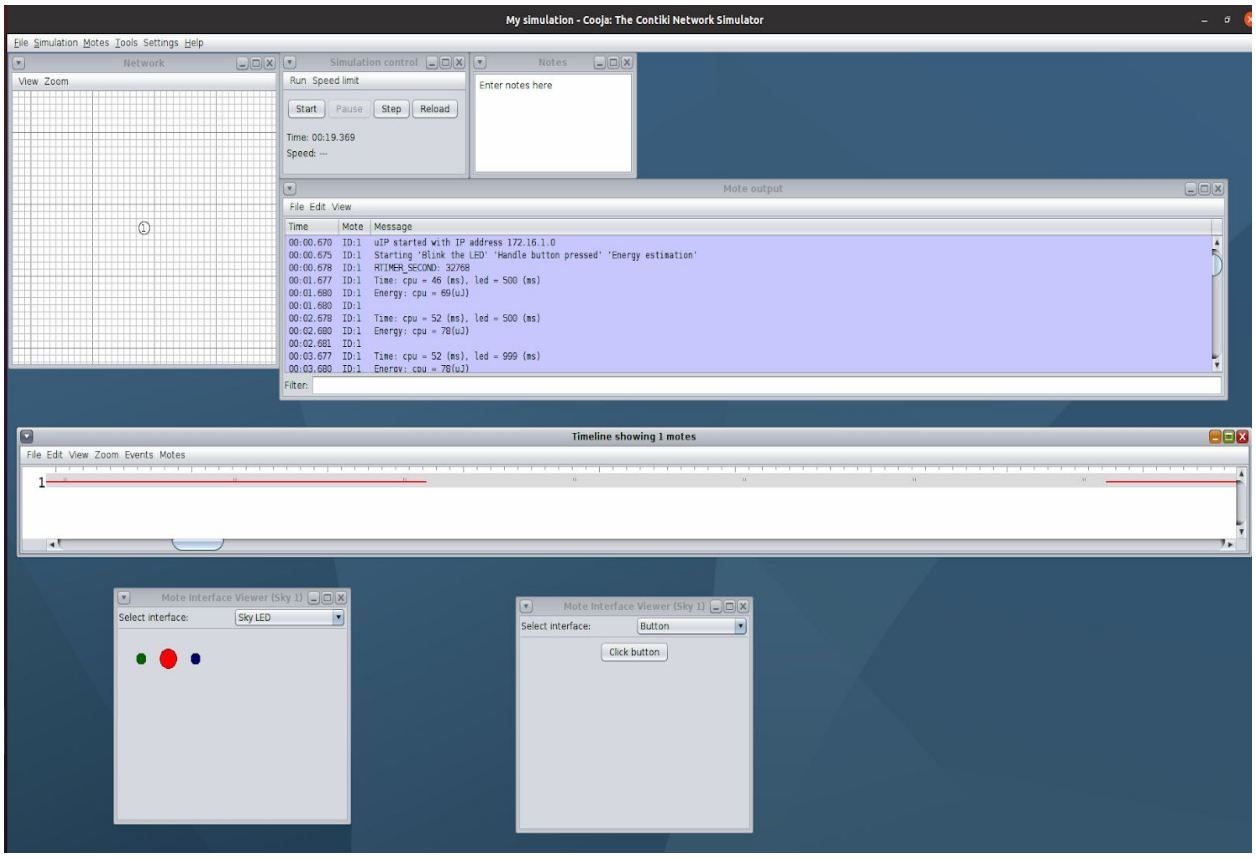
Group: Homework2_Group_110

Q2-3. The LED is on for 1s (CLOCK_SECOND) and off for 0.5s (CLOCK_SECOND / 2). Global variables *time_on* and *time_off* are set to store these time intervals. When the program starts, the LED keeps on turning on and off i.e on for 1 CLOCK_SECOND and off for half CLOCK_SECOND. *etimer_set* is used to set the timers and *PROCESS_WAIT_EVENT_UNTIL* is used to wait until the timer is expired and LED is then turned on and off alternatively.

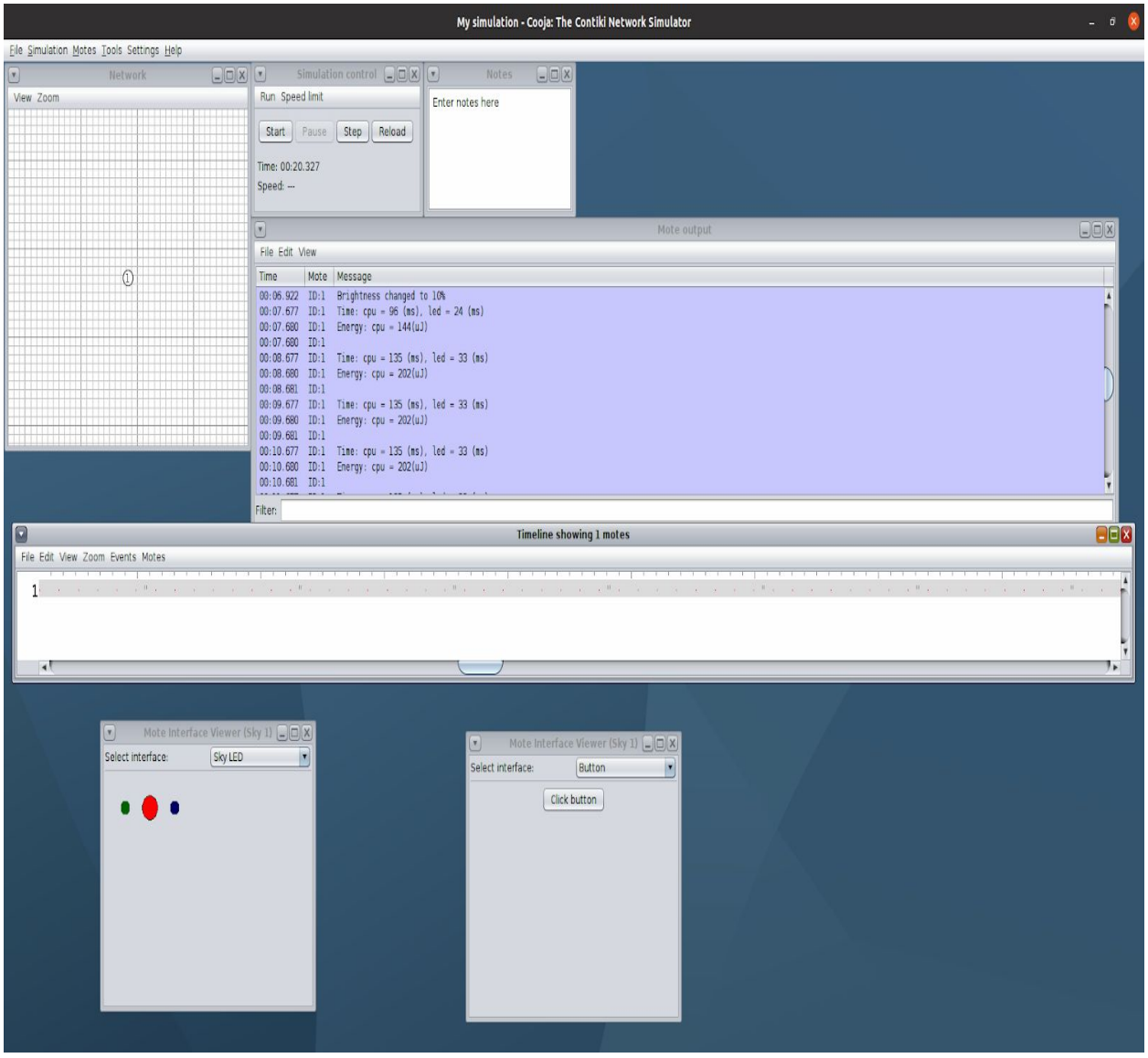


Q2-4. The brightness of LED is controlled by using PWM (Pulse Width Modulation). A duty cycle is calculated to control the brightness to 10%, 50%, and 90%. A 10% duty cycle means that a pulse is on for 10% of the time during a cycle and off 90% of the time.
Given oscillating speed = 50hz per second
Time for 1 oscillation t = 1/50 s = 0.02s

For 10% brightness i.e 10% duty cycle
LED should be on for 10% of time during a cycle i.e 0.02 * 0.10 * CLOCK_SECOND
LED should be off for 90% of time during a cycle i.e 0.02 * 0.90 * CLOCK_SECOND

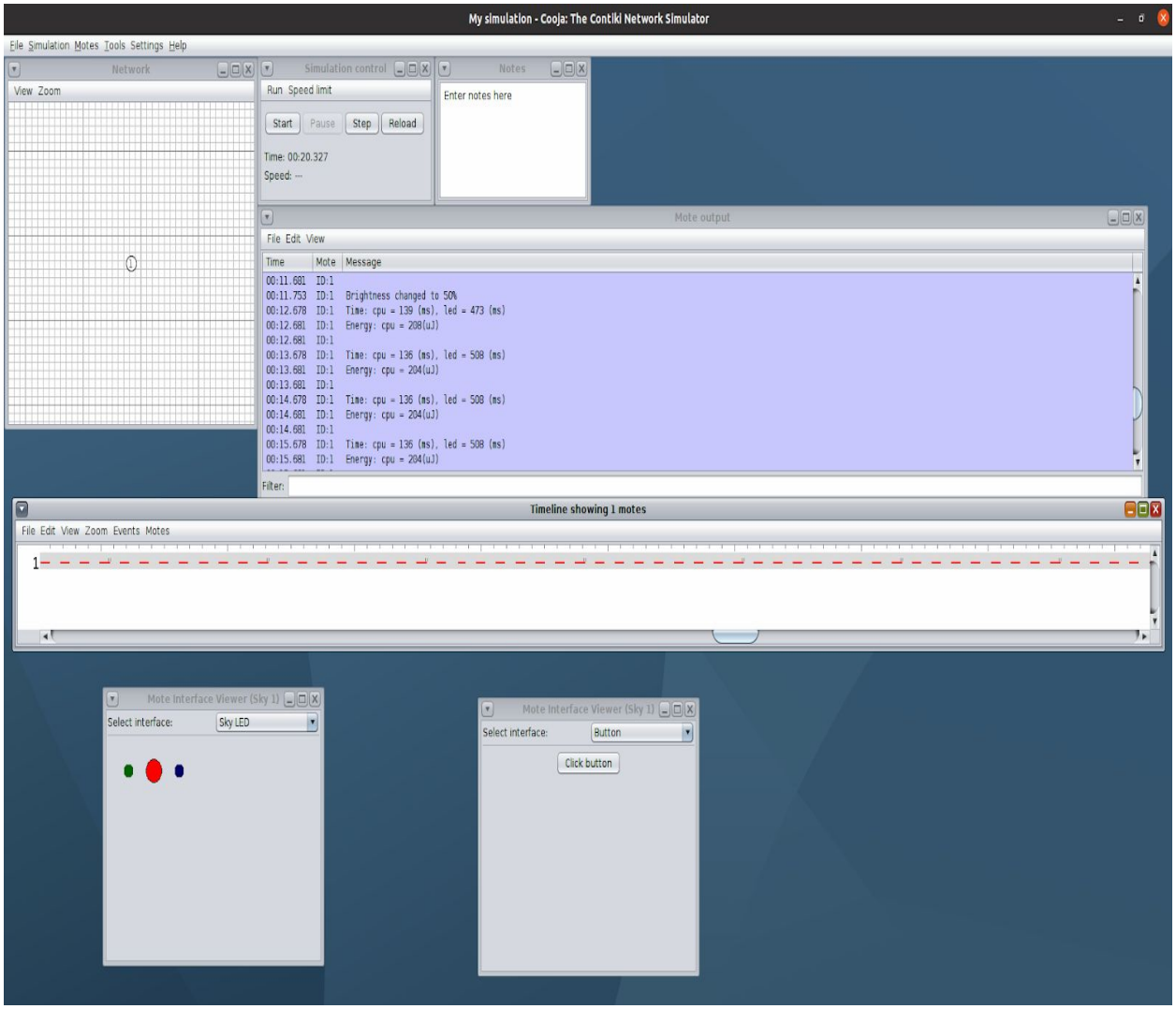
Similarly 50% and 90% duty cycle/brightness are calculated.

10% duty cycle



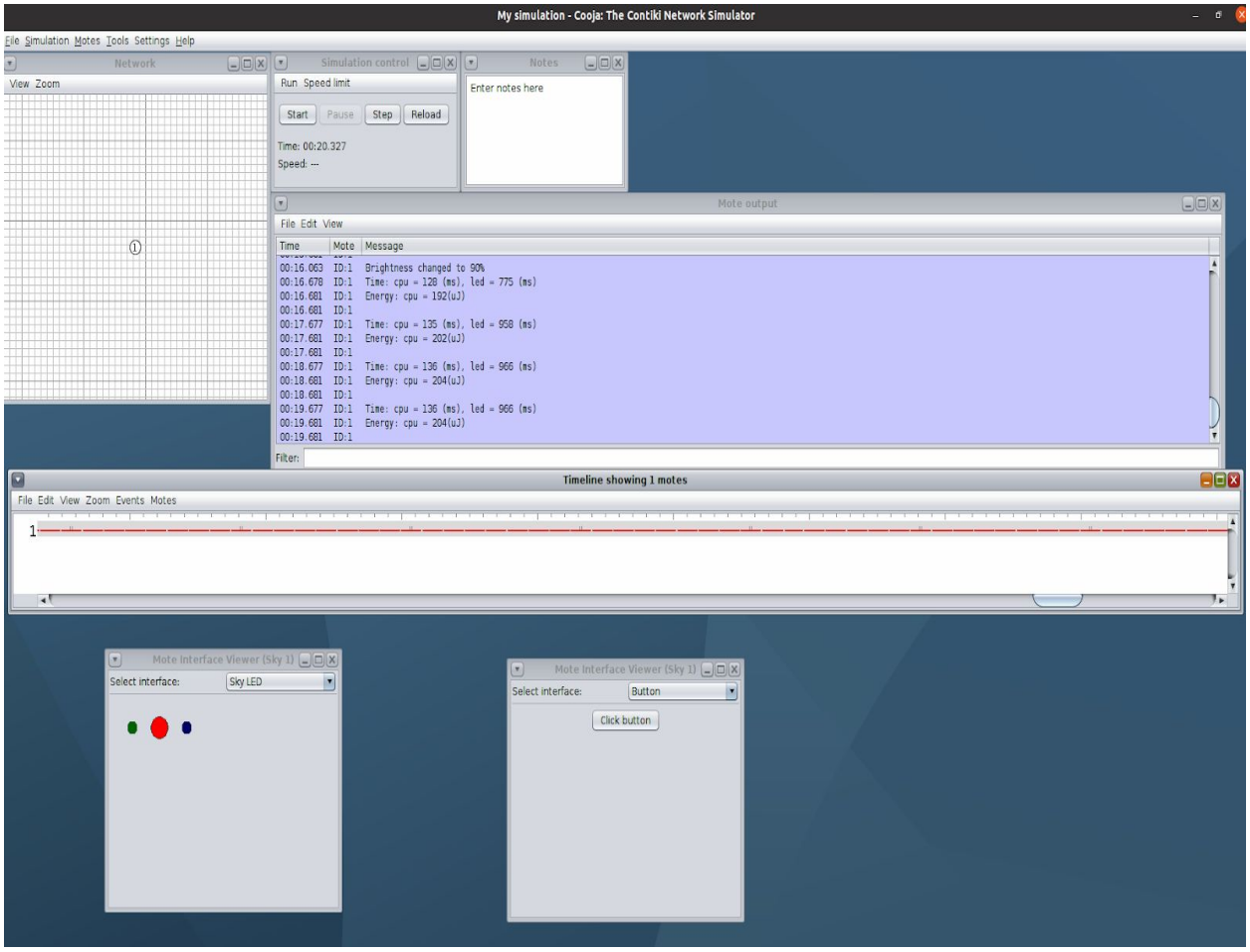
It can be seen in the Timeline that there are small red light on intervals. This represents that LED is on just for a small time interval i.e 10% in a cycle and the rest 90% is off. This corresponds to 10% brightness.

50% duty cycle



It can be seen in the Timeline that there are equal red light on and off intervals. This represents that LED is on 50% of time in a cycle and the rest 50% is off. This corresponds to 50% brightness.

90% duty cycle



It can be seen in the Timeline that there are big red light on and small off intervals. This represents that LED is on 90% of time in a cycle and the rest 10% is off. This corresponds to 90% brightness.

Q2-5. In the third process, the requirement is to collect every second, how long the CPU and the red LED were active in the last second. This calculation is done in the third protothread i.e *energy_pt*.
energest_init() is used to initialize the Energest module. *etimer_set* is used to set a timer for 1 CLOCK_SECOND to calculate the time ticks every second. The time ticks are calculated using *energest_type_time* . The calculated time ticks are stored in static variables every second to subtract them from the new value of *energest_type_time* in the next second. The value is then divided by RTIMER_SECOND i.e the possible ticks per second. It is then multiplied with 1000 to convert it into milliseconds. Energy for cpu is calculated by using the formula:
Energy = current * time * voltage
From the data sheet of tmote sky:
https://insense.cs.st-andrews.ac.uk/files/2013/04/tmote-sky-datasheet.pdf
Active current Vcc i.e 3V, 1Mhz i.e 500µA -> 500µA = 0.5 mA
The values for time and energy can be seen in the above screenshots.