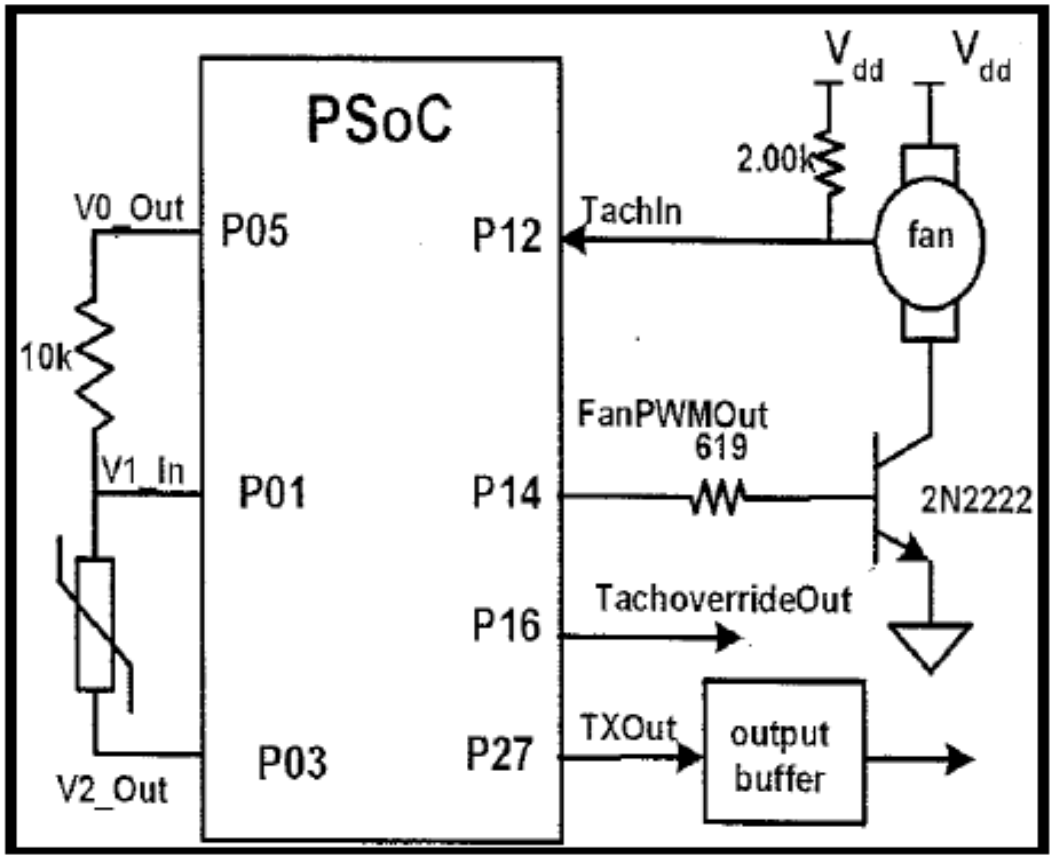
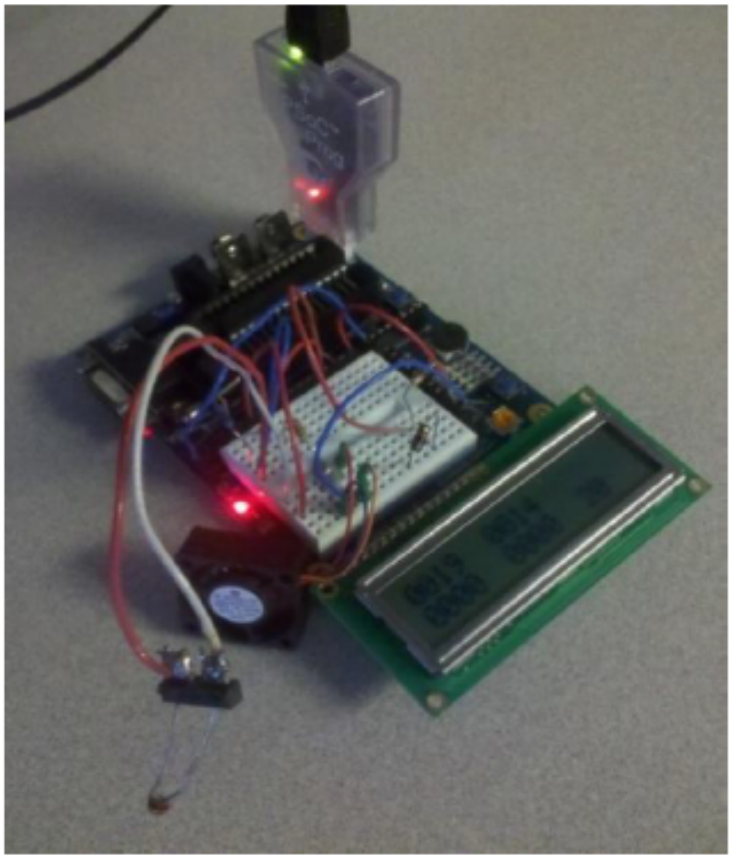
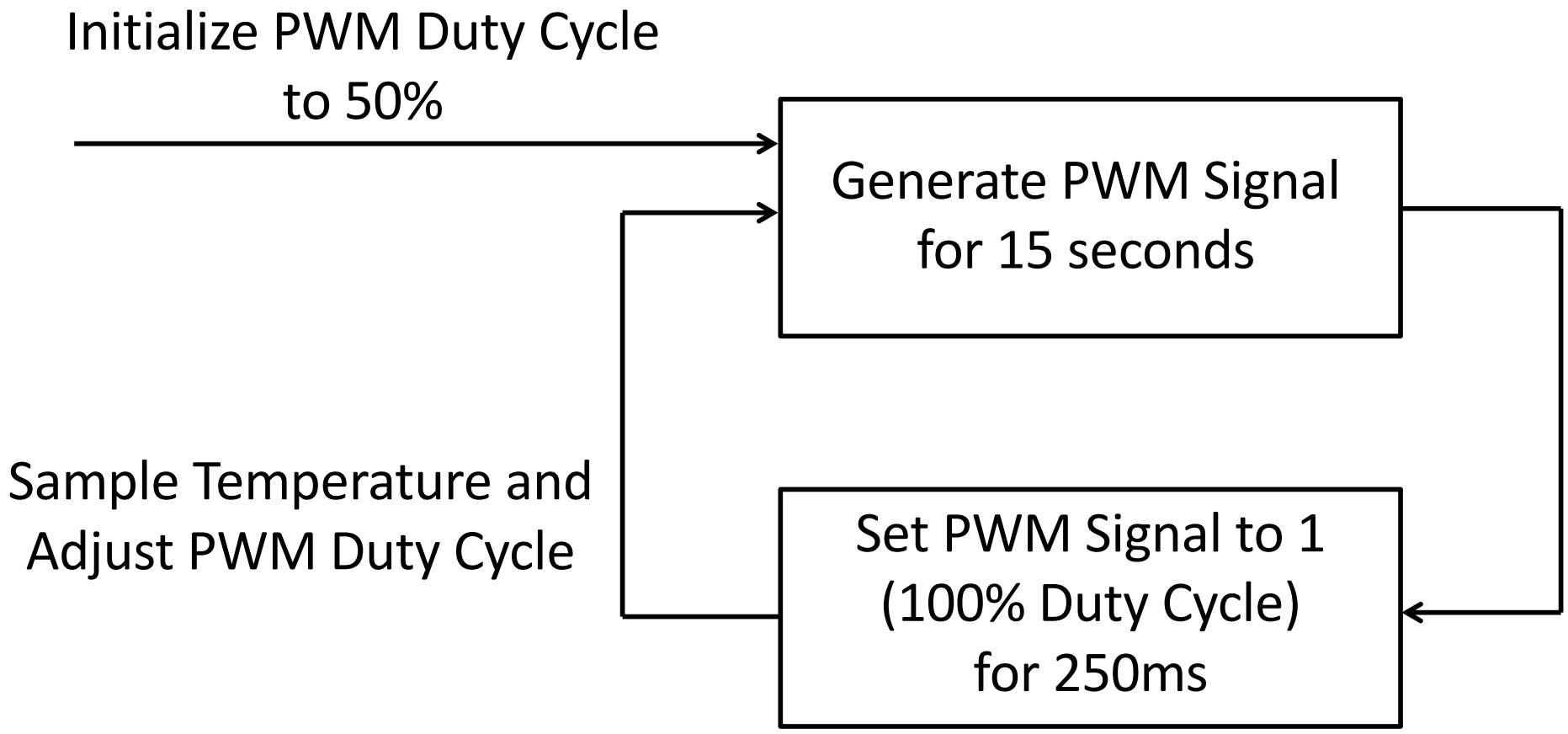
Fan-based Temperature Controller Design Problem Solution



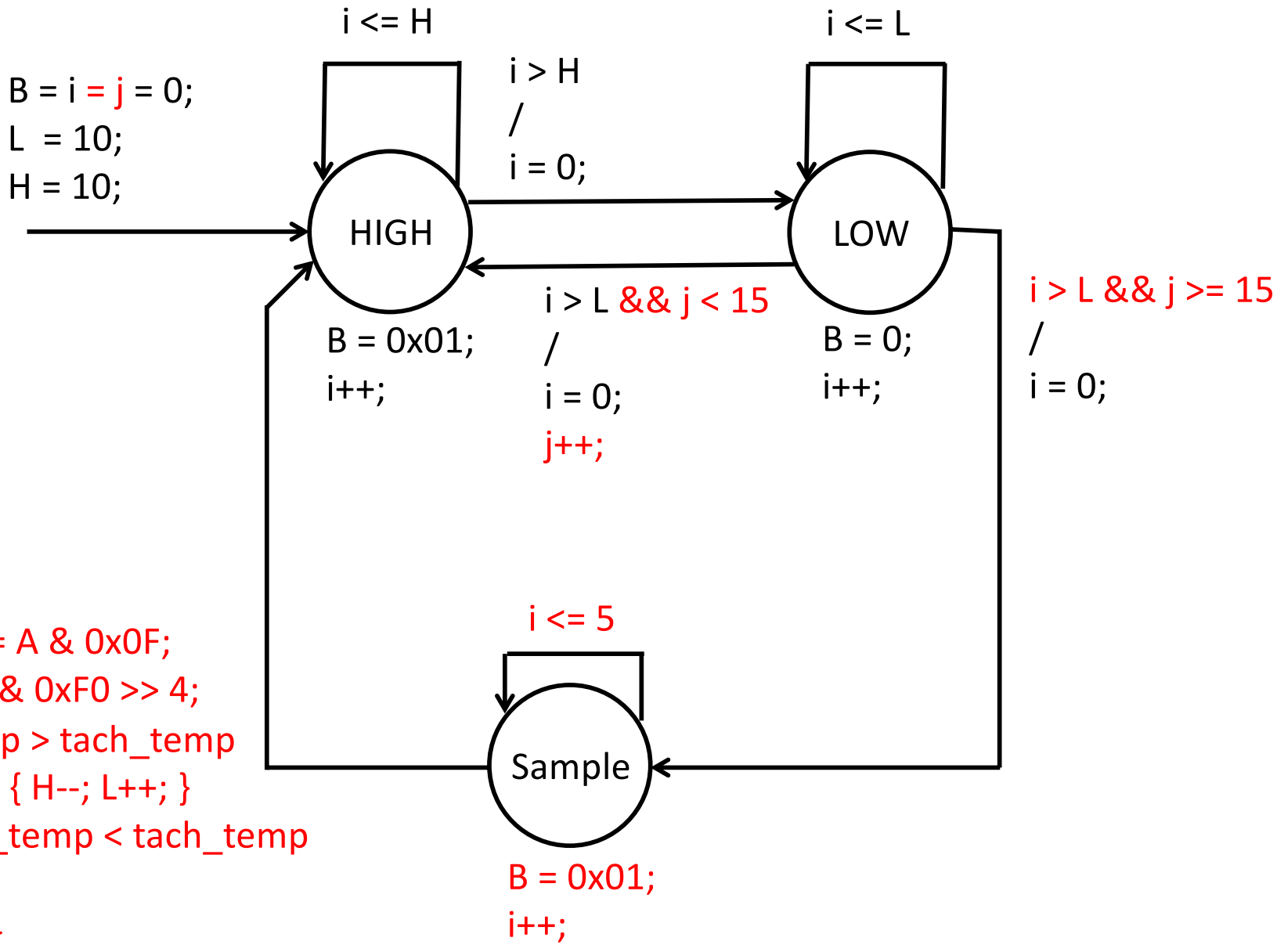


Temperature Controller Functionality



Single-Task Solution

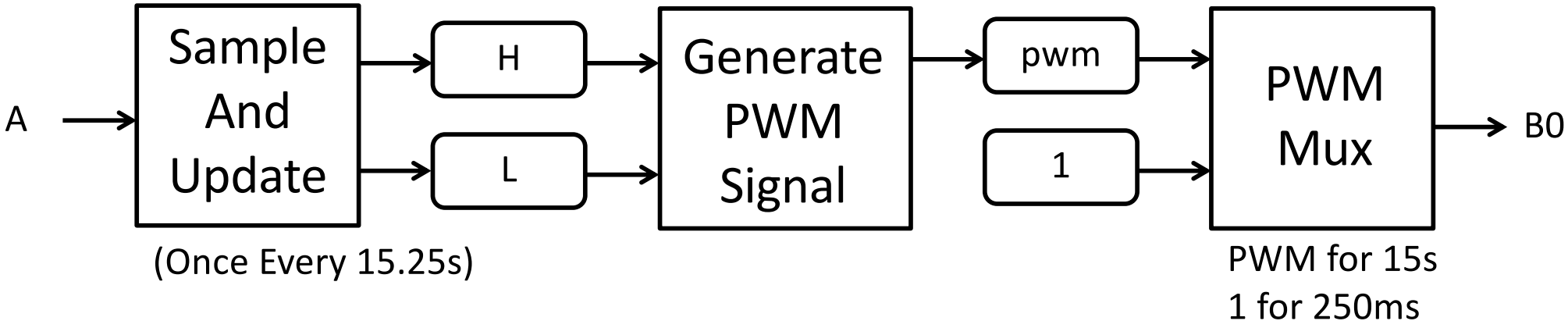
PWM
unsigned char i, j, L, H;
unsigned char desired_temp;
unsigned char tach_temp;
Period = 50 ms;




```
i > 5
/
i = j = 0;
desired_temp = A & 0x0F;
tach_temp = A & 0xF0 >> 4;
If( desired_temp > tach_temp
        && H > 6 ) { H--; L++; }
else if( desired_temp < tach_temp
        && L > 0 )
        { H++; L--;}
```

Concurrent SynchSM Solution #1

unsigned char H, L, pwm;
Period = 50 ms

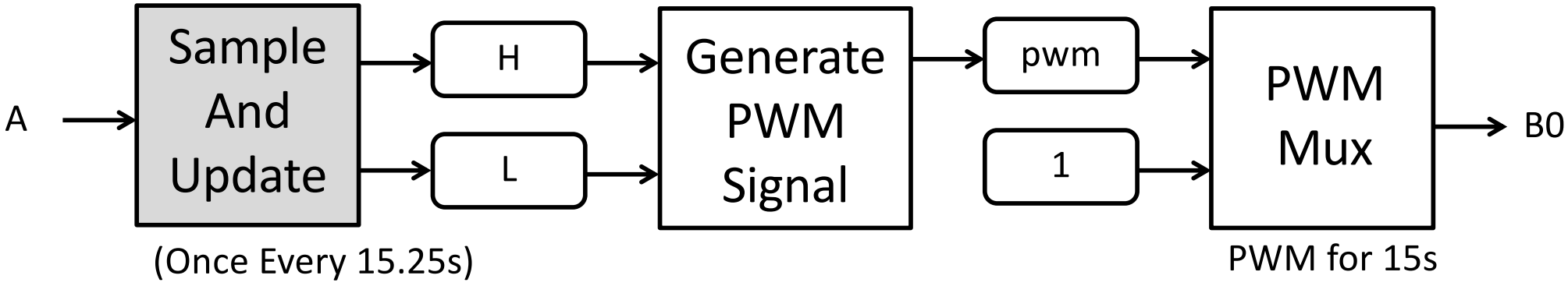


(Once Every 15.25s)

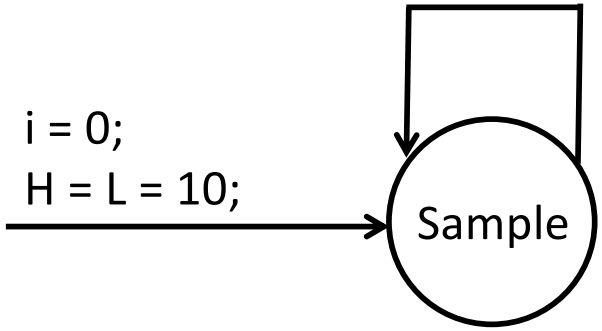
PWM for 15s
1 for 250ms

Concurrent SynchSM Solution #1

Unsigned char H, L, pwm;
Period = 50 ms




```
// max value of i is
// (15250 ms) / (50 ms) = 305 ticks
unsigned short i;
```

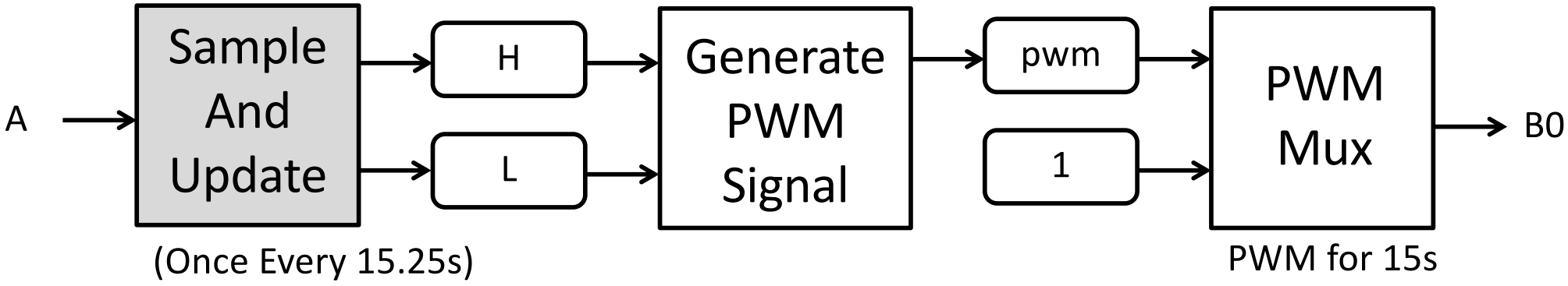



```
i = (i == 15250/50) ? 1 : i +1;
```

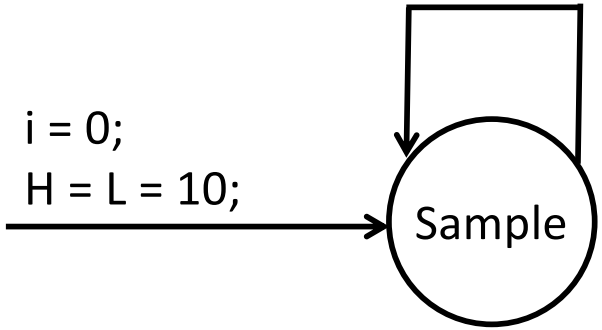
```
1
/
if( i == 15250/50 ) {
        desired_temp = A & 0x0F;
        tach_temp = A & 0xF0 >> 4;
        If( desired_temp > tach_temp  && H > 6 )
                { H--; L++; }
        else if( desired_temp < tach_temp && L > 0 )
                { H++; L--;}
}
```

Concurrent SynchSM Solution #1

Unsigned char H, L, pwm;
Period = 50 ms




```
// max value of i is
// (15250 ms) / (50 ms) = 305 ticks
unsigned short i;
```

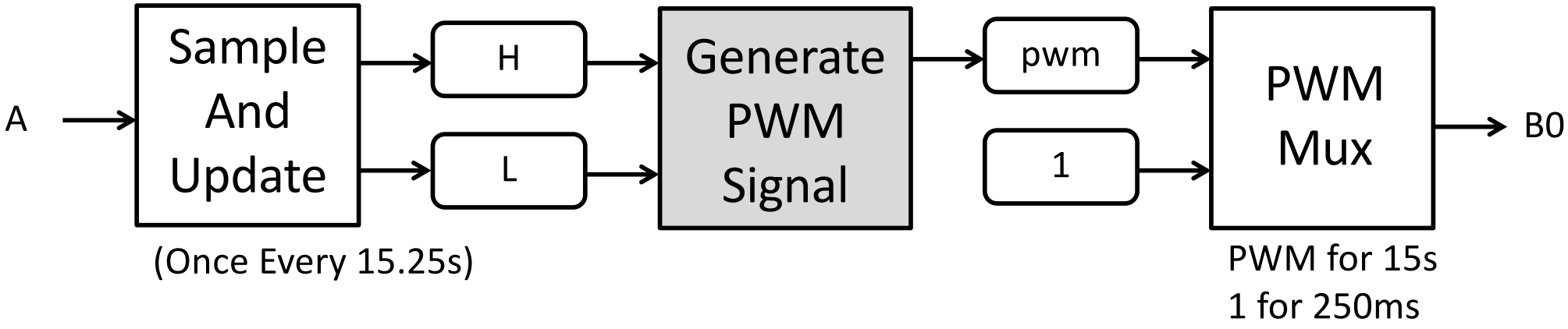



```
i = (i == 305) ? 1 : i +1;
```

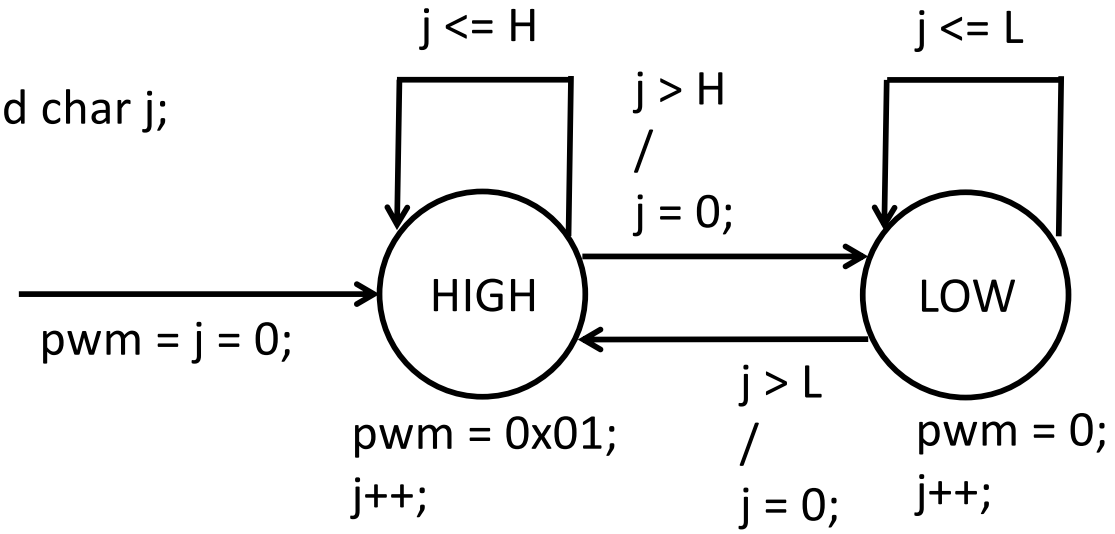
```
1
/
if( i == 305) {
        desired_temp = A & 0x0F;
        tach_temp = A & 0xF0 >> 4;
        If( desired_temp > tach_temp  && H > 6 )
                { H--; L++; }
        else if( desired_temp < tach_temp && L > 0 )
                { H++; L--;}
}
```

Concurrent SynchSM Solution #1

Unsigned char H, L, pwm;
Period = 50 ms

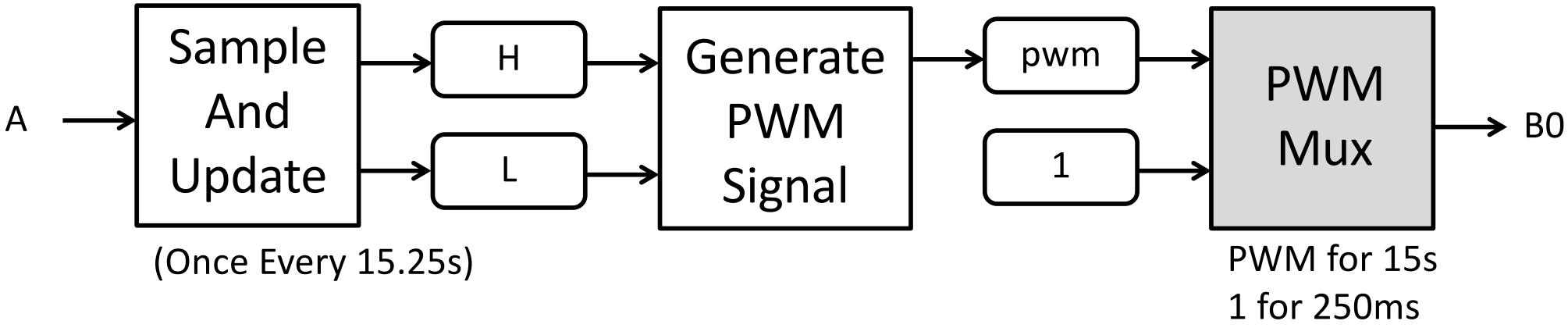


unsigned char j;

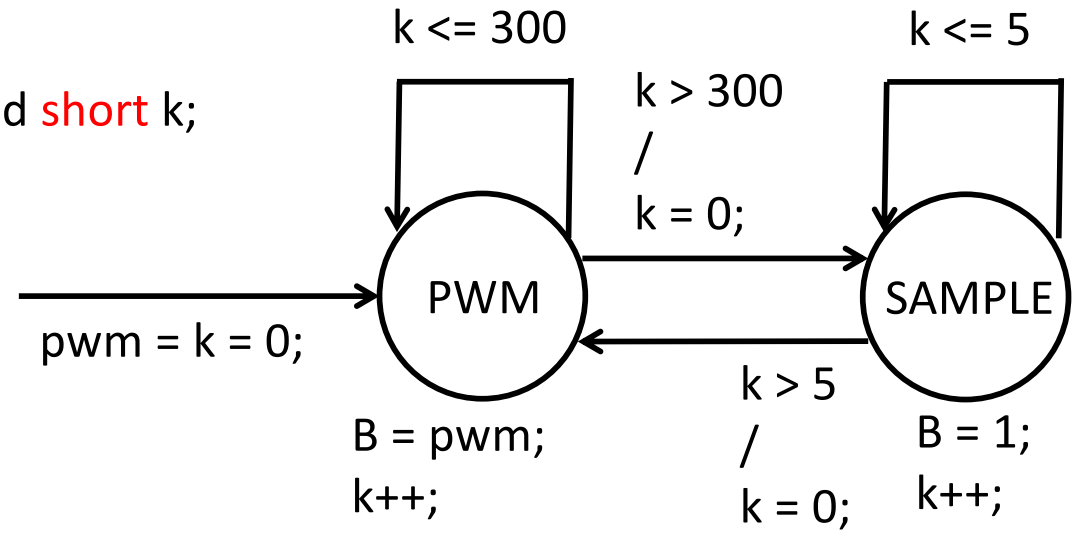


Concurrent SynchSM Solution #1

unsigned char H, L, pwm;
Period = 50 ms

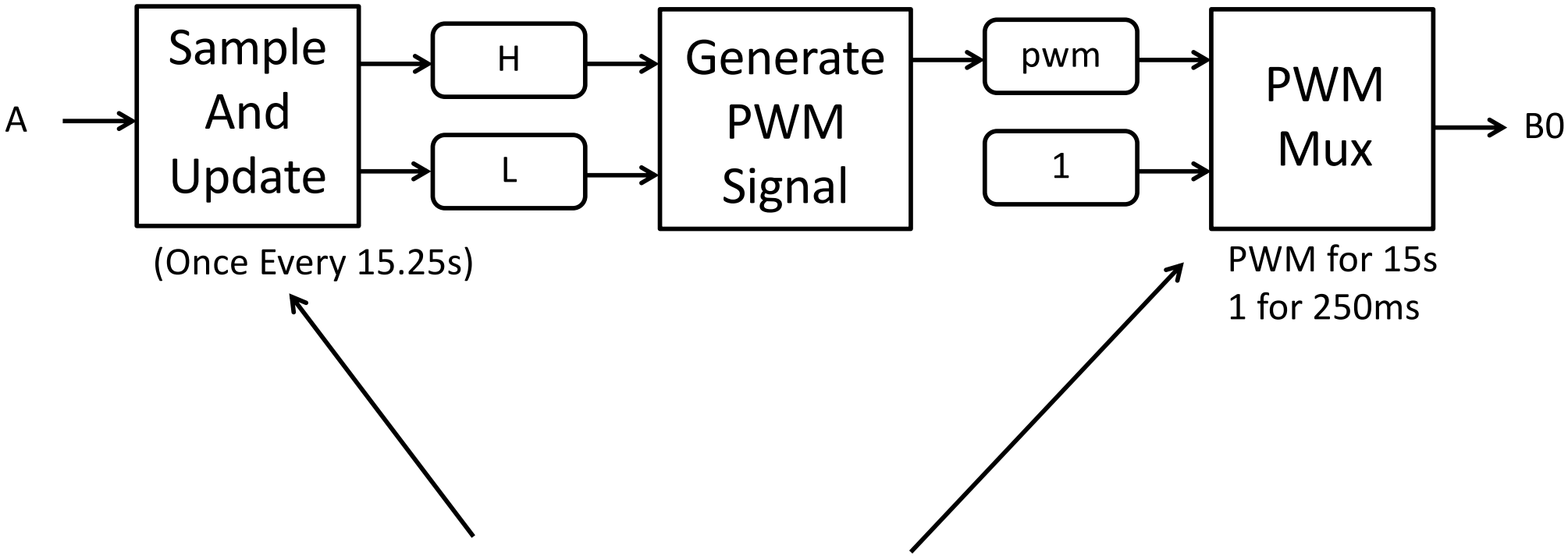


unsigned short k;



Pitfalls and Challenges

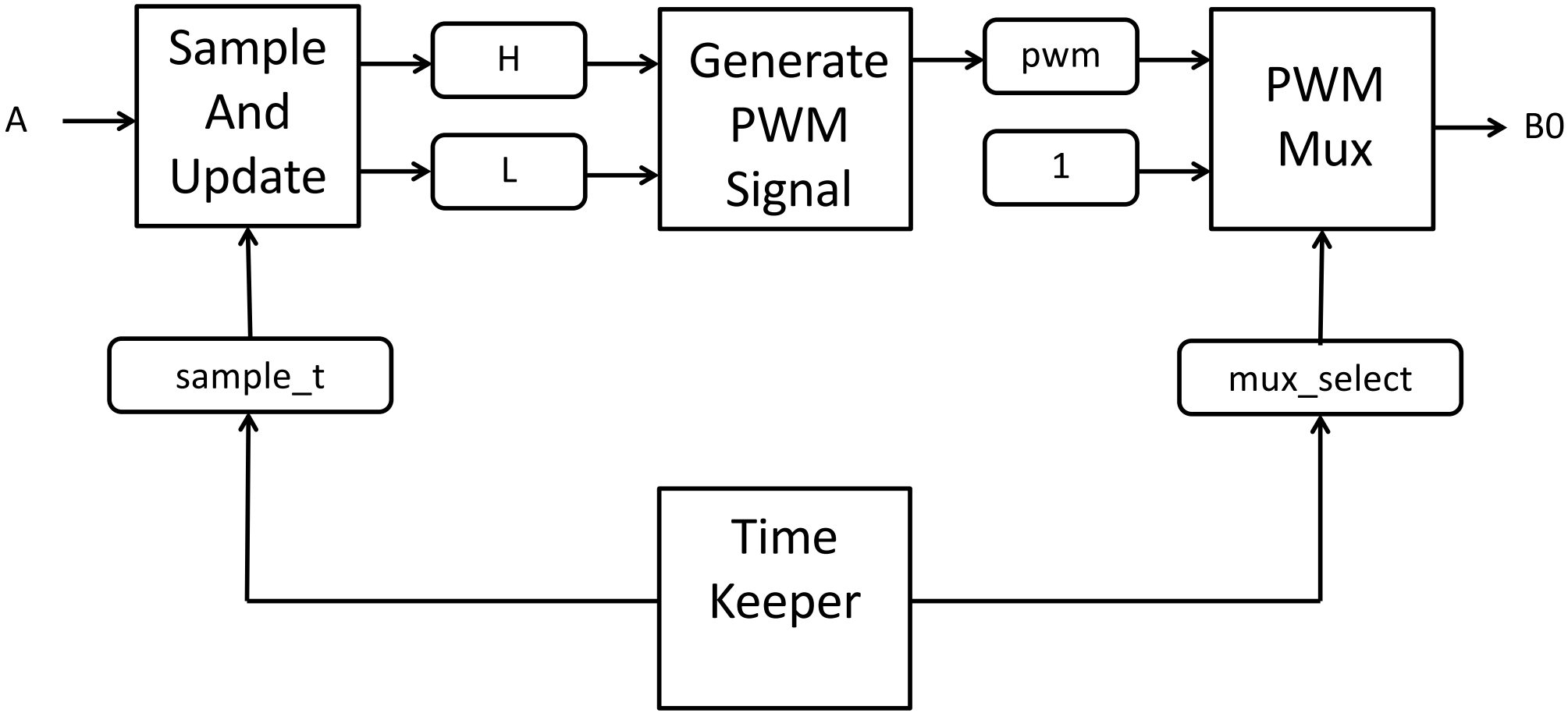
Unsigned char H, L, pwm;
Period = 50 ms



How do we ensure that these two tasks are completely Synchronized? (And imagine challenges if we scale up to more tasks, multiple levels of synch, etc.)

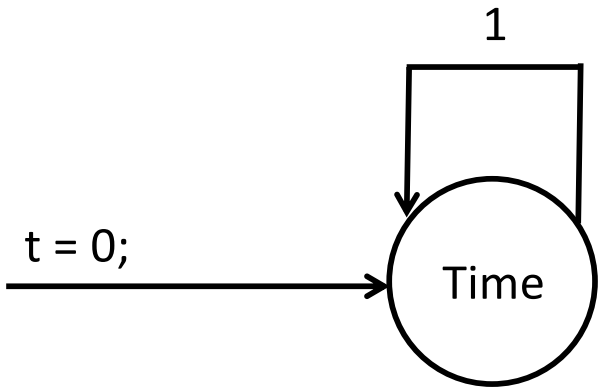
Alternate Solution

unsigned char H, L, pwm, sample_t, mux_select;
Period = 50 ms

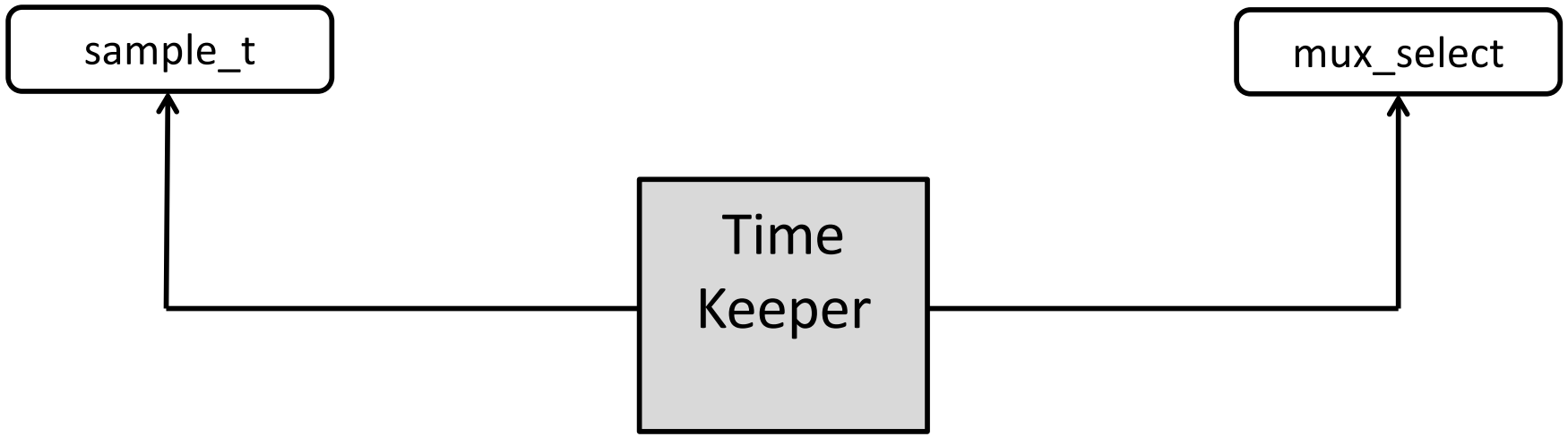


Alternate Solution

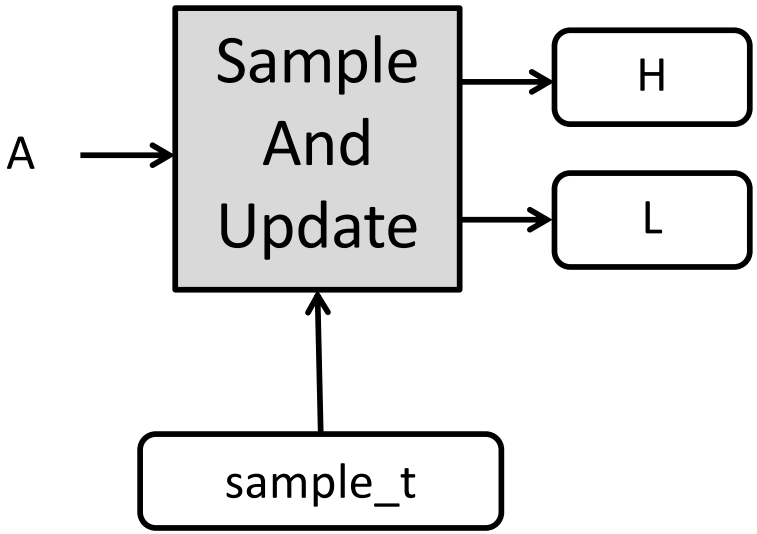
```
// 1 to 15.0 seconds = 300 ticks
// 15.25 seconds = 305 ticks
unsigned short t;
Period = 50 ms
```



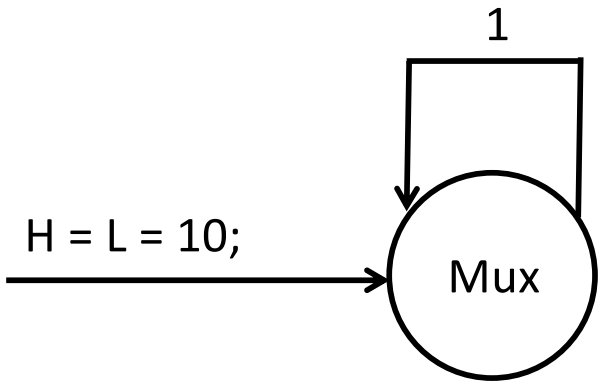

```
t = (t == 305) ? 1 : t + 1;
mux_select = (t <= 300) ? 1 : 0;
sample_t = (t == 305) ? 1 : 0;
```



Alternate Solution



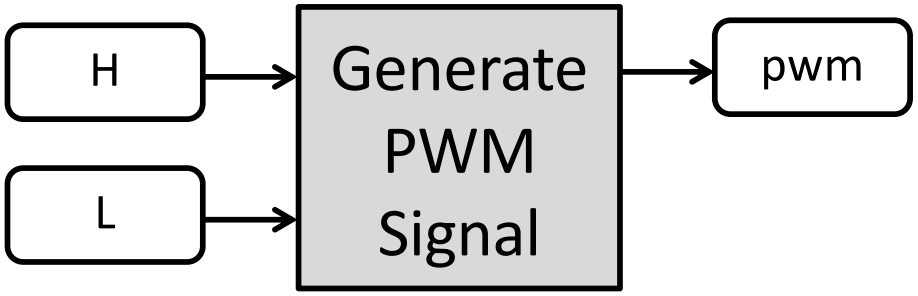
Period = 50s

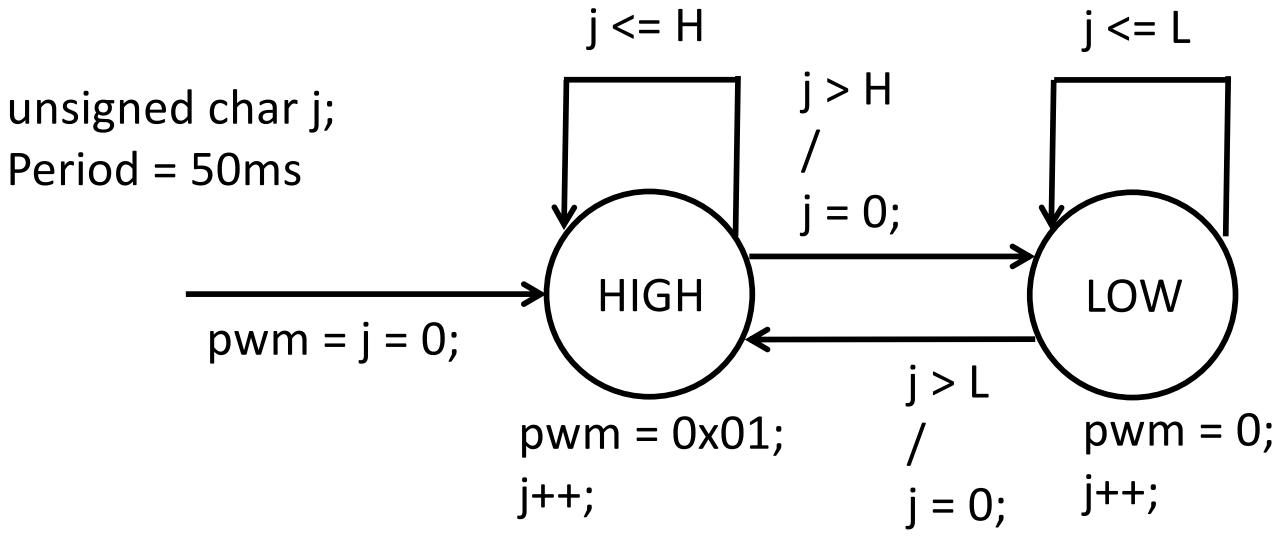



```
if( sample_t ) {
        desired_temp = A & 0x0F;
        tach_temp = A & 0xF0 >> 4;
        If( desired_temp > tach_temp  && H > 6 )
                { H--; L++; }
        else if( desired_temp < tach_temp && L > 0 )
                { H++; L--;}
}
```

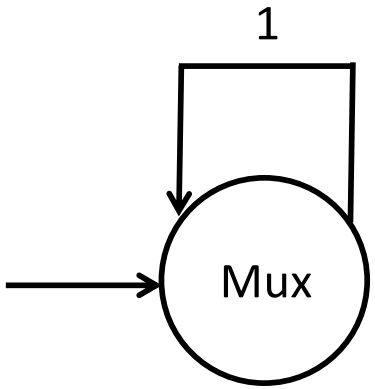
Alternate Solution

(No Change)

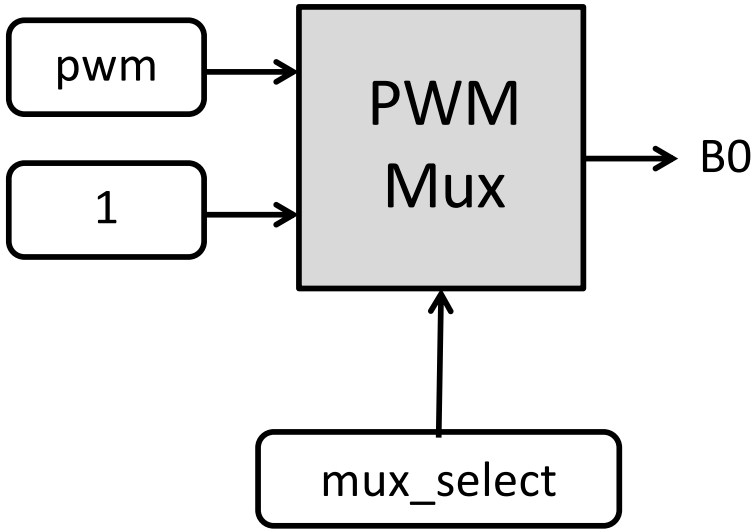




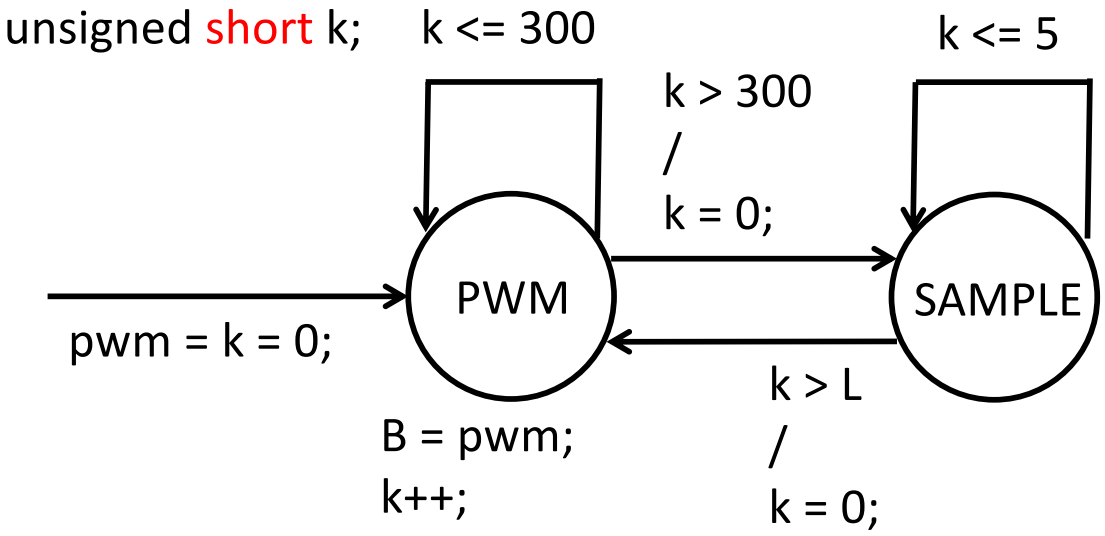
Alternate Solution

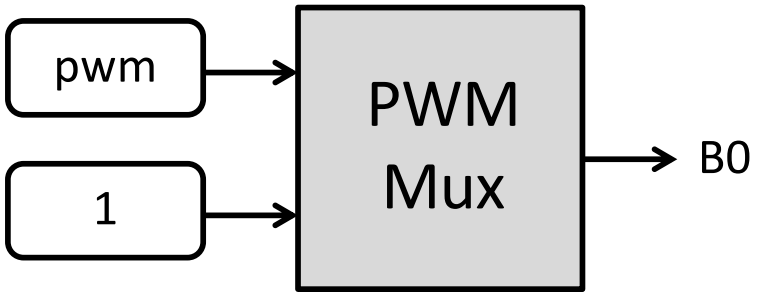


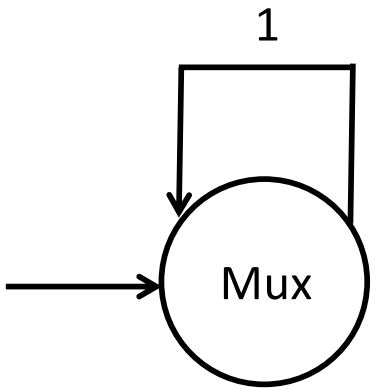
B0 = mux_select ? pwm : 1;



Before/After (PWM Mux)







B0 = mux_select ? pwm : 1;