Politecnico di Torino

CAOS Project -
HacOSsim

Fabio Lorenzato (332186) - Alessandro Milani (s332136) - Matteo Scrusatone (332153)

Real-Time Operating System

- The extensive documentation available
- A really active forum
- That one being open source, of course
- Prior knowledge of it could be useful in the future, because it’s backed by Amazon

Board & Emulator

We emulated the Luminary Micro Stellaris LM3S6965EVB thanks to Qemu.

This board has some interesting feature like:

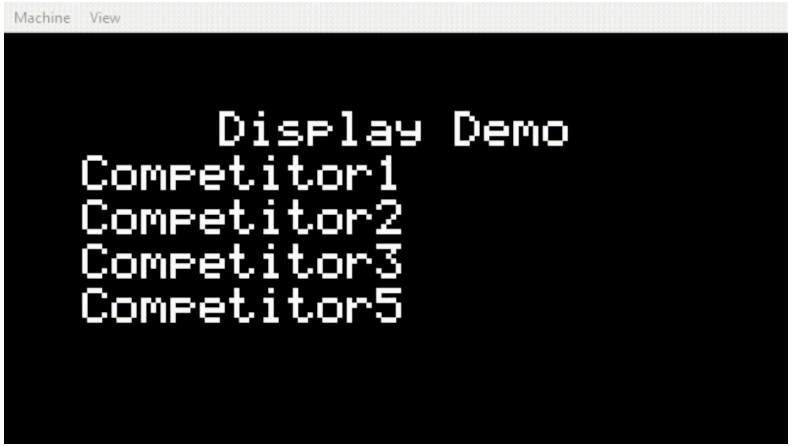
- 256k Flash memory and 64k SRAM
- Lots of featured and interfaces available (Timers, UARTs, ADC, I2C, SSI interfaces, . . .)
- Some graphical drivers already available
- lots of guided examples

Display Demo

Functionalities implemented:

- HW
  - Display

- SW
  - Semaphore
  - message queue

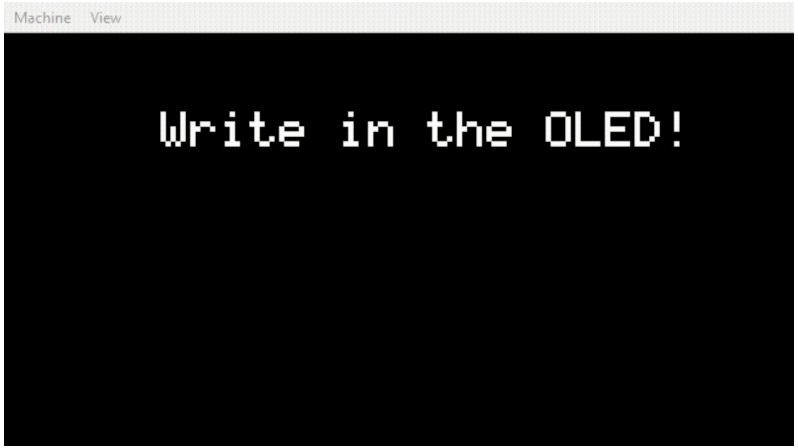


Input Demo

Functionalities implemented:

- HW
  - UART device

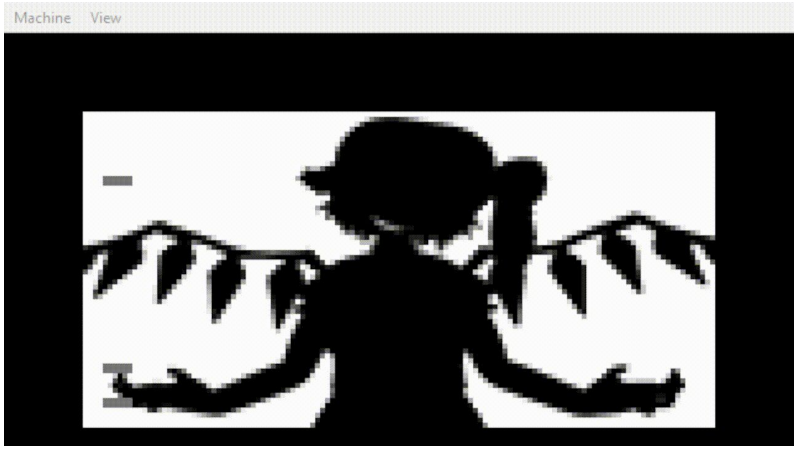
- SW
  - Keyboard input function



CHAOS demo

Other implementation:

- SW
  - More task that have access to the display simultaneously
  - Bitmap
  - Pseudo Random Generator



Pong

Politecnico di Torino

Funny to play until you comprehend that you cannot win.

EDF implementation

New scheduler has to be enabled.

```
#define configUSE_EDF_SCHEDULER 1 //Enables EDF scheduling for periodic tasks
#define ENABLE_TRACING            //Enables tracing functions for easier debug
```

```
#if ( configUSE_EDF_SCHEDULER == 1 )
        PRIVILEGED_DATA static List_t xReadyTasksListEDF;
#endif
...
#if (configUSE_EDF_SCHEDULER == 1)
        TickType_t xTaskPeriod; // In tskTaskControlBlock
#endif /* configUSE_EDF_SCHEDULER  */
```

New ready list to handle tasks, made possible by adding the period to the Task PCB.

EDF implementation

New way to create tasks(period instead of priority).

```
BaseType_t xTaskPeriodicCreate(
                TaskFunction_t pxTaskCode,
                const char * const pcName,
                const configSTACK_DEPTH_TYPE usStackDepth,
                void * const pvParameters,
                UBaseType_t uxPriority,
                TaskHandle_t * const pxCreatedTask,
                TickType_t xPeriod);
```

```
xReturn = xTaskPeriodicCreate(
                prvIdleTask,
                configIDLE_TASK_NAME,
                configMINIMAL_STACK_SIZE,
                ( void * ) NULL,
                portPRIVILEGE_BIT,
                &xIdleTaskHandle,
                xIdleTaskPeriod // set with configIDLE_TASK_PERIOD
            );
...
pxCurrentTCB->xStateListItem.xItemValue = xTickCount +
        configDLE_TASK_PERIOD + xMaxTaskDeadLine;
```

Idle task became periodic, which will never run unless it’s necessary.

EDF implementation

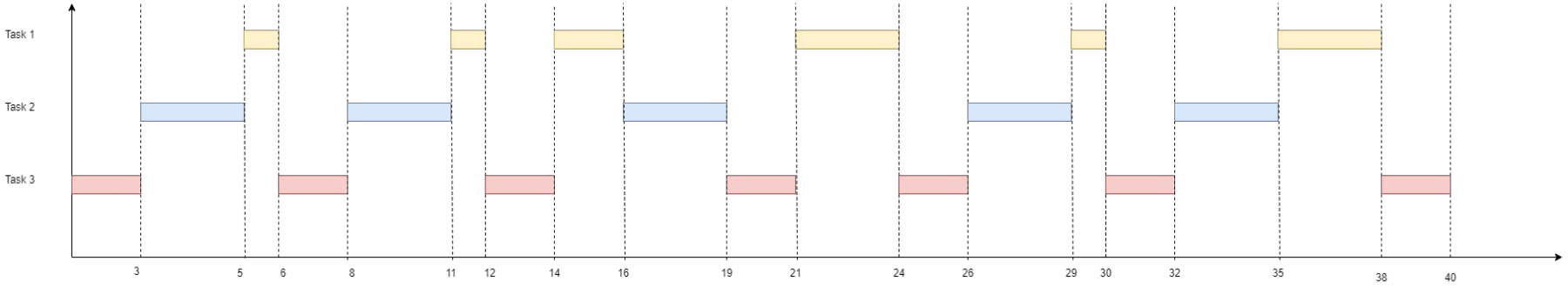
Politecnico di Torino

Changed the logic for context switch.

```
 #define prvAddTaskToReadyList( pxTCB )                                          \
        do {                                                                     \
            traceMOVED_TASK_TO_READY_STATE( pxTCB );                             \
            vListInsert( &( xReadyTasksListEDF ), &( ( pxTCB )->xStateListItem ) ); \
            tracePOST_MOVED_TASK_TO_READY_STATE( pxTCB );                        \
        } while( 0 )
...
#if ( configUSE_EDF_SCHEDULER == 0 )
       taskSELECT_HIGHEST_PRIORITY_TASK();
#else
       pxCurrentTCB = ( TCB_t * ) listGET_OWNER_OF_HEAD_ENTRY( &(xReadyTasksListEDF ) );
#endif
```

EDF Performance Evaluation

	Task period	Execution time
Task 1	40	11
Task 2	8	3
Task 3	6	2



EDF benchmark

Effectiveness:

- 42.358% reduction of switch in
- 56.311% reduction of idle ticks
- More balanced overall lateness

	Default	EDF
Idle ticks	103	58
Switch in	1289	546
Lateness Task 1	-13.93	-6.31
Lateness Task 2	-1.47	-4.32
Lateness Task 3	-1.57	-4.0

*All results in ticks

Project contribution

Politecnico di Torino

Task	Lorenzato	Milani	Scursatone
Repo setup and configuration	X	X	X
Demo code implementation	X	X	X
Scheduling algorithm implementation	X		
Performance evaluation	X	X	
Report and Documentation	X	X	X

Politecnico
di Torino

Thanks for your attention!