Be Boulder.

PROJECT #1 GUIDE

UCB ECEN 5803 FALL 2017 PROJECT #1: FREESCALE MBED AND KEIL

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INTRODUCTION - MBED

The mbed platform provides free software libraries, hardware designs and online tools for professional rapid prototyping of products based on ARM microcontrollers.

The platform includes a standards-based C/C++ SDK, a microcontroller HDK and supported development boards, an online compiler and online developer collaboration tools.

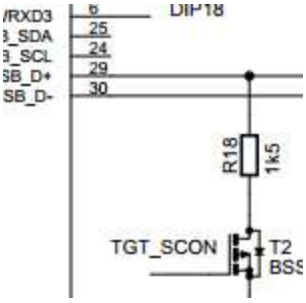
SOFTWARE DEVELOPMENT KIT (SDK)

The mbed Software Development Kit (SDK) is an open source C/C++ microcontroller software platform relied upon by tens of thousands of developers to build projects fast. We've worried about creating and testing startup code, C runtime, libraries and peripheral APIs, so you can worry about coding the smarts of your next product.

The SDK is licensed under the permissive Apache 2.0 license, so you can use it in both commercial and personal projects with confidence.

The mbed SDK has been designed to provide enough hardware abstraction to be intuitive and concise, yet powerful enough to build complex projects. It is built on the low-level ARM CMSIS APIs, allowing you to code down to the metal if needed. In addition to USB and Networking libraries, a cookbook of hundreds of reusable peripheral and module libraries have been built on top of the SDK by the mbed Developer Community.

- mbed SDK



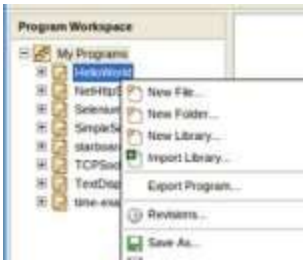
HARDWARE DEVELOPMENT KIT (HDK)

The mbed Hardware Development Kit (HDK) provides full microcontroller sub-system design files and firmware for building development boards and custom products that benefit from the native support of the mbed SDK and free mbed Online Compiler and mbed Developer Platform.

The HDK specifies all support components and circuits including the mbed Onboard Interface design that provides simple USB drag-n-drop programming and CMSIS-DAP debug interface for the target microcontroller.

Development boards that are already based on the HDK are the quickest way to get started with the mbed platform. We manufacture official mbed Microcontroller modules that are specifically optimized for flexible rapid prototyping, and are available from distributors worldwide. Our partners are now also creating mbed-enabled hardware such as ultra-low-cost ARM evaluation boards in the popular Arduino form-factor.

- mbed HDK
- mbed Hardware



FREE ONLINE DEVELOPMENT TOOLS

The mbed Compiler is a powerful online IDE that is free for use with hardware implementing the mbed HDK, and tightly integrated with the mbed SDK and Developer Website. Under the hood, it relies on the industry standard ARM professional C/C++ compiler, pre-configured and tested to generate fast, efficient code without fuss.

Login anywhere to get instant access to your development environment, on Windows, Mac, Linux. You can even work from tablets!

Whilst the mbed Compiler provides you your own private workspace, it is also fully integrated with the mbed.org Developer Website so you can easily import libraries and examples. If you choose to, publishing your own code

and collaborating with other mbed users is just a few clicks too. The mbed Compiler also supports full export to different toolchains, in case your project demands it as you go to production.

- mbed Compiler
- Collaboration
- Export

WORLDWIDE DEVELOPER COMMUNITY

Using mbed means a huge shared context with other developers, and that means when you have a question, there is less pre-amble, less explanation and less time reproducing issues, and more time getting answers. We're proud that this has helped us grow an active and friendly community of skilled developers that are collectively helping get prototypes made even faster.

But where it really gets interesting is with code. Our developers are sharing thousands of open source repositories and building an extensive cookbook of recipes that you can reuse to build your products.

We've also made contributing back is easy; you can publish a library to mbed.org with a few clicks in the IDE, and let others build on your hard work. In fact, this is how some of our users end up collaborating on hard problems, and even getting contract work.

HAVE FUN!

I. MODULE 1: ASSEMBLY ARITHMETIC

1. From D2L, download the word document Lab_Exercise_2.docx and Code2.zip.

2. Follow the Lab_Exercise_2 directions.

3. Test your code with these inputs: 2, 4, 22, and 121. Record the results.

4. Estimate the number of CPU cycles used for this calculation.

5. Auto-generate documentation using Doxygen. Provide either an HTML directory or PDF file documenting your codebase.

II. MODULE 2: FEEL THE VIBRATIONS

1. Create a program to more fully evaluate the Freescale Kinetis KL25Z MCU for use in a Flowmeter:
   a. Write a program either using the mbed compiler, or in the Keil MDK, to read the accelerometer to sense vibration
   b. Use the "vibration" values to drive a control output. In this case, make the color of the RGB LED change with respect to movement of the board
   c. Read the output from the capacitive touch slider, and use it to dim the LED
2. Estimate the processor load in % of CPU cycles
3. Auto-generate documentation using Doxygen. Provide either an HTML directory or PDF file documenting your codebase.

III. MODULE 3: SERIAL PORT DEBUG MONITOR

1. From D2L, download the word document Project1_Module3.docx and Code3.zip
2. Follow the directions given in the Project1_Module3.docx
3. Add a command to the monitor. Capture a screenshot of the new monitor window.
4. Estimate the % of CPU cycles used for this process, assuming a 100 millisecond operating cycle.
5. As a separate project, run either the Dhrystone or the Whetstone benchmark program on your target processor. If running the Dhrystone, calculate the number of VAX DMIPS.
6. Auto-generate documentation using Doxygen. Provide either an HTML directory or PDF file documenting your codebase.

IV. MODULE 4: BARE METAL FLOWMETER SIMULATION

1. From D2L, download the word document Project1_Module4.docx and Code4.zip.
2. Follow the directions in the Project1_Module4.docx.
3. Once you have completed the code to calculate the volumetric flow, request the simulated ADC data file from your instructor. Each project team data file will be different.
4. Record the reported values of frequency and flow from your monitor program.
5. Estimate the % of CPU cycles used for this process, assuming a 100 millisecond operating cycle.
6. Calculate the power consumption for your complete system (including proposed hardware additions) when in full run mode, and again in low power mode. Include detailed timing assumptions used in each mode.
7. Auto-generate documentation using Doxygen. Provide either an HTML directory or PDF file documenting your codebase.