KEURIG GREEN MOUNTAIN

END OF CO-OP FINAL PRESENTATION

By: Christopher Tannock

ABOUT ME

- From Smithfield, RI

- Northeastern University
  - B.S. in Electrical Engineering
  - Minor in Mathematics
  - Graduation Date: May 2018

- Embedded Software Engineering Co-op
  - Manager: Isaac Horn
  - Mentor: Brian Rheaume

- Third Work Experience; First Co-op
  - MIT Lincoln Laboratory – Lexington, MA
  - Naval Undersea Warfare Center – Newport, RI

PRESENTATION AGENDA

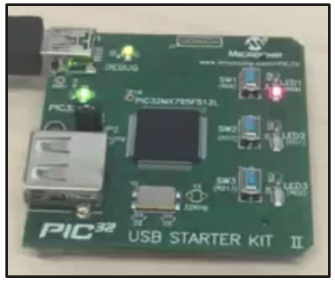
- Projects:
  - Blinking LEDs
  - Keyboard Wedge Application
  - System Test Platform for Serial Communication Protocols
  - Software Team Coding Standards
  - Software Project Development

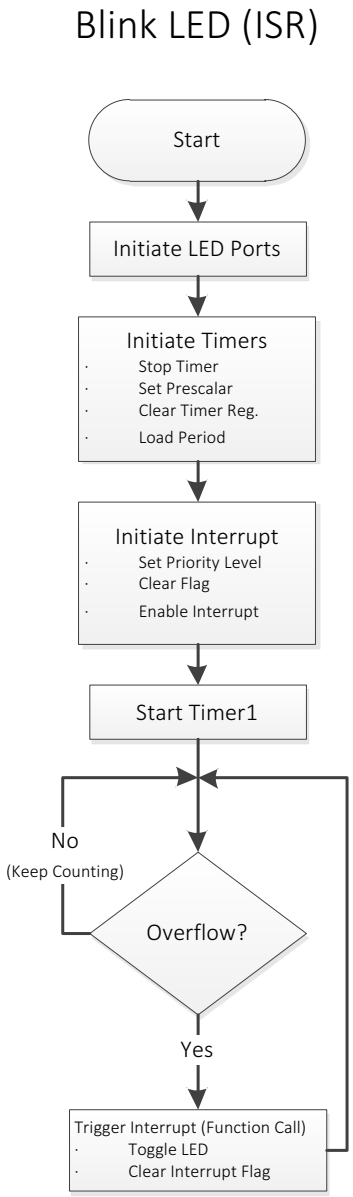
- Overall Co-op Experience:
  - Learning Outcomes
  - Networking
  - Likes and Dislikes
  - Final Thoughts

PROJECTS

BLINKING LEDS

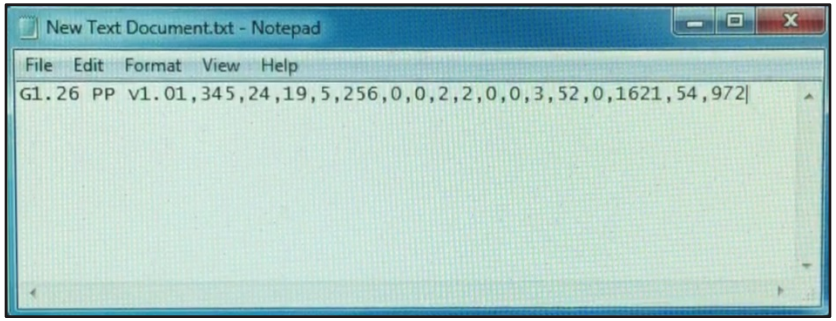
- Objective:
  - Gain experience working with microcontrollers by blinking an LED
- Tasks:
  - Blinking an LED
  - Polling a timer to blink an LED
  - Utilizing an ISR to blink an LED
- Learning Outcomes:
  - Educational project
  - Appreciation for design before coding
  - Experience with hardware peripherals





KEYBOARD WEDGE APPLICATION V2.0

- Objective:
  - Design and implement the functionality to extract maintenance mode data from appliances
  - Maintain current K2.0 functionality
- Tasks:
  - Understanding pre-existing functionality
  - High-level Design Decisions
    - Pop Up Button
    - Configuration Window
    - Keyboard Sequence

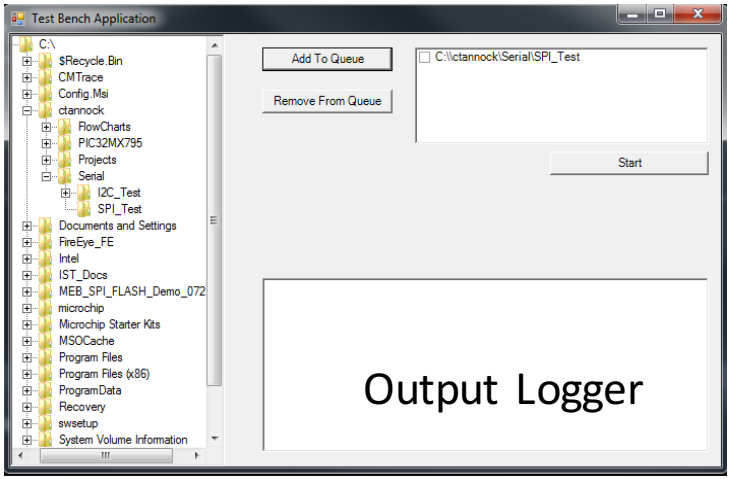


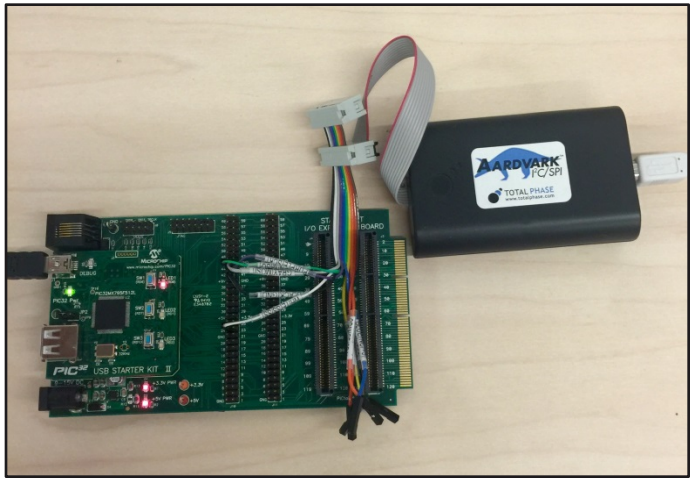
KEYBOARD WEDGE APPLICATION V2.0

- Obstacles:
  - Writing commands to the serial port
  - Three key press release
  - Extra keys pressed during sequence
  - Removal of unnecessary strings at beginning of maintenance code stream
- Learning Outcomes:
  - Visual Basic .NET
  - Windows Dynamic-Link Libraries
  - Multithreading
  - Handling and Raising Events
  - UART Serial Communication
  - Utilizing Stash and SourceTree
- Deliverables:
  - Released application to Data Analytics Team
  - Delivered Maintenance Coder Reader Documentation

System Test Platform

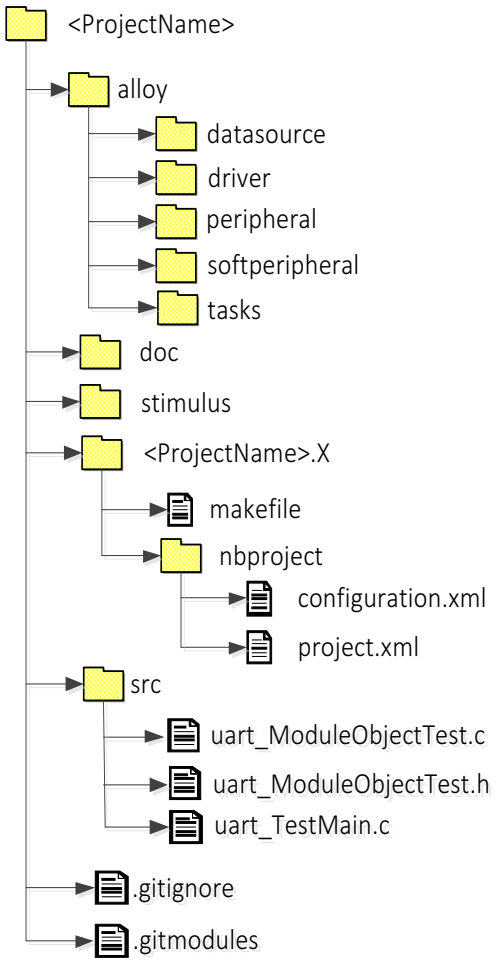
- Objectives:
  - Design and implement system test platforms to test serial communication protocols
- Tasks:
  - Create generic test application
  - Investigate running multiple tests
  - Parse through XML files for:
    - Setup Configuration
    - Serial Read/Writes
    - Feedback
  - Ability to expand from SPI to I2C
- Learning Outcomes:
  - XML files and schemas
  - Additional VB.NET experience
  - Multiple device communication
- Deliverables:
  - Initial design
  - Proof of concept





Software Team Coding Standards

- Objectives:
  - Develop coding standards to unify software team efforts
- Tasks:
  - Review former coding standards
  - Update file templates
  - Expand formatting styles
  - Create new directory structures
  - Explore the use of “code beautifier” tools
- Learning Outcomes:
  - Collaborate with different members of the software team
  - Exposure to different C coding styles



SOFTWARE TEAM CODING STANDARDS

- Deliverables:
  - SWT – Coding Guidelines Document
  - Procedures to add and utilize:
    - File Templates
    - UnCrustify

```
 for (temp = 0; temp < USART_NUMBER_OF_MODULES; temp++)
  {
    free(uart_chn);
     uart_chn = NULL;
       uart_chn = UART_InitializeChannel( temp,
        USART_ENABLE_TX_RX_USED,
              TEST_CHN_CLK_FREQ,
TEST_CHN_BAUDRATE,
        USART_9N2 );
     TEST_ASSERT( uart_chn);
  }
```

<- Before

After ->

```
for ( temp = 0; temp < USART_NUMBER_OF_MODULES; temp++ )
   {
      free( uart_chn );
      uart_chn = NULL;
      uart_chn = UART_InitializeChannel( temp,
                                         USART_ENABLE_TX_RX_USED,
                                         TEST_CHN_CLK_FREQ,
                                         TEST_CHN_BAUDRATE,
                                         USART_9N2 );
      TEST_ASSERT( uart_chn );
   }
```

```
//===========================================================================
//! @file       ${nameAndExt}
//! @details    Add a detailed description of the source file here.
//!
//! @copyright  (C) Keurig Green Mountain, Inc.                    <br>
//!             All Rights Reserved                                <br>
//!             No part of materials included in this project may be
//!             reproduced, copied, modified or adapted, without the prior
//!             written consent of the company.
//!
//===========================================================================
// Module Versioning Section
//===========================================================================
/*<~~~ Add necessary versioning information here ~~~>*/

//===========================================================================
// Include Section
//===========================================================================
/*<~~~ Add necessary system and user header files here ~~~>*/

//===========================================================================
// Define and Typedefs Section
//===========================================================================
/*<~~~ Add all necessary enums, typedefs, and macro defines here ~~~>*/

//===========================================================================
// Function Definition Section
//===========================================================================
/*<~~~ Add function definitions here using the template provided below ~~~>*/

//===========================================================================
// Function: rtnType functionName( param1Type Param1, param2Type, Param2, ... )
//===========================================================================
//! @details  This section shall describe a detailed description of the
//!           function. Add as little or as much information as necessary.
//!
//! @param              Param1              Brief description of Param1
//! @param              Param2              Brief description of Param2
//! @param              ...                 ...
//!
//! @returns  Brief description of the function return.
//!
//===========================================================================


//===========================================================================
// End of ${nameAndExt}
//===========================================================================
```

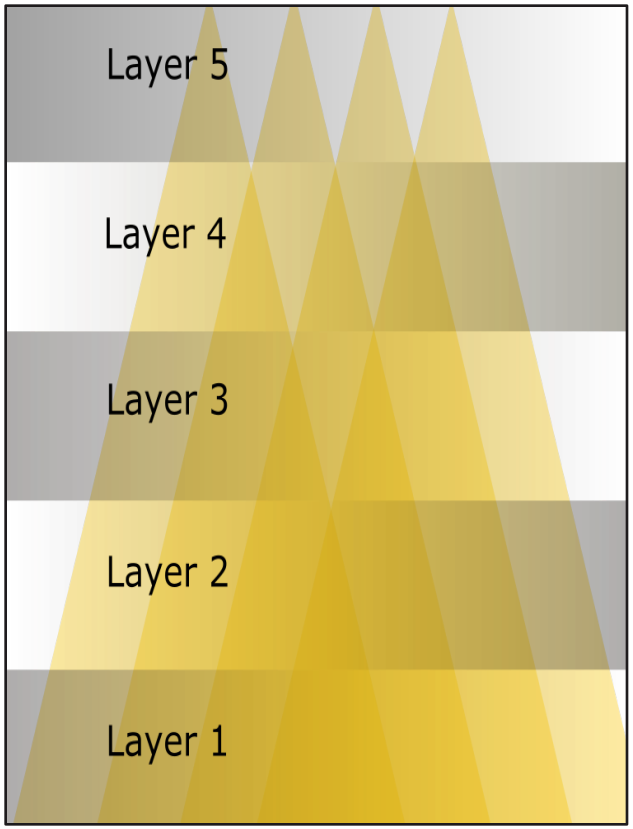
KEURIG GREEN MOUNTAIN

PROJECT DEVELOPMENT
Unified Modular Codebase

- Objectives:
  - Develop modules with embedded unit tests to further assist in software development efforts.
- Tasks:
  - Design and create peripheral modules:
    - UART
    - Timer
    - Interrupt
  - Produce corresponding embUnit integration tests for each peripheral module

Software Module Layered Architecture

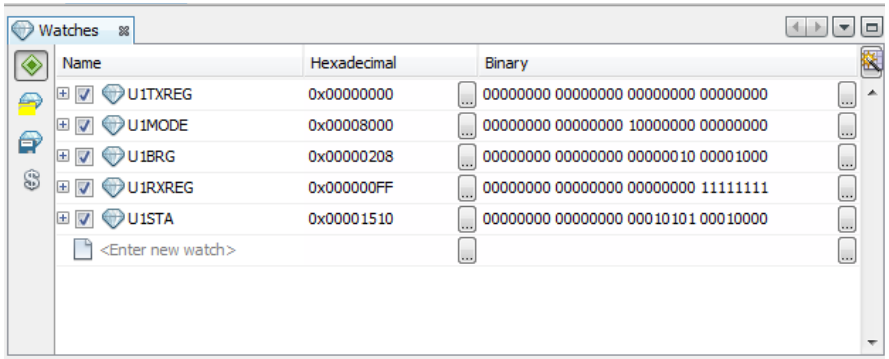
- Layer 5: Tasker/RTOS/SuperLoop
  - Responsible for execution of all tasks
- Layer 4: Application Tasks
  - Engines / UI
- Layer 3: Component Functionality Behaviors
  - Capabilities (State variables, PWM)
- Layer 2: System Component Abstractions
  - Component Objects (Comprised of HW)
- Layer 1: Abstracted HW Functionality
  - On-board Peripherals (Touches metal)

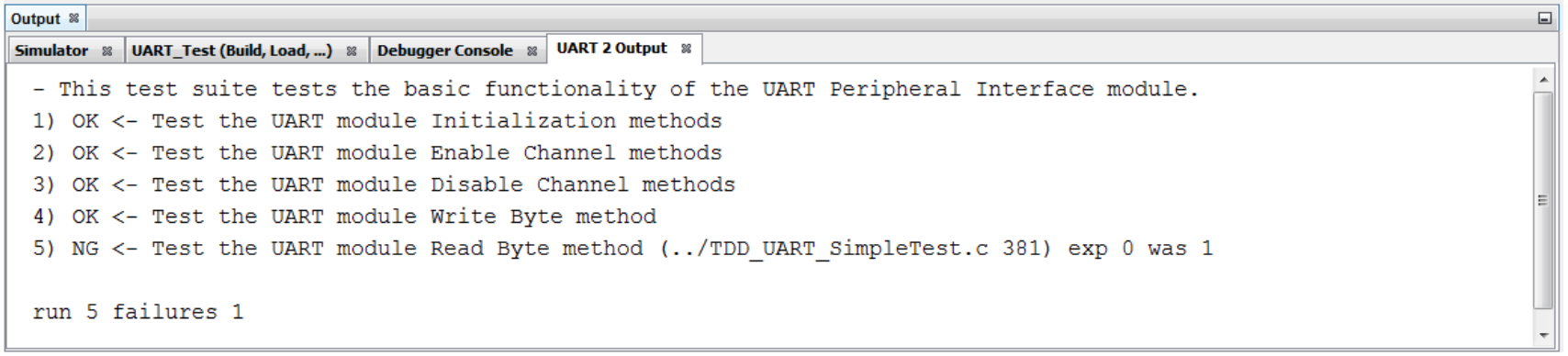


- Focus:
  - Develop Layer 1 modules
  - Intent to have necessary modules for Layer 5 – Tasker

Software Module Development

- Learning Outcomes:
  - Understanding of data sheets
  - Unit testing
  - Stimulus Control Language (VHDL)
  - Git submodules
  - Git pull requests
  - Stronger comprehension of developed modules
- Deliverables:
  - Developed initial timer, interrupt, and UART modules
  - Documented designs of developed modules





OVERALL CO-OP EXPERIENCE

LEARNING OUTCOMES

Software Skills:

- Languages
  - C
  - VB.NET
  - XML
  - Stimulus Control Language
- Productivity Tools
  - JIRA
  - Confluence
- Version Control
  - SourceTree
  - Stash

Microcontrollers:

- Devices
  - Microchip PIC32
- Hardware Peripherals
  - Timers
  - Interrupts
  - UART
  - SPI
  - I2C
- Debugging Tools
  - TotalPhase Aardvark I2C/SPI Adapter
  - ICD 3 In-Circuit Debugger

LIKES AND DISLIKES

- Likes:
  - Personal and collaborative projects
  - Excellent mentorship
  - Opportunity to learn transferable skills
  - Ability to connect and meet other co-ops/interns
- Dislikes:
  - Projects occasionally shifted or drop off
  - Hardly any co-op programming events as summer ended
  - Few holidays and no vacation time

THANKS!

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