



Building Superior Embedded Systems

EMBEDDED**ARTISTRY**

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CPF Code Review Proposal

Embedded Artistry will review the current source code for the STM32 CPF prototypes. We will recommend improvements, unit testing strategies, and static analysis tools.

Situation Appraisal

MBARI has developed an autonomous oceanographic coastal profiling float (CPF) that has been in operation for several years. The existing implementation is designed around a GHI G400S SOM and the code is written in C# using the .NET Micro Framework. The existing SOM has reached end-of-life, and there are general concerns with the greater oceanographic research community's willingness to adopt a C# codebase due to a general familiarity with and preference for C/C++. These two factors are driving a redesign of the CPF system.

The current effort is focusing on a custom SOM based on the STM32H7A3 processor with an implementation in C and C++. Prototyping efforts have been completed which demonstrate general viability of the processor with existing CPF peripheral hardware. However, there are issues getting the code for these prototypes to work properly when they are combined into a single system. Rather than burning time to debug these issues, MBARI is interested in engaging with an experienced embedded systems firm to implement a foundational project structure that can be extended to continue the development of the redesigned CPF system. This foundational structure should be well-designed from the start, avoiding unnecessary rewrites as new functionality is incorporated. Additionally, the software must be designed to work in an asynchronous and non-blocking manner.

Before development on the foundational project structure begins, Embedded Artistry will perform a review of the current prototype C and C++ source code. We will make recommendations for how the existing code can be improved, as well as provide an evaluation of the overall viability of the design. Since MBARI is rightly interested in incorporating unit testing and static analysis into the system from the beginning, we will also provide recommendations for testing frameworks and static analysis tools that can be used on the project.

The code review will also provide Embedded Artistry with the familiarity necessary for providing a quote for the follow-on development project. If both of our companies enjoy working together, Embedded Artistry will provide a follow-on proposal upon completion of this project that will cover the implementation of the foundational project structure.

Objectives

This initial engagement comprises three primary objectives:

1. Review the current source code and build environment for the C/C++ implementation of the CPF STM32 prototype software and provide recommended modifications and improvements.

2. Provide recommendations for unit testing frameworks, methods for applying unit testing to the project, and examples of the kinds of tests that should be developed.
3. Recommend specific static analysis tools to use and general methods for applying static analysis tools to the project.

Secondary objectives for this engagement include:

- Gain familiarity with the existing source code in order to provide a proposal for the initial implementation of the foundational project structure.
- Identify design and code guidelines that should be used to implement the CPF redesign in C/C++.

Work Products

The following work products will be delivered to MBARI:

1. Recommended changes to the prototype software and the build environment
 - a. Changes will be categorized as “Required” or “Suggested”, as well as “Broad” (applying to the project as a whole) or “Specific” (applying to a specific instance within the code).
2. A presentation summarizing our recommendations for unit testing and static analysis, including delivery of slides and optionally a recording of the session for future reference.
3. Reference documentation describing our unit testing recommendations in detail, including links to supporting documentation and reference implementations.
4. Reference documentation describing our static analysis recommendations in detail, including links to supporting documentation, reference implementations, and recommended settings for the tools that we discuss.

MBARI has identified Visual Studio and VisualGDB as the primary development environment for this project. Keeping this in mind, for objectives 2 and 3 (testing and static analysis recommendations) we will provide:

- General recommendations that do not take VisualGDB into consideration.
- A review of the capabilities supported out-of-the-box by VisualGDB.
- Any methods that can be used within VisualGDB to extend support to include additional tools and test frameworks.

Delivery Metrics

We will track recommended software changes in a shared document so that Gene Massion may review our findings as we note them. Following the completion of our review, we will meet with Gene to discuss any items that require further clarification or exploration.

Unit testing and static analysis documentation will be delivered via email to Gene Massion.

Embedded Artistry will provide a weekly status report on Friday. The report will provide a summary of work performed that week, planned work for the following week, and relevant service announcements.

Joint Resource Commitments

MBARI has already provided source code access for the project.

Embedded Artistry may request write access to the source code repository in the event that we jointly determine source code feedback is best documented through comments contained in the code base directly. If this is the case, comments will be kept on a branch and will be opened as a pull request for review. They will not be committed to the primary project branch.

Embedded Artistry will acquire Windows 10, Visual Studio, and Visual GDB licenses for use on this project.

Timing

Embedded Artistry is available to begin working with MBARI starting 17 January. We anticipate completion of this project by 11 February.

Fee

The fixed fee for this project is \$12,500. Payments are due on the following schedule (invoices will be provided):

- \$1,250 deposit due to start the engagement
- \$10,000 due upon completion (estimated 11 February)

We offer a 10% discount on the total fee if the full project fee is paid up-front (total of \$11,250).

Payment Method

Embedded Artistry prefers payment via direct transfer but will also accept payment via check and credit card. Payment remittance information is provided on the invoice. Please provide instructions if invoices are to be sent to an accounting team.

Late Payments

A 3% monthly interest charge will be applied to late payments starting the business day following the invoice due date. Work will be halted until payment has been made.

Expenses

Any project-related expenses that are incurred will be billed at the end of each month with Net15 payment terms. Approval will be requested in advance for any anticipated expenses and receipts will be provided with the expense invoice.

We do not anticipate any expenses for this engagement.

Out-of-Scope Requests

Embedded Artistry is willing to support requests that are outside of the primary engagement objectives, subject to our approval. Any such requests will be billed in increments of 15-minutes at our standard hourly rate of \$250. We will notify MBARI of any subsequent delays that will be incurred on the primary scope of work.

We will send a summary of billable hours worked in the weekly status report. An invoice for hourly support will be issued every two weeks with Net15 payment terms.

Acceptance

Your signature below indicates acceptance of this proposal. Work will begin once the deposit and required materials are received.

This proposal is valid through **31 December 2021**.

CONSULTANT:

CLIENT:

MBARI

A handwritten signature in black ink, appearing to read 'P Johnston', with a long horizontal flourish extending to the right.

Phillip Johnston
Embedded Artistry LLC

Date: 16 December 2021

Name: _____

Title: _____

Date: _____