

Embedded Hardware and Operating Systems: Practice Peer-graded

Assignment TinyOS -- Hands-on

Objective: To program a TinyOS application in practice

Materials: For the current assignment, the TinyOS is installed on a Contiki (3.0) system. This system is run using the latest VMWare player.

Introduction: TOSSIM is a discrete event simulator that can simulate entire sensor networks in TinyOS applications. TOSSIM is automatically built when applications are compiled. In the present assignment, to compile, we first move into the /apps/Blink directory (in the TinyOS demo examples), from where calling the “make micaz sim” command compiles the blink application.

The **dbg** function allows the TOSSIM for debugging output at runtime. In the present assignment, the **boot** mode of dbg is used when the LEDs are programmed to blink.

Implementation: Following sections describe the implementation of the two tasks in the present assignment, namely the simulation of blinking of the LEDs in correspondence with the timers.

A. Task 1

In this task, simulated timers are used to blink LEDs in the TinyOS program. A “runblink.py” program is created in Python language. The program is compiled using the TinyOS compiler and the compiled environment is then run in the TOSSIM simulator. The output from the program is as shown in figure 1.

```
*** Successfully built micaz TOSSIM library.
user@instant-contiki:~/tinyos-release/apps/Blink$ gedit runblink.py
user@instant-contiki:~/tinyos-release/apps/Blink$ python runblink.py
DEBUG (1): Timer 0 fired @ 0:0:0.244140645.
DEBUG (1): Timer 0 fired @ 0:0:0.488281270.
DEBUG (1): Timer 1 fired @ 0:0:0.488281280.
DEBUG (1): Timer 0 fired @ 0:0:0.732421895.
DEBUG (1): Timer 0 fired @ 0:0:0.976562520.
DEBUG (1): Timer 1 fired @ 0:0:0.976562530.
DEBUG (1): Timer 2 fired @ 0:0:0.976562540.
DEBUG (1): Timer 0 fired @ 0:0:1.220703145.
DEBUG (1): Timer 0 fired @ 0:0:1.464843770.
DEBUG (1): Timer 1 fired @ 0:0:1.464843780.
DEBUG (1): Timer 0 fired @ 0:0:1.708984395.
DEBUG (1): Timer 0 fired @ 0:0:1.953125020.
DEBUG (1): Timer 1 fired @ 0:0:1.953125030.
DEBUG (1): Timer 2 fired @ 0:0:1.953125040.
DEBUG (1): Timer 0 fired @ 0:0:2.197265645.
DEBUG (1): Timer 0 fired @ 0:0:2.441406270.
DEBUG (1): Timer 1 fired @ 0:0:2.441406280
user@instant-contiki:~/tinyos-release/apps/Blink$
```

Figure 1: Results of Task 1 from the runblink.py script to blink the LEDs

B. Task 2:

- In Task 2, a timer called “Timer 3” is added to the Blink Application using the following line:

```
components new TimerMilliC() as Timer3;
```

- This timer is scheduled for every 100ms in the BlinkC.nc script using the following line:

```
call Timer3.startPeriodic( 100 );
```

- This timer is programmed to print out “I am Timer 3 and I have the shortest period!” using the following lines of code:

```
event void Timer3.fired()  
{ dbg("BlinkC", "I am Timer 3 and I have the shortest  
period! fired @ %s.\n", sim_time_string()); }
```

- Finally, the python script is edited to simulate for 2000 events instead of 100 just by replacing the input to the loop:

```
for i in range(0, 2000):  
    t.runNextEvent()
```

A screenshot of the output simulation is shown in figure 2.

Results: Thus, in this assignment, timers were programmed in the TinyOS LED blinking application. As can be seen from the results of Task 1 and Task 2, the application was compiled and simulated successfully using the TOSSIM library via a python script.

```

user@instant-contiki:~/tinyos-release/apps/Blink$ python runblink.py
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.097656270.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.195312520.
DEBUG (1): Timer 0 fired @ 0:0:0.244140645.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.292968770.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.390625020.
DEBUG (1): Timer 0 fired @ 0:0:0.488281270.
DEBUG (1): Timer 1 fired @ 0:0:0.488281280
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.488281290.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.585937520.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.683593770.
DEBUG (1): Timer 0 fired @ 0:0:0.732421895.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.781250020.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.878906270.
DEBUG (1): Timer 0 fired @ 0:0:0.976562520.
DEBUG (1): Timer 1 fired @ 0:0:0.976562530
DEBUG (1): Timer 2 fired @ 0:0:0.976562540.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:0.976562550.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.074218770.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.171875020.
DEBUG (1): Timer 0 fired @ 0:0:1.220703145.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.269531270.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.367187520.
DEBUG (1): Timer 0 fired @ 0:0:1.464843770.
DEBUG (1): Timer 1 fired @ 0:0:1.464843780
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.464843790.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.562500020.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.660156270.
DEBUG (1): Timer 0 fired @ 0:0:1.708984395.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.757812520.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.855468770.
DEBUG (1): Timer 0 fired @ 0:0:1.953125020.
DEBUG (1): Timer 1 fired @ 0:0:1.953125030
DEBUG (1): Timer 2 fired @ 0:0:1.953125040.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:1.953125050.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:2.050781270.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:2.148437520.
DEBUG (1): Timer 0 fired @ 0:0:2.197265645.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:2.246093770.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:2.343750020.
DEBUG (1): Timer 0 fired @ 0:0:2.441406270.
DEBUG (1): Timer 1 fired @ 0:0:2.441406280
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:2.441406290.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:2.539062520.
DEBUG (1): I am Timer 3 and I have the shortest period! fired @ 0:0:2.636718770.

```

Figure 2: Results of Task 2 simulation for 2000 events after addition of Timer 3