Bare Machine Design Example (4A)

Please send corrections (or suggestions) to youngwlim@hotmail.com.

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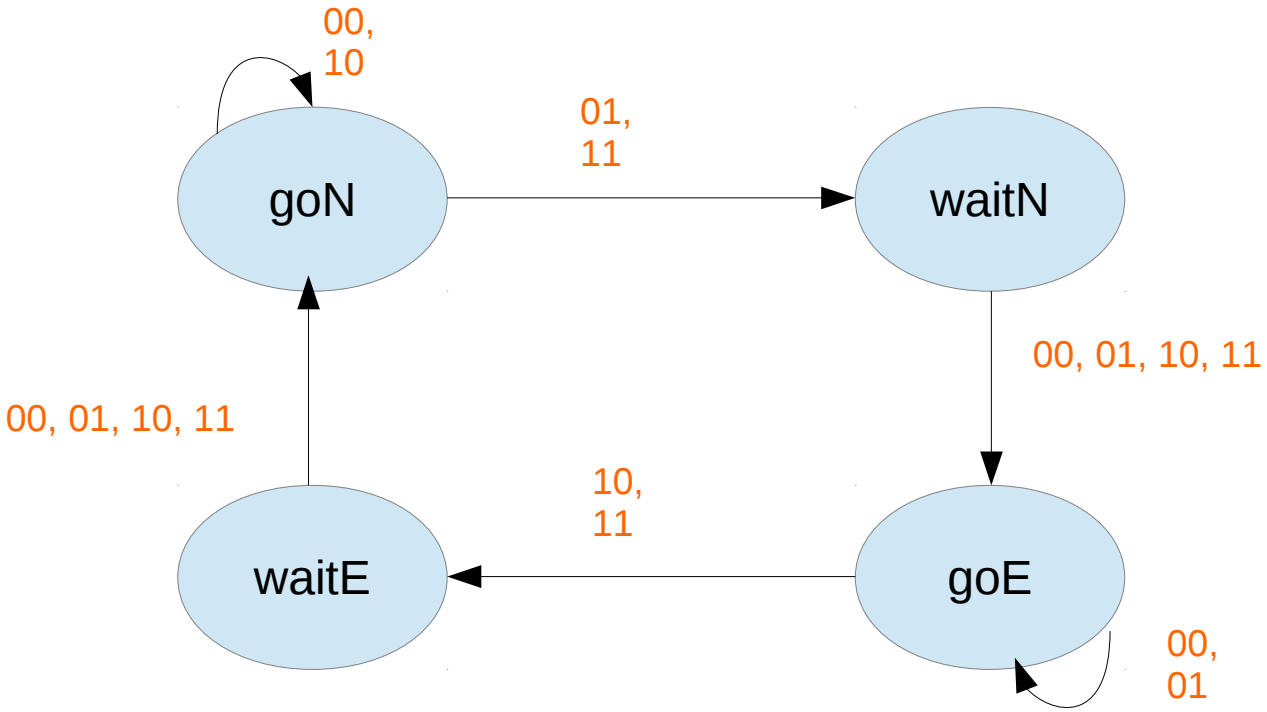
Main Infinite Loop

```
void main(void){
    STyp *Pt; // state pointer
    unsigned char Input;
    Timer_Init();
    DDRT = 0xFC; // lights and sensors
    Pt = goN;
    while(1){
        PTT = Pt->Out << 2; // set lights
        Timer_Wait10ms(Pt->Time);
        Input = PTT & 0x03; // read sensors
        Pt = Pt->Next[Input];
    }
}
```

http://users.ece.utexas.edu/~valvano/Volume1/E-Book/C10_FiniteStateMachines.htm

FSM SW Implementation

			00,	01,	10,	11
goN	FSM[0] =	{0x21, 300,	{goN,	waitN,	goN,	waitN}
waitN	FSM[0] =	{0x22, 50,	{goE,	goE,	goE,	goE}
goE	FSM[0] =	{0x04, 300,	{goE	goE,	waitE,	waitE}
waitE	FSM[0] =	{0x14, 50,	{goN	goN,	goN,	goN}

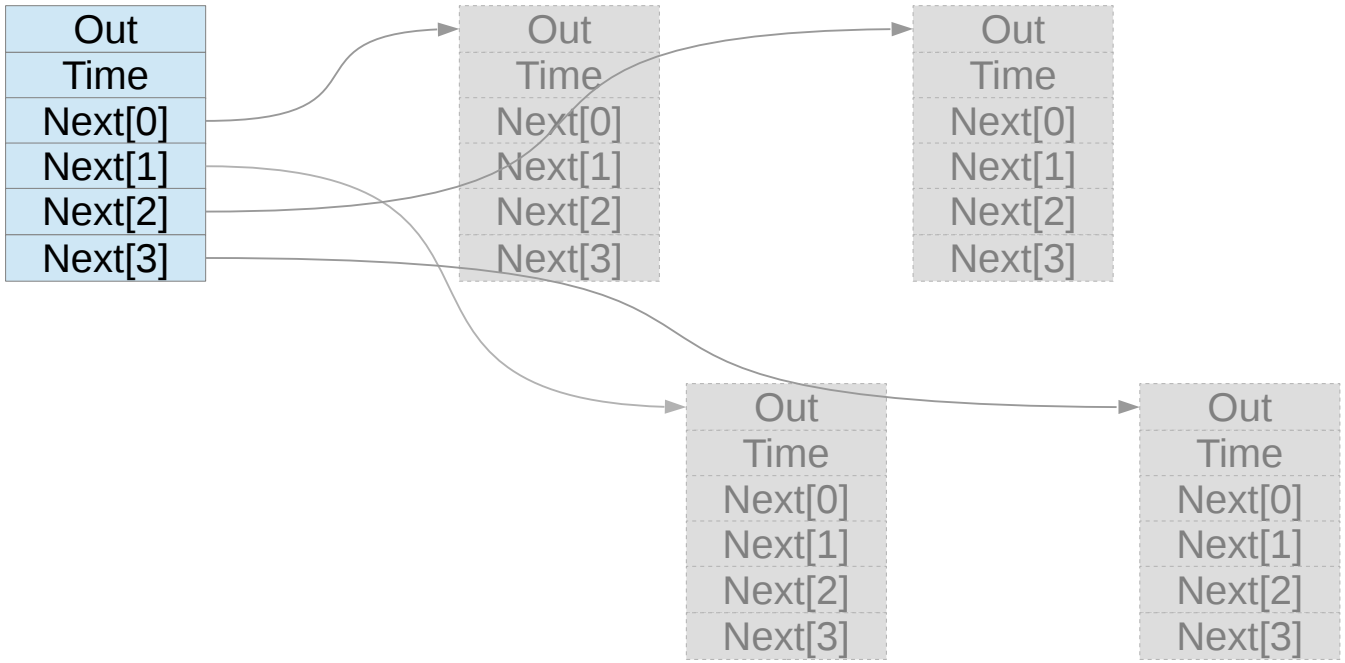


http://users.ece.utexas.edu/~valvano/Volume1/E-Book/C10_FiniteStateMachines.htm

Struct State

```
struct State {
        uint32_t  Out;
        uint32_t  Time;
        const struct State *Next[4];
};

typedef   const struct State        STyp;
```

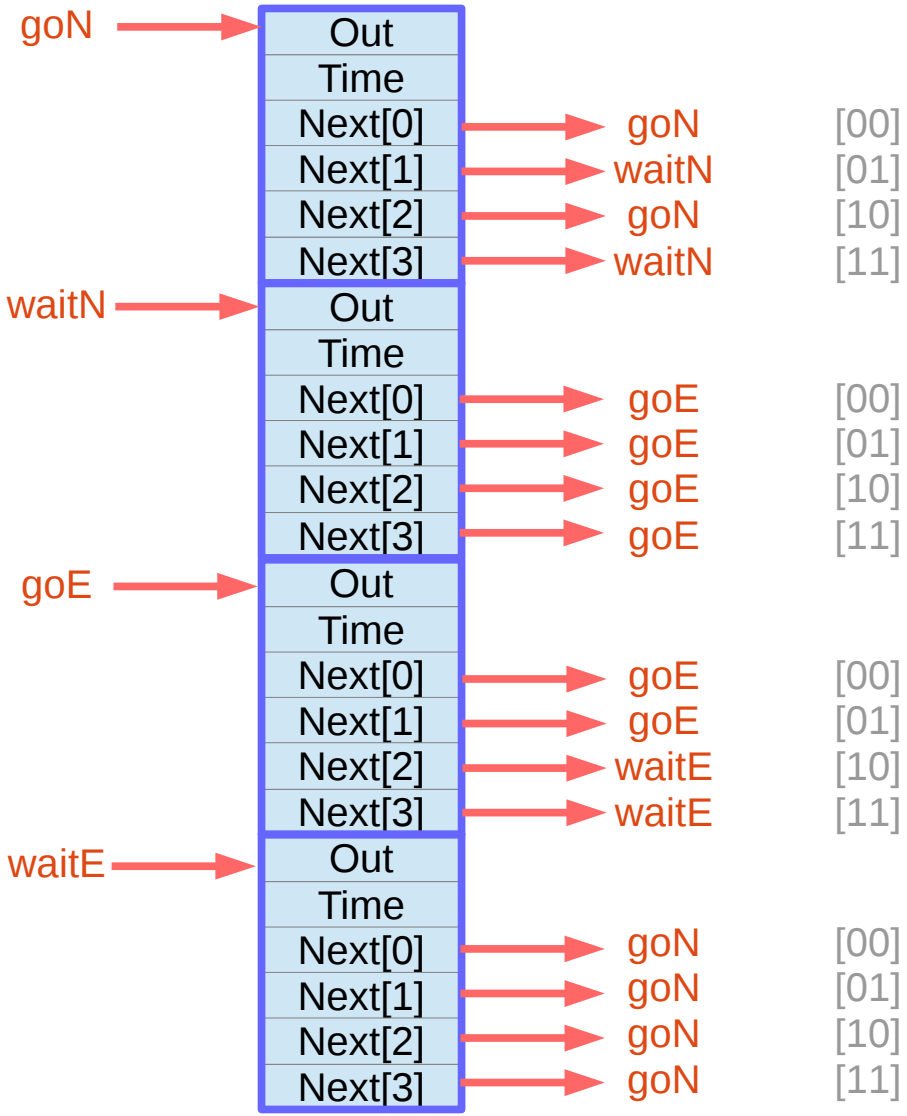


http://users.ece.utexas.edu/~valvano/Volume1/E-Book/C10_FiniteStateMachines.htm

STyp FSM[4]

```
#define  goN      &FSM[0]
#define  waitN    &FSM[1]
#define  goE      &FSM[2]
#define  waitE    &FSM[3]

STyp FSM[4] = {
{0x21, 300,   {goN,waitN,goN,waitN}},
{0x22,  50,   {goE,goE,goE,goE}},
{0x0c, 300,   {goE,goE,waitE,waitE}},
{0x14  50,    {goN,goN,goN,goN}} }'
```



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Simple Index Implementation

```
struct State {
  unsigned long Out;
  unsigned long Time;
  unsigned long Next[4];};

typedef const struct State STyp;

#define goN     0
#define waitN   1
#define goE     2
#define waitE   3

STyp FSM[4]={
 {0x21,3000,    {goN,waitN,goN,waitN}},
 {0x22, 500,    {goE,goE,goE,goE}},
 {0x0C,3000,    {goE,goE,waitE,waitE}},
 {0x14, 500,    {goN,goN,goN,goN}}};

unsigned long S;  // index to the current state
unsigned long Input;
```

```
unsigned long S;  // index to the current state

int main(void){

        volatile unsigned long delay;

        S = goN;

        while(1){
                LIGHT = FSM[S].Out;  // set lights

                SysTick_Wait10ms(FSM[S].Time);

                Input = SENSOR;     // read sensors

                S = FSM[S].Next[Input];
        }
}
```

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Assembly Implementation

```
org $0800
Pt          rmb  2      ;state pointer
;Linked data structure
org         $4000       ;Put in ROM
OUT         equ  0      ;offset for output
WAIT        equ  1      ;offset for time
NEXT        equ  3      ;offset for next
goN         fcb  $21
            fdb  3000
            fdb  goN,waitN,goN,waitN
waitN       fcb  $22
            fdb  500
            fdb  goE,goE,goE,goE
goE         fcb  $0C
            fdb  3000
            fdb  goE,goE,waitE,waitE
waitE       fcb  $14
            fdb  500
            fdb  goN,goN,goN,goN
```

```
main  lds   #$4000      ;stack init
      bsr   Timer_Init  ;enable TCNT
      ldaa  #$FC        ;PT7-2 are lights
      staa  DDRT        ;PT1-0 are sensors
      ldx   #goN        ;State pointer
      stx   Pt

FSM   ldx   Pt
      ldab  OUT,x       ;Output value
      lslb
      lslb              ;line up with 7-2
      stab  PTT         ;set lights
      ldy   WAIT,x      ;Time delay
      bsr   Timer_Wait10ms
      ldab  PTT         ;Read input
      andb  #$03        ;just bits 1,0
      lslb              ;2 bytes/address
      abx               ;add 0,2,4,6
      ldx   NEXT,x      ;Next state
      stx   Pt
      bra   FSM
      org   $FFFE
      fdb   main        ;reset vector
```

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Simple Index Implementation

```
struct State {
  unsigned long Out;
  unsigned long Time;
  unsigned long Next[4];};

typedef const struct State STyp;

#define goN      0
#define waitN    1
#define goE      2
#define waitE    3

STyp FSM[4]={
 {0x21,3000,     {goN,waitN,goN,waitN}},
 {0x22, 500,     {goE,goE,goE,goE}},
 {0x0C,3000,     {goE,goE,waitE,waitE}},
 {0x14, 500,     {goN,goN,goN,goN}}};

unsigned long S;  // index to the current state
unsigned long Input;
```

```
unsigned long S;  // index to the current state

int main(void){

    volatile unsigned long delay;

    S = goN;

    while(1){
        LIGHT = FSM[S].Out;  // set lights

        SysTick_Wait10ms(FSM[S].Time);

        Input = SENSOR;     // read sensors

        S = FSM[S].Next[Input];
    }
}
```

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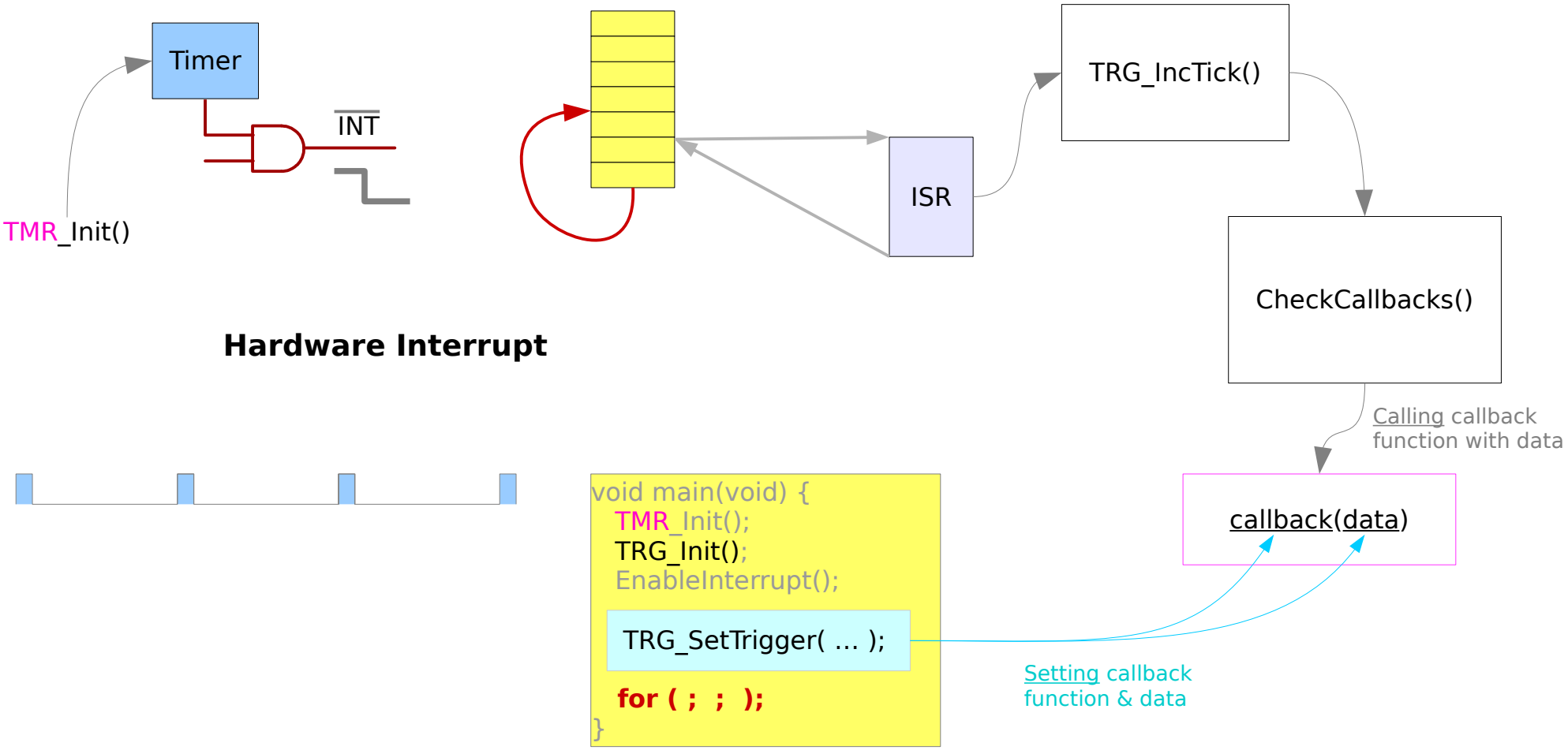
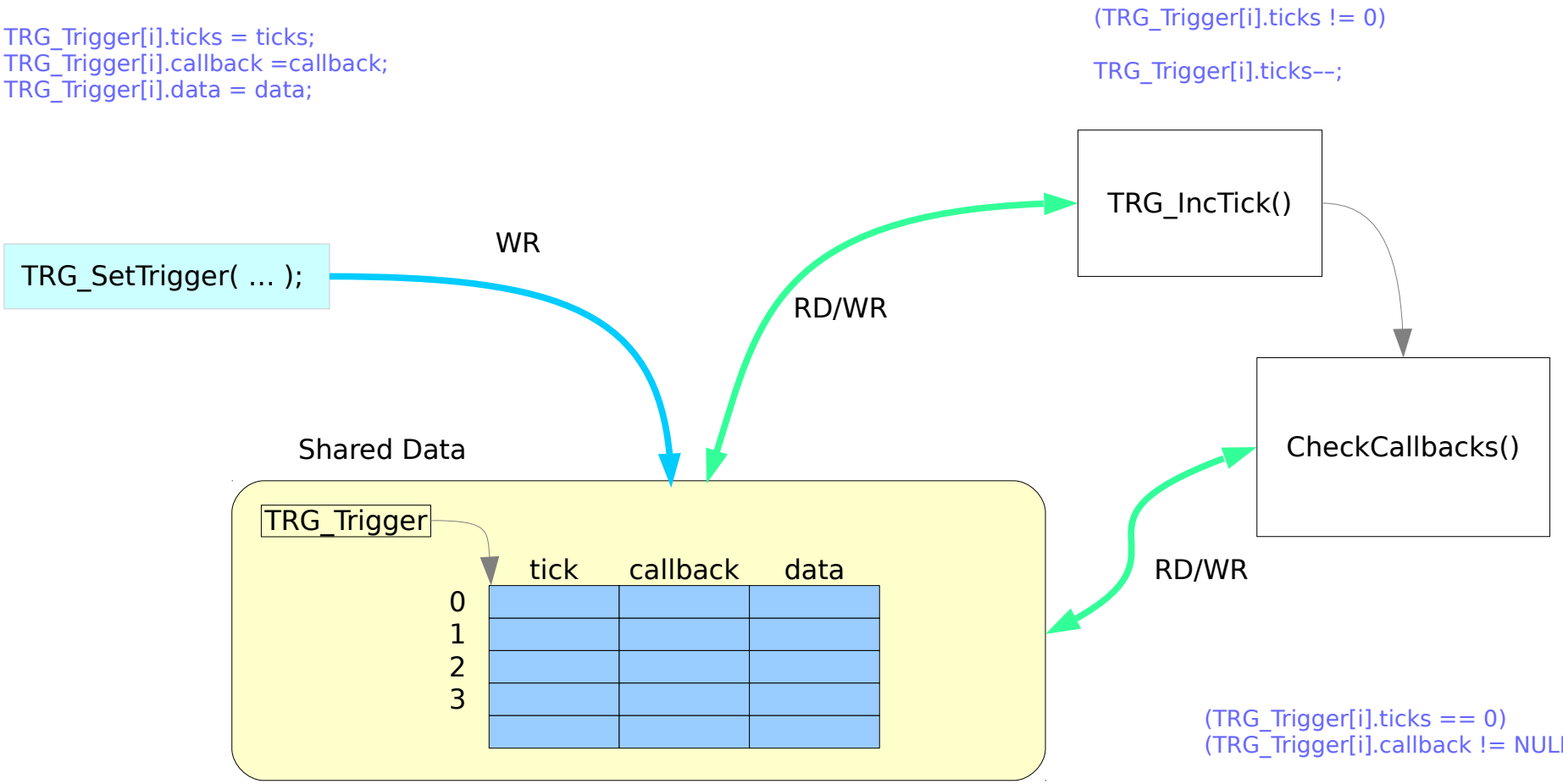
Timer & Interrupt



Critical Section Access




```
static TRG_TriggerDesc TRG_Triggers[TRG_NOF_TRIGGERS];
```

File Scope : static global variable

References

[1] http://en.wikipedia.org/
[2] D.M. Harris, S. L. Harris, “Digital Design and Computer Architecture”