

2017 ASEE Texas Instruments Workshop
TI LaunchPad Development Kit for Embedded Systems and IoT Courses
University.ti.com
Embedded System Education – Real Time Operating Systems

Hardware

- 0) MSP432 LaunchPad (MSP-EXP432P401R)
- 1) MKII Educational Boosterpack (BOOSTXL-EDUMKII)

Install Software

- 0) Install **Code Composer Studio 7** (configure for MSP432)
<http://www.ti.com/tool/CCSTUDIO>
- 1) Install TI RTOS (configure for MSP432)
<http://www.ti.com/tool/TI-RTOS>
- 2) This ASEE workshop example code (unzip into a location easy to find)
http://edx-org-utaustinx.s3.amazonaws.com/UT601x/Valvano_TI_RTOS.zip
This workshop PowerPoint <http://users.ece.utexas.edu/~valvano/ASEE2017.ppt>

Optional Software with lots of examples

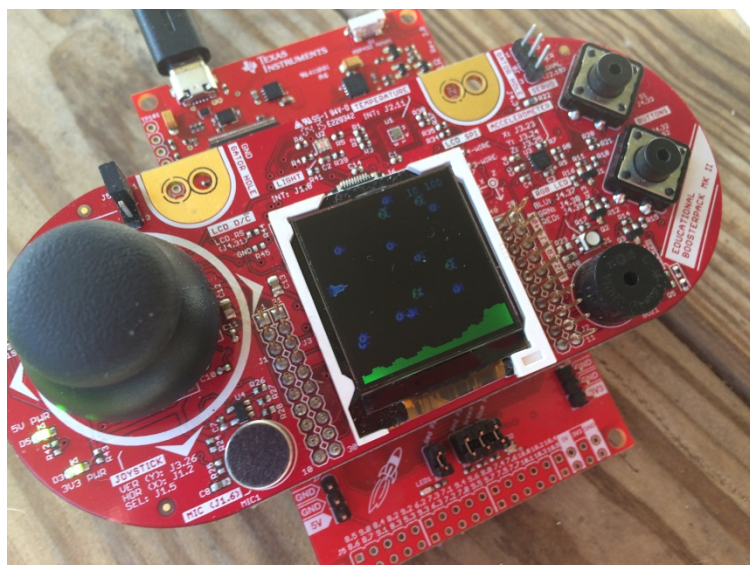
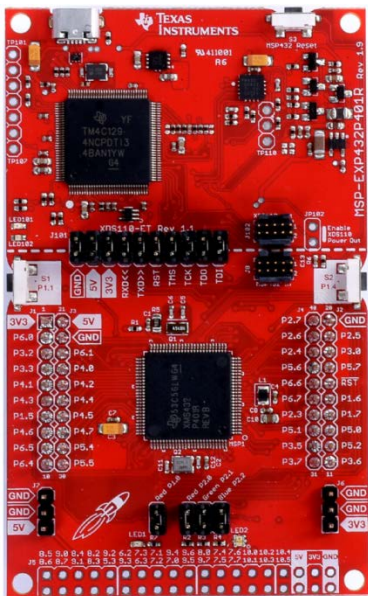
- 0) MSPware (MSP432 examples from TI) <http://www.ti.com/tool/mspware>
- 1) edX MOOC examples (RTOS+BLE)
<http://edx-org-utaustinx.s3.amazonaws.com/UT601x/RTOSsoftware.html>
- 2) Valvano examples (MSP432 examples for books)
<http://users.ece.utexas.edu/~valvano/arm/downloadmsp432.html>

Documentation

- 0) MSP432 <http://www.ti.com/ww/en/launchpad/launchpads-msp430-msp-exp432p401r.html>
- 1) TI RTOS <http://www.ti.com/tool/TI-RTOS>
- 2) MKII <http://www.ti.com/tool/boostxl-edumkii>

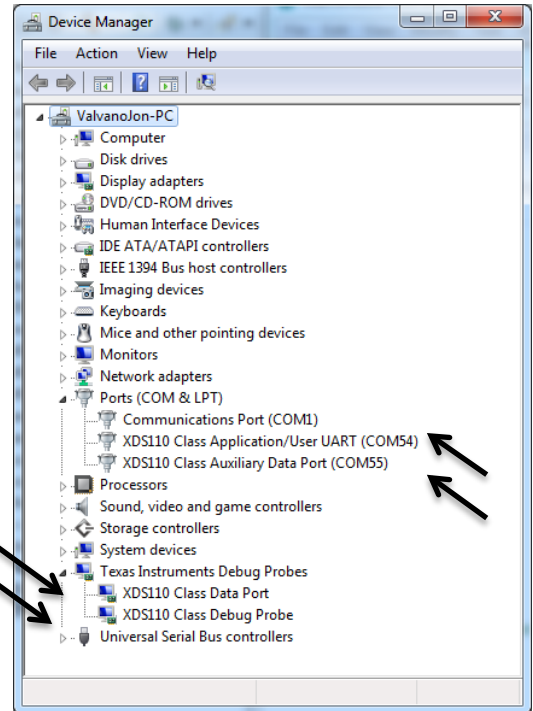
Configure jumpers, boards

- 0) On MSP432 LaunchPad leave in all jumpers; the USB cable is needed. Line up the silk screens. Connect MSP432+MKII boards. Double check for alignment before powering



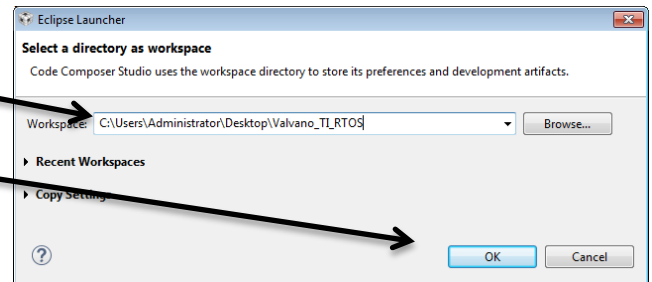
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1) Plug LaunchPad USB into PC and observe the drivers in the **device manager**

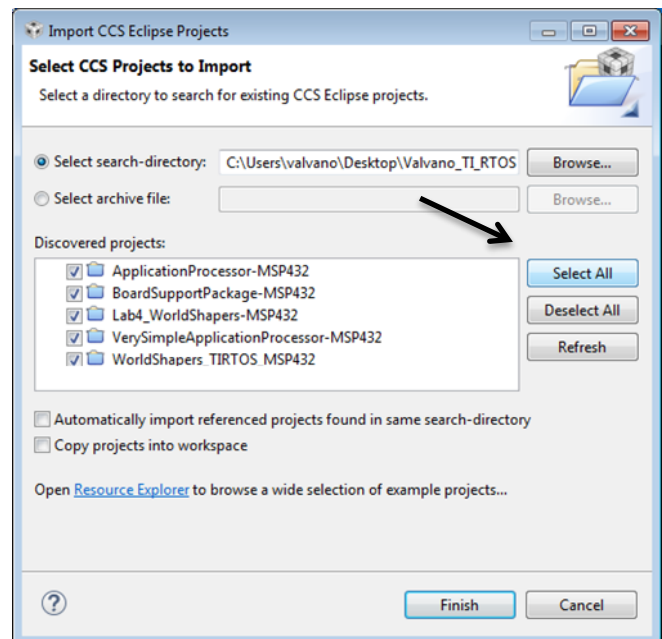


Demo: WorldShapers_TIRTOS_MSP432 project

1) Open **Code Composer Studio** Execute **File->Switch Workspace** choose *Other...*
Browse, find the folder with **Valvano_TI_RTOS** and click OK

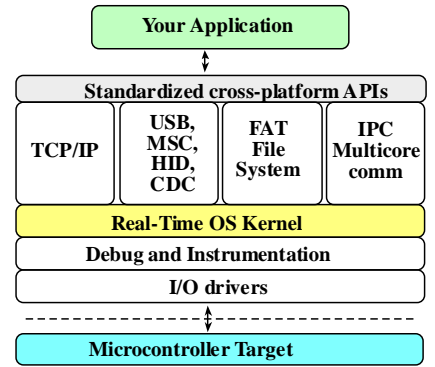
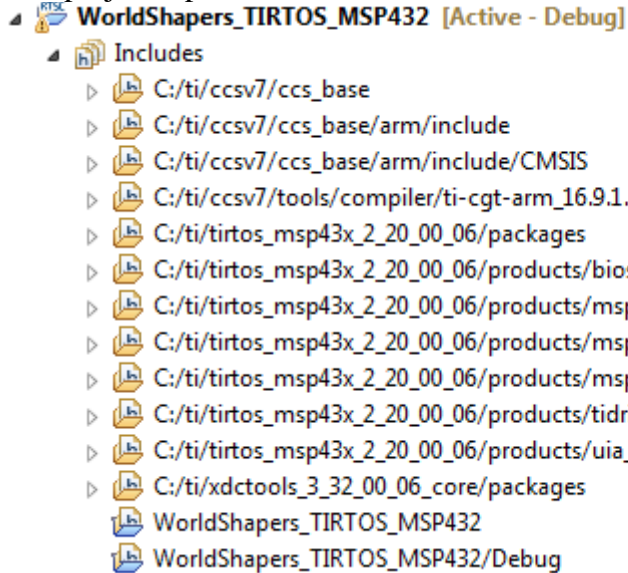


2) Execute **Project->Import CCS Projects**,
Browse for folder, Select them all, Click Finish



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3) See how the project connects to TI RTOS, click project, open **Includes**

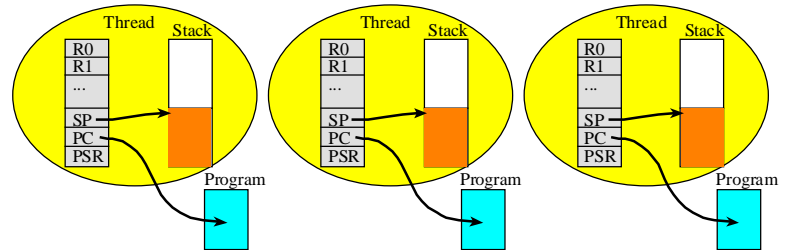


4) See low level I/O functions for MK-II, open **BSP.c**
 Written in “Valvano style”

Note:
Run WorldShapers_TIRTOS_MSP432
 not Lab4_WorldShapers-MSP432

5) See high-level game engine, open **WorldShapersMain.c**

- Three main threads “thread”
 - Look like main programs
 - Have priority
- I/O-triggered thread “task”
 - Looks like an interrupt service routine
- Search for “thread”
 - Use sleep to cooperate
- MoveEnemiesThread (low priority)
 - Implements AI of enemies
- GameThread (middle priority)
 - Execute player dynamics
 - Runs about 30 Hz
- SoundThread (high priority)
 - Outputs sound to buzzer
 - Runs at 1.4 kHz
- Search for “SlowPeriodicTask”
 - Triggered by periodic clock
 - Looks like an ISR
- Search for “stack”
 - Each thread has its own stack
- Search for “main”
 - See how four threads are created
- Search for “semaphore”
 - Pend: decrement counter, block if <0
 - Post: increment counter, wake up one block if needed



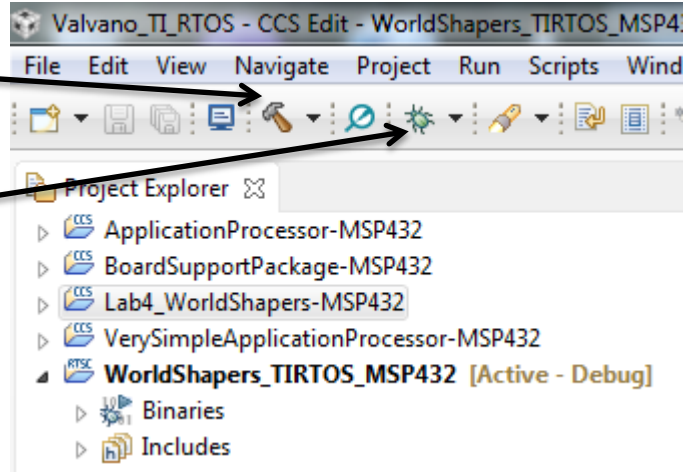
<pre>void Thread1(void){ Init1(); while(1){ Semaphore_pend(MutexHandle); // exclusive access Semaphore_post(MutexHandle); // other processing } }</pre>	<pre>void Thread2(void){ Init2(); while(1){ Semaphore_pend(MutexHandle); // exclusive access Semaphore_post(MutexHandle); // other processing } }</pre>
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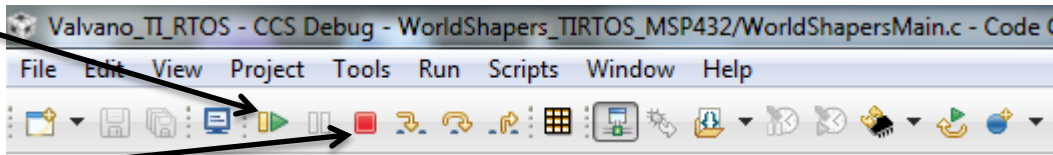
- construct

6) Debug

- Build
 - Compile and link
- Debug
 - Download and debug



- Run
- Edit
 - Quit
 - Edit line 592 in Intermission(),
 - Edit lines 110-114, reducing the KillCount to make game easier
 - Build, debug, **run!**



Additional Resources:

Embedded Systems MOOC

- <https://www.edx.org/course/embedded-systems-shape-world-utaustinx-ut-6-10x>
- <https://www.edx.org/course/embedded-systems-shape-world-multi-utaustinx-ut-6-20x>
- <http://users.ece.utexas.edu/~valvano/Volume1/E-Book/VideoLinks.htm>

Real-time Bluetooth MOOC

- <https://www.edx.org/course/real-time-bluetooth-networks-shape-world-utaustinx-ut-rtbn-12-01x>
- <http://edx-org-utaustinx.s3.amazonaws.com/UT601x/RTOS.html>

ASEE 2015 Resources (wifi)

- 2015 Workshop PowerPoint <http://users.ece.utexas.edu/~valvano/ASEE2015.pdf>
- 2015 Workshop Server code <http://users.ece.utexas.edu/~valvano/ASEE2015.zip>
- 2015 Workshop server <http://embedded-systems-server.appspot.com/>
- 2015 Workshop map <http://embedded-systems-server.appspot.com/map>
- MOOC server <http://embsysmooc.appspot.com/>
- MOOC map <http://embsysmooc.appspot.com/map>

ASEE 2016 Resources (BLE)

- 2016 Workshop PowerPoint <http://users.ece.utexas.edu/~valvano/ASEE2016.pdf>
- 2016 Workshop projects code <http://edx-org-utaustinx.s3.amazonaws.com/UT601x/BLE.zip>

Valvano Example code

- Valvano home page <http://users.ece.utexas.edu/~valvano/>
- Individual projects <http://users.ece.utexas.edu/~valvano/arm/>
- ValvanoWareTM4C123 folder <http://tinyurl.com/nuq4zpx>
- LaunchPad tester <http://users.ece.utexas.edu/~valvano/arm/tester/>