const Copy_color);
00063
00064
00065 #endif          /* TRAFFIC_H */
```

4.13 code/include/traffic_cfg.h File Reference

Traffic Light System interfaces header file. See traffic.c for more details.

This graph shows which files directly or indirectly include this file:



Data Structures

- struct TRAFFIC_CONFIGS_t

Enumerations

- enum TRAFFIC_SEQUENCE_DURATION_t { TRAFFIC_DURATION_RED = 4 , TRAFFIC_DURATION_RED_AMBER = 2 , TRAFFIC_DURATION_GREEN = 4 , TRAFFIC_DURATION_AMBER = 2 }

Variables

- TRAFFIC_CONFIGS_t TRAFFIC_Configs

4.13.1 Detailed Description

Traffic Light System interfaces header file. See traffic.c for more details.

Author

Mahmoud Karam (ma.karam272@gmail.com)

Version

1.0.0

Date

2022-03-22

Copyright

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Definition in file traffic_cfg.h.

4.13.2 Enumeration Type Documentation

4.13.2.1 TRAFFIC_SEQUENCE_DURATION_t `enum TRAFFIC_SEQUENCE_DURATION_t`

Enumerator

TRAFFIC_DURATION_RED	Red light duration in seconds
TRAFFIC_DURATION_RED_AMBER	Red-Amber light duration in seconds
TRAFFIC_DURATION_GREEN	Green light duration in seconds
TRAFFIC_DURATION_AMBER	Amber light duration in seconds

Definition at line 15 of file traffic_cfg.h.

4.13.3 Variable Documentation

4.13.3.1 TRAFFIC_Configs `TRAFFIC_CONFIGS_t TRAFFIC_Configs [extern]`

< Traffic Light System pins connections.

Definition at line 18 of file traffic_cfg.c.

4.14 traffic_cfg.h

```
00001
00009 #ifndef TRAFFIC_CFG_H
00010 #define TRAFFIC_CFG_H
00011
00012 /*------------------------------------------------------------------------*/
00013 /*                YOU CAN CHANGE THE FOLLOWING PARAMETERS                 */
00014 /*------------------------------------------------------------------------*/
00015 typedef enum {
00016     TRAFFIC_DURATION_RED = 4,
00017     TRAFFIC_DURATION_RED_AMBER = 2,
00018     TRAFFIC_DURATION_GREEN = 4,
00019     TRAFFIC_DURATION_AMBER = 2,
00020 }TRAFFIC_SEQUENCE_DURATION_t;
00021
00022
00023
00024
00025
00026 /*------------------------------------------------------------------------*/
00027 /*                YOU MUST <<NOT>> CHANGE THE FOLLOWING PARAMETERS       */
00028 /*------------------------------------------------------------------------*/
00029 typedef struct {
00030     TRAFFIC_SEQUENCE_DURATION_t red_duration;
00031     TRAFFIC_SEQUENCE_DURATION_t red_amber_duration;
00032     TRAFFIC_SEQUENCE_DURATION_t green_duration;
00033     TRAFFIC_SEQUENCE_DURATION_t amber_duration;
00034 }TRAFFIC_CONFIGS_t;
00035
00036 extern TRAFFIC_CONFIGS_t TRAFFIC_Configs;
00037
00038 #endif /* TRAFFIC_CFG_H */
```

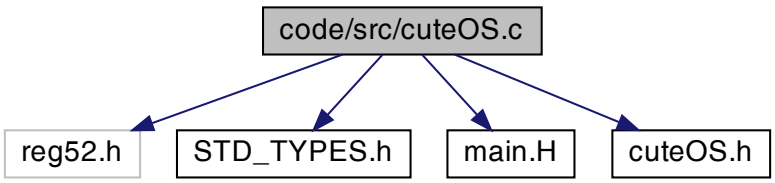
4.15 code/src/cuteOS.c File Reference

Main file for Cute Embedded Operating System (cuteOS) for 8051.

```
#include <reg52.h>
#include "STD_TYPES.h"
#include "main.H"
```

```
#include "cuteOS.h"
```

Include dependency graph for cuteOS.c:



Data Structures

- struct cuteOS_TASK_t

Macros

- #define MAX_TICK_TIME_MS 65

  Maximum tick time in milliseconds.
- #define MAX_TASKS_NUM 10

  Maximum number of tasks the OS can handle.

Functions

- ERROR_t cuteOS_TaskCreate (ERROR_t(∗const callback)(void), const u16 TICK_MS)

  Create a task with the given task function and the given tick time.
- ERROR_t cuteOS_TaskRemove (ERROR_t(∗const callback)(void))

  Remove a task from the tasks array.
- void cuteOS_Start (void)

  Start the Cute Embedded Operating System (cuteOS)
- ERROR_t cuteOS_SetTickTime (const u8 TICK_MS)

  Set the tick time in milliseconds.
- ERROR_t cuteOS_GetTickTime (u8 ∗const tickTimeInMsPtr)

  Get the value of the tick time in milliseconds.
- ERROR_t cuteOS_Init (void)

  Sets up Timer 2 to drive the simple EOS.

Variables

- cuteOS_TASK_t tasks [MAX_TASKS_NUM] = {0}

4.15.1 Detailed Description

Main file for Cute Embedded Operating System (cuteOS) for 8051.

Author

Mahmoud Karam (ma.karam272@gmail.com)

cuteOS schedules the tasks in a cooperative manner. It invokes te scheduler (cuteOS_ISR()) periodically by Timer overflow. So, the timing of the tasks is determined by the frequency of Timer overflow defined by the variable cuteOS_TICK_TIME.

Note

cuteOS uses the timer2 for scheduling.

Version

1.0.0

Date

2022-03-22

Copyright

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Application usage:

- At main.c:
  1. Initialize the Cute OS.
     ```
     cuteOS_Init();
     ```
  2. Initialize the tasks.
     ```
     cuteOS_TaskCreate(task1, 1000); // task1 will run every 1 second
     cuteOS_TaskCreate(task2, 2000); // task2 will run every 2 seconds
     ```
  3. Start the Cute OS scheduler.
     ```
     cuteOS_Start();
     ```

Definition in file cuteOS.c.

4.15.2 Macro Definition Documentation

4.15.2.1 MAX_TASKS_NUM `#define MAX_TASKS_NUM 10`

Maximum number of tasks the OS can handle.

Number of tasks created by the user.

Definition at line 55 of file cuteOS.c.

4.15.2.2 MAX_TICK_TIME_MS `#define MAX_TICK_TIME_MS 65`

Maximum tick time in milliseconds.

This variable is used to set the maximum tick time in milliseconds. The maximum tick time is used to set the maximum time of the tasks. It has a maximum value of 65 ms because:

1. The maximum value of the timer 2 is 65535 (16-bit timer).
2. The 8051 microcontroller has 1 MIPS (1 million instructions per second), with 12MHz clock, and 12 clock cycles per instruction. So, the maximum tick time = (65535 $*$ 12) / 12000000 = 65 ms. Tick time in ms (must be less than MAX_TICK_TIME_MS).

Definition at line 44 of file cuteOS.c.

4.15.3 Function Documentation

4.15.3.1 cuteOS_GetTickTime() `ERROR_t cuteOS_GetTickTime ( u8 *const tickTimeInMsPtr )`

Get the value of the tick time in milliseconds.

Get the tick time in milliseconds.

Definition at line 209 of file cuteOS.c.

4.15.3.2 cuteOS_Init() `ERROR_t cuteOS_Init ( void )`

Sets up Timer 2 to drive the simple EOS.

Initialize the Cute OS using Timer 2 overflow:

- Timer mode
- Tick time
- Interrupt enable
- Auto-reload mode

< Disable Timer 2

Enable Timer 2 (16-bit timer) and configure it as a timer and automatically reloaded its value at overflow and

< Load Timer 2 control register

< Number of timer increments required (max 65536)

< Inc = (Number of mSec) * (Number of Instructions per mSec)

< Number of mSec = cuteOS_TickTimeMs

< Number of Instructions per mSec = (Number of Oscillations per mSec) * (Number of Instructions per Oscillation)

< Number of Oscillations per mSec = OSC_FREQ(MHz) / 1000

< Number of Instructions per Oscillation = 1 / OSC_PER_INST

< 16-bit reload value

< 8-bit reload values (High & Low)

< High byte

< Low byte

< Load T2 and reload capt. reg. high bytes

< Load T2 and reload capt. reg. low bytes

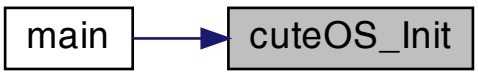
< Enable Timer 2 interrupt

< Start Timer 2

< Globally enable interrupts

Definition at line 228 of file cuteOS.c.

Here is the caller graph for this function:



4.15.3.3 cuteOS_SetTickTime() `ERROR_t cuteOS_SetTickTime ( const u8 TICK_MS )`

Set the tick time in milliseconds.

Set the value of the tick time in milliseconds. So, the timing of the tasks is determined by the frequency of Timer 2 overflow. Overflow occurs every tickTimeInMs milliseconds. < Set the value of the tick time in ms

Definition at line 191 of file cuteOS.c.

4.15.3.4 cuteOS_Start() `void cuteOS_Start ( void )`

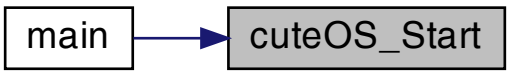
Start the Cute Embedded Operating System (cuteOS)

The OS enters 'idle mode' between clock ticks to save power. < Super loop

< Enter idle mode to save power

Definition at line 179 of file cuteOS.c.

Here is the caller graph for this function:



4.15.3.5 cuteOS_TaskCreate() `ERROR_t cuteOS_TaskCreate ( ERROR_t(*)(void) callback, const u16 TICK_MS )`

Create a task with the given task function and the given tick time.

This function does the following:

- Increment the task counter.
- Set the task ID.
- Set the pointer to the task function.
- Set the number of schedular ticks after which the task will run.

Definition at line 126 of file cuteOS.c.

Here is the caller graph for this function:

4.15.3.6 cuteOS_TaskRemove() ERROR_t cuteOS_TaskRemove (ERROR_t(*)(void) *callback*)

Remove a task from the tasks array.

This function does the following:

- Search for the task in the tasks array.
- If found, remove the task from the tasks array.
- Rearrange the tasks array.
- Decrement the task counter.
- If the task is not available, an error is returned.

Parameters

in	*callback*	Pointer to the task function.

Returns

ERROR Status: Check the options in the global enum ERROR_t.

< Find the task in the task array

< Task found

< Decrement the number of tasks

Definition at line 152 of file cuteOS.c.

4.15.4 Variable Documentation

4.15.4.1 tasks `cuteOS_TASK_t tasks[MAX_TASKS_NUM] = {0}`

Definition at line 66 of file cuteOS.c.

4.16 cuteOS.c

```
00001
00023 #include <reg52.h>
00024 #include "STD_TYPES.h"
00025 #include "main.H"
00026 #include "cuteOS.h"
00027
00028
00029 /*-----------------------------------------------------------------*/
00030 /*                          PRIVATE DATA                           */
00031 /*-----------------------------------------------------------------*/
00032
00042 #define MAX_TICK_TIME_MS  65
00043
00045 static u8 cuteOS_TickTimeMs = 50;
00046
00048 static u16 cuteOS_TickCount = 0;
00049
00050
00053 #define MAX_TASKS_NUM   10
00054
00056 static u8 cuteOS_TaskCounter = 0;
00059 typedef struct {
00060     ERROR_t (*callback)(void);
00061     u16 ticks;
00062     u8  id;
00063 }cuteOS_TASK_t;
00064
00066 cuteOS_TASK_t tasks[MAX_TASKS_NUM] = {0};
00067
00068
00069
00070
00071
00072
00073
00074 /*-----------------------------------------------------------------*/
00075 /*                          PRIVATE FUNCTIONS                      */
00076 /*-----------------------------------------------------------------*/
00077
00081 static void cuteOS_ISR() interrupt INTERRUPT_Timer_2_Overflow {
00082     u8 i = 0;
00083
00085     TF2 = 0;
00086
00088     ++cuteOS_TickCount;
00089
00091     for(i = 0; i < cuteOS_TaskCounter; ++i) {
00092         if( (cuteOS_TickCount % tasks[i].ticks) == 0) {
00094             // cuteOS_TickCount = 0;
00095
00097             if(tasks[i].callback != NULL) {
00098                 tasks[i].callback();
00099             }
00100         }
00101     }
00102 }
00103
00104
00110 static void cuteOS_Sleep(void) {
00112     PCON |= 0x01;
00113 }
00114
00115
00116 /*-----------------------------------------------------------------*/
00117 /*                          PUBLIC FUNCTIONS                       */
00118 /*-----------------------------------------------------------------*/
00119
00126 ERROR_t cuteOS_TaskCreate(ERROR_t (* const callback)(void), const u16 TICK_MS) {
00127     ERROR_t error = ERROR_NO;
00128
00129     ++cuteOS_TaskCounter;
00130
00131     if(cuteOS_TaskCounter > MAX_TASKS_NUM) {
00132         error = ERROR_OUT_OF_RANGE;
00133     } else {
00134         tasks[cuteOS_TaskCounter - 1].id = cuteOS_TaskCounter - 1;
00135         tasks[cuteOS_TaskCounter - 1].ticks = TICK_MS / cuteOS_TickTimeMs;
```

```
00136         tasks[cuteOS_TaskCounter - 1].callback = callback;
00137     }
00138
00139     return error;
00140 }
00141
00142
00152 ERROR_t cuteOS_TaskRemove(ERROR_t (* const callback)(void)) {
00153     ERROR_t error = ERROR_YES;
00154     u8 i = 0;
00155
00157     for(i = 0; i < cuteOS_TaskCounter; ++i) {
00158         if(tasks[i].callback == callback) {
00159             error = ERROR_NO;
00161             for(; i < cuteOS_TaskCounter - 1; ++i) {
00162                 tasks[i] = tasks[i + 1];
00163             }
00165             tasks[cuteOS_TaskCounter - 1].callback = NULL;
00166
00168             --cuteOS_TaskCounter;
00169             break;
00170         }
00171     }
00172
00173     return error;
00174 }
00175
00176
00179 void cuteOS_Start(void) {
00181     while(1) {
00182         cuteOS_Sleep();
00183     }
00184 }
00185
00186
00191 ERROR_t cuteOS_SetTickTime(const u8 TICK_MS){
00192     ERROR_t error = ERROR_NO;
00193
00194     cuteOS_TickTimeMs = TICK_MS;
00195
00196     if(cuteOS_TickTimeMs > MAX_TICK_TIME_MS) {
00197         error = ERROR_OUT_OF_RANGE;
00198     } else {
00200         cuteOS_Init();
00201     }
00202
00203     return ERROR_NO;
00204 }
00205
00206
00209 ERROR_t cuteOS_GetTickTime(u8 * const tickTimeInMsPtr){
00210     ERROR_t error = ERROR_NO;
00211
00212     if(tickTimeInMsPtr != NULL) {
00213         *tickTimeInMsPtr = cuteOS_TickTimeMs;
00214     } else {
00215         error |= ERROR_NULL_POINTER;
00216     }
00217
00218     return error;
00219 }
00220
00221
00228 ERROR_t cuteOS_Init(void) {
00229     ERROR_t error = ERROR_NO;
00230     u32 Inc;
00231     u16 Reload_16;
00232     u8 Reload_08H, Reload_08L;
00233
00234     TR2 = 0;
00236
00240     T2CON = 0x04;
00248     Inc = ((u32)cuteOS_TickTimeMs * (OSC_FREQ/1000)) / (u32)OSC_PER_INST;
00249
00251     Reload_16 = (u16) (65536UL - Inc);
00252
00254     Reload_08H = (u8)(Reload_16 / 256);
00255     Reload_08L = (u8)(Reload_16 % 256);
00257     // Used for manually checking timing (in simulator)
00258     //P2 = Reload_08H;
00259     //P3 = Reload_08L;
00260     RCAP2H = TH2 = Reload_08H;
00261     RCAP2L = TL2 = Reload_08L;
00263     ET2 = 1;
00264     TR2 = 1;
00265     EA = 1;
00267     return error;
```

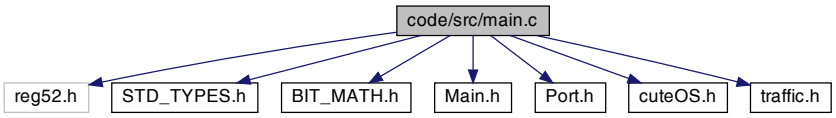
```
00268 }
00269
```

4.17 code/src/main.c File Reference

Testing cute OS.

```
#include <reg52.h>
#include "STD_TYPES.h"
#include "BIT_MATH.h"
#include "Main.h"
#include "Port.h"
#include "cuteOS.h"
#include "traffic.h"
```

Include dependency graph for main.c:



Functions

- void main (void)

4.17.1 Detailed Description

Testing cute OS.

Author

Mahmoud Karam (ma.karam272@gmail.com)

Traffic light system (Chapter 8 - Embedded C by Professor j. Pont).
See traffic.c for the implementation and sequence of the system

Application usage:

1. Initialize modules.
   ```
   cuteOS_Init();
   TRAFFIC_Init();
   ```
2. Create the tasks.
   ```
   cuteOS_TaskCreate(task1, 1000); // task1 will run every 1 second
   cuteOS_TaskCreate(task2, 2000); // task2 will run every 2 seconds
   ```

Start the Cute OS scheduler.
```
cuteOS_Start();
```

1. The application will run as follows: 5.1. Red for some seconds, then 5.2. Red-Amber for some seconds, then 5.3. Green for some seconds, then 5.4. Amberfor some seconds, then 5.5. Repeat from step 1. The duration of each state is defined in the enum TRAFFIC_SEQUENCE_DURATION_t in traffic_cfg.h file.

Version

1.0.0

Date

2022-03-24

Copyright

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Definition in file main.c.

4.17.2 Function Documentation

4.17.2.1 main() `void main ( void )`

< Initialize Cute OS

< Initialize the traffic light system

< Create the tasks

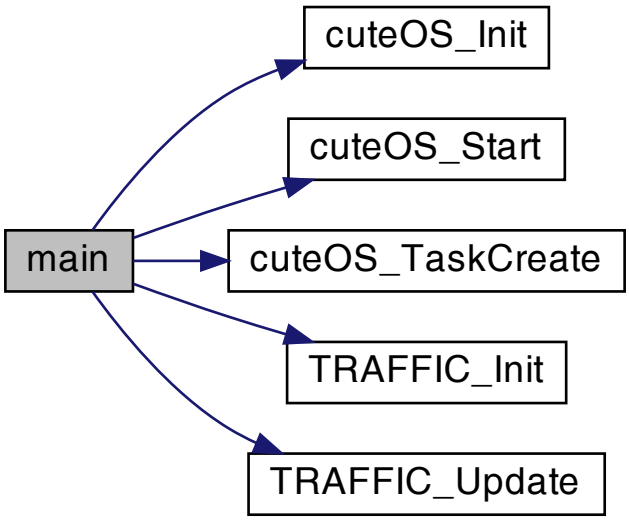
< Create a task to run the traffic light system

< Start the Cute OS scheduler

< The scheduler will never return from here

Definition at line 39 of file main.c.

Here is the call graph for this function:



4.18 main.c

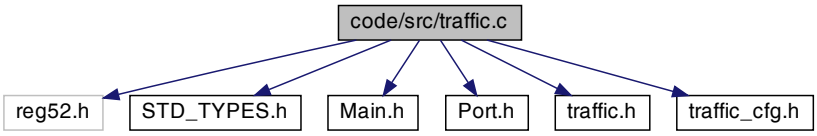
```
00001
00031 #include <reg52.h>
00032 #include "STD_TYPES.h"
00033 #include "BIT_MATH.h"
00034 #include "Main.h"
00035 #include "Port.h"
00036 #include "cuteOS.h"
00037 #include "traffic.h"
00038
00039 void main(void) {
00040     /* Initialize the system */
00041     cuteOS_Init();
00042     TRAFFIC_Init();
00045     cuteOS_TaskCreate(TRAFFIC_Update, 1000);
00048     cuteOS_Start();
00049
00051     while(1);
00052 }
```

4.19 code/src/traffic.c File Reference

A simple traffic Light system.

```
#include <reg52.h>
#include "STD_TYPES.h"
#include "Main.h"
#include "Port.h"
#include "traffic.h"
#include "traffic_cfg.h"
```

Include dependency graph for traffic.c:



Functions

- ERROR_t TRAFFIC_Init (void)

  Initialize the traffic light system to RED state.
- ERROR_t TRAFFIC_DeInit (void)

  De Initialize the traffic light system by turning off all the lights.
- ERROR_t TRAFFIC_Update (void)

  Update the traffic light system to the next state.
- ERROR_t TRAFFIC_SetColor (const TRAFFIC_SEQUENCE_t Copy_color)

  Set the traffic light color sequence to the given color sequence.
- ERROR_t TRAFFIC_GetColor (TRAFFIC_SEQUENCE_t ∗const Copy_color)

  Get the traffic light color sequence.

4.19.1 Detailed Description

A simple traffic Light system.

Author

Mahmoud Karam (ma.karam272@gmail.com)

It uses the cuteOS library to create tasks and schedule them. It uses TRAFFIC_Update() function to update the traffic light system. See traffic.h for the implementation and sequence of the system.

Version

1.0.0

Date

2022-03-22

Copyright

Definition in file traffic.c.

4.19.2 Function Documentation

4.19.2.1 TRAFFIC_DeInit() ERROR_t TRAFFIC_DeInit (void)

De Initialize the traffic light system by turning off all the lights.

This function does the following:

- Turning off all the traffic lights.
- Assign the callback function of the OS delay to NULL.

< Setting traffic light to red

< Setting callback function to NULL

Definition at line 67 of file traffic.c.

4.19.2.2 TRAFFIC_GetColor() ERROR_t TRAFFIC_GetColor (TRAFFIC_SEQUENCE_t *const *Copy_color*)

Get the traffic light color sequence.

Parameters

out	*Copy_color*	pointer to the variable to store the color sequence. See TRAFFIC_SEQUENCE_t for more details about the color sequences.

Returns

ERROR_t: Error status. Check the options in the global enum ERROR_t.

Definition at line 124 of file traffic.c.

4.19.2.3 TRAFFIC_Init()

```
ERROR_t TRAFFIC_Init (
        void  )
```

Initialize the traffic light system to RED state.

Returns

ERROR_t: Error status. Check the options in the global enum ERROR_t.

< Reset the time counter

< Initialize the colorSequence

Definition at line 47 of file traffic.c.

Here is the caller graph for this function:

4.19.2.4 TRAFFIC_SetColor()

```
ERROR_t TRAFFIC_SetColor (
        const TRAFFIC_SEQUENCE_t Copy_color )
```

Set the traffic light color sequence to the given color sequence.

Parameters

in	*color*	sequence: The color sequence to set. See TRAFFIC_SEQUENCE_t for more details about the color sequences.

Returns

ERROR_t: Error status. Check the options in the global enum ERROR_t.

Definition at line 115 of file traffic.c.

4.19.2.5 TRAFFIC_Update() `ERROR_t TRAFFIC_Update ( void )`

Update the traffic light system to the next state.

This function does the following:

- Setting the traffic light color sequence according to the current color sequence.
- Update the OS delay for the current color sequence.
- Update the color sequence value to the next color sequence. So, when calling this function again, the color sequence will be changed.

< Switch on the current color sequence

< Illegal color sequence

Definition at line 89 of file traffic.c.

Here is the caller graph for this function:

4.20 traffic.c

```
00001
00014 #include <reg52.h>
00015 #include "STD_TYPES.h"
00016 #include "Main.h"
00017 #include "Port.h"
00018 #include "traffic.h"
00019 #include "traffic_cfg.h"
00020
00021 /*-----------------------------------------------------------------*/
00022 /*                          PRIVATE DATA                           */
00023 /*-----------------------------------------------------------------*/
00024 static TRAFFIC_SEQUENCE_t   colorSequence       = RED;
00025 static u16                  timeInState = 0;
00028 /*-----------------------------------------------------------------*/
00029 /*                   PRIVATE FUNCTIONS PROTOTYPES                  */
00030 /*-----------------------------------------------------------------*/
00031 static ERROR_t TRAFFIC_RedSequence(void);
00032 static ERROR_t TRAFFIC_RedAmberSequence(void);
00033 static ERROR_t TRAFFIC_GreenSequence(void);
00034 static ERROR_t TRAFFIC_AmberSequence(void);
```

```
00035
00036 static ERROR_t TRAFFIC_GenericSequence(const STATE_t red, const STATE_t amber, const STATE_t green,
       TRAFFIC_SEQUENCE_DURATION_t duration);
00037
00038
00039
00040
00041
00042
00043
00044 /*-------------------------------------------------------------------------*/
00045 /*                            PUBLIC FUNCTIONS                             */
00046 /*-------------------------------------------------------------------------*/
00047 ERROR_t TRAFFIC_Init(void) {
00048     ERROR_t error = ERROR_NO;
00049
00051     timeInState = 0;
00052
00054     colorSequence = RED;
00055     redPin   = HIGH;
00056     amberPin = LOW;
00057     greenPin = LOW;
00058
00059     return error;
00060 }
00061
00062
00067 ERROR_t TRAFFIC_DeInit(void) {
00068     ERROR_t error = ERROR_NO;
00069
00071     redPin   = LOW;
00072     amberPin = LOW;
00073     greenPin = LOW;
00074
00076     //cuteOS_(NULL);
00077
00078     return error;
00079 }
00080
00081
00089 ERROR_t TRAFFIC_Update(void) {
00090     ERROR_t error = ERROR_NO;
00091
00093     switch(colorSequence) {
00094         case RED:;
00095             error |= TRAFFIC_RedSequence();
00096             break;
00097         case RED_AMBER:;
00098             error |= TRAFFIC_RedAmberSequence();
00099             break;
00100         case GREEN:;
00101             error |= TRAFFIC_GreenSequence();
00102             break;
00103         case AMBER:;
00104             error |= TRAFFIC_AmberSequence();
00105             break;
00106         default:;
00107             error |= ERROR_ILLEGAL_PARAM;
00108             break;
00109     }
00110
00111     return error;
00112 }
00113
00114
00115 ERROR_t TRAFFIC_SetColor(const TRAFFIC_SEQUENCE_t Copy_color) {
00116     ERROR_t error = ERROR_NO;
00117     colorSequence = Copy_color;
00118
00119     error |= TRAFFIC_Update();
00120
00121     return error;
00122 }
00123
00124 ERROR_t TRAFFIC_GetColor(TRAFFIC_SEQUENCE_t * const Copy_color) {
00125     ERROR_t error = ERROR_NO;
00126
00127     *Copy_color = colorSequence;
00128
00129     return error;
00130 }
00131
00132
00133
00134
00135
00136
```

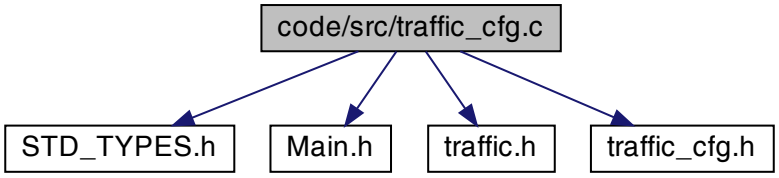
```
00137 /*--------------------------------------------------------------------*/
00138 /*                 PRIVATE FUNCTIONS DEFINITIONS                      */
00139 /*--------------------------------------------------------------------*/
00140
00145 static ERROR_t TRAFFIC_RedSequence(void) {
00146     ERROR_t error = ERROR_NO;
00147
00148     error |= TRAFFIC_GenericSequence(HIGH, LOW, LOW, TRAFFIC_Configs.red_duration);
00149
00150     return error;
00151 }
00152
00153
00158 static ERROR_t TRAFFIC_RedAmberSequence(void) {
00159     ERROR_t error = ERROR_NO;
00160
00161     error |= TRAFFIC_GenericSequence(HIGH, HIGH, LOW, TRAFFIC_Configs.red_amber_duration);
00162
00163     return error;
00164 }
00165
00166
00171 static ERROR_t TRAFFIC_GreenSequence(void) {
00172     ERROR_t error = ERROR_NO;
00173
00174     error |= TRAFFIC_GenericSequence(LOW, LOW, HIGH, TRAFFIC_Configs.green_duration);
00175
00176     return error;
00177 }
00178
00179
00184 static ERROR_t TRAFFIC_AmberSequence(void) {
00185     ERROR_t error = ERROR_NO;
00186
00187     error |= TRAFFIC_GenericSequence(LOW, HIGH, LOW, TRAFFIC_Configs.amber_duration);
00188
00189     return error;
00190 }
00191
00192
00215 static ERROR_t TRAFFIC_GenericSequence(const STATE_t redState, const STATE_t amberState, const STATE_t
       greenState, TRAFFIC_SEQUENCE_DURATION_t duration) {
00216     ERROR_t error = ERROR_NO;
00217     u8 tickTime = 0;
00218
00220     if(++timeInState >= duration) {
00221         timeInState = 0;
00222         switch(colorSequence) {
00223             case RED:
00224                 colorSequence = RED_AMBER;
00225                 redPin   = HIGH;
00226                 amberPin = HIGH;
00227                 greenPin = LOW;
00228                 break;
00229             case RED_AMBER:
00230                 colorSequence = GREEN;
00231                 redPin   = LOW;
00232                 amberPin = LOW;
00233                 greenPin = HIGH;
00234                 break;
00235             case GREEN:
00236                 colorSequence = AMBER;
00237                 redPin   = LOW;
00238                 amberPin = HIGH;
00239                 greenPin = LOW;
00240                 break;
00241             case AMBER:
00242                 colorSequence = RED;
00243                 redPin   = HIGH;
00244                 amberPin = LOW;
00245                 greenPin = LOW;
00246                 break;
00247             default:
00248                 error |= ERROR_ILLEGAL_PARAM;
00249                 break;
00250         }
00251     } else {
00252         redPin   = redState;
00253         amberPin = amberState;
00254         greenPin = greenState;
00255     }
00256
00257     return error;
00258 }
```

4.21 code/src/traffic_cfg.c File Reference

Configurations of Traffic Light System.

```
#include "STD_TYPES.h"
#include "Main.h"
#include "traffic.h"
#include "traffic_cfg.h"
```

Include dependency graph for traffic_cfg.c:



Variables

- TRAFFIC_CONFIGS_t TRAFFIC_Configs

4.21.1 Detailed Description

Configurations of Traffic Light System.

Author

Mahmoud Karam (ma.karam272@gmail.com)

Version

1.0.0

Date

2022-03-22

Copyright

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Definition in file traffic_cfg.c.

4.21.2 Variable Documentation

4.21.2.1 TRAFFIC_Configs TRAFFIC_CONFIGS_t TRAFFIC_Configs

Initial value:

```
= {
    TRAFFIC_DURATION_RED,
    TRAFFIC_DURATION_AMBER,
    TRAFFIC_DURATION_GREEN,
    TRAFFIC_DURATION_RED_AMBER,
}
```

< Traffic Light System pins connections.

Definition at line 18 of file traffic_cfg.c.

4.22 traffic_cfg.c

```
00001
00009 #include "STD_TYPES.h"
00010 #include "Main.h"
00011 #include "traffic.h"
00012 #include "traffic_cfg.h"
00013
00014 /*-----------------------------------------------------------------------*/
00015 /*                YOU CAN CHANGE THE FOLLOWING PARAMETERS                */
00016 /*-----------------------------------------------------------------------*/
00018 TRAFFIC_CONFIGS_t TRAFFIC_Configs = {
00019     TRAFFIC_DURATION_RED,
00020     TRAFFIC_DURATION_AMBER,
00021     TRAFFIC_DURATION_GREEN,
00022     TRAFFIC_DURATION_RED_AMBER,
00023 };
```

Index